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RCA Corporation
Consumer Electronics
Technical Training
600 N. Sherman Drive
Indianapolis, Indiana 46201

CTC 51/52 VOLUME/ON/OFF SYSTEM

Remote-controlled color TV receivers which use either chassis CTC 51 or CTC 52 are equipped with a two-frequency remote control system. One frequency activates the channel-change system, and the other activates a four-step volume/on/off system.

The four-step volume/on/off system turns the receiver on and off and switches the volume to any one of three levels—high, medium and low. The theory of operation of this unique system is explained in this, the first of a two-part series. Part 2 will present a systematic approach to localizing and isolating defects in the system.

Analysis of Individual Circuits in the System

A complete schematic diagram of the CTC 51/52 volume/on/off system is shown in Figure-1. Refer

(continued on page 2)

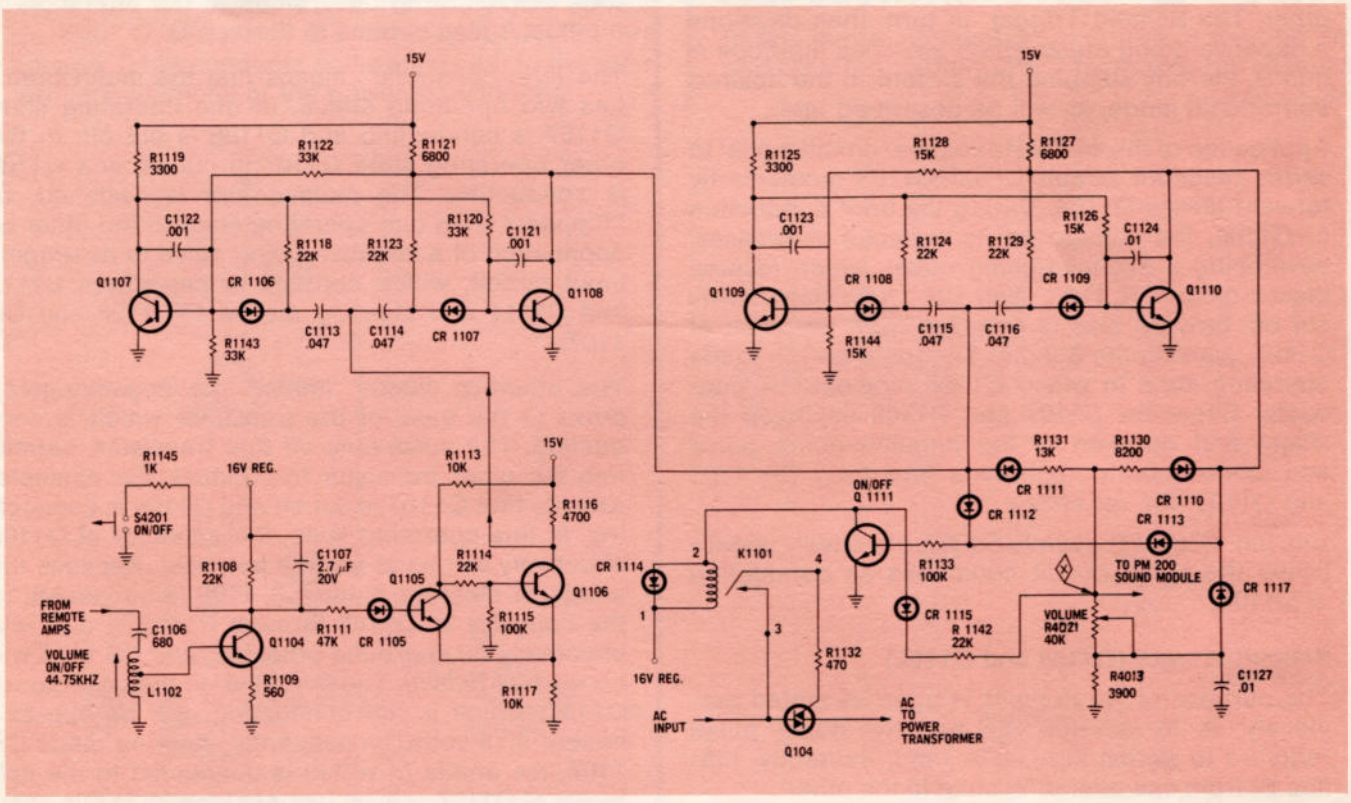

Figure 1—Schematic diagram of CTC 51/52 volume/on/off system

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Operational Mode vs Circuit Status

