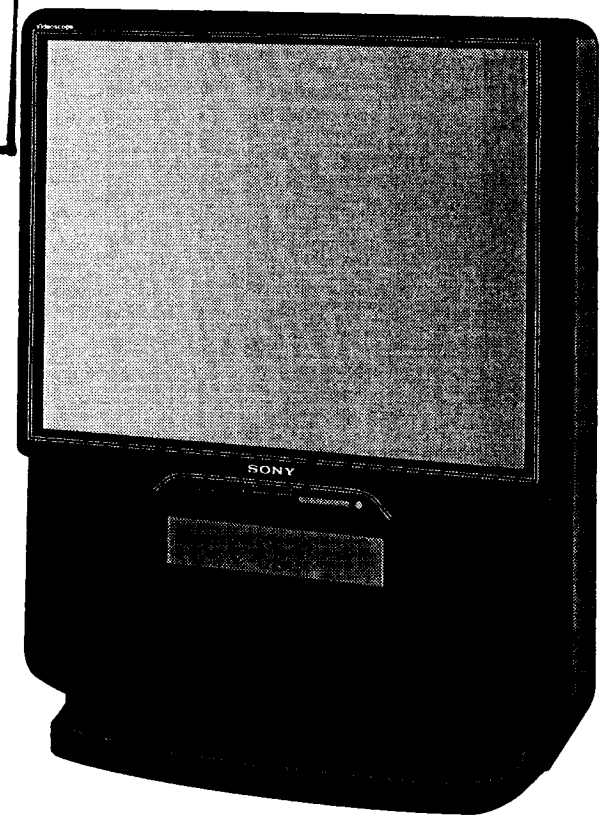
SONY ®

Training Manual

MASTER FILE
SERVICE

Projection TV Troubleshooting



Chassis: RA Chassis (KP-41T15/-46S15)
AP Chassis (KP-41EXR96)
KPR-46CX10

Circuit Troubleshooting/Analysis

Course: TVP-06 R2

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Introduction

For some time now servicers have been asking for a Projection TV course that presented methods of isolating and troubleshooting circuits that are sometimes difficult to repair. This course attempts to address this request by outlining troubleshooting strategies for "Dead Set", "Power Shutdown", "High Voltage Shutdown" and "Video Blanking" problems in sample RA, AP and KPR-46CX10 Chassis.

As far as is possible, circuit explanations have been kept to a minimum. Having an understanding of how the circuit works, helps in formulating a troubleshooting strategy. Flowcharts are used to guide the servicer to the defective circuit, and sometimes to the most likely defective component. A method of verifying that the power supply is OK after it is repaired is also presented.

The ideas and methods presented here are by no means the only ones that work. Some servicers may have already developed systems that work well for them, but by investigating the ones presented here, together with the ones that may be discussed by other servicers in the classroom, improvements to various methods may be made, and other new ideas may be generated.

Dead Set and Shutdown Problems

A television is "Dead" if it does not respond when the power switch is pushed. In shutdown, on the other hand, it powers up and then shuts OFF. These symptoms should lead the servicer first to the power supply.

The power supply is composed of three sections:

1. **The Standby Power Supply** which powers the main Microprocessor, the Power Relay and the SIRCS receiver, before the set is switched ON.
2. **The Main Power Supply** which provides power to most of the other circuits after the set is switched ON.
3. **The Over Voltage, Low Voltage and Over Current Protection circuits.** These circuits disable the main power supply when there is an over current or over voltage condition in selected power sources. The Standby Power supply is usually unaffected by shutdown.

Because the symptom produced by a dead set and a set in shutdown appears to be the same, a servicer must be able to differentiate between them. We would look at the power supply and shutdown/protection circuits in the RA chassis, AP chassis and KPR46CX10 chassis.

Dead Set.

The primary cause of a dead set is a defective standby power supply, or a defective main power supply. The main power supply can be disabled by defects in circuits it powers that do not have over current protection. **Therefore,** unprotected circuits on the secondary windings of the Power Input Transformers should be investigated in addition to the suggestions of the following flow chart.

Shutdown/Protection.

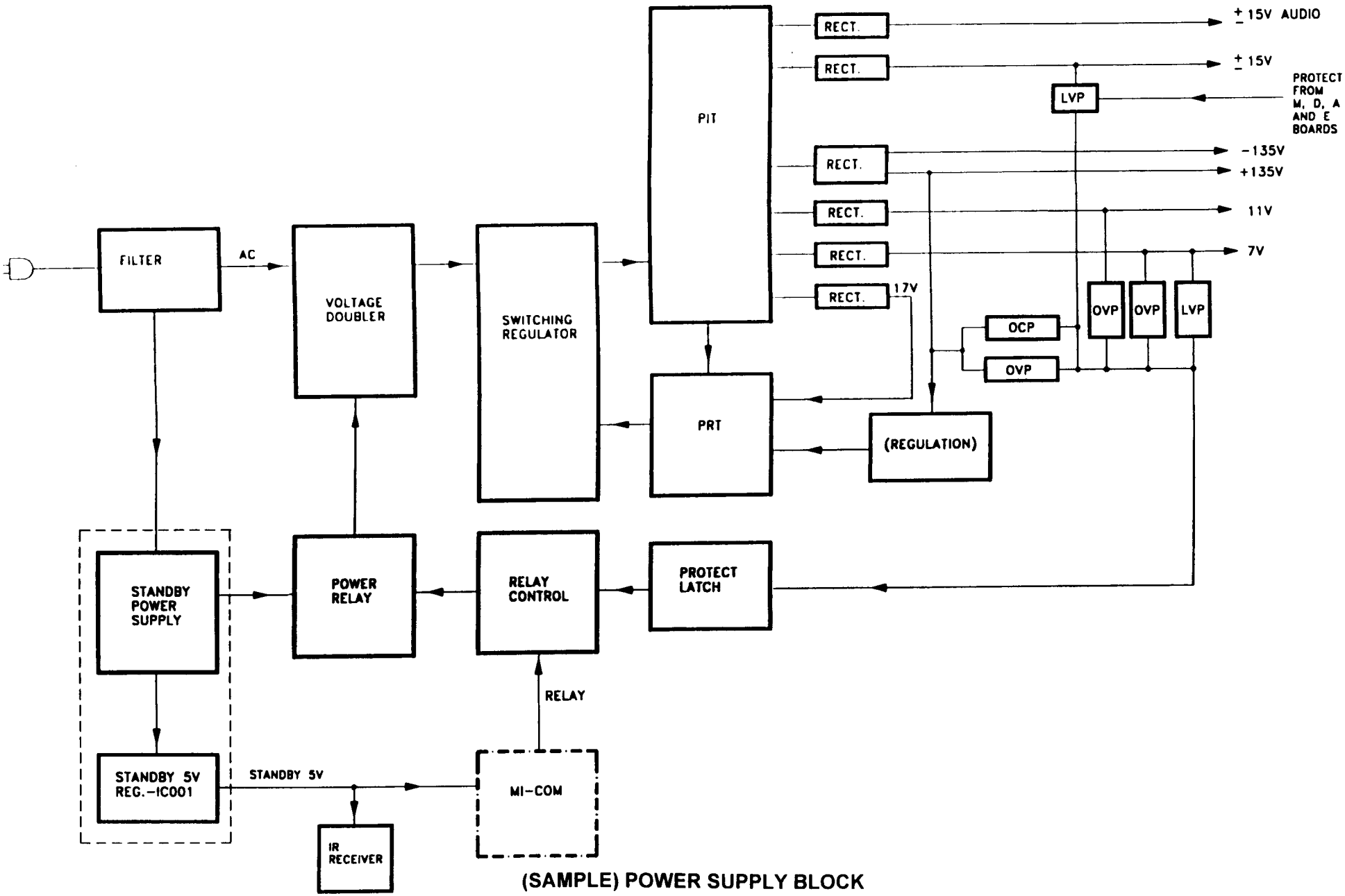
In power shutdown, the "Timer/Standby" Led in the RA and AP chassis blinks momentarily after the "Power" button is pushed. If shutdown is caused by a defective protect circuit, it flashes continually. In the KPR-46CX10 chassis, the 'SLEEP' Led remains ON.

The rasping sound of the high voltage turning ON, then OFF may also be heard as the power relay and degaussing relay engage and disengage. Multiple clicks are heard.

Shutdown may be caused by any of the following conditions:

1. An over voltage (open) or overcurrent (short) condition on any monitored voltage supply line.
2. A defective overvoltage or overcurrent sensing circuit.

Always check first for an over current condition whenever there is a shutdown problem.



(SAMPLE) POWER SUPPLY BLOCK

Troubleshooting an Overcurrent Condition

1. Plug the unit into an isolation transformer and variac, preferably one with a power switch. Switch OFF.
2. Connect the positive terminal of a voltmeter to the 135V line
3. Switch the isolation transformer ON. Switch the set ON. The 135V line should rise momentarily to 135V, then fall off as the power relay is disabled.
4. Repeat the above test for the other supplies on the board.
5. **Overcurrent** should be suspected if the voltage line tested, does not rise momentarily. Ensure that there is continuity between the supply source and the test point. (Connector). If there is continuity, check for a short circuit in the circuits directly connected to the paticular supply line.

If each voltage line rises momentarily to its normal voltage before falling off, proceed to the shutdown troubleshooting flowchart for the specific chassis.

If the voltages rise to only about 50% of their normal level before falling off, troubleshoot the following shutdown/protect circuits on the G board, one may be shorted.

In the **RA-1 Chassis** check:

- Q651, Q6661, Q663, Q660, Q658, Q659, and Q654. The operational state of these transistors is given in the RA-1 Chassis "Shutdown Flowchart".

In the **AP Chassis** check:

- Q618, Q621 and Q623. They should all be OFF.

In the **46CX10** Chassis check:

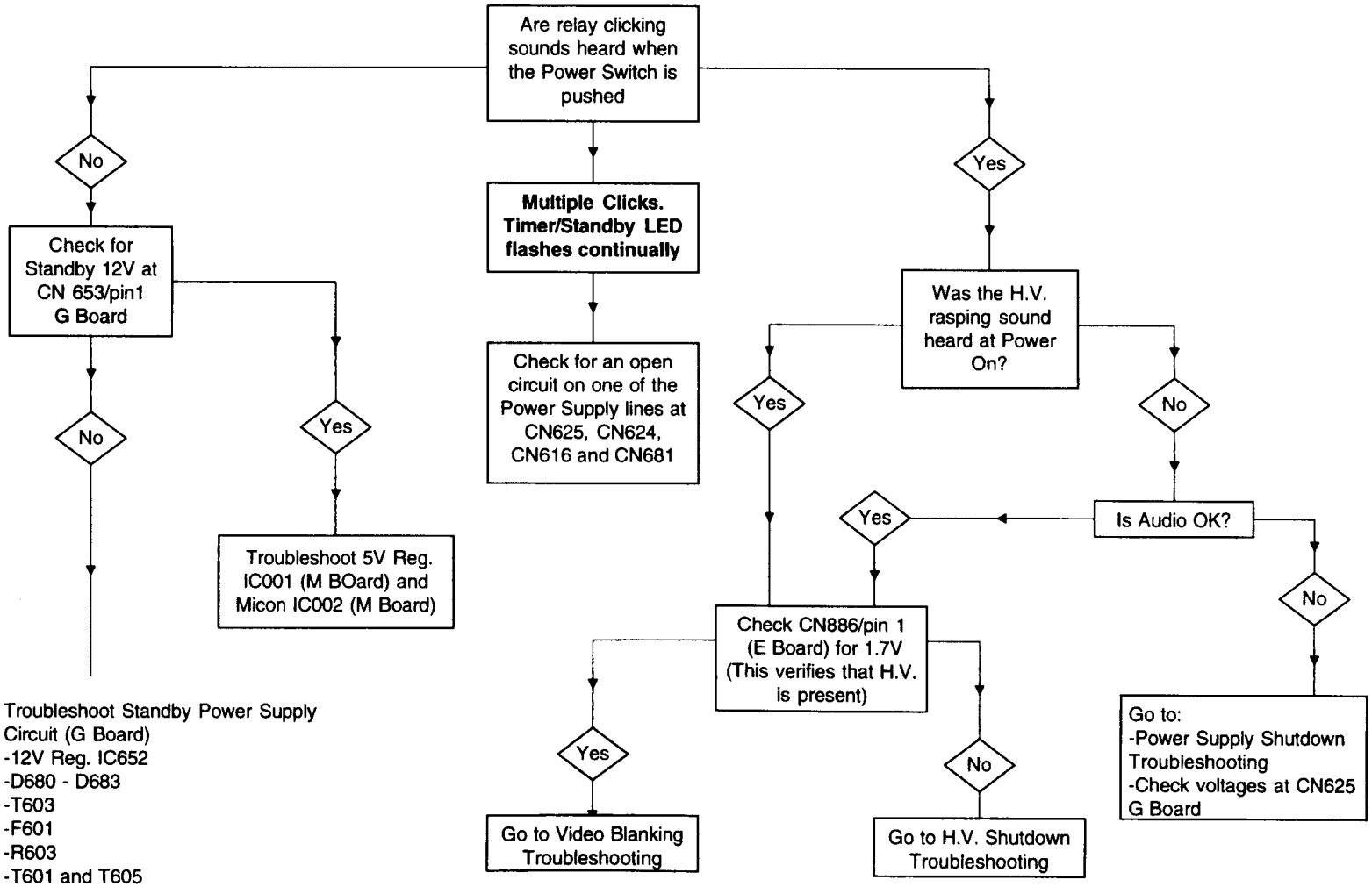
- IC601 and IC602 pin 1. If LOW , one of them has activated shutdown/protect by disabling Relay Drive Transistor Q651 on the A board.

