

# PRACTICAL TELEVISION

3/6

JULY  
1970

GETTING STARTED WITH...

**COLOUR  
FAULT  
FINDING**



**ALSO:**

UHF PREAMP

CIRCUIT DEVELOPMENTS

CONVERGENCE WAVEFORMS

# BENTLEY ACOUSTIC CORPORATION LTD.

38 CHALCOT ROAD, CHALK FARM, LONDON, N.W.1  
THE VALVE SPECIALISTS Telephone 01-722 9090  
SAVE POSTAL COSTS! CASH AND CARRY BY CALLERS WELCOME

|        |      |        |      |          |      |        |      |            |         |            |      |            |        |        |      |       |       |           |        |           |       |      |      |       |      |
|--------|------|--------|------|----------|------|--------|------|------------|---------|------------|------|------------|--------|--------|------|-------|-------|-----------|--------|-----------|-------|------|------|-------|------|
| 0A2    | 5.9  | 6B30   | 2/6  | 6P25     | 12/- | 12AT5  | 4/6  | 30FL14     | 14/6    | A2134      | 19/6 | DLE33      | 6/-    | ECC82  | 4.6  | EP184 | 6/-   | KT41      | 19/6   | PCL84     | 7/6   | R17  | 17/6 | U19   | 34/6 |
| 0B2    | 4.6  | 6BA6   | 4/6  | 6P28     | 12/- | 12AT7  | 3/6  | 30FL15     | 13/9    | A3042      | 15/- | DLE35      | 4/-    | ECC83  | 31/6 | EPF60 | 10/-  | KT44      | 20/-   | PCL85     | 9/-   | R18  | 10/- | U22   | 7/9  |
| 0Z1    | 4.6  | 6B28   | 4/6  | 6P29     | 25/- | 12AT7  | 4.6  | 30FL17     | 15/6    | AC3PEN     | 19/6 | DLE4       | 5/9    | ECC84  | 29/6 | EH90  | 7/6   | KT61      | 12/-   | PCL86     | 8/6   | R19  | 7/6  | U25   | 13/- |
| 1A3    | 4.6  | 6B35   | 7/6  | 6Q7      | 8/6  | 12AV6  | 1/6  | 30P4       | 12/-    | AC3PEN/7   | 19/6 | DLE6       | 7/6    | ECC85  | 11/- | EL32  | 3/6   | KT63      | 5/-    | PCL88     | 15/-  | R20  | 11/9 | U26   | 11/9 |
| 1A5    | 5/-  | 6B35   | 4.6  | 6Q7G     | 6/-  | 12AV7  | 4.6  | 30P4MR     | DD 19/6 | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC86  | 3.9  | EL33  | 12/-  | KT66      | 17/3   | PEN45     | 7/-   | R21  | 11/9 | U28   | 11/9 |
| 1A7GT  | 7/3  | 6B35   | 4.6  | 6Q7G     | 11/- | 12AV7  | 4.6  | 30P4MR     | DD 19/6 | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC87  | 4.6  | EL34  | 10/6  | KT71      | 12/6   | PEN45     | 7/-   | R22  | 7/6  | U31   | 8/-  |
| 1C5    | 4.6  | 6BQ7A  | 7/-  | 6R7G     | 7/-  | 12BA7  | 9/6  | 30P12      | 17/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC88  | 4.6  | EL34  | 10/6  | KT76      | 12/6   | PEN45     | 7/-   | R23  | 12/6 | U35   | 15/6 |
| 1D3    | 7/6  | 6B1K7  | 15/6 | 6SA7GT   | 7/-  | 12BA8  | 6/-  | 30P12      | 17/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC89  | 5.6  | EL41  | 11/-  | KT88      | 34/-   | PEN45DD   | SP61  | 3/3  | U37  | 34/11 |      |
| 1D6    | 9/6  | 6B1R3  | 12/6 | 6SA7M    | 7/-  | 12BA8  | 6/-  | 30P12      | 17/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC90  | 5.6  | EL42  | 10/6  | KTW612/6  | 15/-   | TH43      | 10/-  | U45  | 15/6 |       |      |
| 1FD1   | 6/6  | 6B37   | 25/- | 6SB7G    | 6/6  | 12B1H  | 9/-  | 30P12      | 17/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC91  | 5.6  | EL41  | 11/-  | KTW6212/8 | PEN46  | 4/-       | TH43  | 7/-  | U47  | 13/-  |      |
| 1FD9   | 4.3  | 6B37   | 13/- | 6SB7     | 6/-  | 12B1H  | 9/-  | 30P12      | 17/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC92  | 4.3  | EL24  | 10/6  | KT74      | 12/6   | PEN45DD   | TP929 | 3/9  | U49  | 11/9  |      |
| 1G6    | 6/-  | 6B26   | 6/-  | 6SH7     | 7/-  | 12J7GT | 6/6  | 30P14      | 15/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC93  | 4.6  | EL37  | 3/9   | LN152     | 7/-    | PEN4A19/6 | CAF49 | 10/3 | U50  | 5/6   |      |
| 1H3GT  | 7/-  | 6C9    | 3/9  | 6SJ7     | 6/6  | 12K5   | 10/- | 30P13      | 15/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC94  | 4.6  | EL38  | 8/-   | LN309     | 10/-   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 1L4    | 2/6  | 6C9    | 14/6 | 6SK7GT   | 7/6  | 12K5   | 10/- | 30P13      | 15/6    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC95  | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| LLD5   | 6/-  | 6C9D6  | 23/- | 6SN7GT   | 4/6  | 12Q7GT | 5/-  | 33A5       | 10/-    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC96  | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| LN3E   | 8/-  | 6C9E8  | 7/-  | 6SN7GT   | 4/6  | 12Q7GT | 5/-  | 33A5       | 10/-    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC97  | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| LN3GT  | 7/6  | 6C9E8  | 8/6  | 6SN7GT   | 4/6  | 12Q7GT | 5/-  | 33A5       | 10/-    | AC3PEN/7   | 19/6 | DLE10      | 9/6    | ECC98  | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 1R3    | 5/6  | 6C9W4  | 12/6 | 6SQ7GT   | 7/6  | 12R0T  | 5/-  | 33W4       | 4/6     | ATP4       | 2/3  | E1148      | 10/6   | ECC99  | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 1R4    | 4/9  | 6D3    | 7/6  | 6T7G     | 10/6 | 12R0T  | 5/-  | 33W4       | 4/6     | ATP4       | 2/3  | E1148      | 10/6   | ECC100 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 1R5    | 4/9  | 6D3    | 7/6  | 6T7G     | 10/6 | 12R0T  | 5/-  | 33W4       | 4/6     | ATP4       | 2/3  | E1148      | 10/6   | ECC101 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 1F4    | 5/6  | 6F1    | 12/6 | 6V6GT    | 6/6  | 12R17  | 4/6  | 33Z4GT     | 5/-     | AZ31       | 9/6  | E173       | 8/6    | ECC102 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 2D21   | 6/6  | 6F1    | 12/6 | 6V6GT    | 6/6  | 12R17  | 4/6  | 33Z4GT     | 5/-     | AZ31       | 9/6  | E173       | 8/6    | ECC103 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 2A5    | 10/- | 6F6G   | 5/-  | 6X4      | 4/3  | 12R2GT | 5/-  | 33Z4GT     | 5/-     | AZ31       | 9/6  | E173       | 8/6    | ECC104 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3B7    | 5/-  | 6F12   | 3/6  | 6X3GT    | 5/-  | 14H7   | 9/6  | 6C9D6G43/3 | CV8     | 10/6       | E184 | 4/6        | ECC105 | 4.6    | EL38 | 8/-   | LN310 | 13/9      | PEN/DD | UB41      | 6/6   | U74  | 4/9  |       |      |
| 3D5    | 3/9  | 6F12   | 3/6  | 6Y7G     | 12/6 | 14H7   | 15/- | 6C9D6G43/3 | CV8     | 10/6       | E184 | 4/6        | ECC106 | 4.6    | EL38 | 8/-   | LN310 | 13/9      | PEN/DD | UB41      | 6/6   | U74  | 4/9  |       |      |
| 3Q4    | 7/6  | 6F15   | 10/- | 7B7      | 10/9 | 16A05  | 4/6  | 72         | 6/6     | CY31       | 7/6  | E184       | 4/6    | ECC107 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3Q5GT  | 6/-  | 6F18   | 7/6  | 7B7      | 10/9 | 16A05  | 4/6  | 72         | 6/6     | CY31       | 7/6  | E184       | 4/6    | ECC108 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3R4    | 5/9  | 6F23   | 14/6 | 7C6      | 6/-  | 19H1   | 4/6  | 85A2       | 8/6     | D63        | 5/6  | E184       | 4/6    | ECC109 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3Y4    | 6/3  | 6F24   | 13/6 | 7F8      | 12/6 | 20D4   | 20/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC110 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3R4GY  | 10/8 | 6F25   | 13/6 | 7H7      | 5/6  | 20F2   | 14/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC111 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3U4G   | 5/6  | 6F28   | 14/6 | 7R7      | 13/6 | 20L1   | 20/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC112 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3V4G   | 5/6  | 6F32   | 14/6 | 7R7      | 13/6 | 20L1   | 20/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC113 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3Y3GT  | 5/6  | 6F36GT | 3/6  | 7V7      | 13/6 | 20P1   | 17/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC114 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3Z3    | 9/-  | 6F36   | 2/9  | 7V7      | 13/6 | 20P1   | 17/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC115 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 3Z4G   | 7/6  | 6F39   | 2/9  | 7V7      | 13/6 | 20P1   | 17/6 | 85A3       | 8/6     | D77        | 5/6  | E184       | 4/6    | ECC116 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6B30L2 | 12/- | 6J7G   | 4/6  | 10C2     | 10/- | 25L5GT | 5/6  | 20P1       | 17/6    | 85A3       | 8/6  | D77        | 5/6    | ECC117 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A8G   | 6/6  | 6J7GT  | 4/6  | 10D1     | 8/-  | 25L5   | 5/6  | 20P1       | 17/6    | 85A3       | 8/6  | D77        | 5/6    | ECC118 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A7    | 3/-  | 6K7G   | 2/-  | 10D2     | 14/7 | 25Y5G  | 8/6  | 20P1       | 17/6    | 85A3       | 8/6  | D77        | 5/6    | ECC119 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A6G   | 4/-  | 6K7GT  | 4/6  | 10F1     | 15/- | 25Z4G  | 8/6  | 20P1       | 17/6    | 85A3       | 8/6  | D77        | 5/6    | ECC120 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A6K5  | 5/-  | 6K8G   | 9/-  | 10F9     | 9/-  | 25Z4   | 8/6  | 20P1       | 17/6    | 85A3       | 8/6  | D77        | 5/6    | ECC121 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A6K9  | 6/-  | 6L1    | 19/6 | 10F18    | 7/-  | 25Z6G  | 8/6  | 20P1       | 17/6    | 85A3       | 8/6  | D77        | 5/6    | ECC122 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A5L5  | 2/3  | 6L6GT  | 7/6  | 10LD1110 | 30C1 | 6/6    | 856  | 2/-        | DH110   | 25/-       | 10/6 | DH10717/11 | 10/6   | ECC123 | 4.6  | EL38  | 8/-   | LN310     | 13/9   | PEN/DD    | UB41  | 6/6  | U74  | 4/9   |      |
| 6A6M3  | 3/3  | 6L7GT  | 12/6 | 10P13    | 13/- | 30C13  | 13/- | 1821       | 10/6    | DH10717/11 | 10/6 | ECC124     | 4.6    | EL38   | 8/-  | LN310 | 13/9  | PEN/DD    | UB41   | 6/6       | U74   | 4/9  |      |       |      |
| 6A6Q5  | 5/6  | 6L18   | 6/-  | 10P14    | 20/- | 30C17  | 16/- | 6763       | 10/6    | DH10717/11 | 10/6 | ECC125     | 4.6    | EL38   | 8/-  | LN310 | 13/9  | PEN/DD    | UB41   | 6/6       | U74   | 4/9  |      |       |      |
| 6A6R6  | 20/- | 6L19   | 87/6 | 12A6     | 12/6 | 30C18  | 14/- | 6990       | 5/6     | DK40       | 10/6 | ECC126     | 4.6    | EL38   | 8/-  | LN310 | 13/9  | PEN/DD    | UB41   | 6/6       | U74   | 4/9  |      |       |      |
| 6A6T6  | 4/-  | 6L29   | 9/6  | 12A6G    | 7/6  | 30F5   | 15/- | 7193       | 10/6    | DK91       | 5/9  | ECC127     | 4.6    | EL38   | 8/-  | LN310 | 13/9  | PEN/DD    | UB41   | 6/6       | U74   | 4/9  |      |       |      |
| 6A6U9  | 5/-  | 6N7GT  | 6/6  | 12AD9    | 7/6  | 30FL1  | 13/9 | 7473       | 14/-    | DK92       | 9/-  | ECC128     | 4.6    | EL38   | 8/-  | LN310 | 13/9  | PEN/DD    | UB41   | 6/6       | U74   | 4/9  |      |       |      |
| 6A6V9  | 5/6  | 6P1    | 12/- | 12AE6    | 12/6 | 30FL12 | 10/- | A1894      | 20/-    | DK96       | 7/-  | ECC129     | 4.6    | EL38   | 8/-  | LN310 | 13/9  | PEN/DD    | UB41   | 6/6       | U74   | 4/9  |      |       |      |

|       |      |       |      |           |       |            |       |       |      |       |      |
|-------|------|-------|------|-----------|-------|------------|-------|-------|------|-------|------|
| ECC32 | 4.6  | EP184 | 6/-  | KT41      | 19/6  | PCL84      | 7/6   | R17   | 17/6 | U19   | 34/6 |
| ECC33 | 31/6 | EPF60 | 10/- | KT44      | 20/-  | PCL85      | 9/-   | R18   | 10/- | U22   | 7/9  |
| ECC34 | 29/6 | EH90  | 7/6  | KT61      | 12/-  | PCL86      | 8/6   | R19   | 7/6  | U25   | 13/- |
| ECC35 | 11/- | EL32  | 3/6  | KT63      | 5/-   | PCL88      | 15/-  | R20   | 11/9 | U26   | 11/9 |
| ECC36 | 3.9  | EL33  | 12/- | KT66      | 17/3  | PEN36G     | R59   | 7/6   | U31  | 8/-   |      |
| ECC37 | 4.6  | EL34  | 10/6 | KT71      | 12/6  | PEN45      | 7/-   | R21   | 11/9 | U28   | 11/9 |
| ECC38 | 4.6  | EL37  | 17/3 | KT76      | 12/6  | PEN45      | 7/-   | R22   | 12/6 | U35   | 15/6 |
| ECC39 | 6/3  | EL41  | 11/- | KT88      | 34/-  | PEN45DD    | SP61  | 3/3   | U37  | 34/11 |      |
| ECC40 | 5.6  | EL42  | 10/6 | KTW612/6  | 15/-  | TH43       | 10/-  | U45   | 15/6 |       |      |
| ECC41 | 5.6  | EL41  | 10/- | KTW6212/8 | PEN46 | 4/-        | TH43  | 7/-   | U47  | 13/-  |      |
| ECC42 | 7/6  | EL33  | 7/6  | KTW63     | 6/-   | PEN45DD    | TP929 | 3/9   | U49  | 11/9  |      |
| ECC43 | 12/6 | EL34  | 4/6  | LN152     | 7/-   | PEN4A19/6  | CAF49 | 10/3  | U50  | 5/6   |      |
| ECC44 | 12/6 | EL38  | 8/-  | LN309     | 10/-  | PEN/DD     | UB41  | 6/6   | U74  | 4/9   |      |
| ECC45 | 5.8  | EL39  | 5/8  | LN310     | 13/9  | 4029       | 17/6  | UBC41 | 9/-  | U78   | 4/3  |
| ECC46 | 6/6  | EL39  | 5/8  | LN339     | 13/9  | PFL29011/8 | UBC81 | 7/-   | U197 | 18/3  |      |
| ECC47 | 9/6  | EL39  | 5/8  | LZ329     | 8/6   | PL33       | 10/8  | UBF80 | 5/6  | U191  | 13/6 |
| ECC48 | 6/6  | EL39  | 5/8  | MS192     | 12/6  | PEN39      | 9/6   | UBF89 | 6/9  | U261  | 14/8 |
| ECC49 | 6/6  | EL39  | 5/8  | MS192     | 12/6  | PL31       | 9/6   | UBL21 | 9/-  | U291  | 8/-  |
|       |      |       |      |           |       |            |       |       |      |       |      |

## NEW LINE OUTPUT TRANSFORMERS

ALBA 655, 656, 717, 721 75/-.  
 BUSH TV53 to TUG69 40/-  
 DECCA DM1, DM3C, (90°) 78/-, DM4C (70°) 78/-.  
 DYNATRON TV30, TV35 55/6, TV36 70/-.  
 EKCO T231, T284, TC267, T283, T293, T311, T326, T327, T330 55/6. TMB272 68/6. T344, T344F, T345, TP347, T348, T348F, TC347, TC349, TC356, T368, T370, TC369, T371, T372, TP373, TC374, T377A, T393, T394, 433, 434, 435, 436, 437 all at 70/-.  
 503, 504, 505, 506 95/-.  
 FERGUSON 306T, 308T 55/6 each. 406T, 408T, 416, 436, 438, 506, 508, 516, 518, 536, 546, 604, 606, 608, 616, 619, 636, 646, 648, 725, 726, 727, 3600, 3601, 3602, 3604, 3611, 3612, 3614, 3617, 3618, 3619, 3620, 3621, 3622, 3623, 3624, 3625, 3626, 3627, 3629 80/-.  
 FERRANTI T1001, T1002, T1002/1, T1004, T1005 55/-, T1023, T1024, T1027, T1027F, TP1026, T1071, T1072, T1121, TC1122, TC1124, T1125, TC1126 70/-, 1154, 1155 95/-.  
 G.E.C. BT302, BT304 62/6. BT454DST-456DST, 2010, 2013, 2014, 2012, 2000DS, 2001DS, 2002DS 85/-.  
 H.M.V. 1865, 1869 55/6. 1870, 1872, 1874, 1876, 1890, 1892, 1894, 1896 80/-.  
 KB OV30, NF70, NV40, PV40, QV10, PVP20 90/-, Featherlight 90/-.  
 PILOT PT450, 452, 455, 650, PT651, P60A, P61 70/-.  
 PHILCO 1019, 1020, 2021 82/6. 1029, 1030, 1035, 1036, 1040, 1050, 1060 82/6.  
 PYE V200, V400, 200LB, 210, 220, 300F, 300S, 310, 210S, 410 70/-, PYE 11U-P/No. AL21003 70/-.  
 REGENTONE TV403 90/-.  
 R.G.D. RV203 90/-.  
 ULTRA 1770, 2170, 1772, 1782, 2172, 1771, 2171, 1775, 2175, 1774, 2174, 1773, 2137, 1980c, 1984c, 100c, 200c, 2380, 2384, 1984, 1985, 1986, 1980, 1980a, 1780, 2180, 2181, 2183, 2182, 1871, 1783 80/-.

### LINE OUTPUT TRANSFORMER INSERTS

BUSH TV92-TV93, TV94-TV95-TV96-TV97, TV98, TV99, TV100, TV101, TV103, TV104, TV105, TV106, TV108, TV109, TV110, TV113, TV115, TV115R, TV115c, 123, 125, 128, TV75, TV85, 55/-, Complete with heater windings.  
 DECCA DR95, DR100, DR101, DR202, DR303, DR404, DR505, DR606, 55/-  
 EMERSON E700, E701, E704, E707, E708, E709, E710, E711, Portarama 37/6.  
 FERGUSON 204T, 205T, 206T, 214T, 235T, 236T, 244T, 245T, 246T 40/-.  
 FERRANTI 14T2, 14TC, 14T3F, 14T4, 14T4F, 14T5, 14T6, 17K3, 17K3F, 17T3, 17T3F, 17K4F, 17K6, 17SK6, 17T4, 17T4F, 17T5, 17T6, 21K6, 21K6V 37/6.  
 INVICTA T118, T119, T120 50/-.  
 KB PV40, MV100, OF100, PV100, NV40, NF70, OV30, QV10, QV30 40/- pair.  
 PETO SCOTT 1416, 1418, 1419, 1422, 1423, 1716, 1719, 1720, 1922, 1723, 1724, 1725 29/6.  
 PYE V4, VT7, CTM4, TCM7 50/-.  
 REGENTONE 10-4, 10-6, 1021, 17-18, 10-12 35/-, T176, T177, 191, 192 37/6.  
 R.G.D. Deep 17, The 17, 590, 600, 606, 611, 710, 723 35/-.  
 Guarantee. Post and Package 4/6. C.O.D. 6/-, We can rewind most LOPT 90/-.

### PRESET CONTROLS

Wirewound, 3 W rating . . . . . 5/- Each. P.P. 6d.  
 Ohms 10, 25, 50, 100, 250, 500.  
 K Ohms 1, 2, 3, 5, 10, 25, 30.  
 Carbon, 1/2 W rating . . . . . 4/2 Each. P.P. 6d.  
 K Ohms 50, 100, 250, 500.  
 M Ohms 1, 2.

### OPEN (SKELETON) PRESETS

Open type controls with mounting lugs to suit printed circuit boards.  
 Vertical Mounting . . . . . 2/6 Each. P.P. 6d.  
 K Ohms 5, 10, 25, 100, 150, 250, 500, 680.  
 M Ohms 1, 2, 2.5.  
 Horizontal Mounting . . . . . 2/6 Each. P.P. 6d.  
 K Ohms 100, 250, 500, 680.  
 M Ohms 1, 2, 2, 3.  
 Miniature Horizontal Mounting . . . . . 2/6 Each. P.P. 6d.  
 Ohms 100, 220, 470.  
 K Ohms 1, 2-2, 4-7, 10, 22, 47, 100, 220, 470.  
 M Ohms 1.

### NEW UHF TUNERS, £6 10s. P.P. 4/6.

BRAND NEW VHF TUNERS. PC97-PCF805. Uses less valves.  
 45/-, P.P. 4/6.  
 SCAN COILS MURPHY 470, 480, 490, 500 . . . . . 90/-  
 SCAN COILS DECCA DRI etc. . . . . 90/- P.P. 4/6.  
 System switch for KB Featherlite, 19/6. P.P. 2/6.

### IRON DUST CORES . . . . . 8/- Dozen. P.P. 6d.

Dimensions: L.5" dia. 6mm (normal thread), hexagon centre hole.  
 Trimming Tool for adjusting 6mm. cores as above 1/- Each. P.P. 4d.  
 10-oz. tin Switch Cleaner 9/-. Aerosol Switch Cleaner 17/6.

### REPLACEMENT DROPPERS

Ferguson, H.M.V., Marconi, Ultra 800 & 850 Series (Convertible)  
 37 + 31 + 97 + 26 + 168. 12/6 P.P. 11d.  
 As above 850 Series (Dual Standard) 14 + 26 + 97 + 173 12/6 Each.  
 P.P. 1/-.

### E.H.T. CAPACITORS

Single O.B.A. Stud Mounting. 001 uf 20kV . . 10/6 each. P.P. 2/6.  
 High Voltage Pulse Ceramics.  
 10, 15, 22, 33, 68, 82, 100, 120, 140, 155, 180, 220, 250pf 1/6 P.P. 6d.

### CALLERS WELCOME.

All new components inserts are guaranteed for three months from the date of invoice subject to the breakdown being due to faulty manufacture or materials.  
 S.A.E. all enquiries.

## Dept. "R" D. & B. TELEVISION (Wimbledon) LTD.

80 MERTON HIGH STREET, S.W.19  
 01-540 3513 01-540 3955

### T.V. CANNED ELECTROLYTICS

|                                     |                                     |
|-------------------------------------|-------------------------------------|
| 64-100. 450v. 22/6 each. P.P. 2/6.  | 100-400-16.                         |
| 100-200. 275v. 18/- each. P.P. 2/6. | 275v. 26/- each. P.P. 2/6.          |
| 100-200. 350v. 22/6 each. P.P. 2/6. | 150-100-100-150.                    |
| 100-200-60.                         | 320v. 39/9 each. P.P. 2/6.          |
| 300v. 22/6 each. P.P. 2/6.          | 200. 350v. 15/- each. P.P. 2/6.     |
| 100-300-100-16.                     | 200-200-100.                        |
| 275v. 27/- each. P.P. 2/6.          | 350v. 31/6 each. P.P. 2/6.          |
| 100-400. 275v. 19/- each. P.P. 2/6. | 300-300. 300v. 37/9 each. P.P. 2/6. |

### POWER RESISTOR SECTIONS

These wirewound sections enable you to build up any Mains Dropper to your requirements. A central 28.A. hole is provided for mounting.  
 Ohms 7, 9, 10, 12, 14, 17-5, 20. All at .7A. . . . . 3/10d. each  
 Ohms 22, 25, 28, 30, 33, 36. All at .7A. . . . . 4/9d. each  
 Ohms 40, 47, 52, 56, 60, 63, 66, 75, 87, 100 at .3A. . . . . 3/10d. each  
 Ohms 120, 140, 160, 180, 200, 250, 270 at .3A. . . . . 4/9d. each  
 Ohms 300, 350, 400, 470, 560, all at .12A. . . . . 3/10d. each  
 Ohms 726 at .15A. . . . . 4/9d. each  
 K Ohms, 1 K ohm at .1A. . . . . 3/10d. each  
 K. Ohms, 2 (-07A.) . . . . . 4/9d. each

Postage each section 6d.

### PARTS FOR THE CONSTRUCTOR 625 RECEIVER

|                             |            |           |
|-----------------------------|------------|-----------|
| T.2                         | 35/-       | P.P. 4/6. |
| L.3 Scan Coils              | 90/-       | P.P. 4/6. |
| T.3 Line Output TX          | 80/-       | P.P. 4/6. |
| T.4 Audio Output            | 21/-       | P.P. 2/6. |
| Electrolytic 100+100+300+16 | 27/-       | P.P. 1/-. |
| D1 to D4                    | 6/- each.  | P.P. 6d.  |
| D5, D8, D10, D11, D13       | 2/6 each.  | P.P. 6d.  |
| D9, D12                     | 2/7 each.  | P.P. 6d.  |
| C35, Pulse Ceramic          | 1/6 each.  | P.P. 6d.  |
| BSX 21                      | 9/-        | P.P. 6d.  |
| AC 127                      | 6/6d.      | P.P. 6d.  |
| 27 Way Tag Strip            | 5/6 for 3. | P.P. 1/-  |
| VA1015 Thermistor           | 3/6 each.  | P.P. 6d.  |
| Fuse Carriers 20mm.         | 5/9 each.  | P.P. 6d.  |
| S.W.1 switch                | 6/3 each.  | P.P. 6d.  |
| Ceramic valveholders B9A    | 1/6 each.  | P.P. 6d.  |
| Ceramic valveholders Octal  | 1/7 each.  | P.P. 6d.  |
| 3 Ohm Elliptical speaker    | 34/10 inc. | 6/10 tax. |
|                             |            | P.P. 3/6. |

Capacitors prices on request.

Complete set of 9 Potentiometers . . . . . 43/8. P.P. 4/6.

# Colour T.V. in the home means Teleequipment in the service bay

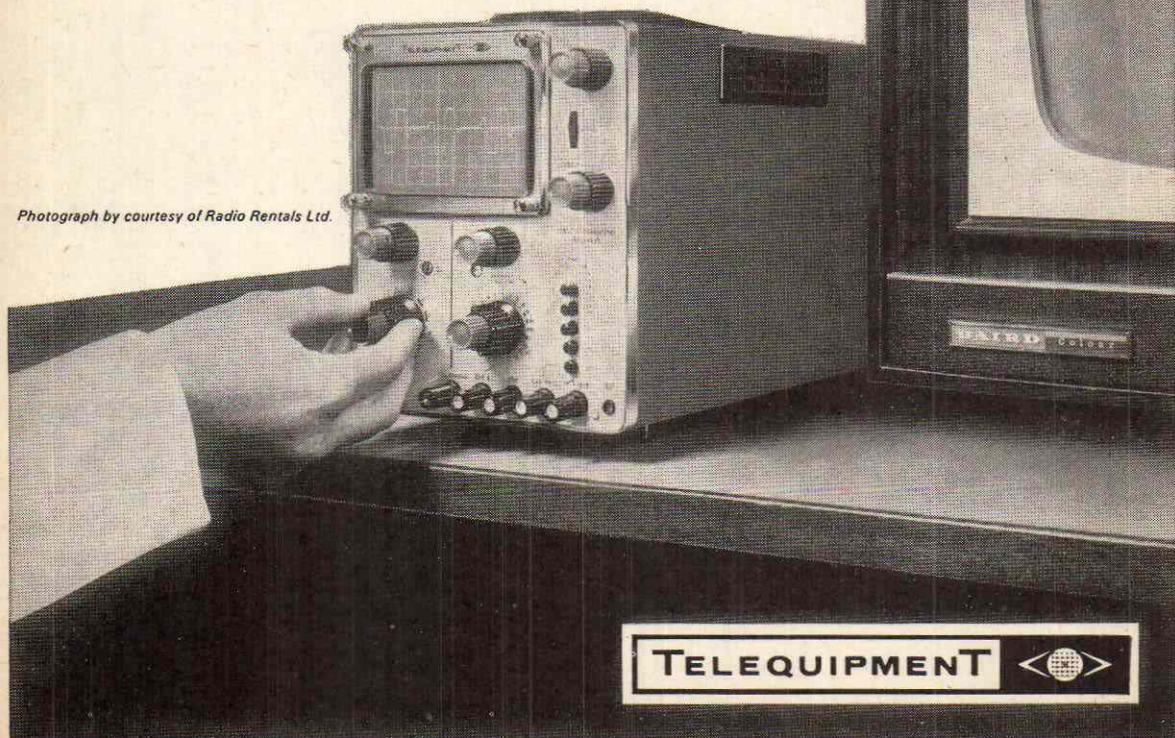
3 channel colour T.V. means more sets – more viewers needing first-class servicing facilities.

A first-class oscilloscope is essential – it must have the right performance – be tough enough to withstand long years of hard work – and be available at a truly economic price.

Teleequipment 'scopes proved that they were absolutely right from day 1 of the B.B.C.2 colour service.

Specification and prices by return.

*Photograph by courtesy of Radio Rentals Ltd.*



**TELEQUIPMENT**



**TELEQUIPMENT**, 313 Chase Road, Southgate, London N.14. Telephone: 01-882 1166. Telex No: 262004.  
A Division of Tektronix U.K. Ltd.

# PRACTICAL TELEVISION

VOL 20 No 10  
ISSUE 238

JULY 1970

## TECHNICAL REVOLUTIONS

THIS month Harold Peters gives encouragement and some sound practical guidance to any faint-hearted readers who may feel that fault-finding in a colour set is a bit beyond them while next month Martin Michaelis takes us for the first time in these pages into the world of that very versatile device the integrated circuit operational amplifier. All this brings home to us the rapid changes that are at present taking place in our chosen field.

Integrated circuits have perhaps been a little slow to establish themselves in domestic electronic equipment. However with three of the six main TV groups now using them for the inter-carrier sound channel in single-standard chassis and two groups using video i.c.s they have definitely come to stay in the TV set. They should make life easier in the long run for the harassed service engineer since with their use a whole mass of circuitry is neatly packed into what is essentially a "go" or "no go" device.

The circuitry inside an intercarrier sound i.c. consists basically of a series of d.c. amplifiers and is in this respect much the same as an operational amplifier. If "operational amplifier" sounds strange or something of a mouthful it is nevertheless quite a simple arrangement which could as well be described as a high-gain direct-coupled amplifier. Such circuits were first used extensively in analogue computers where they were ideal for carrying out such operations as signal addition, integration, differentiation and so on: thus the name "operational amplifier". In i.c. form the basic operational amplifier configuration provides performance which is impossible to obtain using discrete components. Martin Michaelis will be following up next month's feature with an i.c. millivoltmeter, oscilloscope preamplifier and frequency meter. The use of this type of i.c. provides considerable scope for the serious experimenter so the future has much to offer us.

W. N. STEVENS, *Editor*

### LATE PUBLICATION

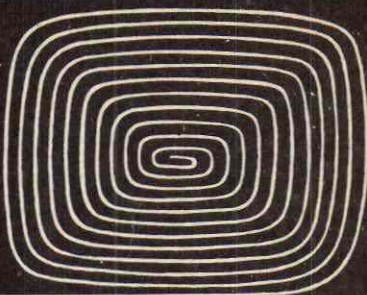
We apologise to readers for any inconvenience caused by the late appearance of this and the previous issue, due to a dispute at the printers. We hope to have the August issue out on time but this might also be slightly delayed.

## THIS MONTH

|  |     |
|--|-----|
| Teletopics   | 436 |
| Circuit Notes—Recent Circuit Developments<br><i>by H. K. Hills</i>                               | 438 |
| Single-Standard 625-Line Receiver for the Constructor—Part 5<br><i>by Keith Cummins</i>          | 443 |
| Servicing Television Receivers—GEC-Sobell 2010-1010 series continued<br><i>by L. Lawry-Johns</i> | 448 |
| Strobe-Trigger Timebase Unit—Part 4<br><i>by Martin L. Michaelis, M.A.</i>                       | 452 |
| Getting Started with Colour Fault-Finding<br><i>by H. Peters</i>                                 | 456 |
| Underneath the Dipole<br><i>by Iconos</i>  | 462 |
| Waveforms in Colour Receivers—Part 12—Convergence Waveforms<br><i>by Gordon J. King</i>          | 464 |
| DX-TV<br><i>by Charles Rafarel</i>   | 469 |
| UHF Aerial Amplifier<br><i>by Roger Bunney</i>   | 470 |
| Your Problems Solved   | 474 |
| Test Case 92   | 475 |

THE NEXT ISSUE DATED AUGUST WILL  
BE PUBLISHED JULY 17

# TELETOPICS



## TV INTEGRATED CIRCUITS

RCA Great Britain Ltd. (Lincoln Way, Windmill Road, Sunbury-on-Thames) have introduced a new—termed “third generation”—integrated circuit type CA3064 to provide automatic fine tuning in TV receivers. The i.c. features high sensitivity to make it suitable for receivers with low-level i.f. outputs. The device, which is encapsulated in a 10-lead TO-5 type pack, incorporates a built-in d.c. amplifier with 20dB improvement in sensitivity, a.g.c. amplifier, zener diode voltage regulator and differential detector.

Also introduced is a new integrated circuit sound channel for television receivers, type CA3065, in 14-lead dual in-line plastic encapsulation. This i.c. provides the functions of i.f. amplifier, limiter and f.m. detector, with an electronic attenuator, zener diode power supply regulator and audio amplifier-driver. The electronic attenuator replaces the need for a volume control: it operates with a variable resistor connected between the control terminal and earth to alter the bias levels. As there is no audio signal present at the control terminal hum and noise can be bypassed. The audio drive capability is 6mA p-p and the undistorted audio output voltage 7V p-p.

SGS have also introduced an integrated circuit for TV sound channel use, the TAA661 intercarrier sound amplifier-limiter, detector and a.f. pre-amplifier. It includes a multistage amplifier-limiter with built-in power stabilisation, balanced full-wave coincidence gate detector and emitter-follower preamp. At an input level of 1mV the a.m. rejection is better than 40dB and good performance is provided over a supply voltage range of 4.5-15V with a typical quiescent current of 15mA at 12V. To complement this the TAA621 is an integrated circuit audio amplifier which can deliver 3W r.m.s. at a supply voltage of 24V.

## NEW PLUMBICON CAMERA TUBE

A new 1in. Plumbicon camera tube, type 19XQ, incorporating an additional gun electrode has been introduced by Mullard. The extra electrode enables “comet tails” (bright trails that appear to follow brightly illuminated objects as they move across the screen) to be virtually eliminated and also enables a great deal more detail in the brightly lit areas of the picture to be seen. Comet tails are caused by the inability of the scanning beam to fully charge the photoconductive tube screen in areas of overbright illumination. As a result an

unwanted signal is produced after the bright spot in the scene has moved away, the effect also tending to obscure detail in brightly lit areas. A potential is applied to the extra electrode during the line flyback period to increase the effective beam current so that the photoconductive layer can be recharged during the time when the video signal is not being used for transmission. Stored signals below the high-light level are protected by biasing the cathode during the line flyback period.

The new tube has high sensitivity, low dark current and fast response virtually independent of light levels and is thus considered to be particularly suitable for use in portable colour TV cameras.

## RECENT SETS

**Pye** have introduced a new 25in. single-standard colour receiver, Model CT78, at £294. It is fitted with the 691 chassis, featuring a.f.c. and an i.c. sound channel.

New from **Teleton** (Teleton Electro (Distributors) Co. Ltd., Teleton House, Robjohns Road, Widford, Chelmsford, Essex) is a 13in. mains-battery operated portable single-standard monochrome model, the TH14, at £83. A loop aerial is incorporated and the receiver weighs 22lb.

Two single-standard colour sets have joined the **Alba** range, the CS1919 19in. model and CS2022 22in. model.

## LATEST TRANSMITTERS

The ITA u.h.f. colour service from **Mendip** is now operational on channel 61 carrying Harlech West of England programmes. A horizontally polarised group C aerial is required.

The BBC-1 u.h.f. colour service has now started from the **Keighley** relay station on channel 58 with vertical polarisation. A group C aerial is needed.

## COLOUR DELIVERIES INCREASE

The BREMA figures of set deliveries by manufacturers for the first quarter of the year show a continued increase in the demand for colour sets. 84,000 colour sets were delivered during the January-March period, 30,000 of these during March. Monochrome set deliveries recovered from the downward trend in the latter half of 1969, 410,000 sets being delivered during the first three months, a decrease of only 1% compared with the same period of 1969. Deliveries of radios, car radios and radiograms were all down on the first quarter of 1969, radios being down 5%, car radios down 13% and radiograms down 7%.

## NEW FROM ANTIFERRECE

Antiferrence Ltd. (Aylesbury, Bucks.), have extended their range of Troubleshooter log-periodic aerials while the Trucolour range of aerials is now available for loft mounting. Amongst other additions to their range is an aerial switch type AS11 which can be used to select one of two aerials or to switch the input from a single aerial from one set to another, a double coaxial outlet type COB12 providing straight-through connections for TV and f.m. or u.h.f. and v.h.f., a TV/f.m. filter type Y12 for selecting from a common downlead the signals required by separate TV and f.m. receivers and a u.h.f. masthead amplifier type MA100 channelised for channel groups A, B or CD with power unit type PU100 for mounting on the back of the set.

The new range of Troubleshooters comprises the TS21 Mk. 2 (5 gns.) 21-element array covering all the u.h.f. channels—21-68—and the TS415 15-element array covering the group A channels 21-34 and TS515 15-element array covering the group B, C, D and E channels 39-68, both £4 10s. Further versions, the ATS21, ATS415 and ATS515 respectively, are available fitted with the MA100 masthead amplifier (PU100 power unit also supplied). When ordering the channel groups A, B or CD must be specified.

## LATEST PUBLICATIONS

The trade will welcome the new 1970 edition of the *Trader Year Book*, now available from Dorset House, Stamford Street, London, SE1, at £2 per copy, plus 2s. 6d. postage.

The *BBC Handbook 1970* has now been published at 10s. It can be obtained by post at 1s. 6d. extra from BBC Publications, London W1A 1AR.

The 1970 edition of the *Mazda Valve and Picture Tube Data Booklet* is now available—still free of charge to the trade (from Thorn Radio Valves and Tubes Ltd., Publicity Dept., 7 Soho Square, London W1V 6DN).

## NEW LABGEAR PATTERN GENERATORS

Two new pattern generators have been added to the Labgear Colourmatch range. The CM6004/PG has been developed for use with single-standard receivers and provides adjustable crosshatch, dot and line patterns as well as grey-scale and blank raster waveforms on the 625-line standard. Band III coverage is included to enable the generator to be used with wired TV systems.

The CM6010/RG gated rainbow generator has been designed for the installation and field servicing of colour receivers. With this instrument the outside service engineer can in addition to carrying out the normal convergence procedures also make adjustments to the decoder. The CM6010/RG provides adjustable crosshatch, dot and line patterns, blank raster waveforms plus gated rainbow and special rainbow colour displays to the PAL standard.

## STUDIO EQUIPMENT DEVELOPMENTS

EMI have developed a fully automatic system for centering three-tube colour cameras to relieve the operating engineer from the need to make routine manual adjustments to counteract the registration

drift that occurs with multi-tube cameras. Red, green and blue video colour separation signals are fed to the auto-centering unit, type 2117, from the information content of an area in the centre of the viewed scene. Using the green signal as the reference, the red and blue signals are electronically inspected for centering errors and compensating correction signals generated and applied to the camera's normal centering circuits. An additional feature is a "correction-signal store" which holds the correction signals for up to four hours in the absence of a picture, a facility that is useful when, for example during crew mealtimes, the camera is capped. The present unit has been designed for the North American market but a version for four-tube cameras is at an advanced stage of development.

