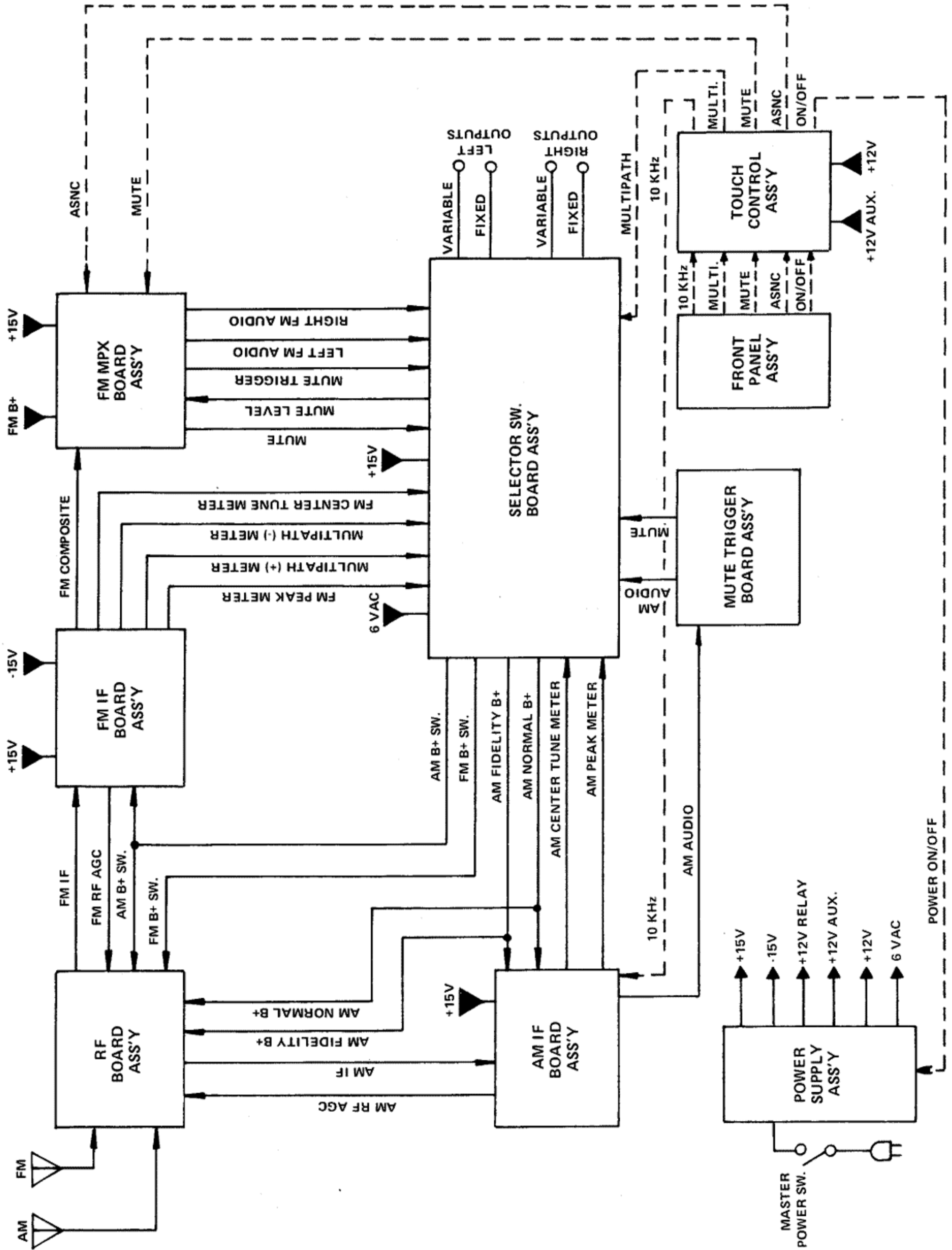


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AH673-44 TUNER BLOCK DIAGRAM



CIRCUIT DESCRIPTION

Power Supply Assembly

The Power Supply Assembly provides the various voltages for the operation of the receiver. There are six source voltages available from the board; +15V, -15V, +12V Aux, +12V Switched, +12V Relay and 6 VAC.

The +12V Aux source voltage is developed whenever the Master Power switch is On. All other sources are developed only when both the Master Power switch and the Power On-Off touch-control are ON. The +12V Aux source voltage supplies power for the On/Off relay, K501, and its associated switching circuitry. This source also supplies voltage to the flip-flops and the Darlington switches on the Touch Control assembly, thus maintaining the state of the touch-control circuits when the Power Touch-Control is turned off.

The +12V Relay source voltage supplies power for the relays located on the Selector Switch board assembly.

The 6 VAC source voltage supplies power for the Function lamps.

The +12V source voltage supplies power to IC1, a Quad 2-input Nand Schmitt Trigger, on the Touch Control Assembly, and through R504 to forward bias the Power Switch light emitting diode, D1, whenever the unit is switched ON.

The +15V and -15V source voltages apply power to the IF and selector switch circuits.

The following is a description of how these source voltages are obtained. When the unit is connected to an AC source and the Master Power switch is in the OFF position, 120 VAC is applied only to the unswitched AC receptacle. Once the Master Power switch, S501, is turned on, 120 VAC is applied to the primary of T502, where it is stepped down to a low AC voltage at the secondary. This low AC voltage is rectified by D506 and filtered by C510. The DC level at the positive side of C510 is regulated at +12V by zener diode Z501, forming the +12V Aux source. This +12V is applied to the emitter of Q502, through R503 to the base of Q502, and to the collector of Q501 through K501. Since the Power Touch Control is not activated, base current in Q502 will not flow, thus Q502 is cut-off. With Q502 cut-off, Q501 has no forward bias and is also cut-off. Since Q501 is cut-off it will not develop collector current, therefore, no current will flow through the coil of K501 and it will remain de-energized. The On/Off relay, K501, is a bistable relay employing a mechanical latch which opens or closes the contacts each time the relay is energized. Therefore, when the relay is energized (contacts initially open) the latch will close the contacts and keep closed even after the relay again becomes de-energized. To re-open the contacts the relay must be energized a second time.

