THOMSON CONSUMER ELECTRONICS

The CTC 168/169

Troubleshooting Guide

RCA

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FORWARD

This handout is designed to assist the technician troubleshooting dead set symptoms in televisions using the CTC168/169 chassis. A dead set symptom in the CTC168/169 chassis can be caused by one of several circuit areas, plus one of 5 protection circuits. To isolate a dead set symptom to a defective circuit area or a protection circuit this handout uses a series of checks. These checks send the technician to key points in the chassis to make voltage or waveform measurements. An explanation of each check is provided to help the technician in performing the check and if the result of the check is incorrect, help interpret the result of the check to determine the defective circuit area.

The techniques discussed in this training manual are a review of the information presented in three Thomson Consumer Electronics publications: CTC168/169 Technical Training Manual (# T-CTC168/169-1/2), CTC169 Projection Television Troubleshooting Guide (# T-169PTV-1), and the CTC168/169 In-Home Service Guide (#T-PRO168/9 H-SG). This handout only addresses troubleshooting techniques for dead set symptoms of the CTC168/169 chassis, for basic operational theory and in-depth operation of the circuits in the CTC168/169 chassis, consult the three training manuals listed above.

SAFETY INFORMATION

This publication is intended to be used only as a training aid and not intended to replace service data. Thomson Consumer Electronics Service Data for these instruments contains specific information about parts, safety, and alignment procedures and must be consulted before performing any service. Servicers who defeat safety features or fail to perform safety checks may be liable for any resulting damages and expose themselves and others to possible injury.

All integrated circuits, all surface mounted devices, and many other semiconductors are electrostatically sensitive and therefore require special handling techniques.

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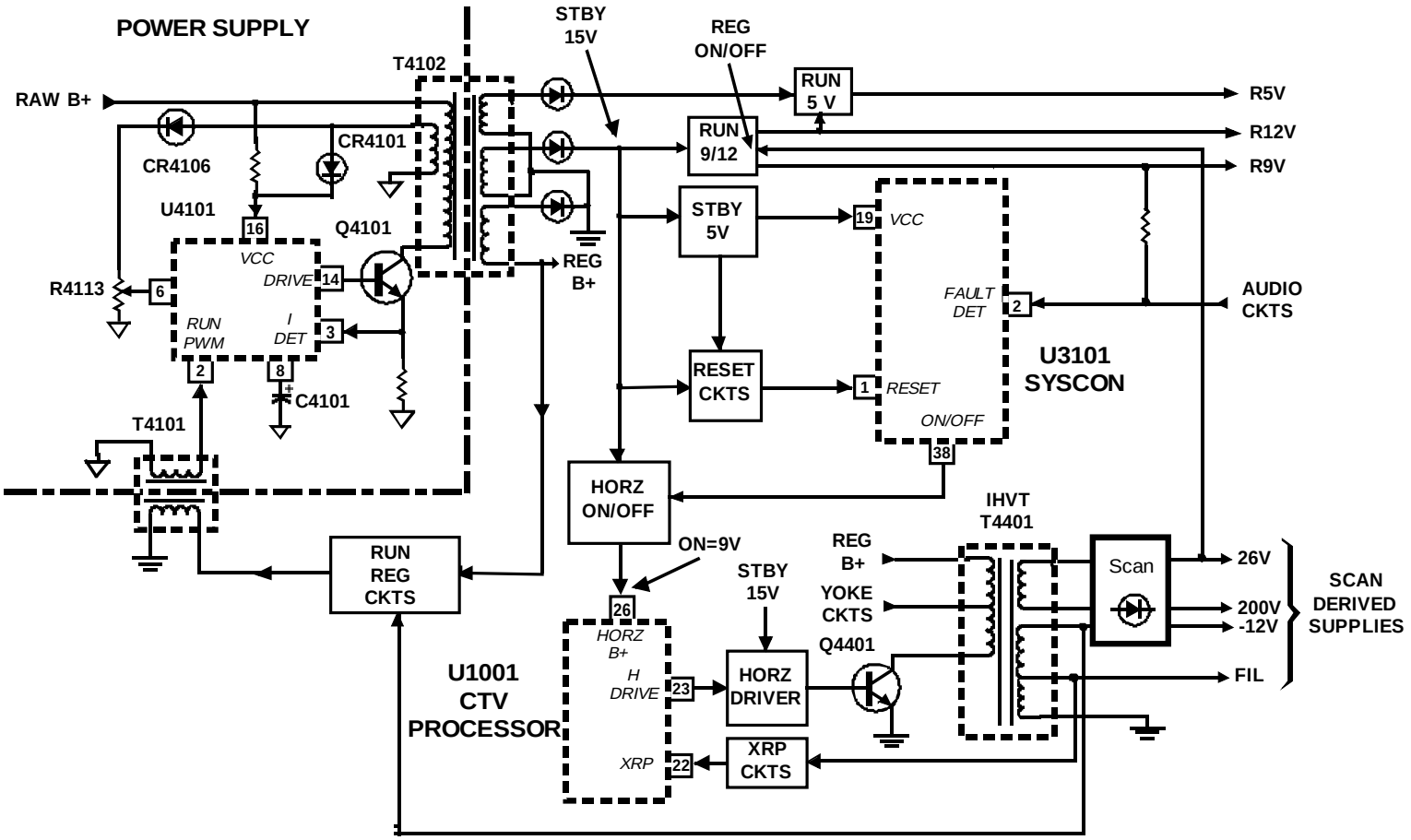


Figure 1, Turn On Circuits

TURN ON CIRCUITS

To troubleshoot a CTC168/169 chassis with a dead set symptom, it is important to understand the operation of the circuits that switch the chassis from *off* to *on*. These circuits are critical not only during the turn *on* operation (switching the chassis from *off* to *on*) of the chassis, but also while the chassis is *on* and producing a picture. The circuits that perform these operations are: power supply, system control, and horizontal deflection. While the chassis is operating, each of these circuits has a protection circuit that monitors the operation of the chassis. These protection circuits are commonly referred to as shutdown circuits because they shut the chassis down (switch it from the *on* mode to the *off* mode) if a problem with the chassis is detected. If a CTC168/169 chassis comes in for repair and the symptom is dead set, the chances are good one of these circuits will be the culprit. Keep in mind that another circuit may be triggering a shutdown circuit in one of these circuits. Before we discuss the shutdown modes of these circuits, it is important to understand their operation while the chassis switches from *off* to *on* (the turn on sequence). The following explanation addresses the operation of these circuits when the chassis switches from *off* to *on*.

The CTC168/169 power supply is a switching type of supply that provides power to the chassis in both the *off* and *on* conditions. Because of the different current requirements of the chassis in these two conditions, the power supply has two operating modes — standby and run. The power supply operates in the standby mode when the television is *off* and AC power is supplied. The power supply operates in the run mode when the television is *on* and producing a picture. In the run mode, the load on the power supply increases so the power supply must increase its output and provide tighter regulation of the voltages supplied to the chassis. In-depth circuit descriptions for the power supply (in both modes) are in the CTC168/169 Technical Training Manual (T-CTC168/169-1/2). It is important to remember that the power supply is operating and developing voltages on the secondary of the chopper transformer (T4102) whenever AC power is supplied to the chassis. So, even though a supply, such as the REG B+ supply, is only used in the run mode, there is still voltage present in the standby mode.

In the standby mode, power is supplied to the system control and horizontal deflection circuits. Remember from our discussion above, these two circuit areas are used during the turn *on* sequence. The STBY (Standby) 15 volt supply supplies power to the system control circuits via the STBY 5 volt regulator. The STBY 5 volt regulator reduces and regulates the STBY 15 volts to 5 volts before supplying it to the system control circuits. The STBY 15V supply also supplies power to the on/off circuits. These circuits are controlled by the system control microprocessor, and considered part of the system control circuit in this manual.

In the standby mode, B+ from the power supply is supplied to the horizontal driver and horizontal output transistor. With B+ supplied to these devices whenever AC power is applied to the chassis, all that is needed to start them operating is horizontal drive. This drive is from U1001 pin 23 and is switched *on* and *off* by commands from the system control microprocessor. When the system control microprocessor starts the turn on sequence, it switches *on* horizontal drive to the horizontal deflection circuits. With B+ supplied from the power supply, and horizontal drive supplied from U1001, the horizontal deflection circuits begin operation. Once operating, the horizontal output switches *on* and *off* to control yoke current and current through the primary winding of T4401. With current flowing through T4401's primary winding, voltage is generated in the secondary windings. This voltage is rectified to develop the scan derived B+ supplies. These supplies are then routed to different circuit areas of the chassis.

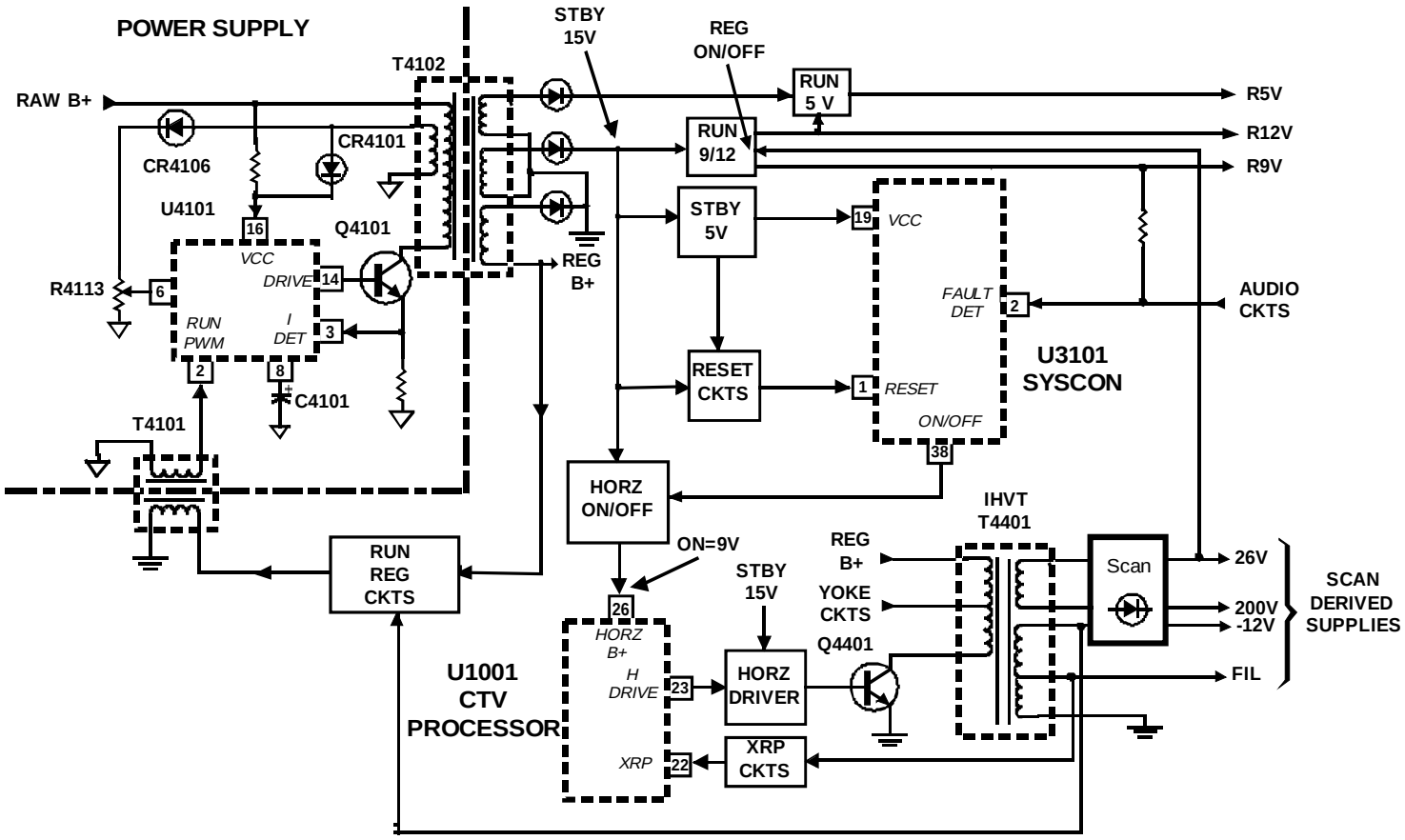


Figure 2, Turn On Circuits (Repeated)

TURN ON OPERATION

The voltage developed from the secondary windings of T4401 serves two functions during the turn on sequence. The first of these functions is to switch *on* the run 9 and 12 volt B+ supplies. This is done by the scan derived 26 volt supply. When scan derived 26 volts is present at the 9 and 12 volt run regulators, they are switched on. The second function is to switch the power supply to the run mode. This is done with a horizontal pulse supplied to the run regulator circuits. When this pulse is present, the power supply operates in the run mode.