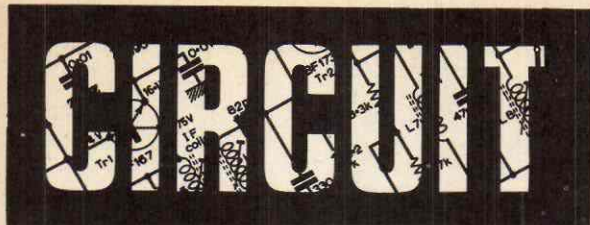
The 3M company has developed a new process, called the Chromabeam system and expected to be available next year, for recording colour-encoded video signals from videotape or a colour camera on to 16mm. colour film. The system uses an electron-beam recorder and colour-film printer. The video signals are first decoded and then fed to a field sequential switching arrangement which provides separate alternate red, green and blue fields. These are fed to the electron-beam recorder which records them on a black-and-white master film. A continuous-motion film transport mechanism is used, the film motion providing the vertical scan and the electron beam the horizontal scan for each field/frame. After developing the master film is loaded into the printer. Each frame of the colour film on to which the programme is to be recorded is here exposed in sequence to the red, green and blue fields from the master film through appropriate colour filters. In this way the separate red, green and blue fields recorded on the black-and-white master film are combined on to each frame of the colour film.

Marconi have introduced a completely automatic presentation system for television stations with worded display readout of the forthcoming programme schedule. Known as the Marconi Presentation Switcher type B3727 it uses advanced computer techniques with the signal switching performed entirely by solid-state circuits. The new system needs only to be loaded with the day's programme schedules. From then on it automatically switches as many as 30 different programme sources on to transmission at exactly scheduled times. Changes to the schedule can be made at any time without difficulty.

## MAZDA EXTEND PICTURE TUBE RANGE

Five new tube types have joined the Mazda range of TV c.r.t.s, two monochrome and three shadow-mask colour tubes. The monochrome tubes are the CME1202 (A31-181W), the first 12in. picture tube with Rimband reinforcement and mounting lugs in the UK, and the CME2013 (A50-120W) a 20in. tube with Rimguard III reinforced envelope and lugs.

Two of the new shadowmask tubes feature straighter sides and squared-off corners, the A67-120X 26in. tube and the A56-120X 22in. tube which has a deflection angle of 92°. Both these tubes incorporate temperature-compensated shadowmask assemblies and high resolution guns and are Moiré minimised for 625-line working. The A63-200X is a new 25in. rectangular shadowmask tube.



# NOTES

H.K.HILLS

THE various single-standard monochrome and colour models that have recently been introduced fairly bristle with new and surprising innovations, the dominant general trends being increasing use of transistors and integrated circuits and a very welcome simplification of circuitry due to the omission of system switching. Transistor use is now extended to positions which in standard-size domestic models were formerly mainly the province of valves, notably the video output stage, sync separator and in colour models the luminance output stage.

A.G.C. systems have changed in both character and design, being based on true rather than mean-level signal strength since on 625 lines the pulse tips represent 100% modulation making it comparatively easy to directly relate gain to signal amplitude (by measuring the sync tip amplitude).

## Single-Standard IF Strips

ONE might assume that i.f. circuits offer little scope for a fresh approach since they are simply fed with the tuner output which they amplify to the required level, trapping out the unwanted adjacent channel signals, attenuating the u.h.f. sound i.f. signal so that it cannot exceed the minimum vision signal amplitude and providing means for manual or automatic gain control. In valved receivers the line-up was usually a common i.f. stage, a vision-only and a sound-only i.f. stage, though Philips used two vision and two sound i.f. stages with both channels fed directly from the tuner on 405 and with the 6MHz intercarrier sound extracted from the vision detector stage on 625. Transistorised dual-standard models tended to follow the former approach but with usually two common i.f. stages, one vision-only stage and two sound-only stages.

Current designs however show some surprising changes. For example, the latest monochrome Bush TV181S/Murphy V2016S single-standard model uses a conventional BF127 first i.f. stage capacitively driving two BF123s in cascode, these in turn capacitively feeding another common-emitter BF123. All these stages are operated from a +20V l.t. rail provided by a rectified feed from the line output transformer. A two-stage sound i.f. amplifier is used with the collector load of the first stage consisting of a 5.6k $\Omega$  resistor instead of the usual tuned

circuit. Pye also use a cascode circuit in their i.f. strip (Pye 169 chassis).

The latest BRC single-standard models, using the 1500 chassis, follow the physical layout of the earlier 1400 dual-standard chassis in having a vertical hinged chassis but are of completely new design with transistors used for i.f. amplification, video amplification and sync separation, valves being retained for the timebases and a.f. stages only. In this outline we

# RECENT CIRCUIT DEVELOPMENTS

will concentrate on the many original features of the i.f. and a.g.c. circuits.

Being for 625 operation only, the tuner is a conventional two-transistor type. It is very similar to that used in the 1400 chassis but whereas in the former chassis it was possible to give the u.h.f. tuner output further amplification by using the valves in the v.h.f. tuner this facility is no longer available so that the i.f. strip amplification must be increased to compensate. BRC engineers calculated that a three-valve i.f. strip would be needed to provide equivalent overall amplification to that given by the two-valve i.f. strip plus v.h.f. tuner in the 1400 chassis.

In view of their low heat dissipation with relative freedom from ageing however attention was turned to transistors and initially a three-stage line-up was considered. The high gain required of each stage however made alignment difficult and neutralising essential. A four-stage line-up was therefore decided on. This permitted individual stage gain to be reduced by half, completely eliminated the need for neutralising and made alignment very much easier.

As only low-value loads were needed it was next decided to take full advantage of this and employ printed-circuit coils with close-tolerance fixed capacitors for tuning. As the inductance of printed-circuit coils can be made to  $\pm 1\%$ , the use of 5% tolerance fixed capacitors for tuning enables optimum alignment to be achieved without manual adjustment. These coils are L3, L4, L5 and L8 in Fig. 1. This leaves only a bandpass tuning coil L1 and the wave-trap coils L2, L6 and L7 plus a coil in the tuner for slug adjustment when setting up the vision response.

This is a complete transformation from the multiplicity of slug adjustments necessary in conventional dual-standard designs and has the advantage that alignment will be at optimum with exceptional long-term stability.

The absence of core slugs means that only value change in a shunting capacitor can affect the alignment, so should alignment ever be in doubt replacement of the shunting capacitors must effect a cure. For various reasons including the higher inductance required and the need for greater selectivity conventional tuned circuits are used in the 6MHz sound i.f. strip and for take-off and rejection between video driver and output stage.

It will be seen from Fig. 1 that the tuner output is applied via C1 and the bandpass coil L1 to the base of the first vision i.f. amplifier Tr4. L2 and C7



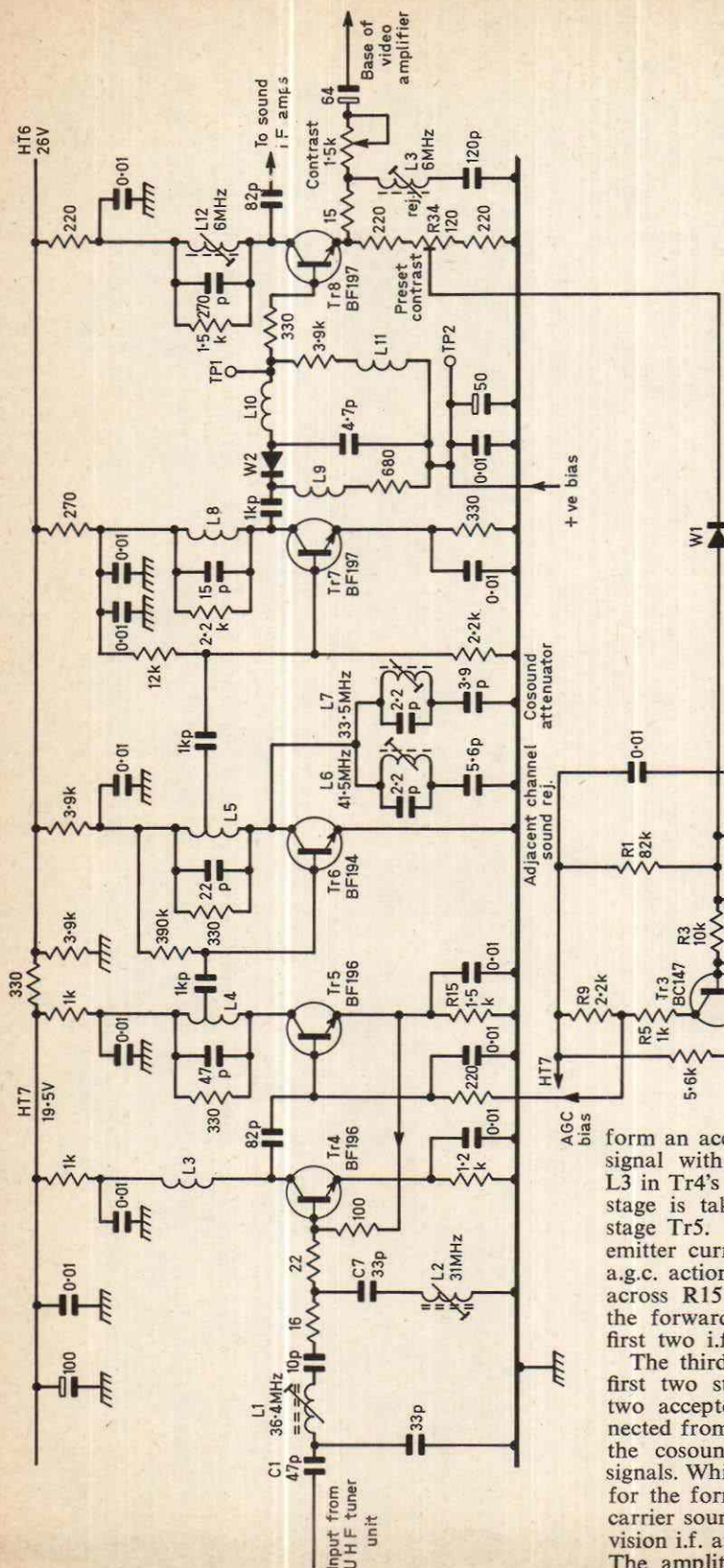


Fig. 1: Vision i.f. stages and a.g.c. circuitry, BRC 1500 chassis. L3, L4, L5 and L8 are printed circuit coils.

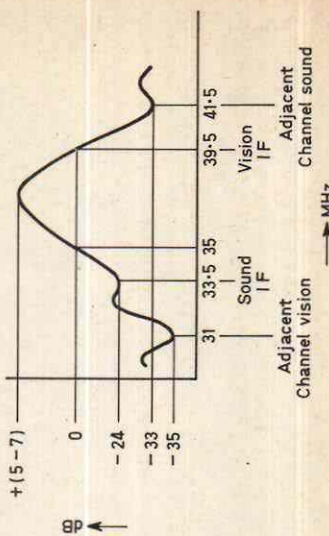


Fig. 3: I.F. response, BRC 1500 chassis.

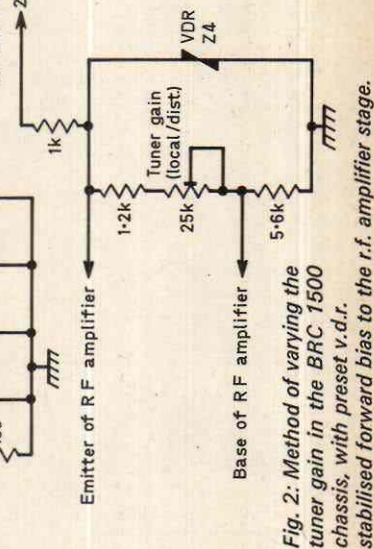


Fig. 2: Method of varying the tuner gain in the BRC 1500 chassis, with preset v.d.r. stabilised forward bias to the r.f. amplifier stage.

form an acceptor trap to the adjacent channel vision signal with the amplified output developed across L3 in Tr4's collector lead. The forward bias for this stage is taken from the emitter of the second i.f. stage Tr5. As a.g.c. is applied to this transistor its emitter current increases on strong signals (forward a.g.c. action) so that the emitter potential developed across R15 will proportionally increase to increase the forward bias applied to Tr4. In this way the first two i.f. stages are gain controlled.

The third i.f. stage Tr6 is basically similar to the first two stages except that the gain is fixed and two acceptor traps tuned by L6 and L7 are connected from the collector to chassis to attenuate both the cosound and the adjacent channel sound i.f. signals. While need for the latter is obvious the reason for the former may not be. It is because the inter-carrier sound signal is produced by the beat between vision i.f. at 39.5MHz and the sound i.f. at 33.5MHz. The amplitude of the 6MHz "difference" product

cannot exceed that of the smallest amplitude fundamental, and as the vision signal is constantly varying in amplitude down to 18-20% at peak-white should this be smaller than the fixed-amplitude f.m. signal these minimum vision signal excursions would impress their modulation on the f.m. signal to give vision buzz that could not be subsequently removed. The 33.5MHz trap is therefore an attenuator rather than a complete stopper.

The vision detector stage is fairly conventional with the negative-going output from diode W2 d.c. fed to the base of an npn video driver stage Tr8, superimposed upon the necessary positive forward bias required by this stage. Signal reception will result in a decrease from the no-signal emitter current value at this stage, with the sync pulse tips, being at peak value, producing peak-value negative-going voltage pulses which are rectified by the a.g.c. detector W1. The video output from the emitter is applied to the base of the transistor output stage Tr9 while the slider setting of the preset contrast potentiometer R34 in the emitter lead of Tr8 determines the signal amplitude applied via W1 to the base of the a.g.c. amplifier Tr3.

The anode of diode W1 is held at a positive voltage by the potential divider R1, R2 which also sets the forward bias applied to the a.g.c. amplifier, making it fully conductive on no-signal. Its collector will then be at a low voltage to chassis, the junction of R5 and R9 being approximately 6.7V positive. This potential provides the forward bias to Tr5.

When the sync pulse tips (from the preset contrast control) momentarily reduce W1 cathode voltage below its fixed anode voltage conduction occurs through the diode and results in a lowering of the forward bias applied to the a.g.c. amplifier. The reduced collector current caused by this reduced bias then raises the voltage at the junction of R5 and R9 due to the reduced  $IR$  drop through R5. The increased positive potential at Tr5 base increases Tr5 emitter current and by forward a.g.c. action reduces stage gain. As previously mentioned the increase in Tr5 emitter current increases the forward bias to Tr4 so that the gain of both stages is reduced.

C3, R3 and C6 in the a.g.c. amplifier base circuit filter out the field sync pulse signals which might otherwise introduce hum.

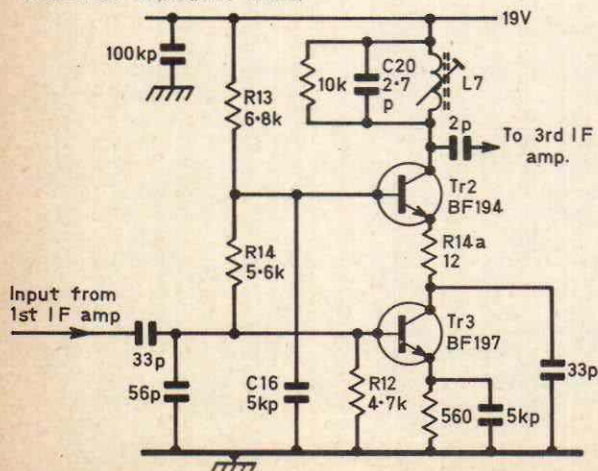


Fig. 4: Cascode i.f. stage used in the Pye 169 single-standard monochrome chassis.

A.G.C. is not applied to the tuner, the front-end gain being preset by a v.d.r. stabilised circuit as shown in Fig. 2. This is normally set for maximum gain but for strong inputs it may be necessary to reduce the setting to avoid risk of cross-modulation.

The preset contrast control R34 is a factory-set adjustment and unless either the video driver, a.g.c. amplifier or a.g.c. rectifier is replaced should not need readjustment. When incorrectly set it can cause loss of picture and sound at one extreme and impaired sync at the other.

If an oscilloscope is available the correct readjustment procedure is to inject a 3-10mV modulated u.h.f. signal or strong transmission at the aerial socket and adjust the preset to obtain 110V peak-to-peak between the c.r.t. cathode and chassis. If an oscilloscope is not available apply a similar 3-10mV but unmodulated u.h.f. signal at the aerial socket and adjust the preset to obtain 2.2V d.c. on an Avo meter connected across test points TP1 and TP2 in the video driver base circuit.

As previously mentioned both Pye and Bush-Murphy employ a cascode i.f. amplifier as the second stage in the three-stage i.f. strips used in their latest single-standard monochrome models. These cascode circuits are basically similar to the valve arrangements employed for so many years as v.h.f. r.f. amplifiers prior to the introduction of PC97-PC900 neutrodes.

The transistor i.f. versions give greater gain than a single transistor stage while the feedback is so low that neutralising is completely unnecessary. The cascode combination is really a common-emitter stage driving a common-base stage with the input impedance of the latter being the load of the former. As the input impedance of the common-base stage is very low and as the gain of the common-emitter stage depends directly on its collector load value most of the combination's amplification is provided by the driven common-base transistor.

The circuit employed in the Pye 169 chassis is shown in Fig. 4. R13, R14 and R12 provide forward bias to both transistors, R14a coupling Tr3 collector output to Tr2 emitter while the vital capacitor C16 earths Tr2 base to chassis. Tr3 collector current variations produced by the input from the first i.f. stage are therefore applied across the base-emitter junction of Tr2 for further amplification. The output is developed across the collector tuned circuit L7, C20 and then capacitively fed to the final i.f. stage.

The selectivity required in the i.f. channel can be obtained using three single-transistor i.f. stages but this arrangement provides insufficient gain: the use of a cascode second stage neatly solves this design problem, providing high gain with good stability.

## Hybrid Field Generator

A HIGHLY original valve-transistor combination is used in the Pye 169 single-standard chassis as field multivibrator. The circuit is shown in Fig. 5, the valve (triode section of a PCL85) being fed in the normal manner from the boost rail via the height control which varies the anode potential while the transistor is fed from a 237V h.t. rail. The transistor used (BC147) being an npn type is fed from a positive rail and its operation is thus closely analogous to that of a valve in that increasing

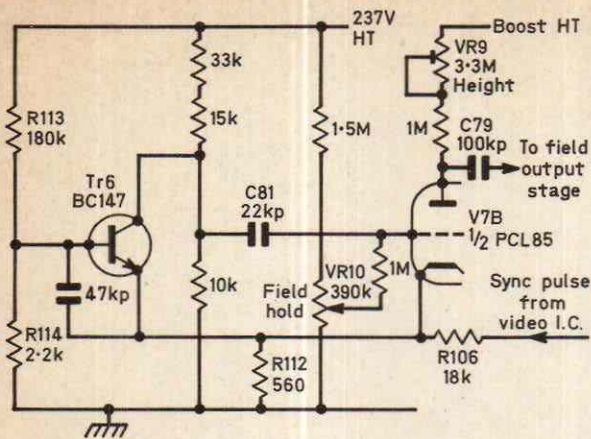


Fig. 5: Hybrid multivibrator circuit used as field generator in the Pye 169 chassis.

positive forward bias at the base increases collector current in the same way that reduction of negative grid bias increase valve anode current, i.e., in both instances the bias changes are positive-going for increased output.

The necessary feedback for oscillation is obtained by linking the transistor's collector to the valve grid by C81 and returning both valve cathode and transistor emitter to chassis through the common 560Ω resistor R112. This arrangement is thus very similar to that employed in two-valve cathode-coupled multivibrators as an alternative to the capacitively cross-coupled type of multivibrator in which the anodes and grids of the two valves are RC coupled to each other. The junction of R113, R114 provides forward bias for the transistor while the operational frequency is set by VR10 which varies both the grid bias and total grid circuit resistance of the PCL85 triode.

This recent chassis uses a TAA700 integrated circuit for video preamplification, a.g.c., sync separation and to provide flywheel phase detection for the line generator. Pin 15 on this unit provides the field sync pulse feed (12V positive-going) and this is applied via R106 to both the triode cathode and transistor emitter. As the transistor is an npn type this pulse injection results in simultaneous momentary reductions in collector and anode currents. The main effect, however, is on the transistor, driving it hard off so that V7B grid is driven positive via C81 which charges to h.t. via V7B grid current, cutting V7B off again. A 70V peak-to-peak sawtooth output stage drive waveform is generated at V7B anode, C79 being fully discharged to give the negative-going flyback portion of the sawtooth when V7B conducts briefly.

## Line Output Stage

THE dramatic decrease in the complexity of line output stage circuitry following the change from dual-standard to single-standard operation is well brought out by the complete line output stage circuit (Fig. 6) employed in the new 625-only monochrome GEC range of models. However, although the simplicity of design is reminiscent of earlier 405-only models the stage contains several important developments not then in use. These are auto-

matic width and boost voltage control, desaturated transformer to eliminate line whistle, provision of a transistor l.t. rail, and far higher efficiency to provide wide-angle scanning at 18kV a.h.t.

Drive from a PCF802 line generator is applied via C1 and a 1kΩ grid stopper to the output pentode PL504. The bias for this valve depends on three factors, (a) the grid drive, (b) the slight positive d.c. drain through the 10MΩ resistor R2, the v.d.r. and VR1, and (c) the negative potential developed by the v.d.r. on pulse feed from the line output transformer. Adjustment of VR1 regulates the total effective bias and thereby the operating conditions of the PL504 which in turn develops the boost rail voltage.

A v.d.r. is not a rectifier and can only develop a d.c. potential from a nonsymmetrical waveform—since its resistance varies with applied voltage. With a sine or other symmetrical waveform that has identical voltage excursions each side of zero it cannot produce any "rectified" output. Once VR1 is correctly set—in this model it is adjusted to produce a boost potential of 890V—variations in mains voltage and the effects of valve ageing are automatically compensated, giving constant boost rail voltage and picture width.

The absence of system switching and capacitor duplication in the transformer circuit leaves this singularly uncluttered, making it easy to 'follow through' circuit action. This will certainly aid fault diagnosis in this area. Due to the single-standard working, the line linearity control can again be achieved by an easily adjustable saturable inductor type of control in series with the scan coils instead of by a scan coil insert. The tapping point on the transformer for the linearity coil also supplies a reference pulse feed to the dual-diode a.f.c. discriminator.

The l.t. supply mentioned earlier is derived from a low-voltage tapping on the transformer, rectified by a BA148, and smoothed by a 10Ω resistor and two 160μF electrolytics in a pi filter to give 18V output. This supply is sufficient to provide the total current requirements of the receiver's seven transistor complement plus the 20mA required by the TAA570 integrated circuit unit which provides

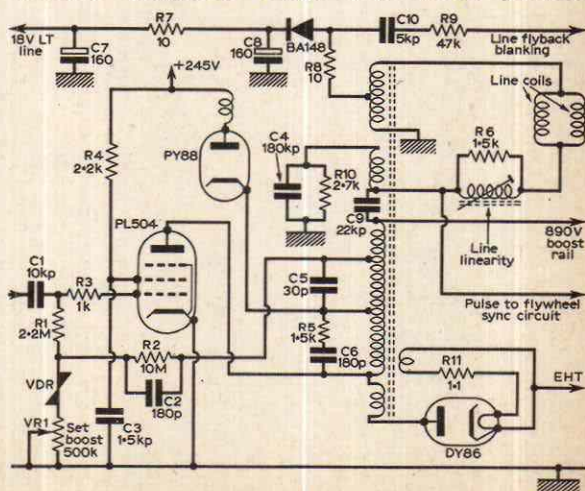


Fig. 6: GEC single-standard line output stage, which also provides the 18V l.t. supply.

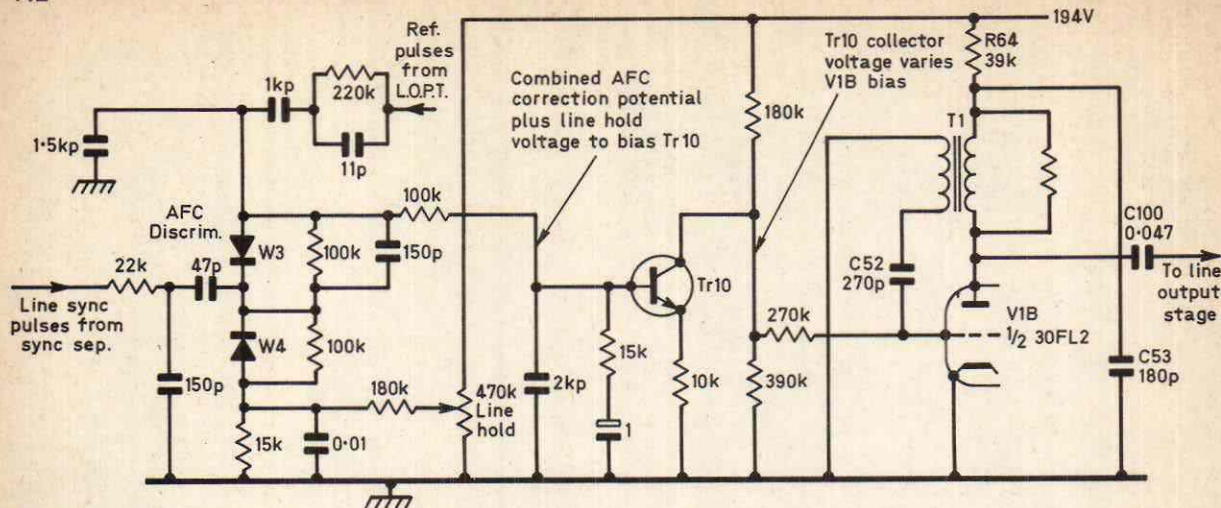


Fig. 7: Hybrid line generator circuit used in the BRC 1500 chassis. The value of the damping resistor across the blocking oscillator transformer T1 primary is  $15k\Omega$ .

sound i.f. amplification, detection and a.f. pre-amplification of the 6MHz sound signal.

The desaturated line output transformer eliminates audible line whistle by removing the d.c. core magnetization which normally causes the laminations to vibrate at line frequency. The a.c. line currents magnetize the core at twice line frequency since both positive and negative half-cycles produce the same magnetostrictive effect and therefore produce vibrations above audible range. By arranging for direct current flow to be in opposite directions through the transformer windings their core magnetising effect cancels out, removing audible line whistle and permitting the use of smaller diameter cores at higher flux densities.

### Hybrid Line Generator

ANOTHER example of transistor-valve hybrid circuitry is to be found in the BRC 1500 single-standard chassis in which the frequency of the triode blocking oscillator line generator is directly controlled by a transistor d.c. amplifier instead of the more usual grid circuit potentiometer. The complete circuit is shown in Fig. 7 and employs a conventional double-diode a.f.c. discriminator which compares the frequency of the line sync pulses from the sync separator anode with that of reference pulses from the line output transformer. A  $470k\Omega$  line hold control shunted across h.t. and chassis is directly linked to the discriminator so that the output of the discriminator is the combination of the correcting d.c. potential developed and the voltage tapped from the line hold control.

Ideally the a.f.c. correcting voltage should be zero when the line hold is correctly set, going positive or negative when the line frequency increases or decreases. (Change in frequency alters the sync and reference pulse synchronism and thus the discriminator output.) This variation is only quite small so to increase its operational range the combined discriminator-line hold potential is applied as forward bias to the base of the d.c. amplifier Tr10. As this transistor is directly coupled to the grid of the line oscillator triode it will directly

control the latter's frequency by varying its bias.

The output from the triode anode is capacitively fed via C100 to the grid of the line output pentode. The time-constant of C52 and the control network sets the timing of the circuit while the output waveform is generated by C53 charging via R64 and then discharging when V1B briefly conducts to give the flyback portion of the waveform.

*Feature to be continued*

### WORLD'S FIRST REGULAR PHONE-TV SERVICE

Bell Telephone is offering in Pittsburg USA the world's first regular commercial combined telephone-television service to enable callers to see and hear the person they are talking with. In view of the cost of the system Bell expect the first customers for their "picture phone" system to be large corporations.

### HIGH-SPEED VIDEOTAPE DUPLICATION

Ampex have developed an experimental system for the high-speed duplication of colour and monochrome videotape recordings. The system has been demonstrated duplicating a one-hour high-band colour videotape recording in less than six minutes—the present system in use is based on playing a master tape on a recorder for the full hour. The new system can expose several blank tapes to the master recording as it traverses an extended tape path so that a number of copies can be made simultaneously, and is claimed to give duplicates of quality indistinguishable from the original. The master tape is specially formulated and designed to give repeated duplications. The time saving gives economic programme distribution at present only available with film.

### ITA'S NEW DIRECTOR GENERAL

Brian Young, Director of the Nuffield Foundation, has been appointed by the ITA to succeed Sir Robert Fraser as Director General from October this year.

# SINGLE-STANDARD PART 5

# 625-LINE RECEIVER

## FOR THE CONSTRUCTOR

KEITH CUMMINS

THIS is the final part of the series for those readers who succeeded in obtaining the specified tuner and i.f. strip before the heavy demand caused supplies of the i.f. strip to run out. Further articles later will deal with the construction of an alternative i.f. strip.

The first points we will deal with concern the finishing touches to the completed receiver. The outer coating of the cathode-ray tube must be earthed. This is achieved by laying a bare piece of 22 s.w.g. wire across the tube as shown in the photographs in the March issue and tensioning the wire with a small spring. The spring is attached to the top left-hand cathode-ray tube securing bolt (looking at the set from the front). The wire is soldered to an earthing tag half way down the right-hand side plate.

### Initial Tests & Checks

Next the h.t. supply line should be checked—using an Avometer on the ohms range—to ensure that no short-circuit exists. Measurements should also be taken at the anodes of the valves to make sure there are no shorts.

Now fit the mains fuse F1 but leave the h.t. fuse F2 out. Remove the c.r.t. base from the tube, connect the set to the mains and switch on. The valve heaters should light up and the +12V transistor supply should be present. Run the receiver in this condition for several minutes to ensure that the supplies are operating correctly and that no overheating is taking place. Using the Avometer on the 10V a.c. range, check the voltage at pins 1 and 8 of the c.r.t. base. It should read between 6.2 and 6.5V. If the heater voltage measures correctly the base may be connected to the c.r.t. and the tube heater should light.

Do not be tempted to bypass any of this procedure. If the mains transformer secondaries have been incorrectly connected for example the c.r.t. heater could be blown open-circuit immediately on switching on! This is about the worst calamity that can occur but other lesser tragedies can be averted by not being too eager or anxious to have everything working as quickly as possible. As established engineers will testify, unhappy experiences are often the result of too much haste.

Next the c.r.t. base should be removed along with the e.h.t. cap. This latter should be kept well away from surrounding objects and metal work. Turn the contrast control to maximum, the line and field hold controls to the half-way position, the height to minimum, the linearity controls and width control half way. The front controls for volume and

brilliance should be set to minimum, the receiver switched off and turned upside down.

The h.t. fuse may now be fitted and the Avometer hooked in to measure the h.t. voltage on the 250V or 300V d.c. range. The receiver can now be switched on again, a careful eye being kept on the meter. The h.t. voltage should rise slowly to around +230V; a keen ear should detect the line whistle start up; and the EY86 e.h.t. rectifier heater should light. Using an insulated screwdriver it should be possible to draw a small spark from the e.h.t. connector previously disconnected from the tube.

When the volume control is turned up a hiss should be heard. Connect the u.h.f. aerial and tune one of the buttons. If all is well a sound signal should be received. The line whistle may alter pitch as the vision signal tries to synchronise the timebase.

Connect the Avometer on the 1000V d.c. range to the positive side of the boost reservoir capacitor C33. Adjust the width control for a reading of +700V. Next carefully measure the voltages at the disconnected c.r.t. base. The cathode (pin 7) should read 100-120V. The grid (pin 2) should read zero, rising to +100V as the brilliance control is turned to maximum. Having tested this voltage return the control to minimum. The first anode (pin 3) should read approximately +450V. The focus anode should be earthed along with the ring trap (pins 4 and 5 respectively).

### Setting up

Having established that the c.r.t. supply voltages are correct the receiver can be switched off and the tube connections remade. Take care to discharge to earth any residual e.h.t. on the e.h.t. lead before connecting it to the c.r.t.

Switch the receiver on again and wait for conditions to stabilise. Carefully advance the brilliance control, when something should be seen on the screen. This "something" will probably be an off-centred, askew raster of insufficient height. Rotate the scan coils (taking care not to get a shock) until the top and bottom of the raster are parallel to the edges of the tube. If a signal is being received adjustment of the line and field hold controls should resolve a picture of sorts. Open out the height until the picture proportions are approximately correct and adjust the linearity controls in conjunction with the height control as necessary. If a test card is available so much the better. If the picture is upside down reverse the primary connections of the field output transformer. Centre the picture by rotating the shift magnets at the rear of the scanning coils.

If everything is working correctly adjustment of

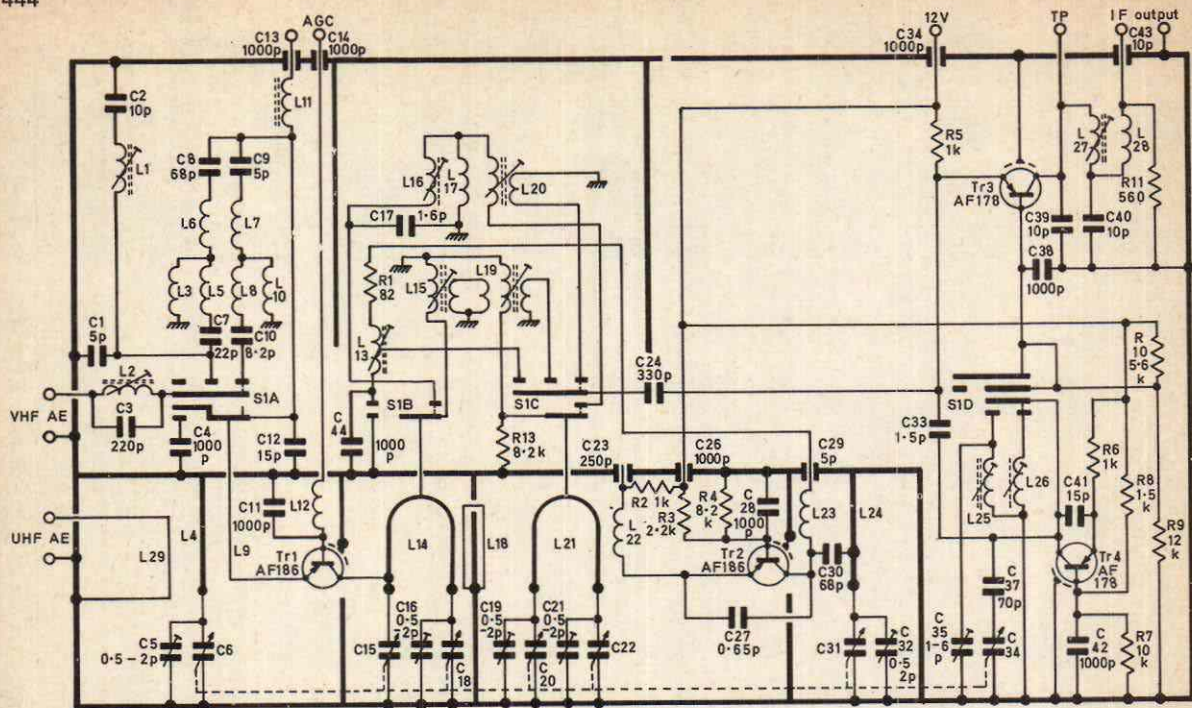


Fig. 16: Circuit diagram of the integrated v.h.f./u.h.f. tuner unit used in the prototype receiver.

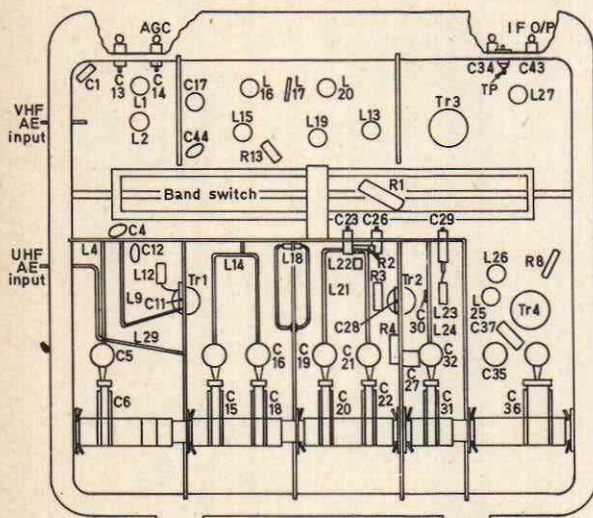


Fig. 17: Tuner unit layout.

the tuning buttons and contrast control should enable very encouraging results to be obtained, but before going further we shall consider the courses of action to take if any of the foregoing operations do not work out in practice.

### Checking for Faults

First if the h.t. or mains fuse should blow as soon as the receiver has warmed up check that line drive to the output valve PL36 is present. A negative voltage should be present at the grid (pin 5) of V6 if the oscillator is running correctly.

If no signal is received check that the contrast

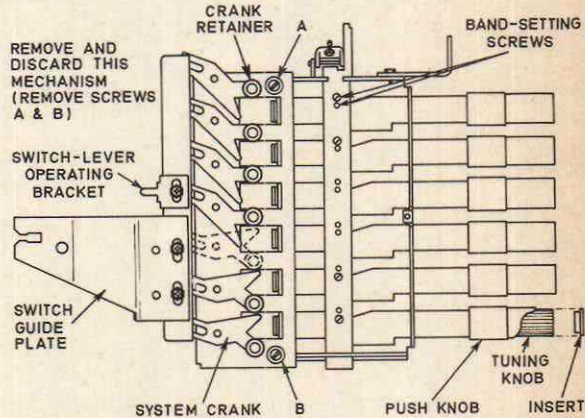
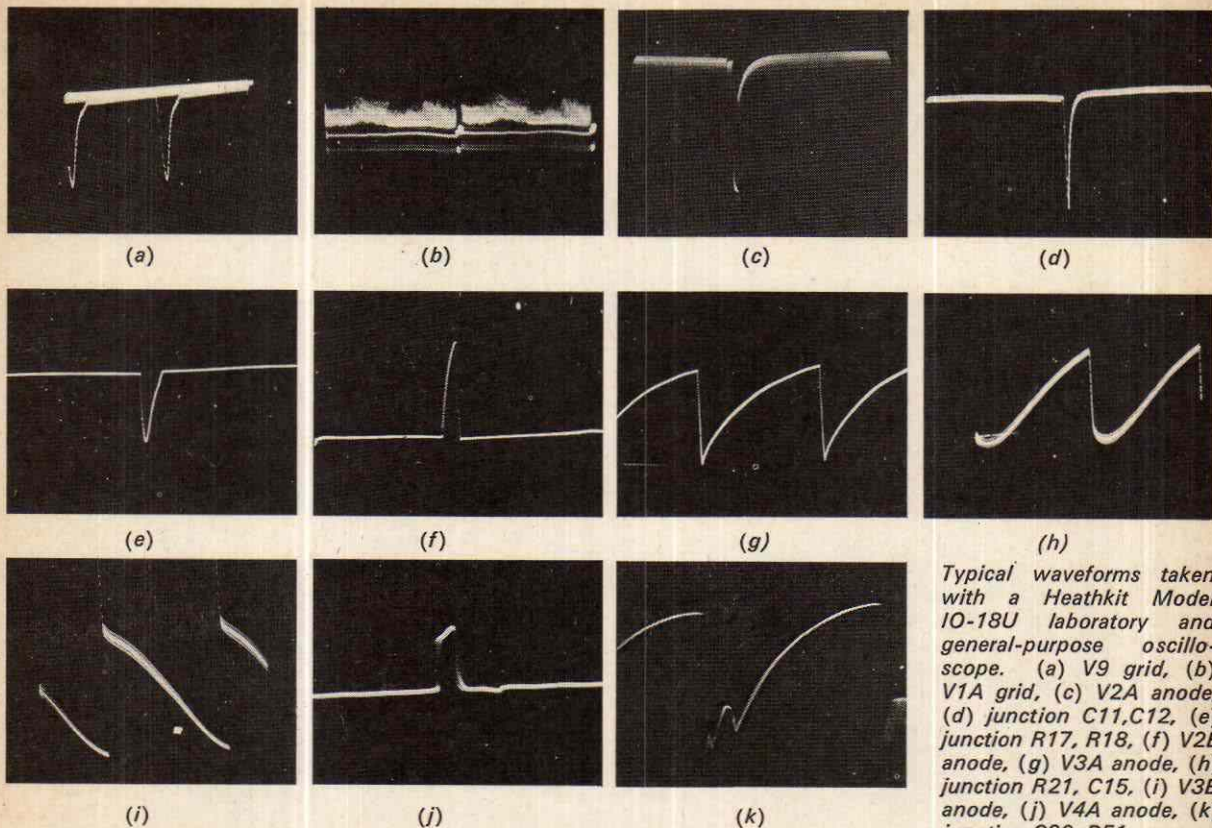


Fig. 18: Tuner unit press-button mechanism.

control is at maximum, that is with the slider at the end nearest the  $1M\Omega$  resistor R29. If still no signal comes in, or no snow is visible on the screen, check the voltages applied to the tuner and i.f. strip. If the receiver still appears to have r.f. or i.f. trouble a careful check of voltages around the transistors is a useful guide. Measurement of the base-emitter voltage is very telling: a voltage in excess of 0.6V can indicate an open-circuit emitter while no voltage at all can mean a shorted transistor. Finally check that the system and bandswitch sliders of the i.f. strip and tuner are correctly positioned as described earlier in this series.