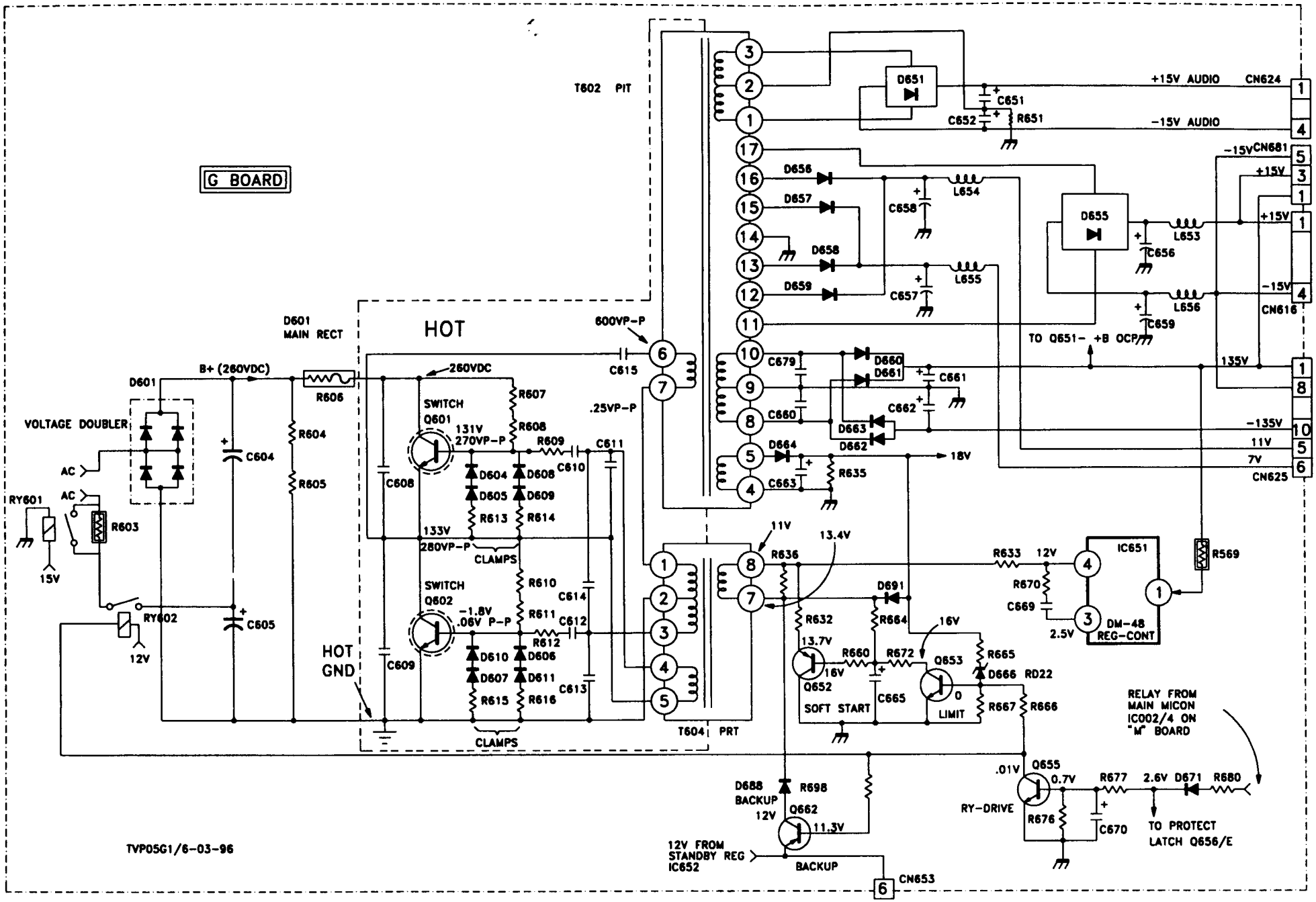
Troubleshooting RA Chassis Dead Set (No picture)

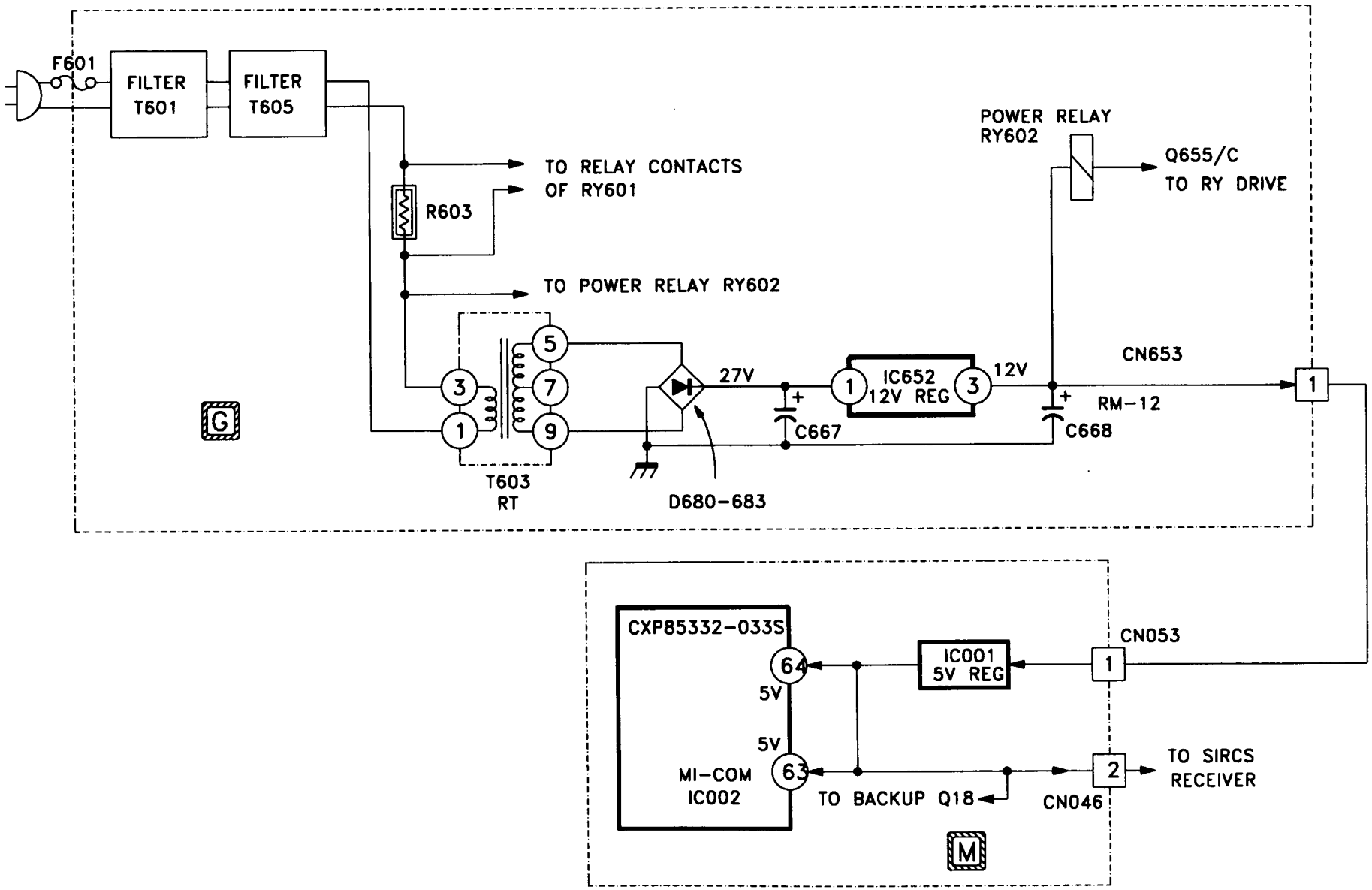
The following RA Chassis No Picture flowchart will help isolate the circuit or components responsible for no picture. If the Timer/Standby LED on the front panel blinks continually, the set is either in power supply shutdown, high voltage shutdown or video blanking. Which one it is, is easily determined by observing whether there is sound, and checking CN886/pin 1 on the E Board for 1.75V.

- **In Power Supply shutdown**, none of the supply voltages on CN625 on the G Board will be present.
- **In High Voltage shutdown**, Horizontal Drive Buffer Q810/Base on the E Board will be 0V. All the power supply voltages at CN625 will be present, and audio will be present.
- **In Video Blanking**, audio will be present and Horizontal Drive Buffer Q810/Base (E Board) will be 2V.

No Picture - RA Chassis




G BOARD
T602 PIT
D601
MAIN RECT
HOT
600VP-P
C615
B+ (260VDC)
260VDC
R606
D601
VOLTAGE DOUBLER
AC
AC
RY601
15V
R603
C604
R604
R605
C605
RY602
12V
SWITCH
Q601
131V
270VP-P
R607
R608
R609
C610
C611
.25VP-P
C608
D604
D605
D608
D609
R613
R614
133V
280VP-P
CLAMPS
SWITCH
Q602
-1.8V
.06VP-P
R610
R611
R612
C614
C612
C613
C609
D610
D607
D606
D611
R615
R616
HOT
GND
CLAMPS
T604 PRT
D651
C651
C652
R651
+15V AUDIO
CN624
-15V AUDIO
D656
D657
D658
D659
L654
C658
L655
C657
D655
L653
C656
L656
C659
-15V
CN681
+15V
+15V
-15V
CN616
TO Q651- +B OCP
C679
D660
D661
C661
C660
C662
D663
D662
135V
-135V
11V
7V
CN625
D664
C663
R635
18V
11V
13.4V
R636
D691
R632
R664
13.7V
16V
Q652
SOFT START
R660
R672
C665
Q653
0
LIMIT
R665
D666 RD22
R667
R666
R633 12V
R670
C669
2.5V
IC651
DM-48
REG-CONT
R569
RELAY FROM
MAIN MICON
IC002/4 ON
"M" BOARD
.01V
Q655
0.7V
R677
2.6V D671
R680
RY-DRIVE
R676
C670
TO PROTECT
LATCH Q656/E
D688
BACKUP
12V
R698
Q662
11.3V
12V FROM
STANDBY REG
IC652
BACKUP
CN653
TVP05G1/6-03-96



RA CHASSIS STANDBY POWER SUPPLY

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Pre Power ON Test

After repairing a dead set, especially when the converter transistors were shorted, do the following test before full AC power is applied to the set.

Plug the set into a variac/isolation transformer SET TO 0V.

1. Unplug CN624, CN625, CN616, CN653 and CN681 from the G Board.

2. Use an alligator clip jumper and connect any side of R603 to JW629 (left of R603) on the G Board. See diagram. **(Check the variac. Make sure it is SET TO 0V)**

3. Switch ON the variac and **gradually increase the voltage to 40VAC MAXIMUM**, while monitoring the ampmeter of the variac. There should be no current. If the current increases, there is still a problem on the G Board. Check for open or shorted capacitors and diodes in the converter circuit.

   The reduced voltage readings of the various supplies at CN625 and CN624 (G Board) with 40VAC input should be as follows:

Normal Voltage	135V	15V	11V	7V	-135V	Audio 15V	Audio -15
Reduced Voltage	83.5V	8.9V	6.9V	4.6V	-98V	11V	-11.7V

If all the voltages are OK, turn the variac down to 0V and switch it OFF.

Use a 100 Ohm resistor to bleed off the -15V line at CN625/pin8 to ground. If this is not done, F1602 on the D Board will open.

- Reconnect the connectors and remove the alligator clip jumper.

Next, connect an external 12V supply to Standby Reg. IC652/pin 3. You should hear the power relay click as it closes.

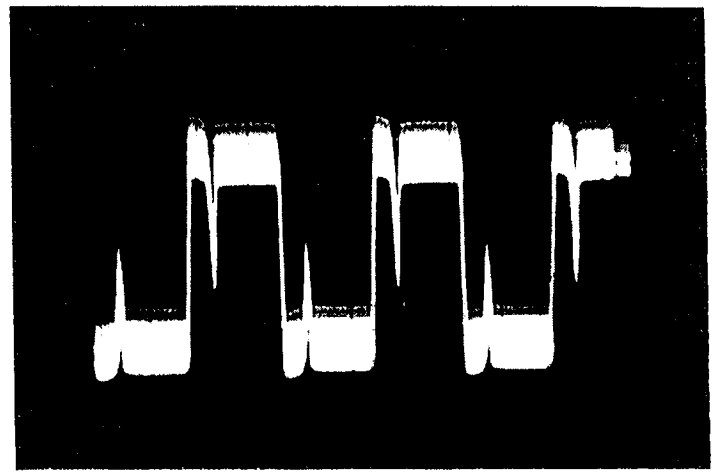
If Relay RY602 does not close, check Relay RY602, Relay Drive Q655, (G Board), 5V Regulator IC001 and Mi Com IC002 on the M Board.

Set up a scope as follows: 5usec/Div. 20V/Div., and connect it to Q602/C (G Board).

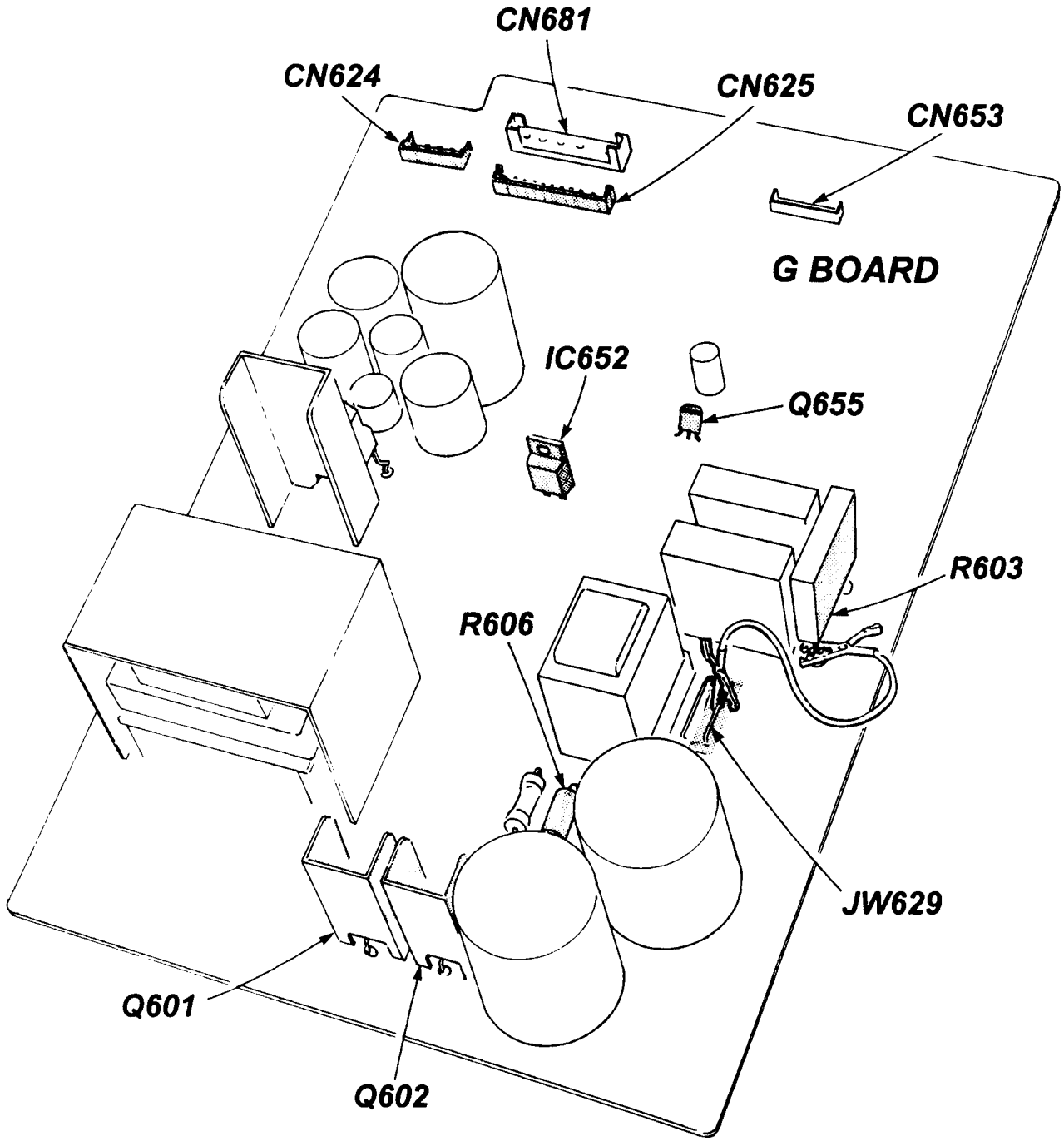
Switch the variac ON and slowly increase the AC voltage to 30VAC. The current drawn should not exceed 0.75Amps, and the waveform on the scope should be 80Vp-p as follows. Any difference indicates a problem in one of the circuits that the supply powers.

If the waveform looks normal, but the current drawn is excessive,

- Check for a short on the Audio +15 and -15V supply lines on CN624.
- Check Audio Amp IC230 on the A Board.



Q602/Collector. (80Vp-p)



RA CHASSIS - G BOARD

RA Chassis Protection Circuits

Most of the supply voltages from the Power Input Transformer T602, have a protection circuit. Some are located on the G board, and the others on the M, D, A and E boards. The following is a summary of the protect circuits operations on the G board:

Protection on the G Board.

Shutdown occurs whenever an over current or overvoltage condition in the set activates one of the protect circuits. The protect circuit then triggers shutdown by placing a HIGH at Q657. This turns ON the latch circuit that turn Relay Drive Q655 OFF.

135V OVP is provided by D673, that conducts when the 135V line rises enough to increase the voltage drop across R662 to above 18V.