Function	Flip-Flop A		Flip-Flop B							
	Q1107	Q1108	Q1109	Q1110	Q1111	CR 1110	CR 1111	CR 1112	CR 1113	Q104
TV Off (remote system in standby	OFF	ON	OFF	ON	OFF	ON	ON	OFF	OFF	OFF
TV On/High Volume	ON	OFF	OFF	ON	ON	ON	OFF	ON	OFF	ON
Medium Volume	OFF	ON	ON	OFF	ON	OFF	ON	OFF	ON	ON
Low Volume	ON	OFF	ON	OFF	ON	OFF	OFF	ON	ON	ON

to it during the following analysis of the individual circuits which make up the system.

Ring-up circuit (Q1104)

The purpose of the ring-up circuit is to convert the 44.75-kHz volume/on/off signal into a short negative-going pulse which will momentarily switch the Schmitt Trigger from one operating state to the other. The Schmitt Trigger, in turn, then develops a negative-going pulse which switches flip-flops A and B, thereby stepping the system to the desired operational mode, as will be described later.

Application of the 44.75kHz volume/on/off signal to series resonant circuit L1102/C1106 momentarily forward biases Q1104. During the brief conduction of Q1104, the voltage on its collector decreases, developing a negative-going pulse, which reverse biases diode CR 1105. With CR 1105 momentarily cut off, forward bias is removed from the base of Q1105, causing the Schmitt Trigger to switch to the operating state in which Q1106 momentarily conducts. Capacitor C1107 and R1108 establish the shape and duration of the negative-going pulse and, consequently, determine how long CR 1105 and Q1105 are cut off.

Closing ON/OFF switch S4201 effectively establishes the same circuit conditions as conduction of Q1104.

Schmitt Trigger (Q1105 and Q1106)

The purpose of the Schmitt Trigger, as stated previously, is to develop the negative-going pulse required to switch flip-flop A (and, indirectly, flip-flop B) from one operating state to the other.

In the quiescent, or no-signal, state, forward bias is applied to the base of Q1105 through diode CR 1105. Conduction of Q1105 keeps Q1106 cut off. When diode CR 1105 is momentarily cut off by conduction of the ring-up transistor or by closing of ON/OFF switch S4201, forward bias is removed from Q1105, permitting conduction of Q1106. During the brief conduction of Q1106, the voltage on its collector decreases, developing a short, negative-going pulse which switches the operating state of flip-flop A.

Flip-flop A (Q1107/Q1108) and flip-flop B (Q1109/Q1110)

Because these are identical bi-stable multivibrators, the following description of the operation of flip-flop A also applies to flip-flop B.

The term "bi-stable" means that the multivibrator has two operating states. In one operating state Q1107 is conducting and Q1108 is cut off. In the other operating state Q1107 is cut off and Q1108 is conducting. The multivibrator is switched, or "flipped," from one operating state to the other by application of a negative-going pulse to its trigger-input circuit, which consists of capacitors C1113 and C1114 and steering diodes CR 1106 and CR 1107.

The steering diodes "steer" the negative-going pulse to the base of the transistor which is conducting. The pulse cuts off that transistor, permitting the other transistor to conduct. For example, assume that Q1107 is cut off and Q1108 is conducting. In this operating state, the collector of Q1108 effectively will be at ground potential. Because the anode of steering diode CR 1106 is connected to the collector of Q1108 through R1122, it also will effectively be at ground potential, and CR 1106 will be reverse biased. The potential on the collector of Q1107, which is not conducting, will be approximately +15 volts.Consequently, steering diode CR 1107, the anode of which is connected to the collector of Q1107, will be forward biased. In this operating state, a negative-going pulse at the junction of C1113 and C1114 will be applied to the base of Q1108 through CR 1107, which is forward biased, but will not be applied to the base of Q1107 because CR 1106 is reverse biased. The negative-going pulse will cut off Q1108, permitting conduction of Q1107. Once flip-flop A is switched so that Q1107 is conducting and Q1108 is cut off, it

will remain in that operating state until another negative-going pulse is applied to its trigger-input circuit.