Fault-finding in this receiver follows basic practice, waveforms and voltage measurements having been included on the main circuit diagram as a guide. It cannot be too heavily stressed that accuracy of construction initially can save hours of bother later on, so be sure that you have wired up correctly.



Typical waveforms taken with a Heathkit Model IO-18U laboratory and general-purpose oscilloscope. (a) V9 grid, (b) V1A grid, (c) V2A anode, (d) junction C11, C12, (e) junction R17, R18, (f) V2B anode, (g) V3A anode, (h) junction R21, C15, (i) V3B anode, (j) V4A anode, (k) junction C29, R51.

Weak reception can be caused by a defective AF186 transistor in the r.f. stage of the tuner. This transistor can easily be checked by measurements taken at the external connections of the tuner, remembering that the transistor's collector has a direct connection to earth so far as d.c. is concerned. If the AF186 is defective great care should be taken when replacing it, with particular reference to the position of leads in the tuner. Also the base decoupling capacitor (C11) is a disc ceramic soldered directly to chassis; too much heat or force applied here can crack the capacitor. The AF186 is very sensitive to excess voltage transients and the chassis should be disconnected completely from the mains and aerial while the replacement is carried out.

These difficulties did not arise during the development of the prototype receiver; they are quoted from the writer's experience in general.

The prototype was not running long before a picture of sorts was obtained. Slight modifications to the original design were then carried out to optimise performance. The receiver was then subjected to a period of tests under domestic viewing conditions. After about a month the first vision i.f. transistor failed. This was the first and only failure. The transistor was replaced and the receiver has since continued to operate satisfactorily, first under the same conditions and then during independent tests.

## Modifications

Certain queries have arisen during the publication of this series. One concerns the use of the PL36 as

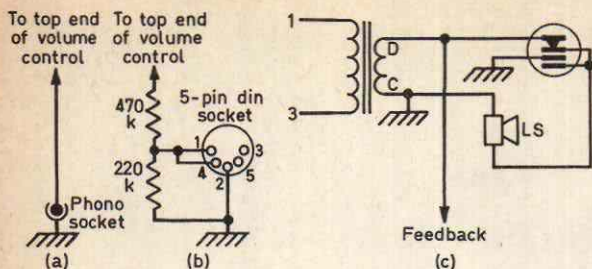
opposed to a PL504 line output valve. A PL504 valve can be used if a B9D base is fitted. Unfortunately this base is difficult for constructors to obtain and for this reason the PL36 with its octal base was chosen. The PL504 strictly speaking requires an extra 2V applied to its heater but the total change of current in the series chain as a result of fitting a PL504 is not significant.

Another reader asked why three instead of four buttons were employed for the tuner. Four buttons out of the original six may be retained if required: three only were used in the prototype since only three u.h.f. channels are available in the writer's area.

As far as possible this design has tried to eliminate the need for special components. Only one voltage-dependent resistor (or varistor) has been employed, in the width stabilisation circuit. However, two other positions exist where v.d.r.s may be employed with advantage. First the supply to the c.r.t. first anode and the height control can be stabilised by replacing R52 with a v.d.r. type MU01: this improves the brilliance and height stability against fluctuations in the mains voltage. Secondly a v.d.r. type E298ED/A258 can be connected across the primary of the field output transformer where it protects the transformer against excessive peak voltages and flashover under certain types of fault condition.

## Audio Connections

As mentioned in earlier articles audio connections to this receiver may be made simply and safely. The chassis is earthed so no risk is present when connect-



ing other equipment. A possibility does exist however when an external amplifier or tape recorder is connected that an earth loop with attendant hum problems could be set up if the extra equipment is also earthed via the mains plug. Should trouble occur from this source it is best to open the earth connection to the tape recorder or amplifier.

The output arrangements for audio are shown in Fig. 19. A phono socket outlet arrangement is shown in Fig. 19(a). Sufficient output is available here to drive the auxiliary input of British or American standard equipment. Fig. 19(b) shows the arrangement where output to the DIN standard is required. This output is applied to the diode socket of continental standard tape recorders and amplifiers. Where a stereo amplifier is to be connected a standard "5 to 5" coupling lead is connected to the DIN socket; otherwise use a "3 to 3" lead.

Some readers will have realised that if they wish

Fig. 19 (left): (a) Audio take off for British standard equipment. (b) audio take off for DIN standard equipment. (c) audio take off at loudspeaker using a DIN loudspeaker socket.

the audio output section of the receiver could be omitted, an external amplifier being used instead. However, the usefulness of the built-in stage renders it very desirable except under exceptional circumstances. Note that the volume control does not affect the output from the audio sockets mentioned above.

Should it be required to increase the bass response of the receiver the  $0.033\mu\text{F}$  capacitor (C56, Fig. 13) coupling the audio signal out of the ratio detector—mounted on the i.f. panel—can be removed or short-circuited. If it is removed a link should be fitted in its place.

If an extension loudspeaker is to be fitted it is strongly recommended that a continental DIN type speaker socket be used for the purpose. Fig. 19(c) shows the arrangement of the wiring. The continental speaker socket has the advantage that the plug may be inserted in either of two ways; in one position the receiver's speaker is muted while in the other it is not. In both positions the signal is fed to the extension speaker. This useful facility can only be achieved easily by using a DIN standard socket.

A final note concerning the sound section. If oscillation occurs it will probably be caused by instability, the result of positive feedback. In this

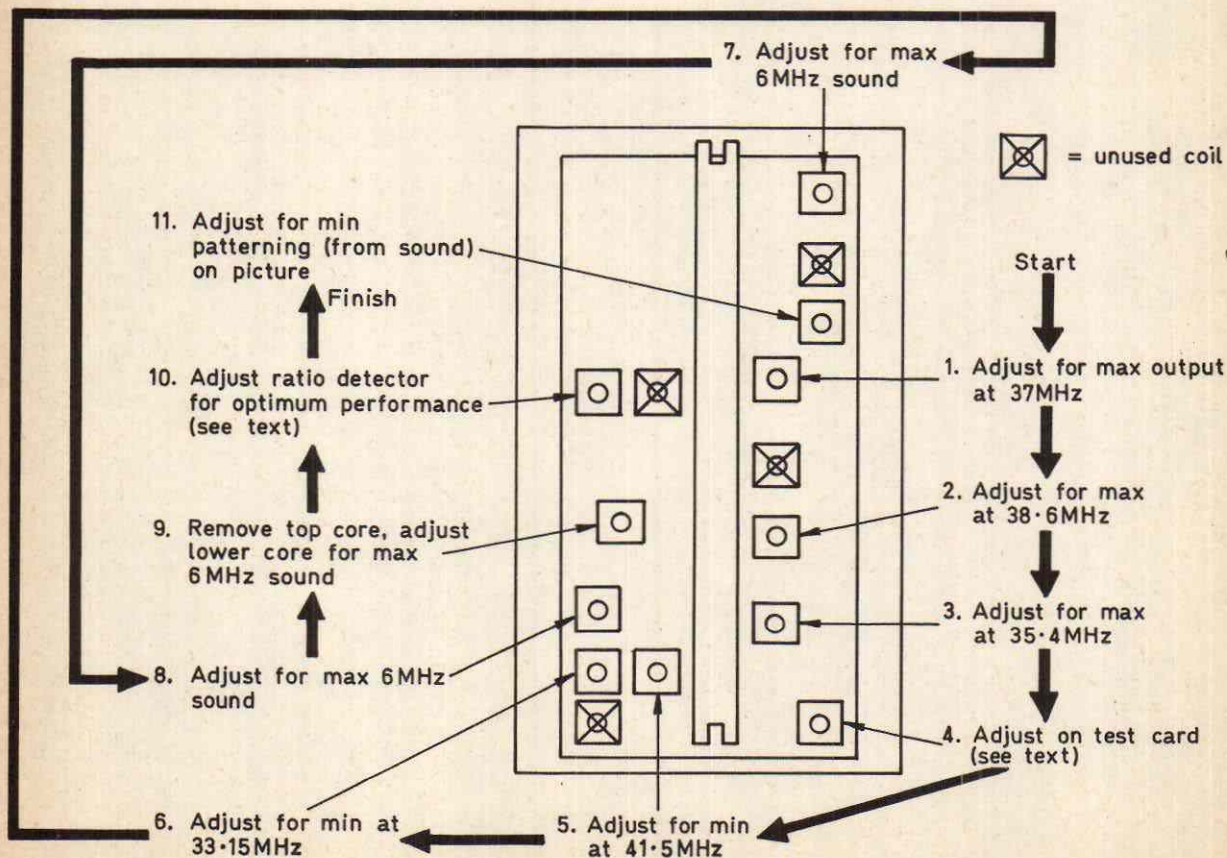


Fig. 20: I.F. alignment. Keep the signal generator output to a minimum consistent with about  $-0.5\text{ V}$  signal at the video output lead of the i.f. strip.



case it probably means that the output transformer connections need reversing at the primary so that the feedback is negative instead of positive around the loop. We now return to the vision side of the receiver. It will be noticed that the focusing anode (pin 4) of the c.r.t. is connected to earth. In the majority of cases this connection will provide excellent focus all over the face of the tube. If however it is felt that the focus is below optimum the focus anode can be connected to either the boost rail (c.r.t. pin 3) or the main h.t. rail. In this latter case an additional lead from the c.r.t. base to the main chassis will be required. Normally connection of the focus anode to one of those three points—earth, h.t. or boost—will provide optimum focus.

It is possible that an alternative type of field output transformer to that used in the prototype may be supplied. If this is the case the windings can easily be identified by using the Avometer on the resistance range. The anode winding of the transformer has the higher resistance. If the picture is upside down the primary connections of the field transformer should be reversed to correct matters: reversal of the scan coil connections will correct the picture sense but the field blanking polarity will remain incorrect providing a brightening of the field flyback instead of suppression.

## IF Alignment

We now come to the final process, that of optimising the alignment of the i.f. strip. This can be carried out using a test card. It is likely, though not necessarily true in every case, that the i.f. strip will be reasonably well adjusted from the start. If the test card looks good and the sound is reasonable then little adjustment is likely to be necessary. On the other hand if everything seems very dead yet the voltages etc. mentioned earlier are correct it will probably be advisable to obtain a signal generator. A 36MHz signal can then be injected at the bases of the transistors (via a 10pF capacitor) moving from the detector end of the i.f. strip towards the input end. The i.f. coils can then be checked to see whether they are anywhere near the correct frequency.

Figure 20 shows the alignment details for the different coils. Those coils marked with a cross are used in the 405-line operation of the i.f. strip and consequently do not need adjustment. The stage-by-stage alignment is easily carried out by following the arrows, starting at point 1 and carrying on from there.

In addition to the coils two preset potentiometers are fitted to the i.f. strip. One (R29) adjacent to the 6MHz ratio detector transformer is a discriminator balance control and should be adjusted for maximum a.m. rejection in conjunction with the top core of the ratio detector transformer. The adjustment is best carried out during a silent period (such as the one-minute silent period which occurs about every fifteen minutes during trade test transmissions). The a.m. rejection potentiometer and ratio detector transformer are then carefully adjusted for minimum buzz.

The other potentiometer on the i.f. strip (R10) adjusts the damping of the second vision i.f. transformer and is relatively uncritical. It should be set at about half travel.

The i.f. input (stage 4 of the alignment shown in

Fig. 20) should be adjusted while receiving a test card and simply set up to give the best picture, i.e. optimum definition without smearing or "plastic" effects. Where the i.f. strip is reasonably aligned to begin with complete alignment is unnecessary. In this case adjustment at stages 2, 3 and 4 using the test card should be sufficient. (The i.f. tuning in the tuner is very flat and should not need adjustment.) Likewise on the sound side the adjustment at stage 10 may be all that is necessary.

If difficulty is experienced in tuning to the required channel, depress and turn fully clockwise the button to be set then turn back (i.e. anticlockwise) approximately the number of turns as follows:

| Ch. | Turns   | Ch. | Turns   | Ch. | Turns  |
|-----|---------|-----|---------|-----|--------|
| 21  | 26½-28½ | 37  | 18½-21  | 53  | 10-12½ |
| 23  | 25½-27½ | 39  | 17-20   | 55  | 9-11½  |
| 25  | 24½-26½ | 41  | 16-19   | 57  | 7½-10½ |
| 27  | 23½-26  | 43  | 15-17½  | 59  | 7-9½   |
| 29  | 22½-25  | 45  | 14-16½  | 61  | 6-8½   |
| 31  | 21½-24  | 47  | 13-16   | 63  | 5-7½   |
| 33  | 20½-23  | 49  | 11½-14½ | 65  | 4½-7   |
| 35  | 19½-22  | 51  | 11-13½  | 67  | 3½-6   |

## Miscellaneous Points

While as previously stated this receiver has good sensitivity it cannot give of its best unless a good aerial signal is provided and conveyed from the aerial to the receiver by low-loss coaxial feeder. If any doubt exists as to the strength of the available signal the easiest way to assess the situation is to borrow a receiver of known condition and test the performance of the aerial. Under very difficult conditions a mast-head amplifier may be needed in addition to an eighteen-element aerial. Generally speaking this combination should produce a signal if it is possible to do so.

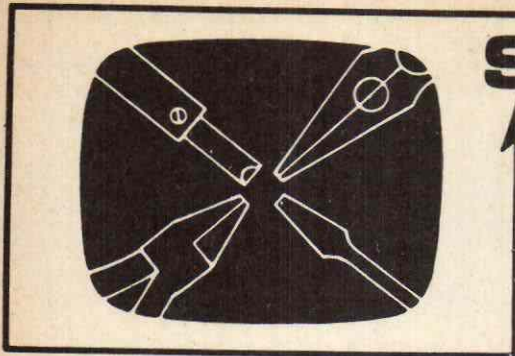
Under difficult conditions it is possible to optimise the noise-cancelling action in the sync separator by adding a 100 kΩ potentiometer in series with R13. When viewing under difficult conditions this potentiometer is adjusted from the no-resistance end until the most stable picture is obtained. If the value is increased excessively picture content will interfere with synchronisation and the d.c. restoration will be imperfect. This is the reason why this adjustment is not included in the basic design. It is the writer's opinion that very few cases will warrant the addition of this potentiometer.

The very last adjustment to be carried out is a recheck of the picture centring (having first checked that the line hold control is in its optimum position, that is the position where minimum delay occurs in pulling into sync after an interruption of signal). When the picture has been accurately centred and set up the four geometry correction magnets attached to the scanning coils should be adjusted to straighten out the edges of the picture.

A last word concerns the availability of the BSX21 transistor. Any simple npn switching transistor with a V<sub>ce</sub> of 100V or more will serve as the spot-suppression transistor. If a less sophisticated type is not available a BF178 can be used without modification to the circuit.

While on the subject of spot suppression it is worth emphasising that as the suppression circuit cuts

—continued on page 473



# SERVICING television receivers

L. LAWRY-JOHN

GEC-SOBELL 2010-1010 SERIES—cont.

## Line Hold

If the picture will not lock but wanders across one way or the other at the point where it should lock check the PCF802 before suspecting the discriminator diodes and associated components.

## Field Timebase

Our old friend (?) the PCL85 sits fair and square in the field oscillator-output position. Change him (to a PCL805) in the event of any trouble concerning the vertical scanning and then bear the following points in mind. Reduced height (if even top and bottom) is often due to the 1.2M $\Omega$  resistor R132 in the boost feed changing value. Bottom compression may be due to a faulty 100k $\Omega$  linearity control P8 (note the effect of putting a 27k $\Omega$  fixed resistor across it) or leaky 0.01 $\mu$ F capacitors (C151 and C155). Remember that the output bias resistor

R108 330 $\Omega$  has a fairly critical value. If its value increases (not often) the top of the picture compresses while if the value falls the bottom is compressed and the PCL85 is over-run. The 250 $\mu$ F shunt electrolytic C154 can become open-circuit to cause very severe compression.

Vertical hold troubles can result when capacitors become open-circuit or shorted. In this connection the 0.05 $\mu$ F (C156 sync filter) often shorts causing complete loss of field lock and the control to be at one end of its range to achieve a near lock. The fact that the hold may be found hard over one way should also draw attention to C148 (0.005 $\mu$ F) and to a lesser extent C150 (0.005 $\mu$ F rated at 1kV or over).

A white line across the centre of the screen which indicates complete loss of field scanning can if not due to the PCL85 be caused by a number of factors

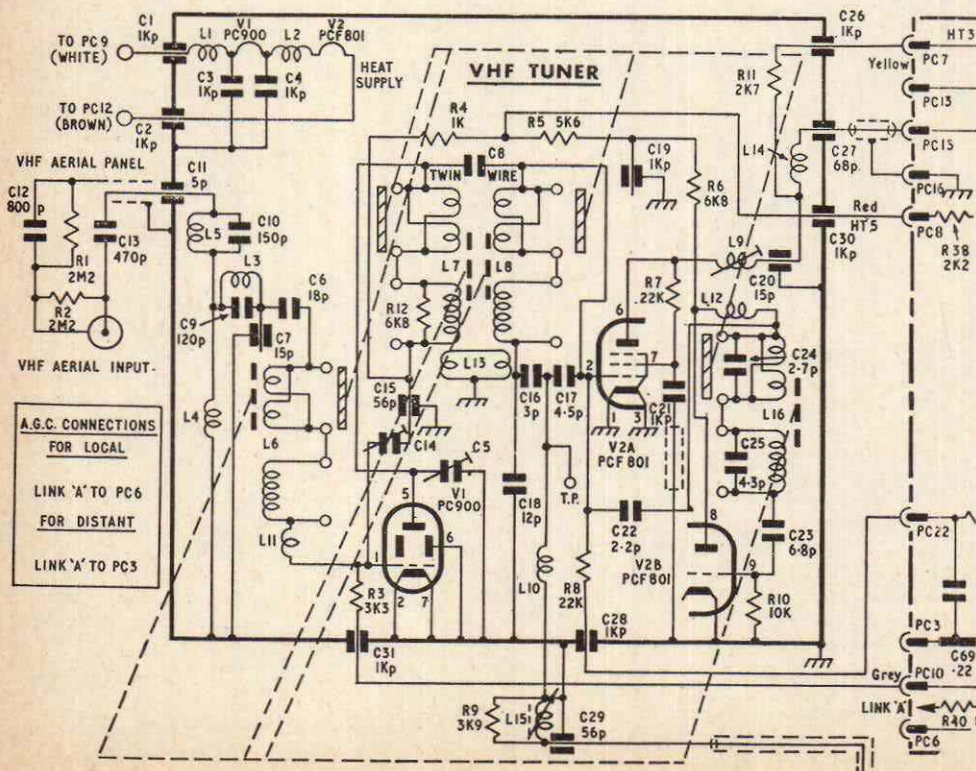


Fig. 4: V.H.F. tuner used on later models.

The following models are fitted with the chassis covered this month and last:

### GEC

|      |      |
|------|------|
| 2010 | 2021 |
| 2013 | 2022 |
| 2014 | 2023 |
| 2018 | 2038 |
| 2019 | 2039 |
| 2020 |      |

### Sobell

|       |      |
|-------|------|
| 1010  | 1020 |
| 1010A | 1021 |
| 1013  | 1022 |
| 1014  | 1023 |
| 1018  | 1038 |
| 1019  | 1039 |

### Masteradio

|      |      |
|------|------|
| 4018 | 4021 |
|------|------|

In addition the time-base circuits are common to a number of hybrid models.

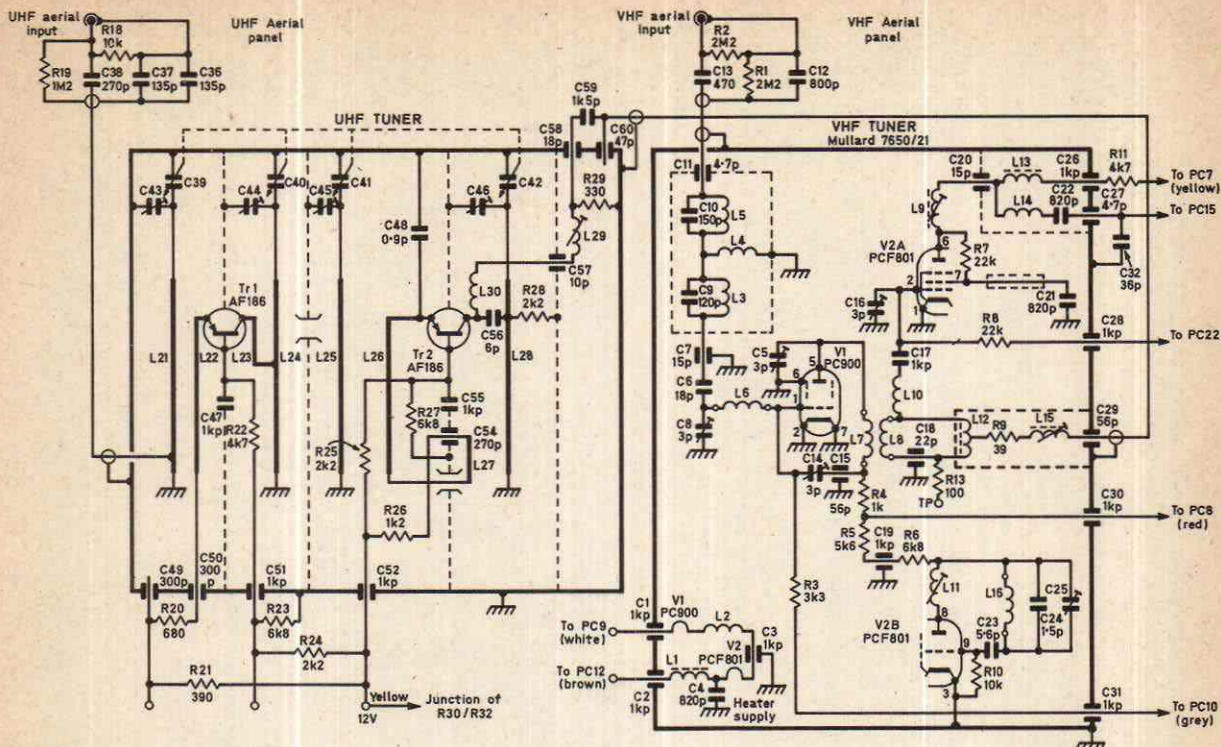


Fig. 5: The u.h.f. tuner and the Mullard v.h.f. tuner used on earlier models.

which can mostly be checked out using a voltmeter. For example h.t. at pin 7 but not pin 6 strongly suggests that the field output transformer T12 is at fault with an open-circuit primary, but if the primary winding is itself intact trace the track from SC1 to pin 6. If it is damaged check C152 (0.001 $\mu$ F). If there is no voltage at either pin 6 or pin 7 check the upstanding resistors which supply HT3 and HT4. R144 is likely to be open-circuit. In this event check the previously mentioned points and the 50 $\mu$ F electrolytic C187.

## Video Stage

The video amplifier and sync separator valve is a PFL200. Faults due to this valve vary from no picture to weak contrast and impaired line and field locking. The moral here is to check this valve if the picture quality is impaired in any way.

The most frequent failure in this stage however does not affect the picture so much as the sound. The 32 $\mu$ F electrolytic C93 which decouples the screen supply also decouples the supply to the EH90. A distinct buzz results when this capacitor goes open-circuit, the buzz varying with the picture content which would tend to suggest cross-modulation in the earlier stages except that this is obviously not occurring.

## IF Stages

The usual trouble in the EF183 and EF184 stages is simply loss of gain as these valves lose emission. The resultant increase in picture noise may suggest that the trouble is in the tuner but in fact as far as 405-line operation is concerned the PC900 r.f.

amplifier is not so often at fault (not so often for example as when a PCC89 or similar cascode valve is employed). Therefore the i.f. stages are more suspect than in earlier receivers using EF80 and EF85 valves in these stages. In addition to this the EF183 has a tendency to develop grid-cathode leakage which partially cancels the a.g.c. rendering the contrast control less effective. Internal shorts in these valves are not uncommon and a burnt out resistor should call attention to this possibility as well as the probability of a shorted decoupling capacitor.

## Tuner Units

As far as the u.h.f. tuner is concerned the difficulty for the writer is knowing whether or not to advise sending these back to the makers for service. Quite often the faults which occur are quite simple and obvious but the units can be ruined by ham-fisted dabbling (hopefully prodding or aimlessly adjusting critically tuned circuits).

However, it is often worthwhile to check the voltage readings of the transistors bearing in mind the fact that the collector is chassis connected from the d.c. point of view, that the emitter is fed from the 12V supply through a resistor which if the transistor is drawing current will have a small voltage drop across it (in the case of Tr1 this would be R20, 680 $\Omega$ ) and that for correct working the base is a little (very little) less positive than the emitter. It is mainly Tr1 (AF186) which becomes defective, resulting in a marked loss of gain.

Another point which rewards examination is the capacitor gang (tuning) where the vanes may be

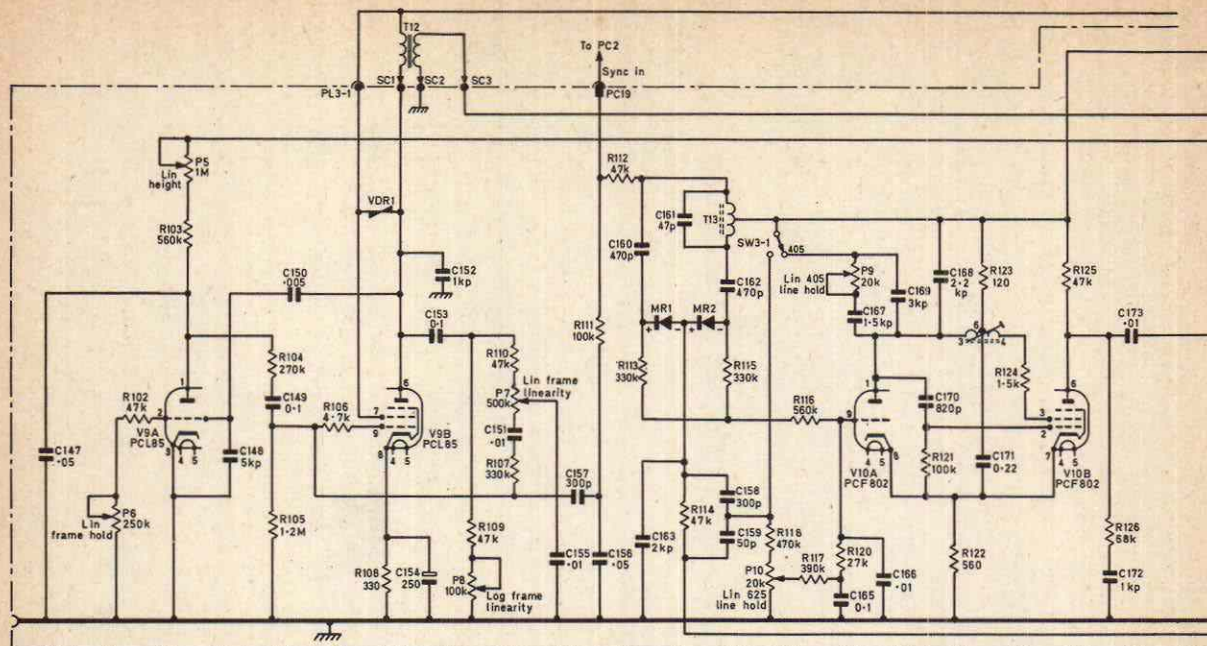


Fig. 6: Circuit diagram of the timebases and power

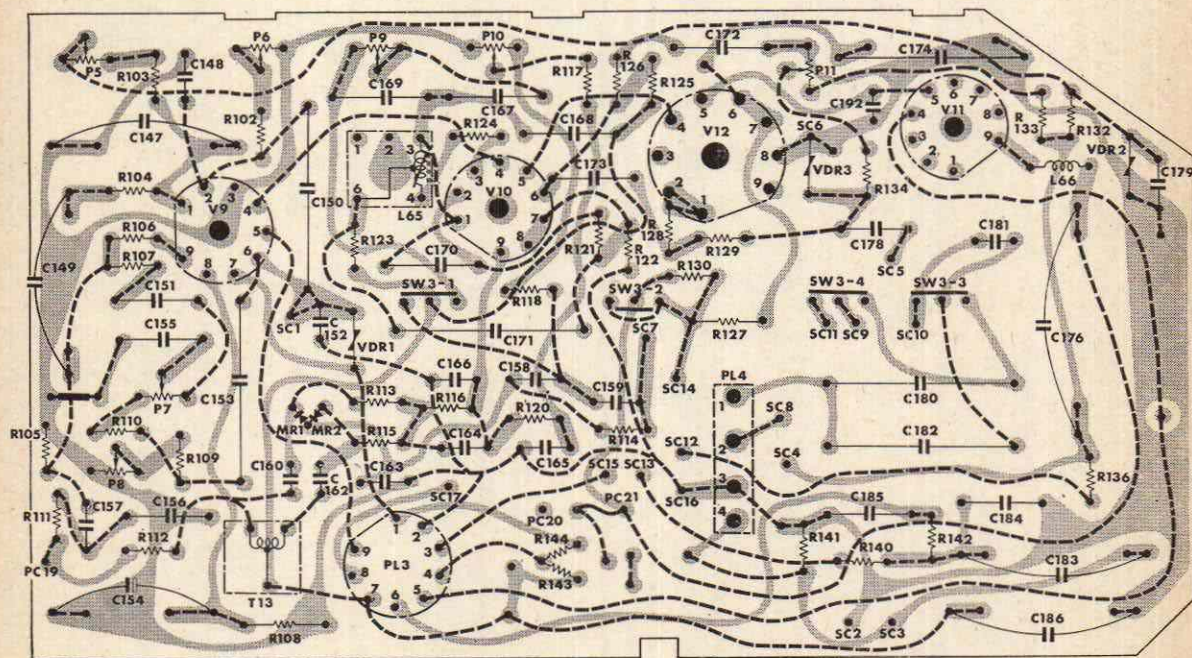


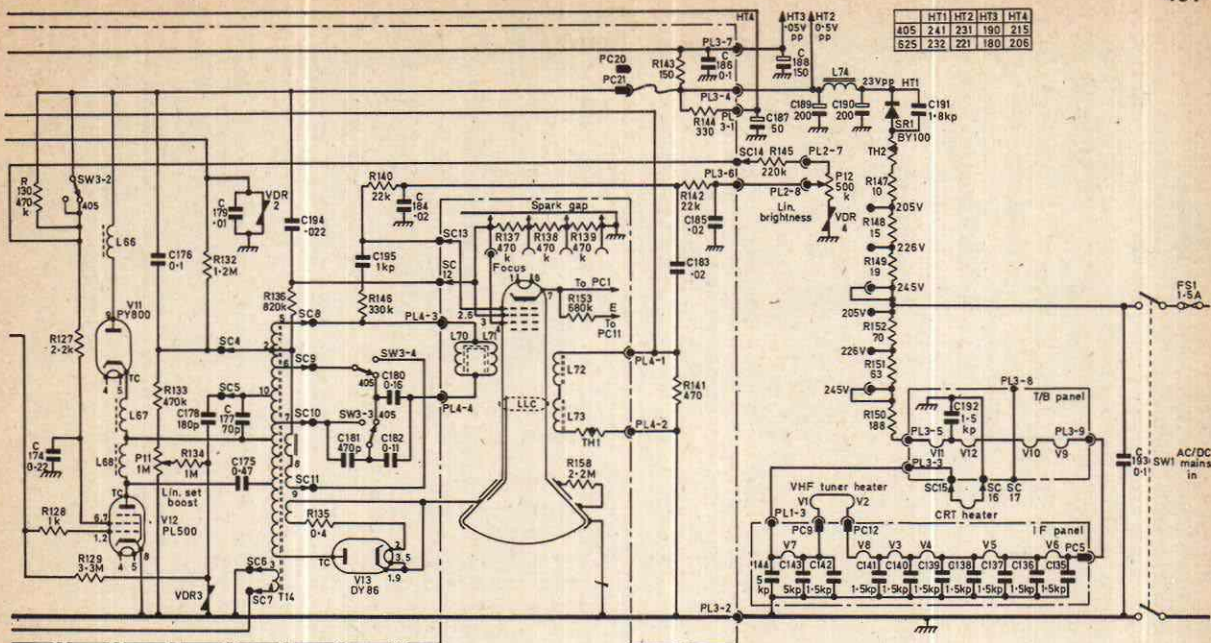
Fig. 7: Timebase board layout, print side. PL3 not on later models—see Modifications.

fouling on one section or at one point of rotation. Earthing clips not making good contact are another source of trouble which is afflicting the u.h.f. tuners of another make and more recent receiver, but that is another story.

As far as the v.h.f. tuner is concerned the servicing depends on the type fitted. The small turret type of Mullard manufacture is quite easy to service, suffering mainly from poor contact between the biscuits and the springs and faulty fine tuner opera-

tion. This type of tuner has been discussed many times past in past articles and in the main it is a matter of cleaning the contact surfaces and ensuring that the mechanical bits and pieces are operating properly.

The tuner which is likely to cause most trouble is the one mentioned earlier. This is a larger unit than the turret type and is by no means easy to dismantle and reassemble. The band coils are selected by a sliding bar operated by the indentations



circuits, GEC-Sobell 2010-1010 series.

## VOLTAGE AND CURRENT DATA

The readings in the table below for V1-V8 (excluding V5B) were taken with 245V a.c. mains input, no signal and contrast control at maximum using a 20,000  $\Omega$ /volt meter. Measurements on 625 with v.h.f. tuner in u.h.f. position. Voltages marked with an asterisk obtained via 100k $\Omega$  resistor in series with meter clip. Timebase valve voltages (including V5B) taken as above but with signal applied and attenuated so as to just lock the timebases, with controls adjusted for a normal picture.

E.H.T. 16.8kV (405), 17kV (625). C.R.T. cathode 112V (405), 114V (625); first anode 490V (405), 510V (625). Total h.t. current (through L74) 325mA (405), 340mA (625); heater current 300mA; u.h.f. tuner current 8mA. Boost h.t. 760V (405), 780V (625).

| Valve |        | Anode volts |      | Screen volts |      | Cathode volts |      | Cathode current (mA) |      |
|-------|--------|-------------|------|--------------|------|---------------|------|----------------------|------|
|       |        | 405         | 625  | 405          | 625  | 405           | 625  | 405                  | 625  |
| V1    | PC900  | 140*        | —    | —            | —    | —             | —    | 9                    | —    |
| V2A   | PCF801 | 152*        | 138* | 110*         | 77*  | —             | —    | 8.7                  | 11.5 |
| V2B   |        | 56*         | —    | —            | —    | —             | —    | 7.4                  | —    |
| V3    | EF183  | 182*        | 172* | 75*          | 50*  | 1.6           | 1.85 | 14.7                 | 17   |
| V4    | EF184  | 180*        | 172* | 180*         | 172* | 2.1           | 2    | 14                   | 13.3 |
| V5A   | PFL200 | 141*        | 120* | 178*         | 167* | 3.5           | 5.5  | 20                   | 28   |
| V5B   |        | 165*        | 155* | 90*          | 90*  | —             | —    | —                    | —    |
| V6    | EF80   | 178*        | 172* | 178*         | 172* | 2.1           | 2    | 14                   | 13.3 |
| V7    | EH90   | 81          | 125  | 46           | 41   | 1.7           | 1.6  | 1.7                  | 1.6  |
| V8A   | PCL84  | 220         | 218  | 230          | 228  | 4.1           | 3    | 25.8                 | 25   |
| V9A   | PCL85  | 49          | 52   | —            | —    | —             | —    | —                    | —    |
| V9B   |        | 195         | 190  | 212          | 205  | 17            | 16.5 | 51.5                 | 50   |
| V10A  |        | 194         | 185  | —            | —    | 3.4           | 3.4  | —                    | —    |
| V10B  | PCF802 | 122         | 115  | 187          | 180  | 3.4           | 3.4  | —                    | —    |
| V11   | PY800  | 232         | 225  | —            | —    | —             | —    | —                    | —    |
| V12   | PL500  | —           | —    | 212          | 203  | —             | —    | 114                  | 142  |

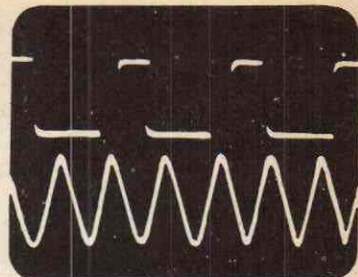
on the disc at the rear of the tuner. The selected coils are slug tuned by a cam-operated gantry with a spring return.

Before attempting to dismantle the unit ensure that this is really necessary. Check the valves, supply voltages and the correct movement of the switch bar. The disc can become slightly loose resulting

in insufficient movement of the bar to contact properly on channels 7-13. A frequent cause of loss of Band III signals is an alteration in the resistance of R6, 6.8k $\Omega$ . This is the PCF801 oscillator anode load (part). It is necessary to dismantle the tuner (into two parts) to gain access to this resistor.

—continued on page 463

# STROBE-TRIGGER TIMEBASE UNIT



## PART 4

THE strobe gate generator is shown in Fig. 5. Tr18 and Tr21 form a cathode-coupled univibrator (flip-flop circuit) which produces a positive pulse of duration determined by C20 and VR5, commencing in response to each positive trigger pulse applied to Tr18 base via the trigger driver stage Tr 17. Tr19 and Tr20 form a Darlington output amplifier for the strobe gate pulse produced by the univibrator. A hold-off diode circuit is not required at Tr21 collector to improve the leading flank of the strobe gate pulse because the univibrator circuit does not use any feedback capacitor at Tr21 collector so that the gate pulse is already sharp here.

The same kind of hold-off diode circuit as for the master multivibrator is however used at Tr18 collector because the feedback capacitor bank S5A, C20 is connected to this point from which the *negative* replica of the strobe gate pulse must be taken as the drive pulse for the strobe ramp generator. It is most important to ensure that this pulse has steep, accurately-timed flanks so that the strobe ramp starts and terminates in coincidence with the positive gate pulse at Sk5 used to bright-up the c.r.t. trace during the strobe and to cut it off at all other times.

The differentiated output pulse flanks from the strobe threshold discriminator (produced by C5, R27) consist of a positive pip at the moment the strobe delay ramp reaches the threshold point and a negative pip occurring when the threshold discriminator drops back at the end of the next master pulse. In the trigger mode the positive pip is produced at the moment the sync output waveform crosses the point which lies 0.6V more positive than the negative peak and the negative pip appears when the sync output waveform drops below this level again.

Only the positive pip is wanted and capable of firing the strobe gate generator. Tr18 is normally resting just cut off by the voltage divider R59, VR4 which brings the base potential of Tr18 almost but not quite up to the emitter potential due to the resting current through Tr21 which flows through the shared emitter resistor R62. The train of alternate positive and negative pips from the threshold discriminator is fed in via C21. Only the positive pips can cut on D9 and Tr17 to produce a corresponding brief rise of voltage across VR4. This lifts Tr18 above cut on, so that one gate pulse follows immediately by multivibrator action and the circuit then returns to its resting state and waits for the next positive trigger pip. The negative trigger pips are ignored because D9 blocks them. At the same time D9 prevents these negative pips from reaching Tr18

## Martin L. Michaelis M.A.

base because they would exceed the maximum permissible inverse bias for Tr18.

One might think that the gate width may have any stable duration extending even beyond the end of the next master pulse since the next threshold trigger point would appear to be the logical limit. In practice this is not quite so because the circuit must be given an adequate recuperation interval after returning to the resting stage at the end of the gate—since C20 must recharge through R61. The actual limit beyond which the gate is automatically shortened below its nominal duration is reached with a nominal gate termination position somewhere between the end of the next master pulse and the next threshold trigger point. Hence the need to select minimum strobe delay and maximum possible gate duration before shortening commences, for the initial synchronising operation as described above.