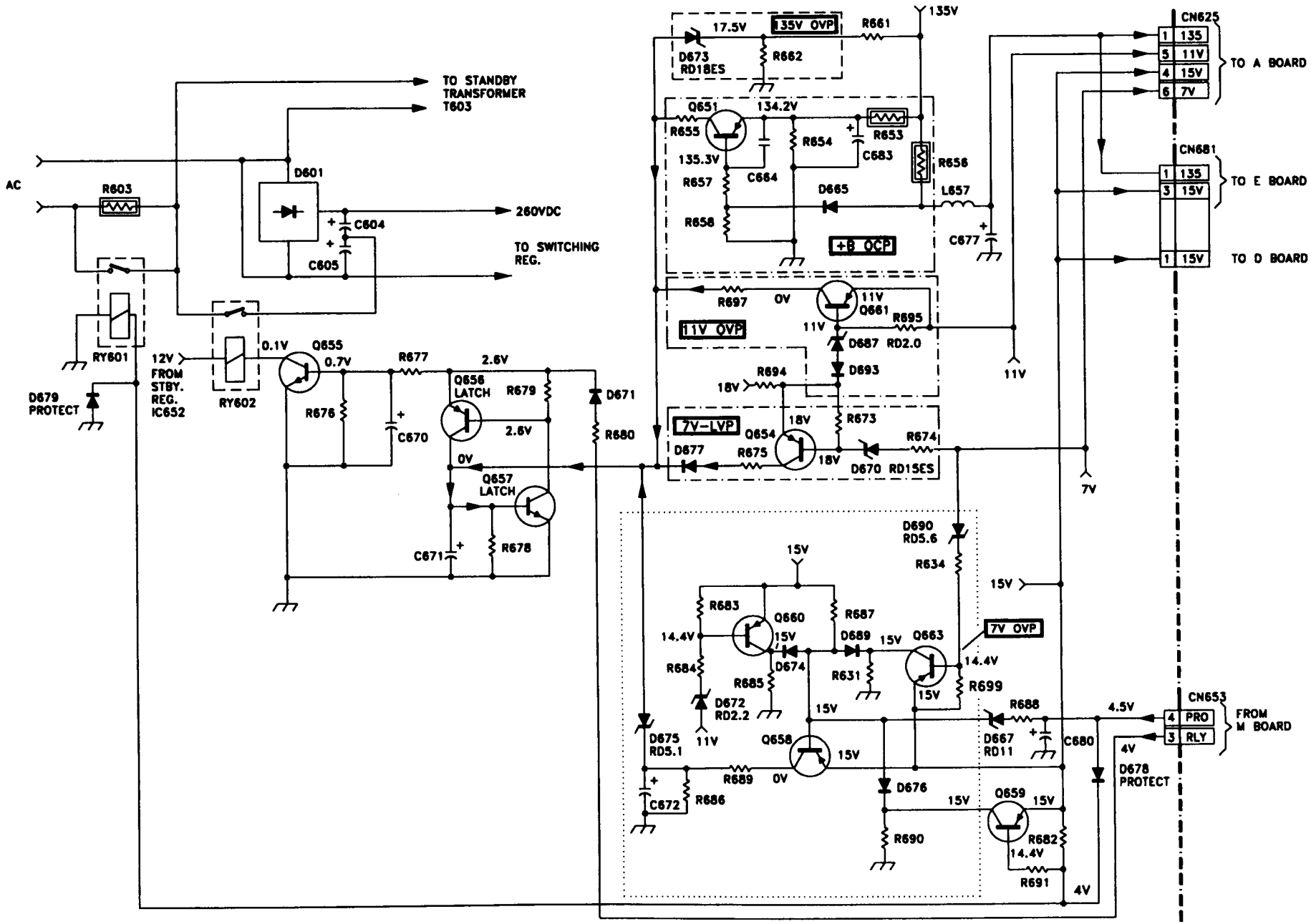
135V OCP is provided by Q651, R656, D665 and associated components. Excessive load on the 135V line increases the voltage drop across R656 and turns Q651 ON.

15V LVP for the A, D and E boards is provided by Q660, Q658, D675, D674, D672 and associated components. If the 15V supply falls to 14V, Q658 and Q650 change state causing D675 to zener and activate the latch.

11V OVP is provided by Q661, D687, and associated components. If the 11V supply increases, D687 zeners and turns Q661 ON to activate the latch circuit.

7V OVP is provided by Q663, Q658, D690 and associated components. If the 7V line increases, D690 which is normally operating near its zener point, shuts OFF. This shuts OFF Q663. Q658 turns ON and develops a voltage across R686 to zener D675. This activates the latch circuit.

7V LCP is provided by Q654, D670 and associated components. Normally D670 is OFF, thereby keeping Q654 OFF. A severe drop or loss of the 7V will cause D670 to conduct and turn ON Q654. This will turn On the latch circuit.



RA CHASSIS - PROTECTION 1

Protection on the M,D, A and E Boards

The protect circuits on the M, D, A and E boards protect the following voltage regulators from low voltage (over current) conditions, and in some cases over voltage conditions.

Whenever any of these protect circuits is activated, the Protect line at CN053/pin 4 (M Board) goes LOW. This LOW is coupled to the G Board. There, it activates the Low Voltage Protect Circuit of Q658 and D675, which shuts down the unit.

M Board: 5V Standby Regulator. (Overcurrent protection). This voltage is used primarily for maintaining power to System Control IC002 and the sircs remote receiver. Overcurrent protection is provided by D001 which is reversed biased under normal operating conditions. An overcurrent problem will lower the 5V line and forward bias D001. This LOW is coupled to the protect line that activates Q658 and D675 to bring about shutdown.

D Board: 12V, -12V, 5V and -5V Regulators. (Overcurrent and over voltage protection). The D Board contains the convergence and vertical deflection circuits. It is powered by the 15V and -15V derived voltages. The 15V is stepped down to 12V by Regulator IC1808; and to 5V by Regulator IC1804. Similarly, -12V is produced by Regulator IC1807; and -5V by Regulator IC1803.

Excessive current on the 12V line will lower the voltage and forward bias D1825. The Protect Line lowers and activates shut down.

A voltage increase on the 12V line will turn ON Q1805. This will lower the Protect Line and activate shut down.

A low voltage on the -12V will turn ON Q1805. This lowers the Protect Line and activate shut down.

Similarly, the 5V and -5V supplies are protected by D1812, 1814 and Q1803.

A Board: 12V, 9V and 5V Regulators. (Overcurrent protection). Speaker Protection. This board houses the tuner, audio and horizontal deflection circuits. Most of the power on this board is provided by the 12V, 9V and 5V Regulators. Only overcurrent protection is provided for these regulators.

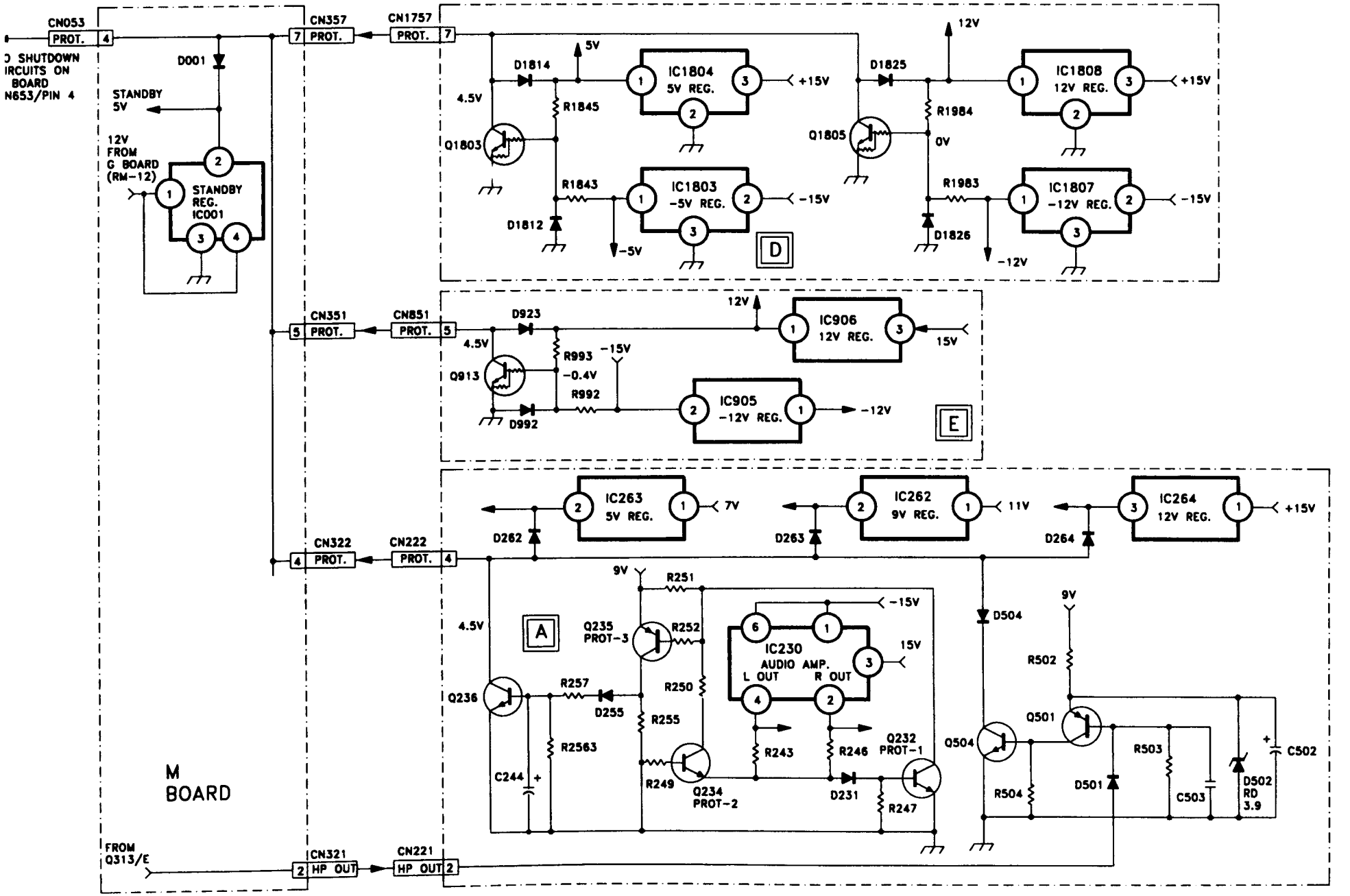
Overcurrent protection for the 12V Regulator is provided by D264. For the 9V Regulator it is provided by D263, and for the 5V Regulator it is provided by D262. Should any of these voltages drop to 3.9V, the respective diode will conduct and lower the Protect line activating shut down.

Protection is also provided for the speakers, on this board. Audio Amp IC230/pins 2 and 4 drive the speakers. Should a malfunction in IC203 create a positive voltage on either output line, D231 will forward bias and turn ON Q232. This turns latch Q235 and Q234 ON; Q236 turns ON and activates shutdown via the Protect line. A negative voltage on either output line will turn Q234 ON. This will turn ON Q235 and Q236 and activate shutdown.

The final protection circuit on this board is the Horizontal Pulse Detection circuit. A 4Vp-p signal is developed on the M board when the horizontal circuit is operating. This is fed to Q501/.B. Q501/E is held at 3.9V by Zener Diode D502. This keeps Q501 and Q504 OFF. A loss of H Pulses will turn Q501 and Q504 ON and activate shutdown.

E Board: 12V and -12V Regulators. (Overcurrent and over voltage protection) This board has the High Voltage, Dynamic Focus and HV protection circuits. The voltage developed from 12V Regulator IC906 is monitored for low voltage by D923. Over voltage protection is provided by Q913. Normally this transistor is OFF, but should the 12V line increase, Q913 will turn ON and activate shut down.

The -15V line from the G Board is the source voltage for the -12V Regulator. Though the -12V line is not monitored for low voltage, the -15V supply is. Voltage reduction of the -15V supply will turn Q913 ON and activate shut down.



PROTECT CIRCUITS - M, D, A, E BOARDS

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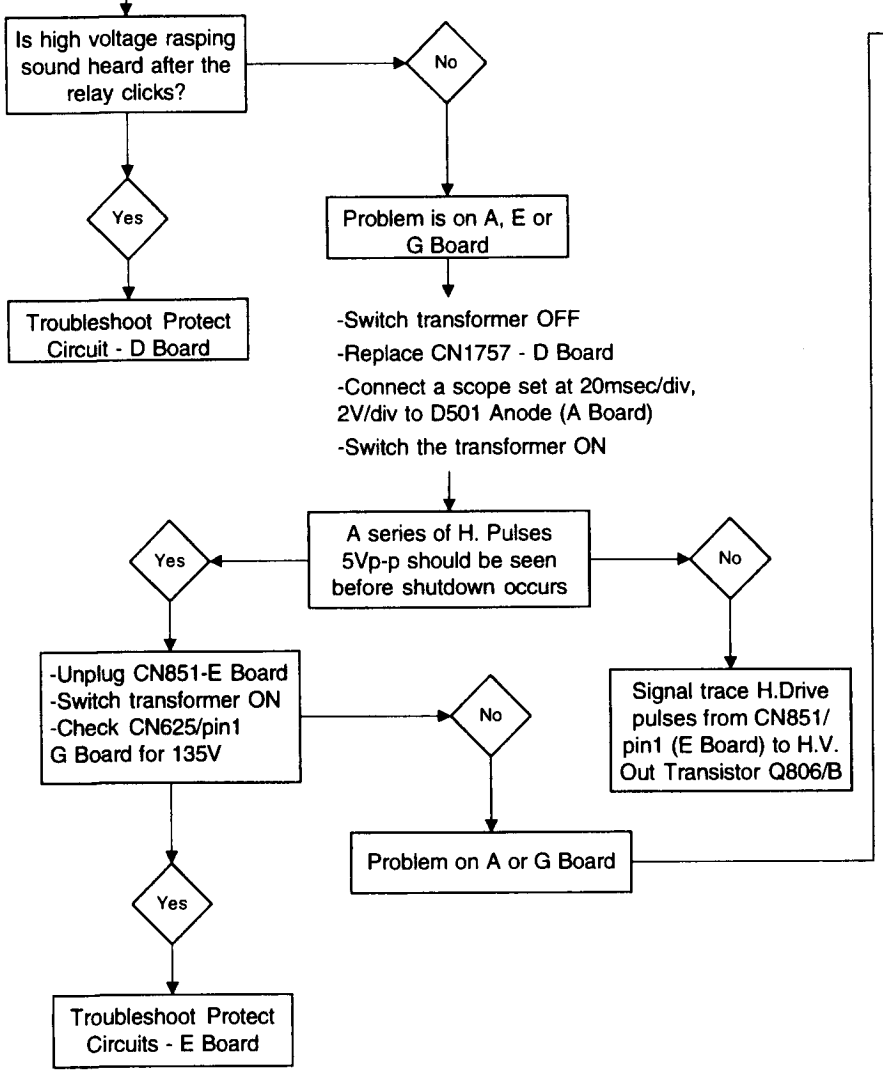
RA CHASSIS POWER SUPPLY SHUTDOWN

-Plug set into an isolation transformer (trans. switched OFF)
-Unplug CN1757 (D Board)
-Switch the transformer ON
-Switch the set ON



-Switch transformer OFF
-Replace CN851 - E Board
-Unplug CN624, CN625 and CN681 - G Board
-Short the collector of Q655 to ground - G Board
-Switch transformer ON
-Check the following transistors for the logic state and collector voltage shown

Q651	Q661	Q663	Q660	Q658	Q659	Q654
OFF	OFF	ON	ON	*ON	ON	OFF
0V	0V	11.5V	11.5V	12.7V	12.7V	0V

-The transistor that is not in the state shown, leads to the circuit with the problem