The horizontal drive circuit is supplied power from the STBY 15 volt supply. The reg B+ line supplies voltage to the horizontal output transistor through T4401. Because the power supply is operating even when the television is *off* (the power supply in the standby mode), there is voltage on this line. This voltage will be approximately 140 volts DC in the standby mode, which is higher than if the power supply were in the run mode. This is due to less of a load on the reg B+ line in the standby mode.

With the power supply providing power to the system control and horizontal deflection

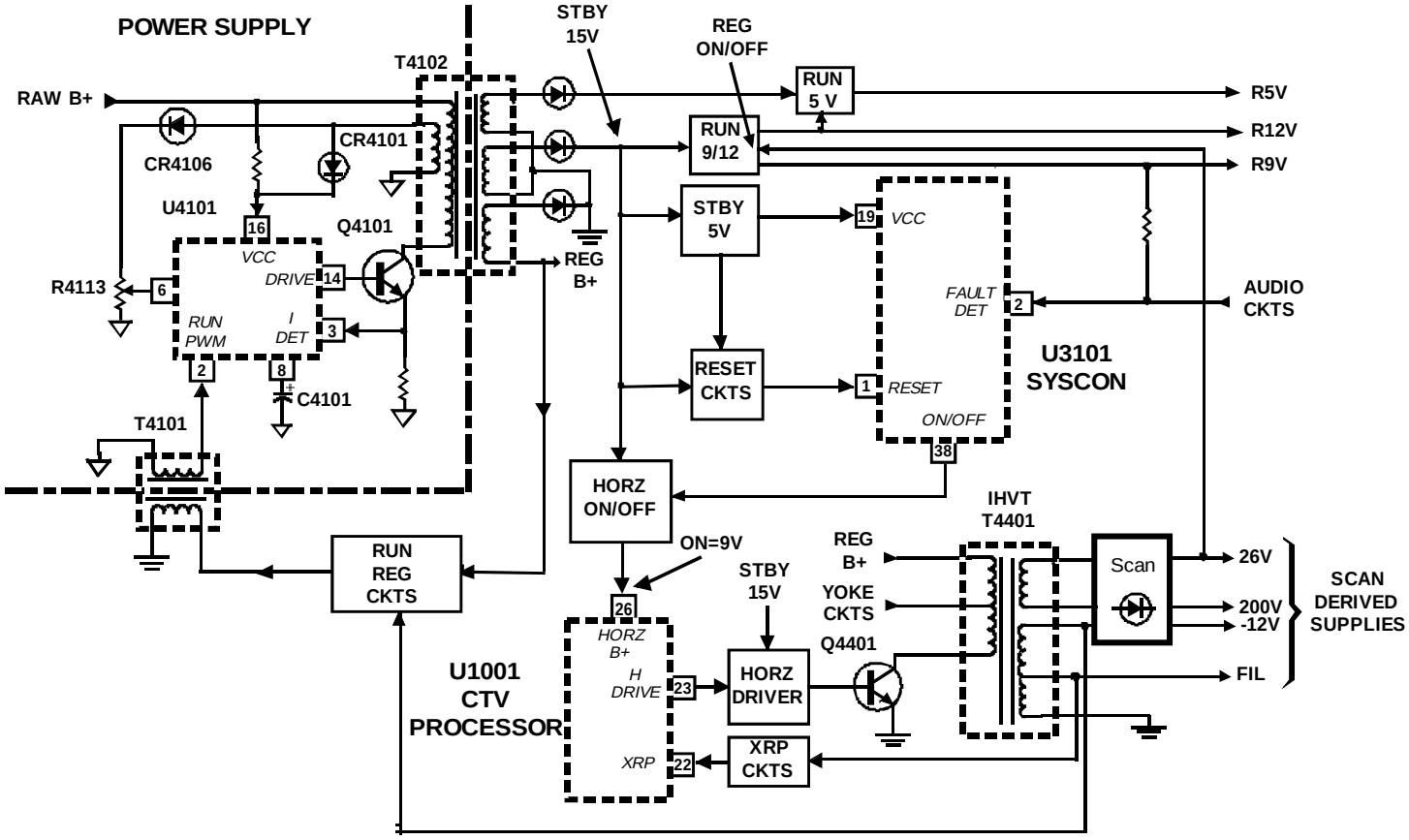


Figure 3, Turn On Circuits (Repeated)

circuits, the chassis can be turned *on*. This is done with either a command from the remote transmitter or the front panel keyboard. Both of these commands are input to the system control microprocessor U3101. After decoding the *on* command, the system control microprocessor starts the turn *on* routine by pulling the on/off line high (5 volts). The on/off line controls the on/off circuits. These circuits switch horizontal drive *on* and *off* by applying, or removing, B+ to U1001. U1001 supplies drive to the horizontal deflection circuits when B+ is present. The on/off circuits supply B+ to U1001 when the on/off line from U3101 is high.

With B+ supplied from the power supply and horizontal drive supplied from U1001, the horizontal deflection circuits begin operating. The horizontal deflection circuits generate HV (High Voltage), horizontal yoke current, scan derived voltage sources, and horizontal reference pulses. The HV and yoke current are routed to the CRT. The scan derived B+ sources are developed by rectifying the horizontal pulses on the secondary windings of the IHVT. One scan derived source is used to switch the run 12 and 9 volt regulators *on* and *off*. This is the scan derived 26 volt source. Once the horizontal begins operation, it supplies scan derived 26 volts to the 9 and 12 volt run regulators. When the 12 and 9 volt regulators sense the presence of the scan derived 26 volt supply, they switch *on* and supply regulated 12 and 9 volts to the chassis. At this point the turn on sequence is complete and the television is *on* and producing a picture.

What happens if one of the circuits used to switch *on* the CTC168/169 chassis is not operating? As would be expected, the television would not turn on (dead set symptom). For example, if the power supply were not operating, B+ would not be supplied to the system control and horizontal deflection circuits. If the system control circuits were not functioning, they would not pull the on/off line high to start the turn *on* sequence. If the horizontal deflection circuits were not operating, HV and scan derived voltages would not be generated to supply B+ to the chassis.

The system control microprocessor detects if the horizontal is operating or not, by the presence of the run 9 and 12 volt supplies. These supplies are switched *on* and *off* by the scan derived 26 volts; therefore, if one of them is missing, the system control microprocessor determines there is a shutdown condition and shuts the chassis *off*. The presence of the run 9 and 12 volt supplies is detected at the fault detect input to the system control microprocessor, U3101 pin 2. If system control microprocessor detects these supplies missing, it will pull the on/off line low, terminating the turn *on* sequence. An explanation of this circuit is given in the fault detect shutdown section of this manual.

SHUTDOWN CIRCUITS

There are 5 shutdown circuits in the CTC168/169 chassis that place the chassis in a protective mode when they detect a problem. These circuits monitor various conditions in the chassis for abnormal operation and either prevent the chassis from initially turning *on* or turn it *off* (place it in a shutdown mode) while it is operating. These protective circuits are important to the safety of the people around the television and to the reliability of the chassis, so they should never be modified or defeated.

Each of the five shutdown circuits monitor a specific condition of the chassis and performs a protective operation when they detect a problem. These shutdown circuits are distributed in three circuit areas of the chassis: power supply, system control, and horizontal deflection.

Power Supply Shutdown Circuits

Two shutdown circuits are located in the power supply of the chassis. These shutdown circuits detect if the power supply is operating under an excessive load or allowing the regulated voltages it develops to rise too high. If one of these conditions occurs, the shutdown circuits detect it and disable the operation of the power supply. These shutdown circuits are active in both the run and standby modes of the power supply. Therefore, the television does not have to be *on* and operating when one of these shutdown circuits is triggered.

If either of the power supply's shutdown circuits is triggered, the symptom displayed on the television will be the same — the television does not turn *on* when the power button is pressed. Even though the symptom may be the same when either of the shutdown circuits is triggered, the operation of each shutdown circuit is different and the method used to disable the power supply is different. Remembering this will make troubleshooting the power supply (when it is in a shutdown condition) easier.

Overvoltage Shutdown

The overvoltage shutdown circuits are built into U4101. The overvoltage shutdown circuit monitors the B+ applied to U4101 at pin 16. If the voltage at pin 16 rises above 15 volts, U4101 goes into a shutdown condition. In this condition, U4101 disables drive to Q4101, shutting the power supply down. U4101 remains shutdown until the voltage at pin 16 drops below 7.5 volts and then rises above 10.5 volts. To repeat this sequence of events and return U4101 to normal operation, AC power must be removed from the chassis long enough to allow any capacitors on pin 16 to discharge and then re-apply AC power. If the failure that caused the initial shutdown has cleared, U4101 will return to normal operation. If pin 16 rises above 15 volts again, U4101 will once again go into the overvoltage shutdown condition.

Now that we know what the overvoltage shutdown circuits is, how do we tell when the CTC168/169 chassis is in this condition and what are some typical failures that can trigger this type of shutdown? As previously stated, if any one of the two power supply shutdown modes is activated, the television will not turn *on*. The first step in troubleshooting a dead set symptom is to determine if the power supply is operating or not. To do this look for DC voltage on the B+ sources supplied by the power supply. These voltages should be present in both the run and standby modes of the power supply. If the B+ sources are present, the power supply is operating and not in a shutdown mode. If the B+ sources are missing, the power supply is not operating and must be repaired.