When a finger is placed on the Power Touch Control, S1, on the Front Panel Assembly, Q502 is biased on through the network of R503, R515 and the resistance of the finger across the Touch Control. When Q502 conducts, its collector voltage becomes positive causing Q501 to conduct. Since the collector current of Q501 must flow through the coil of K501 to reach the +12V Aux source the relay becomes energized, reversing the state of the contacts.

With the contacts of K501 closed, 120 VAC is applied through F503 and F501 to the primary of the Power Transformer, T501. The main secondary winding of T501, with its center-tap grounded, is connected to a full-wave

bridge rectifier. The positive output voltage of the bridge rectifier is applied to the input of the Positive Regulator, IC1, with its output of a regulated +15V. The negative output voltage of the rectifier is dropped through R507, R508 and is held constant by zener, Z504 (15V), which develops the regulated -15V source.

The voltage developed by the other secondary winding of T501 is applied through R514 to D505 where it is half-wave rectified. The rectified voltage is then filtered by C507, R505 and C515 to form the +12V switched source.

Touch Control Assembly

The Touch Control Assembly functions as a switching network for all the Front Panel Assembly touch-controls except the Power On/Off touch-control. Since the switching circuits on this board assembly are nearly identical only the circuit which activates the Mute Switch, S4, will be explained.

In this circuit Q5 represents the switch used to activate the Mute Schmitt-Trigger circuitry. Q5 is either cut-off or saturated. The purpose of the Touch Control logic circuits is to make it possible to change the conduction of the switching transistor, Q5, by means of a touch-control. The main components used to perform this function are: Q4, which acts as a momentary switch, IC1, a quad 2-input Nand Schmitt Trigger, and IC2, a dual flip-flop. Separate voltage sources, +12V Aux source and the +12V Switched source, are used by the components in the circuit to maintain the state of the logic when the unit is switched off. The inputs to IC1 are connected together so that when they receive a low potential, the output will go high. The flip-flop, IC2, is connected so that the state of its output (high or low) is reversed each time it receives a high input.

When the Mute switch circuitry is not activated, Q4 is cut-off because of the open touch-control in its base circuit. The input to IC1, pins 5 and 6, is approximately +12V volts, through R22, R18, and R1 to the +12V Aux source. The output of IC1, pin 4, and the input of IC2, pin 11, are low. The output of IC2, pin 13 is low and keeps Q5 at cut-off. With Q5 not conducting there is no current path for the Mute switch LED, D4, to light, thus, indicating that the Mute switch is not activated. Also with no current flowing through Q5, its collector voltage remains +12V, keeping the Mute Schmitt-Trigger circuitry on the FM MPX board assembly in the "Mute Off" state.

When a finger is placed on the Mute touch-control the voltage drop across the divider R10, R6 and finger resistance is sufficient enough to bias Q4 into conduction. With Q4 conducting the emitter voltage will go towards ground. This low voltage is coupled through the de-bounce circuit, R22, D4 and C6, to the input of IC1, pins 5 and 6. The de-bounce circuit is designed to keep the switching circuit from being activated more than once when firm contact with the touch-control is not made. By brushing over the touch-control, Q4 may be rapidly turned On and Off several times. The de-bounce circuit changes the rapid changes in the Q4 emitter voltage caused by this condition to a more constant potential at the input of IC1, causing it to change states only once. When the inputs at pins 5 and 6 of IC1 go low, the output, pin 4, goes high. This high voltage is direct coupled to the input of IC2, pin 11, causing its output, pin 13, to change states.

Since the output at pin 13, was low, it now becomes high and remains high until IC2 receives another high input. This

high output at pin 13 of IC2, drives Q5 into saturation placing its collector voltage near ground and forming a current path for the Mute Switch LED (D4), on the Front Panel Assembly, through R31. The Mute switch LED lights, indicating that the Mute circuit is now operational. The Mute circuit is activated because the low voltage at the collector of Q5 is also applied to the Mute Schmitt-Trigger circuit on the FM Multiplex board assembly, switching it to the "Mute On" state. (For a more detailed description of the Mute circuit see "FM Multiplex Board Assembly").

When the finger is removed from the touch-control, Q4 returns to cut-off state, the input of IC1 returns to a high state and the output of IC1 returns to its low state. Since the output of the flip-flop, IC2, changes state only when its input goes high, the new conditions will have no effect on it. Therefore, pin 13, of IC2 will remain high keeping Q5 saturated and the Mute circuit, on the FM Multiplex board assembly, will remain activated.

By touching the Mute touch-control, S4, a second time, another high input is applied to IC2, reversing the state of its output to a low potential. Therefore, Q5 cuts-off and its collector voltage again rises to approximately +12V, turning off the Mute circuit on the FM Multiplex board assembly. Also with Q5 cut-off, the current path for the Mute switch LED (D4) no longer exists, therefore, it stops conducting, indicating that the Mute circuits are deactivated.

Selector Switch Board Assembly

The Selector Switch board assembly contains the customer operated controls and switches, including the AM Level control; Mute Level control; FM Level control and the Function Selector switch.

The controls will be discussed briefly along with the Function Selector switch. The Function Selector switch, S1, is a five position, six section wafer switch. The action of each section of the wafer switch, S1-1 thru S1-6 will be summarized.

Section 1 of S1 is used for switching B+ voltages in the AM, FM, AM NORMAL and AM FIDELITY modes to the receiver sections that are activated to perform the selected function.

