# 1 INTRODUCTION

The 10 watt VHF Transmitter/Receiver Type HP.85A is designed for mobile duty such as vehicular and marine work. It provides frequency modulated telephony at any assigned frequency within the 70-100 Mc/s band, simplex or duplex operation. The transmitter, the receiver and a common power unit are carried on separate chassis in a metal case. Separate control facilities and Loudspeaker are provided, and a Loudhailer may be operated. Power supply is from 6V or 12V batteries. Communication may be on either of two channels provided in the equipment and crystal ovens can be incorporated if required.

The HP.85B is a similar equipment but allowing choice of up to seven channels. Crystal ovens cannot be incorporated in this model.

# 2 TECHNICAL SUMMARY

## 2.1 General

| | |
|---|---|
| Service | FM telephony |
| Frequency Range | 70-100 Mc/s |
| Frequency Stability | Better than ± .003% without crystal oven (within an ambient temperature range of 0-60°C).<br>Better than ± .001% with crystal oven (Within an ambient temperature range of 0-60°C). |

## 2.2 Transmitter

| | |
|---|---|
| RF Power Output | 10W minimum |
| Modulation | FM (corrected PM) |
| Frequency Multiplication | X36 |
| Spurious Radiation | Lower than -60dB relative to carrier level. |
| Maximum Deviation | ± 15 kc/s, adjustable by preset control. |
| Frequency Response (Pre-emphasis characteristic) | Within + 1 or -3 dB for a true 6 dB per octave pre-emphasis, between 300-3000 c/s. |
| Frequency Response: (Flat characteristic) | Between ±3dB, referred to 1000 c/s, from 600 to 3500 c/s falling to between -3 and -6dB at 300 c/s and steeper than 12dB per octave at about 3500 c/s. |

| | |
|---|---|
| Modulation Limiter: | Deviation limited to a maximum value, regardless of speech input level. |

## 2.3 Receiver

| | |
|---|---|
| Audio Output: | 1 watt (max.) to Loudspeaker. |
| Audio Response: | (a) ± 6 dB over the range 300-3000 c/s with respect to a true 6 dB per octave curve centred at 1000 c/s (or straight line response, if required). |
| Spurious Response: | Not less than -80 dB. |
| RF Sensitivity: | 1.25μV (with ± 5 kc/s deviation) at 1000 c/s for 100mW output as in a) above. |
| | 20 dB straight line response } as in (a) above<br>25 dB de-emphasis response } as in (a) above |
| Selectivity: | To meet customer's channelling requirements. |
| Oscillator Radiation: | Less than 0.02 μW. |
| Muting sensitivity: | 0.3 - 1μV. |

## 2.4 Power Supplies

| | |
|---|---|
| Normal Input Voltage: | 6V or 12V (nominal) |
| Current Consumption: | (for terminal voltage of 13.2V) |
| Receiver only: | 2.8A |
| Standby: | 4.5A |
| Transmit Simplex | 11A |
| Transmit Duplex | 12.5A |

These figures are for 12V supplies and should be doubled for 6V working.

## 2.5 Dimensions

| | Height | Width | Depth | Weight |
|---|---|---|---|---|
| Trans/Rec. Unit | 6¼ins. (16cm) | 14¾ins. (38cm) | 18¼ins. (46cm) | 30 lb. (13.6 kg). |
| Control Unit | 5ins. (127 cm) | 8⅝ins. (22 cm) | 3¼ins. (8.3 cm) | 2¾ lb. (1.25 kg) |

## 3.3 Valve List

The valves used in all units are shown in Tables 1 and 2. There are no valves in the Power Unit.

TABLE 1

(TRANSMITTER)

| Valve Ref.No. | Type | Services Spec.No. | Function |
|---|---|---|---|
| V1 | 6BH6 | CV3908 | Crystal Oscillator |
| V2 | B309 | CV455 | Phase Modulator |
| V3 | 6BH6 | CV3908 | 1st Tripler |
| V4 | 6BH6 | CV3908 | 2nd Tripler |
| V5A | B329 | CV491 | 1st Doubler |
| V5B | B329 | CV491 | 2nd Doubler |
| V6 | 6F17 | CV416 | RF Penultimate Amplifier |
| V7 | QQV03-10 | | Final Amplifier and Loud-Hailer output stage. |
| V8A | B309 | CV455 | 1st Audio Amplifier |
| V8B | B309 | CV455 | 2nd Audio Amplifier/Filter |
| V9 | D77 | CV140 | Peak Deviation Limiter |
| V10 | B309 | CV455 | Phase Splitter |

