FN Chassis

FN Power Supply

Standby Power Supply

As soon as AC is applied to the set, D601 and C604 produce 150V across R603 with reference to hot ground. (67.5V with respect to cold ground) This voltage is used to activate and power the switching circuit (oscillator) made up of Q601, Q602, Q603, Q604, T603, T605 and associated components. The oscillator oscillates at 143Khz in the standby mode. When the set is switched ON, it oscillates at 127Khz with a white screen and 136Khz with a black screen.

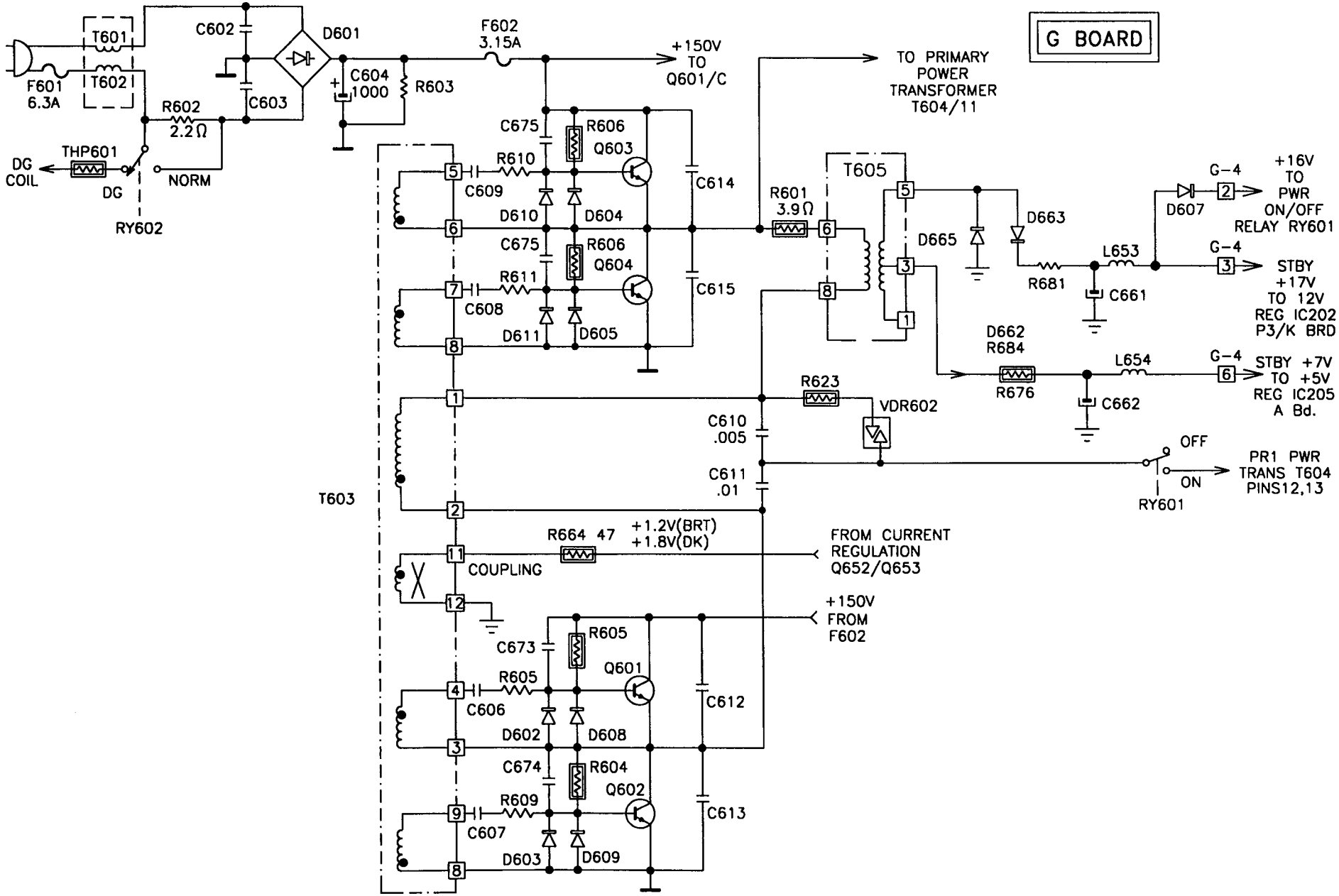
The first half cycle of the oscillator's output waveform is produced as current flows from hot ground through Q602, T603 pins 2 to 1, then through T605 pins 8 to 6, and finally through Q603 to the 150V supply.

The current that flows through T603 pins 2 to 1, induces a current into the windings between pins 5 and 6, and pins 8 and 9 causing Q602 and Q603 to go into saturation. At the same time the current induced into the windings at pins 7 to 8, and 3 to 4 is of opposite polarity, so Q604 and Q601 are kept OFF.

At saturation, the magnetic field in T603 collapses and induces currents of opposite polarities into the windings mentioned in the above paragraph. Now Q601 and Q604 turn ON and are driven to saturation as Q602 and Q603 are held OFF. This produces the second half cycle of the oscillator's output waveform. Oscillations are maintained this way.

The standby voltage is developed off pulses induced into the secondary of T605. These pulses are rectified by D665 and D663 to produce the 7V and 17V standby supplies.

During this time Power Relay RY601 is OFF. No signals reach Power Transformer T604.



FN STANDBY POWER

CTV23J21 414 7 25 96

FN Main Power Regulation and Protection Circuits

Power ON

At power ON, Main Control IC001/pin 8 on the M board goes HIGH and forward biases ON/OFF Driver Q655 via D669. This engages Power Relay RY601 that couples signals from the switching circuit to PRT T604/pins 10 and 13. These signals are induced into the secondary windings where they are rectified to develop most of the set's operating voltages.

Regulation and Shutdown

IC651 has two main functions:

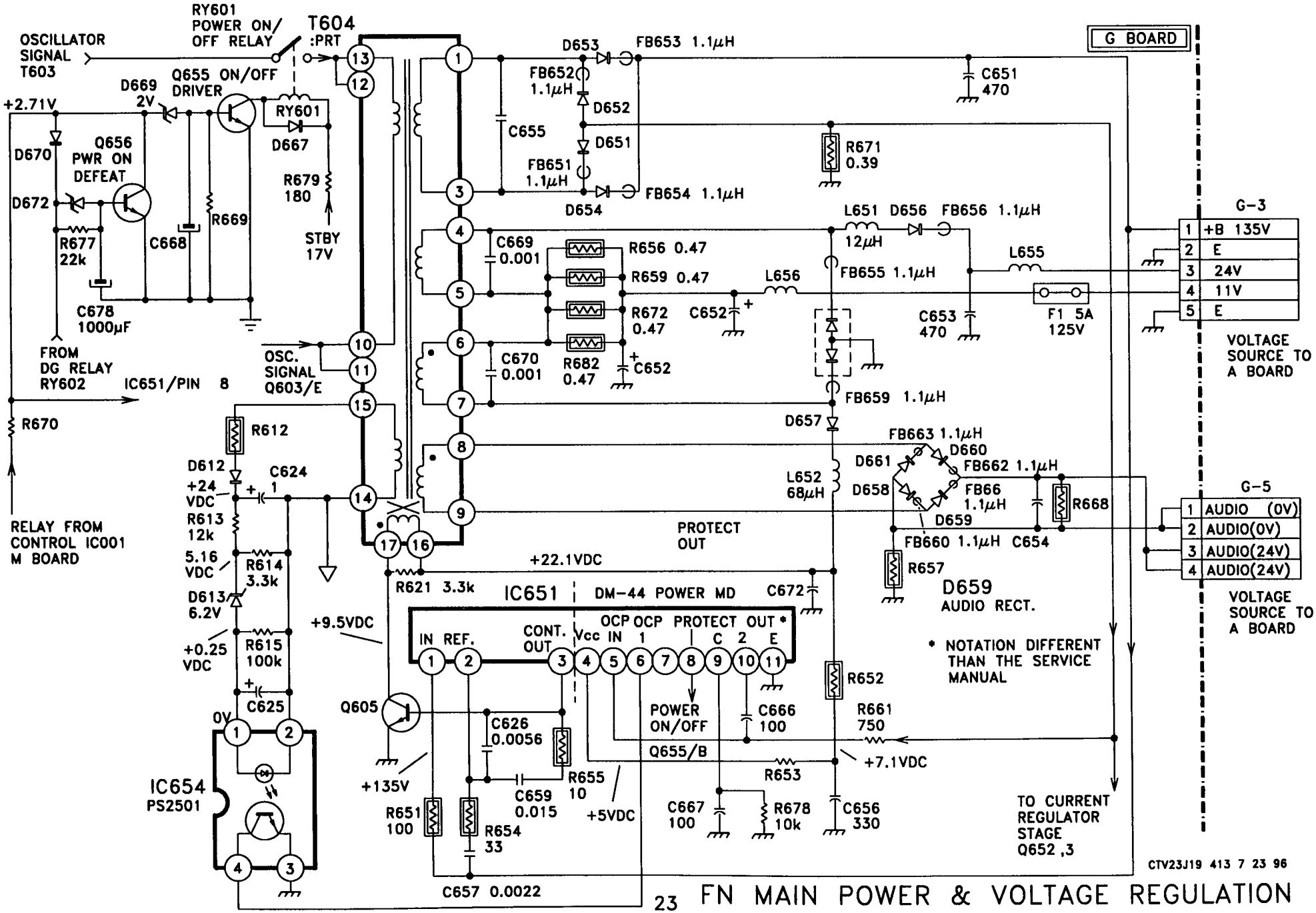
1. It is used to shutdown the set if an overcurrent condition is sensed on the 135V supply line, or in PRT T604. An excessive current increase will decrease the voltage across R671, thereby decreasing the voltage at pin 5. When the voltage reaches -0.69V, a latch within IC651, latches pin 8 LOW. Pin 8 is normally at 3.3V. The LOW disables Relay Drive Q655 and the set shuts down. The latch is maintained by the HIGH Relay line from Main Control IC001/pin 8 on the M Board. It is reset when AC is removed from the set and then reapplied.

An excessive current increase in PRT T604 will induce an increased voltage to the windings between pins 14 and 15. When this voltage is high enough to zener D613, the transistor within IC654 will conduct and reduce the voltage at IC651/pin 6. As this voltage reaches 2.7V, Pin 8 will latch LOW and disable Relay Drive Q655. The set shuts down.

2. It is used to regulate the output voltages from PRT T604 by monitoring the 135V supply and comparing it to an internal reference voltage at pin 2. Differences between these two voltages are inversely reflected at pin 3 and are used to control the conduction of Control Transistor Q605. This in turn controls the current through the control winding between T604/pins 16 and 17.

If the 135V increases, the voltage at pin 3 decreases, causing less current to flow in the control winding, the effect of which reduces the efficiency of T604, therefore the output voltages decrease. The opposite is true if the 135V supply lowers.

Additional regulation is accomplished by using the current drawn on the 135V line to control the frequency of the switching circuit. This is discussed in the following section.

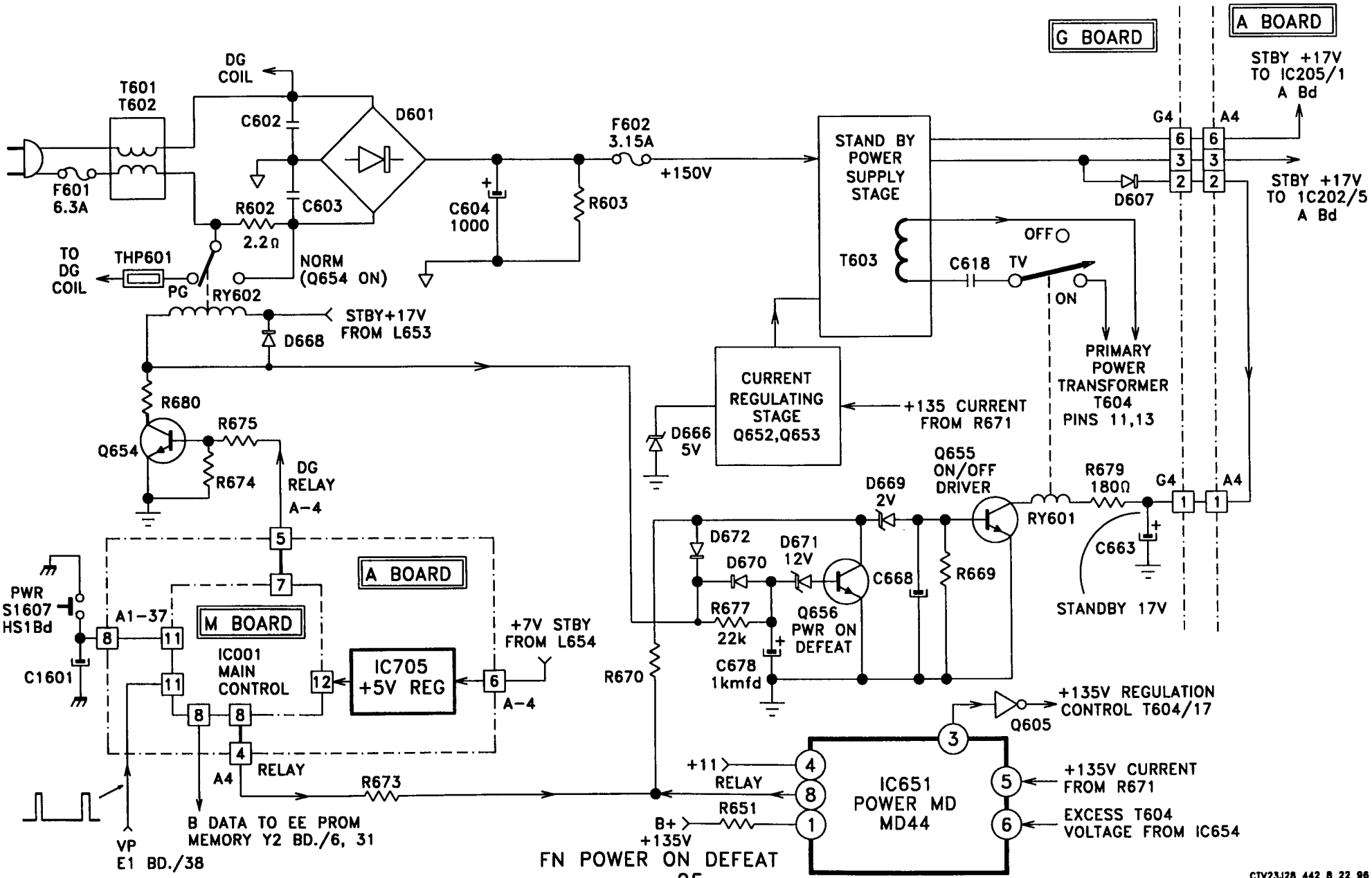


FN MAIN POWER & VOLTAGE REGULATION

Power On Defeat Circuit.

This circuit monitors the actions of the Degaussing Relay RY602. When AC is first applied to the set, Main Control IC001 resets and then pulls pin 7 LOW for about 5 seconds. This LOW keeps DG Relay Drive Q654 OFF for that time. During this time the switch in Relay RY602 is in the position shown and the set is degaussed. After the 5 seconds, Q654 is turned ON and the switched in the relay is toggled to the other position to stop the degaussing process, and bypass Surge Resistor R602.

