Chapter 19

DEMODULATOR, RADIO FREQUENCY 5821-99-913-4674

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Introduction

Purpose of unit

1. The demodulator, radio frequency 5821-99-913-4674, referred to throughout the remainder of this Chapter as the demodulator, is a sub-unit of the transmitter receiver, radio 5821-99-913-4669. This transmitter-receiver is similar to the basic R/T transmitter-receiver Type TR5/ARC52 (fully described and illustrated in A.P.116D-0105—1), except that the demodulator is fitted in place of the guard receiver. The f.s.k. (frequency shift keying) signal received by the transmitter-receiver is demodulated by a discriminator circuit in the demodulator to produce a video output wave-form similar to the original digital modulating signal. This video output is fed to the signal data converter.

2. The input to the demodulator is derived from the final amplifier in the intermediate frequency amplifier and comprises frequencies of 1·87 MHz, corresponding to a binary 'O', and 1·83 MHz, corresponding to a binary '1', i.e. a deviation of 20 KHz about the nominal second i.f. of 1·85 MHz. The input signal is fed via an aperiodic amplifier stage to two limiter amplifiers which remove any amplitude modulation that may be present, and is then demodulated by the discriminator, a modified form of the Foster-Seely circuit. The discrimin-

ator output is directly coupled to an amplifier, which in turn is directly coupled to the output cathode follower to produce the rectangular waveform required for operation of the signal data converter.

3. The demodulator is of open construction, with the smaller electronic components mounted on two printed circuit boards and the valves and other large components individually mounted. Except for a flying lead, which carries the input for the intermediate frequency amplifier, interconnections between the demodulator and the transmitter-receiver chassis are provided by a fixed multi-pole plug on the underside of the unit. This plug automatically mates with a corresponding socket on the chassis when the unit is fitted in place. Two locating dowels on the underside of the unit guide the plug into the socket and also ensure that the demodulator can be fitted only into its correct position on the chassis. Four captive screws, coloured red, on the underside of the transmitter-receiver chassis secure the demodulator in position. The location of all components of the demodulator is given in A.P. 116D-0133—1A. A wiring diagram of the demodulator appears at the end of the Chapter in fig. 3. A circuit diagram of the demodulator appears in fig. 13 of A.P.116D-0133—10.

Preliminary inspection

4. On receipt of a demodulator for repair, it should be inspected as follows:—

(1) Verify that the serial number and modification state are as entered on the repair card accompanying the unit.

(2) Remove the side covers, remove also the screening cover from the r.f. amplifier. Thoroughly clean the unit of any dust with a portable blower or other approved supply of dry air under pressure, if necessary, using a soft squirrel hair brush to assist in the process. Since the transmitter-receiver is enclosed within an airtight casing, the presence of dust, dirt or moisture should be fully investigated.

(3) Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Any loose components must be securely refitted. Should it be necessary to change any components it is important to ensure that they are positioned accurately and correctly connected, particularly in the case of valves, semiconductors and electrolytic capacitors. Screws and nuts removed during examination or servicing and which are not fitted with locknuts or lockwashers, must be locked with an approved varnish when refitted.

(4) Examine the unit for accuracy of wiring, neatness of soldering, absence of dry joints and a general satisfactory condition of the wiring and insulation. Particular attention should be paid to the sleeving covering the connections to the multi-pole plug. No

