SECTION 1

TELEVISION TRANSLATOR EP7/501

1.1. Introduction

The EP7/501 translator receives a vision-and-sound signal from one radio-frequency channel and converts it, without demodulation, to another channel. The inherent difficulties and distortions which are introduced during demodulation and modulation processes are therefore avoided. Further, because of its simplicity, the translator offers considerably greater reliability than a conventional receiver-transmitter combination.

In the EP7/501 the received Band-I signal is reduced to an intermediate frequency, amplified and then frequency-changed again to the required output frequency in Band-I. Use of a fixed intermediate frequency simplifies the amplification process, and the double frequency-changing is a safeguard against oscillator harmonics falling within the passband, which they are otherwise liable to do owing to the close Band-I channel separation.

In an a.m. vision-and-sound system in which the two carriers share a common amplifier, any appreciable non-linearity produces intermodulation between the two carriers. For that reason it is desirable to separate the two signal components at an intermediate point and to recombine them after the output stages. This method is adopted in the system used, which has the arrangement shown by the Fig. 1.1 schematic. Shaded items in this diagram are not part of the translator, but are mounted separately on the rack, or alternatively in the cabinet, fitted with that equipment; these additions are described in Section 2.

It has been found that where interference exists between two co-channel vision transmitters a maximum protection against patterning is obtained if one of the carriers is offset by odd multiples of half line-frequency, that is (2n + 1) times 10·125 kc/s. However, to provide optimum protection against interference patterns resulting

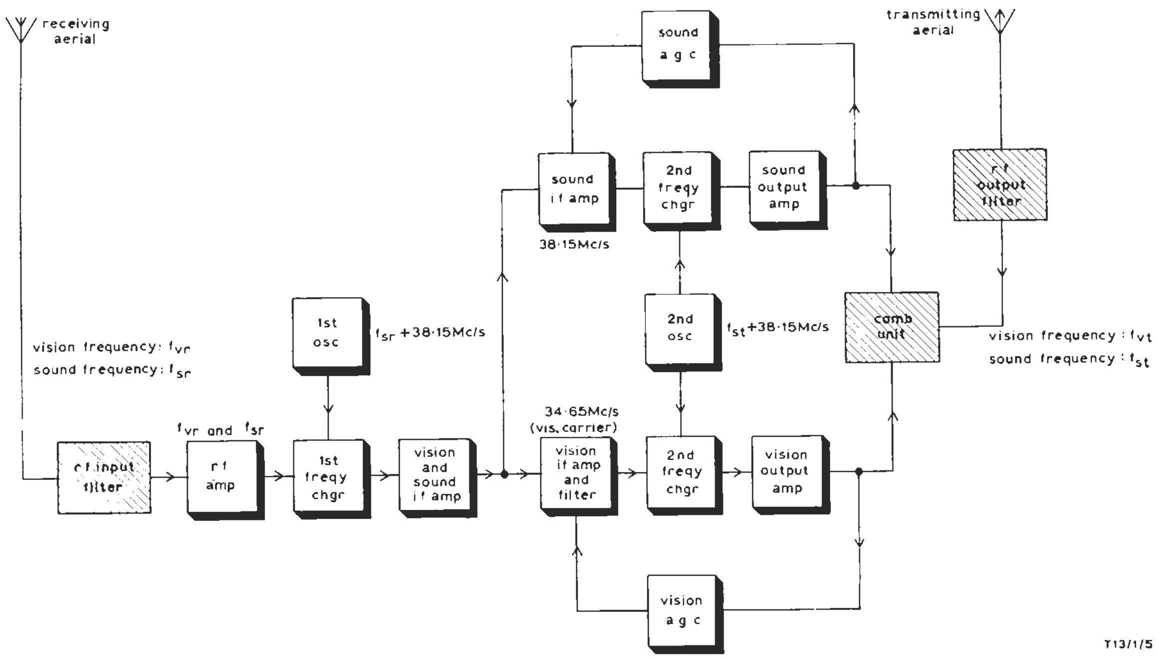


Fig. 1.1. Block Schematic of EP7/501 Equipment and Ancillary (shaded) Items

from a multiplicity of co-channels, the offsets used are plus and minus two-thirds (or, with discretion, five-thirds) of the line frequency. This makes it easier to ensure that the actual frequency separation between any two co-channel stations is not an integral multiple of the line frequency, which would give no protection against patterning. The reduction in protection with offsets of two-thirds, instead of half, line frequency is relatively slight. The sound offset is usually 20 kc/s, which places the beat frequency outside audible range. Note that offset frequencies are determined by the parent station and are unaffected by the vision-and-sound translation.

The receiving and transmitting aerials are usually mounted on a common mast and therefore coupling inevitably exists between the translator input and output circuits. This is a significant factor in the design of the overall system, which must be arranged so that feedback due to coupling is not excessive, to avoid the possibility of either instability or high noise level, perhaps both of these. The overall loop gain of the system must therefore be limited and must not exceed the *Figure of Merit* quoted for the equipment at the particular channel translation. This *Figure of Merit:*

$$M = S_m + L_m - 6 \text{ dB},$$

where S_m is the maximum working gain of the translator (with a.g.c. at zero), and L_m is the output-to-input coupling (in dB) at which the transmission suffers sudden and appreciable deterioration. The 6-dB margin is included as a precaution against fluctuations in S_m and L_m. This subject is considered at greater length, in relation to v.h.f./f.m. sound translators, in Section 1 of Instruction T.12.

Because many translators are required to work on unattended sites, important factors are reliability and stability of operation over long periods. Consequently simplicity has been treated as a major factor in design and no attempt has been made to exceed the required minimum performance specified where this would add to the complexity of the equipment.

The simple t.v. translator is coded EP7/501, but where standby equipment and automatic change-over facilities are provided, the translators are modified and recoded EP7/502. When mounted in a bay, the complete equipment is coded BA13/501, and when housed in a cabinet the code reference is CA1/502. These variants are described in Section 2.

1.2. Assembly

The EP7/501 comprises five sub-units, all assembled and wired on silver-plated copper boxes which are 15⅜ in. by 3⅜ in. by 1⅝ in.; see Fig. 1.2. These sub-units are assembled into a special mounting frame, which is bolted either on to a bay or into a cabinet. Fig. 1.3 shows the assembly.

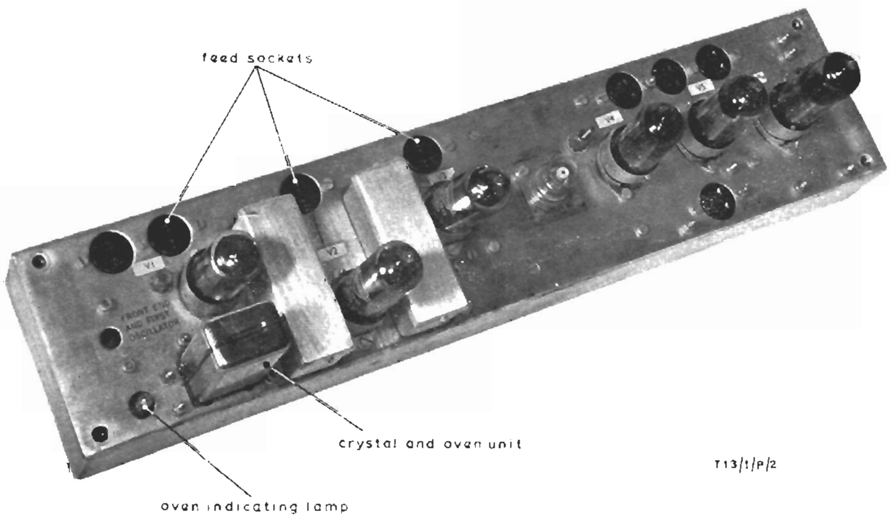
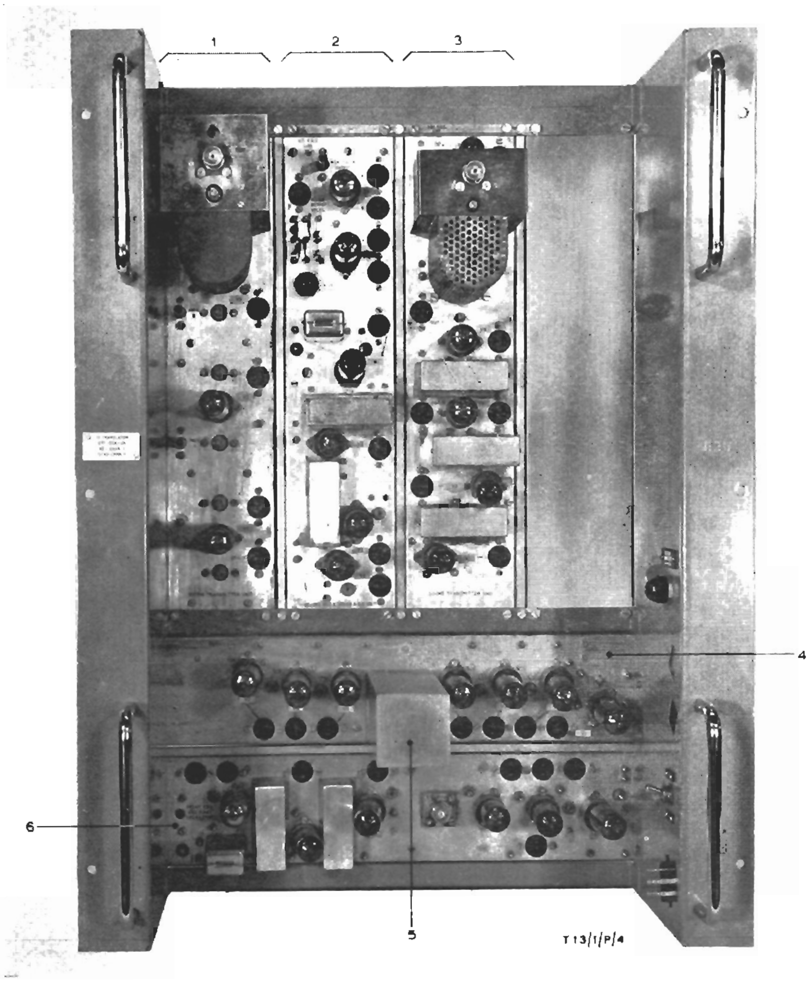


Fig. 1.2. Typical Box-construction Sub-unit of EP7/501

Fig. 1.3. EP7/501 Assembly: Front View

1. Vision Transmitter Unit
2. Second Oscillator and A.G.C. Unit
3. Sound Transmitter Unit
4. I.F. Unit
5. I.F. Filter (FL1/510)
6. Front End and First Oscillator Unit



The sub-units are not individually coded, but are engraved with functional titles as follows:

(a) Front End and First Oscillator Unit.
(b) I.F. Unit.
(c) Second Oscillator and Vision A.G.C. Unit.
(d) Sound Transmitter Unit.
(e) Vision Transmitter Unit.

Item (b) incorporates an I.F. Filter type FL1/510, this being positioned as shown in Fig. 1.3.

R.F. interconnection of units is by short leads via chassis feed-through adaptors, two of which are encircled in Fig. 1.4 showing the rear aspect of the assembly. D.C. interconnections are cable-formed and tied into the framework, and the r.f. input and output connections are via coaxial sockets.

Monitoring and valve-feed sockets are conveniently placed on the front panel of each unit. All controls and valves are readily accessible at the front of the translator.

1.3. Power Supplies

Two commercially-made supply units (All-Power Transformers Ltd. type 6311 A and B) are mounted separately and make interconnection through Painton multi-way plugs and sockets. The supplies available are:

H.T.1	+275 volts (±5 volts)
H.T.2	+265 volts (±10 volts)
Bias	−45 volts
L.T.	6·5 volts (±0·1 volt)
Relay Supply	50 volts (±5 volts)

Details are given in Section 2.

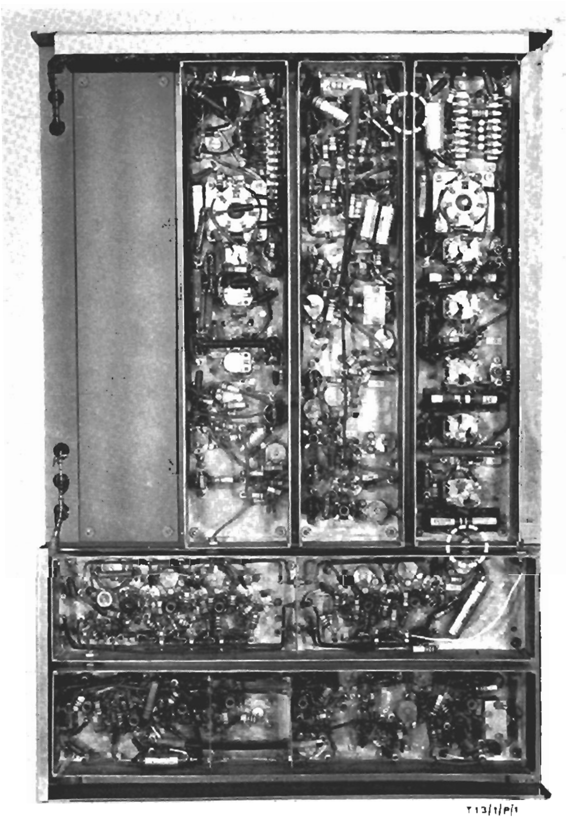


Fig. 1.4. EP7/501 Assembly: Rear View with Covers off Units. Note inter-unit connections, within broken rings

1.4. General Specification

Output Power	Vision: 10 watts (peak white). Sound: 2·5 watts c.w.
Output Load Impedance	Vision and sound: 50 ohms.
Sensitivity	Vision: 150 μV r.m.s. Sound: 75 μV r.m.s.
Input Impedance	75 ohms.
Noise Figure	Better than 7 dB Channel 1 and 9 dB for Channel 5, for vision and sound.
Amplitude Characteristic	20 per cent video distortion factor, measured on a 5-step staircase with bar on and bar off.
Pulse and Bar K-rating	2 per cent; frequency-amplitude response to be $\pm$1 dB between ($f_{carrier}$ +1 Mc/s) and ($f_{carrier}$ 3 Mc/s).
A.G.C.	Vision and sound: input variations of $\pm$10 dB reduced to $\pm$2 dB at output.
Channel Availability	Any Band-I channel (adjacent-channel translations require special modification).
Frequency Stability	Better than $\pm$10 parts in 10^6.
Frequency Accuracy	Better than 10 parts in 10^6.
Spurious Radiation	Without output filters: less than 26 dB for second harmonic and less than 35 dB for all other frequencies between 3 Mc/s and 235 Mc/s. With output filters: 30-dB improvement.
Sound Frequency Response	60 c/s to 10 kc/s ($\pm$0·5 dB).