Also during the 5 seconds that degaussing is taking place, Q656 is held OFF as C678 charges through R677. At the end of the 5 seconds, Q654 turns ON and C678 discharges through D672 thereby keeping Power ON Defeat Q656 OFF. If for any reason Q654 does not turn ON and discharge C678, Q656 will turn ON and place a LOW on the Relay line and disable Relay Drive Q655. The set shuts down. The Standby 17V across R677 keeps the circuit latched.



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FN Current Regulation

The purpose of the current regulating stage is to monitor the current being drawn on the 135V line, and vary the switching circuit (oscillator) frequency to provide optimum current transfer. This circuit works with the voltage regulating circuit discussed in the previous section, to regulate the power supply. **If the current regulating stage does not function, the oscillator frequency will vary with changes in picture brightness levels.** For example, in the case where a scene has quick changes from dark to bright, the oscillator's frequency will hunt. This will affect all the other voltages that are produced off PRT T604, since frequency is one of the factors in determining the output voltages.

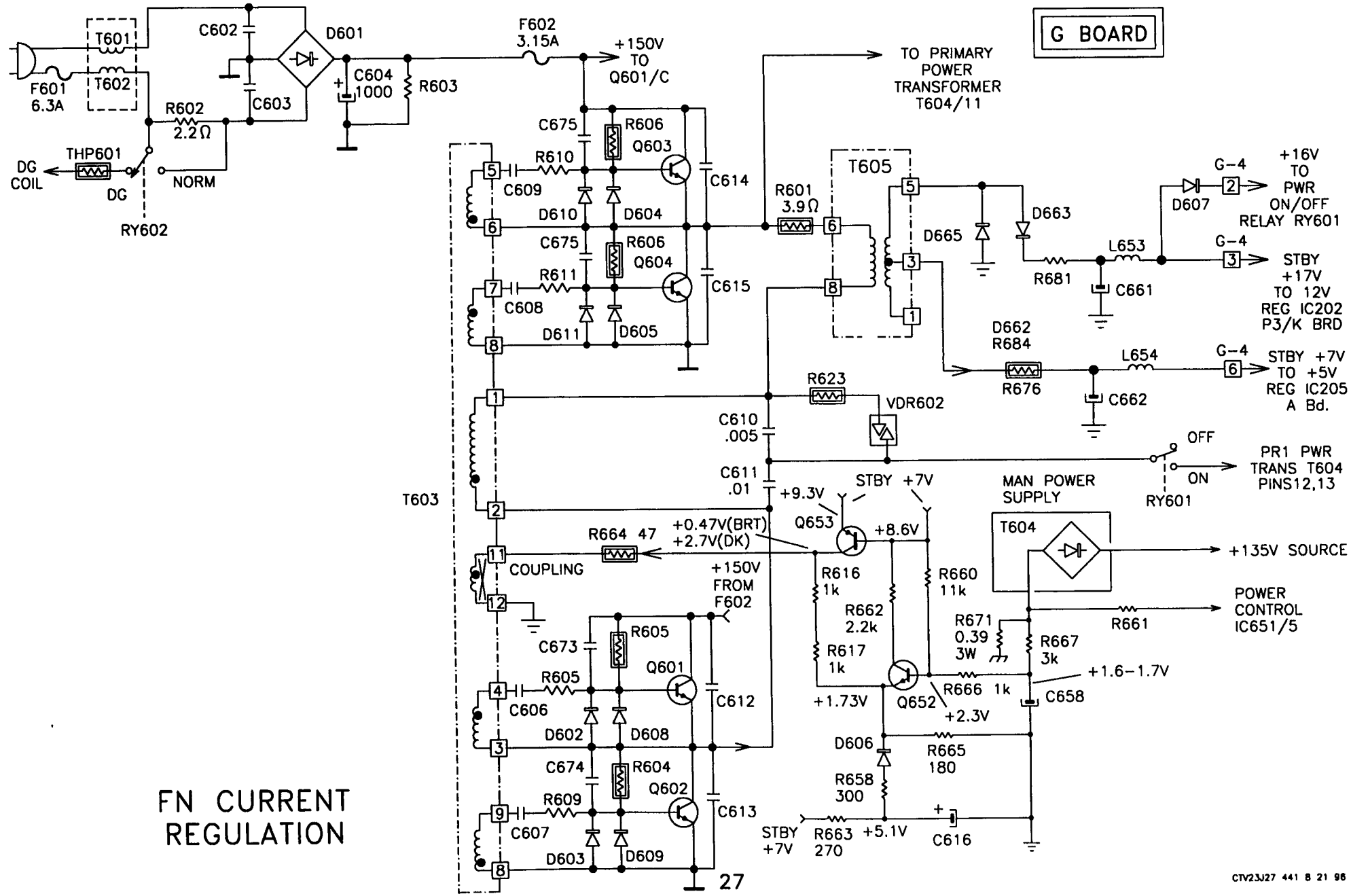
Operation

The current through R671 varies with the brightness level of each line in the scene and produces -0.2V to -0.46V across the resistor. This is applied to the current regulating circuit through R667 where it controls the conduction of Q652 and Q653.

When the scene changes quickly from dark to bright, the voltage across R671 increases negatively causing Q652 and Q653 to conduct less. Less current will therefore flow through pins 11 and 12 of PRT T603, and the switching circuit's frequency which would try to increase under this condition will be maintained.

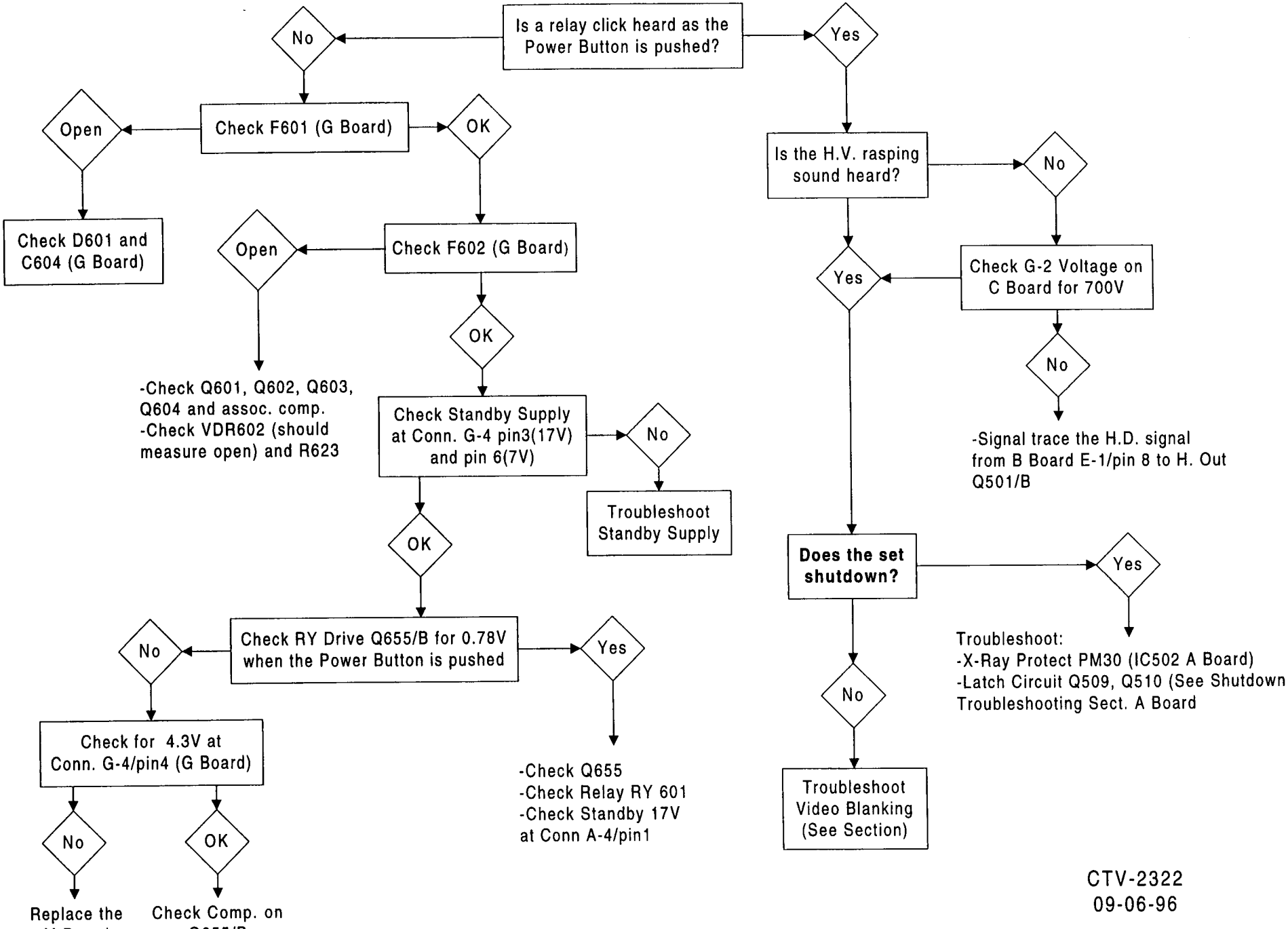
When the scene changes from bright to dark, the opposite action takes place. The current through T603 pins 11 and 12 increases, and inhibits the frequency from lowering. It tries to lower because there is less current demand.