-If everything is OK, troubleshoot the Protect circuits on the A Board

***Note:Q658 which is normally OFF , will be on because the supplies are unloaded**

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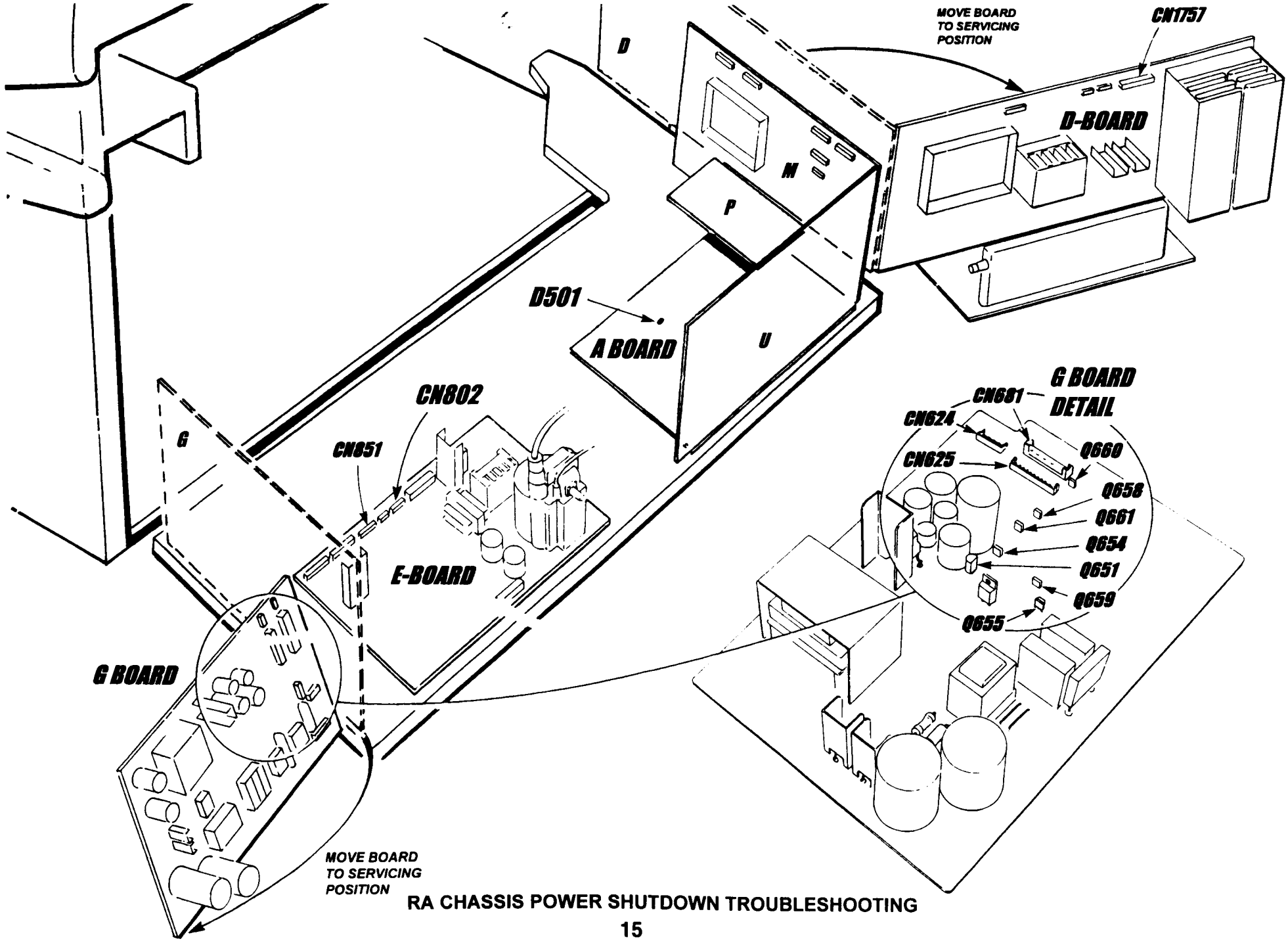

MOVE BOARD
TO SERVICING
POSITION
CN1757
D-BOARD
D
M
P
U
D501
A BOARD
CN802
CN851
G
E-BOARD
G BOARD
G BOARD
DETAIL
CN681
CN624
CN625
Q660
Q658
Q661
Q654
Q651
Q659
Q655
MOVE BOARD
TO SERVICING
POSITION

RA Chassis High Voltage Development

Overview

The prime functions of this section are to develop the high voltage, focus voltage (G2), heater voltages (6.3V), and the video amp drive voltage (200V for each picture tube). These voltages are developed by Flyback transformer T801 and Low Voltage Output Transformer T803. The switching action of HV Output Transistor Q806 drives these transformers.

Operation

The H. Drive originates in the Y/C Jungle IC301/pin 37 as a 2.8Vp-p H rate signal. It is buffered by Q810 and applied to HV Drive transistor Q801. It is also applied to H. Phase Shift Q901/B for use by the regulation circuit.

Q801 drives the primary of T802, controlled by Q803 on the power supply side of the winding. During normal operation, the amplitude of the drive pulses on HV Output Q806/Base is 140Vp-p. Much of this amplitude is due to the switching action of the transistor reflected on the base. If Q806 opens, or does not receive collector voltage, the drive voltage at its base will be 4Vp-p.

The H Pulses on Q806/Base switches it ON/OFF sharply, causing flyback transformer T801 and LOT T803 to produce voltages at the secondary. T801 produces the HV and focus voltage, and the secondary of T803 produces the filament (heater) voltage and the 200V supply. The 200V supply is produced by adding the 135V line to the rectified 65V produced across T803 pins 13 and 11.

High Voltage Regulation

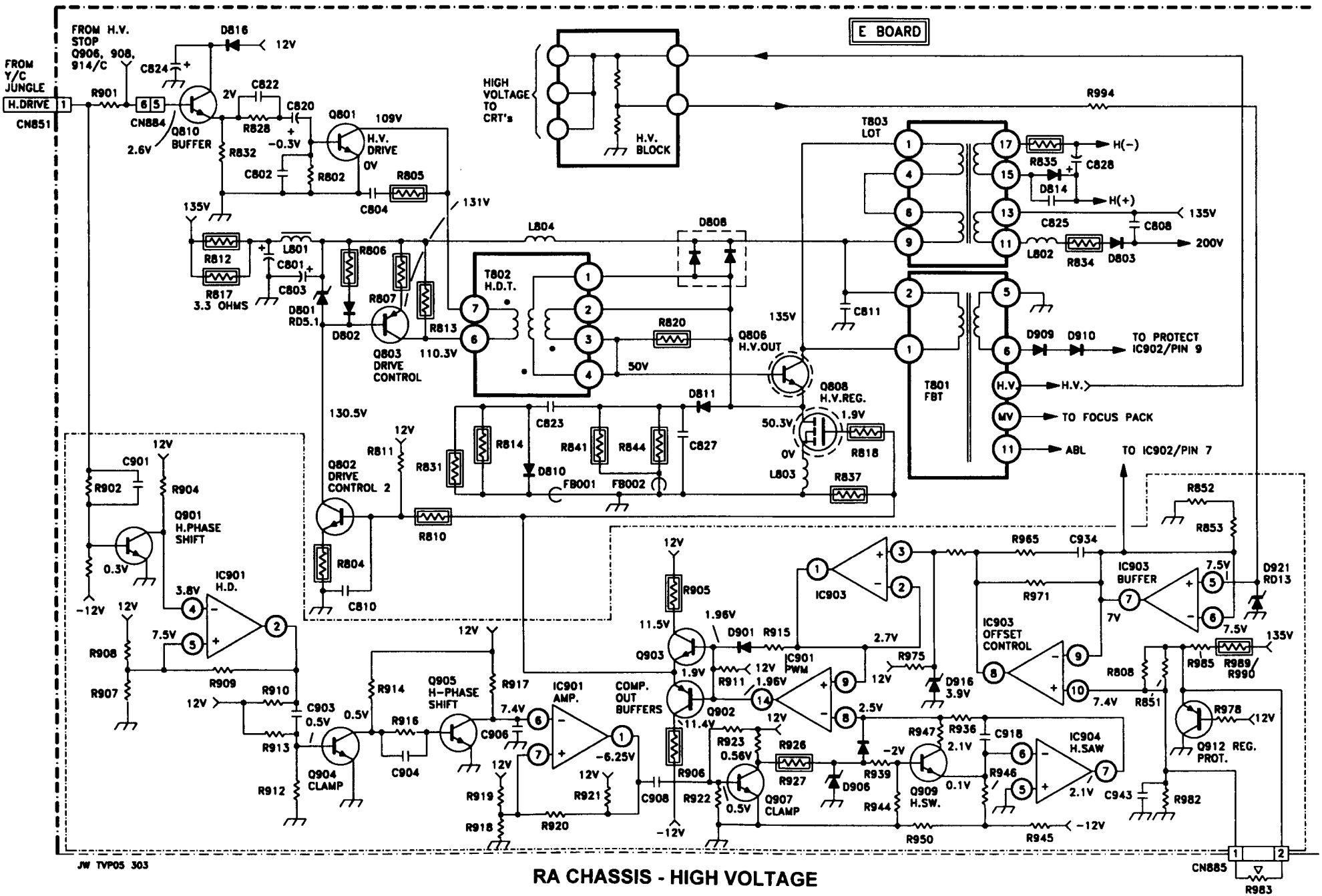
High Voltage Regulation is achieved by comparing a voltage divided sample from the high voltage block to a reference H. Sawtooth signal to develop a pulse-width modulated control signal. This signal varies the conduction of the HV Output Transistor Q806 via HV Control Q808. It also varies the conduction of Horizontal Drive Control Transistor Q803.
A sample of the high voltage (7.5V) is tapped off the HV Block, buffered by IC903/pins 5-7, and applied to Offset Control (level shift) IC903/pin 9. Pin 10 has a fixed 7.4V reference from the 135V supply. ***(This reference can be varied after servicing by changing the value of R808).***

Variations in high voltage are reflected at the output of IC903/pin 8, and are applied via a buffer (IC903/pins 3 and 1) to the non-inverting input of PWM IC901/pin 9 and Q903/Base. A sawtooth waveform is applied to the inverting input of PWM IC901/pin 8. (The sawtooth waveform is produced by H. Saw IC904/pins 5-7). Voltage comparisons are made between these two inputs, resulting in a 24Vp-p PWM signal varying in step with HV fluctuations at IC901/pin 14.

The varying PWM signal is buffered by complementary push - pull transistors Q902 and Q903 and applied to Drive Control Q802/B and to HV Reg Q808/Gate to control their conduction time. Q808 is in the emitter circuit of Q806, in parallel with R814, R831, R841, R844, etc. In this way the PWM pulses control the HV OUT emitter current by controlling the conduction of Q808. The overall effect of these circuits is to maintain a constant HV level.

Developing the Reference Sawtooth/PWM Waveform.

The reference sawtooth for PWM IC901/pin 8 is developed from the 8.7Vp-p H. Drive signal at CN851/pin 1. Q901 amplifies and inverts the H. drive signal to 10V p-p, then applies it to the inverting input of H.D Amp IC901/pin 4. The circuits between IC901/pin 2 and IC904/pin 7 shape, and phase shift the H. Drive pulses to create the



RA CHASSIS - HIGH VOLTAGE

sawtooth pulses used as the reference input to IC901/pin 8 to produce the controlling PWM signal.

High Voltage Protect Circuits

The high voltage protection circuits are triggered under the following conditions.

- Excessive ABL current.
- Overcurrent condition in the high voltage/deflection circuits.
- Excessive high voltage.

Excessive ABL Current

The purpose of the ABL (Automatic Brightness Level) signal is to provide feedback to the Y/C jungle for it to compensate for fluctuations in high voltage which would cause varying picture brightness. The amplitude of the ABL pulses from FBT T801/pin11, varies inversely with respect to the flyback transformer current. These pulses are converted to DC by D306, C305, R331 and C303, and applied to the Y/C jungle IC301/pin 27.

The normal ABL voltage is approximately 1.6Vdc with color bars present, and 5.7Vdc with no video signal. The minimum allowable voltage before picture blanking is 1.2Vdc.

Increased ABL current is usually accompanied by increased high voltage when a CRT is shorted or a C board is defective.. Therefore, the increase high voltage feed back signal to IC902/pin 9 will turn Q914 ON to activate HV shutdown.

Over current conditions in the High Voltage/Deflection circuits

Excessive loads on the Flyback T801 will reduce the output pulses on the ABL line (pin 11) and pin 6. This will disable IK-Protect 2 Q911, and IK Protect 1 Q910, thereby bringing their collectors HIGH; the final result is Q906 and Q908 turning ON to activate HV shutdown.

Shorted windings in the flyback transformer, or shorted components on its secondary windings can cause this problem.

Excessive High Voltage

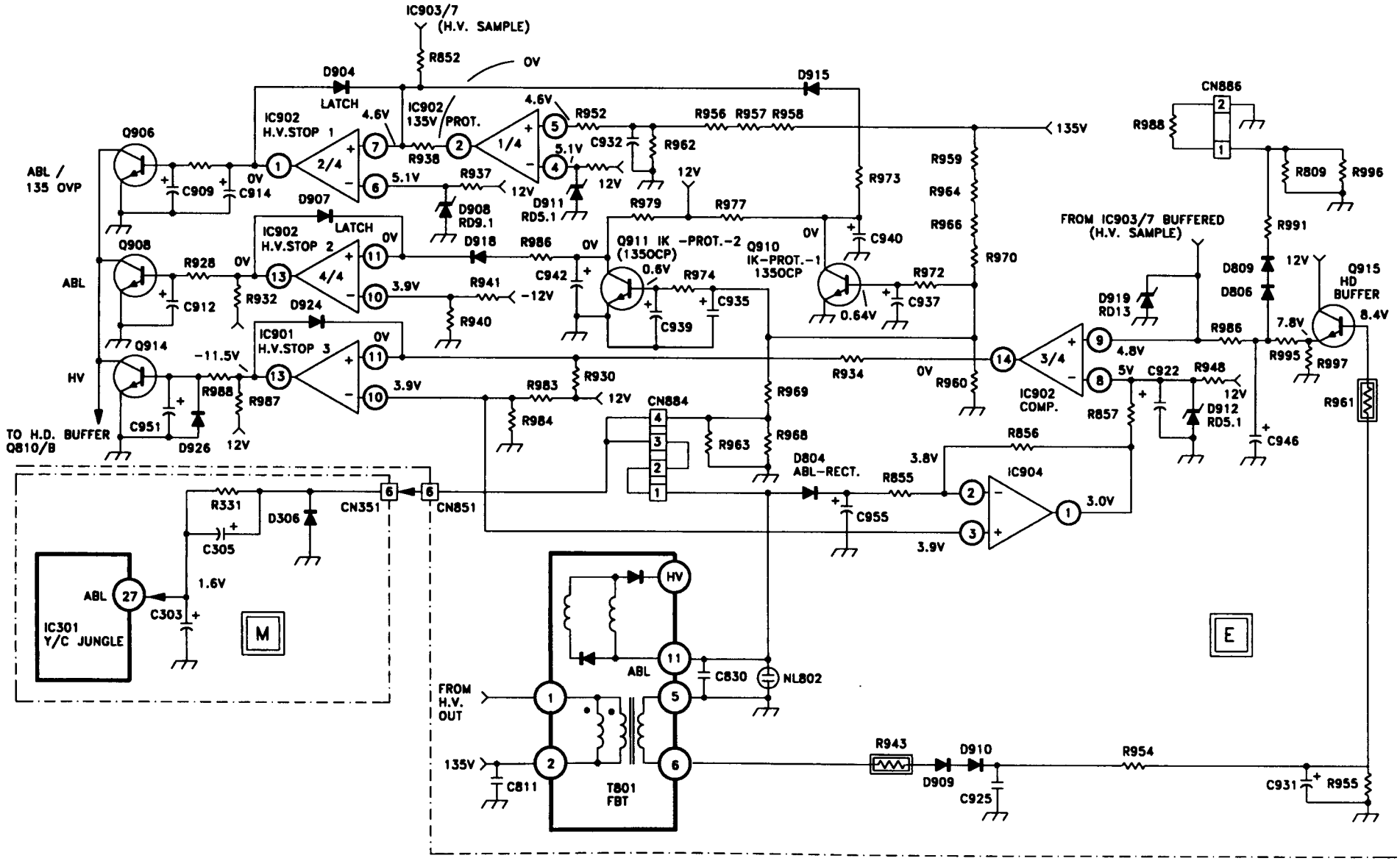
Excessive High Voltage can activate shutdown in three ways in this set.