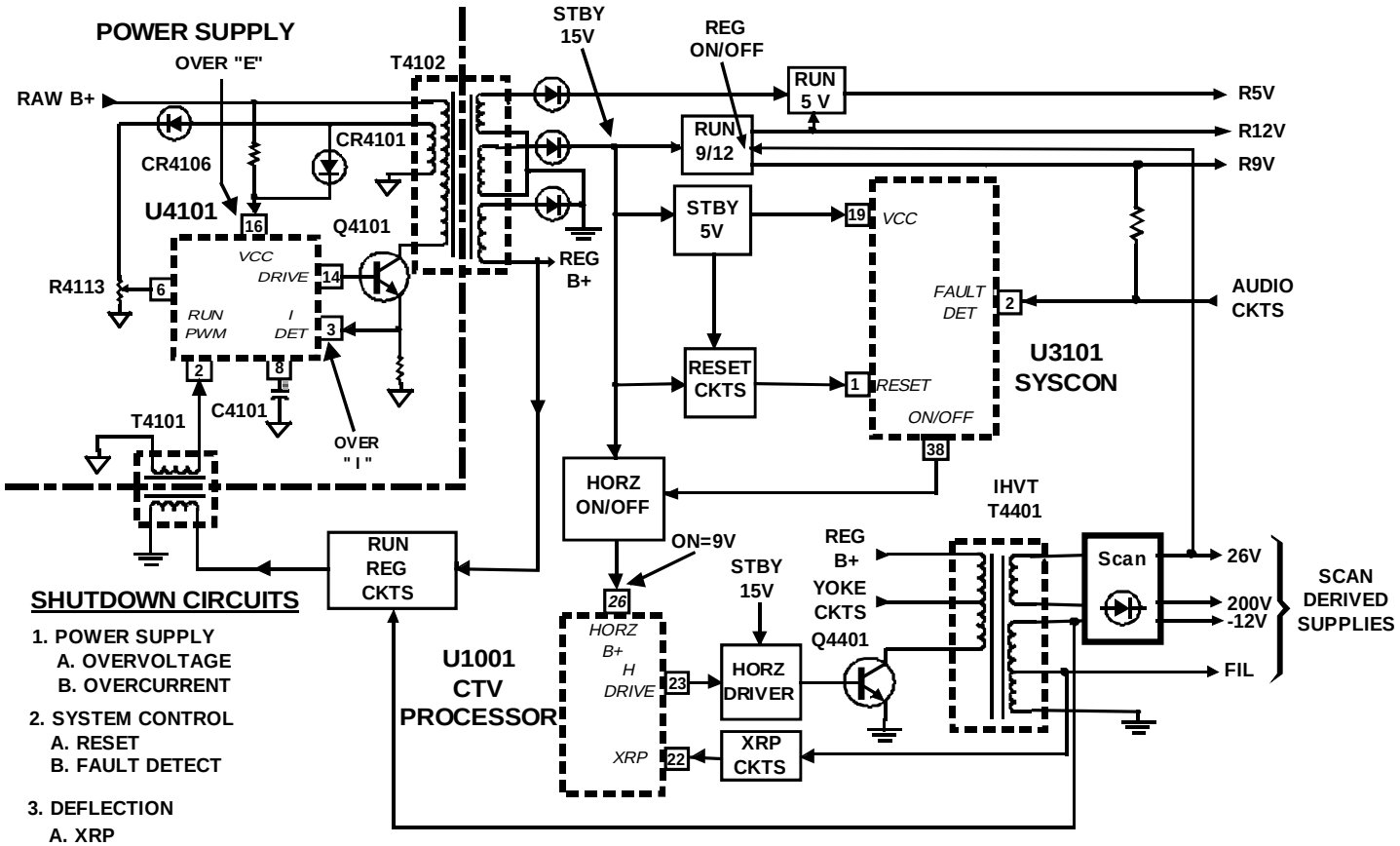


Figure 4, Shutdown Circuits

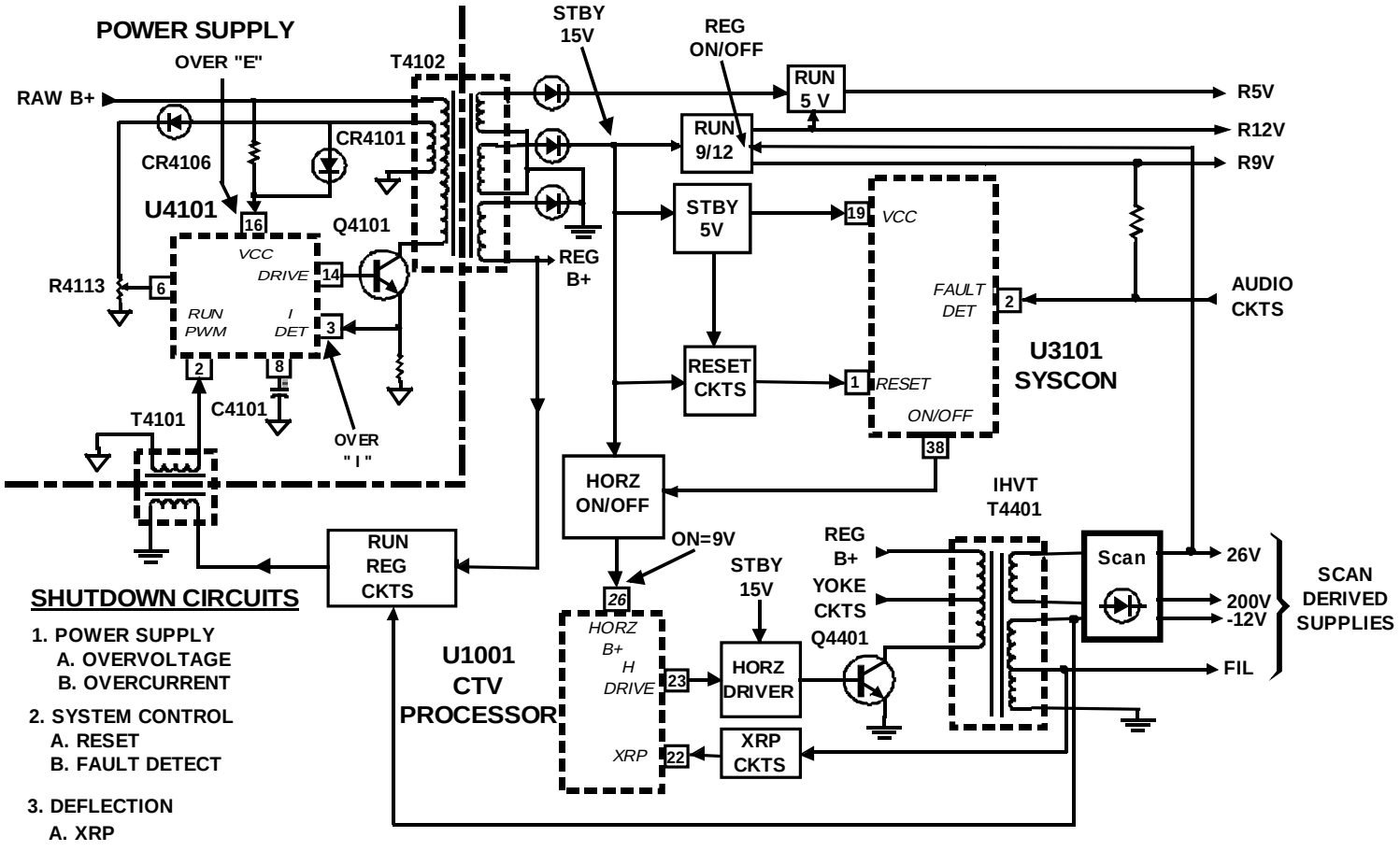


Figure 5, Shutdown Circuits (Repeated)

If the power supply is not operating and the main chassis fuse (F4001) is not blown, the next step is to determine if the power supply is in a shutdown condition. This can be done by measuring the DC voltage on pin 16 of U4101. If this voltage is above 15 volts DC, the power supply may be in one of several conditions, including the overvoltage shutdown condition. Another condition causing pin 16 to be above 15 volts is a defective U4101. If the voltage level on pin 16 is below 15 volts, consult the overcurrent shutdown explanation in this manual.

What failures in the power supply can cause an overvoltage shutdown condition? The failures that can cause the overvoltage shutdown condition can be in the feed back components of the standby regulation circuits. If the standby reference voltage does not get to pin 6 of U4101, U4101 increases the power supply's output in attempt to lift the voltage at pin 6. As the output of the power supply increases, the voltage at pin 16 of U4101 also increases until it eventually exceeds 15 volts and U4101 goes into overvoltage shutdown. A problem in the collector circuit of Q4101 also will cause the voltage on pin 16 of U4101 to increase. Steps to isolate these different conditions are given in the troubleshooting section of this manual.

Overcurrent Shutdown

As in the overvoltage shutdown circuits, the overcurrent shutdown circuits are also built into U4101. These circuits monitor the current through Q4101 at pin 3 of U4101. If the load on one or more of the B+ sources becomes excessive, the current through Q4101 increases, lifting the voltage on pin 3 of U4101. The larger the load on the B+ source, the larger the voltage on pin 3 of U4101. The voltage on pin 3 can place U4101 into two overcurrent shutdown conditions. The first of these conditions occurs when the voltage on pin 3 exceeds 0.6 volts but remain below 0.9 volts. When this condition occurs, U4101 momentarily inhibits drive to Q4101, briefly shutting the power supply down. When the power supply shuts down, the voltage on pin 3 drops below 0.06 volts, because no current is flowing through Q4101, and the power supply resumes operation again. If the excess load on the power supply continues, the cycle will be repeated. However, each time this cycle is repeated, a charge is placed on C4101. When the accumulated charge on C4101 exceeds 2.8 volts, U4101 is placed into a hard shutdown mode. In this mode U4101 is shutdown completely and remains shutdown until the voltage on pin 16 drops below 7.5 volts and then rises above 11 volts.

The second overcurrent shutdown mode occurs when the voltage on pin 3 quickly rises above 0.9 volts. When this occurs U4101 goes into the hard shutdown. This hard shutdown condition has the same characteristics as the hard shutdown condition described above.

Now that we understand the operation of the power supply in the overcurrent shutdown mode, how do we determine when the power supply is in this mode or there is a failure in one of the other circuits in the chassis? As with the overvoltage shutdown circuits, the overcurrent shutdown condition can be triggered in both the run and standby modes of the power supply. When the power supply is in the overcurrent shutdown condition the television will not turn *on*.

To troubleshoot the CTC168/169 chassis when it will not turn *on*, the first step is to check for the presence of B+ on the outputs of the power supply. If the correct voltage is present on the output of the power supply, the problem is not the power supply but in another circuit area of the chassis. If the output voltages are missing, the power supply is not operating and must be repaired.

Once it is determined the power supply is not operating and raw B+ is being supplied to the power supply, check the voltage on pin 16 of U4101. If the voltage on pin 16 fluctuates between 7 and 10 volts, the power supply is most likely in the overcurrent shutdown condition. If the voltage on pin 16 is above 15 volts, suspect an overvoltage shutdown condition. Troubleshooting information for the power supply is given in the troubleshooting section of this manual.

What failures in the CTC168/169 chassis can place the power supply in the overcurrent condition? These failures can be described as anything loading one of the power supplies B+ sources. This can be anything from a shorted diode on one or more of the secondary windings of T4102 to a shorted horizontal output transistor Q4401. Failures in the power supply itself, such as a defective Q4101 or Q4101's emitter resistor increasing value, can also trigger an overcurrent shutdown condition in U4101.

System Control Shutdown Circuits

There are two shutdown circuits in the system control section of the chassis — reset and fault detect. These circuits protect the system control microprocessor from B+ fluctuations and shut the chassis down if a problem occurs in the horizontal circuits, audio circuits, and run 9 and 12 volt supplies. Each of the system control shutdown circuits effect the operation of the television differently. Because of this, a slightly different symptom will be displayed on the television for each system control shutdown modes. These symptoms can range from: the set will not power *on*, to: the television turns *on* and quickly *off* again. The key to troubleshooting the system control's shutdown circuits is knowing what each circuit is detecting and what protective operation it performs.

Reset

The reset circuit serves several functions in the CTC168/169 chassis. When AC power is initially applied to the chassis, the reset circuit pulls the reset line (U3101 pin 1) low to perform the initial reset operation of U3101. The reset circuit also stops U3101's clock if B+ to U3101 is lost or momentarily drops out. This places U3101 in the low power mode which reduces the load on the 5 volt standby supply. With the load on the

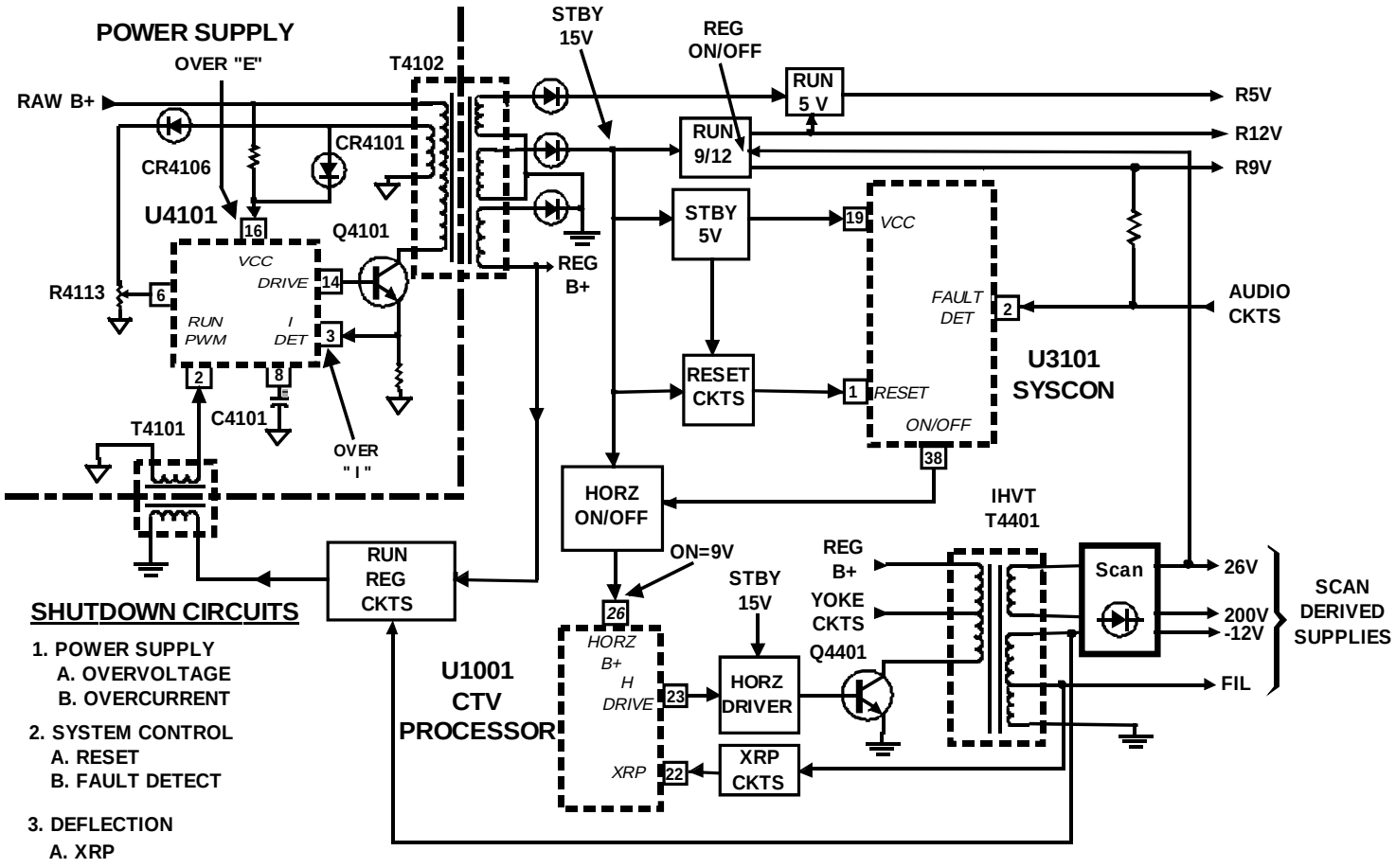


Figure 6, Shutdown Circuits (Repeated)

