

Tuner and control problems

By Homer L. Davidson

Symptoms such as a snowy picture, a white and dark raster, erratic or intermittent picture all point to a defective tuning system. In early TV sets, the mechanical tuner consisted of a wafer or turret type tuner controlled by a manually turned tuning knob.

In today's sets, the tuning section may include such circuits as a control system, prescaler, band switching, microcomputer, AIU and CITAC tuning controllers.

RCA's digital control systems

In RCA's CTC140 chassis, the digital tuning control system consists of a system control microcomputer, U3100, an analog interface unit (AIU), U3300, and a band switching IC, U3600 (see Figure 1). The AIU controls the tuning operation. The system control microcomputer, U3100, is controlled by a keyboard or remote control to select the correct station.

The system control microcomputer in this set sends the channel information to the AIU, U3300. The AIU supplies band switching information to the op-amp/band-switch IC, U3600. The band switch IC provides tuning voltage to a varactor-tuned oscillator in the tuner assembly.

Sylvania's B1 series tuning system

The Sylvania TS-17 tuning system has a microcomputer, computer interface tuning and control IC (CITAC) and varactor tuner. This tuning system may be controlled via a remote control or through controls on the set. The tuning system selects channels in a number of ways: by scanning or random access from the remote control, or by scanning or random access from the on-set keyboard.

Most TV microcomputer control systems are alive at all times, supplied with standby voltage. The CITAC controls band switching and channel tuning (Figure 2).

In this system, the microcomputer, IC302, receives the control signal from the on-set keyboard or from the remote control system, and controls IC301. IC-

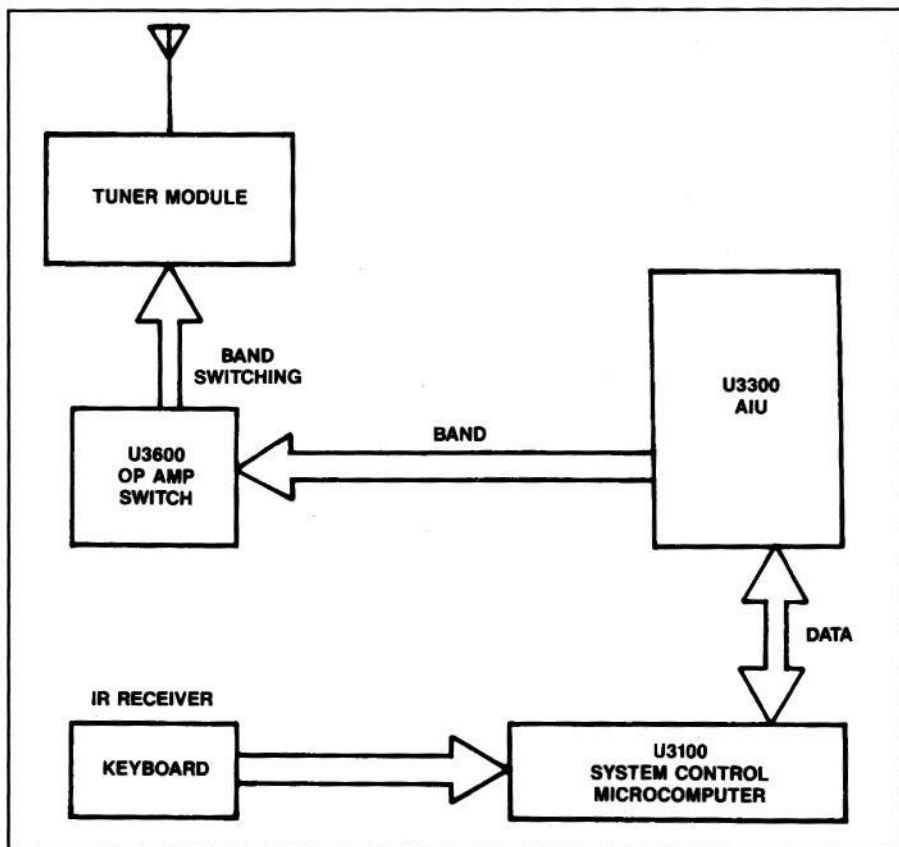


Figure 1. The system control IC, U3100, in RCA's CTC140 chassis, controls U3300 and band switching IC, U3600, which supplies a tuning voltage to the tuner assembly to select the correct channel.

301 sends a control voltage to the UHF/VHF varactor tuner.

Some of these U/V tuners may actually have as many as 152 channel, cable-ready control systems.

As with other control systems, while the RCA and Sylvania tuning systems may be based on different components the control system results are the same: the control system provides a change in voltage to the varactor tuner, which in turn, tunes in the selected channel.

