SECTION 2

V.H.F./F.M. TRANSLATOR EP7/5

2.1 Introduction

The EP7/5 translator is an all-transistor equipment with a nominal output power of 15 watts. It is capable of receiving an f.m. transmission on any predetermined channel in Band II and, without demodulating the signal, effecting a conversion to any other channel in that band. This translation is subject to the conditions explained in Section 1. The code BA13/9 applies to a bay holding three EP7/5 assemblies and a number of auxiliaries, some associated with the individual translators. This combination is considered separately in Section 3. Fig. 2.1 gives a general view of the translator.

The translator employs the double frequency-changing technique described in Section 1, the bulk of the amplification being carried out at intermediate frequency (10·7 Mc/s). The schematic in Fig. 2.2 shows the arrangement, including two crystal-controlled local oscillators operating at frequencies which are 10·7 Mc/s below the input and output frequencies. Separately-mounted filters, not part of the EP7/5 assembly but essential for operation of the translator, are placed as indicated by the diagram. At each point the filtering is achieved with a bandpass unit (FL2/4) and a unit containing high-pass and low-pass sections (FL1/15); see Section 3.

The input is taken through a bandpass filter (UN1/37) to the first mixer (MX1/3), which has a conversion gain of 6 dB approximately. The difference-frequency output (10·7 Mc/s) of this mixer is amplified by about 60 dB and also limited, before application to the second mixer (MX1/4). From this mixer output the sum-frequency component, which is the required carrier frequency, is selected for additional amplification in an r.f. amplifier (AM14/4) and an r.f. output amplifier (AM14/3).

The arrangement in Fig. 2.2 is somewhat simplified, as in practice the input signal is obtained from a notching and splitting filter (FL6/8) which incorporates notches at the appropriate output

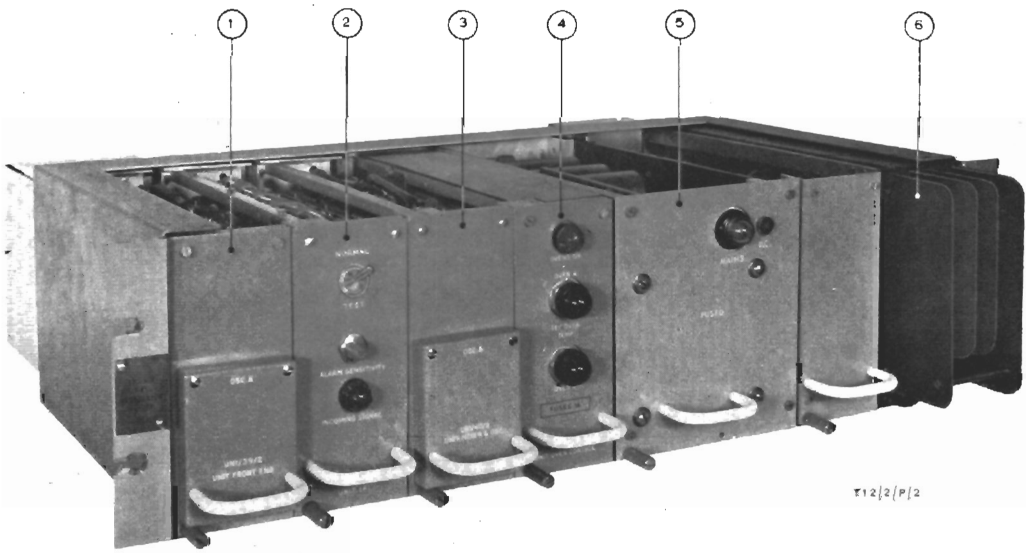


Fig. 2.1. EP7/5 Translator Assembly

1. Front End Unit UN1/39
2. I.F. Unit UN1/41
3. Mixer and Oscillator Unit UN1/40
4. Oven Control Unit UN1/38
5. Stabilised Power Supplier PS2/37
6. R.F. Output Amplifier AM14/3

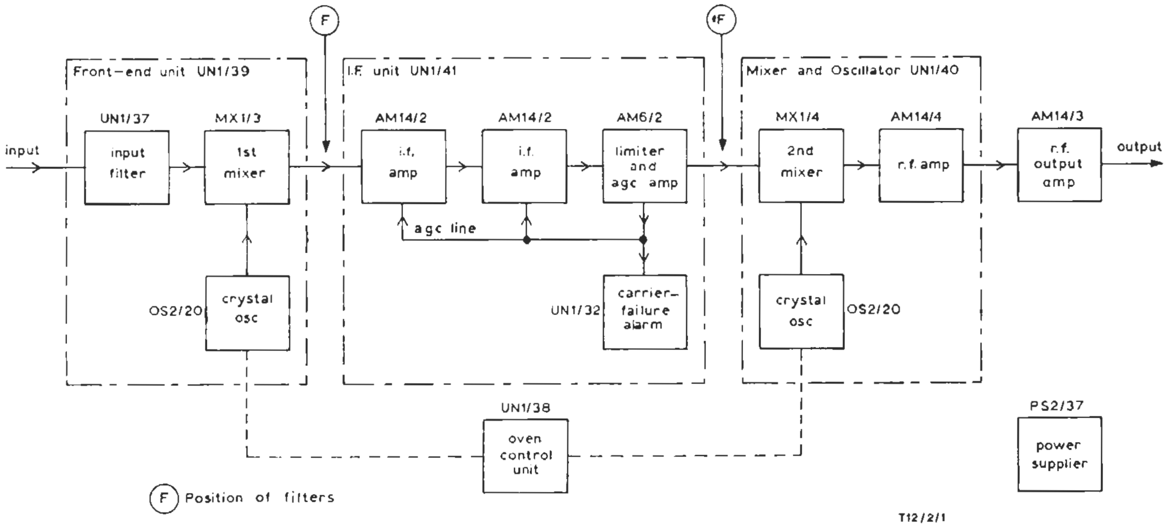


Fig. 2.2. Schematic of EP7/5 Arrangement

frequencies. The output, also filtered, is applied to the transmitting aerial through a combining unit.

2.2 General Specification

Input Frequency Range	87·5—97·5 Mc/s.
Input Impedance (nominal)	50 ohms (unbalanced)
Minimum Input Signal	125 µV.
Frequency Translation	Normally between 0·6 and 1·6 Mc/s.
Output Power (nominal)	15 watts (Total current taken from PS2/37 supplier must not exceed 1·8 amperes).
Harmonic Distortion	Not more than —45 dB, using 75-kc/s deviation.
Signal/noise Ratio	Better than —50 dB unweighted, relative to 75-kc/s deviation.
Unwanted Terms in Output	Better than 60 dB below normal output level (with output notch filtering).
Figure of Merit	Not less than 60 dB, using (a) four input notch filters, (b) two output notch filters, and (c) a frequency spacing of 0·6 Mc/s.

2.3 Electro-mechanical Arrangements

The six plug-in units of an EP7/5 assembly are accommodated by a general-purpose mounting panel PN3/23. The available width is taken up with a blank panel placed between the power supplier and the r.f. output stage, that is the units with the highest dissipations. The filters inserted before and after the i.f. amplifier are mounted on trays placed between the EP7/5 assemblies; coaxial sockets providing for their in-circuit connection are on the rear of the translator.

Fig. 2.3, including all but the power supplier, shows the compartmented construction of various units. In most of these the constituent items are contained largely in BX1/4 copper screening boxes, shown without lids in the photograph. On the upper faces of the boxes are terminals for external connection, and they are normally concealed by a thin insulating panel extending the full front-back dimension of each unit.

The four units directly concerned with the translation process are fitted with multi-way connectors which carry r.f. signals in addition to serving their usual purpose. For these units the indexing adopted to safeguard against engagement at wrong positions is based on a 3-by-3 formation of pegs and sockets. The other two units, the oven control unit and power supplier, are fitted with the more usual 15-way in-line connector and their indexing conforms to the 15-by-2 configuration; see Section 6 of Instruction G.1 for further information. The summarised details are:

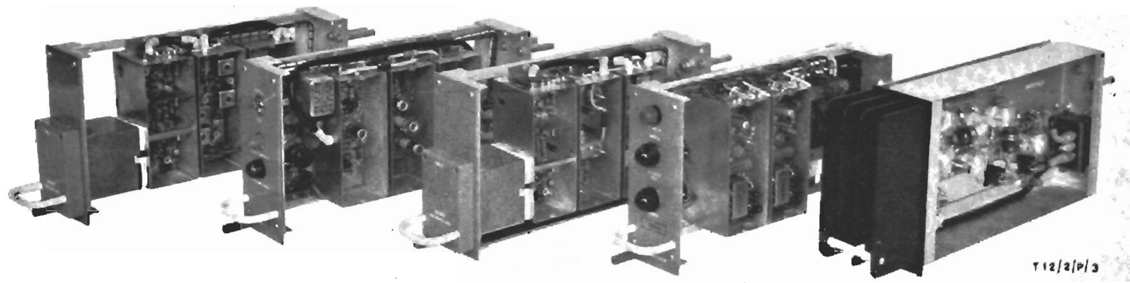


Fig. 2.3. EP7/5 Translator: View of Constituent Operational Units Left-right and Front-rear Order

UN1/39: OS2/20 (Osc. A), MX1/3 and UN1/37
UN1/41: AM6/2, AM14/2, AM14/2 and UN1/32
UN1/40: OS2/20 (Osc. B), AM14/4 and MX1/4
UN1/38: UN1/15A (for Osc. A) and UN1/15A (for Osc. B)
AM14/3

Unit	*Chassis Type*	*Indexing Positions*	*Grouping*
UN1/39	CH1/27	1 and 2	3 × 3
UN1/41	CH1/27	1 and 3	3 × 3
UN1/40	CH1/27	1 and 4	3 × 3
UN1/38	CH1/27	10 and 15	15 × 2
PS2/37	CH1/12B	8 and 27	15 × 2
AM14/3	CH1/28	2 and 4	3 × 3

The chassis extender provided to facilitate in-circuit testing and adjustment of the four units with 3-by-3 indexing is the type CH1A/5. Fig. 2.4 shows this extender fitted to one unit of the EP7/5 assembly.

2.4 Circuit Description

Circuit details of the equipment are given in Figs. 1 to 6. Each of the first three diagrams provides separate information about the constituent sub-units of the Front-end Unit (UN1/39), the I.F. Unit (UN1/41) and the Mixer and Oscillator (UN1/40).

2.4.1 Front-End Unit UN1/39 (Fig. 1)

The unit comprises:

Input Filter UN1/37.
First Mixer MX1/3.
Crystal Oscillator OS2/20.

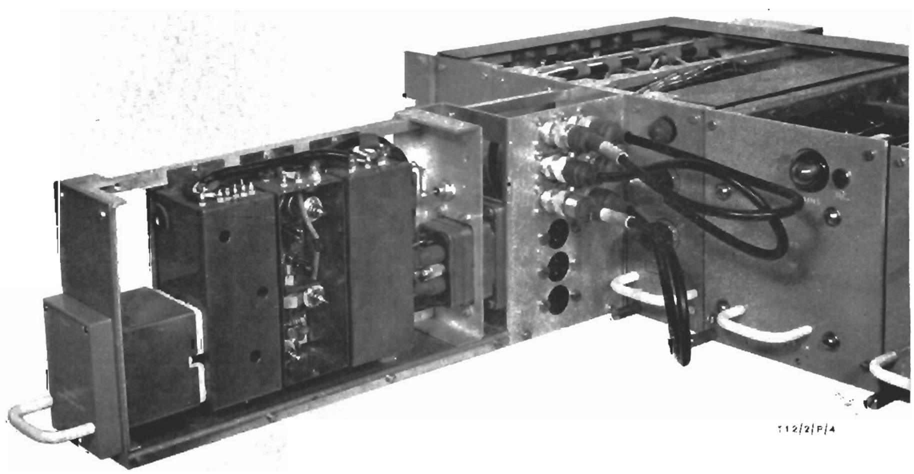


Fig. 2.4. Showing Unit in Forward Position on Chassis-extender CH1A/5

An output at 10·7 Mc/s is obtained by applying to the mixer (a) the received signal taken through the input (bandpass) filter, and (b) a signal from the oscillator adjusted to work at a frequency 10·7 Mc/s below that of the incoming signal.