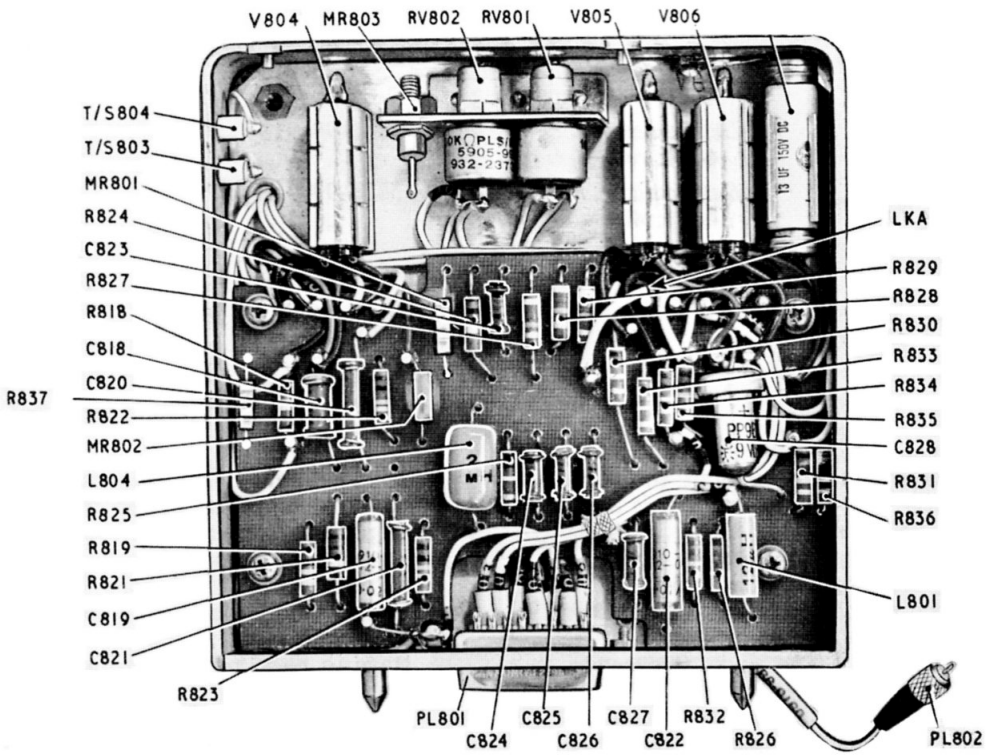


Fig. 1. Demodulator, radio frequency, 5821-99-913-4674: front view

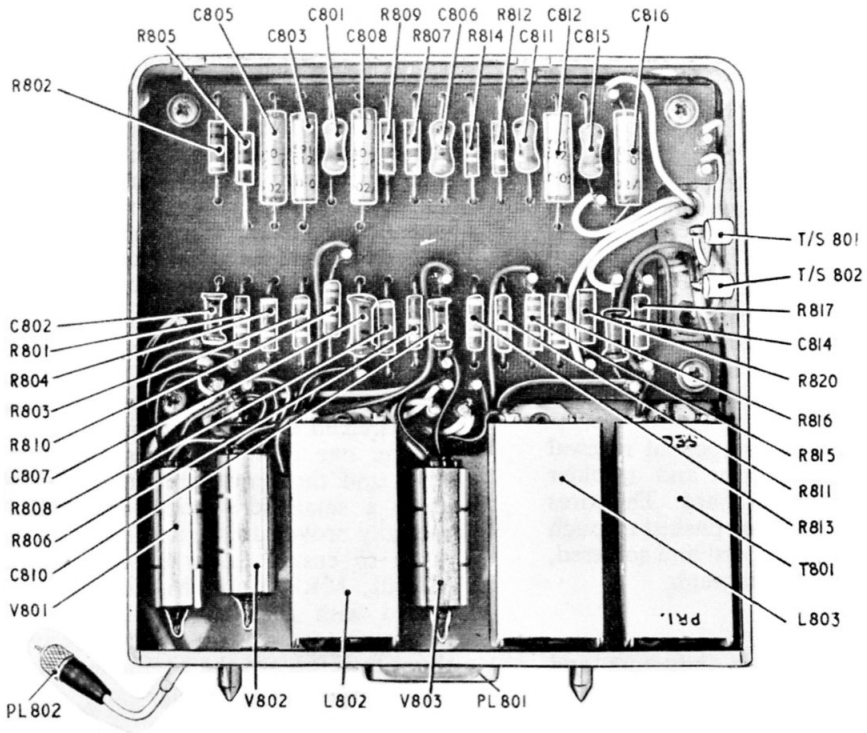


Fig. 2. Demodulator, radio frequency, 5821-99-913-4674: rear view

inadvertent connections or tracking paths due to excess solder, wire clippings or dirty connections should be permitted. It is important to ensure that the renewal of wiring is done with the correct type of wire, with the gauge, length and routeing exactly the same as the original wiring, except where modifications have brought about changes.

Test equipment

5. The following items of test equipment are required:—

(1) Test set, demodulator, 6625-99-195-5998 (See note below).

(2) Power supply 6130-99-999-7812, for use with item (1).

(3) Headset, telephone, Type 9 (Ref. No. 10AH/14), for use with item (1).

(4) Multimeter CT429, 6625-99-943-8384.

(5) Generator, signal CT452-Set, 6625-99-913-1420.