The manual tuner

Until remote control TV systems were introduced, manually-operated wafer or turret type tuners were used in every TV chassis. The manual tuner was controlled with a tuning knob, which changed channels and also switched in the UHF tuner.

The manual ultra-high-frequency

(UHF) tuner is located under or on top of the very-high-frequency (VHF) tuner, and is also rotated manually (Figure 3). Some of these tuners are still found in a few low-priced TV receivers, especially monochrome models.

In time, the silver contacts of the mechanical tuner become tarnished or dirty. When these tuners become dirty, they require cleaning. To clean a mechanical tuner, spray cleaning fluid inside the switch contacts, and rotate the tuning knob.

Another tuner-related problem encountered with mechanical tuners is caused by the RF transistor when it becomes defective. When the RF transistor is defective, it causes snow in the picture.

If it is not possible to tune in stations the problem may be a defective oscillator or mixer transistor.

Some technicians replace the RF tran-

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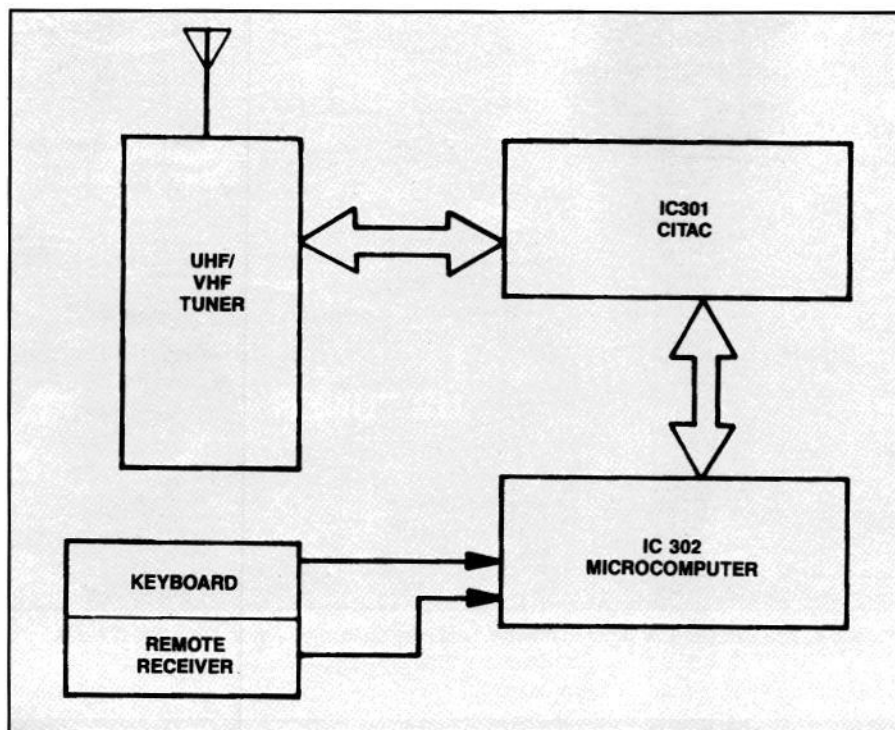


Figure 2. In the Sylvania TS-17 tuning system, microcomputer IC302 controls data to IC301, which provides local oscillator tuning voltage to the U/V tuner.

sistor if it is easily accessible. Most tuners, however are sent to a service depot to be remanufactured.

Varactor tuners

When the voltage applied to a varactor diode is changed, the capacitance across the diode changes. In effect, the varactor diode is a semiconductor-type voltage-variable capacitor.

In varactor tuning, the frequency of an

oscillator consisting of an inductor and a varactor diode is controlled by changing the voltage across the diode, which alters its capacitance. The varactor diode takes the place of the variable capacitor ordinarily used to tune the oscillator.

In sets with mechanical tuners, the tuner is usually at the right side of the front of the TV. That's because it makes sense to locate the tuner directly behind the tuning control knob.

Today, you may find the varactor U/V tuner anywhere in the set, even in the middle of the chassis (Figure 4). A varactor tuner can be mounted any place, as long as the control system changes the tuning voltage applied to the varactor tuner.

The varactor tuner has no moving parts, so cleaning it is not a concern. But varactor tuners do experience tuning problems. A defective varactor tuner may cause a snowy picture or drifting of the channel off frequency, or may fail to tune stations in.

You may find surface mounted components (abbreviated SMD; for surface-mount device) in the latest varactor tuners. These SMDs are found on the pc wiring or foil side. You may need a magnifying glass to see them (Figure 5). The large tuning components are found on the side of the pc board opposite the wiring.

