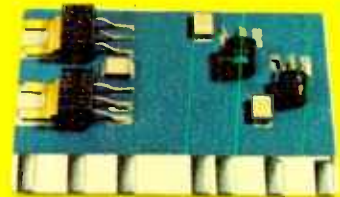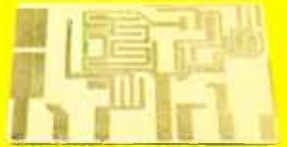# RCA

1973

Product Technical Manual

1973

Television, Radio, Phonograph, and Tape Products Technical Manual

Prepared By

RCA Corporation

Consumer Electronics
Technical Training
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Indianapolis, Indiana 46201

About Our Cover

As the sales catalogs and brochures describe the features of the new RCA Product Line. the annual Product Technical Manual describes the new circuits and design concepts which make these features possible. One of the concepts of design that has contributed to RCA leadership in the industry is the plug-in module. These "building blocks" have proven their worth in practically every type of chassis—from small-screen monochrome portables to top-of-the-line color receivers.

The ceramic-substrate module is truly a "state-of-the-art" device. Silk-screened conductors provide the basic current paths. Laser trimming of the "conducting-ink" resistors; furnace soldering of the capacitors and transistors —all these steps employ technologies which were unknown only a decade ago.

Our cover was designed to echo the "clean" look of the module. And. as the module is designed to be a "building block" of the finished instrument. this manual is designed as a foundation for understanding the techniques of servicing those instruments.

RCA

1973

Product Technical Manual
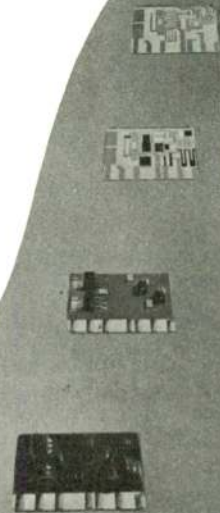
Introduction

Only four years have passed since the annual "Product Manual" first mentioned the RCA concept of an all-solid-state color television receiver. In those four years there has been a steady progression of improvements to the first fruit of that concept. From the CTC 40, "all solid state except the high-voltage rectifier," great strides were taken to develop the "Set of the Future"—the all-solid-state G2000.

Contained in the CTC 47 chassis of the G2000 were most of the new RCA circuit designs which later were popularized in the successor to the CTC 40 chassis—the CTC 44. This all-solid-state chassis featured motorless remote control of volume, tint, and color; AccuTint*; black-matrix picture tubes; separately aligned tuner and IF amplifier; a high-voltage quadrupler; 75-ohm VHF antenna terminals; focus voltage derived from high voltage; and others.

Hard behind these instruments appeared the CTC 49 and CTC 46. These forebears of our present generation of chassis introduced still newer RCA concepts of design. The extensive use of integrated circuits is, in itself, a major breakthrough in the industry, but this hardly outshines the "built-in serviceability" afforded by modular construction. "Out front," AccuMatic® fine tuning sets a new standard of convenience for the viewer. In the CTC 54 chassis, all these features have been combined with parity of UHF and VHF tuning, plus the advantages of varactor tuners.

The majority of the R-Line all-solid state console instruments use a new chassis—the CTC 48. In it will be found the features and performance of its forerunners. Also to be seen in it are the results of a year of effort directed toward enhancing the reliability of the CTC 46—and simplifying its circuits where this could be done without sacrificing performance. "Out front," slider controls add to viewer convenience. Parity of VHF and UHF tuning in 25-inch (diagonal) remote-controlled receivers—and in many manually controlled models—is available.

The CTC 54 continues as the top-of-the-line console chassis, but, here again, a year of experience and effort have been put to good use to enhance the quality and performance of the instrument.

In color portables, the new CTC 63 offers large-screen viewing with several new circuits, including a solid-state high-voltage rectifier. Many of the circuits developed for this chassis are also being used to enhance the proven quality and performance of the R-Line CTC 51, 52, 53 and 55.

At the top of the color-portable line continues the CTC 59. This proven instrument combines the performance of the solid-state consoles with the big-screen portability that is possible only with the 110° wide-deflection kinescope.

Added to the lineup of seven continued monochrome television chassis is another TransVista® chassis, the KCS 187. This 12-inch (diagonal) model brings, for the first time, the modular, all-solid-state concept down into this small-screen field. Another first for RCA is parity of VHF and UHF tuning in black-and-white, which is available in some large-screen models.

And, there is something new in the RCA FM-Stereo R-Line. Varactor-tuned FM reception is now available in a wide variety of console and modular FM-Stereo instruments. Along with varactor-tuned FM reception, this new tuner line, the RC 1245, 1246, and 1247, also features ceramic filters in the FM IF amplifier and an integrated-circuit, modular, phase-locked-loop stereo decoder system.

This continuous effort to bring to the consumer the very newest and best in the state of the art can be successful only if these products are supported by an efficient, well informed servicing industry.

This manual provides an introduction to the various new or "different" circuits employed in the RCA R-Line. Hopefully, it will serve as a foundation upon which the necessary servicing skills can be developed. By carefully studying this Product Technical Manual, attending the Workshop Training Programs to be offered, and utilizing the Service Data for specific instruments, the service technician should experience little difficulty in providing this necessary support.

Contents

RCA

RCA RADIO/PHONOGRAPH/TAPE

The RCA Radio-Phonograph-Tape products for 1973 reflect more than a refurbishing of earlier products. Solid engineering advances in circuitry coupled with new concepts in versatility will appeal to those who desire the finest. Nor has the servicing industry been forgotten. As this chapter will show, **it is possible to combine performance and serviceability.** But first, these are the highlights of the 1973 line.

A new AM/FM Tuner is introduced in the R-Line products Features of the new tuner include **varacter tuning, ceramic IF band pass filters,** and a plug-in module containing a **multiplex circuit** new to RCA tuners.

The **TC 604,** 8-track tape player is included with the AM/FM Tuner, record changer, and amplifier in all console radio phonograph instruments except the "80 Series," which accommodates the **VC 100.**

The R-Line tape products include several models available in a choice of cassette or cartridge types. The tape cassette models are available in either monaural or stereo, and with a choice of either battery-only or AC/DC operation. The **Stereo-8** cartridge models are available as self contained units or for use in conjunction with a separate sound system.
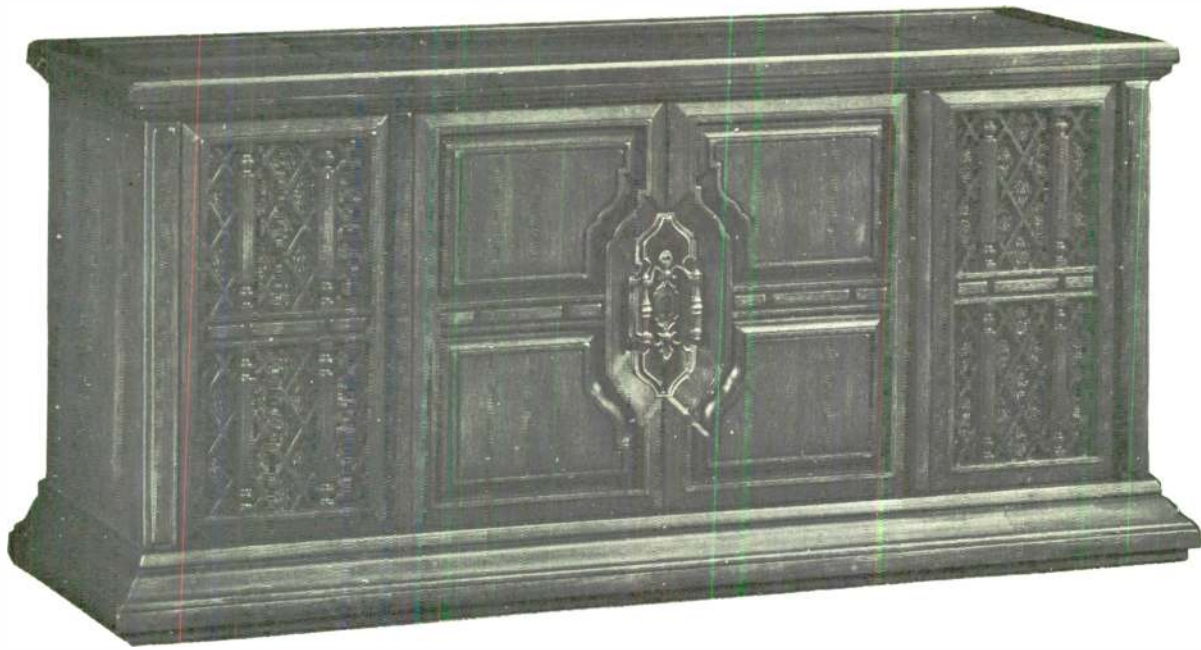
VRT 62S—Console Radio Phonograph

The RC 1245

Of particular interest is the newly developed AM/ FM tuner. The RC 1245 offers varactor FM tuning, ceramic IF filters, and a plug-in module containing a **phase-locked-loop multiplex circuit** new to RCA tuners. The RC 1245 is used extensively in console radio-phonograph instruments to replace the familiar RC 1239 tuner. Four separate circuit boards are used in the RC 1245.

1. The FM board, PB 40, contains discrete components in the FM RF amplifier, oscillator, mixer and IF amplifier. Integrated circuits are used for FM detection (which includes some IF amplification), multiplex decoding, and power supply regulation.

2. An edge connector socket is included on the FM board into which the multiplex board, PB 39, is plugged.

3. The AM board, PB 37, consists of a discrete-component RF amplifier and an integrated circuit to perform the functions of mixer, oscillator, IF amplifier, and detector. The AM tuning capacitor is mounted on the AM board and the FM tuning control is ganged on the shaft.

4. Two 2-stage preamplifiers are included on a separate board, PB 38, to provide sufficient gain to drive the audio amplifiers. Customer controls on the preamp board include **bass, treble, balance** and **loudness.**
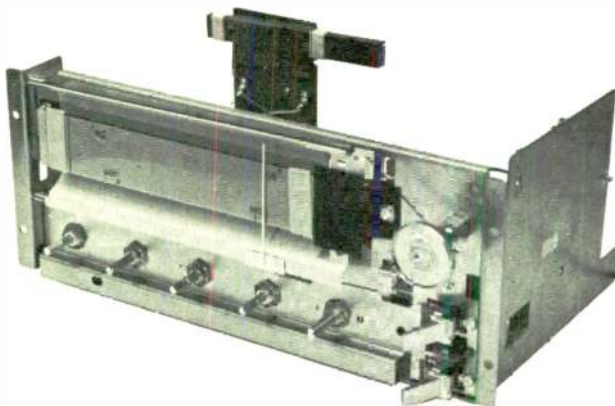
RC 1245A—Tuner Chassis
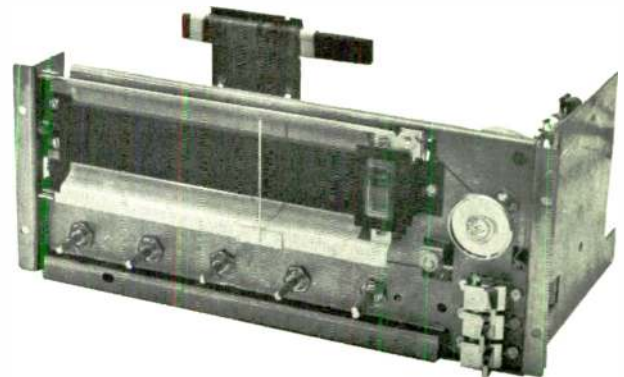
RC 1245B—Tuner Chassis

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Varactor Tuning

The principle of varactor tuning is not new to RCA home entertainment instruments, having been introduced last year in the Color TV Line. However, this is the first time RCA has employed varactors to tune an FM radio.

Varactor tuning is possible because of the capacitive characteristic of a reverse-biased diode. Consider the fundamental theory of capacitors. The amount of capacitance is determined by the physical makeup of the capacitor. Set in a mathematical equation:

$$C = \frac{.2248 \, kA}{t}$$

Where C is capacitance in picofarads,

      k is the dielectric constant of the spacing material,

      A is the area of the plates in inches, and

      t is the thickness of the spacing material in inches.

We can see from this equation that the amount of capacitance will vary inversely to a change in thickness of the space between the plates; i.e. as thickness increases, capacitance decreases. It is on this characteristic that the principle of varactor tuning is based.
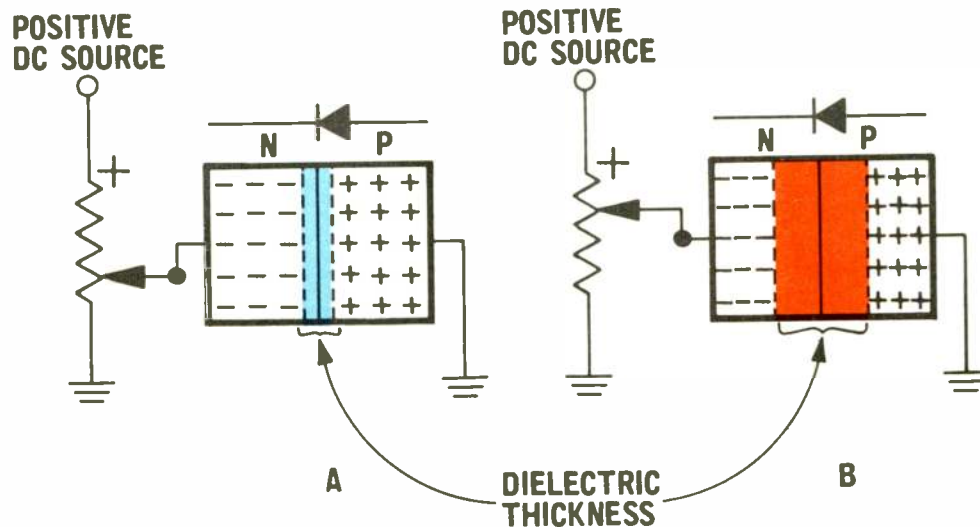
The accompanying diagram, **Basic Varactor Principle** illustrates the concept of varying the capacitance of a diode. When a diode is forward biased the properties of a conductor are exhibited and no significant capacitance is observed. Reverse biasing a diode makes it appear as an open, or more precisely, it has the properties of two electrodes separated by a dielectric material—a capacitor.

Illustration A shows a diode under a reverse-biased condition, a positive potential applied to the N-type material and a negative potential to the P-type. Note the attraction of the negative carriers in the N-type material toward the positive potential, while the positive carriers in the P-type material are pulled toward the negative (ground) potential. The area to either side of the NP junction is void of current carriers and is known as the depletion region. The depletion region is the dielectric material and the properties of a capacitor are exhibited.

Illustration B shows the effect on the diode as the reverse bias is increased. The current carriers are now pulled further away from the junction by a greater potential; thus, the depletion region becomes wider or the thickness of the dielectric is increased.

By varying the reverse bias applied to a diode, the capacitance is made variable. As the reverse bias is increased the thickness of the dielectric material is increased. By applying this change to the equation in the previous discussion, it is apparent that an increase in the thickness of the dielectric will cause a decrease in capacitance.

Shown in the illustration, **Varactor Tuned Circuit,** the capacitance exhibited by the diode determines the frequency to which the circuit is tuned. By making the arm of the potentiometer, R1, more positive, the reverse bias applied to CR 1 is increased, thereby decreasing the circuit capacitance, and the circuit is tuned to a higher frequency. Conversely, as the reverse bias is decreased the capacitance will increase, thus tuning the circuit to a lower frequency.


Basic Varactor Principle
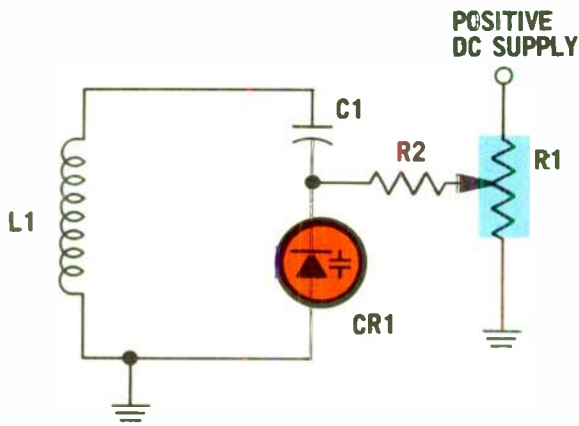
Varactor Tuned Circuit

RC 1245 Tuner Circuits

The application of the varactor tuning principle is illustrated in the accompanying diagram, **RC 1245 Tuning Circuits.** Varactor diodes CR 201 and CR 203 determine the RF frequency to be coupled to the mixer stage. Diode CR 204 is the variable capacitance which, in conjunction with L207 and L208, determines the oscillator frequency. The receiver employs the standard superheterodyne principle of tuners, only the method of tuning is different.

If the three tuned circuits are to track across the FM band, the three varactors must track each other. The varactors are matched in production, and matched sets must be installed if one becomes defective. **RCA Parts and Accessories** will stock them in matched sets.
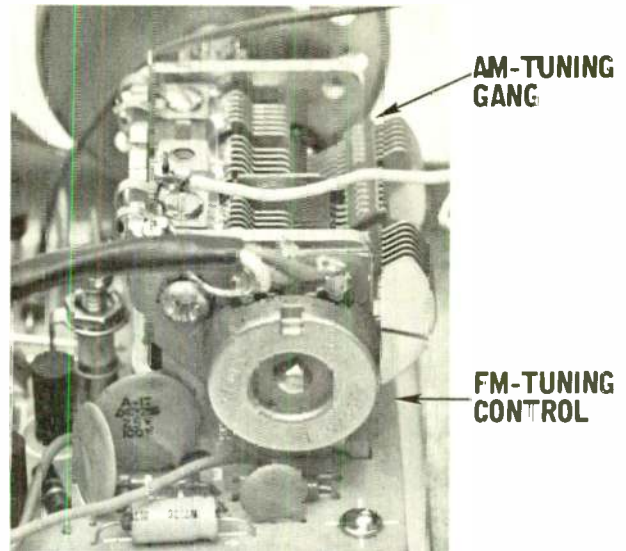
RC 1245—Tuning Controls

The tuning voltage (reverse bias) for each of the three varactor diodes is supplied from the wiper arm of the FM tuning control, R200. The tuning control is a 10K-ohm linear-taper potentiometer.

Resistors R201, R208, and R222 with capacitor C202 serve as isolation between the RF circuits and the tuning voltage source. The tracking controls, R212 and R238, are connected in a series divider network with the tuning control, R200. The low-end tracking control, R212, is adjusted to supply the correct tuning voltage to the varactor diodes when tuned to the low end of the band (87.2 MHz). Tracking is assured by adjustment of R238 to supply the correct tuning voltage when tuning to the high end of the band (108.5 MHz).
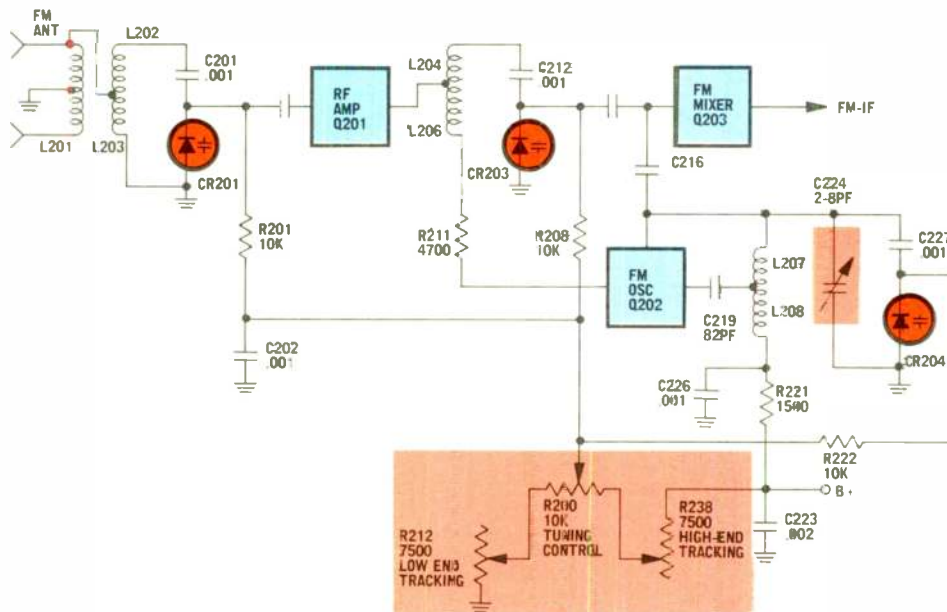
RC 1245—FM Tuning Circuits (Simplified Schematic)
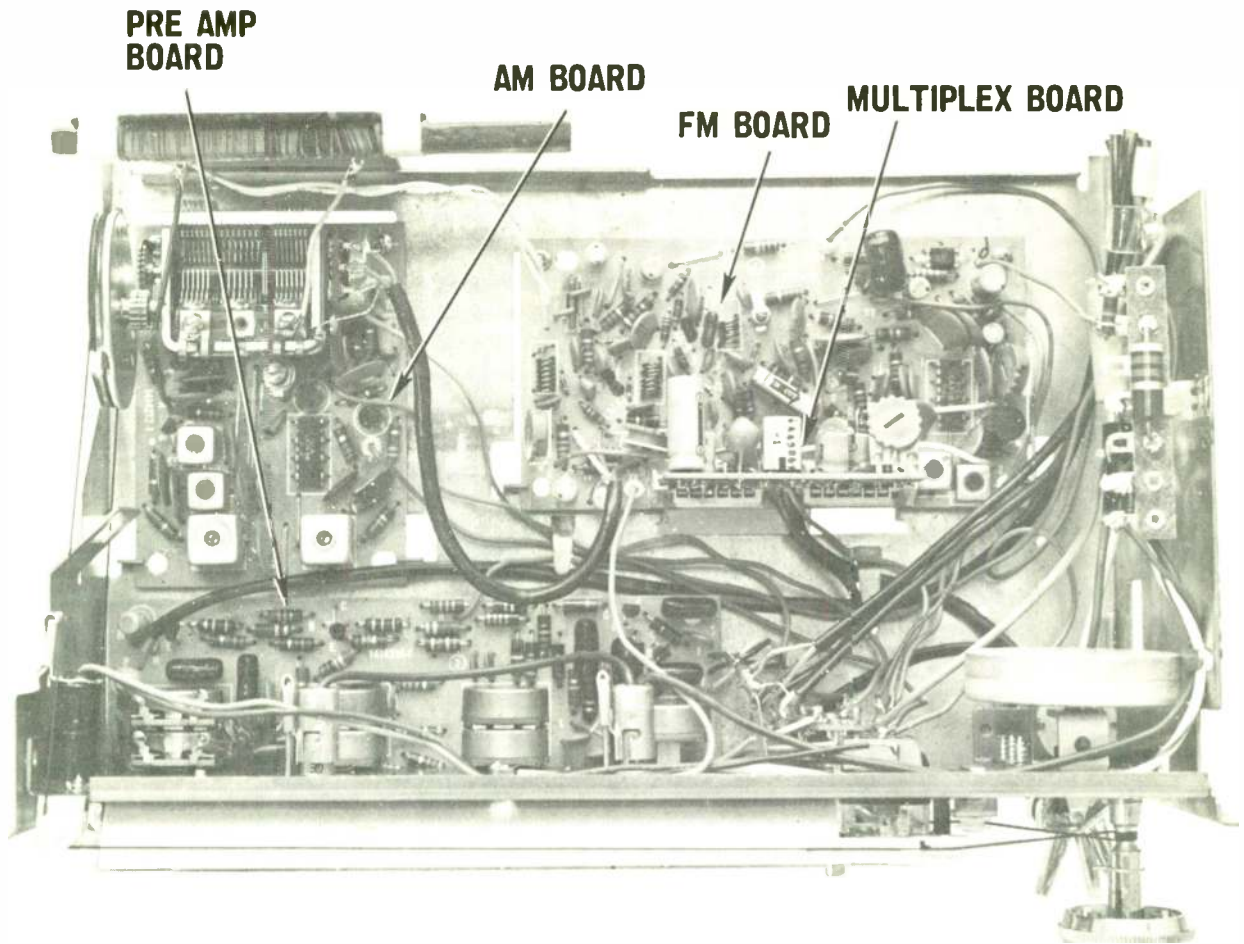
RC 1245B—Top View

CR 202 is used to provide RF attenuation of high amplitude signals. Under low signal conditions this diode is biased off, whereas it is biased on at high RF levels by AGC and tuning-meter drive voltage. A relatively constant input impedance to the RF amplifier is maintained by minimizing capacitive changes which would detune the antenna circuit.

The output of the RF amplifier is coupled, via topped capacitance divider, C213 and C214, to the base of

the mixer transistor, Q203. The oscillator signal is coupled to the mixer base by C216.

IF Amplifier

The first stage of IF amplification is accomplished by a discrete-component amplifier in a common-emitter configuration. The input signal is coupled to the base of Q204 by the ceramic filter, which is comparable to two double-tuned circuits. The high Q of the ceramic filter provides excellent selectivity
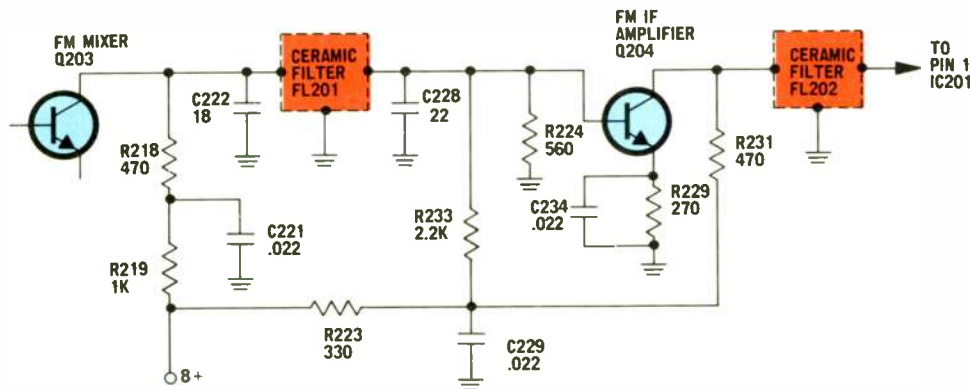
RC 1245—FM IF Amplifier (Simplified Diagram)
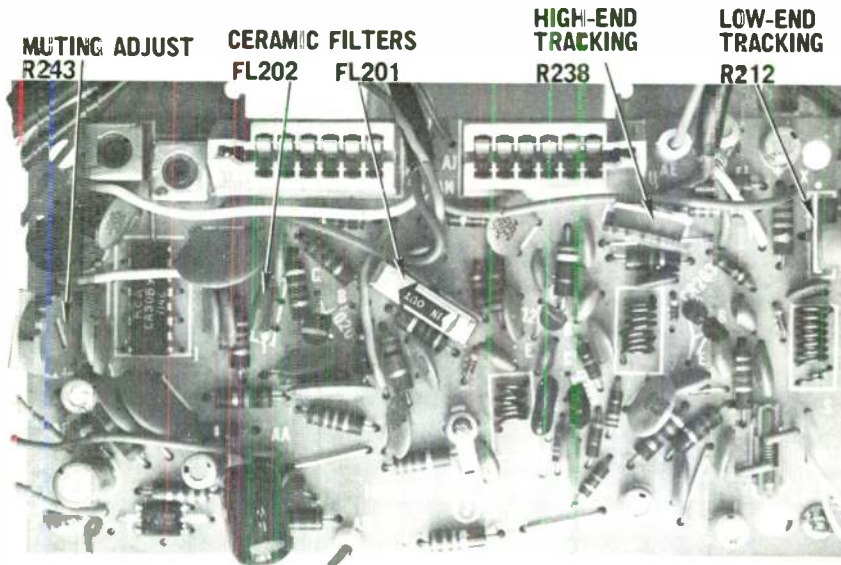
RC 1245—FM Circuit Board

and a flat response. A ceramic filter, FL 202, comparable to a double-tuned circuit, is employed to couple the IF amplifier output to the integrated circuit device, IC 201.

The ceramic filters, **FL 201 and FL 202 are used in color-coded, matched pairs.** Should replacement of either filter be necessary, the replacement device must have the same color code; otherwise, both filter devices must be replaced with a matched pair. **RCA Parts and Accessories** will stock replacement pairs of filters under one part number.

FM Detection

The remainder of the FM IF circuitry, consisting of three differential-pair amplifiers, is contained in
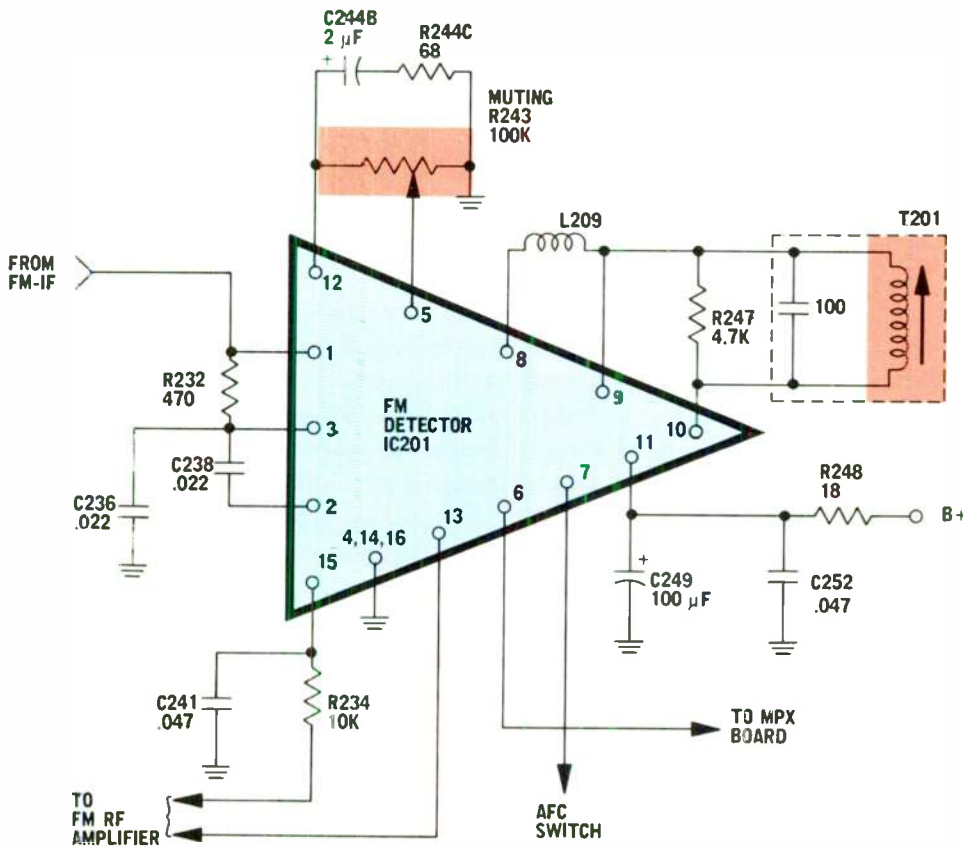
RC 1245—FM Detector (Partial Schematic)

IC 201, the FM detector integrated circuit. The IF signal from the final IF stage is internally coupled to the FM detector in IC 201.

FM detection is accomplished by a doubly balanced quadrature detector which produces an output of 370 millivolts at 100% modulation ($\pm$75 kHz frequency deviation). AGC, AFC, and audio muting are developed within IC 201. A delayed AGC voltage (about 3 volts) is coupled to the base of the RF amplifier, Q201.

AFC voltage is available at pin 7 of IC 201. Enabled by the AFC switch, the AFC voltage is applied to the tuning bias circuit, thus changing the reverse bias applied to the varactor diodes to correct the frequency.

Audible noise occurring as the FM receiver is tuned between stations is automatically muted within IC 201. As the muting adjustment, R243, is rotated from the counterclockwise extreme (maximum noise between stations) noise is reduced. At the clockwise limit there is no interchannel noise, but only very strong signals will be received. The control is factory adjusted for best reception in the majority of locations; however, readjustment may be desirable in areas where reception conditions are abnormal.

Only one adjustment is required for the alignment of circuitry associated with the FM detector board, that being the quadrature coil, T201. Procedures for this adjustment are covered in the servicing section in later text.