(6) Generator, signal CT520, 6625-99-944-7666.

(7) Generator, signal Type 16728, 6625-99-999-9604.

(8) Indicator, distortion, 6625-99-944-7661.

Note . . .

If a test set, demodulator is not available, the following items will be required:

(*a*) *Transmitter-receiver, radio,* 5821-99-913-4669 (*Type* 11672).

(*b*) *Test kit,* (*AN/ARC* 52) 6625-99-943-6904.

(*c*) *Control, radio set, Type C*1607/4, 5821-99-945-5739.

(*d*) *Test kit,* 6625-99-943-7032.

(*e*) *Counter, frequency, electronic* 6625-99-952-0550.

(*f*) *Paper dielectric capacitor of not less than* 3μ*F with a working voltage of not less than* 25 *V.*

(*g*) *Resistor, fixed, film,* 2 *kilohm* ± 2%, ¼W 5905-99-012-2698.

Servicing notes

Printed circuit boards

6. The printed circuit boards used in the demodulator present special problems with regard to servicing as they may be irreparably damaged by excessive or sustained heat from a soldering iron, This will cause the printed circuit board to lift from the board and render it unfit for further use. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:—

(1) Remove the faulty component from the board by clipping the wires as close to the component as possible, thus leaving the wire ends still soldered to the board. In some cases it may be necessary to crush the component, by careful use of a pair of pliers, in order to obtain the maximum possible lengths of wire.

(2) Wrap the wire ends of the new component around the wires attached to the board, using one turn only and ensuring that the new component is fitted so that its value is clearly indicated.

(3) Using a suitable heat shunt, solder the wire joints as quickly as possible with a lightweight soldering iron which has been allowed to reach its optimum operational temperature.

7. An alternative method of component renewal is to cut out the faulty component and unsolder its wires from the printed circuit board. The wires of the new component may then be pushed through the holes in the printed circuit board and soldered, as described in the previous paragraph.

Adjustable cores

8. The adjustable cores of the inductors and transformers in the demodulators are locked after alignment, with varnish oil, reference No. 8010–99–947–7826. Before attempting to adjust any core, the locking varnish should be softened with paint remover, reference No. 8010–99–947–7825. One application of this solvent with a small pencil brush will usually be sufficient to permit adjustment of the core after two or three minutes. When the solvent has evaporated the original varnish may well relock the core, but if not, a light application of new varnish should be made. The application of more varnish should be avoided whenever possible. Care should be taken to keep the varnish and its solvent away from naked lights as both are highly inflammable.

Valves and semi-conductors

9. The valves used in the demodulator are of the wired in type and are retained by clips. To remove one of these valves, unsolder the flying leads and then prise the valve out of the clips, using a small screwdriver inserted through the specially provided hole in the case. Care must be taken to ensure that the semi-conductor diodes MR801, MR802 and MR803 are correctly connected with regard to polarity; if it becomes necessary to change a diode, always use a heat shunt to safeguard the component against damage from heat when soldering.

TABLE 1
Valves and Semi-conductors

Circuit Ref. No.		C.V. No.	N.A.T.O. Stock No.	Preferred manufacturer (see para. 9, caution)
V801		CV3929	5960–99–000–3929	Mullard
	or	CV2432	5960–99–000–2432	
V802		CV3929	5960–99–000–3929	Mullard
	or	CV2432	5960–99–000–2432	
V803		CV3929	5960–99–000–3929	Mullard
	or	CV2432	5960–99–000–2432	
V804		CV3929	5960–99–000–3929	Mullard
	or	CV2432	5960–99–000–2432	
V805		CV3929	5960–99–000–3929	Mullard
	or	CV2432	5960–99–000–2432	
V806		CV3986	5960–99–000–3986	Mullard
MR801		CV5196	5960–00–617–4113	Hughes (Ypye HD6616)
	or	CV8825	5960–99–037–4115	Transitron (Type SG5134)
MR802		CV5196	5960–00–617–4113	Hughes (Type HD6616
	or	CV8825	5960–99–037–4115	Transitron (Type SG5134)
MR803		CV7226	5960–99–037–2633	

Caution . . .

If a valve or semi-conductor which is not of the preferred manufacture (Table 1) is used, degraded performance of the demodulator may be experienced.