supply reduced, the voltage stored in the filter capacitors on the 5 volts line discharge slower maintaining the voltage level on the 5 volt line for a longer period of time. This builds into the system control circuits of the chassis small amount of memory retention while a power loss is occurring. The reset circuit also monitors the standby 5 volt line for noise spikes and drop outs. When either of these two conditions are detected, the reset circuits pull the reset line low. This prevents U3101 from locking up during drop outs of the standby 5 volt supply.

The initial reset operation is performed by the standby 15 volt supply. When AC power is supplied to the chassis, the standby 15 volt supply rises and the reset circuits perform the reset operation. Voltage from the standby 5 volt supply is sent directly to the reset circuits where they are monitored for fluctuations and drop outs. If the reset circuit detects a drop out of the standby 5 volt supply, it pulls pin 1 of U3101 low placing it in the low power mode.

If a reset shutdown is activated, the CTC168/169 chassis can have more than one symptom depending on whether data in U3101's memory is corrupted. If the reset line is pulled low and the data in U3101's memory is correct, the television will momentarily shut *off* and then turn back *on* by itself. When the chassis turns *on* it will go to the channel, volume, and picture levels the television was operating at just before the shutdown. This type of shutdown is typically triggered by CRT arcs and noise on the AC power line. If the reset line is pulled low and the data stored in U3101's memory is damaged, the television will shut *off* and must be manually turned *on* again by the operator. Because the data in U3101's memory was corrupted, the television will turn *on* but the customer must adjust channel, volume, and picture levels to the settings they were operating at before the shutdown. Once this is done the television will operate correctly.

Most of the reset circuit shutdowns are due the a problem occurring in other circuit areas of the chassis, for example: kine arcs, standby 5 volt supply loading, etc. The key indicator to signal that the television has experienced a reset shutdown is the chassis either powers *off* and then back *on* or the chassis powers *off* and turns right back *on* after the power button is pressed.

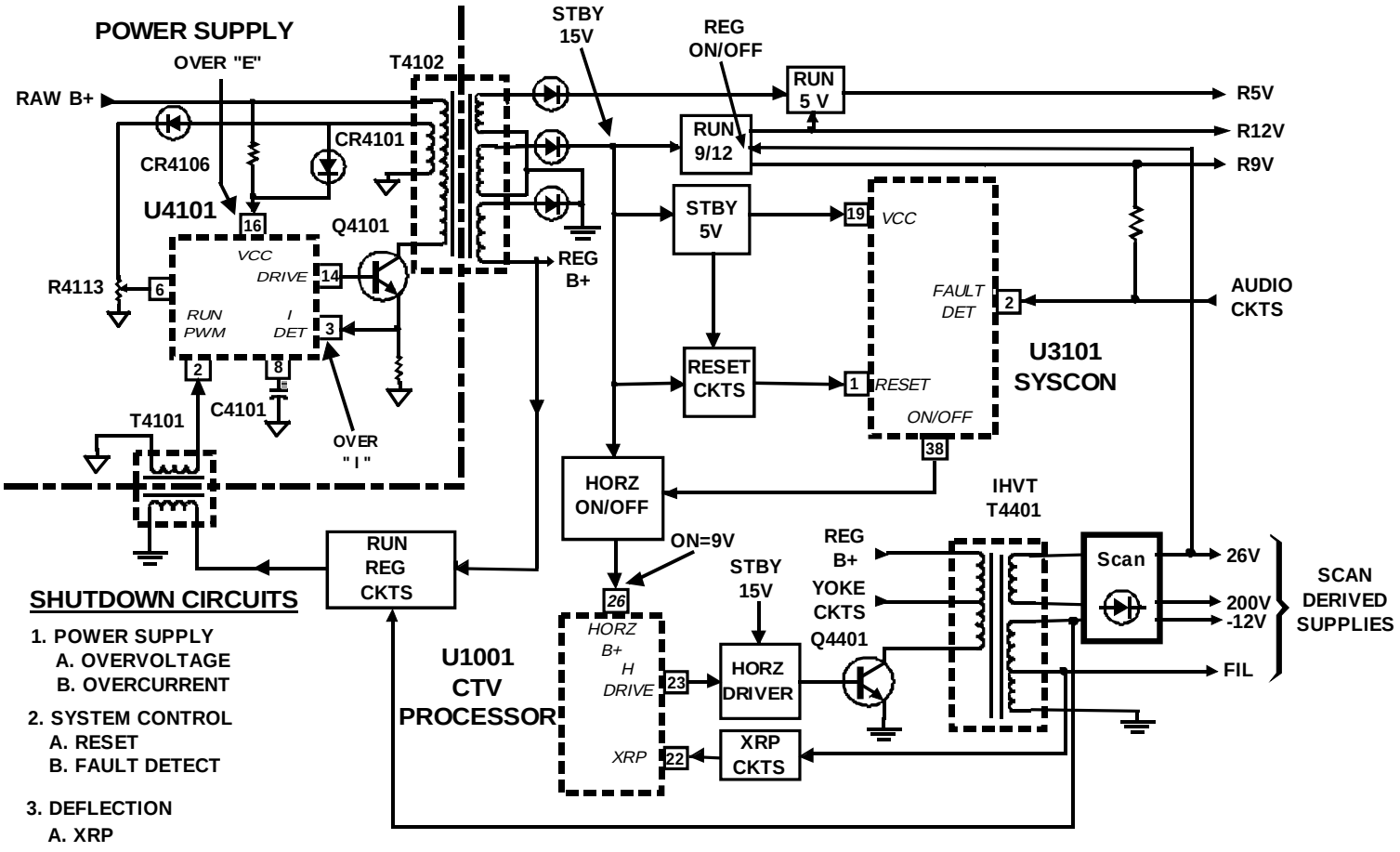


Figure 7, Shutdown Circuits (Repeated)

Fault Detect Shutdown

The fault detect shutdown is only active when the chassis is *on* and operating. If a fault detect shutdown is triggered, the television will power *off* and attempt to restart again. If whatever was triggering the fault detect shutdown clears, the chassis can restart again and resume normal operation. If the fault remains, the chassis continues to cycle *off* and *on* several times before it remains *off.*

The fault detect shutdown is built into the system control microprocessor U1301. When the chassis is *on* and producing a picture, the fault detect circuits monitor the voltage level on pin 2 of U3101. If the voltage level on U3101 is high (above 2.5 volts), the system control circuits determine the chassis is operating normally. If the voltage level is low, the fault detect shutdown circuits trigger and the system control microprocessor pulls the on/off line low. The system control microprocessor holds the on/off line low then pulls it high. This starts the turn *on* sequence again. About 300 milliseconds after the on/off line is pulled high, the system control microprocessor checks voltage level on the fault detect input. If this level is still low, the off/on cycle repeats. If this level is high, the chassis switches *on* and resumes operation.

Now that we know how the fault detect shutdown operates, what triggers it? Of course the answer to that question is the voltage on pin 2 of U3101, but what supplies the voltage to pin 2 and what removes it from pin 2? The answer to that question is the run 9 volt supply which provides voltage to pin 2 of U3101, either a failure in the run 9 volt supply or a failure in the audio outputs can remove it.

During the turn *on* operation the scan derived 26 volts is used to switch *on* the run 9 and 12 volt supplies. Once the run 9 volt supply is switched *on,* voltage is supplied to pin 2 of U3101. If the horizontal deflection circuits do not turn *on* when the system control microprocessor pulls the on/off line high, the scan derived 26 volt supply is not generated. With the scan derived supply not switching the run 9 and 12 volt supplies *on*, pin 2 of U3101 is not pulled high. The system control microprocessor detects the fault detect input not being pulled high about 300 milliseconds after the *on* command is given and goes into fault detect shutdown. If the horizontal deflection quits or scan derived 26 volt supply drops while the chassis is operating, the same sequence of events occur and the television will go into fault detect shutdown.

The fault detect circuits are also used to shut the chassis down if there is a problem with the audio output circuits. Specifically, the audio circuits contain a protection circuit that monitors the DC level on the lines going to the speakers. If this protection circuit is triggered, it pulls the fault detect input to the system control microprocessor low. This places the chassis in shutdown before damage to the speakers occur.

How do you determine a CTC168/169 chassis is in the fault detect shutdown condition? Unfortunately the cycling on/off of the chassis is not conclusive evidence of the chassis being in the fault detect shutdown condition. An easy way to determine a fault detect shutdown is to measure the voltage on pin 2 of U3101. When the on/off line of U3101 is high, the fault detect input to U3101 should rise above 2.5 volts within 300 milliseconds. If it does, the chassis is not in the fault detect shutdown condition. If it doesn't, the chassis is in the fault detect shutdown mode.

XRP

Horizontal Deflection Shutdown Circuits

The one shutdown circuit in the horizontal deflection circuits is the XRP (X-ray protection) circuit. This shutdown circuit monitors the level of high voltage and disables horizontal drive from U1001 if it becomes excessive. Without drive the horizontal deflection circuit quit operation and HV, scan derived B+ supplies, and horizontal reference pulses quit. Without scan derived 26 volts the run 12 and 9 volt regulators are disabled. The fault detect input to U3101 then goes low, because the run 9 supply is missing, and U3101 pulls the on/off line low. After this process is complete, U3101 may pull the on/off line high and attempt to restart the chassis. If the on/off line is pulled high and the XRP circuit do not trigger again, the chassis will resume normal operation. If the condition causing the XRP circuit to trigger still exists, the chassis will shutdown again. This shutdown cycle will repeat 3 to 4 times before it stops and the chassis remains shutdown. At this point the power button can be pressed and the chassis will attempt to turn *on*.

The XRP circuits determine the level of high voltage by monitoring a horizontal pulse from a secondary winding of the IHVT. If the amplitude of this pulse increases (indicating the HV is increasing) the XRP circuits trigger and apply about 1.5 volts to pin 22 of U1001. When U1001 detects this voltage level, it disables drive to the horizontal deflection circuits.

What can cause the XRP circuits to trigger? Usually failures of the components in the collector of the horizontal output transistor can cause too much HV to be developed. A failure in the run regulator circuits in the power supply can cause too much reg B+ to be supplied to the horizontal deflection circuits. This would also cause the HV to climb, triggering the XRP circuits.

When the television experiences an XRP shutdown, the symptoms are very similar to a fault detect shutdown. When the shutdown is triggered, the television will shut *off* and attempt to cycle *on* again. This process will be repeated several times before the television remains *off*.