Sections 2 and 3 are used for switching the AM and FM audio signals to the Left/Right Variable Output and Left/Right Fixed Output jacks. To simplify discussion, only the Left Audio signal and section 2 of S1 will be described.

When AM has been selected the audio signal is applied through pin 4 of J4, the wiper of the AM Level control, R7, the selector switch contacts of section 2 and coupled through C2, to the base of Q4. From the emitter of Q4, the signal is coupled through C4, R36 and pin 10 of J4 to the Left Variable Output jack. The audio signal from pin 4 of J4 is also applied through section 3 of S1 and C8 to the base of Q6. The signal at Q6 emitter is coupled through R38 and pin 9 of J4 to the Left Fixed Output jack.

When the Mute circuits are not activated and an FM function has been selected, Q2 has no forward bias, and so is cut-off. Switching transistor Q3, is forward biased through R33, and provides a path to ground for relay K3. Positive 15 volts is applied through R32 to switch Q8 On, and so (B+) is applied to the opposite end of K3 through Q8, D7 and Q3. Q3 and Q2 form a Darlington switch which is forward biased by R2. Therefore, relay K3 will be energized. With K3 energized, its normally

open contacts will be closed providing a path for the Left and Right channel audio signals.

When FM has been selected the Left audio signal is applied through pin 3 of J4, the contacts of relay K3 (which are closed when the signal is unmuted), the wiper of the FM Level control, R8, the selector switch contacts of section 2 and C2, to the base of Q4 (an impedance matching transistor). From the emitter of Q4 the signal is coupled through C4, R36 and pin 10 of J4 to the Left Variable Output jack. The audio from pin 4 of J4 is also applied through section 3 of S1 and C8 to the base of Q6. The signal at Q6 emitter is coupled through R38 and pin 9 of J4 to the Left Fixed Output jack.

The Mute Level control, R4, is used in conjunction with the Mute touch-control switch. With the Mute switch activated the Mute Level control, R4, can be adjusted to set the mute threshold. The mute threshold determines at what noise level the incoming signals are muted. As the Mute Level control is turned clockwise the sensitivity of the Mute circuit is increased. Therefore, when the control is set to the counterclockwise extreme a large amount of noise is needed to activate the mute circuits, whereas, with the control set to the clockwise extreme only a small amount of noise is necessary to activate the mute circuit. Due to this action when the control is set to the counterclockwise position only interstation noise will be muted. As the control is turned clockwise, weak noisy stations will also begin to activate the mute circuits. When the control is fully clockwise all but the strong stations will be muted.

When the mute circuits are activated, (see "FM Multiplex board assembly") a high voltage potential will be present at pin 5 of J4. This voltage is applied to the base of Q2, through D6 and the divider network of R34 and R35, driving the transistor into conduction. With Q2 now saturated, its collector voltage will go towards ground. This near ground potential is applied to the base of Q3, through R5, causing the transistor to cut-off. With Q3 in a cut-off condition, relay K3 will de-energize, causing its contacts to open, hence, no audio signal will be present at the output jacks.

When the mute circuits are not activated the potential at pin 5 of J4 will be near ground. This ground potential keeps Q2 cut-off, causing its collector voltage to rise towards B+. This positive voltage drives Q3 into saturation forming the current path needed to energize K3. With K3 energized the audio signal will be coupled through its contacts to the output jacks.

During AM operation it is desirable to open the mute relay contacts in order to keep noise generated in the FM circuits to a minimum. This is accomplished by applying the AM (B+) through D5, D4 and the divider network of R34 and R35, to the base of Q2. This action drives Q2 into saturation, which in turn cuts-off Q3 and de-energizes the mute relays.

Section 4 of S1, along with the associated switching circuitry of Q1 and relays K1 and K2, are used to supply the correct signals to the Multipath/Center tune meter. When switch S1-4 is in either AM position the meter operates as a center tune meter, with its negative terminal grounded through S1-4, and its positive terminal connected through S1-4 to the AM center tune signal developed on the AM IF board assembly.

When S1-4 is in any of the FM positions the meter function is determined by relays K1 and K2. The signals needed to use the meter as an FM center tune meter are controlled

by K1, while the signals needed to use the meter as a Multipath meter are controlled by K2. These relays are connected so that when the contacts of one relay are closed (relay energized), the contacts of the other are open (relay de-energized). The state of the relays is determined by the state of Q1, which in turn is determined by the Multipath Trigger voltage from the Touch Control board assembly. When the Multipath touch-control has not been activated (Multipath Indicator Off) the Multipath Trigger voltage applied to the base of Q1 from the Touch Control board assembly is high. This high voltage (about 12V) biases Q1 into saturation, forming a current path for K1, causing it to energize. Under these conditions the negative terminal of the tuning meter is grounded by the contacts of K1 and S1-4. The positive terminal of the meter receives the FM center tune signal through the other set of contacts on K1 and S1-4. Therefore, the meter acts as an FM center-tune meter.

When the Multipath touch-control has been activated (Multipath Indicator On) the Multipath trigger voltage applied to the base of Q1 from the Touch Control board assembly is low. This low potential (near ground) cuts-off Q1 and forms a current path for K2, causing it to energize. With Q1 cut-off, K1 no longer has a current path and becomes de-energized. The negative terminal of the meter now receives the negative multipath signal via K2 and S1-4, while the positive terminal of the meter receives the positive multipath signal through the other set of contacts on K2 and S1-4. The meter now acts as an FM Multipath meter.

Section 5 of S1 is used for switching the FM signal to a mono or a stereo mode of operation. When a monaural mode has been selected, a ground is applied to pin 8 of IC1 (Stereo Demodulator) on the FM Multiplex board assembly, through the contacts of the selector switch, pin 10 of J3, and pin 7 of J15. Due to the action of the IC, this applied ground will change the state of operation to a mono condition instead of a stereo operation.