NOTE!!: A quick way to test this entire circuit is to check the voltage at Q653/Collector. With the Picture level set at 50% and the Brightness level set at maximum, the voltage should be 0.47V. When the screen is darkest, the voltage is 2.7V. Use the cold ground for this measurement.



FN CURRENT REGULATION

FN Chassis
No Picture / No Power



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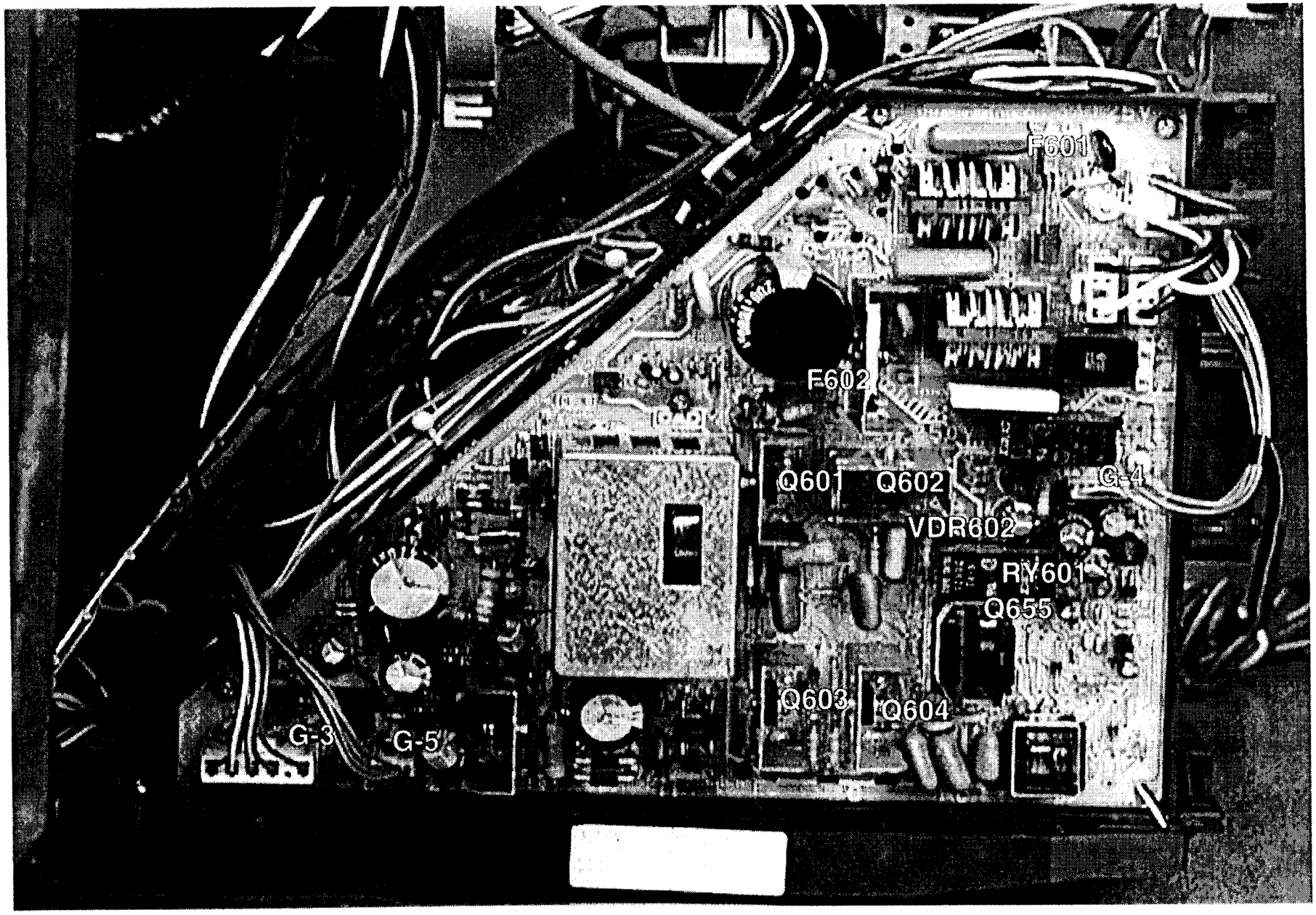


FN NO POWER G-BOARD

FN Pre Power ON Test

Before applying full AC power to the unit after the switching transistors and associated circuits have been replaced, it is recommended that a test to ensure the integrity of the circuit be performed.

Switcher Check

Plug the set into a variac/isolation transformer with an ammeter. **SET THE VARIAC TO 0V.**

- Connect a scope set to 0.5V/Div 2usec/Div to Q604/Base on the G Board. (Reference to hot ground on the heat sink).
- Slowly increase the AC voltage to 40V while observing the ammeter. The current should remain at 0 Amps (after capacitors initial charge), and a 1.25Vp-p signal at 140Khz should be on the scope. (See scope shot **"A"**).

Any variation indicates that a problem still exists. Check the following: C606 -- C609, the diodes on Q601 -- Q604/Base, and VDR602. There is also the possibility of a defective T603 or T605.

PRT T604 Power supplies check.

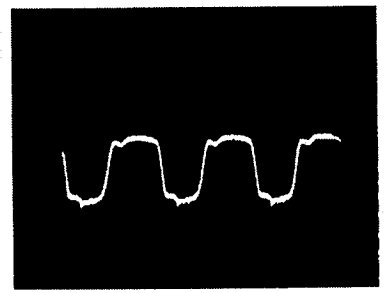
If the Switcher checks OK, turn the variac back to 0V, (scope still connected to Q904/Base), and perform the following tests which will indicate whether there is a problem in PRT T604 circuit, or the circuits it supplies.

- Unplug Connectors G-3 and G-5 from the G board. This removes the loads from the power supply.
- Short Relay Drive Q655 Collector to Emitter, (Ground) and connect an external 12V supply to R679. This should close Relay RY601 and switch in PRT T604.
- Slowly increase the AC voltage while observing the ammeter. The current may increase to about 0.75 amps as the capacitors in the circuits charge. It should then fall to almost 0 Amps. As the input AC is increased to 40VAC, a 1.7Vp-p waveform as shown in Scope Shot "**B**" should appear on the scope.