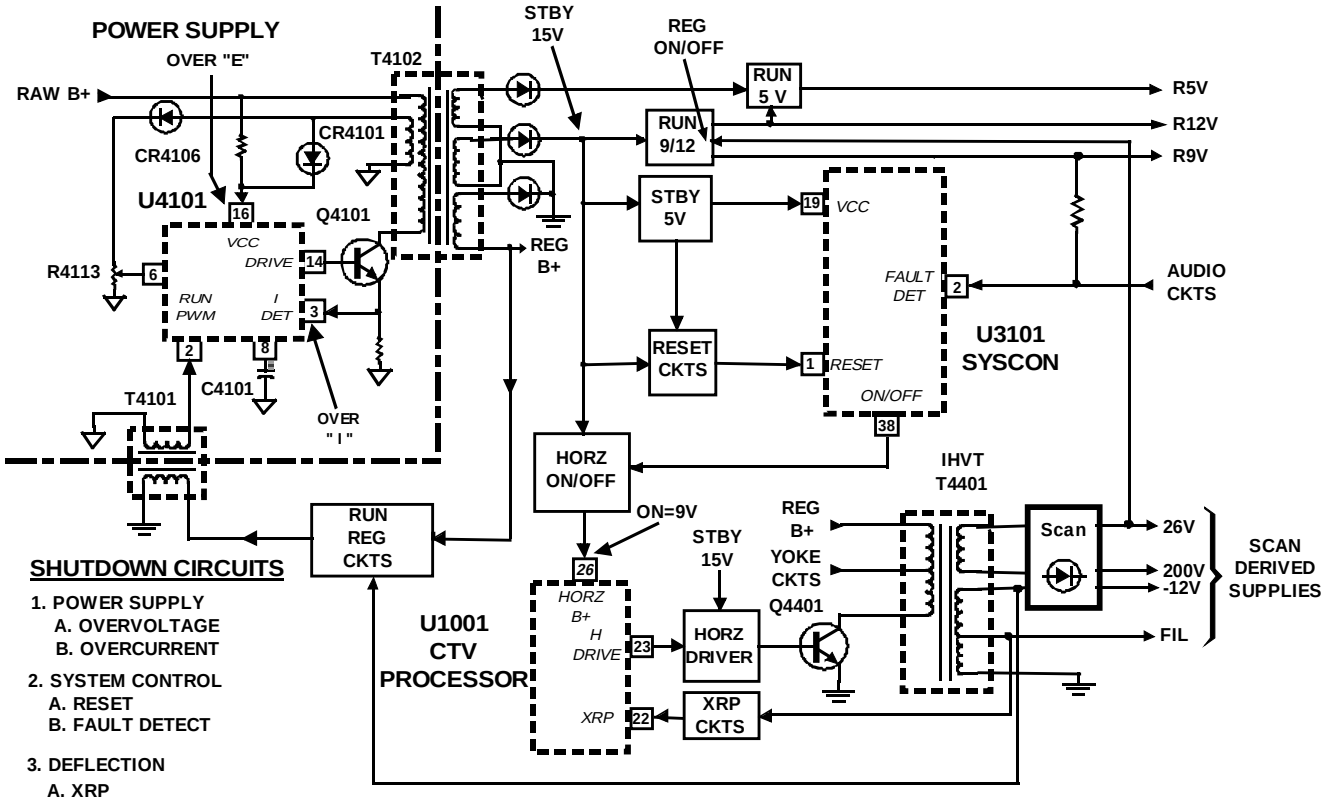


Figure 8, Shutdown Circuits (Repeated)

DEAD SET TROUBLESHOOTING

Follow the steps below to help isolate a dead set symptom to a circuit area in the CTC168/169 chassis. Each step in the procedure has you check the voltage at a test point or component on the chassis. The location of these components can be found using the service data or the service information label (this label is secured to the cabinet back of the television). It is recommended that these steps be followed in the given order for completeness. Keep in mind these checks only isolate to a circuit area; once in that area, component level troubleshooting must be performed to determine the specific component. To help with the procedure, each step has a written explanation of the theory of the step, plus how to interrupt the results of the step. These explanations are located after the procedures in the troubleshooting table.

STEP	PROCEDURE	TEST POINT	RESULT
1	Apply 120VAC to the chassis with a variable isolation transformer. With a DVM measure the voltage on pin 1 of T4401. If the result of the check is 137 VDC, go to step 2. If 137VDC is missing, see the power supply troubleshooting section of this manual.	T4401 PIN 1	137 VDC
2	Connect a voltmeter to TP4706. Press the power button and check for the presence of 26 volts. If 26 volts is present or is momentarily present, go to step 3. If the voltage on TP4706 is not present or doesn't change when the power button is pressed, go to step 5.	TP4706	26 VDC
3	Short T4101 pin 4 to HOT ground. While monitoring the voltage at TP4706 apply AC power and press the power button. Does TP4706 rise to 26 volts? If it does, suspect the horizontal deflection circuits or the power supply's run regulator circuits. If TP4706 does not climb to 26 volts, disconnect the short on T4101 pin4 and go to step 4.	TP4706	26 VDC
4	Unplug J1903 of the audio circuit board. Apply AC power and press the power button. Does TP4706 climb to 26 volts and stay? If so, troubleshoot the audio output circuits. If TP4706 does not change, go to step 5.	TP4706	26 VDC
5	Ground the collector of on/off transistor Q4304 and apply AC power. Does the voltage at TP4706 come up and stay at 26 VDC? If so, supect the system control circuits and the fault detect shutdown circuits. If not, suspect the horizontal	TP4706	26 VDC

Figure 9, Dead Set Troubleshooting Procedure

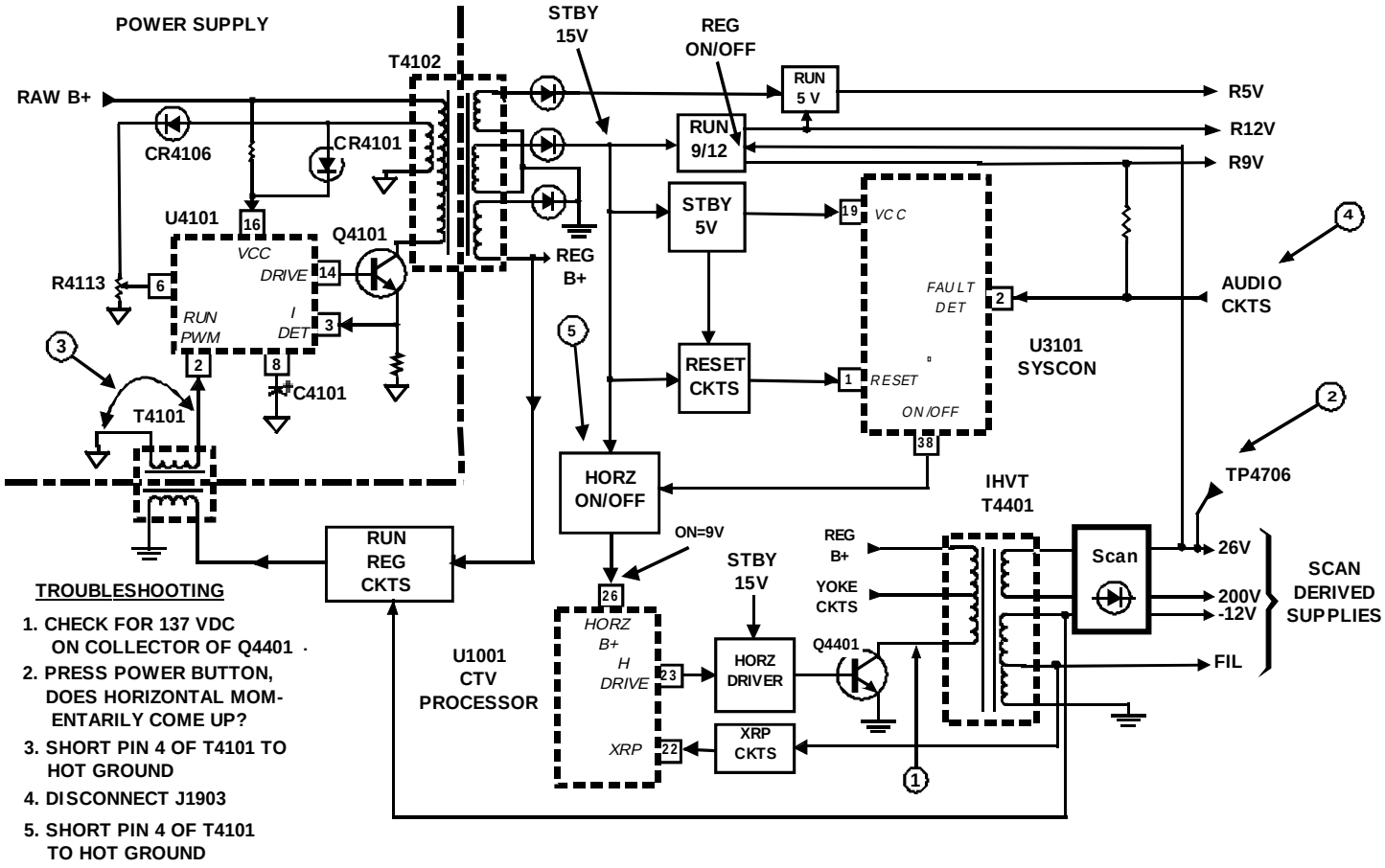


Figure 10, Dead Set Troubleshooting

STEP

1. This step confirms the operation of the power supply in the standby mode. If at least 137 VDC is present on the REG B+ line (T4401 pin 1), the power supply can be considered operational in the standby mode.

   NOTE: If REG B+ is not present at T4401 pin 1, there is either a problem with the power supply or it is in one of its shutdown conditions. In either case consult the power supply troubleshooting section of this manual for a troubleshooting procedure.

2. This step confirms the operation of the horizontal deflection circuits by checking the voltage level of the 26 volt scan derived supply (TP4706). This supply is generated from the a secondary winding of the IHVT. If the horizontal deflection circuits are operating, scan derived 26 volts will be developed when the power button is pressed. If the chassis is going into a shutdown mode, the horizontal deflection circuits may come up momentarily and then shutdown. With this occurring, the voltage on the scan derived 26 volt supply will rise while the horizontal deflection circuits are operating and drop when the horizontal deflection circuits stop

   If the voltage on TP4706 attempts to rise to 26 volts when the power button is

pressed, the horizontal deflection circuits are at least partially operating. This step confirms that the horizontal deflection circuits are at least being driven by U1001 and the horizontal output transistor is switching on and off. However there still may be problems in the horizontal deflection circuits. These problems will be detected later in this procedure.

- If the voltage on TP4706 attempts to rise to 26 volts, go to step 3.
- If TP4706 does not attempt to climb to 26 volts, the horizontal deflection circuits are not operating at all. This could be because of lack of drive from U1001 or a defective component in the deflection circuits. If this is true, go to step 5.

3. This step reduces the voltage on the REG B+ line by forcing the power supply to remain in the standby mode. To force the power supply to remain in the standby mode, short pin 4 of T4101 to HOT ground. This prevents the run PWM signal from reaching U4101 and switching it to the run mode. Once this is done apply AC power to the chassis, press the power button and monitor TP4706 for 26 volts.

   - If the scan derived 26 volts is present after the power button is pressed, the chassis is probably going into the XRP shutdown mode or there is a problem in the run regulator circuits. Follow the troubleshooting procedures outlined in the horizontal deflection troubleshooting section of this manual.
   - If the scan derived 26 volts is not present after the power button is pressed, disconnect the short on T4101 and go to step 4 in this troubleshooting procedure.

4. This step verifies, or removes, the possibility of defective audio outputs shutting the chassis down by unplugging J1903. Once J1903 is unplugged, press the power button and monitor the voltage on TP4706.

   - If the chassis resumes operation (the 26 volts source rises to 26 volts when the power button is pressed), there is a defect (short) on the audio circuit board.
   - If the chassis remains shutdown, go to step 5 of this procedure.

5. This step eliminates the system control circuits and the on/off circuits as the cause of the dead set symptom. By grounding the collector of Q4304, the on/off circuits are forced to supply B+ to U1001. U1001 then sends drive to the horizontal deflection circuits which begin operation. If the horizontal deflection circuits are

defective, the chassis will not generate HV or scan derived B+ sources. In this situation the scan derived 26 volts, on TP4706, will not be present. If the horizontal deflection circuits are functioning normally, there will be scan derived 26 volts on TP4706.