1.5. Circuit Description

1.5.1. Front End and First Oscillator Unit (Fig. 1)

Fig. 1 is the circuit diagram of this sub-unit.

V1 is a cathode-coupled double-triode oscillator in which crystal frequency is given by:

$$\frac{\textit{Sound carrier frequency} + \textit{offset} + 38{\cdot}15\ \textit{Mc/s}}{2\ (\text{or}\ 3)}$$

The divisor is 2 for Channels 1, 2 and 3, and 3 for Channels 4 and 5. These figures ensure that the oscillator frequency is kept well below 34·65 Mc/s, which is the vision i.f.

The anode circuit of V1b, tuned appropriately to either twice or three times the oscillator frequency, is coupled into the tuned grid circuit of V2. This stage also is tuned to the requisite multiple of the oscillator frequency, and is coupled into buffer stage V3 feeding through a capacitor into the mixer formed in the anode of V5.

The received carrier is fed into a double-triode cascode amplifier (V4) through R23 and L5, which are carefully set up to provide a non-reactive 75-ohm input. The V4 output is coupled to the grid of an r.f. amplifier (V5), whose gain is variable by means of sensitivity control R1 mounted, as noted in Fig. 1, on the translator framework. Mixing is effected in the grid input circuit of V6, which is an amplifier tuned to the centre frequency of the i.f. band. Sound and vision i.f. signals are fed to the main i.f. amplifier.

V4, V5 and V6 are tuned for a bandspread coverage of frequencies between 4·32 Mc/s below and 2·32 Mc/s above the carrier frequency; this range is required for the purpose of accommodating the sound carrier and the vestigial-sideband response curve.

An oscillator-voltage monitoring socket is provided at the input to the mixer circuit, and sockets for measuring total valve-feeds are provided in each h.t. line.

1.5.2. I.F. Unit (Fig. 2)

The circuit diagram, Fig. 2, shows pentode V1 working as an r.f. amplifier to cover the sound and vision i.f. with the sound carrier at 38·15 Mc/s. The i.f. video band is spread over 34·65-37·65 Mc/s, with the vision carrier at 34·65 Mc/s; see Fig. 1.8.

The coupling between V1 and V2 provides the correct impedance conditions at the appropriate resonant frequencies for:

(a) Acceptance of vision and attenuation of sound signals at V2 grid.

(b) Acceptance of sound and attenuation of vision signals at the sound transmitter input.

(c) Shaping of the video response curve.

For explanatory purposes the transformer L3 of Fig. 2 is redrawn in Fig. 1.5(a), which has arrows indicating the direction of winding. The halves of the complete winding have individual inductances of value L and they are coupled by a mutual inductance of value M. An equivalent of this circuit is shown in Fig. 1.5(b). By introducing into the shunt arm of this circuit an impedance Z (representing the paralleled combination of L9, C60 and C61 in Fig. 2) the configuration of Fig. 1.5(c) is obtained.

It is arranged that $Z = jM$, or $Z - jM = 0$, at the sound i.f. of 38·15 Mc/s. At this frequency therefore the shunt arm has zero impedance, which prevents a through path to vision i.f. circuits connected at terminal 3. Even so a voltage is developed at 38·15 Mc/s across Z and this is used to feed sound i.f. to the transmitter input.

In practice a high C/L ratio is obtained by tapping into L9 (Fig. 2), instead of using high values of capacitance. This produces a steep reactance-frequency characteristic and therefore a narrow high-attenuation sound notch; use of a resistor for improving this notching is mentioned subsequently.

At 38·15 Mc/s the impedance Z is not at resonance, but inductive ($Z = jM$). Consequently if a Polyskop is used to apply a signal between terminals 1 and the common end of a circuit as in Fig. 1.5(c), as well as to indicate the swept output between terminal 2 and the common connection, the observed trace has a resonance peak at other than 38·15 Mc/s. The sound channel is therefore slightly asymmetric as suggested by Fig. 1.6 but, although discernible during alignment, this has no significant effect on the operation of the translator.

Impedance Z has negative resistance which is offset by use of R46 in the practical arrangement (Fig. 2), thereby increasing the depth of the notch.

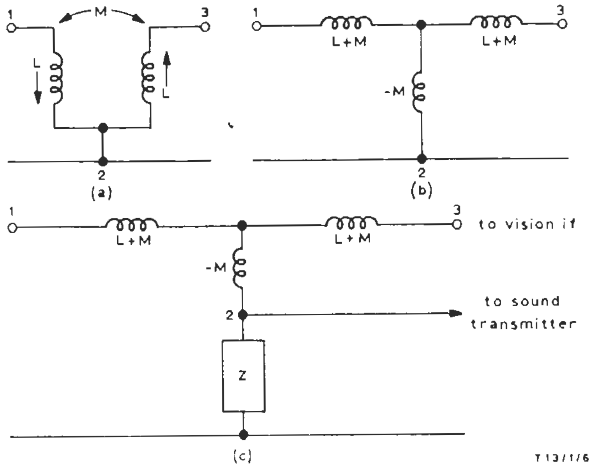


Fig. 1.5. Illustrating Derivation of Circuit for Separating Vision and Sound Signals

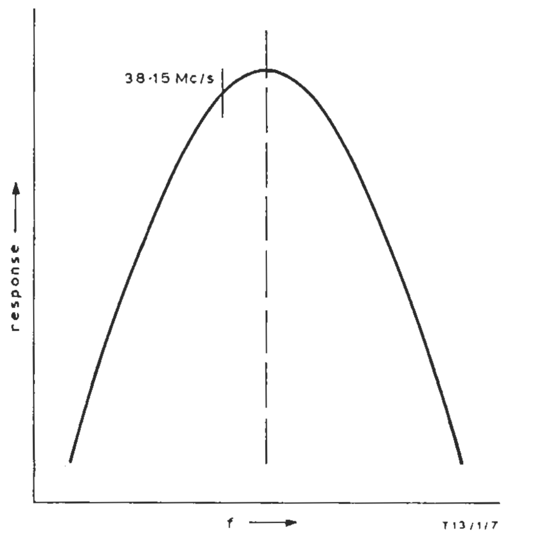


Fig. 1.6. Illustrating Asymmetric Tuning of Sound Channel

C9 is adjusted on test, to compensate variations in the L3 inductance owing to differences in batches of core material provided for these inductors. The sound i.f. input, and so overall sensitivity, is controlled by the value adopted for C56 during initial alignment. The range of possible values is 3·3 to 6·8 pF. Any disturbance causing alteration in the value of this component involves complete realignment of the sound trap.

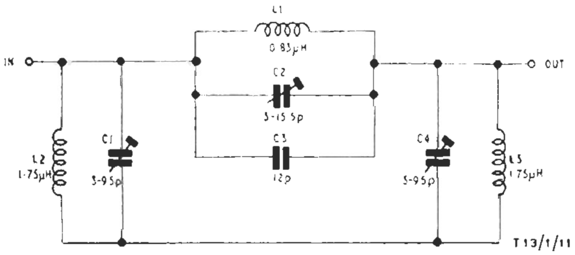


Fig. 1.7. I.F. Filter FL1/150: Circuit

The rest of the vision i.f. chain is a four-stage stagger-tuned amplifier, with a filter placed between V4 and V5. The filter, a type FL1/510, is fitted as a separate entity in the amplifier and it has the circuit arrangement of Fig. 1.7. It is tuned to provide an attenuation maximum at 41·5 Mc/s and a passband at lower frequencies in the i.f. band, this being necessary because of the closeness of Channel-I sound to the upper limit of the i.f. band.

A typical i.f. response curve is shown in Fig. 1.8, in which the sound notch is at 38·15 Mc/s and the calibration pips are spaced by 1 Mc/s. For reference purposes the horizontal trace, marked 0 - 0, has been set at 1 dB below the flat portion of the response curve.

H.T. feed sockets are available for each valve.

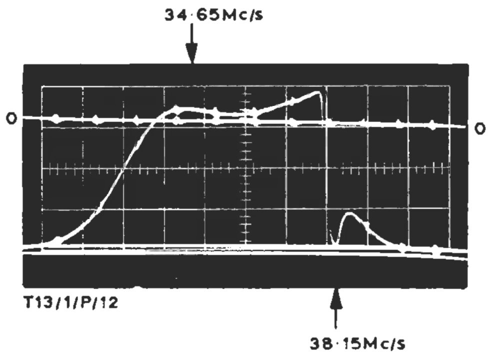


Fig. 1.8. Vision I.F. Response Curve

1.5.3. Second Oscillator and Vision A.G.C. Unit (Figs. 3 and 4)

Although fitted into one unit, the two items are not directly connected and their circuits are shown separately in Figs. 3 and 4.

Second Oscillator Circuit (Fig. 3)

V1 is a tuned-anode tuned-grid oscillator with controlled reactive coupling provided by L1 in connection with the screen grid. The miniature oven-controlled crystal, operating at one-sixth of the oscillator-output frequency, is connected in the V1 grid circuit and shunted by tuning capacitor C1. The requisite multiplication is obtained with L2 tuned to twice the oscillator frequency and L3 tuned to six times the oscillator frequency.

V3 and V4 are in buffer output stages coupled to the sound and vision mixers respectively.

Vision A.G.C. Circuit (Fig. 4)

Fig. 4 shows a circuit deriving vision a.g.c. from the back porch of the synchronising signals. This is intended primarily to compensate for changes due to ageing of valves, which in additive fashion may result in large changes of output power. The a.g.c. also compensates for fading of the r.f. input signals.

The a.g.c. circuit provided by V5, V6 and TR1 is basically a standard clamp in which the potential of the line synchronising-pulse back porch, as seen at V6a anode, is clamped at a point determined initially by the setting of RV1.

Any subsequent changes in translator gain, or in the applied r.f. signal, result in corresponding changes in sync-pulse amplitude at the base of TR1. This in turn determines the current flow in the transistor, and the direct voltage across the R45, C39 combination alters accordingly. Control is exercised by feeding this voltage to the vision i.f. stages, so that its changes cause alteration of their biasing.

For a detailed description of a standard clamp circuit, refer to Volume 4 (Chapter 5) of the BBC Engineering Training Manual titled Television Engineering: Principles and Practice.

Feed sockets are provided in the h.t. supply to each valve.

1.5.4. Sound Transmitter (Fig. 5)

The circuit diagram, Fig. 5, shows a two-stage pentode amplifier using V1 and V2 to raise the level of the i.f. signal before this 38·15 Mc/s signal is applied to mixer V3. The mixing with the second-oscillator frequency is effected on the grid of V3, the oscillator signal being injected through the centre-tap on tuned secondary of transformer L3. The anode circuit of V3 is tuned to the sound output-carrier frequency.

V4 and V5 are tuned double-tetrode amplifiers, working in cascade to raise the output power to the required 2·5 watts into 50 ohms. The output stage includes a simple diode-rectifier circuit which not only provides an a.g.c. voltage for the two initial stages, but is also means of adjusting output by variations of the bias applied to its cathode from RV1.

Careful arrangement of the grid and anode circuits, which are placed on opposite sides of the chassis, has been necessary to prevent instability. As in other units, there are feed sockets providing for total-current measurement of each valve.

1.5.5. Vision Transmitter (Fig. 6)

Fig. 6 shows V1 preceded by a bifilar-wound input transformer in which the vision i.f. signal is mixed with the second-oscillator feed. Following this stage are two double-tetrode valves, V2 and V3, associated with tuned-grid and tuned-anode circuits for the purpose of amplifying and band-spreading the vision carrier to produce 10 watts into 50 ohms. The inter-stage tuned and coupled circuits are designed to provide an overall frequency response that is ±1 dB between limits of −3 Mc/s and +1 Mc/s relative to the vision carrier frequency.

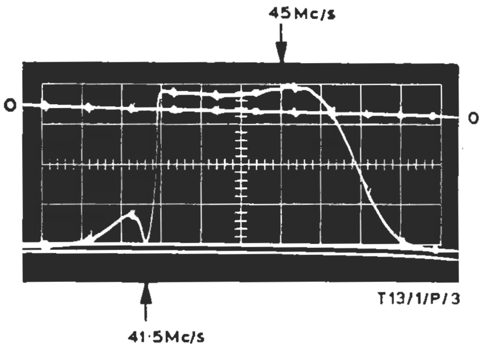


Fig. 1.9. Vision Transmitter Output-response Curve

Fig. 1.9 shows a typical vision output response curve, but note that this applies to a Channel-1 output frequency. Although curves for the other output channels have a generally similar shape, their 1-Mc/s reference points are displaced by 0·25 Mc/s. The reason for this can be found by examination of the channel carrier frequencies.

Diode V4 provides a rectified video-signal feed to the A.G.C. unit (Fig. 4) and is used as a sampling source of synchronising pulse amplitude as described under heading 1.5.3.

As for the sound transmitter already described, the grid- and anode-circuit components are carefully arranged as a precaution against instability. Each valve has a feed socket for measuring total current.

1.6. Circuit Testing and Alignment

1.6.1. Test Equipment

Listed below is all the apparatus needed for tests described subsequently.