1. Feedback sample to IC902/pin 9. (Discussed in ABL section)
2. An excessive amplitude increase of the pulses at pin 6 of FBT T801. This will increase the base and emitter voltages of Q915. causing IC902/pin 9 to rise higher than the 5V at the inverting input, pin 8. Pin 14 goes HIGH and activates shutdown.
3. ABL pulses at FBT T801/pin 11 are also monitored to detect excessive changes in the high voltage. D804 rectifies ABL pulses to produce 3.6V at the inverting input of IC904/pin 2. Pin 3, the non-inverting input, is held at 3.9V. A voltage increase above 3.9V will cause IC902/pin 14 to go HIGH and activate HV shutdown via IC901 and Q914.

The amplitude of the pulses developed by the flyback, are directly affected by the 135V supply. The frequency is affected by C818 off HV Out Q806/c. Always check C818 when there is an elusive high voltage problem.

An increase in the 135V supply will increase the high voltage. As a result, the 135V supply is monitored by IC902/pin 5. An abnormal increase of the 135V line will cause the voltage at IC902/pin 5 to rise above the regulated 5V at pin 4, and trigger shutdown.

NOTE: After repairing the high voltage circuit, make certain that the voltage at CN886/pin 1 is 1.75V This voltage can be adjusted by changing the value of R809.



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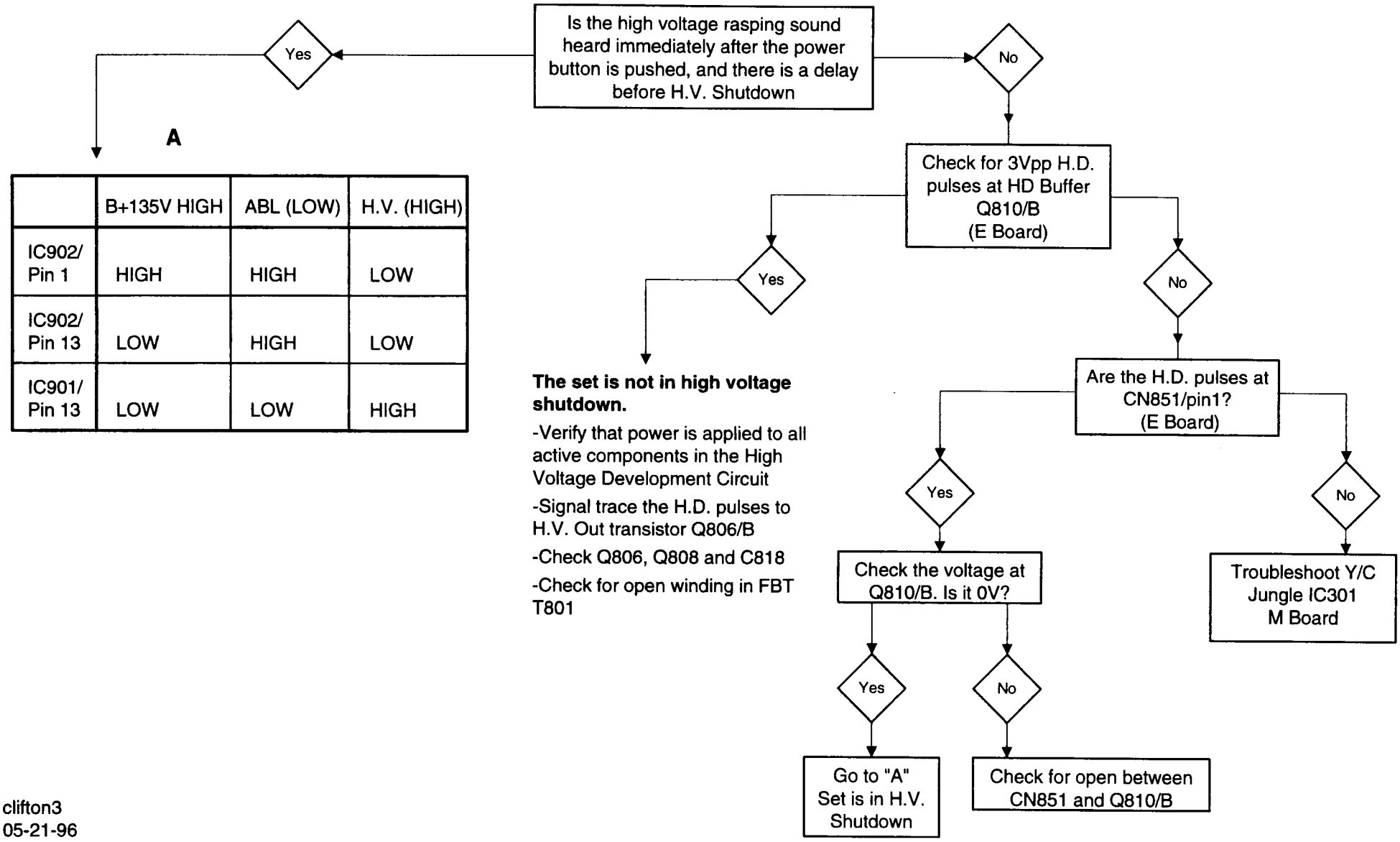
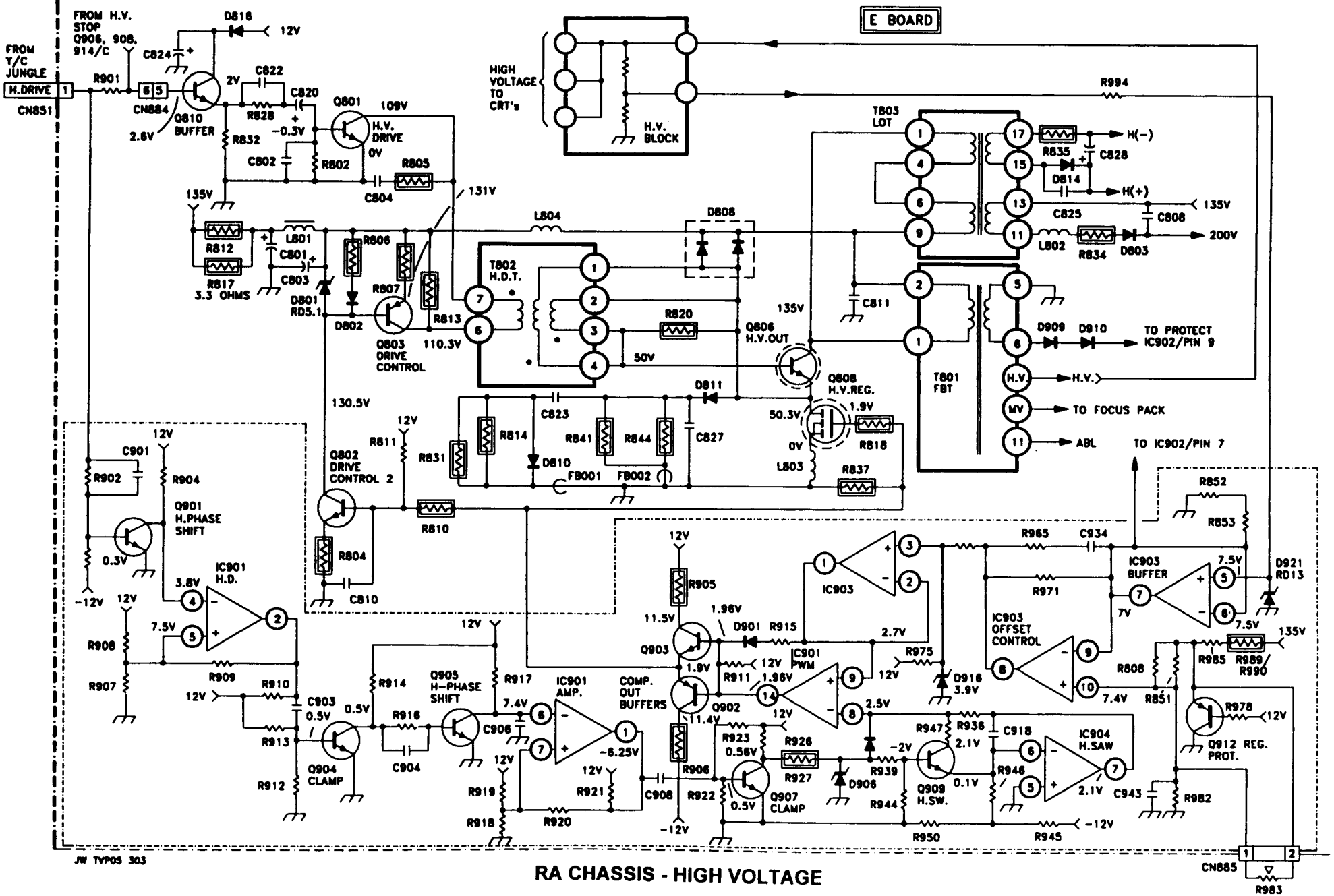
RA CHASSIS - H.V. PROTECT.

RA Chassis
High Voltage Shutdown

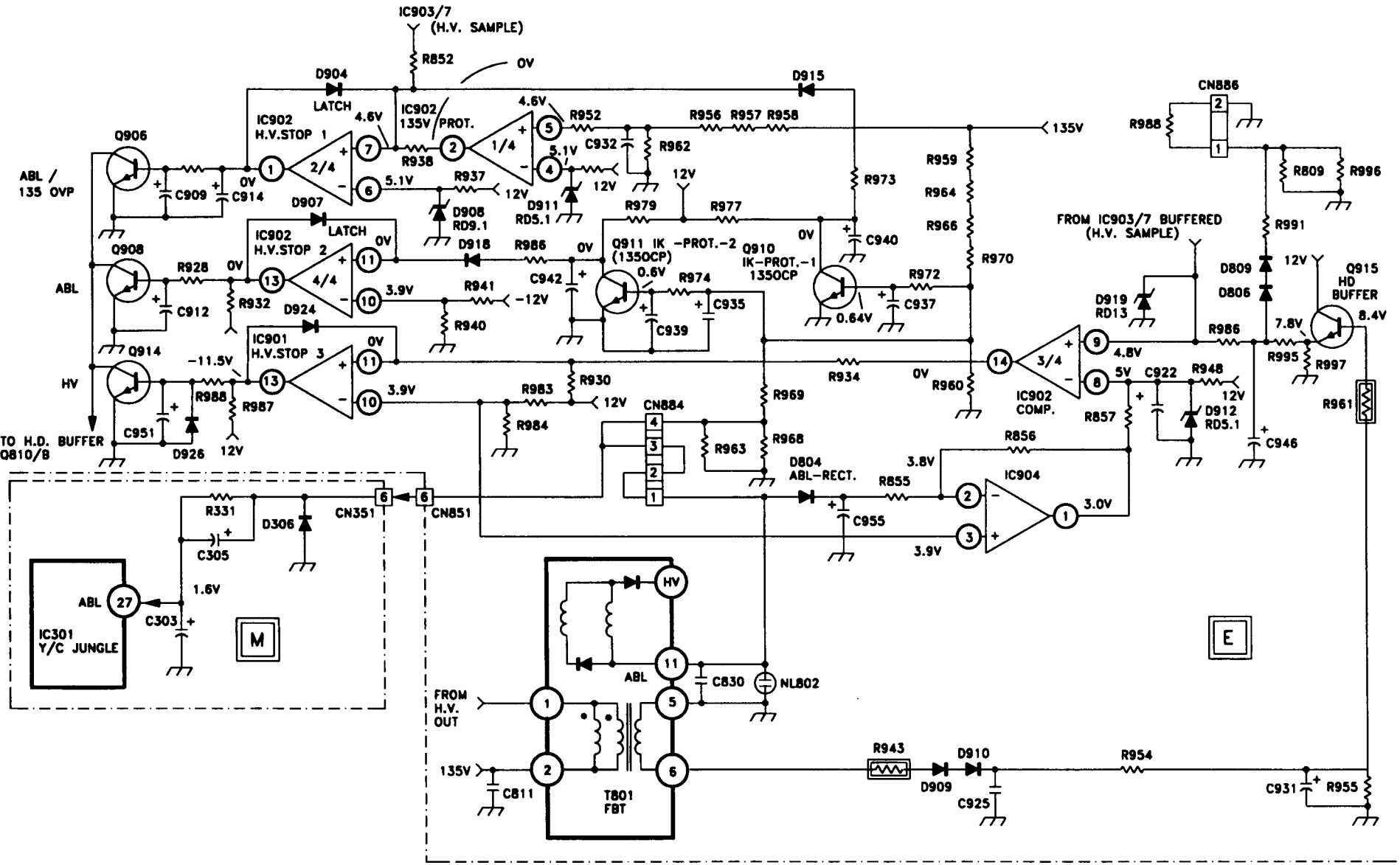


	B+135V HIGH	ABL (LOW)	H.V. (HIGH)
IC902/ Pin 1	HIGH	HIGH	LOW
IC902/ Pin 13	LOW	HIGH	LOW
IC901/ Pin 13	LOW	LOW	HIGH

clifton3
05-21-96



RA CHASSIS - HIGH VOLTAGE



JWTVP05 297 4.19.95

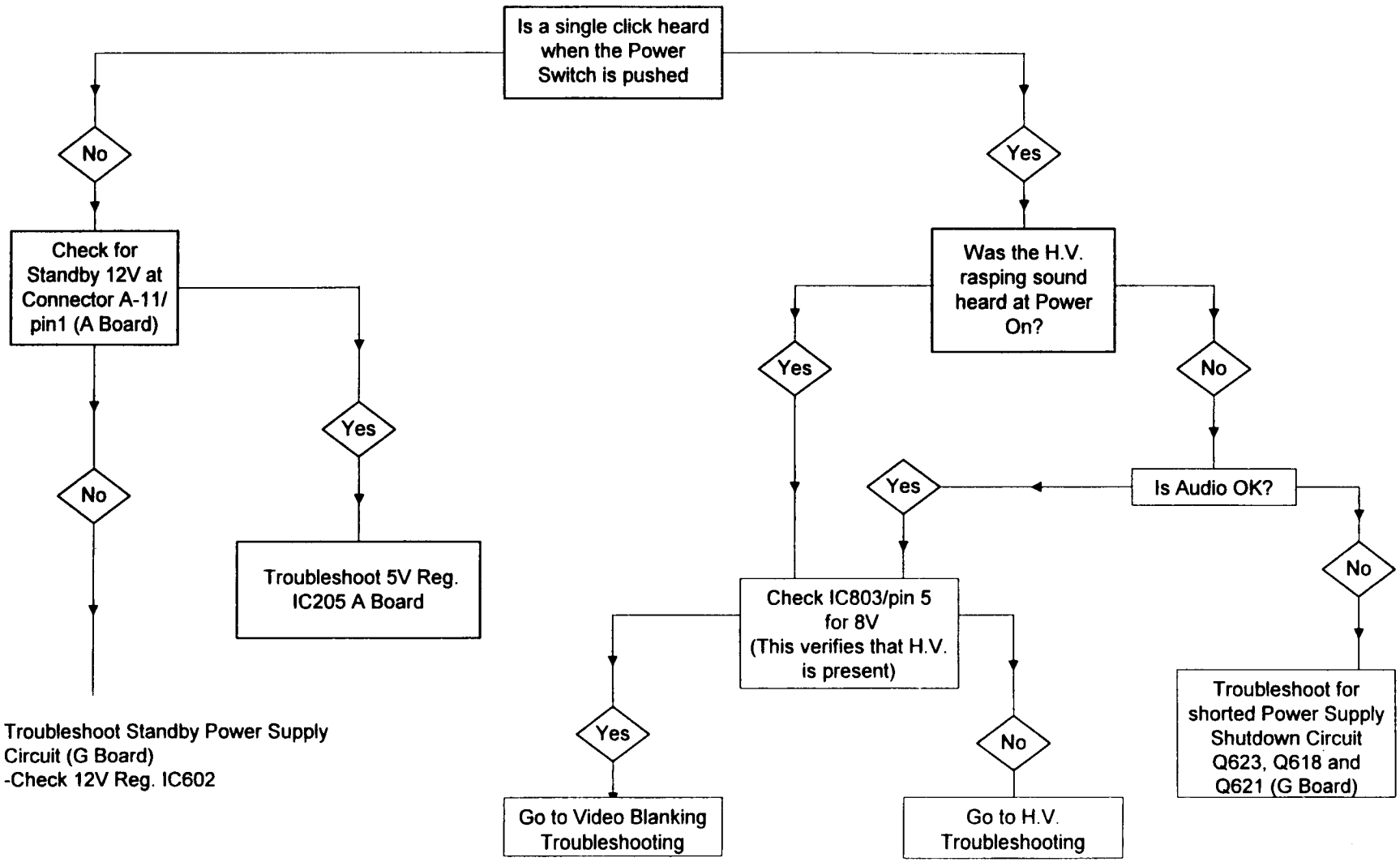
RA CHASSIS - H.V. PROTECT.

