

RCA

Plain Talk and Technical Tips

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Basic Test Equipment Program

A new Technical Training Program entitled "Basic Test Equipment" is now being presented by RCA Consumer Electronics Distributors. This program, dealing with the four most-often used test instruments, the VOM — VTVM — Color Bar Generator and Oscilloscope, is designed to familiarize (or review) the service technician with the operation and applications of his service test equipment.

The two-part program consists of a slide/lecture, designed to reveal the basic operating principles of each test instrument. The second section of the program is a workshop presentation (using fourteen flipcharts) to illustrate typical examples of how these instruments should be used to effectively service color television receivers.

At the conclusion of the approximately four-hour program, the participants will receive a 52-page book entitled "**Basic Test Equipment—Book One Circuits and Applications.**" This book reproduces the slide lecture in a handy 5-½ x 8-½ inch pocket size. In addition, the participant will receive a reduced copy of the flipchart used in the workshop presentation, for his personal application and/or usage.

The RCA Consumer Electronics Distributor in your area has complete information on how you may participate in this test equipment meeting and future programs to be developed by RCA Technical Training.



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WT-509A Picture Tube Tester

The recently announced WT-509A tests both color and black-and-white picture tubes for emission quality, interelectrode leakage, and shorted elements. Solid-state circuitry is used, including a triac device for controlling internal voltages.

Test data is furnished to permit testing over 1000 picture tube types. Five socket adaptors are supplied with the instrument, including a versatile "universal" adaptor that can be connected to the base of any picture tube.

The WT-509A has a large, three-color meter to indicate emission quality, cut-off adjustment, leakage, picture tube voltages and power-line voltage. The AC power-line measurement feature is helpful for determining whether improper line voltage is affecting TV performance. This feature also provides a reference for accurately calibrating the instrument.

A sensitive adjustment establishes the proper cut-off point for the testing of each tube, and/or gun of a color picture tube. The internal B+ and bias voltages of the Tester are regulated to assure an accurate test of picture tube performance. A special "activate" function is provided to improve the performance of low-emission tubes.

Additional features of the WT-509A include a 50,000 DC volt range for use with an RCA WG-297 High-Voltage Probe to measure picture tube anode voltage. A 1500 volt input is also provided for measuring picture tube electrode voltages.



Figure 1 — WT-509A Picture Tube Tester

The WT-509A includes a sturdy, luggage-type carrying case, with a storage compartment for socket adaptors, instruction manual, and test data booklet. The instrument measures 12" by 10" by 5", and weighs approximately 10 pounds. The unit is operated from a standard 105-132 volt, 50-60 Hz AC power line. A WT-509A model is also available for operation from a 240 volt, 50-60 Hz power source.

Normal Battery Life?

Occasionally the service technician will be asked by a customer, "What is the normal life of the battery used in my portable radio or tape recorder?" What he really wants to know is, "How many hours can I play my portable before I replace the battery?" This is not an easy question to answer, because battery life depends on many things.

The two primary factors to consider when attempting to predict battery life are the average current drain when the unit is operating and the number of hours per day the instrument is used. Battery life also depends on the type and size of the cells used in the battery package.

Generally, there is seldom a question of battery life in transistor radios because of the relatively low current drain. Typically, the battery drain of small radios will be about 50 to 100 mA. The principle variable in predicting radio battery current is the volume control setting. All RCA portable radios use a push-pull class "B" audio output stage wherein the operating current increases in proportion to sound level.

Tape recorders and tape players are also equipped with class "B" audio amplifiers, although the output power and battery drain may be somewhat higher. The battery current drawn by the amplifier in a typical tape recorder operating at average room volume would be approximately 75 to 100 mA. The motor in the typical tape recorder contributes an additional 75 to 100 mA current drain, so that the total operating current of the tape recorder will be approximately 100 to 200 milliamperes. Obviously this represents a two or more times increase in battery drain over that of the transistor radio.