(*a*) *Input Filter UN1/37*

The filter, Fig. 1(a), employs a pair of parallel-tuned circuits, screened from one another and coupled by capacitors C2, C4 and C3. The last-mentioned is a variable element for altering the coupling. During manufacture the tappings on L1 and L2 are carefully chosen to provide good 50-ohm matching.

The unit is housed in a copper box with three compartments, the middle one accommodating the variable coupling capacitor only, and the others containing the tuned circuits, as suggested by the dashed lines of Fig. 1(a). Connections are made by soldered-in coaxial cables.

As aligned during manufacture, the filter has a bandwidth of 0·5 Mc/s for the 0·25-dB down points and 2·5 Mc/s (+0·5 Mc/s) for the 3-dB down points. The in-band loss is about 2 dB.

(*b*) *First Mixer MX1/3*

This is basically a diode mixer, employing a bandpass-coupled output circuit. The circuit diagram in Fig. 1(b) shows TR2 serving as an oscillator-buffer amplifier with a tuned collector circuit. Initially the correct operating point for mixing is selected by choosing a C4 setting and an R7 value that produces a flow of a few milliamperes through the mixer diode D1; current is monitored by a meter temporarily inserted at the test point in connection with the negative rail. TR1 provides amplification for the incoming r.f. and its output also is applied to the mixer diode.

The diode output is fed to L3, L4 and associated components, which act as a 10·7-Mc/s bandpass output filter whose response is adjusted by means of C10.

C14 is used for impedance correction, so that good matching to 50 ohms is obtained at the output.

The conversion gain is approximately 6 dB and the noise factor is better than 12 dB.

(*c*) *Crystal Oscillator OS2/20*

The frequency range of this oscillator is 78 to 95 Mc/s, but only slight modification is needed to work in the range 95 to 110 Mc/s. Typically the output voltage is 200 to 300 millivolts into 75 ohms; the lowest acceptable value is 150 millivolts. The output impedance is 75 ohms. The oscillator requires a 12-volt (positive earthed) supply at 14 milliamperes.

Fig. 1(c) shows the first stage using TR1 as a common-base amplifier with positive feedback applied from collector to emitter through a series-resonant quartz crystal. A tuned collector-load ensures that the crystal operates on its fifth overtone. The circuit is of standard Colpitts form, but may look unfamiliar owing to the rearrangement to allow one side of the crystal to be earthed. Inductor L2 is placed in parallel with the crystal to form a high-impedance resonant circuit which inhibits a tendency to spurious oscillation owing to feedback through the self-capacitance of the crystal and associated wiring.

The oscillator stage is coupled by a low-value capacitor to TR2 in a common-emitter stage, the input impedance of which is raised by application of series negative feedback. Alternating current at the TR2 collector is fed into the very-low-impedance emitter circuit of the final stage, using TR3 as a common-base amplifier with a tuned collector load. The impedance step-down to 75 ohms at the output is obtained by a capacitive tap on the tuned circuit, a choke-fed arrangement allowing both capacitors to have one side earthed. One capacitor, C13, is variable, and in conjunction with L3 (tuned by dust-core adjustment) it is used to establish a ratio giving both a resonant condition and correct output impedance.

The crystal is maintained at a relatively constant temperature in a small oven which plugs into one side of the oscillator box. Temperature control is effected with a control unit of the proportional type (UN1/15A), which is one of the two housed in the Oven Control Unit UN1/38; see under 2.4.5. The available range of working temperatures is 70—80 degrees C, that normally adopted being about 75 degrees.

2.4.2 I.F. Unit UN1/41 (*Fig. 2*)

Most of the overall gain of the translator is provided in this unit. The full complement of sub-units in the bookcase-type chassis (CH1/27) is:

Two of the I.F. Amplifier AM14/2.
Limiter and A.G.C. Amplifier AM6/2.
Carrier Failure Unit UN1/32.

These are permanently interconnected by soldered leads, and all except the last item are in separate copper boxes. Externally the unit is connected through a multi-way connector carrying the d.c. operating supply and r.f. signal feeds.

The AM14/2 amplifiers, each with two stages, contribute equally to the total gain. Their design is based on the principle of the a.c.-coupled cascode, with a practical arrangement aimed at deriving maximum benefit from paired combination of an untuned stage followed by a tuned stage. The tandem-connected amplifiers alone provide only one cascode, formed of the second stage in the first amplifier and the first stage in the second. Effectively another two are obtained by the association of the remaining i.f. stages (first and last) with the MX1/3 output stage and the MX1/4 input stage. Thus, with constituent stages in different screened units, the high-impedance input of each cascode is well isolated from the high-impedance output. This provides a high degree of stability and makes for ease of alignment.

The specification is:

Input and Output Frequency	10·7 Mc/s.
Bandwidth (at 2 dB down)	±100 kc/s.
Input and Output Impedances	50 ohms.
Maximum Gain	65 dB.
Power Consumption (max.)	100 mA at 12 volts.
Normal Output Voltage	200 mV.

(a) I.F. Amplifier AM14/2

This amplifier has a gain of approximately 30 dB and a substantially flat response over a 200-kc/s bandwidth.

The circuit diagram, Fig. 2(a), shows tuned (first) and untuned (second) stages using TR1 and TR2 connected in the common-base and common-emitter configurations respectively. The common-base stage has a low input impedance, about 50 ohms.

Normally TR2 is biased with the voltage on the A.G.C. 2 line of the AM6/2 unit described subsequently, but there is a facility to enable fixed bias to be derived from the 12-volt operating supply. For this purpose there are two linking points to be joined when the A.G.C. 2 voltage is not to be used.

L1, L2, L3 and associated components form a bandpass circuit employing bottom inductor coupling. L1 and L3 are adjusted so that their circuits are resonant at 10·7 Mc/s, and L2 is adjusted to give the required bandwidth of 200 kc/s.

Diode D1 prevents TR2 from being momentarily reverse-biased by a large input, which might damage the transistor.

(b) Limiter and A.G.C. Amplifier AM6/2

This unit is fed from the second of the two AM14/2 amplifiers, as described under (a). It has two a.g.c. output lines. One (A.G.C. 2) provides amplified d.c. to operate the carrier failure circuit, apart from its conventional use in controlling the second stage of each of the two i.f. amplifiers. The other (A.G.C. 1) provides an unamplified input for the noise-amplifier section of the carrier failure unit.

Fig. 2(b) shows TR1 in an amplifying stage with a relatively wideband characteristic and a gain between 15 and 20 dB. The TR1 output is applied (a) to diode D1 providing an input for the a.g.c. amplifier using TR2 and TR3, and (b) through C4 to the limiter comprising TR4 and associated components.

The input to D1 is transformer-coupled by L1, to isolate the 12-volt operating supply from the a.g.c. circuit. The rectified current from D1 charges C14, and thence C8. The charge on this capacitor determines the degree of conduction of TR2, which feeds through emitter-follower TR3 to the A.G.C. 2 output. The A.G.C. 1 voltage is taken as a direct connection from D1, so this circuit has a comparatively short time-constant determined by R6 and C14.

In the limiter the diode D2 is used to prevent TR4 from becoming reverse-biased by a large-amplitude input signal. The fixed voltage applied to the TR4 base is taken through L2 to prevent r.f. from passing into the operating-supply circuit.

(c) Carrier Failure Unit UN1/32

The duty of this circuit, Fig. 2(c), is to respond to the received-signal carrier by altering the state of the translator from partial powering to the complete powering required for radiation, and to maintain the condition until the received carrier disappears. These changes are effected by switching the operating supply for two r.f. amplifying stages in the AM14/4 preceding the r.f. output amplifier. For this control the A.G.C. 2 output of the AM6/2 is applied to the d.c. amplifier formed by TR4, TR5 and TR6, the last having the coil of relay RLA as its collector load. When operated, the relay makes the 32-volt supply to the UN1/40 and signals the condition by making a supply to the lamp on the front of the I.F. Unit UN1/41.

The noise-amplifier section ensures that RLA does not remain operated by noise only after the incoming carrier disappears. Its input signal is taken from the A.G.C. 1 line of the AM6/2 and amplified by TR1 and TR2. The emitter resistors of these transistors are only partially decoupled for the purpose of accentuating the amplifier response at the higher audio frequencies. The emitter resistor of TR2 is RV1 which, in conjunction with C3, provides for gain control by variation of the amount of current feedback.

The TR2 output is rectified by D1 and D2, and the voltage developed across load R6 is applied to the d.c. amplifier TR3. The collector of this transistor is connected directly to the TR5 base. Thus the desired de-operation of RLA is brought about by a cancelling action in which TR3 produces an output voltage opposing the bias applied to TR5 from the emitter circuit of TR4. Diode D4 operates with a very restricted voltage across it, so ensuring that TR5 is easily cut off when the input exceeds a certain value.

2.4.3 Mixer and Second Oscillator UN 1/40 (Fig. 3)

The unit provides for conversion of the i.f. signal to the required output frequency and also the amplification to obtain sufficient drive for the r.f. output amplifier. It comprises the following items:

Second Mixer MX1/4.
R.F. Amplifier AM14/4.
Fixed Frequency Oscillator OS2/20.

These are housed separately in copper screening boxes on a general-purpose chassis CH1/27.

Two power supplies are needed, one at 12 volts and the other at 24 volts. The 24-volt supply is not directly available from the PS2/37 supplier, so a feed stabilised to the requisite voltage is obtained by use of a suitable voltage-dropping resistor and a zener diode (both in the UN1/40) in connection with the 32-volt output of that unit. This special feed is subject to control by the carrier failure unit; see under 2.4.2(c).

The oscillator is a crystal-controlled type identical with the one in the UN1/39, and it derives a crystal-oven supply from the control unit described under 2.4.5. The UN1/40 assembly is equipped with one multi-way connector through which all connections, including those at r.f., are made.

The essential specification for the unit is:

Input Frequency	10·7 Mc/s.
Output Frequency	In the band 87·5—97·5 Mc/s.
Bandwidth	±100 kc/s.
Input and Output Impedances	50 ohms.
Normal Input Level	10 mV.
Output Power	1 watt (min.)
Stability of Frequency Conversion	±500 c/s.
Unwanted Components in Output	Greater than 40 dB down.

(a) Second Mixer MX1/4

This circuit, Fig. 3(a), employs TR1 and TR2 in a balanced mixer stage, followed by TR3 to provide additional amplification. The oscillator voltage is applied through a push-pull circuit, L4, C3 and C4, to the emitters of TR1 and TR2. A push-pull input circuit is used also to apply the i.f. signal to the bases of these transistors; the input amplitude must not exceed the listed figure of 10 mV if harmonics in the output are to be kept at a low value. The collectors of TR1 and TR2 are joined in common to a parallel-tuned circuit, L2 and C7. The first-stage emitter circuit includes RV1 as a balancing control, capable of adjustment making the output almost devoid of any residual oscillator-frequency component. The mixer operating-supply is specially decoupled by L3 and C5, and the unit works in a particularly stable manner.

