

it to function. The 38 Kc oscillator is synchronized by the 19 Kc pilot signal from the FM station. In order to switch the multiplex circuit to mono, the switch is connected to a positive voltage of approximately 12 volts. The voltage first biases the 38 Kc oscillator in reverse, and thereby prevents a 38 Kc output. Secondly, this positive voltage applied to the 33 K resistor, will also apply a positive voltage to the center tap of the secondary of the oscillator transformer and allows both direct and signal current to flow through diodes D501 and D504 and resistors R504 and R509. The DC control current flows to ground partly through the separation controls and partly through 10,000 ohm resistors, R506 and R507. Diodes D502 and D503 will be reversed biased.

Since in stereophonic operation the diodes conduct at only alternate half cycles, signal current from the FM detector will appear at the left and right outputs only half the time, but flowing through two 10,000 ohm resistors in parallel. In mono operation, it will flow at all times through only one 10,000 ohm resistor. Audio output level remains constant in mono and stereo.

In order to have automatic switching from mono to stereo, a control circuit is required, a schematic of which is shown in Figure 20, page 48, which is also a portion of the LT-112 multiplex section. Here, two transistors Q504 and Q505 are arranged in a switching circuit. In normal monophonic operation, the first switching transistor conducts to some degree, and the second transistor is fully turned on with a voltage drop from collector to emitter of almost zero.

When a multiplex signal is received, the 19 Kc pilot signal from the FM detector is amplified in a separate two-stage amplifier (not shown in Figure 20) and the output of this 19 Kc amplifier is rectified partly to obtain a negative control voltage with respect to the 25 volt supply. This relatively negative voltage is then fed through the two 10,000 ohm resistors, R519 and R518, to the base of the first switching transistor, causing it to conduct more current. The voltage drop across its 10,000 ohm collector resistor R509 increases and reduces the base current of the second transistor, thereby reducing its collector current. In order to have this second transistor switch off, positive DC feedback is applied from its emitter through the 2,200 ohm resistor R516 to the emitter of the first transistor, thereby causing the first transistor to conduct more, and turning the second transistor off. Therefore, the voltage drop on the collector of the second transistor has now decreased from 12 volts to almost zero volts.

The decrease in collector current of the second transistor Q505 changes the voltage drop across the 1,000 ohm series collector resistor R525 which is used to turn on further transistors (Q506 and Q507 not shown in this diagram), causing a stereo indicator light to operate.

This group of circuits could be used, without any further modification, to switch automatically from monophonic to stereophonic operation according to whether stations are being received with mono or stereo modulation. Off station there is enough noise output from the FM detector to give the 19 Kc pilot circuit the same amount of signal as the pilot signal normally broadcast from the FM station. However, under these conditions, the stereo indicator would light off station and the multiplex circuit would be switched to stereo. This is a common failing of most automatic multiplex circuits.

Further refinements were made to prevent the circuit from switching to stereo unless the minimum signal-to-noise ratio exists.

For this fully automatic switching, the detector output is connected to a high-pass filter which passes noise above 75 Kc since an FM detector can produce signals of 150 Kc and higher when the tuner is tuned off station. The amount of high frequency noise reaching the noise amplifier can be adjusted by shunting the output of this filter with the 50,000 ohm threshold control. The output of the noise amplifier is rectified in a peak-to-peak detector D502 and D503, which produces a reverse bias to the first 19 Kc amplifier. Thus, the 19 Kc amplifier cannot operate unless the noise at the output of the FM detector has decreased to such a value which will not cause further reverse bias of this 19 Kc amplifier.

The sensitivity of this switching circuit is adjusted so that it does not switch the multiplex demodulator circuit over to stereo unless the amount of the amplified pilot signal is well in excess of that required for good synchronization of the 38 Kc oscillator. This, in effect, removes noise modulation of this oscillator and will permit listening to stereo with an improved signal-to-noise ratio.

The switching circuit is also designed to require a higher signal-to-noise ratio for switching to stereo than for switching back to mono, preventing the multiplex section from continually switching as a marginal stereo signal fades in and out.

Figure 23 in Section 8.1, page 54, shows the complete automatic multiplex circuit. The circuits in Figures 19 and 20 are portions of this circuit. It may also be of interest that there is only a single-pole,