The very large resting collector voltage for the strobe gate output amplifier Tr19, Tr20 is necessary in order to be able to connect load impedances down to 500Ω to Sk5 without amplitude clipping, even for the widest strobe gates. R63 affords short-circuit protection for the output.

## TRACE BRIGHT-UP

In common with most other oscilloscopes having an intensity-modulation input the Videoscope MV3 requires positive-going pulses to bright-up the c.r.t. trace. Amplitude of some +8V is correct for the Videoscope MV3 in relation to its intensity control input sensitivity and should be at least adequate for other oscilloscopes. With the Videoscope MV3, adjust the intensity-modulation gain control for optimum clarity of the strobe trace with no spurious disturbance appearing from signal excursions outside the strobe gate period. It will be found that such disturbance appears with excessive as well as with inadequate intensity control gain setting. The gain setting however is not in any way critical. Just advance from zero until the strobe trace is quite clean.

For normal operation with the internal timebase of the Videoscope MV3 the intensity-control mode switch must be set to "blanking" (to give automatic flyback blanking), the intensity-modulation gain control left at zero and the trace intensity adjusted in the normal manner with the intensity control (brightness control) which is combined with the mains on/off switch. For strobe-timebase operation the brightness control *must be left set to zero*, i.e. the position where the mains switch has only

just clicked on, the intensity-control mode switch must be set to "bright-up" and the intensity-modulation gain control now effectively serves as strobe brightness control.

## OTHER USES

The strobe gate output forms a versatile pulse signal generator for any experiments requiring this facility. We can (in the strobe mode setting) determine the repetition frequency with the free-running master multivibrator and the pulse width *independently* with the gate width control. Since we have the master pulse available too at another output we have a signal generator giving pulse pairs whose separation can be chosen at will with the gate delay control, in addition to independent choice of all other parameters of such pulse pairs. Moreover the second pulse of the pair is accurately coincident with the strobe ramp, a single sawtooth cycle. With simple external networks we can add the gate and ramp in any desired proportions to produce pedestal waveforms, for example for experimenting with magnetic-deflection circuits. Other simple networks can produce the necessary differentiation and integration to give waveforms of the kind required in colour-convergence circuits.

All these types of output waveforms can be synchronised via the master multivibrator to arbitrary waveforms taken from the equipment being experimented on. Direct lock is available in the trigger mode. It is therefore clear that this strobe-timebase unit is an extraordinarily versatile signal generator of a kind welcome for all manner of television circuit experiments.

## RAMP GENERATOR

Figure 6 shows the circuit of the strobe ramp generator. Tr22 is used as a switch transistor operated directly by the strobe gate which is fed in via C24. The timebase capacitor is the bank S5B, C26 which is switch-ganged with the strobe gate width control S5A, C20. The charging resistance for the timebase capacitor C26 is R72, VR6.

As long as the switch transistor Tr22 is cut on it holds the timebase capacitor C26 short-circuited and thus discharged. If Tr22 is cut off the short-circuit is removed and C26 can commence to charge positively through R72 and VR6. As soon as Tr22 is cut on again the charging process is stopped and the short-circuit produces immediate flyback to the discharged condition of C26. R73 is a current-limiting resistor for this discharge flyback and thus essentially determines the flyback time. D11 prevents the charge potential of C26 from ever going negative on account of resting-state potential displacements caused by emitter-follower action of Tr22 and charging of the coupling capacitor C25 to the ramp amplifier. Without D11 the strobe ramp starts with an undershoot and the accuracy of its timing in relation to the strobe gate is seriously impaired at high frequencies.

It is clear from the action described that we need a negative replica of the strobe gate to drive Tr22 because this transistor must be cut off during the strobe trace and cut on at all other times. The resulting input to the ramp amplifier is a positive-going ramp at Tr23 base. R74 and R75 provide

static bias just above the class B point since otherwise the ramp would have to rise above the triple Darlington threshold before anything appeared at the output. The result would be an undesirable bright spot at the left end of the trace.

Many oscilloscopes require positive-going drive at the external X-deflection input to move the spot to the right on the screen. A timebase should always run from left to right on the c.r.t. screen. Thus for these oscilloscopes the ramp polarity is already correct at Tr25 emitter and R78 should be taken straight to Sk6 omitting Tr26, Tr27 and the associated circuitry. The Videoscope MV3 happens to require a negative-going external X-deflection input to move the spot to the right so that a negative ramp is needed to give a proper polarity trace showing later events further to the right. Tr26 and Tr27 provide the necessary ramp polarity inversion and at the same time adjust the amplitude to suit the X-input sensitivity of the Videoscope MV3.

## RAMP AMPLITUDE AND ALIGNMENT

The ramp timebase capacitor value C26 is switched with S5B in the same ratio as the gate width capacitor value C20 is switched with S5A. This ensures that for a given setting of VR6 the ramp amplitude is independent of the selected gate width. If however one tries to select a gate width which is illogically large in relation to the repetition frequency so that the actually produced gate is narrower than the switched in capacitor C20 would demand, C26 is then too large so that the ramp amplitude reduces and the illogical control settings are visually indicated by severe shortening of the trace on the c.r.t. This is a welcome feature in the interests of synoptical operating procedure.

The actual amplitude of the ramp is determined by VR6. The correct setting is just before the output of Sk6 (observed with the Videoscope MV3 in the normal internal synchronised timebase mode, or with any other oscilloscope) starts to fold over at the end of the ramp as clearly shown in the deliberately misaligned oscillogram A(a). This foldover is due to bottoming of Tr26 collector when the positive ramp at Tr26 base has reached a certain level beyond which Tr26 collector rises (by transferred bottomed emitter-follower action instead of polarity inversion). If it is not possible to get adequate output amplitude for a full screen width trace without foldover judiciously reduce the value of R75 and try again.

This may be necessary in particular if slightly different components are used in the power supply. The circuit is correct as published for supply voltages as indicated at all appropriate points in the circuit diagrams. These readings must be checked with a high-impedance meter, preferably an electronic voltmeter of some kind, and the specified control settings must be observed since actual readings in many cases depend strongly on these.

## CAPACITOR BANKS

The complete strobe-timebase unit employs four capacitor banks, two for the master multivibrator and one each for the strobe gate and strobe ramp.

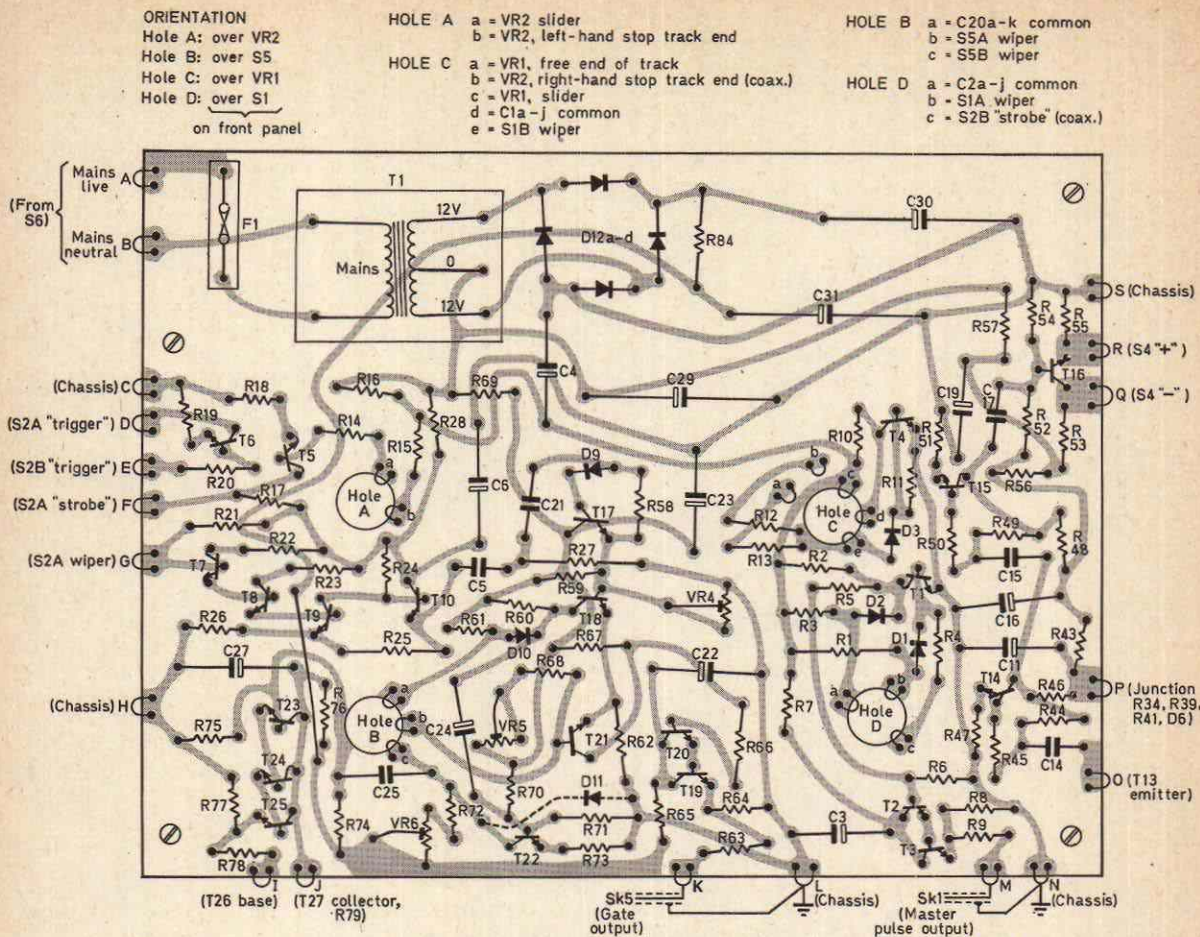


Fig. 9: Layout of the printed circuit board, viewed from the component side. Size 15 × 20 cm.

The two multivibrator banks respectively determine the master pulse duration and the delay ramp duration. Two switches only are used because the four timing functions are logically linked in pairs. The strobe gate and strobe ramp banks are straightforward switch wafers selecting one of eleven provided capacitor values each. But the two master multivibrator banks C1 and C2 embody some special additional features.

In each bank the smallest capacitor—C1j and C2j respectively—is connected permanently irrespective of the switch setting. This is essential to prevent self-muting of the multivibrator when switching between the coarse ranges, especially the higher ones. If C1j and C2j are not permanently connected there will be no feedback capacitors except strays—which are insufficient—connected when the switch wipers are moving between successive contacts. Both transistors Tr1 and Tr4 would then open together and run up to saturated conduction. In this state they stick, even after the switch wipers have reached the new contacts and feedback capacitors are in circuit again. Oscillation can recommence only by switching off at the mains switch and switching on again. This self-muting trouble is apparent above a certain frequency determined by the discharging time of the capacitor on the first switch wiper to break circuit and the

time taken by the switch wiper to reach the new contact, i.e. the behaviour is obviously erratic. The trouble is entirely removed by placing C1j and C2j permanently in circuit so that there is always sufficient feedback capacitance to allow the multivibrator to continue to oscillate even when the switch wipers have broken their circuits.

The outermost settings of S1 switch the master multivibrator off. Note that this is effected by shorting the anodes of the base diodes to chassis, not by removing feedback capacitance. This ensures that oscillation can recommence as soon as the switch is returned to one of the active positions, without any need to switch the mains switch off and on again. It is rarely necessary to switch off the multivibrator because with proper layout and coaxial cables as and where indicated on the wiring diagrams breakthrough of spurious interference into the Y-channel never exceeds 5mV which is less than the trace width in the most sensitive setting of the Videoscope MV3. If scoping smaller signals in the microvolt range the necessary preamplifier must be placed between the signal probe and the strobe-timebase unit, not between the latter and the Y-input of the oscilloscope. The latter incorrect arrangement would not only make the 5mV maximum interference level intolerable but also the Y-signal level in the strobe-



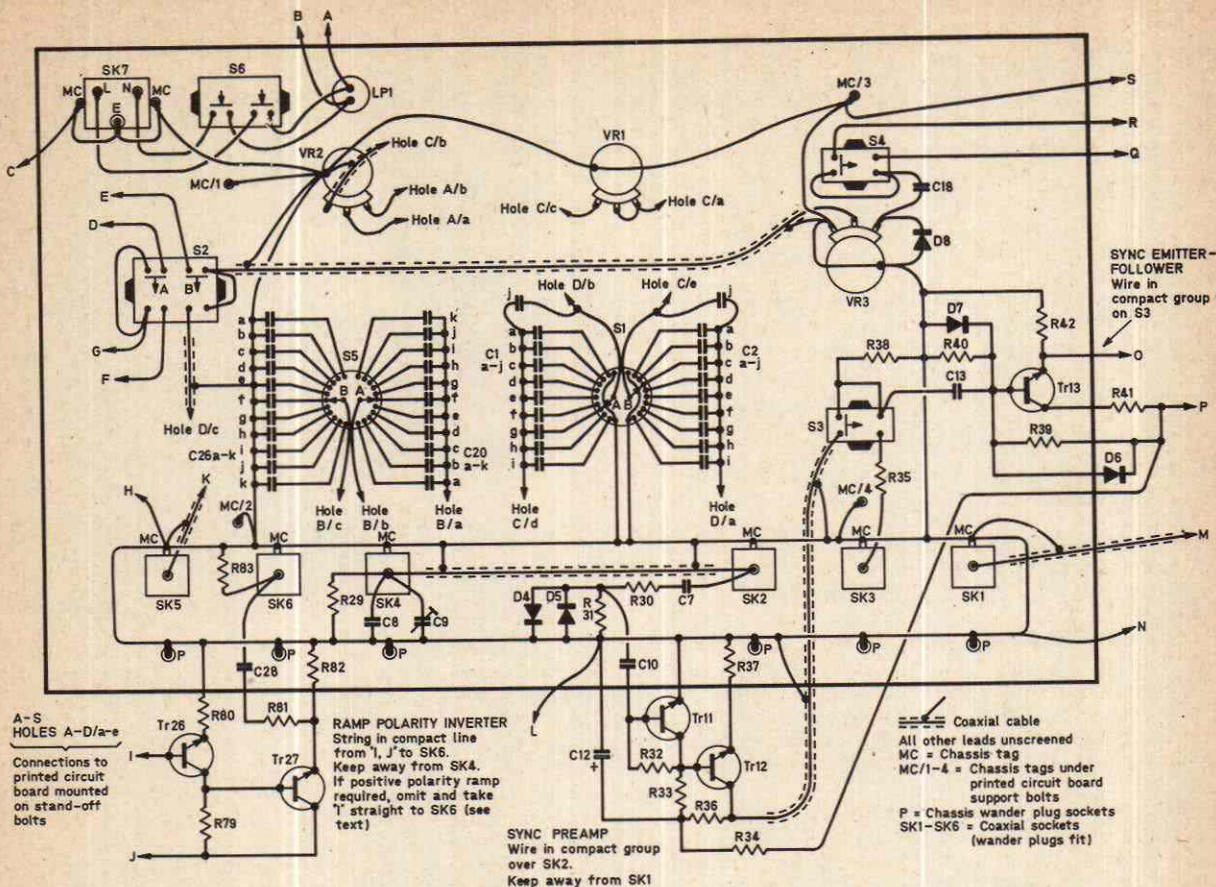


Fig. 10: Wiring on the rear of the front panel.

timebase unit would be insufficient for internal sync.

The chief reason why "off" positions have been provided for the master multivibrator is to give a convenient means to switch the excitation on and off when using the unit as signal generator to examine transient responses, with the internal timebase of the oscilloscope or with the strobe function. The gate width and strobe ramp capacitor banks do not need a permanently connected capacitor because the associated circuits are not self-oscillating. Neither do they require an off position because they are muted anyway when the master multivibrator is switched off.

## POWER SUPPLY

The chief smoothing components are the various decoupling resistors and electrolytics in the feeds to the respective circuit sections as shown on the individual circuit diagrams. Do not substantially alter the values of these components and certainly do not alter the arrangement as otherwise ripple may become excessive and severe jitter will restrict the usable strobe ratio. The central power supply is very simple as shown in Fig. 8. A mains transformer with an accurately centre-tapped 24V winding is required. A very small transformer suffices. If unavailable directly rewind the secondary of a miniature heater transformer or bell transformer; a rating of 3 to 5W

is fully adequate. This transformer is small and light enough for mounting directly on the main printed circuit board.

A bridge rectifier arrangement is used to rectify the full 24V a.c., providing a 30V output on load via a conventional smoothing circuit using a resistor and two large electrolytics. It is a property of any bridge rectifier circuit that half the output voltage is available as pure d.c. directly at the centre tap of the winding feeding the bridge rectifier. C29 is the reservoir capacitor for this 15V output which feeds most of the individual circuits.

## FINAL ALIGNMENT

VR5 should be adjusted to make the actual gate widths correspond to the nominal values. Checks are best made by strobing displays of sine wave signals from a signal generator, adjusting VR5 to display the correct number of cycles on the strobe trace. With the 20 $\mu$ sec gate width for example exactly four complete cycles of 200kHz sine wave (readily available from any r.f. signal generator) should appear on the strobe trace. Provided the capacitance ratios of C20 a-k are correct all other gate widths will then also be correct. This can be achieved by using a capacitor bridge or by padding the capacitors instead of touching VR5 again in all other gate width settings with reference to suitable

continued on page 468

# getting started with

THROUGHOUT the evolution of radio and television each major new development has taken its toll of a number of the "faithful". The birth of the super-het took its toll of many combined cycle and radio dealers, and by now some of you may be wondering if colour TV will do the same to you. Our intention is to try and encourage the doubtful to stay a little longer and at the same to give newcomers a basic method by which to tackle fault-finding in colour sets. We assume that you are quite at home with black-and-white servicing and that you have made inroads into the theory of colour TV (if this comes hard tackle stereo radio theory first—it's very helpful).

Apart from the decoder there are few big differences between colour and monochrome receivers. The initial setting up of convergence, purity, and grey-scale is admittedly a little frightening at first, but these are mainly mechanical processes beset with mechanical faults and respond to a little patient care and as much practice as you can get. Over three years now of PAL colour has proved that colour set faults can be cured by extension of black-and-white techniques but that the temptation to have a twiddle must be resisted with all the self-control that you can muster.

How little gear must you have to begin colour servicing? My own view is that a 625-line cross-hatch generator is a must. 405-line convergence can usually then be completed on a test card, but this depends on the brands you will be handling. The



BRC dual-standard convergence drill for example starts on 405. Another essential item is a good multi-meter with e.h.t. probe, and another little meter to take extra readings whilst the former is tied up with the e.h.t.

The third must is an oscilloscope on which you can see the chroma signal. A bandwidth of 10MHz is desirable but inexpensive portables with a flat response of only 3MHz give usable results in situations where the chroma level has not to be measured precisely. A  $\div 10$  probe is a handy extra item since its low input capacitance permits it to be

| Colour bar hue                           | White   | Yellow    | Cyan       | Green            | Magenta    | Red        | Blue   | Black |
|--|---------|-----------|------------|------------------|------------|------------|--------|-------|
| Tube guns on for correct hues            | R, G, B | R, G      | B, G       | G                | R, B       | R          | B      | None  |
| Main colour-difference signal(s) present | None    | -(B-Y)    | -(R-Y)     | -(B-Y)<br>-(R-Y) | B-Y<br>R-Y | R-Y        | B-Y    | None  |
| Blue gun only on                         | Blue    | Black     | Blue       | Black            | Blue       | Black      | Blue   | Black |
| Red gun only on                          | Red     | Red       | Black      | Black            | Red        | Red        | Black  | Black |
| Green gun only on                        | Green   | Green     | Green      | Green            | Black      | Black      | Black  | Black |
| Blue gun off                             | Yellow  | Yellow    | Green      | Green            | Red        | Red        | Black  | Black |
| Red gun off                              | Cyan    | Green     | Cyan       | Green            | Blue       | Black      | Blue   | Black |
| Green gun off                            | Magenta | Red       | Blue       | Black            | Magenta    | Red        | Blue   | Black |
| No B-Y signal                            | White   | Off-white | Green      | Green            | Red        | Red        | Black  | Black |
| No R-Y signal                            | White   | Yellow    | Pale Mauve | Dark Green       | Blue       | Black      | Blue   | Black |
| R-Y signal out-of-step                   | White   | Off-white | Magenta    | Dark Orange      | Blue       | Dark Green | Purple | Black |

Fig. 1: A key to colour faults as shown by the colour-bar section above test card F.

# COLOUR FAULT FINDING

H. Peters

colour to be lost before anything else. Remember when doing so that some sets deliberately trap out the higher definition frequencies from the luminance amplifier so as to reduce the crosstalk caused by the presence of too much subcarrier.

Picture geometry must be precisely adjusted too as the currents for dynamic convergence are derived from the line and field timebases. Before starting on the colour section then we assume that the set displays a first class monochrome picture.

## The Colour Bar

Careful study of the colour bar will save countless hours of trouble hunting (see Fig. 1). On a monochrome set it is reproduced as a grey-scale from white on the left to black on the right and a 'scope will show it as a staircase waveform—see Fig. 3(a). On a colour set the bars are reproduced as pure primary and secondary colours of high saturation, from left to right white, yellow, cyan, green, magenta, red, blue and black.

If we switch off the red and green guns only the blue gun will conduct and then only on the white, cyan, magenta and blue bars. Thus we should see

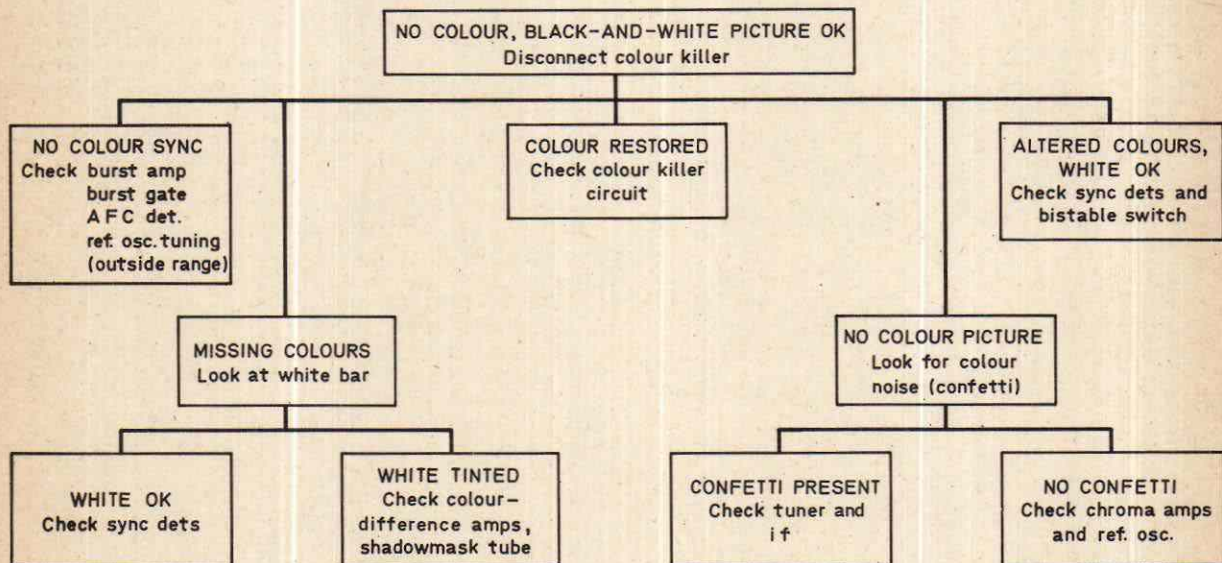


Fig. 2: Starting from lack of colour on an otherwise OK receiver proceed as above.

hung on any part of the circuit without distorting the trace, loading up the stage under test or mopping up all the chroma signal.

Test card F on BBC-2 will provide most of your other wants and its most important feature is the small band of colour bar along the top. This can be shifted down the screen until it can be clearly seen and on oscilloscopes with a trigger type sync circuit it can be picked out so that its path through the decoder can be readily followed.

## How to Begin

The golden rule is "get it right in black-and-white". You must not stop however at just restoring any old picture. The definition must be checked as misalignment of the r.f. and i.f. stages will cause

four equally spaced vertical blue bars under these conditions—a squarewave in fact at four times line frequency. Now let us turn off the blue gun and turn on the red gun. This will be on for white, yellow, magenta and red and will thus produce two equally spaced red bars due to a squarewave at twice line frequency. In the same way the green gun alone will be on for white, yellow, cyan and green giving a squarewave at line frequency.

The correct hues will only be displayed if all three guns are on in the right proportion. This can be readily seen by looking at the bars produced by the single guns as above and ensuring that all the bars of one gun are reproduced equally. For example if the third blue bar is brighter than the other three magenta will be too mauve. Adjustments to correct this are provided in the colour-

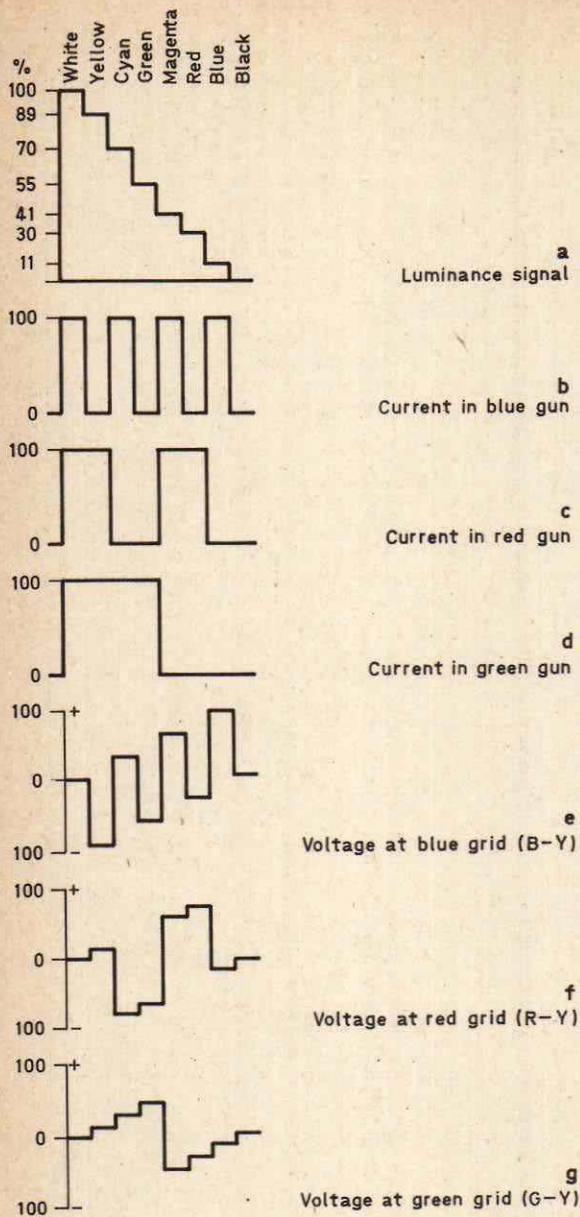


Fig. 3: Waveform analysis of the colour-bar pattern.

difference amplifiers but you must leave these alone when fault-finding (as opposed to setting up) until the trouble has been located.

Figure 3 shows the waveforms to be expected. On the face of it one would expect three simple squarewaves, one at each shadowmask tube gun as in (b), (c) and (d), but this applies to beam current only and is seen directly only on sets with R, G, B drive (more below on this). On most sets the three cathodes will be getting the luminance staircase (a) or Y signal. The blue gun producing four bars as in (b) thus needs to have on its grid a waveform which is the *difference* between (a) and (b), that is (e) which is expressed as  $B-Y$ . Similarly the red grid waveform (f) is the difference

between Y (a) and (c), i.e.  $R-Y$ , while the green grid waveform (g) is the difference between Y (a) and (d), i.e.  $G-Y$ .

## RGB Drive

Sets such as the BRC and RBM all-transistor models have only sufficient drive to modulate the shadowmask tube cathodes. The matrixing—as the mixing process just described is called—is therefore carried out prior to the c.r.t. and on these sets a 'scope on the tube cathodes will display the squarewaves (b), (c) and (d).

## "Ditching" the Colour Killer

Most of the troubles giving rise to no-colour symptoms are to be found in the decoder and unfortunately for us this section of the receiver has a stage called the colour killer which switches off the decoder in the absence of a colour programme to avoid colour noise (confetti).

The killer is usually operated by the 7.8kHz ident signal which is derived from the "swinging burst" signal. (The burst signal synchronises the reference oscillator in the decoder and in the PAL system also swings  $\pm 45^\circ$  in phase from line to line to synchronise the receiver's R-Y switching with the line-by-line R-Y phase alternation carried out at the transmitter.) If anything prevents the burst signal giving rise to this ident waveform the colour killer will cut off the chrominance amplifier and we shall see no colour. The first step therefore in finding colour faults is to "ditch" the killer and allow the chrominance amplifier to conduct. Under no-signal conditions a working set will then display coloured noise in addition to the usual "snow". In case you have not seen "confetti" yet, it has a different texture to snow. The dots are longer—rather like rice compares with tapioca.

Just how you ditch the killer depends on your set. Rank-Bush-Murphy suggest connecting the base of the chroma stage controlled by the killer to the 15V line via a 15k $\Omega$  resistor. The Pye group suggest a 3V battery from killer output to chassis. Others leave you to your own devices. The colour killer rectifies the ident signal to obtain a turn-on bias potential for the controlled chroma stage. Ditching the killer thus consists of replacing this bias with a fixed bias.

Having ditched the killer look carefully at the picture. If colours are *immediately restored* suspect the killer circuit itself. If there is still no colour or confetti suspect faulty chroma amplifiers or an inoperative reference oscillator which would stop the synchronous detectors operating. Also worth checking are the power supplies to the colour-difference or R, G, B drive circuits. If there is *confetti but no colour picture* the signal path through the decoder is intact so that the fault will lie between the vision detector and the decoder input—check plugs and cableforms. Suspect also faulty i.f. or a.f.c. alignment.

## Basic Colour Faults

The no colour sync symptom appears on the screen as running bars of mainly red and green horizontal stripes and can be due simply to incorrect

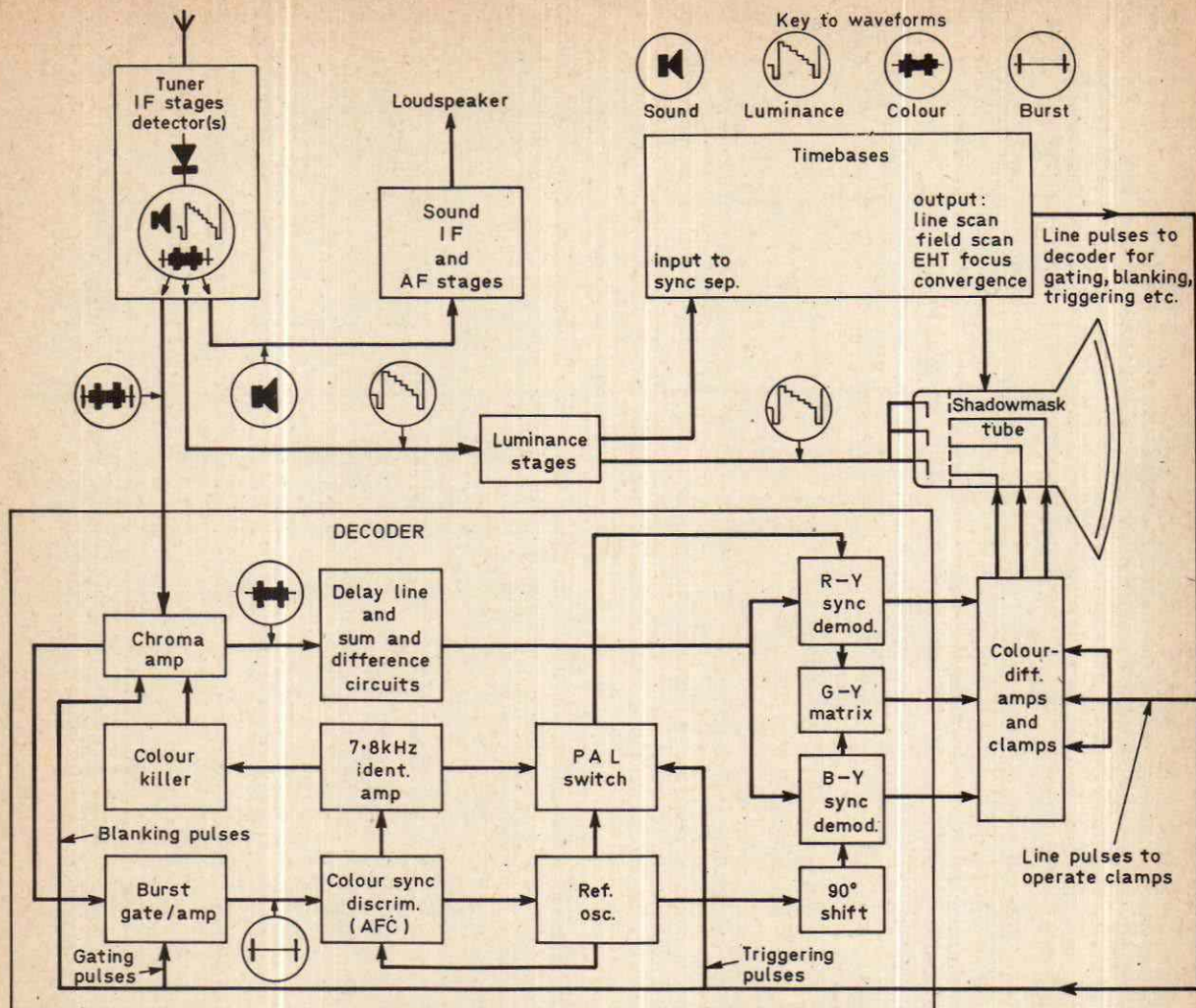


Fig. 4: Finding your way around the average colour set.

adjustment of the reference oscillator bias or to faults in the preceding discriminator or burst amplifier stages.

Missing colours point to trouble at the rear end of the decoder, such as one diode faulty in a demodulator or faults in the R, G, B or colour-difference stages.

The cause of altered or missing colours with white correct will be found around the synchronous detectors, showing up as no R-Y or no B-Y signal. If the colours are at times right and at other times wrong and if interrupting the signal changes the condition a faulty PAL switch is indicated. Some sets such as the KB ones and BRC single-standard models dispense with the bistable PAL switch, using amplified 7.8kHz ident signals instead for R-Y switching. On such sets the conditions just mentioned should rarely arise.

The colour bar (Fig. 1) makes checking for altered or missing colours easy. The most important clue lies in the white bar. If it is tinted the fault is in video drive circuits but if it is white the trouble is due to absence of one of the colour-difference signals.

Summing up so far we get four golden rules:

- (1) Don't twiddle—precision is essential.
- (2) Get it right in black-and-white first.
- (3) Ditch the colour killer.
- (4) Look carefully at the colour bar—especially the white block.

We can now look at the receiver stage-by-stage with special emphasis on the sections where it differs from its monochrome counterpart.

### Tuner and IF Stages

It is imperative that this section is correctly aligned so if the correct equipment is not to hand it is best left alone. A falling frequency response or a misadjusted trap in the passband can cause no colour. Other faulty alignment symptoms are buzz-on-sound, 1.5MHz beat patterns between sound and colour, ringing and smearing. A rule-of-thumb check on the overall performance is to connect an oscilloscope across the vision detector load. This should show about 3V peak-to-peak composite vision signal and if all is well with the a.g.c. this level should remain constant for all signal levels from 50 $\mu$ V to 10mV approximately.

Automatic frequency control is fitted on some chassis to relieve the user of the responsibility for

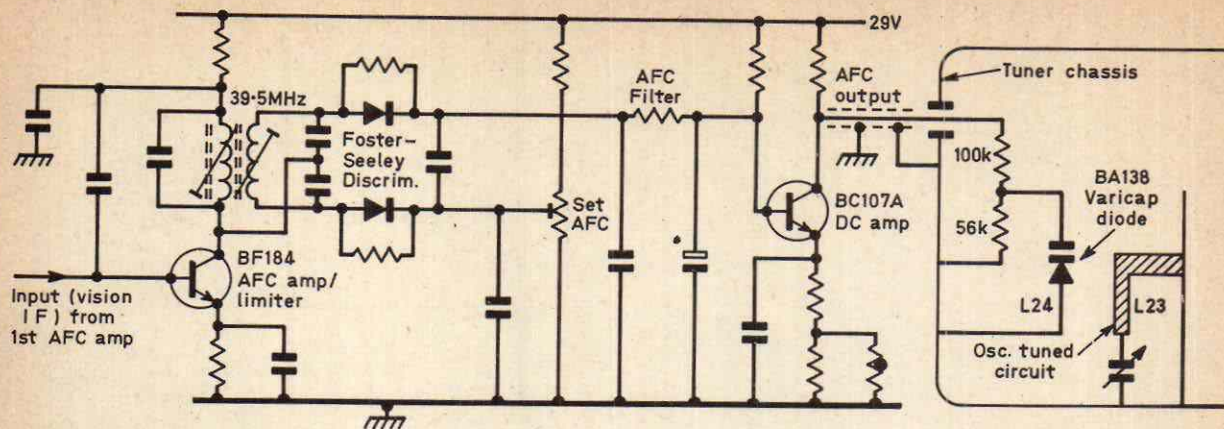


Fig. 5: The a.f.c. circuit used in the BRC 2000 dual-standard colour chassis (first a.f.c. amplifier not shown). The Foster-Seeley discriminator produces a d.c. control voltage proportional to the mistuning. This is amplified and used to adjust the oscillator tuning in the u.h.f. tuner unit, the varicap diode and L24 forming a tuned circuit varied by the control voltage. To set up, the input to the first a.f.c. amplifier is shorted and the set-a.f.c. potentiometer adjusted for a reading of 13V d.c. at the d.c. amplifier collector.

tuning in precisely. A discriminator circuit tuned to the vision carrier frequency generates a d.c. voltage when off tune and this is applied to a varicap diode in the tuner to pull the local oscillator back on tune. The slightest mistuning of the discriminator secondary will therefore keep the set off tune despite the user's efforts. Resetting the circuit can always be done with reference to the manual without having to realign the i.f. strip.

### Luminance Amplifier

This has more gain and sophistication than its monochrome counterpart the video amplifier. Its bias is varied to control the brightness of all three guns together. Preceding it is the luminance delay line which delays the Y signal about 600n sec with respect to the narrowband chroma signal so that they coincide on the screen. The effect of this delay can be seen by connecting a wire from the input to the output of the luminance delay line when direct and delayed signals can be seen together.

### Field Timebase

Part of the field scan is used to produce the dynamic convergence waveforms. The field scan

must therefore be full and linear before convergence is attempted.

### Line Timebase

The hold controls must be set exactly to ensure that the pulses used to gate the colour burst in the decoder catch all 10 cycles of burst and not just the first few. If the pulse arrives too soon weak or no colour symptoms arise, if it arrives too late altered colours can result. On test card F early gating would show green and red running bars across the centre circle, i.e. weak colour sync, whilst late gating could show a mauve tablecloth (instead of orange) due to the set mistaking the blue castellation for the burst.

E.H.T. is also critical. Too little will make focusing, convergence and purity adjustments difficult. Too much will not only be an X-ray hazard but will also produce some nasty cracks and bangs across the various spark traps. In turn the back-e.m.f. from these fireworks can find its way into the signal stages, destroying any semiconductor that stands in its way. Line drive controls, sometimes marked "Set E.H.T.", are provided for each system and are normally adjusted in turn for 25kV at the shunt stabiliser anode or shadowmask tube final anode. The stabiliser grid circuit may need adjusting too. For

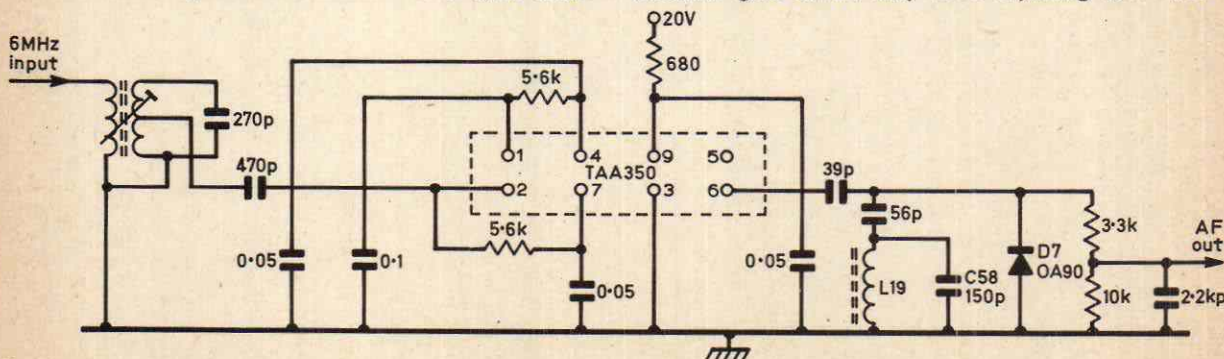


Fig. 6: The TAA350 i.c. sound i.f. channel used in recent (single-standard) Pye group and Bush-Murphy colour chassis. Input is to pin 2, pins 1, 4 and 7 are externally decoupled, pin 3 is chassis and pin 9 the 12V i.t. input. Output from pin 6 is demodulated by the slope detector L19, C58 with D7. After de-emphasis the signal is fed to the a.f. circuits. Circuit shown is the Pye one.

this purpose a  $1k\Omega$  resistor is usually fitted in the cathode lead, its voltage conveniently indicating the current in milliamps. The more modern tripler e.h.t. rectifiers operate in conjunction with a beam current limiting circuit in the brightness control circuit.