The mixer output, at the required final frequency, is amplified by TR3, this providing a signal amplitude of approximately 700 millivolts for the r.f. amplifier described under (b). Note that decoupling of R8 in Fig. 3(a) may not be readily apparent; this resistor is shunted by capacitance formed of C12 in series with C13, connected to the negative rail.

The damping at the frequencies involved in operation of this unit is such that adequate bandwidth can be achieved without resorting to bandpass-coupling circuits and their accompanying complication.

(b) R.F. Amplifier AM14/4

Working at the desired carrier frequency, this three-stage amplifier is designed to deliver at least 1 watt into the AM14/3 output amplifier. Operating supplies comprise one at 12 volts, for the first stage only, and one at 24 volts. The higher of these voltages is obtained as explained in previous notes about the UN1/40. The 12-volt and 24-volt supplies are decoupled by C3 and C9 respectively.

Referring to Fig. 3(b), both TR1 and TR2 work as class-A stages. TR3 operates principally in the class-B condition, subject to the possibility of a change to class-C if the transistor is driven hard. This transistor is held at cut-off by the r.f. choke L3, which is returned to the negative rail. A small bias for TR3 is obtained from the voltage developed during conductive periods across a low-value resistor (R7) in the emitter circuit. The decoupling of R7 with two capacitors, C10 and C11, is to minimise componcnt self-inductance as well as component-lead inductance. C15 is normally short-circuited by a link, as its purpose is to divert r.f. from a meter introduced to monitor TR3 collector current during setting-up operations.

Coupling capacitors C5 and C8 have values appropriate to good inter-stage matching. The value of C14 also is chosen to provide the appropriate impedance (50 ohms) giving good matching in connection with the r.f. output amplifier.

(c) Crystal Oscillator OS2/20

Information about this oscillator is in sub-section (c) under heading 2.4.1. The relevant circuit diagram is Fig. 1(c).

2.4.4 R.F. Output Amplifier AM14/3 (*Fig. 4*)

The specification for this unit is

Frequency Range	87·5—97·5 Mc/s.
Bandwidth	±100 kc/s.
Input Impedance	50 ohms.
Nominal Input Power	500 mW.
Output Impedance	50 ohms.
Output Power (nominal)	*15 watts.
Operating Voltage (nominal)	32 volts.

The chassis is made of copper and has a heavy construction to dissipate heat corresponding to a power of 20 watts or more at the collectors of the transistors. Extra surface area is provided by fins projecting from the front of the unit; see Figs. 2.1 and 2.3.

The amplifier features a special technique arising from the need to achieve safe working temperatures. Although applied in all three common-emitter stages as a matter of convenience, it was adopted particularly on behalf of the last stage using two parallel-connected transistors to produce the quoted output. Heat conduction is improved by dispensing with an insulating washer, which would increase thermal resistance, to allow the transistor to be mounted with the collector in direct contact with the chassis. Consequently the earthed collector necessitates application of a d.c. feed as in Fig. 2.5. In effect this arrangement places the supply source between collector and load, instead of in the customary position between emitter and load.

Circuit Description

Fig. 4 shows TR1 in a first stage which is class-A operated, TR2 in a class-C second stage, and TR3 and TR4 working as a paralleled-pair in class-C also. The class-C stages are not forward-biased, because the required angle of current flow in those is less than 180 degrees, but the class-A first stage has a zener diode (D1), in series with the feed, to provide a suitable bias voltage.

Inter-stage coupling is by double-tuned transformers, these having parallel-resonant primaries and series-resonant secondaries. Mutual couplings are carefully chosen to provide large currents into transistor-base circuits and yet present reasonably high impedances to collector circuits so that good power transfers are obtained.

Fig. 4 shows that the input-circuit tuning capacitance of the final stage is split into two parts, C6 and C7, even though TR3 and TR4 work in parallel. This division is means of obtaining reasonably equal power-sharing, for by joint adjustment of these capacitors it is possible to offset to some extent any differences between the transistors and their associated wiring.

The emitter circuit of each stage includes a low-value resistor across a test socket for feed-current monitoring. A suitable instrument is the Portable Test Meter, PTM/6, which has a resistance of 10 kilohms and reads 1 volt at the limit of a scale calibrated 0—100. This meter and an output-power meter are used during the lining-up process.

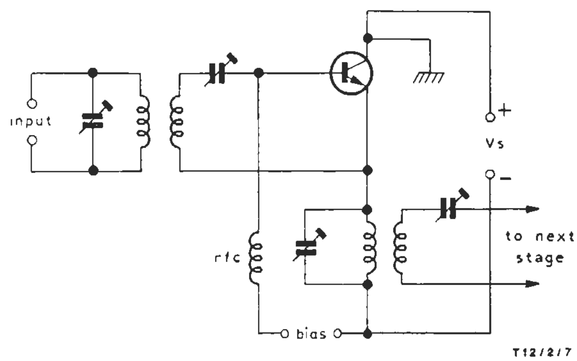


Fig. 2.5. Common-emitter Stage with Collector Earthed

2.4.5 Oven Control Unit UN1/38 (*Fig. 5*)

The UN1/38 is a CH1/27 chassis carrying two of the Temperature Control Unit UN1/15A and a few auxiliaries needed in connection with them. The control from this equipment is applied to ovens which are part of the OS2/20 units in the UN1/39 and UN1/40 assemblies. The specification is:

* Current taken by amplifier must not exceed 1·65 amperes, which leaves a suitable margin for the AM14/4 stages operated from the 32-volt supply.

Supply	240 volts, 50 c/s, approximately 25 watts.
Oven	Salford type QC940B (mod. to DA.13177).
Temperature Range	70—80 degrees C.
Temperature Stability	±1 degree for 40-degree ambient change.
Temperature Adjustment	Temperature increase for clockwise movement of control.

Fig. 5 gives separate circuit diagrams of (a) the chassis, and (b) the typical UN1/15A unit.

The chassis is fitted with a mains transformer providing 6·3 volt (nominal) feeds from which the temperature control units derive their operating supplies. Separate l.v. windings are used for this, to avoid spurious cross-connection which could occur because the temperature units have final-stage transistors with earthed collectors. On the front of the chassis are preset resistors (*Set Oven Temp.* controls) for adjusting the individual oven temperatures, in addition to a lamp to indicate when the mains supply is present. On the chassis-rear are two fuses and a 15-way in-line connector.

The essential arrangement depicted in Fig. 2.6 shows one arm of the d.c.-energised bridge as a thermistor sensing-element TH1 which is tightly-coupled thermally to the oven. To illustrate the action, suppose the oven temperature rises beyond that for which the controller is set by RV1. Consequently the resistance of TH1 falls and point A moves positively with respect to point B, which turns on more fully the first stage of the amplifier. Consequently the second transistor is driven towards cut-off, which reduces the oven current. Thus the initial tendency to an oven-current increase is opposed by this oven-current decrease.

With this type of controller the gain obtainable is limited by thermal phase-shift in the feedback loop, and gains greater than 100 without instability are extremely difficult to achieve. In this instance the overall figure is about 60, the control thermistor having been selected and placed with great care to ensure there is no instability. Given this gain an ambient-temperature change of, say, 30 degrees C ought to produce an oven-temperature change of 0·5 degree C; this ambient/gain quotient is commonly termed the *following error.* However, the base-emitter voltage/temperature coefficient of a transistor is about —2 mV/degree C, so the first stage of the amplifier introduces an error opposed to and greater than the following error, and thus there is liability to rise of ambient temperature causing fall of oven temperature.

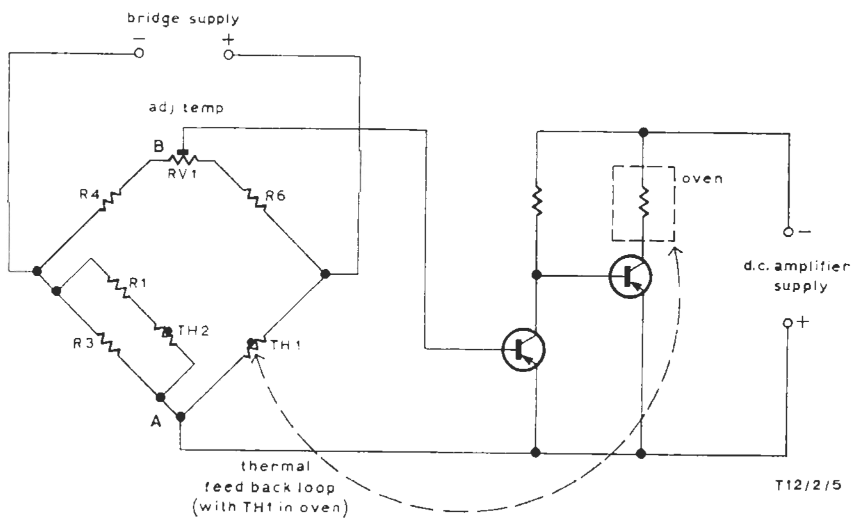


Fig. 2.6. Basic Temperature-control System

Temperature Control Unit UN1/15A

This unit is a controller of the proportional type in which the effect of a change of, for example, ambient temperature on oven temperature is reduced by a factor equal to the gain of the amplifier. The circuit is given in Fig. 5(b).

This unwanted outcome is avoided by applying correction with TH2 placed across the R3 arm of the bridge. The amount of correction by this thermistor is determined with R1, for which it is possible to choose a value giving almost exact compensation. Even with the centre design value for R1 the working oven temperature will not change by more than 1 degree C for an ambient-temperature change of 40 degrees C.

A 6·3-volt a.c. supply was chosen for its suitability also with ovens employing thermostats. This supply is applied directly to a rectifier meeting the needs of the amplifier, and through a transformer-and-rectifier combination to provide d.c. for the controller bridge-circuit. The last-mentioned is voltage-stabilised, by zener diode D1, to about 4 volts.

The amplifier uses TR1 and TR3 in input and output stages, with emitter-follower TR2 between them to provide current gain and impedance matching. R10 is shunted across the base-emitter junction of TR3 to ensure positive action when RV1 is set to reduce the working temperature of the oven. By such readjustment the amplifier becomes temporarily cut off, consequently the output resistance of TR2 increases from the normal low value, which in turn makes TR3 liable to pass excessive leakage current. By R10 the source impedance for TR3 is held to a reasonably low value and consequently the oven current is kept to a low value until the new working temperature is reached.

C3 shunts the amplifier output to obviate the chance of oscillation at some high frequency. The reason for earthing the TR3 collector is as for the r.f. output amplifier, that it enables thermal resistance to be reduced by dispensing with insulating washers.

2.4.6 Stabilised Power Supplier PS2/37 (Fig. 6)

The PS2/37 supplier was designed initially to power either the EP7/5 equipment or the EP7/506 translator for television on v.h.f. It incorporates a current-limiter for protection of the dependent equipment, and its limiting condition is determined with a preset control. For use with the EP7/5 this control is set for limiting at about 2·5 amperes, a value which does not necessarily apply to use with other types of translator.

Although nominally 32 volts, the output voltage is capable of increase to 34 volts by adjustment of a presetting control on the rear of the chassis. This facility offers some latitude regarding small variations in the efficiency of transistor class-C amplifiers at v.h.f. A subsidiary output at 12 volts is provided from a voltage-dividing circuit across the main output.

