UHF aerials for the constructor

log-periodic

Yagi

bisquare

also:

VIDEO MONITOR
SCOPE DUAL-TRACE UNIT
VIDEO HF RESPONSE
TELEVISIONS  
ELIZABETHAN TW12L PORTABLE TV
12 in. screen model complete with loop aerial system. Operates on 230/240v, AC or 12v. DC battery or 12v. DC car battery. All transistor covering UHF BBC1, BBC2 and ITA Channels 21-70. Size 15 in. × 12 in. × 12 in. Weight 6lbs. List Price £7.95. OUR PRICE £58.50. Carr. £1.
Also the 14 in. Elizabethan Television Model covering UHF BBC1, BBC2 and ITA Channels battery or 12v. DC car battery. All transistor system. Operates on 230/240v. AC or 12v. DC.

MULTI-METERS AND OSCILLOSCOPES
TWO NEW OSCILLOSCOPES FROM RUSSIA
CI-5 SINGLE BEAM OSCILLOSCOPE
10 microsec/pulse, triggered sweep from 1 microsec. to 3 milliseconds. Free running time base from 20 microsec to 2000 microsec. Built-in time marker and amplitude calibrator. 3-in. cathode ray tube with telescopic viewing hood. £39.00

CI-16 DOUBLE BEAM OSCILLOSCOPE
5 microsec/pulse. Separate Y1 and Y2 amplifiers, rectangular 6 in. × 4 in. cathode ray tube. Calibrated triggered sweep from 0.2 usec to 100 millisecond, per cue. Free running time base 50 microsec to 1 microsec. Built-in time base calibration and amplitude calibrator. £47.00

BEST QUALITY CAPACITORS
WIMA DUROFIT

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Voltage</th>
<th>Tolerance ±20%</th>
<th>Net</th>
<th>Pack of 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.022 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.047 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.068 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.15 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.22 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.33 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.47 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.68 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.7 µF</td>
<td>630</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

NOW INTRODUCE COMPONENTS

WIMA TROJAN

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Voltage</th>
<th>Tolerance ±20%</th>
<th>Net</th>
<th>Pack of 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.015 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.022 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.047 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.068 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.15 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.22 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.33 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.47 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.68 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.7 µF</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

WIMA MKS

<table>
<thead>
<tr>
<th>Capacitance</th>
<th>Voltage</th>
<th>Tolerance ±20%</th>
<th>Net</th>
<th>Pack of 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.015 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.033 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.047 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.068 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.1 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.15 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.22 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.33 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.47 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.68 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.7 µF</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOP-QUALITY CARBON FILM RESISTORS

<table>
<thead>
<tr>
<th>Type</th>
<th>Watt</th>
<th>Tolerance</th>
<th>Ohmic Value Range From To</th>
<th>Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP0131</td>
<td>1/8W</td>
<td>±5%</td>
<td>5-1 330 Ω</td>
<td>100</td>
</tr>
<tr>
<td>WP0651</td>
<td>1/2W</td>
<td>±5%</td>
<td>10-10M</td>
<td>100</td>
</tr>
</tbody>
</table>

ALL ITEMS ADVERTISED IN LAST MONTH'S ISSUE ALWAYS IN STOCK FOR SAME DAY DELIVERY
TERMS, CASH WITH ORDER ONLY. POST AND PACKING PAYABLE ON ORDERS UP TO £6. AFTER THAT, FREE EXCEPT C.R.T.'s.
Be a technician on radar, radio and electronics.

As an Artificer Apprentice, you train to be one of the Navy’s top technicians: at 24 you’ll be a £2,000 a year man responsible for ultra modern radar, radio and electronic equipment. If you’re 15½-17½, with ‘O’ level standard in Maths, and Science or English, send for details.

APPRENTICESHIPS

Name
Address
Date of birth

(Enquiries from U.K. residents only)

Royal Naval Careers Service (8290E I), Old Admiralty Bldg., Whitehall, London S.W.1. Please send me, without obligation, your free booklet, “Royal Navy Technician Apprenticeships”.

---

k.s.t. ltd.

for men of vision rebuilt T.V. tubes

Current types

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>17&quot;</td>
<td>£4.75</td>
</tr>
<tr>
<td>19&quot;</td>
<td>£5.00</td>
</tr>
</tbody>
</table>

Panorama & Rimguard types

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>19&quot;</td>
<td>£7.00</td>
</tr>
<tr>
<td>23&quot;</td>
<td>£9.00</td>
</tr>
</tbody>
</table>

Twin panel

<table>
<thead>
<tr>
<th>Size</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>19&quot;</td>
<td>£7.50</td>
</tr>
<tr>
<td>23&quot;</td>
<td>£9.50</td>
</tr>
</tbody>
</table>

Cash or P.O. with order no C.O.D. Free delivery in U.K.

Each tube fitted with new electron gun assembly. Fully guaranteed for two years against any fault except breakage.

Special terms for Hospitals, Orphanages, Old People’s homes.

Manufactured in our own factory backed by over 20 years’ experience in the field of electronics. Callers always welcome (by appointment) at Providence Mills, Viaduct Street, Stanningley, Nr. Leeds, Yorks.

---

KONTAKT 60

FOR INACCESSIBLE CONTACTS—More than just a cleaner. KONTAKT 60 guarantees perfect cleaning of contacts chemically in accordance with today’s technology.

KONTAKT offers the following advantages:

1. Dissolves oxides and sulphides the safe way without attacking contact substances.
2. Contains carefully selected solvents which do not attack plastics whereas they do dissolve re-sinified contact greases and dirt.
3. Contains no silicone.
4. Contains a light lubricant in order to avoid the contact paths being corroded.
5. Prevents further oxidation setting in.

Because of these outstanding properties KONTAKT 60 is one of the best and most popular contact cleansing agents in the world.

Users include: Rolls Royce Ltd., C.E.G.B., South of Scotland Electricity Board, Trinity House Workshops, Kolster Brandes, Mullard, Plessey Cos., etc.

OTHER KONTAKT PRODUCTS ARE:

70 Protective Lacquer
72 Insulating Spray
75 Cold Spray For Fault Location
80 Special Siliconized Polish
100 Antistatic Agent For Plastics
101 Dehydration Fluid

Write for full details of above complete range of Kontakt products to:

SPECIAL PRODUCTS DISTRIBUTORS LIMITED
81 Piccadilly, London, W.I 01-629 9556
**WILLOW VALE ELECTRONICS LIMITED**

*The Service Department Wholesalers*

**Compare our prices**

e.g. NEW 19" C.R.T's ... OUR PRICE £7.95  
Plus 65p carriage

---

**Please note:** Components are sold in packs, quantities per pack are shown under each heading. Prices are per piece of each value.

<table>
<thead>
<tr>
<th>TUBULAR CAPACITORS (5's)</th>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.005 (500p)</td>
<td>Ohm</td>
<td>£0.02</td>
</tr>
<tr>
<td>0.002 (200p)</td>
<td>Ohm</td>
<td>£0.03</td>
</tr>
<tr>
<td>0.004 (400p)</td>
<td>Ohm</td>
<td>£0.03</td>
</tr>
<tr>
<td>0.001 (100p)</td>
<td>Ohm</td>
<td>£0.03</td>
</tr>
</tbody>
</table>

**BIAS ELECTROLYTICS (5's)**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>250p</td>
<td>£0.07</td>
</tr>
<tr>
<td>500p</td>
<td>£0.09</td>
</tr>
<tr>
<td>1000p</td>
<td>£0.10</td>
</tr>
</tbody>
</table>

**RECORD PLAYER CARTRIDGES**

- 1000p: £0.03
- 1500p: £0.03
- 2200p: £0.04
- 2700p: £0.04
- 3200p: £0.04

**SUB-MINIATURE ELECTROLYTICS (5's)**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1mfd</td>
<td>£0.09</td>
</tr>
<tr>
<td>2mfd</td>
<td>£0.09</td>
</tr>
<tr>
<td>5mfd</td>
<td>£0.09</td>
</tr>
</tbody>
</table>

**RADIO/TV GLASS FUSES**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 amp</td>
<td>£0.15</td>
</tr>
<tr>
<td>1.5 amp</td>
<td>£0.25</td>
</tr>
<tr>
<td>2 amp</td>
<td>£0.30</td>
</tr>
</tbody>
</table>

**Mains Fuses**

- 2 amp, 3 amp, 5 amp, 13 amp, 30 amp, 63 amp, 100 amp, 150 amp, 200 amp, 250 amp, 300 amp, 400 amp

**TERMINAL STRIPS**

- 2 amp, 2.5 amp, 5 amp, 15 amp

**CARBON FILM RESISTORS**

- 1 watt, 2 watt, 5 watt, 10 watt, 20 watt, 50 watt

**WIRE-WOUND RESISTORS**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>100K</td>
<td>£0.08</td>
</tr>
<tr>
<td>220K</td>
<td>£0.08</td>
</tr>
<tr>
<td>330K</td>
<td>£0.09</td>
</tr>
</tbody>
</table>

**BIAS ELECTROLYTICS**

- Wire, 450V working

**CONTACT COOLED FULL WAVE**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>750p</td>
<td>£0.06</td>
</tr>
<tr>
<td>1000p</td>
<td>£0.08</td>
</tr>
<tr>
<td>1500p</td>
<td>£0.10</td>
</tr>
</tbody>
</table>

**MOISTURISERS**

- Tubular type

**SMOOTHING ELECTROLYTICS**

- Wire, 450V working

**ATTACH COOL AN AXIAL PLUGS**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1µm</td>
<td>£0.04</td>
</tr>
<tr>
<td>1nm</td>
<td>£0.04</td>
</tr>
</tbody>
</table>

**SLIDER PRE-SETS (3's)**

- 100K, 220K, 470K, 1M, 2.2M

**CANNED ELECTROLYTICS**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>100/200µfd</td>
<td>£0.63</td>
</tr>
<tr>
<td>220/470µfd</td>
<td>£0.85</td>
</tr>
<tr>
<td>100/200µfd</td>
<td>£0.95</td>
</tr>
</tbody>
</table>

**THERMISTORS (5's)**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>500p</td>
<td>£0.06</td>
</tr>
<tr>
<td>1500p</td>
<td>£0.09</td>
</tr>
<tr>
<td>3000p</td>
<td>£0.10</td>
</tr>
</tbody>
</table>

**RECORDING CARTRIDGES**

- 100K, 220K, 470K, 1M, 2.2M

**CERAMICS (6's)**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>22pf</td>
<td>£0.03</td>
</tr>
<tr>
<td>68pf</td>
<td>£0.03</td>
</tr>
<tr>
<td>820pf</td>
<td>£0.03</td>
</tr>
<tr>
<td>1000pf</td>
<td>£0.03</td>
</tr>
<tr>
<td>1500pf</td>
<td>£0.03</td>
</tr>
<tr>
<td>2000pf</td>
<td>£0.03</td>
</tr>
<tr>
<td>2500pf</td>
<td>£0.03</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servosol can</td>
<td>£0.63</td>
</tr>
<tr>
<td>Electrolube 2AX</td>
<td>£0.70</td>
</tr>
<tr>
<td>Electrolube No. 1 Snake</td>
<td>£0.80</td>
</tr>
<tr>
<td>Electrolube 2GX Grease</td>
<td>£0.42</td>
</tr>
</tbody>
</table>

**DOUBLE DIODE RECTIFIERS**

<table>
<thead>
<tr>
<th>Value</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>5K, 10K, 25K, 50K, 100K, 250K, 500K</td>
<td>£0.31</td>
</tr>
<tr>
<td>1 AEG, 2 meg</td>
<td>£0.31</td>
</tr>
</tbody>
</table>

**MOBILE STORES VANS IN LONDON, WEST COUNTRY, WALES AND SCOTLAND**

**VOLUME CONTROLS**

- Standard spindle with flat. Double pole switch £0.25
- Without switch (One per pack) £0.19
- 5K, 10K, 25K, 50K, 100K, 250K, 500K
- 1 AEG, 2 meg

**REPLACEMENT STYLIS**

- TC8 £0.23
- GC8 £0.23
REBUILT AND NEW TUBES—TWO YEARS’ GUARANTEE

REBUILT BRAND NEW

<table>
<thead>
<tr>
<th>Size</th>
<th>Rebuilt</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>17&quot;</td>
<td>£5.95</td>
<td>£6.50</td>
</tr>
<tr>
<td>19&quot;</td>
<td>£5.95</td>
<td>£7.95</td>
</tr>
<tr>
<td>21&quot;</td>
<td>£7.95</td>
<td>£9.90</td>
</tr>
<tr>
<td>23&quot;</td>
<td>£7.95</td>
<td>£10.80</td>
</tr>
</tbody>
</table>

COLOUR TUBES ALL PRICES ARE NETT IN STOCK. PRICES ON APPLICATION

19" TWIN CM1906 £5.95 £6.50 AW43-80, CRME170, CRME173, MW43-80, MW43-69*, CRME172*, AW43-88, AW43-89, CRME1703, CRME1705, C17AF, C17SM, etc.


*NEW ONLY, NO REBUILDS

IN STANDARDS. TERMS: CASH WITH ORDER. CARRIAGE ANYWHERE IN U.K. BRITAIN 65p per Tube

RADIO AND TELEVISION VALVES SMALL SELECTION

British made valves normally supplied. EVERY TYPE IN STOCK

<table>
<thead>
<tr>
<th>Code</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>DY86/7</td>
<td>EY86/7</td>
</tr>
<tr>
<td>DY802</td>
<td>EZ80</td>
</tr>
<tr>
<td>EAB80</td>
<td>EZ81</td>
</tr>
<tr>
<td>EB91</td>
<td>EZ90</td>
</tr>
<tr>
<td>EBC90</td>
<td>CZ14</td>
</tr>
<tr>
<td>EBF80</td>
<td>GY501</td>
</tr>
<tr>
<td>EBF99</td>
<td>PC86</td>
</tr>
<tr>
<td>ECC81</td>
<td>PC88</td>
</tr>
<tr>
<td>ECC82</td>
<td>PC97</td>
</tr>
<tr>
<td>ECC83</td>
<td>PC900</td>
</tr>
<tr>
<td>ECC864</td>
<td>PC84</td>
</tr>
<tr>
<td>ECE81</td>
<td>PC88</td>
</tr>
<tr>
<td>ECE84</td>
<td>PC89</td>
</tr>
<tr>
<td>ECL80</td>
<td>PC189</td>
</tr>
<tr>
<td>ECL82</td>
<td>PCC86</td>
</tr>
<tr>
<td>ECL83</td>
<td>PCC80</td>
</tr>
<tr>
<td>ECL84</td>
<td>PCC86</td>
</tr>
<tr>
<td>ECL86</td>
<td>PCC87</td>
</tr>
<tr>
<td>EFR8</td>
<td>PC801</td>
</tr>
<tr>
<td>EFR85</td>
<td>PC802</td>
</tr>
<tr>
<td>EFR86</td>
<td>PC805</td>
</tr>
<tr>
<td>EFR9</td>
<td>PC806</td>
</tr>
<tr>
<td>EFL83</td>
<td>PC808</td>
</tr>
<tr>
<td>EFL84</td>
<td>PC812</td>
</tr>
<tr>
<td>EFL90</td>
<td>PC83</td>
</tr>
<tr>
<td>EFL94</td>
<td>PC84</td>
</tr>
<tr>
<td>EFL95</td>
<td>PC85</td>
</tr>
</tbody>
</table>

COMPREHENSIVE CATALOGUE listing valves, tubes, L.O.P.T.'s, components, transistors, including HUGE VALVE EQUIVALENTS LIST. 15p in loose stamps, please.

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

TRADE & SERVICE ENGINEERS ONLY SUPPLIED

Cash with order. 10% less will be deducted from the advertised prices EXCEPT FOR NETT ITEMS, C.O.D., OR TUBES

All orders must exceed £5.00 in value otherwise postage and packing will be charged at 25p per invoice. Components must be ordered in multiples as packed.

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: LONDON 01-567 5400-2971, 01-579-3582. SOMERSET 045-84-2597

4 & 5 THE BROADWAY, HANWELL, LONDON, W.7

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

42 WEST END, STREET, SOMERSET 045-84 2597
**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-MAZAIR BRIMAR GEC, ETC.:**

| A21-11W (P) | AW4791 (M) | C19/AK (M) | CME1902 (M) | 173K (M) |
| A28-14W | MW45-64 (M) | C21/1A (M) | CME1903 (M) | 212K (M) |
| A31-18W (P) | MW45-69 (M) | C21/7A (M) | CME1905 | 720A (M) |
| A47-11W (P) | MW43-80 (M) | C21/AA (M) | CME1906 | 740A (M) |
| A47-13W (T) | MW52-20 (M) | C21/AF (M) | CME1908 | 740A (M) |
| A47-14W (M) | MW53-80 (M) | C21/KM (M) | CME3101 | 730A (M) |
| A47-17W (P) | AW4797 (M) | C21/M (M) | CME1904 | 730A (M) |
| A47-18W (P) | AW53-80 (M) | C23/AA (M) | CME2301 | 710A (M) |
| A47-26W (P) | AW53-88 (M) | C23/10 (M) | CME2302 (M) | 701A (M) |
| A59-11W (P) | AW53-89 (M) | C23/AK (M) | CME2303 (M) | 701A (M) |
| A59-12W (P) | AW59-90 (M) | CME120 (P) | CME2304 (T) | 701A (M) |
| A59-13W (T) | AW59-91 (M) | CME120 (P) | CME2305 (P) | 701A (M) |
| A59-14W (T) | C17/1A (M) | CME1402 (P) | CME2306 (P) | 701A (M) |
| A59-15W (M) | C17/5A (M) | CME1601 (P) | CRM172 (P) | 701A (M) |
| A59-14W (T) | C17/7A (M) | CME1602 (P) | CRM173 (P) | 701A (M) |
| A59-12W (P) | C17/AA (M) | CME1702 (P) | CRM122 (P) | 701A (M) |
| A59-13W (T) | C17/AA (M) | CME1702 (P) | CRM122 (P) | 701A (M) |
| A59-14W (T) | C17/AF (M) | CME1705 (P) | CRM111 (P) | 701A (M) |
| A59-13W (T) | C17/AF (M) | CME1705 (P) | CRM111 (P) | 701A (M) |
| A59-15W (M) | C17/5A (M) | CME1901 (P) | 171K (P) | 701A (M) |
| A59-14W (T) | C19/10AP (M) | CME1901 (P) | 172K (P) | 701A (M) |

**LAWSON BRAND NEW TELEVISION TUBES**

18 CHURCHDOWN ROAD, MALVERN, WORCS.

Malvern 2100

2 YEARS’ GUARANTEE
FULL TUBE FITTING
INSTRUCTIONS
Tubes are despatched passenger train, road or goods taking far too long for customer satisfaction.

**REBUILT TUBES**

**LAWSON “RED LABEL” CRTS** are particularly useful where cost is a vital factor, such as in older sets or rental use. Lawson “Red Label” CRTs are completely rebuilt from selected glass, are direct replacements and guaranteed for two years.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CME 1601</td>
<td>£8.50</td>
<td>£9.25</td>
</tr>
<tr>
<td>17”</td>
<td>£6.25</td>
<td>£7.25</td>
</tr>
<tr>
<td>19”</td>
<td>£7.25</td>
<td>£8.87</td>
</tr>
<tr>
<td>21”</td>
<td>£8.50</td>
<td>£9.75</td>
</tr>
<tr>
<td>23”</td>
<td>£9.75</td>
<td>£10.25</td>
</tr>
<tr>
<td>19” Twin Panel</td>
<td>£11.25</td>
<td>£12.25</td>
</tr>
<tr>
<td>23” Twin Panel</td>
<td>£15.25</td>
<td>£16.25</td>
</tr>
<tr>
<td>19” Panorama</td>
<td>£9.38</td>
<td>£10.25</td>
</tr>
<tr>
<td>20” Panorama</td>
<td>£9.50</td>
<td>£10.25</td>
</tr>
<tr>
<td>23” Panorama</td>
<td>£11.95</td>
<td>£12.95</td>
</tr>
</tbody>
</table>

**THE NEW UM4**

"COLOURBOOSTER"

**UHF/625 LINE**

**CAN PRODUCE REMARKABLE IMPROVEMENTS IN COLOUR AND PICTURE QUALITY IN FRINGE OR DIFFICULT AREAS WITH SIGNIFICANT REDUCTION IN NOISE (SNOW).**

HIGH GAIN—VERY LOW NOISE
FITTED FLY LEAD—INSTALLED IN SECONDS
HIGHEST QUALITY COMPONENTS
IVORY PLASTIC CASE 31 x 31 x 11 CORK BASE
CHANNELS: Group A, Red code 21-33
Group B, Yellow code 39-51
Group C-D, Green code 52-68
EQUALLY SUITABLE FOR BLACK AND WHITE
Also the M4 DUAL BAND UHF UNIT
BOOSTS ALL BAND III and ANY SPECIFIED BAND 1 CHANNEL SIMULTANEOUSLY
NOMINAL GAIN 17-18 DB BOTH BANDS

| PRICE BOTH TYPES: |
| £3.75 Battery model or £5.87 Self-contained mains version |

**TRANSISTOR DEVICES LIMITED**

6 ORCHARD GARDENS, TEIGNMOUTH, DEVON

Telephone: Teignmouth 4757

**THE NEW UM4**

"COLOURBOOSTER"

**UHF/625 LINE**

**CAN PRODUCE REMARKABLE IMPROVEMENTS IN COLOUR AND PICTURE QUALITY IN FRINGE OR DIFFICULT AREAS WITH SIGNIFICANT REDUCTION IN NOISE (SNOW).**

HIGH GAIN—VERY LOW NOISE
FITTED FLY LEAD—INSTALLED IN SECONDS
HIGHEST QUALITY COMPONENTS
IVORY PLASTIC CASE 31 x 31 x 11 CORK BASE
CHANNELS: Group A, Red code 21-33
Group B, Yellow code 39-51
Group C-D, Green code 52-68
EQUALLY SUITABLE FOR BLACK AND WHITE
Also the M4 DUAL BAND UHF UNIT
BOOSTS ALL BAND III and ANY SPECIFIED BAND 1 CHANNEL SIMULTANEOUSLY
NOMINAL GAIN 17-18 DB BOTH BANDS

| PRICE BOTH TYPES: |
| £3.75 Battery model or £5.87 Self-contained mains version |

**EX RENTAL TV’S**

19” — £29.95
23” — £39.95

All Channels 405/625
2 Years Guarantee.
Free List by return.