The negative-going pulse which switches flip-flop A is obtained directly from the collector of Q1106 whenever the Schmitt Trigger is switched, as described previously.

The negative-going pulse which switches flip-flop B is obtained from the collector of Q1108 of flip-flop A. Flip-flop B is switched only when flip-flop A is switched to the operating state in which Q1108 is conducting. Because of this circuit arrangement, flip-flop A is switched *each* time a volume/on/off signal is received or the ON/OFF switch is closed but flip-flop B is switched only every *second* time. In this manner, the two operating states of each flip-flop are combined to produce four operating states, which, as will be described later, are used to produce the four operational modes listed in the accompanying chart.

On/off circuit (Q104, K1101, Q1111, CR 1112 and CR 1113)

Conduction of on/off transistor Q1111 energizes relay K1101, the contacts of which apply gate voltage to triac Q104. When the contacts of K1101 are closed, Q104 conducts and applies AC to the main primary windings of the power transformer.

Forward bias is applied to Q1111 through diode CR 1112 and/or CR 1113, depending on the operating state of flip-flops A and B. For example, if Q1108 of flip-flop A is cut off, diode CR 1112 is forward biased and, consequently, the positive voltage present on the collector of Q1108 is applied through CR 1112 to the base of Q1111. If Q1108 and Q1110 both are conducting, neither CR 1112 nor CR 1113 is forward biased, and no forward bias is applied to Q1111.

Volume level control circuit (CR 1111, CR 1110, R1131, R1130, R4021 and R4013)

Three ranges, or levels, of volume are provided by the volume/on/off system—high, medium and low. These three levels are achieved by electrically switching either R1131 or R1130 in parallel with volume control R4021. Diodes CR 1111 and CR 1110 perform this switching action in accordance with the operating states of flip-flops A and B.

Circuit Action Associated With Each Operational Mode

TV Off (Remote System in Standby)

In this mode, conduction of Q1108 of flip-flop "A" and Q1110 of flip-flop "B" decreases the potential

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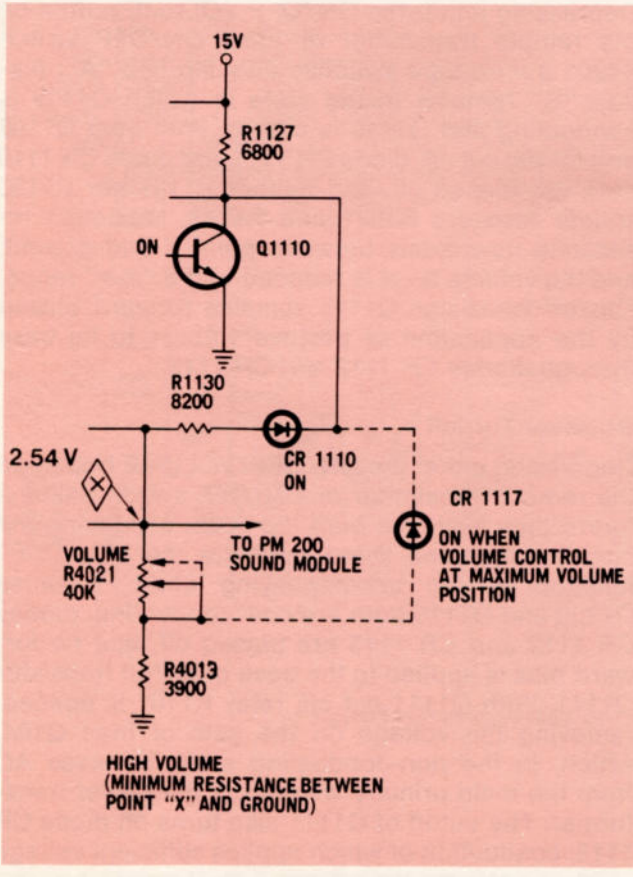