The specification is:

Main Output	
Output Voltage	32—34 volts.
Max. Load Current	1·8 amperes (32-volts output)
Output Resistance	Less than 0·3 ohms.
Output Impedance	Less than 0·3 ohms at 1 kc/s.
Ripple Content	Less than 3 mV p-p (measured at 32 volts and 1·5 amperes).
Regulation	0·2 per cent for 5 per cent mains-voltage variation.
Max. Ambient Temperature	55 degrees C.
Temperature Coefficient	Less than 5 mV/degree C (averaged over range 20—55 degrees C).
Subsidiary Output	
Output Voltage	12·2 (±0·6) volts (with max. load current).
Max. Load Current	120 mA.
Output Resistance	Less than 3 ohms.

Fig. 6 refers to the possibility of earthing either side of the supply, but note that the requisite strapping should be done at the bay block and not in the supplier.

The chassis is a standard double-width book-type unit CH1/12B, fitted with a strengthening plate that also serves as the main heat-sink for two transistors in series with the output. Normally the unit is accommodated in a nesting box assembly PN3/23 and, being relatively small, the supplier must have a reasonably free flow of air around it; local air temperature should not exceed 55 degrees C. Two front-panel lamps indicate the presence of the mains supply and the d.c. output. On the rear of the chassis are two mains fuses (which must be anti-surge type) and a d.c. supply fuse, as well as the two presetting controls already mentioned. There is no mains switch.

Circuit Description (Fig. 6)

Fig. 6 gives separate diagrams of the rectifier and stabiliser portions of the supplier. The stabiliser is a simple series type, exemplified in many of the suppliers dealt with in Part 2 of Instruction G.2. That gives adequate information about the operating principle, so ensuing description is restricted to various details of the particular supplier, including separate treatment of the current-limiting circuit.

(*a*) *Rectifier and Stabiliser*

Obtaining the required electrical performance from apparatus taking up so little space necessitated special attention to achieve safe working temperatures. As a measure to limit dissipation, the unstabilised voltage is as low as possible consistent with a margin needed for correct operation of a regulating transistors TR4 and TR5 when the supplier is delivering the stipulated output voltage at the maximum load current. Dissipation in these two transistors is at maximum when the supplier is adjusted to its lowest output voltage at approximately 1·5 amperes. Although parallel-connected, TR4 and TR5 are well separated and have low thermal resistance to the ribbed copper heat-sink on which both are mounted.

TR4 and TR5 have low-value emitter resistors (R4 and R5) to build out their internal resistances, in which respect the individual transistors are liable to variability. Adding the resistors assists toward equal-current sharing and helps to limit the current drawn in the event of a short-circuit condition. The rectifier circuit incorporates R12 and R13 to both limit fault current and safeguard the rectifiers by limiting the switch-on charging current of the reservoir capacitors.

The reference-voltage source employs two low-voltage zener diodes (D5 and D6) instead of a single higher-voltage equivalent, because their temperature coefficient is lower. The reference voltage is as high as possible to enable a large percentage of d.c. negative feedback to be used. By addition of C5 the a.c. negative feedback is at maximum to reduce ripple in the output. The combination of R8 and C19 provides a single dominant phase lag to the amplifier, thereby reducing the gain for high frequencies, at which otherwise instability might occur.

Bias resistor R3 acts as a drain for leakage current from TR4 and TR5, enabling them to remain cut off at elevated temperatures. Without this resistor an abrupt removal of heavy loading could cause the output voltage to rise momentarily to equality with the stabiliser-input voltage, before subsiding to the correct value as the transistors cooled. Because they are silicon types the other three transistors have negligible leakage currents.

The voltage-divider across the output has a symmetrical form allowing the 12-volt supply (when required) to be commoned to either side of the 32-volt supply. For the common-positive arrangement applying to use with the EP7/5 translator the resistor R10 is short-circuited, whereas for common-negative working R9 is short-circuited. As with strapping for alternative earthing, that for short-circuiting the appropriate resistor must be on the bay socket. Thus suppliers are left undisturbed and are therefore capable of the ready interchangeability for which they are designed.

(*b*) *Current-limiting Circuit*

Normally the dissipation in the series transistors is not excessive for an overload condition, although that may considerably increase the temperature of the mains transformer. Thus protection for the power supplier itself is provided simply by a fuse.

Protection of apparatus depending on the supplier must also be considered, particularly where sudden extreme demands for current may result in destruction of transistors in r.f. amplifiers. As the safeguard a current-limiter using TR6 and TR7 is provided in connection with the stabiliser.

Transfer from constant-voltage to constant-current operation is required when the output current reaches a prescribed value, determined by the presetting control RV2. At this current the voltage across R4 and R5 is sufficient to turn on transistors TR7 and TR6, and they over-ride the voltage-sensing function of TR1. Thus the series transistors TR4 and TR5 are proportionally turned off as load resistance is reduced, and the output current tends to a constant value. The change-over from constant-voltage to constant-current working is sharply defined, as can be seen from Fig. 2.7. The effectiveness may be judged by the change of output resistance from 0·3 ohms to about 130 ohms.

The power in the load falls as load resistance is reduced, by a transfer of power to the series transistors TR4 and TR5. Thus the supplier is capable of providing about 50 watts into a load under normal conditions, the heat-sink dissipation then having the comparatively small value of about 12 watts. With current-limiting and under near-short-circuit conditions the heat sink has to dissipate about 60 watts. This is a disadvantage, but prolonged operation in the constant-current region should only occur under fault conditions and be rare. For a short-circuited output sufficient to reduce output voltage below 6 volts, the constant-current condition is not maintained and the resultant output-current increase ruptures FS3.

The graph in Fig. 2.7 also indicates, for two greatly different ambient temperatures, the maximum-allowable continuous power dissipation when operating in the current-limiting condition. It is most important to provide a current-limiting condition as far as possible from the working point, by adjustment of the rear-mounted component RV2. Note that increase of output resistance (0·3 ohms to 130 ohms, as stated previously) introduces serious common coupling between individual units fed from the same supply.

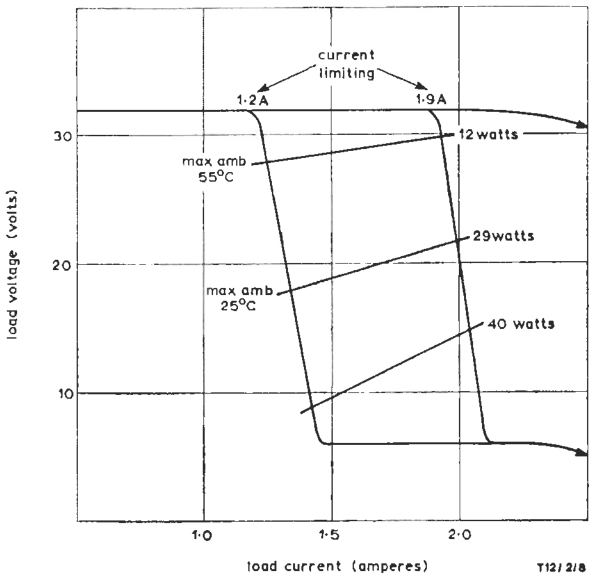


Fig. 2.7. PS2/37 Supplier: Output Characteristics for Current-limiting Condition

2.5 Alignment Procedure

Subsequent descriptions apply to operations that may have to be undertaken after, say, servicing of the various units, and they do not necessarily cover initial setting-up of the EP7/5. The four units dealing with signals are capable of being supported by the chassis extender CH1A/5, as explained under heading 2.3.

2.5.1 Front End Unit UN1/39

Because it has no active components the UN1/37 section of the assembly ought not to need realignment, but the method is included for the sake of completeness. The required test equipment is:

Polyskop (Rohde and Schwarz type SWOB).
Avometer Model 7 (or Model 40).
Valve-voltmeter, suitable for measuring 150 mV at v.h.f.
0·5-pF capacitor.

1. Disconnect the UN1/37 output from the MX1/3, and terminate it at a 50-ohm B.N.C. socket; this can be secured to the screening box by temporary use of the lid-fastening screw-hole.

Note: The top cover of the UN1/37 must be fitted to the unit before the final alignment.

2. Provide the UN1/37 with an input signal from the Polyskop, and attach the 50-ohm input of that instrument to measure the UN1/37 output.
3. With the Polyskop operating at sweep frequency, adjust C1, C3 and C5 to obtain a response (a) centred on the desired incoming-carrier frequency, and (b) having a bandwidth of 2·5 Mc/s (±0·5 Mc/s) at the 3-dB down points.
4. Detach the temporary termination and restore the link between the UN1/37 and the MX1/3.
5. Use the valve-voltmeter to measure the oscillator input of the MX1/3; the reading should be not less than 150 mV.
6. Break the link between two points marked *Test* in the MX1/3; see Fig. 1(b). Set the Avometer to read direct current and insert it at the test point. Tune C4 for maximum current in diode D1. The value should be between 1 and 3 milliamperes, if necessary by adjustment of the value of R7.
7. Remove the Avometer and restore the test link.
8. Set the Polyskop to sweep relative to 10·7 Mc/s, and apply this signal feed to the *Out* terminal of the MX1/3. Connect the Polyskop probe through the 0·5-pF test capacitor to the C10, L3 junction of the MX1/3 output bandpass circuit.
9. Adjust L3 and L4, in conjunction with coupling capacitor C10, to obtain a symmetrical response (a) centred on 10·7 Mc/s, and (b) having a bandwidth between ±450 kc/s and ±850 kc/s at the 3-dB down points.

Note: The cores of L3 and L4 should be at the printed-card ends of the coil formers.

10. Transfer the Polyskop signal feed to the UN1/37 input. Adjust the instrument to provide sweeping relative to the desired carrier frequency, as for items 2 and 3 but measuring at the MX1/3 output in this instance.

Note: The Polyskop signal output must be low enough to avoid overloading of the UN1/39; the 30-dB setting of the output attenuator should be satisfactory. Measure with the Polyskop probe at the output terminal of the MX1/3 if that unit is connected to the subsequent AM1/42. If the MX1/3 has no output loading, measure through the 50-ohm input of the Polyskop.

11. Observe the Polyskop trace while adjusting C2 for maximum response. The conversion gain should be between 5 dB and 8 dB, with bandwidth as quoted in item 9.

2.5.2 I.F. Unit UN1/41

The required test apparatus is:

Polyskop (Rohde and Schwarz, type SWOB).
An accurate source of 10·7-Mc/s signal at about 100 mV, for use as external marker with Polyskop.
Tone Source TS/9.
Fixed attenuator; 10-dB loss and 50-ohm impedance.

1. In both AM14/2 amplifiers, strap the tags for linking R4 to C8. Feed the UN1/41 via the fixed attenuator from the Polyskop signal output.
   Take the bottom lid off the first AM14/2 box to gain access to internal test point marked *MP*, and connect this through the 0·5-pF capacitor to the probe of the Polyskop.
   Prepare the Polyskop by (a) putting its output attenuator to the 30-dB setting, (b) injecting the external 10·7-Mc/s marker signal and adjusting the frequency controls to place this marker at the centre of the screen.
2. Adjust L1 and L3 (of the first AM14/2) for a response peaked at 10·7 Mc/s, making certain that the Polyskop input is not causing overloading. Adjust the coupling by means of L2, then re-tune L1 and L3 to obtain a slightly over-coupled response centred on 10·7 Mc/s and having a bandwidth of ±100 kc/s at the 1-dB down points.

Note: Indication that the inductors are adjusted correctly is given by a tilting of the response curve for any additional adjustment of L3.