17” Slim line TV’s £11.95, 19” Slim line TV’s £15.95. Guaranteed 2 years.
Send for List. Carr. £1.00.

**TEAK HI-FI STEREO CABINETS £14.95**
Brand New 441 wide, 16” deep x 31” high with Legs. A superb piece of furniture. Carr. £1.00.

**TV TUBES REBUILT GUARANTEED 2 YEARS**

**DUKE & CO. (LONDON) LTD.**
621/3 Romford Road, Manor Park, E.12

Phone 01-478 6001-2-3

Stamp for Free List
Monty Python's Exploding TV Set

Most readers will remember those horrific reports in the daily newspapers last year when headlines screamed out about "Exploding TV Sets" and informed the public that one in ten colour television receivers would burst into flames, pour forth smoke, explode or otherwise exhibit alarming symptoms more appropriate to a Goon Show or the big top of Monty Python than the dear old homely telly.

Well, BREMA was also alarmed about all this, which was inspired by a report published in Which?, and asked the Consumers' Association to requiz its panel. Surprise, surprise!—several of the panel "had no recollection of saying there had been an explosion" and BREMA concludes that there was not a single incident which could be regarded as an explosion. BREMA also scotched the reports of "spontaneous" and "delayed-action" fires, there being no evidence of receivers bursting into flames on their own account—reports that fires occurred after sets had been switched off were found to be unsubstantiated. The nearest approach to an explosion consisted of a flashover or blowing fuse.

BREMA called the publicity "disproportionate press comment", a surprisingly restrained criticism under the circumstances. It strikes us as being more like irresponsible sensationalism on the part of the "experts" of the daily press. It also strikes us that this is not the first time that Which? has strayed into complex technical matters to the detriment of both manufacturers and the lay public to which its comments are directed.

When members of the publication's panel do not seem to know the difference between an "explosion" and a "sharp crack" and when reinvestigation brings forth a totally different assessment perhaps it is time someone did a Which? report on the Consumers' Association!

W. N. Stevens, Editor

© IPC Magazines Limited 1971. Copyright in all drawings, photographs and articles published in "TELEVISION" is fully protected and reproduction or imitation in whole or in part is expressly forbidden. All reasonable precautions are taken by "TELEVISION" to ensure that the advice and data given to readers are reliable. We cannot however guarantee it and we cannot accept legal responsibility for it. Prices are those current as we go to press. All correspondence intended for the Editor should be addressed to Fleetway House, Farringdon Street, London, EC4A 4AD. Address correspondence regarding advertisements to Advertisement Manager, Fleetway House, Farringdon Street, London, EC4A 4AD.
SHOWTIME '71

May this year was certainly Showtime in the world of TV, with the Components Show at Olympia, the Montreux Symposium-Exhibition (reported on a later page) and the Radio-TV Trade Shows. The latter of course have previously occurred in August but it looks as if the move to spring—which we have long advocated as being better suited to the annual pattern of trade—has been a success. Deliveries of many of the models shown are not expected to start till autumn (indeed there were one or two mock-ups, presumably to gauge interest) but should then be available for the peak selling season.

COMPONENTS EXHIBITION

The stands that caught our eye here as having something to say about future trends in TV sets were Mullard (of course!) and ITT. The following items were some of those on show on the Mullard stand.

The recently introduced TBA series of integrated circuits for colour and monochrome receivers (see Teletopics February and March this year). New are the TBA560 which contains the equivalent of the TBA500 and TBA510 combined; and the TBA750 intercarrier sound channel which was featured in the 625-line i.f. strip design in our July issue. The latter is a five-stage limiter-amplifier with balanced quadradature detector and preamplifier that can drive a triode-pentode or suitable transistor audio amplifier; the limiting action starts at 1mV so that good suppression of a.m. signals above 1mV is achieved, and the d.c. volume control has a range greater than 80dB with good control characteristics and low spreads. There were also two development types, the 2870M and 3790M, which have similar functions to the TAA700 and TBA550.

On the transistor side Mullard were showing the BU108 which is for use in the line output stage of colour receivers fitted with 110° deflection-angle e.r.t.s and features a maximum total dissipation of 12.5W, a maximum peak collector voltage rating of 1.5kV and maximum peak collector current rating of 5A; the BD160 for use in the line deflection circuits of monochrome receivers fitted with 110° deflection angle 12in. e.r.t.s; a new range of transistors with increased voltage, peak current and power ratings for use in colour and monochrome receiver video stages, the BF336, BF337 and BF338 (these transistors can also be used as high-voltage drivers in monochrome receiver line timebases); and a new transistor, type BU126, developed for use in switched-mode power supply circuits in 90° and 110° colour receivers—it has maximum voltage ratings of 750V, can conduct a peak current of 5A and has a total power dissipation of 30W.

In addition to their A56-120X 22in. shadowmask tube Mullard were also showing a 26in. version, the A66-120X. Mullard also now have a tube, type A31-120W, for use in 12in. mains/battery portable monochrome receivers. This tube requires a heater supply of only 11V at 75mA and is a narrow-neck type. For use in larger 17in. portable monochrome models is the A44-120W/R. All these tubes are protected types suitable for use with pushthrough presentation. Also on show were a new deflection coil-convergence assembly, type AT1060, for use with 110° shadowmask tubes and a new e.h.t. supply module containing a tripler circuit and giving focus and e.h.t. voltages of 8 and 25kV respectively for use with both 90° and 110° colour picture tubes.

ITT had on their stand a solid-state colour chassis fitted with their narrow-neck 110° shadowmask tube type A67-150X. This showed excellent convergence and focus characteristics and apart from the field output stage the circuitry was very compact. An innovation here that looks likely to be of considerable importance in the years ahead was the use of a thyristor line output stage. Two thyristors are employed, a BT119 to give the deflection current build up and a BT120 used in the control circuit to initiate the flyback. This type of circuit was originally devised by RCA in 1968 and has since been used in some half a million of their 90° deflection-angle colour sets. We hope to publish an article on this before long. Certainly thyristor line timebases appear to be reliable and simple.

Guest International Ltd. showed a new device for testing and extracting dual 8-in-line colour TV integrated circuits.

TRADE SHOWS AND OUTLOOK

At the Trade Shows pride of place from the TV point of view must undoubtedly go to BRC for their magnificent response to the challenge of low-cost colour TV from Japan: the Ferguson Colourstar 17in. colour Model 3712 has the extremely competitive recommended price of £189.75. It is a full PAL-D specification set using a new solid-state colour chassis—the Thorn/BRC 8000 chassis—which incorporates numerous interesting technical features. It is for example the first Thorn TV chassis to use integrated circuits—three of them, one for chroma signal demodulation and matrixing in the decoder, one as sound channel limiter, detector and audio amplifier, and the third as low-level synchronous detector in the i.f. channel. This is the first time so far as we know that a synchronous detector has been used for
i.f. demodulation in a commercial set for the domestic market: it avoids quadrature distortion and provides an inherently linear detection characteristic. Another first in this part of the set is the use of a crystal filter. Other features include the use of a field effect transistor in the decoder reference oscillator control loop, an exclusive BRC vacuum-impregnated line output transformer, complementary class B field output stage with heavy negative feedback and a thyristor controlled 180V line for the line timebase and video amplifier stages. The circuits are protected by a pushbutton reset cut-out.

Other main impressions from the Trade Shows are of the still increasing number of imported sets, both colour and monochrome, on offer and second signs at last of a determined effort by UK setmakers to introduce some small-screen mains/battery portable models. In this connection Philips showed a new TVette, the TVette 12, a 12in. single-standard mains/battery portable with daylight viewing filter, two-speed rotary tuner, a phones/tape socket and 1W audio output. This model incorporates two i.c.s, weighs 17½lb, and is to be available later this year. The price has not been fixed. Likewise BRC showed in their *Ultra* range a 14in. mains/battery portable, Model 6818, which will be available later this year at about £68. *KB* showed the Featherlight 12 weighing just over 16lb, and expected to retail at about £65. *Decca* showed their Model MS1210 12in. mains/battery portable and *Pye* their Model 99 12in. mains/battery portable which has a suggested price of £78/80. The 12in. mains/battery portable shown by *Rank-Bush-Murphy*, Model TV300, is manufactured in Japan to RBM design, weighs 20lb, and is priced at £63-50. RBM also showed an e.h.t. meter at £24 plus 50p post and packing which measures up to 30kV and has a 0-1mA f.s.d. movement.

Amongst imports *Grundig* have decidedly come on the TV scene with four models, a 20in. monochrome model, the T2002, at £89-95, a portable version, the P2002, at £92-45 and a 24in. version, the R500E, at £97-80. Their 26in. colour model, the 717, is priced at £359-85. All these sets feature varicap tuners, slider volume, brightness etc., user controls, phones/external loudspeaker socket and provision for remote control. New colour models were also shown by *Kuba* and *Korting*. A combined radio (m.w. plus v.h.f.) and TV model with pop-up 6in. screen and built-in rechargeable batteries and a 4½in. colour set were shown by *National Panasonic*. The first Hong Kong built set on the market, the 12in. Minitele at £53, was shown by *Haskel Electronics Ltd*. *Europhon* had an Italian-built portable. *Hitachi* introduced a further 12in. mains/battery model, the TWU67 at £75. The surprise in the Russian-built *Rigonda* range—distributed by Brown Brothers Ltd.—was a 4½in. mains/battery model at £39-50.

On the home front *ITT-KB* introduced the first 20in. colour model, the Colourscene 20 Model CK500 at £247. This is fitted with their CVC5 chassis. *ITT* have also relaunched their RGD brand. Additions to the BRC ranges included the *Ferguson* 26in. colour Model 3711, *HMV* 26in. colour Model 2711, *Ultra* 22in. colour Model 6704, 17in. mains portable Model 6814 and 12in. portable Model 6805 at £58-60, the *Marconiphone* 22in. colour Model 4704 at £280-70, 12in. mains portable Model 4805 at £58-60 and 20in. dual-standard black-and-white Model 4673 at £83-45. *Philips* showed three new colour models fitted with their G8 chassis, the 22in. Noveau Model 524 and two 26in. versions the 521 and 522. A new 24in. monochrome model, the 4308 at £87, was also shown. *Pye* introductions included two colour models, the 19in. Model CT153 at £259-50 fitted with the 691 chassis and the 26in. Model CT154 at £349 fitted with the 693 chassis. Monochrome introductions included the 24in. Models 98 and 151 fitted with the 769 chassis and the 20in. Model 155 fitted with the 169 chassis. In the *Invicta* range were the 20in. Model 7120 at about £80 and the 24in. Model 7124 at about £88, both fitted with the 169 chassis, and a 26in. colour model, the 7056, at about £325 fitted with the 693 chassis. *GEC* showed three colour models, the 19in. Model 2103 at £229, 22in. Model 2100 at £275 and 26in. Model 2107 at £270 and three new monochrome models, the 20in. Model 2084 at £72-50, the 20in. Model 2104 at £78-50 and 24in. Model 2105 at £86. The 2104 and 2105 are available in different colour finishes. *Sobell* introductions included the 22in. colour Model 1100 at £275 and two monochrome models, the 20in. 1101 at £78-50 and 24in. 1102 at £86. A very noteworthy introduction was the Kercionic Sphere by *Kera-colour*. This is a 25in. colour set (fitted with a single-standard Decca chassis) with a spherical white swivel plastic housing on a reinforced stand: the price is £385.

The latest BREMA figures, for April, are as follows: colour set deliveries for the month 45,000, monochrome set deliveries 92,000. In comparison with April 1970 there was a marked increase in colour set deliveries and a marked fall in monochrome set deliveries.

Leonard Govier, managing director of Granada TV Rental, has suggested that at the current rate of colour TV set production in the UK there will soon be excess stocks leading to large-scale price-cutting. He estimates from BREMA figures that stocks will soon rise to 350,000 in comparison to 162,000 at the end of last year. During the first quarter he reckoned that 80,000 of the total production of 180,000 colour sets went into stock. It certainly looks as if the days of the sellers' market in colour TV are now over.

**TWIN-PANEL TUBE REPLACEMENT KIT**

Mullard have introduced a 23in. twin-panel tube replacement kit to enable the 23in. twin-panel tube type A59-16W to serve as the replacement for their 23in. Parallel push-through type A59-23W (the ringtrap type A59-23W/R must not be used as the replacement).

**TRANSMITTER NEWS**

The ITA U.H.F. transmitters at Caradon Hill, Redruth and Belmont are now in operation. Caradon Hill and Redruth both carry Westward Television programmes, Caradon Hill on channel 25 with horizontal polarisation (receiving aerial Group A) and Redruth on channel 41 with horizontal polarisation (receiving aerial Group B). *Belmont* carries Anglia Television programmes on channel 25 with horizontal polarisation (receiving aerial Group A). Belmont carries Anglia Television programmes, Caradon Hill on channel 25 with horizontal polarisation (receiving aerial Group A). *Belmont* carries Anglia Television programmes, Caradon Hill on channel 25 with horizontal polarisation (receiving aerial Group A) and Redruth both carry Westward Television programmes. Caradon Hill on channel 41 with horizontal polarisation (receiving aerial Group A). Belmont carries Anglia Television programmes, Caradon Hill on channel 41 with horizontal polarisation (receiving aerial Group A) and Redruth both carry Westward Television programmes. Caradon Hill on channel 41 with horizontal polarisation (receiving aerial Group A) and Redruth both carry Westward Television programmes.
The display of colours on the screen of the shadow-mask tube is the result of each of the three beams of the tube being modulated by the appropriate colouring signal. In the previous two articles the circuits leading to this end result with colour-difference drive have been examined. It will be recalled that in this system the Y signal drives the three tube cathodes simultaneously while each grid receives its appropriate colour-difference signal. This means that between the grid and cathode of each tube gun appears a signal which carries the information of the original primary-colour signal delivered by the camera. Because both the grid and cathode of a gun can be modulated it follows that the guns can serve as matrixes combining the Y signal with the colour-difference signals so that the beams recreate the original primary-colour signals.

With primary-colour drive the primary-colour signals are reassembled from the colour-difference and Y signals prior to the picture tube. The primary-colour signals are then fed separately to the three tube cathodes, the grids controlling the tube biasing in the ordinary way.

Matrixing

A block diagram illustrating the scheme is shown in Fig. 1. The R−Y and B−Y colour-difference preamplifiers receive the appropriate signals from the synchronous detectors while the G−Y colour-difference signal is matrixed from the R−Y and B−Y ones in the same way as previously described for receivers using colour-difference drive. Instead of the colour-difference signals being fed to the tube grids however they are fed to the primary-colour matrix/output stages along with the luminance signal. It is common for a single stage to act as matrix and primary-colour drive amplifier, feeding the primary-colour signal direct to a tube cathode.

One of the first colour chassis to employ this technique was the BRC (Ferguson, HMV, Ultra, Marconiphone, DER, etc.) 2000 dual-standard all-transistor one. The subsequent BRC 3000 single-standard chassis also uses primary-colour tube drive and the appropriate circuit sections are shown in Fig. 2.

Let us follow the circuit from the outputs of the synchronous detectors at the bottom left-hand corner. The signal from the V detector goes via filter R226/C210 and then C211 to the base of the R−Y preamplifier VT207 while the signal from the U detector goes via C229 to the base of the B−Y preamplifier VT213. The G−Y preamplifier is VT210 and is connected in the common-base mode, the base components C223/R253 giving an input (base) impedance similar to that at the other colour-difference preamplifiers. The emitter of VT210 receives the input signal which is compounded of suitable proportions of R−Y and B−Y signals from the emitters of VT207 and VT213. The proportions of signal to yield the G−Y signal are obtained from R241 (R−Y) and R259 (B−Y) with the capacitors across them providing a degree of compensation.

Each colour-difference preamplifier is followed by a d.c. coupled emitter-follower (VT208 R−Y, VT211 G−Y and VT214 B−Y). The colour-difference signal from the low-impedance emitter output of each of these stages is then coupled directly to the emitter circuit of each of the three primary-colour output stages via a "set video gain" preset control network. In addition to providing tube drive each primary-colour output stage also serves as the appropriate primary-colour matrix as the Y signal is applied simultaneously to the bases of each of these three stages from the luminance channel. Addition of the luminance and colour-difference signals thus occurs in these stages.

Luminance Channel

The luminance channel in the BRC 3000 chassis comprises first a Y delay line driver which receives Y signal at its base from the luminance detector and delivers amplified Y signal from its collector to the delay line shown at the top left-hand side of Fig. 2. The delay line driver transistor is not shown but is a pnp device, R201 being its collector load. The delay line input is loaded by the collector impedance of the driver transistor in parallel with R201 and in series with R279. L202 is a stopper choke.

The output of the delay line then feeds signal to the base of the post delay line amplifier VT201 so that the delay line output is mainly loaded by VT201 base input impedance in parallel with R204. The Y delay is about 600nsec and it is rather important.

![Fig. 1: Block diagram of the primary-colour drive system.](image-url)
NEW LINE OUTPUT TRANSFORMERS

ALBA 655, 656, 717, 721 £3.75, 890-895, 1090, 1135, 1195, 1235, 1395, 1435 £5.00.

ARGOSY, 17K10 17K11, 17K12 17K14 17K17 17K43 £4.00.

BAIRD, All models price £5.00, from model 600 quote part no. normally found on TX plate.

BUSCH TV15 or TV30 £2.50, From model TV17 an alternative Square Tag Panel was fitted on Main, Bobbin, please state if required.) TV141 to TV176, TV75 to TV86 £4.75 (except TV80).

COSSOR 504 to 557 £4.50, CT1700U to CT2738A £5.00.

DECCA DM1, DM3C (90°), DM4C (70°), DR1, DR2, DR121 £4.50, DR95, DR106, DR101, DR202, DR303, DR404, DR505, DR606 £4.50

DEFIANT £7.00 Prices on request.

DYNAVOR TV30, TV35, TV36, TV37, TV38, TV40, TV42, etc. £4.00.

EKCO TV21, TV24, TC267, TV283, TV293, TV311, TV326, TV337, TV340, TV344, TV345, TV347, TV348, TV349, TV354, TV356, TV358, TV360, TV367, TV373, TV374, TV377A, TV393, TV394, 433, 434, 435, 436, 437 all at £4.00, 503, 504, 505, 506 £7.65


KB PV30, NFV40, PV40, QV10, OV10, RV10, RV20, RV30, FPV20 £4.50, Featherlight £5.00, Chassis No. VC1-VC2-VC3-VC4 £4.50.

MASTERADIO 4013 DST, B001 DST, D007 DST £2.45.

MARCONI VT153, VT155, VT156, VT157, VT159, VT161, VT165, VT170, 4611, 4800, 4801, 4803, 4815 £4.00.

PAM 600S to 5106 £4.00.

PETO SCOTT, Prices on request.


PHILIPS 11TG190 to 24TG1 £5.00, 17BGU £7.00 Rewind £3.75 (old unit required).

POLY 1405, 450, 455, 650, PTF61, PFOA £4.00.

PYE V200, V400, 2010L, 210, 220, 300F, 300S, 310, 210S, 410, 510, 530, 600, 620, 630, 700 A or D, 710 A or D, 830 A or D or LBA £4.00.

11U Series, 11U-P/NO, AL21003, 21F to 81. Part Nos must be given when ordering Pye LOPTS £4.00.

REGENSCOTT 197-198, 298, TV402, TV401, TV501 £4.00, TV502 £5.00, 10-4, 10-1, 11-18, 10-12, 19-19 £4.00.


SOBEL 1000DS, 1002DS, 1005DS, 1010DS, 1012, 1013, 1014, 1018, 1019, 1020, 1021, 1032, 1033, 1038, 1039 £4.25.

STELLA T110U £14.95.


VAM 5106 to 5108 £4.00.

WELCH £4.00, £4.00.

503, 504, 505, 506 £7.65

These wirewound sections enable you to build up any Mains Dropper

100-100-300-100-16.

25v. £1.50 each. P.P. 17p

100-100-200.

50v. £1.75 each. P.P. 17p

100-200.

350. £1.93 each. P.P. 17p

100-400.

575. £1.15 each. P.P. 17p

100-300.

300. £2.00 each. P.P. 17p

100-400.

17p.

125+200+300+32-275v. £1.40

POWER RESISTOR SECTIONS

These wirewound sections enable you to build up any Mains Dropper to your requirements. A central 28A hole is provided for mounting.