Performance tests

General

10. Unclip the demodulator side covers by easing a screwdriver between the mating edges. Ensure that link LKA is in place and that link LKB has been removed. These links are located on the printed circuit board TB802 and are shown on the wiring diagram (fig. 1), LKA being connected between terminals 12 and 20 and LKB between terminals 30 and 31.

11. If a demodulator test set (para. 5 (1)) is available, proceed as follows:

(1) Fit the demodulator to the interconnecting box supplied as part of the test set, tighten the retaining screws and connect the demodulator signal input plug PL802 to the socket SKTF on the interconnecting box.

(2) Using the cable assemblies supplied as part of the test set, connect the INTERCONNECTING BOX and SIG. GEN. OUTPUT sockets on the test set front panel to the plug PLB and the socket SKTD respectively on the interconnecting box. Connect the output of the signal generator CT452 to the SIG. GEN. INPUT socket.

(3) Connect the output of the power supply (para. 5 (2)) to the P.S.U. 130V plug on the test set front panzl by means of the connector provided with the power supply and, with h.t. and l.t. inputs to the test set of 130V d.c. and 6·3V a.c. respectively, set the test set HT switch to ON.

12. If a test set is not available, the demodulator may be tested by employing a serviceable transmitter-receiver (para. 5 note) with its demodulator removed. The procedure is as follows:

(1) Remove the transmitter-receiver from its cover, as described in Chap. 16, disconnect the demodulator flying lead from the chassis-mounted adaptor socket and remove the demodulator from the chassis.

(2) Connect the multi-pole plug PL801 of the demodulator under test to the socket J1508 of the chassis by means of the electrical power cable assembly, 5995–99–392–1908 (part of the test kit in para. 5 (8b)).

(3) Ensure that the change-over switch on the right-hand side of the radio control set is set to the yellow D/L (data link) position and that the function switch on the front panel is turned to OFF.

(4) Interconnect the transmitter-receiver and the radio set control by means of the interconnecting box and connectors of the test kit and connect the 27·5V d.c. supply. (Full details of the test kit are given in A.P.116D–0133—1B). Connect the output of the signal generator CT452 to the demodulator input at the plug PL802.

(5) Turn the function switch on the radio control set to DL and the CHAN switch to any channel but G. Allow 15 minutes for the equipment to reach its operating temperature before proceeding further.

Note . . .

The d.c. supply to the equipment must be maintained at 27·5V throughout the performance tests.

Frequency calibration

13. During the performance tests, the output frequency of the signal generator CT452 must be accurately set to the specified frequency, either by calibration with the crystal oscillator incorporated in the demodulator test set or by measurement with the frequency counter. If a test set is used, the procedure is as follows:

(1) Connect the telephone headset (para. 5 (3)) to the PHONE jack socket.

(2) Set the signal generator and the CAL. OSC. switch to the required frequency.

(3) Adjust the signal generator frequency to obtain zero beat in the telephone headset.

(4) Turn the CAL. OSC. switch to OFF.

Limiter amplifier alignment

14. The alignment procedure is as follows:

(1) Connect the multimeter CT429, adjusted to measure d.c. voltages, between the test socket T/SKT801 and earth. If a test set is being used, turn the TEST switch to the VOLTS UNLOADED position.

(2) Set the signal generator CT452 to a frequency of 1·85 MHz at an output level of 2·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level more negative than −1·6V.

(3) Transfer the multimeter connection to the test socket T/SKT802 and adjust the core of the first limiter anode coil L802 to obtain maximum defledtion on the multimeter. Note this measurement, which shoyuld be more negative than −5·7V.

(4) Transfer the multimeter connection to the test socket T/SKT803 and adjust the core of the second limiter anode coil L803 to

obtain maximum deflection on the multimeter. Note this measurement, which should not be more negative than −3·0V.

(5) Reduce the input signal level until the multimeter indication is 90% of that noted in sub-para (4) and verify that the input signal level does not exceed 15 mV r.m.s. (open-circuit voltage).

(6) Transfer the multimeter connection to the test socket T/SKT802. Increase the input signal level until the multimeter indication is 90% of that noted in sub-para (3) and verify that the input signal level does not exceed 220 mV r.m.s. (open-circuit voltage).

Limiter amplifier bandwidth

15. With the multimeter still connected to the test socket T/SKT802, proceed as follows:

(1) Set the signal generator CT452 to a frequency of 1·8 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level more negative than −4·5V. Note the reading obtained.