3. Transfer the Polyskop probe and the series-connected 0·5-pF capacitor to the corresponding test point in the second AM14/2. Alter the Polyskop output attenuator to the 60 dB setting.
4. Adjust L1, L2 and L3 (of the second AM14/2) to obtain a symmetrical response centred on 10·7 Mc/s and having a bandwidth of ±100 kc/s at the 2-dB down points.

Note: The response should be flatter than for the first AM14/2 only, and if there is difficulty in obtaining a satisfactory curve it is permissible to try a slight readjustment of L3 in that preceding unit. As before, correct adjustment in the second AM14/2 is indicated by tilting of the characteristic for any further adjustment of its own L3.

5. Detach the Polyskop probe and capacitor from the test point in the second AM14/2. Apply the output of the UN1/41 to the *R.F. Input* of the Polyskop, and set the Polyskop output attenuator for maximum loss.
6. Tune L1 (in the limiter compartment of the AM6/2) for a symmetrical flat-topped response; slight readjustment of L3 in the second AM14/2 may be necessary to achieve that condition.
7. Gradually reduce the loss of the Polyskop attenuator, to check that the limiter is functioning properly. Correct operation is indicated by limiting before the attenuation removed has reached 10 dB.
8. Use the Polyskop to measure the gain of the UN1/41, which should be not less than 60 dB. Take care to see that the input is low enough to avoid overloading.
9. Remove the temporary straps fitted as mentioned under item 1.

A.G.C. Voltage

1. Feed the UN1/41 input from a signal generator providing a 10·7 Mc/s signal at 150 μV.
2. Measure the a.g.c. line voltage (A.G.C.2) with respect to chassis. It should be −4·5 volts (±0·5 volt).
3. Vary the applied signal amplitude to ascertain that the a.g.c. voltage alters correspondingly.

Carrier Failure Circuit

1. Referring to the UN1/32, Fig. 3(c), set the noise-amplifier gain control RV1 fully clockwise and adjust the alarm sensitivity control RV2 so that, with no carrier input, the indicating lamp just lights.
2. Disconnect the A.G.C.1 input connection and substitute a 20-kc/s input from the TS/9 tone source. Apply this tone through a repeating coil terminated in 600 ohms.
3. Starting from about −25 dB, gradually reduce the tone-source output while watching for de-operation of relay RLA. That should occur between −35 dB and −45 dB. If the

sensitivity is greater than —45 dB, reduce it by reducing the value of R5.

2.5.3 Mixer and Second Oscillator UN1/40

The required test apparatus comprises:

Signal Generator (Marconi type TF995A, with Terminating Unit type TM5551).
Avometer Model 8.
Wattmeter (Burndept type BE294)
Millivoltmeter (Rohde and Schwarz type URBN 1901).

D.C. Measurements

For the no-input condition the currents drawn from the 12-volt and 24-volt supplies should not exceed 50 mA and 120 mA respectively. With the full-output condition the current through L4 of the AM14/4 should be 85 mA ± 10 mA; a test-link position is available to make this measurement.

Mixer Adjustment

1. Referring to Fig. 3(a), check that the oscillator injection voltage across the L4 primary is 170 mV ± 30 mV.
2. With the millivoltmeter across C18, adjust RV1 to reduce the residual oscillator output to a minimum, which should not exceed 20 mV.
3. Apply to the mixer input a 10·7-Mc/s signal at 10 mV, and feed the mixer output to the valve-voltmeter. Sequentially adjust L1, C7 and C15 to obtain maximum output voltage; this should be not less than 650 mV.

R.F. Amplifier Alignment

1. Connect the wattmeter to the UN1/40 output. Referring to Fig. 3(b), adjust C4, C7 and C13 for maximum output power. This should be not less than 1 watt.
2. Open the test-link position across C15 in the AM14/4, and use the Avometer to check that full-output current through L4 is within limits already specified.

Note: Production spreads for the transistor in the TR2 position are very large. Therefore in fitting a new transistor it is advisable to try several of the type for the purpose of choosing one giving the requisite output power.

A translator may fail to deliver correct output power despite apparently satisfactory alignment of the UN1/40 and proper setting-up of the r.f. output stage AM14/3. Such deficiency almost certainly results from the AM14/4 working into a load other than 50 ohms, the value for which this driver stage unit is optimised. The recommended action is to adjust the driver stage unit with the UN1/40 in its normal service position instead of on the chassis extender.

The method is to:

1. Take the oven control unit UN1/38 out of the assembly to provide space giving access to the r.h. side of the UN1/40.
2. Take the lid off the screening box of the AM14/4, and in its place fit a spare lid with a ½-in. drilled hole to correspond with the position of C13.
3. Use a Philips trimming tool to adjust C13 for maximum output power from the AM14/3 amplifier.

R.F. Voltages

The table listing these voltages is intended as a guide to probable values. Measurements were undertaken with the Rohde and Schwarz millivoltmeter, with the i.f. and oscillator inputs of the UN1/41 at 10 mV and 170 mV respectively.

Unit	*Test Point*	*Voltage*
MX1/4	*TR1 base	60 mV
	†TR1 emitter	250 mV
	*TR2 base	60 mV
	†TR2 emitter	250 mV
	TR1, TR2 emitter junction	800 mV
	R7, R9 junction	100 mV
	Output	2 volts
AM14/4	R4, R5 junction	4 volts
	TR3 base	3 volts
	Output (across 50 ohms)	7 volts

* With no oscillator input.
† With no i.f. input.

2.5.4 R.F. Output Amplifier AM14/3

Warning: It is very important to ensure that the unit always works with a properly-connected 50-ohm load, as otherwise the output transistors may be damaged. Such damage can also result from mistuning while a correctly-aligned translator is fully powered.

The purpose of the alignment is to achieve (a) maximum power transfer to the load, (b) correct amplitude/frequency response, (c) maximum efficiency in the output stage, and (d) correct input and output impedances. The complete alignment detailed here will rarely be required in service. The replacement for a faulty component, for instance, should necessitate only a slight trim of tuned circuits associated with that component.

An input power of at least 0·5 watt is required from the driving source. This is best provided from the associated UN1/40 (Mixer and Oscillator), driven in turn by a signal generator set to 10·7 Mc/s. A high-frequency oscilloscope should be connected across the output load in order to check for the presence of instability, which usually manifests itself as spurious amplitude modulation of the output waveform. To hold off its input capacitance, the oscilloscope probe should be connected through a 0·5-pf capacitor.

The required test apparatus is:

- Valve-voltmeter (Marconi type TF.1041).
- R.F. Power Meter (Marconi type T.F1152/1).
- F.M./A.M. Signal Generator (Marconi type TF.995A).
- Portable Test Meter PTM/6 (or equivalent).
- R.F. Oscilloscope (Tektronix type 585, with either a type 82 plug-in unit or a type 80 plug-in unit and a P80 probe).
- Selektomat (Rohde and Schwarz type USWV BN15221).
- Reflectometer (Rohde and Schwarz type ZUP BN3569/50).

If the last two items are not available, prepare a 26-in. length of UR43 cable for the use specified in respect of item 16.

1. Referring to Fig. 4, take C27 out of circuit and in its place connect a concentric trimmer with a range 4—60 pF. Similarly for C26, substitute a concentric trimmer (4—60 pF) in parallel with a 33-pF fixed capacitor.
2. Set all variable capacitors in the unit to their mid-point values.
3. With the power supply switched off, connect the 50-ohm power meter to the output socket of the EP7/5 assembly. Plug the AM14/3 into position through a chassis extender type CH1A/5.
4. Apply a 10·7 Mc/s signal at 10mV from the signal generator to the *Filter 2 Out* socket at the rear of the EP7/5 assembly.
5. See that the UN1/40 operating supply will be available, checking for strapping of pins 1 and 2 of socket N and pins 8 and 9 of socket B. Switch on the power supply.

Note: Initially the supply voltage should be set to 32 volts by means of the presetting resistor at the rear of the PS2/37.

6. Connect the valve-voltmeter between TR1 emitter and the chassis, and adjust C1 and C3 for maximum-voltage reading.
7. Transfer the voltmeter to TR2 emitter, and adjust C4 and C5 for maximum-voltage reading.

Note: At this stage it should be possible to observe a reading on the power meter, so judging by this:

8. Adjust C6, C7, C8 and C26 for a maximum-power reading.
9. Remove the valve-voltmeter. Adjust C5 for maximum-power reading, which should be in excess of 10 watts.
10. Allow one hour for the unit to attain its normal working temperature.
11. In the given order, successively adjust the variable capacitors and couplings between inductors to obtain a maximum power output in each instance. The sequence is:
    C1, C3, C27, L1, L3, C4, C5, L5, C6, C7 and C26.
    Then *repeat* this sequence of adjustment.

Note: C6 and C7 must be tracked together to obtain maximum power. If either capacitor has to be rotated more than 30 degrees, C8 also should be adjusted during the tracking process.

12. To check for maximum power with maximum efficiency, connect the PTM/6 to socket C on the AM14/3 chassis. Tune C8 slowly until the meter shows a current-feed dip.

Note: Output power tends to remain constant for small excursions about the feed dip-point of C8, but the dip is quite sharp and indicates maximum efficiency.

The Rohde and Schwarz equipment enables the input impedance to be made 50 ohms by procedure as follows, but if these instruments are not available the alternative method set out in items 16 and 17 can be adopted.

13. With the AM14/3 on the chassis extender, connect the Reflektometer in the r.f. input lead and use the power output meter as an output load.
14. Switch the power supply on. Connect the Selektomat to the Reflektometer receiver socket and tune it to the signal.
15. Adjust the spacing between the L1 primary and secondary, and also trim C1 and C3, until the reflection coefficient is better than 16 dB.

Note: The tuning of the later stages may alter the adjustment slightly. When the input is correctly matched, trim all the amplifier adjustments.

Assuming operations 13—15 are impracticable, proceed by using the 26-in. length of UR43 cable, as follows:

16. Adjust C27 and the L1 coupling, and also trim C1 and C3, until the output power is the same (a) with the test length of cable added to the 6-in. length supplied with the chassis extender and (b) with the test length removed.
17. Now adjust C4 and C6 for maximum power output. Finally, trim all the amplifier adjustments for maximum power.
18. Subsequent to either item 15 or item 17, remove the concentric trimmers temporarily fitted as C27 and C26, and in their places connect the appropriate values of fixed capacitance.
19. Replace the metal lid of the AM14/3. Connect the wattmeter load and then power the unit for at least one hour.
20. Adjust C25, C1 and C3-C8, in that order, for maximum-power reading.

Note: Output power tends to vary, as between units, but it should be possible to obtain an output of 15 watts. If the output remains low despite careful alignment, the power-supply voltage may be raised from 32 volts to 34 volts.

21. Check that the power supplier is not loaded to an extent that it will be overloaded when supplying the whole translator. Specifically this means that the AM14/3 consumption must not exceed 1·65 amperes, and the whole-translator current should not exceed 1·8 amperes; see data under heading 2.4.6.
22. Using the oscilloscope, check that the a.m. component is less than 2 per cent at the AM14/3 output when the carrier is deviated by ±75 kc/s.

2.5.5 Crystal Oscillators and Oven Control

The crystals in the OS2/20 units have a manufacturer's cutting tolerance of 1·5 kc/s at 100 Mc/s, but phase shift in the maintaining amplifier tends to pull the natural frequency of a crystal away from the cut value.