If the current drain and daily playing time of a radio or tape recorder are known, it is possible to estimate the battery life, based on an end-of-life voltage of 1.1 volts per cell. RCA battery operated products are designed to operate down to a 1.1 volts per cell end point. In an instrument which

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Zener Regulated Power Supplies

The avalanche-breakdown (zener) diode is no stranger in solid-state circuits. The zener diode is constructed much like a silicon rectifier diode. When **forward** biased the zener conducts with minimum voltage drop. When **reverse** biased, however, it does not conduct until a specific **break-down** voltage is reached. It is the reverse voltage characteristic of the zener diode that distinguishes it from the silicon rectifier.

Zener diodes are available with a selection of breakdown voltages, wattages and tolerances. Manufacturers are furnishing the electronics industry with units having breakdown voltages ranging from as low as 3.9 volts to upwards of 200 volts.

To better understand the reverse voltage (break-down) characteristics of zener diodes it would be well to examine Figure 2, which illustrates the voltage/current curve of a typical zener diode. Notice that the break-down voltage remains essentially constant from a minimum sustaining current of about 5 mA up to the maximum power rating of the diode.

Simple Regulator Circuit

The simplified circuit (Figure 3) illustrates a zener regulator system often used to supply a constant DC voltage to circuits that are sensitive to voltage changes. This simple regulator might be used to supply -9.1 volts DC to an AM-FM radio tuner. A similar circuit derives tuner power for the familiar RC 1218 radio tuner.

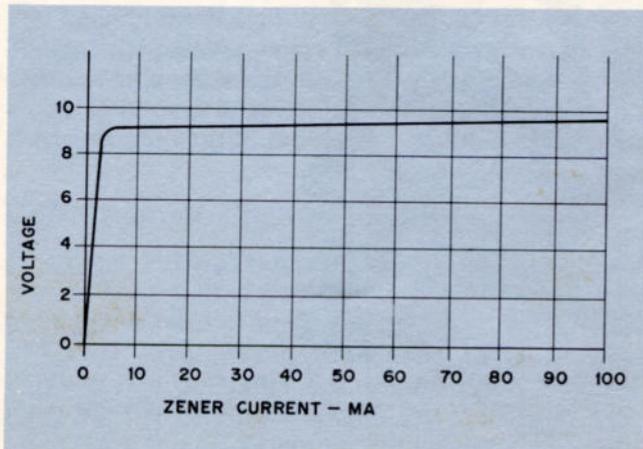


Figure 2 — Typical Voltage/Current Curve

Several things must be known in order to design the circuit. These include, the maximum and minimum DC voltage input to the regulator circuit, and the maximum/minimum DC current requirements from the regulated supply. It is also necessary to know the minimum sustaining current of the zener diode—may be assumed to be 5 mA. Upon examining the requirements for this circuit, it is found that the regulator must operate over a range of input voltages from -27.5 volts down to -20 volts DC. It is also necessary for the regulator to provide a constant 9.1 volts with current loads ranging from approximately 20 mA to as high as 70 mA. With these considerations in mind, a circuit can be designed to provide the desired performance.

The first design consideration is low input voltage and maximum output current. With -20 volts input and a load current of 70 mA plus the 5 mA zener sustaining current, the total regulator input current is 75 mA. Computation yields a value for the current limiting resistor (R_c) of 145 ohms—150 ohms, the closest standard value can be used.

The next design step is to determine the maximum power dissipated in the zener diode under worst case conditions. This would be at maximum input voltage and minimum load—27.5 volts input and 15 mA output. To determine the dissipated power, it is first necessary to know the total current in the circuit and hence the current through resistor R_c . This is also easily calculated. Under these conditions, the voltage drop across R_c will be the difference between 9.1 volts (zener voltage) and the 27.5 volts input—or 18.4 volts. This voltage is used to calculate the current in the circuit ($I = E/R$) so that the zener diode power dissipation ($P_d = E \times I$) may be calculated. This voltage drop is also used to calculate the resistor power dissipation ($P_d = E^2/R$) which is about 2.3 watts, so a 3 watt wire-wound resistor would be suitable.