Figure 2—CTC 51/52 high-volume mode

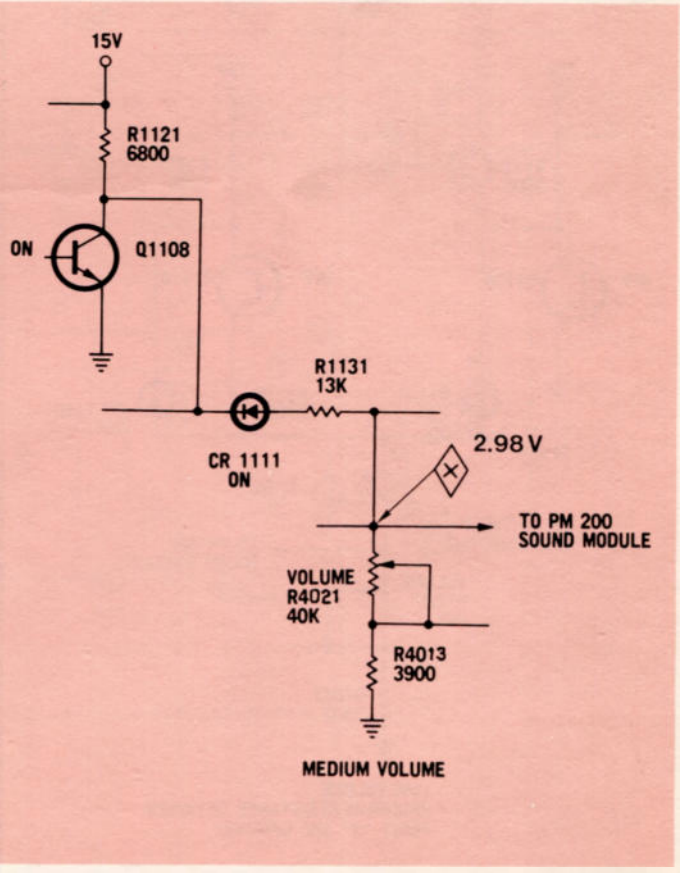

Figure 3—CTC 51/52 medium-volume mode

on their respective collectors to less than +.05 volt. Diodes CR 1112 and CR 1113, the anodes of which are connected to Q1108 and Q1110, respectively, are cut off, and no forward bias is applied through the diodes to the base of on/off transistor Q1111. With Q1111 cut off, insufficient current flows through the relay coil of K1101 to close it, and no voltage is applied to the gate of triac Q104. Without voltage applied to its gate, Q104 remains cut off, and no AC is applied to the main primary windings of the power transformer.

TV On/High Volume (Figure-2)

When the ON/OFF/VOLUME button on the remote transmitter or ON/OFF switch S4201 is closed while the TV is in the OFF state, the negative-going pulse produced by the Schmitt trigger switches flip-flop "A" so that Q1107 is conducting and Q1108 is cut off. (Flip-flop "B" is not switched because the pulse produced by the cut off of Q1108 is positive-going; only negative-going pulses switch the flip-flops.) With Q1108 cut off, the voltage on its collector increases to about +12 volts, biasing on diode CR 1112, which, in turn, applies the +12 volts to the base of on/off transistor Q1111. With forward bias applied to its base, Q1111 saturates, producing sufficient current through the relay coil of K1101 to keep the relay closed. Voltage now is applied through K1101 to the gate of triac Q104, which conducts and applies AC to the main windings of the power transformer. Simultaneously, with Q1110 still conducting, diode CR 1110 is forward biased and connects R1130 in parallel with the resistance of volume control R4021 and resistor R4013. This establishes minimum resistance at point X, and the receiver comes on with the volume in the *"high"* range.