**Warning:** if you habitually check monochrome e.h.t. stages with a neon screwdriver get your next of kin to cover you well with insurance before you extend the technique to colour.

### Convergence and Purity Adjustments

Patience to go over adjustments repeatedly is needed here. Purity is usually a red gun adjustment performed with the scan coils hard back in their moulding. You may find two settings of the purity magnet rings that give a red centre. Choose the one giving the larger area then slide the scan coils forward until the screen is all red. Switch on the other two guns and if necessary do a final trim on white. This way you see all three impurities together.

If convergence is bad on one system only check the system switch before making any adjustment. This may save you hours of work.

### The Decoder

This section demands the intelligent use of a good oscilloscope, proceeding as outlined earlier. A useful tip for field engineers is to inject the signal from a signal generator tuned to 4.43MHz at the decoder input and to ditch the colour killer. If all is well you should see a variety of rainbow hues moving wildly across the screen. Although the applications of such a pattern are limited it can help trace faults in interconnecting leads.

### Integrated Circuits

At the time of writing these divide into two groups. The first is the limiting amplifier used in single-standard sets as the f.m. sound channel. This is a high-gain device—usually wire-legged and circular—and special care must be taken to keep leads short and have good decoupling for stable operation. Probably because it is relatively easy to remove and replace it is fairly reliable and most sound troubles resolve as off-tune detector coils or faulty decouplers.

The second type fulfil signal processing functions. These have in-line encapsulation and their relatively low gain gives them a stability offset only by their complexity and difficult replacement. In this in-line category the best known device is used in the RBM decoder where it functions as synchronous detectors, G-Y matrix and R, G, B preamplifier stages.

All i.c.s are d.c. coupled devices and provided you are sure the external circuits are not at fault their state of health can be accurately judged by the electrode voltages. Sound i.c.s usually fail completely but the other types can fail partially giving some weird symptoms. It is quite normal for them to feel warm to the finger in use and faulty i.c.s have been known to misbehave when cold or after a few minutes run. The makers' manuals give full service notes on these devices. Use transistor techniques when soldering or desoldering them, but don't rush the job and spoil the copper print on the board. The i.c. in a set has already withstood many seconds of preheating and dip-soldering so it must be pretty tough!

NEXT MONTH IN

# Practical TELEVISION

## USING LINEAR INTEGRATED CIRCUITS

Silicon integrated circuit operational amplifiers give quite unparalleled performance as d.c. amplifiers and are now readily available to the constructor at reasonable prices. Before they can be used however it is necessary to understand the basic principles of d.c. amplifier design using them and their performance and characteristics. These will be explained next month in a feature which will lead on to several practical projects using linear i.c.s.

## UHF SET-TOP AERIALS

Three simple ways of constructing bi-square aerials, and a four-element Yagi design, are described with full data for the various aerial groups.

## TIME-DELAY TECHNIQUES

There are various ways of obtaining a time delay in electronics, for example by the use of a transmission line, by acoustic or ultrasonic techniques—as for example are used to obtain the line-period delay needed in a PAL colour receiver decoder—or by means of pulse delay circuits. These techniques are described and practical examples given.

## TELEVISION RECEIVER SERVICING

The next chassis to be dealt with in our servicing series is the STC (ITT) VC51/52/53 chassis used in many KB and RGD receivers and also in some rental models.

PLUS ALL THE REGULAR FEATURES

ORDER YOUR COPY ON THE FORM BELOW

TO.....  
(Name of Newsagent)

Please reserve/deliver the AUGUST issue of PRACTICAL TELEVISION (3/6), on sale JULY 17th, and continue every month until further notice.

NAME .....

ADDRESS.....

.....

## ICONOS

# UNDERNEATH THE DIPOLE

It seems a very long time ago that the Sergeant-Major shouted "Private Iconos! You can't pick it up before you put it down!" as I fumbled with an antiquated carbine. He was quite right of course, especially as the carbine was loaded and the safety catch was off. It was a situation not unlike that presented every day to the operators of computers, who have to feed their machine with the right information. It is this human element which causes computer mistakes that cannot be corrected even by Rossum's Universal Robots.

### THE COMPUTER AGE

The analysis and solution of major industrial problems requires creative thinking and new initiative. This was the objective of *Idea, Development and Advancement in Engineering Design*, a seminar—initiated by the Industrial and Commercial Techniques Organisation—which followed the recent *International Symposium for Computer Graphics* held at the Brunel University Uxbridge, which also presented a large trade exhibition of computer equipment. "Private Iconos" was dazzled with the "digital high-speed incremental plotters", "scoplots", "statistical analysis and matrix arithmetic schemes", "options and peripherals", etc. The cathode-ray display unit has now become an important factor in improving the "man-machine interface". These developments are mainly concerned with research but there are a growing number of computer uses in film and television.

The most obvious use for computers in a television studio is for recording the lighting arrangements as worked out during the final "hot" rehearsals of a play or feature, particularly a colour television play. The first successful developments used punched cards, then a magnetic drum and more recently a magnetic tape as in the Thorn "Q" File system. For the final live or videotaped recording colour variations, dimmings and rapid light changes are made. Subsequent overall amendments in colour balance can be computerised and automatically controlled.

### THE MINICAM

Developments and improvements—computerised—in colour television cameras are coming along very quickly these days—on an international basis. The Pye-CBS miniature colour television camera was demonstrated before the British Kinematograph Sound and Television Society by Len Cosgrove of

Pye TVT Ltd. immediately following a similar unveiling at the National Association of Broadcasters in Chicago. This camera uses three Philips Plumbicon tubes, has a rather odd (but logical) shape and is capable of being used hand-held on outside broadcast events. It can be battery driven and radio linked (together with intercom) with a nearby mobile base receiver in a truck. In one mode—mounted on a special tripod—the camera can be "commanded" by a digital computer code to focus, expose correctly, zoom, pan and tilt.

### ENGINEERS' ACHIEVEMENTS

The Royal Television Society's Conference at Cambridge underlined the enormous progress that has been made during the last few years. Howard Thomas, Managing Director of Thames Television, pointed out that unlike the rate of progress in the film industry the pace-makers in television have been the engineers. "During these past 15 years—the *ITV chapter of television history—the engineers have invented, pioneered and blazed trails—but unfortunately the programme makers have been slow to rise to the challenge.*"

He pointed out that 43 years after the introduction of talking films the cinema has made little progress in technology—apart from wider screens, magnetic recording, an attempt at stereo sound, colour and special effects—except for the progress made by producers and directors. "The electronics men have provided the new tools, the revolutionary techniques," said Mr. Thomas. "Videotape recording, editing by computer, alternative colour systems, electronic lighting control and satellite TV transmission have led the way; the programme makers, producers, directors and writers have followed in the engineers' footsteps!" This is all quite true. But certain progressive techniques can be claimed by the engineers of film studios, particularly in lighting, special effects, sound recording and dubbing techniques.

### NOMENCLATURE EXTRAORDINARY

At the very start of motion pictures the British engineers Robert Paul, Cecil M. Hepworth, James Williamson and others achieved many startling productions in their multiple activities as producers, directors, cameramen and salesmen. That was the



The Pye/Philips/CBS Minicam colour television camera in operation at Cambridge.



age of the technological one-man-band. *Living Pictures* published in 1898 set out dozens of British patents for motion-picture photography.

After quite extensive research I am now able to set out in alphabetical order a few of the names of the motion-picture "appliances" revealed at that time. Some appear to be derived from personal names, others to be mis-spellings, but the list will serve as a warning against the evolution of further etymological monstrosities in this age of electronics: Anarithroscope, Animatograph, Animatoscope, Anarthroscope, Aphengoscope, Apollo Kinetograph, Artograph, Badizograph, Centograph, Chronographophotographoscope, Cinagraphoscope, Cinegraph, Cineoscope, Cosmoscope, Cosmonograph, Diaramiscope, Electroscop, Hypnoscope, Kathoscope . . . ! Jumping from K to Z I notice the name "Zine-matograph.

After perusal of these technological terms it might be thought that names no less than mechanical principles have been well-nigh exhausted. The

tongue-twisting name "Chronographophotographoscope" wears many people out merely saying it loudly and thinking it is either a Welsh designed navigational photographic chronometer or the name of a Harlech v.h.f. relay transmitter!

The names and the intermittent-film transport mechanisms may have been examples of misapplied ingenuity; but many of them are genuine. There was Charles Urban's Warwick Biokam, Beard's Cinematograph, Vever's Videograph, Wood's Movendoscope, the Edison projecting Vitascope and Appleton's Cieroscope. Eddy's Vitascope—quite different from Edison's projector—is a case of a name misleading the potential purchaser, turning out to be an apparatus for obtaining a bird's-eye landscape view of surrounding country by means of mirrors suspended from a kite! Substitute a modern Minicam TV camera (remote controlled) for the mirrors and a small barrage balloon for the kite and you can view the sunny countryside on a monitor before your very eyes!

## SERVICING TV RECEIVERS

—continued from page 451

The electrical part of the tuner (valves, coils, components etc.) is a separate unit and is joined to the main mechanical unit by a series of small PK screws. The lower front screws are shorter and must be used in this position to avoid fouling the cam. The rear bar mechanism must be dismantled and with the side screws removed the units can be carefully separated, lifting the electrical section off the tuning slugs which remain on their long wire stems. It is essential to avoid bending these wires as this would cause the slugs to stick inside the coil formers upon replacement so that the cam will push them up but the spring will be unable to pull them down. The resistors are at the rear of the unit, concealed by a strip of tape. Once this point is reached there is no particular difficulty in replacing faulty parts except that space is limited.

If a switch leaf contact is found to be broken the unit should be reassembled and returned to the makers. Reassembly is awkward and it is essential to ensure that the slugs are free to return down by the spring action when the cam is rotated. A little oil in the coil formers may facilitate this action.

Finally, get the screws in the right holes and ensure that the bar is actuated by the lever and disc. The long rod which operates the chassis system switch must be checked to ensure that no movement has taken place at the tuner end. It is freed at the chassis end by removal of a collar at the rear.

### VHF Relay Operation

Remove the flying lead from the v.h.f. tuner from PC8 on the i.f. board and connect to the unused h.t. tag (2020 series PC13, 2012 series PC7). Alter the cam at the rear of the v.h.f. tuner to switch the i.f. board at the desired v.h.f. channel setting.

### Tube Base Voltages

If the voltage at pin 3 is low (say, about 230V) resulting in a very dark picture or no raster at all with no input, check the 0.022 $\mu$ F capacitor (C194,

not on earlier models) which decouples the first anode supply to the HT2 line as this may well be shorted.

### Modifications

A number of minor modifications have been introduced during the production of this group of chassis. The following capacitors have been increased in value to 1.8kpF: C65, C80, C82, C90, C107, C111, C112, C119, C121, C125 and C135-C142. C130 was 1.5kpF in early production. Later C107 was increased further to 5kpF and C130 to 10kpF. C76 and C77 also increased to 5kpF.

C74 changed to 18pF, C75 to 33pF and C73 to 8pF with L34 in series (tuned to 39.65MHz). C79 changed to 8pF, R97 1k $\Omega$  added in V8A screen feed, R137 changed in value to 1.5M $\Omega$  and connected to chassis, R138 and R139 being deleted (focus adjustment to SC12, SC18 or SC16 (earth)). R96 is 120 $\Omega$  on some models.

In earlier production R79 was 150 $\Omega$ , R143 330 $\Omega$ , R153 1.5M $\Omega$ , R146 and C195 (line flyback blanking) not fitted, C183 0.1 $\mu$ F, R74 470k $\Omega$  was connected from the junction C102, R72, PC1 to chassis, C164 2000pF was connected across R116. In the line output circuit of early models a 1.8k $\Omega$  (R131) and 180pF (C177) capacitor in series were connected across L68 and C175 with C177 (later position as in Fig. 6) omitted. Note that two different line output transformers have been used: the connections are the same but the appearance differs. C194 was omitted on early models and the spot suppression circuit differed as follows: R145 390k $\Omega$  and VDR4 deleted with a 47k $\Omega$  resistor instead connected from PL2 to the neutral side of the mains input.

In some early models the a.g.c. feed to V2A differed as follows: junction of R8 and C28 taken via R12 (2.2M $\Omega$ ) to PC10, R39, C92 and PC22 being omitted. With the later v.h.f. tuner R38 is changed to 3.9k $\Omega$  and removed from the printed circuit board.

In later chassis PL3 is removed, solder connections being used instead. PL3-1=SC19; PL3-2=SC20; PL3-4=SC21; PL3-5=SC24; PL3-6=SC23; PL3-7=SC25; PL3-8=SC26; PL3-9=SC27; PL3-3=SC22.

# waveforms in **COLOUR** receivers

GORDON J. KING

PART 12

*In this final instalment of the series Gordon J. King describes the need for convergence with a shadowmask tube and the waveforms required to converge the three beams.*

THE timebases of monochrome sets have the prime job of driving current through the line and field scanning coils in a manner to incite a linear movement of the scanning spot from the left to the right of the screen (line) and from the top to the bottom of the screen (field). Both scanning strokes need to be very accurately geared to the similar scanning action to which the electron beam in the camera tube at the transmitting end is subjected, and both scans on completion must return swiftly to their starting points (retrace) and arrive there before the next line or field of signal occurs. Thus the retraces take place during the blanking and sync pulse periods of the composite signal. The sync pulses ensure that the scanning strokes at the receiver exactly follow those at the camera tube while the blanking pulses provide small intervals of time for the video circuits to stabilise and for the synchronising to become properly active before the picture signal recommences.

The field scanning duration closely matches the duration of a complete sinewave of 50Hz mains supply. At one time the field repetition frequency used to be locked to the 50Hz mains supply but nowadays there is rarely synchronising between the two signals which is why we sometimes see a ripple moving up or down the picture when the mains smoothing filters in the receiver have lost efficiency and when an electrolytic capacitor or a valve with poor heater-cathode insulation is in need of replacement. The symptom was not present when field-frequency/mains-frequency synchronisation was used. Then slight hum merely produced mild shading across the picture—the hum bar as it is called—locked in position by the synchronising. The subjectively more disconcerting ripple is effectively a beat between the field and mains frequencies and as the difference is only a cycle or so the bar moves slowly up or down the screen.

## Colour Timebase Requirements

Colour set scanning is just the same and hum bars in the luminance or chroma sections are far more annoying than on monochrome. In a colour set however the scanning current has to deflect the three electron beams of the shadowmask picture tube together and of course in unison. Moreover the greater e.h.t. voltage of colour sets (25kV compared with about 18kV in a monochrome set) makes the beams "stiffer" and that much more difficult to deflect over the full screen. The timebases of colour sets are thus a little more powerful than those found in monochrome sets.

The timebases of colour sets have another job

to do in addition to that of line and field scanning. They have to produce a specific type of current waveform in the line and field dynamic convergence coils to enable each of the three shadowmask tube beams to be separately influenced as it scans vertically and horizontally. The reason for this is the need to get the three beams to impinge exactly at the same point on the shadowmask screen at all scanning positions. The physical characteristics of the tube make this impossible without external electromagnetic assistance, and this is where the dynamic convergence currents come in.

## Need for Convergence

The shadowmask tube can be regarded as three tubes with one screen, having three electron guns and beams. The screen is composed of phosphor dots of the three primary colours red, green and blue. The shadowmask carries almost half a million very small holes and the geometry is such that when the beam of say the red gun is active the holes in the shadowmask allow it to impinge only on the red phosphor dots, giving a red raster. Likewise with the green and blue beams, and with the three beams in operation three superimposed rasters are produced. When the light energy is "equalised" by adjusting the red, green and blue drives to the guns a raster composed of the three colours appears as white light.

## Dynamic Convergence

Now, since the deflection radius of the three beams differs from that of the shadowmask and phosphor dot screen, and since the guns must out of necessity be displaced a little from each other in the tube neck, it is obvious that the beams, which may be converged correctly at the middle of the screen, will tend to deviate from correct convergence as they are deflected in unison away from the centre. This results in the compound scanning spot from the three guns diverging so that the individual primary colours appear at the top, bottom and sides of the screen. The result when a picture is being reproduced is that its elements appear with colours fringing them. Dynamic convergence attempts to combat this by bending the beams separately as they are deflected in such a manner that their points of screen impingement coincide as nearly as possible over the entire screen area. This is a complicated business and something of a compromise but in practice remarkably good dynamic convergence is possible in a well designed and set up receiver. This

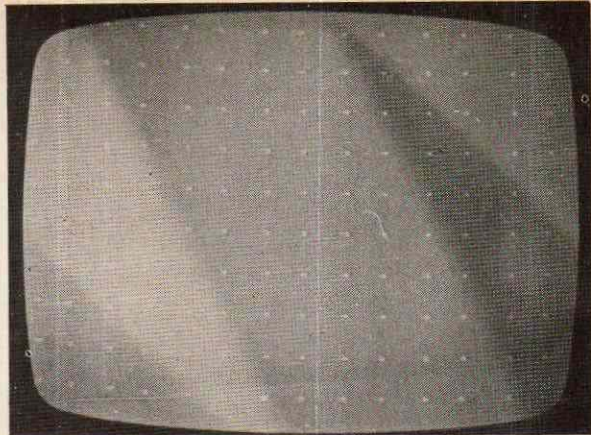
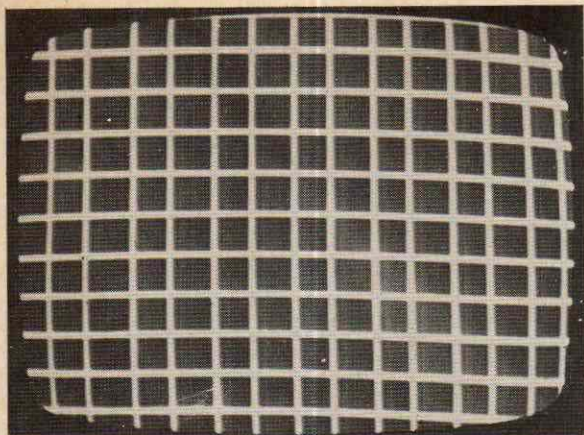


Fig. 1: Left, crosshatch display, right dot display. Either a crosshatch pattern or dots can be used for convergence adjustments. The former is best for dynamic and the latter best for static convergence.

beam convergence is necessary on monochrome transmissions as well as on colour ones—indeed poor convergence shows up more on monochrome than on colour, since colours then start to appear on what should be a monochrome display.

Dual-standard colour sets must incorporate a dynamic line convergence system that can be switched between the two standards. This complicates matters even more, making two sets of dynamic convergence adjustments necessary. To enable each colour set to be individually set up for correct dynamic convergence each set is equipped with a number (some twelve on single-standard models and almost double this number on dual-standard models) of preset dynamic convergence controls. These enable the strength and the nature of the current waveforms in the dynamic convergence coils to be adjusted by the service technician—using a crosshatch or dot pattern produced by a special generator—for best overall convergence on both standards or on 625 lines only where the receiver is a single-standard model.

## Static Convergence

In addition to dynamic convergence the colour tube must be provided with static convergence fields to make the three beams converge accurately in the middle of the screen. The static fields are provided by small adjustable permanent magnets (or electromagnets energised with direct current—some-

times an adjustable d.c. is fed to the dynamic convergence coils along with the dynamic convergence currents). Thus each beam is provided with its own static convergence field and each field is adjusted to provide optimum convergence within a small area at the centre of the screen. Again, a crosshatch and/or dot generator is required for setting up. Fig. 1 shows typical off-screen patterns, (left) crosshatch and (right) dot.

## Convergence Assemblies

Within the neck of the shadowmask tube three pole pieces are provided through which the electron beams pass, each one being magnetically shielded from its partners. These pole pieces link up with the pole pieces on the convergence unit which slides on to the tube neck behind the scanning coils. In this way maximum magnetic coupling is separately directed to each beam. Fig. 2 shows part of a convergence unit with the pen pointing to one of the small adjustable static convergence magnets. There are two more, one on each of the other two limbs of the unit. This magnet is made of a ceramic material and the field it reflects to the associated tube pole piece can be regulated by rotating the magnet in its socket.

## Purity

Other hardware on the tube neck includes the blue lateral magnet (see later) and a pair of purity magnets. The latter, looking like the picture shift magnets of a monochrome set and adjustable in a similar manner, can be clearly seen in Fig. 2. The two magnets apply a field across the tube neck and this influences the three beams together. By rotating the two magnets together the field is rotated and by rotating one relative to the other the field strength is adjusted from almost zero to a maximum value. The field provided by these magnets adjusts the approach angle of the three beams to the screen so that they pass through the correct shadowmask holes to strike the appropriate colour phosphor dots. This differs from convergence since we can achieve pure red, green or blue rasters when the purity adjustment is correct without the three beams converging accurately at the screen. Correct reproduc-

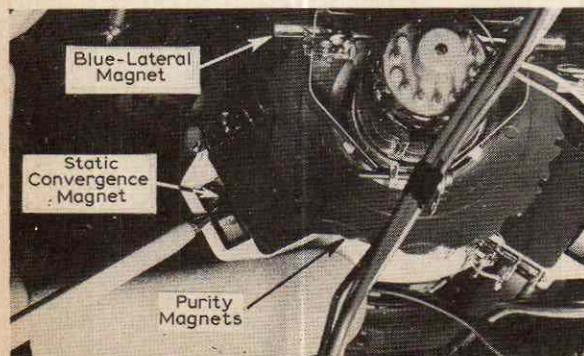
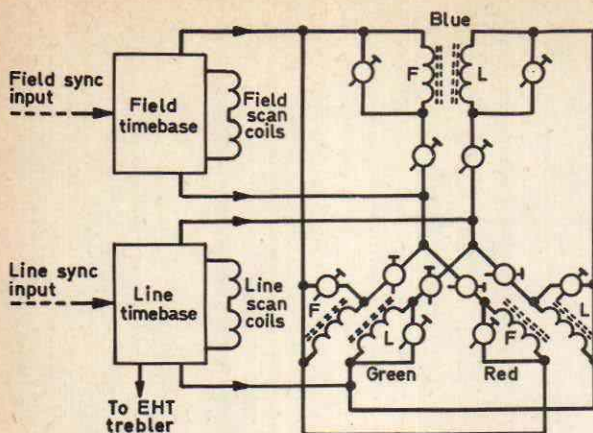


Fig. 2: Shadowmask tube neck hardware.



tion relies on the accurate registration of the picture elements, purity merely meaning that the beams are striking the correct colour phosphors and not necessarily in correct registration or convergence.

## Convergence Circuits

Figure 3 shows in block diagram form the dynamic convergence arrangements in a colour set. The signals present are those generated in the line and field timebases, the dynamic convergence circuits adapting these to provide the signals that give rise to the changing magnetic fields in the convergence coils. As we have seen these fields "bend" the beams in a continuously varying manner as they are deflected by the scanning fields away from the centre of the screen so as to provide the best possible instantaneous convergence or image registration over the entire tube face.

## Vertical Convergence

Let us look first at field convergence. Fig. 3 shows that apart from driving current through the field scan coils the field timebase also energises the red, green and blue field or vertical convergence coils.

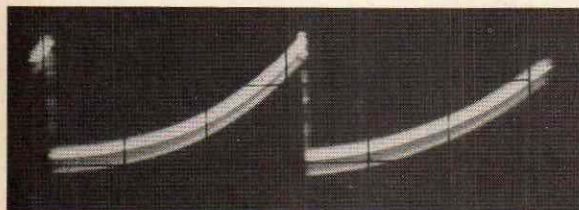


Fig. 4: Sawtooth current waveform in the field scan coils. The waveform may not be a true sawtooth owing to beam linearising requirements.

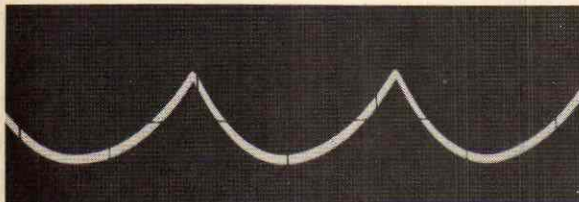
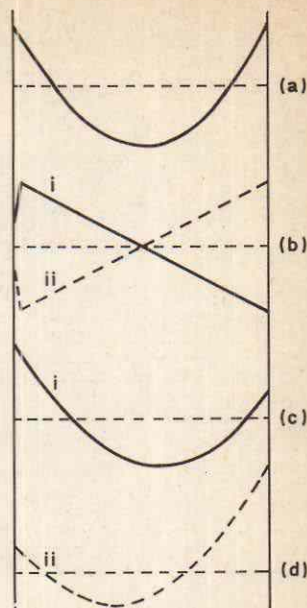


Fig. 5: Parabolic waveform. This is mixed with the sawtooth waveform in the convergence coils to provide optimum correction.

Fig. 3 (left): The basic dynamic convergence system. For each of the three beams in the tube there are two dynamic convergence coils, one to provide vertical correction and the other horizontal correction. Each coil has two basic controls, one to adjust amplitude and the other the tilt of the waveform. In addition the blue beam has a separate lateral correction system.

Fig. 6 (right): Showing the development of the tilted parabolic waveforms (c) and (d) from the true parabolic (a) and sawtooth (b) waveforms.



Each beam has two coils associated with it, one carrying the vertical (field) convergence signal current and the other the horizontal (line) convergence signal current, and each coil has two associated controls. One regulates the amplitude of the convergence current and the other effectively adjusts the shape of the current waveform. These are basic functions. In practice the functions are slightly modified—"differential" controls easing setting up—but the principle remains the same.

## Convergence Waveforms

A field timebase generates several signals. One is the well known sawtooth signal shown in Fig. 4. Another is the parabolic current signal shown in Fig. 5. The former is present in the scan coils and the latter across the cathode or emitter resistor of the field output stage. Both these signals are fed via the controls to each vertical convergence coil. The result of their integration is a tilted parabolic current waveform and it is this sort of waveform which is required by the convergence coils for dynamic beam correction. One control adjusts the phase of the sawtooth—positive or negative—this adjustment having the effect of *tilting* the parabolic waveform. The other control regulates the amplitude of the parabolic waveform. The combination of these two adjustments makes it possible to secure quite reasonable convergence over the vertical scan.

The formation of the convergence signal is shown in Fig. 6: (a) is the parabolic waveform from the emitter or cathode circuit of the field amplifier (as shown in Fig. 5); (b) is the sawtooth waveform which is adjustable in phase between (i) and (ii); (c) is the combination of (a) and (b) when (b) is phased as at (i), while (d) is the combined waveform when (b) is phased as at (ii). The sawtooth phasing adjustment thus makes it possible to vary the "tilt" of the parabolic waveform between (c) and (d). The amplitude adjustment in addition regulates the amplitude of the parabolic waveform at any selected tilt. Fig. 7 indicates one basic arrangement for combining the two

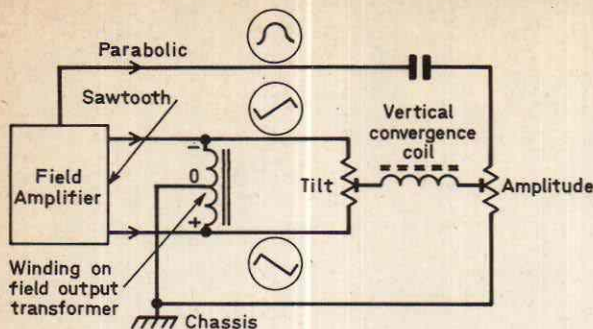


Fig. 7: Basic vertical convergence circuit.

signals and the operation of the two controls. Different arrangements may be found in practice but both the principle of operation and the net results are the same. Sometimes the timebase signal is fed to a series low-impedance convergence system and at other times in parallel with a high-impedance system.

## Horizontal Convergence

A parabolic current is also required for horizontal convergence and one way of obtaining this is shown in Fig. 8. The action is as follows. The amplitude inductor picks up retrace pulses from the line output transformer and the action of the inductance causes a gradual build-up of current during the retrace pulse period through  $R$  to chassis. During the line scan period the current decays fairly linearly and a voltage waveform appears across  $R$  of sawtooth form. In Fig. 8 this sawtooth voltage is applied in parallel to the horizontal convergence coil, and since at line frequency this coil has a substantial inductive influence the current through it resulting from the sawtooth voltage drive is of a parabolic nature. The strength of the parabolic current is governed by the amplitude of the sawtooth voltage across  $R$  and this is adjustable by a sliding core in the former of the amplitude inductor. This varies the series impedance of the circuit at line frequency.

Since a retrace pulse—like a true squarewave—when fed through an inductance creates a sawtooth current waveform it is obvious that a sawtooth current must flow through the convergence coil in addition to the parabolic current through the coil. This sawtooth current is controlled by  $C$  and the tilt inductor which is in parallel with  $R$ . The basic action is that the sawtooth current through  $C$  produces a parabolic voltage across it which is added

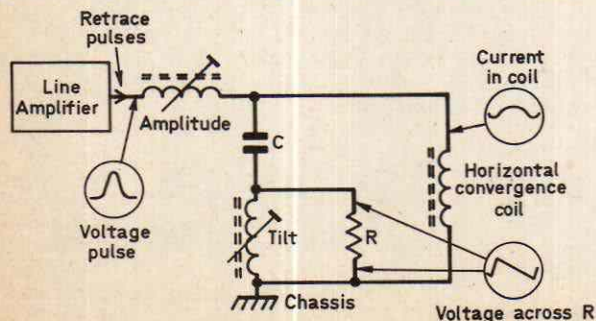


Fig. 8: Basic horizontal convergence circuit.

to the sawtooth voltage across  $R$ , the ratio of the voltages being determined by the setting of the tilt inductor. This means that the net current in the horizontal convergence coil can be modified in a similar manner to the vertical convergence current adjustment shown at (c) and (d) in Fig. 6.

## Differential Controls

Because the dynamic correction required by the red beam is virtually a mirror image of that required by the green beam modern colour sets generally use green and red dynamic convergence controls of a differential type, with such labelling as red-green amplitude, red-green tilt, red-green differential and so forth.

## The Blue Lateral Magnet and Symmetry Controls

Receivers also carry a blue lateral magnet—referred to earlier—and this may or may not be the kind of assembly having a blue lateral winding. If there is no winding the permanent blue lateral magnet serves to shift the blue beam slightly laterally with respect to the red and green beams to facilitate optimum static convergence. The magnet in this assembly may slide within a tube for adjustment. This is commonly clamped to the tube neck as shown in Fig. 2. If the assembly also carries a winding this is energised from line retrace pulses via a blue lateral inductor with a sliding core to vary the impedance of the circuit.

Since the ultimate degree of convergence is governed somewhat by the symmetry of the scan coils most receivers include a symmetry adjusting inductor across the line scan coils and a symmetry adjusting potentiometer across the field scan coils. These components are arranged to form a bridge circuit, the adjustments to them being made for optimum bridge balance and hence symmetry.

## Pin-cushion Distortion

Many colour sets also adopt a special type of coupling between the field and line timebases to combat the effect of pin-cushion distortion. In monochrome receivers this type of distortion, which is caused by the radius of deflection of the electron beam differing from that of the screen, is cancelled by the use of small adjustable permanent magnets around the tube flare. Such magnets cannot be used with a shadowmask tube since they would upset the purity and convergence adjustments. Thus correction has to be performed by electronic means instead. A common method uses a device called a transducer. This is a kind of transformer connected between the line and field circuits but unlike an ordinary transformer its action depends on the non-linear permeability produced by the line and field currents flowing through its specially arranged windings. It is in effect a transformer with poor regulation.

To stretch out the bowed sides of a picture suffering from pin-cushion distortion the coupling between the field and line deflection circuits results in the line amplitude progressively increasing at field frequency to a maximum half way down the field and then progressively decreasing to the bottom of the field.

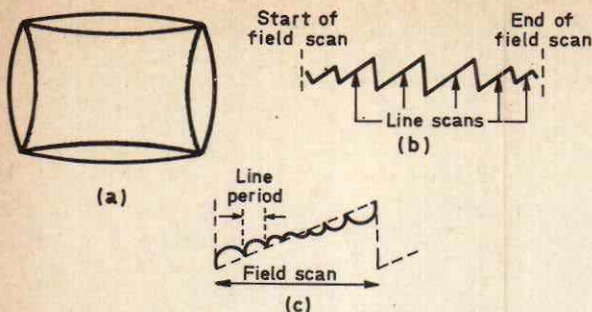


Fig. 9 (above): Pin-cushion distortion (a) can be corrected by means of a transducer which adjusts the amplitude of the line scans over a field (b) to give side correction and increases and decreases the excursions of the field at line frequency, as shown at (c) in Fig. 9.

Fig. 10 (right): Windings on the transducer (a) and the transducer in circuit (b).

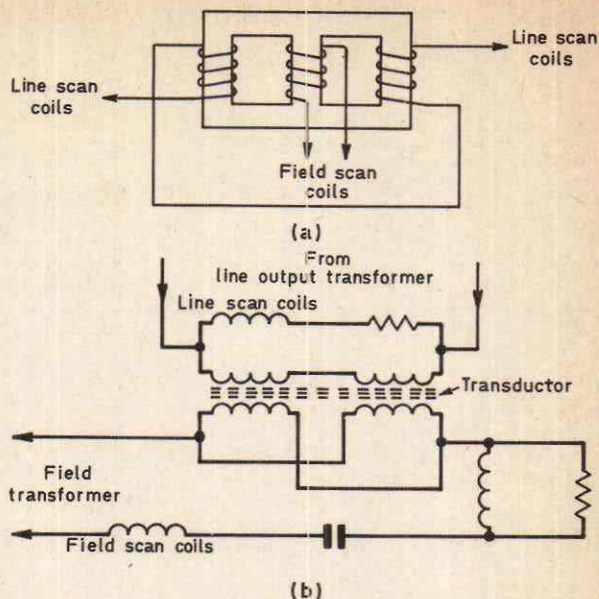


Fig. 9 shows at (a) the nature of pin-cushion distortion and at (b) how it is corrected at the sides. The bows at the top and bottom of the picture are pulled out by the field-line transducer coupling increasing and decreasing the excursions of the field at line frequency, as shown at (c) in Fig. 9. Fig. 10 shows at (a) the basic design of the transducer and at (b) the transducer in circuit.

## Conclusion

In conclusion it should be mentioned that the waveforms and signals produced by the timebases for scanning are identical to those produced by the

timebases of monochrome receivers. The ultimate job of each timebase is of course to produce a sawtooth current waveform in the scan coils of the kind shown in Fig. 4. This differs a little from a pure sawtooth owing to the action of the scan linearising circuits. What is wanted is a linear movement of beam over the scanning strokes and a perfectly linear sawtooth is not likely to provide this. Hence the deviation from pure sawtooth of the waveform, shown in Fig. 4.

## STROBE-TRIGGER TIMEBASE UNIT

*continued from page 455*

other sinewave frequencies from an r.f. or a.f. signal generator. This is not over-critical but the better the calibration accuracy the better the absolute strobe-time measurements which can be made.

Once the strobe gate width capacitor bank is properly aligned the ramp bank C26 can be adjusted by padding one position after another to give the same ramp amplitude (strobe trace length) in each case or by using a capacitor bridge to establish the correct capacitance ratios. Again this is not particularly critical since slight variations of trace length from one position to another are hardly disturbing. The better the matching however the higher the precision of the instrument for all subsequent quantitative measurements made on the observed waveforms.

The adjustment of VR6 has already been described. The correct setting is such that the strobe ramp just does not fold over at its end. VR4 must be adjusted correctly before the strobe gate and ramp generators will work at all, but this adjustment is non-critical. If VR4 is set too low there will be no strobe at all. Beyond a certain point a strobe will appear but its duration tends to be short and little affected by the gate width capacitor. At some still higher setting—near the maximum resistance of VR4—the proper duration gates will appear. The correct setting resistance of VR4 is slightly beyond this point. Note that beyond this point the gate width is slightly

affected by VR4 too so that VR4 must not be touched again after aligning VR5 and matching the capacitor bank 55A.

## VOLTAGE ADJUSTMENTS

If all voltages are high or low try to correct this with the mains primary tapings such that they are just high. Then bring them to nominal with a suitable carbon resistor across the entire secondary winding of the mains transformer. Take care not to exceed the power rating of the transformer, and use a resistor of correct wattage rating. In severe cases the transformer secondary winding itself must be corrected. It is essential to preserve symmetry, i.e. to keep an exactly positioned centre tap. Thus if turns are added (a few turns can usually be slipped through without dismantling the transformer) do this at both ends of the winding in equal amounts. The extra turns can be connected in series if voltage boost is needed or in series phase opposition if voltage reduction is needed.

If any such voltage adjustments are necessary they should be effected at least coarsely before making any other alignment. For this purpose make the adjustments with reference to the line A and line B voltage readings. Readers desiring maximum precision and willing to devote the necessary patience to their instrument may find it advisable to follow this sequence: coarse power supply voltage adjustment, general pulse circuit alignment, fine power supply voltage adjustment, final pulse circuit alignment.

# DX-TV

## A MONTHLY FEATURE FOR DX ENTHUSIASTS

### CHARLES RAFAREL

SOME better news at last! There has been a significant improvement in SpE reception during April and even the Tropics have shown a little progress. Openings have been mainly of short duration but have been more frequent and the range of stations has been rather more varied. Very short-skip SpE has also been in evidence with reception of E2 Belgium and E2 Switzerland. This is unusual at this time of the year. The most startling signal for me, however, was a sight of test card G on Ch.R1. This must have been Bulgaria which is a first for me.

All this is a pointer for good SpE next month (May) which is normally the start of the SpE season.

Now for the log here for the period 1-30/4/70. Blank days were the 1st, 2nd, 18th and 19th—and I was away during most of the last two dates.

- 3/4/70 Russia R1, West Germany E2.
- 4/4/70 Poland R1.
- 5/4/70 Russia R1, Poland R1 and Sweden E2.
- 6/4/70 Russia R1.
- 8/4/70 Bulgaria R1.
- 9/4/70 Sweden E2 and E4.
- 10/4/70 Spain E2.
- 11/4/70 Sweden E2, Russia R1.
- 13/4/70 Norway E2.
- 14/4/70 Sweden E2, Russia R1.
- 15/4/70 Russia R1.
- 16/4/70 Czechoslovakia R1, Portugal E2.
- 17/4/70 Russia R1, West Germany E2.
- 20/4/70 Russia R1.
- 21/4/70 Switzerland E2 (very good).
- 22/4/70 Poland R1, Czechoslovakia R1, Russia R1, Sweden E2.
- 23/4/70 Poland R1, Czechoslovakia R1, Sweden E2, West Germany E2, Belgium E2.
- 24/4/70 Russia R1, Czechoslovakia R1, Poland R1, West Germany E2.
- 25/4/70 Poland R1, Czechoslovakia R1, Sweden E2.
- 26/4/70 Czechoslovakia R1, Sweden E2, West Germany E2.
- 27/4/70 Czechoslovakia R1, West Germany E2, Sweden E2.
- 28/4/70 Czechoslovakia R1, Poland R1, West Germany E2, Sweden E2, Belgium E2.
- 29/4/70 Czechoslovakia R1.

30/4/70 Czechoslovakia R1, West Germany E2, Belgium E2.

The improvement in the Tropics was mainly towards the end of the month. With the more settled weather conditions the local French v.h.f. and u.h.f. signals were better, but no signs yet of Holland or West Germany so we still have a long way to go.

F2 was still about with 38-40MHz stations coming in on 8/4/70.

Belgium is using a variation of the standard BRT test card. At times this now carries a sawtooth pattern (left-hand side white, shading through grey to black at the right-hand side) across part of the centre circle. I noted this on the 28th but on the 30th it had reverted to the old type.

R. Bunney has information from Istanbul, Turkey: "The experimental TV station at the Technical University has a power of 50W (this has been stated in some lists as now being 50kW). Although there is a project for a 450W station it is not yet ready and no mention is made of the suggested high-power network. They refer only to a Band III transmitter in Ankara, so no joy for us yet!"