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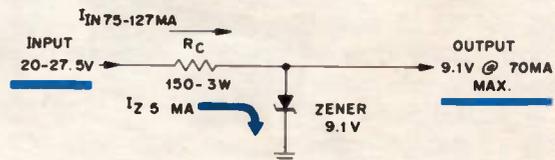


Figure 3—Simple Zener Regulator

New Modular Black and White Chassis

This year's black and white television line features two new hybrid chassis, which are physically and electrically similar. The KCS 176 is used in instruments that are equipped with 9-inch diagonal picture tubes. Larger screen receivers (12-inch diagonal) utilize the KCS 177 which has circuit modifications to permit driving the larger screen picture tube.

Modular Construction

Both chassis feature three plug-in circuit boards containing solid-state circuitry similar to that used in the KCS 169 chassis. The first board, illustrated

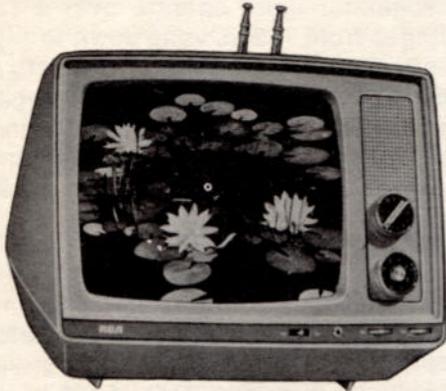


Figure 4 — Instrument Equipped With KCS 177

in the accompanying photograph, is referred to as the "pix Module." It contains the pix IF amplifiers, picture detector, video driver stage and the AGC circuits.

A second plug-in board, designated as the "video module" includes the video output stage, together with the AGC and sync separator circuits.

The third board is the "sound module." It features the familiar integrated circuit sound system utilized in many RCA color receivers. The audio output from the "IC" drives a 12FX5 audio output stage.

Chassis Servicing

The plug-in module represents a significant advance in chassis design. It is possible, by placing a large part of the circuitry on plug-in boards, to construct a smaller "main" circuit board, and consequently smaller cabinet than has been possible with past chassis designs. The vertically oriented boards, occupy space in the cabinet that was previously empty area. These module boards, with conventional solid-state circuitry, are constructed in what may be thought of as the "computer card" configuration. In this type construction, the copper pattern forms a mating contact that complete the circuit when the board is inserted in the pair of sockets located on the main circuit board.

RCA engineers have standardized on modules, utilizing a total of 12-contacts. These are located on the edge of the circuit board, so that they contact two in-line sockets.

To facilitate servicing, the boards may be extended from the main chassis by using extension cables which are available from RCA Parts and Accessories. The use of these cables is clearly indicated in the photograph showing the "pix module" extended for servicing.

This feature, and complete access to entire bottom area of the circuit board in both the KCS 176 and 177 chassis, should make this chassis close to the ultimate in serviceability.