- Portable Test Meter PTM/6 (or a 100-μA meter built out to 10 kilohms ±1 per cent).
- Signal generator (Marconi type TF.995A/1, or TF.995A/2).
- Valve-voltmeter (Marconi type TF.1041).
- Polyskop (Rohde and Schwarz type BN4244/50) or alternatively a Wobbulator (Samwell and Hutton type 41B1).
- Electronic counter (Hewlett-Packard).
- Two connectors; see Fig. 1.11.
- Two high-dissipation matching attenuators; see Fig. 1.12.
- Combining pad (6 dB); see Fig. 1.14.
- Resistors: 10, 30 and 220 ohms, all ±10 per cent (Erie type 9).
- Capacitors: 1 pF and 10 pF, 300-volt types.
- Two variable attenuators, 0-90 dB (S.T. and C. type 74600, or equivalent).
- Two variable attenuators, 0-9 dB (S.T. and C. type 74600, or equivalent).
- Receiver (Eddystone type 770R, or equivalent).
- Receiver (Eddystone type 770S, or equivalent).
- Receiver (Eddystone type 770U, or equivalent).
- Noise generator (Marconi type TF.1106).
- Tone source, to provide 1 kc/s from 600 ohms (harmonic distortion less than 0·5 per cent).
- Oscilloscope (Tektronix type 524D).
- Non-linearity Test Signal Generator GE4/505.
- Filter FL1/509A.
- Pulse and Bar Generator GE4/504A.
- Modulator MD2/502.
- Receiver RC4/501.
- Filter FHP/3.
- A.C. Test Meter ATM/1.

The diagrams mentioned in this list provide constructional details of the particular items, and are with information relating to their uses. The four variable attenuators are used as two pairs, each capable of introducing a total loss of 99 dB; in further description the term variable attenuator is to be taken as referring to one of these combinations.

1.6.2. D.C. Measurements

The translator should be powered for a warming-up period of at least 10 minutes before measurements are undertaken. Another preliminary is the adjustment of the power supplier to deliver bias at 45 volts, corresponding to a 45-μA deflection of the PTM/6.

Table 1 gives figures to be expected by use of the PTM/6. This meter is essentially a 1-volt instrument which, when connected across a 10-ohm shunt, indicates current directly in milliamperes on its 0/100 scale. The table includes the appropriate multiplying factor (M.F.) where other values of shunt are fitted.

Readings marked with an asterisk vary considerably with alignment; they should be rechecked after operations up to and including that under heading 1.6.8.

Table 1

Position		*Reading*	*M.F.*
First Osc.	V1a	60 ± 15	0·1
	V1b	60 ± 15	0·1
	V2	32 ± 8	0·1
	V3	30 ± 7	0·1
Front End	V4	38 ± 10	0·3
	V5	80 ± 20	0·1
	V6	62 ± 15	0·1
	*Osc. V	60 ± 30	—
I.F. Unit	V1	27 ± 7	0·3
	V2	27 ± 7	0·3
	V3	27 ± 7	0·3
	V4	27 ± 7	0·3
	V5	27 ± 7	0·3
	V6	64 ± 16	0·3
	V7	64 ± 16	0·3
Second Osc.	*V1	55 ± 14	0·1
	*V2	55 ± 14	0·1
	V3	36 ± 9	0·3
	*V4	32 ± 8	0·3
Vision A.G.C.	V5a	44 ± 11	0·1
	V5b	8 ± 2	0·1
	V6a	80 ± 20	0·1
	V6b	80 ± 20	0·1
Sound Transmitter	V1	80 ± 20	0·1
	V2	27 ± 7	0·3
	V3	42 ± 10	—
	V4	60 ± 15	—
	V5	44 ± 11	—
	*Osc. V	40 ± 25	—
Vision Transmitter	V1	36 ± 9	—
	V2	65 ± 16	—
	V3	20 ± 5	3·0
	*Osc. V	40 ± 25	—

* *See under 1.6.2*

Power-supply Readings (by PTM/6)

H.T. volts	92 ± 7
H.T.1 current	36 ± 7
H.T.2 current	53 ± 10
Relay-supply volts	50 ± 5

1.6.3. Filter FL1/510

For the Channel-1 input frequency an alignment of the filter is necessary at this stage, but for all other frequencies the operation should be included with the procedure detailed under 1.6.6. The sound notch attenuation at 41·5 Mc/s is effective only when Channel 1 is used.

1. Connect the filter into a test circuit as shown in Fig. 1.10.
2. Apply the Polyskop r.f. output to the test-unit input, and connect the test-unit output to the Y-input of the Polyskop.
3. Adjust the C2 element of the filter to give maximum rejection at 41·5 Mc/s.
4. Adjust C1 and C4 of the filter to give a flat response, within ±0·5 dB, between 33·65 Mc/s and 37·65 Mc/s.

Note: The notch attenuation should be approximately 10 dB.

5. Fit the filter into the I.F. sub-unit of the translator.

1.6.4. First Oscillator

1. Check that the crystal-oven thermostat is operating, as indicated by the periodic lighting of the lamp to the left of the oven assembly.
2. Remove the crystal, substituting for it the 39-ohm test resistor.
3. Tune the 770R receiver to the nominal crystal frequency and loosely couple its aerial input to the envelope of V1.
4. Tune C4 in the oscillator for maximum receiver input, as shown by the S-meter. Restore the crystal to the first-oscillator circuit.
5. Retune the receiver to the frequency represented by adding 38·15 Mc/s to the input sound-carrier frequency, and couple it through the 10-pF test capacitor to the V2 anode.
6. Connect the 10-ohm test resistor across the L2 secondary, and adjust C10 for maximum receiver input. Transfer the resistor to L2 primary, then adjust C13 for maximum receiver input.
7. By the foregoing method, determine the tuned settings for C18 and C20 while shunting the

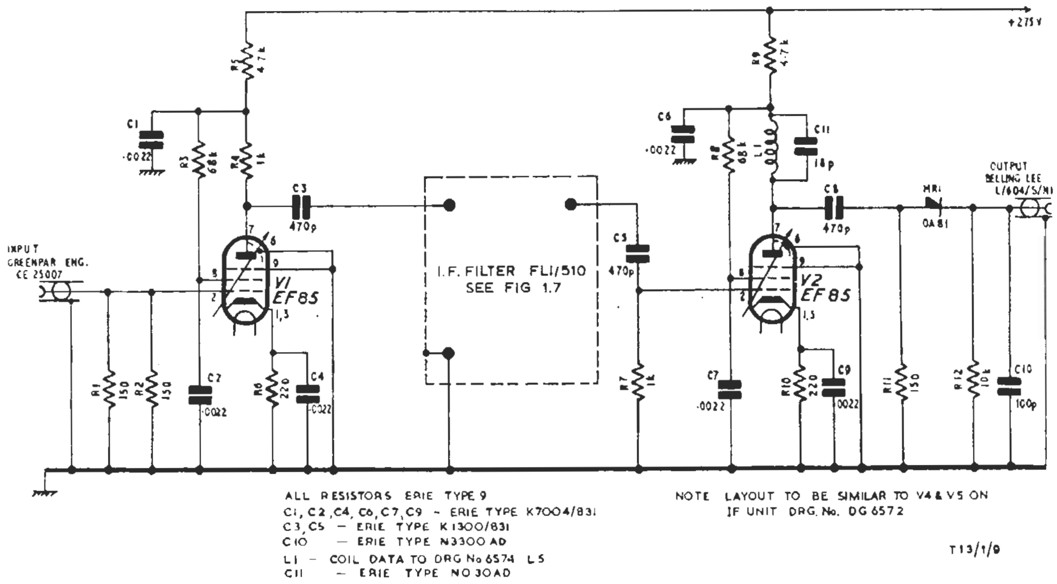


Fig. 1.10. Test Circuit for I.F. Filter FL1/510

L3 secondary and primary respectively with the 10-ohm resistor.

8. Disconnect the receiver and plug the PTM/6 into the *Osc. V.* socket on the front-end section of the sub-unit.
9. First tune C27 and then C20 in a repeated alternation to obtain a maximum reading by the PTM/6.
10. Connect the frequency counter via the 10-pF test capacitor to the V3 anode. Adjust C4 until the frequency is precisely either twice or three times that of the crystal, and output is at a maximum.

Note: The multiplication figure depends on the Channel number, as explained under 1.5.1.

11. Disconnect the frequency counter.

1.6.5. Second Oscillator

12. Check that the crystal oven is operating correctly, by observation of the periodic lighting of the lamp to the left of the oven assembly.
13. Set C1 (Fig. 3) to the centre of its capacitance range. Connect the valve-voltmeter across the crystal; between the grid of V1 and earth is a convenient point.
14. Monitor the V1 feed. Tune C7 for minimum V1 feed and crystal voltage.
15. Tune L1 for maximum crystal voltage.
16. Tune C1 for correct output frequency.

Note: If C1 is adjusted appreciably, repeat operations 14 and 15. Under tuned conditions, the V1 feed should be about 2 milliamperes and the crystal voltage should not exceed 4 volts.

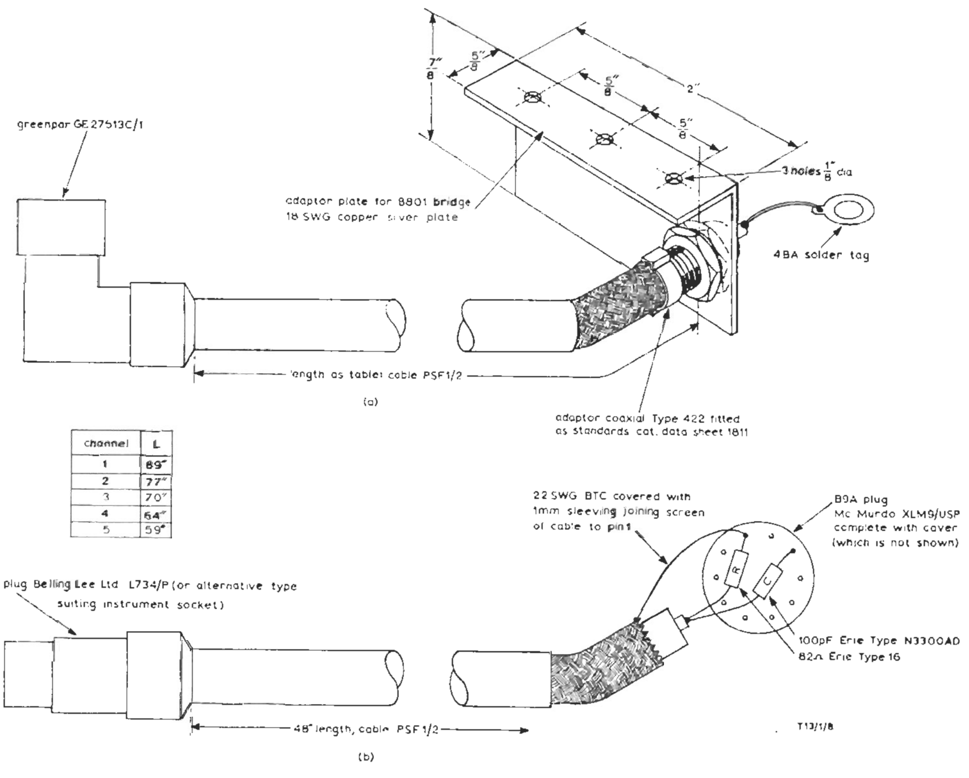
17. Tune the receiver to twice crystal-frequency and couple its input through the 10-pF test capacitor to the V2 anode.
18. Tune C7 and C10 for maximum receiver input; in each instance damp the opposite side of L2 by means of a 10-ohm resistor.
19. Retune the receiver to six times the crystal frequency and connect its input through the 10-pF test capacitor to the V3 anode.
20. Tune C14 and C15 for maximum receiver input, while damping the L3 windings alternately by the method of item 18.
21. Disconnect the receiver.
22. Plug the PTM/6 into the *Osc. V* socket on the sound-transmitter unit, and adjust C20 for maximum deflection.
23. Transfer the PTM/6 to the *Osc. V* socket on the vision transmitter, and adjust C15 for maximum deflection.
24. Connect the Hewlett-Packard counter through the 1-pF test capacitor to the V4 anode, and adjust C1 until the frequency is as precise as possible.

25. Disconnect the counter and retrim C25, C15, C14, C10 and C7 for maximum reading on the PTM/6.
26. Readjust C1 for correct frequency.
27. Trim C20 and C25 alternately for maximum PTM/6 reading.

1.6.6. Front End and I.F. Unit

The front-end input circuit is adjusted to provide a non-reactive 75-ohm input impedance. If considered necessary, the impedance should be checked with a type-B801 (Wayne-Kerr) admittance bridge, and it is important to connect this to the input circuit through coaxial cable with an electrical length of 0·5λ; see Fig. 1.11(a) for details. Resetting involves adjustment of L5 and R23 until the reactive component is zero and the resistive value is 75 ohms.

28. Remove the crystals in the first and second oscillators.
29. Connect the signal generator to the front-end unit, feeding from the low-output level of one to the input socket of the other.
30. Connect the 770R receiver through the 10-pF test capacitor to the anode of V6 (front-end section).
31. Tune the signal generator and receiver to the frequency given by adding 2·32 Mc/s to the input vision-carrier frequency.
32. Tune L10 (front-end section) for maximum receiver input.
33. Remove the receiver-input connection from V6 anode, and put the first-oscillator crystal back into circuit.
34. Plug the PTM/6 into the *Osc. V* socket on the front-end unit, and tune C27 for a maximum reading.
35. Remove the first-oscillator crystal and retune L10.
36. Repeatedly adjust C27 (with crystal in) and L10 (with crystal out) until the input-signal and crystal-oscillator circuits are correctly tuned. Finally, leave the crystal in circuit.
37. Use the valve-voltmeter to measure the oscillator voltage between the centre-tap of L10 and earth, readjusting C27 for maximum



channel	L
1	89"
2	77"
3	70"
4	64"
5	59"

Fig. 1.11. Construction of Test Connectors for use with (a) Admittance Bridge and (b) Polyskop Output (see under 1.6.7)

voltage if necessary.