When the STEREO ONLY mode has been selected, only those FM stations which are broadcasting in stereo are received. All interstation noise and monaural stations will automatically be muted. This is accomplished by triggering the Mute circuit with the stereo indicator voltage. This voltage is coupled through S1-5 to the mute circuit only when the Selector switch is in the STEREO ONLY position.

When there is no stereo signal the voltage at pin 6 of IC1, on the FM Multiplex board assembly, is approximately the same as the FM (B+). Therefore, the Stereo indicator, LED 1, will not turn on and the positive voltage will be coupled through R1, pin 6 of P/J4, Pin 8 of P/J3, S1-5, pin 9 of P/J3 and pin 6 of P/J15 to the anode of D3. This forward biases D3 and couples the voltage through pin 5 of P/J15 and pin 5 of P/J4 to the anode of D6, on the Selector switch board assembly. D6 also becomes forward biased and couples the voltage through R34 to the base of Q2. Q2 saturates, Q3 cuts-off, and the mute relays become de-energized, muting the audio signals.

When a stereo signal is being received the voltage at pin 6 of IC1, on the FM Multiplex board assembly, is near ground. Therefore, the Stereo indicator LED 1, will be biased on, and the near ground potential will be coupled through R1, pin 6 of P/J4, pin 8 of P/J3, S1-5, pin 9 of P/J3 and pin 6 of P/J15 to the anode of D3. With the anode of D3 at a near ground potential the diode will not conduct. With no positive potential coupled to the base of Q2 on the Selector switch board assembly, the transistor will be cut-

off. With Q2 cut-off, Q3 will saturate causing the mute relay to energize, closing its contacts.

The Mute control may be adjusted to receive only strong FM signals. For a more detailed description of the Mute circuits see the "FM Multiplex Board Assembly".

Half of section 6 on switch S1 provides switching to illuminate the correct function lamp when a mode of operation is selected. The other half of section 6 determines whether the AM or the FM peak meter signal is applied to the Peak Tuning Meter.

When AM has been selected, the peak meter output signal from the AM IF board assembly is connected to pin 2 of J2, coupled through the contacts of section 6, to the Peak Tuning Meter to indicate the signal strength being received.

If an FM mode of operation has been selected the FM peak meter output signal from the FM IF board assembly is connected to pin 3 of J2, coupled through the contacts of section 6, to the Peak Tuning Meter. Again this will give indication of the signal strength being received.

RF Board Assembly (FM Section)

The first and second FM RF Amplifiers, Q1 and Q3, as well as the FM Mixer, Q7, are N-channel, Dual Gate, MOS Field Effect transistors. MOSFET's combine a high input impedance and a very high signal-to-noise ratio with relatively high power gain.

When an FM station is selected, the input signal from the FM antenna is coupled to G1 of the 1st FM RF Amplifier, Q1. Bias is supplied to G1 from the FM B+ Switched source through a voltage divider formed by R1 and R2. The gain of Q1 is controlled by the RF AGC voltage applied to G2. Under a no signal condition, the AGC circuit supplies a positive voltage to G2, causing Q1 to operate at maximum amplification. When a strong signal is received, the AGC circuit supplies a less positive voltage to G2, reducing the gain of Q1. The amplified signal at the drain of Q1 is developed across a tuned circuit and coupled to G1 of Q3, the 2nd FM RF Amplifier, through C9 and C10. Q3 further amplifies the signal and is AGC controlled in the same manner as described for Q1. The signal present at the drain of Q3 is coupled through L6 and L7 to G1 of the FM Mixer, Q7. L6, L7 and associated tuned circuit components are designed to provide a narrow bandpass, which, allows greater selectivity. The output of Q5, the FM Oscillator, is coupled through a tuned circuit to G2 of the Mixer Q7. The Mixer circuit combines the oscillator signal with the selected RF signal to produce a 10.7 MHz IF signal. The IF signal present at the drain of Q7 is coupled through the FM IF/Mixer transformer, T3, to the IF output, pin 2 of J7.

(AM Section)

If an AM station is selected with the Function Selector in the Normal mode, B+ is applied through pin 2 of P/J6, R51 and R52 to the anode of D6. This forward biases D6 and provides a low impedance path to ground for the antenna through C52 and D6. The antenna will not operate normally. However, if the Fidelity mode is selected, B+ is applied through pin 4 of P/J6 and R53 to the anode of D2. Diodes D2, D1, D3 and D4 become forward biased and apply a ground to R54. The B+ that was applied to D6 is now removed and R75 is placed in series with the antenna to ground. By placing R75 in series and R54 in parallel with the antenna the "Q" of the antenna is lowered and the bandpass is widened.

The signal from the antenna is coupled to G1 of Q2, the 1st AM RF Amplifier. Bias is supplied to G1 from the AM (B+) Switched source through a voltage divider formed by R56 and R57. The gain of Q2 is controlled by the AM RF AGC voltage applied to G2. Under a no signal condition the AGC circuit supplies a positive voltage to G2, causing Q2 to operate at maximum amplification. When a strong signal is received, the AGC circuit supplies a less positive voltage to G2, reducing the gain of Q2. The amplified signal at the drain of Q2 is applied to the primary center-tap of T1, Mixer Transformer. The output signal of Q6, AM Oscillator, is coupled through C62 to the secondary of T1, Mixer Transformer. The combined signals from T1 are applied to the base of Mixer, Q4, to produce a 455 KHz IF signal. The IF signal from the secondary of the AM IF/Mixer Transformer, T2, is direct coupled to the base of RF Amp, Q8. Q8 amplifies the 455 KHz IF signal and couples it through C64 to the AM IF Output, pin 3 of P/J8.