New stations now in service: *West Germany* Ravensburg DBP3 Ch.40 250kW horizontal and Pfaffenburg BR Ch.59 100kW horizontal. *France* Alès Mt Bouquet Ch.21 100kW horizontal well south and not too likely here. *Iceland* Vodleheidi E6 490kW horizontal, high-power and because of this a possible for Scottish DXers.

## DX LOGGING SYSTEMS

I suppose we all have different methods of recording DX-TV results in our logs. Thus when we try to compare our reception with that of other DXers we often run into difficulties since there are no generally accepted standards to guide us. With this problem in mind we are going to suggest three possible systems which I have been discussing with Roger Bunney. We offer the following to our DX-TV friends for their criticism and comment—we would like to know your views.

(1) VAFI (Video, Audio, Fading and Interference) suggested by M. Goldman in the United States and reported to us by F. Dombrowski in the Digest. This is based on the well-known SINPO shortwave system.

|                   |                         |
|-------------------|-------------------------|
| <i>Video (V)</i>  | <i>Audio (A)</i>        |
| No signal 0       | No signal 0             |
| Just detectable 1 | Just detectable 1       |
| Heavy snow 2      | Poor 2                  |
| Moderate snow 3   | Fair 3                  |
| Light snow 4      | Good 4                  |
| Snow free 5       | Excellent 5             |
| <i>Fading (F)</i> | <i>Interference (I)</i> |
| Auroral flutter 0 | Loss of signal 0        |
| Deep to fast 1    | Extreme 1               |
| Slow deep 2       | Heavy 2                 |
| Moderate 3        | Moderate 3              |
| Light 4           | Light 4                 |
| None 5            | None 5                  |

If over here with the multiplicity of TV systems

—continued on page 473

# UHF aerial

## AMPLIFIER

Roger Bunney

WE installed a group E Parabeam aerial and then thought to try adding an aerial preamplifier with coverage over Band V, i.e. channel groups B and C. At present the Mullard BF180 transistor is used in many integrated tuners and as this particular type is readily available at low prices it seemed to be the ideal choice for the amplifier under consideration.

Rather than use a coil in the collector circuit, a quarter-wave line tapped towards the dead end to achieve a reasonable match into  $75\Omega$  is used. The article by Gordon J. King on *Coaxial Resonators* in PRACTICAL TELEVISION June 1967 gives further information on this type of tuned circuit.

### Construction

The amplifier is mounted on a tin subchassis within an Eddystone diecast box. The latter ensures a rigid and completely screened container, although any other metal container such as a 2oz. tobacco tin could be used. The wiring at these frequencies must be kept short and where possible soldered to one earthing point. The transistor itself should be mounted on a metal clip and screening between the emitter-base and collector circuits is essential to avoid instability. The usual soldering precautions should be observed.

### Circuit

The circuit of the preamplifier is extremely simple. L1 is an r.f. choke which presents a high impedance to the wanted u.h.f. signals but allows a discharge path for any static build up within the aerial system. The signals are coupled to the BF180 emitter by C1 with emitter biasing by R1. The base is biased

by the potential divider R2, R3 and decoupled to r.f. by C3. If instability occurs the value of C3 could be increased to 1000pF.

The collector load L2 is a quarter-wave line tuned by C4. The signals are tapped off by C5 towards the low-impedance end of the line. The Band V dimensions given should enable the amplifier to tune over all this Band. If difficulty is experienced in obtaining optimum gain at the h.f. end of Band V with C4 at minimum, possibly the capacitor leads to the output socket are too long and the line may have to be repositioned. Alternatively the line could be shortened slightly. No trouble was experienced in the prototype in covering Band V. Dimensions are also given to enable the constructor to make a line for Band IV.

The line itself is 0.048in. diameter copper, actually the inner conductor from a piece of Super Aeraxial type 499 coaxial cable. If the Eddystone box is used the Band V line will allow the coaxial sockets to be

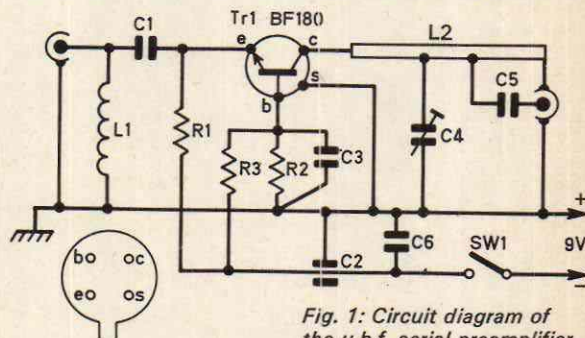


Fig. 1: Circuit diagram of the u.h.f. aerial preamplifier.

BF180 base viewed from underneath

### components list

#### Capacitors;

|    |   |
|----|---|
| C1 | 5pF   |
| C2 | 1000pF feedthrough                              |
| C3 | 470pF   |
| C4 | 4-10pF low-loss tubular trimmer (Henry's Radio) |
| C5 | 5pF   |
| C6 | 1800pF  |

All 20% midget ceramic unless otherwise specified

#### Miscellaneous;

|        |  |
|--------|--|
| L1     | R.F. choke, 8 turns 28g. close-spaced $\frac{1}{8}$ in. diameter |
| L2     | See text and Fig. 2  |
| Tr1    | BF180  |
| Switch | two coaxial sockets, Eddystone diecast box type 7134P.           |

#### Resistors;

|     |                     |
|-----|---------------------|
| R1  | 1kΩ                 |
| R2  | 10kΩ                |
| R3  | 3.3kΩ               |
| All | 10% $\frac{1}{4}$ W |

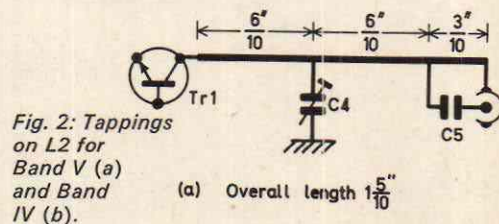


Fig. 2: Tappings on L2 for Band V (a) and Band IV (b).

(b) Overall length 2"



# STEPHENS

ELECTRONICS,  
P.O. BOX 26,  
AYLESBURY, BUCKS.

SEND S.A.E. FOR LISTS  
GUARANTEE  
Satisfaction or money  
refunded.

## VALVES

|         |      |          |      |        |      |        |      |
|---------|------|----------|------|--------|------|--------|------|
| AZ31    | 9/6  | EF184    | 11/3 | PL81   | 10/3 | 6AT6   | 9/9  |
| DAF91   | 8/3  | EH90     | 10/3 | PL81A  | 12/6 | 6U6A   | 15/6 |
| DpF96   | 8/3  | EL34     | 9/9  | PL82   | 7/3  | 6AV6   | 6/6  |
| DF91    | 9/-  | EL41     | 10/- | PL83   | 10/3 | 6BA6   | 9/6  |
| DF96    | 9/-  | EL81     | 9/6  | PL84   | 8/3  | 6BE6   | 12/- |
| DK91    | 11/6 | EL84     | 7/9  | PL500  | 16/6 | 6BR7   | 15/- |
| DK96    | 11/6 | EM81     | 11/6 | PL504  | 17/- | 6BR8   | 19/- |
| DL92    | 7/6  | EM84/7   | 12/9 | PL505  | 29/- | 6BW6   | 16/6 |
| DL94    | 7/6  | EY51     | 7/6  | PL508  | 20/- | 6BW7   | 13/9 |
| DL96    | 9/6  | EY86/7   | 7/9  | PL509  | 30/9 | 6CD6G  | 28/- |
| DY86/7  | 8/-  | EZ40/1   | 7/6  | PL802  | 17/3 | 6V6G   | 8/-  |
| EY802   | 8/6  | EZ80     | 6/6  | PL805  | 17/3 | 6X4    | 7/6  |
| EABC80  | 10/6 | EZ81     | 5/9  | PY32   | 10/- | 6X5    | 9/6  |
| ECC33   | 11/- | GY501    | 14/6 | PY33   | 10/9 | 12AU6  | 15/- |
| EBC41   | 9/6  | GZ30     | 9/6  | PY81   | 8/3  | 12BA6  | 9/6  |
| EBC81   | 6/6  | GZ32/4   | 11/9 | PY800  | 8/3  | 12BE6  | 12/- |
| EBC90   | 9/6  | GT33/7   | 16/3 | PY801  | 8/3  | 12BH7  | 14/- |
| EBF80   | 8/-  | KT66     | 25/6 | PY82   | 7/-  | 35W4   | 9/6  |
| EBF83   | 8/-  | KT88     | 32/6 | PY83   | 10/- | 50C5   | 12/6 |
| EBF89   | 8/-  | N37      | 15/6 | PY88   | 8/3  | 50CD6G | 28/- |
| EB91    | 5/3  | N339     | 25/6 | PY500  | 20/- | 6F23   | 15/6 |
| ECC81   | 8/-  | PC86/8   | 10/3 | PZ30   | 16/- | 6F24/5 | 12/6 |
| ECC82/3 | 8/6  | PC900    | 10/3 | R19    | 13/- | 6F26   | 8/3  |
| ECC84/5 | 8/6  | PC95     | 7/3  | R20    | 15/- | 6F28   | 11/6 |
| ECC88   | 11/- | PC97     | 8/3  | UABC80 | 10/6 | 6/30L2 | 15/6 |
| E88CC   | 12/6 | PCC84    | 9/3  | UBF89  | 8/-  | 10F1   | 15/- |
| ECF80/2 | 9/6  | PCC85    | 8/6  | UBC41  | 9/9  | 10F18  | 10/- |
| ECF86   | 11/- | PCC88    | 14/- | UCC85  | 9/3  | 10P13  | 16/- |
| ECH35   | 13/6 | PCC89    | 12/3 | UCH42  | 13/9 | 10P14  | 19/- |
| ECH42   | 13/6 | PCC189   | 12/3 | UCH81  | 10/9 | 20P4   | 20/- |
| ECH81   | 10/3 | PCF80    | 10/3 | UCL82  | 10/3 | 30C1   | 10/3 |
| ECH83   | 8/-  | PCF82    | 10/6 | UCL83  | 12/3 | 30C15  | 13/9 |
| ECH84   | 9/6  | PCF84    | 9/6  | UF41/2 | 11/- | 30C17  | 15/9 |
| ECLL800 | 20/- | PCF86    | 12/3 | UF80/5 | 7/6  | 30C18  | 13/6 |
| ECL80   | 8/-  | PCF200/1 | 16/3 | UF89   | 8/3  | 30F5   | 16/6 |
| ECL82   | 9/9  | PCF801   | 12/3 | UL41   | 11/6 | 30FL1  | 12/9 |
| ECL83   | 11/6 | PCF802   | 12/3 | UL84   | 11/- | 30FL12 | 17/6 |
| ECL86   | 9/9  | PCF805   | 13/- | UM80/4 | 9/-  | 30FL14 | 13/6 |
| EF39    | 10/6 | PCF806   | 12/3 | UY41   | 8/-  | 30L1   | 9/3  |
| EF80    | 8/-  | PCF808   | 13/6 | UY85   | 6/9  | 30L15  | 15/3 |
| EF83    | 10/- | PCH200   | 11/6 | U25    | 15/- | 30L17  | 14/6 |
| EF85    | 8/3  | PCL82    | 10/3 | U26    | 15/- | 30P12  | 15/6 |
| EF86    | 13/3 | PCL83    | 12/3 | U191   | 14/6 | 30PL1  | 12/9 |
| EF89    | 8/-  | PCL84    | 10/3 | U193   | 8/3  | 30P4MR | 20/- |
| EF91    | 8/6  | PCL85    | 10/6 | U301   | 17/- | 30P19  | 12/9 |
| EF92    | 10/- | PCL86    | 10/3 | W729   | 11/- | 30PL13 | 18/6 |
| EF93    | 9/6  | PD500    | 30/6 | Z759   | 24/6 | 30PL14 | 18/6 |
| EF94    | 15/6 | PFL200   | 14/9 | 5Y3    | 8/6  | 30PL15 | 18/6 |
| EF95    | 12/6 | PL36     | 12/9 | 5Z4    | 9/6  |        |      |
| EF183   | 11/3 | PL38     | 18/- | 6U4    | 15/- |        |      |

90% B.V.A. BOXED (NORMAL GUARANTEE) OR OWN VALVES SUPPLIED, 1 YEAR'S GUARANTEE. ADD 6d. PER VALVE ON ORDERS UNDER 6, OTHERWISE FREE POST & PACKING.

## SEMICONDUCTORS

|        |      |        |      |          |      |          |      |
|--------|------|--------|------|----------|------|----------|------|
| AC117  | 12/- | BC115  | 6/6  | BF225    | 6/-  | 2N1305   | 4/10 |
| AC126  | 4/4  | BC117  | 7/9  | BF257    | 9/6  | 2N1306   | 6/2  |
| AC127  | 4/9  | BC118  | 7/9  | BF22A    | 9/6  | 2N3055   | 15/- |
| AC128  | 4/6  | BC134  | 11/6 | NKT125   | 5/9  | 2N3392   | 5/-  |
| AC176  | 7/4  | BC147  | 5/8  | NKT281   | 4/-  | 2N3702   | 5/6  |
| ACY17  | 6/-  | BC148  | 4/4  | NUT401   | 17/6 | 2N3705   | 4/6  |
| ACY20  | 6/-  | BC152  | 5/6  | OC25     | 9/6  | 2N3711   | 4/9  |
| AD149  | 11/8 | BC175  | 5/6  | OC44     | 5/6  | 2N3819   | 9/-  |
| AD161  | 6/9  | BC187  | 5/8  | OC45     | 5/4  | 2N3826   | 6/-  |
| AD162  | 6/9  | BC213L | 5/4  | OC71     | 4/4  | 2N4062   | 4/6  |
| AF114  | 4/8  | BDY20  | 30/6 | OC72     | 5/4  | 2N4289   | 4/6  |
| AF115  | 4/8  | BFY50  | 5/-  | OC77     | 5/6  |          |      |
| AF116  | 4/9  | BFX84  | 7/-  | OC78     | 5/-  |          |      |
| AF117  | 4/6  | BFX29  | 7/6  | OC81     | 4/-  |          |      |
| AF118  | 12/- | BF115  | 5/6  | OC81D    | 4/-  |          |      |
| AF126  | 4/8  | BF117  | 9/6  | (GET113) | 4/4  |          |      |
| AF127  | 4/8  | BF163  | 7/-  | OC84     | 5/-  |          |      |
| AF139  | 8/8  | BF167  | 6/-  | OC169    | 4/8  |          |      |
| AF178  | 9/-  | BF173  | 7/-  | OC171    | 6/-  |          |      |
| AF179  | 9/-  | BF178  | 7/-  | OC200    | 6/6  |          |      |
| AF180  | 12/4 | BF180  | 8/-  | OC202    | 9/6  |          |      |
| AF181  | 9/4  | BF181  | 8/-  | OC203    | 6/6  |          |      |
| AF186  | 13/4 | BF182  | 8/-  | OC207    | 12/6 |          |      |
| AF239  | 8/6  | BF184  | 5/-  | P346A    | 4/6  |          |      |
| BC107A | 5/-  | BF194  | 5/-  | 2N456A   | 17/6 |          |      |
| BC108B | 4/6  | BF197  | 6/4  | 2N697    | 5/10 |          |      |
| BC109C | 5/-  | BF200  | 7/4  | 2N698    | 10/6 |          |      |
| BC113  | 5/6  | BF224  | 6/-  | 2N1132   | 11/6 | (SERIES) | 6/6  |

## CATHODE RAY TUBES

New and Budget tubes made by the leading British manufacturers. Guaranteed for 2 years. In the event of failure under guarantee, replacement is made without the usual time-wasting forms and postage expense.

| TYPE       | NEW      | BUDGET   |
|------------|----------|----------|
| MW36-20    |          | £4.10.0  |
| MW36-21    |          | £4.10.0  |
| MW43-69Z   |          | £4.12.6  |
| MW43-80Z   | CRM171   | £6.12.0  |
| AW43-80Z   | CRM172   |          |
|            | CRM173   | £6.12.0  |
|            | CME1702  | £6.12.0  |
|            | CME1703  | £6.12.0  |
|            | CME1706  | £6.12.0  |
|            | C17AA    | £6.12.0  |
|            | C17AF    | £6.12.0  |
| AW43-88    | CME1705  | £6.12.0  |
| AW47-90    | A47-14W  | £7.13.4  |
| AW47-91    |          |          |
| A47-14W    | CME1901  | £7.13.4  |
|            | CME1902  | £7.13.4  |
|            | CME1903  | £7.13.4  |
|            | C19AH    | £7.13.4  |
| A47-13W    | CME1906  | £10.5.6  |
| A47-11W    | CME1905  | £8.17.3  |
| A47-26W    | CME1905  | £8.17.3  |
| A47-26W/R  | CME1913R | £9.6.8   |
| A50-120V/R | CME2013  | £10.17.0 |
| AW53-80    |          | £8.18.8  |
| AW53-88    | CME2101  | £8.18.8  |
| AW59-90    | CME2303  | £9.11.8  |
| AW59-91    |          |          |
| A59-15W    | CME2301  | £9.11.8  |
|            | CME2302  |          |
|            | CME2303  |          |
| A59-11W    | CME2305  | £13.13.0 |
| A59-13W    | CME2306  | £13.13.0 |
| A59-16W    | CME2306  | £12.12.0 |
| A59-23W    | CME2305  | £12.12.0 |
| A59-23W/R  |          | £12.12.0 |

## PORTABLE SET TUBES

|         |        |              |
|---------|--------|--------------|
| TSD217  |        | £6.15.0      |
| TSD282  |        | £6.15.0      |
| A28-14W | £9.3.4 | Not supplied |
| CME1601 |        | £7.15.0      |
| CME1602 |        | £8.0.0       |

A discount of 10% is also given for the purchase of 3 or more New tubes at any one time.

All types of tubes in stock. Carriage and insurance 15/-.

## TRANSISTORISED UHF TUNER UNITS

NEW AND GUARANTEED FOR 3 MONTHS

Continuous tuning 90/- Push button 100/-  
Complete with Aerial Socket and wires for Radio and Allied TV sets but can be used for most makes.

## STYLII

TC8, GC2, GP59, GC8, DC284, Stereo 105, 106, 208. 2/- each (individually boxed).  
ST3/5, ST8/9, 9TA, 9TA/HC, GP91. 8/- Diamond. Post and packing 5d. per item for orders under 24.

## TAPES (Polyester PVC)

|  |                          |                      |
|--|--------------------------|----------------------|
| 4 in. L.P. 8/6                                     | 3 in. L.P. 5/6           |                      |
| Standard Play                                      |                          |                      |
| 600 ft. 5 in. 8/6                                  | 900 ft. 5 1/2 in. 10/6   | 1,200 ft. 7 in. 12/6 |
| Long Play  |                          |                      |
| 900 ft. 5 in. 11/-                                 | 1,200 ft. 5 1/2 in. 13/- | 1,800 ft. 7 in. 18/- |
| Double Play  |                          |                      |
| 1,200 ft. 5 in. 16/-                               | 1,800 ft. 5 1/2 in. 19/- | 2,400 ft. 7 in. 28/- |
| Philips type Cassettes. (In plastic library pack.) |                          |                      |
| C60 10/6   | C90 12/6                 | C120 19/6            |
| Post and packing 1/6d. on all orders.              |                          |                      |

## ACOS CARTRIDGES

|           |  |                  |
|-----------|--|------------------|
| GP91-1    | Medium output Mono Crystal                           | 21/- inc. P. Tax |
| GP91-3sc. | High output Mono Crystal (TC8H, TC8M, BSR, X3H, X3M) |                  |
| GP93-1    | Stereophonic Crystal                                 | 24/9 "           |
| GP94-1    | Stereophonic Ceramic                                 | 31/- "           |
| GP95-1    | Stereophonic Crystal                                 | 24/9 "           |
| GP96/1    | Stereophonic Ceramic                                 | 31/6 "           |

ADD 5d. PER ITEM FOR POST AND PACKING FOR ORDERS UNDER 24 PIECES.

TERMS, CASH WITH ORDER ONLY. POST & PACKING PAYABLE ON ORDERS UP TO £3, AFTER THAT FREE EXCEPT C.R.T.'s.

# VALVES SAME DAY SERVICE

NEW! TESTED! GUARANTEED!

**SETS** 1R5, 185, 1T4, 884, 3V4, DAF91, DF91, DK91, DL92, DL94.  
Set of 4 for 18/6. DAF98, DF96, DK96, DL96, 4 for 27/-.

|          |      |        |      |         |      |        |      |            |       |             |      |
|----------|------|--------|------|---------|------|--------|------|------------|-------|-------------|------|
| 0Z4      | 4/6  | 20P3   | 11/9 | DK96    | 7/8  | EL41   | 11/- | PCL83      | 12/-  | UBF89       | 6/9  |
| 1A7GT    | 7/8  | 20P4   | 18/6 | DL35    | 5/-  | EL84   | 4/6  | PCL84      | 7/6   | UC084       | 7/8  |
| 1E5GT    | 7/8  | 251A6T | 9/-  | DL92    | 5/9  | EL90   | 4/6  | PCL85      | 9/-   | UC085       | 7/8  |
| 1N5GT    | 7/8  | 261A6T | 11/6 | DL94    | 6/8  | EL90   | 12/6 | PCL86      | 9/8   | UC090       | 7/8  |
| 1R5      | 5/9  | 30C1   | 6/6  | DL96    | 7/8  | EM80   | 8/6  | PCL88      | 14/6  | UC092       | 12/6 |
| 185      | 4/8  | 30CL5  | 13/- | DY86    | 5/9  | EM81   | 8/6  | PCL80015/6 | UC081 | 6/8         |      |
| 1T4      | 5/9  | 30C17  | 16/- | DY87    | 5/9  | EM84   | 6/9  | PENAA      | 8/6   | UC182       | 7/8  |
| 884      | 5/9  | 30C18  | 18/6 | RABC080 | 6/6  | EM87   | 7/6  | PFL20011/9 | UC183 | 11/9        |      |
| 3V4      | 9/3  | 30P5   | 19/- | EA42    | 10/- | EY51   | 7/3  | PL36       | 9/9   | UP41        | 10/6 |
| 5Y3GT    | 5/9  | 30FL1  | 12/9 | EB01    | 2/3  | EY56   | 6/6  | PL81       | 9/3   | UF85        | 6/9  |
| 5Z4G     | 7/6  | 30FL12 | 14/6 | EB03    | 3/8  | EZ40   | 8/-  | PL82       | 8/6   | UF89        | 6/9  |
| 6/80L2   | 12/- | 30FL14 | 14/6 | EB04    | 9/6  | EZ41   | 8/-  | PL83       | 6/8   | UL41        | 12/- |
| 6AL5     | 2/8  | 30L1   | 6/6  | EBF80   | 6/9  | EZ80   | 4/6  | PL84       | 6/6   | UL44        | 20/- |
| 6AM5     | 2/9  | 30L15  | 13/- | EBF89   | 6/9  | EZ81   | 4/9  | PL500      | 13/-  | UL84        | 7/-  |
| 6AQ5     | 4/6  | 30L17  | 16/6 | ECC81   | 3/9  | GZ32   | 3/9  | PL504      | 13/6  | UM80        | 5/6  |
| 6AT8     | 4/-  | 30P4   | 12/- | ECC82   | 4/9  | KT41   | 15/6 | PL508      | 23/6  | UM84        | 4/8  |
| 6BA6     | 4/8  | 30P12  | 13/9 | ECC83   | 7/-  | KT61   | 9/9  | PM84       | 7/8   | UY41        | 7/8  |
| 6BA6     | 4/8  | 30P19  | 12/- | ECC85   | 5/-  | KT86   | 10/9 | PX25       | 23/6  | UY85        | 5/9  |
| 6B5      | 4/9  | 30PL1  | 13/9 | ECC804  | 12/- | LN329  | 14/6 | PY32       | 10/-  | VP4B        | 15/6 |
| 6B6      | 5/8  | 30PL13 | 15/6 | ECP80   | 6/8  | N78    | 17/6 | PY33       | 10/-  | W77         | 3/6  |
| 6C5G     | 4/9  | 30PL14 | 14/6 | ECP82   | 6/8  | P1     | 10/- | PY31       | 5/8   | W119        | 7/-  |
| 6F13     | 3/6  | 35L6GT | 4/9  | ECH85   | 6/-  | PABC80 | 7/7  | PY82       | 6/8   | Z77         | 2/9  |
| 6F14     | 9/-  | 35W4   | 4/6  | ECH42   | 13/6 | PC86   | 10/3 | PY83       | 6/9   |             |      |
| 6F33     | 14/8 | 35Z4GT | 5/-  | ECH81   | 5/9  | PC88   | 10/3 | PY88       | 6/9   | Transistors |      |
| 6F35     | 13/- | 37G    | 9/-  | ECH82   | 5/9  | PC96   | 8/6  | FY800      | 7/6   | AC107       | 3/6  |
| 6J5G     | 4/9  | 6063   | 13/6 | ECH84   | 7/6  | PC97   | 8/-  | FY801      | 7/6   | AC387       | 2/6  |
| 6K7G     | 2/6  | AC/VP2 | 15/6 | ECL80   | 7/-  | PC900  | 7/6  | R19        | 9/6   | AD140       | 7/6  |
| 6K8G     | 2/9  | AZ31   | 9/6  | ECL82   | 6/9  | PC920  | 6/6  | R20        | 12/6  | AF115       | 3/6  |
| 6SN7GT   | 4/8  | B349   | 18/- | ECL86   | 8/6  | PC885  | 6/-  | U26        | 13/-  | AF116       | 3/6  |
| 6V6G     | 6/8  | B728   | 12/6 | EF37A   | 6/6  | PC888  | 8/-  | U26        | 12/-  | AF117       | 4/-  |
| 6V9GT    | 6/8  | CEH35  | 13/6 | EF39    | 4/9  | PC899  | 10/6 | U47        | 13/6  | AF125       | 3/6  |
| 6X4      | 4/8  | CL33   | 18/6 | EF41    | 11/9 | PC8189 | 10/6 | U49        | 13/6  | AP37        | 3/6  |
| 6X5GT    | 5/9  | CY31   | 6/9  | EF80    | 4/9  | PC805  | 13/- | U78        | 4/8   | OC26        | 5/8  |
| 10P1     | 14/- | DAC32  | 7/3  | EF85    | 6/8  | PCF80  | 6/6  | U91        | 12/6  | OC44        | 2/6  |
| 10P13    | 7/-  | DAF91  | 4/8  | EF86    | 6/8  | PCF82  | 6/6  | U93        | 8/6   | OC45        | 2/6  |
| 12A7     | 3/9  | DF33   | 7/9  | EF89    | 5/8  | PCF86  | 10/- | U251       | 14/6  | OC71        | 2/6  |
| 12A7     | 3/9  | DF33   | 7/9  | EF91    | 2/9  | PCF800 | 13/6 | U301       | 10/6  | OC72        | 2/6  |
| 12A6U    | 4/9  | DF91   | 2/9  | EF94    | 4/6  | PCF801 | 8/9  | U329       | 14/8  | OC75        | 2/6  |
| 12A7     | 4/9  | DF96   | 7/3  | EF183   | 5/9  | PCF802 | 9/-  | U801       | 10/6  | OC81        | 2/6  |
| 12AX7    | 4/9  | DH77   | 4/6  | EF184   | 6/6  | PCF805 | 13/6 | UABC80     | 6/8   | OC81D       | 2/6  |
| 12X6GT   | 7/8  | DK32   | 7/6  | EH90    | 8/8  | PCF806 | 12/6 | UAF42      | 10/3  | OC82        | 2/6  |
| 19B6G617 | 8/8  | DK91   | 5/9  | EL36    | 9/9  | PCF809 | 14/6 | UBC41      | 9/-   | OC82D       | 2/6  |
| 20P2     | 13/6 | DK92   | 8/6  | EL34    | 9/6  | PCL82  | 7/8  | UBF80      | 9/9   | OC170       | 4/6  |

## READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD, ESSEX. Tel. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

## PADGETTS RADIO STORE

OLD TOWN HALL, LIVERSEDEGE, YORKS

Tel. Heckmondwike 4285

Speakers Removed from TV Sets. All P.M. 3 ohm. 6x4in. 3/- each. 5in. Round 3/- each. 7x4in. 5/- each. Slot Speakers, 8x2 1/2in. 5/- each. Post on any speaker, 4/-.

Reclaimed TV Tubes. With 6 month guarantee. 17in. type AW43/80. AW43/88. 40/-, MW 43/69 30/- each. All Tubes 15/- carriage.

Silicon Rectifiers 500mA 800 P.I.V., 2/6 post paid, 24/- per dozen, post paid.

Jap Earpieces. Magnetic 8ohm. Small and large plug, 1/11 post paid.

G.P. Diodes 3/6 per dozen, post paid.

Top Grade Mylar Tapes, 7in. Standard 11/6, 7in. Long Play 14/-, 5in. Standard 7/9. 5in. Long Play 10/-, post and packing on any tape 2/-.

Amplifier Unit Type A1413. Complete with valves 5Z4, 6V6GT, 230-250 volt, 50 cycles transformer. Clean condition. Untested 25/- Carriage BRS. 15/-.

Amplifier and Diode Bridge Unit, type 17626. Complete with miniature sealed relay and miniature plug and socket. Ex units. Bargain price 7/6, post paid.

Air Mileage Unit complete with 24 volt motor and gears, etc. Clean condition, untested, less Relay 15/- Carriage B.R.S. 12/- Panels of Resistors and condensers, post paid per dozen 8/- Complete untested 17in. TV Sets, 12 channel, 50/-, carriage £1.

VALVE LIST—Ex Equipment, 3 months' guarantee. Single Valves Post 7d., over 3 Valves p & p. paid.

|       |     |       |     |        |     |
|-------|-----|-------|-----|--------|-----|
| AR12  | 1/6 | EF133 | 4/- | EW51   | 5/- |
| EB01  | 9d. | EF134 | 4/- | 6B5    | 1/8 |
| EF85  | 3/- | PCL82 | 4/- | 6B7    | 2/8 |
| EBF80 | 3/- | PCL83 | 5/- | 6K7    | 1/9 |
| EC081 | 3/- | PL36  | 5/- | 6U4    | 5/- |
| EC082 | 3/- | PL38  | 6/- | 6P28   | 5/- |
| EC083 | 4/- | PL51  | 6/- | 10P13  | 2/6 |
| ECL80 | 1/6 | PY33  | 5/- | 183BT  | 3/6 |
| EF50  | 1/- | PY81  | 1/6 | 20D1   | 3/- |
| EF80  | 1/6 | PY82  | 1/6 | 20P1   | 6/- |
| EF91  | 9d. | PZ30  | 5/- | 20P3   | 2/6 |
| EY36  | 5/- | U191  | 5/- | 30P11  | 5/- |
| PC834 | 2/- | U281  | 5/- | 30P12  | 5/- |
| PCF80 | 2/- | U282  | 5/- | 30P5   | 2/8 |
| PCL84 | 4/- | U301  | 5/- | 30FL1  | 5/- |
| PCL85 | 4/- | U329  | 5/- | 6/80L2 | 5/- |

## Learn at home... First Class Radio and TV Courses



After brief, intensely interesting study—undertaken at home in your spare time—YOU can secure a recognised qualification or extend your knowledge of Radio and TV. Let us show you how.

**FREE GUIDE**  
The New Free Guide contains 120 pages of information of the greatest importance to both the amateur and the man employed in the radio industry. Chambers College provides first rate postal courses for Radio Amateurs' Exam., R.T.E.B. Servicing Cert., C. & C. Telecoms., A.M.I.E.R.E. Guide also gives details of range of certificate courses in Radio/TV Servicing. Electronics and other branches of engineering, together with particulars of our remarkable terms of Satisfaction or refund of fee Write now for your copy of this valuable publication. It may well prove to be the turning point in your career.

Founded 1885 - Over 150,000 successes

**CHAMBERS COLLEGE**  
(Incorp. National Inst. of Engineering)  
(Dept. 844V) 148 Holborn, London, E.C.1.

## NEW RANGE U.H.F. - TV - AERIALS

All U.H.F. aerials now fitted with tilting bracket and 4 element grid reflectors.

Loft Mounting Arrays, 7 element, 40/-; 11 element, 47/6; 14 element, 55/-; 18 element, 62/6. Wall Mounting with Cranked Arm, 7 element, 60/-; 11 element, 67/6; 14 element, 75/-; 18 element, 82/6. Mast Mounting with 2in. clamp, 7 element, 42/6; 11 element, 55/-; 14 element, 62/-; 18 element, 70/- Chimney Mounting Arrays, Complete 7 element, 72/6; 11 element, 80/-; 14 element, 87/6; 18 element, 95/- Complete assembly instructions with every unit. Low Loss Cable, 1/6 yd. U.H.F. Pre-amps from 75/-. State clearly channel number required on all orders.

## BBC - ITV AERIALS

BBC (Band 1), Loft 25/-, External S D, 30/- "H", £2.15.0.  
ITV (Band 3), 3 element loft array, 30/-, 5 element, 40/-, 7 element, 50/-, Wall mounting, 3 element, 50/-, 5 element, 55/-, Combined BBC/ITV, Loft 1+3, 40/-; 1+5, 50/-, 1+7, 60/-; Wall mounting 1+3, 60/-; 1+5, 70/-; Chimney 1+3, 70/-; 1+5, 80/-, VHF transistor pre-amps, 75/-

**COMBINED BBC 1-ITV-BBC2 AERIALS** 1+3+9, 70/-, 1+5+9, 80/-, 1+5+14, 90/-, 1+7+14, 100/- Loft mounting only.  
F.M. (Band 2), Loft S D, 17/6. "H", 35/-, 3 element, 57/6. External units available. Co-ax. cable, 8d. yd. Co-ax. plugs, 1/6. Outlet boxes, 5/- Diplexer Crossover Boxes, 17/6. C.W.O. or C.O.D. P. & P. 6/6. Send 6d. stamps for illustrated lists.  
CALLERS WELCOME  
OPEN ALL DAY SATURDAY  
**K.V.A. ELECTRONICS (Dept.P.T.)**  
40-41 Monarch Parade  
London Road, Mitcham, Surrey  
01-648 4884

## DIMMASWITCH



This is a dimmer of standard size in ivory and chrome to replace modern light switches without wiring change—controls 40-600W, 200/250V at 50Hz. of all lights except fluorescents.

Two models are available with on/off switch to control from maximum to zero. DS500/2 at £3.12.6d. with clockwise or reverse dimming, with the switch at full reverse rotation.

DS500/2/P at £3.18s. uses a patented switch giving on/off control at any position of dimming.

Both are available in D.I.Y. kit form at 10/- less. Fuse protection is available at 2/6d. extra.

Please send C.W.O. to:  
**DEXTER & COMPANY**  
ULVER HOUSE, 19 KING STREET,  
CHESTER CHI 2AH  
Tel.: Chester 25883

As supplied to H.M. Government Depts., Hospitals, Local Authorities, etc.

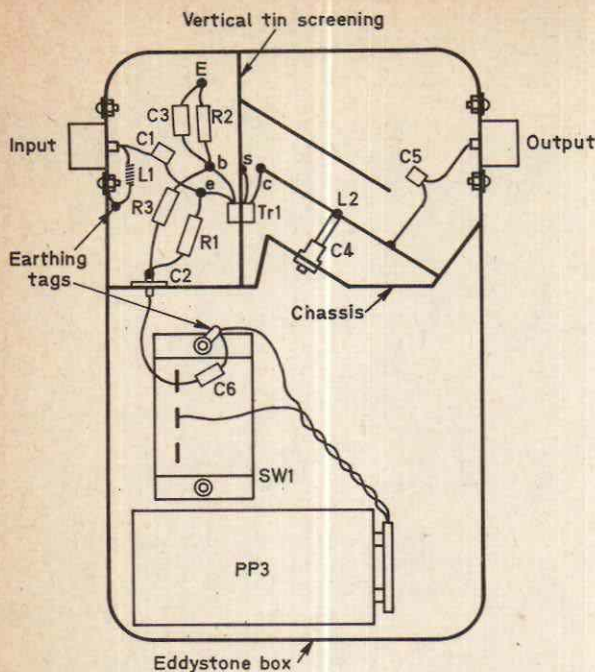


Fig. 3: Physical layout.

## DX-TV

—continued from page 469

and receivers the Audio is not receivable this column can be ignored and the system becomes VFI. An example of the full system would be for a certain date and time TVE E2 3233, meaning moderate snow, poor audio, moderate fading and moderate interference.

(2) R. Bunney's system. (1) No image resolvable. (2) Barely perceivable and unlockable. (3) Heavy noise just lockable. (4) Very noisy, bold details only at 1.0MHz resolution. (5) Noisy but viewable, 1.5MHz resolution. (6) Detail observable at 2.0MHz resolution. (7) Some noise, fair quality at 2.5MHz resolution. (8) Good quality, noise just discernible. (9) Excellent, no noise.

Propagation: Auroral reflection A, SpE E, F2 layer reflection F, meteor-shower reflection M, Tropospheric T. Duration of signal: Long duration L, medium duration M, short durations S, bursts B.

(3) My own system which is as follows:

| Video                | Duration                   |
|----------------------|----------------------------|
| Very weak VW         | Bursts B                   |
| Weak but lockable WL | Short duration plus fading |
| Fair viewable F      | SD (up to 1 minute)        |
| Good G               | Medium plus fading MD      |
| Excellent E          | (up to 5 minutes)          |
|                      | Long duration, no fading   |
|                      | LD                         |

The propagation symbols I use are basically those in (2) above.

In addition to the above many DXers keep a record of the weather at the time of reception—barometric pressure, etc.—and what I think is the most important of all the contents of any programmes received. This often can help when no

fitted on opposite sides of the box. If the Band IV line is made however an alternative physical layout will be required.

Mullard give the following performance figures for the BF180 npn transistor: gain 14dB at 500MHz and 12dB at 900mHz, typical noise figure at 800mHz being 7dB.

## Alignment

The alignment of the unit is extremely simple. Assuming the amplifier is required to cover the l.f. end of Band V, i.e. group B channels, tune the set to a weak signal in midband then tune C4 to give maximum gain. It will be found that the tuning is extremely broad. Check that there is no instability by tuning the receiver over the entire range. Once correctly aligned no instability should occur.

With the amplifier tuned to group B we found it possible here at Romsey, Hants to receive a lockable signal from Sutton Coldfield on ch. 40. Previously only weak line syncs could be observed.

A self-contained battery—type PP3—is used, the circuit taking about 2.5mA. A small piece of plastic foam should be stuck inside the lid of the diecast box to prevent the battery moving about inside.

The channels contained in each aerial group are as follows: group A channels 21-34, group B channels 39-51, group C channels 50-66, group D channels 49-68 and group E channels 39-68.

test card or caption is received: someone else has often had the same programme plus some other means of identification so that one can by comparison arrive at a decision from whence it came.

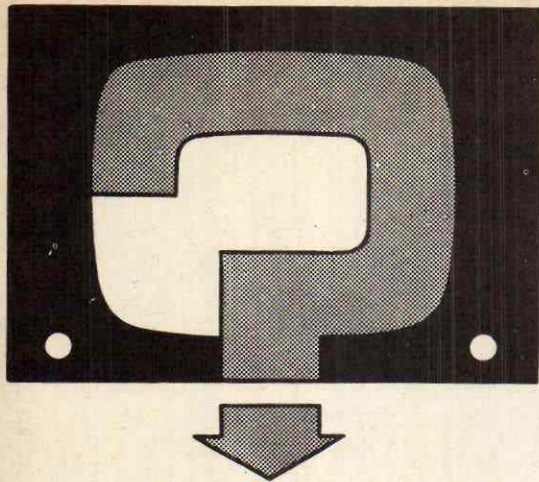
Methods (1) and (2) above give details in a more objective way than "Wow!" or "Pounding in!" entered in the log, but I can see some problems. For example, how does one deal with a typical SpE signal that say over a period of 15 minutes runs through the full range of signal strengths, interference, etc., changing minute by minute. It would seem that we would end up with a somewhat "impersonal" list of numbers which to the layman would be somewhat meaningless. I can scarcely visualise my boasting to a non-DX friend that last evening I had TVE/E2 at 19.35-3233, at 19.37 5445 and 19.40-1011. He is more likely to be impressed and become a DXer himself if I tell him that last night's reception of the bull fight was good at times! Are we trying to make our hobby too complicated?

I do however feel that any attempt to solve this problem is worthwhile and hope that the above will provoke other ideas from readers. We would like to hear from you.

## 625-LINE RECEIVER —continued from page 447

the c.r.t. off the e.h.t. circuit can remain charged for a long period after switching off. The e.h.t. should therefore be discharged before handling this part of the circuit no matter how long the receiver has been switched off.