If there is 26 volts on TP4706 after grounding the collector of Q4304, the system control circuits and the on/off circuits are not supplying B+ to U1001. This can be caused by the system control circuits being in one of the system control shutdown modes or there is a defective component in the on/off circuits.

- If the chassis develops scan derived 26 volts when the collector of Q4304 is grounded, suspect a problem with the system control circuits or the on/off circuits.

- If the chassis does not develop scan derived 26 volts when the collector of Q4304 is grounded, suspect the horizontal deflection circuits.

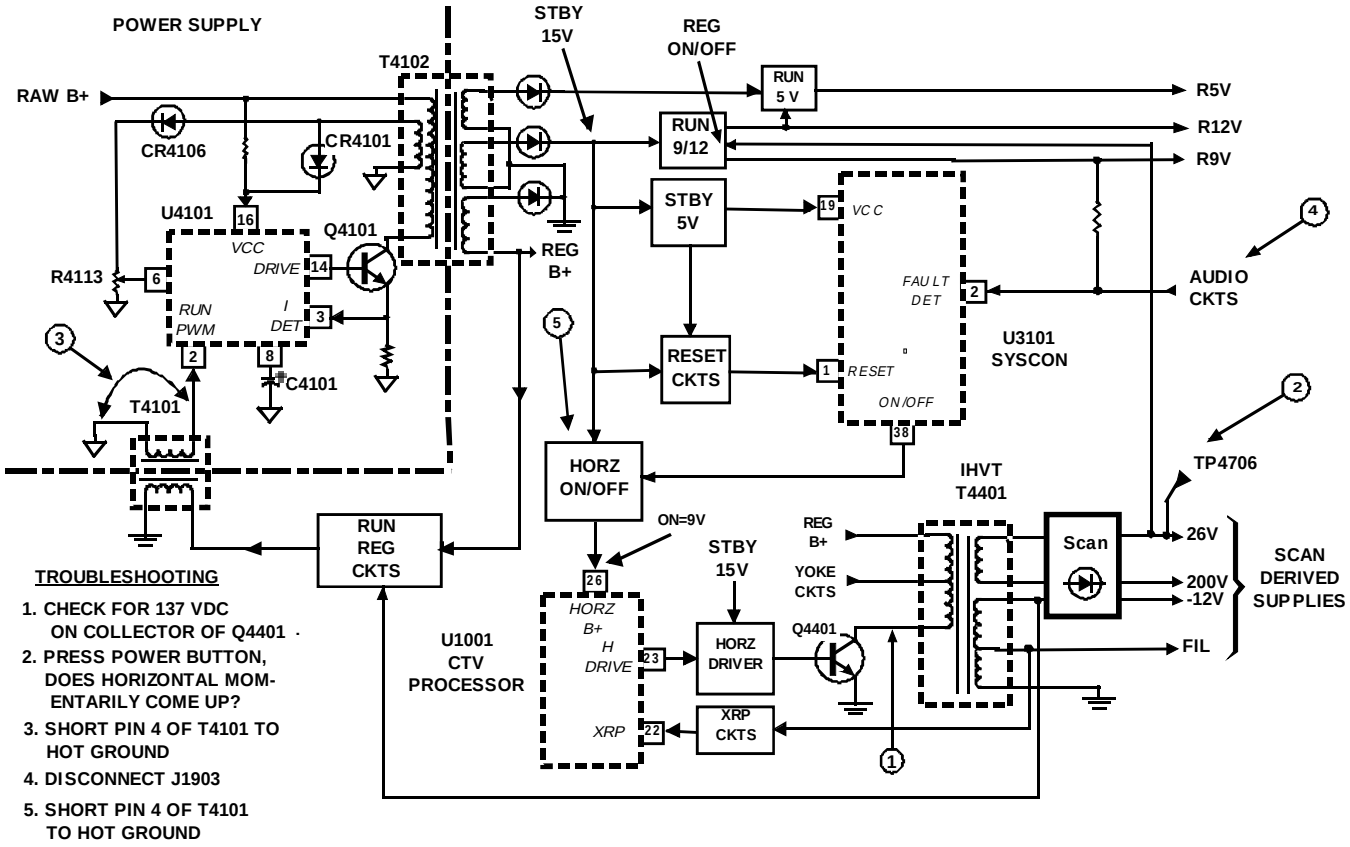


Figure 11, Dead Set Troubleshooting

POWER SUPPLY TROUBLESHOOTING

Follow the steps in the procedure below to isolate a power supply problem to a deflective component group in the power supply or determine if the power supply is in a shutdown condition. These steps are only intended to help isolate a power supply problem to a group of components and not a specific component in the power supply. An explanation of each step of this procedure is also given in this section of the training manual. Included in this section is an explanation of each step plus information on how to interpret the results of the test performed in the step.

STEP	SETUP	TEST POINT	RESULT
1	Apply 120 VAC and check for RAW B+ at the collector of Q4101. If missing, check for open fuse and surge resistor, also suspect shorted Q4101. If present, go to step 2.	Q4101 Collector	150 VDC
2	With 120 VAC applied check the DC voltage at pin 16 of U4101. During normal operation this voltage is about 10 to 11 volts. If this voltage fluctuates between 7 and 11 volts see the overcurrent shutdown test procedure. If this voltage is greater than 15 and or less than 2.5, supect U4101 or the standby voltage adjust	U4101 Pin 16	Normal aprox 10 VDC

Figure 12, Power Supply Troubleshooting Procedure

STEP

1. This step checks for the presence of RAW B+ on the collector of the chopper transistor Q4101. This B+ is generated by the input bridge rectifier and filter circuits.

   - If 150VDC is present on the collector of Q4101, go to step 2 of this procedure.
   - If 150 VDC is missing, check for an open fuse (F4001) or surge resistor (R4001). If either of these devices are open, suspect a shorted Q4101, or shorted bridge rectifier CR4001-CR4004.

2. The next troubleshooting step is to check the DC voltage on pin 16 of U4101. The level of this DC voltage can indicate what failure mode the power supply is in. During normal standby mode operation the voltage on pin 16 will be about 10 to 11 volts DC.

If this fluctuates between 7 and 11 volts, U4101 may be in one of two conditions. The first of these conditions occurs if U4101 is in the overcurrent shutdown mode. The second of these conditions occurs if Q4101 is not switching *on* and *off*. To determine which of these two conditions are occurring, follow the power supply shutdown test procedure in this manual. If the voltage on pin 16 of U4101 is below 2.5 volts, either U4101 is defective or there is a leaky component connected to U4101 pin 16. If the voltage on pin 16 is above 15 volts, suspect a defective component in the standby regulator feedback circuits (for example: CR4106, or R4113).

- If the voltage on pin 16 of U4101 fluctuates between 7 and 11 volts, follow the procedures outlined in the power supply shutdown test procedure in this manual.

- If the voltage on pin 16 of U4101 is greater than 15 volts, U4101 is being placed in the overvoltage shutdown condition. This maybe due to a defective component in the standby regulator circuits.

- If the voltage on pin 16 is less than 2.5 volts, U4101 may be defective or there may be a defective component connected to pin 16. With an ohmmeter check the resistance from pin 16 to HOT ground. This resistance should typically be greater than 40K ohms. If the resistance is less than 40K ohms, suspect a leaky component connected to pin 16 or a defective U4101.

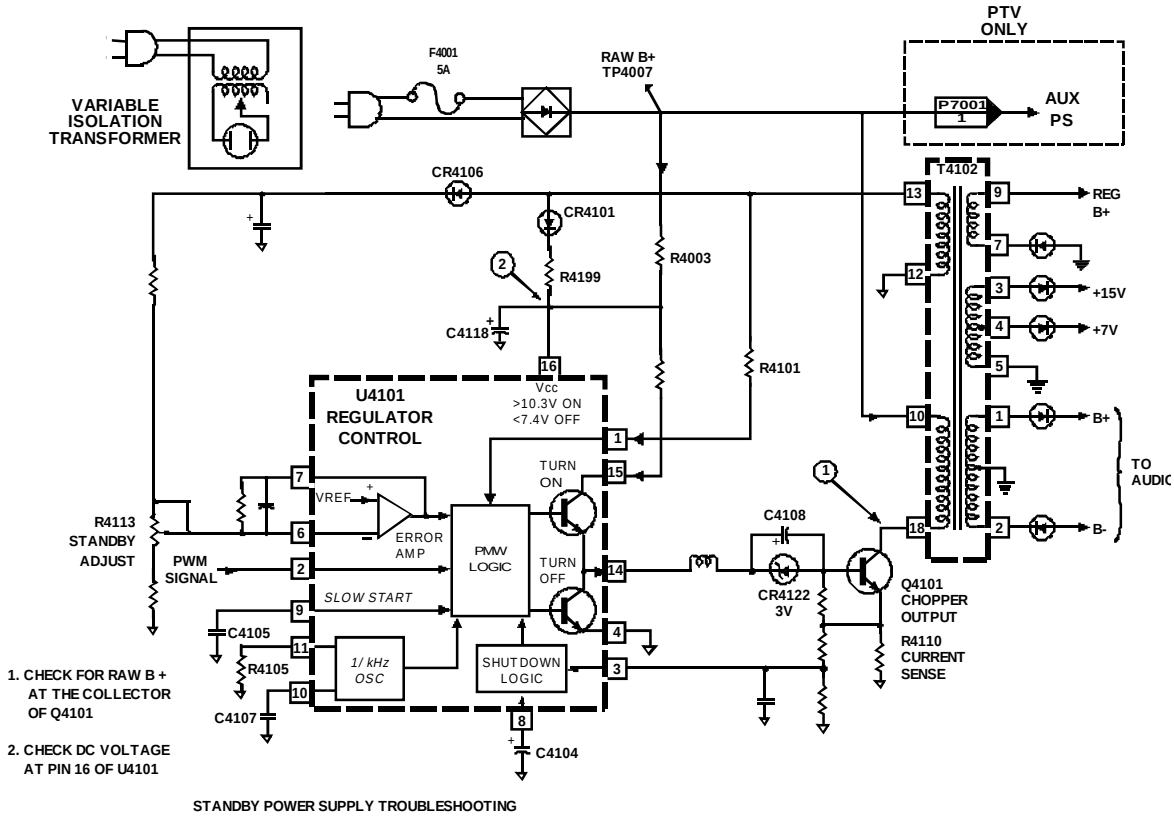


Figure 13, Standby Power Supply Troubleshooting

Power Supply Shutdown Test Procedure

If the voltage on pin 16 of U4101 fluctuates between 7 and 10 volts, one of several failure conditions can exist in the power supply. These conditions vary from a defective U4101 to the power supply being in a shutdown condition. This procedure isolates between these conditions to help the technician determine the failed circuit area in the power supply.

STEP	SETUP	TEST POINT	RESULT
1	Apply 120 VAC and check for RAW B+ at the collector of Q4101. If missing, check for open fuse or surge resistor also suspect shorted Q4101. If present go to step 2.	Q4101 Collector	150 VDC
2	With 120 VAC applied check the DC voltage at pin 16 of U4101. If the voltage is above 15 VDC trobleshoot overvoltage condition. If the voltage bounces between 7 and 10 volts suspect an overcurrent shutdown condition	U4101 pin 16	Normal aprox 10 VDC

Figure 14, Shutdown Test Procedure

STEP

1. U4101 goes into a hard shutdown condition when the charge on C4104 rises above 2.5 volts (a complete explanation of this mode is in the power supply overcurrent shutdown section of this manual). Once in this condition U4101 will not send drive to Q4101 until the voltage on pin 16 drops below 7 volts and then rises above 10 volts. When U4101 goes into this hard shutdown the voltage stored on C4104 drops immediately preventing voltage checks from being made once the IC is in shutdown. This procedure uses a voltmeter to monitor pin 8 of U4101 while the pin 16 of U4101 is being pulled low and allowed to go above 10 volts. If the voltmeter on pin 8 briefly rises then falls, U4101 maybe in the overcurrent condition.

CAUTION — Accidentally shorting pin 15 to pin 16 of U4101 will destroy both the output transistor (Q4101) and U4101. When performing, this procedure extreme caution must be taken to avoid destroying these devices.