Note: The reading should be 2 volts, and must be made that value by adopting a suitable value for the damping resistor across the L3 secondary in the first-oscillator section (see R49 in Fig. 1).

38. Disconnect the valve voltmeter and retune C27 for maximum reading by the PTM/6.
39. Remove the first-oscillator crystal and retune both the signal generator and receiver to the frequency represented by subtracting 4·32 Mc/s from the input vision-carrier frequency. Connect the receiver input, through the 10-pF test capacitor, to the V6 anode.
40. Tune L9 for maximum receiver input, as seen on the S-meter.
41. Transfer the receiver input to the *Mon. 1* socket on the vision transmitter. Retune the signal generator and the receiver to 39·4 Mc/s.
42. In the i.f. unit (Fig. 2), adjust C18 and C38 for maximum receiver input as read by the S-meter.
43. Alter the tuning of the signal generator and the receiver to 31·9 Mc/s.
44. In the i.f. unit, adjust C25 and C44 for maximum receiver input.
45. Retune the signal generator and receiver to 35·65 Mc/s. Adjust L11 in the front-end unit for maximum receiver input.
46. In the i.f. unit, shunt C54 with the 10-ohm test resistor. On the vision transmitter, tune C3 for maximum receiver input.
47. Reverse the preceding, by transferring the resistor to shunt C3 (vision transmitter) and adjusting C54 (i.f. unit) for maximum receiver input.
48. Remove the shunt resistor and disconnect the signal generator.
49. Put the second-oscillator crystal back into circuit. In the vision transmitter (Fig. 6), connect the valve-voltmeter between the centre-tap of L1 and earth.
50. In the second-oscillator unit (Fig. 3), adjust C25 for a maximum reading by the valve-voltmeter; this should be not less than 11 volts.
51. Disconnect the valve-voltmeter and plug the PTM/6 into the *Osc. V* socket in the vision transmitter. Retune C25 (second-oscillator unit) for a maximum reading.
52. Remove the second-oscillator crystal.

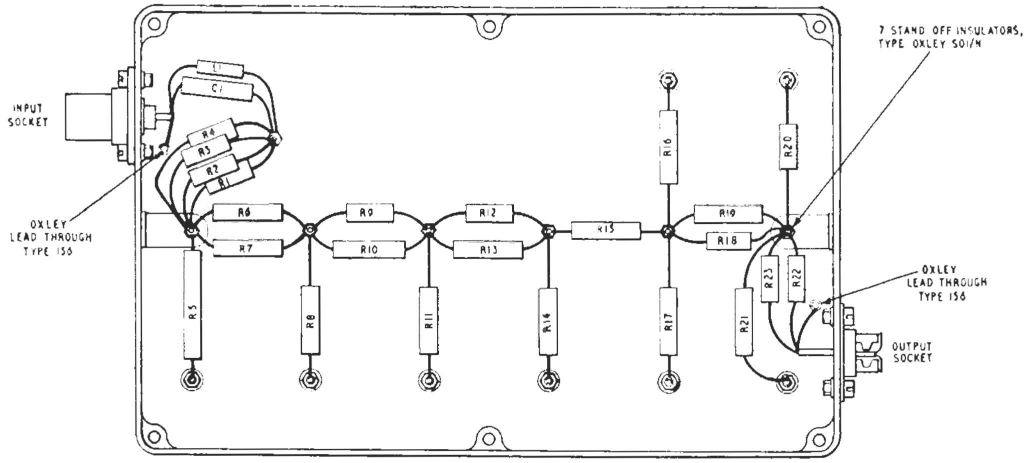
1.6.7. Vision Transmitter

Serious errors can occur throughout the transmitter alignment procedure if a mis-matched load is used. It is essential therefore that the test attenuator, built as specified by Fig. 1.12, shall be correctly matched at the appropriate output frequency.

The vision transmitter circuits are carefully aligned in Equipment Department before installation, the test work ending with a sealing of all tuning coils affecting the video response curve. Consequently it is impossible for station staffs to carry out a complete alignment, although useful checks can be made at various points and some adjustment is available by means of variable capacitors. Any difficulties outside control by these capacitors should be referred to Equipment Department.

53. Remove V3 from the sound transmitter.
54. Terminate the vision transmitter with a high-dissipation attenuator, as in Fig. 1.12.
55. Using the test connector shown in Fig. 1.11(b), feed the Polyskop r.f. output into the V7 valve-holder on the i.f. unit (Fig. 2).
56. In the vision transmitter, shunt the L1 secondary with the 220-ohm test resistor and connect the Polyskop probe to the L2, MR2 junction.
57. Adjust C9 and C10 to give a 4-Mc's passband centred on the frequency represented by subtraction of 1 Mc/s from the output carrier frequency.
58. Shift the Polyskop probe to the L4, MR3 junction. Adjust C15 and C16 for a similar passband.
59. Restore the second-oscillator crystal to its circuit. In the i.f. unit, move the test connector to the V6 valve-holder and put V7 back into its holder. In the vision transmitter, remove the 220-ohm resistor fitted for test purposes across the L1 secondary.
60. Adjust C54 (i.f. unit) and C3 (vision transmitter) to provide a 4-Mc/s pass-band centred on 35·65 Mc/s. Then remove the Polyskop-probe connection from the L4, MR3 junction.
61. In the vision transmitter, adjust C19 and C20 to give a 4-Mc/s passband at the output of the high-dissipation attenuator. With the Polyskop output voltage at maximum there should be at least 16 volts across the transmitter load.

    Proceed to check the i.f. response, as well as that of the filter FL1/510, thus:
62. Connect the Polyskop Y-input to the *Mon. 2* socket on the vision transmitter, and feed the Polyskop output into the V6 valve-holder on the i.f. unit. Note the response curve dis-



NOTE :- ALL LEADS TO BE AS SHORT AS POSSIBLE

COMP.	MAKE	TYPE	VALUE	COMP.	MAKE	TYPE	VALUE
L1	PAINTON	4RH200154		R11	MORGANITE	R	270 Ω
C1 CH 1	ERIE	N750M	150p	R12	ERIE	9	47
" " 2	"	N750L	120p	R13	MORGANITE	R	18
" 3			"	R14	"	"	150
" " 4	"	"	100p	R15		"	22
" " 5	"		82p	R16	ERIE	8	180
R1	ERIE	9	10 Ω	R17	"	8	180 "
R2		9	"	R18		9	56
R3		9	"	R19	"	8	18
R4		9	12 Ω	R20		9	330
R5	DUBILIER	B.T.B	470 Ω	R21	"	8	120 "
R6	ERIE	8	18 "	R22	"	9	56 "
R7	MORGANITE	R	10 "	R23	"		180
R8	"	R	330 "	INPUT SKT	GREENPAR ENG.	PANEL SKT GE25007H	50 "
R9	ERIE	9	47 "	OUTPUT	BELLING LEE	L/604/S/NI	
R10	MORGANITE	R	10 "	BOX	EDDYSTONE	No.845	

NOTE :- ALL RESISTORS ±10 %.

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Fig. 1.12. Construction of High-dissipation Attenuator

played by the Polyskop.

63. In the i.f. unit, remove the test connector from the V6 valve-holder and restore the valve to that position. Fit the test connector into the V5 valve-holder.
64. Reduce the Polyskop output until the displayed response is like that of item 62. The reduction should be about 25 dB and the response-curve slope should not exceed ±1 dB.
65. In the i.f. unit, shift the test connector to the V3 valve-holder and put V5 into its holder.
66. In the FL1/510 filter, adjust C1, C2 (see exception noted below) and C4 for minimum loss and a slope and bandwidth similar to that of the item-62 test.

Note: In the order named, the three capacitors control the slope, bandwidth and filter loss. The Polyskop output should not need more than a 1-dB increase to give the response curve resulting from the item-64 test. *Where the input frequency is that of Channel 1, C2 should not be moved from the setting found during operations specified under 1.6.3.*

67. Detach the test connector from the V3 position in the i.f. unit and attach it to the V6 valve-holder in the front-end unit. Restore V3 to the i.f. unit. In this unit, connect the C9, C61 junction to earth.
68. Reduce the Polyskop output to produce a response similar to that of the item-66 test. The reduction ought to be approximately 24 dB, and the slope should remain unchanged, but can be trimmed by adjustment of C11 in the i.f. unit.
69. Remove the earth connection from the junction of C9 and C61, (i.f. unit).

Note that:

(a) The sound notch occurs at 38·15 Mc/s, and has a rejection of 30 dB. Frequency and attenuation are controlled by C61 and L9, respectively, in the i.f. unit.

(b) The response curve should show similar gains at 37·65 Mc/s and 34·65 Mc/s; it is controllable by C11, preceding V2 in the i.f. unit.

(c) C9 in the i.f. unit has a value selected for an optimally-flat characteristic below 37.65 Mc/s.

70. Connect the vision transmitter through the high-dissipation test attenuator, adjusted for a loss of at least 16 dB, to the Polyskop input. Connect the valve-voltmeter across the attenuator input.

71. Set the Polyskop output to −60 dB. Change the test connector from the V6 to the V3 position in the i.f. unit; also put V6 back into its holder.

72. Increase the Polyskop output until the displayed trace indicates the vision output level at saturation. The output voltage for this condition should be greater than 40 volts.

Note: This test must be completed rapidly to avoid possible damage to the output stage.

73. Detach the test connector and fit V3 into the vacated position. Restore the first-oscillator crystal to its circuit.

74. Connect the Polyskop output to the input socket on the front-end unit, and adjust the input level until the vision transmitter produces a 10-watt output. As seen at the transmitter output, the frequency response should be within ±1 dB between limits of +1 Mc/s and −3 Mc/s with respect to the vision carrier.

1.6.8. Sound Transmitter

75. Restore V3 to the sound transmitter and take V1 out of the vision transmitter. Plug the PTM/6 into the *Output Volts* socket on the sound transmitter (Fig. 5).

76. Connect the signal generator to the input socket on the front-end unit, adjusting its frequency to that of the input sound carrier.

Note: The generator needs adjustment that gives a sound i.f. of precisely 38·15 Mc/s, this being determined while measuring the frequency at the anode of V2 in the sound transmitter. Then, if there is sufficient transmitter output for a noticeable deflection of the PTM/6, take the opportunity of tuning for a maximum by adjustment of C10, C11, C17, C21, C26, C32 and C36. It may, however, be necessary to tune the stages individually, using the 770R receiver (fed through the 10-pF test capacitor) in successive connection with their anode circuits.

77. Measure the transmitter output either by means of the high-dissipation attenuator and the valve-voltmeter or by use of a 50-ohm power meter. The maximum available (saturated) power should be not less than 18 watts, corresponding to 30 volts r.m.s. across the stipulated load.

Note: This test must be carried out quickly to avoid damage to the transmitter.

78. Restore V1 to the vision transmitter.

1.7. Overall Translator Tests

Unless stated otherwise, all tests should be carried out with the *Increase Sensitivity* control (mounted separately from the front-end unit but included in Fig. 1) at the maximum-gain setting. Prior to conducting c.w. tests on one of the transmitters it is essential to remove valves from the early stages of the other, thereby providing an inoperative condition to protect output valves.

1.7.1. Vision Frequency Response

1. Disable the vision a.g.c. by short-circuiting the *Vis. A.G.C.* tags in the second-oscillator and a.g.c. unit (Figs. 3 and 4).
2. Connect the output of the Polyskop, adjusted to the appropriate input-carrier frequency, to the translator input socket. Adjust the Polyskop level so that 22·4 volts r.m.s. is measured across the transmitter output terminated in the high-dissipation attenuator.
3. At the attenuator output, check that the vision response is ±1 dB between +1 Mc/s and −3 Mc/s relative to the vision carrier.
4. Remove the white lead from tag 3 in the i.f. unit (Fig. 2). Use a dry battery to apply −1·5 volts (with respect to earth) to tag 3.
5. Adjust the Polyskop output so that 22·4 volts r.m.s. is again measured across the transmitter output load. Check that the vision response is unchanged.
6. Alter the tag-3 bias to −3 volts and repeat the test specified under 5.
7. Remove the battery and reconnect the lead detached from tag 3. Remove the Polyskop connections.

1.7.2. Vision Sensitivity

8. Assuming the vision a.g.c. line is short-circuited (refer to item 1), feed the translator

input socket from a signal generator adjusted to provide an unmodulated signal at incoming-carrier frequency.

9. Adjust the applied-signal level so that there is 22·4 volts r.m.s. across the transmitter output loaded by the high-dissipation attenuator. The generator-output level to obtain this should be not greater than 150 μV.
10. Set the *Increase Sensitivity* control (previously at maximum as explained in the introductory notes) to the minimum setting. Adjust the generator-output level to restore the 22·4-volt transmitter output. The generator-output level should now be 750 μV or more.
11. Reduce the generator-output level and reset the *Increase Sensitivity* control to maximum.

1.7.3. Sound Sensitivity and A.G.C. Characteristic

12. Disable the sound a.g.c. circuit by earthing the *Sound A.G.C. Line* terminal in the sound transmitter (Fig. 5). Check that the vision a.g.c. is disabled as described in item 1.
13. Set the signal generator to the incoming sound-carrier frequency and adjust its output to provide 11·2 volts r.m.s. across the 50-ohm transmitter load. This should be achieved with a generator-output level not exceeding 75 μV.
14. Put the *Increase Sensitivity* control to its minimum position, and restore the transmitter output to the original 11·2 volts by increasing the signal-generator output. The generator-output voltage for this condition should not be less than 375 μV.
15. Alter the signal-generator output to 75 μV and adjust the *Increase Sensitivity* control to provide the 11·2-volt output. Then remove the earthing connection from the sound a.g.c. line and increase the signal-generator output to 300 μV.
16. Find a setting for the *Adj. Output* control (on the sound transmitter) such that the transmitter output voltage is 11·2 volts.
17. Change the input level of the translator by $\pm$10 dB, for which the transmitter-output level should not change by more than $\pm$2 dB.