Repairing these small tuners is difficult and time consuming, unless the problem is caused by something obvious, like poor soldered joints, loose terminals, or connected wiring. Be careful when soldering suspected terminals, to avoid damaging SMD diodes and transistors. If the set is in warranty, send the tuner to the manufacturer. If the set is out of warranty, send the tuner to a tuner service depot.

Tuner modules

In many sets, the tuner and control circuits are in separate modules. Although TV sets are no longer being manufactured with modular circuits, you still may encounter a few sets that have tuner modules. You can easily determine which of the modules is the tuning module: it's the one with the antenna and IF cable attached to it. The control module will have several plug-in type wire harnesses (Figure 6).

When the symptom is a snowy picture or raster, or if you can't tune in a station, simply remove two or more metal screws, and the IF cable, and pull out the tuner module and install a replacement. Sometimes both modules must be replaced when damaged by lightning.

The defective module can be sent into a tuner service station for an exchange or for servicing.

Replace the control module when stations cannot be selected or if there are no control features.

Tuner subber

The tuner subber may be used to deter-

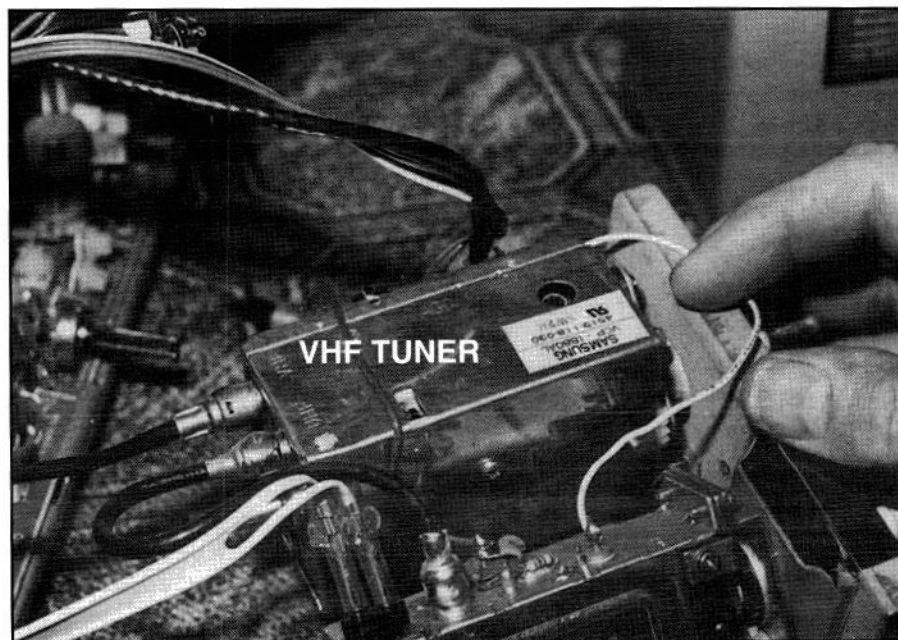


Figure 3. The mechanical turret or wafer tuner requires periodic cleaning of the switching contacts.

mine if the tuner is defective, control circuits are defective, or the chassis is causing the snowy raster or picture. Actually, the solid-state subbers are nothing more than a channel 2 to 13 tuner operating from a battery source.

Simply connect or plug in the subber to the IF cable of the TV chassis in place of the TV's tuner. Connect the antenna lead to the tuner subber and tune in a station (Figure 7).

If the subber tunes in all stations connected to the IF cable, you may assume that the chassis is normal and that the tuner is defective. When the picture tuned in by a known-good substitute tuner is snowy, or if you can't tune in a picture at all, check the IF and AGC circuits of the TV chassis.

Although some tuner subbers may be collecting dust on a shelf of the service bench, they are still effective and an easy method to tell if the tuner or chassis is defective, even in the latest TV chassis using varactor tuning.

Locating the defective tuner

When the symptom is a snowy picture, no stations tuned in or drifting off channel, the source of the problem can be isolated by checking the dc supply voltage, and the AGC, and substituting a tuner subber for the suspected tuner. Simply measure the supply voltage, V_{CC} , and the tuning voltage applied to the local oscillator circuits within the varactor tuner.

After checking the B+ voltage (+12V in Figure 8), locate the tuning voltage supplied by the band switch, prescaler, or microcomputer control to the varactor tuner. Check to see if the voltage changes as different stations and channels are selected (pin 5). This voltage will vary from 0.5V to 35V.