FM Multiplex Decoder

The decoder circuitry is fully contained in a plug-in module physically similar to those used in RCA television products. The majority of the decoder circuitry is within an integrated circuit and there are a minimal number of discrete components. Electrically the circuit design is a closed-loop system utilizing a phase-locked loop. Features of this system include: only one adjustment for complete multiplex alignment, automatic stereo switching, driver for stereo indicator, excellent noise immunity, high stability within a wide ambient temperature range, and excellent separation.

STEREO THRESHOLD
ADJUSTMENT
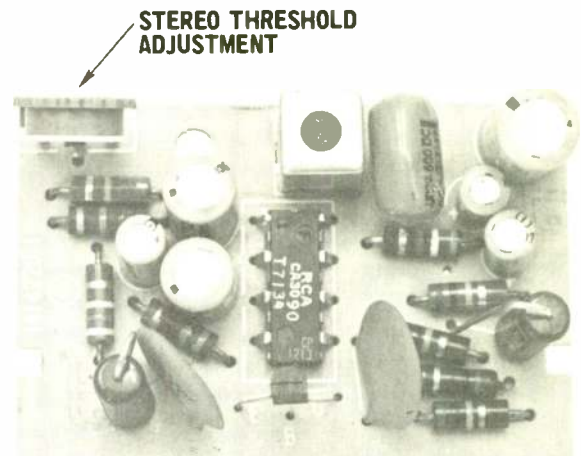
RC 1245—Multiplex Circuit Board
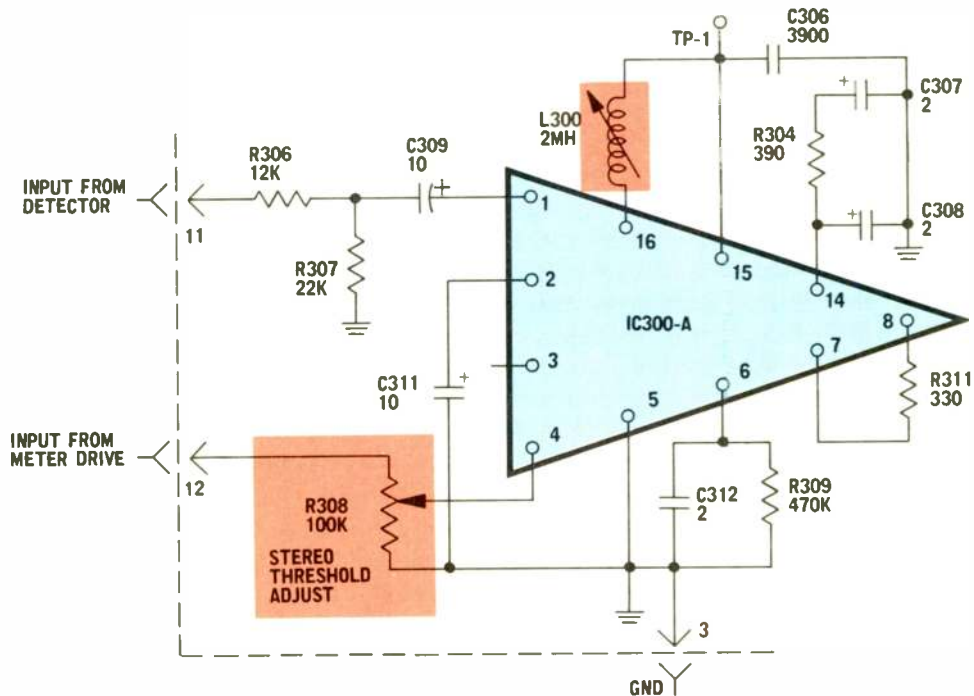
RC 1245—FM Multiplex Decoder (Section A)
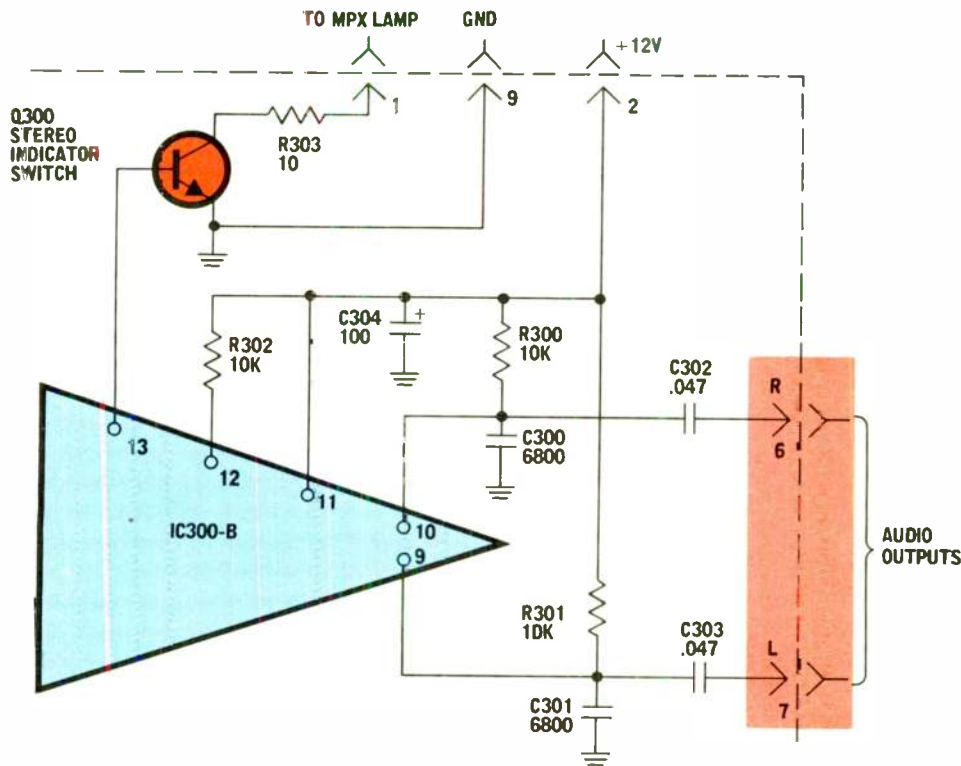
RC 1245—FM Multiplex Decoder (Section B)

The schematic of the multiplex board is illustrated in two parts for simplicity in diagramming. The input from the FM detector arrives at board contact 11 and is applied to the divider network of R306 and R307. The composite stereo signal is then coupled, via C309, to pin 1 of IC 300. The right and left channel audio signals are available at board contacts 6 and 7, respectively. The stereo indicator switch, Q300, is controlled by internal circuitry to operate the stereo indicator lamp.

The stereo threshold control voltage is adjustable by R308. When the RF signal from the FM board exceeds the threshold, it turns on the indicator lamp and automatically switches from monaural to stereo operation.

Integrated Circuit

Specific consideration is given in the design of this multiplex system to meet the requirements of a quality stereo receiver. The 38-kHz subcarrier must be reestablished at a precise phase angle to accomplish decoding. Degradation of the signal-to-noise ratio must be held to an absolute minimum in the decoder. There must be maximum rejection of the SCA signal. Interstation flicker of the stereo light while tuning across the FM band should be eliminated.

The stereo-decoding integrated circuit used in this system is equivalent to 129 transistors and diodes plus some 400 discrete components. A description of the IC appears in **RCA Solid State Division Publication File No. 502.** For the purposes of this manual the accompanying block diagram is used to explain the basic operation of the decoding process.

The key circuitry in this system is the **phase-locked loop** consisting of a voltage controlled oscillator (VCO), a series of frequency dividers, and a phase sensitive detector. The VCO used in this circuit is an LC oscillator operating at a frequency of 76 kHz. The harmonic frequency is used to insure the reinsertion of a symmetrical 38 kHz carrier; a nonsymmetrical carrier will impair channel separation and induce SCA interference.

The 76 kHz oscillator signal is coupled to a frequency divider, which divides by 2, giving a 38 kHz output. The 38 kHz sub-carrier is applied to the L-R detector and to two separate dividers, each providing a 19 kHz output. The 19 kHz output from the first divider is coupled to the phase-lock detector.

The phase relationship between the 19 kHz input from the divider and the 19 kHz component of the

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14 15 16

VOLTAGE CONTROLLED OSCILLATOR

DIVIDER F/2 38 kHz

DIVIDER F/2 19 kHz

DIVIDER F/2 19 kHz

11

POWER SUPPLY REGULATOR

STEREO GATING SIGNAL

PRE AMP

1

2

COMPOSITE SIGNAL

PHASE LOCK DETECTOR 19 kHz

PILOT PRESENCE DETECTOR 19 kHz

L-R DETECTOR 38 kHz

L-R SIGNAL

MONO STEREO LOGIC

SCHMITT TRIGGER

MATRIX

L-AMP

9

R-AMP

10

STEREO ENABLE SIGNAL

IC300

TO PILOT PRESENCE DETECTOR

LAMP DRIVER

3 4 5 6 7 8 12 13

IC 300—Multiplex Decoder Block Diagram

composite stereo signal should be 90 degrees. The phase detector makes a phase comparison of these two 19 kHz signals. As long as a 90 degree phase relationship exists, no correction voltage is produced. Should the phase deviate from 90 degrees, a correction voltage is supplied to the voltage controlled oscillator (VCO) to reestablish the 90 degree phase difference between the two signals.

Because the phase detector can produce zero correction voltage when no pilot signal is received, a second detector, the pilot presence detector, is needed to switch automatically from stereo to monaural. The output of the pilot presence detector activates the mono-stereo logic circuit, which in turn controls operation of the schmitt trigger circuit. The outputs from the schmitt trigger enable the lamp driver and 38 kHz L-R detector.

The L-R detector is a doubly-balanced synchronous detector, the outputs of which are applied to the matrix summing network to produce separate left and right channel audio signals. The composite signal preamp and audio post-detection amplifiers complete the stages within the integrated circuit. The audio signal is taken from the multiplex board at terminals 6 and 7, and applied to the audio preamp via the function switch. An external lamp-driver stage is used to provide the necessary power for the stereo indicator.

Interstation lamp flicker is minimized by means of a DC control voltage, developed in the FM-IF chip, which locks out the decoder at low RF levels.

During non-stereo broadcasts the decoder is kept turned off by the lack of a pilot signal. The audio from the FM detector is coupled to the post amplifiers via the matrix network.

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AM Receiver

Components making up the AM portion of the RC 1245 tuner include a discrete transistor, an AM overload device, an integrated circuit, and the FM tuning potentiometer. The accompanying illustration shows a simplified diagram of the complete AM portion.

The RF amplifier uses a common-base configuration. The RF input is coupled to the emitter. The AM overload circuit is also connected to the emitter circuitry to attenuate exceptionally strong signals by regulating the input impedance.

The RF signal along with the oscillator signal is applied to the converter, represented by IC 101A. The IF output of the converter is coupled to the first IF amplifier by a double-tuned transformer. The first IF stage is represented by IC 101B. A second double-tuned IF transformer is utilized to couple the IF signal to the 2nd IF amplifier and detector represented as IC 101C.

AGC voltages are developed inside the IC. AGC is internally applied to the first IF amplifier, and RF AGC, available at IC terminal 13, is applied to the base of the RF amplifier. A meter drive signal is generated internally and appears at terminal 12.

An audio preamp rounds out the circuitry contained within the integrated circuit. The audio signal is coupled to the preamp board through the function control.
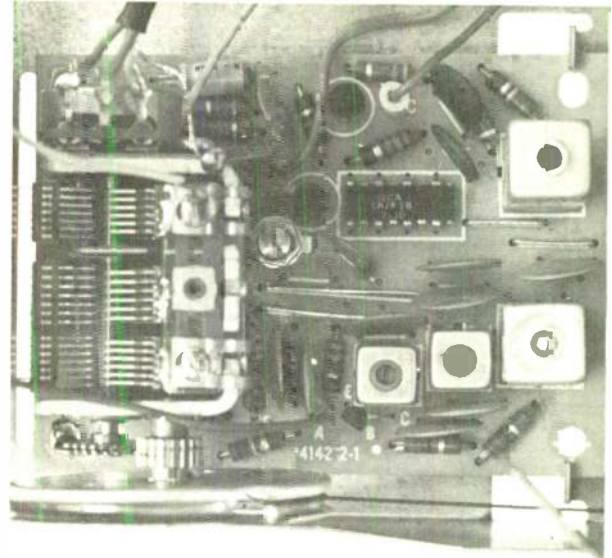
RC 1245—AM Circuit Board
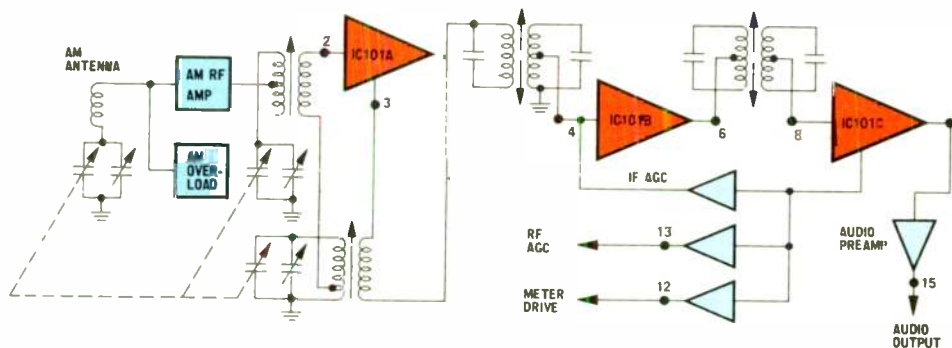
RC 1245—AM Tuning Circuits (Simplified Schematic)

Audio Preamplifier

The audio preamplifier consists of four transistor amplifiers, two per channel, and associated components. The customer controls, bass, treble, balance, and loudness, are included in the preamp circuits. AM, FM, and phono inputs are applied to

RC 1245—Preamp Circuit Board

RC 1245—Preamp Block Diagram

the first preamplifier stage. This stage is bypassed for the tape function, since the tape player has its own preamplifier. The audio output from the pre-amp is coupled to an external power amplifier.
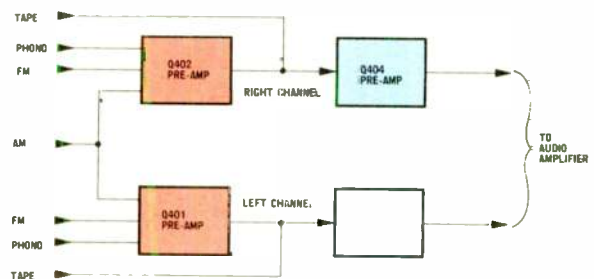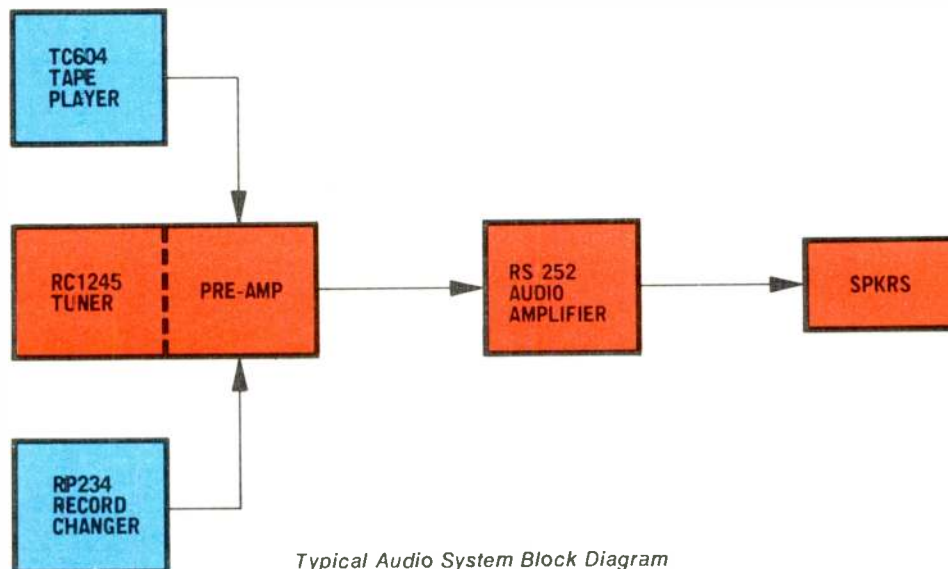
Power Supply Regulator

Zener regulators are built into the integrated circuits and **each regulates its own voltages.** However, since the B+ supply is the source for the tuning bias, it is important to control it within very close tolerance. Twenty-five volts DC is supplied to the tuner assembly from the power amplifier. B+ for the tuner preamp is supplied directly from the 25-volt line, and thus it is independent of the function switch.

The 25 volt line also supplies the regulator stage of IC 202. The regulator maintains a nominal 12 volts B+ for the remaining tuner circuitry.
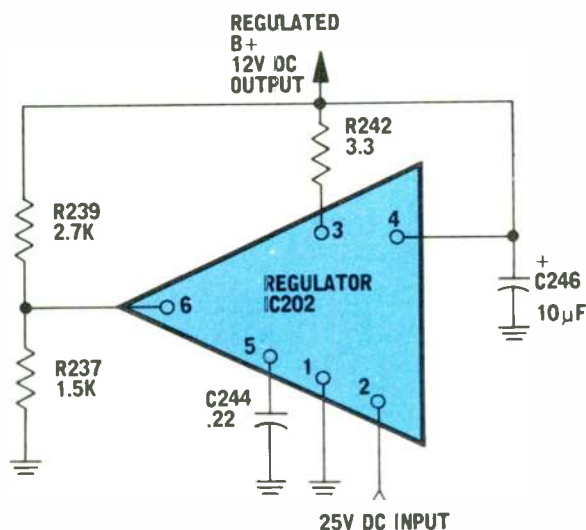
RC 1245—Voltage Regulator Schematic

Variations

Two versions of the RC 1245 tuner will appear in the 1973 Product Line, the difference designated by suffix letters A and B. The **RC 1245B** contains a tuning meter, mono-stereo switch, and flywheel tuning. One position on the function switch serves for both stereo FM and monaural FM. The **RC 1245A** function switch has separate positions for FM and FM stereo.

Servicing

Four separate boards are used for the AM receiver, FM receiver, multiplex decoder, and preamplifiers. Since the multiplex board is a plug-in module, there is no difficulty if replacement becomes necessary. Nevertheless, care should be exercised in the removal or insertion of this module so not to exert undue pressure on the parent board.

The preamp board is mounted to the chassis by the lock-nuts on the front panel controls and may be taken out by removing the lock-nuts and un-soldering the necessary leads. The remaining boards are tack soldered to the chassis on two corners of one edge while the other side is held in position by slotted brackets. These boards may be removed by unsoldering the corners from the chassis, sliding the board out of the slots and removing the interconnecting leads. However, virtually all components can be removed and replaced with the boards remaining in place.

In most instances, **voltage measurements will be sufficient to locate malfunctions.** The following tables show nominal voltages to be expected of a normally operating tuner.

Typical Audio System Block Diagram

PB-40 FM TUNER

Device	Terminal	Voltage	Comments
Q201 FM RF Amp	Base	3V	
	Emitter	2.3V	
	Collector	9V	
Q202 Oscillator	Base	1.7V	
	Emitter	1.2V	
	Collector	9V	
Q203 Mixer	Base	1.7V	
	Emitter	1.1V	
	Collector	10V	
Q204 IF Amplifier	Base	1.9V	
	Emitter	1.2V	
	Collector	8V	
IC201	1	2.2V	
	2	2.2V	
	3	2.2V	
	4, 14, 16	0	
	5	0	On Station
		1.85V*	Off Station
	6	6V	
	7	6V	
	8	6V	
	9	6V	
	10	6V	
	11	11V	
	12	4.2V	
	13	2.4V	
	15	5.3V	
IC202 Regulator	1	0	
	2	25V	
	3	11.6V	
	4	12V	
	5	13V	
	6	4.2V	

*Adjustable voltage
All voltages are measured with respect to chassis ground.
Function switch in FM position with stereo reception.

PB-37 AM TUNER

Device	Terminal	Voltage	Comments
R200 FM Tuning	Wiper Arm	Variable 4V to 9V	From low end to high end of FM band
Q101 AM RF Amp	Base	2.5V	
		3.3V	No signal
	Emitter	1.8V	
		2.5V	No signal
	Collector	5.3V	
		4.7V	No signal
IC101 AM Circuits	1	.8V	
	2	1.4V	
	3	5.5V	
	4	.5V	
		.65V	No signal
	5	0	
	6	5.6V	
	7	1.3V	
	8	1.3V	
	9	.9V	
		.7V	No signal
	10	5.5V	
	11	.7V	
		.6V	No signal
	12	.1V	
		.01V	No signal
	13	2.5V	
		3.3V	No signal
	14	1.2V	
	15	2.4V	
	16	12	

All voltages measured with respect to ground.
Function switch in AM position except for FM
tuning bias values.

PB-39 FM MULTIPLEX DETECTOR

Device	Terminal	Voltage	Comment
Q300 Stereo Indicator	Base	.7V	Stereo signal
		.23V	No stereo signal
	Emitter	0	
	Collector	.13V	Stereo signal
		8.3V	No stereo signal
IC300	1	3.5V	
	2	3.5V	
	3	0	No connection
	4	1.5V*	Stereo signal
		.5V	No signal
		.8V	Monaural signal
	5	0	
	6	4.3V	Stereo signal
		1.3V	No signal
		2.4V	Monaural signal
	7	.25V	
	8	.25V	
	9	6V	
	10	6V	
	11	12V	
	12	.8V	No signal
		12V	Monaural signal
	13	.7V	No signal
		.23V	Monaural signal
	14	2.5V	
	15	3.1V	
	16	3.1V	
Circuit Board	1	.5V	Stereo signal
		8.3V	No stereo signal
	2	12V	
	3	0	
	4	0	No connection
	5	0	No connection
	6	.5V	
	7	.5V	
	8	0	No connection
	9	0	No connection
	10	0	No connection
	11	5.6V	
		4.8V	No signal
	12	1 to 3V	Varies with signal strength

*Adjustable voltage
All voltages taken in respect to ground. Function switch
in FM position with stereo operation except as noted.

PB-38 AUDIO PREAMPLIFIER

Device	Element	Voltage
Q401	Base	1.8V
	Emitter	1.2V
	Collector	12.5V
Q402	Base	1.8V
	Emitter	1.2V
	Collector	12.5V
Q403	Base	.85V
	Emitter	.35V
	Collector	21V
Q404	Base	.85V
	Emitter	.35V
	Collector	21V

FM Tuner Alignment

It is unlikely that sweep alignment of the FM tuner will become necessary unless the "front end" inductors are deformed by tampering. Complete sweep alignment data are being published in the Service Data to provide for this eventuality. **The simplified procedures given here will be adequate for the majority of cases.**

Field alignment of the FM tuner is essentially a matter of making the RF amplifier, local oscillator, and mixer track across the FM band. To make these tracking adjustments, a voltmeter, preferably a VTVM or EVM such as the **RCA WV 98 or WV 510,** and a modulated signal generator such as the **RCA WR 99** are required. (It is recognized that the WR 99 is not designed to be frequency modulated; nevertheless, its 600-Hz internal modulator does produce an audible output from the FM receiver.)

1. Set the receiver function switch to FM position and apply power to the receiver and test equipment. Allow 10 minutes for warm-up.

2. Connect the DC voltmeter to the center arm of the FM tuning control, R200 (or point "V" on the FM circuit board, PB40).

3. Adjust the FM tuning control to the low end of the dial (87.5 MHz) and adjust R212, low end tracking, for a 4-volt indication on the meter.

4. Adjust FM tuning control to the high end of the dial (108.5 MHz) and adjust R238, high end tracking, for a 9-volt indication on the meter.

5. Connect the signal generator to the FM antenna terminals and tune the generator to 108.5 MHz modulated by an audio tone. Then adjust the FM oscillator trimmer capacitor, C224, for maximum audio.

6. Tune the generator to 87.5 MHz and tune the receiver to the lower limit of the FM dial. Adjust R212, low end tracking, until maximum output is heard.

7. Return the generator to 108.5 MHz and tune the receiver to the upper limit of the FM dial. Adjust R238, high end tracking, until maximum output is heard.

Because of the interaction between the tracking controls, **steps 6 and 7 may require repetition for optimum tracking.** It may be desirable to "fine tune" the tracking controls by using known FM stations broadcasting at frequencies toward the limits of the FM band.

Quadrature Detector

1. Switch off AFC.

2. Connect a DC voltmeter to the high side of R308, the stereo threshold adjustment (edge connector 12 of multiplex board).

3. Tune the receiver to a medium strength station (approximately 2 volts on meter).

4. Adjust T201, the quadrature coil, while at the same time turning the AFC switch on and off. T201 should be adjusted for minimum voltage change as the AFC switch is repeatedly turned on and off.

Multiplex Alignment

1. Tune the receiver to a station known to be broadcasting a stereo signal.

2. Turn the core of the multiplex coil, L300, to the bottom.

3. Momentarily short across the FM antenna terminals. The stereo indicator light should now be off. It may be necessary to disconnect the antenna from the chassis in strong-signal areas.

4. Very carefully back off the core of L300 until the stereo indicator lights. Note the mechanical position of the core slot.

5. Turn the core of the multiplex coil, L300, to the top.

6. Momentarily short the FM antenna terminals. The stereo indicator light should now be off.

7. Very carefully adjust the core of L300 until the stereo indicator lights and note the mechanical position of the core slot.

8. Adjust L300 so that the core slot is centered between the mechanical positions just determined.

Stereo Threshold Adjustment

1. Turn R308, stereo threshold control, fully clockwise.

2. Tune to the weakest desired FM stereo broadcast signal.

3. Adjust R308, stereo threshold control, counterclockwise until the indicator light just turns off; then back it off until the light turns on.

Muting Threshold Adjustment

Advancing the muting control in the clockwise direction will decrease noise between channels and prevent reception of very weak signals. If the control is advanced too far, there will be no noise between stations; but weak, usable signals may be muted, and the receiver will "thump" when a strong signal is tuned in. Local conditions and preferences will dictate the degree of muting which should be used.

Transistor Testing

As another service aid, an in-circuit check of the transistors can be made using the **RCA WC-528A Quicktracer Transistor Checker.** The waveform photographs shown are those obtained for each transistor in the RC 1245B chassis.
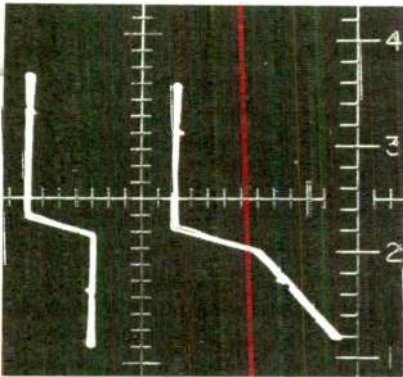
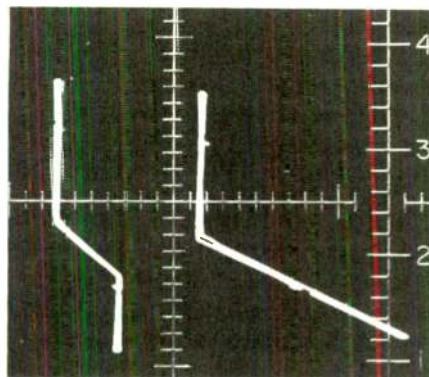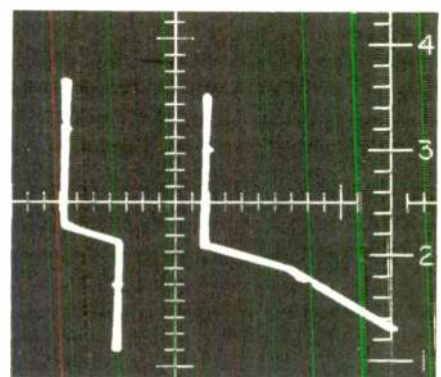| Base to Emitter	Base to Collector	Base to Emitter	Base to Collector	Base to Emitter	Base to Collector

Q201

Q202

Q203
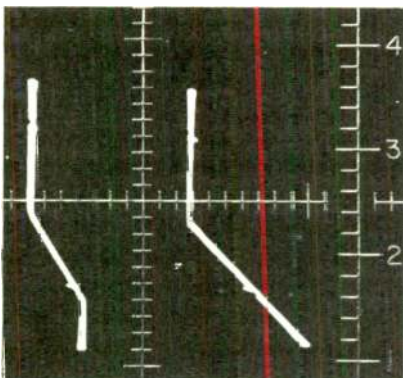
Q204
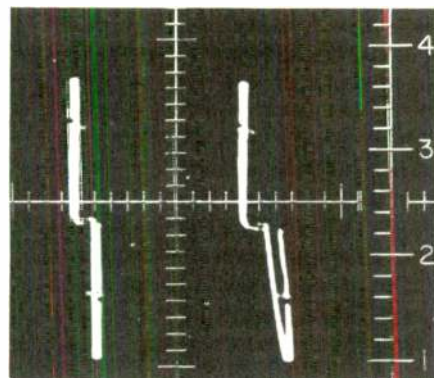
Q300
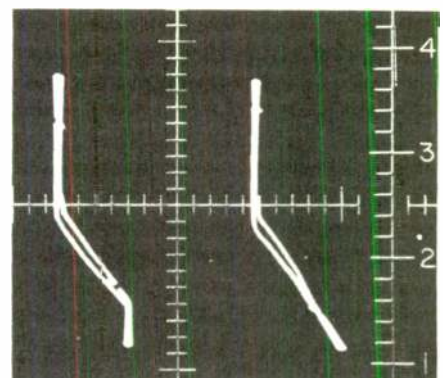
Q101
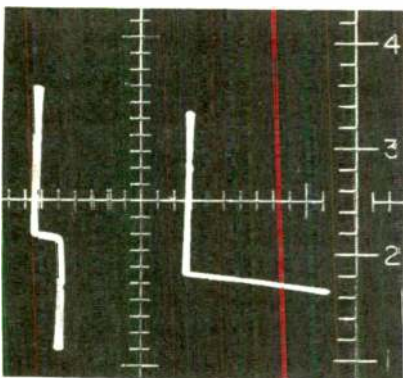
Q401
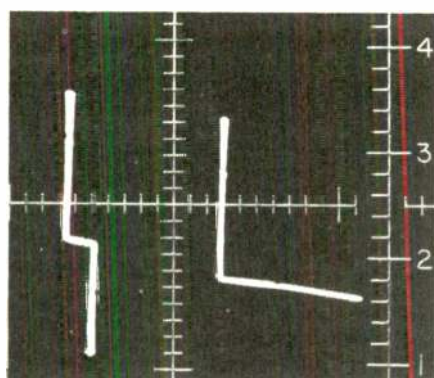
Q402
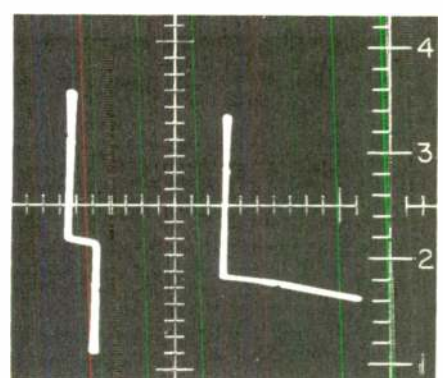
Q403
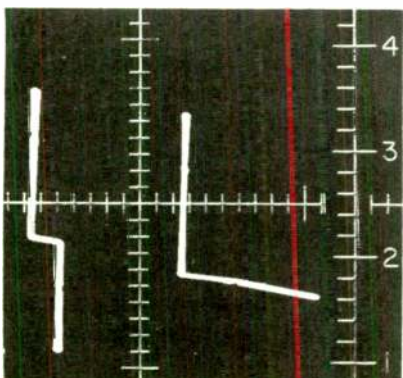
Q404

Conditions of test: These waveforms were obtained using the **RCA WC 428A Quicktracer Transistor Tester** and the **RCA WO 505A Oscilloscope** as described in **"TRANSISTOR TESTING"** *RCA Television Service Tips, Volume XXIII, Issue 1.* All power to the chassis was removed.

RC 1246 and RC 1247

The RC 1246 and RC 1247 are new receiver chassis designed for use in modular sound systems. The same circuit boards are used in these chassis that appear in the RC 1245. For application to modular sound systems the power amplifier board is assembled on the same chassis. The RC 1246 develops a peak power output of 50 watts, while the RC 1247 is rated for 100 watts. The RC 1246 and RC 1247 are used in applications comparable to those where the RC 1244 and RC 1240, respectively, were used.