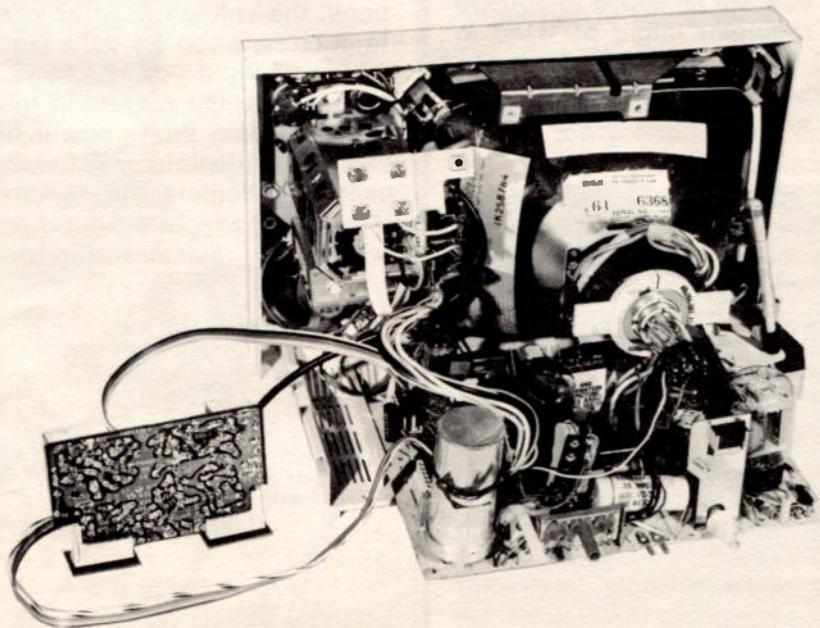


Figure 5 — Pix Module Extended for Servicing

Zener Supplies

(Continued from Page 3)

The calculations above indicate that the total input current to the regulator circuit is about 127 mA. The current through the zener diode is the input current less the 15 mA output, or 112 mA. Therefore, the power dissipated in the zener diode equals about 1.02 watts. This leaves the designer two choices; he must use a 2 watt zener, or a more sophisticated regulator circuit with a transistor amplifier stage.

Emitter-Follower Regulator

Figure 6 illustrates a simple emitter-follower circuit that may be used when the regulated power requirements exceed what may be obtained with a shunt regulator circuit using a low-wattage zener diode. This regulator takes advantage of the inherent characteristics of an emitter follower circuit—unity voltage gain and substantial power gain. The power gain in this circuit is equal to the DC current gain (beta) of the transistor.

The emitter-follower circuit uses the zener diode to establish a reference voltage on the base of transistor Q1. Because the current in the base circuit of this stage is less than 1 milliamperes, it is obvious that the zener diode may operate at a very low power level. The diode is biased from the unregulated input voltage by 2200 ohm resistor whose value has been chosen to supply the minimum zener sustaining current of 5 milliamperes at the low-limit input voltage of 20 volts. Notice in the illustration, that even under worst case conditions of the maximum input voltage of 27.5 volts, the maximum zener current is only 8.4 mA. Consequently, the power dissipated in the zener diode is minimal.

CTC 40 Remote Channel Change Operation

The operation of the remote control system used in the CTC 40 console instruments closely parallels that used in remote controlled CTC 28 instruments. There are, however, some differences in the remote channel change operation. These differences include UHF and VHF defeat switching and dual-diode decoupling in the sound muting circuit.

VHF Channel Change

When the "VHF Channel Change" button on the remote hand unit is depressed, a 40.25 kHz signal from the remote preamplifier appears at the base of Q1107 (VHF keying transistor) causing it to conduct and complete the ground return for VHF relay K1107. When energized, the VHF relay contacts close the AC power circuit for the VHF motor, which rotates the shaft of the VHF tuner. The VHF relay is energized by the remote unit, sufficient

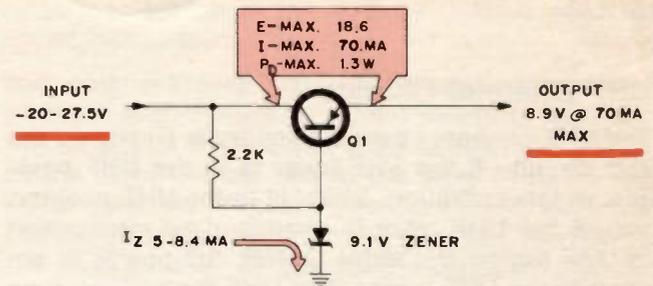


Figure 6 — Emitter Follower Regulator

The emitter-follower stage will supply a regulated voltage that equals the 9.1 volt zener voltage less the base-emitter voltage drop of approximately .3 volts. Thus, the output voltage in this case equals about 8.9 volts DC.

Figure 6 also illustrates that under worst case conditions of 27.5 volts input and 8.9 volts at 70 mA output, the peak power dissipation of the regulator transistor will not exceed 1.31 watts. As a result, the designer has a wide choice of inexpensive transistors that may be used as the series transistor Q1.