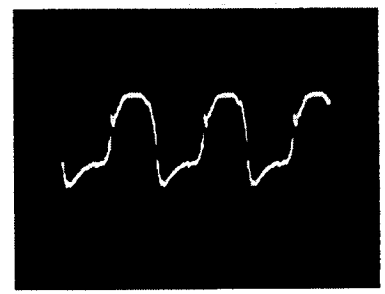
Any variation in the current drawn, or the waveform, indicates that there is a problem in PRT T604 and its associated circuits. Check D651 -- D654, D658 -- D661, and their associated circuits.

Next turn the variac down to 0V and reconnect Connectors G-3 and G-5 on the G Board. **Do not remove the external 12 V supply.**

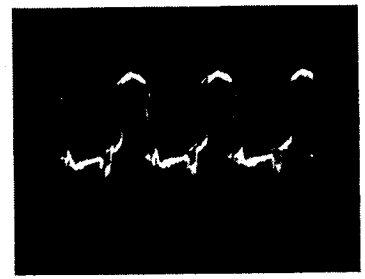
- Turn up the variac slowly to 40VAC. The waveform in "**B**" should appear, and the current should only increase to about 0.1Amp.
- If the waveform in "**C**" appears on the scope as the AC voltage reaches 25VAC, check the circuits on the 135V line, (Connector G-3/pin 6) and the Audio 24V supply off D658 - D661. (G-5/pins 3 and 4).
- If the waveform in "**D**" appears as the input AC voltage reaches 25VAC, troubleshoot circuits on the 24V line. (G-3/pin 3).



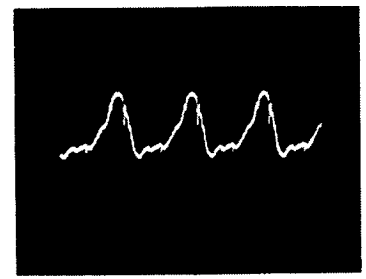
. Q604/Base (1.25Vp-p)



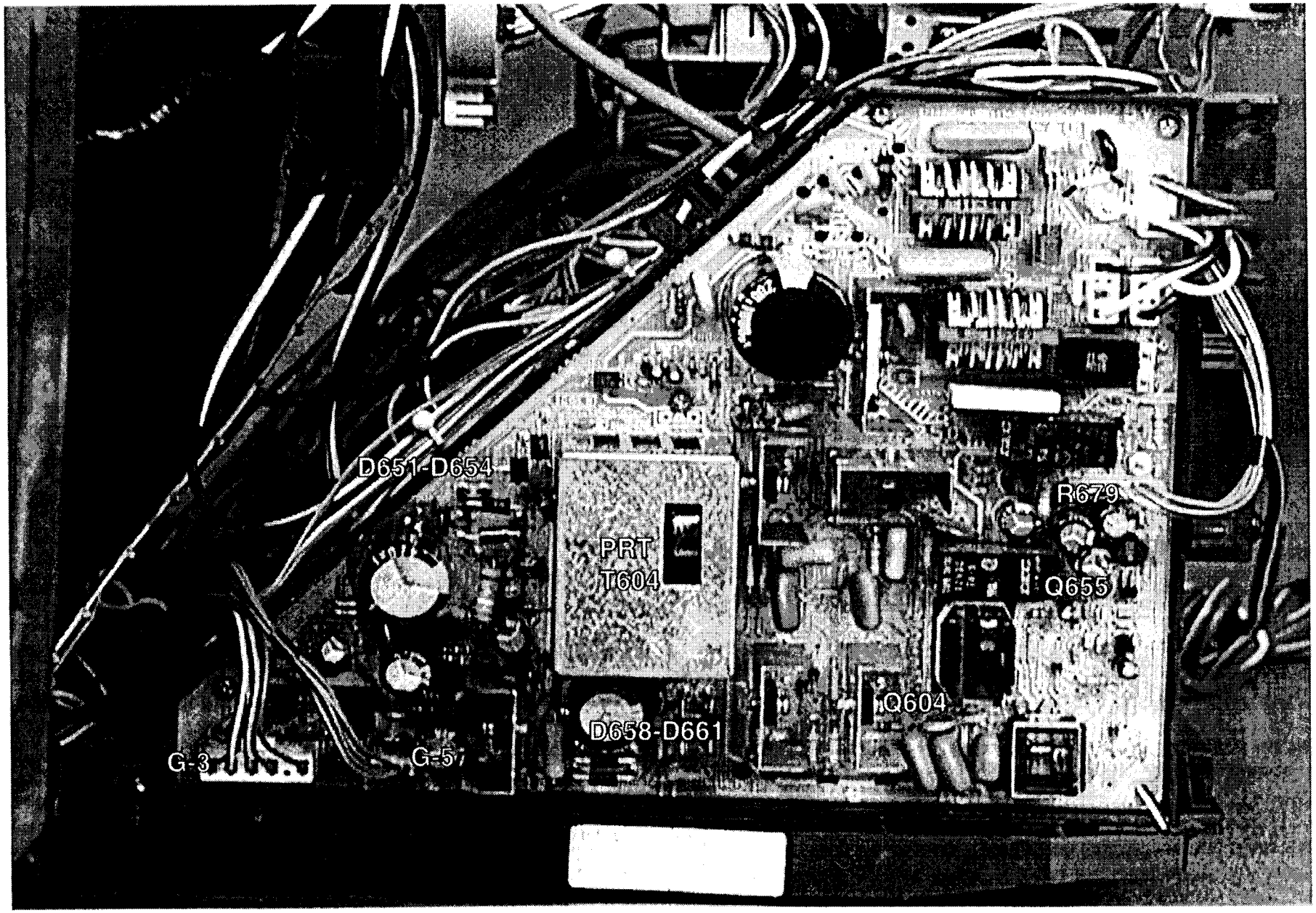
. Q601/Base 1.75Vp-p



Q604/Base 2Vp-p.