Pulling is introduced intentionally for the purpose of obtaining an oscillator frequency very close to the figure marked on the crystal. One method is to add in series with the series-resonant crystal, the capacitance provided by C5 and C6, thereby increasing frequency. Another method, giving the option of either increasing or decreasing the frequency, is to mis-tune slightly the TR1 collector tuned circuit to force the crystal to its correct frequency. Only a small amount of pulling is practicable, for when carried beyond a reasonable limit it leads to inferior frequency stability and the possibility of an eventual cessation of oscillation.

Aside from component faults the process of aging introduces the risk of a cessation of oscillation in the course of time, due to the resonant frequencies of the crystal itself and the maintaining amplifier moving away from each other.

The quoted cutting tolerance corresponds to 15 parts in 10^6, and by a pulling-action adjustment it ought to be possible to set the oscillator frequency to within ±3 parts in 10^6. Typically the frequency changes to be expected from disturbance of working conditions are:

Ambient temperature (assuming crystal is maintained at constant temperature)	Less than 5 c/s per degree C.
Supply Voltage	Less than ±3 parts in 10^6 for a 1-volt change.
Crystal Aging	+2 to −8 parts in 10^6 per year.

The test equipment required for adjustment of frequency comprises:

Valve-voltmeter with 300 mV minimum f.s.d. (Marconi type TF1041B).
Frequency Counter, operating up to 100 Mc/s.
Absorption Detector (see Fig. 2.8).

1. Set the temperature of the appropriate crystal oven (A or B) to about 75 degrees C, by turning the associated *Set Oven Temp.* control to the mid-position.
2. Connect the valve-voltmeter and the frequency counter across the OS2/20 output.
3. In the OS2/20, Fig. 1(c), set C5 to approximately half of its maximum capacitance before adjusting the core of L1 for a maximum valve-voltmeter reading; readjust C13 also if necessary. Note the frequency indicated by the frequency counter.

Note: If a valve-voltmeter reading is not obtained, make use of the absorption detector as in Fig. 2.8. Place the detector loop around coil L1 and adjust the core until a meter deflection is obtained. Once the first stage is oscillating, remove the loop and proceed with the valve-voltmeter at the output. If considerable adjustments have been made to both L3 and C13, the output impedance should be checked. First, measure the open-circuit output voltage. Then see if the indicated voltage falls to half the open-circuit value when a 75-ohm resistor is placed across the output. If not, alter the ratio of L3 to C13 until the specified reduction is obtained; the alteration must be such that resonance is maintained.

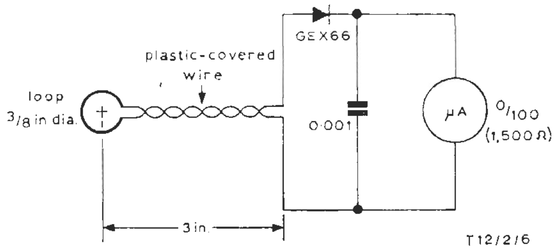


Fig. 2.8. Circuit of Absorption Detector

4. If the indicated frequency is lower than that marked on the crystal, as is most probable, reduce the inductance of L1 by slightly withdrawing its core until correct frequency is obtained. Before a final adoption of this setting, prove by an over-shoot adjustment that oscillation is maintained beyond the point where correct frequency is obtained; this is done to ascertain that the oscillator is unlikely to stop functioning after a period of use.
   Alternatively, if indicated frequency is higher than required, try to reduce frequency by increasing the value of C6 rather than by screwing-in the core of L1 to increase its inductance. If the L1 inductance is increased, make a check by over-shoot adjustment to see that oscillation exists beyond the point giving correct frequency, for the reason as above.

Note: Very-small frequency changes can be made by adjustment of C5.

Crystal frequency can be changed by alteration of oven temperature, of course, but the direction of the change cannot be assumed even though experience suggests increased frequency for decreased temperature. This indirect means of changing frequency is most convenient, for it avoids the need to disturb the oscillator units in any way.

Typical values of oven current are:

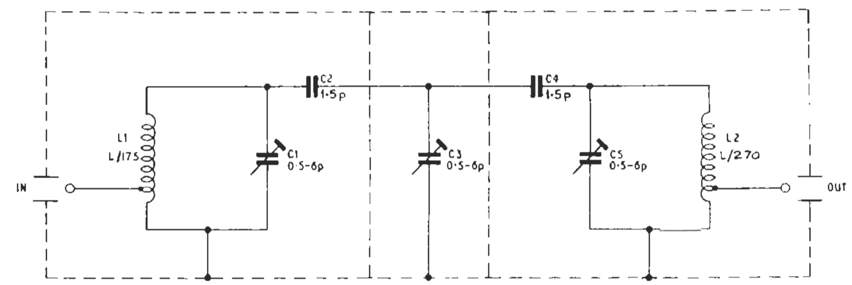
With oven cold	650 mA approximately.
With oven operating normally	250—450 mA.
With oven hotter than the temperature corresponding to the control setting	Less than 100 mA (that is, the leakage current of TR3).

S.H.F. & G.B.(X)/J.R./0666

FIG 1

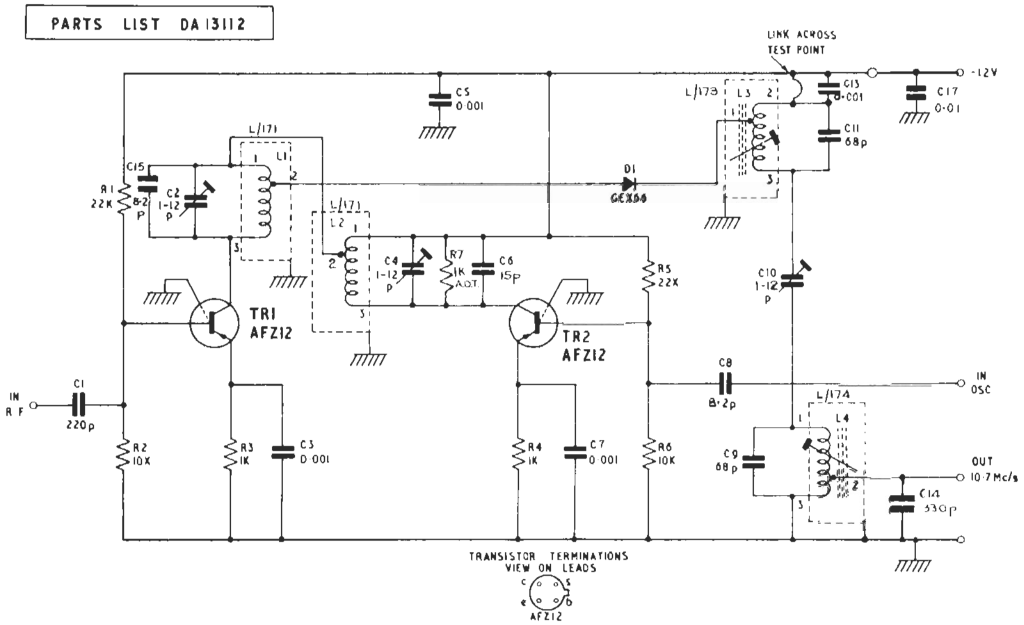
A B C D E F G H I J K L M N O P Q R S T U V W

PARTS LIST DA13174



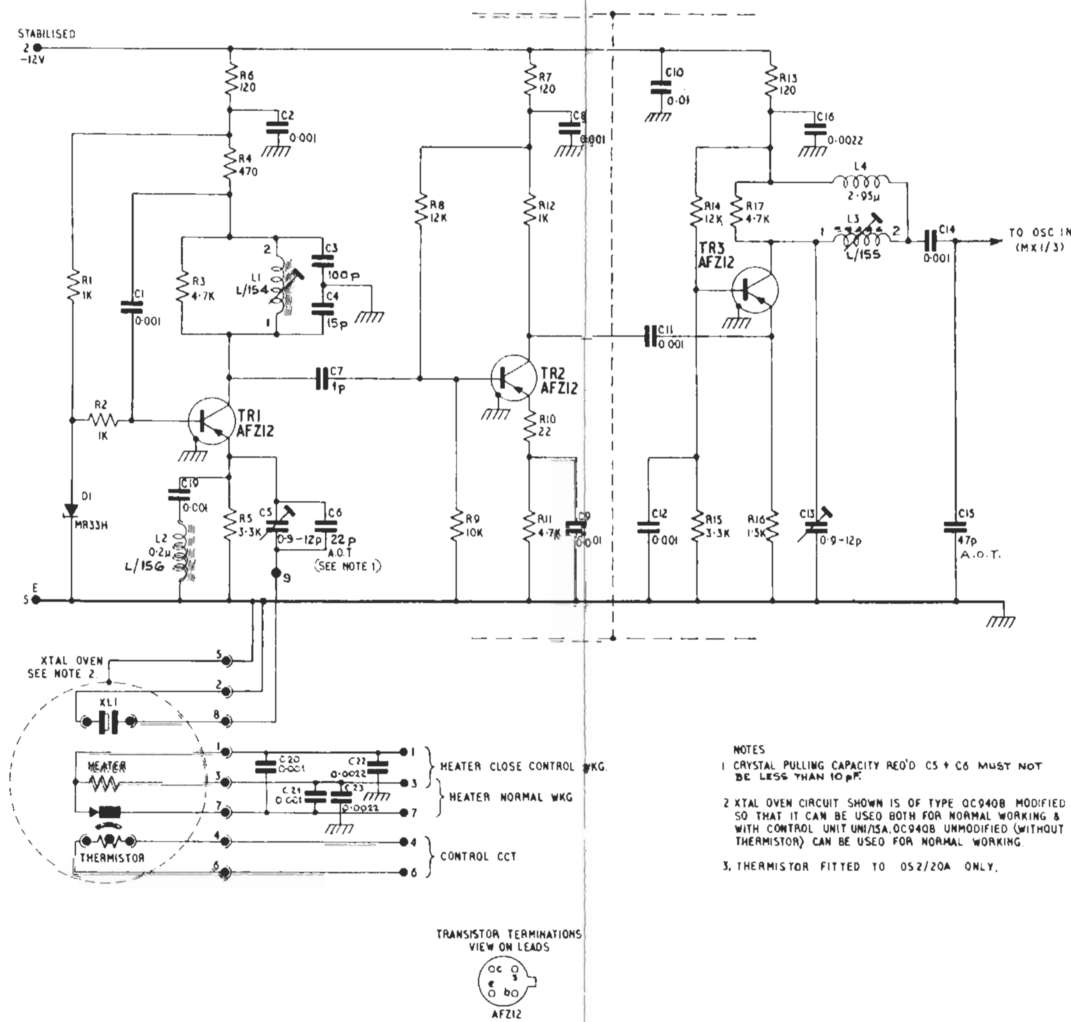
(a) INPUT FILTER UNI/37

PARTS LIST DA13112



(b) FIRST MIXER MX1/3

PARTS LIST DA12811



NOTES
1 CRYSTAL PULLING CAPACITY REQ'D C5 + C6 MUST NOT BE LESS THAN 10 pF.
2 XTAL OVEN CIRCUIT SHOWN IS OF TYPE OC940B MODIFIED SO THAT IT CAN BE USED BOTH FOR NORMAL WORKING & WITH CONTROL UNIT UNI/15A. OC940B UNMODIFIED (WITHOUT THERMISTOR) CAN BE USED FOR NORMAL WORKING.
3. THERMISTOR FITTED TO OS2/20A ONLY.