(2) Transfer the multimeter connection to the test socket T/SKT803 and verify that the multimeter indicates a d.c. level more negative than −2·0V. Note the reading obtained.

(3) Reduce the input signal level until the multimeter indication is 90% of that noted in sub-para. (2) and verify that the input signal level does not exceed 25 mV r.m.s. (open-circuit voltage).

(4) Transfer the multimeter connection to the test socket T/SKT802. Increase the input signal level until the multimeter indication is 90% of that noted in sub-para. (1) and verify that the input signal level does not exceed 250 mV r.m.s. (open-circuit voltage).

(5) Set the signal generator to a frequency of 1·9 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level more negative than −4·5V. Note the reading obtained.

(6) Transfer the multimeter connection to the test socket T/SKT803 and verify that the multimeter indicates a d.c. level more negative than −2·0V. Note the reading obtained.

(7) Reduce the input signal level until the multimeter indication is 90% of that noted in sub-para. (6) and verify that the input signal level does not exceed 25 mV r.m.s. (open-circuit voltage).

(8) Transfer the multimeter connection to the test socket T/SKT802. Increase the input signal level until the multimeter indication is 90% of that noted in sub-para. (5) and verify that the input signal level does not exceed 250mV r.m.s. (open circuit voltage). Disconect the multimeter from the test socket.

Discriminator alignment

16. The alignment procedure is as follows:

(1) Disconnect the demodulator output stages by removing link LKA from the printed circuit board TB802 and connect the damping resistor R838 across the secondary winding of the discriminator transformer T801 by temporarily connecting the terminals of link LKB.

(2) Connect the multimeter, set to measure a.c. voltages, between earth and the junction of capacitors C820, C821 and unscrew the cores of the primary and secondary windings of transformers T801 to their full extent.

(3) Set the signal generator CT452 to a frequency of 1·85 MHz at a level of 1·0V r.m.s. (open-circuit voltage) and adjust the primary core of transformer T801 to obtain maximum deflection on the multimeter.

(4) Remove link LKB and adjust the secondary core of transformer T801 to obtain minimum deflection on the multimeter. Disconnect the multimeter.

(5) Connect the multimeter, adjusted to measure d.c. voltages, between test socket T/SKT804 and adjust the secondary core of transformer T801 to obtain zero deflection on the multimeter.

(6) Set the signal generator to a frequency of 1·8 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level more negative than —8·0V.

(7) Set the signal generator to a frequency of 1·9 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level more than +8·0V.

(8) Set the signal generator to a frequency of 1·85 MHz at an output level of 2·0 r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level of between +0·1V and −0·1V.

(9) Set the signal generator to a frequency of 1·83 MHz at an output level of 2·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level more negative than −3·0V. Note the reading obtained.

(10) Set the signal generator to a frequency of 1·87 MHz at an output level of 2·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level of not less than +3·0V and which differs in magnitude from the measurement noted in sub-para. (9) by not more than 8%. Disconnect the multimeter and reconnect link LKA.

Output amplifier setting up

17. If a test set is being used, turn the D.C. V.V. SELECTOR switch to DATA and the TEST switch to VOLTS UNLOADED and connect the multimeter, adjusted to measure d.c. voltages, to the D.C. V.V. PROBE socket. Otherwise, connect the multimeter between pole-7 of the plug PL801 and earth. Proceed as follows:

(1) Set the signal generator CT452 to a frequency of 1·85 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and adjust the preset potentiometer RV801 (OUTPUT LEVEL D.C.) to obtain a multimeter indication of −4·0V.

(2) Set the signal generator to a frequency of 1·87 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and adjust the preset potentiometer RV802 (OUTPUT LEVEL A.C.) to obtain a multimeter indication of −8·5V.

(3) Repeat the procedures described in sub-para. (1) and (2) until input frequencies of 1·85 MHz and 1·87 KHz produce d.c. output levels of 4·0V ± 0·2V and −8·5V ± 0·2V respectively. Note the d.c. level obtained with an input frequency of 1·85 MHz.

(4) Set the signal generator to a frequency of 1·83 MHz at an output level of 1·0V r.m.s. (open-circuit voltage) and verify that the multimeter indicates a d.c. level 4·5V ± 1·0V more positive than that obtained at a frequency of 1·85 MHz. Disconnect the signal generator from the test set or the plug PL802.