T.V. CANNED ELECTROLYTICS

100-200. 350v. £1.25 each. P.P. 17p

200-300. £2.05 each. P.P. 17p

100-200. £3.50, 95p each. P.P. 17p

200-100-100. £1.75 each. P.P. 17p

100-200-100.

17p.

350. £1.93 each. P.P. 17p

100-400-275v. £1.15 each. P.P. 17p

300-300.

300. £2.00 each. P.P. 17p

100-400.

17p.

400+400-350v. £2.30

NEW REPLACEMENT L/OP/TX MURPHY £4.75 26p P.P.

V310 TO 929

REPLACEMENT DROPPERS

Philips Type 301 25+2 85 63p, P.P. 7p.

Ferguson, M.V., Marconi, Ultra 800 & 850 Series (Convertible) 37+31+97+26+168. 63p, P.P. 7p.

As above 85 series (Dual Standard) 14+26+97+173 63p each. P.P. 7p.

BRAND NEW VHF TUNERS


T.V. CANNED ELECTROLYTICS £4.10 450v. £1.25 each. P.P. 17p

100-200 275v. £1.10 each. P.P. 17p

T.V. CANNED ELECTROLYTICS

100-200. 350v. £1.23 each. P.P. 17p

200-300. £2.05 each. P.P. 17p

100-200. £3.50 95p each. P.P. 17p

200-100-100.

17p.

350. £1.93 each. P.P. 17p

100-400-275v. £1.15 each. P.P. 17p

300-300.

300. £2.00 each. P.P. 17p

100-400-17p.

275v. £1.50 each. P.P. 17p

400+400-350v. £2.30

ALL STOCK ORDERS DESPATCHED BY RETURN POST.

CALLERS WELCOME. But to avoid disappointment please phone to check that the items you require are in stock.

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
for the input and output loading to be correct if coincidences between the luminance and colour information on the display is to be secured. It is the purpose of the Y delay line to hold back for a small fraction of a second the luminance signal so that it arrives at the primary-colour matrices at the same instant as the colour-difference information which will have been delayed relative to the pre-delay line Y signal because the chroma channel has a more restricted passband than the Y channel. Lack of coincidence shows on the display as a small horizontal displacement of the colour relative to the luminance.

The luminance signal from VT201 collector is fed to the base of the luminance emitter-follower VT206. Contrast control is effected at this point by R207 (the contrast control) which is in parallel with the luminance signal. The control is d.c. isolated from VT201 collector by C204 and from VT206 base by C205. Thus the level of the signal fed to the luminance emitter-follower is reduced as R207 is adjusted to reduce the shunt resistance.

The post-delay line amplifier incorporates a 4-43MHz chroma trap in its emitter circuit. This consists of L201, C201 and its purpose is to notch out any chroma signal which could result in picture interference if allowed to pass through the luminance channel.

The luminance signal developed across R240 the emitter load of VT206 is coupled directly to the bases of the three primary-colour output stages so that each of these transistors is in receipt of both the Y signal and the appropriate colour-difference signal. The collectors of the primary-colour output stages thus deliver true primary-colour signals to the tube cathodes.

**Brightness Control System**

There are several extra complications in the circuit. It will for example be seen that the luminance signal after passing through VT201 is subjected to brightness and beam current limiting controls by way of the offset-pulse generator VT204 and the following stage VT205 which operates the beam limiter. As these are rather unusual circuits it is worth taking a look at their operation.

The circuit of the beam limiter is shown in Fig. 3(a) and contains the brightness control. The picture tube grids are preset to a suitable negative potential and receive the line and field blanking pulses as shown in Fig. 3(b). The action of the brightness control differs from convention in that the offset system in Fig. 2 is an adder stage VT205 which incorporates the Y signal proper passes from VT201 collector to VT206 base. The offset-pulse generator stage VT204 effectively "stabilises" during the sync pulse and porch period the biasing of the luminance channel at the selected brightness setting. For this purpose line frequency pulses from a 400V source are fed to VT204 base through the resistive attenuator R217, R218 and R219. The pulses appearing at VT204 output are then given a d.c. datum by diodes W202 and W203. The job of the adder stage VT205 is to relate this datum to the sync pulses and porches present in the luminance signal.

Alteration in VT205 base bias has the effect of making the pulses from VT204 either positive- or negative-going since this bias change alters the conductivity of the diode pair W202 and W203 differentially. Since these pulses coincide with the sync pulses and porches already present in the luminance channel the effect is either to add to or subtract from the sync pulses and this is tantamount to a positive or negative displacement of the picture information relative to luminance signal black level (which of course is the porch level).
Fig. 2: Video section of the BRC 3000 chassis which employs primary-colour tube drive.

Components in the green and blue channels for which no value is given have the same value as the equivalent component in the red channel.
In this way the black level is maintained constant in spite of changes in picture brightness. Preset R211 sets the luminance channel bias during the sync pulses and porches. The bias is correct when R211 is adjusted to provide 10.7V at VT206 emitter on an Avo Model 8 switched to the 25V d.c. range. The adjustment should be made with the field collapsed by the set-white switch S201 and the beams switched off.

The oscillograms in Fig. 4 give a good impression of how the offset pulses at VT206 emitter change from positive-going through zero to negative-going as the brightness control is adjusted. The pulse amplitude here is of course significantly below that at the 400V source.

Clamping

For all this to happen correctly the primary-colour signals must be clamped to a d.c. potential. Stabilisation of this kind is provided by the same line pulses used to drive VT204. These pulses are timed by L205 (with R227 providing damping). Diode W205 deletes negative-going overshoot while the three clamp diodes W206-W208 to the three primary-colour amplifier collectors are in phase with the pulses. The feed resistors are R246, R247 and R248 and the negative potential at the anodes of the three clamp diodes is returned to the bases of the three colour-difference preamplifiers, separately in each case. This effectively locks the black level.

The tube grid circuit also receives a clamping potential from diode W204 (top right-hand corner of Fig. 2), the clamping level here being preset by R230.

Beam Limiter Operation

Now let us return to Fig. 3 to see how the beam limiter works. To increase tube current the bias from connector 22/2 to VT205 base must be negative-going whilst to decrease tube current it must be positive-going. The beam limiting action is based on the current flowing through R907 in VT901 emitter lead. This resistor is also connected in the earth return side of the e.h.t. and line scan circuits. Thus the beam limiter VT901 monitors a current which is proportional to the total e.h.t. current (i.e. the beam current). When the beam current rises above the permitted maximum established by the preset R903 the potential across R907 increases to a level at which VT901 collector current starts to fall. Its collector voltage then of course increases. A positive-going potential is thus reflected from R906 slider to VT205 base circuit reducing the Y signal drive datum potential in the same way as when the brightness control is turned down and thereby diminishing the beam current. Preset R906 sets the range of the brightness control.

TO BE CONTINUED

CIRCUIT NOTE: HEATER PROTECTION

H. K. Hills

To reduce heat dissipation from mains dropper resistors—particularly important when only a few valves are employed, as in the current hybrid models—it is now usual to include a power rectifier in series with the heater circuit. This permits the use of a lower-value dropper resistor since conduction through the rectifier occurs only on alternate half-cycles of the input. The disadvantage with this arrangement is that if this rectifier should go short-circuit all the valves and the c.r.t. will be grossly over-run and although the brilliance, contrast and picture size will be abnormal the set owner may be unaware that a major fault exists.

As well as relying on the heater fuse blowing the various setmakers incorporate circuit dodges to prevent set use should this fault occur. In earlier Bush-Murphy models for example the sync separator screen voltage was tapped from a point along the rectified heater supply. Thus if the rectifier went short-circuit the heater current would be pure a.c., there would be zero sync separator d.c. screen potential and the peak 50Hz excursions would constantly trip the field timebase.

In some Thorn models the negative bias for the field output pentode was taken from the heater circuit. In this case if the rectifier goes short-circuit the loss of bias results in a severely cramped raster with weak or non-existent lock.

In the latest Bush-Murphy single-standard models a new, simple but very effective method is employed. The arrangement is shown in Fig. 1. 3D9 is the heater circuit rectifier and produces a positive-going output. During normal operation the heater protection diode 3D12 is thus reverse biased and has no effect on the circuit. Should 3D9 go short-circuit however 3D12 will conduct heavily when the live supply goes negative, blowing the 1.25A fuse immediately. Should the protection diode go short-circuit 3D9 would conduct heavily during positive half-cycles, again blowing the fuse.

Fig. 1: Heater circuit used in the latest Bush-Murphy single-standard hybrid chassis; heater protection diode 3D12 prevents the valves and c.r.t. being over-run in the event of the heater rectifier 3D9 short-circuiting.
BASIC CIRCUITS FOR THE CONSTRUCTOR

Winding the coils for the i.f. amplifier is the most tedious part and to obtain the best results it is suggested that the constructor should knock together a coil winding jig, possibly from Meccano. All that is needed is a rigid shaft with a handle and provision for the coil to be firmly mounted on the shaft during winding. The wire on all the coils should be close wound and sealed with wax or glue (enamelled wire) or acetone if TNA wire can be obtained. Having wound the basic coils components should be added on the inside of the coil base as indicated in Figs. 3 and 7. Take care to prevent loose ends shorting to the screening cans. The detector coil assembly (L209/L210, etc.) is wound on a 1¼ in. former.

Testing and Alignment

Remove link 4 and replace R211 with a 10kΩ lin. potentiometer. This disables the a.g.c. and allows manual gain control adjustments to be made. Connect a stable 15V supply to the main rail and check voltages as follows: Tr201 emitter 3.2V, base 4.0V (set by manual gain potentiometer), collector 7.7V; Tr202 emitter 2.3V, base 4.0V, collector 10V; Tr203 emitter 1.6V, base 2.3V, collector 13.4V; Tr204 emitter 2.4V, base 3.1V, collector 14V; IC201 pin 2 12V, pin 5 5.8V. VR201 should be initially adjusted for 0.8V at the emitter of Tr207. All these voltages are measured with respect to chassis and should be within 10% of the stated figures. Any faulty components or wiring errors should be rectified before proceeding further. The alignment of the i.f. amplifier may then be carried out by one of the following methods: (1) Wobbulator, detector probe and oscilloscope alignment, adjusting each stage individually as a separate unit. (2) Signal generator, detector amplifier and voltmeter, used as in (1). (3) Signal generator overall alignment. (4) Alignment without instruments on test card.

Methods (1) or (2) should be used if at all possible so that a good phase response may be achieved. If the phase response is incorrect it will show on test card either as preshoot (black before a white bar) or overshoot (black after white). In severe cases of bad phase response ringing will occur after sharp edges in the picture. The only way to ensure that an i.f. amplifier has a good phase response is to synchronously tune the stages of amplification. The frequency response of each coil assembly—apart from the traps—is centred on 37MHz and the individual responses all stack up to produce a totally predictable overall response.

Alignment—Methods 1 and 2

Disconnect R204 and link 1. Connect a 1000Ω resistor across L204, i.e. across pins 3 and 6 of the coil former. Set the cores of the coils as follows: L201

Fig. 7: Coil details for the 625-line i.f. strip.
Input from signal generator
Coaxial socket
5-15k (R205)
Output to tuner test point

Input
Output
22uH
OA90
15p
+7k
To oscilloscope

Fig. 8: Injection pads. For tuners other than the ELC1043 replace R205 with a 1pF capacitor. Injection is still at the tuner test point (see Fig. 2 for the usual position of this point on surplus u.h.f. tuner units).

Fig. 9: Detector probe for use with a wobbulator and oscilloscope.

fully screwed in, L202 midway, L203 full out, all other coils midway. Set the preset gain control (10kΩ lin. potentiometer in place of R211 as described earlier) so that the gain of Tr201 is reduced by 20dB. This level of reduction corresponds to 3.3V on the emitter of Tr201. Disconnect the earthy end of R205 in series (see Fig. 8 pad 1). Inject a 500mV signal across the 75Ω resistor, centred on 37MHz with a sweep width of about 15MHz. Detect the signal at the collector of Tr201. Adjust the tuner output coil and L202 to give response 1. Set the traps L201 and L203 to give response 2. The golden rule to remember is that decibels add while ratios multiply: for example, 

\[-27\text{dB} = -20\text{dB} - 7\text{dB} = 0.1 \times 0.45 = 0.045.\]

Reconnect link 1 and remove the 100Ω resistor from L204 placing it across L205. Disconnect link 2 and inject a 50mV signal at the tuner test point using pad 1 as before. Detect the signal at the collector of Tr202. Keeping Tr201 at 20dB gain reduction align L204 to give response 3.

Reconnect link 2 and disconnect link 3. Remove the 100Ω resistor from L205 and place it across L206. Detect at the collector of Tr203 injecting as before except at about 15mV. Align L205 to give response 4.

With link 3 still disconnected inject 150mV at the base of Tr204 using pad 2. Slide the core of L210 fully into the coil. Monitor the voltage at the base of Tr207 with an oscilloscope (wobbulator alignment). Connect a voltmeter between pins 1 and 3 of the detector coil assembly L209 etc. (signal generator alignment). Finely adjust the level of injection to give 0.5V detected output. Align L208 and L209 to give response 5 and then L210 to give response 6.

Short-circuit L208 and disconnect link 2. Remove the 100Ω resistor from L206 and reconnect link 3. Inject 200mV via pad 2 at Tr203 base. Align L206 and L207 to give response 7, detecting at Tr204 base. Change injection level to 10mV and remove the short across L208. Monitor the detector output as before, at the base of Tr207, and adjust the level of injection to give 0.5V detected output. A very slight adjustment of L207 will give response 8. Repeat the last two sections if large adjustment of L207 is necessary.

**Overall Response**

Reconnect link 2 and inject about 2mV via pad 1 to the tuner test point. As before adjust the injection level to give 0.5V detected output from the vision detector. Tr201 should still be set at 20dB gain reduction. If the instructions have been followed exactly response 9 should be obtained: this is the addition of all the individual responses. If the response is slightly tilted it is permissible to make a small adjustment to L205. Check that the response does not alter significantly with different degrees of gain control, maintaining the detector output at 0.5V throughout the test. If there is a great shift in response shape check that you are not running Tr201 into reverse gain control. Finally remove pad 1 and

![Fig. 10: Response curves. Fig. 11 (right): Decibel to voltage ratio nomograph.](image-url)
reconnect link 4, R204, R205 and R211 as for normal operation. This completes the alignment procedure for the composite i.f. amplifier.

**Sound Alignment**

Disconnect the lead going to pin 4 of L213 coil former and inject at pin 4 a 500mV 6MHz signal, going in via pad 3. Detect at pin 3 of IC201 and align L213 and L214 to give response 10. When the receiver is working and tuned to a test card on which there is a continuous tuning note align L215 for maximum audio output across R241. The audio may be measured on an oscilloscope or an a.c. voltmeter. Note that the i.c. will not work at all unless VR202 is connected.

**Signal Detection**

When a wobbulator and oscilloscope are used for alignment the detector probe shown in Fig. 9 may be used for signal detection. With the signal generator and voltmeter method the detector amplifier shown in Fig. 12 is recommended. The amplifier may be built on a metal chassis using a similar method of construction to that of the i.f. amplifier itself. Alternatively it may be built on paxolin pinboard but in this case be sure to provide a really stout earthing busbar. As long as short leads are used for all components the layout is not critical. The response of the detector amplifier is virtually flat from 35 to 40MHz and 10mV at the input via the 2.2pF capacitor will produce 1V output on the meter. At maximum d.c. sensitivity the meter reading should not exceed 5V and the level of injection from the signal generator may have to be reduced below the levels stated in the previous alignment instructions in order to comply with this requirement.

**Injection Level**

With all methods of alignment it is most important that no part of the circuit is overloaded. The injection levels have been given as a guide and it is appreciated that many signal generators have an uncalibrated output. There should be no problems in using an uncalibrated generator provided reasonable precautions are taken: the generator output should be reduced to a level at which response "crushing" no longer occurs—if the shape of the response alters as the injection level is changed. Overloading is almost certainly occurring.

---

**Signal Generator Alignment**

This method of alignment is very much simpler than the previous methods but the amplifier will have rather a dubious phase response. Inject via pad 1 to the tuner test point and detect with a voltmeter connected between pins 1 and 3 of the detector coil assembly. Disconnect R204 and link 4 and replace R211 with a 10kΩ lin. potentiometer. Set this to give 3-3V at Tr201 emitter. Set all coil cores to their mid-position except for L203 which should be fully out and L201 and L210 which should be fully in.

Set the signal generator to 37MHz and peak up all the i.f. coils (not the traps) for maximum indication on the meter, constantly reducing the voltage injected to maintain a meter indication of 0.5V. Then manually sweep the signal generator frequency between 34 and 40MHz and adjust the coil cores (including the tuner output coil) until the response has a flat top between 36 and 38MHz. Set L201 and L210 for minimum meter indication at 33-5MHz and L203 for minimum at 41.5MHz. Make slight adjustments to all coils to bring the response as close as possible to response 9. Finally reconnect link 4, R204, R205 and R211.

**Test Card Alignment**

For experienced i.f. core twiddlers who would like to attempt alignment on test card the following tips may be useful. (1) Remove L203 core completely and forget about it. (2) Adjust all cores (except the traps) to give the best possible picture taking into account both phase and frequency response. (3) Set L201 and L210 for minimum sound-chroma beat patterning.

**Performance**

The video output from the i.f. strip has been tested on a Rank-Cintel video monitor and also a 26in. colour receiver. Excellent pictures were produced in both cases. The sound output is also of very high quality (less than 1% total harmonic distortion) and is suitable for feeding into a high-quality audio amplifier.

**Varicap Tuner and I.C.s**

Gurney’s (Radio) Ltd. inform us that they have the varicap tuner and i.c.s in stock. The tuner, type ELC1043, is priced at £6.75. The i.c.s are priced as follows TAA550 £0.59, TAA570 £1.91, TBA750 £2.31. (Mullard recommended prices.)
Provided the r.f. and i.f. alignment provide adequate bandwidth correctly shaped to accommodate the vestigial sideband transmission, picture quality in terms of fidelity to the transmitted picture is almost wholly dependent on the video circuits, ability to focus the c.r.t. beam sufficiently sharply to permit reproduction of the top video frequencies probably being the main secondary factor. The video circuits of a receiver extend from the vision detector to the c.r.t. cathode and should ideally provide equal amplification to all frequencies from zero (d.c.) to 3MHz on v.h.f. and 5.5MHz on u.h.f. with negligible or frequency-proportional phase shift (the phase shift, i.e. signal delay, introduced by the amplifier should be proportional to frequency over the entire passband).

It is convenient to think of the h.f. end of the video spectrum as that at which the reactance of the capacitance shunting the load is comparable in value with the load resistor. The reactance of any coupling and decoupling capacitors at h.f. is very low so that they can be ignored. Generally speaking the problems of h.f. amplification begin to emerge at around 100kHz.

**Gain at HF**

In this article we'll concentrate on valve circuits, following up in a later article with the peculiarities of transistor video circuits. The gain \( A \) of a pentode video amplifier is given approximately by the formula \( A = gm \times RL \) (gm in mA/V and RL in kΩ). This expression is not completely accurate but is quite adequate for practical purposes. It brings out the fact that at medium video frequencies stage gain depends on the valve's mutual conductance \( gm \) and the value of the load resistor (RL). Thus high voltage amplification can be obtained simply by using a high-value load resistor. To obtain linear amplification at h.f. however it is necessary to use low-value load resistors. This is basically because at h.f. the load impedance is no longer RL but the combination \( (ZL) \) of RL and the reactance \( Xc \) of the load shunting capacitance. The formula for h.f. stage gain thus becomes \( A = gm \times ZL \) and, unlike \( gm \times RL \), \( gm \times ZL \) is not a fixed figure since \( Xc \) varies inversely with frequency. This means that the gain progressively falls towards the top limits.

**Shunt Capacitance**

The total capacitance shunting the load is made up of (a) the pentode anode capacitance to chassis, (b) the capacitance present across the load component and leads, (c) the c.r.t. input capacitance, (d) the capacitance present because of signal feed components and wiring to chassis and (e) the sync separator input capacitance. While only (b) directly shunts the load the others also do so because the decoupled h.t. line effectively earths the feed end of the load resistor so that all these capacitances are from anode to earth.

The total shunt capacitance in practice can be between 20 and 30pF and an average value of 25pF will have a reactance of about 2-1kΩ at the top v.h.f. video frequency of 3MHz. This reactance is given by the formula \( Xc = 10^6 / 6.28fC \) where \( Xc \) is in ohms, \( f \) in MHz and \( C \) in picofarads. The video load impedance at this frequency is thus the combination of this reactance and \( RL \) but as these two are electrically at right-angles to one another their net value must be determined vectorially. It is given by \( Z = (R \times Xc) / (\sqrt{R^2 + Xc^2}) \). Note that when both values in ohms are equal the total impedance is 0.707 of this value (not half as is the case with pure resistances).

**Turnover Frequency**

Thus high gain cannot be obtained from a high-value load resistor if the reactance of the load shunting capacitance is low at the frequency concerned—the capacitive reactance simply shorts the load resistor. The frequency at which the reactance of the load shunting capacitance is equal to the load resistance is regarded as the top practical response limit since above this the gain falls away rapidly. This frequency is given by \( f = 1 / 6.28 \times RL \times Cs \).

