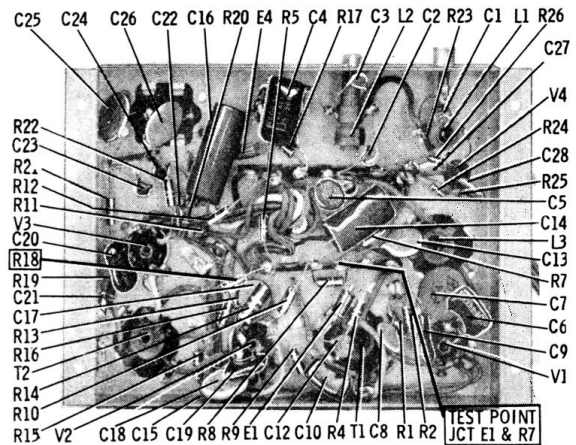
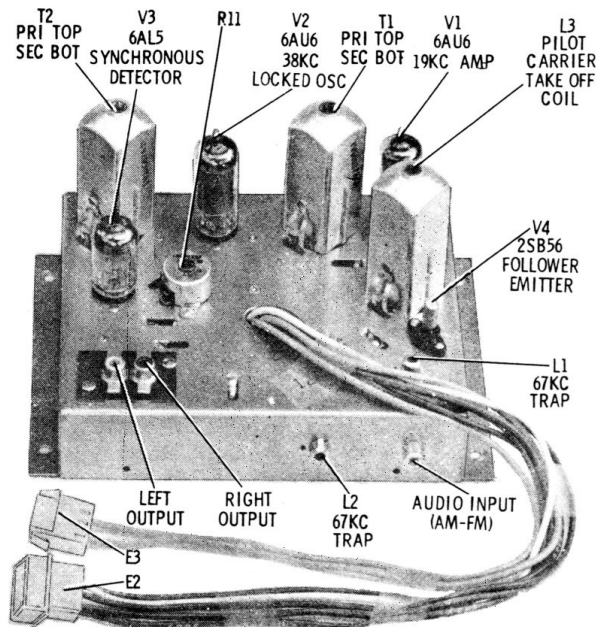


Motorola HS-996 (HK54)



HS-996 (HK54) PARTS AND ALIGNMENT POINTS LOCATION

CIRCUIT DESCRIPTION

FM-STEREO MULTIPLEX UNIT HK54

This unit is designed to convert a standard AM-FM tuner for FM-STEREO reception. The multiplex unit receives a FM-STEREO signal from a standard FM tuner, demodulates and separates the stereo information (left and right channels) and feeds the information into existing stereo audio amplifiers.

See the "STEREO MODEL INFORMATION" chart for adaptors required (if any) and their function.

CIRCUIT ANALYSIS

See page 17 for the complete circuit diagram of the Motorola FM-STEREO MULTIPLEX UNIT. The following text makes reference to the circuit diagram.

The emitter follower V4 (2SB56) matches the FM detector output impedance to the input impedance of the multiplex unit. The inductances and capacitors L-1, L-2, C-1 and C-3 are tuned to the 67Kc storecast sub-carrier frequency and offer more than 40 db attenuation to prevent interference from storecast transmission.

The plates of the synchronous detector are biased to plus 2 volts by the voltage divider R18 and R17. This provides automatic switching between monaural and stereo depending on the type of transmission received.

As we shall see later, the 38Kc oscillator is automatically turned off on monaural FM signals. Therefore, no 38Kc output is present at the secondary of T-2. The secondary of T-2 offers low impedance to audio frequencies, therefore the signal is fed parallel to the diodes. The peak value of detector output is maintained below 2 volts, therefore the diodes are always conducting.

This circuit fulfills the requirements for feeding a monaural signal into a stereo system.

When a stereo signal is received, the pilot carrier is taken off by the 19Kc tuned circuit L-3 and C-6. The trap action of this circuit also removes the pilot carrier from the signal as it is passed to the synchronous detector. The tuned circuit L-3 - C-6 is a high Q circuit and is also used to make minor phase adjustments for proper combining of signals at the synchronous detector for optimum separation.

The pilot carrier is amplified by V-1 and coupled to the grid of V-2 through the double tuned transformer T-1. This contributes additional selectivity to provide the narrow bandwidth desirable for optimum oscillator control and maximum noise immunity. The pilot carrier reaches a peak to peak value of 200 volts across the full secondary of T-1.

The pilot carrier causes neon bulb E-13 to light indicating that the set is tuned to a stereo broadcast. A forward bias of 60 volts is applied to the stereo indicator E-13 in order to lower the peak value of pilot carrier required to light the indicator. The bias is supplied through R-5 and voltage is regulated by neon bulb E-4.

The pilot carrier must also perform the two important functions of turning on the oscillator and controlling its phase and frequency. When no pilot carrier is present, the 20 volt source places a high value of positive bias on the oscillator cathode holding it in cut-off. When the pilot carrier appears, the signal current is rectified through E-1 causing the voltage at the junction of R-7 and R-8 to go positive and turn on the oscillator. Resistor R-8 and capacitor C-14 provide time delay to prevent noise bursts on monaural broadcasts from activating the oscillator, which would cause annoying pops in the output of the receiver.