This same circuit, with modifications to permit increased base current, can be used to provide regulated output currents of several amperes. The maximum output power of this type regulator circuit is limited only by the maximum permissible power dissipation of the series transistor.

The emitter-follower, or series regulator, circuit finds use in some RCA Consumer Electronics Products. One example, although the circuit is designed to provide 12 volts DC, is the regulator circuit used in the RK 314 power supply to furnish power for the RC 1223 AM/FM Stereo tuner.

relay "holding" current is maintained by a path to ground through resistor R1201, the station stopper switch, or the manual/remote and program switches. Thus, the relay remains energized, and the motor runs until a programmed VHF channel is reached, and both the station stopper and program switches open simultaneously. The closing of the VHF manual/remote, station stopper, and program switches also grounds the base of UHF defeat transistor Q1201, through the 100K resistor (R1203), preventing conduction of Q1201 by removing its base bias, which is obtained from the +16V supply via the VHF relay coil and resistors R1201 and R1203. Obviously, when R1201 is cut-off the UHF relay cannot be energized by Q1108, the UHF keying transistor. Thus Q1201, when cut-off, acts as a UHF defeat "switch." In a like manner, a minute base bias for Q1202 (VHF defeat transistor) is obtained from the +16V supply via

the UHF relay coil (K1108), resistors R1202 and R1204.

UHF Channel Change

The UHF channel change circuitry is similar to the VHF circuit—if the VHF tuner is in the UHF position. In this condition, S1004 is in the UHF position and, if the UHF relay is energized by conduction of UHF keying transistor Q1108, AC power is applied to the UHF motor. The UHF motor then runs until the tuner reaches a programmed VHF channel and both the UHF station stopper and program switches open. The VHF motor cannot run during UHF channel change because the UHF manual/remote, station stopper, and program switches prevent conduction of VHF defeat transistor Q1202, otherwise obtained from the +16V supply via the UHF relay coil and resistors R1202 and R1204. Thus, Q1202 acts as a VHF defeat “switch.”

VHF to UHF

This action is accomplished by a diode hold-in circuit, operating in conjunction with switch S1004 (located on rear of VHF tuner) and both relays.

Assume the instrument is tuned to a VHF channel and the “UHF” button on the remote hand unit is depressed. This causes conduction of the UHF keying transistor resulting in the following actions:

1. The UHF relay energizes (contacts), completing a ground path for the cathodes of both diodes (CR 1201 and CR 1202) via S1004 and the 330-ohm resistor R198. Under these conditions, holding current for the UHF relay (initially energized by the keying transistor) is maintained by a path to ground through CR 1202 and the VHF relay is energized through CR 1201. Sufficient current to activate the VHF relay is assured by using a rather low value of 330 ohms for resistor R198. Both relays (VHF and UHF) will remain energized until switch S1004 changes position, when the VHF tuner reaches the UHF detent position.
2. When the VHF relay switch closes, the VHF motor starts and continues to run until the tuner reaches the UHF detent position at which time switch S0104 changes to the UHF position.
3. When S1004 changes to the UHF position, both diode ground paths open, both relays de-energize, the VHF motor stops (on the UHF detent), and the circuit is ready for UHF operation. (Note that the VHF and UHF program switches are overridden