So we conclude this basic series of articles covering the 625-line single-standard receiver's design and construction. Further articles will appear as soon as possible on a constructor's i.f. strip to suit the receiver.



# YOUR PROBLEMS SOLVED

*Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply service data or provide instructions for modifying equipment. We cannot supply alternative details for constructional articles which appear in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. The coupon from page 475 must be attached to all Queries, and a stamped and addressed envelope must be enclosed*

## **Baird M650**

When the brilliance control is increased the width increases until the picture disappears completely. This happens on 405 and 625 lines. The PL500, PY88 and DY86 have been replaced. The h.t. and boost voltages seem a little low on 405, 185V and 560V respectively.—R. Springle (Hayes).

The trouble appears to be lack of drive to the PL500. Check the ECC82 oscillator valve and the components in the line stabilisation circuit where the resistors tend to go high value. Check all the resistors associated with the v.d.r. and the preset control.

## **Bush TV56**

This set has suddenly developed field slip which cannot be corrected with the hold control. The slip was slow at first but is now very fast. The field timebase valves have been replaced without success.—W. Smith (London, SW6).

There are two main suspects: the 680k $\Omega$  resistor from the slider of the hold control to pin 2 of the PCL83 and the 0.01 $\mu$ F coupler from this pin to pin 6 of the ECC83. Check these.

## **Ekco T221**

There is no picture. The U25 e.h.t. rectifier has been replaced but does not show any sign of life. The c.r.t. is completely dead but the U301 has a sound filament.—D. Healy (Bristol).

Check for line drive at the 20P4 grid (indicated by a heavy negative voltage at this point). If present check the line output stage through, but if absent check around the 20L1 line oscillator stage.

## **Poor Reception**

An Alba Model T766 gives good results on Anglia but rarely good results on BBC-1. The sound is all right but the picture drops or flickers from the left-hand corner—as if the contrast has been turned down. On BBC-1 the contrast has at all times to be fully turned up. Once when the set was giving particularly poor results it was tried on a neighbour's aerial and then gave perfect results on both channels. A Philips Model 1796U gave good pictures on the

same occasion on my aerial on both channels.—G. Andrews (Suffolk).

The fact that the Philips receiver performed well on your aerial is no guarantee that the aerial is not at fault. It has higher gain and more effective a.g.c. than the Alba set. You should therefore check the rods of your aerial, the connector box and the diplexer to which the feeder is connected.

## **GEC BT304**

There is sound but no picture. When the line whistle commences the U191 efficiency diode starts to spark inside. The sparking stops when the top cap is removed. The PL36, U191 and EF80 line oscillator have all been replaced. The line output transformer has been tested: the winding that should be 7.2 $\Omega$  reads 5.2 $\Omega$ .—E. Cottrell (Glos.).

Check what happens when one end of the U47 e.h.t. rectifier is disconnected. If there is no difference replace the high-voltage 100pF ceramic capacitor wired on the line output transformer. This often shorts and overheats. Check the 0.1 $\mu$ F boost capacitor.

## **Bush TV63**

With the help of the fine tuning control channels 4 and 5 and v.h.f. sound on channel 6 can be tuned in, but not channels 7, 8 and 9. However channel 10 can be tuned.—F. S. Malpass (Birmingham).

The first suspect must be the PCF80 frequency changer on the tuner unit. Then check the 47pF and 4.7pF capacitors associated with pins 1 and 9 of the PCF80.

## **Decca DM56**

The picture moves slowly up and down about an inch and simultaneously from side to side. This takes three or four seconds to occur. At the same time straight verticals become S shaped.—W. Watson (Wirral).

You will have to improve the smoothing of the supply to the timebases. Either replace the 100 plus 200 $\mu$ F electrolytic with a 100 plus 400 $\mu$ F one or add extra capacitance to the 200 $\mu$ F section, say another 200 or 300 $\mu$ F.

## Tape Recorder Connection

I have a Ferguson Model 3653 and would like to know if I can connect an Elizabethan tape recorder (Model FT1) to the speaker terminals of the television set for recording, using the radio input on the recorder.—P. Grigsby (Basingstoke).

If you connect the tape recorder input directly across the speaker terminals of the speaker in the set there will be a severe mismatch and you will get a distorted recording. To match correctly and obtain a less distorted input the recorder should be fed from the demodulator output. The best point to take this is from across the sound output valve grid leak resistor, i.e. across R91 (10M $\Omega$ ) from V8 (30PL1) pin 2 to chassis. We must warn you however that although your receiver has a non-reversible mains input lead the chassis may be live which would make the tape recorder live. The only safe way of overcoming this is to feed the mains input to the set via an isolating transformer.

## Ferguson 145T

After switching on the picture rolls diagonally backward and forwards, gradually becoming more upright until it locks after about a minute. The sync is still critical and is often lost on channel changing. Then after about 15-30 minutes the brightness begins to

# TEST CASE



# 92

Each month we provide an interesting case of television servicing to exercise your ingenuity. These are not trick questions but are based on actual practical faults.

? A Philips Model 19TG125 in which the tube had been replaced was brought in by an enthusiast with the complaint of low brightness, the display having an overall grey effect accompanied by a gradual dimming in the middle of the picture with increasing brightness control setting. It would seem that the enthusiast diagnosed the trouble as a worn picture tube but on replacing it found that the trouble was just the same!

The effect was very similar to that present on early models when the ion-trap magnet on the tube neck was incorrectly positioned. However, a check was first made of the h.t. voltage for when this is low the line output stage is under-run with a consequent drop in e.h.t. voltage. Since the picture did not "blow up" as the brightness was increased it was considered that the e.h.t. rectifier was in order and this was not checked. The h.t. was found to be slightly below normal but a replacement rectifier failed to cure this. Neither were the symptoms

fluctuate from normal to a dark 4 to 5in. deep bar across the tube face. During this period the picture quality falls and black streaks appear after white highlights. After an hour or more the brightness corrects itself with an overall improvement in picture quality.—E. Nunn (Coventry).

The flywheel sync unit used in the 145T series was never completely successful. There are two 0.01 $\mu$ F capacitors in the oscillator transformer which give trouble. Replace these and readjust the phasing core if you are sure the EF80 and EB91 valves are OK. The hum bar you describe is likely to be due to a faulty PL83 video amplifier. If this is not so check the choke in the control grid circuit which may have a dry-joint at one end and check the valve base for accidental contact from one of the heater pins or wires to the grid or cathode.

## QUERIES COUPON

This coupon is available until July 17, 1970, and must accompany all Queries sent in accordance with the notice on page 474.

**PRACTICAL TELEVISION, JULY 1970**

cleared by replacing the line output valve and boost diode.

What important first check was overlooked and what would be a possible cause for these symptoms? See next month's PRACTICAL TELEVISION for the solution to this problem and for a further item in the Test Case series.

## SOLUTION TO TEST CASE 91 Page 426 (last month)

A common cause of coupling from the field into the line scan—which was what the trouble eventually proved to be—lies in or around the scanning coils. Sometimes unbalance between the two halves of the field and/or line coils can evoke a ripple along each line of the scan. Such unbalance gives a greater field in one half than in the other and this can encourage mutual coupling. The scanning coils are of course designed for the least mutual coupling, but if they are stressed (during tube replacement for example) or damaged in any way the symptom can to some degree result.

Examination of the coil assembly in the Ferranti Model T1086 revealed in fact that the clamp which holds the ferrite core sections of the yoke together had fractured, causing the yoke pieces to separate. The trouble was completely cured by replacing the assembly. It is sometimes possible to effect a temporary repair by winding the yoke with cord. On no account should wire be used, especially if forming a closed-circuit, since this can extract significant energy from the timebases and thus affect the raster size and linearity.

# WILLOW VALE ELECTRONICS

LIMITED

*The Service Department Wholesalers*

4 THE BROADWAY, HANWELL, LONDON, W.7

Telephones: 01-567 5400 01-567 2971 01-579 3582

## Compare our prices

e.g. NEW 19" C.R.T's . . . OUR PRICE £5-19-0 Plus 10/6 carriage

Normal trade £7-13-4 SAVE £1-3-8 per tube

All 14, 16, 17, 19, 21, 23 and 25 inch C.R.T's in stock at really good discounts to you as the above example shows.

|   |            |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
|---|------------|---|--------|---------------|-------|--------------------------|-------|---|------------|--|--------|---------------------------|--------|---|--------|------------|--------|------------|--------|------------|--------|----------------|--|---------------|--------|----------------|--------|---------------|--------|---------------|--------|------|--------|--------|------|--------|--------|------|--------|--|------|--------|-------|------|--------|-------|---|--------|-------|-------|--------|-------|------|--------|-------|---|-------|-------|-------|-------|-------|-------|--------|--------|---------|--------|----------|-------|----------|--------|----------|-------|----------|-------|-------------|---------|------|-------|---------|------|-------|---------|------|-------|---------|------|-------|---------|------|--------|-------|------|-------|-------|------|-------|--------|------|-------|--------|------|-------|--------|------|-------|---------|------|-------|---------|------|--------|------|-----|----|---|------|-----|
| <p>Please note: Components are sold in packs, quantities per pack are shown under each heading. Prices are per piece of each value.</p>   |            | <p><b>SUB-MINIATURE ELECTROLYTICS (3's)</b></p> <table border="1"> <tr><td>1mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>2mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>4mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>5mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>8mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>10mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>16mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>25mfd</td><td>18v.</td><td>1/8d.</td></tr> <tr><td>32mfd</td><td>18v.</td><td>1/10d.</td></tr> <tr><td>50mfd</td><td>18v.</td><td>1/10d.</td></tr> <tr><td>100mfd</td><td>18v.</td><td>1/10d.</td></tr> <tr><td>200mfd</td><td>18v.</td><td>2/3d.</td></tr> </table> |        | 1mfd          | 18v.  | 1/8d.                    | 2mfd  | 18v.  | 1/8d.      | 4mfd   | 18v.   | 1/8d.                     | 5mfd   | 18v.  | 1/8d.  | 8mfd       | 18v.   | 1/8d.      | 10mfd  | 18v.       | 1/8d.  | 16mfd          | 18v.   | 1/8d.         | 25mfd  | 18v.           | 1/8d.  | 32mfd         | 18v.   | 1/10d.        | 50mfd  | 18v. | 1/10d. | 100mfd | 18v. | 1/10d. | 200mfd | 18v. | 2/3d.  | <p><b>RADIO/TV GLASS FUSES</b></p> <p>1 amp, 1.5 amp, 2 amp, 3 amp. Per dozen 3/0d.</p> <p><b>MAINS FUSES</b></p> <p>2 amp, 3 amp, 5 amp, 13 amp. Per dozen 5/0d.</p> <p><b>TERMINAL STRIPS</b></p> <p>2 amp 2/3d.<br/>5 amp 2/10d.<br/>15 amp 5/9d.</p> |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1mfd  | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2mfd  | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 4mfd  | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 5mfd  | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 8mfd  | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 10mfd   | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 16mfd   | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 25mfd   | 18v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 32mfd   | 18v.       | 1/10d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50mfd   | 18v.       | 1/10d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100mfd  | 18v.       | 1/10d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 200mfd  | 18v.       | 2/3d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>TUBULAR CAPACITORS (3's)</b></p> <table border="1"> <tr><td>.001</td><td>400v.</td><td>9d.</td></tr> <tr><td>.0022</td><td>600v.</td><td>9d.</td></tr> <tr><td>.0033</td><td>600/1500v.</td><td>9d.</td></tr> <tr><td>.0047</td><td>600/1500v.</td><td>9d.</td></tr> <tr><td>.01</td><td>400v.</td><td>10d.</td></tr> <tr><td>.022</td><td>600v.</td><td>11d.</td></tr> <tr><td>.033</td><td>600v.</td><td>11d.</td></tr> <tr><td>.047</td><td>600v.</td><td>11d.</td></tr> <tr><td>.1</td><td>600v.</td><td>1/-d.</td></tr> <tr><td>.22</td><td>600v.</td><td>1/-d.</td></tr> <tr><td>.47</td><td>600v.</td><td>2/10d.</td></tr> <tr><td>.01</td><td>1000v.</td><td>1/1d.</td></tr> <tr><td>.022</td><td>1000v.</td><td>1/1d.</td></tr> <tr><td>.047</td><td>1000v.</td><td>1/8d.</td></tr> <tr><td>.1</td><td>1000v.</td><td>1/8d.</td></tr> <tr><td>.22</td><td>1000v.</td><td>2/8d.</td></tr> <tr><td>.47</td><td>1000v.</td><td>3/8d.</td></tr> <tr><td>.001</td><td>1500v.</td><td>1/6d.</td></tr> </table> |            | .001  | 400v.  | 9d.           | .0022 | 600v.                    | 9d.   | .0033   | 600/1500v. | 9d.  | .0047  | 600/1500v.                | 9d.    | .01   | 400v.  | 10d.       | .022   | 600v.      | 11d.   | .033       | 600v.  | 11d.           | .047   | 600v.         | 11d.   | .1             | 600v.  | 1/-d.         | .22    | 600v.         | 1/-d.  | .47  | 600v.  | 2/10d. | .01  | 1000v. | 1/1d.  | .022 | 1000v. | 1/1d.  | .047 | 1000v. | 1/8d. | .1   | 1000v. | 1/8d. | .22   | 1000v. | 2/8d. | .47   | 1000v. | 3/8d. | .001 | 1500v. | 1/6d. | <p><b>BIAS ELECTROLYTICS (3's)</b></p> <table border="1"> <tr><td>25mfd</td><td>25v.</td><td>1/6d.</td></tr> <tr><td>50mfd</td><td>25v.</td><td>1/8d.</td></tr> <tr><td>100mfd</td><td>25v.</td><td>1/11d.</td></tr> <tr><td>250mfd</td><td>25v.</td><td>3/0d.</td></tr> <tr><td>500mfd</td><td>25v.</td><td>3/8d.</td></tr> <tr><td>1000mfd</td><td>12v.</td><td>6/0d.</td></tr> <tr><td>1000mfd</td><td>25v.</td><td>5/9d.</td></tr> <tr><td>2000mfd</td><td>30v.</td><td>7/0d.</td></tr> <tr><td>2500mfd</td><td>30v.</td><td>9/0d.</td></tr> <tr><td>3000mfd</td><td>30v.</td><td>9/6d.</td></tr> <tr><td>5000mfd</td><td>30v.</td><td>10/0d.</td></tr> <tr><td>25mfd</td><td>50v.</td><td>1/8d.</td></tr> <tr><td>50mfd</td><td>50v.</td><td>2/0d.</td></tr> <tr><td>100mfd</td><td>50v.</td><td>2/6d.</td></tr> <tr><td>250mfd</td><td>50v.</td><td>3/8d.</td></tr> <tr><td>500mfd</td><td>50v.</td><td>4/6d.</td></tr> <tr><td>2000mfd</td><td>50v.</td><td>9/0d.</td></tr> <tr><td>2500mfd</td><td>50v.</td><td>10/6d.</td></tr> </table> |       | 25mfd | 25v.  | 1/6d. | 50mfd | 25v.  | 1/8d.  | 100mfd | 25v.    | 1/11d. | 250mfd   | 25v.  | 3/0d.    | 500mfd | 25v.     | 3/8d. | 1000mfd  | 12v.  | 6/0d.       | 1000mfd | 25v. | 5/9d. | 2000mfd | 30v. | 7/0d. | 2500mfd | 30v. | 9/0d. | 3000mfd | 30v. | 9/6d. | 5000mfd | 30v. | 10/0d. | 25mfd | 50v. | 1/8d. | 50mfd | 50v. | 2/0d. | 100mfd | 50v. | 2/6d. | 250mfd | 50v. | 3/8d. | 500mfd | 50v. | 4/6d. | 2000mfd | 50v. | 9/0d. | 2500mfd | 50v. | 10/6d. |      |     |    |   |      |     |
| .001  | 400v.      | 9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .0022   | 600v.      | 9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .0033   | 600/1500v. | 9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .0047   | 600/1500v. | 9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .01   | 400v.      | 10d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .022  | 600v.      | 11d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .033  | 600v.      | 11d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .047  | 600v.      | 11d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .1  | 600v.      | 1/-d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .22   | 600v.      | 1/-d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .47   | 600v.      | 2/10d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .01   | 1000v.     | 1/1d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .022  | 1000v.     | 1/1d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .047  | 1000v.     | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .1  | 1000v.     | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .22   | 1000v.     | 2/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .47   | 1000v.     | 3/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| .001  | 1500v.     | 1/6d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 25mfd   | 25v.       | 1/6d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50mfd   | 25v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100mfd  | 25v.       | 1/11d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 250mfd  | 25v.       | 3/0d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 500mfd  | 25v.       | 3/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1000mfd   | 12v.       | 6/0d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1000mfd   | 25v.       | 5/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2000mfd   | 30v.       | 7/0d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2500mfd   | 30v.       | 9/0d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 3000mfd   | 30v.       | 9/6d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 5000mfd   | 30v.       | 10/0d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 25mfd   | 50v.       | 1/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50mfd   | 50v.       | 2/0d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100mfd  | 50v.       | 2/6d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 250mfd  | 50v.       | 3/8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 500mfd  | 50v.       | 4/6d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2000mfd   | 50v.       | 9/0d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2500mfd   | 50v.       | 10/6d.  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>WIRE-WOUND RESISTORS (3's)</b></p> <p>10 watt rating, suitable for mains dropper sections.</p> <table border="1"> <tr><td>1</td><td>Ohm</td><td>1/9d.</td></tr> <tr><td>10</td><td>Ohms</td><td>1/9d.</td></tr> <tr><td>13</td><td>"</td><td>1/9d.</td></tr> <tr><td>25</td><td>"</td><td>1/9d.</td></tr> <tr><td>33</td><td>"</td><td>1/9d.</td></tr> <tr><td>50</td><td>"</td><td>1/9d.</td></tr> <tr><td>87</td><td>"</td><td>1/9d.</td></tr> <tr><td>100</td><td>"</td><td>1/9d.</td></tr> <tr><td>150</td><td>"</td><td>1/9d.</td></tr> <tr><td>220</td><td>"</td><td>1/9d.</td></tr> <tr><td>330</td><td>"</td><td>1/9d.</td></tr> <tr><td>1K</td><td>"</td><td>1/9d.</td></tr> <tr><td>2.2K</td><td>"</td><td>1/9d.</td></tr> <tr><td>3.3K</td><td>"</td><td>1/9d.</td></tr> <tr><td>4.7K</td><td>"</td><td>1/9d.</td></tr> </table>   |            | 1   | Ohm    | 1/9d.         | 10    | Ohms                     | 1/9d. | 13  | "          | 1/9d.  | 25     | "                         | 1/9d.  | 33  | "      | 1/9d.      | 50     | "          | 1/9d.  | 87         | "      | 1/9d.          | 100  | "             | 1/9d.  | 150            | "      | 1/9d.         | 220    | "             | 1/9d.  | 330  | "      | 1/9d.  | 1K   | "      | 1/9d.  | 2.2K | "      | 1/9d.  | 3.3K | "      | 1/9d. | 4.7K | "      | 1/9d. | <p><b>SMOOTHING ELECTROLYTICS</b></p> <p>Wire ended, 450v. working.</p> <table border="1"> <tr><td>1mfd</td><td>1/6d.</td></tr> <tr><td>2mfd</td><td>1/6d.</td></tr> <tr><td>4mfd</td><td>2/3d.</td></tr> <tr><td>8mfd</td><td>2/6d.</td></tr> <tr><td>16mfd</td><td>3/0d.</td></tr> <tr><td>32mfd</td><td>4/6d.</td></tr> <tr><td>50mfd</td><td>5/0d.</td></tr> <tr><td>8/8mfd</td><td>4/0d.</td></tr> <tr><td>8/16mfd</td><td>5/0d.</td></tr> <tr><td>16/16mfd</td><td>5/0d.</td></tr> <tr><td>16/32mfd</td><td>5/0d.</td></tr> <tr><td>32/32mfd</td><td>5/0d.</td></tr> <tr><td>50/50mfd</td><td>8/0d.</td></tr> <tr><td>50/50/50mfd</td><td>10/0d.</td></tr> </table> |        | 1mfd  | 1/6d. | 2mfd   | 1/6d. | 4mfd | 2/3d.  | 8mfd  | 2/6d.   | 16mfd | 3/0d. | 32mfd | 4/6d. | 50mfd | 5/0d. | 8/8mfd | 4/0d.  | 8/16mfd | 5/0d.  | 16/16mfd | 5/0d. | 16/32mfd | 5/0d.  | 32/32mfd | 5/0d. | 50/50mfd | 8/0d. | 50/50/50mfd | 10/0d.  |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1   | Ohm        | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 10  | Ohms       | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 13  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 25  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 33  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 87  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100   | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 150   | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 220   | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 330   | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1K  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2.2K  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 3.3K  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 4.7K  | "          | 1/9d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1mfd  | 1/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2mfd  | 1/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 4mfd  | 2/3d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 8mfd  | 2/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 16mfd   | 3/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 32mfd   | 4/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50mfd   | 5/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 8/8mfd  | 4/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 8/16mfd   | 5/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 16/16mfd  | 5/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 16/32mfd  | 5/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 32/32mfd  | 5/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50/50mfd  | 8/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50/50/50mfd   | 10/0d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>PULSE CERAMICS (3's) 12KV</b></p> <table border="1"> <tr><td>100pf</td><td>22pf</td><td>1/1d.</td></tr> <tr><td>120pf</td><td>47pf</td><td>1/1d.</td></tr> <tr><td>180pf</td><td>68pf</td><td>1/1d.</td></tr> <tr><td>250pf</td><td></td><td>1/1d.</td></tr> </table> <p>Tubular type for use in Scan correction circuits and Line Outputs.</p>   |            | 100pf   | 22pf   | 1/1d.         | 120pf | 47pf                     | 1/1d. | 180pf   | 68pf       | 1/1d.  | 250pf  |                           | 1/1d.  | <p><b>CANNED ELECTROLYTICS</b></p> <table border="1"> <tr><td>100/200mfd</td><td>12/6d.</td></tr> <tr><td>100/400mfd</td><td>16/6d.</td></tr> <tr><td>200/200mfd</td><td>16/0d.</td></tr> <tr><td>200/200/100mfd</td><td>18/6d.</td></tr> <tr><td>200/400/32mfd</td><td>18/6d.</td></tr> <tr><td>100/300/100/16</td><td>18/6d.</td></tr> <tr><td>100/400/32mfd</td><td>18/6d.</td></tr> <tr><td>100/400/64/16</td><td>21/0d.</td></tr> </table> |        | 100/200mfd | 12/6d. | 100/400mfd | 16/6d. | 200/200mfd | 16/0d. | 200/200/100mfd | 18/6d.   | 200/400/32mfd | 18/6d. | 100/300/100/16 | 18/6d. | 100/400/32mfd | 18/6d. | 100/400/64/16 | 21/0d. |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100pf   | 22pf       | 1/1d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 120pf   | 47pf       | 1/1d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 180pf   | 68pf       | 1/1d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 250pf   |            | 1/1d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100/200mfd  | 12/6d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100/400mfd  | 16/6d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 200/200mfd  | 16/0d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 200/200/100mfd  | 18/6d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 200/400/32mfd   | 18/6d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100/300/100/16  | 18/6d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100/400/32mfd   | 18/6d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100/400/64/16   | 21/0d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>CERAMICS (6's)</b></p> <table border="1"> <tr><td>500pf</td><td>22pf</td><td>8d.</td></tr> <tr><td>680pf</td><td>47pf</td><td>8d.</td></tr> <tr><td>820pf</td><td>68pf</td><td>8d.</td></tr> <tr><td>1000pf</td><td>100pf</td><td>8d.</td></tr> <tr><td>1500pf</td><td>120pf</td><td>8d.</td></tr> <tr><td>3000pf</td><td>180pf</td><td>8d.</td></tr> <tr><td>5000pf</td><td></td><td>8d.</td></tr> </table>  |            | 500pf   | 22pf   | 8d.           | 680pf | 47pf                     | 8d.   | 820pf   | 68pf       | 8d.  | 1000pf | 100pf                     | 8d.    | 1500pf  | 120pf  | 8d.        | 3000pf | 180pf      | 8d.    | 5000pf     |        | 8d.            | <p><b>SKELETON PRE-SETS (3's)</b></p> <table border="1"> <tr><td>25K</td><td>Vertical</td><td>1/4d.</td></tr> <tr><td>50K</td><td>"</td><td>1/4d.</td></tr> <tr><td>100K</td><td>"</td><td>1/4d.</td></tr> <tr><td>250K</td><td>"</td><td>1/4d.</td></tr> <tr><td>500K</td><td>"</td><td>1/4d.</td></tr> <tr><td>1 meg</td><td>"</td><td>1/4d.</td></tr> <tr><td>2 meg</td><td>"</td><td>1/4d.</td></tr> <tr><td>500K</td><td>Horizontal</td><td>1/4d.</td></tr> <tr><td>680K</td><td>"</td><td>1/4d.</td></tr> <tr><td>1 meg</td><td>"</td><td>1/4d.</td></tr> </table> |               | 25K    | Vertical       | 1/4d.  | 50K           | "      | 1/4d.         | 100K   | "    | 1/4d.  | 250K   | "    | 1/4d.  | 500K   | "    | 1/4d.  | 1 meg  | "    | 1/4d.  | 2 meg | "    | 1/4d.  | 500K  | Horizontal  | 1/4d.  | 680K  | "     | 1/4d.  | 1 meg | "    | 1/4d.  |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 500pf   | 22pf       | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 680pf   | 47pf       | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 820pf   | 68pf       | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1000pf  | 100pf      | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1500pf  | 120pf      | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 3000pf  | 180pf      | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 5000pf  |            | 8d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 25K   | Vertical   | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 50K   | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100K  | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 250K  | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 500K  | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1 meg   | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2 meg   | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 500K  | Horizontal | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 680K  | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1 meg   | "          | 1/4d.   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>RECTIFIERS Silicon Mains (3's)</b></p> <table border="1"> <tr><td>Westinghouse S10AR2</td><td>6/6d.</td></tr> <tr><td>BY127 Mullard</td><td>5/3d.</td></tr> <tr><td>BY105 Mazda</td><td>7/0d.</td></tr> <tr><td>BY327</td><td>5/6d.</td></tr> </table>  |            | Westinghouse S10AR2   | 6/6d.  | BY127 Mullard | 5/3d. | BY105 Mazda              | 7/0d. | BY327   | 5/6d.      | <p><b>CONTACT COOLED FULL WAVE</b></p> <table border="1"> <tr><td>75ma</td><td>12/8d.</td></tr> <tr><td>100ma</td><td>13/8d.</td></tr> <tr><td>150ma</td><td>16/8d.</td></tr> </table> |        | 75ma                      | 12/8d. | 100ma   | 13/8d. | 150ma      | 16/8d. |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Westinghouse S10AR2   | 6/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| BY127 Mullard   | 5/3d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| BY105 Mazda   | 7/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| BY327   | 5/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 75ma  | 12/8d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100ma   | 13/8d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 150ma   | 16/8d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>CO-AXIAL PLUGS</b></p> <table border="1"> <tr><td>Bakelite top</td><td>10d.</td></tr> <tr><td>Egen metal</td><td>1/4d.</td></tr> <tr><td>Single point (car radio)</td><td>2/0d.</td></tr> </table>  |            | Bakelite top  | 10d.   | Egen metal    | 1/4d. | Single point (car radio) | 2/0d. | <p><b>CARBON FILM RESISTORS</b></p> <p>1/2 watt and 1 watt.</p> <p>The following values are packed in cartons of six of each value. Price 2/6d. per carton.</p> <table border="1"> <tr><td>10</td><td>ohm</td><td>1.2K</td><td>150K</td></tr> <tr><td>12</td><td>"</td><td>1.5K</td><td>180K</td></tr> <tr><td>15</td><td>"</td><td>1.8K</td><td>220K</td></tr> <tr><td>18</td><td>"</td><td>2.2K</td><td>270K</td></tr> <tr><td>22</td><td>"</td><td>2.7K</td><td>330K</td></tr> <tr><td>27</td><td>"</td><td>3.3K</td><td>390K</td></tr> <tr><td>33</td><td>"</td><td>3.9K</td><td>430K</td></tr> <tr><td>39</td><td>"</td><td>4.3K</td><td>470K</td></tr> <tr><td>43</td><td>"</td><td>4.7K</td><td>560K</td></tr> <tr><td>47</td><td>"</td><td>5.6K</td><td>680K</td></tr> <tr><td>56</td><td>"</td><td>6.8K</td><td>820K</td></tr> <tr><td>68</td><td>"</td><td>8.2K</td><td>1M</td></tr> <tr><td>82</td><td>"</td><td>10K</td><td>1.2M</td></tr> <tr><td>100</td><td>"</td><td>12K</td><td>1.5M</td></tr> <tr><td>120</td><td>"</td><td>15K</td><td>1.8M</td></tr> <tr><td>150</td><td>"</td><td>18K</td><td>2.2M</td></tr> <tr><td>180</td><td>"</td><td>22K</td><td>2.7M</td></tr> <tr><td>220</td><td>"</td><td>27K</td><td>3.3M</td></tr> <tr><td>270</td><td>"</td><td>33K</td><td>3.9M</td></tr> <tr><td>330</td><td>"</td><td>39K</td><td>4.3M</td></tr> <tr><td>390</td><td>"</td><td>43K</td><td>4.7M</td></tr> <tr><td>430</td><td>"</td><td>47K</td><td>5.6M</td></tr> <tr><td>470</td><td>"</td><td>56K</td><td>6.8M</td></tr> <tr><td>560</td><td>"</td><td>68K</td><td>8.2M</td></tr> <tr><td>680</td><td>"</td><td>82K</td><td>10M</td></tr> <tr><td>820</td><td>"</td><td>100K</td><td>12M</td></tr> <tr><td>1K</td><td>"</td><td>120K</td><td>15M</td></tr> </table> |            | 10   | ohm    | 1.2K                      | 150K   | 12  | "      | 1.5K       | 180K   | 15         | "      | 1.8K       | 220K   | 18             | "  | 2.2K          | 270K   | 22             | "      | 2.7K          | 330K   | 27            | "      | 3.3K | 390K   | 33     | "    | 3.9K   | 430K   | 39   | "      | 4.3K   | 470K | 43     | "     | 4.7K | 560K   | 47    | "   | 5.6K   | 680K  | 56    | "      | 6.8K  | 820K | 68     | "     | 8.2K  | 1M    | 82    | "     | 10K   | 1.2M  | 100   | "      | 12K    | 1.5M    | 120    | "        | 15K   | 1.8M     | 150    | "        | 18K   | 2.2M     | 180   | "           | 22K     | 2.7M | 220   | "       | 27K  | 3.3M  | 270     | "    | 33K   | 3.9M    | 330  | "     | 39K     | 4.3M | 390    | "     | 43K  | 4.7M  | 430   | "    | 47K   | 5.6M   | 470  | "     | 56K    | 6.8M | 560   | "      | 68K  | 8.2M  | 680     | "    | 82K   | 10M     | 820  | "      | 100K | 12M | 1K | " | 120K | 15M |
| Bakelite top  | 10d.       |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Egen metal  | 1/4d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Single point (car radio)  | 2/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 10  | ohm        | 1.2K  | 150K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 12  | "          | 1.5K  | 180K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 15  | "          | 1.8K  | 220K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 18  | "          | 2.2K  | 270K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 22  | "          | 2.7K  | 330K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 27  | "          | 3.3K  | 390K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 33  | "          | 3.9K  | 430K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 39  | "          | 4.3K  | 470K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 43  | "          | 4.7K  | 560K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 47  | "          | 5.6K  | 680K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 56  | "          | 6.8K  | 820K   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 68  | "          | 8.2K  | 1M     |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 82  | "          | 10K   | 1.2M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100   | "          | 12K   | 1.5M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 120   | "          | 15K   | 1.8M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 150   | "          | 18K   | 2.2M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 180   | "          | 22K   | 2.7M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 220   | "          | 27K   | 3.3M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 270   | "          | 33K   | 3.9M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 330   | "          | 39K   | 4.3M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 390   | "          | 43K   | 4.7M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 430   | "          | 47K   | 5.6M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 470   | "          | 56K   | 6.8M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 560   | "          | 68K   | 8.2M   |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 680   | "          | 82K   | 10M    |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 820   | "          | 100K  | 12M    |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1K  | "          | 120K  | 15M    |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>SLIDER PRE-SETS (3's)</b></p> <table border="1"> <tr><td>100K</td><td>1/6d.</td></tr> <tr><td>1 Meg</td><td>1/6d.</td></tr> <tr><td>2.2 Meg</td><td>1/6d.</td></tr> </table>  |            | 100K  | 1/6d.  | 1 Meg         | 1/6d. | 2.2 Meg                  | 1/6d. | <p><b>JACK PLUGS</b></p> <table border="1"> <tr><td>Chrome standard</td><td>4/0d.</td></tr> <tr><td>Standard</td><td>3/0d.</td></tr> <tr><td>3.5mm. metal</td><td>3/0d.</td></tr> </table>  |            | Chrome standard  | 4/0d.  | Standard                  | 3/0d.  | 3.5mm. metal  | 3/0d.  |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 100K  | 1/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 1 Meg   | 1/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 2.2 Meg   | 1/6d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Chrome standard   | 4/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Standard  | 3/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 3.5mm. metal  | 3/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>DIN PLUGS (3's)</b></p> <table border="1"> <tr><td>3-pin</td><td>1/10d.</td></tr> <tr><td>5-pin</td><td>2/2d.</td></tr> <tr><td>Sockets</td><td>1/0d.</td></tr> </table>  |            | 3-pin   | 1/10d. | 5-pin         | 2/2d. | Sockets                  | 1/0d. | <p><b>DOUBLE DIODE RECTIFIERS (3's)</b></p> <table border="1"> <tr><td>Bush/Murphy/BRC etc.</td><td></td></tr> <tr><td>Line/frame timebases etc.</td><td></td></tr> <tr><td>3 leg</td><td>6/3d.</td></tr> <tr><td>4 leg</td><td>6/3d.</td></tr> <tr><td>5 leg</td><td>6/3d.</td></tr> </table>  |            | Bush/Murphy/BRC etc.   |        | Line/frame timebases etc. |        | 3 leg   | 6/3d.  | 4 leg      | 6/3d.  | 5 leg      | 6/3d.  |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 3-pin   | 1/10d.     |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 5-pin   | 2/2d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Sockets   | 1/0d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Bush/Murphy/BRC etc.  |            |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| Line/frame timebases etc.   |            |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 3 leg   | 6/3d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 4 leg   | 6/3d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| 5 leg   | 6/3d.      |   |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |
| <p><b>VOLUME CONTROLS</b></p> <p>Standard spindle with flat. Double pole switch 4/7d. Without switch 3/6d. (One per pack)</p> <p>5K, 10K, 25K, 50K, 100K, 250K, 500K, 1 meg, 2 meg.</p>   |            | <p>*Special for Philips TV's: 8 2M 2-watt, 4/6d. per pack.</p>  |        |               |       |                          |       |   |            |  |        |                           |        |   |        |            |        |            |        |            |        |                |  |               |        |                |        |               |        |               |        |      |        |        |      |        |        |      |        |  |      |        |       |      |        |       |   |        |       |       |        |       |      |        |       |   |       |       |       |       |       |       |        |        |         |        |          |       |          |        |          |       |          |       |             |         |      |       |         |      |       |         |      |       |         |      |       |         |      |        |       |      |       |       |      |       |        |      |       |        |      |       |        |      |       |         |      |       |         |      |        |      |     |    |   |      |     |

**RECORD PLAYER CARTRIDGES**

ACOS; GP67/2g. High gain general purpose Mono  
 GP91/3SC. Stereo-compatible replacement  
 GP91/3SC. High gain version of above  
 GP94/1SS. Stereo cartridge

16/8d.  
 22/0d.  
 22/0d.  
 37/9d.

GENERAL PURPOSE REPLACEMENT FOR TC8 s etc.  
 High gain, plenty of output (Jap.)  
 Stereo version

19/10d.  
 37/9d.

**SERVISOL AND ELECTROLUBE PRODUCTS (Nett trade)**

Servisol aerosol can  
 Electrolube 2AX aerosol  
 Servisol Freezit  
 Electrolube No. 1 Snorkel  
 Electrolube 2GX Grease  
 Servisol Aero-Clene for tape heads  
 Servisol Aero-Duster

12/6d. nett  
 14/0d. nett  
 9/6d. nett  
 18/0d. nett  
 8/4d. nett  
 10/6d. nett  
 10/6d. nett

**REPLACEMENT STYLI**

TC8 4/6d.  
 GC8 4/6d.

**REBUILT AND NEW TUBES—TWO YEARS GUARANTEE**

| RE-BUILT                                  | BRAND NEW                     | A FEW SAMPLE TYPES, REMEMBER WE STOCK EVERY TUBE  |
|---|-------------------------------|---|
| 17" @ £4 14 6                             | £5 10 0                       | CME1702, AW43-80, CRM173, MW43-80, MW43-69*, CRM172*, AW43-88, AW43-89, CME1705, CME1703, C17AF, C17SM etc. |
| 19" @ £4 17 6                             | £5 19 0                       | CME1903, CME1902, CME1901, AW47-90, AW47-91, A47-14W C19AH, C19AF, C19A.                                    |
| 21" @ £7 5 0                              | £8 10 0                       | CME2101, AW53-88, AW53-89, CRM211*, CRM212*, MW53-20*, MW53-80*.  |
| 23" @ £7 5 0                              | £8 19 0                       | CME2303, CME2301, AW59-90, AW59-91.   |
| ALL PRICES ARE NETT.                      |                               | * NEW ONLY. NO REBUILDS   |
| TWIN PANELS 19" CME1906 A47-13W } £10 1 0 | 23" CME2306 A59/13W } £14 1 0 |   |

EVERY TUBE IN STOCK INCLUDING 11", 12", 16" PORTABLES, PANORAMA & RM GUARDS + Philips Tvette and KB Featherlight etc. TERMS: CASH WITH ORDER. CARRIAGE ANYWHERE IN GT. BRITAIN 10/6 per Tube

**HOT-LINE ORDERS**  
**Tel: 01-567 5400/2971**  
 TRADE ONLY

e.g. New VALVES . . . 33½ plus 13% plus quantity discounts 6%

**RADIO AND TELEVISION VALVES SMALL SELECTION**

British made valves normally supplied. EVERY TYPE IN STOCK

|             |              |             |
|-------------|--------------|-------------|
| DY86/7 10/- | EY86/7 10/-  | PCL86 11/4  |
| DY802 9/1   | EZ80 10/10   | PD500 31/7  |
| EABC80 12/8 | EZ81 8/2     | PFL200 15/9 |
| EB91 8/2    | EZ90 9/3     | PL36 16/4   |
| EB90 10/10  | GZ34 13/7    | PL81 13/7   |
| EBF80 10/10 | GY501 15/9   | PL81A 14/6  |
| EBF89 10/10 | PC86 14/6    | PL82 10/10  |
| ECC81 10/0  | PC88 14/6    | PL83 13/8   |
| ECC82 10/0  | PC97 10/10   | PL84 12/8   |
| ECC83 10/0  | PC900 12/8   | PL302 13/7  |
| ECC804 15/4 | PCC84 10/0   | PL504 20/-  |
| ECH81 14/6  | PCC88 16/8   | PL508 20/4  |
| ECH84 12/8  | PCC89 13/7   | PL509 13/7  |
| ECL80 9/6   | PCC189 13/7  | PY33 12/2   |
| ECL82 12/8  | PCC806 15/9  | PY81 10/10  |
| ECL83 13/4  | PCF80 11/4   | PY800 10/10 |
| ECL84 11/4  | PCF86 13/7   | PY801 10/10 |
| ECL86 12/8  | PCF87 18/1   | PY82 8/4    |
| EF80 9/6    | PCF801 13/7  | PY83 13/7   |
| EF85 12/8   | PCF802 13/7  | PY500 20/4  |
| EF86 16/4   | PCF805 14/11 | UABC80 13/7 |
| EF89 10/10  | PCF806 13/7  | UCH81 13/7  |
| EF183 12/8  | PCF808 14/11 | UCL82 12/8  |
| EF184 12/8  | PCL82 11/4   | UCL83 14/6  |
| EH90 13/7   | PCL83 13/4   | UL41 14/6   |
| EL34 10/0   | PCL84 13/7   | UL84 12/8   |
| EY51 13/7   | PCL85 13/7   | UY85 9/0    |

ALL MAZDA/BRIMAR TYPES IN STOCK.