FM IF Board Assembly

The FM IF Board Assembly performs the following functions: amplification of the FM IF signal, detection of the FM IF signal, development of the FM IF and RF AGC voltages, and development of the driving signals, used by the FM Center Tuning Meter, the FM Peak Tuning Meter, and the Multipath Meter.

The 10.7 MHz FM IF signal from the RF Board Assembly is coupled through pin 3 of P/J11 and C1 to the base of Q2, a common-emitter FM IF amplifier. The output of Q2 is coupled from its collector to T3, the first of three 8-pole FM IF filters. These 8-pole filters are replaceable as complete units since field alignment is extremely difficult, and not recommended. The two outputs from T3 are direct coupled to the inputs, pins 4 and 6, of IC1, an FM IF amplifier. The gain of IC1 is determined by the IF AGC voltage applied to pin 5. The two outputs of IC1, pins 8 and 1, are direct coupled to the second 8-pole filter T4. The operation of T4, IC2, and T5 is identical to that just described, with the amplifiers boosting the signal strength and the filters determining the bandpass. The output of T5 is coupled to the base of the next FM IF amplifier, Q13, through C33 and R55. The output of Q13 is coupled from its collector through C35, R80, and C47 to the input (pin 1) of IC3, the FM Limiter. The amplitude of the signal is limited to suppress noise spikes and AM interference. The output of IC3 is coupled from pin 5 through C55 to the input of common emitter amplifier Q17. The output of Q17 is coupled from its collector through C64 to the input of the FM ratio detector consisting of T1, T2, D8, D9, and their associated components. The audio output (detected FM IF) of the ratio detector is coupled from the junction of R111 and R124, through R128 and C62 to the base of Q16. Meanwhile the DC potential developed at the junction of R111 and R124 is coupled through R128 and R106 to the base of Q18. Due to the characteristics of a ratio detector, this DC potential becomes more positive as the receiver is tuned off-station in one direction, and more negative as the receiver is tuned off-station in the other direction. This DC potential is amplified by a differential amp (Q18 and Q19) and a common emitter amp (Q20), after which it is coupled off the board, through R125 and pin 1 of P/J13, to drive the FM Center Tuning Meter. The FM Center Tuning Meter Adjust control can be used to vary the operating point of Q20 which in turn, determines the location of the needle on the Center Tune Meter when either a properly tuned signal or no signal condition exists.

The output of the ratio detector which was coupled to the base of Q16 is amplified by Q16 and Q15, arranged in a cascade configuration. The output at the collector of Q15

(the composite signal) is coupled through L8 and C52, to pin 6 of P/J13. A portion of the Q15 collector signal is coupled through C53 and R92 to the emitter circuit of Q16 for negative feedback. The signal at the collector of Q15 is also coupled through C48 to the base of Q14, the Multipath FM Amplifier.

The Multipath circuits are designed to provide a visual indication of the amount of Multipath distortion present in the received FM signal. This indication may be seen on the multipath meter or displayed on an oscilloscope, by means of the jacks on the rear of the unit. When multipath occurs the FM signal exhibits amplitude variations highly correlated with the signal frequency variations. These amplitude variations may be viewed by either of two methods. These methods are AC, through an oscilloscope, or DC, through the multipath meter. In the AC method, the rectified FM IF (which includes any amplitude variations) present at the base of Q6 is amplified and coupled through C23 to the Vertical Out jack on the rear of the unit. The Horizontal Out jack receives a sample of the composite signal through C45, L3, and emitter follower Q14. When an oscilloscope is connected to the Multipath jacks the patterns produced on the screen are used to indicate multipath conditions. In the DC method, the signal at the collector of Q13 is coupled through C35 to D7, where it is halfwave rectified. The pulsating DC at the anode of D7 is coupled through R76, C17, and R34 to the base of Q6, the Multipath FM amplifier. The signals at the collector of Q6 and the emitter of Q14 are rectified and their absolute DC values are simultaneously applied to a correlation detector consisting of Q7 through Q12. The output of this circuit is a DC potential proportional to the amount of multipath distortion in the received signal. By using a correlation detector only those amplitude variations caused by multipath will affect the meter. Therefore, the circuit is not disturbed by noise or fading.

Since the DC output of the correlation detector is not referenced to ground it is coupled off the board using two lines, (multipath meter +, and multipath meter -), at pins 4 and 5 of P/J13. The Multipath Meter Adjust, R53, is used to place the needle of the meter at a reference mark by varying the potential on the Multipath Meter (-) line.

The signal at the anode of D7 is also coupled through R76 and R33 to the base of Q5 where it is filtered by C10 to form a DC potential proportional to the strength of the received signal. This potential is amplified by Q5, a DC amp, and applied to the base of Q4, an emitter follower. The divider network consisting of R18, R20, and R21 in the emitter circuit of Q4, develops two proportional voltages. The IF AGC voltage developed at the junction of R20 and R21 is applied to pin 5 of IC1 and IC2 through R23 and R40 to set the gain of IC1 and IC2 according to the strength of the received signal. The voltage developed at the arm of R18, the FM Peak Tuning Meter Adjust, is coupled through Z2, a 5.6 volt zener diode, to the base of Q3. The voltage developed at the emitter of Q3 is coupled through R8 to pin 4 of P/J12 to drive the FM Peak Tuning Meter. The voltage developed at the collector of Q3 is coupled through R9 to the base of Q1. The zener diode, Z1, in the base circuit limits the base voltage to 6.2v. Transistor, Q1, operating as an emitter follower, develops the RF AGC voltage which is coupled off the board at pin 5 of P/J12.

When the unit is operated in an AM mode a high positive potential is applied to the AGC inputs of IC1 and IC2 through R23, R40, D10, R127, and the AM Switched B+. This action prevents noise interference which may be generated by the FM IF amplifiers if they are allowed to operate at full gain.