TABLE 2

(RECEIVER)

| Valve Ref.No. | Type | Services Spec.No. | Function |
|---|---|---|---|
| V1 | EC91 | CV417 | RF Amplifier |
| V2A ) | 6J8 | | 1st Mixer |
| V2B ) | | | Oscillator Amplifier |
| V3 | 6BH6 | | 1st Oscillator |
| V4 ) | B309 | CV455 | 2nd Mixer |
| V4B ) | - | | 2nd Oscillator |
| V5 | 6BH6 | | IF Amplifier |
| V6 | 6BH6 | | IF Amplifier |
| V7 | 6BH6 | | IF Amplifier |
| V8 | 6BH6 | | 1st Limiter |
| V9 | 6BH6 | | 2nd Limiter |
| V10 | EABC80 | - | Discriminator |
| V11 | B319 | CV492 | Noise Rectifier |
| V12 | B319 | CV492 | 1st AF Amplifier and Muting |
| V13 | QS75/20 | CV284 | Voltage Stabiliser |
| V14 | EL85 | - | AF Output |

# 4 DESCRIPTION

The Transmitter, Receiver and Power Supply Unit of the HP.85A and HP.85B (see Drgs.WZ.16846/D Sh.1 - 4 WZ.16845/D Sh.1-2are assembled on three separate chassis fastened to a common front panel and secured at the rear by a metal strip. The power supply chassis is fitted with socket terminated cables which mate with plugs on the receiver and transmitter.(See Drg.WZ.16851/D Sh.1.)

The whole assembly slides into a dustproof case where it is held by two fasteners, from which it can readily be removed.

In a passenger car installation, this case is usually fixed in the boot of the car.

Control is carried out from a separate control unit consisting of a diecast box which may be fitted in any convenient position. In a vehicle this is usually under the dashboard.

A separate loudspeaker unit is supplied and a loudhailer may be operated from the equipment if required.

The aerial consists of a quarter-wave omni-directional rod.

# 5 CIRCUIT DESCRIPTION

## 5.1 General

The Transmitter consists of crystal oscillator, phase modulator, multiplier stages and power amplifier.

Speech input to the phase modulator is applied via AF amplifier and limiter stages.

The receiver is a crystal-controlled double superheterodyne with highly slective IF circuits which guard against adjacent channel interference and allow close channel operation.

## 5.2 Transmitter

Reference should be made to Circuit Diagram WZ.16324/D Sh.1, 2 and 3.

In the HP.85A intended for two channel working, two crystals may be fitted either of which may be switched in by RLC. Up to seven crystals may be fitted in the HP.85B any one being selected by a Ledex-driven switch. In either equipment each crystal has a tuning capacitor which is used for fine adjustment.

The electron-coupled oscillator V1 operates at 1/36th of the desired carrier frequency, and feeds into the phase modulator V2. The RF potential at V2 anode is the vector resultant of two component signals, one of which depends upon the action of V2.

Voltages transferred from the audio section of the transmitter via R3 to the grid of V2 cause the operating point of the valve to vary at an audio rate, and phase modulation results.

The microphone input level to V8A is adjusted to be suitable for average speech, but provision is made for this level to be adjusted by 4dB above or below this level in order to take account of language or local noise difference.

The amplified output from V8A is fed to the double limiter valve V9 which limits the response level to a fixed maximum which is fed to V8B.

A selective negative feedback network is connected between the anode and grid of V8B; in conjunction with the further network interposed between the anode of V8B and the phase modulator and the 6dB/octave high frequency emphasis characteristic of the latter, a substantially flat deviation versus frequency response is produced, with a very pronounced cut-off at its upper limit of 3500 c/s.

Pre-emphasis can be applied by varying the connections to the components associated with the cathode input to the limiter valve V9 as detailed in NOTE 3 on the circuit diagram.

The Van Roberts phase modulator valve is followed by two tripler stages V3 and V4 and by two doubler stages, the two halves of V5; thus the total multiplication is 36 times the crystal frequency. The RF amplifier V6 feeds the push-pull power amplifier V7.

The power amplifier valve V7 is also used as amplifier for the loud-hailer. This is done by operating the loudhailer switch on the Control Unit (see Section 5.5) which completes the earth return of RLA via pin 8 of PLB. Contact RLA2 thereupon switches HT voltage to V10, and contact RLA1 removes HT from the oscillator and frequency multiplying stages.

Audio output derived from the anode of the microphone amplifier V8A at the junction of R38 and R39 is applied to the grid of the phase splitter V10. This produces two opposed phases which are fed across R29, R30 to the grid of V7.