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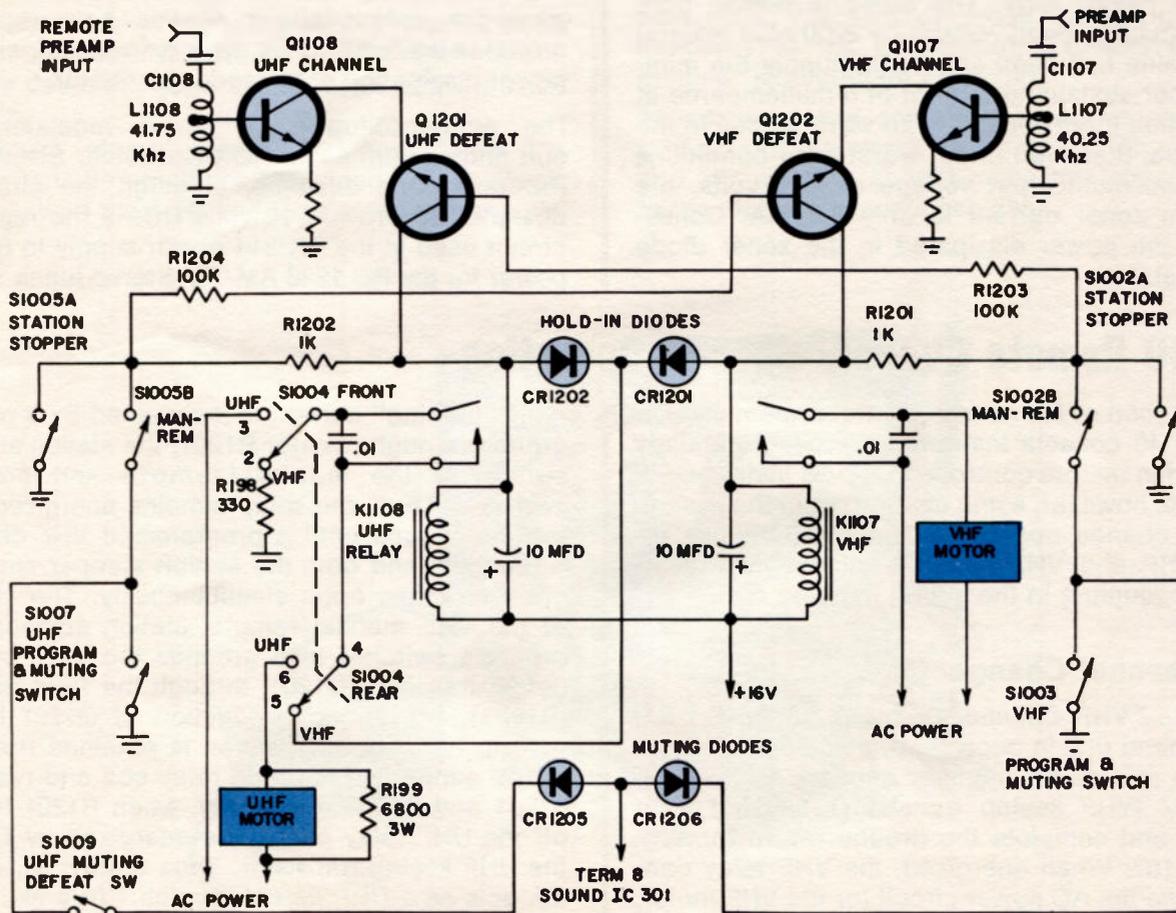


Figure 7 — Channel Change Circuit

Automatic Chroma Control

PART TWO

(Continued from May-Jun)

Part one of this article discusses the basic aspects of the burst portion of the chrominance signal, and how variations of burst amplitude can be related to changes in color signal level.

Part one also describes the operation of a typical ACC system (CTC 38 closed-loop) whereby burst/chroma level variations can be minimized by using a sample of burst, rectified to DC, to effect a gain change in the chrominance channel to counteract the undesired burst/chroma level change.

This month, the operation of the ACC system employed in the solid-state CTC 40 Chassis will be explored.

Figure 8 shows the configuration of the ACC circuit used in the CTC 40. The method of obtaining the ACC control voltage is basically the same as in the CTC 28 chassis, as well as earlier models which use a phase-sensitive detector and reactance control tube to phase the reference oscillator. The ACC circuit in the CTC 40 differs in three respects from these other chassis: It uses solid-state devices and it has an inverter stage, needed because the solid-state chroma amplifier requires **forward-biased** ACC instead of the **reverse bias** required with a vacuum tube. Also the CTC 40 uses a closed-loop system whereby the amplitude of of

both burst and chrominance are controlled; the open-loop system of the CTC 28 controls only the chrominance level.