Continued Tuners

The **RC 1238F** is continued for use in some console radio-phonograph instruments. Features such as flywheel tuning, stereo indicator light, tuning meter, and lever switches are retained. The RC 1238F remains virtually unchanged from 1238-series tuners employed in previous model years.
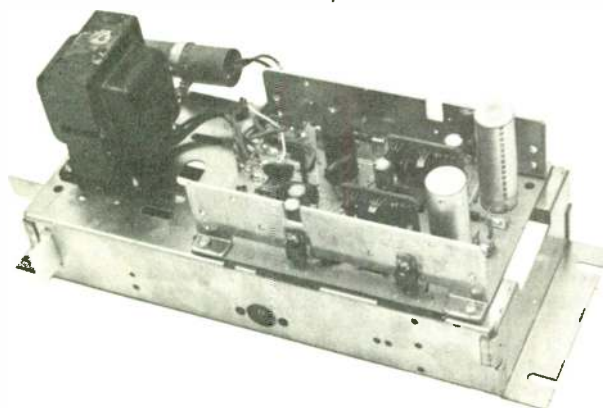
The **RC 1244** and **RC 1240** are also continued for use in some modular sound systems.

Amplifiers

Amplifiers for use in R-Line radio-phonograph instruments include several continued chassis. The **RS 252** and **RS 253** rated at 50 and 100 watts peak
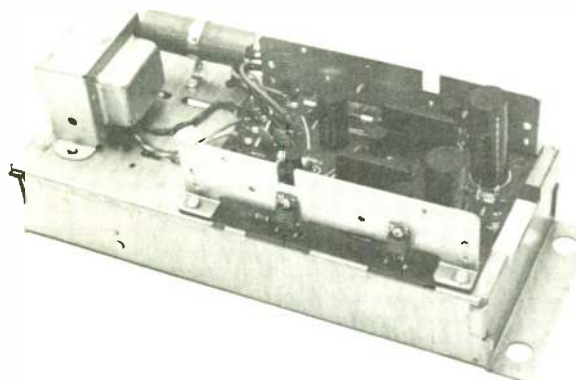
RS 252B—Audio Amplifier Chassis

RS 252J—Audio Amplifier Chassis

music power, respectively, are continued, along with the 200-watts-peak-power **RS 266** chassis.

The significant difference appearing in the R-Line chassis is the use of discrete-component driver modules (one per channel) to replace the encapsulated version. The two types are completely interchangeable, and early production may use either type until the supply of encapsulated modules is exhausted.
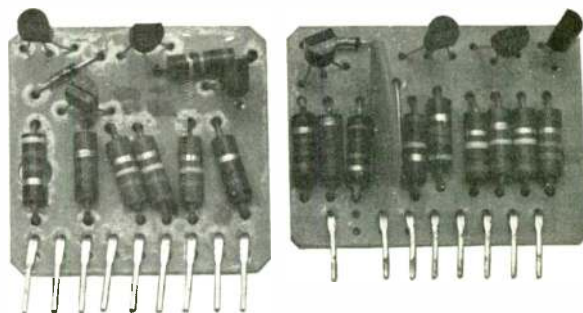
Discrete Component Driver Modules

The 500-watt, peak rated, **RS 263** chassis is also continued for use in top-of-the-line consoles. The **RS 270** and **RS 271,** both rated at four watts peak, are continued for use in portable phonograph instruments. A discrete-component driver module will also appear in the later versions of these amplifiers, replacing the encapsulated driver module.

Modular Sound Systems

The 1973 product line offers a selection of modular sound systems. They range from models featuring phonograph function only to models which contain an AM/FM/FMS tuner, record changer, and an 8-track cartridge tape player. Several different radio tuners appear in the various models, including the new varactor FM tuners (RC 1246 and RC 1247) discussed before. Speakers employed with the modular instruments range from individual speakers housed in separate cabinets to the familiar SPK 350's.

VS 5001—Modular Sound System
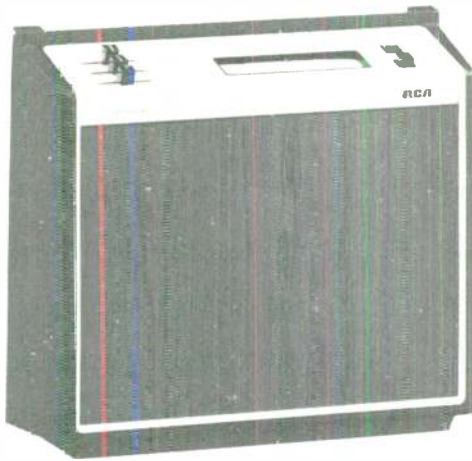
YZD 584—8 Track Stereo Player

Tape Instruments

The 1973 product line includes a wide variety of tape instruments from which the desired features can be selected. The various features include: monaural or stereo, cassette or cartridge, battery operated, AC or AC/DC, record and playback or player only. One model, the **YZB 537,** is a cassette tape record and playback unit which features a built in AM/FM radio. Provision is made for recording with an external microphone, or internally from the radio.

TC 604 8-Track Tape Player

The TC 604 is an 8-track stereo cartridge player which will be widely used in console stereo instruments. Automatic or manual track selection is included. Four indicator lamps are provided to show

TC 604—8 Track Stereo Tape Deck

the selected program. Two three-stage pre-amplifiers are used to provide signals to drive the output amplifiers. A ganged LEVEL control is included to adjust the output signal of each channel to the desired amplitude.

Mechanical adjustments include head height, azimuth, and tape pressure. For the most part, the procedures for the mechanical adjustments should be familiar. However, for convenience, the TC 604 adjustments are included here.

YZB 537—Cassette Recorder

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MOTOR

AZIMUTH
ADJ.

POWER
TRANS.

FLYWHEEL

SOLENOID

AUTO
TRACK SW.

T30798-001

TC 604—Tape Deck (Top View)

ON/OFF SW.

OUTPUT
LEVEL ADJ.

HEAD HEIGHT
ADJ.

PRESSURE ADJ.
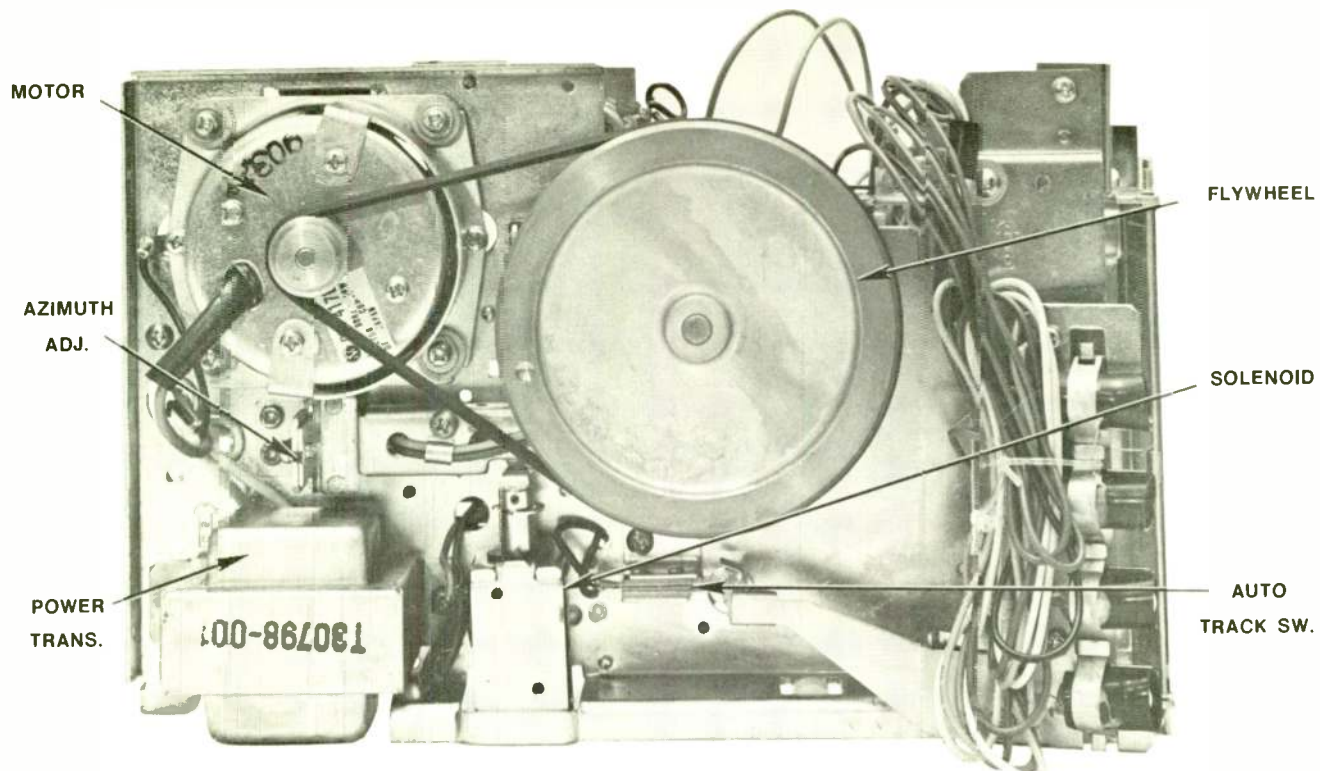
MANUAL TRACK
SW.
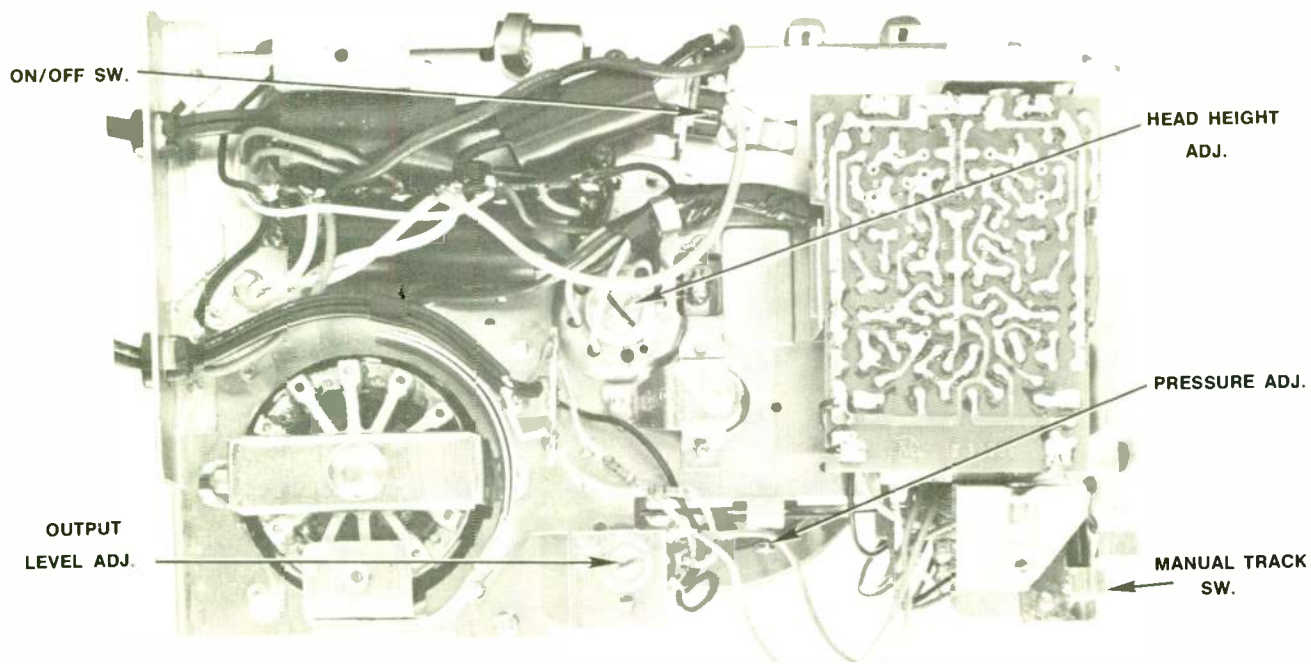
TC 604—Tape Deck (Bottom View)

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Head Height

Select track 2 of **RCA test cartridge #321.** Connect a VTVM or oscilloscope across the left channel LEVEL control. Adjust the head-height screw for minimum signal. (Use the shallow slot in head–height screw.)

Azimuth

Still using track 2 of test cartridge #321, connect a VTVM or oscilloscope across the right-channel LEVEL control. After loosening the lock screw in the head mounting assembly, insert a non-magnetic screwdriver into the yoke of the head mounting assembly and adjust for maximum output indication.

Tape Pressure

Tape pressure is the amount of "pull" required to retract the cartridge sufficiently to cause tape slippage. The normal pressure is 3 pounds. To check for pressure, attach a spring scale to the front edge of the cartridge and note the amount of "pull" required to cause slippage. To correct the tape pressure, the pressure roller screw is adjusted as required to yield a 3 pound pressure as measured above. A "pull" of approximately 0.6 pounds is developed per revolution of the screw.

Clock Radios

The clock radio line for this year offers a wide variety of features with practically any combination being available. Both digital and dial-face clocks are available with AM or AM/FM receivers.

RZD 426—AM/FM Clock Radio

RZC 259—AM/FM Table Radio

Table Radios

Several table models are introduced with the R-Line radio products. As in previous years a selection can be made from various cabinet styles in AM, AM/FM, or AM/FM/FM-stereo radios.

RZS 477—AM/FM Clock Radio

One model, the RZS 477, features a low profile, digital clock, and a graph type dial for AM/FM tuning. Other features included in various models are: wake-to-music, slumber button, buzzer alarm, and night light.

RZC 251—AM/FM Table Radio

Portable Radios

The 1973 portable radio line includes both battery operated and AC/DC models in a variety of sizes and styles. Either AM, AM/FM, or multiple-band receivers are available.

RZM 176—AM/FM Portable Radio
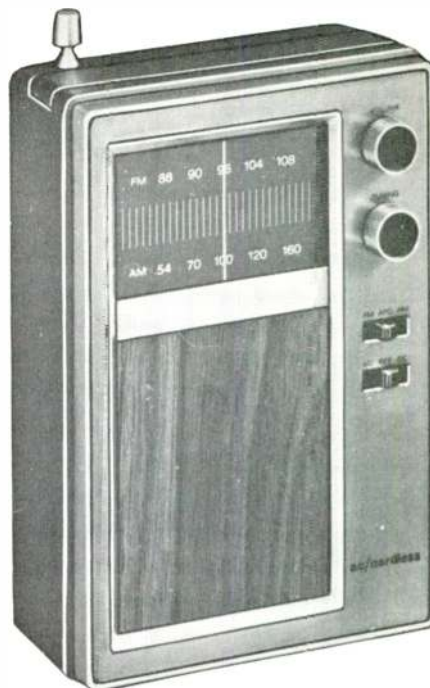
RZM 171—AM/FM Portable Radio

RCA

BLACK AND WHITE TELEVISION

A total of eight different chassis fulfill the requirements for every type of monochrome TV viewing. Two chassis, the **KCS 188,** and the new **KCS 187** provide a choice of tube-type or all-solid-state performance in the 12-inch diagonal screen size. The **KCS 168** is available for those who prefer the extra viewing area of a 15-inch diagonal screen.

In large-screen portable receivers a wide choice of features are made available in three continued chassis. All-solid-state performance and the serviceability of modular construction are featured in the 19-inch (diagonal) **KCS 186.** The tube-type **KCS 171** gives a choice of 18-inch and 19-inch diagonal screens; 19 and 20-inch diagonal screens are available in the **KCS 172** tube-type chassis.

Rounding out the R Line of black-and-white instruments are the continued **KCS 179** and **KCS 183.** Both of these are used with 22-inch diagonal screens; both are horizontal, hybrid chassis. The KCS 179 is used in table models, and the KCS 183 is installed in consoles.

Module Usage Chart

The chart below lists all modules which have been used in RCA Black-and-White Television Receivers. An X at the intersection of a module line and a chassis column indicates that the module is used in that chassis. A downturned arrow indicates that the module has been used, and can be used, in the chassis; but, a later version of the module is being supplied. The later version of the module has some change which may be required by a new chassis or may improve performance in some, or perhaps all, instances. Consider the MAF 001A, B, and C modules. These may be used interchangeably in the M, P, and Q line chassis, **but only the MAF 001C is recommended for the new R Line chassis.** Replacement stock of these modules is therefore not outdated but continually up-dated.

Service Data

Numerous field personnel have been requesting a different numbering system for RCA Service Data. They have expressed a desire to maintain separate files for monochrome and color television. A new numbering system was initiated with the 1972 RCA Service Data.

"B/W" preceding the file number indicates black-and-white chassis information and "CT" indicates color television information.

Gray shading is being used on all schematic diagrams to designate components or assemblies which have safety-related characteristics. In many instances this characteristic may not be identifiable by inspection, nor may it be assumed that a component having a higher voltage rating, higher wattage rating, etc. is an acceptable substitute. For continued minimization of hazards, only exact RCA replacement parts shown in the RCA Service Data parts list should be used.

	KCS 176 M, P, Q-LINES	KCS 176 R-LINE	KCS 177 M, P, Q-LINES	KCS 177 R-LINE	KCS 184	KCS 185	KCS 186	KCS 187	STOCK NO.
MAF001A	↓		↓			↓			131314
MAF001B	↓		↓			↓			133415
MAF001C	x	x	x	x		x		x	135158
MAF002A					x				131952
MAF003A							x		134766
MAG002A							x		134768
MAH002A						x		x	132540
MAH003A							x		134769
MAI001A	↓	↓	↓	↓	↓	↓	↓	↓	129702
MAI001B	x	x	x	x	x	x	x	x	136014
MAL002A							x		134767
MAM001A	↓	↓	↓	↓					129700
MAM001B	x	x	x	x	x	x		x	131951
MAN001A						x		x	132538
MAO001A						x			132539
MAO002A								x	135737

New Black-and-White Chassis

The KCS 187

The modular concept is expanded in the black-and-white line by the introduction of the **TransVista®** **KCS 187.** This 12-inch (diagonal) solid-state modular chassis carries the **RCA "Purchaser Satisfaction"** one year warranty.

KCS 187—Chassis View

Model AR 128E—KCS 187

Familiar circuits, adapted from the KCS 185, are used in the IF amplifier, audio-IF and output circuits, video amplifiers, and horizontal oscillator. Variations occur in the power supply and the deflection-output circuits because of requirements of the larger picture tube.

Block Diagram

Approximately 80% of the circuit functions of the KCS 187 are accomplished by the six modules shown in red. In addition to the plug-in modules, **the regulator, vertical-output, and horizontal-output devices are plug-in transistors** mounted to
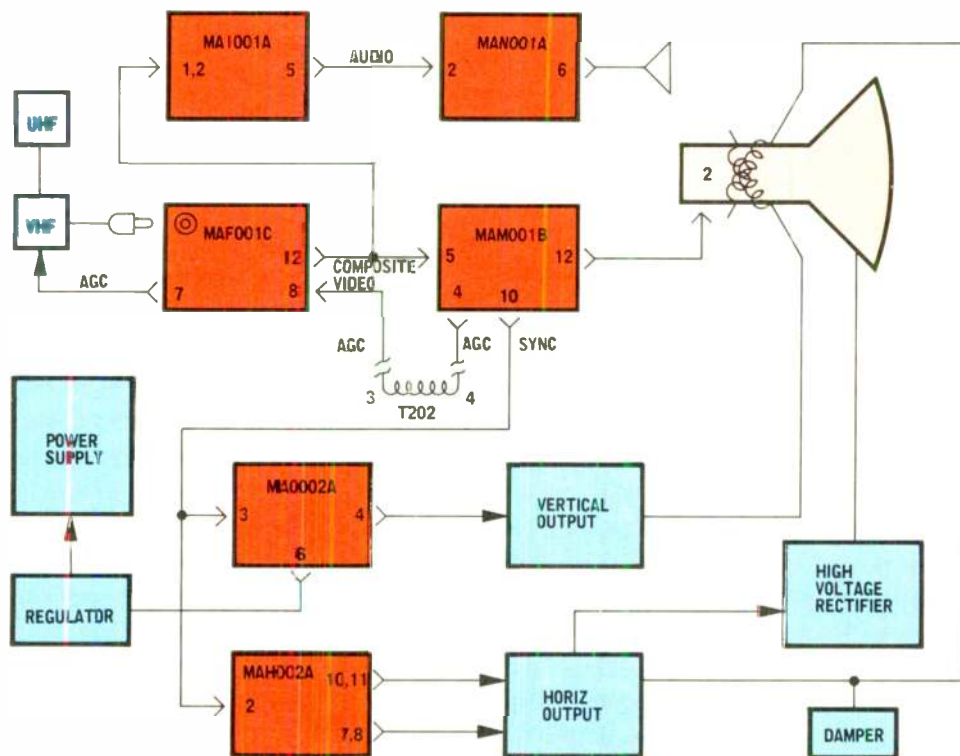
Block Diagram of KCS 187
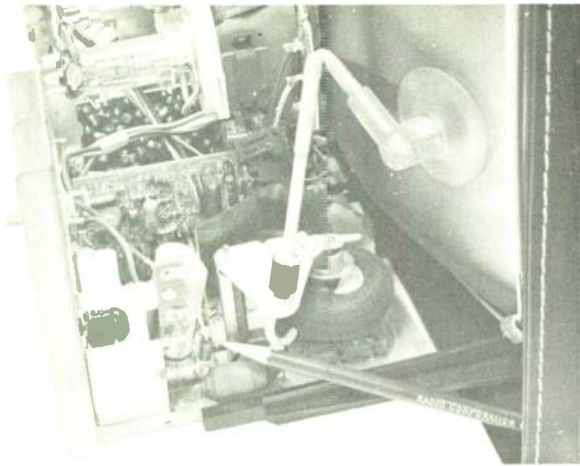
Damper and "Stick" Diodes
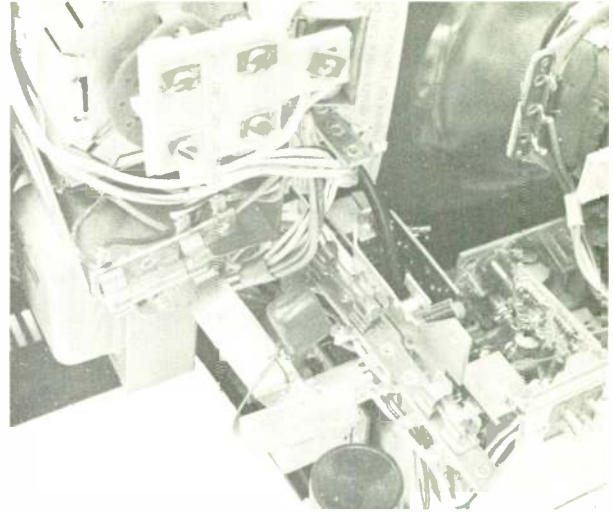
Fuse Locations in KCS 187

their rear-panel heat sinks by self-tapping screws. The damper diode is soldered to a terminal strip immediately behind the flyback transformer and is readily accessible. High voltage rectification is performed by a socket-mounted, solid-state, "stick" rectifier.

Power Supply

Improved regulation, higher output, greater reliability, and safety have been designed into the 12-volt power supply for the KCS 187. Isolation of faults in the power supply is provided by three separate fuses. The first, F101, provides overload
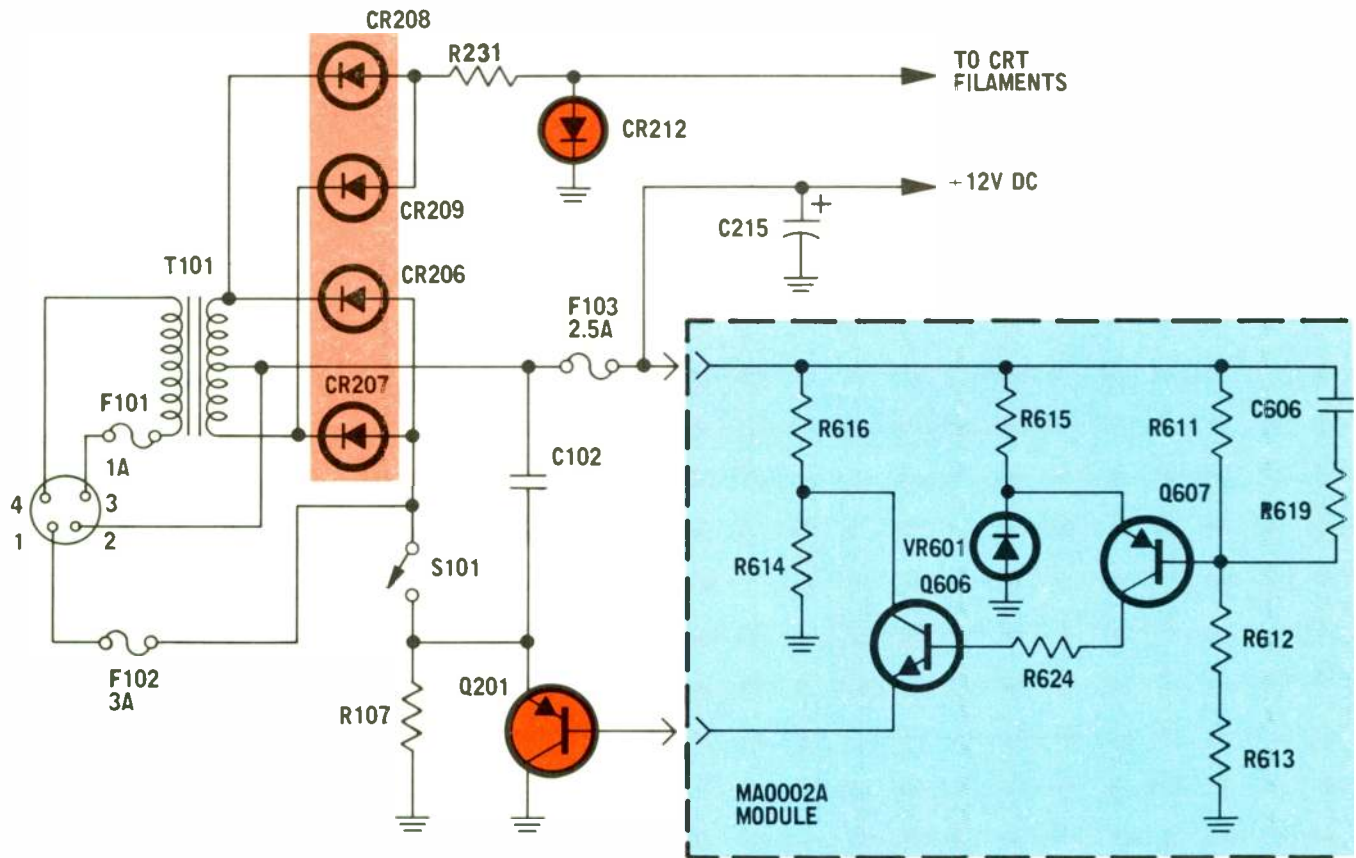
Simplified Schematic of KCS 187 Power Supply

protection for the primary of the power transformer during AC operation. The second, F102, protects the external +12 volt source, including the optional battery pack. The third, F103, protects the +12-volt bus from overloads within the operational circuitry. An improvement in regulation, compared to the KCS 185, has been realized by adding an error-amplifier stage into the regulation loop. A factory selected resistor, R612, is selected to compensate for the tolerances of the zener diode VR 601, and resistors R611 and R613, to hold B+ between 11.5 and 12.2 volts.

If the zener diode, VR 601, is replaced, the B+ voltage must be measured and, if it is outside the limits of 11.5 and 12.2 volts, a new value for R612 must be selected. Increasing the resistance of

R612 will decrease B+. With the line voltage set to 120 volts, install the standard value of R612 which most nearly produces 11.8 volts. The limits of resistance are between 1.8K and 4.7K ohms.

The **Instant-Pic** feature of the KCS 187 chassis allows immediate beam current in the picture tube. When the instrument is connected to the AC line, diodes CR 208 and CR 209 supply filament power to the picture tube at all times.

Deflection Output Circuitry
The power demands of the 12 inch diagonal picture tube, as compared to the KCS 185, are satisfied by increasing the DC voltage supplied to the horizontal module and by using higher-power-gain devices in the horizontal and vertical output stages.
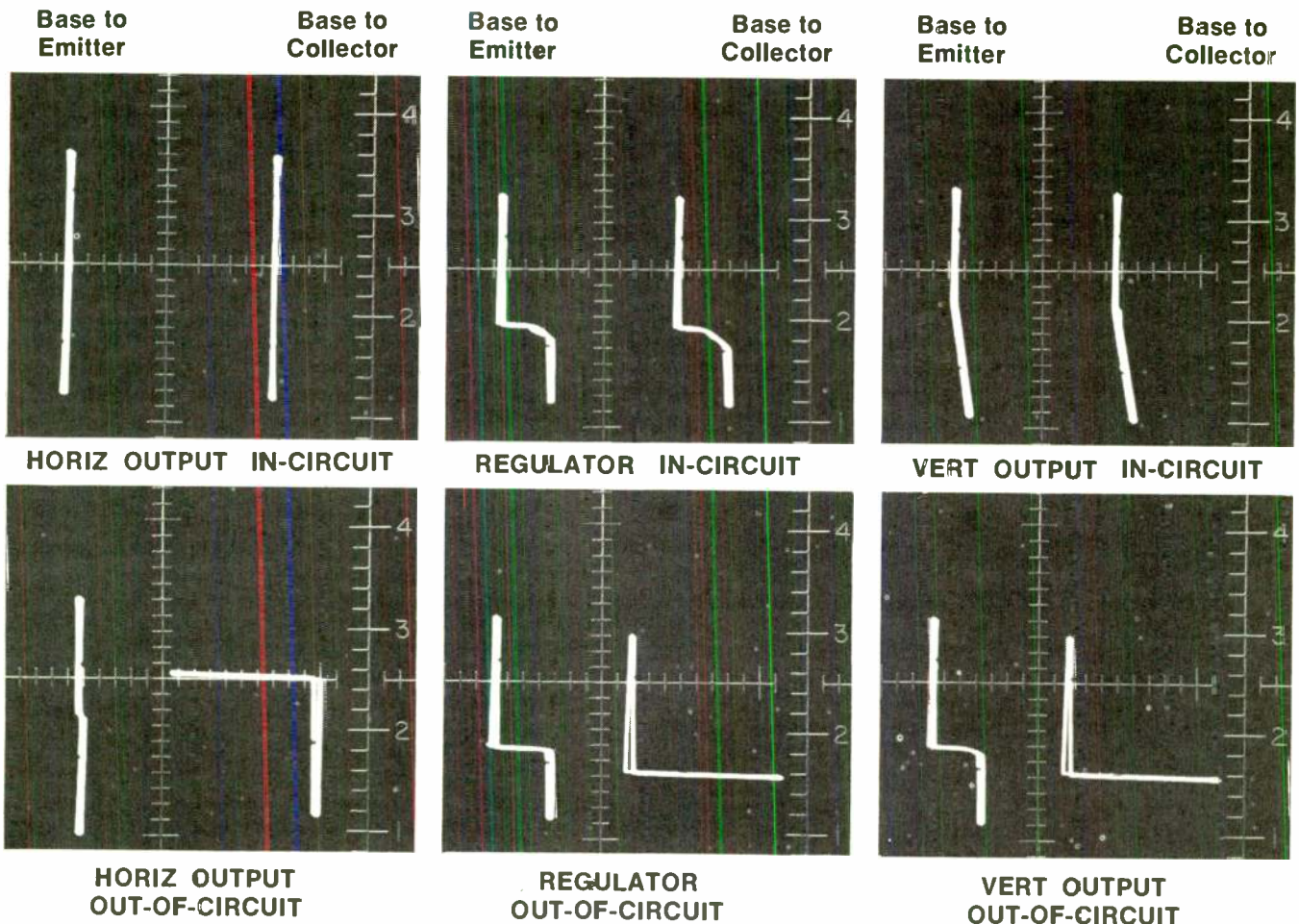
Base to Emitter	Base to Collector	Base to Emitter	Base to Collector	Base to Emitter	Base to Collector

HORIZ OUTPUT IN-CIRCUIT	REGULATOR IN-CIRCUIT	VERT OUTPUT IN-CIRCUIT

HORIZ OUTPUT OUT-OF-CIRCUIT	REGULATOR OUT-OF-CIRCUIT	VERT OUTPUT OUT-OF-CIRCUIT

Conditions of test: These waveforms were obtained using the **RCA WC 428A Quicktracer Transistor Tester** and the **RCA WO 505A Oscilloscope** as described in "**TRANSISTOR TESTING**" *RCA Television Service Tips, Volume XXIII, Issue 1.* All power to the chassis was removed. The in-circuit waveforms for the horizontal-output and regulator transistors are not conclusive; therefore, out-of-circuit testing is recommended if a fault is suspected.