Harmonic distortion

18. Connect the signal generator CT520 to be frequency modulated by the signal generator Type 16728, to the SIG. GEN. INPUT socket, or, if a test set is not being used, to the demodulator input plug PL802. With the multimeter connected as in para. 13, proceed as follows:

(1) Set the signal generator CT520 to a nominal frequency of 1·85 MHz at an output level of not less than 0·75V r.m.s. (open circuit voltage), frequency modulated to a nominal deviation of ± 20 KHz by a 5 KHz sinusoidal waveform.

(2) With the multimeter adjusted to measure d.c. voltages, adjust the frequency of the signal generator to obtain a d.c. level of −4·0V, as indicated by the multimeter.

(3) Set the multimeter to measure a.c. voltages and, of a test set is being used, transfer the multimeter to the A.C. V.V. PROBE socket. Adjust the deviation of the signal generator to obtain an a.c. level of 3·5V r.m.s., as indicated by the multimeter, note the deviation indicated by the signal generator deviation meter and ensure that this deviation is maintained throughout the following tests.

(4) Disconnect the multimeter and, if a test set is being used, turn the TEST switch to DIST. and connect the distortion indicator between the D.F.M. and EARTH terminals on the test set front panel. Otherwise, connect the distortion indicator between pole-7 of the plug PL801 and earth. Verify that the percentage distortion of the output waveform as measured by the distortion indicator, does not exceed 5% at the following modulation frequencies: 100 Hz, 1000 Hz, 2500 Hz, 5000 Hz and 7500 Hz.

(5) Disconnect the multimeter and the distortion indicator. If a test set is being used, turn the TEST switch to the VOLTS UNLOADED position and connect the multimeter, adjusted to measure d.c. voltages, to the D.C. V.V. PROBE socket. Otherwise, connect the multimeter to pole-7 of the plug PL801. Switch off the modulation and verify that the mean d.c. level of the output, as measured by the multimeter, does not change by more than 5%.

Output impedance

19. Proceed as follows:

(1) Set the signal generator CT520 to a nominal frequency of 1·85 MHz at an output level of not less than 0·75 r.m.s. (open-circuit voltage), frequency modulated to a nominal deviation of ± 20 KHz by a 2·5 KHz sinusoidal waveform by the signal generator Type 16728.

(2) With the multimeter set to measure d.c. voltages, adjust the frequency of the signal generator VT520 to obtain a d.c. level of −4·0V, as indicated by the multimeter.

(3) Adjust the multimeter to measure a.c. voltages and, if a test set is being used, transfer the multimeter to the A.C. V.V. PROBE socket. Adjust the deviation of the signal generator CT520 to obtain an a.c. level of 3·5V r.m.s., as indicated by the multimeter.

(4) Turn the TEST switch to the VOLTS LOADED position. If a test set is not being used, disconnect the multimeter from pole-7 of the plug PL801, connect the 3μF capacitor and the 2 kilohm resistor (para. 5 note) in series between pole-7 of the plug PL801 and earth and connect the multimeter, adjusted to measure a.c. voltages, across the resistor. In either case, verify that the a.c. level indicated by the multimeter is not less than 1·75V r.m.s. Note the reading obtained.

Output frequency response

20. Using the reading obtained in para. 19 (4) as a reference level, verify that the a.c. level indicated by the multimeter is within the limits shown at each of the modulating frequencies listed in Table 2.

TABLE 2

Demodulator, radio frequency-output frequency response

Modulating frequency (Hz)	Limits of deviation from reference level (dB)
80	±1·0
300	±0·5
1000	±0·5
2500	reference level
5000	±1·0
7500	±1·0

21. On satisfactory completion of the performance tests, set the test set HT switch to the off position or turn the function switch on the radio control set to OFF and switch off the power supplies. Disconnect all test equipment and disconnect the demodulator under test from the interconnecting box or the transmitter-receiver. Lock the adjustable cores of the limiter anode coils L802 and L803 and of the discriminator transformer T801 and refit the demodulator side covers. Refit the demodulator removed from the transmitter-receiver and refit the transmitter receiver in its cover.

Modifications

22. At present there is only one modification applicable to the demodulator. This is modification No. 7874/1 which involves changing R832 from 47K to 56K in order to centralize the setting of the OUTPUT LEVEL D.C. control, RV801. For full details of this modification and the method to be used to incorporate it, reference should be made to the appropriate leaflet in A.P.116D–0133–2 (formerly AP2531J, Vol. 2).