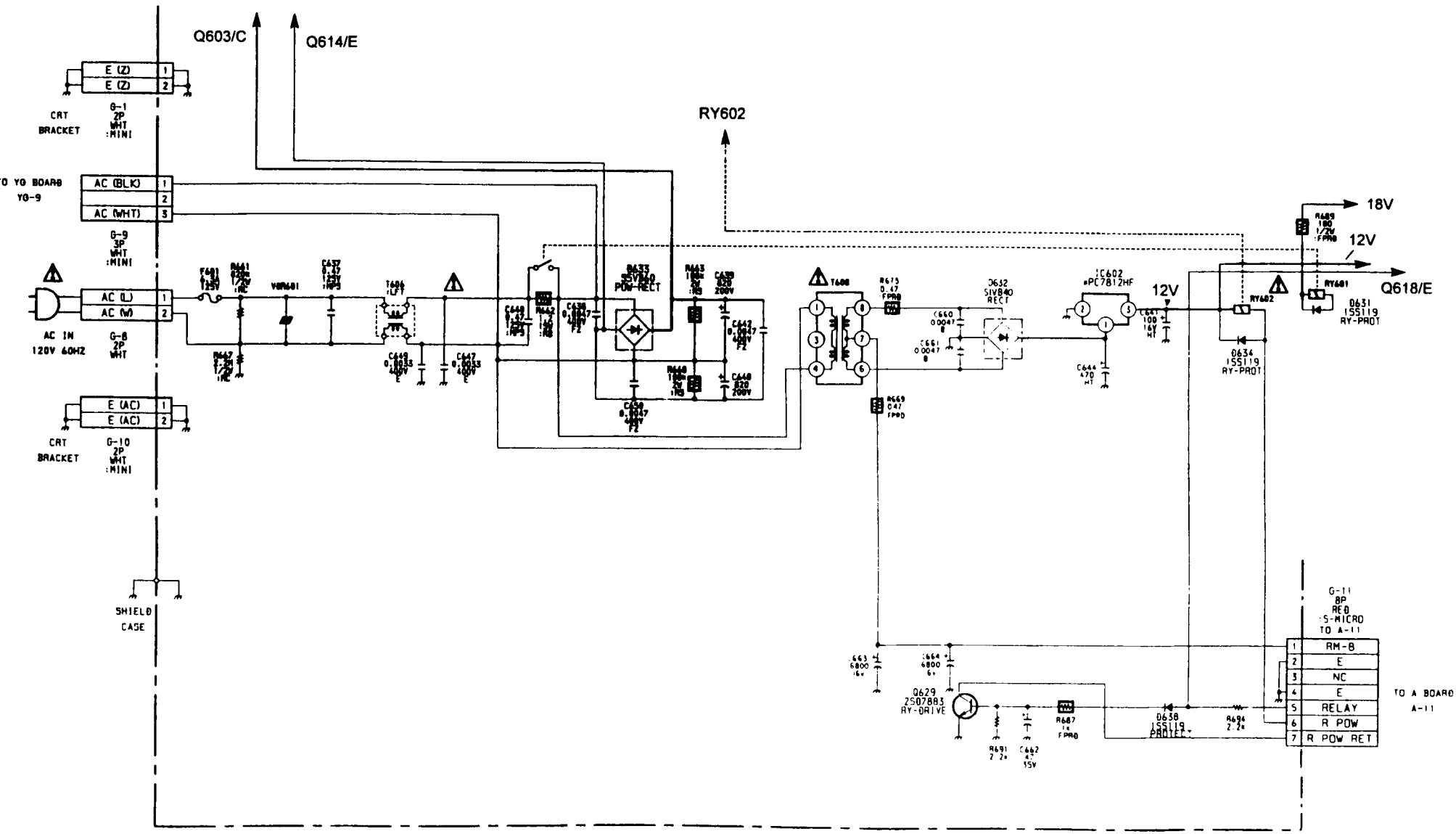
NOTES

Troubleshooting AP Chassis Dead Set (No Picture)

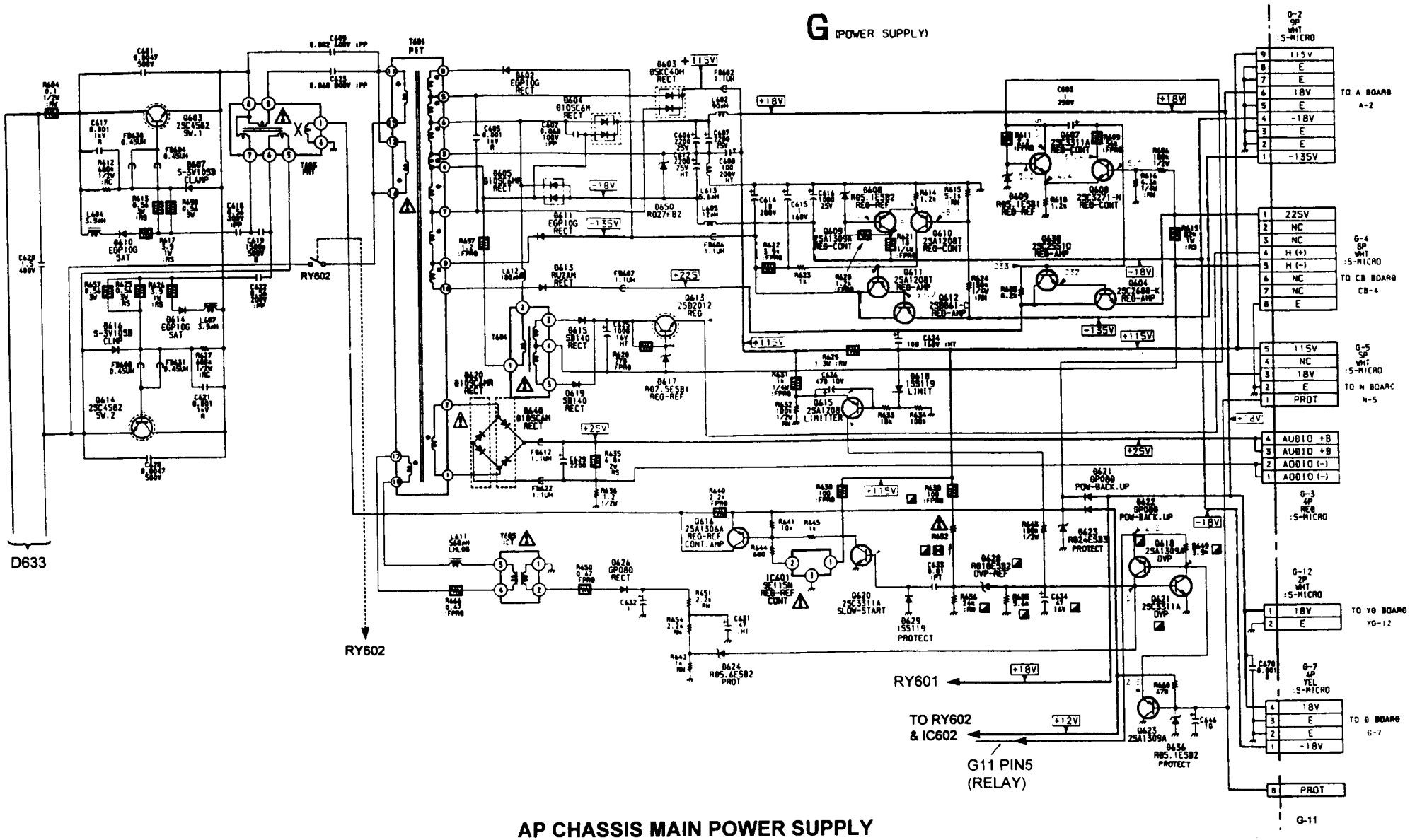
The following will help isolate the circuit or components responsible for no picture problems. If the Timer/Standby LED on the front panel blinks continually, the set is either in power supply shutdown, highvoltage shutdown, or video blanking. Which it is can be determined by checking the sound and for 8V at H.V. Reg. Det IC803/pin 5 on the N Board.

No Picture - AP Chassis





AP CHASSIS STANDBY POWER SUPPLY



AP CHASSIS MAIN POWER SUPPLY

NOTES

Pre Power ON Test

After repairing a dead set, especially when the converter transistors were shorted, do the following test before full AC power is applied to the set.

1. **Plug the set into a variac/isolation transformer set to 0V.**
2. Set an external power supply to 12V and connect it to D622/Anode on the G Board.
3. Short the collector of Q629 to ground. There should be a click as the power relay engages.
4. Set up a scope as follows: 5usec/div. 20V/div. and connect it to Q614/C.
5. Increase the AC supply on the variac to 22VAC. The waveform in **Fig. 1** should be present. If it is not, unplug G-2, G-3, G-4, G-5 and G-12 on the G board one at a time, starting with G-2, while observing the scope. If the waveform appears when one is unplugged, there is a short in one of the circuits that the connector supplies.
- Check for low resistance across each load of the Power Input Transformer.
6. A problem still exists on the G board if the waveform is not produced after removing the connectors. Check for open or shorted capacitors and diodes in the converter circuit.

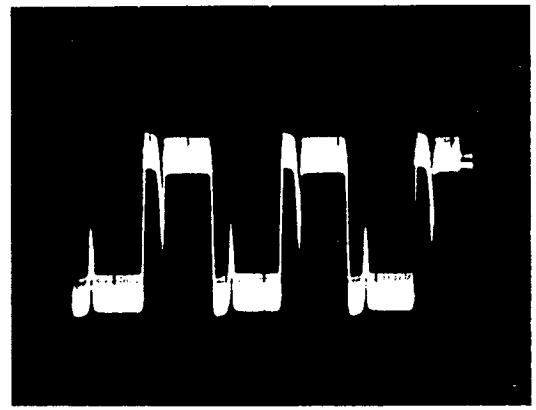
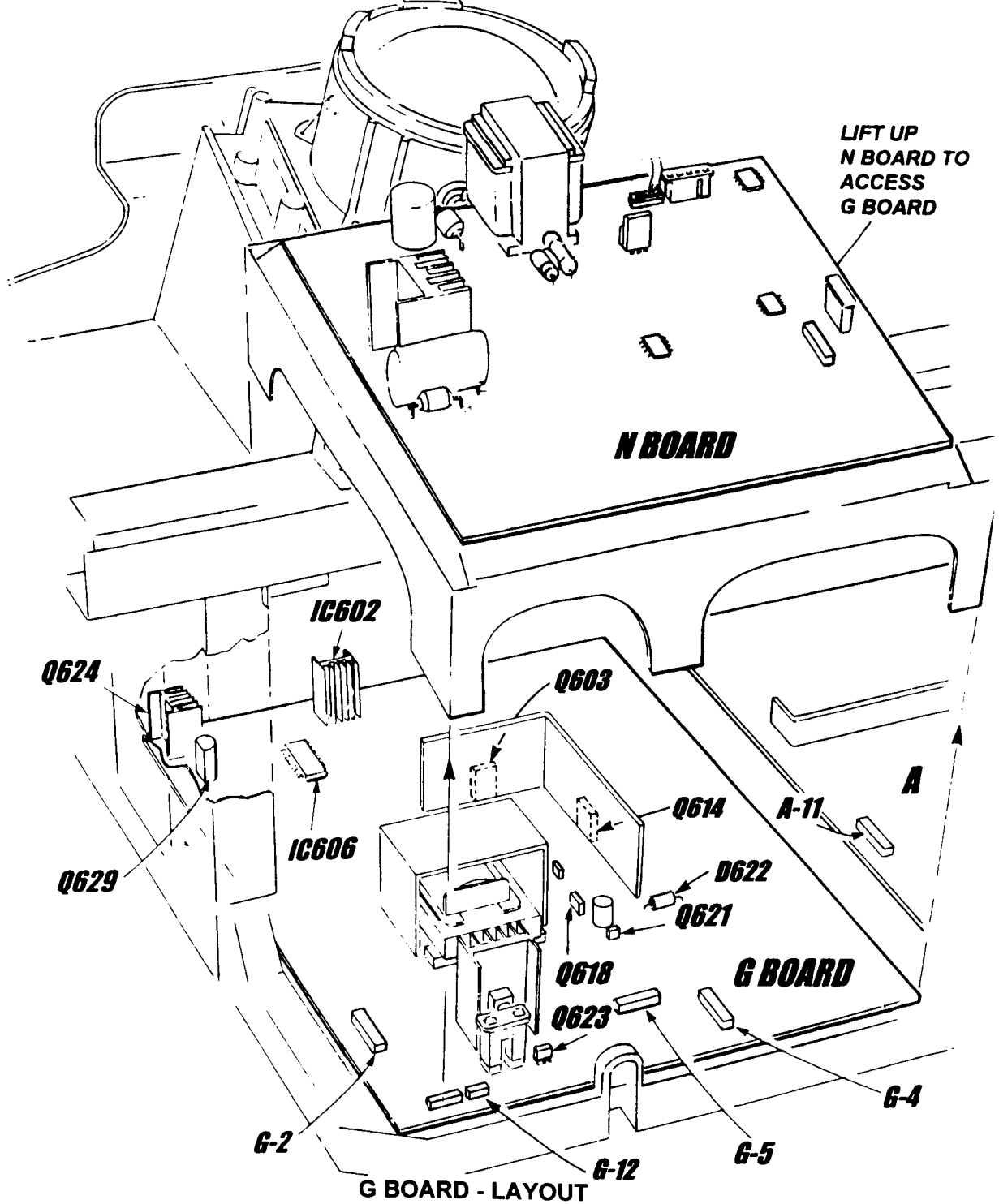


Fig. 1. Q614/Collector (60Vp-p).

CAUTION: Do not apply full AC voltage to the set until the above voltages are present.



G BOARD - LAYOUT

AP Chassis Protection Circuits

Over Voltage Protection (OVP) and over current protection are triggered by latch circuit Q618 and Q621. The circuit is activated:
1. When a HIGH (0.6Vdc) is sensed at the base of Q621 or
2. When Q618 base is made LOW.

Triggering the latch grounds the RELAY signal from Control IC001/pin 21 to Relay Drive Q629/Base, thereby shutting down the power supply.

Over Current Protection

An overcurrent condition in PIT T601 will induce an increased voltage to T605, resulting in a voltage high enough to zener D624 and activate the latch circuit. D624/Cathode is normally 3.8V.

The 115Vdc line is also protected from overload conditions via current limiter Q615. This circuit operates whenever current flow through R629 exceeds 1Amp. As a result, Q615 turns ON and activates the latch circuit.

In addition, the latch circuit will also be activated if an overcurrent condition develops on the 15V, -15, 12V, 9V, and 5V supplies on the N, D, and A Boards.

Finally, Horizontal Pulses from HOT T508 are monitored by Q511 and Q512 and associated components on the A Board. A loss of these pulses will turn Q512 ON and place a LOW on the Protect line to activate the latch circuit and disable Relay Drive Q629.

Over Voltage Protection

Over voltage protection is provided by monitoring the 115V line with voltage divider R639, R652, R656 and zener diode D638. The voltage normally present at the junction of R656 and the cathode of D628 is about 17.4Vdc. If an over voltage condition occurs (approximately 121Vdc), D628 will zener and place a HIGH on Q621/Base. The latch turns ON and disables Relay Drive Q629.