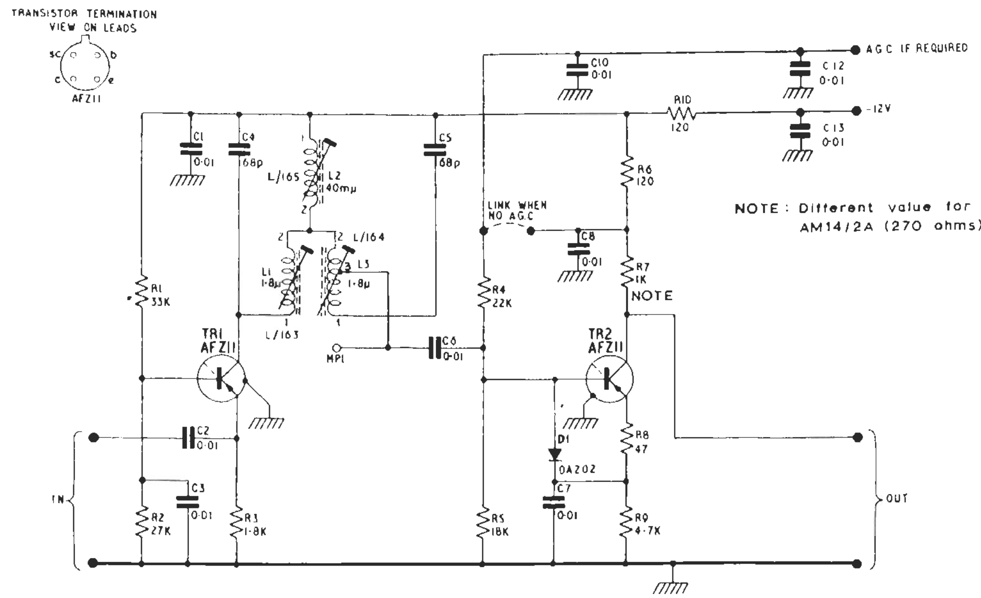
(c) CRYSTAL OSCILLATOR OS2/20
(AMENDING DETAIL FOR OS2/20A IS INCLUDED)

V.H.F./F.M. TRANSLATOR EP7/5: FRONT-END UNIT UNI/39: CIRCUITS

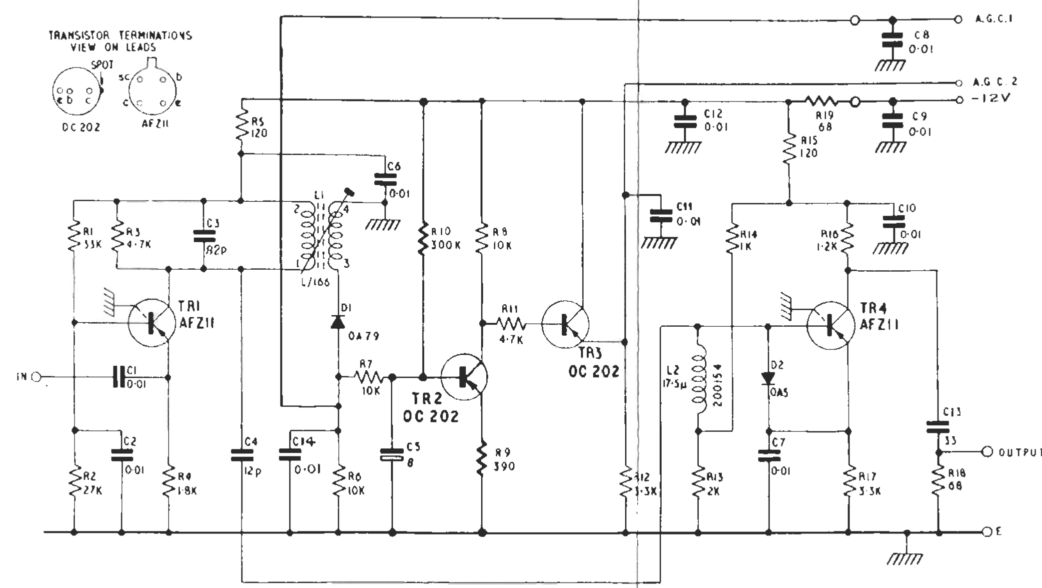
PARTS LIST DA12455

PARTS LIST DA12461

A B C D E F G H J K L M N O P Q R S T U V W

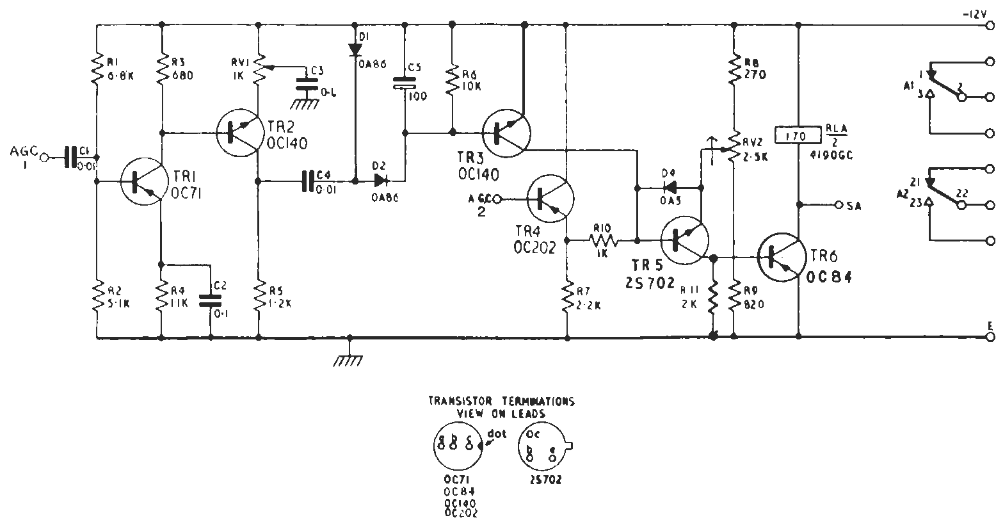


(a) I.F. AMPLIFIER AM14/2
(COMPLETE AMPLIFIER HAS TWO UNITS AS SHOWN)