**Fig. 1:** Shunt compensation: the h.f. peaking coil \( Lc \) is in series with the load resistor but as shown in (b) in shunt with the stray capacitance \( Cs \) as the electrolytic earths the h.t. rail. Response characteristics with different peaking coil values based on different a factors are shown at (c).
When the shunt reactance is very much less than $R_L$, it effectively forms the total load impedance and the gain falls by close to 6dB per octave. The frequency at which $X_c$ is equal to $R_L$ is referred to as the turnover frequency, half-power or −3dB point.

The gain at the half-power point is 0.707 times the gain at m.f. where $X_c$ is so high that it can be ignored. Having found the total shunt capacitance and its reactance at the top video frequency required, therefore, the circuit designer must use a value of load resistor which will ensure that the gain is maintained at 0.707 at m.f. up to this top video frequency. Now unless countermeasures are adopted a total shunt capacitance of 25pF will mean the use of a low-value load resistor if linear overall response is to be maintained. Two countermeasures are used in practice, (a) the inclusion of peaking or compensating coils which in effect offset the circuit capacitance—by introducing inductive reactance to offset the circuit capacitive reactance—and (b) the inclusion of a cathode-follower stage.

**Use of Peaking Coils**

The first method is very widely used and results in a lift in gain towards the top limit. This although resembling tuned circuit response must however not permit the circuit to even approach resonance or severe ringing will be produced. Response improvement by using peaking coils is both complex and largely mathematical and is further complicated by the fact that there is no one ideal inductor value for any circuit, the precise value being determined by the particular feature it is desired to optimise. To explain this, it is possible to aim for (a) maximum overall linearity, (b) best phase response, (c) best transient response without overshoot or (d) to raise the −3dB point to the m.f. amplitude. The coil inductance adopted is usually a compromise between any two of these features. It should however be pointed out that, although the inclusion of a peaking coil will generally improve all these characteristics and any one in particular, a more rapid decline from the peak point than that obtained by normal h.f. roll-off in an uncompensated $RC$ stage is produced. The precise peaking point must therefore be carefully chosen to avoid too sharp a fall in gain within the video passband.

![Fig. 2: Series compensation; here the peaking coil $L_c$ is in series with the signal feed to the c.r.t. cathode. Responses shown at (b) vary with different a factors. Generally, higher coil values are used in comparison to shunt-compensated circuits, producing a steeper and more linear fall-off after the peaking point.](image)

**Shunt-compensated Circuits**

Although as shown in Fig. 1(a) the compensating coil $L_c$ in a shunt-compensated circuit is placed in series with the load resistor it is effectively in shunt with the circuit capacitance as shown in Fig. 1(b).

The coil inductance for any combination of $R_L$ and $C_s$ can be calculated from the formula $L = a \times R_L^2 \times C_s$ where $a$ is a factor depending on the particular characteristic aimed for. These are as follows: for equalising the h.f. −3dB response to the m.f. level, 0-5; for best overall linearity 0-414; for best phase response 0-322; for best transient response without overshoot (critical damping) 0-25.

If the pentode section of a PCL84 which has a gm of 10-4mA/V is used with a load resistor of 2-6kΩ the stage gain at m.f. will be 10-4 × 2-6 or 27-04. It will be only 0-707 times this figure at the turnover frequency. Let's see what the inductance in microhens of a shunt coil required to achieve equalisation at this frequency, i.e. to raise the gain to the m.f. figure, is.

$$L = \frac{0.5 \times 2,600^2 \times 20 \times 10^{-12} \times 10^6 \mu H}{a \times R_L^2 \times C_s \text{ in } \mu H}$$

The response curve using a coil with this $a$ factor is shown in Fig. 1(c). It will be seen that the gain rises above the m.f. gain just before the uncompensated amplifier turnover frequency and equals the m.f. gain at this frequency. The response with a coil having an $a$ factor of 1 shows a more pronounced peak. Practical values tend to lie between 0-25 and 0-75.

**Series-compensated Circuits**

In series-compensating circuits the coil is connected in the signal feed from the anode of the video amplifier to the c.r.t. cathode. The arrangement functions by dividing the total circuit capacitance as shown in Fig. 2(a) where the divided circuit capacitance is represented by $C_1$ and $C_2$. It will be seen that the coil $L_c$ with $C_1$ and $C_2$ form a low-pass filter which gives a lift at the required point but sharply increases the attenuation to frequencies above the video passband.

Series-compensating arrangements can give slightly better results than shunt circuits but have the disadvantages that (a) the h.f. roll-off after the peak is steeper than for shunt types, (b) the component values are rather more critical while (c) the peaking coil inductance and effect is largely determined by how it separates the total circuit capacitance. This last factor is determined mainly by the physical position of the coil. Thus two types of graph must be considered in relation to series-compensating circuits, (a) a graph showing the response curves of coils with different $a$ factors and (b) a graph of curves showing the effect of varying the total capacitance division each side of a specified coil. The graph shown in Fig. 2(b) shows the effect on h.f. response produced by coils with different $a$ factors when $C_2$ is twice $C_1$. Another widely used ratio is with $C_2$ equal to three times $C_1$.

In some series-compensating circuits the peaking coil is connected in series with the anode load in a similar manner to Fig. 1(a): however as the c.r.t. drive is tapped from the junction of the coil and the load resistor instead of being taken direct from the
not only reduces the overall gain but also degrades the effect of increasing the load resistor value—as we saw in the formula previously given the correct inductance for any a factor depends on the circuit capacitance and the squared value of the load resistor.

Use of Cathode-followers

Although not so widely used cathode-followers (see Fig. 4) are found in many chassis as a means of increasing or maintaining h.f. response without recourse to the use of peaking coils. In video circuits the cathode-follower cathode load resistor is generally of equal or higher value than the pentode anode load resistor. The cathode-follower does not contribute voltage gain—indeed its output/input ratio is slightly less than unity—but enables the pentode amplifier to give greater amplification by freeing it from most of the stray and circuit capacitance so that a much higher value load resistor can be used. Whereas a video pentode used on its own generally has a load resistor of about 4.7kΩ, in circuits using a cathode-follower—for example many Decca and Bush-Murphy chassis—a pentode load resistor of up to 10kΩ without any compensation is used.

When a pentode feeds a cathode-follower the only capacitance present—except for the anode to chassis capacitance and that across the load resistor—is the triode cathode-follower's input capacitance, approximately Cga, which in this application does not exceed about 2pF. The c.r.t. input capacitance, wiring and feed component capacitances and that of the sync separator input are all transferred to the triode's cathode circuit. The input impedance of a cathode-follower is high so that it imposes negligible loading on the previous stage but its output impedance is low, being approximately equal to 1/gm and averaging only a few hundred ohms. For example the triode section of a PCL84 has a mutual conductance of 4mA/V so that when arranged as a cathode-follower its output impedance is roughly 1/(4 x 10^-4) or 250kΩ. This low output impedance arises from the fact that Ra = µ/gm and as the µ of a cathode-follower is about unity for all practical purposes Ra = 1/gm. The output impedance is strictly the parallel addition of Ra and the cathode resistor but as the latter is usually so very much greater than the former it has negligible effect.

The value of the cathode load resistor is mainly dictated by normal anode current considerations and must be large enough to permit the cathode voltage to be raised close to the grid voltage without over-running the valve. The stage gain is actually µ/(µ + 1). Thus increasing µ slightly decreases the disparity between the input and the output while the load resistor value, provided it exceeds the minimum value dictated by Ra, has no real effect on amplification.

As we saw previously an uncompensated video amplifier may have a total load shunt capacitance of about 25pF which has a reactance at 3MHz of 2.1kΩ so that the load resistor must not exceed this value if the response is to fall to only -3dB at 3MHz. The use of a cathode-follower will reduce the total shunt capacitance to about 7pF. Thus a proportionately higher value load resistor can be used, increasing the gain, or if the load is kept con-
Fig. 5: Use of negative feedback in the video amplifier cathode circuit. In (a) C1 decouples all frequencies except those approaching d.c. (Philips 210 chassis). In (b) C2 provides decoupling mainly at h.f., introducing negative feedback at m.f. and l.f. (BRC 1400 chassis). C3 in (c) fully decouples R4 but slight negative feedback is developed across R3 at m.f. and l.f. since C4 provides effective decoupling only at h.f. (Bush-Murphy A640 chassis).

stant the turnover frequency is increased proportionally. In practice a mid-position is chosen, i.e. a load resistor of greater value than can be used with a single pentode is employed and with the reduced load capacitance the turnover frequency is made much higher than with an uncompensated stage.

Use of Negative Feedback

The techniques so far described linearise the response by increasing the h.f. gain. There is however another method of linearising the response—by reducing the m.f./l.f. gain through the use of frequency-selective negative feedback. This commonly used technique is achieved by the use of cathode decoupling capacitor(s) with a value that offers negligible reactance at h.f. but a high reactance (capacitive reactance increases as frequency decreases) at m.f. and l.f. so that negative feedback, reducing stage gain, is introduced progressively at these frequencies.

Video Pentode Cathode Circuits

Figure 5 shows three typical video pentode cathode circuits. In (a) the 150Ω bias resistor is shunted by a 250μF electrolytic which gives virtually complete decoupling at all frequencies. In (b) the decoupler is only 3,000pF which has a reactance of more than 1MΩ at 50Hz while by proportion its reactance is 50Ω at 1MHz and 17Ω at 3MHz. Clearly although there will be some slight decoupling before 1MHz the decoupling only becomes fully effective towards the top end of the u.h.f. video spectrum. Thus negative feedback is applied at l.f. and m.f. but becomes negligible at h.f. where full gain must be maintained. Example (c) operates similarly but to a reduced extent because the main 270Ω bias resistor is fully decoupled by the large electrolytic only the 18Ω resistor being partially decoupled by the 3,300pF capacitor to give a small amount of l.f. and m.f. degeneration.

As with peaking coils many interesting experiments can be undertaken using different values of cathode decoupler. Where the smaller values are tried it is an advantage to use a compression trimmer so that the effect of adjustment can be observed.
It is often an advantage when using an oscilloscope for servicing or design work to be able to view two different waveforms at the same time. For example when measuring the gain and possibly the harmonic distortion of an amplifier, input and output waveforms can then be compared directly. If, as is usually the case, only a single-beam oscilloscope is available the experimenter need not despair however: it is possible to look at two different traces using a single-beam scope for the minimal outlay and time required to construct this twin-trace oscilloscope unit. No power supply is necessary and the only other instrument required is a signal generator to provide an output to switch on and off the two transistors used in the unit. The frequency range is limited only by the transistor types used and the method of construction adopted. The unit will operate satisfactorily from a few Hertz to well beyond the audio range.

**Circuit Description**

The circuit (Fig. 1) is extremely simple. The two transistors used act as electronic switches whose "on-off" repetition rate is determined by the frequency of the squarewave signals applied to their bases. During the first half cycle of the squarewave input one transistor is reverse while the other is forward biased. The transistors must be driven quite hard so that the reverse biased one is fully cut off (non-conducting) and the other one is fully on (bottomed).

Now suppose a signal is fed to one of the inputs—say Input 1—and the output from the circuit is monitored on an oscilloscope. During the half cycle that Tr1 is cut off this transistor presents a very high collector-to-emitter impedance to the incoming signal and thus acts as an open switch, having no effect on the signal. The incoming signal consequently passes straight through to the output terminal via one of the series isolating resistors RL1 or RH1 and may be seen on the oscilloscope. During the next half cycle Tr1 is turned hard on by the squarewave at its base and the collector-to-emitter impedance then presented to the input signal is extremely low, the transistor acting as a short-circuit (or closed switch). The incoming signal is thus clamped to ground and no signal is seen on the oscilloscope.

If now two separate input signals are connected to the unit, one to each input, and a switching waveform

![Circuit diagram of the unit. In the prototype a single double-pole changeover switch is used for S1, S2.](image1)

![External view of the prototype.](image2)

![Internal view showing method of construction.](image3)
The maximum frequency response or bandwidth of the unit depends on the mode of construction and the transistors used. Printed-circuit construction and the use of high-frequency transistors yields a very acceptable unit. If the instrument is housed in a metal box the box itself may be used as a common earth point and coaxial sockets may be fitted for the inputs and outputs.

Having constructed the unit and thoroughly checked that there are no errors it may be tested. First plug into Input 1 one of the signals to be observed and ensure that switch S1 is set in the appropriate impedance position. Because of the nonlinear nature of the transistor a sinewave input signal will appear on the oscilloscope—connected at the output—as in Fig. 2 (a). If phase relationships between input signals are to be observed then synchronise the oscilloscope with this input signal: adjust the oscilloscope timebase so that about eight complete cycles are observed on the screen.

Next connect the squarewave generator and set the frequency to about half that of the signals being observed. Increase the generator output level until the trace appears as in Fig. 2(b). If only a sinewave oscillator is available it will be found that a higher drive voltage is necessary and the trace will not be as good.

To observe one trace directly superimposed over the other the oscilloscope timebase frequency is decreased so that the trace appears as in Fig. 2(c). Finally the second signal to be observed is fed into Input 2 to give—in the case of a sinewave input—a trace such as Fig. 2(d) or (e). The unit has numerous uses including the design of transistor amplifiers, filters and radio receivers and if correctly built will have a bandwidth equal to that of the oscilloscope with which it is used.

Although not tried by the author improved performance and a simplification in the drive requirements could be obtained by the use of an npn-pnp complementary pair of switching transistors.

**FOR THE SERVICE ENGINEER . . .**

Telequipment have introduced a 25MHz bandwidth oscilloscope with full delayed timebase facilities, 3% measuring accuracy and an 8×10cm. viewing area for less than £300.

Newmarket Transistors Ltd. have introduced the NKT-Servikit for service engineers. This contains an updated range of 23 NKT transistors (germanium and silicon types) and diodes which the company claims can be used to replace over 90% of the faulty devices likely to be encountered in servicing radio and TV sets. The Servikit container is easily replenished and comes complete with substitution guide. The recommended retail price for each kit is £10.95.

Adcola have introduced a new range of lightweight, thermally-controlled soldering irons called the Invader range. They feature Noryl plastic handles which remain cool over long periods of use and are claimed to be the slimmest available irons at wattage ratings of 25 and 27W. There are seven stock voltages—6, 12, 24, 50-55, 110, 220 and 230-250V and any specific bit temperature between 250 and 410°C can be supplied. The temperature at the bit face is thermally controlled to ±10°C. Recommended price of the largest tool is £195.

Antex have introduced a 12V soldering iron, type MES12, which comes complete with crocodile clips for direct connection to the battery terminals, 15ft. of two-core lead and a durable plastic wallet. The UK recommended price is £1.95.
No Results

This implies that the receiver is totally inoperative. A glance in the back however will nearly always show
that the valves are glowing normally. This suggests
that the h.t. is out of action and the cause is nearly
always an open-circuit section of the dropper. From
the mains input at the centre of the dropper there are
three sections to the front end of the set. For some
reason the centre section of the three is the section
which is the first one to go. It has a value of 17Ω
and although this value is not critical (14-22Ω is good
enough) it should not be shorted out. With a Radio-
spares dropper section and two PK screws replace-
ment can be effected in minutes without soldering.

When one of the other h.t. sections fails the screwed
on section can be removed and a 33Ω resistor fitted in
its place. The new faulty section can then be linked
across. By this means the total value remains sensibly
the same and the dropper does not resemble a Christ-
mas tree with bits hanging all over it with the all
too often attendant poor soldering.

So here is the first and easily the most common

fault which will be encountered. Having said that
the very next one on the bench has to have an open-
circuit section on the heater end. Well, it happens!
In this case the valves were not lighting and a neon
check showed that R150 was at fault.

Blown Fuse

It is often the case that there is no indication of
mains voltage at any part of the set including the
on-off switch. If it is known that the supply source is
in order it remains to check the supply lead and the
input fuse FS1. This latter item is not in a convenient
clip. It is suspended in the mains wiring to the on-off
switch in a similar manner to a car radio fuse. This
1.5A fuse will often be found to be blown and not
merely melted. There are many possible reasons for
this and a new fuse will probably meet the same
fate. The reader may well say: "Well, if the fuse has
failed in such a manner a meter check will reveal a
dead short which should be rectified before a new fuse
is fitted". Quite so. But what if there is no short?

When one meets this one it is prudent to disconnect

Fig. 3: Layout of the i.f. printed board, viewed from the tin-dip side.
Field Timebase

Troubles in the field timebase are probably the next most frequent complaint. The usual advice applies here, which is to replace the PCL85 first. If the trouble continues one can then look further.

A frequent offender is C156, 0.05μF. This tends to become open-circuit (not leaky) thus failing to filter the line sync pulses out of the field sync circuit and presenting an enlarged, distorted pulse to the field oscillator. Needless to say, this upsets the oscillator and it is impossible to lock the picture vertically. A test capacitor bridged across the suspect will confirm whether this is indeed the fault.

Insufficient height is quite a regular fault. Having checked the PCL85 the next item to check is R132 (12MΩ) in the boost feed to the oscillator triode V9A. This often rises in value to cause an equal loss of height top and bottom. On more than one occasion however the writer has found C179 (0.01pF) leaky to cause the same effect.

When the loss of height is far more accentuated at the bottom, the top being stretched in relation, check C154, R108 and the linearity control P8. C151 and C155 are less often at fault in these more recent chassis.

Moving over a few inches (on the chassis of course) we come to the line oscillator stage. The oscillator valve is a PCF802 and this is most often at fault when it is found to be impossible to lock the picture horizontally, the line hold control having no effect at all. A new PCF802 should put matters right but on the odd occasion it may be found necessary to check the line discriminator diodes (MR1-MR2) as an unbalance here will upset the oscillator frequency or perhaps stop it altogether.

Check the value of R117 and R118 if the locking position has moved to the end of the control.

Lack of Width

Whilst this is normally due to a worn PL500 (PL504) the width control should not escape attention as a dud spot can develop on this (P11, set boost). Operating the control will immediately prove whether it is at fault or not. Whilst the PY800 could be at fault this is more likely to develop arcing inside and is obvious on inspection. A quite alarming variation of this happens when the insulation of the linearity sleeve on the tube neck punctures due to discharge from the line coils. This produces some fireworks on the screen (and sound) and rapid variation of width, tending to lead one to suspect the line output transformer. Withdrawing the sleeve from the coils will prove whether or not it is at fault.

No Picture

If advancing the brilliance produces nothing on the screen at all switch to v.h.f. and note whether the line whistle is normal. If it is, the screening and check whether the DY86 is lighting up. If it is not the chances are that this valve has an open-circuit heater and needs replacing. If it is lighting up the e.h.t. is probably in order and the fault is in the supplies to the tube base socket. A voltage check here will probably show absence of supply to the first anode (pin 3). The decoupling capacitor C197 (0.05μF) may well be shorted. A replacement should
Fig. 5: Circuit diagram, GEC-Sobell 2012-1012 series. All voltages measured on 405 lines with 245V a.c. mains input. Transistor readings taken on 25V range of 20kΩ/V meter with no signal and contrast control at maximum. V1A and V2 readings taken under similar conditions, other valve voltages measured with signal to just lock the timebases.
be rated at 1kV. This and C198 are wired above the tube and form part of the spark discharge circuit which must be kept intact to preserve the transistors.

For the same reason no spark tests should be made on the line output and e.h.t. circuits.

—continued on page 473
Few complaints this month! Excellent Sporadic E conditions have been maintained throughout May with sustained periods of activity for hours at a time. There seems at the time of writing no lull in these conditions. Possibly we are in for the best season for some years— I hope so! As there have been so many openings I propose to give details of my log on the most active days only in order to save space for the considerable number of news items this time.

3/5/71 NRK (Norway) E4; Sweden E4; USSR R1, R2; Czechoslovakia R1, R2; ORF (Austria) E2.

7/5/71 CT (Czechoslovakia) R1; Sweden E2; TVE (Spain) E3; also unidentified signals.

11/5/71 CT R1; also many unidentified stations on R1, R2.

15/5/71 RAI (Italy) 1B; TVE E2, E3, E4.

19/5/71 Sweden E2, E3; WG (West Germany) E2, E3; DFF (East Germany) E2, E3; TVE E2; RAI 1A, 1B; ORTF (France) F2; JRT (Yugoslavia) E3; TVE (Poland) R1, R2; USSR R1, R2; Rumania R2, R3.

20/5/71 TVE E2, E3, E4; CT R1; USSR R1, R2, also unidentified signals.

22/5/71 TVB E2.

23/5/71 RAI 1A, 1B; RAI 1B; JRT E3, E4; TVE E3; ORTF F2; also unidentified signals.

24/5/71 JRT E3, E4; RAI 1A; ORF E4; WG E2; also unidentified signals.

26/5/71 USSR R1, R2, R3; TVP R1, R2; TVE E2, E3, E4; also unidentified signals.

28/5/71 RAI 1A, 1B; JRT E3; ORF E2a, E4; TVE E2, E3, E4; also unidentified stations on R1, R2.

These loggings were solely via SpE and unfortunately many of the openings were already in progress when I switched on. Good openings reported by other enthusiasts were on 10/5/71; 14/5/71; 17/5/71; 21/5/71; 27/5/71.