Referring to Figure 8, the signal consisting of color burst and chrominance information is fed from the output of the second chroma amplifier, Q703 to the color control and to the base of Q701, the burst amplifier. Positive retrace pulses from the horizontal-output transformer also are applied to the base of Q701 to gate on the stage when burst is present. The operation of the burst-amplifier stage is almost identical to the operation of the vacuum-tube burst amplifier in Figure 2 (V702); CR 715 is used simply to protect the base-emitter junction of Q701 from the positive bias voltage on C701.

Three things can affect the amplitude of the output from the ACC detector, which consists of CR703, CR704, R709A, and R709B. These are the **amplitude** of the 3.58 MHz oscillator signal, the **amplitude** of the burst signal, and the **phase angle** between these two signals. The amplitude of oscillator input is unvarying and the phase angle between burst and oscillator signals is held constant by the AFPC circuit; therefore, the output of the ACC detector is controlled **solely** by the amplitude of burst.

CR 703 and CR 704 are polarized so that an **increase** in burst amplitude produces a **negative-going** output. This output is added to a positive DC

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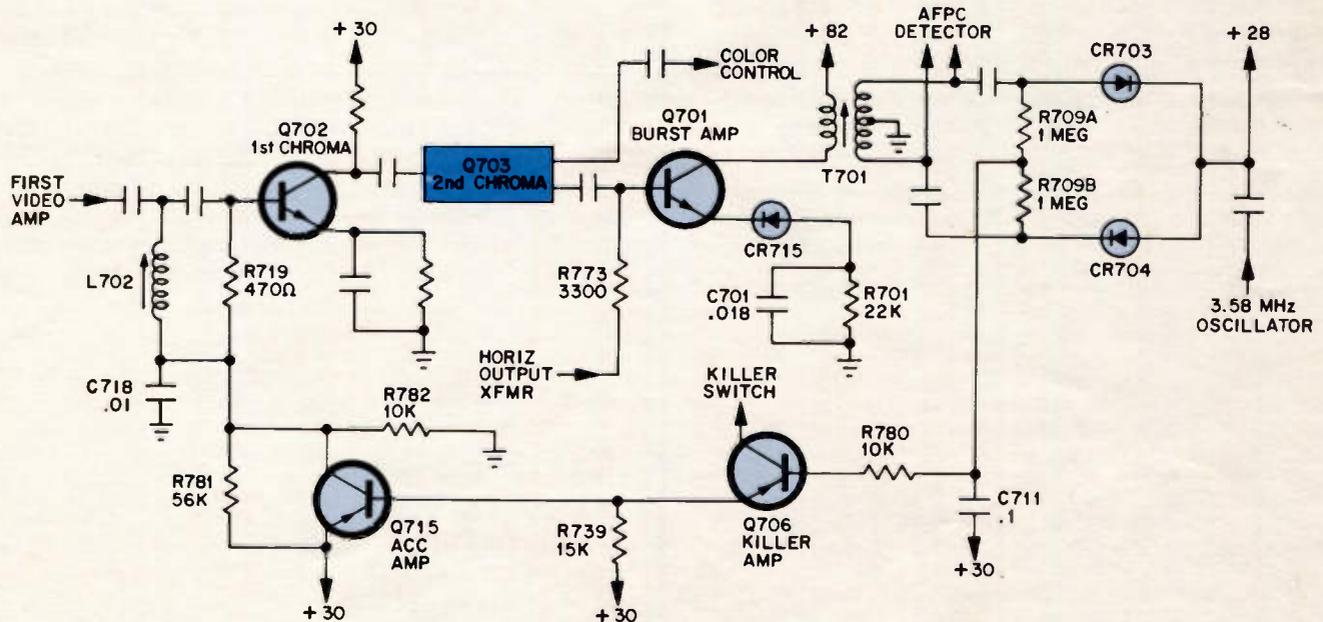


Figure 8 — Simplified ACC for CTC 40

Normal Battery Life?