For instance, when the set is tuned to channel 2 the voltage is around 2.6V. The voltage applied to the varactor diode to tune in channel 3 is about 4.3V. The voltage for channel 6 is about 11.5V. If you measure 0V, or voltages of the wrong value on the tuning oscillator pins, suspect the control circuits.

These voltages may not be the same in the tuning control systems of sets made by other manufacturers. You can use an external voltage source to pin down whether the tuner or the controller is the defective section. Use a bench power supply to inject a variable dc voltage at the

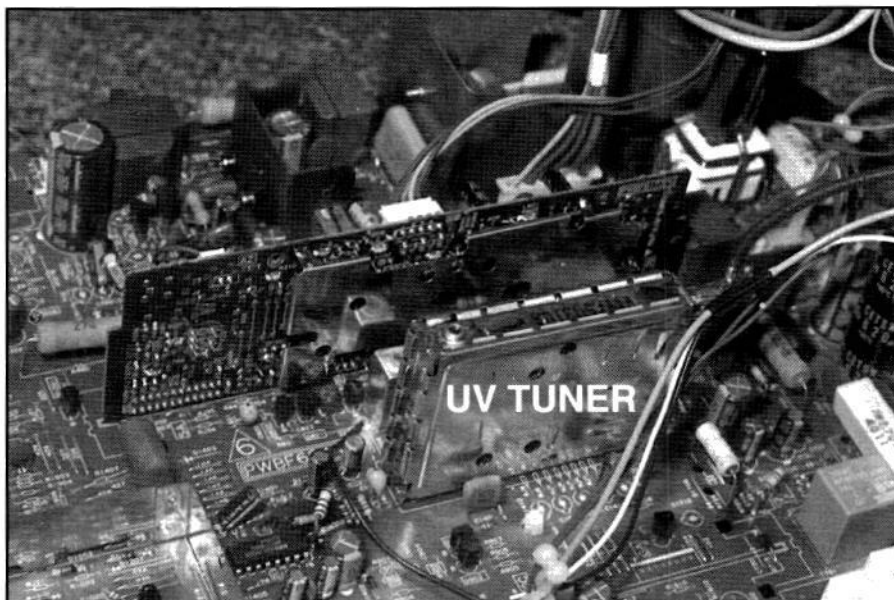


Figure 4. The varactor U/V tuner in modern sets may be located anywhere in the chassis.

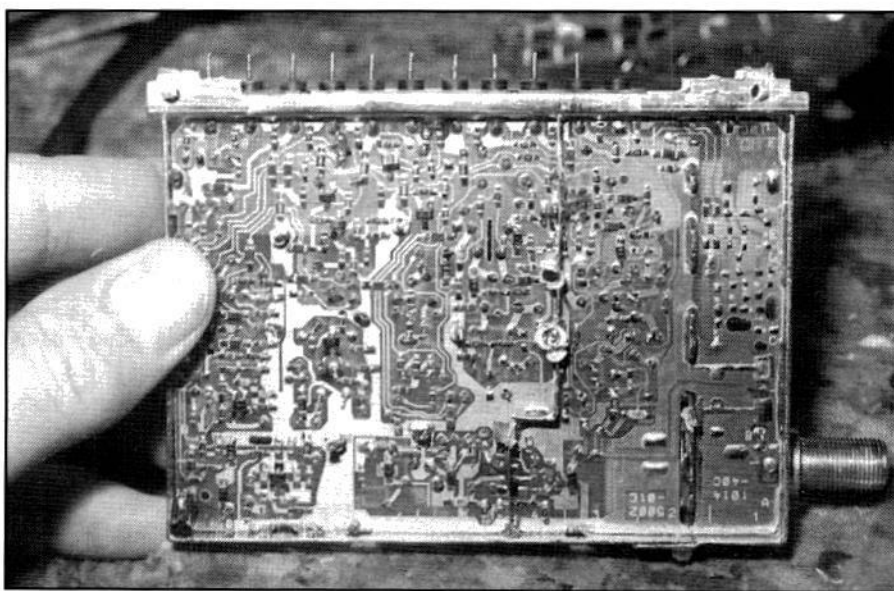


Figure 5. Surface mounted devices (SMD) are located on the pc foil side of the small U/V tuner. Larger, through-hole components are mounted on the other side of the board.

tuning voltage pin of a suspected varactor tuner.

In the case of this set, I connected the variable power supply voltage to pin 5 (see Figure 8) and slowly raised the voltage. I connected the positive lead to pin 5 and the negative to common chassis ground. When you're using a bench power supply to substitute for the varactor tuning voltage, do not vary the voltage over 35V.