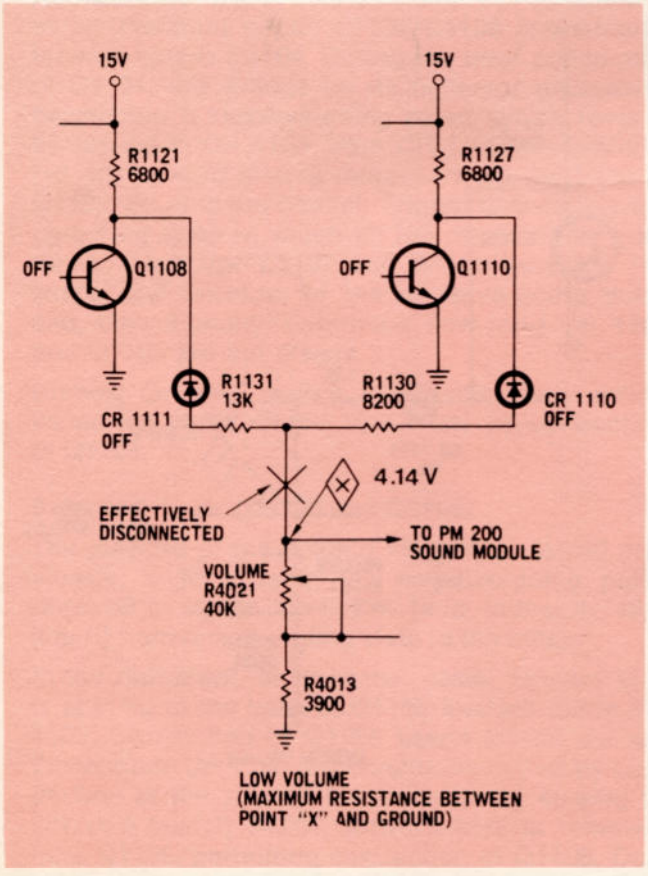

Figure 4—CTC 51/52 low-volume mode

Medium Volume (Figure-3)

Depressing either the ON/OFF/VOLUME button on the remote transmitter or ON/OFF switch S4201 a *second* time switches *both* flip-flops. With Q1108 now conducting, the voltage on its collector decreases to about +.05 volt, biasing on diode CR 1111, which connects R1131 in parallel with the resistance between point X and ground. Simultaneously, with Q1110 cut off, the voltage on its collector increases to about +12 volts, which 1) biases off diode CR 1110, disconnecting R1130 from ground so that it no longer shunts resistors R4021 and R4013, and 2) biases on diode CR 1113, which, in turn, applies the +12 volts on the collector of Q1110 to the base of on/off transistor Q1111, keeping Q1111 saturated so that AC continues to be applied to the power transformer via triac Q104. With 4.8K ohms more resistance now shunting resistors R4021 and R4013, the volume level is reduced to the *"medium"* range.

Low Volume (Figure-4)

Depressing either the ON/OFF VOLUME button on the remote transmitter or local ON/OFF switch S4201 a *third* time switches *only* flip-flop "A"; flip-flop "B" remains in the state in which Q1109 is conducting and Q1110 is cut off. With *both* Q1108 and Q1109 cut off, diode CR 1111 *and* diode CR 1110 both are biased off, and neither R1131 nor R1130 shunts resistors R4021 and R4013. Maximum resistance now exists between point X and ground, and the volume level is reduced to the *"low"* range. (On/off transistor Q1111 remains forward biased by the application of positive voltage to its base through diodes CR 1112 *and* CR 1113.)

Receiver Turnoff

Depressing either the ON/OFF/VOLUME button on the remote transmitter or ON/OFF switch S4201 a *fourth* time switches *both* flip-flops, producing the circuit conditions listed opposite the "TV OFF" function in the accompanying chart. Because Q1108 and Q1110 both are now conducting, diodes CR 1112 *and* CR 1113 are biased off, and no forward bias is applied to the base of on/off transistor Q1111. With Q1111 cut off, relay K1101 is opened, removing the voltage on the gate of triac Q104, which, in the non-conducting state, removes AC from the main primary winding of the power transformer. The cutoff of Q1111 also turns on diode CR 1115, conduction of which applies sufficient voltage at point X to keep the volume from increasing as the receiver is turned off. □