(Continued from Page 2)

operates from a 9-volt battery supply, the batteries should be discarded when the voltage under load drops to 6.6 volts.

The curves at the bottom of the page illustrate life in hours plotted against current drain in milliamperes for a typical "D" size carbon-zinc cell (the typical flashlight battery). The three curves shown represent a usage factor of two hours per day, four hours per day, and eight hours per day at an operating current of 200 milliamperes. It becomes evident on examination of the curves, that as the hours of use per day increases, the total hours of battery life decreases. Consider the two extremes, a typical tape recorder, when used two hours a day, will exhibit a total of 11.5 hours of battery life; when used at an "eight hour" discharge rate the end-of-life point is reached at approximately 5.2 hours.

Because carbon-zinc cells exhibit short life at high currents, they are not recommended in high-current drain applications such as tape recorders. A carbon-zinc battery performs best under conditions of low-current loads such as when used in transistor radios.

To overcome short battery life, the batteries supplied with RCA tape recorders are "alkaline" types that are specifically designed for high-current applications. These batteries, when used in tape recorders, offer a three or more times improvement in overall life over conventional carbon-zinc batteries.

Because both battery types are used as original equipment in RCA products, they are color coded so that the service technician can distinguish between the two types. The carbon-zinc battery used in radios is colored a light blue and is intended for normal service. The extended life alkaline batteries (heavy duty service) furnished with tape recorders are colored purple. Thus, the technician should have no problem in identifying the batteries and replacing them with the correct types.

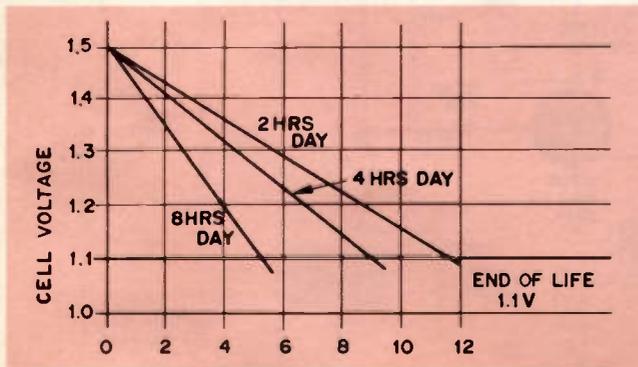


Figure 9 — Battery Discharge Curves

CTC40 Remote Channel Change Operation

(Continued from Page 6)

by the diode circuits during the VHF to UHF transition.) The UHF tuner remains on the UHF channel last selected.

When the "UHF" remote button is depressed again, the UHF keying transistor is again energized, and the normal sequence of UHF operation causes the tuner to rotate to the next programmed UHF channel.

Sound Muting

Sound muting in CTC 40 remote instruments is achieved by the grounding action of the UHF and VHF program switches. When UHF or VHF channel change is initiated, terminal #8 of the sound integrated circuit (IC 301) is grounded via decoupling diode (CR 1205 or CR 1206), thereby cutting off the sound. The UHF muting defeat switch (S1009) prevents muting by the UHF program switch during reception of a VHF channel. This switch is located on the rear of the VHF tuner and is closed only in the UHF position.

Automatic Chroma Control

(Continued from Page 7)

level so that the output of the detector is about 25 volts with zero burst and approximately three volts less positive during normal color reception.

The output of the ACC detector controls the base-to-emitter current of Q715. Since both transistors are PNP, a negative-going signal from the ACC detector (resulting from increased burst) increases their collector currents. The emitter-to-base current of Q702, the first chroma amplifier, is part of the collector current of Q715, so this current also is increased. Increasing the base current of Q702 causes a reduction in gain, thereby stabilizing the burst amplitude at the output of Q703. In this manner, the level of the chrominance information, which is transmitted with a fixed amplitude relationship to burst, is held constant.

RCA Sales Corporation

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600 North Sherman Drive
Indianapolis, Indiana 46201