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Continued B/W Chassis

KCS 168 Chassis

Coupled with the KRK 178 VHF tuner and the K. 152 UHF tuner, the KCS 168 is being used again this year in 15-inch (diagonal) instruments. An important improvement in this horizontal, tube-type chassis is a new **flame-retardant flyback transformer.** It is easily recognized by its glossy gray, plastic-like coating. This flyback transformer is electrically similar to its predecessor but a horizontal retrace suppression winding has been added. A remote version of this chassis is available. It uses a KRK 177 VHF tuner and features an earphone for private listening. The "bonger" remote system allows remote channel selection. Each channel position may be programmed to stop, bypass, or turn the instrument on and off.

Model AR 158R—KCS 168
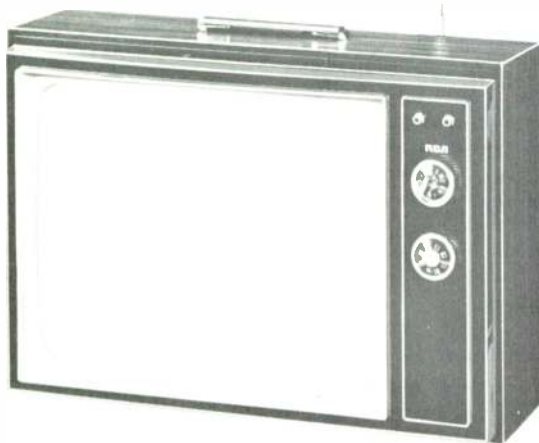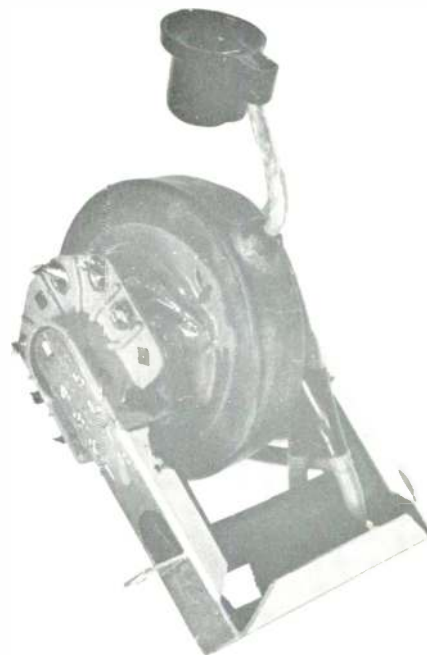
Flame Retardant Flyback Used in the KCS 168 Chassis. It is Typical of the Flybacks Being Used in All Larger Screen Instruments.

KCS 171 Chassis

Eighteen and nineteen-inch (diagonal) portable receivers both employ the vertical, tube-type KCS 171 chassis. The 18-inch diagonal versions will employ the KRK 148 or 178 VHF tuner while the 19-inch diagonal versions will use the KRK 149. Both 18-inch and 19-inch diagonal models will use the KRK 152 UHF tuner.

Model AR 191—KCS 171

KCS 172 Chassis

The KCS 172 chassis, which drives either a 19-inch or a 20-inch diagonal picture tube, is a vertical, tube-type chassis with familiar circuitry. Channel selection is provided by the KRK 149 in the VHF range while the KRK 152 supplies UHF selectivity.
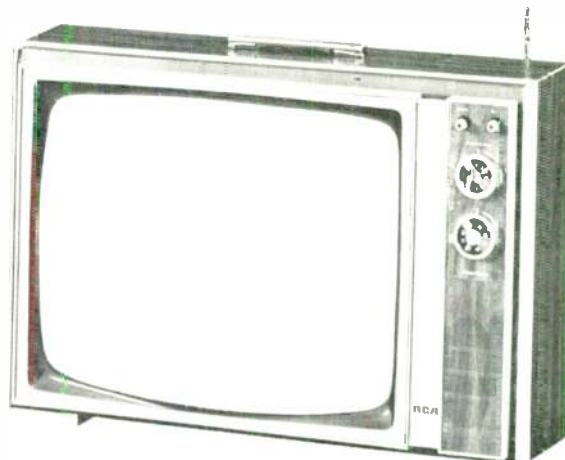
Model AR 200—KCS 172

KCS 186 Chassis

The one-year warranty applicable to the Trans Vista line continues this year with the KCS 186 chassis. This chassis, mated with the KRK 161 and KRK 152 VHF and UHF tuners, provides large-screen (19-inch diagonal) monochrome viewing pleasure. Reliability and serviceability are enhanced by the use of the five plug-in, solid-state modules.

1. IF circuitry   MAF 003
2. Vertical circuitry   MAG 002
3. Horizontal circuitry   MAH 003
4. Sound circuitry   MAI 001
5. Video circuitry   MAL 002

Model AR 193—KCS 186

KCS 188 Chassis

An inexpensive, small-screen chassis, the **KCS 188,** continues this year. Equipped with a 12-inch (diagonal) picture tube, this familiar tube-type chassis is matched to either of two VHF tuners, the KRK 178 or the KRK 137, and the familiar UHF tuner, the KRK 152. One model using this chassis, the **AR 127,** features an earphone jack for private listening pleasure.

Model AR 127—KCS 188

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KCS 179 and 183

Large screen viewing is provided by the KCS 179 and the KCS 183. Both these horizontal, hybrid chassis drive a 22-inch diagonal picture tube, and use the KRK 149 VHF tuner.

The KRK 149 VHF tuner is mated with the KRK 204, a 70-position, detented UHF tuner. The selection of all 82 television channels with parity of UHF and VHF tuning is provided by this combination.

An interesting mechanical feature of the KRK 204 is the operation of the fine tuning control. The fine tuning mechanism is linked to the main channel selector to produce a channel change at either extreme of the fine tuning range.
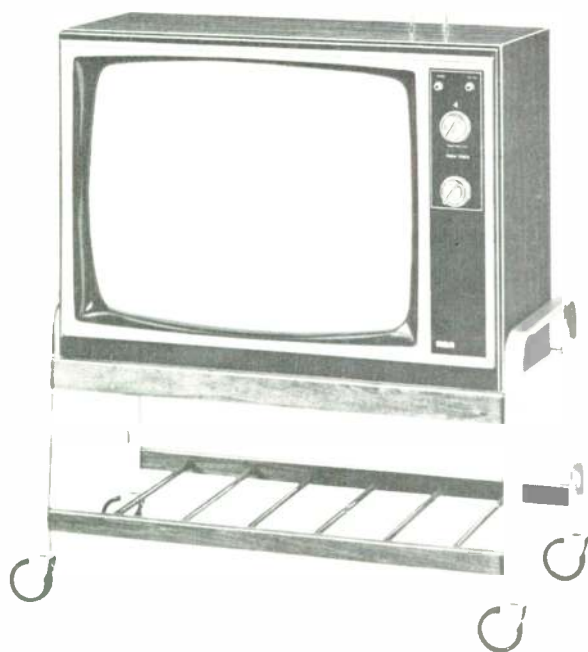
In order to facilitate the replacement of the indicator dial assembly, it is mounted to the drive assembly of the KRK 204 with only one nut and two dowel pins. The mechanical drive assembly is supplied as part of the tuner.

Model CR 122—KCS 183

Dial Assembly of KRK 204

Model BR 225 EN—KCS 179
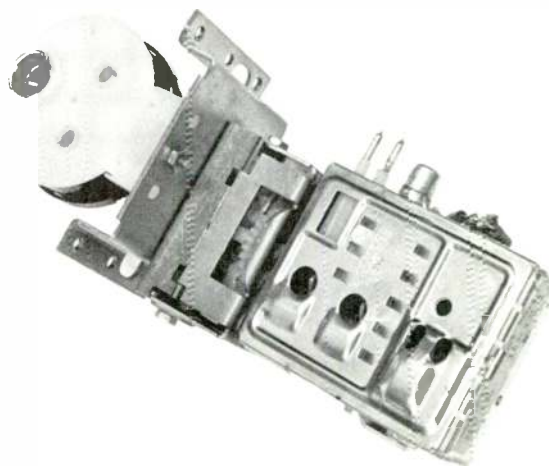
KRK 204

Color Television

Nine chassis provide a wide range of choices in color television. At the top of the line is the all-solid-state **CTC 54** chassis, with varactor tuning ACM, plug-in modules, and all the engineering niceties which go with the most sophisticated chassis in the line. Complementing the CTC 54, and sharing many of its all-solid-state circuits, is the new **CTC 48.** Used in the bulk of the **XL-100** console models, this modular chassis embodies the results of a year of engineering effort devoted to improving the CTC 46 chassis in performance, reliability, and features. Examples of features that are available are **slide controls, 70-detent UHF, varactor-tuned UHF,** and **four-function remote** with triac power control. Although it is being replaced by the CTC 48, some of the earlier models of the R Line will contain the familiar **CTC 46** chassis. These instruments are identified by an "X" suffix in the model numbers. Rounding out the console line is the "old standby" the **CTC 39.** This familiar hybrid chassis is continued with little change.

The **Argosy II, CTC 59** chassis is continued as the top-of-the-line all-solid-state portable. A newcomer, the CTC 63, is a hybrid portable similar to the CTC 55, from which it evolved. An outstanding feature is the high-voltage tripler—the first time RCA has combined in a color receiver a solid-state high-voltage supply with a vacuum-tube deflection system. Other features of the CTC 63 are a new vertical-retrace blanking circuit, overtemperature protection for horizontal deflection components, a new high-voltage protection circuit, and several minor circuit changes.

The remainder of the R-Line portables use the series of chassis familiar from the Q-Line. The CTC 51, CTC 52, CTC 53, and CTC 55 remain, with a few changes which have been "carried back" from the CTC 63 chassis. These changes are in vertical-retrace blanking, overtemperature protection for horizontal components, and the vertical-disable circuit.

Module Usage Chart

The chart below lists all modules which have been used in **RCA Color Television Receivers.** An "X" at the intersection of a module line and a chassis column designates that the module is used in that chassis. A downturned arrow indicates that the module has been used, and can be used, in the chassis; but, a later version of the module is being supplied. The later version of the module has some change which may improve performance in some, or perhaps all, instances. For example, the MAE-001B module has circuit changes designed to enhance the rendition of greens when AccuMatic is used. There would be no advantage to using this module in the CTC 49, which does not have ACM. Nevertheless, it could be used. The differences between A and B versions as summarized below.

MAE001B is designed to enhance greens in ACM instruments. It may be used interchangeably with MAE001A in all instruments, and it is the preferred replacement in all AccuMatic receivers.

MAG001B has additional circuitry to prevent vertical jitter under certain abnormal reception conditions. It is the preferred replacement. MAG001A has been discontinued, but it may be used where reception is normal until supplies are exhausted.

MAK001B has greater AFT pull-in range than MAK-001A. This feature is significant in receivers using varactor tuners, and these R-Line instruments will be the first to be equipped with the "B" model. MAK001B may be used to replace MAK001A in all instances; —A can replace —B except in the receivers with varactor tuners.

MAL001B incorporates changes to decrease its gain and reduce 3.58-MHz dots in the picture. It is the preferred replacement in all receivers and it is being phased into production in all current receivers. MAL001A modules may be used for replacement until supplies are exhausted.

Service Data

In response to numerous requests, the file numbering system of **RCA Service Data** has been changed to distinguish between color and monochrome chassis. Color chassis are identified by "CT" preceding the file number; "B/W" identifies monochrome chassis.

Gray shading is being used on schematic diagrams to designate parts which have safety-related characteristics. In many instances this characteristic may not be identifiable by inspection, nor may it be assumed that a component having a higher voltage rating, higher wattage rating, etc. is an acceptable substitute. **For continued minimization of hazards, only exact RCA replacement parts shown in the RCA Service Data parts list should be used.**

	CTC 41-42-43	CTC 46	CTC 46 (REMOTE)	CTC 48 A, H, P, R, T	CTC 48B (REMOTE)	CTC 48J (REMOTE)	CTC 49	CTC 51-52-53-55-63 (NON AccuTint)	CTC 51-52-53-55 (Q-LINE AccuTint)	CTC 51-52-53-55-63 (R-LINE A-T or ACM)	CTC 54 Q-LINE	CTC 54 Q-LINE COMBO	CTC 54 R-LINE	CTC 55 (REMOTE)	CTC 59	CTC 59 (REMOTE)	STOCK NO.
MAA001A	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	130753
MAB002A							x								x	x	132581
MAB003A		x	x	x	x	x					x	x	x				133563
MAC001A							x										132583
MAC002A		x	x	x	x	x					x	x	x		x	x	134007
MAD001A		x	x	x	x	x	x				x	x	x		x	x	132579
MAE001A		↓	↓	↓	↓	↓	↓				↓	↓	↓		↓	↓	132580
MAE001B		x	x	x	x	x	x				x	x	x		x	x	136691
MAG001A		↓	↓				↓				↓	↓			↓	↓	135871
MAG001B		x	x	x	x	x	x				x	x	x		x	x	135871
MAH001A		x	x	x	x	x	x				x	x	x		x	x	132582
MAJ002A											x	x					134400
MAJ003A													x				137062
MAK001A		↓	↓	↓	↓		↓				↓	↓			↓	↓	132586
MAK001B		x	x	x	x	x	x				x	x	x		x	x	137186
MAL001A		↓	↓	↓	↓	↓	↓				↓	↓	↓		↓	↓	132584
MAL001B		x	x	x	x	x	x				x	x	x		x	x	137187
MAN002A		x	x	x	x	x					x		x		x	x	133455
MAN003A												x					135054
MAP001A											x	x	x				134397
MAS001A								x									133620
MAS002A									↓								133144
MAS004A									x	x				x			136590
MAY003A						x											
MAZ001B					x	x											137366
CRM001A			x											x		x	131789
CRM002A											x	x	x				135081

35

CTC 39 CHASSIS

The familiar **CTC 39** chassis is retained in the R Line with essentially no circuit changes. One significant new feature is a flame retardant horizontal-output transformer. This transformer is electrically the same as the one used in earlier production of this instrument.

CTC 51-52-53-55

All these chassis are continued in the **RCA Color Television R Line.** These changes, all of which were developed for the CTC 63, have been made: In the vertical-disable circuit, the service switch is now connected so that it opens the cathode lead of the vertical-output tube, rather than grounding the grid. A vertical retrace-blanking transistor has been added to improve blanking; however, the high-voltage protection circuit of the CTC 63, which works into the blanker, is not used in these chassis. The thermal fuse, which protects the cabinet and chassis from overheating by opening the cathode of the horizontal-output tube if it overheats, has been added to all these chassis.

These devices and their circuits are described in detail in the discussion of the CTC 63 chassis. For information about them, please refer to that section.

CTC 59 CHASSIS

The **Argosy II, CTC 59 Chassis,** remains virtually unchanged from Q-Line instruments. Early Q-Line production of the remote-controlled chassis did not include the triac power-control circuit, which was incorporated in later production. Its use is continued in the R-Line, and the circuit is discussed as part of the CTC 48.

CTC 63 CHASSIS

The CTC 63 color chassis was introduced in late Q-Line production; but, because several circuits are of particular interest, a short description is given here. This chassis is designed to drive a 19-inch diagonal bi-potential (high focus voltage) kinescope, and the principal differences between this chassis and the CTC 55 are in the deflection and high-voltage system. The low-focus-voltage "Einzel lens" kinescope of the CTC 55 requires less yoke current and no more than 700 volts of focus voltage. The kinescopes used with the CTC 63 require 4 to 6 kV of focus voltage, somewhat higher deflection currents, and about 3500 volts more high voltage.
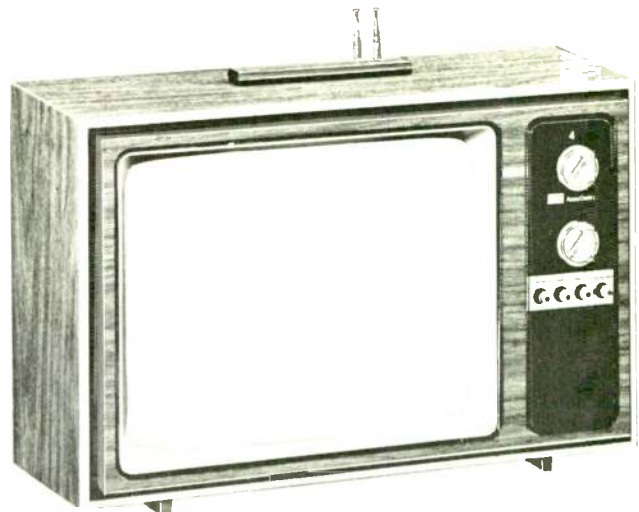
ER 395—CTC 52
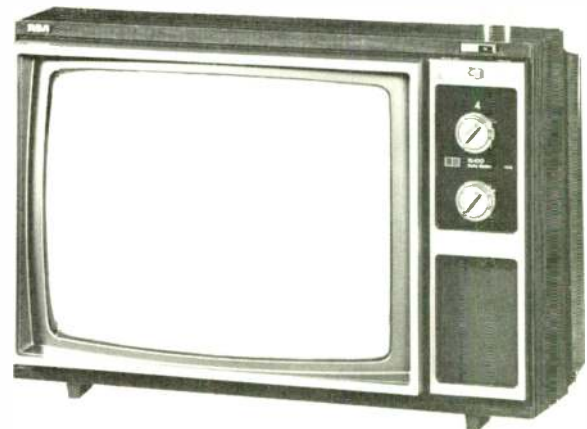
ER 475—CTC 59
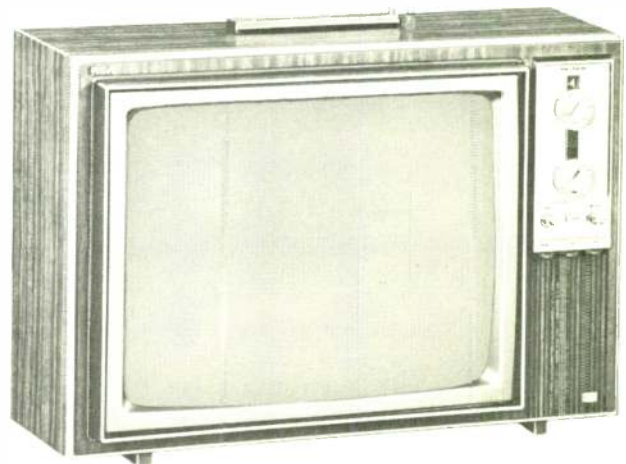
ER 430—CTC 63

Horizontal-Output Circuits

The general configuration of the horizontal circuit is about the same as it is in the CTC 55. The output tube itself is different; the **36MC6** in the CTC 63 has higher ratings to meet the additional power requirements. Also used is a new means of overtemperature protection for the components adjacent to the output tube. A fusible link is used as a "thermal fuse," which opens the cathode of the 36MC6 if this tube overheats.

"Thermal Fuse" Used for Overtemperature Protection

CTC 63—High Voltage Tripler Schematic

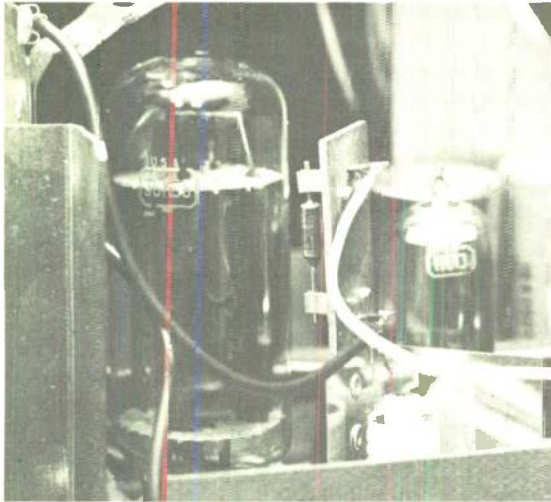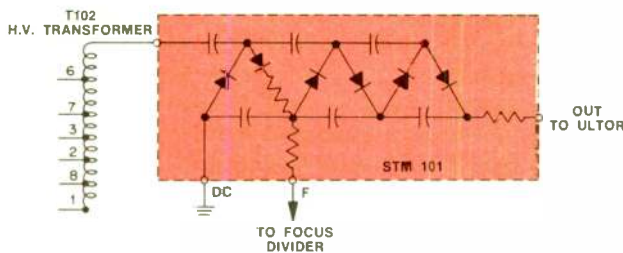The yoke used in the CTC 63 is different and there are several changes in the horizontal-output transformer. The high-voltage tripler used in the CTC 63 requires only about one-third as much driving voltage and the transformer high-voltage turns have been reduced accordingly. Naturally, the rectifier filament winding has been eliminated, and a single auxiliary winding provides pulses to the AGC keyer, blanker, burst amplifier, and convergence circuits.

High-Voltage Circuits

The most noticeable change in the high-voltage system is the incorporation of a voltage-tripler high-voltage rectifier. Solid-state high-voltage quadruplers have been used for several years in RCA all-solid-state color receivers and the advantages of this type of high-voltage rectification **(no filament burn-outs, elimination of corona, elimination of possible radiation from the rectifier, and improved reliability in the transformer)** are now being extended to the hybrid line.

The rectifier tripler is an encapsulated unit and cannot be repaired. As shown in the schematic diagram it consists of six rectifier stacks and six capacitors. By adding additional pairs of rectifiers and capacitors, higher voltage multiplications of the input can be obtained. For example, the familiar high-voltage quadrupler has one additional pair of rectifiers and capacitors.
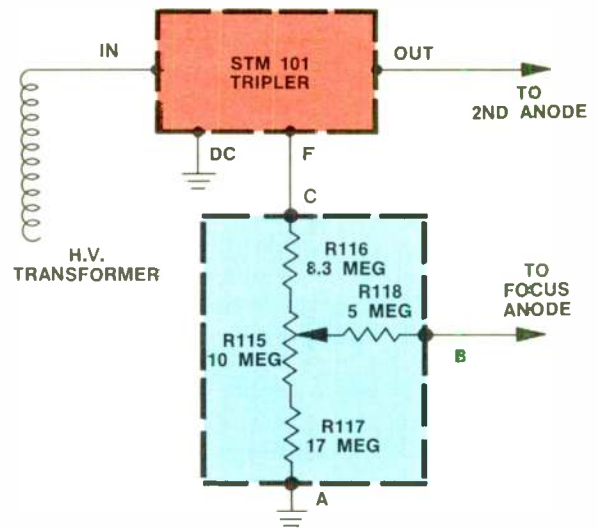
CTC 63—Focus Assembly Schematic
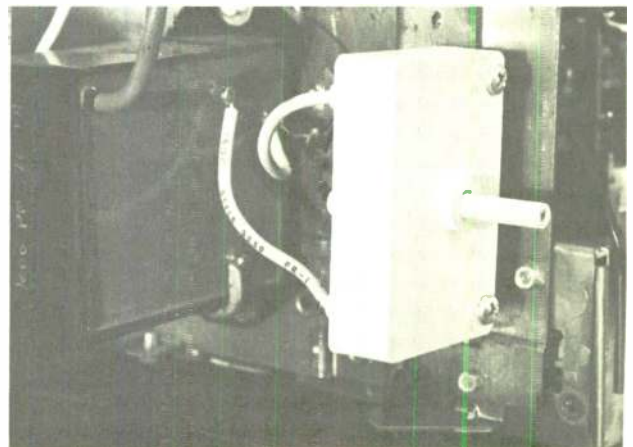
CTC 63—High Voltage Tripler and Focus Control

37
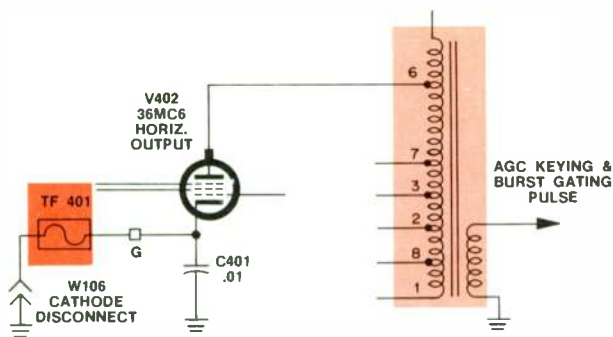
CTC 63—Horizontal Output (Partial Schematic)

The zero-beam ultor voltage in the CTC 63 is nominally 25KV with 120 volts line voltage. Since the rectifier is a tripler, the pulse amplitude of the transformer output is about 8500 volts. (There is some voltage drop in the tripler.)

The kinescope requires 4000 to 6000 volts for focusing, a potential easily obtained by rectifying the high-voltage flyback pulse. Therefore, the second

rectifier stack of the tripler is also used as a half-wave rectifier for focus voltage. The focus control itself is simply a variable voltage divider. The tripler and focus control of the CTC 63 are the same as the ones in the CTC 48, but different from their counterparts in earlier solid-state color receivers.

H-V Regulation and Protection

High voltage is regulated by the same type of circuitry used in the CTC 55. A sample of the flyback pulse is taken from the horizontal-output transformer and capacitively coupled to the control-grid biasing network of the horizontal-output tube. An increase in flyback-pulse amplitude causes the control-grid bias to swing more negative, thereby reducing the power input to the high-voltage system.

The schematic illustrating the vertical blanking circuit also includes the high-voltage protection circuit. To assure compliance with U.S. Department of Health Education and Welfare regulations, this
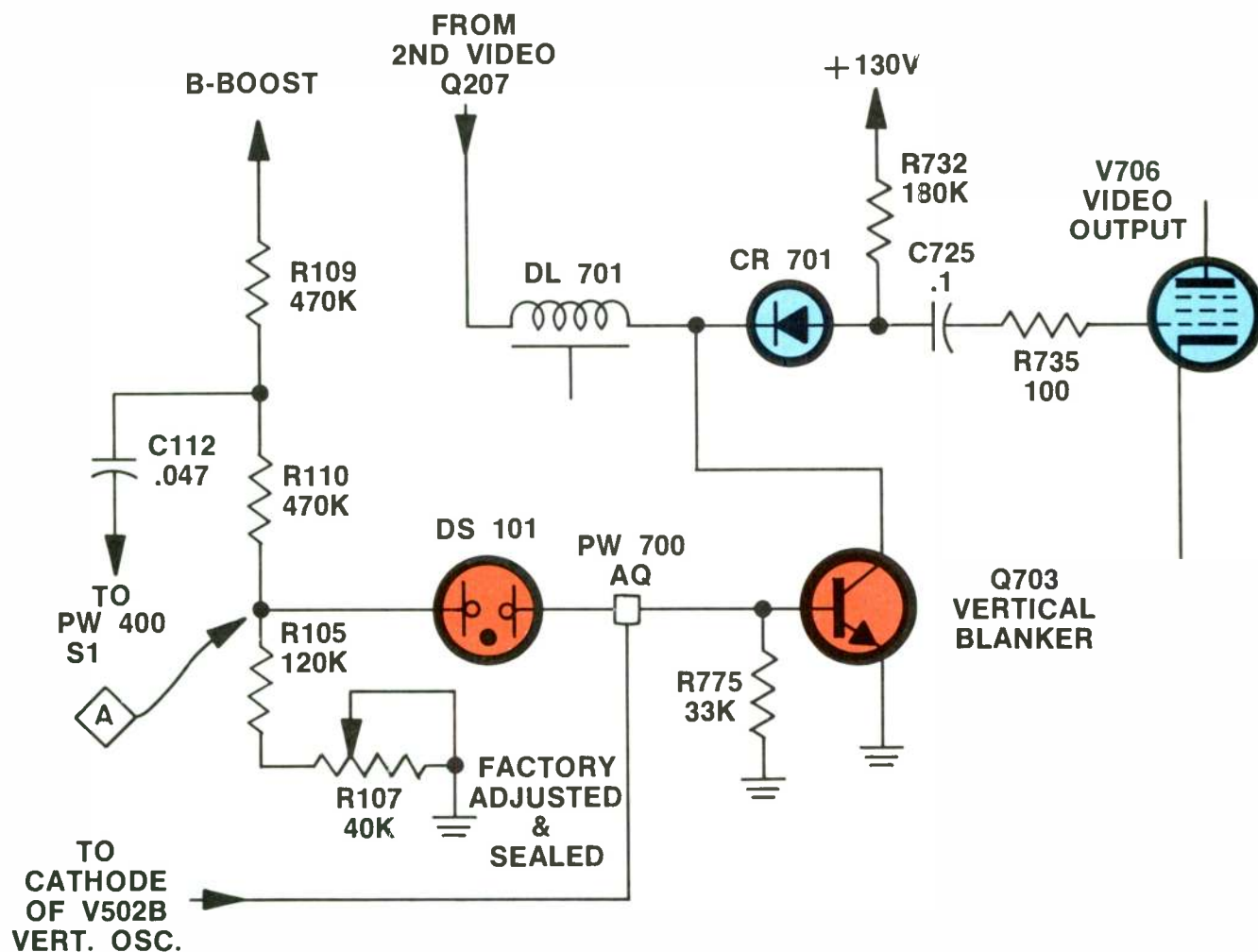
CTC 63—Vertical Blanker and H.V. Protection Circuit Schematic

circuit will produce a non-usable picture, by blanking the video, should there be a malfunction that causes excessive high-voltage.

The circuit consists of resistors R105, R107, R109, and R110, connected in a series divider arrangement from the 720-volt B-Boost source to ground. Neon bulb DS 101 is connected from the junction of R105 and R110 to the base of Q703, the vertical blanker. Resistor R107 is factory adjusted and sealed at a calibrated point so that an increase in voltage at Point "A" of the divider network (as caused by excessive high voltage), will fire the neon bulb. This applies a positive voltage to the base of Q703 sufficient to drive the transistor into saturation. In this way, the picture tube is blanked, producing a symptom of "no picture."

Additional high-voltage protection is provided by a redundant screen-grid regulator circuit of the type used in the CTC 55 chassis.

Servicing the high voltage protection circuit is not particularly difficult, but it must be remembered that **loss of video can be caused by malfunction of the high-voltage system.** If the neon lamp is lit, this is the case. Whether the ultimate cause of trouble is excessive high-voltage or failure within the protection circuit must be determined.

First check the B-Boost voltage. The nominal voltage is 720 volts, and R107 is factory adjusted (and sealed) at the setting which will cause the neon

TEST FIXTURE P106   ADJUSTMENT R107   NEON BULB DS101
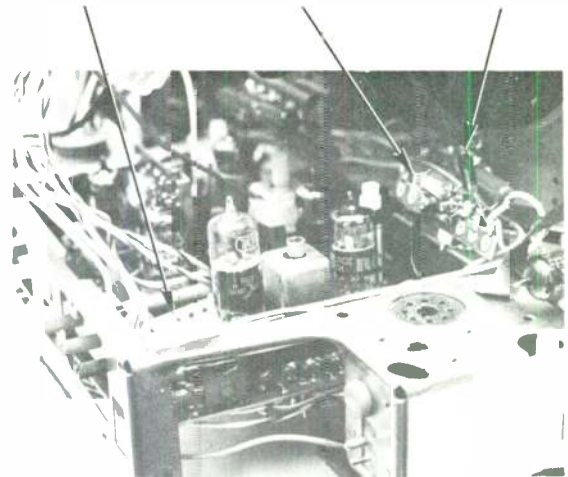
Overvoltage Protection Adjustment and Test Points

lamp to ignite when B-Boost voltage exceeds 880 volts. If B-Boost is found to be higher than 880 volts, a malfunction exists in the regulation circuit.