If stations are tuned in up and down the tuning range as you vary the voltage, suspect a controlling circuit. When no stations can be tuned in with the external

variable power supply, replace the defective varactor tuner. If stations drift off frequency, check the AFT circuits. If the AFT is working properly, replace the tuner.

Checking tuner control

If you don't find any variable voltage at the tuning oscillator pin of the tuner assembly, suspect a defective controller, band switching, prescaler or tuning control IC circuit. Check the supply voltage pin upon each band switch or tuning control IC. Measure all voltages supplied to the U/V varactor tuner.

Test for low and high VHF voltages,

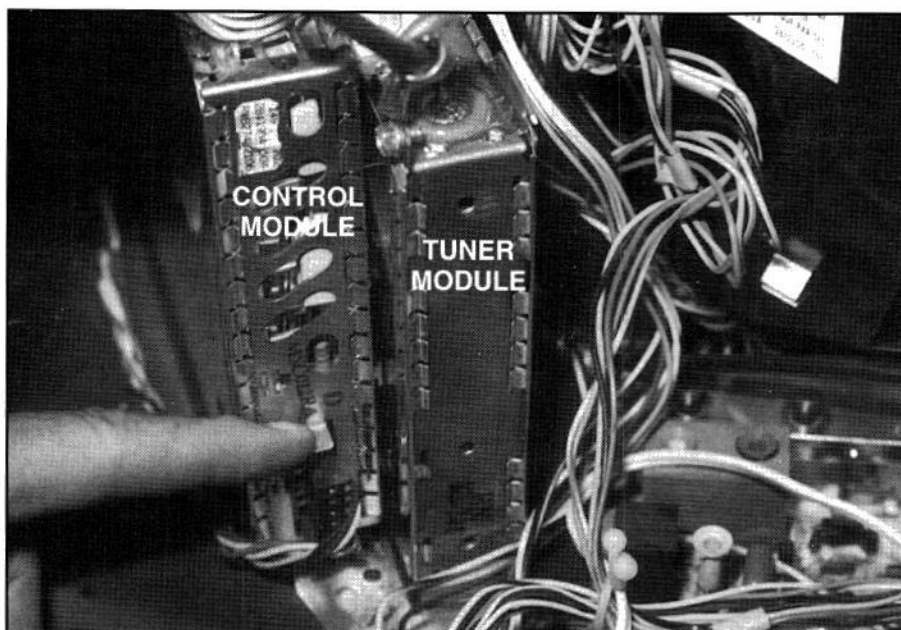


Figure 6. The defective tuner module may be easily located: it's the one with antenna and IF cable connected to it.

UHF and cable channel voltages upon the microcomputer interface tuning and control IC. Band switching charts that indicate a low and high voltage source at each band pin terminals may be found in the service literature.

Scope the phase pulses, data and clock waveforms while tuning in the channels. Simply replace the control module if normal voltage applied to the tuner causes the tuner to appear normal. If you replace the switching control IC, the band switch

IC, or the system control microcomputer chip, use an exact replacement.

Snowy picture in RCA CTC156 chassis

In one RCA CTC156 portable TV that I was working on, the raster was snowy. I couldn't tune in a channel. The first step I took was to measure the tuning voltage at pin 5 of the tuner while attempting to tune in several channels.

The voltage at pin 5 or pin 9 of the band

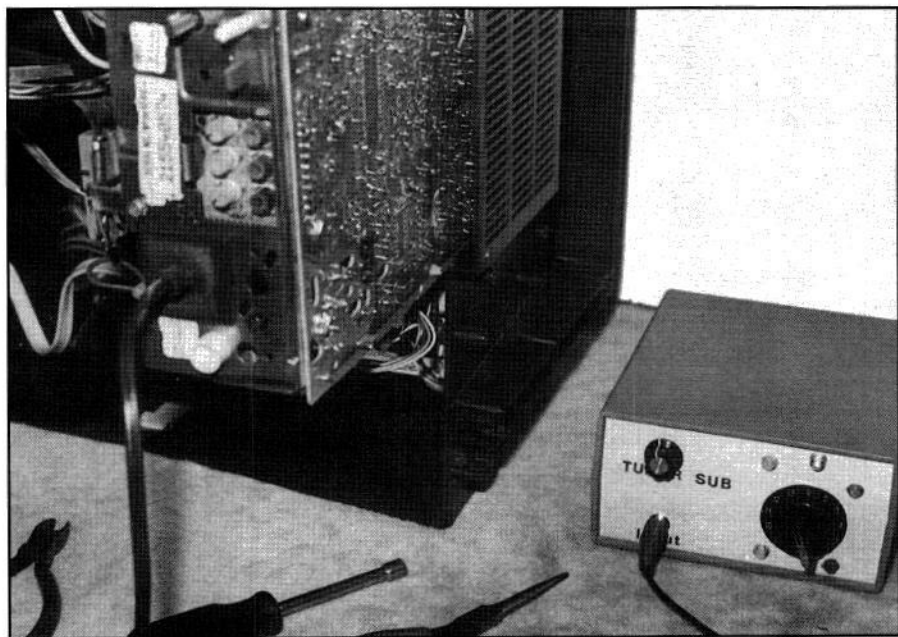


Figure 7. The tuner-substituter can be used to determine if a tuner-related problem is actually caused by the tuner or the chassis or if the control circuits are defective.