(b) LIMITER AND AGC AMPLIFIER AM6/2

PARTS LIST DA13095



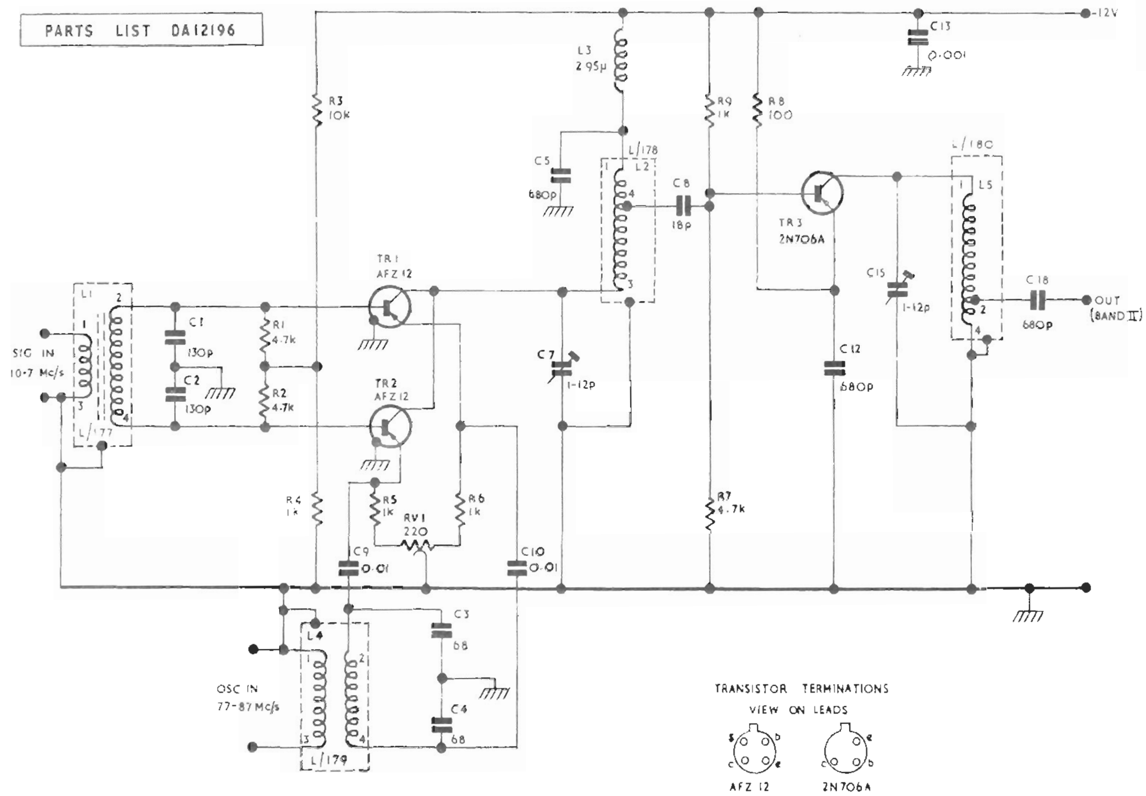
(c) CARRIER FAILURE UNIT UN1/32

V.H.F./F.M. TRANSLATOR EP7/5 : I.F. UNIT UN1/41 : CIRCUITS

65/JR(X)/109
(a) DB 12195
ISS 2
(b) DA 12304
ISS 2

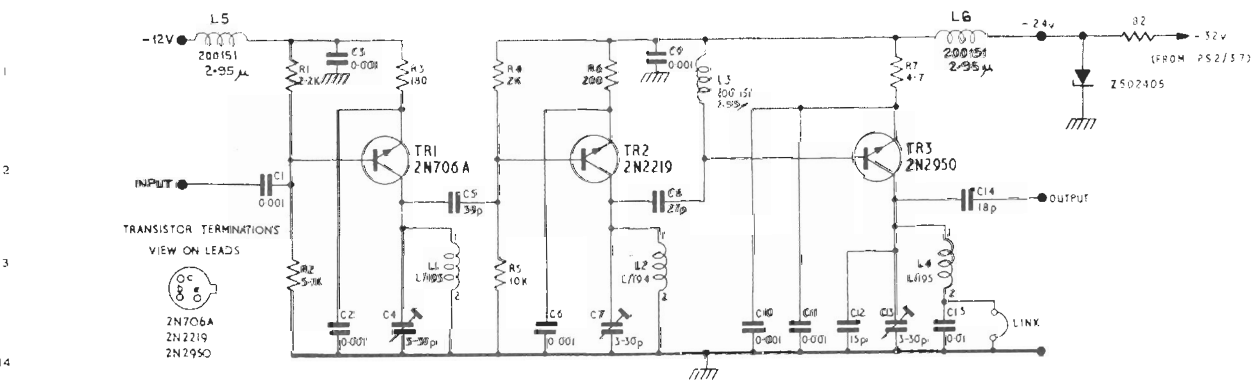
FIG 3

PARTS LIST DA12196



(a) SECOND MIXER MX1/4

PARTS LIST DA12305

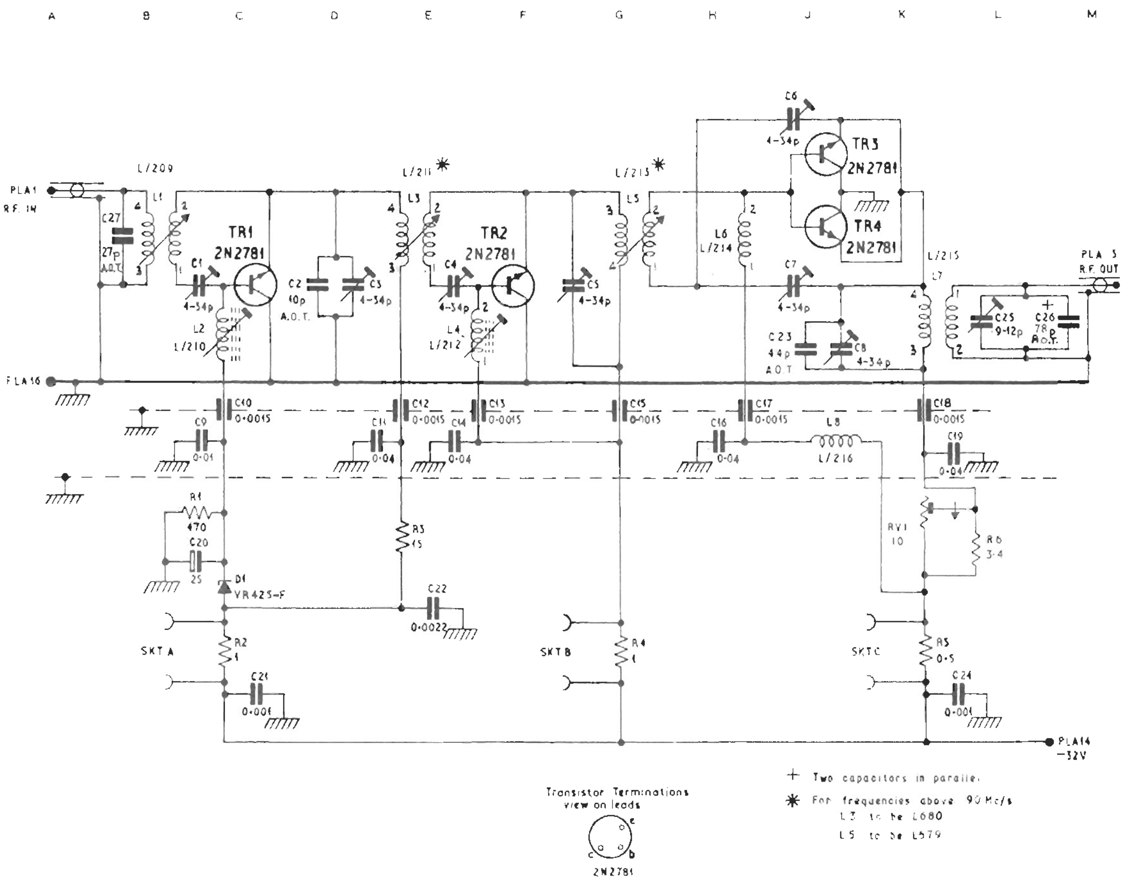


(b) RF AMPLIFIER AM14/4

(c) CRYSTAL OSCILLATOR OS2/20: REFER TO FIG 1(c)

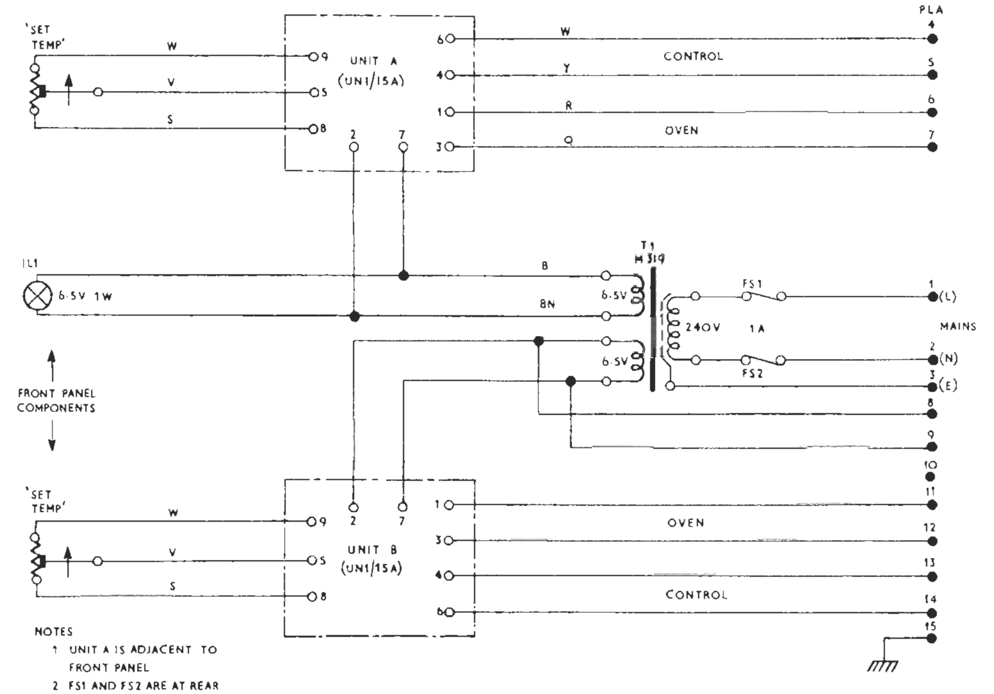
V.H.F./F.M. TRANSLATOR EP7/5: MIXER AND OSCILLATOR UN1/40: CIRCUITS

PARTS LIST DA12512



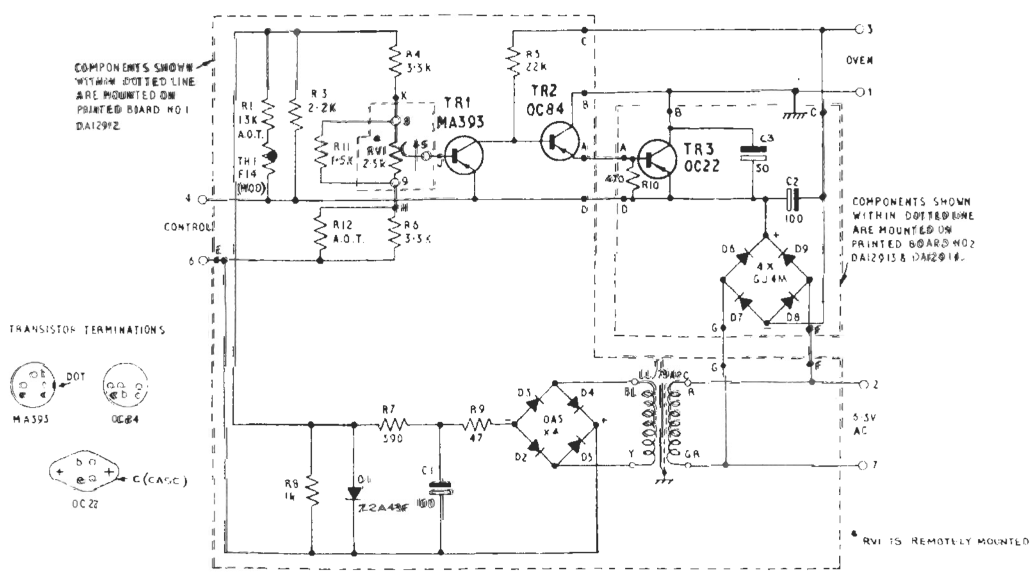
V.H.F./F.M. TRANSLATOR EP7/5
RF OUTPUT AMPLIFIER AM14/3 : CIRCUIT

FIG 5



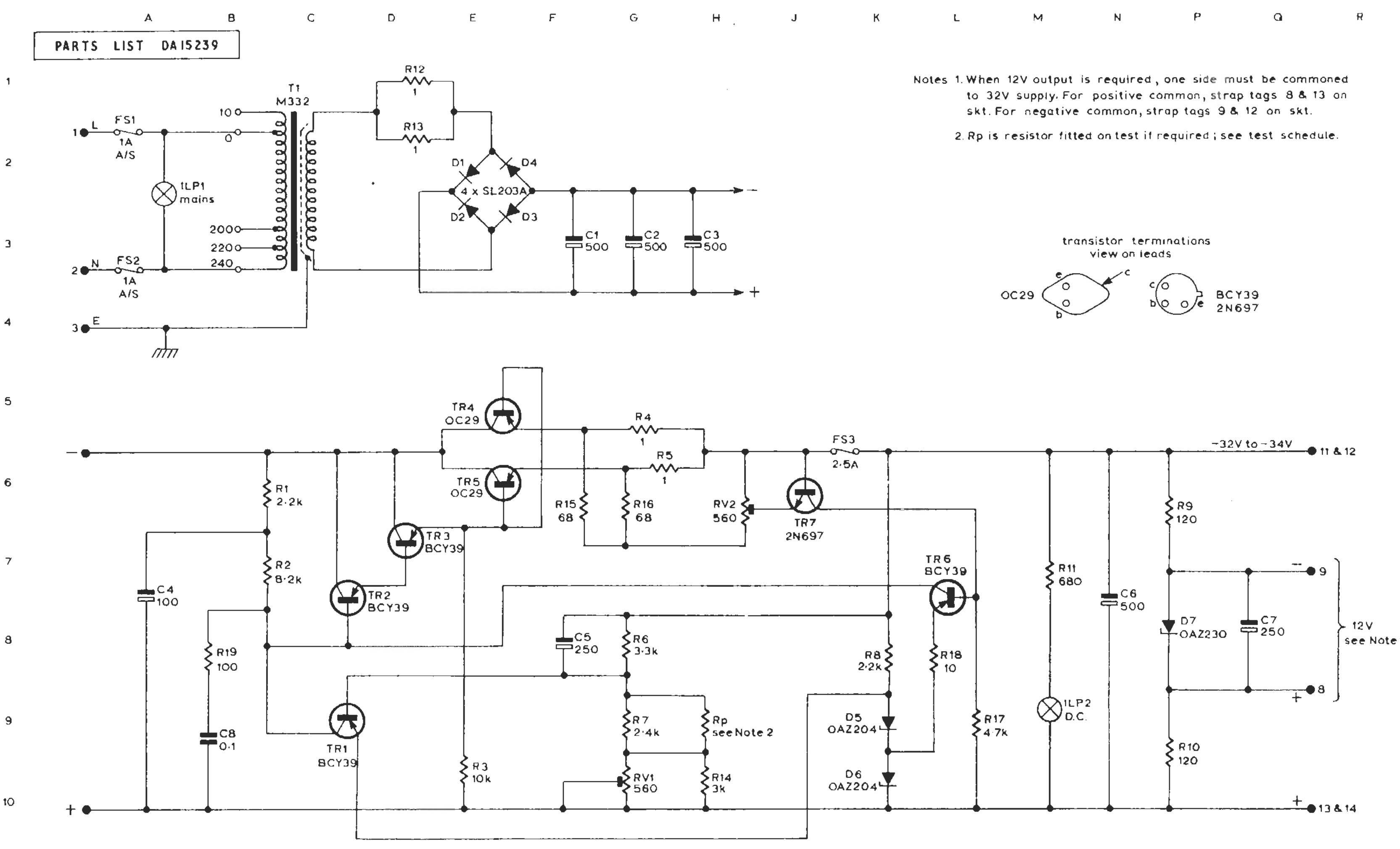
(a) OVEN CONTROL PANEL UN1/38

PARTS LIST DA12910



(b) TEMPERATURE CONTROL UNIT UN1/15A

V.H.F./F.M. TRANSLATOR EP7/5: OVEN CONTROL PANEL UN1/38 CIRCUITS



V.H.F./F.M. TRANSLATOR EP7/5 : STABILISED POWER SUPPLIER PS2/37 : CIRCUIT