If the neon lamp is lit and B-Boost is normal, the various components of the protection circuit should be checked. An increase in the resistance of R107 or R105, for example, would decrease the
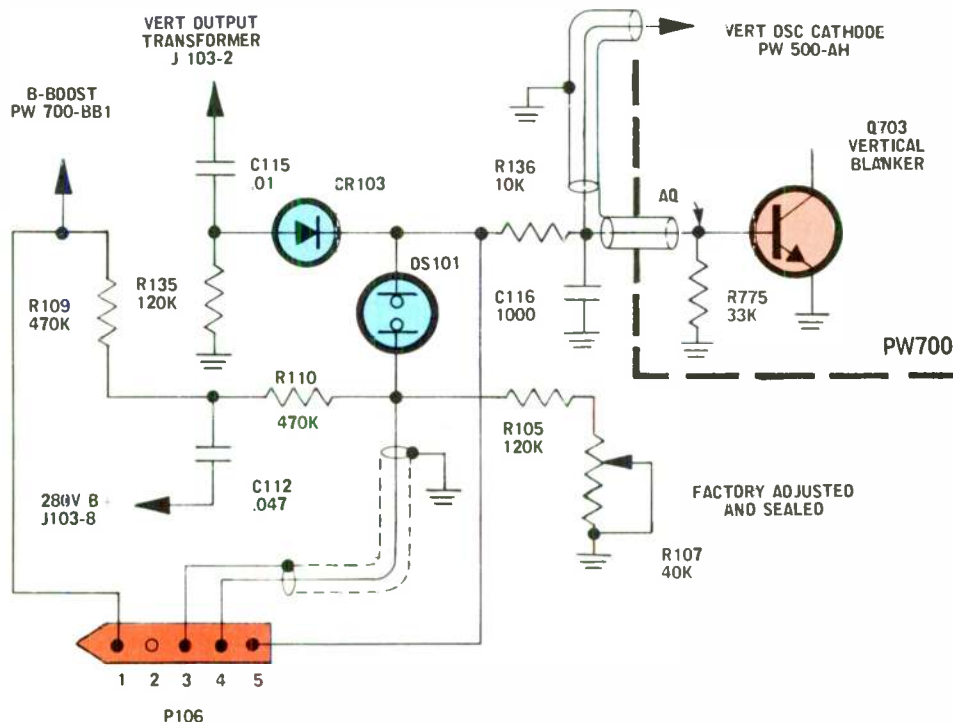
Hold-Down Circuit Details—CTC 63

amount of B-Boost voltage required to light DS101. **If any components of the protection circuit are changed, it will be necessary to check the operation of the circuit.** It is recommended that this procedure also should be performed whenever the receiver is serviced in the shop.

1. Adjust the line voltage to 120 volts.

2. Adjust all receiver controls for normal reception, then set brightness to minimum.

3. Connect a 10-megohm, 1% resistor to pins 1 and 4 of P106. In those instruments which do not have P106, which is only a factory testing aid, connect the resistor from the "high side" of DS 101 to B-Boost. Keep the leads as short as possible. The lamp **should not** light.

4. Substitute a 5-megohm, 1% resistor for the 10-megohm resistor. The lamp **must** light.

If the lamp lights in step 3, there is the possibility that intermittent blanking of video will occur. This could be caused by too much high voltage, or by an off-tolerance resistor in the voltage divider that drives DS 101. These are R109, R110, R105, and R107.

Failure of the lamp to light in step 4 must be investigated and corrected to assure continued compliance with HEW regulations. In some instances it will be necessary to replace R107, which has been factory sealed, and adjustment of the replacement will be necessary.

1. Perform steps 1, 2 and 3 above, and adjust high voltage if necessary. (See below.)

2. Adjust R107 to light DS101, then reduce the setting until the lamp is extinguished.

3. Perform step 4 above to verify correct operation.

4. Seal R107 with epoxy cement.

Adjustment of high voltage is possible by installing, or removing as necessary, a jumper wire across R413. Proceed as follows:

1. Set line voltage to 120 volts and obtain a normal picture.

2. Turn brightness to minimum and measure high voltage.

3. If high voltage exceeds 25KV connect a jumper across R413.

4. If high voltage is less than 23.6KV, remove the jumper across R413.

Vertical Blanking

Vertical retrace blanking is accomplished in the CTC 63 chassis by the blanker transistor, Q703. As illustrated in the simplified schematic, the collector of the blanker transistor is connected to the
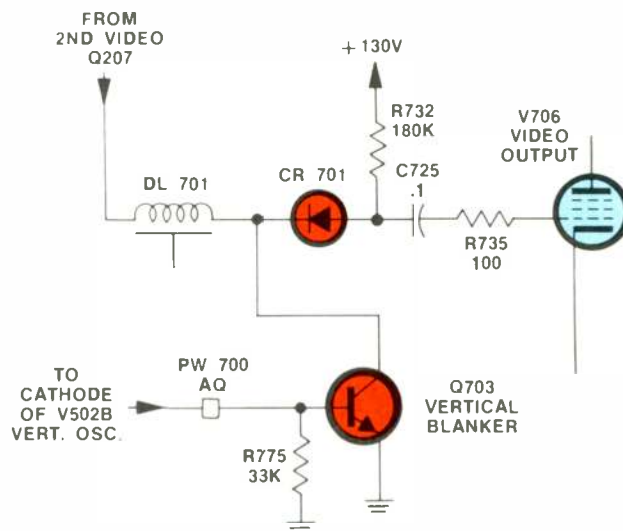
Simplified Vertical Blanking Circuit

ouput end of the delay line, DL 701. The base-emitter junction of Q703 is in series with the cathode of the vertical-oscillator. When the oscillator conducts during vertical-retrace time, Q703 is saturated, effectively grounding the output of the delay line. This negative-going pulse is coupled through C725 to the grid of the video-output stage, driving it and the kinescope into cutoff.

When the high-voltage protection circuit operates, it too saturates Q703 and grounds the output of the video delay line. Therefore, loss of video may be caused by any malfunction which actuates the protection circuit—as well as a fault in the video amplifier.

Other Circuits

The CTC 63 employs a two-section vertical integrator, instead of a single section as used in the CTC 55. This allows a faster rise time of vertical sync while retaining good horizontal-sync rejection. (Poor rejection of horizontal synce pulses can cause loss of interlace.)

A modification of the CTC 55 AGC circuit is necessary to make it compatible with the higher retrace pulse of the CTC 63. C508 has been added to the circuit to act in conjunction with C505 as a pulse-voltage divider.

Another difference of interest is a rearrangement of the service switch connections. Formerly, the service switch disabled the vertical-output stage by grounding its control grid. During normal operation, the wire leading to the switch could pick up spurious voltages under certain conditions. (An ex-

R545
82K

FROM
SYNC
SEPARATOR

R544
47K

C524
1000

C526
1500

TO
VERTICAL
OSCILLATOR

FROM
SYNC
SEPARATOR

R545
120K

C526
1500

TO
VERTICAL
OSCILLATOR
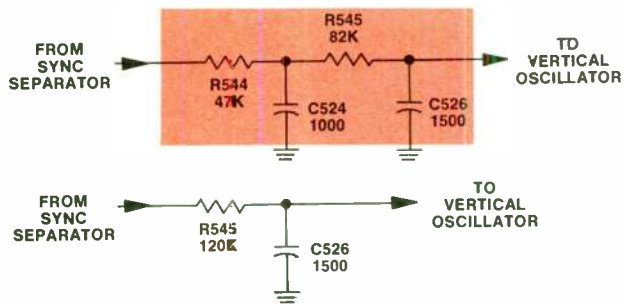
Vertical Integrator Schematics CTC 63-CTC 55

HORIZ. OUTPUT
TRANSFORMER
T102

C505
330

R505
10K

CR 502

PW 500-F

C508
56

Q501
AGC KEYER
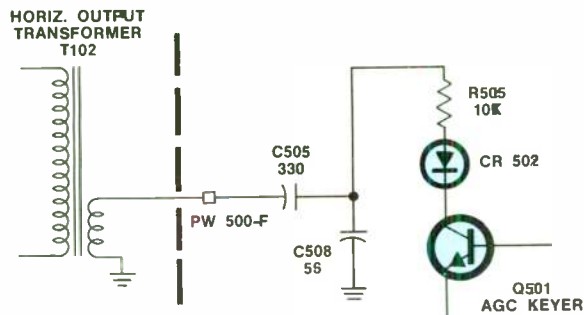
CTC 63—AGC Keyer Circuit (Partial Schematic)

ample is improper lead dress after chassis removal and reinstallation.) Any such stray voltage could be amplified in the vertical-output stage and it might cause vertical jitter. In the CTC 63, the service switch disables vertical sweep by opening the cathode return of the vertical-output stage. Since the cathode circiut has lower impedance than the grid circuit it is much less apt to pick up spurious voltages during normal operation.

PW 500-N

NORMAL

VERTICAL
OUTPUT
V502A

SET-UP
SWITCH
S701

SERVICE

R551
1K

PW 500-AJ   PW 700-C

PW 500-T1   PW 700-AT

R555
820   PW 500-T
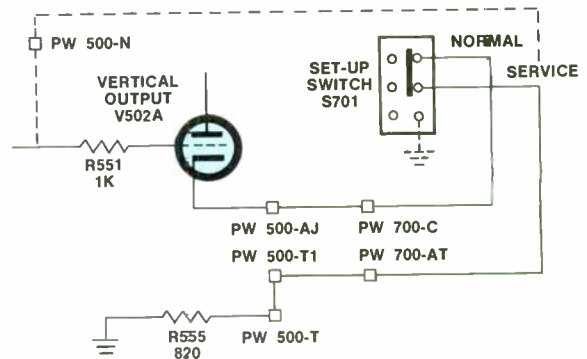
CTC 63—Service Switch (Partial Schematic)

R-Line CTC 54 Chassis

Top-of-the-line instruments of the R-Line will use a CTC 54 chassis which has several significant changes that improve its performance. Among these changes are:

1. A **Program Selector** which uses a new type of potentiometer, redesigned circuitry that reduces potentiometer current, fixed voltage dividers which improve resolution of the VHF tuning controls, high-UHF lockout that "bandspreads" the UHF controls if channels 61 to 83 are not to be received, and elimination of the programing switches.

2. A new voltage-control module, **MAJ 003A,** that incorporates several changes needed to operate the new program selector. A revised circuit improves equalization of the AFT loop gain on all channels and has several "anti-drift" features.

Potentiometer Side of Program Selector
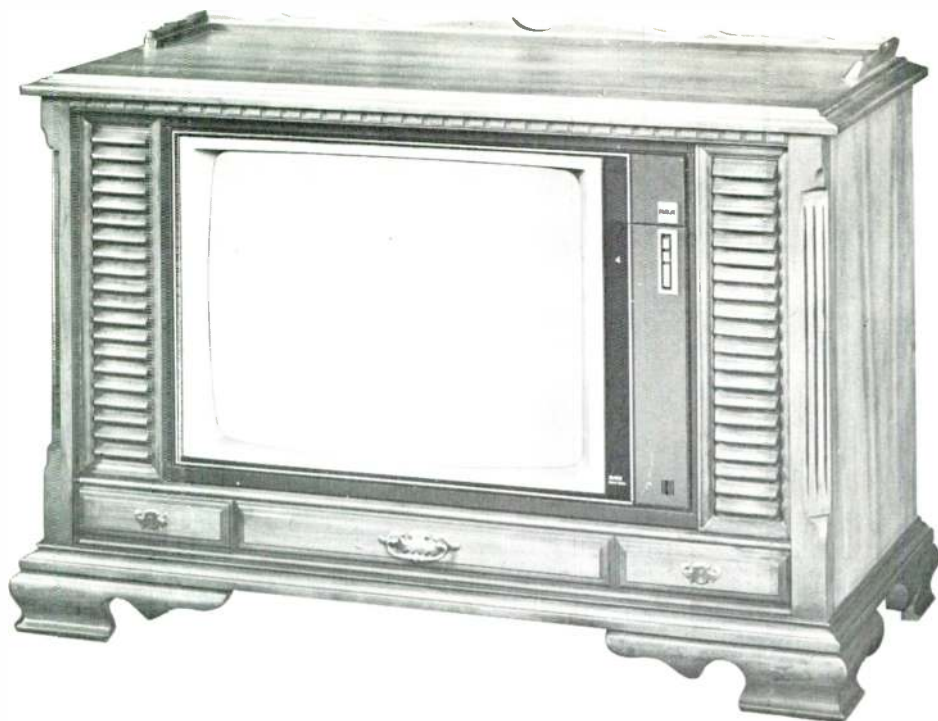
Model GR 846R MPL Uses the CTC 54 Chassis

3. An electronic programming circuit, **PW 3100,** which has been added to take the place of the programming switches. With this new method of programming, any channel is bypassed if the output voltage from that tuning potentiometer is set to less than the voltage required to tune the lowest channel in that particular band.
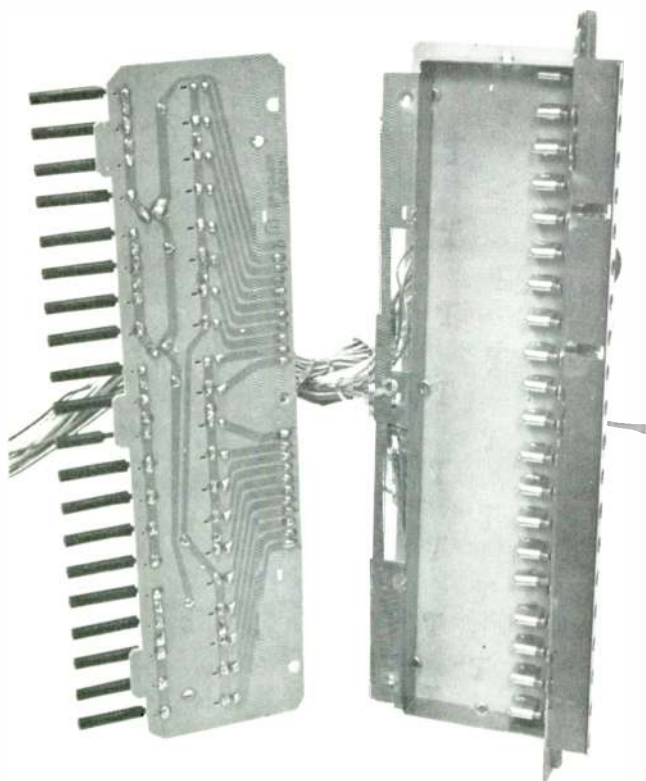
Program Selector "Opened" to Show Lamp Sockets. There Are No Bypass Switches.
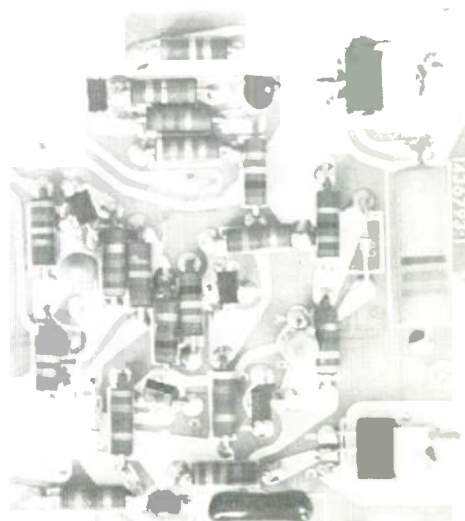
R-Line MAJ 003A Voltage Control

PW 3100—Programming Circuit
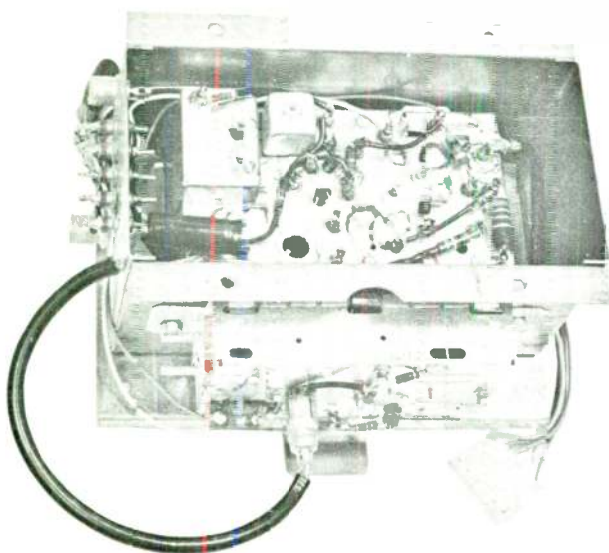
Tuner Assembly Uses a Completely Shielded VHF Tuner With the UHF Tuner Mounted on the Side.

4. A new UHF tuner, **KRK 194.** This tuner uses discrete components, rather than a ceramic-substrate board, and contains the AGC inverter which was formerly located in the VHF tuner.

5. A redesigned VHF tuner, **KRK 155B.** It is basically similar to the KRK 155A, except that the AGC inverter has been eliminated. To reduce interference, this tuner is completely shielded.

6. Minor changes in the PW-4600 parent board to make it compatible with PW 3100. To improve the reliability of the motor-driven switch, "neutral" segments have been placed between all the switch contacts. This last feature was incorporated in late Q-Line instruments.

7. An improved AFT integrated circuit in the MAK module, which increases AFT pull-in range. The IF/AGC/AFT module using this IC is designated **MAK 001B,** and it may be used in place of the MAK 001A module in all instances.

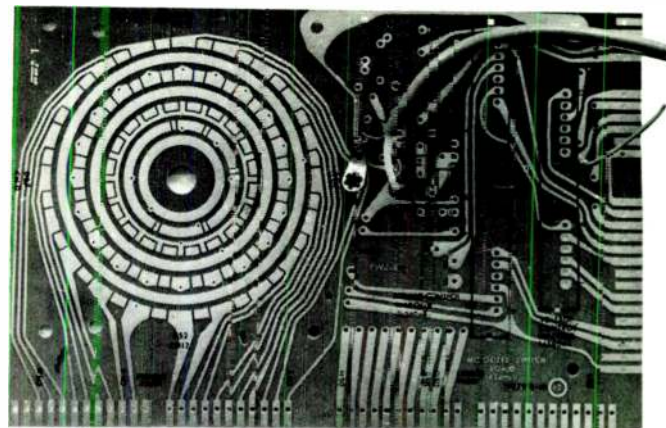PW 4600—Parent Board

Compatibility

Whenever it was possible to do so, compatibility was maintained between the elements listed above and their counterparts in the Q-Line CTC 54. The **MAP 001A** motor-control module is unchanged. The MAK 001B may be used in lieu of the MAK 001A and some improvement in AFT operation will be realized.

The R-Line program selector is not compatible with the Q-Line version; however, it can be substituted if the MAJ 003A and the PW 3100 are installed concurrently. Minor changes on the PW 4600 also would have to be made. It is unlikely that this changeover would ever be justified, although ease of tuning and long-term drift characteristics would be improved.

The KRK 194 UHF tuner is mounted on the side of the KRK 155B VHF tuner, and this complete unit (including the antenna terminal block) may be installed in the Q-Line CTC 54 in place of the original KRK 155A/160 tuner combination. The KRK 155A is not compatible with the KRK 194, nor is the KRK 155B compatible with the KRK 160.

Installation of the new tuner pair is possible without removing the chassis. It might be justified in certain instances, particularly if interference or drift is objectionable. The KRK 155B/KRK 194 combination is completely shielded and it is less susceptible to frequency drift.

Tuner Programming

When the instrument is received from the factory, the twelve VHF tuning controls will be set to the respective channel frequencies. Vacant channels may be bypassed by selecting any vacant channel and rotating the tuning control for that channel in the counterclockwise direction about **one-half turn beyond** the point at which the tuner advances to the next channel. This next channel may be fine tuned or bypassed in the same manner. Unused UHF positions are bypassed the same way.

It will be noticed that nearly the entire range of the VHF tuning controls is used to span either the low-band or high-band VHF channels. This has been made possible by connecting fixed resistors between the high ends of the VHF potentiometers and the supply, and by applying a fixed voltage between the low ends of the high-band potentiometers and ground.

Associated with each group of four UHF tuning controls is a ranging switch which should be set whichever way is appropriate at the time of installation. When the switch is pulled forward, the four associated tuning controls (A, B, C, D, or E, F, G, H) will tune across the entire UHF band. **If the switch is in the normal position, the range of the four associated controls is restricted so that channels 14 through 60 can be tuned.** In the majority of locations there are no active channels above channel 60 and the switch should be left in the normal position to provide maximum resolution of the tuning controls.

As received from the factory, the eight UHF controls will be tuned approximately to channel 14. The required number of controls should be used to tune the active UHF channels and the remainder should be turned counterclockwise to bypass. If there are active channels both above and below channel 60, one set of four controls should be used for the lower channels and the other set for the high channels. The correct UHF channel numbers should be installed from the set provided.

The tuning meter is factory calibrated for correct indication on channels 6, 13, and 50. Since the meter is intended to be used only for channel identification when the tuner is being programmed,

greater accuracy is not considered necessary. Nevertheless, it may be reset for exact indication of any three channels (one in each band) if the user so desires. The adjusting potentiometers are located on the PW 4600 board.

Operation of the Tuning System

The use of varactors to tune a receiver was discussed at length in the **1972 Product Technical Manual,** and has been described in relation to an FM broadcast tuner elsewhere in this manual. For this discussion, the varactor tuners can be considered as "black boxes" which require bandswitching voltage to select LO-V, HI-V, or UHF; and for tuning, a closely regulated voltage, modulated by the AFT error voltage and controlled by a tuning potentiometer.

The degree of required regulation can be appreciated if it is realized that the UHF tuner can be tuned from Channel 14 to Channel 60 by changing the tuning voltage from about 1.5 to 15 volts. The ratio of frequency change to voltage change is greatest at lower frequencies; the wide-range average is about 20 kHz per millivolt. In the high-VHF band this ratio is of the order of 2.5 kHz/mv, and it is further reduced to about 1.2 kHz/mv in low-band VHF.

MAJ Module

The first function of the MAJ module is to provide this "tight" regulation. The second function is to add the AFT control voltage (generated in the MAK module) to this regulated tuning supply voltage. Essentially, this is done by connecting the voltages from the regulators and from the AFT emitter follower in series, as shown in the block diagram.
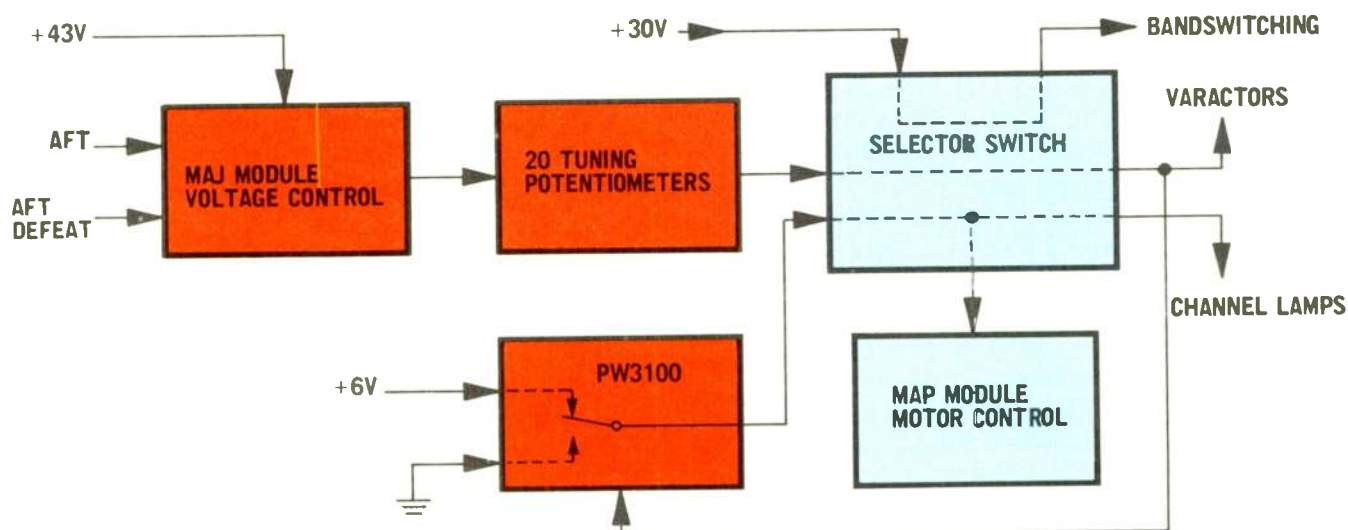
CTC 54—Tuner Control Functional Diagram
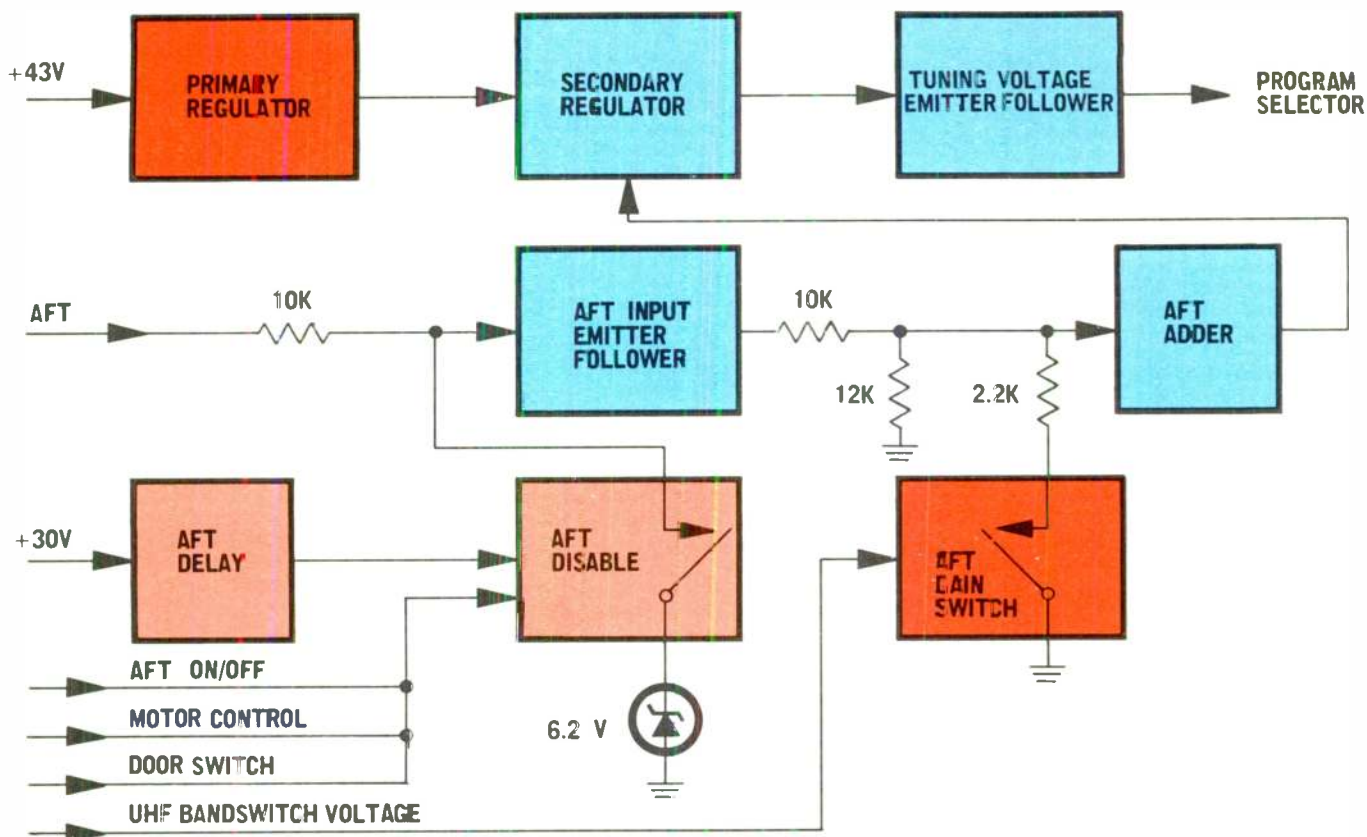
MAJ 003A—Voltage Control Module

The sum of these voltages is the tuning control voltage, which is supplied to the tuning potentiometers by way of an emitter-follower pair and various resistors.

As pointed out earlier, the ratio of frequency change to tuning control-voltage change is much greater in the UHF band than it is in either VHF band. Because of this, **a much smaller amount of AFT control voltage is required for UHF.** The AFT-sensitivity "switch" in module MAJ remains open during VHF reception, and approximately one-half of the total AFT voltage is added to the regulator output. When the receiver is tuned to the UHF band, the AFT sensitivity-switching transistor saturates and reduces the AFT voltage to about one-fifth of maximum, or 40% of VHF AFT voltage.

Also in the MAJ module are the AFT disabling circuits, which turn off AFT whenever the channel-selector motor is running, the fine-tuning access door is open, or the AFT switch is off. In any of the first three instances, the AFT disable switch is "closed" and regulated 6.2 volts is substituted for the AFT voltage. When the instrument is first turned on, the AFT delay circuit closes the AFT disable switch. When the 30-volt supply reaches approximately full voltage, the AFT delay circuit allows AFT to be active.

Program Selector

The schematic diagram of the program selector that is shown here has been simplified by the deletion of sixteen of the twenty identical tuning potentiometers. R4502 through R4505 are parallel with R4506 and tune channels 2 through 5; R4518 through R4520 are parallel with R4521 and tune UHF channels E through G; etc.

The VHF tuner requires a range from about 3 to 22 volts to tune from channel 2 to channel 6, but the tuning supply voltage is roughly 36 volts. Without the resistance of R4501, only about two-thirds of the low-band potentiometers would be used to cover the channels. To cover the high VHF band, tuner voltages ranging from about 9 volts to 22 volts are required, **so the low ends of the potentiometers are raised above ground by a zener.** R4527 drops a fraction of the supply voltage to establish the correct voltage at the high ends of the potentiometers.

In the case of the two groups of four UHF tuning controls, shorting switches have been connected across the dropping resistors. The voltage required to tune from channel 14 to somewhat above channel 60 ranges from about 1.5 volts to about 15 volts; but more than 30 volts may be required to reach channel 83. Without the switches and resis-

MAJ

R4522
5600

R4525
5600

R4527
3300

R4501
3300

R4521
100K

R4523
7500

R4517
100K

R4524
7500

R4513
100K

R4526
4700

R4506
100K

R4528
7500

CHAN H

CHAN D

CHAN 13

CHAN 6

CR4501
6.2 V
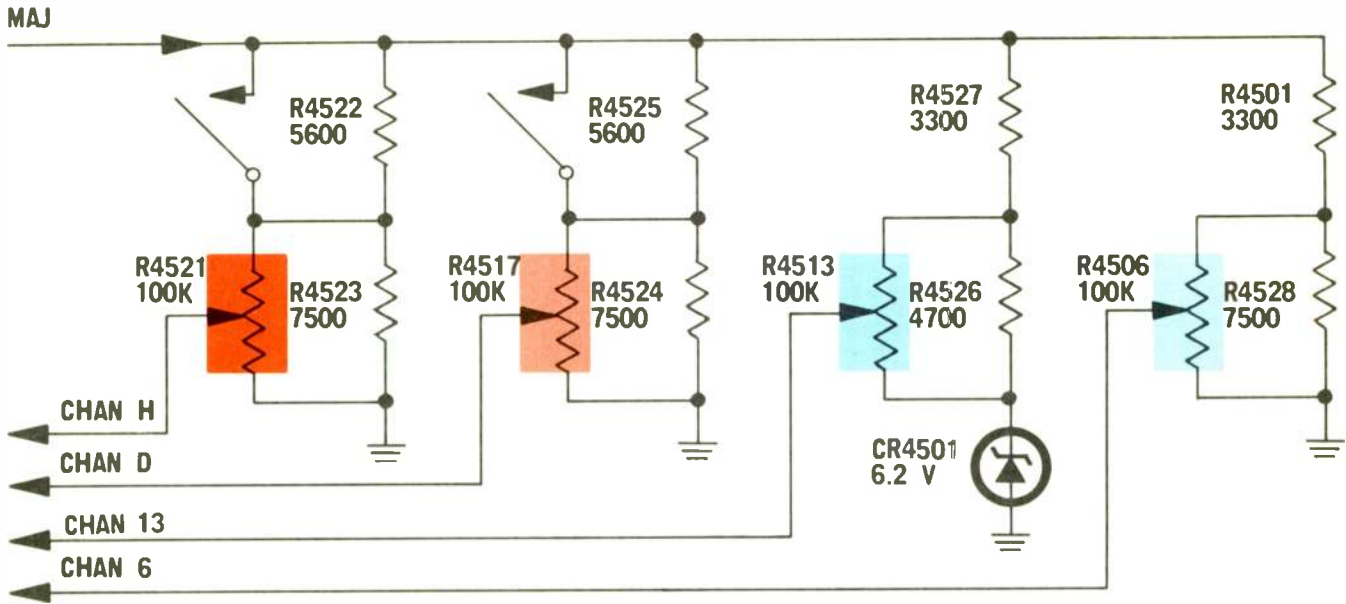
CTC 54—Simplified Channel Selector Circuit

STOP COMMAND → MAP MODULE

CHAN D
CHAN H
CHAN 6
CHAN 13

LAMP BAR

+6V

LAMP
SWITCH
Q3105

BYPASS
SWITCH
Q3106

PROGRAM
SWITCH
Q3107

CHAN H

TUNING
POTS

CHAN D

CHAN 13

CHAN 6

FIRST E/F
Q3101

SECOND E/F
Q3103

THIRD E/F
Q3104

HI-V
SWITCH
Q3102

+30V

TUNING METER

VARACTOR VOLTAGE   TO TUNERS

LO-V BANDSWITCH VOLTAGE

HI-V BANDSWITCH VOLTAGE   TO TUNERS AND
TUNING METER

MAJ

UHF BANDSWITCH VOLTAGE

CTC 54—Selector Switch and Program Control System

tors, roughly half the range of the potentiometers would be unused, except in the few areas which have UHF channels above 60.