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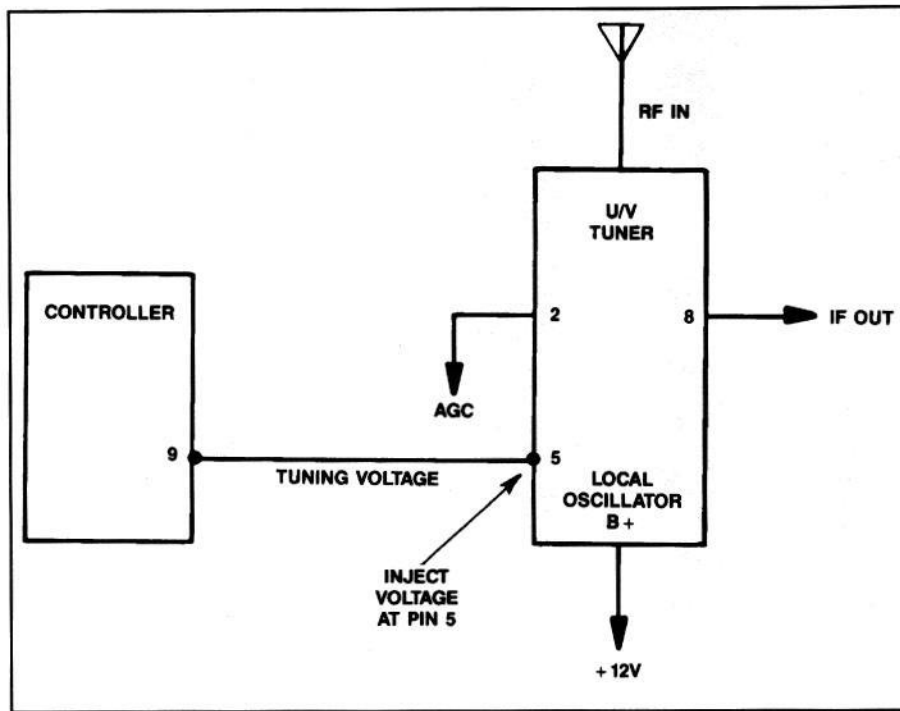


Figure 8. When no local oscillator voltage is found on pin 5 of the U/V tuner, apply 0Vdc to 35Vdc from an external supply to pin 5 to determine if the tuner is functioning.

switch IC (U3600) didn't change significantly as I attempted to tune in a channel. The tuning voltage can also be found at test point TP3608 (Figure 9). Remember the tuning voltages on different tuners and control circuits.

To verify that the tuner was normal, I injected variable dc voltage from an ex-

ternal low-voltage power supply at pin 5 on the tuner. Several VHF stations could be seen as the voltage was raised and lowered. This confirmed that the tuner assembly was good.

Either the band switching IC (U3600) or tuning control IC (U3300) was defective, since no local oscillator voltage was measured at pin 9 of the band switch IC.

A voltage measurement of the supply at pin 12 was 11.8V and pin 10 was a little low (28.8V).

The system control circuits seemed to be normal, except for tuning in the various channels. The tuning control IC voltages, band signals and phase pulses seemed normal while changing the channels.

Although the +33V supply source at pin 10 was a little low, all other voltages and waveforms were normal at the input terminals of the bandswitching IC. All signs pointed to U3600 as the source of the problem, so I replaced it with an exact replacement. The set operated perfectly once the replacement part was installed.

Erratic tuner control

One customer complained that recently the tuning control in a Sylvania 20B1 chassis had become erratic. By the time the set was brought to me, the set could be turned on by the keyboard or the remote, but there was no picture or sound. I removed the back cover of the chassis to get at the microcomputer and tuner control. The U/V tuner is located at the back to make voltage measurements easy.