FM Multiplex Board Assembly

The FM Multiplex board assembly performs the following functions; demodulating the composite signal to form the Left and Right audio signals, muting interstation noise and weak stations when the mute circuits are activated, and cancelling the noise in stereo signals when the ASNC circuit is activated.

The Stereo Demodulator, IC1, performs several functions. The output signals are determined by the presence or absence of voltages at various pins on the chip.

The following is a brief pin by pin summary of the Stereo Demodulator, IC1. Pin 1 is used for the connection of the B+ voltage. Pin 2 is the input terminal. The composite signal from the FM IF board assembly is coupled to Pin 2 through the high frequency boost network of L7, C79 and R7; and through the network comprised of L1, C18, C10 and C15 where a very sharp high frequency boost is obtained. Capacitor C16 on this line keeps any DC potential from affecting Pin 2, but has no effect on the input signal. Capacitor, C10, in the high frequency boost network is a trimmer capacitor which can be adjusted to control channel separation. Pins 3 and 11 are used for phase compensation. Capacitors C3 and C1, between pins 3 and 11 generate a phase shift in the regenerated 38 KHz sub-carrier so that it is reproduced in phase with the original. Pin 6 is connected to the Stereo indicator lamp, LED 1, through R2 and pin 5 of J4. The internal circuitry of the IC which connects to pin 6 functions as an electronic switch. During non-stereo operation this internal switch acts as an open circuit, therefore, the stereo lamp does not light. However, when stereo signals are present the internal circuitry connected to pin 6 acts as a closed switch, connecting pin 6 to ground and providing a path for current flow. In this condition the stereo indicator lamp will illuminate, indicating that the stereo signal is being received and processed. Also controlled by the switching action of pin 6 is the Stereo Only muting feature. For more information on this feature see the "Selector Switch Board Assembly".

Pin 7 is ground. Pins 8 and 9 are used for the external monaural/stereo switching with C8 as the switch filter capacitor. When a monaural mode has been selected, a ground is applied through pin 7 of P/J15, pin 10 of P/J13, and the contacts of S1-5, on the Selector Switch board assembly to pin 8 of IC1. With this ground potential on pin 8 all input signals will be reproduced monaurally. The same monaural operation can be accomplished by applying a positive potential to pin 9 of IC1. This is done through D5, R84, and the Mute circuits during interstation noise and exceptionally noisy signals, in order to keep the Stereo Indicator, LED 1, from false triggering (flickering).

At pin 10 of IC1 is the 19 KHz output signal. A frequency counter may be connected to this point to measure the oscillator free-running frequency for alignment. Pins 12 and 13 contain the Phase-lock loop filter components (R6, C5, C6, R8 and C7). At Pin 14 is the oscillator timing network which consists of C4, R4 and the 19 KHz oscillator adjust, R3.

Audio is available from the Stereo Demodulator, IC1, at pins 4 and 5. For monaural operation, identical information is present at both outputs. However, during stereo operation, Right channel information is at pin 5 and Left Channel information is at pin 4. From pins 4 and 5 of the Stereo Demodulator, IC1, the audio is processed and amplified through two separate identical audio channels.

Because the channels are identical, the circuits of only the Right channel will be discussed.

The Right channel output signal at pin 5 of IC1 is coupled through C20, to L2 and L4, which are the 38 KHz and 20 KHz filters, through the 19 KHz T-filter, T2, and through C34 to the base of Q2. Q2 and Q4 are arranged in cascade to amplify the signal. A sample of the signal at the collector of Q4 is coupled back through C40 and R46, the Right Audio Level adjust, to the emitter of Q2 for negative feedback. The setting of R46 determines the amount of feedback coupled to the Q2 emitter, which in turn, determines the gain of the Q2/Q4 stage. The signal at the collector of Q4 is coupled to the base of Q6 through R48. Q6 is an emitter-follower, lowering the impedance of the output signal.

The same composite signal that is applied to the Stereo Demodulator, IC1, is also coupled to the base of Q8, through the high pass filter, C56, L6 and C57. This high pass filter allows only the high frequency noise present in the signal to reach the base of Q8. Q8 is an emitter-follower and is used as a buffer. The noise signal is coupled to the base of the Mute/Noise Amp., Q15, where the noise is amplified. The signal at the collector of Q15 is coupled through C77 to D1 and D2 where it is rectified. Therefore, the DC potential at the base of the DC Amp, Q9, depends upon the level of the noise present in the composite signal. The DC potential is amplified by Q9 and coupled to Q10, which is an emitter-follower. The DC potential at the emitter of Q10 is coupled to the top of the Mute Level Control, R4, on the Selector Switch board assembly. This DC potential is also applied through R84 and D5, to pin 9 of IC1, and through R88 to AGC diodes D7, D8, D9, and D10. When the noise in the received signal reaches a level that would impair stereo reception, the DC potential at the emitter of Q10 becomes sufficient to forward bias D5 through R84, and switches IC1 to monaural operation. This action prevents false triggering of the Stereo Indicator, LED 1, while tuning through interstation noise. The AGC diodes, D7 through D10, are connected so that when the positive potential at the anode of D7 becomes sufficient to forward bias the diodes, a portion of the noise signal at the base of Q15 will be shunted to ground through D9 and D10. This AGC action prevents clipping at the Mute Noise Amp, Q15, and increases the range of the Mute Level Control, R4, on the Selector Switch Board Assembly. The wiper of R4 is adjusted to establish the level of noise which will turn on the Mute circuits, (see the "Selector Switch Board Assembly" for more information on the adjustment of the Mute Level Control).