Troubleshooting.

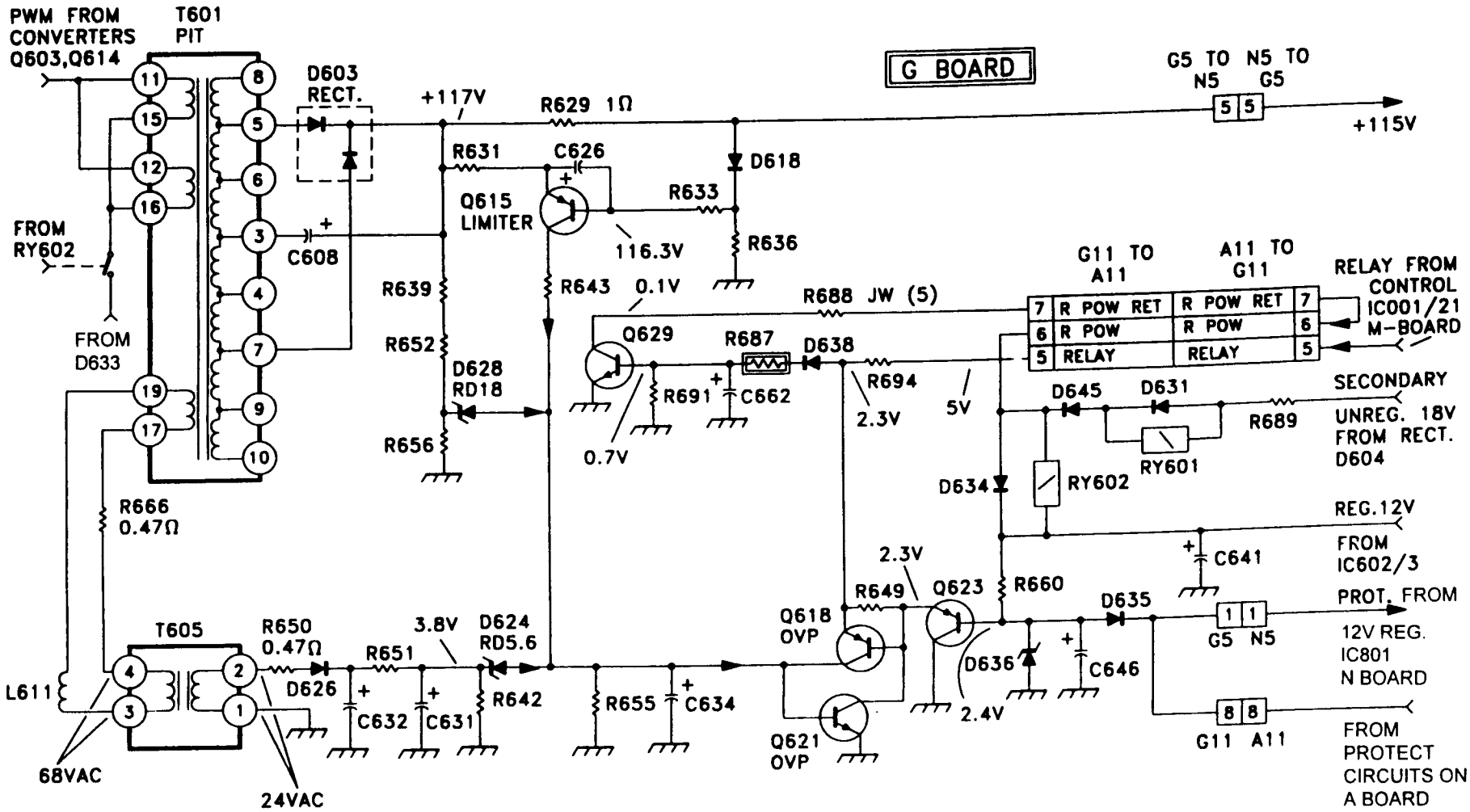
Plug the set into a switched variac/isolation transformer.

To determine which circuit is responsible for activating the latch:
1. Switch the set ON and check the voltage at the base of Q623.
- If it measures 0.65Vdc, check for shorts on the regulated B+ line.
- If it measures 1.4Vdc, check protection circuits on the A, D and N Boards. (See following flowchart)

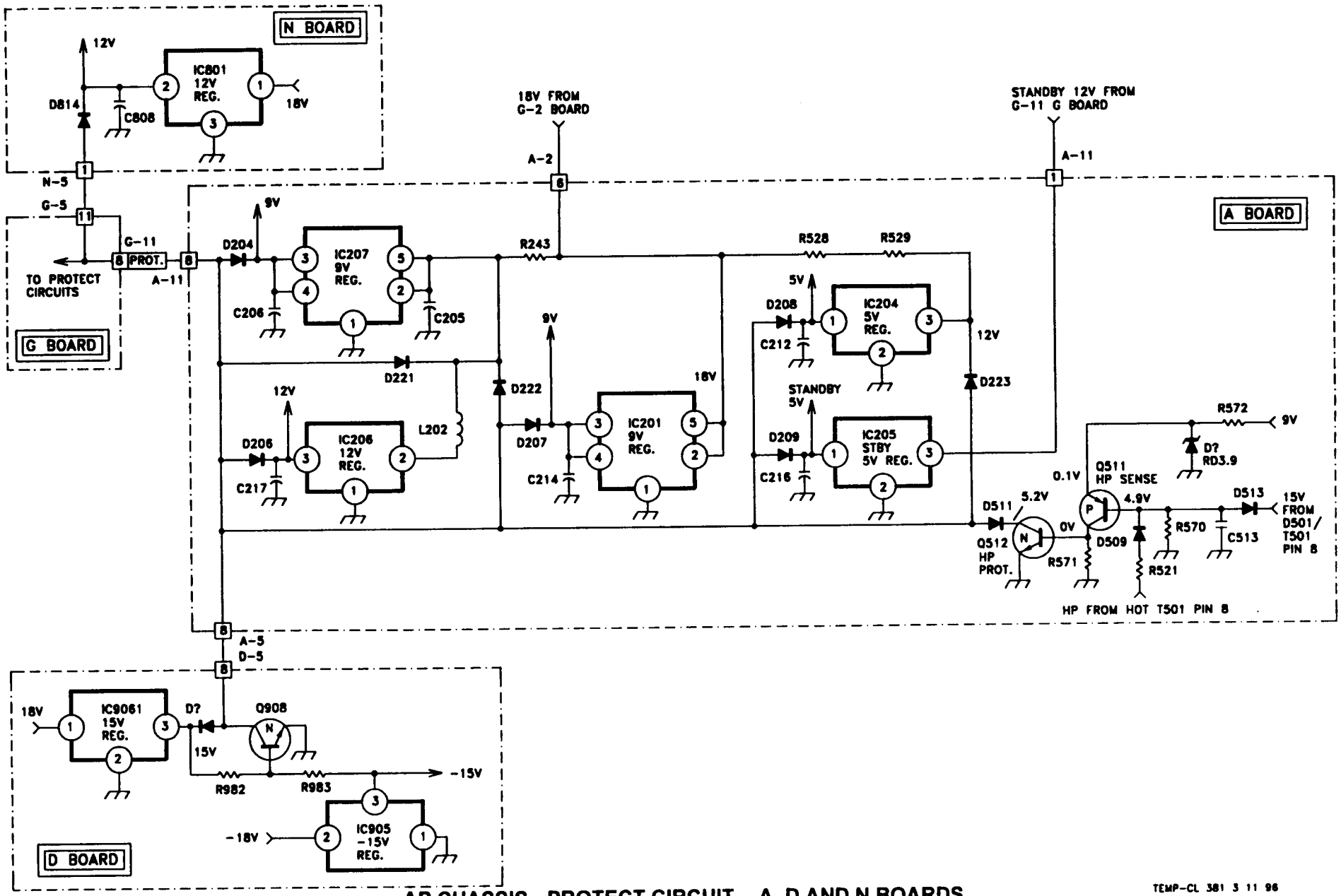
2. If the voltage at the base of Q623 is OK (2.4V),
- Switch OFF the isolation transformer and wait 15 seconds.

3. Switch the power back ON and check that the voltage at the cathode of D624 does not exceed 5.6Vdc at turn ON.
- If this voltage goes above 5.6Vdc, check for short circuit conditions in the secondary of PIT T601.
- If the cathode of D624 does not exceed 5.6Vdc, switch OFF the isolation transformer and wait 15 seconds.

4. Switch the power back ON and check that the voltage at the cathode of D628 does not exceed 18Vdc at turn ON.
- If it does, check PRT Regulation.-- IC601, Q616, D621, D622 and T603.



AP CHASSIS - PROTECT CIRCUIT



AP CHASSIS - PROTECT CIRCUIT - A, D AND N BOARDS

TEMP-CL 381 3 11 96

AP Chassis
Power Supply Shutdown

Plug the set into an Isolation Transformer. Switch ON
Switch the set ON
-Verify Stby. 12V at Connector A-11/pin1
-Verify a HIGH at A-11/pin 5 (Relay)

Switch the Transformer OFF
Unplug connector A-5 from the A Board
-Switch the Transformer ON

High Voltage rasping sound after relay clicks?

Yes

Troubleshoot the 15V and -15V Regulators (IC906 and IC905) on the D Board

No

Switch the transformer OFF
Reconnect connector A-5
-Unplug connector N-5 on the N Board
-Switch the transformer ON
Does the relay click once?

Yes

Troubleshoot 12V Reg IC801 and associated circuits on the N Board

No

Problem is on the A or G Board

Switch the Transformer OFF
Reconnect connector N-5
-Unplug connector A-11 (A Board)
-Use a jeweler's screwdriver to remove the wire at pin 8 of connector A-11
-Plug A-11 back in
-Switch the transformer ON for about 1 sec. then OFF

High voltage rasping?

No

Troubleshoot the protect circuits on the G Board

Yes

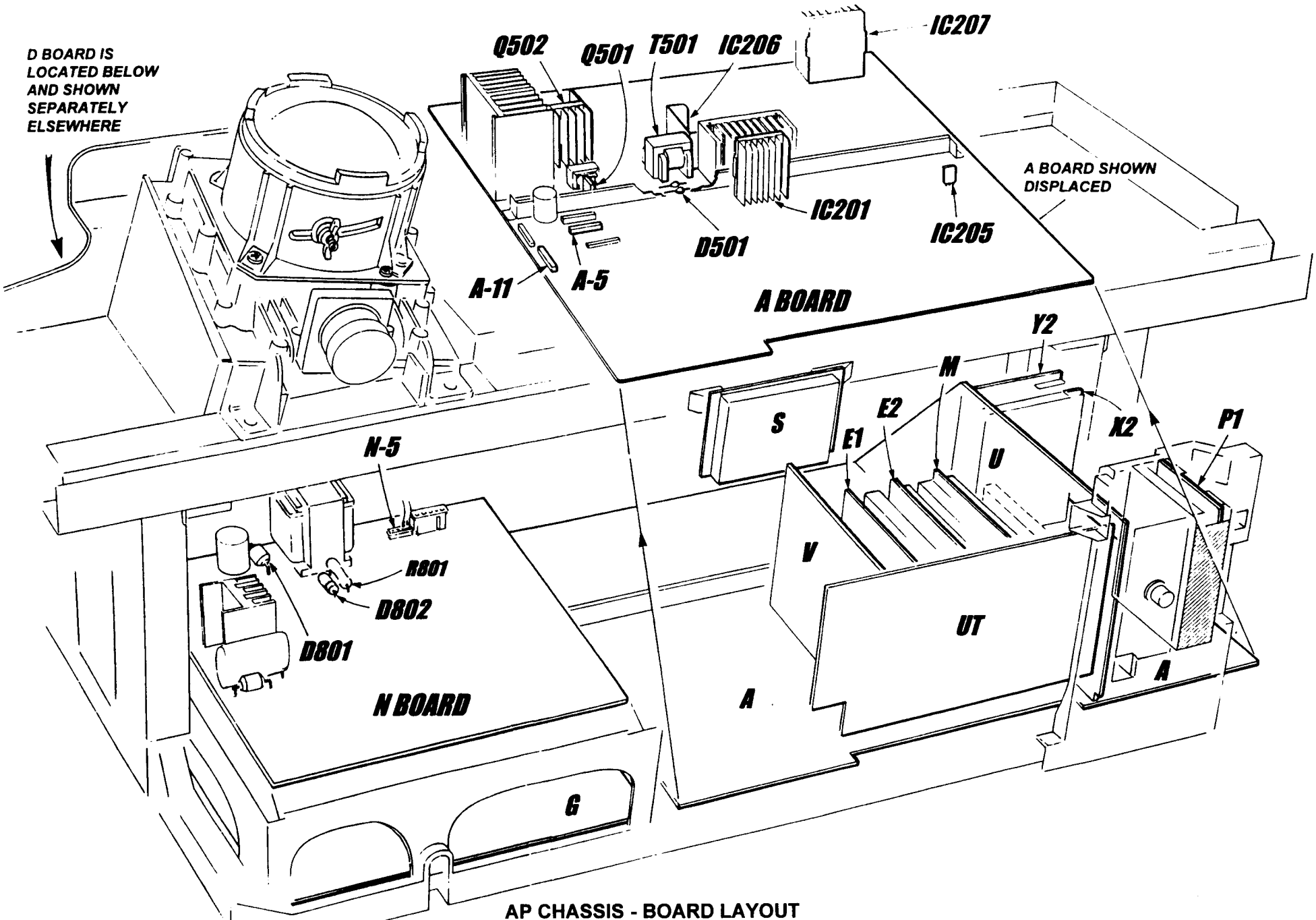
-Place the (+) lead of a voltmeter at D501/Cathode (A Board)
-Switch the transformer ON for about 1 sec.
Is voltage 15V?

No

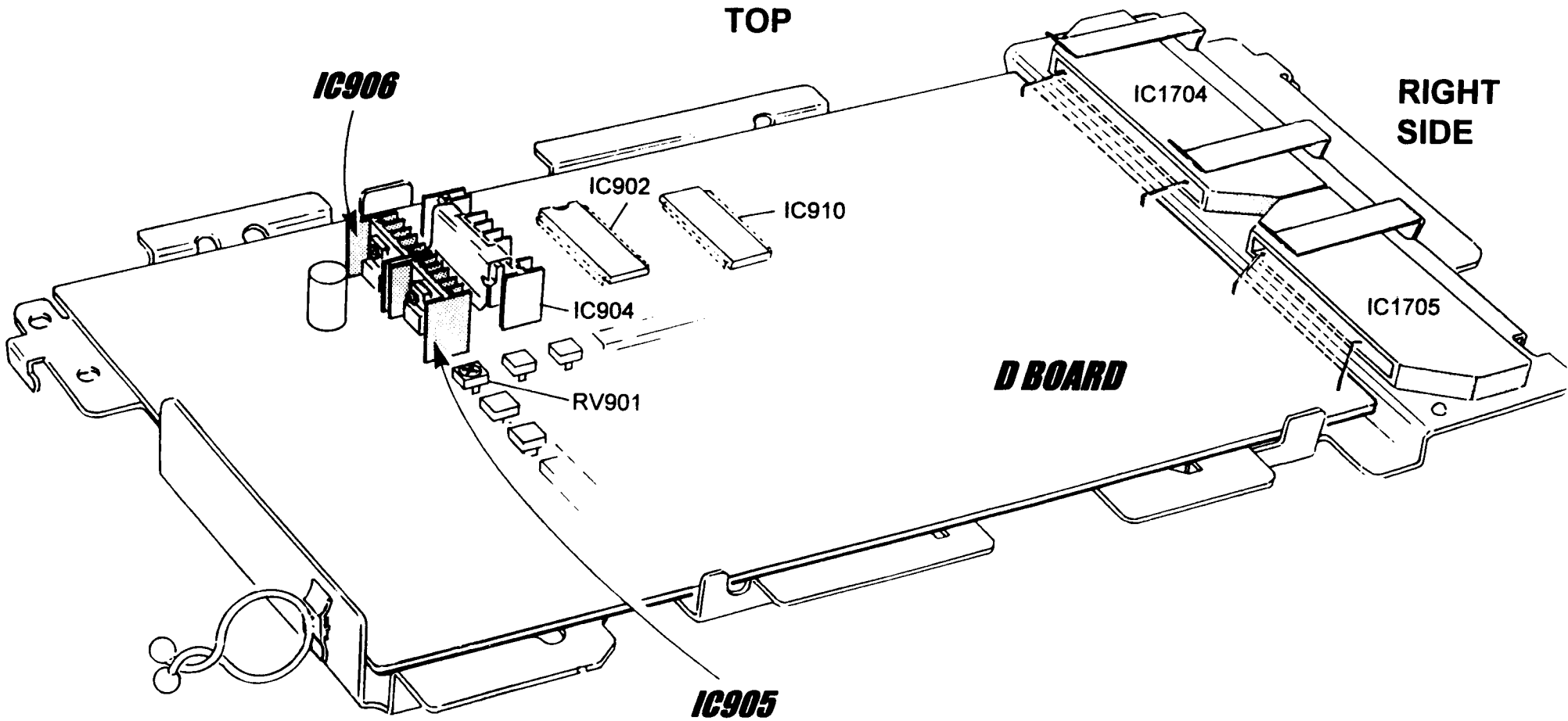
-Troubleshoot the H.Drive circuits: T501, Q501, Q502 and assoc. comp. on the A Board
-Troubleshoot H.P. Sensor and Protect Circuit Q511, Q512 and assoc. circuits on the A Board

Yes

Troubleshoot the 9V(IC201), 12V(IC206) and 5V(IC204) Regulators and associated components on the A Board



AP CHASSIS - BOARD LAYOUT



AP CHASSIS - D BOARD

AP Chassis and KPR-46CX10 Chassis High Voltage Troubleshooting

The high voltage circuits of the AP Chassis are electrically identical to that of the KPR-46CX10 Chassis. The differences are the boards and connectors are labelled differently. Board layout is also different. Circuits are explained with the AP Chassis drawings. However, the troubleshooting flowcharts are chassis specific and contain the differences. Another important difference is that the KPR-46CX10 chassis uses two flyback transformers, (FBT-1 and FBT-2), connected in parallel. They are mounted on the PC Board.