- If the voltage on pin 8 quickly rises and falls, suspect U4101 is being placed in the overcurrent shutdown condition. The usual cause of an overcurrent condition is a shorted rectifier on the secondary B+ supplies of the chopper transformer (T4102) or a shorted horizontal output transistor (Q4401). The first step is to determine where the load on the power supply is located. This can be done with resistance checks to ground. The resistance from the collector of the horizontal output transistor to Cold ground should be greater than 50K ohms. The next step is to determine if one of the power supply's secondary supplies is causing the power supply to go into a n overcurrent condition. Check the resistance of each of the points listed below to confirm this. If these checks do not find the excessive load, suspect a defective chopper transformer (T4102) or defective component in the collect circuit of Q4101.

LOCATION	B+ SUPPLY	OHMS TO COLD GROUND
CR4116 CATHODE	REG B+	50K OR GREATER
CR4118 CATHODE	+15V	500 OR GREATER
CR4117 CATHODE	+7	4K OR GREATER
CR4119 CATHODE	+17 (+24 CTC168)	4K OR GREATER
CR4120 ANODE	-17	4K OR GREATER

Figure 15, Power Supply's Secondary Sources

2. This step uses an external DC power supply to provide B+ to U4101. The first step is to remove AC power from the chassis and momentarily short pin 16 of U4101 to HOT ground. Next, with a DC power supply apply 13 VDC to pin 16 of U4101. With 13 volts applied to pin 16, U4101 should begin operation and send drive pulses, from pin 14, to Q4101.

- If the output pulses are present, check for base drive directly on the base of the chopper transistor Q4101.
- If the output pulses are missing, check for the 20KHz clock signal at pins 10 and 11 of U4101. If the clock signal is missing, suspect C4107, R4105, and even U4101.

Note: If U4101 operates normally when using an external DC supply but does not operate when AC power is applied, suspect the overcurrent shutdown condition.

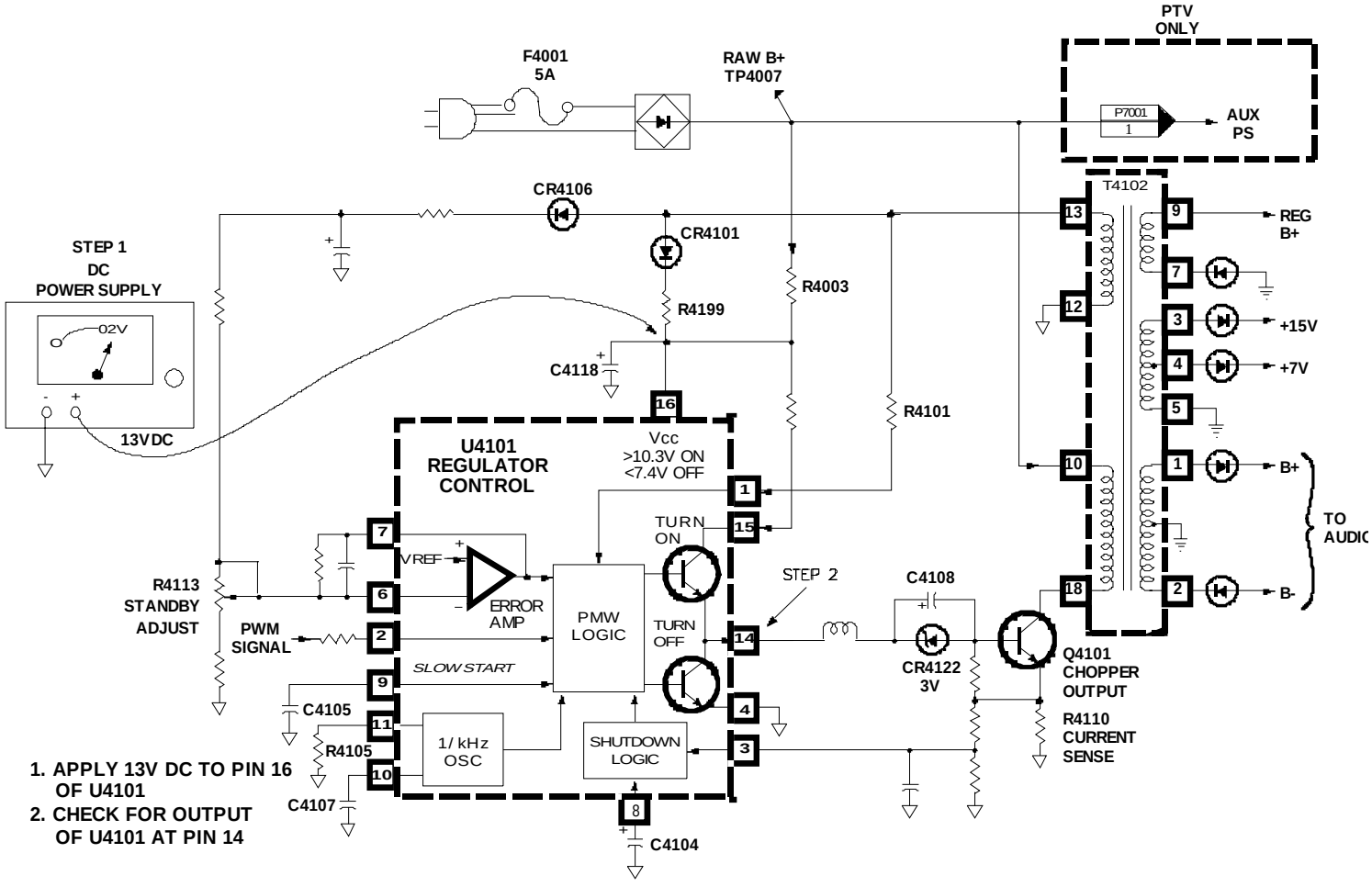


Figure 16, U4101 Confirmation Procedure

Horizontal Deflection Troubleshooting

Failure of the horizontal deflection circuits will typically cause the chassis to go into one of its shutdown modes. Typical failures in the horizontal deflections circuits are: shorted horizontal output transistor, open capacitors in the collector circuit of the horizontal output transistor, and excessive load on one of the secondary windings of the IHVT. These are only some of the many possible components that can cause the chassis to go into one of its shutdown modes. If the horizontal circuits are suspected as the cause of a dead set symptom, the first step is to confirm its operation. This can be done with the procedure below.

This procedure operates the horizontal deflection circuits at a lower voltage. This allows checks to be made in the deflection circuits while they are active and before the chassis can go into a shutdown condition. To do this, the television's power supply is defeated and the horizontal circuits of the chassis are supplied power from a variac and a DC power supply.

The test equipment required to perform this procedure is:

1. Variable isolation transformer (variac). This transformer should be cable of suppling a minimum voltage of 25 VAC and a maximum of 125 VAC.

2. DC power supply. The power supply must be capable of supplying at least 15 volts at 300 milliampere.

3. DC volt meter. This meter must be capable of measuring at least 125 volts DC.

4. Oscilloscope with a 10:1 scope probe.

5. Test leads. At least 3 test leads are needed.

CAUTION: This procedure defeats the B+ regulation provided by the television's power supply allowing the deflection system to operate at lower B+ voltages. Because of this, **EXTREME CAUTION** must be taken when performing this procedure to ensure the deflection circuits are not operating at higher voltages than suggested in the procedure. Also make sure AC power is not supplied to the chassis until instructed to do so by the procedure. While performing this procedure never apply AC power to the chassis without the use of a variable isolation transformer.

Follow the steps below to confirm the operation of the horizontal deflection circuits.

1. The first step in this procedure is to disable the television's power supply. This can be done by unsoldering the collector of the chopper transistor Q4101.

2. The next step forces the on/off circuits *on*. This is done by connecting a jumper from the collector of Q4304 to COLD ground.

3. This step connects the HOT ground circuits of the chassis to the COLD ground circuits of the chassis. To do this connect a jumper between T4102 pin 12 to T4102 pin 5.

4. Connect a jumper between T4102 pin 10 and T4401 pin 1. This connects Raw B+ to Reg B+.

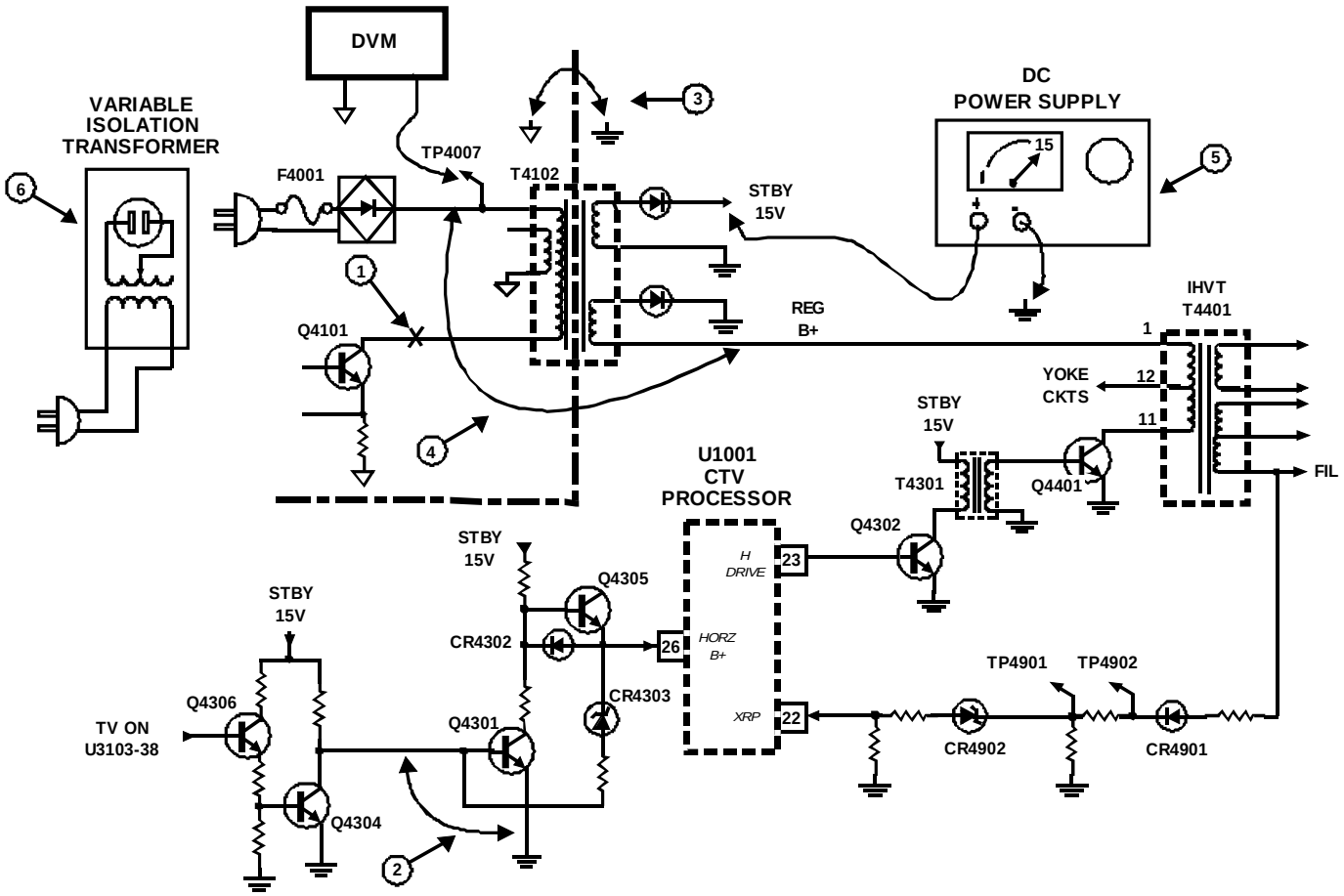


Figure 17, Horizontal Deflection Testing

5. With a DC power supply apply 15 volts to the cathode of CR4118. This supplies B+ to the horizontal drive circuits and to U1001. At this point the horizontal oscillator in U1001 can be checked. To do this connect an oscilloscope to pin 23 of U1001. With 15 volts supplied from the DC power supply, the waveform in figure 18 should be present.