The opening on May 3rd allowed the first detailed examination of the mystery test pattern on R1 noted in last month's column. Consisting of frequency response gratings, various black/white squares, contrast scales, etc. and with a circle, it carries the identification CS U 01 grating. Various black/white squares, contrast scales, examination of the mystery test pattern on RI noted in May 26/5/71 USSR RI, R2; TVP RI, R2; TVE E2, E3, E4; also unidentified stations. On July 14/71 the new electronic test card mentioned recently. On May 20th Maurice also noted the EBU test pattern in use by Hungary on R1. Apparently they are using both the plain type and another carrying the identification MT Budapest. With Poland and Rumania both using this pattern our problems seem to be mounting1.

News

Yugoslavia: We noted recently that Italian programmes are being radiated from Yugoslavia and now have full information. A 400kW ch. E27 transmitter located at Nanos (near Ljubljana) is now testing and broadcasting news bulletins and other programmes in Italian and Yugoslavian. These transmissions—in colour—cover a wide area along the Adriatic coast as far south as the Italian town of Ancona and a considerable part of the inland zones. Following this news I have just heard that Tele-Monte-Carlo is planning a projected high-power colour TV transmitter, its coverage to include Northern Italy, using SECAM.

Belgium: A new 1000kW transmitter is being constructed at Egem, South of Bruges, and will operate on ch. E43. Luxembourg: As from September 1st, 1971 CLT-Television Luxembourg will cease 819-line transmissions on E7, changing to 625 lines with positive image (similar to ORTF-2). The station is planning colour transmission (SECAM) on ch. E7, but later new and higher aerials will be in use for both E7 and E21 uhf. with both transmitters radiating similar programmes. At present we have no details regarding power but Luxembourg has always been a problem for DX enthusiasts. Possibly this will now become an easier signal.

Sunspots: Predictions of smoothed monthly counts: May 69, June 67, July 64, August 61, September 59, October 57. Courtesy of the Swiss Solar Observatory.

From our Correspondents

Last month I mentioned that Doug Bowers (Saltash) had received TVE-Spain via tropospheric reception in Band III. Doug has since kindly sent us the full information: ch. E7 23.45-24.15 BST on 18/12/70; a quiz programme followed by the news and the usual close down sequence. The signals were fairly strong with a characteristic slow fade. The station is located in the South of Spain at Sierra de Lujar-Granada and uses 200kW. This at almost 880 miles is extremely good going—our congratulations on this achievement! Some of the longer established DXers may recall Doug's reception of Madrid ch. E24 some years ago.

Paul Gardiner (Aldershot) has written to tell us of his reception in his area including Bergen ch. E9 via tropospheric reception in Band III. Doug has since kindly sent us the full information: ch. E7 23.45-24.15 BST on 18/12/70; a quiz programme followed by the news and the usual close down sequence. The signals were fairly strong with a characteristic slow fade. The station is located in the South of Spain at Sierra de Lujar-Granada and uses 200kW. This at almost 880 miles is extremely good going—our congratulations on this achievement! Some of the longer established DXers may recall Doug's reception of Madrid ch. E24 some years ago.

Paul Gardiner (Aldershot) has written to tell us of his reception in his area including Bergen ch. E9 via tropospheric reception in Band III. Doug has since kindly sent us the full information: ch. E7 23.45-24.15 BST on 18/12/70; a quiz programme followed by the news and the usual close down sequence. The signals were fairly strong with a characteristic slow fade. The station is located in the South of Spain at Sierra de Lujar-Granada and uses 200kW. This at almost 880 miles is extremely good going—our congratulations on this achievement! Some of the longer established DXers may recall Doug's reception of Madrid ch. E24 some years ago.

Keith Hamer (Derby) has written with an interesting list of stations received during the recent (and current) good conditions. He too has noted the new Czechoslovakian test pattern on ch. R1 and also the rather
difficult Danmarks Radio transmitter an ch. E3 at Fyn.

George Sharples (Malta) has sent a most interesting letter about the conditions in his part of the Mediterranean. Egyptian and Libyan transmitters are often received. The Libyan test card apparently resembles the ORTF French card: the main difference appears to be the inclusion of an eagle in the centre, with Arabic writing above and below, and originates from Tripoli ch. E6. Once again our friend A. Papaeflychiou (Cyprus) has forwarded useful information which we are pleased to pass on. He mentions four stations—which can be termed “exotics”—that may just be possible via multiple-hop SpE in the UK: Jordan E3 (the test card was shown in November 1970 TELEVISION); Lebanon E4 (see accompanying photograph); Tehran—Iran ch. A3; Dahran—Saudi Arabia ch. A2. The last two are 525-line signals. We are most grateful for this information: who will be the first to receive one of these exotics, I wonder?

Finally Michele Dolci (Italy) has reported some remarkable happenings in his area of Bergamo, Northern Italy. An Italian firm has built a series of relay stations—continued on page 469
We have seen that the NTSC specification of November 1951 was well on the way to the modern standard but specified colour phase alternation (CPA) in line with the principle of the PAL system of the mid-sixties. During 1952 RCA became dissatisfied with this standard because of visible flicker at high luminance levels and the effort later to be known as "Hanover Blind", though it was admitted that the system could produce very good pictures. To avoid crosstalk and so enable them to dispense with CPA the RCA engineers concentrated on reducing the bandwidth of the colour signal so that the colour response was as closely as possible trimmed to the response of the human eye. They ended up with a system (first tried in mid-1950) which used the full bandwidth for the luminance signal, a fairly wideband signal (I) of "mixed highs" which could distinguish orange-red from blue-green and a narrowband colour mixture signal (Q) for large areas only which could distinguish such colours as green from purple. The different bandwidths of the I and Q signals were based on the fact that the eye has maximum colour sensitivity—and can thus distinguish finer colour detail—along the orange-cyan axis and has minimum sensitivity to colour detail in the green-purple range.

The wider band mixed-highs signal was modulated as a vestigial sideband on to the subcarrier but the narrowband signal was modulated as a double-sideband signal. Because the signals overlapped very little in frequency response and sideband use the crosstalk was very much lower than in previous systems, making the use of CPA unnecessary. This development was demonstrated to the NTSC in the summer of 1952 and as a result the NTSC published a "Revised Specification for Field Test of NTSC Compatible Colour Television" on February 2nd 1953.

The whole specification of the NTSC signal occupies some four pages and we shall look only at the sections which are of particular interest. The specification gave the composition of the colour signal $E_M$ as:

$$E'_M = E'_Y + [E'_Q \sin (\omega t + 33^\circ) + E'_T \cos (\omega t + 33^\circ)]$$

where $E'_Y$ is the monochrome signal and the prime signifying that the signal is gamma corrected—a process which causes some errors to appear later in the colour signal.

$E'_Q$ is defined as $0.41 (E''_R - E''_Y) + 0.48 (E''_R - E''_Y)$ and is the narrowband signal while $E'_T$ is defined as $-0.27 (E''_R - E''_Y) + 0.74 (E''_R - E''_Y)$ and is the wideband signal.

The white signal $E'_Y = 0.30 E''_R + 0.59 E''_O + 0.11 E''_B$.

The numbers used to multiply the colour signals sometimes cause confusion. They are not arbitrary but arise from the measurements on vision made earlier. For example the proportions of red, green and blue shown as 0.30, 0.59, and 0.11 make up 1.00 exactly and are in such ratio as to give standard white. The situation is the same for the numerical parts of the $E'_O$ and $E'_I$ signals. These are chosen to give colours which match as closely as possible the range corresponding to narrow and wide bandwidth respectively, all of which depends on the sensitivity of the human eye. In these cases the numbers do not add up to 1.00 because their total is not a white signal. The sum is in fact chosen to give a convenient depth of modulation for the chroma signal.

**Field Trials and Survey**

RCA, now certain that they had a workable colour system, then started a final set of field trials which lasted from 2nd-5th June 1953. Questionnaires were handed out to each audience in the lounge of the Cantor Theatre, West 49th Street, New York. The audiences were composed of members of the public who were touring the NBC studios. 763 questionnaires were received back and analysed in remarkable detail. Separate figures were taken of those connected with the industry and those unconnected and the total number was sifted into ranks according to sex, age group, educational background, previous experience of TV and home location. To allow for receiver differences the number of each receiver watched was noted and also the time and date of the show and whether it was a closed circuit, microwave relay or coaxial cable relay transmission.

Summing up the detailed results 85% thought colours much more enjoyable as compared with 13% who were more cautious. 50% rated the overall quality as excellent, 37% as very good; 46% thought the clearness of detail excellent, 39% very good.

About 24% of the non-industry audience mentioned defects in the pictures but few of these said this interfered with their enjoyment of the pictures and there was little agreement about what marred them. As might be expected from the variation of colour vision from one person to another the largest single complaint was that the colours were "not true to life". This amounted to about 5% of the 24% who mentioned defects. In this respect it is interesting to note that a test made later—not by RCA but by the psychology department of a University—found that people made the same complaints about colour when they were looking at an actual scene framed in a...
window which had been made to look like a cinema screen!

The earlier field trials mentioned in Part 1 had indicated complete approval of the black-and-white reception of the colour signals so that another link had now been forged in the strong chain of evidence in favour of the RCA colour system.

**Display Tubes**

The ingenuity spent on the development of methods of coding the colour signal would have been wasted without the development of a suitable method of display and a full-scale programme was also being undertaken by RCA on this side of colour TV. By 1940 mechanical systems using a monochrome c.r.t. in conjunction with a colour scanning disc as described in Part 1 had been developed to their apparent limit but there were severe limitations in the size and the speed at which the disc could be rotated. Early in 1940 RCA demonstrated to the FCC a system using three c.r.t.s whose colour images—using different phosphors—were combined on to one screen by projection, thus cutting out all mechanical moving parts, while in 1942 Baird had shown a c.r.t. which produced two colour images which were combined optically in the tube. His patent applications in 1942 and 1943 showed other developments such as two-sided phosphor screens which he demonstrated in 1944 (Fig. 1).

The actual building of a three-colour tube did not take place until improvements in e.h.t. generation, deflection (particularly line) and better phosphors became available after the war. RCA engineers then worked intensively on these problems so that by early 1950 it was possible to demonstrate what is now known as the shadowmask tube.

On the way to this nearly every scheme known for colour presentation was considered. There was the beam deflection tube in which a single electron beam (Fig. 2) scans a tube face on which parallel horizontal lines of phosphors are laid in an RGB sequence. As the beam scans a line it can be deflected to R or B or left at G according to the colour required or the scanning can be continuous to produce white. This required an impossible scanning accuracy. Beam sensing tubes were also considered, with the beam now scanning across a set of RGB lines and a sensing device incorporated to indicate the position of the beam (on R, G or B) and thus establish which colour signal should be fed to the cathode at any instant. This was abandoned because in the late 40s no sensing device available seemed suitable. Later developments of this and other tubes were covered in *Tubes for Colour TV*, PRACTICAL TELEVISION September 1970.

Adjacent image tubes which presented three separate pictures in primary colours on one tube face with the three combined by a prism were tried but the snag here was registering the three images together. Baird's system of two-colour operation with phosphors of different colour on the two sides of a mica sheet scanned by two separate electron guns was rejected because of its limited colour range. Electron velocity tubes seemed attractive: they used three layers of phosphor on the screen the idea being that a low-velocity beam would excite the first layer to produce one colour, faster electrons would penetrate to the next layer so changing the colour while the fastest electrons would penetrate to the third layer. The electron velocity could be changed by using one gun with variable e.h.t. or three separate guns with different e.h.t.s. Pure colour could not be obtained with this system while single-gun e.h.t. switching or the registration of three guns with different e.h.t.s proved extremely difficult.

**The Origin of the Shadowmask Tube**

The method which seemed more promising than all the others was electron shadowing (Fig. 3). W. Flechsig had proposed in 1938 the use of a screen with lines of colour phosphor shadowed by a wire grid so that the colour of the phosphor struck by an electron beam would depend on its direction of approach to the screen. This principle could be used for simultaneous colour display by arranging for —continued on page 465
A number of set-top u.h.f. aerials made from tinned copper wire or brass rods were described in the August and September issues last year. These all suffer from the limitations of indoor installations at u.h.f. The building materials used absorb and deflect u.h.f. signals so that the picture quality obtained is often poor. In many cases transfer of the aerial to the loft gives no better results. Signal fluctuations due to the presence of people and objects in a room are then eliminated but many roofing materials are particularly absorbent at u.h.f. This attenuation increases with increasing frequencies and is particularly noticeable in Band V.

An example which illustrates the difficulties with indoor aerials at u.h.f. was an attempt by the author to receive the Heathfield Band V transmitter in Burgess Hill at a distance of 15-20 miles. A bisquare set-top aerial gave a low-contrast picture. Its most effective position was by a window, about a foot above the sill: no other part of the room gave anywhere near usable results. An attempt was therefore made to use a loft aerial. Since Heathfield is a Group D transmitter a log-periodic aerial for channels 49-68 was constructed. Holding it outside the window gave an extremely good grain-free picture but when it was put into the roof space above the set using the same short length of low-loss cable only a very poor picture could be obtained. In fact at no position was the picture as good as had been obtained with the set-top bisquare. The loss of signal through the roof was extremely marked. In order to receive BBC-2 at this site without adding to the ironmongery already on the roof the only remaining alternative was an outside wall-mounted aerial. A seven-element Yagi was therefore constructed and mounted just under the eaves: the results were first rate and this small, unobtrusive wall-mounted aerial solved the problem.

Many flatdwellers can use only a set-top or loft-mounted aerial and have to put up with inferior pictures. The only satisfactory set-top aerial found by the author for relatively weak signal strength areas was a log-periodic type. An outside version however mounted perhaps on the windowsill or just alongside will in many cases produce a marked improvement, particularly in eliminating the effects of people moving about in the room. In this article three u.h.f. aerials designed for outdoor use are described, a bisquare, the Yagi just mentioned and a rather more complex log-periodic type. Similar construction techniques are used in all three and the following introductory notes should be read before attempting to build any of them.

**Constructional Notes**

The construction of an outside aerial must be much more robust than that of a set-top or loft one. An outside aerial must withstand wind and corrosion and one of the greatest problems for the home constructor is to provide adequate insulation for the terminals and their protection from the weather. Aluminium was chosen for construction because it is both light and strong. One of the aerials uses half-round strip and channel, another tubing and channel and the third strip and tube. In all cases the mounting bracket is thick sheet aluminium.

All nuts and bolts should be cadmium-plated steel if available. If not steel can be used but should be treated with an antirust compound such as Jenolite. The exposed ends of the cable where they join the elements should be covered with a good thick coat of Bostik White Seal and this compound should also be put over all unplated nuts and bolts after assembly to reduce still further the risk of corrosion. If brass nuts and bolts are used they must also be covered with Bostik to avoid electrochemical reaction with the aluminium. Brass was not used in the construction of these outside aerials because of its weight, cost and brittleness: constant flexing in the wind could lead to metal fatigue over a long period.

**Bisquare Aerial**

The use of aluminium strip and channel gives a rigid outside version of the popular indoor bisquare aerial. This is extremely light and small and can be used where the seven-element Yagi described later is considered to be too obtrusive. The elements are made from $\frac{1}{4}$in. half-round aluminium strip, the cross boom is cut from $\frac{1}{8}$in. aluminium channel and the
The seven-element Yagi for Group C channels weighs 9 1/2 oz. and is less than 2 ft. long. The dimensions were derived experimentally by comparing two costed transmissions on channels 50 and 66. It may be used for Groups C and D as it stands or the dimensions given in Table 2 multiplied by 1.5 for Group A or by 1.2 for Group B.

### Table 1: Bisquare aerial element details.

<table>
<thead>
<tr>
<th>Aerial Group</th>
<th>Dipole side length LD (in.)</th>
<th>Reflector side length LR (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>5.6</td>
<td>5.75</td>
</tr>
<tr>
<td>B</td>
<td>4.3</td>
<td>4.6</td>
</tr>
<tr>
<td>C</td>
<td>3.6</td>
<td>3.75</td>
</tr>
</tbody>
</table>

The spacing between the elements is the same as the dipole side length.

For Groups D and E the bandwidth of this design will probably be inadequate to cover all the channels allocated.

### Seven-element Yagi

The seven-element Yagi for Group C channels weighs 9 1/2 oz. and is less than 2 ft. long. The dimensions were derived experimentally by comparing two costed transmissions on channels 50 and 66. It may be used for Groups C and D as it stands or the dimensions given in Table 2 multiplied by 1.5 for Group A or by 1.2 for Group B. It is not recommended for Group E transmitters (for these the log-periodic aerial to be described next is likely to be more satisfactory). The Yagi may be used for either vertical or horizontal polarisation.

The cross bar is cut from 1/8 in. aluminium tubing and all the elements including the folded dipole are made of 1/16 in. half-round aluminium strip. Only seven elements were included in the design in order to make a reasonable compromise between the gain and weight of the aerial.

The five directors and the reflector are cut from the strip and a 4BA clearance hole is drilled at the middle of each. This should not be countersunk. (The prototype lost three directors in high winds due to the use of countersunk holes which weakened the metal.) Cheesehead bolts with washers are used to attach these elements to the boom. The folded dipole, also cut from strip, is made as shown in Fig. 5. The dipole is spaced from the boom at its locating side by a 1/8 in. long piece of 1/16 in. aluminium tubing. A curved groove is filed in the top of the spacer to locate the dipole in position at 90 degrees to the boom.

Small grooves are also filed in the boom at the appropriate places for the other elements to prevent them twisting in the wind. Details are shown in Fig. 6. Fig. 7 shows the cross bar assembly. Holes X and Y are 2BA, all the others 4BA clearance. If the polarisation required is vertical then X and Y are drilled at right angles to the direction shown.

The assembled aerial is mounted on a 10 or 12 s.w.g. aluminium bracket which should be Rawl-plugged and screwed to the wall. Holes X and Y are used to fix the cross bar to the bracket. Details are shown in Fig. 8. Hole A acts as a pivot for a 2BA...
the extra signal gained from an outside aerial to a set is needed. Poor quality cable is likely to reduce low-loss cable must be used if a long run from the room in which the set is installed is at the opposite regulations forbid the use of an outside aerial. The aerial can be sited under the eaves where recommendations because of size and weight considerations. The aerial can be sited under the eaves where regulations forbid the use of an outside aerial. If the room in which the set is installed is at the opposite side of the house to the direction of the transmitter, low-loss cable must be used if a long run from the aerial is needed. Poor quality cable is likely to reduce the extra signal gained from an outside aerial to below that obtained in the room using a set-top aerial.

Table 2: Yagi element lengths and spacings.

<table>
<thead>
<tr>
<th>Element</th>
<th>Size (in.)</th>
<th>Spacing (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflector</td>
<td>7.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Folded dipole</td>
<td>7.0</td>
<td>2.9</td>
</tr>
<tr>
<td>Director 1</td>
<td>6.4</td>
<td>2.9</td>
</tr>
<tr>
<td>Director 2</td>
<td>6.1</td>
<td>2.9</td>
</tr>
<tr>
<td>Director 3</td>
<td>5.7</td>
<td>2.9</td>
</tr>
<tr>
<td>Director 4</td>
<td>5.6</td>
<td>2.9</td>
</tr>
<tr>
<td>Director 5</td>
<td>5.5</td>
<td>2.9</td>
</tr>
</tbody>
</table>

Log-Periodic Aerial

A previous article (PRACTICAL TELEVISION, September 1970) described the principles and practice of log-periodic aerials with details for the construction of a set-top model. The version described here is suitable for outside use in fairly sheltered positions.

The coverage of the u.h.f. transmitters is planned to give a minimum usable signal strength in a service area of 70dB above a microvolt (3mV). At these high frequencies the scatter of signal strength around a median value is very great and this means that it is quite possible to find near "dead spots" very close to good receiving sites. Very careful aerial siting at u.h.f. is therefore necessary.

The best aerial for use in difficult conditions is a log-periodic. It has very good directional properties and is capable of laying "ghosts" very effectively and suppressing co-channel interference. It also has extremely wide bandwidth, giving virtually even gain over a preselected group of channels. The version described here was built by the author for use in an area of very high signal strength but many ghosts. For this purpose it gives grain- and ghost-free pictures from a loft-mounting position. Dimensions are also given for a Group E version for channels 39-68 which is rather too broad a bandwidth to be covered adequately by most of the conventional models suitable for home construction.

To the uninitiated the log-periodic aerial at first sight looks like an ordinary Yagi array. More detailed examination however shows several marked and important differences. First there are two parallel cross bars about 4in. apart instead of one. They are shorted together by a conventional single reflector at the rear end. Secondly, cable connections are made at the front, the inner of the low-loss coaxial cable to one boom and the outer to the other. Thirdly, all the elements apart from the reflector are active and contribute to the total output from the aerial. Each dipole has one element on either boom and this arrangement alternates along the aerial. Starting from dipole one, this might have its left-hand element on the top boom and its right-hand one on the bottom. The next would therefore have its right-hand element on the top boom and its left-hand one below and so on alternately. The lengths and spacings of the elements are in logarithmic relationship with one another, becoming shorter towards the front of the aerial.

Since all the elements are active, all those at or near resonance at any given frequency contribute to the output. This means that the bandwidth is extremely broad and this was originally the prime interest in log-periodic aerials. However, it was found that the polar diagram was extremely good and that they thus had excellent anti-ghost properties. For both these reasons this type of aerial is well worth considering in difficult reception areas.

To maintain the polar response, it is necessary to mount the aerial at the rear of the reflector and not to put any support along the booms. Similarly the cable must be brought back along one of the booms before being taken down to the set. Log-periodic aerials are suitable for both vertical and horizontal polarisation. For rigidity an insulator such as a nylon screw with locking nuts is used to hold the two cross bars parallel.