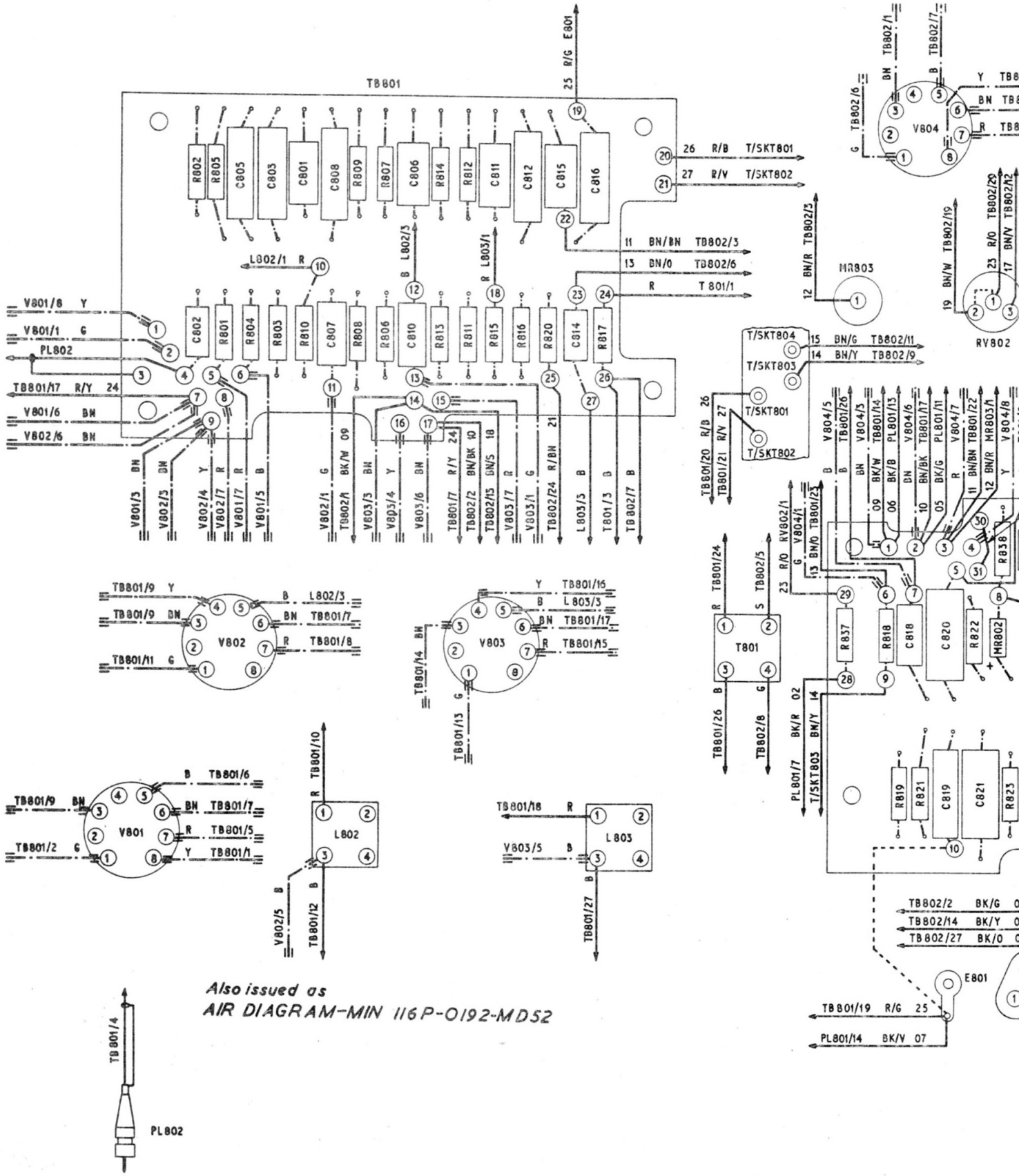
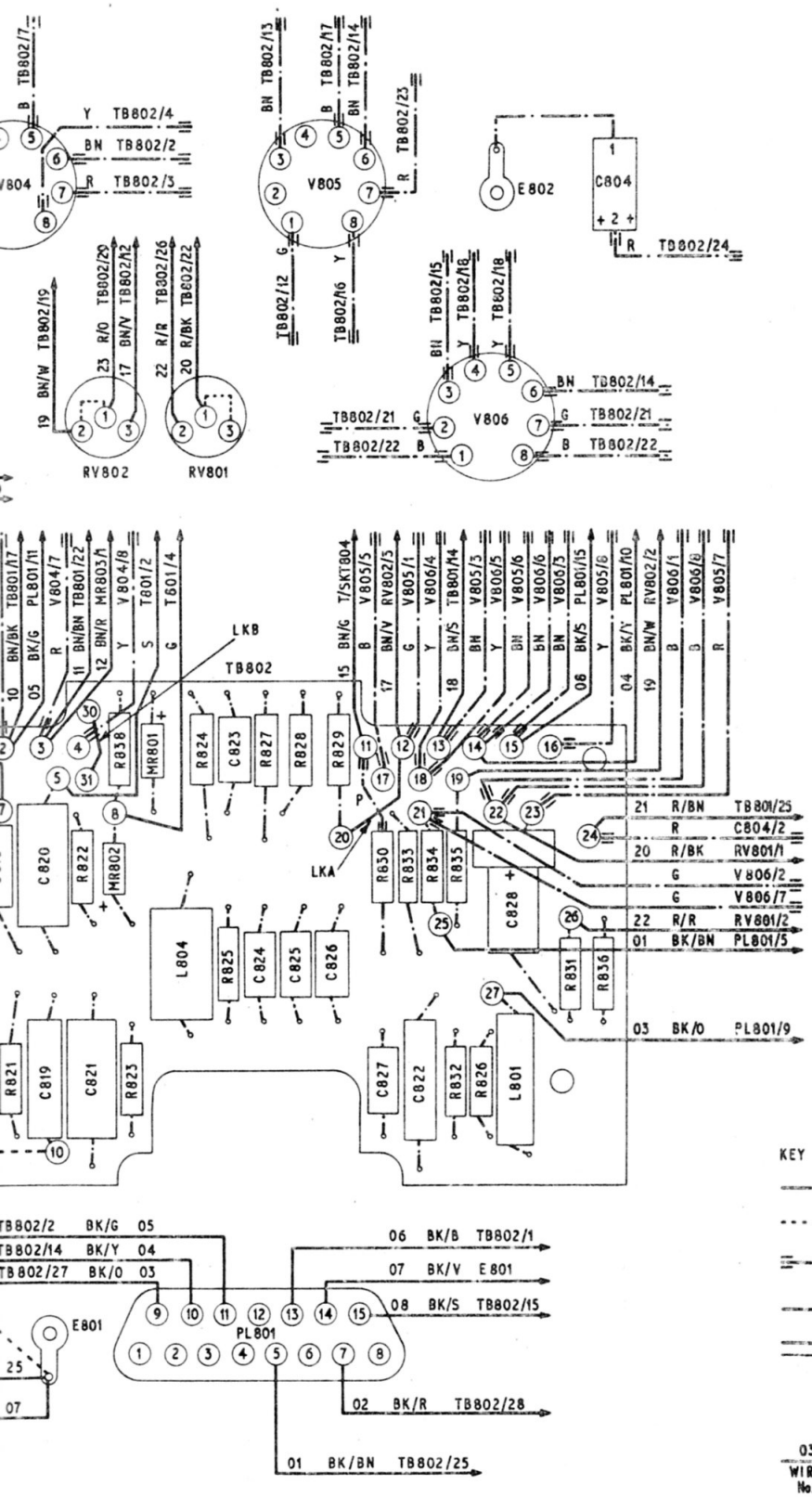


Fig. 3

Demodulator, radio frequency 5821-



KEY TO WIRING :-

- WIRE FORMING PART OF A COMPONENT.
- BARE TINNED COPPER WIRE 22 SWG.
- WIRE FORMING PART OF A COMPONENT & COVERED WITH SLEEVING, COLOUR AS SPECIFIED.
- WIRE ELECTRICAL EQUIPMENT TYPE 2, COLOUR PINK, OR AS SPECIFIED
- CABLE ASSEMBLY, RADIO FREQUENCY 5995-99-914-5561

03	BK/O	PL801/9
WIRE No.	COLOURS OF MARKER	DESTINATION

5821-99-913-4674 : wiring diagram

Fig. 3