Q604/Base 1.75Vp-p



FN PRE POWER ON

FN High Voltage, and ABL Shutdown Circuits

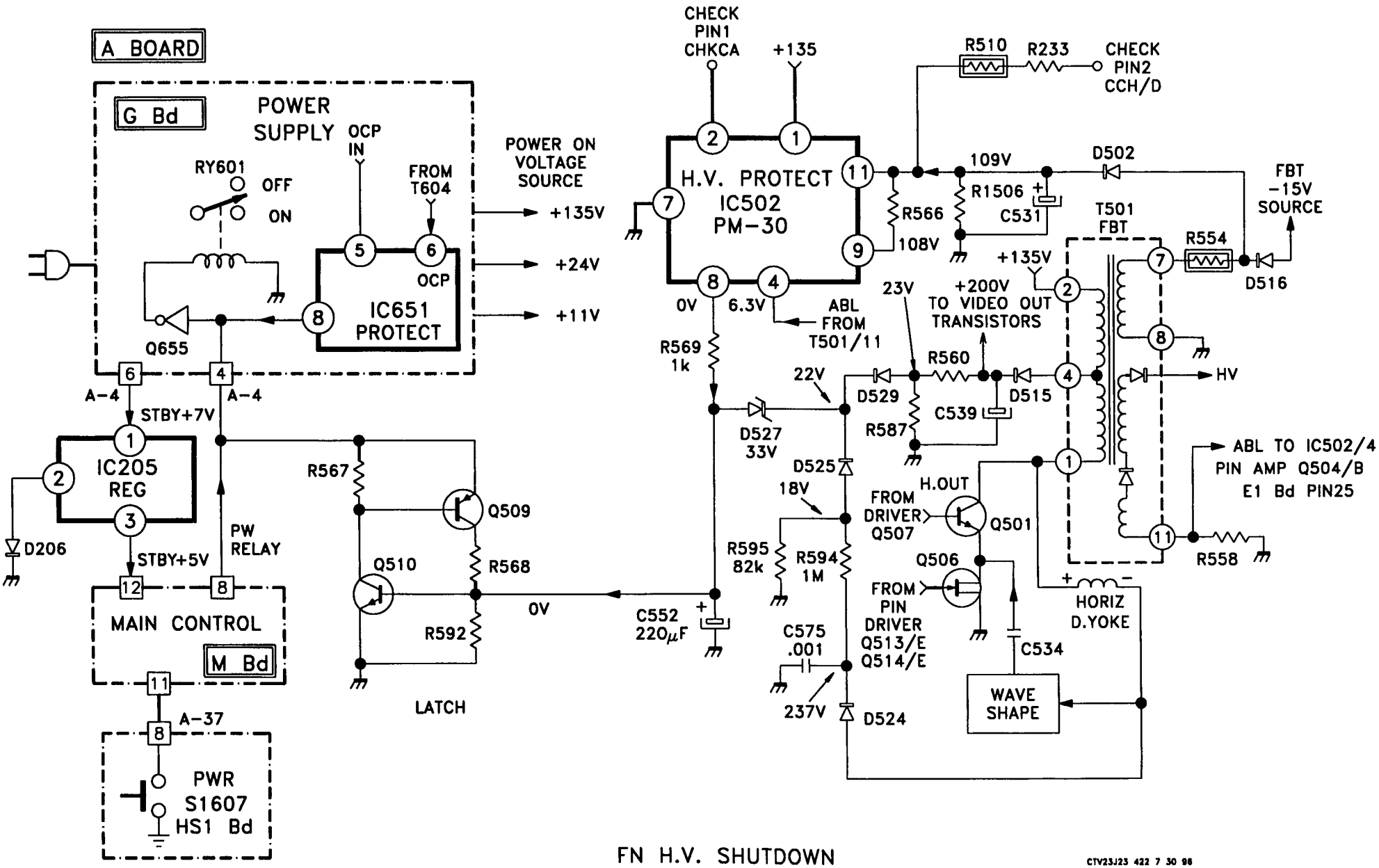
The diagram on the following page shows the circuits that monitor high voltage, ABL current, and over current conditions in the power supply.

Over current conditions in the power supply are monitored by IC651/pins 5 and 6 to bring about shutdown if a problem exists. This operation, together with the Degaussing Relay operation are discussed in the previous section. Here we will focus on high voltage, 135V, flyback and ABL shutdown operations.

IC502 monitors the flyback voltage at pin 11, and the ABL at pin 4. If the pulses from FBT T501/pin 7 rise sufficiently to cause D502 to produce 145V at IC502/pin 11, (indicating an abnormal high voltage increase), pin 8 will rise to 1V and trip the latch circuit of Q509 and Q510. The latch circuit places a LOW on Q655/Base and shuts the set down.

In addition an increase in CRT cathode current that causes 2ma through R558, or if the 135V line rises to 145V, IC502/pin 8 will rise to 1V and activate the latch circuit.

The 200V that powers the video output transistors, and the voltage developed across D524 as a result of HDY current are monitored by Zener diode D527. If any of these voltages rises high enough to place more than 33V on D527/Cathode, the latch is also activated and the set shuts down.



FN H.V. SHUTDOWN

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FN Troubleshooting Shutdown Problems

The previous two sections point out that the set can be shutdown by problems in the power supply and the high voltage circuits. Identifying which one is responsible can pose a problem, however, if the following procedures are followed, the defective circuit will be identified.

If the set shuts down after the screen becomes very bright, troubleshoot the C Board and CRT. The bright screen before shutdown indicates an ABL problem.

If the set shuts down after the high voltage rasping is heard, the problem is either in the power supply or the high voltage circuits.

Power Supply Shutdown Check (Refer to page 23).

To verify the operation of the power supply,

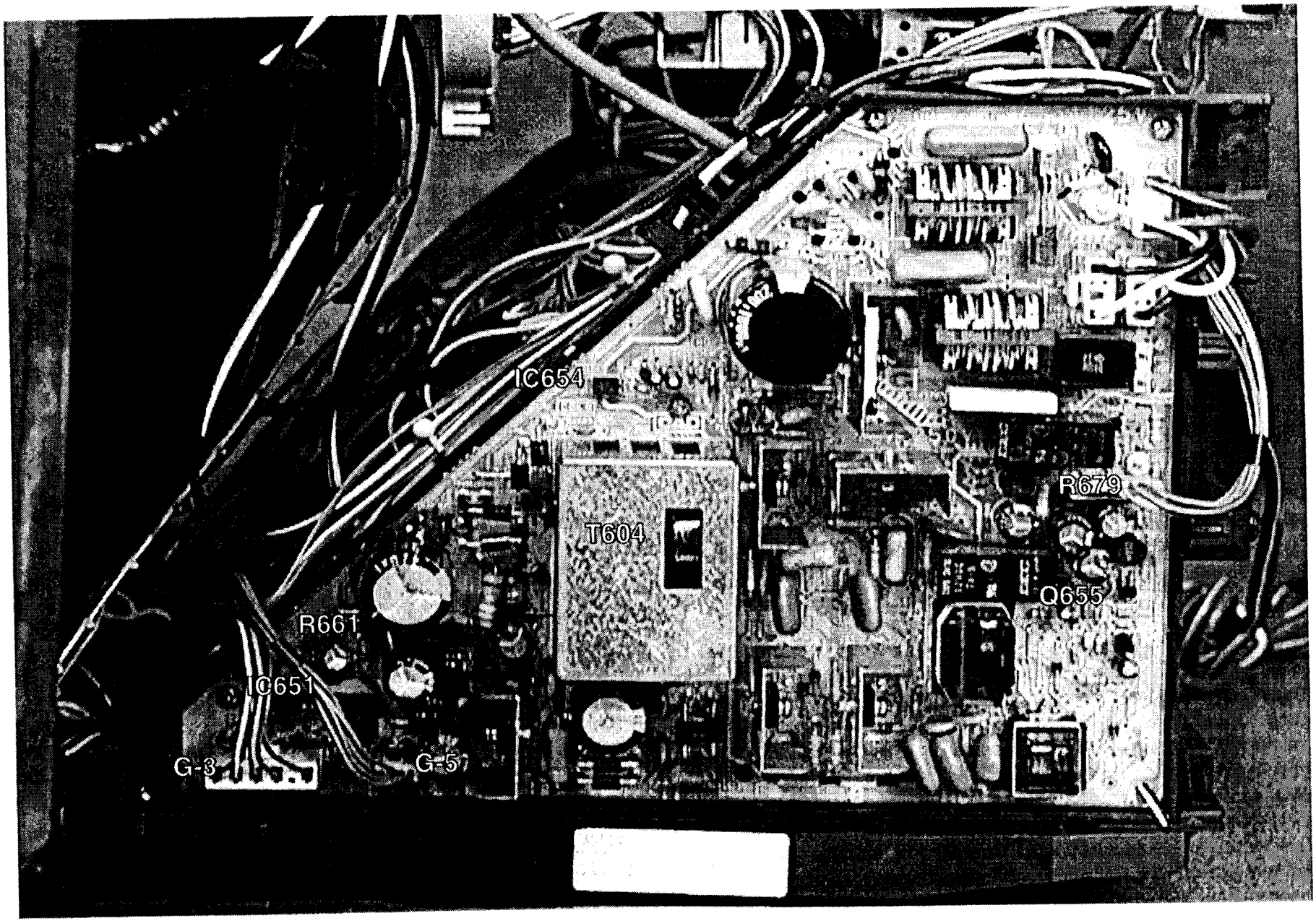
1. Plug the set into an isolation transformer/variac combination with the **variac set at 0V.**
2. Unplug Connectors G-3 and G-5 from the G board. This removes all loads from PRT T604.
3. Short Relay Drive Q655 Collector to Emitter. This completes the ground circuit for Relay RY601.
4. Connect an external 12V supply to R679. This should close Relay RY601 and switch in PRT T604.
5. Monitor the voltage at Opto-Coupler IC654/pin 4 as the AC voltage is slowly increased to 60VAC. At this point the voltage at IC654/pin 4 should be 0.13V -- 0.2V, and connector G-3/pin 1 should be 135V. Power Monitor IC651/pin 8 (Protect Out) should be 2.7V. These voltages indicate that the power supply is OK, so the problem is probably in the high voltage circuit.
6. If IC651/pin 8 falls to 0V as the 135V begins to rise, check the components on PRT T604/pins 14 and 15, including IC654. If these components are OK, replace T604.
7. If the 1.7V is found on IC654, but 0V at IC651/pin 8, return the variac to 0V and monitor the side of R661 closest to IC651 as the AC voltage is increased to 60VAC. It should rise to 0.4V. If this does not occur, replace IC651.
8. Reconnect Connectors G-3 and G-5.