One disadvantage is that with a log-periodic aerial designed for the full u.h.f. bandwidth only a few elements are at or near resonance at any given frequency. Consequently a 20-element log-periodic aerial for channels 21-68 would be equivalent to only an 8- or 9-element Yagi. Its polar response however is much superior and ghosts are greatly attenuated. For

---

![Fig. 9: Log-periodic aerial assembly details. All holes except A and B are 4BA clearance. The slots in the cross booms serve to secure the dipole halves in position. One half of each dipole is on each boom, alternating between top and bottom. The spacer to hold the reflector is cut from 1in. of channel. The upper boom extends 2in. behind the reflector to take two 2BA mounting bolts through holes A and B.](image-url)
specialist purposes such as Group E use, a log-periodic aerial can be designed to give uniform gain over a predetermined bandwidth. Details of the calculation of element sizes for any frequency were given in the September 1970 issue of Practical Television.

**Constructional Details**

Both cross bars are cut from \( \frac{3}{4} \)in. aluminium channel. The upper one extends two inches behind the lower one to provide a means of fixing to the wall mounting bracket. This bracket is made from 12 swg aluminium sheet and is of the same type as used with the other aerials described in this article. Two 2BA clearance holes are drilled to take the fixing bolts. All elements are cut from \( \frac{3}{16} \)in. aluminium tubing.

Figure 9 shows how slots are cut in the side of the channel just wide enough to accommodate the dipole rods. The channel wall is then bent out horizontally to support each dipole rod. 4BA clearance holes are drilled through the rod and channel to lock each element in place.

The reflector is mounted in a \( \frac{3}{4} \)in. long spacer of the same channel material and a bolt joins it to the two booms. For additional strength extra bolts are required farther down the cross bars. These must be made of insulating material and should if available be nylon. Lock nuts are then positioned on the bolts so as to keep the bars parallel. If nylon bolts are not available a wood block secured by screws may be used instead.

For weather protection all steel nuts and bolts should be rust proofed and finally protected with a thick coat of Bostik White Seal. The same material must also be put liberally over the cable joints. The cable is connected to the front pair of elements by means of a second nut and two washers on the securing bolt of each one, put on after the first locating nut is fully tightened. The cable is taped to the lower boom and brought back to the reflector before being taken away.

The model constructed by the author is a six-element one for channels 21-34 (Group A). Table 3 shows the dimensions for this and for a seven-element version for channels 39-68 (Group E).

In the event of difficulty in obtaining any of the materials required for these aerials most are usually obtainable from the Metal Department of Bennett's Ltd., North Road, Brighton. They are willing to fulfil orders by post.

### Table 3: Element lengths and spacings for a log-periodic aerial.

<table>
<thead>
<tr>
<th>Element</th>
<th>Group A</th>
<th>Group E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (in.)</td>
<td>Spacing (in.)</td>
</tr>
<tr>
<td>Reflector</td>
<td>11.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Dipole</td>
<td>2 x 5.5</td>
<td>3.6</td>
</tr>
<tr>
<td>Dipole</td>
<td>2 x 5.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Dipole</td>
<td>2 x 5.0</td>
<td>3.3</td>
</tr>
<tr>
<td>Dipole</td>
<td>2 x 4.7</td>
<td>3.1</td>
</tr>
<tr>
<td>Dipole</td>
<td>2 x 4.4</td>
<td>2.9</td>
</tr>
</tbody>
</table>

The rainbow revolution —continued from page 461

 beams from three guns to reach the screen from different directions or for sequential display by deflecting a single beam so that it could point at each of the three phosphors in turn. It is worth noting that alternatives to the three-gun shadowing display require the colours to be displayed in sequence. At the time of Flechsig's proposal the techniques were not available to construct such a tube though a similar principle is now used in the Sony Trinitron tube.

RCA rejected the wire-shadowing scheme because of the difficulties of making a large-screen version (16in. was thought to be a suitable size to aim at) and instead studied a method which used a screen of tiny glass pyramids (Fig. 4) each side of which was coated with a phosphor of different colour. The difficulty here was in getting the scanning beams to approach the screen at angles such that they would strike only one colour: with wide-angle pyramids scanning was almost impossible while with narrow angles most of the light from the phosphors was lost sideways—as was the case with other geometrical shapes tried.

Printed circuits were at this time under development and the techniques for reproducing patterns in metal by photographic means had been greatly refined. The work being done by RCA in this field became of interest to the colour tube team because it showed the possibility of perforating metal plates with large numbers of accurately located holes which could be used to guide electron beams to colour phosphor dots on the face of the screen. Studies showed that tubes could be made in which a variation of one degree in the angle of approach of the electron beam could change the display from one primary colour to another. It would of course be necessary to use a large number of holes and colour dots to avoid coarse resolution but the photographic printing techniques which were being developed seemed perfectly suited to doing just that.

The tube using the shadowmask—as it was called—could be built in either three- or single-gun versions. The single-gun version used deflectors to move the beam so that it approached the shadowmask from different angles. For some reason this version does not appear to have been developed, possibly because of the extra circuitry needed to change the simultaneous NTSC signal to the sequential signal required by a single-gun tube. It is intriguing however to speculate on what might be made of such a system now.

**CONCLUDED NEXT MONTH**
Montreux differs considerably from its London counterpart (the International Broadcasting Convention) on which we reported in January. Undoubtedly the technical papers presented are poorer in quality and content while the exhibition is much broader—in fact the exhibition has rather begun to run wild.

The afternoon session of the first day consisted of seven country reports—from Canada, France, Germany, Italy, the UK, the USA, and a surprise one from the USSR.

**World-wide Reports**

It was the first time that Canada has described her television system at Montreux. The nationally owned CTV activities (the Canadian Broadcasting Corporation (CBC)) has adopted the policy of extending television coverage to every community and viewer—in the southern, populated areas this presents little difficulty but the extension to the less populated northern territories via microwave links is very uneconomic. This difficulty was not eased when the whole system was converted in 1966 to colour operation. Apart from the coast-to-coast English service there is also a French language network from Montreal eastwards. In addition there are privately owned stations and a private company network. It is planned to overcome these problems with a satellite and a large number of earth receiving stations which are due to become operational in 1973. Until the satellite service begins the programme distribution to more remote areas will continue on the present basis-weekly aircraft delivery of videotapes, which is hardly immediate television!

It was of surprise to many delegates that Italy had still not officially started a colour service. In fact the Italian government has not only not given RAI the go-ahead for colour but has not officially decided on the colour system to be used. This is confidently expected to be PAL and Italian programmes and OBs have been seen over the Eurovision network emanating from the present four colour studios and three OB units. All distribution as well as programme transmission and origination is handled by RAI from their Rome master control. The programmes themselves originate in four television centres at Turin, Milan, Rome and Naples. Transmission of the two programme services is currently from 37 main stations and 748 relays for the first service and 326 relays for the second service (which is still being built up). The large number of relays is necessitated by the mountainous geography of the country—wherever the population seems to be concentrated in long, narrow valley regions. There are also some surprising unofficial TV activities as Roger Bunney mentions elsewhere.

Howard Steele, Director of Engineering of the ITA, represented the UK, on behalf of both the ITA and the BBC. Because the last report at Montreux was in 1969 when there were under 40 hours a week of colour—from BBC-2 only—he had to explain the massive jump to over 140 hours a week with the introduction of colour on the two majority audience channels—BBC-1 and ITV. That this changeover—undoubtedly the largest in the world to date—occurred overnight obviously impressed the delegates, but Mr. Steele was guilty in this respect of creating rather the wrong impression. It has been noted that all studio centres over-night converted all their equipment from 405-line operation to 625 lines in colour. What in fact happened was that the studios had been operating on 625 lines for some time anyway and merely removed the 625-405 line-store converters from their outputs. In their place converters were introduced at the 405-line transmitting stations.

Howard Steele also gave details of colour receiver deliveries in the UK since the beginning of the colour services. With the start of colour on BBC-1 and ITV there was a receiver sales boom which outstripped supplies from the manufacturers. Sales subsequently settled down to a steady climb and we have certainly escaped the horrible 10-year stagnation that was experienced in the US. It is estimated that 1 million receivers will be supplied this year and 1 million in 1972. At the current rates— and it is difficult, as the manufacturers have already found, to be even approximately right about these things—half the receivers in the UK will be colour by 1980.

A rather surprising statement from Mr. Steele—which he emphasised was mainly his own view—was that the expected that the 405-line duplication of services on v.h.f. would have to continue until 1990 or so rather than the originally estimated 1980. This is of considerable financial concern to both the BBC and the ITA because it will almost certainly mean that a number of v.h.f. transmitters will have to be re-equipped in order to maintain a reliable service. It does however offer the financial support for the large investment of both the BBC and the ITA in their development of digital line-store standards converters: the present generation of converters is inherently unreliable and not suitable for unattended station operation.

For one of the first times the USSR felt able to report on its technical progress in television. It was a little politically biased—the nature of the animal?—and this was a pity because much has been achieved in a few years. Their new Moscow TV centre has taken six years to build and equip and now produces about 2000 programme hours a year. This is not a large total but the main problem is the distribution of the three services. One, local around Moscow, is fairly standard but the other two require international operation of both the VHF and the ITA in their development of digital line-store standards converters: the present generation of converters is inherently unreliable and not suitable for unattended station operation.

It has been noted that EMI videotape is commonly used in the USSR, and another UK product, the Vinten pneumatic camera pedestal, has also been sold there. A number of firms have tried to copy the Vinten design incidentally but none of them have ever worked as well. A long conversation with a Russian delegate also showed that their present use of semiconductors is pretty limited and that such things as i.e.s are virtually unknown to them.

**Audio-Visual Systems**

I was surprised that the Montreux programme committee almost deliberately started a minor war, the occasion being a full-day of the symposium devoted to audio-visual systems such as EVR, Philips VCR, Teldec.
etc. These systems cannot be compared directly: each has its own advantages and disadvantages. Unfortunately financial considerations seem to prevail and the arrangements made at Montreux which allowed the protagonists of the various systems to face one another in a "round table discussion" merely led to a slanging match. Quite apart from this it was distressing to find that a group of quite sensible men appeared to know little of what they regard as their immediate market—education.

**Programme Origination**

There was not much new in the symposium papers in the line of studio equipment and techniques. The whole industry in this field is standing still, awaiting the next generation of equipment which will require in perhaps five years' time, most of the European market having dried up after the initial colour equipment boom.

Philips and the English Electric Valve Company (EEV) presented papers on developments in Plumbicon camera tubes and their equivalents. The latest series of 1in. tubes from Philips uses a light-pipe bias on the rear of the target to reduce photoconductive lag (a system first used on very early orthicon tubes) and a system of reducing the effects of picture highlights and the smears or comet tails that result from overloads. The system was originally known as Flyback Highlight Discharge (FHD) but has now become known as the Anti-Comet Tail Tube (ACT). The idea is that any charge voltage on the target above a previously set level is stripped off, or discharged, during the line flyback period by means of the cathode of the tube during this period. The new lin. tubes are at present only being used in the new Philips LDK5 colour camera channel which we will mention later.

Also described was a system to enable an operator to write or draw directly into any television picture. Using an electronic stylus on a position-sensitive surface mounted above a monitor, displaying the transmission picture, the X and Y co-ordinates of the drawing or writing positions are fed to a scan converter and used to derive a source of video which can be added to the original picture source. The system is manufactured by a firm known as Telestrator and we hope to describe it at a future date in TELEVISION.

Computer-type applications are beginning to abound in television—videotape editing and the like—and two more were described at Montreux. The first, by Marconi, was an automatic presentation system. This has been designed mainly to reduce the inevitable operator errors that occur during periods of large numbers of switches of recording sources—e.g. during the complicated commercial breaks. The information for the autoswitching is inserted into the equipment through a preprepared paper tape or directly on a keyboard. The stored instructions are displayed on a monitor fed from a television character generator. Instructions can be modified up to just a few seconds before a change is to take place.

The second computer-type application came up in a discussion by I. R. Young of Evershed on the remote control of cameras. Evershed systems are world famous in this field and although remote cameras can now be programmed in advance little use of them has been made in drama or OB work—principally because the composition of pictures cannot be that accurately dictated. One idea put forward has been particularly for the very small studio or financially difficult productions—that is to have a remote camera slaved to a master, manned camera which has the various artists under shot against a blue background. The slave camera would be looking at a miniature version of the required scene as the master camera moves the slave would move in sympathy. Using chroma-key quite authentic results could be achieved. Another possibility lies in the recently developed areas of colour pattern recognition. This could be used for example to follow a character around a set, although this would be less acceptable to production staff because it would allow little freedom for picture composition.

The only BBC paper read at Montreux was given by Mr. C. B. Wood. It was a pity therefore that this was one of the many non-papers at Montreux. Mr. Wood talked about the use of colour negative film in telecine apparatus. This is something which has been discussed for a long time—the positive print which has been used up to now for both television and cinema causes about 9dB loss at 5MHz. The difficulty has always been the design of suitable telecine apparatus to handle colour negative film and Mr. Wood did not reveal any new developments.

**Transmission and Distribution**

Gates Radio described the largest power u.h.f. transmitter known to be operational anywhere in the world. This is a 220kW transmitter installed at station WDCA-TV in Washington, D.C. The very high transmitter power was necessary at this site because aerial gain was limited and yet a particular coverage was required. The power was achieved by paralleling two 55kW transmitters with a duplicate pair. The problem of correct phasing between the transmitters was neatly solved by Gates in a very simple way. The transmitter is unattended and all the logic control circuitry and monitoring facilities are remote. The solid-state drive uses i.f. modulation rather than modulation at the final output frequency, a technique which has been steadily growing in popularity (it is expected that the next Phase of ITA u.h.f. transmitters will also employ i.f. modulation).

A large amount of interest is developing in the UK over transmission in Band VI (12GHz). This has arisen because of Band IV/V allocation problems. In some areas—South Wales for example—the very large number of u.h.f. relays necessary will quite early exhaust the number of channels available if co-channel and adjacent channel interference problems are to be kept at an acceptable minimum. The use of Band VI would certainly ease this problem and would be in addition to the already planned "active reflectors" developed by the BBC (these stations suffer from a number of limitations, particularly in the number of really suitable locations).

Although a number of organisations have done exploratory work in Band VI the most significant results have come from field tests in Berlin by FTZ. Field strength measurements over a period of two years using three test transmitters were made from different sites.
and using differing aerial heights—ranging from 56m to 200 m. It would appear from the results that satisfactory coverage can be guaranteed for a radius of about 10km. At greater distances the signal strength falls off very rapidly due to attenuation by buildings, etc. There are however possibilities of using a duplicate or even triplicate coverage service to offer practical field strengths at about 25km. Perhaps a more practical possibility is the use of a community aerial system with an s.h.f./u.h.f. converter, feeding standard receivers via a cable network. With the receiving aerials at a height of 40m or more a coverage of 50km can be gained. Band VI certainly offers a practical extension from u.h.f. coverage and it may well be that this development will take place before the use of satellites in this country (the International Telecommunications Union—ITU—has not at the time of writing legalised the use of space broadcasting).

Cable television also featured high in the Montreux programme and it was interesting to note that all the major operators in the US and Europe are now greatly regretting the poor interference isolation that is obtained with their standard 3200 twin-feeder aerial inputs. Many of the recent developments in the CATV field relate to the extension of the number of channels that can be received in the field. It is possible to receive 80 channels in the US over cable (75 European channels). This is by using a set-top converter (with coaxial input!). You would have to be a bit of a masochist to want to receive 80 television channels but the ideas under consideration in this field are to use unwanted channels for return information—such as readings of the subscriber’s electricity meter?—and for providing additional services—e.g. library channels.

**Receivers**

Five receiver papers were presented at Montreux. One given by Thomson-CSF described a system of large screen projection using a standard lamp source. The amount of light reaching the screen is determined by the transparency of a photoconductive layer upon which the picture source, in the form of an electron beam, is focused.

Erik Langer gave a brief summary of the work that has recently taken place in the field of selective networks—e.g. for i.f. strips—covering developments in crystal filters and active RC filters. The use of crystal techniques has been stimulated by the discovery of the two new principles of energy-trapping and the surface wave whilst the active RC filter has received a boost from modern semiconductor and thin-film techniques.

At least two UK setmakers are working on these techniques and a ceramic filter has been incorporated in the latest BRC colour chassis, the 8000 chassis used in their new 17in. colour receiver. The susceptibility of v.h.f./u.h.f. receivers to electromagnetic interference was discussed in a paper by T. Dvorak of ETH-Zurich. This problem is again one that stems from the continental use of 3200 aerial feeder where extremely good screening of the tuner and the interconnections in the receiver is required. In UK receivers the recommended rejection of 35dB is achieved with very little problem.

Undoubtedly the most interesting receiver paper was presented by Charles Rhodes of Tektronix who have developed a new series of black-and-white and colour picture monitors. It is the small-screen colour monitors which are most interesting because Tektronix are making use of the Sony Trinitron—the first professional use of this tube. The small screen is of immediate advantage for equipping an area where colour picture quality can only be gauged and not cured—e.g. videotape recording, radio links. Like their Trinitron receiver counterparts the monitors give an exceptionally bright picture the structure of which is most noticeably different. Tektronix are making these monitors available in RGB form or with either or both NTSC and PAL decoders fitted, making the range the most multidimensional.

One difference between the use of the Trinitron in domestic sets and its professional use in the Tektronix monitors lies in the convergence arrangements. Although the tube uses a horizontal-plane electron gun assembly the standard of vertical convergence is still not really good enough for professional use. Tektronix have therefore added some vertical convergence adjustment. This still gives a simple convergence panel with only five controls for each field standard.

**The Exhibition**

As mentioned at the beginning the exhibition has run rather wild and could do with hefty pruning. In the following notes we have space to mention only those exhibitors and products which particularly caught our attention. The biggest UK representation at Montreux was presented by EMI with Marconi not very far behind. Nothing very new on either stand although the EMI 2005 and the Marconi Mk VIII colour cameras were again being shown. The Marconi camera has recently been ordered by Canada but otherwise both it and the EMI channel are doing very slow business. Of more interest on the EMI stand was the new automatic focusing unit for fitting to their camera. This is a very great improvement on both their original and on many other units of this sort. If EMI can demonstrate that this unit can be fitted to other channels they could be in line for a great deal of business.

Philips were demonstrating just about every bit of broadcasting and CCTV equipment that they manufacture or hope to manufacture. Star of the show was the new LD5 camera channel which was first announced two years ago. This camera uses a double-screened coaxial cable (triax) for the camera cable and is self-contained in being provided with its own coder. It receives power down the coax as well. The telemetry sync commands and timing commands. The coax also distributes video, talk-back etc. All this is done by modulating the information sent down the cable. The advantage is gained in the low-cost camera cable which can be of long runs. It is also possible to operate the camera with two radio links instead of using cable or if required standard camera cable can be used. Unfortunately the camera is not really ready for comment. Philips managed to get operational by the fifth day of the exhibition but the picture quality was poor and there were numerous timing errors present. We must assume therefore that this was a laboratory prototype.
transmitting the Swiss 1st programme to parts of Northern Italy on channels outside the normal broadcast allocations, usually between 250-350MHz and on ch. 38 vertically polarised. The firm apparently markets converters, usually between 250-350MHz and on ch. 38 vertically polarised. The firm apparently markets converters, for the reception of these out-of-band channels. The Carabinieri—the rural police—have recently closed down before the advertising world as a whole is going to be taken by the idea. To start the ball rolling so to speak the RCA machine was leaving Montreux for Yorkshire Television for evaluation. It will be interesting to see whether they retain it after their testing. Meanwhile the equivalent machine from Ampex has still not made its debut in Europe.

Pye-TVT shared their parent company’s stand (Philips). Their major display was the series produced OB unit which was minute compared to the Philips equivalent standing alongside. The same facilities were included however and it was obvious that a number of people were interested in the vehicle and the others like it which are now virtually “off the shelf”. The one on display had in fact just returned from South Africa where it had covered the S. African Grand Prix. Just as soon as it had been loaded for return to Europe the announcement was made that S. Africa is to start television operations—in colour right from the beginning—in about four years’ time. Also on display by Pye was their commercial version of the BBC sound-in-sync system. The system is to be employed in the new Post Office conference television system starting on a trial basis this summer between Birmingham, Manchester and Glasgow. Using sound in sync not only means an economy in the provision of intercity circuits but also offers a degree of secrecy on the sound channel.

Summary

UK representatives this year did not seem too pleased with the event. Although it is invidious to make comparisons with the IBC it is nevertheless inevitable because the two now appear to be competing for the star exhibits and papers. I will confine myself to saying that unless I see a very definite indication of improvement in the standard of the papers—and this means a very hefty reduction in their number as well as more careful choice by the selection committee—I doubt whether I will bother to make the journey again. All this even though the whole atmosphere of Montreux is far more pleasant than that of London.

LONG-DISTANCE TELEVISION—continued from page 459

The principal attraction shown by Link Electronics was a camera tube test channel for making accurate spectral and performance figures for Plumbicon camera tubes. Rupert Neve and Company of Royston have established themselves in only a few years as one of the only manufacturers of high-quality sound desks for both television and sound recording studios.