The pilot carrier is coupled to the grid of the oscillator through C-12 and R-9 to lock it in phase with the pilot carrier. Potentiometer R-11 adjusts the threshold sensitivity of the oscillator. As the resistance of R-11 is increased, the voltage on the cathode of V-2 increases, requiring a higher level of pilot carrier to turn the oscillator on. Normally this control is set in its maximum resistance position. The oscillator is of the Colpitts type; the primary of T-2 and capacitors C-18 and C-19 forming the tank circuit.

The secondary of T-2 provides 38Kc voltage to combine with the 38Kc sub-carrier. The peak to peak value of the 38Kc signal at the synchronous detector diodes is approximately 9 volts, which more than overcomes the 2 volt DC bias and allows the diodes to operate as peak detectors. The oscillator, as it is turned on by the pilot carrier, also automatically performs the function of switching from monaural to stereo.

For detailed explanation of FM-STEREO transmission and reception, see "A Discussion of Stereo-FM Broadcasting" Booklet, Part No. 68P60011A52 and any succeeding supplements.

ALIGNMENT

HK-54 FM-STEREO MULTIPLEX UNIT ALIGNMENT PROCEDURE

Alignment of the HK-54 multiplex unit consists of four operations:

1. Adjustment of the 67Kc storecast traps.
2. Alignment of the 19Kc pilot carrier channel.
3. 38Kc oscillator adjustment.
4. Adjustment for channel separation.

Note: Motorola multiplex units are

factory aligned and have been found to be extremely stable under shipping and handling conditions. Alignment is not required as a part of the normal installation procedure.

Storecast Trap Alignment

The storecast traps provide attenuation in excess of 40 db at the 67Kc storecast sub-carrier frequency. Under normal conditions, they should require no service. They are carefully set at the factory and unless there is a specific complaint of storecast interference, it is best not to include these traps in a routine alignment procedure.

To align the storecast traps, proceed as follows:

1. Disconnect the 3.9M resistor, R-18, from the B+ buss to remove the 2 volt bias from the synchronous detector.
2. Connect positive lead of DC VTVM to pin 5 of the diodes, negative to ground.
3. Apply a 67Kc signal to the input of the traps at the emitter of the emitter follower transistor.
4. Set the traps, L-1 and L-2 for minimum response at the VTVM.
5. Re-connect R-18 to B+.

19Kc Pilot Carrier Channel Alignment

The pilot carrier channel may be aligned from a station broadcasting stereo or from a 19Kc crystal controlled generator.

To align the pilot channel, proceed as follows:

1. Apply a 19Kc crystal controlled signal to the input of the multiplex

unit (station or generator). Set the threshold control R-11 to maximum resistance position (fully counter-clockwise).

2. Place a DC VTVM at the junction of E-1 and R-7.

3. Peak L-3 and the primary and secondary of T-1 for maximum response at the meter. If a 19Kc generator is used, adjust the output to produce approximately +17 V for final adjustment.

38Kc Locked Oscillator Adjustment

The locked oscillator must be adjusted with a FM-Stereo signal or a generator capable of producing an FM-Stereo signal. To adjust the oscillator, proceed as follows:

1. Use a DC VTVM to measure the amplitude of the pilot carrier at the junction of E-1 and R-7.

2. Detune L-3 until the voltage at junction E-1 and R-7 is 5 volts.

3. Remove the bias from the 38Kc oscillator by placing a jumper between its cathode and the junction of R-8 and R-10.

4. Carefully tune the primary of T-2 (top core - oscillator tank) for a zero beat between the oscillator and the 38Kc sub-carrier. If this is done on a station signal, the beat may be heard in the background of the station programming.

5. Move the voltmeter to pin 5 of the diode (V3) and peak the secondary of T-2 for maximum response. Repeat step 4 to eliminate detuning due to interaction between primary and secondary. Note the secondary is at the bottom of T-2.

6. Remove the jumper from the bias circuit of the 38Kc oscillator, reconnect the voltmeter to the junction of E-1 and R-7, and carefully bring L-3 back to peak reading of the voltmeter.

Adjustment for Maximum Channel Separation

If all of the above adjustments have been made very carefully, the multiplex unit will now be very close to the proper setting for maximum channel separation. All adjustments are peaked and the locked oscillator is adjusted so that it remains on frequency and in phase with a minimum of pull-in from the pilot carrier.

All that remains to be done is to make a final phase adjustment of the 38Kc oscillator to bring it exactly in phase with the 38Kc sub-carrier for maximum separation. The preferred method of accomplishing this adjustment is with a signal generator capable of producing a stereo signal. The generator is modulated on the left or right channel only, and L-3 is adjusted for minimum signal at the output of the unmodulated channel. In sets equipped with balance verifiers, a simple method is to turn off the center channel and the modulated channel, and set L-3 for minimum response at the speaker of the unmodulated channel. Some stations broadcast announcements by modulating only one channel which provides a good opportunity to adjust separation. If all the previous adjustments have been made carefully, only a momentary transmission of this type will provide ample time to set separation.

Note: As L-3 is tuned off resonance several points of maximum separation may be encountered. It is possible to reverse channels when L-3 is tuned to produce 180 degree phase shift. These settings, however, are considerably off resonance and will cause attenuation of the pilot carrier resulting in unstable operation of the multiplex unit. Therefore, the pilot carrier must be monitored while L-3 is adjusted for channel separation. Best channel separation should correspond closely to maximum pilot carrier setting.