High Voltage Shutdown Check (Refer to page 33).

First check Latch Q509 and Q510.

Next plug the set into an isolation transformer/variac combination with the **variac set at 0V.**

1. Slowly increase the AC input voltage to the point where the set shuts down. Make a note of the input AC voltage at which shutdown takes place.
2. Lower the input AC voltage back to 0V.
3. Increase the input AC voltage to a level just below the shutdown point.
4. Measure the 135V supply. If it is too high, troubleshoot the power supply regulating circuits. If it is normal, measure the voltages at the following points on the A Board:
   - **D527/Cathode.** This voltage should not rise above 22V. If it does check for abnormally increased voltages at D525/Anode. This will indicate whether there is a problem with D525 or the HDY.
   - **IC502/pin 11.** If this voltage is markedly above 109V, check D502 and associated circuits. Replace FBT T501.
5. If all voltages in Step 4 are OK, replace IC502.



FN TROUBLESHOOTING SHUTDOWN

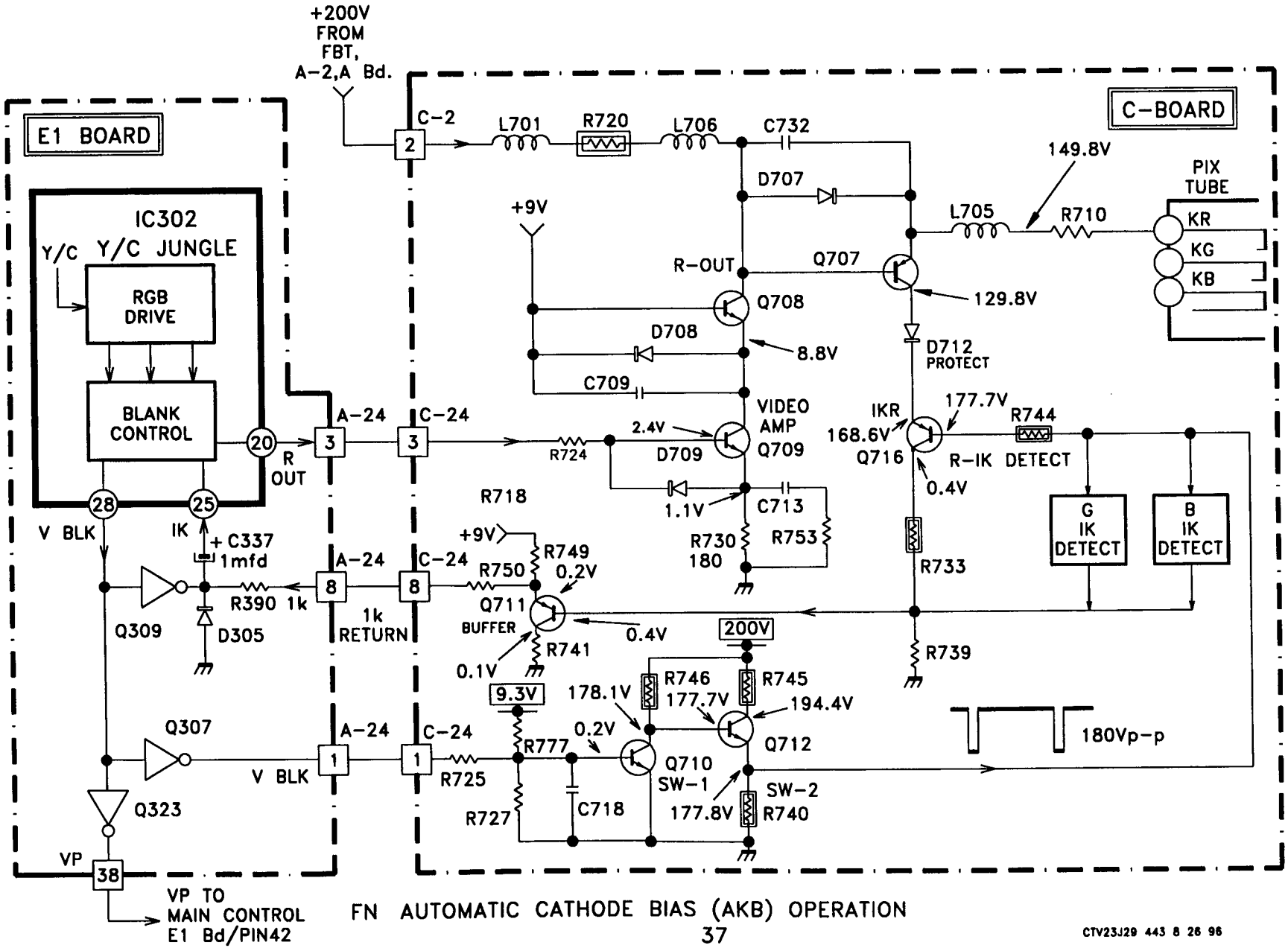
FN AKB/IK Operation

The FN chassis uses an Automatic Cathode Bias (AKB), or IK system to compensate for CRT tolerances, and improve color temperature drift problems which occur during the life of the CRT. The cathode current (IK) of each gun is monitored, and the DC bias to each gun to constantly adjusted to maintain proper grey scale. The Red, Blue and Green AKB circuits operate in a similar manner, therefore, only the Red AKB circuit will be discussed.

The AKB timing generator inside IC201 receives horizontal and vertical pulses and makes AKB reference pulses that are output to the red CRT cathode. The loss of any of these pulses results in a blanked raster. The reference pulses are generated within the vertical blanking period occupying three horizontal lines just prior to the active scan period.

The Red AKB reference pulses are applied to the cathode of the red picture tube gun via video amp Q709 and video drivers Q708, Q707. These pulses set up a reference point used for proper measurement of cathode current. These pulses allow the picture tube to conduct heavily at turn ON, resulting in increased cathode current. As the tube heats up and conducts more, the amlitude of the pulses are lowered to about 1Vp-p. However their amplitude vary slightly continually to maintain cathode current. Video driver Q707 couples the IK signal through Q716 and across R739 to develop a sense or feedback voltage to Y/C Jungle IC302/pin 25. This voltage charges an external capacitor (not shown) and is compared to interval voltage reference. The difference causes a change in voltage level which is used to dynamically offset the dc bias applied to the red picture tube cathode. This will control the bias and color temperature of the picture tube.