As noted earlier, the amount of change in tuning voltage required to produce a certain frequency change is least in the UHF band and greatest in the low VHF band. Within each band, a given swing in the AFT voltage will produce a much greater frequency change at the low end than it will at the high end. Therefore, to obtain the same AFT action across each band, the AFT control voltage must be attenuated at the lower channels. Since the tuning potentiometers serve as variable attenuators of the AFT voltage, adequate equalization is automatic in the low VHF band and the UHF band. In the high VHF band, a dropping resistor could have been used in lieu of CR 4501, except that this would have resulted in too much AFT voltage at the low end of the band.

Channel Bypassing

Refer to the block diagram of PW 3100 and the channel-selector switch. The varactor tuning voltage is supplied to the input of a cascaded pair of emitter followers. The output from the second of these drives the tuning meter and also supplies another emitter follower (ignore the High-VHF switch for the moment) which, in turn, drives the program-switch transistor.

If the tuning voltage is high enough to turn on the program switch, the lamp-switch transistor supplies 6 volts through the 20-channel selector switch to the appropriate channel-indicator lamp and also to the motor-control module, MAP. If the tuning voltage is low, the lamp switch is open and the bypass switch is closed. This supplies ground to the lamp and MAP, causing the motor to continue running.

The low ends of the low-band VHF and UHF tuning potentiometers are connected to ground, so whenever any one of these is turned fully counterclockwise, that channel will be bypassed. The low ends or the high-band tuning potentiometers return to a 6.2-volt reference, so a "ranging" switch is included in PW 3100. The high-VHF bandswitching voltage closes the high-VHF switching transistor in PW 3100, which prevents the third emitter follower from conducting unless the tuning voltage exceeds about 7 volts.

Servicing Notes

In the Q-Line CTC 54 it was possible to plug the IF link cable directly into the output jack of the UHF tuner and obtain reasonably good perform-

ance. In the R-Line instruments, this may still be done; however, B+ is supplied to the UHF tuner from the VHF tuner via the signal cable. Therefore, **it is necessary to connect a regulated B+ jumper between the two tuners.**

Because of circuit changes in the R Line, **the procedures in Problems 11 and 12 of Workshop 8 are slightly different.** In the diagram for problem 11, note that PW 3100 is inserted between the 7.5 ohms of resistance and the selector switch. Also, the bypassing switches are deleted, since this function has been moved to PW 3100.

In the text for Problem 11 make notes that a sustained short (more than a second or two) across the energized channel lamp may destroy Q3106. Defects in PW 3100 can cause the motor to run continuously or not at all. Also, loss of varactor voltage will cause the motor to run continuously, once it is started by a channel change.

The text for Problem 12, step 2 of the AFT alignment should be changed to read, "Connect a VTVM between the emitter and collector of Q2," etc; instead of Q3. On the diagram, the supply and output voltages should be about 43 volts and 36 volts $\pm$ AFT, respectively.

Remote Amplifier Bypassing

As a means of definitely isolating specific faults, it may be desirable to completely bypass the remote receiver. This may be done by remoivng the four connecting jacks, J1101, J1102, J1103, and J1104, from PW 1100. Then make the following interconnections between these jacks:

1. Connect J1101-4 to J1103-6. This provides ground for the channel switches.

2. Connect 4700-ohm resistors between J1101-3 and J1104-2, and between J1101-2 and J1104-3. These two steps enable the channel-change switches.

3. Connect a 2700-ohm resistor from J1102-5 to J1103-5. This enables the volume control.

4. Connect a 120-ohm resistor from J1102-3 to J1103-10. This enables the tint control.

5. Connect a 10,000-ohm resistor between J1102-7 and J1103-7 to enable the color control.

The **RCA WC528A Quicktracer Transistor Checker** is a convenient instrument for checking the transistors in PW 3100. The test waveforms shown here were obtained from a PW 3100 known to be in good condition.

CHANNEL 2   CHANNEL H

GROUND SOCKET

24 VAC

P/J 4605

MAJ

NO 6.2V OUTPUT?

12   13

+30V

FROM
PW 3100

CHANNEL
UP

SELECTOR
SWITCH

+4

SHORT TO
CHECK MOTOR

3   8   12

1   10

MAP

DEFECTIVE?

Q1111

41.75 kHz

P/J 4605-4

6   5   11

NORMALLY
STARTS MOTOR

4.7K

Q1112

40.25 kHz

P/J 4605-3

SELECTOR SWITCH

CHANNEL
DOWN

7.5

PW 3100

DEFECTIVE?

+6V

OVER 1.5V?

VARACTOR
VOLTAGE
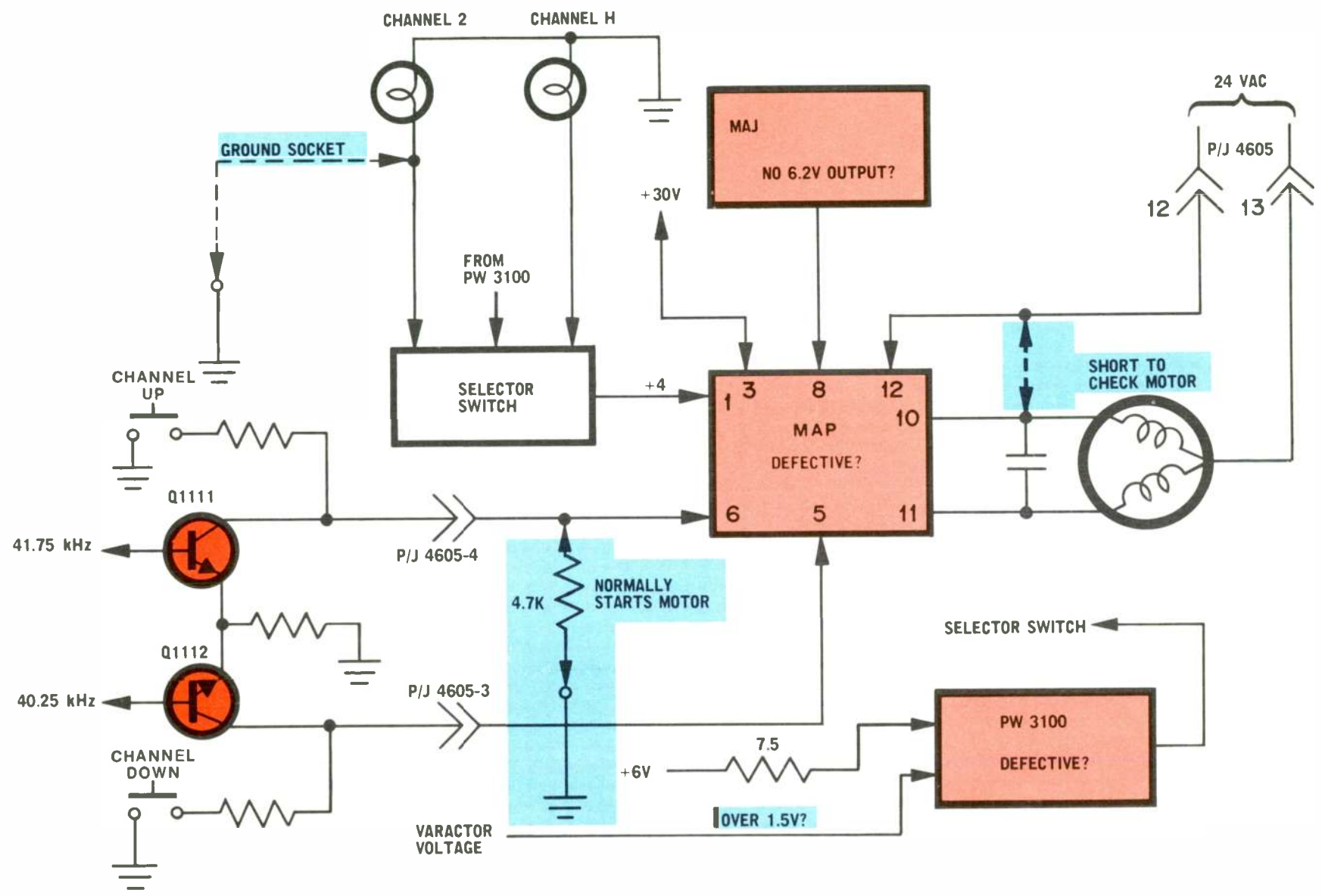
When Servicing the R-Line CTC 54 Use This Sheet for Problem II

World Radio History

Conditions of test: These waveforms were obtained using the **RCA WC 428A Quicktracer Transistor Tester** and the **RCA WO 505A Oscilloscope** as described in **"TRANSISTOR TESTING"** *RCA Television Service Tips, Volume XXIII, Issue 1*. All power to the CTC 54 chassis was removed and the cable between PW 3100 and PW 4600 was disconnected. The waveforms for Q 3105 are normal; however, a shorted transistor can produce the same waveform.

Base to Emitter   Base to Collector
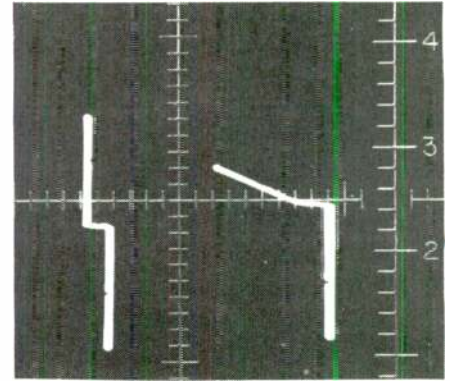
Q3101

Base to Emitter   Base to Collector   Base to Emitter   Base to Collector

Q3102   Q3103   Q3104

Q3105   Q3106   Q3107

49

Model GR 778 PCN with the CTC 48 Chassis

CTC 48

The new **RCA CTC 48** chassis is designed to replace the CTC 46 chassis in R-Line instruments. These two chassis are very similar in design; the major variations are to be found in the horizontal deflection, tuner and remote control, and the auxiliary-control panel.

Because of the similarity of the CTC 46 and the CTC 48, it was decided to "phase in" the production of the CTC 48, rather than to make an abrupt changeover from one chassi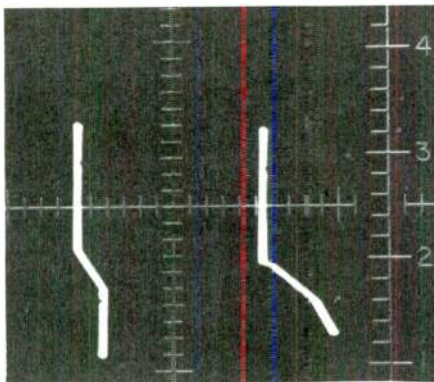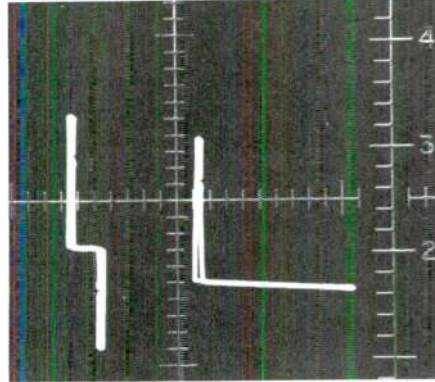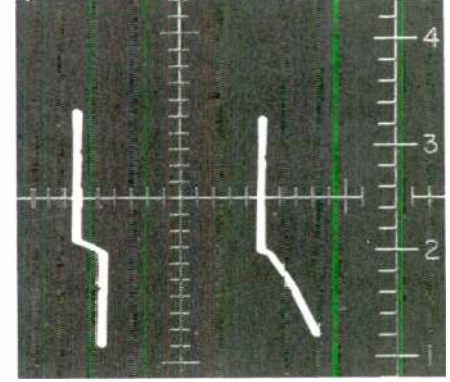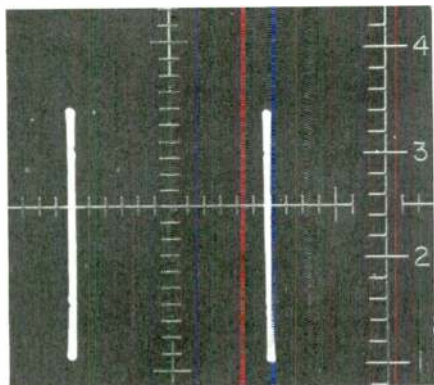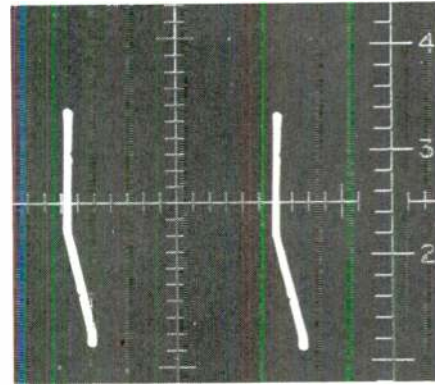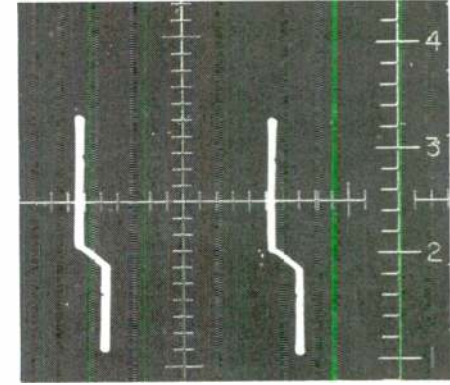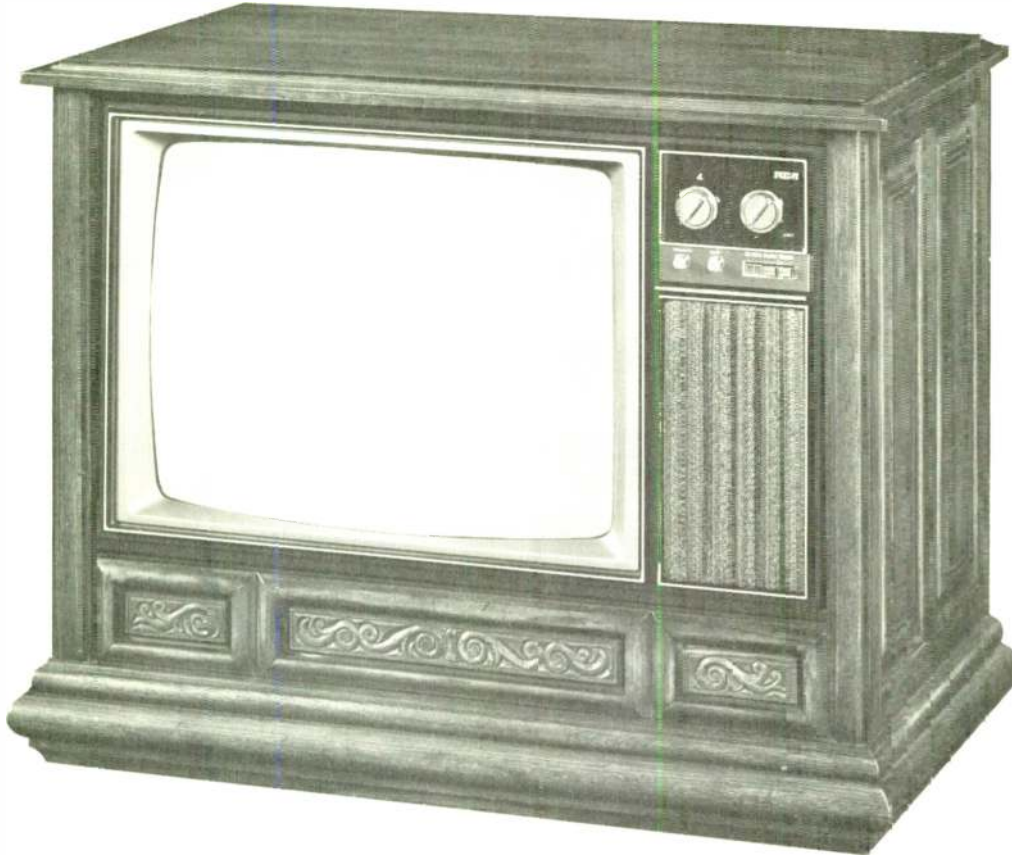s to the other. This has allowed production to keep pace with demand, which would have been virtually impossible if a complete changeover had been attempted all at one time. Because of this, some early units of R-Line models will incorporate the CTC 46 chassis, while later production of the same models will use the CTC 48. **R-Line model numbers with an "X" suffix will have the CTC 46 chassis.**

The CTC 48 chassis has five major variations, to be used as follows:

    1. **CTC 48A** is a manual control chassis for use with a 21-inch diagonal kinescope. It will use rotary auxiliary controls. The ACM color ad-

justment is concentric with the tint control. A continuous tuning UHF tuner and a 13-detent VHF tuner are located on the TMA.

2. The **CTC 48B** is the remote controlled, 21-inch diagonal chassis. The 4-button remote unit controls channel change of the VHF tuner, volume up, volume down, and on-off. The remote preamplifier is cabled to the receiver-amplifier and the transducer.

A triac is used for power control. The auxiliary control panel is the same as the one in the CTC 48A. Both remote-controlled versions of the CTC 48 have an additional winding on the kinescope filament "keep-alive" transformer which supplies AC power to the remote system.

3. Manual control instruments with a 25-inch diagonal kinescope use the **CTC 48H.** Featured in many of these models is the **70-position, detented UHF tuner.** This tuner is designed to give full parity of UHF—VHF tuning in a manually operated television. Also featured are **slide potentiometers** in the auxiliary control panel. The ACM color adjustment is concentric with the brightness control.

4. The 25-inch diagonal remote instruments use the **CTC 48J** chassis. The outstanding feature of

The Slider Controls Are Constructed as a Subassembly with Plug-In Connections.

The remote receiver amplifier is functionally the same as the one in the CTC 48B, however, a new module, MAY 003A, serves as the remote pre-amplifier. Electrically, it is the same as the PW 900 of the CTC 48B, except that the transducer is an integral part of the MAY module.

A triac is used for power control in this chassis. The bin-mounted auxiliary controls are slider-type potentiometers. The ACM color adjustment is concentric with the brightness control.

5. Three chassis variations will be used in TV-Stereo-Radio combination instruments. The CTC 48P is designed for 25-inch diagonal receivers and will drive two speakers. Receivers using a 21-inch diagonal kinescope will use the CTC 48R, which drives one speaker. Top-of-the-line instruments, having doors and a 25-inch diagonal picture tube, use the CTC 48T, which also drives two speakers. In all versions, the television audio system is separate from the radio-stereo system. These chassis are all similar to their TV-only counterparts, except that a change in the power switching de-energizes the R/V system whenever the television is turned on. The stereo and radio components used in R-Line combinations are basically the same as those used in corresponding Q-Line models.

Horizontal Deflection System

The deflection system of the CTC 48 chassis is one of the family of SCR systems first introduced in the CTC 40 chassis in 1968. In this chassis, as in the CTC 40, there is no impedance-matching required between the yoke and the trace diode, CR 401. Recall that an additional flyback-transformer winding was used in the CTC 44 and subsequent chassis.

The Complete 70-Detent UHF Tuner Is Shown at the Top. Center Is the Tuner With Indicator Drum Removed. Bottom Shows Indicator and Single Mounting Screw at Left.

this instrument is the hybrid tuner—conventional VHF and varactor-tuned UHF—which provides complete parity of remote selection of twelve VHF channels and any eight UHF channels. In addition to channel change, the remote system provides control of volume and on/off.

- 160V

R113 3.9 10W

R125 27 5W

CR403

C404 18

T401

R403 330

L401 470

HI VOLT ADJUST

+ 77V

CR405 13V

CR404

Q401 REG

C419 1000

T402

SCR102

MAH

C122 3300

R126 120 5W

CR401

C403 390

L108 64

C407 .066

FB 402

R406 3.9 2W

C406 .072

R405 4.7 2W

SCR101

R404 470

CR401

YOKE

C120 1.5

C121 1.5

CR104

C107 .01

C108 .01

R104 1800 4W

T403

15

12

11

2

8

7

L402 10

SCREEN CONTROLS

TRIPLER INPUT

PW300

6

PW800

5

MAH (NC)

4

MAE MAH MAK

3

R430 270

R412 100

R411 330

C409 4700

TO CR405

T 405 PINCUSHION

W2

RT401 1500

NARROW W3

WIDE W1

HOLD DOWN

C410 1.5

VERT

VERT

CR406

Horizontal Deflection, Flyback, and Width Control Circuits

The use of a **high-voltage tripler** in the CTC 48, instead of a quadrupler, requires a greater pulse output from the CTC 48 flyback transformer, about 9kV instead of 7.5kV. The use of **flame-retardant insulation,** begun with the CTC 46 chassis, permits the high-voltage "cage" to be eliminated. This allows better ventilation of the flyback, which enhances its reliability.

By carefully designing the high-voltage regulation circuits and flyback transformer, it has become possible to eliminate the high-voltage bleeder resistor while still maintaining adequate voltage regulation. Careful control of the decay times of the kinescope voltage provides for a degree of high-voltage bleed-off when the instrument is turned off; nevertheless, **the possibility of residual high voltage is greater in this chassis than it was in earlier solid-state chassis. Observe the same precautions that are necessary when servicing vacuum-tube high-voltage systems.**

The "snubber" network, C122 and R126, had counterparts located on PW 400 in the CTC 46 chassis. These parts are now located adjacent to SCR 102 to mininize still further the radiation from this device.

High Voltage and Width Control

T401, the input reactor, is now wound as an autotransformer. This change is significant to the service technician only in the event of leakage through C404. Since supply voltage is present on the trigger winding of T401, leakage through C404 will turn on SCR 101, taking its anode to ground. In all the SCR deflection circuits, grounding this point is a recommended method to kill both high voltage and deflection. Moderate leakage through C404 will have the same effect; if the leakage current is great enough, SCR 101 will be destroyed.

In all the RCA SCR deflection systems, high-voltage regulation is achieved by controlling the voltage across the commutating capacitor, C406 in the CTC 48. Briefly, a voltage sample indicative of high voltage is used to control the current through the control winding of the regulator saturable reactor. In turn, the degree of saturation of this reactor controls the resonant frequency of the power-input circuit. The resonant frequency of C406, C407, T401, and T402 is such that the voltage across the capacitors normally reaches its crest before the time when it is discharged by the retrace circuit. Therefore, increasing the resonant frequency of the power-input circuit decreases the charge across the capacitors.

Referring to the schematic diagram, an increase in pulse voltage at the wiper of the high-voltage control, R412, increases the conduction of Q401 and increases the resonant frequency of the power-input circuit. This decreases the voltage

across C406 and C407 at the time when retrace is initiated, thereby reducing the input power to the yoke and flyback transformer. In this manner, both the yoke current and the high voltage are regulated.

To change the sweep width in this system, it is necessary to change the division of energy between the yoke and the flyback transformer. In some earlier chassis, this has been done by connecting a variable inductance in series with the yoke. By increasing this inductance the width could be decreased.

In the CTC 48 chassis, **width is controlled by selecting the appropriate "tap" on the flyback primary windings.** The winding between W1 and W3 (one or two turns) serves to "buck" the flyback primary; therefore, connecting C410 to W3 tends to increase the high voltage with respect to the yoke current. However, the regulator maintains substantially constant high voltage, so the net effect is to decrease the width. Connecting C410 to W1 disconnects the bucking winding, allowing the width to increase.

In production, instruments having 21" diagonal kinescopes will have the jumper connected to the wide tap, W1, and those with 25" diagonal kinescopes will have the connection made to W3, the narrow tap. (21-inch diagonal tubes have a slightly greater horizontal-deflection angle.) **To decrease the width of scan on a 21" diagonal kinescope, simply move the white jumper from W1 to W3.**

If overscan is a problem with a specific receiver, and connecting the jumper to W3 does not reduce it sufficiently, proceed as follows:
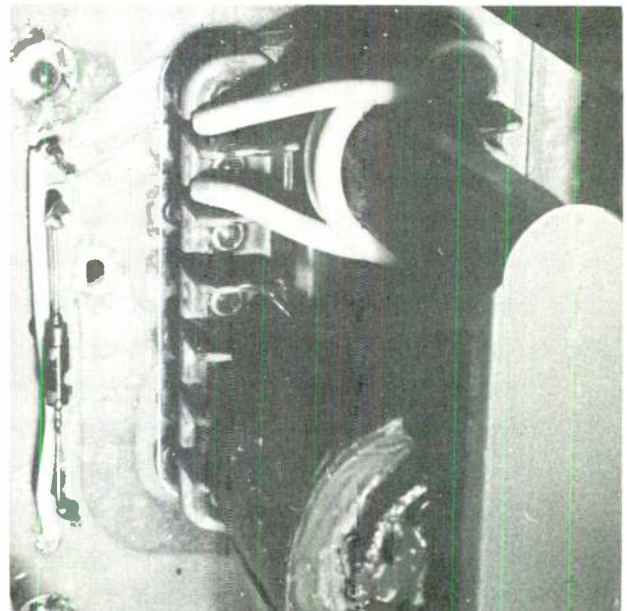
Width "Taps" Are Located to the Left of the Unshielded Flyback Transformer.

1. Connect the jumper to W3.

2. Connect L402 between W2 and W1.

This reverses the phase of the "bucking" winding so that it aids the flyback primary and attempts to boost the high voltage. Since the regulator maintains constant high voltage, input power to the deflection system is decreased and there is less power available to the yoke.

Before changing the width taps, be certain that high voltage is correctly adjusted. With zero beam current and 120 volts line voltage, the high voltage must be 26.5kV. When changing the width tap, be particularly careful not to short-circuit the width winding connected between W1 and W3. To do so may damage the flyback transformer or other components.

Pincushion Transformer

One of the characteristics of the SCR deflection system is that a short across the trace devices causes no damage, but an open circuit—particularly in the yoke circuit—will almost certainly destroy either SCR 101 or CR 401, or both. **To preclude damage from opens in the yoke circuit insofar as possible, all pincushion components have been connected across the primary of the flyback transformer instead of in series with the yoke.**

The pincushion circuit will be described in greater detail later in this text; for the moment consider T405 as a voltage source which increases the voltage across the primary of the flyback at the top and bottom of the field relative to the voltage at the center of the field. This tends to increase high voltage at the top and bottom of the field, but this is impossible because of the action of the regulator. Instead, the horizontal yoke current is diminished at the top and bottom. Observe that the general scheme of operation is identical to the operation of the width circuit.

High Voltage Regulation

In earlier configurations of the high-voltage regulation system, the high-voltage sampling point was the high side of the yoke-return capacitor (the counterpart of C120 and C121 in this chassis); the pincushion and width-control components were between this point and the low end of the yoke. In the CTC 48, the top of C120 cannot be used as a sampling point for the high voltage, because the voltage at this point is modulated by the pincushion input. If it were used, the regulator would simply "regulate away" the pincushion correction. Therefore, the sampling point for the regulator has been removed to a secondary winding of the flyback transformer. This change in the sampling point dictated a change in the offset voltage provided by CR 405, which formerly was 6.8 volts.

The collector circuit of the regulator transistor, Q401, is powered by the 77-volt supply, rather than by energy from the flyback transformer. Since the 77-volt supply varies with power-line voltage, line regulation of the high voltage is better than it would have been if the Q401 collector had been powered from the flyback transformer.
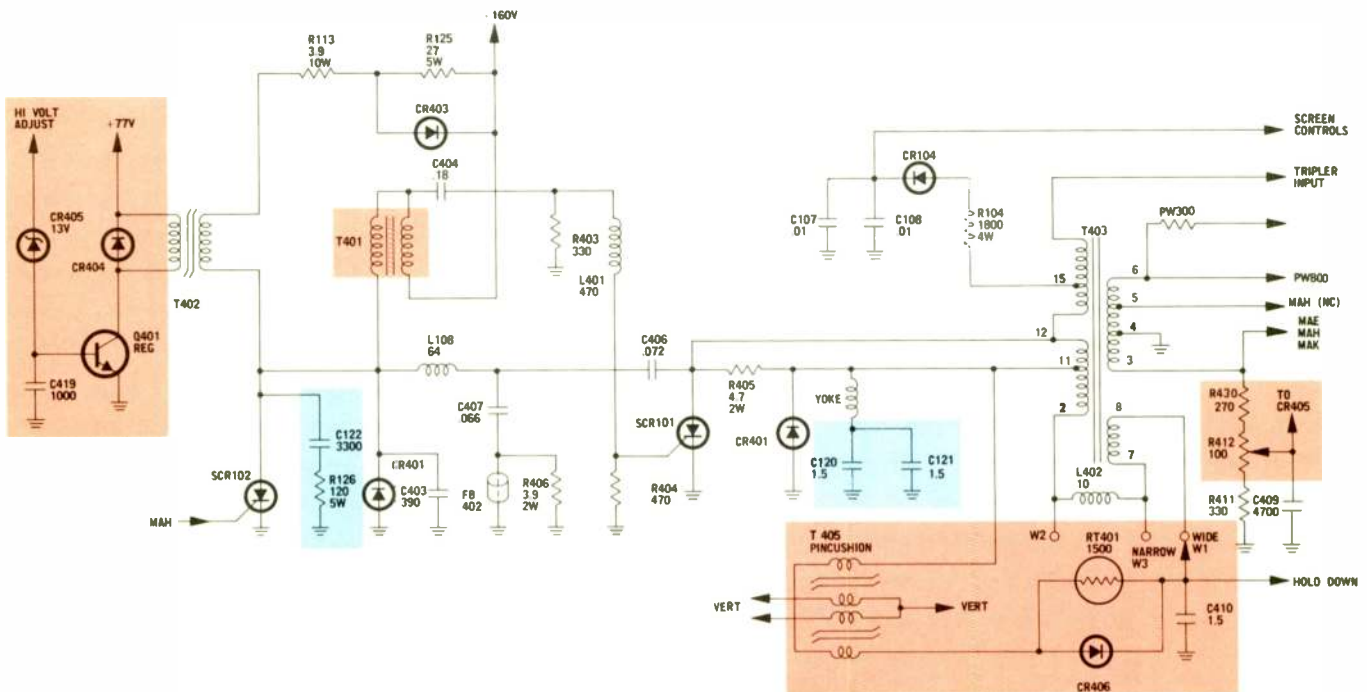
Horizontal Deflection System (Repeated for Convenience)

Horizontal Yoke Circuit

It is well known that SCR's are inherently low-impedance devices; that is, they can carry high currents, but voltages should be held as low as possible. To this end, the yoke impedance in the CTC 48 has been lowered to $325\mu H$. (It is about $455\mu H$ in earlier solid-state console chassis, but only $200\mu H$ in the portables.) The lowered yoke inductance requires a reduction in the series capacitive reactance, and so a parallel pair of capacitors, C120 and C121, are used. Notice that these capacitors are chassis mounted, thus reducing the number of connections and the amount of copper pattern on the circuit boards. This is a facet of the design objective of minimizing the potential failure points in the yoke circuit.