**TRADE & SERVICE ENGINEERS ONLY SUPPLIED**

Cash with order. 10% MAY BE DEDUCTED FROM THE ADVERTISED PRICES EXCEPT FOR NETT ITEMS, C.O.D., OR TUBES

All orders must exceed 50/0d. in value otherwise postage and packing will be charged at 5/0d. per invoice. Components must be ordered in multiples as packed.

SEE WHAT YOU SAVE AT WILLOW VALE, THE SERVICE DEPT. WHOLESALE, 4 THE BROADWAY, HANWELL, LONDON, W.7. 01-567/5400-2971, 01-579 3582.

Send 2/6d in loose stamps for our comprehensive catalogues listing valves, components, tubes, transistors, mikes, aerials, Line output transformers. BY RETURN SERVICE ANYWHERE.

**L.O.P.T.'s**

LINE OUTPUT TRANSFORMERS

ALL MAKES SUPPLIED

**EXCHANGE UNITS AND NEW REPLACEMENTS**

EVERY MAKE SUPPLIED  
 (EXCEPT MURPHY OIL-FILLED)

REWIND SERVICE FOR OBSOLETE MODELS

FRAME OUTPUT, SOUND OUTPUT AND MAINS TRANSFORMERS REWOUND



REMEMBER . . . We are the Service department Wholesalers and supply only the Service Engineers requirements and can therefore carry large stocks, and also we know and understand your problems regarding getting the right spares QUICKLY and the RIGHT PRICE.  
 HOT-LINE Orders: 01/567 5400-2971. 01/579-3582.

# Practical Television Classified Advertisements

## EDUCATIONAL

BECOME "Technically Qualified" in your spare time guaranteed diploma and exam. Home-study courses in radio TV servicing and maintenance. T.T.E.B. City and Guilds, etc., highly informative 120-page Guide—FREE. CHAMBERS COLLEGE (Dept. 858K), 148 Holborn, London, E.C.1.

TV and RADIO, A.M.I.E.R.E., City & Guilds, R.T.E.B., Certs., etc. on "Satisfaction or Refund of Fee" terms. Thousands of passes. For full details of exams and home training courses (including practical equipment) in all branches of Radio, TV, Electronics, etc., write for 132-page Handbook—FREE. Please state subject. BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY (Dept. 172K), Aldermaston Court, Aldermaston, Berks.

## TRAIN FOR SUCCESS WITH ICS

Study at home for a progressive post in Radio, TV and Electronics. Expert tuition for City & Guilds (Telecoms Techn's Cert. and Radio Amateurs') R.T.E.B., etc. Many non-exam courses incl. Closed circuit TV, Numerical control & Computers. Also self-build kit courses—valve and transistor.

Write for FREE prospectus and find out how ICS can help you in your career.

ICS, DEPT. 560, INTERTEXT HOUSE, STEWARTS ROAD, LONDON S.W.8.

## TECHNICAL TRAINING

CITY & GUILDS (electrical, etc.) on "Satisfaction or Refund of Fee" terms. Thousands of passes. For details of modern courses in all branches of electrical engineering, electronics, radio, TV, automation, etc., send for 132-page handbook—FREE. B.I.E.T. (Dept. 173K), Aldermaston Court, Aldermaston, Berks.

## SITUATIONS VACANT

ENGINEERS. A TECHNICAL CERTIFICATE or qualification will bring you security and much better pay. Elem. and adv. private postal courses for C. Eng., A.M.I.E.R.E., A.M.S.E. (Mech. & Elec.), City & Guilds, A.M.I.M.I., A.I.O.B., and G.C.E. Exams. Diploma courses in all branches of Engineering—Mech., Elec., Auto., Electronics, Radio, Computers, Draughts, Buildings, etc. For full details write for FREE 132 page guide: BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY, (Dept. 171K), Aldermaston Court, Aldermaston, Berks.

RADIO AND TV Exams and Courses by Britain's finest home study School. Coaching for Brit.I.R.E., City and Guilds Amateur's Licence, R.T.E.B., P.M.G. Certificate etc. Free brochure from British National Radio School, Russel Street, Reading.

## WANTED

SERVICE SHEETS AND MANUALS PURCHASED. Highest prices paid. Sultan Radio, 29 Church Road, Tunbridge Wells, Kent. Phone: T.W. 22093.

WANTED! New valves especially TV types. Cash waiting. Bearman, 6 Potters Road, New Barnet, Herts. Tel. 449/1934.

RATES: 4/- per line (minimum 3 lines) Box No. 1/- extra. Advertisements must be prepaid and addressed to Advertisement Manager, "Practical Television," I.P.C. Magazines Ltd., Fleetway House, Farringdon Street, London, E.C.4. All cheques, postal orders, etc. to be made payable to Practical Television and crossed "Lloyds Bank Ltd."

## WANTED (continued)

CASH PAID for New Valves. Payment by return. WILLOW VALE ELECTRONICS, 4 The Broadway, Hanwell, London, W.7. 01-567 5400/2971.

SERVICE SHEETS purchased, HAMILTON RADIO 54 London Road, Bexhill.

C.C.T.V. SETS, vidicon transistorised 625 lines interlocked, for reasonable prices. Box 84

NEWNES "Radio & TV Servicing" 1959-65 inclusive. Please state price/condition. A. Lawson, 46 Gerard St., Derby. Tel 48613

CHANNEL SELECTOR KNOB for EKCO 221 or 284. Box 85.

## SERVICE SHEETS

SERVICE SHEETS with Free Fault Finding Chart, 4/6. S.A.E. Lesmar, 15 Conholt Rd., Andover, Hants. (Mail only). No business from June 27th-July 11th.

RADIO, TELEVISION over 3,000 models. JOHN GILBERT TELEVISION, 1b Shepherds Bush Road, London, W.6. SHE 8441.

## TRADER SERVICE SHEETS

5/- each plus postage

We can supply Trader Service Sheets for most makes and types of Radios, Tape Recorders and Televisions—Manuals for some.

Cheques and open P.O.s returned if sheets not available.

## OAKFIELD ENTERPRISES

LIMITED

30 CRAVEN STREET, STRAND  
LONDON WC2

| Make | Model | Radio/TV |
|------|-------|----------|
|      |       |          |
|      |       |          |
|      |       |          |
|      |       |          |

1970 List now available at 2/- plus postage

If list is required indicate with X

From .....

Address .....

enclose remittance of .....

(and a stamped addressed envelope)

s.a.e. with enquiries please

MAIL ORDER ONLY (July PT)

## SERVICE SHEETS (continued)

## LARGE SUPPLIER

OF

## SERVICE SHEETS

(T.V., RADIO, TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOGRAMS, RADIOGRAMS, CAR RADIOS)

FREE. Fault Tracing Guide or TV list on request with order.

5/- each, Manuals from 10/- plus large S.A.E.

(Uncrossed P.O.s please, original returned if service sheets not available.)

## C. CARANNA

71 BEAUFORT PARK  
LONDON, N.W.11

We have the largest supplies of Service Sheets (strictly by return of post). Please state make and model number/alternative.

Mail order only.

SERVICE SHEETS (1925-1970) for Televisions, Radios, Transistors, Tape Recorders, Record Players etc., by return post, with free Fault-finding Guide. Prices from 1/-. Over 8,000 models available. Catalogue 2/6. Please send S.A.E. with all orders/enquiries. Hamilton Radio, 54 London Road, Bexhill, Sussex.

SERVICE SHEETS. Radio, TV etc. 8,000 models. List 2/-. S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

## AERIALS

### BAKER AND BAINES

BBC dipole 30/-, H 42/-, 3 ele 89/-, ITA 3 ele 26/-, 5 ele 34/-, 8 ele 47/5, 11 ele 57/6, ITA doubles 8 ele 112/-, 11 ele 140/-, 13 ele 159/-, Combined BBC/ITA D+5 45/-, D+8 52/-, H+5 69/-, X+5 75/-, Combined Loft Special D+5 with loft pole and fixings 37/-, UHF Aerials BBC-ITA 14 ele 37/-, 18 ele 54/-, 22 ele 63/-, Double 22 ele 142/-, CO-AX low loss at 1/3 and 2/3. Co-Ax plugs 1/4.

Diplexers—Triplexers—Matched UHF/VHF Diplexers. VHF/UHF Pre Amps 75/-, Poles, Lashings, Clamps, Couplers, etc. Postage paid inland on aerials. Extra on accessories.

Please state channels when ordering.  
11 Dale Cres., Tupton, Chesterfield.

## FOR SALE

VALVE CARTONS at keen prices. Send 1/- for sample and list. J. & A. BOX-MAKERS, 75a Godwin Street, Bradford 1.

BUSH TV53 and TV66. Converted ready for DX reception. Offers? Hellier, 326 Finchley Rd., N.W.3.

625/405 VHF/UHF IF Panels. B.R.C. 850 series. Ideal for components, I.F. transformers and switching, P/C Valve bases or repairs to this Thorn receiver. 35/- each plus 4/6 p.p. WILLOW VALE, 4 The Broadway, Hanwell, W.7.



## SETS &amp; COMPONENTS

## AERIAL BOOSTERS 59/- EACH

Three types of high gain transistorized pre-amplifiers to work off FP3 battery or 210-250 D.C.

1. U.H.F. 625 Type L45 this will tune the complete U.H.F. band.
2. V.H.F. 405 Type L12 with separate tuning for band I and III. Please state band I Channel No. required.
3. F.M. V.H.F. Radio Type L11 with bandwidth for the complete band. All pre-amplifiers are complete and ready to use. Size 3½ x 3½ colour Ivory. The 210-240 DC unit is 7/- extra.

## VELCO ELECTRONICS

62 Bridge Street, Ramsbottom, Bury, Lancs. Tel. 3036

## TOP PRICES PAID

for new valves and components

Write:

## KENSINGTON SUPPLIES,

(A), 367 Kensington Street,  
Bradford 8, Yorks.

TELEVISION SALES, 77-79 Victoria Road, Warminster, Wilts., Phone Warminster 8156. Valves, boxed, tested and guaranteed. PCF80, PCC84, PL81, PY81, EY86, EF80, 30F5, EB91, ECC82, PCL83, 30FL1, ECL80, PCL82, PY82, PCL84, 6-30-L2, you select 8 for 20/-, p. & p. 2/- S.A.E., other types, several CRTs cheap, tested, for callers only.

GUARANTEED TUBES AT  
REDUCED PRICES

We are the area stockists for Display Electronics Re-manufactured Tubes. These tubes have a complete new gun assembly, the glass is the only re-conditioned part and that can't wear out. We invite enquiries from the trade or the public.  
Daily 9.30-5.30. Fri. 9.30-8. Closed Wed.  
TELEVISION CITY  
50 Richmond Road, Kingston, Surrey.  
Tel. 01-546 3961 (100 yds. from station).

150 NEW ASSORTED Capacitors, Resistors, Silvered Mica, Ceramic, etc. Carbon, Hystab, Vitreous ½-20 watt, 15/- Post Free. WHITSAM ELECTRICAL, 33 Drayton Green Road, West Ealing, London, W.13.

WITWORTH  
TRANSFORMERS LTD.

Dept. P.T., 26 All Saints Road,  
North Kensington, W.11

Telephone: 01-229 9071. 9 a.m. till 5 p.m.

TELEVISION LINE  
OUTPUT  
TRANSFORMERS

PRACTICALLY ANY MAKE OR MODEL  
SUPPLIED OR REWOUND

EKCO, FERRANTI, DYNATRON  
Replacement cases 16/- each, please state model.

S.A.E. for return of post quotation.  
TERMS: Cash with order or C.O.D., please add 4s. for postage.

C.O.D. orders will be charged 6s.  
Transformers fully guaranteed.

(98)

## VALVE BARGAINS

Any 1-2/-, 5-9/-, 10-14/-, 100-£5.10.0.

EB91, EBF80, EBF89, ECC82, EY86, EF80, EF85, EF183, EF184, PCC84, PCC89, PCF80, PCF86, PCL82, PCL83, PCL84, PL36, PL81, PY32, PY33, PY800, PY801, 30PL1, 30FL1, 30F5, 6F23, 6-30L2, 10F1.

Many other types in stock. BY100 Type Rectifiers 2/6 each

Guaranteed valves 4/- each. Any from the list above (except valves in bold type) selected, tested, boxed and with three month written guarantee. S.a.e. for leaflets.

P. & P. on all goods 1/6.

Money refunded if not satisfied, if returned within 7 days.

## VALVES, VALVES, VALVES

Any ten of your choice 14/6d., post 1/-.  
100 £5 10s. Od., post paid.  
EF85, EF80, EB91, EBF89, ECL80, EF183, EY86, PCF80, PCC84, PL36, PY81, PCL82, PCL83, PCC89, PY33, PY82, PY800, PY801, PY88, PCL84, 30F5, 6BW7, PY801.

BOB'S,

2 St. James Street, Rawtenstall  
Rossendale, Lancs.  
Mail order ONLY.

NEW! Continuous range high-gain pre-Amplifier, 40-900 MHz! Television, Radio, Stereo, all Bands, all Channels, VHF, UHF, Colour! Precision made, built-in power unit, totally enclosed, neat case. Fixed in seconds back of set, no mods, aerial connection only. Superb value at £7.12.6d. post paid to any address in U.K. Send S.A.E. for leaflet: Johnsons (Radio), St. Martins Gate, Worcester, WR1 2DT.

EX N.E.V. C.C.T.V. Camera and Monitor Circuits, S.A.E. for list. LOWE, 29 Vanner Point, Hackney, London, E.9. 5AX

NEW BVA VALVES! Huge range by return postal service well known to the trade. Brief list of television types herewith, full list S.A.E. All types ex stock!

|         |      |          |      |         |      |        |              |
|---------|------|----------|------|---------|------|--------|--------------|
| DY86/7  | 8/-  | PCF86    | 12/3 | PY82    | 7/-  | 20L1   | 19/6         |
| EB91    | 5/-  | PCF801/2 | 12/3 | PY800/1 | 8/3  | 20P4   | 20/-         |
| ECC82   | 8/6  | PCF805   | 13/- | R19     | 13/- | 30C15  | 13/9         |
| ECL80   | 8/-  | PCF808   | 13/6 | U25     | 15/- | 30C17  | 15/9         |
| EF80    | 8/-  | PCL82    | 10/3 | U26     | 15/- | 30F5   | 16/6         |
| EF85    | 8/3  | PCL83    | 12/3 | U37     | 15/- | 30FL1  | 12/9         |
| EF183/4 | 11/3 | PCL84    | 10/3 | U191    | 14/6 | 30L15  | 15/3         |
| EH90    | 10/3 | PCL85    | 10/6 | U193    | 8/3  | 30L17  | 14/6         |
| EY51    | 7/6  | PCL86    | 10/3 | U251    | 17/3 | 30P12  | 15/6         |
| EY86/7  | 7/9  | PL36/8   | 12/9 | U301    | 17/- | 30PL1  | 12/9         |
| PC86/8  | 10/3 | PL81     | 10/3 | U801    | 24/- | 30P4MR | 20/-         |
| PC97    | 8/3  | PL83     | 10/3 | 6/30L2  | 15/6 | 30P19  | 12/9         |
| PC900   | 10/3 | PL84     | 8/3  | 6AT6    | 9/9  | 30PL13 | 18/6         |
| PCC84   | 9/3  | PL500    | 16/6 | 6BW7    | 13/9 | 30PL14 | 18/6         |
| PCC89   | 12/3 | PL504    | 17/- | 6CD6G   | 28/- |        |              |
| PCF80   | 10/3 | PY81     | 8/3  | 6F23    | 15/6 | etc.   | Trade prices |

POST FREE OVER £3—LATEST ENCAPSULATED BY 100 & 33 ohm res, 4/-!

Note. Ask for separate components lists.

LOOK! Nearly every type in stock now!!

## NEW TELEVISION TUBES!

TWO YEAR FULL REPLACEMENT GUARANTEE

SEE THE DIFFERENCE A NEW TUBE CAN MAKE TO YOUR VIEWING—  
LATEST SCREENING TECHNIQUES INCLUDING TINTED SCREENS ON  
MOST 19" & 23" TYPES

Large stocks by Cathodeon & other leading manufacturers so why buy ordinary rebuilds? Colour 25" £60!

Special offer! 19" rebuilds, 2 year guarantee £5 10s. 1 23" £7 10 0.

12" £3 0 0 (not 110°) 20" Mullard. 14" to 16" (not 110°) £4 15 0

17" £5 17 6 A50/120W £10 17 0 19" 1901 & 19AH £7 10 0

Other 19" mono tubes—all £6 17 6. Carriage all 12/-. All 21" mono tubes—£7 17 6, 23" mono tubes £9 10 0. Carriage 15/-

RIMBANDS, 19" £8 10 0; 23" £11 10 0

TWIN PANELS, 19" £9 17 6; 23" £14 0 0

Carriage  
20/-

Bulk enquiries welcomed, special terms.

PAY BY GIRO. Our No. 34.361.4006.

## PHILIP H. BEARMAN

(Suppliers to H.M. Govt. etc.)

6 POTTERS ROAD, NEW BARNET, HERTS.

Closed Thurs & Sat afternoons TEL. 449/1934 (Robophone) & 7873

## TELEVISION TUBE SHOP

BRAND NEW TUBES AT  
REDUCED PRICES

|                 |          |
|-----------------|----------|
| A28-14W         | £11. 0.0 |
| A31-18W         | £12.10.0 |
| A47-11W         | £9.19.6  |
| A47-13W         | £11.15.0 |
| A47-14W         | £7.12.6  |
| A47-26W         | £10.15.0 |
| A50-120WR       | £12.10.0 |
| A59-11W         | £12.19.6 |
| A59-13W         | £15.10.0 |
| A59-15W         | £9.19.6  |
| A59-16W         | £14.15.0 |
| A59-23W         | £14.15.0 |
| AW21-11         | £10.10.0 |
| AW36-20, 21     | £5.12.6  |
| AW36-80         | £5. 7.6  |
| AW43-80         | £6.17.6  |
| AW43-88, 43-89  | £6.12.6  |
| AW47-90, 91     | £7.10.0  |
| AW53-80         | £8.17.6  |
| AW53-88, 53-89  | £8. 5.0  |
| AW59-90, 59-91  | £9.10.0  |
| C17LM, PM, SM   | £6.12.6  |
| CME1201         | £12.10.0 |
| CME1101         | £11.19.6 |
| CME1601         | £10. 5.0 |
| CME1602         | £12. 0.0 |
| CME1702, 1703   | £6.12.6  |
| CME1705         | £7.12.6  |
| CME1901, 1903   | £7.10.0  |
| CME2013         | £12.10.0 |
| CME2101, 2104   | £8. 5.0  |
| CME2301, 2302   | £8.15.0  |
| CME2306         | £15.10.0 |
| CRM93           | £5.10.0  |
| CRM124          | £5.10.0  |
| CRM141, 2, 3, 4 | £5.12.6  |
| CRM171, 2, 3    | £6. 7.6  |
| CRM211, 212     | £8.17.6  |
| MW36-24, 44     | £5. 2.6  |
| MW43-64, 69     | £6. 7.6  |
| MW43-80         | £6.17.6  |
| MW53-20         | £8.17.6  |
| MW53-80         | £8.17.6  |
| 7405A           | £6.12.6  |
| TSD217, 282     | £14. 0.0 |

All tubes tested before despatch and guaranteed for 12 months.

Fully rebuilt tubes available—prices on request.

CARRIAGE 10/-, via B.R.S. or 15/- via Passenger train. Add 2/6 for Comprehensive insurance.

## COLOUR TUBES

(Carriage & Insurance 40/-)

|          |          |
|----------|----------|
| A49-11X  | £66. 0.0 |
| A56-120X | £72. 0.0 |
| A63-11X  | £77. 0.0 |

## TELEVISION TUBE SHOP

48 BATTERSEA BRIDGE ROAD  
LONDON, S.W.11. BAT 6859

WE GIVE GREEN SHIELD  
STAMPS

LIFT  
1,000lbs!  
WITH EASE!

The light way to tackle heavy jobs! a rustproof pulley hoist with super-tough alloy wheels and mild steel construction. Weighs only 1 lb!

In blue, brown, or grey. Complete with 80 ft. nylon cord (10' lift). Ideal for motorists. (Lifts engines) — D.I.Y. enthusiasts caravanning, houseowners, etc. Virtually indestructible in normal use!

IMMEDIATE DELIVERY. only

49/6 + p&p  
4/6

Money ref. 30ac  
Or 57/6 +4/6 + p  
for deluxe model lifts 2,500 lbs.

Enclose cutting of ad. with completed coupon and remittance to: SELECT SUPPLIES, Dept (PTV) 5 Blythe Hill Lane, Catford, London, S.E.6

Name: \_\_\_\_\_  
Address: \_\_\_\_\_  
De-luxe model: \_\_\_\_\_ (tick) Colour: \_\_\_\_\_

## GRAINGER &amp; YOUNG

TV Services & Electronics

Very High Grade Replacement  
Tubes—2 Years Guarantee.

|     |      | £  | s    | d |
|-----|------|----|------|---|
| 16" | 110° | 5- | 0-0  |   |
| 17" | 110° | 4- | 15-0 |   |
| 19" | 110° | 4- | 17-0 |   |
| 21" | 110° | 6- | 5-0  |   |
| 23" | 110° | 6- | 10-0 |   |

Please state Tube Type

Terms—Cash with order

Carriage anywhere in Great Britain  
10/- per Tube.

Phone enquiries: Middlesbrough  
43859

42 Borough Rd.,  
Middlesbrough, Teesside.

## R &amp; R RADIO

51 Burnley Road, Rawtenstall

Rossendale, Lancs.

Tel.: Rossendale 3152

VALVES BOXED, TESTED &  
GUARANTEED

|       |     |       |     |       |     |
|-------|-----|-------|-----|-------|-----|
| EF80  | 3/- | PCC84 | 3/- | PY81  | 3/6 |
| EBF89 | 3/6 | PCF80 | 3/- | PY82  | 3/- |
| ECC82 | 3/- | PCF82 | 3/6 | U191  | 4/6 |
| ECL80 | 3/- | PCL82 | 4/- | 30F5  | 2/6 |
| EF80  | 3/6 | PCL83 | 4/- | 30L15 | 5/- |
| EF85  | 3/- | PL36  | 5/- | 30P12 | 4/6 |
| EY85  | 4/- | PL81  | 4/- | 30C15 | 5/- |
| EZ40  | 4/6 | PL83  | 4/- |       |     |
| EBC41 | 4/6 | PY33  | 5/- |       |     |

POST: ONE VALVE 9d. TWO TO SIX 6d.  
OVER SIX POST PAID.

## TOWERBY LTD

For Line Outputs and Deflector Coils

We have the Country's largest stock of Manufacturer's Original (or Authorised Replacement) Line Output Transformers for many "difficult" makes, including Ambassador, Baird, Cossor, Decca, Dynatron, Ekco, Ferguson, G.E.C., H.M.V., K.B., Masteradio, Peto-Scott, Philips, Regentone, RGD, Sobell, Ultra, etc. Also deflector coils output and oscillator transformers, inc. Alba, Bush, Murphy, Examples, L.O.P.T. Murphy 350/410/540/659/759, 147/-; Bush TV80, TV95, TV96, 147/-; Cossor 950, 77/6; Ferguson 306/308, 79/6; Philips 1768U L.O.P.T. assembly, 135/-; Ultra 1984-200c, 101/3.

Rewind most L.O.P.T., 90/-.

## SPECIAL OFFER

Ekco improved type for Models T221, 231, 310, all at 45/-; Ferranti 1474 series inserts, 25/-; Philco 1019/1021, 52/6. Terms: C.W.O. or C.O.D. (3/6) post/packing 6/-; 2 or more L.O.P.T.s post/packing free.

All enquiries answered but regret no lists available. Same day delivery on most types.

## TOWERBY LTD

MAIL ORDER DIVISION OF T.C.S. LTD.  
70 STREATHAM HILL, LONDON, SW2.  
Tel: 01-674 2185.

BARGAINS any 1-2/-, 5-9/-, 10-18/-, 50-52/6, boxed, tested, your choice, ARP12, ECC82, ECL80, EF80/5, EF50, EB91, EF912/6, ECL32, EL95, PCC84, PCF80, PCL82/3/4, PL81/3/4, UL44, U35, U281, PY81/2, T41, 6F1/13, 6SN7, 6J5, 6K7/8, 6V6, 6Q7, 6BE6, 6SP28, p.p. up to ten 1/-, also L.O.P.T., F./O.P.T., SCAN COILS, TUNER UNITS, and many others, new and obsolete components at lower prices and guaranteed, S.A.E. for lists. J. S. Sondhis, 94A, Netherwood Road, London, W.14. (Mail orders.)

## NEW VALVES

Guaranteed and Tested  
24 HOUR SERVICE

|        |      |        |      |        |      |
|--------|------|--------|------|--------|------|
| 1B5    | 5/6  | EBC33  | 7/9  | PCL82  | 6/9  |
| 1B5    | 4/8  | EBG41  | 9/3  | PCL83  | 11/9 |
| 1T4    | 2/9  | EBF80  | 6/8  | PCL84  | 7/-  |
| 3B4    | 5/9  | ECC81  | 3/6  | PCL85  | 8/8  |
| 3V4    | 5/9  | ECC82  | 4/-  | PCL86  | 8/-  |
| 6/30L2 | 11/6 | ECC83  | 4/9  | PF200  | 11/6 |
| 6AQ5   | 4/8  | ECC85  | 5/-  | PL86   | 9/2  |
| 6AT6   | 3/10 | ECH85  | 5/6  | PL81   | 8/-  |
| 6SN7GT | 4/-  | ECH81  | 5/9  | PL82   | 5/9  |
| 2SL6GT | 4/6  | ECL80  | 6/8  | PL83   | 8/8  |
| 30C15  | 12/9 | ECL82  | 6/8  | PL84   | 6/-  |
| 30FL1  | 12/6 | ECL86  | 7/6  | PL500  | 12/9 |
| 30FL12 | 14/8 | EF37A  | 6/-  | PL504  | 12/8 |
| 30P4   | 11/9 | EF39   | 4/8  | PY32   | 10/- |
| 30L15  | 12/9 | EF80   | 4/8  | PY33   | 10/- |
| 30P19  | 11/9 | EF85   | 5/9  | PY81   | 5/-  |
| 30PL1  | 12/6 | EF86   | 6/8  | PY82   | 5/-  |
| 30PL13 | 15/- | EF89   | 4/9  | PY83   | 6/6  |
| 30PL14 | 14/- | EF83   | 5/6  | PY88   | 6/6  |
| CL35   | 13/- | BF184  | 6/-  | PY800  | 7/-  |
| CL33   | 17/6 | EB90   | 6/-  | PY801  | 6/9  |
| DAC32  | 6/9  | EL33   | 9/3  | R19    | 8/8  |
| DAF81  | 4/3  | EL44   | 4/9  | U26    | 12/9 |
| DAF86  | 6/9  | EY51   | 7/-  | U36    | 11/6 |
| DF33   | 7/6  | EY85   | 6/8  | U191   | 18/- |
| DF91   | 2/9  | EZ80   | 4/8  | U251   | 14/- |
| DF96   | 6/9  | EZ81   | 4/6  | U329   | 14/- |
| DR77   | 3/10 | KT61   | 9/3  | UABC80 | 6/-  |
| DK32   | 6/9  | KT66   | 18/6 | UBC41  | 8/8  |
| DK91   | 5/9  | NT3    | 17/- | UBF89  | 8/8  |
| DK92   | 9/8  | PC88   | 10/8 | UCB85  | 7/8  |
| DK96   | 7/8  | PC97   | 7/9  | UCH81  | 6/6  |
| DL35   | 4/9  | PC900  | 7/-  | UCL82  | 6/9  |
| DL92   | 5/9  | PC984  | 6/8  | UF41   | 10/8 |
| DL94   | 5/9  | PC989  | 8/11 | UF89   | 6/-  |
| DL96   | 5/9  | PCF80  | 5/11 | UL41   | 11/9 |
| EY85   | 5/3  | PCF801 | 6/6  | UL84   | 6/8  |
| EY87   | 5/3  | PCF802 | 8/9  | UY41   | 7/-  |
| EABC80 | 5/9  | PCF805 | 12/9 | UY85   | 5/8  |

Postage on 1 valve 9d. extra. On 2 valves or more postage 6d. per valve extra. Any parcel insured against damage in transit 6d. extra.

Office address, no callers.

## GERALD BERNARD

83 OSBALDESTON ROAD  
STOKE NEWINGTON  
LONDON, N.16

# LAWSON BRAND NEW TELEVISION TUBES



**SPECIFICATION:** The Lawson range of new television tubes are designed to give superb performance, coupled with maximum reliability and very long life. All tubes are the products of Britain's major C.R.T. manufacturers, and each tube is an exact replacement. Tubes are produced to the original specifications but incorporate the very latest design improvements such as: High Brightness Maximum Contrast Silver Activated Screens, Micro-Fine Aluminising, Precision Aligned Gun Jigging, together with Ultra Hard R.F. High Vacuum Techniques.

## DIRECT REPLACEMENTS FOR MULLARD-MAZDA BRIMAR GEC, ETC.

|             |          |              |             |         |
|-------------|----------|--------------|-------------|---------|
| A47-11W (P) | MW53/20  | T914         | CME1901     | 21C2P4  |
| A47-13W (T) | MW53/80  | C19/10A      | CME1902     | 21DKP4  |
| A47-14W     | AW-47-97 | C19/10AP (T) | CME1903     | 23SP4   |
| A47-17W (P) | AW-53-80 | C19/AK       | CME1905     | 171K    |
| A47-18W (P) | AW53-88  | C21/1A       | CME1906 (T) | 172K    |
| A59-11W (P) | AW53-89  | C21/7A       | CME1908     | 173K    |
| A59-12W (P) | AW59-90  | C21/AA       | CME2101     | 212K    |
| A59-13W (T) | AW59-91  | C21/AF       | CME2104     | 7205A   |
| A59-14W (T) | C17/1A   | C21/KM       | CME2301     | 7405A   |
| A59-15W     | C17/4A   | C21/SM       | CME2302     | 7406A   |
| A59-16W (T) | C17/5A   | C21/TM       | CME2303     | 7502A   |
| AW36-80     | C17/7A   | C23/7A       | CME2305 (P) | 7503A   |
| AW43/80     | C17/AA   | C23/10A      | CME2306 (T) | 7504A   |
| AW43-88     | C17/AF   | C23/AK       | CME2308     | 7601A   |
| AW43-89     | C17/FM   | C23/AKT (T)  | CRM173      | 7701A   |
| AW47-90     | C17/HM   | CME1402      | CRM212      | CRM121  |
| AW47-91     | C17/SM   | CME1702      | CRM211      | MW31-74 |
| MW43-69     | MW/53-80 | CME1703      | 17ARP4      |         |
| MW43-64     | T908     | CME1705      | 17ASP4      |         |
| MW43-80     | T911     | CME1706      | 17AYP4      |         |

## FOR YOUR INFORMATION

Experience of supplying CRTs over many years has shown us that when a customer requires a new CRT he means **Immediately**. We at Lawson's are geared to give a by-return service. Tubes are sent fully insured by passenger train. Goods or Road Services are not used, delivery taking far too long for customer satisfaction.

|                    | Carr.    | Insur. |
|--------------------|----------|--------|
| 12-14" Types       | £4.10.0  | 10/-   |
| 16-17" "           | £5.19.0  | 12/6   |
| 19" "              | £6.19.0  | 12/6   |
| 21" "              | £7.19.0  | 12/6   |
| 19" Panorama (P)   | £8.10.0  | 12/6   |
| 23" Mono           | £9.10.0  | 15/-   |
| 23" Panorama (P)   | £11.10.0 | 15/-   |
| 19" Twin panel (T) | £9.17.6  | 15/-   |
| 23" Twin panel (T) | £13.10.0 | 15/-   |
| 20" A50/120W/R     | £10.15.0 | 15/-   |

## LAWSON TUBES STATION ESTATE, MALVERN

Offices  
18 CHURCHDOWN ROAD,  
MALVERN, WORCS. MALVERN 2100

## 2 YEARS' FULL REPLACEMENT GUARANTEE

Complete tube fitting instructions are supplied with each tube.

## A NEW "KING TELEBOOSTER"



### THE M4 DUAL BAND V.H.F. UNIT KING . . .

the name you  
can depend on.

- \* Boosts all Band III and any specified Band I Channel simultaneously.
- \* Still higher gain . . . nominally 17-18 d.B. both Bands.
- \* Very low noise third generation passivated transistor.
- \* Fitted fly lead . . . installed in seconds.
- \* Quality Case 3½" x 3½" x 1½" Cork base.

Specify Band I channel when ordering.  
**THE NEW UM4 UHF "COLOURBOOSTER"**  
Channels:-Group "A" Red Spot. "B" Yellow Spot, "C" Green Spot. Prices: Both types:-£75/- Battery Model OR £51.7.6 Self Contained Mains Model.  
P/P 2/6d.

**TRANSISTOR DEVICES LIMITED**  
Bridge House, NEWTON ABBOT, Devon.

Literature on request.

## UHF, COLOUR AND TELEVISION SPARES

COLOUR Leading Brit. makers surplus time base units incl. frame o/p, line o/p and HLT transist. £5.0.0, p.p. 10/-. Scan coils £3.10, p.p. 6/-.  
UHF/625 conversion kits and tuners at reduced prices. Lists available.  
UHF integrated transistad. 6 position push button tuners, leading Brit. maker surplus, £4.10.0, p.p. 4/8.  
MURPHY 600/700 series UHF conversion kits in cabinet plinthassy, can be used as separate UHF receiver £7.10.0, p.p. 10/-. 625 IF amplifier incl. 5 valves and circuit 58/6, p.p. 6/-.  
SOBELL/GEC dual 405/625 IF amp, and o/p chassis incl. circuit 22/6 ULTRA 1990C to 2384 625 IF amp, chassis and switch incl. circuits 30/-, p.p. 4/8.  
UHF TUNERS transistad. incl. s/w drive £5.5.0, valve type 58/6, p.p. 4/8.  
TV SIGNAL BOOSTER UNITS Sens. gain all stations. P.YE/LABGEAR trans'd. BBU/ITA or UHF Battery "plug in", 75/- UHF Masthead £5.5.0.  
FIREBALL TUNERS. Ferrg., HMV, Marconi new 37/8, other types salvaged 18/8, p.p. 4/8. PUSH BUTTON. Plessey, Ekco incl. valves 58/6, p.p. 4/8.  
TURRET TUNERS PETO SCOTT 960, COSGRO 1064, DECCA DR 95, 101/800 3/86 CYLON C 20/- EKCO 288/330 25/- AB dual standard suitable Ferguson, K.B. Baird etc. 25/- P.YE CEM 17 25/-, p.p. 4/8. Large selection ch. coils.  
LINE OUTPUT TRANSFS. Popular types available, brand new replacements fully guar. A selection which can be supplied, p.p. 4/8, C.O.D. 3/6.  
PHILIPS 17TG100 range, STELLA 1011/1029 70/-  
BUSH TV33 to 89 32/8, 91 to 135 . . . 90/-  
EKCO 221 to 331 (U25 or U26 types) . . . 42/8  
FERRANTI 1001 to 1019 (U25 or U26 types) . . . 42/8  
EKCO 342 to 394, FERRANTI 1021 to 1065 . . . 75/-  
EKCO/FERRANTI 418, 1093, etc. . . . 62/8  
DECCA DML7, 3, 4 (70%) DR95, 101/696 . . . 78/6  
FERG 305 to 436, 45/8; 505 to 727 . . . 55/-  
FERG HMV MARCONI ULTRA PHILCO  
3600, 2900, 4500, 8500, 1000 ranges, Jellypot  
KE QVP20, QV20/1 to 8V20 . . . 75/-  
KE PVP 20 84/-, VCI to VCI1 . . . 78/-  
MARCONI VT157 to 172 . . . 55/-  
GEC 302 to 348, 45/-; 445, 2000 series . . . 88/8  
HMV 1365/9, 1870, 42/8; 1990 to 1924 . . . 55/-  
P.YE VT17, CS, CEM, CWT17, 17/21, 17/8,  
110 to 510, 700, 830, 11U to 40F . . . 62/8  
PAM INVICTA equiv. LOPTS to above P.YE  
PETO SCOTT 1419 to 1725, 35/-; 733 to 738  
SOBELL/MCMICH TFS173, 190, T23, 24, 178  
273, 3024, 370, MP17, 18, MP3, 74 . . . 45/-  
TFS781, P279, 8334, 370, MP27, M75, 75, 93  
195, 232, 1000, 782, 3000 series . . . 88/8  
PHILCO 1019 to 1021, 45/-; 1029 to 1090 . . . 55/-  
ULTRA 1770 to 2384, PILOT PT450 to 630  
72/8  
SCAN COILS, Frame O/P, mains droppers, etc  
C.O.D. despatch available.

## MANOR SUPPLIES

172 WEST END LANE, LONDON, N.W.6.

(Near W. Hampstead tube stn; 28, 59, 159 Bus Routes) 01-794 8751

MAIL ORDER: 64 GOLDERS MANOR DRIVE, LONDON, N.W.11

# VALUABLE NEW HANDBOOK FREE TO AMBITIOUS ENGINEERS

Have you had your copy of "Engineering Opportunities"?

The new edition of "ENGINEERING OPPORTUNITIES" is now available—without charge—to all who are anxious for a worthwhile post in Engineering. Frank, informative and completely up to date, the new "ENGINEERING OPPORTUNITIES" should be in the hands of every person engaged in any branch of the Engineering industry, irrespective of age, experience or training.

## On 'SATISFACTION or REFUND of FEE' terms

This remarkable book gives details of examinations and courses in every branch of Engineering, Building, etc., outlines the openings available and describes our Special Appointments Department.

## WHICH OF THESE IS YOUR PET SUBJECT ?

**TELEVISION ENG.**  
Advanced Television Eng.—  
Gen. Television Eng.—Tele-  
vision Servicing and Main-  
tenance.

**ELECTRONIC ENG.**  
Advanced Electronic Eng.  
Gen. Electronic Eng.—  
Applied Electronics—  
Practical Electronics—  
Radar Tech.—Frequency  
Modulation—Transistors.

**MECHANICAL ENG.**  
Advanced Mechanical Eng.  
Gen. Mechanical Eng.—  
Maintenance Eng.—Diesel  
Eng.—Press Tool Design—  
Sheet Metal Work—  
Welding—Eng. Pattern  
Making—Inspection—  
Draftsmanship—  
Metallurgy—  
Production Eng.

WE HAVE A WIDE RANGE OF COURSES IN OTHER SUBJECTS INCLUDING CHEMICAL ENG., AERO ENG., MANAGEMENT, INSTRUMENT TECHNOLOGY, WORKS STUDY, MATHEMATICS, ETC.

Which qualification would increase your earning power?  
B.Sc. (Eng.), A.M.S.E., C.Eng., A.M.I.E.R.E., R.T.E.B., A.M.I.P.E.,  
A.M.I.M.I., A.M.I.E.D., A.R.I.B.A., A.I.O.B., P.M.G., A.R.I.C.S., M.R.S.H.,  
A.M.I.Mun.E., CITY & GUILDS, GEN. CERT. OF EDUCATION, ETC.

**British Institute of Engineering Technology**

445A ALDERMASTON COURT, ALDERMASTON, BERKSHIRE

## THIS BOOK TELLS YOU

- ★ HOW to get a better paid, more interesting job.
- ★ HOW to qualify for rapid promotion.
- ★ HOW to put some letters after your name and become a key man . . . quickly and easily.
- ★ HOW to benefit from our free Advisory and Appointment Dept.
- ★ HOW you can take advantage of the chances you are now missing.
- ★ HOW, irrespective of your age, education or experience, YOU can succeed in any branch of Engineering.

164 PAGES OF EXPERT  
CAREER-GUIDANCE

### PRACTICAL EQUIPMENT

Basic Practical and Theoretic Course for beginners in TV, Radio, Electronics etc. A.M.I.E.R.E. City & Guilds Radio Amateurs' Exam. R.T.E.B. Certificate P.M.G. Certificate Practical Radio Television & Radio Servicing Practical Electronics Electronics Engineering Automation

### INCLUDING TOOLS

The specialist Electronics Division of B.I.E.T. NOW offers you a real laboratory training at home with practical equipment. Ask for details.

**B.I.E.T.**

You are bound to benefit from reading "ENGINEERING OPPORTUNITIES", and you should send for your copy now—FREE and without obligation.



## POST COUPON

TO B.I.E.T., 445A ALDERMASTON COURT,  
ALDERMASTON, BERKSHIRE

Please send me a FREE copy of "ENGINEERING OPPORTUNITIES." I am interested in (state subject, exam., or career).

NAME .....

ADDRESS .....

WRITE IF YOU PREFER NOT-TO CUT THIS PAGE

**THE B.I.E.T. IS THE LEADING INSTITUTE OF ITS KIND IN THE WORLD**