When the Mute touch-control has not been activated a high positive potential (about +12V) will be coupled from pin 3 of P/J18 through pin 2 of P/J15 and R75 to the base of Q14. This positive potential saturates Q14, causing its collector voltage to go towards ground. When the Q14 collector voltage is near ground, D4 is reverse biased and no voltage is coupled to the base of Q2 on the Selector Switch Board Assembly. Therefore, due to the switching action of Q2 and Q3 (see "Selector Switch Board Assembly") the Mute relays are energized and the signal is not muted. Under these conditions Q14 will remain saturated regardless of the condition of Q13. Therefore, the Mute Level Control is inoperative and the signal will remain unmuted regardless of the noise level.

When the Mute touch-control has been activated, a low (near ground) potential will be coupled from pin 3 of P/J18 through pin 2 of P/J15 and R75 to the base of Q14. As long as Q13 remains cut-off the voltage divider made up

of R75, R81, and R76 will develop the bias needed to keep Q14 saturated, thus the signal will remain unmuted. When the noise present in the received signal reaches a level determined by the setting of the Mute Level Control, the DC potential at the arm of the control biases Q13 into conduction through pin 7 of P/J3, pin 4 of P/J15, and R99. With Q13 turned on, its collector voltage will drop towards ground. This action will ground R81, causing Q14 to turn off. With Q14 turned off, its collector voltage will rise towards B+. This positive voltage forward biases D4 and is applied through pin 5 of P/J15, pin 5 of P/J4, D6 and R34 to the base of Q2 on the Selector Switch Board Assembly. Q2 saturates which cuts-off Q3 and de-energizes the mute relays, thus causing the signal to be muted. Diode, D3, on the FM Multiplex Board Assembly, is reverse biased during the muting operation. This is necessary to keep the positive potential at the diode's cathode from interfering with the Stereo indicator circuit during Stereo Only operation (see "Selector Switch Board Assembly" for more information on Stereo Only operation).

The ASNC circuit is designed to cancel out-of-phase noise in the right and left channels during stereo reception of weak or noisy stations. The circuit operates only when the ASNC touch-control has been activated and a noisy stereo station is being received. When the ASNC touch-control has not been activated, a high potential (about +12V) will be coupled from pin 4 of P/J18 through pin 1 of P/J15 and R70 to the base of Q12. The positive potential at the base of Q12 drives it into saturation, causing its collector voltage to drop towards ground. The low voltage at the collector of Q12 is applied through R54 to the gate of Q7. This voltage makes Q7 act as an open switch (source to drain), and the audio in both channels is unaffected. Under these conditions Q12 will remain saturated, and the ASNC circuit will remain deactivated regardless of the state of Q11 or the level of noise present in the received stereo signal. Q7 is an N-channel FET that acts as a closed switch when its gate voltage is high (about +9V) or an open switch when its gate voltage is low (near ground). This FET in series with C46 and C47, is connected between the left and right channels. Therefore, when Q7 acts as an open switch, the left and right channels are unaffected; but, when Q7 acts as a closed switch the channels are connected, via C46, C47, and the FET, thereby, cancelling any out-of-phase noise.

When the ASNC touch-control has been activated a low (near ground) potential will be coupled from pin 4 of P/J18 through pin 1 of P/J15 and R70 to the base of Q12. As long as Q11 remains cut-off, the voltage divider made up of R70, R97, and R96 will develop the bias needed to keep Q12 saturated, and the ASNC circuit will remain de-activated. When the noise level of the stereo signal reaches the ASNC threshold, the DC potential applied to the base of Q11, via R69, R101 and R102 (in the emitter circuit of Q10) will drive the transistor into saturation. This action will effectively remove R70 and R97 from the bias network for Q12, causing the transistor to turn off. With Q12 turned off its collector voltage will rise towards B+. This high positive potential is applied to the gate of Q7 via R54, thereby, causing it to act as a closed switch and activating the ASNC network. With C46 and C47 switched into the circuit by Q7, out-of-phase noise is cancelled, reducing the noise content of the signal considerably. Separation is also reduced when the ASNC circuit is operating, but stereo is still present.

AM IF Board Assembly

The AM IF Board Assembly contains circuits to perform the following functions: Shape the AM IF bandpass to

either narrow or wide for Normal or Fidelity operation; AM IF amplification; develop AM RF & IF AGC voltages; AM Audio detection; 10 KHz Whistle Filter; AM Audio amplification; and develop voltages for operation of the AM Peak and Center Tune meters.

When the AM Fidelity mode is selected, B+ is applied to pin 3 of P/J9 and current flows from ground through R5, D1, R2 and R1. This B+ also causes current to flow from ground through R19, D3, R16 and R15. D1 and D3 are now very low impedances to the AM IF signal present at pin 5 of P/J9 and the signal passes through D1, C1, LC1 (an 8 pole filter), C14 and D3. LC1 and associated components are designed to provide a wide bandpass for Fidelity operation. The forward biased states of D1 and D3 present reverse bias to D2 and D4, respectively, preventing the AM Normal circuitry from turning-on at the same time.

When the AM Normal mode is selected, B+ is applied to pin 1 of P/J9 and current flows from ground through R5, D2, R4 and R3. This B+ also causes current to flow from ground through R19, D4, R18 and R17. The forward biased states of D2 and D4 present reverse bias to D1 and D3, respectively, preventing the AM Fidelity circuitry from turning-on at the same time. The AM IF signal present at pin 5 of P/J9 is applied through D2 and C2 to the input of LC2, a 4 pole filter. The output of LC2 is coupled through C12 to the base of Q1. Q1 amplifies the IF signal and couples it through C10, LC3 (a 4-pole filter), C11 and D4.