1.7.4. Sound Frequency Response

18. Assuming the sound and vision a.g.c. circuits are disabled, as under item 12, adjust the signal-generator *frequency* to give maximum r.f. output from the sound transmitter.
19. Adjust the signal-generator feed (unmodulated) to produce about 10 volts across the transmitter-output load. By using internal crystal-check points, vary the signal-generator frequency over a band of $\pm$25 kc/s and check that the translator output does not fall by more than 0·5 dB.

1.7.5. Sound-carrier Rejection

20. Check that both the sound and vision a.g.c. circuits are disabled; refer to item 12. Move the *Increase Sensitivity* control to its maximum setting.
21. Remove V3 from the sound transmitter. Set the signal generator, with unmodulated output, to the vision carrier frequency and adjust its output voltage to 100 mV. Interpose the combination of variable attenuators, one offering 90-dB loss and the other 9-dB loss, between this signal feed and the translator input socket.
22. Adjust the variable attenuators to give 22·4 volts at the vision transmitter output. Note the value of attenuation for this setting.
23. Retune the signal generator to the input sound-carrier frequency; the minimum dip will be found at precisely sound-carrier frequency. Adjust the attenuators to restore the 22·4 volt output and then read the loss at their new settings.
24. Subtract the attenuator loss of operation 22 from that of operation 23 to ascertain the sound carrier rejection in dB. This figure should be greater than 30 dB.
25. Put V3 into the sound transmitter.

1.7.6. Sound and Vision Noise Factors

26. Check that both the sound and vision a.g.c. circuits are disabled, as item 12. Also check that the *Increase Sensitivity* control is at maximum.
27. Prepare the noise generator for use by connecting it, with the range switch at *Off*, to the translator input. Measure the noise voltage across the terminated sound-transmitter output, by means of the valve-voltmeter.
28. Introduce the noise-generator output, increasing this input until the measured noise voltage is $\sqrt{2}$ times the value originally indicated. Read the noise factor from the generator dial.

Note: The noise factor expressed in dB is derived by calculating $10 \log_{10}$ of the indicated figure.

The noise limits are 7 dB for the Channel-1 input frequency, with increases of 0·5 dB per channel up to 9 dB on Channel 5.

29. By the method already detailed, measure and calculate the noise factor of the vision-transmitter output.

1.7.7. Sound Harmonic Distortion

This test and succeeding ones are carried out with the translator in a test equipment assembly as shown in Fig. 1.13, but first see the note under 30.

30. Check that the sound and vision a.g.c. circuits are disabled, as in item 12. Remove V1 from the vision transmitter. For the RC4/501 receiver, set the a.g.c. control to the *A.G.C.* position and adjust the preceding variable attenuator to the setting that gives a 3-mV input.

Note: The MD2/502 modulator has an uncalibrated output, so the required level into the translator has to be established initially, thus:

31. In place of the MD2/502, connect a signal generator through the variable attenuator to the translator input. Set the signal-generator frequency to that of the input sound carrier and make adjustments providing a 75-μV input for the translator.
32. Adjust the *Increase Sensitivity* control to develop 11·2 volts r.m.s. across the sound-transmitter output terminated in the 50-ohm load.
33. Substitute the MD2/502 for the signal generator and, with no modulation, adjust the input variable attenuator to obtain 11·2 volts, as before, across the transmitter output.
34. Detach the earthing connection from the sound a.g.c. circuit; refer to item 12.
35. Increase the translator input by 12 dB. Then set the sound-transmitter output voltage to 11·2 volts by means of the *Adj. Output* control (RV1 in Fig. 5).
36. Modulate the MD2/502 with 1-kc/s tone at varying depths specified in Table 2; the a.f. levels are those of the MD2/502 input.

Table 2

A.F input (dB)	+9	+8	+7	+4·5	+1·0	−5·0
Mod. depth (per cent)	100	90	80	60	40	20

37. Use the FHP/3 and ATM/1 in measurements of harmonic distortion. Adjust R44 in the sound output amplifier for minimum harmonic distortion at 40 per cent modulation and 1 kc/s. Total harmonic distortion should not exceed 3 per cent at all modulation depths up to 90 per cent. If R44 is varied appreciably, the sensitivity should be checked and can be corrected by adjustment of C56 in the i.f. unit.

1.7.8. Vision A.G.C.

38. Restore V1 to the vision transmitter and take V3 out of the sound transmitter. Check that the vision a.g.c. circuit is disabled, as specified by item 1.
39. Substitute a signal generator, producing the frequency of the vision input carrier, for the MD2/502. Set the input variable attenuator to provide a translator input of 150 μV.
40. Adjust the *Increase Sensitivity* control to give 22·4 volts r.m.s. across the transmitter termination.
41. Substitute the MD2/502 for the signal gener

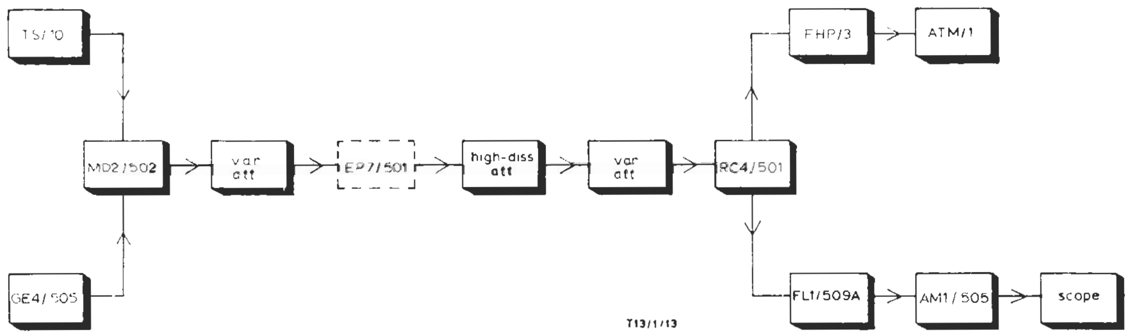


Fig. 1.13. Translator Overall-test Arrangement

ator, and modulate it with syncs and sawtooth from the GE4/505 generator.

42. Adjust the input variable-attenuator to produce 22·4 volts at the transmitter output.
43. Remove the short-circuit from the vision a.g.c. line; refer to item 1.
44. Increase the translator input by 12 dB, and set the *Adjust Vision Output* control (RV1 in Fig. 4) to restore the output voltage to 22·4 volts.
45. Vary the input level by ±10 dB and check that the output does not vary by more than ±2 dB.
46. Set the input attenuator for the RC4/501 to give a 3-mV input to the receiver, also setting the a.g.c. control of the receiver to the *Man.* position.
47. Adjust the *Man. O/P* control of the receiver so that the oscilloscope displays a video output trace with an amplitude of 1 volt. Measure the sync-pulse amplitude.
48. Reduce the video signal to blanking level and again measure the sync-pulse amplitude.
49. Increase the video to peak-white bars and once more measure the sync-pulse amplitude.

Note: Change of sync pulse amplitude between blanking level and sawtooth, as well as between peak white and sawtooth, should be less the 3 per cent with respect to the video signal.

50. With an applied video signal of peak-white bars, increase the translator input to 5 mV. Disconnect the MD2/502 from the input variable attenuator, and then reconnect it, while observing the video output of the receiver to check that the translator a.g.c. has not locked out.
51. Connect the vision-transmitter output to a 50-ohm wattmeter. Put a readily-detachable earth connection on the vision a.g.c. line.
52. Revert to a signal-generator input for the translator, obtaining from that a c.w. signal at the vision input frequency and of sufficient amplitude to produce a transmitter output of 12 watts.
53. Remove the earth from the a.g.c. line, and check that the output power does not fall.
54. Again earth the a.g.c. line, and increase the signal-generator input until the output power is 20 watts.
55. Remove the earth from the a.g.c. line, and check that the output power is between 12 and 16 watts.
56. Increase the input by 20 dB and check that the output power does not rise above 20 watts.

Note: If power limiting occurs at the wrong output level, change the value of R48, nominally 820 kilohms, in the i.f. unit (Fig. 2).

1.7.9. Vision Non-linearity

57. Set the MD2/502 on a suitable channel and connect it through an attenuator to the receiver, adjusting the loss to provide this with a 3-mV input.
58. Measure the 5-step waveform amplitude and calculate the receiver non-linearity, expressed as a percentage by:

$$\frac{b - a}{b} \cdot 100$$

where b is the largest pulse amplitude and (b − a) is the difference between it and the smallest pulse amplitude; refer to Instruction V.3, Section 6. The figure obtained for receiver non-linearity should not exceed 10 per cent.

Note: If a long period has elapsed since completion of an a.g.c. line-up, it is advisable to repeat the a.g.c. line-up procedure detailed under 1.7.8.

59. Transfer the RC4/501 input to the output of the high-dissipation attenuator. Check that the receiver input is about 3 mV. Also, see that the receiver a.g.c. selector switch is at *A.G.C.* and make adjustments giving a receiver-output signal at 1 volt.
60. Revert to the translator-input condition of Fig. 1.13, the vision signal being a 5-step C.C.I.R. black and staircase waveform as used in the receiver non-linearity test, above. Display the receiver output on the oscilloscope, fed through the FL1/509A filter and AM1/505 amplifier. Note the amplitudes of the pulses corresponding to the 5 steps.
61. Repeat the foregoing test on a black staircase and a linear staircase. Calculate the overall non-linearity, expressed as a percentage by:

$$\frac{b' - a'}{a'} \cdot 100$$

In this instance b′ and a′ are the largest and smallest figures, respectively, obtained through division of the individual pulse amplitudes of this complete-system test by those obtained in the item-58 test of the receiver only. Overall non-linearity should not exceed 20 per cent.

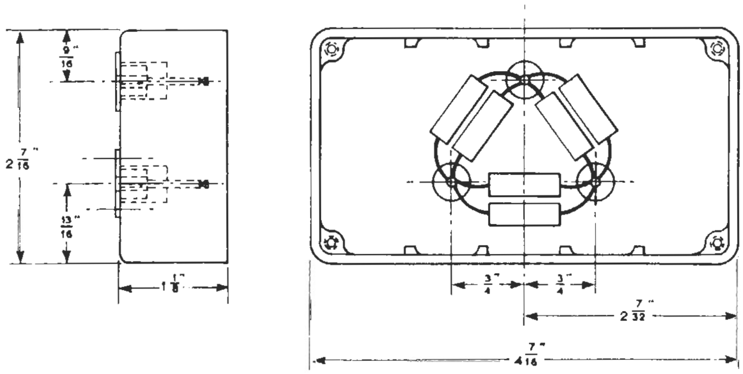
1.7.10. K-rating

62. Feed the RC4/501 receiver from the MD2/502 output, as in item 57 of the preceding non-linearity test. Measure the 2T pulse and bar and 50-c/s k-rating for this combination. The overall rating should be less than 2 per cent.
63. Transfer the MD2/502 output to the translator input, making sure that the test signal is at the translator input frequency. Measure the k-rating; overall rating should not exceed 4 per cent.

Information on the principles of pulse and bar testing, as well as the k-rating system, is in Section 10 of Instruction V.3.

form of line sawtooth and syncs.

66. Check that the sound output is 11·2 volts r.m.s., and the vision output is 22·4 volts r.m.s., measuring across the transmitter output loads.
67. Set the attenuator between the combining pad and receiver to introduce a loss of 65 dB. Tune the 770R receiver to the vision output carrier, and adjust its gain control to give a reading of 7 on the S-meter.
68. Use communications receivers having the required frequency coverages, to check the level of spurious signals on the translator output.



No OFF	DESCRIPTION
1	BOX, DIECAST, EDDYSTONE CAT. No 896
3	SOCKET, COAXIAL, BELLING–LEE TYPE L734/S
6	SCREW 6 BA x 3/8" CS'K. HD. ST. CAD. PL.
6	NUT 6 BA HEX. ST. CAD. PL.
6	WASHER 6 BA SHAKEPROOF ST. CAD. PL.
4	SCREW 4 BA x 1/4" ST. CAD. PL.
6	RESISTOR 150Ω ±10%. MORGANITE TYPE 'R'

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Fig. 1.14. Construction of Combining Pad

1.7.11. Spurious Radiation

64. Combine the outputs of the two high-dissipation attenuators by means of the 6-dB combining pad; see Fig. 1.14 for constructional information. Connect this combined output through the variable attenuator to the 770R receiver.
65. Modulate the sound section of the MD2/502 with 1-kc/s tone to a depth of 40 per cent, in addition to providing vision modulation in the

Unwanted signals should be attenuated by at least 35 dB between 3 Mc/s and 235 Mc/s, excepting the second harmonics of the sound and vision output carriers, which should be at least 32 dB and 26 dB down respectively. When making measurements it is essential to take account of variations in receiver sensitivity.