RCA always make a good showing and pride of place on their elaborate stand was their TCR100 tape cartridge recorder. The recorder can handle up to 22 three-minute cassettes and its usefulness is in the automation of programme breaks on commercial TV networks. The idea would be to dub all advertisements, programme trailers and announcements on to cassettes. This can only really succeed in this country with the co-operation of all the programme companies and the advertising agencies. It will undoubtedly come in time and the situation will then be that the advertising agencies will merely post cassettes around the country instead of the present film stock. It will require at least one of the major facilities companies to acquire cassette recording arrangements

A letter has come to us from Mr. G. Hansen, the director of the EBU in Brussels. With the increasing interest in long-distance television it seems that the EBU are receiving an increasing number of queries relating to station identification. They would like to stress that they are unable to assist with such problems but suggest that the List of Television Stations mentioned last month in this column will facilitate identification. If anyone does have identification problems we at Television are pleased to assist where possible.
VIDEO
MONITOR
KEITH CUMMINS

Shortly after the Single-Standard 625-line Receiver for the Constructor was published as a constructional series commencing in March, 1970, interest was expressed in its potential use as a video monitor. There are two ways of setting about this. One involves the incorporation of an optional video preamplifier circuit while retaining the original off-air reception facility of the receiver as originally designed. The second approach is to use the original video, time-base and power supply circuits only, leaving out the tuner and i.f. sections. The sound circuits may be retained if required.

Monitor Requirements

When closed-circuit television is used the normal method of distribution is via coaxial cable carrying a 1V peak-to-peak positive-going video signal. Monitors and videotape recorders are designed to accept such a signal. A camera channel likewise produces this type of signal at the output of its sync mixer where the video from the camera has the locally generated sync pulses added to it.

It will be realised that unlike most domestic receivers the chassis of a monitor has to be isolated from the mains supply since the outer connection of the coaxial cable has to be earthed to chassis. As the video signal contains low- as well as high-frequency components isolation by capacitors is not feasible. The Constructor’s 625-line Receiver employs an isolated power supply—as well as preserving the black level—and so is potentially attractive for use as a monitor.

The 1V peak-to-peak video signal mentioned above is inadequate to drive the video amplifier stage directly and a video preamplifier is therefore necessary. The video amplifier stage needs a positive-going signal so the preamplifier must not invert the phase of the video signal. Since the closed-circuit video signal is presented at an impedance of 75Ω it is possible to use a common-base video preamplifier transistor. The low-impedance input signal is fed to the low-impedance emitter circuit of the transistor whose base is effectively grounded so far as signals are concerned. The amplified video signal is then taken, in the same phase as the emitter signal, from the collector.

Video Preamplifier Circuit

The circuit which has been developed for this purpose is shown in Fig. 1. The video input is introduced via Skt1 and coupled via C1 to the emitter circuit of Tr1, a BC107 transistor. The signal is introduced part-way up the emitter resistance which consists of two parts R2 and R3. The presence of R3 introduces an impedance in series with the video feed to Tr1 emitter. Since the emitter-current of Tr1 is very nearly the same as its collector current the ratio of R3 to VR1 determines the stage gain to a first-order approximation. High-frequency boost is achieved by placing C4 100pF across R3, thereby increasing the video drive as the frequency increases.

The bias for Tr1 is obtained from the network R4 and R5 with C2 providing a.c. decoupling to earth the base signalwise. VR1 forms the collector load resistor and the required amount of signal is tapped off to drive the main video amplifier. VR1 in fact forms the contrast control for the monitor. Care should be taken to avoid excessive stray capacitance around VR1 and it is suggested that a skeleton potentiometer is used in this position and preset. If a variable facility is required a plastic shaft should be employed, attached to VR1 by Araldite or other suitable adhesive.

R1 is included to lower the input impedance of the circuit to 75Ω. Failure to pay attention to detail here can result in mismatching to the coaxial cable with the attendant problems of reflection and poor response.

The preamplifier takes its supply from the +12V line provided in the Constructor’s 625-line Receiver (Fig. 3, junction R5, C5). If the i.f. and tuner stages are not fitted R5 should be increased in value to 470Ω.

A.C. coupling is permissible in the preamplifier

![Fig. 1: Circuit of the video preamplifier developed for monitor use. If used permanently with the main chassis shown in Fig. 3 the smoothing components R6 and C3 above may be omitted and the I.T. supply taken from the junction of R5 and C5 in Fig. 3.](image1)

![Fig. 2: Suggested video preamplifier layout on tagboard. The tagboard can be attached to the side plate of the 625-line receiver, on the opposite side to the i.f. strip and the tuner unit.](image2)
Fig. 3: Circuit of the Constructor's Single-Standard 625-line Receiver, with all modifications incorporated. A surplus u.h.f. tuner and i.f. strip were used in the original prototype.

Fig. 5 (below): Switching for "monitor/off-air" use.

Fig. 4: Simple power supply which may be needed for some applications of the video preamplifier.

Components list

Resistors:
- R1: 120Ω
- R2: 470Ω
- R3: 220Ω
- R4: 10kΩ
- R5: 3.9kΩ
- R6: 120Ω

Capacitors:
- C1: 250μF 6V Electrolytic
- C2: 250μF 6V Electrolytic
- C3: 250μF 15V Electrolytic
- C4: 100μF mica

Miscellaneous:
- Coaxial socket, tagstrip, etc.
since d.c. restoration is employed in the main video stage. Where no off-air facility is required the slider of VR1 can be connected directly to C6 in the main circuit. If the equipment is to perform a dual role however switching is necessary. A small low-capacitance slide switch is best, fitted to the rear of the receiver. The switch can handle both audio and video signals, the arrangement being shown in Fig. 5.

There is no reason why the video preamplifier circuit should not be used with receivers other than the Constructor’s 625-line Receiver but care should be taken to ensure that the chassis is isolated. In the majority of cases this will involve fitting a 1:1 mains isolation transformer. Also there may be no suitable power supply available for the preamplifier. This problem can be overcome by building a power supply circuit along the lines shown in Fig. 4.

The whole of the basic video preamplifier can be constructed on one piece of tagstrip laid out as shown in Fig. 2. No particular points need to be noted except that the leads should be kept short to avoid excessive stray capacitance and inductance.

Tests

Tests on the preamplifier using a Sony 625-line camera and a test card have been very satisfactory. It was under these test conditions, with a Sony CVC2100 ACE camera and Marconi Resolution Chart No. 1, that the value of C4 was optimised. A small but noticeable improvement in definition is achieved without introducing overshoot. If the preamplifier is to be used with equipment other than that for which it was originally designed the value of C4 may need to be changed. Apart from this component the preamplifier should operate correctly under any conditions using the components specified.

The tests carried out indicated that the horizontal resolution of the set-up described above was about 450 lines and good pictures were obtained indoors in a room illuminated by a 125W fluorescent lamp. Subject matter included natural subjects, pages from books, the earlier part of this article in its draft form, and an interesting calendar. Stable pictures were obtained under all conditions with the video drive set to roughly equal proportions of black and white, adjust P1 for a locked picture with weak contrast. It is this voltage which is used to operate the a.g.c. circuit, as drive to the base of the a.g.c. amplifier Tr9. If the control voltage is present (which it should be if the PFL200 is functioning) but there is no variation of contrast Tr9 (OC44) should be checked together with the associated electrolytics. Note that when the PFL200 is replaced it is advisable to reset the preset control P1 to obtain the correct range of the contrast control. Turn P2 to minimum, switch to a 405-line channel transmitting a test card or a picture with roughly equal proportions of black and white, adjust P1 for a locked picture with weak contrast and then adjust P2 for a normal picture.

If there are no sound or vision signals at all although the screen is illuminated first ensure that the supply is present at its source it is then a matter of checking that it is getting to the tuners and i.f. stages (approximately 12V to the tuners, 14V to the i.f. stages).

Audio Circuits

A PCL86 is used in the audio output stage. One of two defects can be expected as a general rule. The first is a total loss of sound which can sometimes be restored by tapping the PCL86 (to indicate that this is the culprit). The other is when the sound is low and distorted with the PCL86 overheated. This is usually due to the valve developing internal leakage and although replacing the valve may restore apparently normal conditions it is essential to check the condition of the bias resistor R99. This can often be damaged by a faulty valve and change value (going low) and if left in circuit will cause the new valve to overheat thereby necessitating another early replacement. R98 should also be checked for correct value.

Very weak sound has often been traced to R97 (220kΩ) going high. C142 will often be found open-circuit causing a drop in output but as this is not drastic it may not be noticed.

The messy one is when the PCL86 becomes faulty and burns up the bias resistor causing it to become open-circuit. This leaves the cathode voltage high and the electrolytic C142 can then sometimes explode depositing silver foil, waxed paper etc. all over the place which takes a bit of clearing up before the valve, the resistor and the capacitor are replaced.
BUSH TV125

The raster cannot be resolved on 625 lines though the sound is OK. When switched to 625 the line whistle is faint and ragged before fading altogether. I have replaced the preset 625-line hold control and the feed resistor from the h.t. line to the main line hold control without improving matters.—T. Humm (Rochester).

The fact that the line whistle can initially be heard at all suggests that the line hold is a long way out. Check 3R11 in series with the preset 625-line hold control, the PCF80 line oscillator valve and the flywheel sync discriminator diodes.

HMV 2635

This set uses the Thorn 950 chassis and has two faults, first poor sound when the volume control is turned down and secondly lack of width on 625 lines.—T. Bristow (Chelmsford).

The poor sound could be due to a defective audio output valve or a leaky coupling capacitor associated with it but in several instances with this chassis we have found the loudspeaker to be at fault. The poor width should lead to a check on the PL504 (PL500) line output valve and the width circuit resistors. Also check the 0.1µF capacitor C98 in series with the line coils on this standard.

KB RV20

The set originally had a tendency to field slip after it had been in operation for some time. This was cured by replacing the ECC83 sync separator valve and the h.t. rectifier (as the h.t. voltage was low). Now however the picture lacks interlace—the scanning lines are thick with wide spacing. All voltages are correct and the PCL82 field timebase valve has been replaced without any improvement being obtained. There is also about 1½in. foldover on the left of the picture.—R. Stuart (Dudley).

Interlace problems on older receivers are fairly common and are usually due to small changes in component values and poor design. The second section of the ECC83 acts as a field sync pulse amplifier with the grid biased by a potential divider consisting of R99 22MΩ to h.t. and R100 120kΩ to chassis. To improve the interlace replace R99 with a 1MΩ resistor in series with a 1MΩ potentiometer and use this as a variable control to set up for best interlace. If this fails to give adequate range replace R98 1MΩ from the potential divider to the grid with a potentiometer as well. If neither of these gives any great variation in interlace there is almost certainly a component value change and the following components should be checked: C83 sync pulse feed to the PCL82, C84 sync pulse feed to the sync amplifier section of the ECC83, R97 the anode load of the latter and R107 in series with the field hold control. For the line foldover fault check the S-correction capacitor C60 and the harmonic tuning capacitor C62. If these are OK check the line output and boost diode valves. If these are OK the line output transformer is probably faulty.

GEC 2028

This colour receiver is suffering from lack of width. The line output valve has been replaced without improving matters.—R. Olwyn (Gloucester).

The usual cause of lack of width in the GEC/Sobell dual-standard colour receiver chassis is change of value of R704 5.6MΩ in series with the e.h.t. stabilising VDR701. Use a 2W type if this has to be replaced.

PHILCO 1036

When switched on from cold the picture breaks up immediately on both channels but after about ten minutes the fault corrects itself and the trouble is not experienced again until switching on from cold the following day. The tuner and video amplifier/sync separator (PCL84) valves have been replaced.—F. Smales (Torrington).

The probable cause of the picture breaking up before the set reaches normal operating temperature is low h.t. on switching on. Check at the output of the h.t. rectifier valve (PY32). If a rectifier change is necessary we would suggest the use of a silicon rectifier such as the BY127 with a 5Ω 5W resistor in series and bridged by a 1,000pF capacitor—also short-circuit the heater pins on the base of the PY32 valve holder. If this should not happen to be the cause of the trouble check the second sync separator valve used in this set (V13 ECC82) and the line multivibrator valve (V12 ECC82).
PYE CTM17/S CONTINENTAL

The set has good sound but there is severe picture cramping in the form of a 3in. band across the centre of the screen. The PCL82 field timebase valve has been replaced without remedying the fault.—J. Crouch (Barnes).

The fault you describe is almost certainly due to a faulty capacitor and it is as well in this model to replace all those associated with the PCL82 as they are liable to become leaky giving rise to further trouble. The principal suspect is the coupling capacitor C53 (0.25µF) to the pentode output section but those associated with the linearity controls—C54 0.01µF and C55 0.1µF—may also be found to be at fault.

SOBELL ST196

The screen goes blank with the sound still present. If the set is switched off and allowed to cool down for about five minutes and then switched on again the picture comes back. The set may then be all right for a few hours or even several days but eventually the picture goes once more. The DY86 and PY800 have been replaced.—D. Newell (Doncaster).

If the line whistle stops completely when the fault occurs and the PL500 overheats replace the PCF80 line oscillator valve. If the PL500 does not overheat check that its screen feed resistor is correctly contacting (one end may be improperly contacting to the panel) and check the PL500 (PL504) itself.

PHILIPS 19TG190A

There is an intermittent fault in the field timebase. After about twenty minutes a single white line appears across the screen though with the back off the fault takes about an hour to develop. The picture can be restored by pressing or rocking the EF80 on the timebase panel. This EF80 glows red when the white line appears.—F. Salmon (Carlyle).

The EF80 forms one half of the field multivibrator with the triode section of the PCL85. It will therefore overheat if the PCL85 stops working due to the removal of the working bias on it. Thus the fault could be in the PCL85, in the cross-coupling capacitors C427 and C429 or in the boost supply to the triode section of the PCL85. As far as the latter is concerned check the supply via the height control to pin 1 of the PCL85—the decoupler C414 to the h.t. line may be faulty here. Also check C428 the coupler to pin 2 of the PCL85 and the tracks between these various components.

TEST CASE

104

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.

Symptoms of abnormally high hum level, mild bending of picture verticals and poor field locking on a Marconiphone Model 4603 led to the field technician setting out complete with a replacement main electrolytic. In spite of the replacement clearing the hum and picture bending however the field lock remained in error. After trying a new PCL85 and other valves which might affect the field lock, all to no avail, the set was brought into the workshop for more detailed investigation.

Here it was discovered that once the field was correctly locked on one channel it held without error until the channel was changed. To restore the lock careful readjustment of the hold control was then necessary after which the lock held again.

This alteration in field locking conditions with channel change could not be immediately related so tests of the smaller components of the field timebase were made in an endeavour to find a clue. During this testing the anode of the field oscillator triode was inadvertently shorted to chassis while the set was running. This instigated the symptom, this time without channel changing but with the added symptom of reduced picture height. The height gradually increased to its original value but it was then found that the height control was almost fully advanced.

What component in the field circuit is most likely to be responsible for this effect and how could the symptom be affected by channel changing? See next month’s TELEVISION for the solution and for a further Test Case item.

SOLUTION TO TEST CASE 103

Page 426 (last month)

Often overlooked is the voltage across the heater of the oscillator valve or indeed across the heaters of other valves in affected circuits. In the case in question the technician discovered that the heater voltage across the line oscillator valve was only about 4V for a while after the set had warmed up, gradually increasing with further rise in temperature.

It was this changing heater current effect which was responsible for the line frequency drift, but in some instances a valve further along the series-connected line might be responsible—not the valve of the stage in trouble!

The heater of course controls the electron emission, so in all obtinate cases an early test should be that of heater voltage with a good a.c. meter to check for a “slow” or partially shorting heater.

Published approximately on the 22nd of each month by IPC Magazines Limited, Fleetway House, Farrington Street, London, E.C.4. Printed in England by Fleetway Printers, Crede Hall Road, Gravesend; Sole Agents for Australia and New Zealand—Gordon and Gotch (Aust) Ltd.; South Africa—General News Agency Ltd.; Rhodesia and Zambia—Kingsons Ltd.; East Africa—Stationery and Office Supplies Ltd. Subscription Rate (including postage); for one year to any part of the world, £2.65. "Television" is sold subject to the following conditions, namely, that it shall not, without the written consent of the Publishers first having been given, be lent, resold, hired out or otherwise disposed of by way of Trade at more than the recommended selling price shown on the cover, and that it shall not be lent, resold, hired out or otherwise disposed of in a mutilated condition or in any unauthorised cover by way of Trade, or affixed to or as part of any publication or advertising, literary or pictorial matter whatsoever.
**The largest selection**

**BRAND NEW FULLY GUARANTEED DEVICES**

**74 Series T.T.T. I.C-s**

**NOW LOWER THAN EVER PRICES**

**GREATER RANGE**

BI-PAK Semiconductors offer the fullest and most complete range of I.C.'s available, at these EXCLUSIVE LOW PRICES. TT L

**Order No.**

**Similar Types to - Description**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price and qty. prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>A16</td>
<td>Various types</td>
<td>(0.00 - 0.15)</td>
</tr>
</tbody>
</table>

**Price list**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price and qty. prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>A16</td>
<td>Various types</td>
<td>(0.00 - 0.15)</td>
</tr>
</tbody>
</table>

**ANOTHER BI-PAK FIRST !**

**THE NEW S.G.S. EA 1000 AUDIO AMPLIFIER MODULE**

**Guaranteed not less than 3 Watts RMS.**

**Specifications**

- 5-G.S. incorporation of their preeminent Linear I.C. Audio Amp. TA-631 providing unlimited applications for enthusiasts in the construction of radios, record players, Audio and Stereo units. Also ideal for telecom applications and phone answering machines. OTHER USES: portable equipment where use of prime importance is required.

- Sensitivity 40 mV for 1 watt. VOLT.

- Supply Voltage 15 VDC can be varied up to 73 dB for some applications.

- Frequency response better than 50 Hz.

- Normal supply Voltage 9 - 24V.

- Suitable for 8-16 Ohm loads.

- Overall Size 2 x 3 x 0.75 in.

**Price list**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price and qty. prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>A16</td>
<td>Various types</td>
<td>(0.00 - 0.15)</td>
</tr>
</tbody>
</table>

**DIODES & RECTIFIERS**

**Price list**

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Price and qty. prices</th>
</tr>
</thead>
<tbody>
<tr>
<td>A16</td>
<td>Various types</td>
<td>(0.00 - 0.15)</td>
</tr>
</tbody>
</table>

**All prices quoted in new pennies.**

**Guaranteed Satisfaction or Money Back**

**Minimum order 50p.** Data with order please.
TELEVISION CLASSIFIED ADVERTISEMENTS

The pre-paid rate for classified advertisements is 4p a word (minimum 12 words), box number 74p extra. Semi-display setting £2.50 per single column inch. All cheques, postal orders, etc., to be made payable to TELEVISION and crossed “Lloyds Bank Ltd.” Treasury notes should always be sent registered post. Advertisements, together with remittance, should be sent to the Classified Advertisement Manager, TELEVISION IPC Magazines Ltd., Fleetway House, Farringdon Street, London, EC4A 4AD, for insertion in the next available issue.

EDUCATIONAL

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. Colour TV Servicing, Numerical control & Computers. Also self-build kit courses—Radio and TV servicing, R.T.E.B.,ton Court, Reading, RG7 4PF.

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

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

ENGINEERS—get a technical certificate, Exam and Certificate Postal Courses in all branches of Engineering, Electronics, Radio and TV, (including Draughts, Building, etc. Write for helpful FREE BOOK—BET (Dept. 171K), Aldermaston Court, Reading, RG7 4PF.

BECOME “Technically Qualified” in your spare time—guaranteed certificate and exam Home Study courses in Radio, TV, servicing and maintenance, R.T.E.B., City & Guilds, etc., highly informative FREE Guide.—Chambers College (Dept. 838), Aldermaston Court, Reading, RG7 4PF.

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


FULL TIME COURSES in ELECTRONICS and TELEVISION; These are nine-month courses, starting next September, which lead to City and Guilds certificates. Extensive laboratory work is included, and there are, in most cases, no fees for those under 18 at enrolment. Full details from Section 48, Electrical and Electronic Engineering Department, Southall College of Technology, Beaconsfield Road, Southall, Middx.

LADDERS

VARNISHED TIMBER LADDERS from manufacturer. LOWEST PRICES anywhere. 15 ft ext. £20; 17 ft ext. £20; 20 ft ext. £35; 21 ft ext. £7.75; 24 ft ext. £8.90; 29 ft ext. £10.25; 31 ft triple ext. £12.25; 36 ft triple ext. £16. Carr. 80p. Free Lists. Also Aluminium Ext. and Loft Ladders. CALLER’S WELCOME. Dept. P.T. HOME SALES, BALDWIN ROAD, STOURPORT, WORCE. Phone 02-990-2574/5222. Placing order on C.O.D.

FOR SALE


“METRIX” WOBULATOR Type 210. 5 to 220 MHz. Sweep width 1 to 20MHz, full instruction manual, £30-90. HAYTER, 149 Valley Road, Solihull, Warks. Tel. 621 743 5684.

TWO Labgear Transistorised crosshatch Generators Type E. £110 each. As new, in good working order. Cost £75 each—£50 n.o.o. Box Number 90.

MISCELLANEOUS

RECORD TV sound using our loud speaker isolating transformer. Provides safe connection to recorder. Instructions included. 70p plus 10p P&P. Crowborough Electronics Ltd., Bridge Road, Crowborough, Sussex.


17" BBC/ITV TELEVISIONS £5

Working Perfectly
Plus P & P £1 CWO.