The lower yoke impedance of the CTC 48 introduces a problem when this chassis is connected to a CTC 40/44 test fixture. Physically, the connection can be made with the same yoke adapter and convergence jumper that is used with the CTC 46. Electrically, the $455\mu H$ impedance of the test-fixture yoke causes the high voltage of the CTC 48 to rise to a level that actuates the hold-down circuit. By adjusting the high voltage as low as possible and defeating the hold-down circuit by grounding TP 402, an overscanned raster can be obtained; but high voltage will be excessive.

To maintain normal operation when the test fixture is used, the $455\mu H$ yoke must be shunted by a $1.2\mu H$ inductance. This is approximately the inductance of the primary of the flyback transformer, T403. If one of these is available the inductor can be fabricated as follows:

1. Remove the high-voltage winding.
2. Connect terminals 2 and 8.
3. Connect terminal 12 to J106-5 and terminal 7 to J106-6.

An adapter cable which includes the $1.2\mu H$ shunt is being developed and is expected to be available by midsummer of 1972.

Focus and High Voltage

The high voltage tripler used in the CTC 48 is similar in appearance to the familiar quadrupler, but it is somewhat smaller. **They are not interchangeable, either physically or electrically.** Obviously, the tripler requires one-third more drive voltage to produce the same output.

Focus voltage is taken from the first section of the tripler and has approximately the same amplitude as the high voltage flyback pulse, about 9kV. Since this is considerably higher than the focus-voltage output of the quadrupler, different resistance values are used in the focus control bleeder and **it is not interchangeable with the focus control used in earlier all-solid-state chassis.**

Service Hints

In general, the servicing techniques used with earlier SCR deflection systems are valid for servicing the deflection system of the CTC 48 chassis. Some of these, as well as techniques peculiar to the CTC 48 circuitry, are outlined in the following paragraphs. Please refer to the schematic diagram.

In most instances, faults which cause the circuit breaker to trip occur in either the power supply itself, or in the horizontal deflection system. Shorted diodes in the power-supply module (MAB 003A) will cause the breaker to trip, and this possibility should be eliminated before attempting to troubleshoot the horizontal-deflection system. The power-supply diodes may be checked individually for shorts, or the MAB module may be checked in its entirety by substitution.

Within the horizontal-deflection system, the most probable cause of circuit-breaker tripping is a short circuit in one of the retrace (commutating) devices, SCR 102 or CR 402, or a fault in the trace devices, SCR 101 and CR 401. Any of the capacitors which are connected between ground and B+ also will trip the breakers if they become shorted. Included are C122, C403, C407, and C406. Although C406 is seemingly isolated from ground by SCR 101, this SCR will be gated into conduction at instrument turn-on, thereby completing the ground path if C406 is shorted.

As pointed out before, the high-voltage regulator transistor, Q401, uses the 77-volt bus for collector supply, instead of being supplied from the flyback transformer. Because of this, a collector-to-ground short will trip the circuit breaker. In earlier chassis, a short in this transistor drove the high voltage low.

A defective trigger from the MAH module may cause the circuit breaker to trip; but this occurrence is rare. The possibility may be eliminated by turning off the receiver, removing MAH, and restoring power. If this clears the overload, MAH is at fault. **Caution:** Any time MAH is removed, the bleed-off time for the 225-volt and 160-volt power supplies is increased. **If the instrument is energized with MAH removed, allow five minutes after turn-off for B+ to discharge, or else discharge B+ with a 10,000-ohm resistor.**

In earlier chassis, the resistive divider that includes the high-voltage control was connected between the yoke-return capacitor and ground. Therefore the DC resistance measured from the high side of the trace devices (SCR 101 and CR 401) to ground was about 4000 ohms. Now that the location of the high-voltage control has been changed, the resistance to ground from the tops of the trace devices is about 16K ohms.

The CTC 48 employs basically the same overvoltage protection that was used in the CTC 46.

In both chassis, any malfunction which leads to the generation of excessive high voltage will drive the horizontal oscillator off frequency. Therefore, off-frequency horizontal deflection may be caused by either of two types of malfunction, oscillator faults or high-voltage regulator faults. The latter may be eliminated by momentarily grounding TP 402, which "disables" the disable circuit. If this restores horizontal sync, high voltage is probably excessive; if it does not, suspect the MAH module and the hold-control circuit.

Excessive high voltage can be caused by a number of faults such as an open regulator transistor, an open between the flyback transformer and the wiper of the high-voltage adjusting potentiometer (R412), an open in the control winding of T402, or an open in the pincushion winding which shunts the primary of the flyback transformer. Other possibilities are an open zener, CR 405, and loss of 77-volt power to the regulator transistor.

As in any color television receiver, loss of the raster is not a sure indication that there is no high voltage. Video-amplifier faults (including the bright ness limiter), certain faults in the chroma modules, and loss of screen or focus voltage can produce a "black raster." Therefore, it is necessary to determine that high voltage truly is absent before attempting to trouble-shoot the high-volage system.

Components of the deflection and high-voltage system which can fail and cause loss of high voltage, without tripping the circuit breaker, include SCR 101 and CR 401. If either is shorted there can be no high voltage and a DC VTVM connected to the high side of either of them will indicate zero volts. Normal voltage is about 54 to 56 volts.

If the voltage measured is low, but not zero, either the trace SCR or diode may be open. Other possibilities are a shorted tripler, shorted flyback transformer, shorted pin-cushion transformer, or shorted screen rectifier.

Top-and-Bottom Pincushion

The complete yoke and pincushion-correction circuit is shown in the schematic diagram below to assist in circuit tracing. As stated before, the horizontal windings of the pincushion transformer are connected parallel with the flyback-transformer primary, rather than in series with the yoke. The means whereby modulation of the flyback transformer ultimately modulates the yoke current was discussed along with the general operation of the horizontal system.

Now consider the current flow in the vertical yoke circuit. From the vertical-output transistors, deflection current passes through C416 and the convergence board to one yoke winding. Passing through this yoke winding, it travels through a winding of L403, both vertical windings of T405, back through L403, and then through the second yoke coil to ground via R13 in the MAG module. This is an alternating current, of course; electron flow from ground upwards through R13 produces upward deflection.

Horizontal-rate current in the windings of T405 which are parallel with the flyback primary induces a voltage in the vertical windings of T405. This produces a horizontal-rate circulating current in the circuit of T405, L403, and C414. The phase of this current, relative to yoke current, is determined by the tuning of L403. Its amplitude is controlled by R417, which is effectively a shunt load
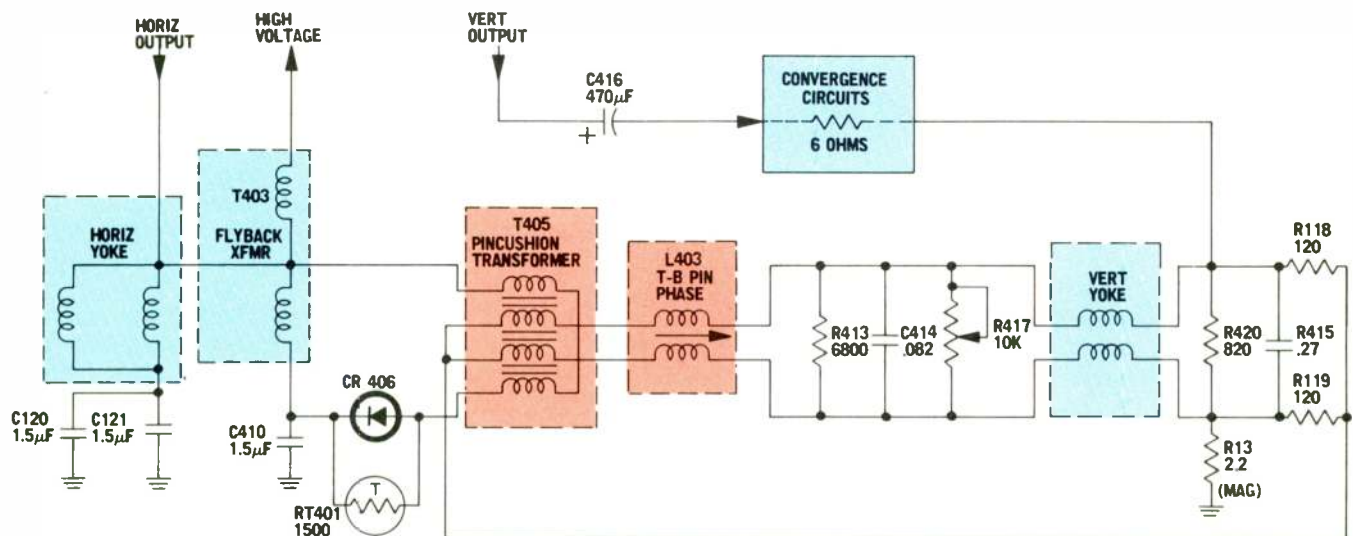
Pincushion Correction Circuit

across the tuned circuit. This circulating current controls the impedance to vertical-yoke current which must pass through T405. When the circulating current is properly phased, impedance to vertical-yoke current will be minimum at the vertical centerline of the raster and maximum at the edges, as required to correct the pincushion effect.

Hybrid VHF-UHF Tuner

The CTC 48J chassis used in 25-inch diagonal remote-controlled models features a "hybrid" tuning system with a **mechanically tuned VHF tuner and the KRK 194 varactor-controlled UHF tuner.** This tuner is the same tuner that is used in the CTC 54, but the control circuitry is completely different.

Tuner Drive System

The tuner drive motor is coupled to a gear reduction unit whose output shaft rotates at 20 times the rotational speed of the VHF tuner. Attached to this shaft is the "station-stopper" cam. This cam operates a switch which opens at the precise times that the tuner is positioned in the channel detents.

The drawing which shows the channel selection system has been greatly simplified and shows only the fundamentals of operation. In it, mechanical connections are shown by broken lines and electrical connections are solid. As indicated, a 13-

position VHF tuner is driven by the motor through a gear train. Unlike other motor-driven tuners, this gear train has 20 "stops" rather than 13.

First consider operation of the system for a remote VHF channel change. Q1111 is saturated, picking up K101, and starting the motor. The station-stopper cam rotates and closes its switch to hold in K101 at least until the VHF tuner reaches the next channel. At the same time, the bypass switch is closed by the lateral thrust of the motor armature. This connects the common ends of the program switches on the VHF tuner in parallel with the station stopper.

Whenever a channel has been programmed to bypass, the program switch for that channel is closed to ground. Thus, when the station stopper switch opens for that channel, the program switch is closed and holds K101 closed. **Therefore, the motor can stop only if the station stopper and the channel-programming switch are both open.** Otherwise it will run to the next channel.

The bypass switch allows the tuner to be manually set to "bypassed" channels. Its function is to disconnect the program switches from the control relay, K101, whenever the motor is at rest.

In the simplified drawing, the tuner is shown at rest on channel 13. If K101 is momentarily closed, the
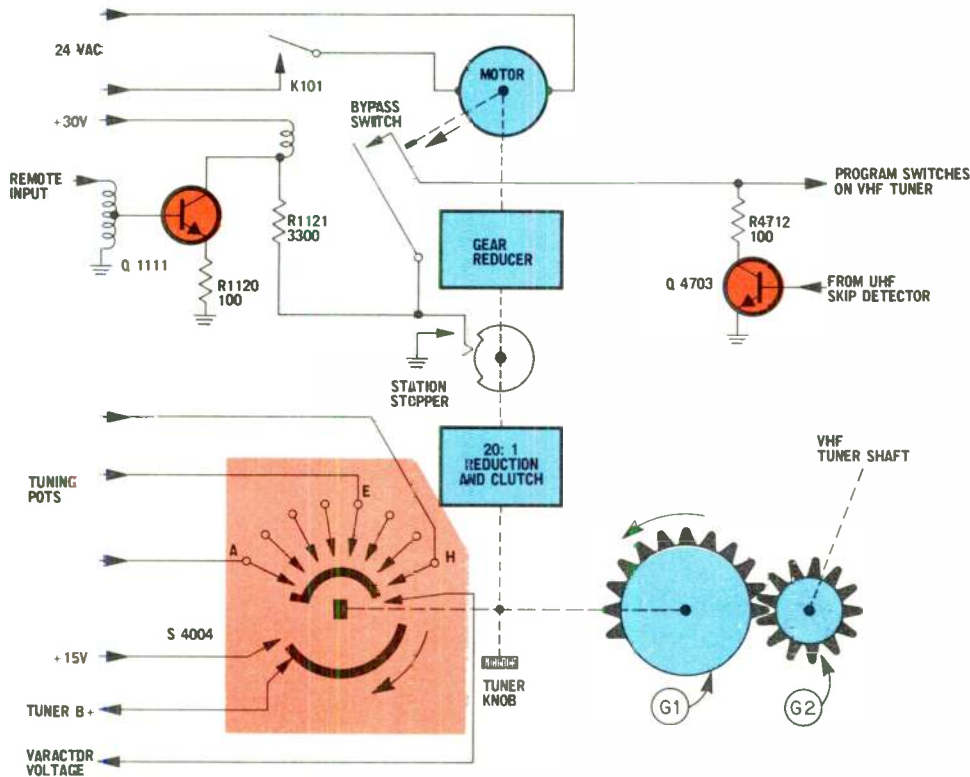
Functional Diagram of Motorized Channel Selector
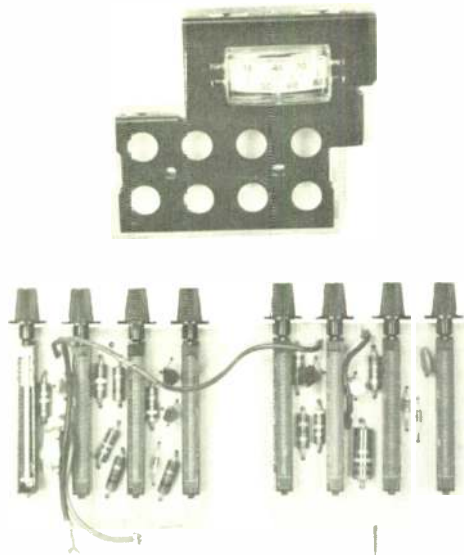
"Exploded" View of UHF Tuning Controls and Meter.

"Hybrid" TMA. The Varactor UHF Tuner Is Mounted Above the Conventional VHF Tuner.

motor will rotate the VHF tuner to the UHF position. Since there is no program switch to close on the UHF position, the tuner comes to rest. (Ignore Q4703 for the moment.)

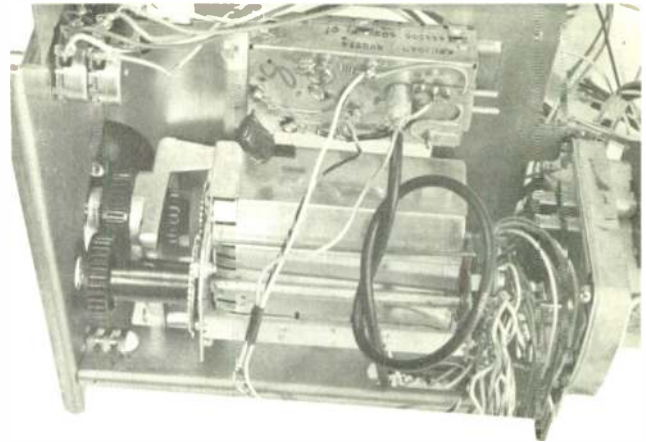When the tuner drive has advanced one "step" from the position shown, B+ is supplied to the UHF tuner through the lower half of S4004. At the same time, the upper half of S4004 connects the slider of UHF tuning potentiometer "A" to the varactors of the UHF tuner. There are eight UHF tuning potentiometers and each of these may be connected to the tuner by actuating the motor or by operating the channel knob.

If it is desired to "program out" one or more of the eight UHF positions, the appropriate tuning po-

tentiometer is turned completely counterclockwise. This increases the varactor voltage to maximum, and a sample of this voltage is used to saturate Q4703. Any time Q4703 is saturated, the motor will run to the next channel.

Notice that eight teeth are missing from gear G1. Therefore the VHF tuner is at rest while S4004 is driven through UHF channels A through H. After UHF channel H has been reached, the next rotation of the tuning motor causes the first tooth of G1 to engage the VHF tuner and move it to channel 2. This also carries S4004 to its blank segments, de-energizing the UHF tuner while the VHF channels are selected.

An additional switch which is not shown is actu-
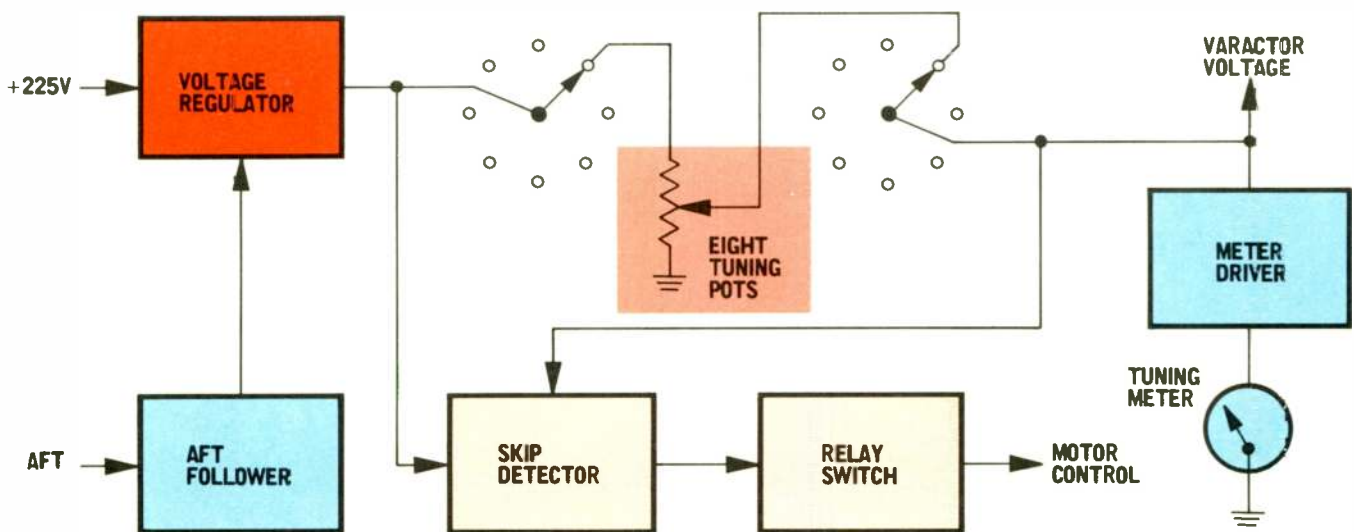
Block Diagram of the Varactor Tuner Control System

ated by the VHF tuner shaft and shorts together the two AFT lines when the tuner is in motion. Also not shown is a section of S4004 which does the same thing during UHF channel change.

UHF Varactor Tuning

Most of the circuit elements which control the UHF tuning are located on two circuit boards designated **PW 4700 and PW 4800.** These boards are part of the TMA, along with the 15-volt zener which regulates UHF B+, the UHF selector switch, S4004, the UHF tuning meter, tuners, drive motor, etc.

The schematic diagram shown here includes components located on PW 4700, PW 4800, and the TMA itself. The location of specific parts is indicated by the symbol numbers. Two sections of S4004 are not shown. One of these sections switches B+ to the UHF tuner; the other shorts AFT during channel changes. Only two of the eight identical tuning potentiometers are shown. Four of these controls are located on each board. The symbols are R4701 through R4704 and R4801 through R4804.

Tuning voltage is obtained by dropping the 225-volt B+ and regulating it with a 30-volt zener. Temperature drift of the zener is compensated by the temperature drift of CR 4801 and CR 4802 to main-

tain substantially constant voltage at all operating temperatures. AFT voltage is added to the regulated voltage by Q4801.

The selector switch connects the sum of the regulated voltage and the AFT voltage to one of the tuning potentiometers, and at the same time the wiper of this potentiometer is connected to the varactors of the UHF tuner. **Thus, each of the eight controls can tune across the entire UHF band.**

Varactor voltage is also supplied to Q4701, the meter driver. The meter, M4001, may be calibrated on any channel by R4706.

Channel bypassing is provided by Q4702 and Q4703. The base bias of Q4702 is determined by R4707 and R4706, and this voltage is somewhat higher than the varactor voltage required to tune to channel 83. Accordingly, Q4702 remains cut off when the receiver is tuned to any UHF channel. If the potentiometer is tuned above channel 83, fully counterclockwise, the emitter of Q4702 goes more positive than the base and conduction results. Q4703 is driven into saturation, supplying a ground to the motor control circuit.

AFT defeat is considerably simpler in this chassis than it is in the CTC 54. Here it is done by shorting together the two AFT leads which come from the MAK module. The differential AFT error voltage is
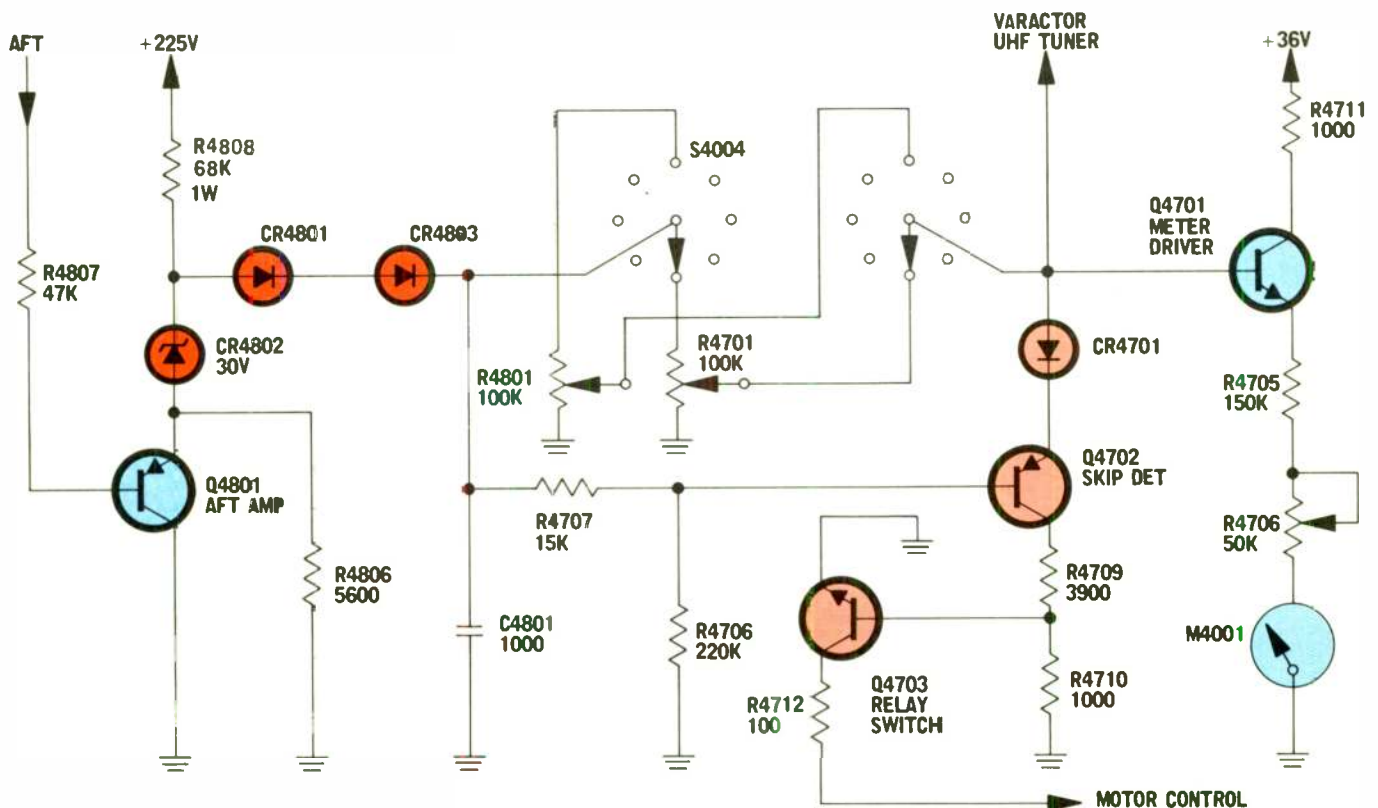
Varactor Tuner Control Circuits

shorted, of course, and the 6.2-volt quiescent voltage from both AFT lines is fed to Q4801 via R4807. AFT is defeated whenever the tuner/selector-switch drive shaft is in motion, when the AFT defeat switch is operated, and when the VHF tuner is fine tuned.

Tuner Control Service Notes

Servicing of the tuner control system falls into two general categories, mechanical and electrical. In the former category, if the gear indexing between the station-stopper cam and the tuner (or S4004) is changed, the motor will stop "between channels." **Incorrect assembly is usually the cause.** If the bypass switch never closes, the tuner will stop on all channels; if it never opens, the motor will start if the tuner is manually set to a bypassed channel. A short in the line to the VHF program switches will cause continuous running; an open allows the tuner to stop on bypassed channels.

If Q1111 shorts, the motor will run continuously; if it opens the motor cannot be started. Q4703 is out of the circuit unless the motor is already running; therefore, a short will have no effect until there is a remote channel change. Once the motor is started, a shorted Q4703 will "bypass" all channels. Naturally, a malfunction in PW 4700 which holds Q4803 in saturation (such as a short in Q4702) will have the same effect.

Presence of varactor voltage is indicated by the tuning meter. AFT voltage may be observed on the tuning meter by opening the UHF tuning access door and "rocking" the tuning control. Observe the meter. If it deflects slightly, AFT is operating.

A collector-base short in Q4701 will apply unregulated 36 volts to the varactors. This will drive the tuner "above" channel 83 and also energize the channel-bypass circuit.

Loss of regulation of the tuning supply voltage will probably cause a drastic change in the varactor

voltage, which can be observed on the tuning meter. A further check of regulation is possible by defeating AFT and observing the tuning meter. If the hi-low line switch is operated, there should be no voltage change.

Remote System

The remote on-off control circuit of the CTC 48 chassis is very similar to the CTC 54 on-off circuit, and there is some similarity between this volume-control system and earlier ones. Nevertheless, there are enough differences to warrant their discussion.

On-Off Control

The on-off circuit is shown in block form and schematically. Referring to the block diagram, observe that both the local on-off push button and the detector provide ground to the input of the schmitt trigger, whenever they are operated. The schmitt trigger produces a negative-going square pulse having a duration about equal to closed-switch time.

The flip-flop is designed to switch only on negative-going spikes, so **it operates when the button is depressed, but not when it is released.** Therefore, the lamp driver is alternately saturated and cut off by successive closures of either on-off switch. When the instrument is turned on, the lamp driver is saturated, providing ground for an incandescent lamp. Light from this lamp reduces the resistance of a photosensitive device connected between AC line and the triac gate, which drives the triac into conduction.

The complexity of this power-control system (compared to a ratchet relay) is justified by the **improved reliability.** This type of circuit was first used by RCA in the Q-Line CTC 54. Later it was incorporated in the design of the CTC 59, and **now it is being used in all remote-control color television receivers.**
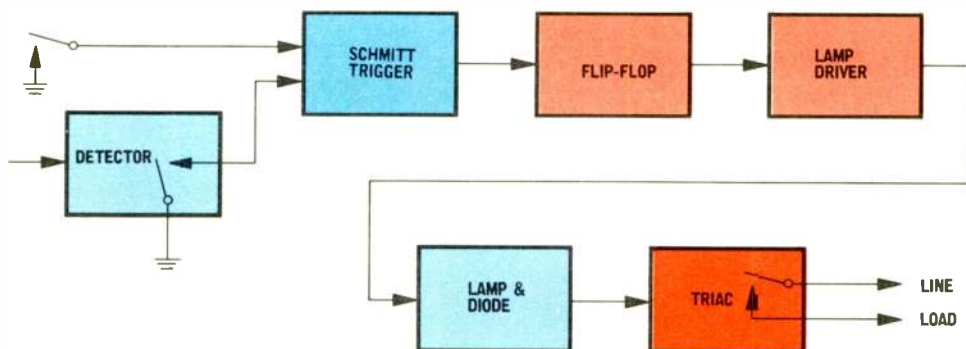
Block Diagram of Triac On-Off Control
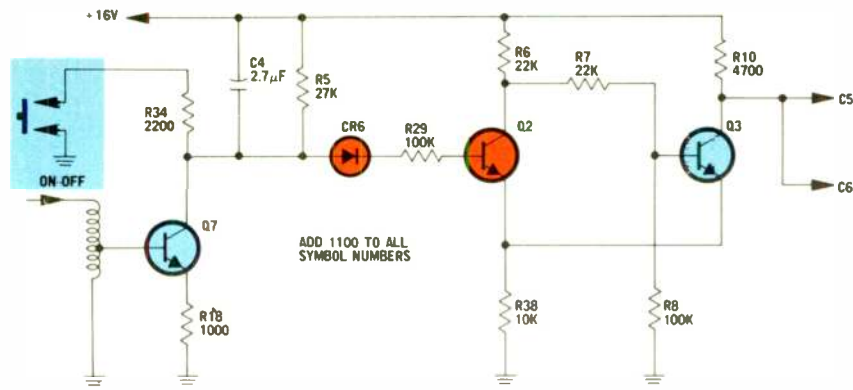
On-Off Schmitt Trigger

Circuit Analysis

Except when either on-off button is depressed, Q2 of the schmitt trigger is in heavy conduction. Therefore, the emitter of Q3 is negative with respect to its base, and its collector potential is about equal to B+.

If a button is depressed, the anode of CR6 goes towards ground at a rate determined by the RC time constant of C4 and Q7. This gradual charging of C4 is needed to provide **noise immunity.** In about .05 second the anode voltage of CR6 goes below the emitter voltage of Q2, and the transistor cuts off. Immediately, the collector of Q2 and the base of Q3 swing positive, saturating this latter device and taking its collector low. This condition continues until the push button is released, when the collector of Q3 goes to B+ once again.

When B+ is applied to a symmetrical flip-flop (one wherein the corresponding components of the two sides are the same) the side which conducts is the one which happens to have greater gain. For several reasons, a television receiver should go to the standby condition every time primary power is made available. By making the collector-load resistance of Q4 (R9) larger than R12, the instrument always "comes on" with Q4 saturated and Q6 cut off. This holds Q5 in cutoff and the receiver is held in standby.