Figure 18, Horizontal Drive U1001 Pin 23

If this waveform is present, the oscillator in U1001 is operating.

-

If this waveform is missing, suspect U1001 and its external components.

-

CAUTION: Before performing the following portion of the test procedure confirm the maximum input voltage of the oscilloscope you are using. Special caution should be taken not to exceed this level. If the input voltage of the oscilloscope is less than the level required to check the horizontal deflection circuits (1200 V P-P), connect it to a secondary winding of the IHVT (for example pin 5 of T4401). This will provide a reduced amplitude representation of the waveform present on the collector of the horizontal output transistor.

6. With an AC variac, apply 25 VAC to the chassis and monitor the DC voltage at TP4007. With an oscilloscope, monitor the waveform on the collector of the horizontal output transistor. Compare the amplitude of this waveform with the waveform shown in figure 19. If the amplitude of the waveform is correct increase the voltage of the variac to each of the levels shown in level in figure 19. At each of the variac settings the amplitude of the collector pulse should be checked.

CAUTION: Under no circumstances let the DC voltage on TP4007 exceed 140 VDC.

If the waveform on the collector of Q4401 is determined abnormal,

- troubleshoot horizontal deflection circuits. See the Retrace Pulse Confirmation section of this manual.

- While increasing the AC voltage supplied to the chassis the horizontal drive disappears, suspect an XRP shutdown condition. This can be confirmed by starting the horizontal confirmation procedure again and monitoring the DC voltage on pin 22 of U1001. If the XRP circuits are operating correctly, this voltage will not exceed 1.5 volts.

- If the horizontal deflection circuits operate normally with 140 VDC at TP4001. The deflection circuits are not deflective.

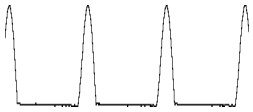
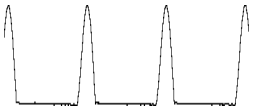
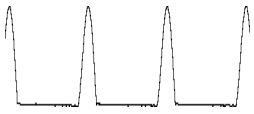
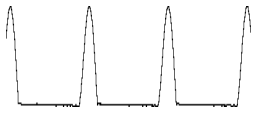
Horizontal Test Mode		
AC Line Voltage	Q4401 Collector Voltage	Q4401 Collector Waveform
25VAC	32VDC	 240 VP-P 20us/Div
50VAC	64VDC	 535 VP-P 20us/Div
70VAC	90VDC	 750 VP-P 20us/Div
110VAC	140VDC	 1200 VP-P 20us/Div

Figure 19, Horizontal Deflection Waveform Table

Horizontal Retrace Pulse Confirmation

In the horizontal deflection confirmation procedure given in this manual, the waveform on the collector of Q4401 is checked to determine if a problem is present in the horizontal deflection circuits. This procedure looks at the amplitude of the horizontal output's (Q4401 in the CTC168/169) collector pulse at a certain B+ voltage. If the amplitude is correct it, can be assumed the horizontal deflection circuits are operating normally. However, if the amplitude is incorrect, there is a problem with the horizontal deflection circuits. This waveform can be used to determine more than just whether or not the horizontal deflection circuits are operating correctly. By looking at the pulse width and shape of the retrace pulse, the type of problem in the horizontal deflection circuits can also be determined.

When the horizontal deflection circuits are operating properly the pulse width of the retrace pulse should approximately 13 microseconds wide. There also should be no ringing or secondary pulses on or after the retrace pulse (see example in figure 20). When the retrace pulse appears as it does in Figure 20, the turned circuits in the collector circuits of the horizontal output transistor are at their correct values and operating correctly.

If the width of the retrace pulse is narrower than 12 microseconds, suspect a problem with the retrace capacitors (in the CTC168/169 chassis suspect C4401 and C4402). The charging and discharging of these capacitors controls the current in the horizontal yoke during retrace. When the retrace pulse narrows the high voltage increases and triggers the chassis into an XRP shutdown condition.

If the retrace pulse is wider than 13 microseconds, suspect an inductance type of problem in the collector circuits of the horizontal output transistor. The wider retrace pulse is typically followed by ringing or a secondary pulse after the retrace pulse. This condition indicates the yoke circuits are not resonant at the correct frequency. This condition can be caused by an excessive load on one of the secondary windings of the IHVT, defective yoke, or even a defective IHVT.

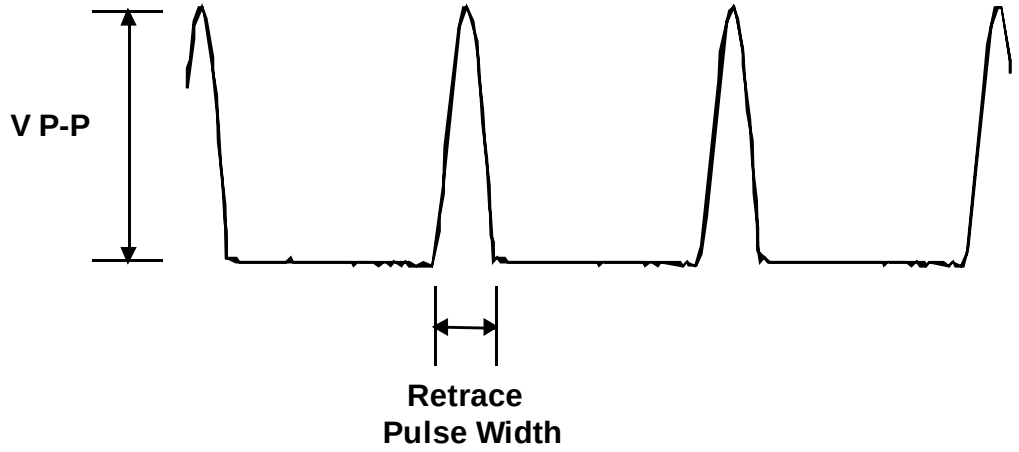


Figure 20, Collector Waveform Q4401

INTERMITTENT SHUTDOWN

To troubleshoot a CTC168/169 chassis with an intermittent shutdown problem, position the television where it can be monitored and follow the steps below to isolate to shutdown circuit or a circuit area of the chassis.

To start this procedure turn the television *on* and tune to an active channel. As the television is operating, mute the audio and look for one of these three conditions:

1. While the television is operating the mute indicator will appear on the screen. If the on-screen mute indicator disappears and the audio remains muted, the system control microprocessor has experienced a momentary shutdown condition. This could have been triggered by the system control fault detect or the reset shutdown circuits. In this condition the system control microprocessor was shut down but its memory remained intact. See the system control shutdown section of this manual for an explanation of this condition.

2. If the television shuts *off* and can be turned *on* again by pressing the power button, the system control circuits have experienced a shutdown. This type of shutdown can also be triggered by the fault detect and reset shutdown conditions. The difference between this shutdown and the shutdown described in condition 1 is that the memory in the system control microprocessor was corrupted. See the system control shutdown section of this manual for a complete explanation.

3. If the television shuts *off* and AC power must be removed before it will turn back *on*, the power supply has been placed in a shutdown condition. See the power supply shutdown circuits for a complete explanation.

DEAD SET TECH TIPS

Fault	Solution
1. On/off line from the system control microprocessor does not go high when the power button is pressed. Further checks confirmed that the 5 volt supply was missing to system control microprocessor U3101.	Shorted CR4606.
2. No raw B+ to the collector of Q4101.	Open R4001 and shorted CR4105
3. U4101 was not sending drive to Q4101.	Shorted CR4101.
4. B+ to U3101 found at 8.6V not 5 volts.	CR4606 zenering at the incorrect voltage.
5. The power supply was not operating in the standby mode. Further checks indicated the U4101 was in the overcurrent shutdown condition	C4146 shorted.
6. Power supply not operating in the standby mode. Further checks indicated that U4101 was in the overcurrent shutdown condition.	CR4118 shorted.
7. Short chopper transistor (Q4101) life.	R4110 increased in resistance.
8. No standby voltages from the power supply. Further checks indicated U4101 was in the overcurrent shutdown condition. Q4101 and the resistances on the B+ sources supplied by the power supply checked fine.	Defective chopper transformer (T4102).
9. Power supply not operating in the standby mode. No drive being sent to Q4101 from U4101.	Leaky C4105.
10. Power supply not operating in the standby mode. Further checks indicated U4101 was in the overcurrent shutdown condition. A low resistance reading was found on the cathode of CR4119.	Defective audio output U1901.

INTERMITTENT SHUTDOWN TECH TIPS

	Fault	Solution
1.	Run regulated B+ was found to high at 149 VDC.	CR4123 was found zenering at the incorrect voltage.
2.	Voltage checks determined that the 15 volt supply was down to 13.2 volts and had 1.5 V P-P ripple.	C4145 open.
3.	The horizontal deflection circuits were generating to much high voltage.	C4401 increased in value.
4.	The chassis shuts down during forward search of a VCR.	C4401.

PICTURE TUBE ARCING CTV2

Date: December 31, 1991

Subject: Picture Tube Arcing/intermittent Shutdown

Symptom: Television set turns itself off momentarily and then back on (sometimes accompanied by a "snap" sound).

Corrective Action: This symptom is normally caused by a picture tube arc. A picture tube arc is an electrostatic discharge occurring inside the picture tube and is commonly experienced during early operation of a new television set. Arcs are typically caused by minute particles within the tube that exist in normal production. These particles dislodge during shipment and usually cause an arc within the first few hours of operation. The occurrence of these arcs diminishes quickly as the set continues to play. Many sets will never experience an arc while others of the same model may experience several.

Picture tube arcs are common with new tubes from all TV manufacturers. TCE chassis are designed to tolerate these electrostatic discharges. However a major concern is microcomputer lock-up. If this occurs, control of operation is lost because the micro becomes "confused" and/or memory contents are altered. To correct lock-up, the set must remain unplugged for several minutes. To minimize the probability of a microcomputer lock-up, and the inconvenience to the customer of having to unplug the set, the chassis is designed to perform a restart function if an arc occurs. The reset circuit momentarily powers down the set immediately after an arc.

When trying to troubleshoot a set for an intermittent shutdown condition, it is necessary to determine how long the set has been in use and how often the shutdowns occur. Shutdowns caused by picture tube arcing are infrequent, and decrease in frequency as the set is used. It is unusual to have a picture tube arc after the set has been in use more than a couple of weeks. If the set is new, advise the customer that arcs are not uncommon, and will diminish and finally stop as the set is used. If there is another cause for the momentary shutdowns, the problem will normally get worse as the set is used. If this is the case, refer to previously issued bulletins for tips on locating the defective circuit components.

PREGLOW AND AFTERGLOW

Date: February 26, 1992

Subject: CUSTOMER CONCERNS OF COLOR PICTURE TUBE "PREGLOW" AND "AFTERGLOW"

Field reports indicate a few owners of color television instruments are concerned about phenomena known as "preglow" and "afterglow".

Preglow is defined as a faint horizontal line that appears across the center of the screen at turn on. The line is present for approximately three seconds, and the television operates normally when the picture appears.

Afterglow is a condition where some portion of the screen remains lit for a period of time (five to fifteen minutes) after the instrument has been turned off. This condition is most noticeable under subdued lighting conditions.

Both of the above conditions are quite normal and should not be regarded as a defect that requires corrective action.

The following are some basic facts about "preglow" and "afterglow" that should strengthen the customer's confidence in their color television instrument.

Preglow -- In order to provide optimum deguassing, the vertical scan is delayed for a few seconds at turn on. This concentrates any small amount of stray emission into a line that is not visible at full scan. This condition will not deteriorate with life, and in most cases will improve.

Afterglow--The duration of the "afterglow" depends on the high voltage bleedoff rate at the second anode of the picture tube. The bleedoff rate is dependent on several factors:

- The internal leakage of the picture tube. The bleedoff rate tends to be slower in a low leakage tube. Hence a better than nominal tube (leakage-wise) may be more prone to exhibiting "afterglow".

- To some extent on picture tube setup (bias and drive adjustments).

- The brightness/contrast control settings at turn off—The high voltage bleedoff will be faster with higher beam current (higher brightness and contrast settings).

Again, these conditions are quite normal and should not be regarded as a defect that requires corrective action. Neither condition has any effect on the performance or reliability of the picture tube. Picture tubes exhibiting either phenomenon are not eligible for warranty consideration.