Suitable for any area.

3 Channel 19” D/S TVs. ITV, BBC 1, BBC 2, £25 inc. carriage. 17"13 Channel, Complete but untested £1-50 each plus £1 P & P CWO.

SPEAKERS

6" x 4", 7" x 4" 3 Ohm, 20p plus 8p P & P each. CWO.

Regular deliveries throughout England & N.Ireland.

TRADE TV’s

407 Thornton Road, Girlington, Bradford 8, Yorks.

WANTED


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

WANTED

Bush TV set between model TV 66 and 95-17" with 13 channel tuner, set used, cut off 0115 RF amp. and had 3 vis. IF stages, EDGEOUSE, 8 Sandringham Road, Walton, Peterborough.

WANTED. Radio and TV Servicing. £4-65. GOOD PRICE PAID. Mackenzie P.O. Buildings, Lochinver, Sutherland.

WANTED

100 PYE TV & similar urgently required complete in clean cabinets. Write Box 89.


TOP PRICES PAID

for new valves, popular TV & Radio Types

KENNSINGTON SUPPLIES

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

SERVICE SHEETS

Radio, TV, etc. 8,000 models. List 10p. S.A.E. enquiries. TELRAY, 11 Maudland Bank, Preston.

TRADER SERVICE SHEETS

30p 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.Os returned if sheets not available.

OAKFIELD ENTERPRISES

LIMITED

29 CHURCH ROAD, TUNBRIDGE WELLS, KENT

Make Model Radio/TV

1971 List now available at 10p plus postage

If list is required

From...............

Address..............

enclose remittance of.

Mail order only (May T)
LARGE SUPPLIER of SERVICE SHEETS
(TV, RADIO, TAPE RECORDERS, RECORD PLAYERS, TRANSISTORS, STEREOSCOPES, RADIOGRAMS, CAR RADIOS)

Only 25p each. Manuals from 50p
PLEASE ENCLOSE LARGE S.A.E. WITH ALL ENQUIRIES AND ORDERS. Otherwise cannot be attended to.

Free TV fault tracing chart or TV list on request with order.
MAIL ORDER ONLY

SERVICE SHEETS (continued)
LARGE RANGE OF MODELS AVAILABLE FOR RADIO, TELEVISION, TAPE RECORDERS, R PLAYERS, ETC.
FROM 25p each. S.A.E. WITH ENQUIRIES PLEASE.
MULLARD TRANSISTOR AUDIO AND RADIO CIRCUITS
TV FAULT FINDING BOOK BY S. W. PLACID
MULLARD VALVE & SEMI CONDUCTOR DATA BOOK
MAZDA VALVE & PICTURE TUBE DATA BOOKLET
BRIMAR VALVES & TELE TUBE DATA LIST
RESITOR COLOUR CODE INDICATOR DISC
Sets of Brand/New Valves supplied for most makes of Radio. T.V. etc.
Please state channel.

SERVICE SHEETS with Free Fault Finding Chart 35p, plus stamped addressed envelope.

AERIALS
BAKER and BAINES
UHF AERIALS—BBC, ITA, BBC2
All aerials come complete with tilt clamp and will fit up to a 2 inch mast.
POSTAGE PAID INLAND 8 element £1.90 — 10 element £2.20
14 element £2.35 — 18 element £3.25
22 element £3.75
UHF Pre-Amps, high gain, low noise, completely self contained, with 9 v. battery. Group A, B and C available.
Battery model £3.75, Mains £5.871.
Orders over £20.00 and over Delivered Free. Otherwise postage 32p.
Terms C.W.O. COD. Please state channel.
HIGHLYFLE ELECTRONICS.
48 Highcliffe Road, Tamworth, Staffs.
Phone 021 743 2395

ABSORB REDUCTIONS
UHF AERIALS AT COST
EG. 9 ele. £1.00
21 ele. £2.00
Orders for £20.00 and over Delivered Free. Otherwise postage 32p.
Terms C.W.O. COD. Please state channel.
HIGHLYFLE ELECTRONICS.
48 Highcliffe Road, Tamworth, Staffs.
Phone 021 743 2395

SETS & COMPONENTS
TOP 20 TV Valves, 10p; PL504, PL36, PY33, 15p, P&P 4p per valve, over 12 valves post free. Guaranteed tested ex-equipment, individually boxed.
Resistors and capacitors, all values and sizes. Leading manufacturers components and high-quality equipment, 10% or more off.
Mail order welcome, discount for quantity. S.A.E. for list.
L & D Components Ltd., 71 Westbury Avenue, Wood Green, N.22. 01-888 2701.


BELL'S TELEVISION SERVICES
48 BATTERSEA BRIDGE ROAD, LONDON, S.W.11.
WE GIVE GREEN SHIELD STAMPS
VALVE BARGAINS

Any 1—100p, 5—45p, 10—70p.

- EB91, EB90/F, ECC82, EB86, ECL80, EF80, EF85, EF183, EF184, PCC84, PCC89, PCC189, PC97, PC80, PC86, PC800, PCL82, PCL79, PCL84, PCL85, PL36, PL81, PL83, PY32, PY33, PY81, PY82, PY800, PY801, 30FL1, 30FL5, 30L15, 6F23, 6-30LZ.

TESTED, WITH 3 MONTH GUARANTEE VALVES 20p Each

BY100 TYPE RECTIFIERS

with Surge resistance on bracket, 122p each.

MAINS DROPPERS 3 SECTIONS 33-33.3 33p each.

VELCO ELECTRONICS

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

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

- DY86/7 43p PCL86 63p PY82 50p 20L1 95p
- EB91 250 PC801/2 62p PY800/1 50p 20P4 £1.00
- ECC82 42p PC805 87p R19 85p 30C15 90p
- ECL80 50p PC808 85p U25 95p 30C17 95p
- EF80 42p PCL82 51p U26 95p 30F5 95p
- EF85 45p PCL83(S) 60p U37 75p 30FL1 & 2 65p
- EF183/4 57p PCL84 60p U191 90p 30L15 95p
- EH90 56p PCL808/86 66p U193 48p 30L17 90p
- EV51 60p PCL86 66p U251 95p 30P12 90p
- EV86/7 43p PL36/8 87p U301 90p 30PL1 90p
- PC86 & 8 75p PL81 80p U801 £1.25 30P4MR £1.25
- PC97 45p PL83 85p 6/30L2 90p 30P19 87p
- PC900- 55p PL84 65p 6AT6 55p 30PL13 £1.00
- PCC84 50p PL500 90p 6BW7 82p 30PL14/5 £1.10
- PCC89 62p PL504 90p 6CD69 95p etc., etc.
- PC808 52p PY81 50p 6F23 95p Trade prices

POST FREE OVER £3.00, 23p PER VALVE BELOW £3.00

LATEST NEW BY100/127 type silicon rectifier 15p, 33Ω res 5p!

Large bulb Imported PCF80 32p! Note. Ask for separate component and transistor 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" and 23" TYPES

Large stocks by British leading manufacturers, why buy cheap reblads. Two year warranty!

COLOUR! FOUR (yes 4) years guarantee: 19" £49-00; 22" £53; 25" £57.

Enquiries welcomed.

Special offer! 19" mono reblads, 2 year guarantee £5.50! 23" £7.50

12" £3.00 (not 110°) 20" £14.00 to 16" (not 110°) £4.75

17" £5.67 A50/120W £10.50

19" mono tubes—all £6.87. Carriage all 60p. All 21" mono tubes—£7.87

23" mono tubes £9.50. Carriage 75p, also 24" and 25" available.

Prices on application. Quality before price!

RIMBANDS, 19" £8.50, 23" £11.50

TWIN PANELS, 19" & 23" £10.12 & £15.00

Carriage

75p

Bulk enquiries welcomed. GIRO 34.361.4006

PHILIP H. BEARMAN

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

6 POTTERS ROAD, NEW BARNET, HERTS.

Closed Thurs. & Sat. afternoons

TEL. 01-449/1934 & 1935 (Robophone)

T.V. SPARES


BAILRD/FERGUSON V.H.F. TUNERS. Uses PC77 and 30C18 valves. Fits 620 to 650 series models, complete with all coils, supplied less valves, £1.75 each plus 25p p.p.


FERGUSON/EBKO PLUG IN MAINS LEADS. Moulded two-pin connector type. 6 for £1.95 plus 25p p.p.


TIMEBASE PANELS to fit Seebell 195, 282, 283, 284, 285, 286, 287, 288 (old DS models), Marconi P7782, 783, 785, P408. Complete and new for direct replacement, £1.75 each plus 25p p.p.


FERGUSON 800/850 series TIMEBASE PANELS, complete and unused in original packing. £2.25 each, plus 25p p.p.

SCAN COILS, 110° type will fit most makes, after modification. Originally manufactured for Pye but we have used them in BRC, Philips, etc. with good results. £1.50 plus 25p p.p.

WILLOW VALE ELECTRONICS LTD.

4 & 5 The Broadway

Hanwell, London, W.7

Tel: 01-567 2971 and 5400

WITWORTH TRANSFORMERS LTD.

Dept. P.T., 236 SANDYCOMBE ROAD.

RICHMOND.

SURREY.

Terms cash with order or C.O.D. 27p extra

S.A.E. all enquiries. Catalogue 20p

TELEVISION LINE OUTPUT TRANSFORMERS PRACTICALLY ANY MAKE OR MODEL SUPPLIED IN STOCK OR REWOUND.

EEKO, FERRANTI, DYNATRON Replacement cases £1.00 each, please state model.

S.A.E. for return of post quotation.

TERMS: Cash with order or C.O.D., please add 20p for postage.

C.O.D. orders will be charged 30p extra.

NEW! Continuous range High-Gain Preamp filter, 40-900 mHz. Television, Radio. Covers all bands including colour! Precision made in next case. Rated in seconds. No modifications. Aerial connection only. Suberb value at £7.15p. Post paid to anywhere in U.K.

SOUTHERN VALVE COMPANY (Valve specialists)
44 Earls Court Road, London, W.8.

ALL valves boxed and brand new, some BVA! Send s.a.e. for free lists.

DY87 37p PC868 50p PCL805 44p U193 35p 30L17 75p
DY802 45p PCL86 40p PCL86 37p U257 62p 30P12 70p
EB91 15p PCF80 32p PL36 52p 6L30L2 46p 30P14 60p
ECC81 37p PCF86 52p PL81 46p 6BW7 60p 30P4MR 95p
ECC82 37p PCF80 50p PL84 55p 6CD6G 90p 30P19 70p
ECL81 40p PCF802 60p PL5004 65p 5G8P 75p 30P13L 75p
EFL0 27p PCF805 50pl PY9I 35p 6FZ8 45p 30P14 75p
EF183 37p PCF806 60p PY800 35p 20L1 85p etc. etc.
EF184 37p PCL82 37p PY901 35p 20P4 90p
EH90 45p PCL83(s) U25 65p 30C15 70p
EY51 50p PCL84 37p U26 60p 30F12 75p
EY86/7 37p PCL85 44p U191 65p 30L15 75p

Post free £2.00 and over. Mail order only.

R & R RADIO
51 Burnley Road, Rawtenstall
Rossendale, Lancs
Tel: Rosendale 3152

TESTED VALVES—3 MONTHS' GUARANTEE
EB80 15p PCL86 15p PY800 17p
EBF89 171p PCL80 20p PY801 17p
ECC82 15p PCL82 20p U121 22p
ECC83 25p PCL83 25p U129 25p
EF80 10p PY21 35p PCL96 25p
EF81 15p PY801 25p PCL95 26p
EY86 10p PY802 15p PCL84 25p

Copper Laminate Board, for etching, 1/2 per
inch. Double sided 1/2 per sheet. Any size cut,
min. order 50p plus 10°, P. & P.

LOW NOISE HI-STABS
1 watt 5°, all BVA values +10° per, p. a. p. 1p
up to 20 resistors—1p for each additional 5°.

POWER SECTIONS
7 to 30v 65p 105p at 7A
100 to 300v 105p 250p at 10A
300 to 500v 250p 425p at 15A

REPLACEMENT DROPPERS
2° - 97° £2 97° - 26° £5
26° - 97° £7 97° - 17° £7
2° - 97° £10 97° - 17° £10

FREE CATALOGUE p. & p. 3p

CHROMASONIC ELECTRONICS
36 Fortis Green Rd., London. N.18.28N.

THE SHORT CUT TO SMOOTHER MOTORING
Are you proud of your car? Can you keep her looking and behaving like new? Can you rely on her on your travels, shopping trips, holidays, summer outings?

PRACTICAL MOTORIST is the magazine with all the answers. Helps you keep your car in good working order and get maximum pleasure from your days at the wheel. Helps to solve your E.E.S. by showing you how to do most of the routine maintenance and simple repairs yourself.

PRACTICAL MOTORIST 15p

Britain's widest-read motoring monthly
Learn at home... First Class Radio and TV Courses

After brief, intensify interesting study—undertaken at home in your spare time—
YOU can achieve a deeper knowledge of Radio and T.V.
Let us show you how.

FREE GUIDE
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 in Radio Amateurs Exam, R.T.E.B. Servicing Cert.,
C. & C. Telecoms., A.M.S.E. (Elec.) Guide also gives details of range of certificate
courses in TV. Free TV Course includes TV courses and other branches of engineering, together
with particulars of our remarkable terms of Satisfaction or refund of fees.
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
(Inc. National Inst. of Engineering)
(Department 8440) Millenium Court, Reading. RG7 4FP
**UHF, COLOUR AND TELEVISION SPARES**

**COLOUR PLEXSYE SCAN COILS** £5-75 p.p. 35p,
**CONVERGENCE COILS** £3-80 25p, **BLUE LATERAL** £1-25 25p, 9p,
or Complete set £10 (p.p. 50p). **SILICAN TYPE** SCAN COILS
**LUMINANCE/CHROMAUXE PANEL** £1 p.p. 25p. **INTEGRATED TRANSISTOIZED**
**DROCODIC UNIT** £1-25 p.p. 10p. **LINE OUTPUT TRANSFORMER**
including EHT and **FOCUS ASSEMBLY** £4-50 35p. (Shop
customers only, assorted Colour Panels of various makes).
**ALSO COLOUR TV CAMERA UNITS:**

**COLOUR TV MONITOR PANELS** Designed to highest BBC
standards. **PAL** filter & **delay** £8-90. Chrominance **£10-90**.
**UHF 625** conversion kits and tuners available at reduced prices.
Lists available.

**UHF** integrated transistid. 6 position push button tuners, leading
British makers surplus £4-50 p.p. 50p, Transistid. **IF PANEL**

**MURPHY** 600/700 series **UHF** conversion kits in cabinet plinth
assembly can be used as separate **UHF** tuner £7-50 p.p. 50p.
625 18 twin amplifier incl. 5 valves and circuit £3 p.p. 35p.
**SOBELL/GEF** Dual 460/625 IF amp and a/p chassis incl. circuit
£1-50 p.p. 35p, UTLRA 1950C to 2824 625 IF amp & switch

**UHF** tuners transistid. incl. S/M drive or push button £5-25

**ERCO/FERRANTI** UHF tuner kit, incl. valves, slow motion
drive, knobs, leads, aerial panel £5-50 p.p. 35p.

**TVMICHAL BOOSTER** UHS £10-25 p.p. 35p. **LARGAIR** all
station **UHF/VHF** tuned, "set back" mains operated £5-90


**TORNET TUNERS**, **AH Standard** Suitable Ferguson
p.p. 35p. Large selection channel coils.

**LINE OUTPUT TUNERS**. Popular types available, brand
new replacements, fully gaur, A selection which can be

**MURPHY** 470 to 530 (modified) £3-75
**MURPHY** 849 to 930 £4-50
**PHILIPS** 17T160 Range 
**STELLA** 1011/1029 £3-50
**PHILIPS** 17T611/12 £3-50
121 to 155 £3-25
**PHILIPS** 17T160, 210 series £3-25
**BUSH** TV53 £3-25 151 £3-25 135 £3-25
**ERCO** 232 to 321 (U25 or U26) £3-25 17-35
**FERRANTI** 1001/10 (U25 or U26) £3-50
**ERCO** 342 to 394, **FERRANTI**
1021 to 1065 £3-75
**ERCO/FERRANTI** 418, 1000 etc.
**DECCA** BM17, 3, 4 (70p) IH05, 101/606 £3-75
**FERG** 305 to 436, 505 to 727 £3-75
**FIEG**, H.M.V., **MARCONI**
**ULTRA**, **PHILCO** 3600, 2600,
4000, 6610, 1100, **Jellypot**
**KIR YOYO**, **PV/20**, **CV/11**
**MARCONI** VT157 to 172 £3-75
**GEC** 302 to 340, £2-50, 416 to 452 £3-75
**GEC** 414, 2000 series £3-75
**HMV** 1850/9, 1870/6, 1890/1924 £3-75
**PYM CM/TV series** (salvaged)
circuit £17/35, 17/1, 10/5 to 110,
700, 830, 11U to 40F £3-50
**PAM INVICTA equiv.** LP154 (above PVE) £3-50
above PVE £3-50

**PETO SCOTT** 1419 to 175 £1-75 £3-75
201/9 £3-75
**SBEOM**/MICHAEL TP1 173, 180, 233, 247, 278, **SC24, 270**, **MP17**, 18, **MT2** etc.
TPS 781, 279, SCH, 370, MP25, **MT6**, 75,
105, 202 to 288, 762, 765 £3-25
850 field output transformer £3-25
850 scan coils £3-90 p.p. 25p
(p.p. on complete set of 5 items 20p)

**VALVE BASES** £90 for PL500 series and colour £12p (p.p. 35p
**SPECIAL OFFER** Leading British makers surplus 625 single
standard 625 TV chassis, latest design, almost complete, includes
transistored 1F stages, frame and line time bases, transformers,
etc., incl. circuit £3-85 p.p. 50p.

**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 GOLDS MANOR DRIVE, LONDON, N.W.11

Staff Holidays: Aug. 16th to 30th
In just 2 minutes, find out how you can qualify for promotion or a better job in Engineering...

That's how long it will take you to fill in the coupon below. Mail it to B.I.E.T. and we'll send you full details and a free book. B.I.E.T. has successfully trained thousands of men at home - equipped them for higher pay and better, more interesting jobs. We can do as much for YOU. A low-cost B.I.E.T. Home Study Course gets results fast - makes learning easier and something you look forward to. There are no books to buy and you can pay-as-you-learn on 'Satisfaction - or Refund of Fee' terms. If you'd like to know how just a few hours a week of your spare time, doing something constructive and enjoyable, could put you out in front, post the coupon today. No obligation.

WHICH SUBJECT WOULD INTEREST YOU?

<table>
<thead>
<tr>
<th>Mechanical</th>
<th>Auto &amp; Aero</th>
<th>General</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.M.S.E. (Mech.)</td>
<td>A.M.I.M.</td>
<td>C.E.I.</td>
</tr>
<tr>
<td>Inst. of Engineers</td>
<td>MAA/MMI Diploma</td>
<td>Petroleum Tech.</td>
</tr>
<tr>
<td>Welding</td>
<td>Master Mechanics</td>
<td>Servicing.</td>
</tr>
<tr>
<td>General Diesel Eng.</td>
<td>A.R.B. Geets.</td>
<td>Rubber Technology</td>
</tr>
<tr>
<td>ENG. Inspection</td>
<td>Management &amp; Production</td>
<td>Timber Trade.</td>
</tr>
<tr>
<td>ENG. Metallurgy</td>
<td>Computer Programming</td>
<td>Farm Science.</td>
</tr>
<tr>
<td>C. &amp; G. Fabrication</td>
<td>A.C.W.A.</td>
<td>General Plastics</td>
</tr>
</tbody>
</table>

Draughtsmanship

A.M.I.E.D.

Gen. Draughtsmanship

Die & Press. Tools

Electric Draughtsmanship

Jig & Tool Design

Design of Elec. Machines

Technical Drawing

Building

Electrical & Electronic

A.M.S.E. (Elec.)


General Elec. Eng.


C. & G. Telecomm.

C. & G. Radio Servicing

Radio & Telecomms. Exam.

Radio Operators' Cert.

Radio & TV Engineering

Radio Servicing

Practical Television

TV Servicing

Colour TV

Practical Radio & Electronics (with kit)

General Certificate of Education

Choose from 42 'A' level subjects including:

- English
- Chemistry
- French
- German
- Mathematics
- Physics
- Technical Drawing

RANGE OF TECHNICAL AND PROFESSIONAL EXAMINATIONS.

Over 3,000 of our students have obtained City & Guilds Certificates. Thousands of other exam successes.

FIND OUT FOR YOURSELF

These letters — and there are many more on file at Aldermaston Court — speak of the rewards that come to the man who has given himself the specialised knowledge employers seek. There's no surer way of getting ahead or of opening up new opportunities for yourself. It will cost you a stamp to find out how we can help you.

Free!

Why not do the thing that really interests you? Without losing a day's pay, you could quietly turn yourself into something of an expert. Complete the coupon (or write if you prefer not to cut the page). We'll send you full details and a FREE illustrated book. No obligation and nobody will call on you... but it could be the best thing you ever did.

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY

Dept B1, Aldermaston Court, Reading RG7 4PF.

POST THIS COUPON TODAY

Name

Age

Address

Occupation

To: B.I.E.T., Dept B1, Aldermaston Court, Reading RG7 4PF

Please send me book and details of your courses in

(Write if you prefer not to cut this page)