A negative-going pulse from the schmitt trigger keys off the saturated transistor (Q4 in this instance) and allows Q6 to conduct. This ultimately turns on the triac and places the receiver into operation. The next square wave from the schmitt trigger will return the flip-flop to its original state and put the receiver in standby.
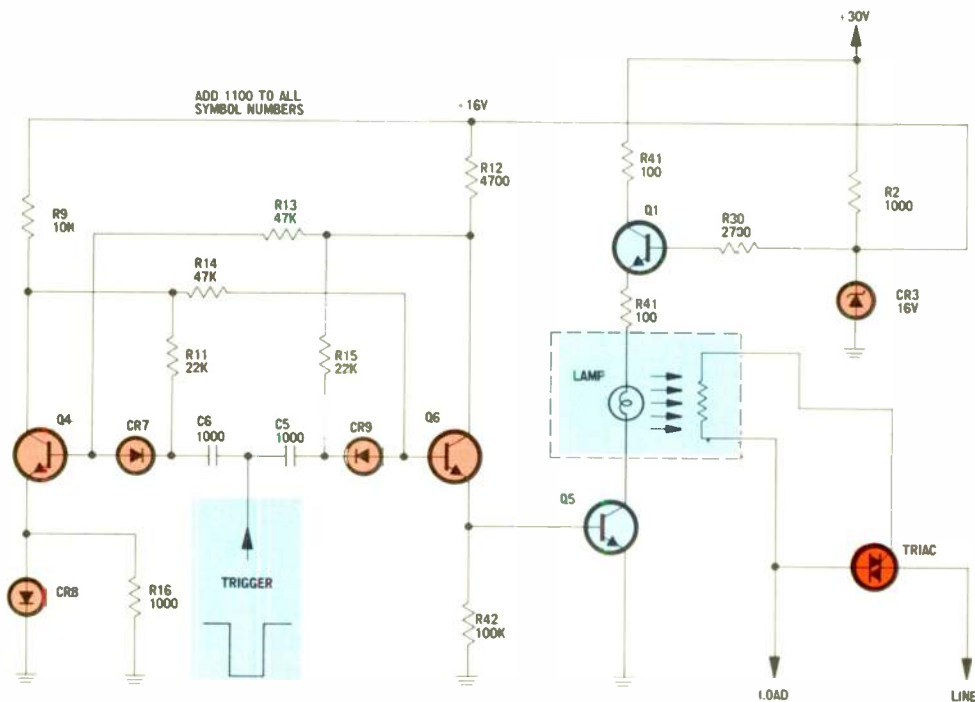
On-Off Flip-Flop and Triac Circuits

61
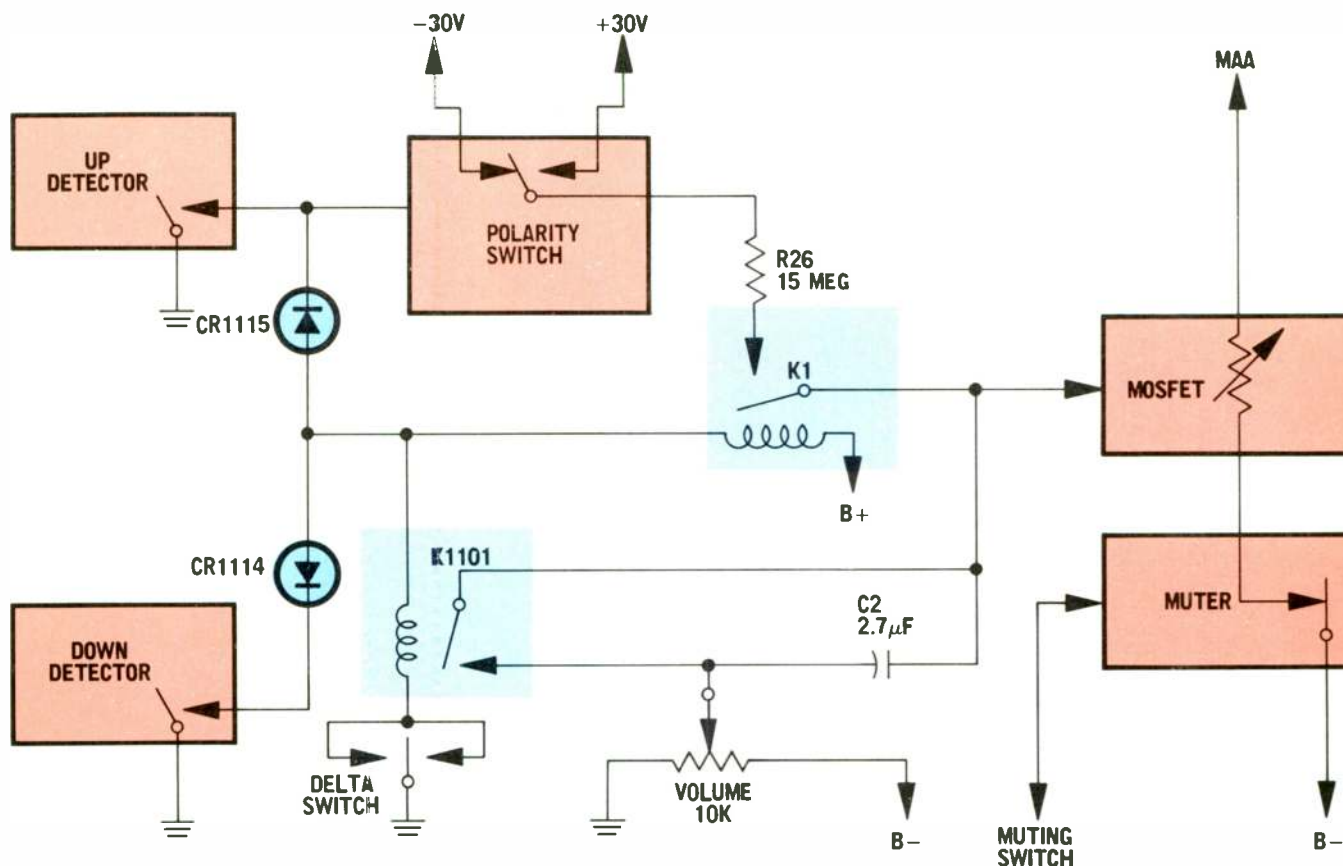
Remote Volume Control Block Diagram

Service Notes

If the instrument is being serviced, it is sometimes annoying to have to depress the on-off button each time the set is plugged in. A convenient method of turning the receiver on from the rear is to jumper the triac. **Be certain the jumper is removed when servicing is completed.**

Problem 10 of Workshop 8 is applicable to this on-off system; however, the transistor symbol numbers are different and should be changed to correspond with the schematic diagram shown here. Also, Q1104 of the Workshop-8 diagram is replaced by a diode (CR 1108) in the CTC 48. As a further troubleshooting aid, the waveforms obtained with the **RCA WC 528A Quicktracer Transistor Checker** are shown in this manual.

Volume Control

The basic "memory-module" remote system was first introduced with the **G2000, CTC 47 Chassis.** It will be recalled that the remote inputs to the memory module passed through neon lamps to the gate of the MOSFET. These lamps have been "designed out" of the MAZ memory module used in the CTC 48, and the majority of the changes in the overall circuit stem from this.

The functional diagram illustrates the basic scheme of operation of the volume control circuit. In the quiescent state, all "switches" are in the positions shown. Whatever voltage is on the wiper of the volume control appears at the gate of the memory MOSFET. This gate voltage controls the conduction of the MOSFET and finally the gain of **MAA (formerly designated PM 200).** Increased conduction (less negative gate) increases volume.

A remote volume-up command excites the up detector, which closes K1 and connects positive voltage to the top of R26, the 15-meghom resistor. C2 discharges slowly through the resistor (RC =4 sec) and volume increases. When the volume-up button is released, the polarity switch drops back to the negative input; but at the same time, K1 opens and the newly established voltage remains on the MOSFET gate. Depressing the volume-down remote button also energizes K1, but it does not operate the polarity switch. Therefore negative voltage is applied to the MOSFET gate and volume decreases.

The delta switch closes each time the local volume control is rotated. This closes K1101 to "erase" any remote-input voltage from C2. The fact that K1 also closes and connects R26 to the MOSFET does

not affect the gate voltage, since the resistance of the volume control is much less than 15 megohms. The muter transistor normally connects the MOS-FET source to a —6.8 volt supply. During channel changes a switch in the tuner removes forward bias from the muter and opens the MOSFET supply. This cuts off MAA.

Referring to the schematic diagram. note that the output end of R26 is clamped between the limits of ground and —10 volts. This equalizes the ranges of local and remote volume control and also provides gate protection for the MOSFET. Within the memory module, the MOSFET is protected from transients by the 10-megohm resistors and the .1-mfd capacitor.

Servicing Hints

In the past, the number of memory module failures has been quite small, and with the elimination of the two neon lamps it should now be smaller still. But, of the modules which have been returned, a **high percentage have proven to be *not* defective.**

In the MAZ 001B, all elements are active for both volume increase and volume decrease. Therefore **it is improbable that the module is defective if either function is operable.**

As a further check, remove the module and connect socket terminal 12 to ground via a 10,000-ohm resistor. This should produce an average to moderately loud sound level. If it does not, suspect the interconnections between the remote system and the main chassis, or components and modules of the main chassis.

It may be desirable to operate the instrument without the memory module. This may be done by tapping P1102-7, the edge connection on PW 1100. This removes B— from the volume control. Then connect a 10,000 ohm resistor between terminals 10 and 12 of the MAZ socket. The control range will be limited and the volume control will work "backwards."

Assuming the mode of failure is an open, malfunction of Q10, Q13, CR 15, or CR 14 will cause loss of the corresponding function. A shorted collector will cause the volume to go to its upper limit (Q10) or lower limit (Q13).

Failure of Q9 will cause volume to go in the same direction, regardless of which remote volume button is depressed. The direction will depend on which voltage is permanently applied to R26 by the malfunction.

If the Q14 circuit fails in a mode which isolates the MAZ module from the —6.8-volt supply, audio will be continuously muted. Conversely, a short from the collector to either other element will cause no muting between channels.

As a further aid to servicing, the waveforms obtained with the **RCA WC 428A Quicktracer Transistor Checker** are reproduced in this manual.
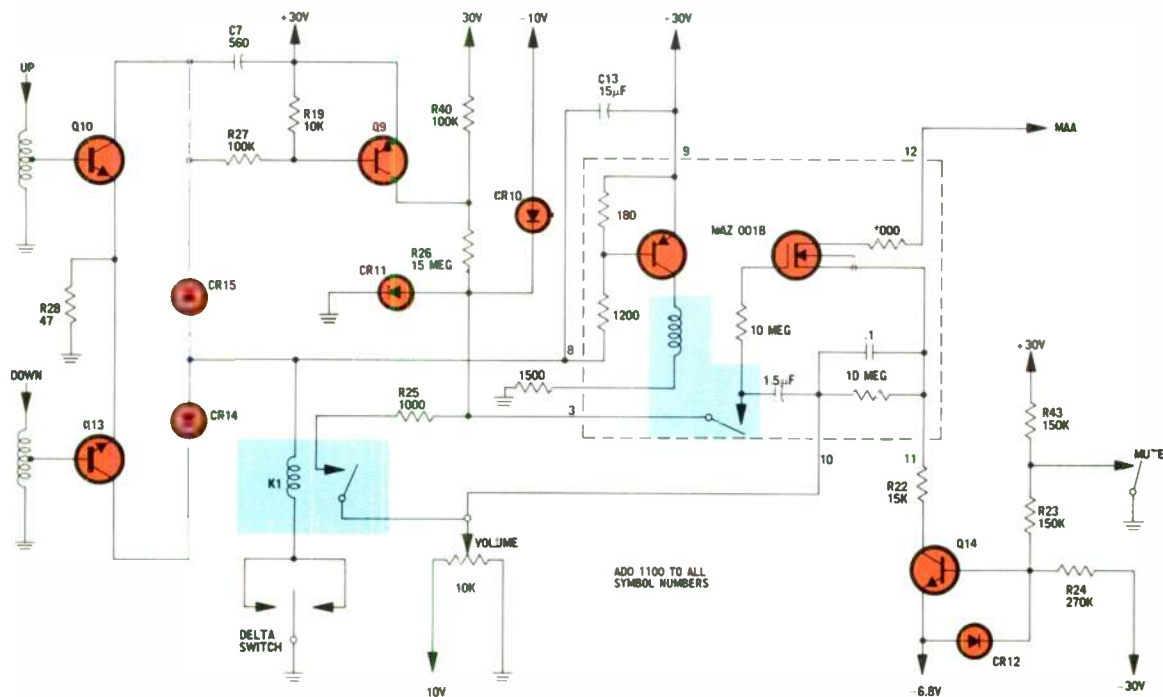
Remote Volume Control Circuit

Conditions of test: These wave-forms were obtained using the **RCA WC 428A Quicktracer Transistor Tester** and the **RCA WO 505A Oscilloscope** as described in **"TRANSISTOR TESTING"** *RCA Television Service Tips, Volume XXIII, Issue 1.* All power to the chassis was removed.

Base to Emitter   Base to Collector

Base to Emitter   Base to Collector

Q1101

Q1102   Q1103   Q1104

Base to Emitter   Base to Collector

Q1105

Q1106
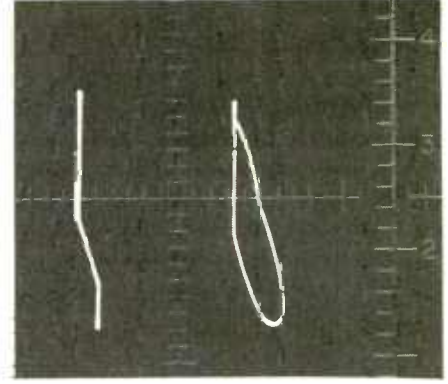
Q1107
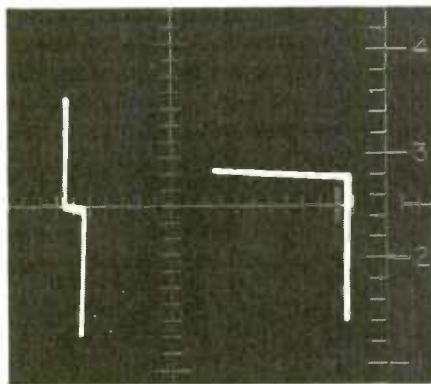
Q1109
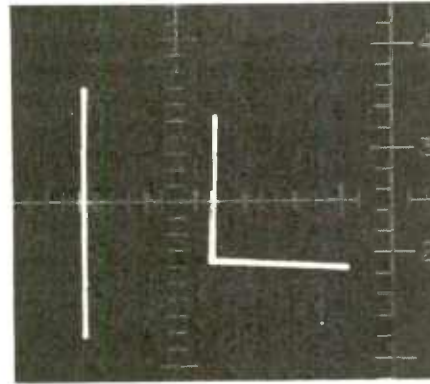
Q1110   Q1113
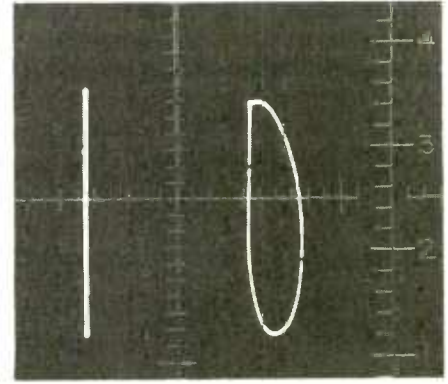
QI111
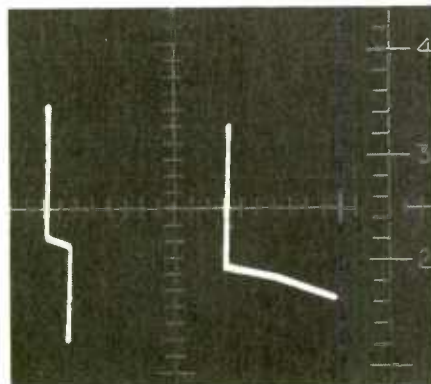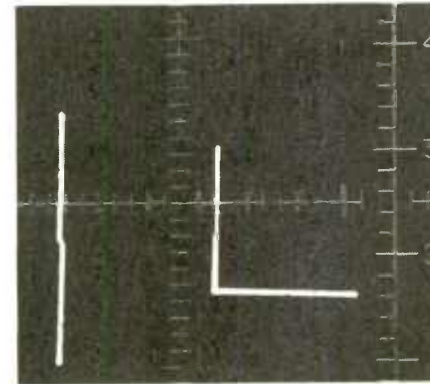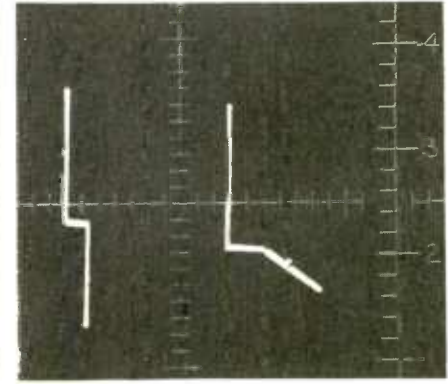
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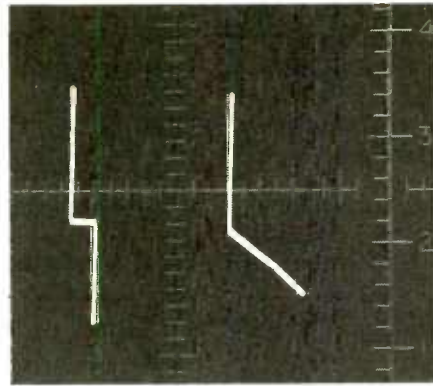
Q1114

QI115

Q4801

Conditions of test: These waveforms were obtained using the **RCA WC 428A Quicktracer Transistor Teste**r and the **RCA WO 505A Oscilloscope** as described in "**TRANSISTOR TESTING**" *RCA Television Service Tips, Volume XXIII, Issue 1.* All power to the chassis was removed.
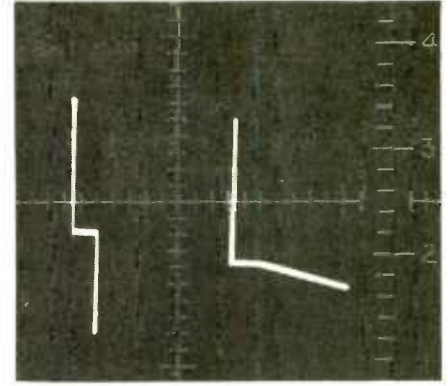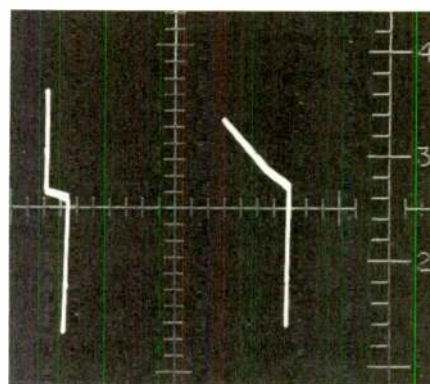
Base to
Emitter

Base to
Collector
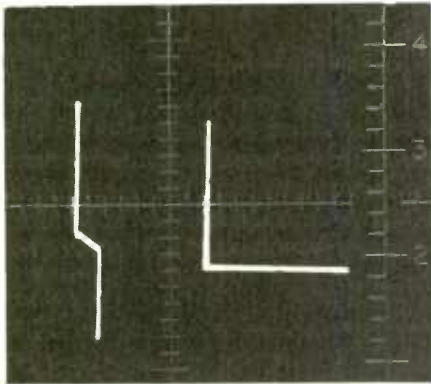
Base to
Emitter

Base to
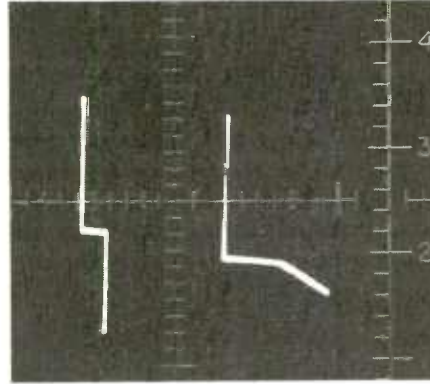Collector
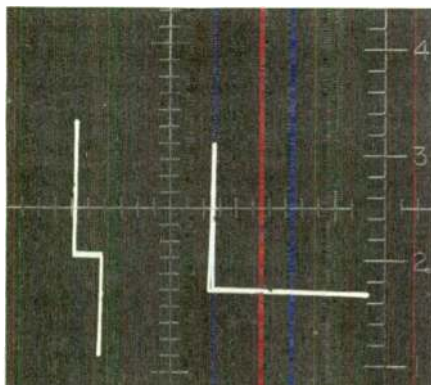
Q4701
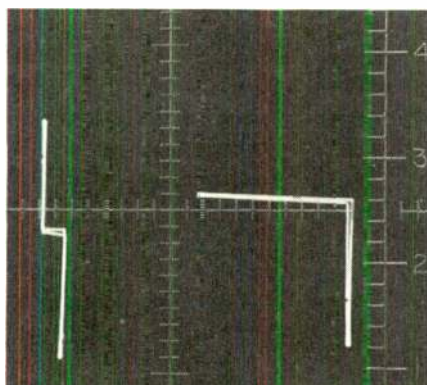
Q4702
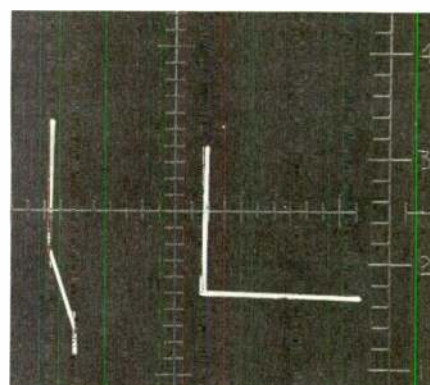
Q4703

1973 MODEL/CHASSIS CROSS REFERENCE

Color Television

MODEL	CHASSIS	VHF	UHF
GR 610W	CTC 39	KRK 173A	KRK 132D
GR 612W	,,	,,	,,
GR 657L	,,	,,	,,
GR 661D, S	,,	,,	,,
FR 505WX	CTC 46	KRK 165E	KRK 156A
FR 510WXEN	,,	,,	,,
GR 530WX	,,	,,	,,
GR 534LX	,,	,,	,,
GR 538DX, SX	,,	,,	,,
GR 544LX, AX	,,	,,	,,
GR 548DX, SX, GX	,,	,,	,,
FR 505 P, WR	CTC 48	KRK 205A	KRK 156A
FR 510WEN	,,	,,	,,
FR 520W	,,	,,	KRK 132D
FR 520WR	,,	KRK 209A	KRK 194B
GR 710W	,,	KRK 205A	KRK 132D
GR 710R	,,	KRK 209A	KRK 194B
GR 714L	,,	KRK 205A	KRK 132D
GR 714LR	,,	KRK 209A	KRK 194B
GR 718D, S	,,	KRK 205A	KRK 132D
GR 718DR, SR	,,	KRK 209A	KRK 194B
GR 723W	,,	KRK 205A	KRK 132D
GR 723WR	,,	KRK 209A	KRK 194B
GR 729W	,,	KRK 205A	KRK 132D
GR 729WR	,,	KRK 209A	KRK 194B
GR 750W	,,	KRK 205A	KRK 132D
GR 754L	,,	,,	,,
GR 758D, S	,,	,,	,,
GR 770W	,,	,,	KRK 207C
GR 774L	,,	,,	,,
GR 778D, S	,,	,,	,,
GR 780W	,,	,,	,,
GR 790W	,,	,,	,,
GR 792F	,,	,,	,,
GR 794L	,,	,,	,,
GR 794LR	,,	KRK 209A	KRK 194B
GR 795H	,,	KRK 205A	KRK 207C
GR 798D, S	,,	,,	,,
GR 798DR, SR	,,	KRK 209A	KRK 194B

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Color Television—continued

MODEL	CHASSIS	VHF	UHF
GR 800M, A	CTS 48	KRK 205A	KRK 207C
GR 802W	,,	,,	,,
GR 804B, L	,,	,,	,,
GR 808D, G, S, Y	,,	,,	KRK 132A
GR 820W	,,	,,	,,
GR 830W	,,	,,	,,
GR 832F	,,	,,	,,
GR 834L	,,	,,	,,
GR 836F	,,	,,	,,
GR 848D, S	,,	,,	,,
ER 330B, E	CTC 51	KRK 180A	KRK 152A
ER 334W	,,	,,	KRK 186A
ER 338W	,,	KRK 179A	KRK 185A
ER 346GEN, YEN	,,	,,	,,
ER 362WEN	CTC 52	KRK 180B	KRK 152A
ER 380W	,,	KRK 187A	KRK 185A
ER 390W	,,	,,	,,
ER 395W, WR	,,	,,	,,
ER 403E	CTC 53	KRK 180B	KRK 186A
ER 405W	,,	,,	,,
ER 410WEN	,,	,,	,,
ER 415W	,,	KRK 179B	KRK 185A
ER 420WEN	,,	,,	,,
ER 425W, WR	CTC 55	KRK 179B	KRK 185A
ER 475W	CTC 59	KRK 165C	KRK 156A
ER 475W, WR	,,	KRK 165D	,,
ER 430W	CTC 63	KRK 179B	KRK 185A

Black and White Television

MODEL	CHASSIS	VHF	UHF
AR 151W	KCS 168	KRK 178B	KRK 152A
AR 154A, W, S, L, F	,,	,,	,,
AR 158WR	,,	KRK 177B	,,
AR 181W	KCS 171	KRK 178B	KRK 152A
AR 184F	,,	,,	,,
AR 191W	,,	KRK 149C	,,
AR 194W, F	,,	,,	,,
AR 195WEN	,,	,,	,,

Black and White Television—continued

MODEL	CHASSIS	VHF	UHF
AR 192W	KCS 172	KRK 149D	KRK 152A
AR 200W	,,	KRK 149C	,,
AR 108Y	KCS 176	KRK 176B	KRK 150A
BR 225WEN	KCS 179	KRK 149C	KRK 204
CR 222W	KCS 183	KRK 149	KRK 204
CR 223L	,,	,,	,,
CR 229L	,,	,,	,,
AR 197W	KCS 186	KRK 161	KRK 152A
AR 128E	KCS 187	KRK 176B	KRK 150A
AR 122F, W	KCS 188	KRK 178B	KRK 152B
AR 123W	,,	KRK 137D	,,
AR 127B	,,	,,	,,

Console Radio-Phonographs

MODEL	CHASSIS	RECORD CHANGER
VRT 20WX	RC 3005C	RP 234B-14
VRT 21LX	,,	,,
VRT 22SX	,,	,,
VRT 30W	RC 1245A RS 252J TC 604	RP 234B-4
VRT 31L	RC 1245A RS 252J TC 604	,,
VRT 32S	RC 1245A RS 252J TC 604	,,
VRT 33F	RC 1245A RS 252J TC 604	,,
VRT 50W	RC 1245B RS 253J TC604	RP 234B-11
VRT 51L	RC 1245B RS 253J TC 604	,,
VRT 52S	RC 1245B RS 253J TC 604	,,

Console Radio-Phonographs—continued

MODEL	CHASSIS	RECORD CHANGER
VRT 54F	RC 1245B RS 253J TC 604	RP 234B-11
VRT 60W	RC 1245B RS 266D TC 604	,,
VRT 61L	RC 1245B RS 266D TC 604	,,
VRT 62S	RC 1245B RS 266D TC 604	,,
VRT 63F	RC 1245B RS 266D TC 604	RP 234B-11
VRT 82S, D	RC 1238D RS 263A	RP 234A-12
VRT 84F	RC 1238D RS 263A	,,
VZT 30W	RC 1239K RS 252J TC 604	RP 234A-4
VTZ 31L	RC 1239K RS 252J TC 604	,,
VZT 325	RC 1239K RS 252J TC 604	,,
VZT 33F	RC 1239K RS 252J TC 604	,,

Portable Phonographs

MODEL	CHASSIS	RECORD CHANGER
VZP 21G, J	RS 269D	RP 235-7
VZP 26J	RC 3009B	RP 235-8
VZP 33J, B	RS 270B	RP 235-3
VZP 38B	RS 270B	,,
VZP 50J	RC 3008A, C	RP 235-4
VRP 48S	RS 271B	RP 235-9
VRP 56W	RS 265D	RP 234B-2
VRP 59B	RS 264C	RP 234B-3
VRP 62R	RC 3004A RS 265F	RP 234B-10
VQP 12N-V	RS 269A	
VQP 22B-V	RS 269C	RP 235-6
VQP 32H-V	RS 271B	RP 235-1
VQP 39B-V	,,	,,

Portable Radios

MODEL	TYPE	SPEAKER SIZE	POWER SOURCE
RZG 102N	AM	2″	9V DC
RZG 135E	AM/FM	3½″	6V DC/120V AC
RZG 354E	AM	4″	6V DC
RZM 141B	AM/FM	2¼″	9V DC
RZM 146A, B	,,	,,	,,
RZM 152E	,,	,,	,,
RZM 166E	,,	3″	9V DC/120V AC
RZM 171E	,,	3½″	6V DC/120V AC
RZM 176E	,,	,,	,,
RZM 188E	AM/FM/SW	,,	5V DC/120V AC
RZM 195E	AM/FM/SW/LW	4″ x 6″	9V DC/120V AC
RZM 198E	,,	,,	,,
RVG 605B	AM	2¼″	9V DC
RVM 653T	AM/FM	2½″	9V DC
RVM 671E	AM/FM		
RVM 685E	AM/FM	3½″	9V DC/120V AC
RVM 694E	AM/FM/PSB/AIR	5″	6V DC/120V AC
RZF 390Y	TRANSCEIVER	2″	9V DC

Clock Radios

MODEL	TYPE	SPEAKER SIZE	POWER SOURCE
RZD 402B	AM	4″	120V AC
RZD 404Y	,,	,,	,,
RZD 424Y	AM Digital Clock	,,	,,
RZD 426W	,,	3½″	,,
RZD 436R	,,	,,	,,
RZS 321A	AM/FM	2″	9V DC Radio 1.5V DC Clock
RZS 332Y	AM/FM Digital Clock	3″ x 5″	120V AC
RZS 444Y, G	AM/FM	3″	,,
RZS 461Y	,,	3″ x 5″	,,
RZS 463B	AM/FM Digital Clock	4″	,,
RZS 467T	,,	3½″	,,
RZS 468W	AM/FM	3″ x 5″	120V AC
RZS 471R	AM/FM Digital Clock	3½″	,,
RZS 473R	,,	3″ x 5″	,,
RZS 477Y	,,	,,	,,
RZS 486L	AM/FM	4″	,,
RZS 490D	,,	,,	,,
RZS 494F	,,	,,	,,
RVD 825Y	AM	4″	120V AC
RVD 837W	AM	3½″	,,
RVS 862Y	AM/FM Digital Clock	,,	,,
RVS 868R	,,	,,	,,
RVS 875R	,,	4″	,,

Table Radios

MODEL	TYPE	SPEAKER SIZE	POWER SOURCE
RZA 202B	AM	4″	120V AC
RZA 207W	,,	,,	,,
RZA 218Y	,,	(2) 4″	,,
RZC 222Y, G	AM/FM	3½ ″	,,
RZC 224W	,,	,,	,,
RZC 240W	,,	3¼ ″ x 4¾ ″	,,
RZC 251W	,,	5″ x 7″	,,
RZC 259L	,,	,,	,,
RZC 262D	,,	,,	,,
RZC 375W	AM/FM/VHF/UHF (Braile)	4″	,,
RZC 379W	AM/FM	,,	,,
RVC 735W	AM/FM/FMS	(2) 4″	,,
RVC 742W	,,	,,	,,
RVC 745L	,,	,,	,,
RVC 748D	,,	,,	,,

Tape Recorders and Players

MODEL	TYPE	SPEAKER SIZE	POWER SCURCE
YZB 387T	Cassette		4.5V DC
YZB 506Y	,,	2½ ″	6V DC/120V AC
YZB 518J	,,	,,	,,
YZB 524S	,,	,,	,,
YZB 537E	AM/FM Cassette	3″	6V DC/120V AC
YVB 616W	Cassette	,,	,,
YZD 572W	,,		
MZD 563W	,,	EXT	120V AC
YZD 579B	8-Track Cartridge	(2) 4″	12V DC/120V AC
YZD 584E	,,	(2) 4″ x 6″	,,
YZD 588Y	,,	(2) 4″	120V AC
YZD 592W	,,	(2) 8″	,,
YZD 400W	4-Channel	(2) 2″, (2) 5″, (2) 8″	,,
YZD 440W	,,	(4) 2″, (4) 8″	,,
YZD 444W	,,	(4) 2″, (4) 8″	,,
YVD 994R	8-Track Cartridge	EXT	,,
MZC 582W	8-Track Cartridge	EXT	,,
YVD 997W	,,	(2) 2″, (2) 5″, (2) 8″	,,
MVC 984W	8-Track Cartridge	EXT	,,

Modular Sound Systems

MODEL	COMPONENTS	RECORD CHANGER
VS 800W	RS 271B	RP 235-3
VS 1002W	RS 265P SPK 50	"
VS 1300W	RZC 295	RP 235-5
VS 1350WEN	RZC 941	"
VS 1400YEN	RZC 288	"
VS 1420YEN	RZC 292	"
VS 1425YEN	YZD 994	"
VS 1440WEN	RZC 298	RP 234A-5
VS 1460W	RQ 400	RP 235A-5
VS 4001WX	RC 1244H SPK 200	RP 234B-11
VS 4001WZ	RC 1246A SPK 200	RP 234B-11
VS 5001WX	RC 1240D SPK 350	RP 234B-12
VS 5001WZ	RC 1247A SPK 350	RP 234B-11
VS 6026WZ	RC 1246A TC 601 SPK 200	"
VS 6061W	RC 1244B TC 702 SPK 200	"
VS 6010W	YZD 598	RP 234A-5
VS 6050W	YZD 573	RP 235A-5
VS 3001W	RC 3015A	RP 234B-4