The RF chokes L10 and L11 maintain a high grid impedance to RF current to prevent the Radio condition being effected by hailer requirements. C43 completes the anode tuned circuit of RF, but allows TR2 to act as anode load when operating on loud-hailer.

5.3 Receiver

Reference should be made to Drg.No.WZ.16328/D Sh.1, 2 and 3.

The RF signal from the aerial is fed via a tuned circuit L2, C1 to a grounded grid triode V1. Band-pass coupling is provided between this and the following stage, the first mixer one section of V2.

A local oscillator, V3 controlled by either crystal XL1 or XL2 generates a frequency the second harmonic of which is passed via L9, C20 to V2B a pentode amplifier. The anode circuit of this valve, L8, C82 is tuned to the fourth harmonic of the crystal frequency, and capacitor C84 passes this frequency to the triode grid of V2. Thereit beats with the signal frequency from V1 to produce the first IF of 8.15 kc/s.

NOTE: On the HP.85B any one of up to seven channels may be chosen by changing over to the required crystal. The change is effected by a Ledex motor.

9.2.2 Transmitter Alignment

Place in socket the correct crystal for the desired oscillator frequency which is 1/36th of the carrier frequency.

Set C1 to a position 4 turns from maximum capacity.

Rotate C45 fully anti-clockwise and then slightly clockwise to clear the stop.

Plug Test Meter into socket SKA.

Put SWA on the control unit to ON, SWB to STANDBY and SWD to RADIO. After not less than one minute interval, apply HT to the Transmitter by pressing the pressel switch, but do not leave HT applied longer than necessary for tuning.

Set Test Meter to position 2, adjust L3 (above chassis) and L4 below chassis for maximum meter reading. Check stud lengths against the approximate lengths given in Table 7 to ensure selection of the correct harmonic.

TABLE 7

| INDUCTOR | Frequency 70 Mc/s | 83 Mc/s | 100 Mc/s |
|---|---|---|---|
| L3 | 5/16" | 7/16" | ½" |
| L4 | ½" | 3/8" | 7/16" |
| L5 | 5/16" | ½" | 7/16" |
| L6 LINK 4.5 | 3/8" | ½" | - |
| LINK 4.1 | - | 7/16" | 9/16" |
| L7 LINK 4.5 | 3/8" | ½" | - |
| LINK 4.1 | - | ⅝" | ⅝" |

Set Test Meter to position 3, adjust L5 for maximum meter reading.

Set Test Meter to position 6, adjust L6 for maximum meter reading.

Set Test Meter to position 7, adjust L7 for maximum meter reading, then adjust C34 for small deflection of meter needle.

Set Test Meter to position 9, adjust C36, then C34 for maximum meter reading.

Set Test Meter to position 5, adjust C42 for minimum meter reading.

Connect RF power output meter to aerial socket SKC. Apply RF and adjust C46 for maximum meter reading.

Increase C45 slightly and readjust C46 for higher maximum meter reading.

Repeat the last operation until after finally adjusting C46 the maximum meter reading obtained in 34μA.

This completes the RF tuning.

Disconnect RF Power Meter and connect in place of it the Frequency Deviation Meter via the length of the attenuator cable.

Re-check aerial tuning and coupling by readjusting C45 and C46 as described above.

TABLE 11 VALVE DATA

| Type | Services Spec'n No. | Description | Valve Base | Filament Volts | Filament Amps | Max. Op'g Anode V | Max. Op'g Screen Grid V | Max. Anode Diss W | Imped Ω | Ampl'n Factor | Mutual Cond. ma/V | Max. DC mA | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D77 | CV140 | Double Diode | B7G | 6.3 | 0.3 | 0.3 | 120 | - | - | - | - | 9 | (EB91) |
| 6F17 | CV416 | HF Beam Tetrode | B7G | 6.3 | 0.3 | 300 | 300 | 3.5 | | | 3.6 | - | |
| B309 | CV455 | Twin Triode | B9A | 12.6<br>6.3 | 0.15<br>0.3 | 300 | - | 2.5+2.5 | 10k | 55. | 5.3 | 15+15 | (ECC81,12AT7) |
| B329 | CV491 | Twin Triode | B9A | 12.6<br>6.3 | 0.15<br>0.3 | 300 | - | 1+1 | 62.5K | 100 | 1.6 | 8+8 | (ECC83,12AX7) |
| 6BH6 | CV3908 | RF PENTODE | B7G | 6.3 | 0.15 | 300 | 150 | 3 | 1.4M | - | 4.6 | - | |
| QQV03-10 | | RF Power Double Tetrode | B9A | 12.6<br>6.3 | 0.42<br>0.83 | 300 | 200 | 5+5 | - | 7.5 | 3.3 | - | |
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