I measured the voltage at each tuner terminal. There was no voltage at the local oscillator pin, or at High VHF or Low VHF on pins 2, 3 and 7 (Figure 10). The 5Vdc and 13Vdc supply voltages were correct at pins 14 and 6 respectively. The AGC voltage at pin 5 measured 9.9V,

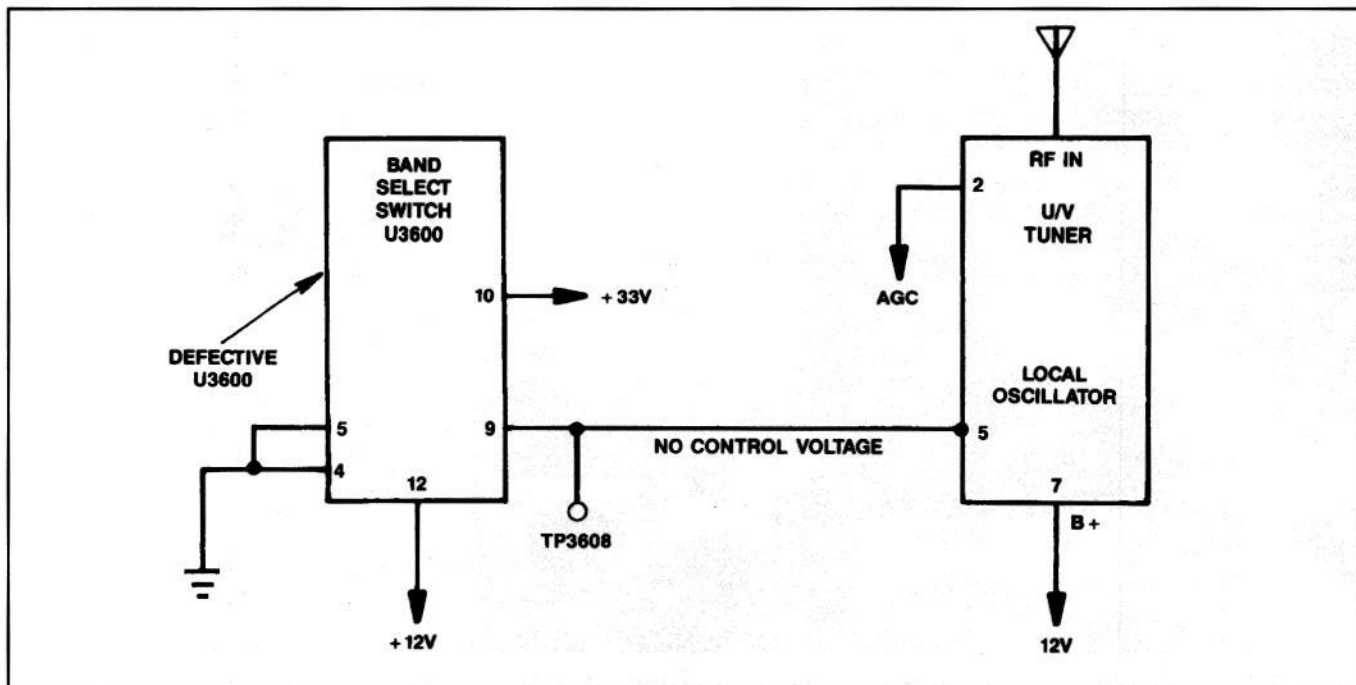


Figure 9. No control voltage was found on pin 5 of the tuner or pin 9 of the bandswitching IC, U3600, in this RCA CTC156 chassis.