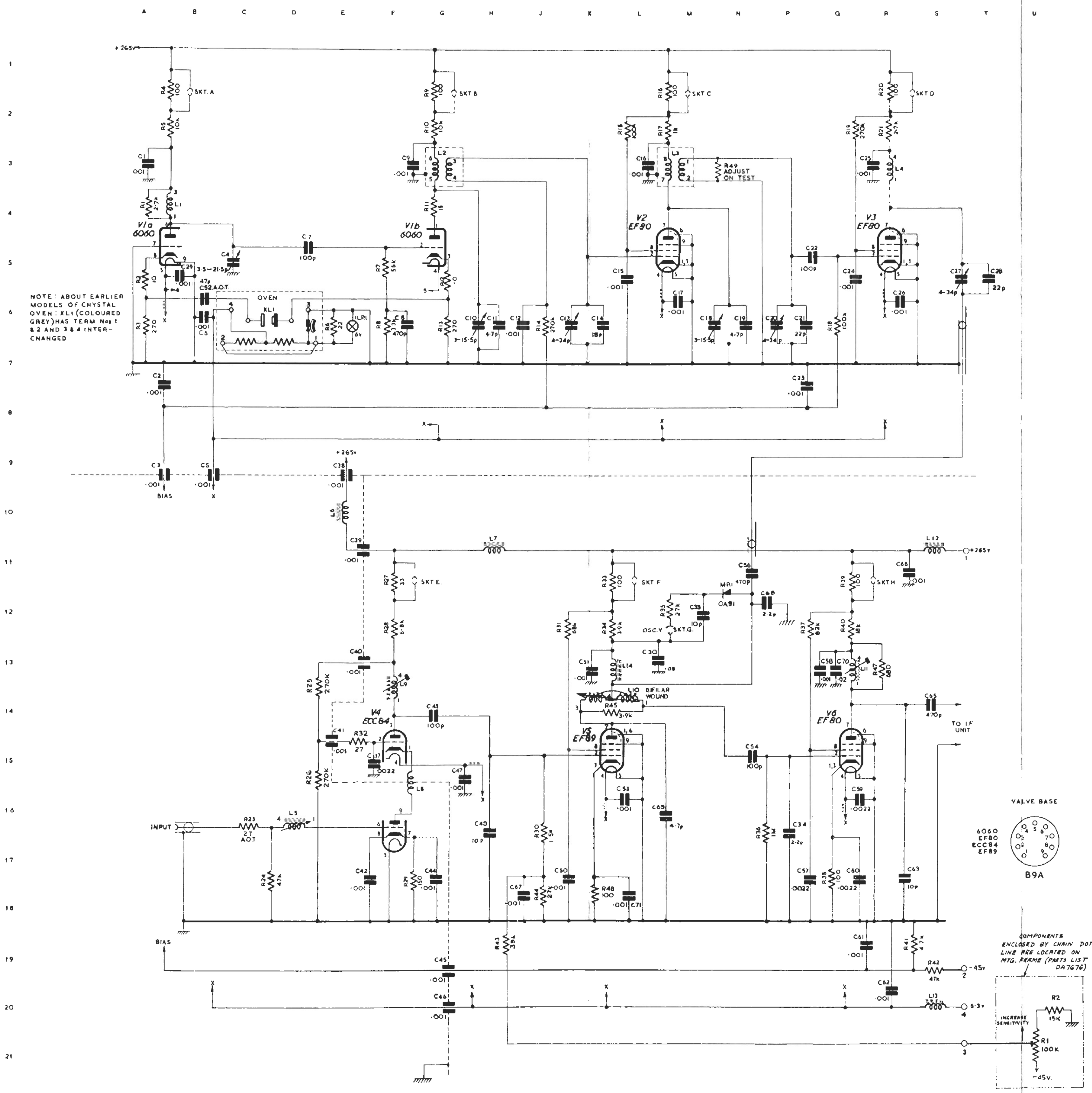
PWG (X)/JR/0565

COMPONENT TABLE: FIG. 1
Page 1

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	A3	Erie K3500/831		C51	K13	Erie K3500/831	
C2	A7	Erie K3500/831		C52	B6	Erie N750AD	
C3	A9	Erie K1200/362		C53	K16	Erie K3500/831	
C4	C5	Oxley A7/18D		C54	N15	Erie N3300AD	
C5	B9	Erie K1200/362		C56	N11	Erie K1200/831	
C6	B6	Erie K3500/831		C57	P17	Erie K3500/831	
C7	D5	Erie N3300AD		C58	P13	Erie K3500/831	
C8	F6	Erie K1200/831		C59	Q16	Erie K3500/831	
C9	F3	Erie K3500/831		C60	Q17	Erie K3500/831	
C10	H6	Oxley A7/12.5D		C61	Q19	Erie K3500/831	
C11	H6	Erie N220AD (±0.5p)		C62	R19	Erie K3500/831	
C12	J6	Erie K3500/831		C63	R17	Erie NO30AD	
C13	J6	Oxley A7/30D		C65	S14	Erie K1200/831	
C14	K6	Erie N220AD		C66	R11	Erie K3500/831	
C15	L6	Erie K3500/831		C67	H18	Erie K3500/831	
C16	L3	Erie K3500/831		C68	N12	Erie NO30AD	
C17	M6	Erie K3500/831		C69	L16	Erie NO30AD	
C18	M6	Oxley A7/12.5D		C70	Q13	T.C.C. CP33N/PVC	
C19	N6	Erie N220AD		C71	L18	Erie K3500/831	
C20	P6	Oxley A7/30D					
C21	P6	Erie N220AD	10	L1	A4		
C22	P5	Erie N3300/AD		L2	G3		
C23	P7	Erie K3500/831		L3	M3		
C24	Q5	Erie K3500/831		L4	R3		
C25	R3	Erie K3500/831		L5	D16		
C26	R6	Erie K3500/831		L6	E10		
C27	S5	Oxley A7/30D		L7	H10	To DA.6724	
C28	T5	Erie N220AD	10	L8	F15		
C29	B5	Erie K3500/831		L9	F13		
C30	L13	T.C.C. CP35N/PVC		L10	K14		
C33	M12	Erie NO30AD		L11	Q13		
C34	P16	Erie NO30AD	10	L12	S10		
C37	E15	Erie K3500/831		L13	S20		
C38	E9	Erie K1200/362		L14	K13	Painton 200150	
C39	E10	Erie K1200/362					
C40	E13	Erie K1200/362					
C41	E14	Erie K1200/362					
C42	E17	Erie K3500/831		R1	A4	Erie 9	10
C43	G14	Erie N3300AD		R2	A5	Erie 9	10
C44	G17	Erie K3500/831		R3	A6	Erie 9	10
C45	G19	Erie K1200/362		R4	B1	Painton MV1A	
C46	G20	Erie K1200/362		R5	B2	Erie 8	
C47	G15	Erie K3500/831		R6	E6	Erie 9	10
C49	H16	Erie NO30AD		R7	F5	Erie 9	10
C50	J17	Erie K3500/831		R8	F6	Erie 9	10

COMPONENT TABLE: FIG. 1
Page 2

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
R9	G1	Painton MV1A		R30	J16	Erie 9	5
R10	G2	Erie 8	10	R31	J12	Dubilier BTB	10
R11	G4	Erie 9	10	R32	E14	Erie 16	
R12	G5	Erie 9	10	R33	K11	Painton MV1A	
R13	G6	Erie 9	10	R34	K12	Painton MV1A	
R14	J6	Erie 9	10	R35	L12	Erie 9	10
R15	L2	Erie 9	10	R36	N16	Erie 9	10
R16	L1	Painton MV1A		R37	P12	Erie 9	10
R17	L2	Erie 9	10	R38	Q17	Erie 9	10
R18	Q6	Erie 9	10	R39	Q11	Painton MV1A	
R19	Q2	Erie 9	10	R40	Q12	Painton P306A	
R20	R1	Painton MV1A		R41	R18	Erie 109	2
R21	R2	Erie 8	10	R42	S19	Erie 109	2
R23	C16	Erie 9	10	R43	H18	Erie 109	2
R24	C17	Erie 9	10	R44	J17	Erie 109	2
R25	D13	Erie 9	10	R45	K16	Erie 9	5
R26	D15	Erie 9	10	R47	R13	Erie 9	5
R27	F11	Painton MV1A		R48	K17	Erie 16	10
R28	F12	Painton P306A		R49	N3	Erie 9	10
R29	F17	Erie 9	10				



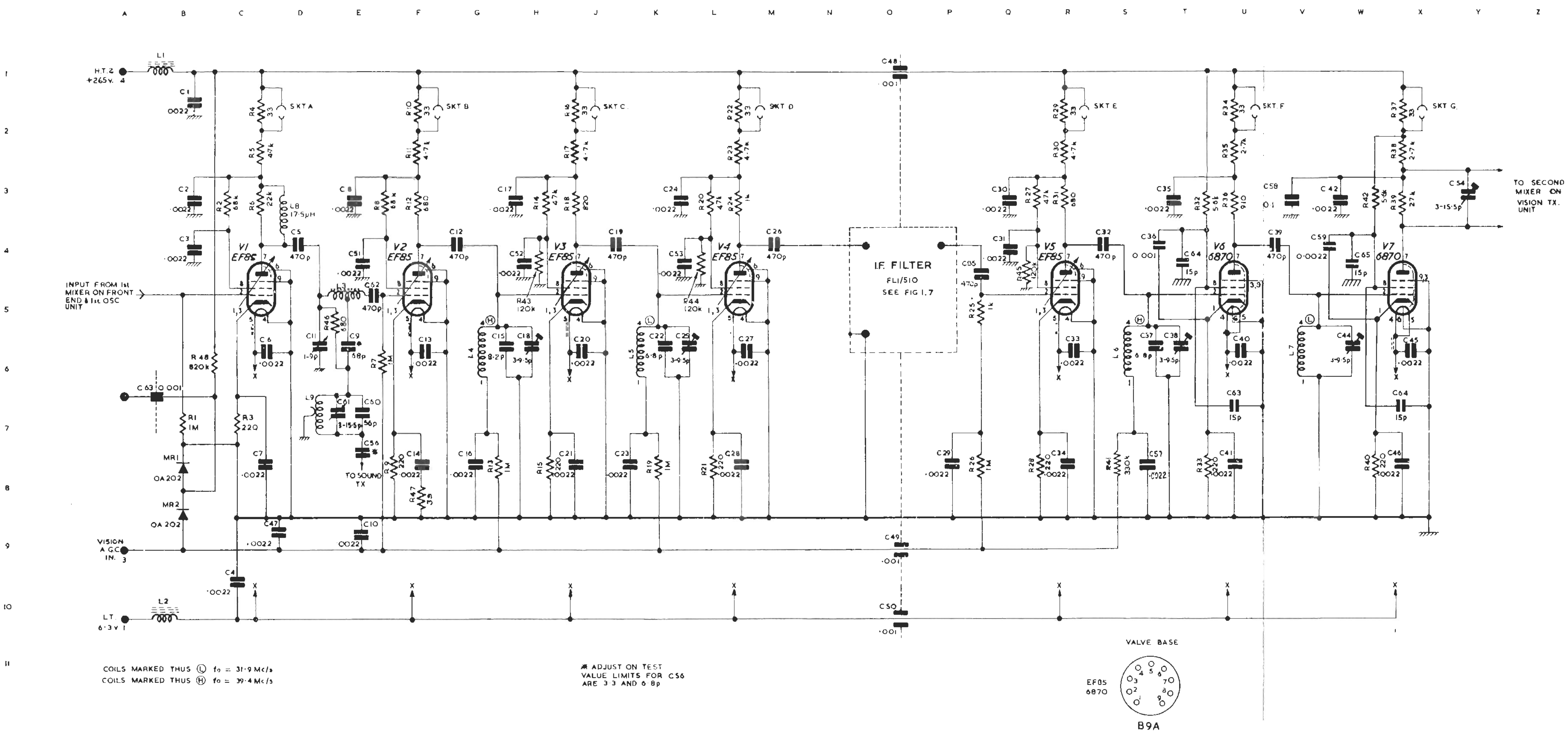
TV TRANSLATOR EP7/501 : FRONT END AND FIRST OSCILLATOR UNIT : CIRCUIT

COMPONENT TABLE: FIG. 2
Page 1

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	B1	Erie K7004/831		C46	X8	Erie K7004/831	
C2	B3	Erie K7004/831		C47	D9	Erie K7004/831	
C3	B4	Erie K7004/831		C48	O1	Erie K1200/362	
C4	C9	Erie K7004/831		C49	O9	Erie K1200/362	
C5	D4	Erie K1200/831		C50	O10	Erie K1200/362	
C6	C6	Erie K7004/831		C51	E4	Erie K7004/831	
C7	C7	Erie K7004/831		C52	H4	Erie K7004/831	
C8	E3	Erie K7004/831		C53	K4	Erie K7004/831	
C9	E6	Erie N750AD		C54	Y3	Oxley A7/12.5D	
C10	E9	Erie K7004/831		C55	Q4	Erie K1200/831	
C11	D6	Wingrove & Rogers S55-11		C56	E7	Erie NO30AD	
C12	G4	Erie K1200/831		C57	S8	Erie K7004/831	
C13	F6	Erie K7004/831		C58	V3	T.C.C. CP46S/PVC	
C14	F8	Erie K7004/831		C59	W4	Erie K7004/831	
C15	G6	Erie NO30AD		C60	E7	Erie NO80CD	
C16	G8	Erie K7004/831		C61	E7	Oxley A7/12·5D	
C17	H3	Erie K7004/831		C62	E5	Erie K1200/831	
C18	H6	Oxley A7/6·5D		C63	B6	Erie K120051/362	
C19	J4	Erie K1200/831		C64	T4	Erie NO30AD	
C20	J6	Erie K7004/831		C65	W4	Erie NO30AD	
C21	J8	Erie K7004/831					
C22	K6	Erie NO30AD		L1	B1		
C23	K8	Erie K7004/831		L2	B10		
C24	K3	Erie K7004/831		L3	E5		
C25	L6	Oxley A7/6·5D		L4	G6	} To DA.6574	
C26	M4	Erie K1200/831		L5	K6		
C27	M6	Erie K7004/831		L6	S6		
C28	L8	Erie K7004/831		L7	V6		
C29	P8	Erie K7004/831		L8	D3	Painton 200150	
C30	Q3	Erie K7004/831		L9	D7	Henry and Thomas 10100/6	
C31	Q4	Erie K7004/831					
C32	S4	Erie K1200/831		R1	B8	Erie 9	10
C33	R6	Erie K7004/831		R2	C3	Erie 9	10
C34	R7	Erie K7004/831		R3	C8	Erie 9	10
C35	T3	Erie K7004/831		R4	C2	Painton MV1A	
C36	T4	Erie K3500/831		R5	C2	Painton MV1A	
C37	S6	Erie NO30AD		R6	C3	Erie 9	10
C38	T6	Oxley A7/6·5D		R7	E6	Erie 9	10
C39	V4	Erie K1200/831		R8	E3	Erie 9	10
C40	U6	Erie K7004/831		R9	F8	Erie 9	10
C41	U8	Erie K7004/831		R10	F2	Painton MV1A	
C42	W3	Erie K7004/831		R11	F2	Painton MV1A	
C44	W6	Oxley A7/6·5D		R12	F3	Erie 9	5
C45	X6	Erie K7004/831		R13	G8	Erie 9	10