The AM IF signal from either D3 or D4 is applied to the input of the RF AGC circuit, and to the IF Amp circuit. C15 couples the signal to Q3 where it is amplified and coupled through C31 to the junction of D5 and D7. D7 rectifies the signal to develop a negative voltage which is proportional to signal strength. This negative voltage is applied through R52 to C38, where it is filtered and subtracts from the positive potential present at C38. This lower positive potential is applied through R20 to pin 2 of P/J9 for use as RF AGC. As the signal strength increases, the positive potential present at pin 2 will decrease, reducing the gain of the RF amplifiers. (See "RF Board Assembly"). The signal present at the collector of Q3 is also applied through C30 to D6. D6 rectifies the signal and applies a positive potential through R50 to C34. C34 filters the rectified signal and applies it through R51 to pin 1 of P/J10 to operate the AM Peak Meter.

The AM IF signal from either D3 or D4 is also coupled through C16 to G1 of Q2. The amplified signal at Q2 Drain is coupled through C23 to G1 of Q4 where it is further amplified and coupled through C39 to the base of Q5. The amplified IF signal at the collector of Q5 is then coupled to both the AM Detector and Q6, the IF/AGC Amp.

The amplified IF signal at the collector of Q6 is applied to the junction of D8 and D9 through C51. D8 rectifies the signal and the resultant negative voltage is applied through R65 to C45 where it is filtered and subtracts from the positive potential present at C45. This decreased positive potential is applied through R61 to R22 and R23 as AGC control for Q2, and through R38 and R39 as AGC control for Q4.

The Q6 collector signal is also coupled through C52, rectified by D10, filtered by C60 and applied through R85 to pin 1 of P/J10. At pin 1 it is added to the DC voltage from R51 and C34 in the RF AGC Circuit to operate the AM Peak Meter.

The collector signal of Q6 is also applied to the primary of T2. T2 and T4 perform as a center tuned ratio detector. The output of T4 is rectified by D14 and D15, filtered by C77 and C78, and provides a positive or negative voltage to pin 2 of P/J10 for control of the AM Center Tune Meter.

The IF signal applied from the collector of Q5 to the primary of T1, the AM Detector transformer, is coupled to the secondary where the audio is detected by D11 and D12. The audio is coupled through C65 and R93, AM Output Level Adjust, to T3, a 10 KHz notch filter. The notch filter is controlled by Q9. When the 10 KHz Filter Touch Switch is activated, a near ground potential is applied to the gate of Q9, which causes Q9 to act as an open switch, and the audio must pass through T3 before being coupled to Q8 by C70. However, if the 10 KHz Filter Touch Switch has not been activated, a high potential is applied to the gate of Q9. This high potential causes Q9 to act as a closed switch, and the audio bypasses T3 because of the lower impedance offered by C75, Q9, and C76. The 10 KHz notch filter is designed to eliminate adjacent station 10 KHz heterodyne whistle.

The audio is coupled through C70 to Q8 where it is amplified and coupled through C81 to Q10, an emitter follower. The audio present at the emitter of Q10 is coupled through C86 to pin 4 of P/J10.

Mute Trigger Board Assembly

The purpose of the Mute Trigger Board Assembly is to mute the AM and FM audio signals momentarily when the unit is switched on with the Power touch-control. This action keeps the output of the unit free from the noise spikes and transients present in the circuits during the turn-on period.

When switching the unit on while in an FM mode, the FM audio is temporarily muted by delaying the voltage necessary to energize the mute Relay, K3, on the Selector Switch Board Assembly. Q2 and Q3 are connected as a Darlington switch between the collector of the mute relay driver and the B+ supply. Therefore, the mute relay driver Q3, on the Selector Switch board assembly, cannot energize the mute relay in its collector circuit until Q2 and Q3 (on the Mute Trigger Board Assembly) turn on. The duration of the muting action, therefore, depends upon how long it

takes to develop the turn-on bias for Q2 and Q3. This bias is delayed due to the charging action of C17 and C18 on the Selector Switch Board Assembly, and C1 on the Mute Trigger Board Assembly. When power is applied to the unit, the mute relay driver, Q3, has no collector supply, and the mute relay remains de-energized and the audio is muted. The +15V supply applied to the Selector Switch Board Assembly must charge C17 through R32 to forward bias Q8. When Q8 turns on, the B+ voltage is coupled via its collector/emitter junction and D7 to the positive plate of C18 causing it to charge towards B+. The potential on the positive plate of C18 is also coupled to the Mute Trigger Board Assembly where it supplies the collector supply and base bias (via R2) for Q2 of the Darlington switch. When the potential on the positive plate of C1 reaches a high enough level, Q2 and Q3 will saturate. This action causes Q2 and Q3 to couple the high positive voltage, through the collector/emitter junction of Q3, to one side of the Mute Relay coil. With the mute driver, Q3 (Selector Switch Board Assembly) already turned on, a current path is formed causing the mute relay to now become energized, (audio unmuted). This entire process takes place very quickly so that when the unit is initially switched-on, an audio output is available in a matter of seconds.

When the unit is switched on while in an AM mode, the AM audio is momentarily muted by shunting the audio line to ground through Q1. With the Master Power Switch, S501, on; and the Power touch-control not activated, the cathode of D1 will be at about +12V, through the field of K501 and the +12V Aux source. This reverse biases D1 which blocks the +12V potential from reaching the gate of Q1. Since Q1 will mute the audio only when its gate is near ground, this condition must exist at the time the power is switched on.

To insure that the gate of Q1 is near ground when the unit is switched on, D1 is connected to the Power touch-control circuit. When the touch-control is activated the cathode of D1 is shorted to ground via Q501 on the Power Supply Assembly. This action forward biases D1 and discharges C1, placing the gate of Q1 near ground, and muting the audio signal. When finger contact with the Power touch-control is interrupted D1 will return to its reverse biased condition. The AM audio, however, will remain muted until the charge on C1 returns to the level needed to turn off Q1.