Q309 turns ON during the picture scan interval, grounding the return signal from the IK detectors when the picture is displayed. Q307, Q710 and Q712 couple vertical blanking pulses to the Red, Green and Blue IK Detectors so the detectors only work during the vertical blanking period.



FN AUTOMATIC CATHODE BIAS (AKB) OPERATION

CTV23J29 443 8 26 96

FN Troubleshooting Video Blanking

If no picture appears within 6 seconds after power ON, the picture is blanked. Blanking of the RGB drive signal to the CRT occurs within the Y/C jungle IC302, preventing the video signals from leaving at pins 20, 22 & 24.

Blanking is usually caused by a loss of one or more of the following inputs:

1. Loss of any one of the three IK return pulses at C-24/pin 8 (C Board).
2. Loss of vertical pulses from the sweep IC1501 at E1/pin 3.
3. Loss of voltage at the ABL current sensing line E1/pin 25, 26.
4. Loss of serial data (unblanking command) to IC302/pin 48.

Loss of cathode current pulses (IK)

Three IK pulses representing each cathodes current draw, must be returned to the Y/C jungle IC302/pin 25 to unblank the RGB drive to the CRT.

A quick test to override blanking is as follows:

a) Momentarily touch a 560 -- IK Ohm resistor between connector C-24/pin 8 and pin 6 on the C Board.

b) Just as the resistor is removed, IC302 will unblank for an instant and a picture should appear. Make sure the picture colors are normal.

- If they are, check for an opened IK Buffer Q711.
- If a color is missing check the IK Detect circuit of that color on the C Board and the respective RGB Buffer on the E1 Board.
- If a picture is not produced, check for a shorted IK Buffer Q711. Verify voltages on the C Board and replace the E1 Board.

Loss of vertical pulses from the V. Output IC1501

The presence of vertical pulses from IC1501/pin 3 keeps the voltage at E1 board/pin 3 at 0V. This keeps IC302/pin 27 HIGH and the set unblanked.

A loss of vertical deflection will cause the voltage at E1 Board/pin 3 to rise to 1V or above, thereby blanking the picture.

Loss of voltage at the ABL input

The Y/C jungle IC302/pin 26 ABL input monitors the CRT current to prevent excessive brightness. With normal brightness the voltage across R558 is about 1.5V. As the brightness of a picture increases, the voltage across R558 decreases. This reduces the voltage fed back to IC302/pin 26 and controls the brightness level.

Blanking is activated when the voltage across R558 falls to 1V.

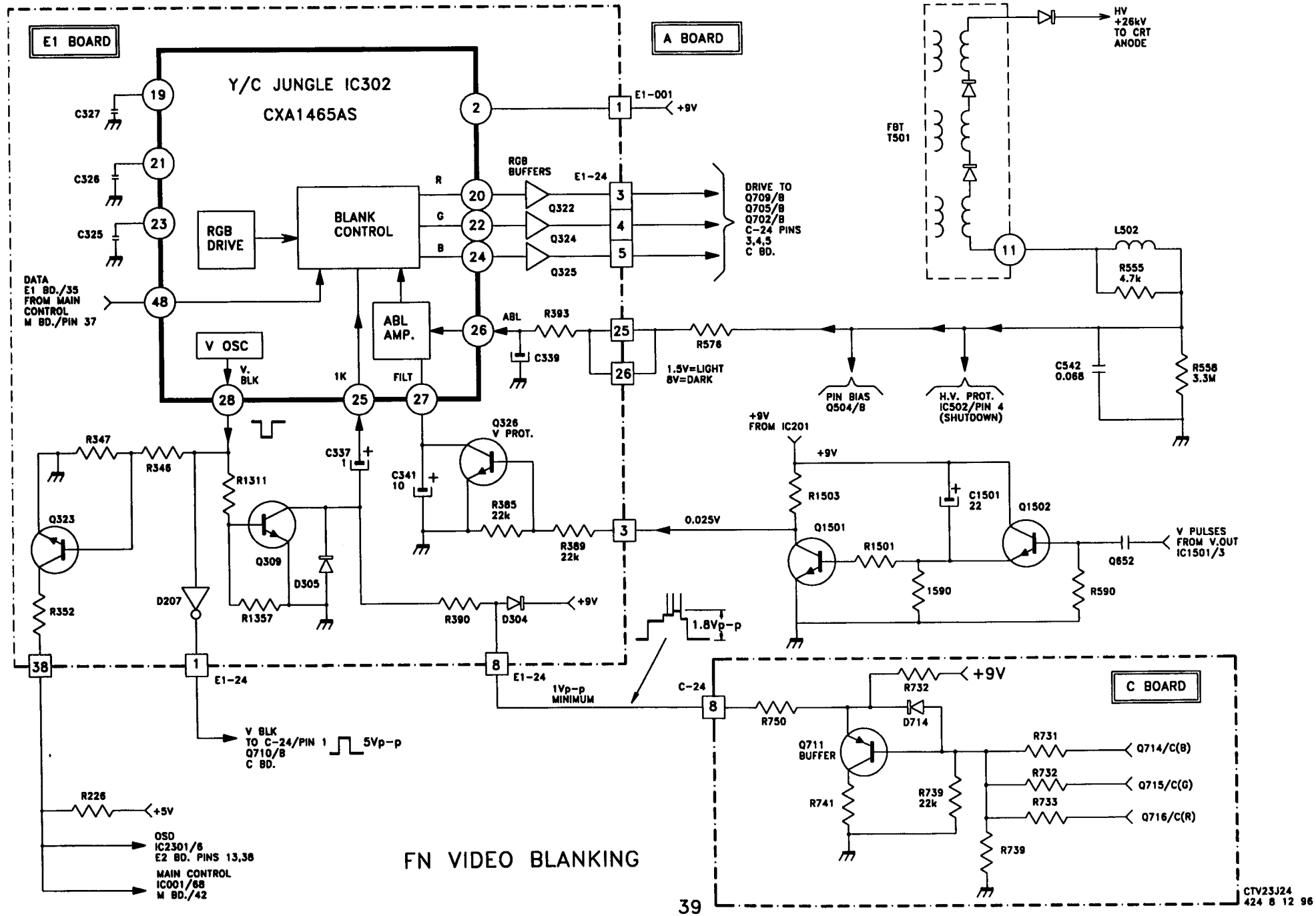
If the picture becomes excessively bright for any reason, (shorted CRT, defective video drive circuits) the increased current through R558 produces a negative voltage across it. This activates high voltage shutdown via H.V. Protect IC502/pin 4

The normal ABL voltage range at Board E-1/pins 25 and 26 is:

+1.5Vdc = normal bright scene.
+6.8Vdc = dark scene

Loss of Serial Data

After power ON, 5Vp-p V. Blanking pulses are output from Y/C Jungle IC302/pin 28. (Board E-1/pin38). These pulses are used to sync the character generators in the Window OSD IC2301 and Main Control IC001. In addition they are used to sync the serial data and clock pulses that are output from Main Control IC001. Without the V. Blanking pulses no serial data signal is sent to Y/C Jungle IC302 to release blanking. It is recommended that a check for 4.5Vp-p serial data at the E1 Board/pin 35 be always made when there is a video blanking problem.



FN VIDEO BLANKING

FN Field Problem Reports

1. Problem: High Voltage Shutdown. The unit would immediately go into high voltage shutdown.

Solution: The problem was caused by a shorted Pin Out FET Q506.

2. Problem: No raster. No vertical deflection.

Solution: Shorted Vertical IC1501. This caused the 15V line to fail. R553 off FBT/pin 9 also opened.

3. Problem: Shimmy in picture at line voltage.

Solution: Replace C658 in the current regulator circuit. This cap was open and caused the power supply to react too quickly to minor load variations.