COMPONENT TABLE: FIG. 2
Page 2

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
R14	H3	Erie 9	10	R32	T3	Erie 8	10
R15	H8	Erie 9	10	R33	T8	Erie 9	10
R16	J2	Painton MV1A		R34	U2	Painton MV1A	
R17	J2	Painton MV1A		R35	U2	Painton MV1A	
R18	J3	Erie 9	5	R36	U3	Erie 9	5
R19	K8	Erie 9	10	R37	X2	Painton MV1A	
R20	L3	Erie 9	10	R38	X2	Painton MV1A	
R21	L8	Erie 9	10	R39	X3	Erie 9	10
R22	L2	Painton MV1A		R40	W8	Erie 9	10
R23	L2	Painton MV1A		R41	S8	Erie 9	10
R24	L3	Erie 9	10	R42	W3	Erie 8	10
R25	P5	Erie 9	10	R43	H4	Erie 9	10
R26	P8	Erie 9	10	R44	L4	Erie 9	10
R27	Q3	Erie 9	10	R45	Q4	Erie 9	10
R28	Q8	Erie 9	10	R46	E5	Erie 9	5
R29	R2	Painton MV1A		R47	F8	Erie 9	10
R30	R2	Painton MV1A		R48	A9	Erie 108	2
R31	R3	Erie 9	5				

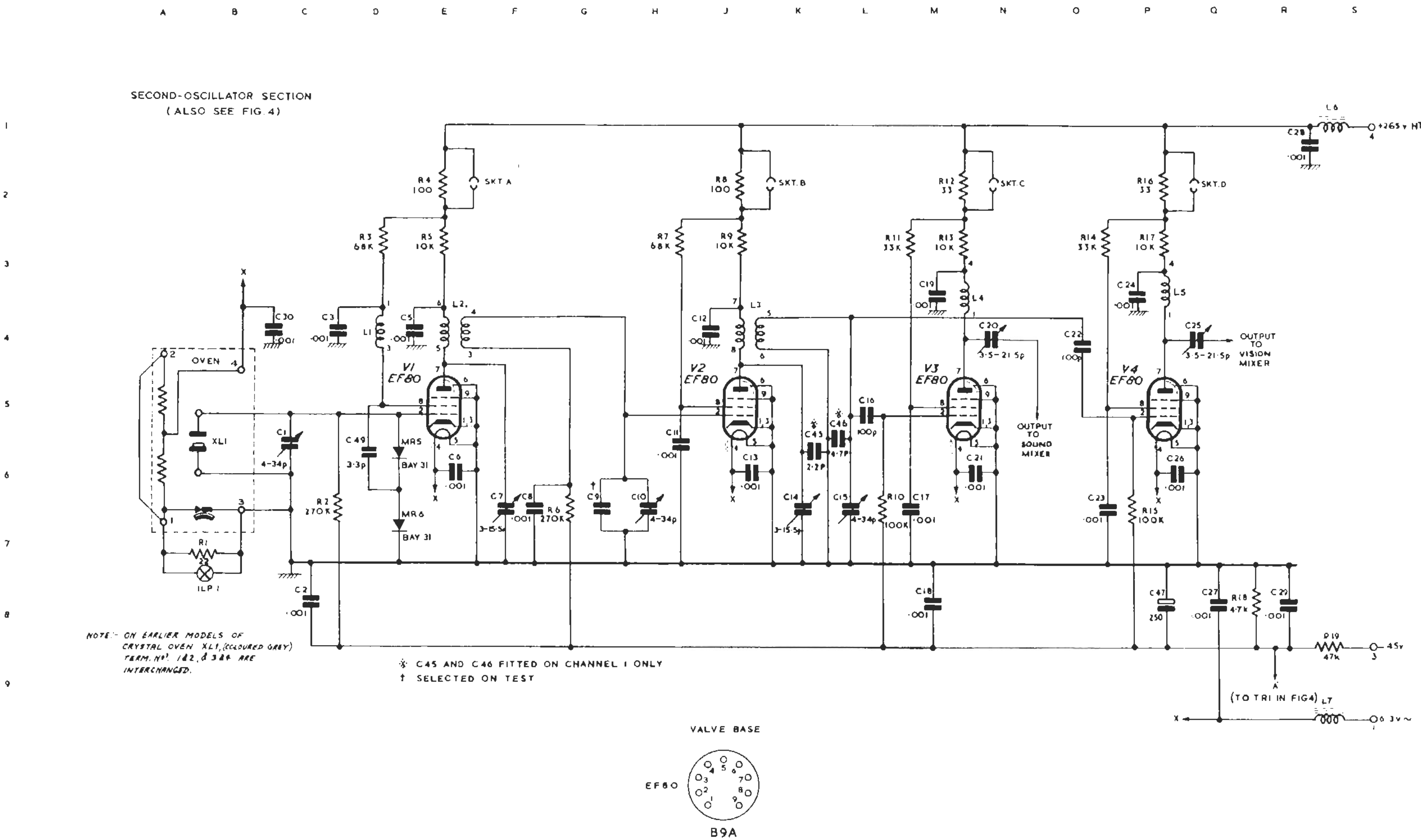


T.V. TRANSLATOR EP7/501 : I.F. UNIT : CIRCUIT

COMPONENT TABLE: FIG. 3

Note: Component coding is complementary to that in Fig. 4 table

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	C5	Oxley A7/30D		C47	P8	U.C.C. SC584/6LS	
C2	C8	Erie K3500/831		C49	D6	Erie NO30AD	
C3	C4	Erie K3500/831					
C5	E4	Erie K3500/831		L1	D4	To DA.6592	
C6	E6	Erie K3500/831		L2	E4	To DA.6592	
C7	F6	Oxley A7/12·5D		L3	J4	To DA.6592	
C8	F6	Erie K3500/831		L4	M3	To DA.6592	
C9	G6	Erie NO80AD	10	L5	P3	To DA.6592	
C10	H6	Oxley A7/30D		L6	S1	To DA.6592	
C11	H5	Erie K3500/831		L7	S9	To DA.6592	
C12	J4	Erie K3500/831					
C13	J6	Erie K3500/831		R1	B7	Erie 9	10
C14	K6	Oxley A7/12·5D		R2	C6	Erie 9	10
C15	L6	Oxley A7/30D		R3	D3	Erie 9	10
C16	L5	Erie N3300AD	10	R4	E2	Painton MV1A	5
C17	M6	Erie K3500/831		R5	E3	Erie 8	10
C18	M8	Erie K3500/831		R6	G6	Erie 9	10
C19	M3	Erie K3500/831		R7	H3	Erie 9	10
C20	N4	Oxley A7/18D		R8	J2	Painton MV1A	5
C21	N6	Erie K3500/831		R9	J3	Erie 8	10
C22	O4	Erie N3300AD	10	R10	L6	Erie 9	10
C23	O6	Erie K3500/831		R11	M3	Erie 9	10
C24	P3	Erie K3500/831		R12	M2	Painton MV1A	5
C25	Q4	Oxley A7/18D		R13	M3	Painton P306A	5
C26	Q6	Erie K3500/831		R14	O3	Erie 9	10
C27	Q8	Erie K3500/831		R15	P6	Erie 9	10
C28	R1	Erie K3500/831		R16	P2	Painton MV1A	5
C29	R8	Erie K3500/831		R17	P3	Painton P306A	5
C30	B4	Erie K3500/831		R18	R8	Erie 109	2
C45	K5	Erie NO30AD		R19	S8	Erie 109	2
C46	L5	Erie NO30AD					

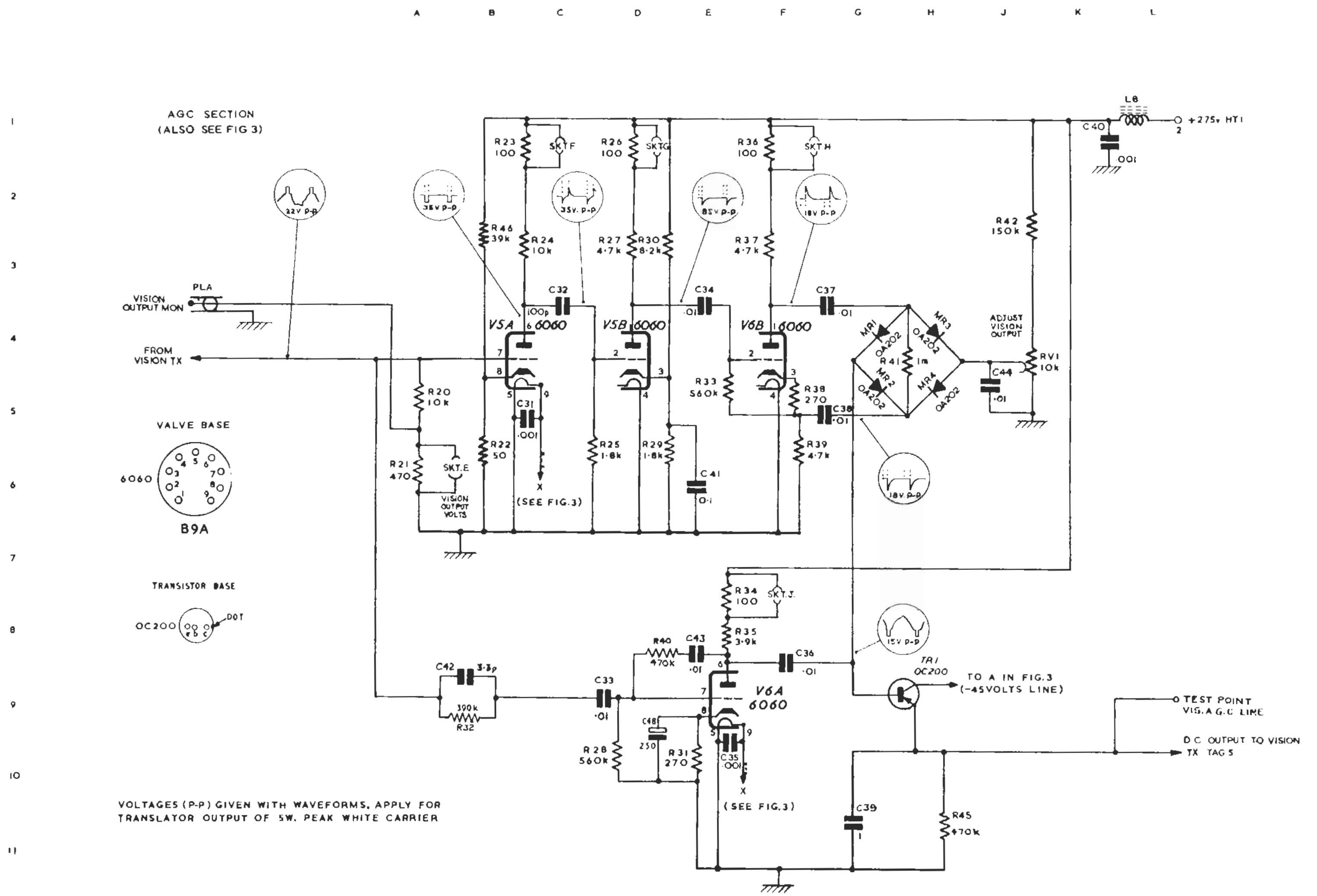


T.V. TRANSLATOR EP7/501: SECOND OSCILLATOR & AGC UNIT (PART) : CIRCUIT

COMPONENT TABLE: FIG. 4

Note: Component coding is complementary to that in Fig. 3 table

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C31	C5	Erie K3500/831		R25	C5	Erie 9	10
C32	C3	Erie N3300AD	10	R26	D1	Painton MV1A	5
C33	D9	Erie K7004/811		R27	D3	Erie 9	10
C34	E3	Erie K7004/811		R28	D10	Erie 108	2
C35	E9	Erie K3500/831		R29	D5	Erie 109	2
C36	F8	Erie K7004/811		R30	D3	Erie 100	2
C37	G3	Erie K7004/811		R31	E10	Erie 109	2
C38	G5	Erie K7004/811		R32	B9	Erie 109	2
C39	G11	Hunt B503K		R33	E5	Erie 9	10
C40	K1	Erie K3500/831		R34	E8	Painton MV1A	5
C41	E6	Hunt B500K		R35	E8	Erie 109	2
C42	B9	Erie NO30AD	10	R36	F1	Painton MV1A	5
C43	E8	Erie K7004/811		R37	F3	Erie 9	10
C44	J5	Erie K7004/811		R38	F5	Erie 9	10
C48	D9	U.C.C. SC584/6LS		R39	F5	Erie 9	10
				R40	D8	Erie 109	2
L8	L1	To DA.6592		R41	H4	Erie 9	10
				R42	J2	Dubilier BTB	10
R20	A5	Erie 9	10	R45	H11	Erie 9	10
R21	A6	Erie 9	10	R46	B3	Painton P302A	5
R22	B5	Erie 109	2				
R23	B1	Painton MV1A	5	RV1	J4	Colvern CLR/1132/15S	10
R24	B3	Erie 8	10				