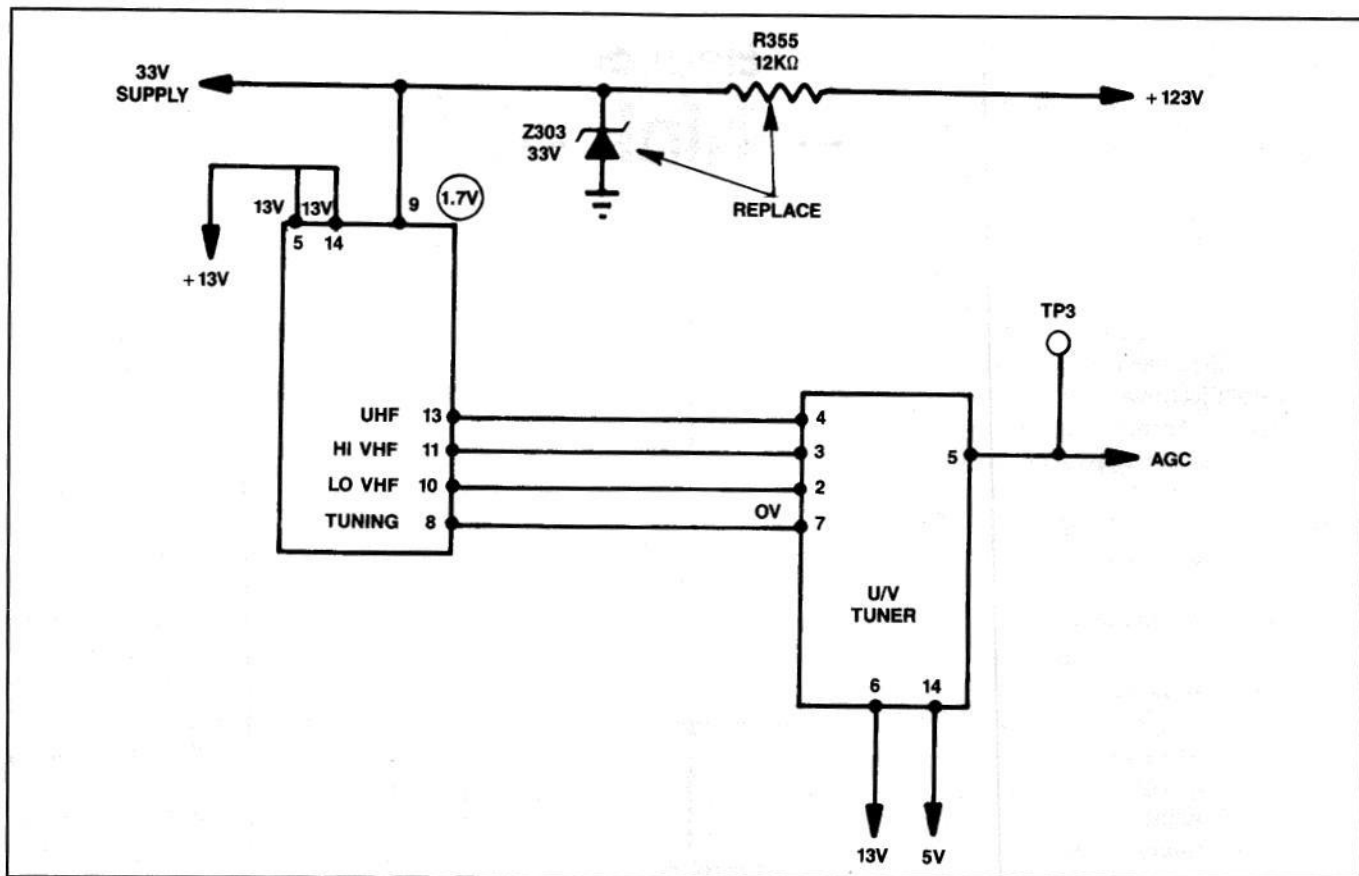


Figure 10. Z303 and R335 in this Sylvania 25B1 chassis were defective, making it impossible to tune in a station.

indicating that it was not receiving a signal. This voltage should measure around 4.8V with normal signal.

Since there was no tuning voltage, I went next to the tuning control, IC301. A normal 13V was found at pins 5 and 14, but the voltage at pin 9 was very low. Upon checking the schematic, I found that pin 8 should have a supply voltage of +33V, from a 12KΩ resistor (R335) and from the 123V source.

I assumed IC301 had internal leakage, or R335 and zener diode Z303 were defective. Z303 showed signs of overheating, and R335 was burned. A quick resistance test across Z303 indicated high leakage. I removed the zener diode from the circuit. It tested bad again out of circuit. Replacing Z303 and R335 restored the set to normal operation.

Channel drifting in RCA CTC146E chassis

In this fairly new 13-inch RCA TV portable, the stations would remain normal for about an hour and then drift off frequency. Sometimes turning the set off and back on would restore the channels to normal. Other times it would not.

The local oscillator control pin voltage

remained normal when the channels drifted, no matter what channel was selected. This suggested that the problem was a defective tuner.

Suspect a defective tuner or UHF control when VHF stations are normal but you can't tune any UHF channels. Replace a drifting tuner with exact part number.

Conclusion

Whenever you suspect tuning problems in a set with varactor-diode tuning, check the tuning control voltage being applied to the local oscillator of the tuner assembly for correct tuning voltage. If no voltage, or an incorrect voltage is found, suspect the controller or band switching IC circuits.

Apply dc voltage from an external supply to the tuner to determine if the tuner is defective. Always measure the dc power source (V_{CC}) supplied to each IC component and tuner.

When the picture is snowy, but the voltage on the local oscillator pin is normal, suspect a defective tuner. Station drifting off channel may be caused by a defective tuner or AFT circuits. Defective tuners may be sent to a service depot to be remanufactured. ■

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