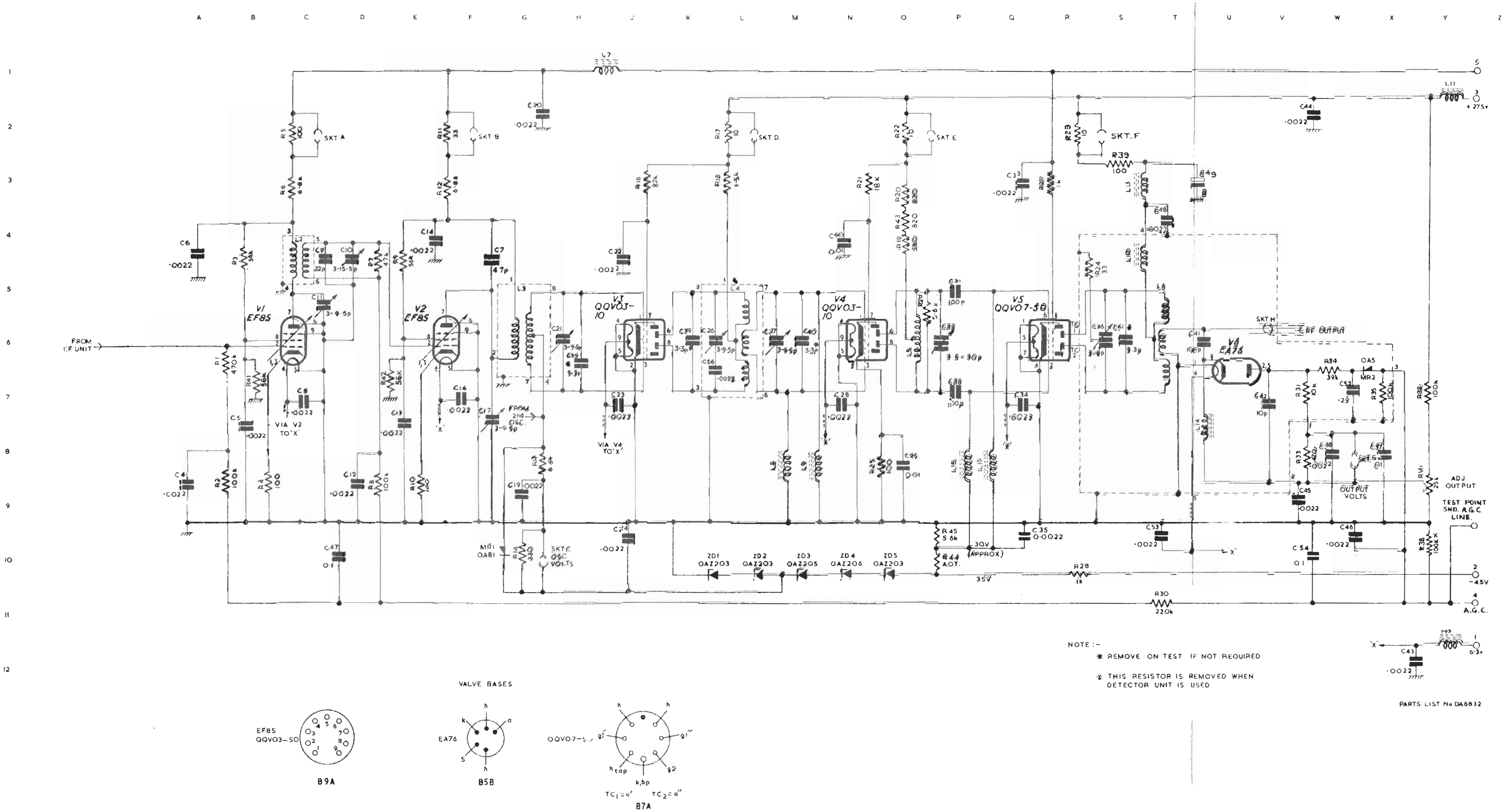
T.V. TRANSLATOR EP7/501: SECOND OSCILLATOR & A.G.C. UNIT (PART): CIRCUIT

COMPONENT TABLE: FIG. 5
Page 1

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C4	A8	Erie K7004/831		C51	S6	Erie NO30AD	
C5	B7	Erie K7004/831		C52	W7	Hunt B501K	
C6	A4	Erie K7004/831		C53	T9	Erie K7004/831	
C7	F4	Erie NO80AD		C54	W1	Hunt B500K	
C8	C7	Erie K7004/831		C55	H6	Erie NO80AD	
C9	C4	Erie NO30BD		C56	L7	Erie K7004/831	
C10	D4	Oxley A7/12.5D					
C11	C5	Oxley A7/6.5D					
C12	D8	Erie K7004/831					
C13	E7	Erie K7004/831					
C14	E4	Erie K7004/831		L2	C4		
C16	F7	Erie K7004/831		L3	G6		
C17	F7	Oxley A7/6.5D		L4	L5		
C19	G9	Erie K7004/831		L5	O6		
C20	G2	Erie K7004/831		L6	T6		
C21	H6	Oxley A7/6.5D		L7	H1		
C22	J4	Erie K7004/831		L8	M8		
C23	J7	Erie K7004/831		L9	M8	To DA.6837	
C24	J10	Erie K7004/831		L10	S4		
C26	L6	Oxley A7/6.5D		L11	Y1		
C27	M6	Oxley A7/6.5D		L12	Y11		
C28	N7	Erie K7004/831		L13	S3		
C29	O8	Erie K7004/811		L14	U8		
C30	P7	Erie N3300AD		L15	P8		
C31	P5	Erie N3300AD		L16	Q8		
C32	P6	Stratton Cat. No. 551					
C33	Q3	Erie K7004/831		R1	A6	Erie 9	10
C34	Q7	Erie K7004/831		R2	B8	Erie 9	10
C35	Q10	Erie K7004/831		R3	B4	Erie 8	10
C36	S6	Jackson C713		R4	B9	Erie 9	10
C37	X8	T.C.C. CP32N/PVC		R5	C2	Painton MV1A	
C38	W8	Erie K7004/831		R6	C3	Erie 8	10
C39	K6	Erie NO30AD		R7	D5	Erie 9	10
C40	M6	Erie NO30AD		R8	D9	Erie 9	10
C41	U6	Erie N3300AD		R9	E4	Erie 8	10
C42	V7	Erie NO30AD		R10	E9	Erie 9	10
C43	Y12	Erie K7004/831		R11	F2	Painton MV1A	
C44	W2	Erie K7004/831		R12	F3	Erie 8	10
C45	V9	Erie K7004/831		R13	G8	Erie 9	10
C46	W10	Erie K7004/831		R14	G10	Painton MV1A	
C47	D10	Hunt B500K		R16	J3	Painton P302A	5
C48	T4	Erie K7004/831		R17	L2	Painton MV1A	
C49	U3	T.C.C. SCE74PE/PVC		R18	L3	Painton P306A	5
C50	N4	Erie K7004/811		R19	O4	Painton P301A	5

COMPONENT TABLE: FIG. 5
Page 2

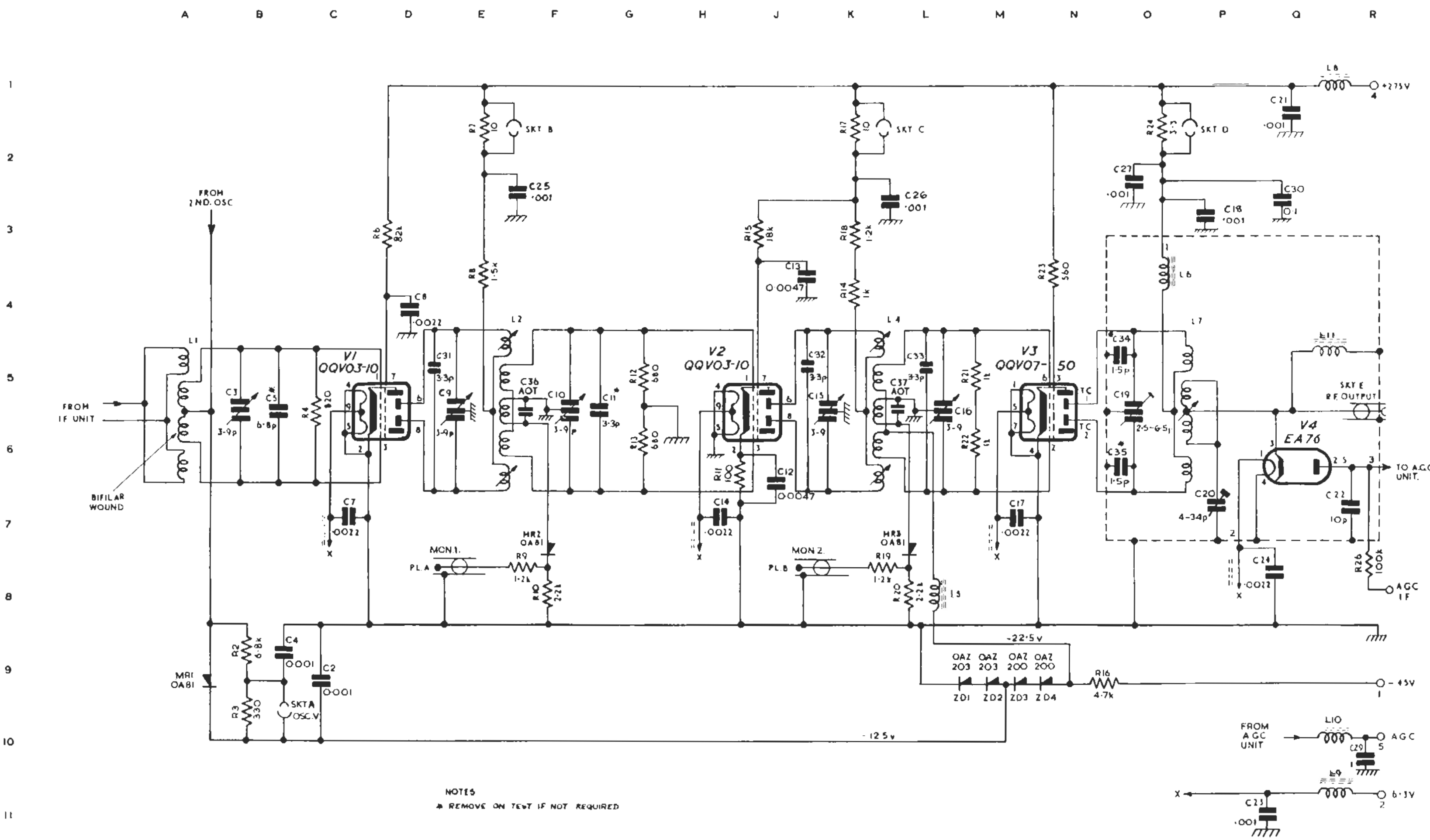
Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
R20	O3	Painton P301A	5	R33	V8	Erie 9	10
R21	N3	Painton P301A	5	R34	W6	Erie 9	10
R22	O2	Painton MV1A		R35	X7	Erie 9	10
R24	R5	Micanite R	10	R38	Y10	Erie 9	10
R25	O8	Erie 8	10	R39	S3	Painton MV1A	
R26	O5	Erie 8	10	R41	B7	Erie 8	10
R27	R3	Erie 9	10	R42	E7	Erie 8	10
R28	R10	Erie 109	2	R43	O4	Painton P301A	5
R29	R2	Painton MV1A		R44	P10	Erie N6 (A.O.T.)	2
R30	T11	Erie 9	10	R45	P10	Erie 109	2
R31	V7	Erie 9	10				
R32	Y7	Dubilier BTB	10	RV1	Y9	Plessey (linear)	20



T.V. TRANSLATOR EP7/501 : SOUND TRANSMITTER : CIRCUIT

COMPONENT TABLE: FIG. 6

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C2	C9	Erie K3500/831		L1	A5	To DA.7033	
C3	B5	Jackson C713		L2	E5	To DA.7033	
C4	B9	Erie K3500/831		L4	K5	To DA.7033	
C5	B5	Erie NO30AD		L5	L8	To DA.7033	
C7	C7	Erie K7004/831		L6	O4	To DA.7033	
C8	D4	Erie K7004/831		L7	P5	To DA.7033	
C9	E5	Jackson C713		L8	Q1	To DA.7033	
C10	F5	Jackson C713		L9	Q11	To DA.7033	
C11	G5	Erie N030AD		L10	Q10	To DA.7033	
C12	J6	Erie K3500/811		L11	Q5	Painton 200150	
C13	J4	Erie K3500/811					
C14	H7	Erie K7004/831		R2	B9	Erie 9	10
C15	K5	Jackson C713		R3	B10	Painton MV1A	5
C16	L5	Jackson C713		R4	C5	Erie 9	5
C17	M7	Erie K7004/831		R6	D3	Painton P302A	5
C18	P3	Erie K3500/831		R7	E2	Painton MV1A	5
C19	O5	Jackson C713		R8	E4	Painton P306A	5
C20	P7	Oxley A7/30D		R9	F8	Erie 9	10
C21	Q1	Erie K3500/831		R10	F8	Erie 9	10
C22	R7	Erie NO30AD		R11	J6	Erie 8	10
C23	Q11	Erie K3500/831		R12	G5	Erie 9	5
C24	Q8	Erie K7004/831		R13	G6	Erie 9	5
C25	E2	Erie K3500/831		R14	K4	Painton P301A	5
C26	L3	Erie K3500/831		R15	J3	Painton P301A	5
C27	O2	Erie K3500/831		R16	N9	Erie 109	2
C29	R10	Hunt B503K		R17	K2	Painton MV1A	5
C30	Q3	T.C.C. CP37N/PVC		R18	K3	Painton P301A	5
C31	D5	Erie NO30AD		R19	K8	Erie 9	10
C32	J5	Erie NO30AD		R20	L8	Erie 9	10
C33	L5	Erie NO30AD		R21	M5	Erie 9	5
C34	O5	Erie NO30AD		R22	M6	Erie 9	5
C35	O6	Erie NO30AD		R23	N4	Painton MV1A	5
C36	F5	Erie NO30AD		R24	O2	Painton MV1A	5
C37	L5	Eire NO30AD		R26	R8	Erie 109	2



NOTES
* REMOVE ON TEST IF NOT REQUIRED

TV TRANSLATOR EP7/501: VISION TRANSMITTER: CIRCUIT

FIG 6