High Voltage Development

The high voltage converter provides the high voltages for the CRT anodes and focus grids. The high voltage is developed from the horizontal drive signals which are produced by the Jungle IC (not shown). In the HV Converter, these signals are amplified, waveshaped, and fed to the flyback transformer. The secondary output of the flyback is rectified, and the voltages distributed to the CRT anodes.

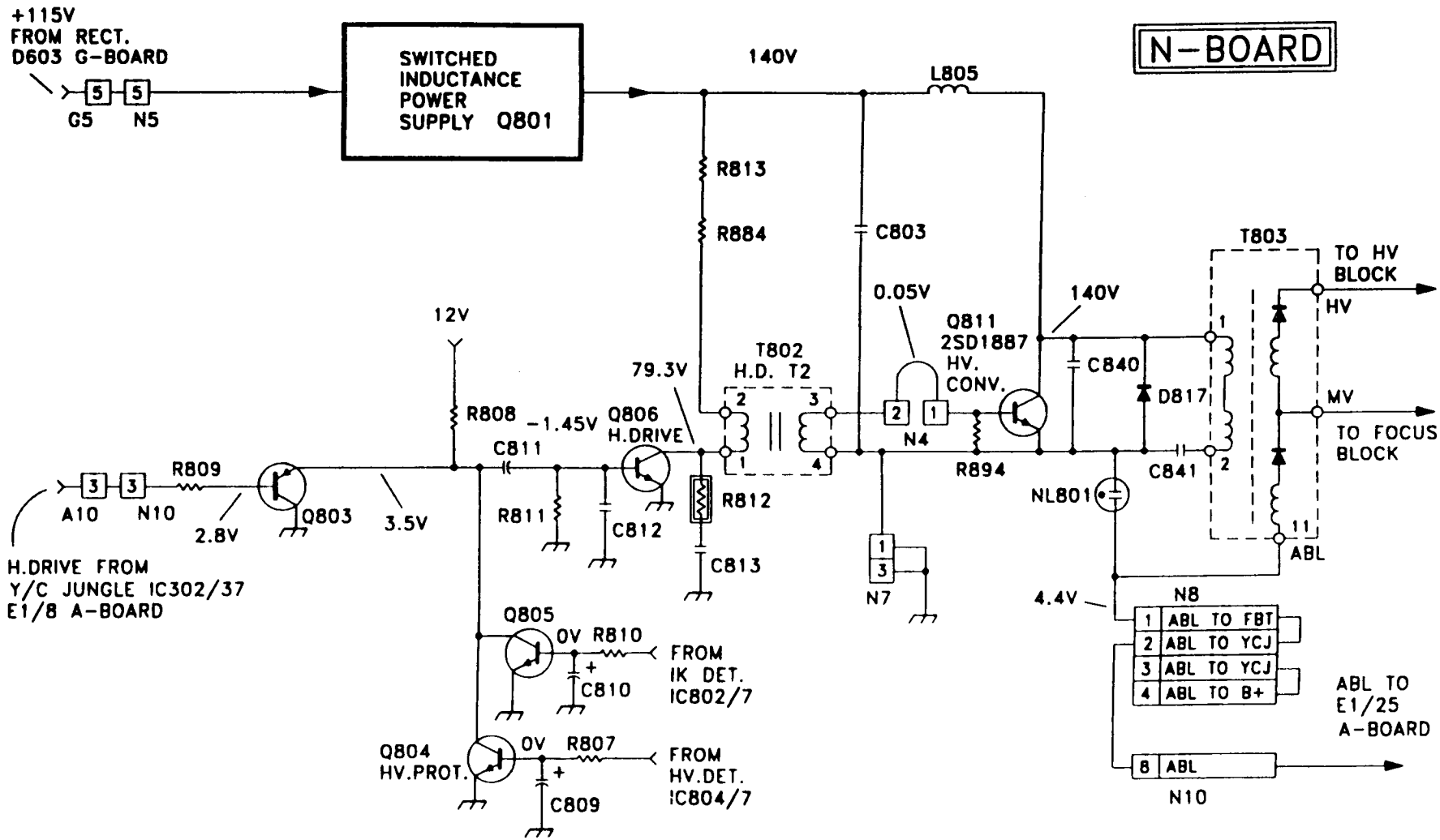
Operation

Horizontal drive pulsed from IC302/pin 37, are amplified by H Drive transistor Q806, and coupled to HV Converter Q811/Base. These pulses switch Q811 ON/OFF at the horizontal rate to create the flyback effect in the Flyback Transformer T803.

T803 has two high voltage secondary windings. The upper winding, labeled 'HV', supplies high voltage to the HV block. The HV block then distributes the high voltage to the three CRT anodes. The lower winding, labeled 'MV', supplies the focus voltage to the focus block. The focus block distributes this voltage to the three CRT focus grids.

HV Shutdown

HV Protect Transistors Q804 and Q805 will shut down the HV Converter circuit when the HV Shutdown circuit is triggered. Both of these transistors are connected to Buffer Q803/E. When the protection circuit (not shown) turns ON, one or both of these transistors will turn ON, shunting the H Drive signals at Q803/E to ground. High Voltage shuts down.


+115V
FROM RECT.
D603 G-BOARD
G5
N5
SWITCHED
INDUCTANCE
POWER
SUPPLY Q801
140V
L805
N-BOARD
R813
R884
C803
T803
TO HV
BLOCK
HV
MV
TO FOCUS
BLOCK
ABL
12V
0.05V
Q811
2SD1887
HV.
CONV.
140V
C840
D817
C841
79.3V
T802
H.D. T2
R808
-1.45V
Q806
H.DRIVE
C811
R809
A10
N10
2.8V
Q803
3.5V
R811
C812
R812
C813
N4
R894
NL801
N7
4.4V
N8
1 ABL TO FBT
2 ABL TO YCJ
3 ABL TO YCJ
4 ABL TO B+
ABL TO
E1/25
A-BOARD
8 ABL
N10
H.DRIVE FROM
Y/C JUNGLE IC302/37
E1/8 A-BOARD
Q805
0V R810
C810
FROM
IK DET.
IC802/7
Q804
HV.PROT.
0V R807
C809
FROM
HV.DET.
IC804/7

High Voltage Regulation

The HV Regulator circuit maintains the high voltage at a constant level. Regulation is accomplished by controlling the supply voltage to the HV converter. This voltage can be measured at D801 Cathode. If the regulator circuit is not operating, this voltage is approximately 117Vdc. With the regulator circuit operating, the switched inductances of L802, D801, C803, and HV Reg. Q801 boost the voltage to 140V.

Operation

The heart of the regulator circuit is IC805. This IC generates a PWM signal at pin 7 which is used to drive the switched inductor circuit. Regulation is maintained by sensing the high voltage level and using it to vary the PWM modulation level.

1. The high voltage level is sensed by sampling a small portion (7.6Vdc) from the H.V. block, then further dropping it down to 3.2V and applying it to IC805/pin 1. As the high voltage varies, this sample voltage will also vary, causing IC805 to produce PWM signals at pin 7 that reflect the variations.

2. From IC805/pin 7 the PWM signal is sent to Q802/B to drive HDT T801. T801 drives HV Reg Q801, the switch for the switched inductor circuit. The duty cycle of the PWM signal determines the boost voltage.

The configuration of the HV regulator circuit is such, that a high voltage increase raises the voltage level at IC805/pin 1. This also raises the voltage level at pin 13, which in turn increases the PWM duty cycle at pin 7. The increased PWM 'ON' time keeps Q802 ON for longer periods, resulting in Q801 being kept OFF for longer periods. This lowers the boost voltage. The lowered boost voltage therefore, lowers the high voltage. The opposite effect occurs when the high voltage lowers.

High Voltage Shutdown

This circuit monitors the high voltage circuit for the following:

- Excessive high voltage from the HV block,
- Excessive boost voltage from the HV booster, and
- Excessive HV current.

Excessive High Voltage

Normal high voltage is 31.5kV. The high voltage level is sensed by monitoring the HV protect pin of the HV block at IC804/pin 3. The voltage at this pin is the HV divided down to 7.7Vdc. The voltage is further reduced to 4.8Vdc, and is compared to a reference 5V at comparator IC804/pin 2. The result is a LOW output at IC803/pin 1 and IC804/pin 7. Boost control IC805/pin 5 is held LOW and the IC operates. HV Protect Q804 is kept OFF.

When the HV level exceeds 33.5kV, the voltage level at comparator IC804/pin 3 will rise above the 5.1Vdc comparator reference voltage at pin 2, causing pin 1 to go HIGH. IC804/pin 7 also goes HIGH. This HIGH serves two functions:

1. It turns ON HV Protect 1 Q804 to ground the HD signals at Q803/C, thereby disabling the HV Converter. High voltage shuts down.
2. It forward biases D810 which places a HIGH at IC805/pin 5 (STOP). This disables the IC and stops HV boost operation.

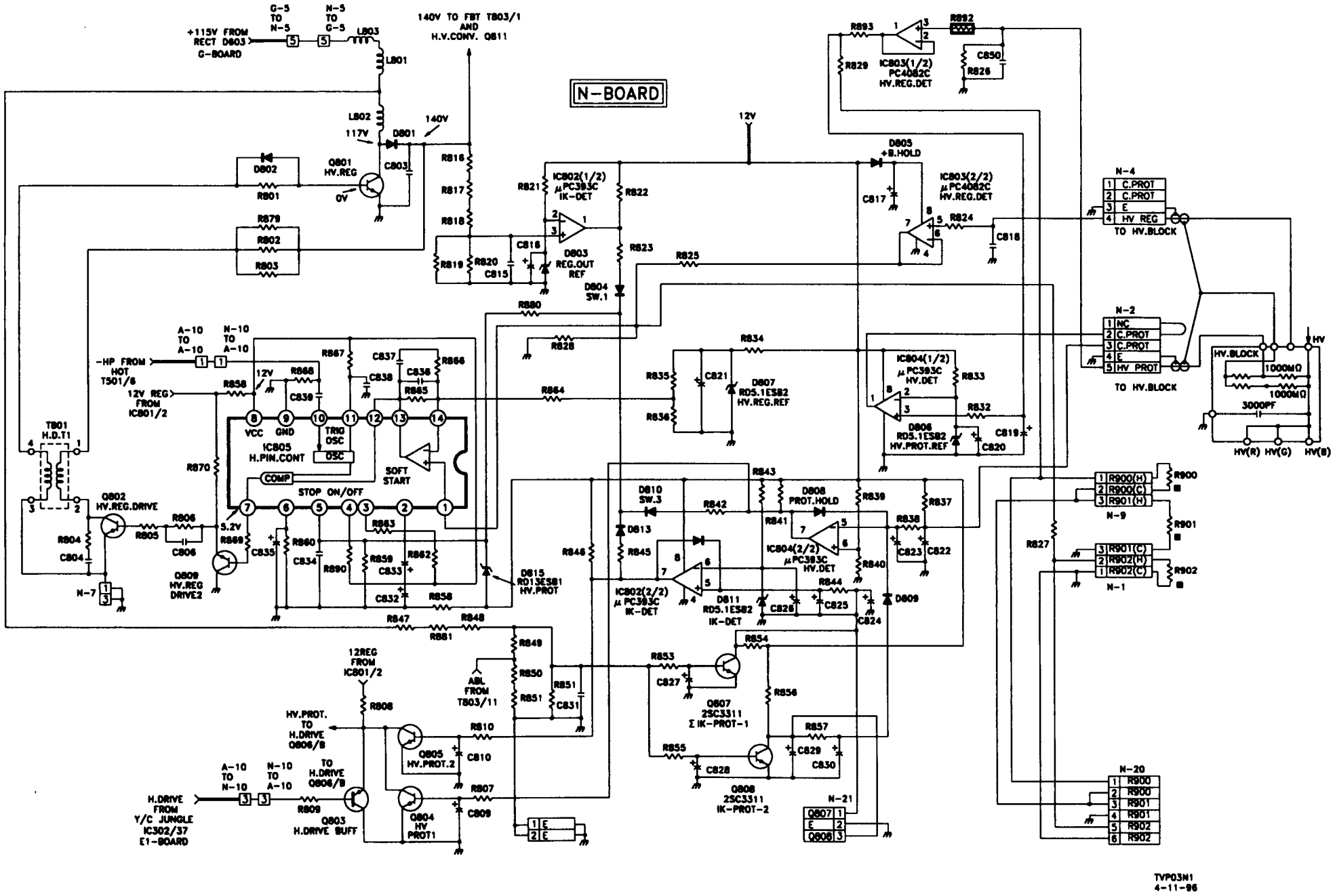
D808, across comparator IC804, latches the circuit until the set is switched OFF.

Excessive Boost +B

The Boost +B voltage is reduced to 3.4V and sent to Comparator IC802/pin 3. Therefore, pin 1 of the comparator is LOW.

If the boost level exceeds 145V, the voltage at comparator IC802/pin 3 will exceed the threshold level, causing pin 1 to go HIGH (12V). This forward biases D804, and sends the HIGH to IC805/pin 5 (STOP) to disable IC805 thereby removing boost.

The Boost +B protect does not latch. However, the picture becomes very dark and its size reduces.



AP CHASSIS - H.V. SHUTDOWN

Over Current Protect

Excessive HV anode current is sensed by Q807 and Q808. The base bias for these two transistors is set by the +115Vdc line, by the variable ABL line, and by the voltage divider consisting of R847 through R851 and R881. During normal operation, the ABL voltage level varies from 4.9Vdc for a dark screen, to 1.1Vdc for a bright screen. The bias configuration is such, that during normal operation Q807 and Q808 are always biased ON. If the HV current exceeds 3.4mA, the ABL line will go sufficiently negative for Q807 and Q808 to turn OFF. These transistors trigger shutdown in different areas of the shutdown circuit. The effect of Q807 will be described first, then the effect of Q808.

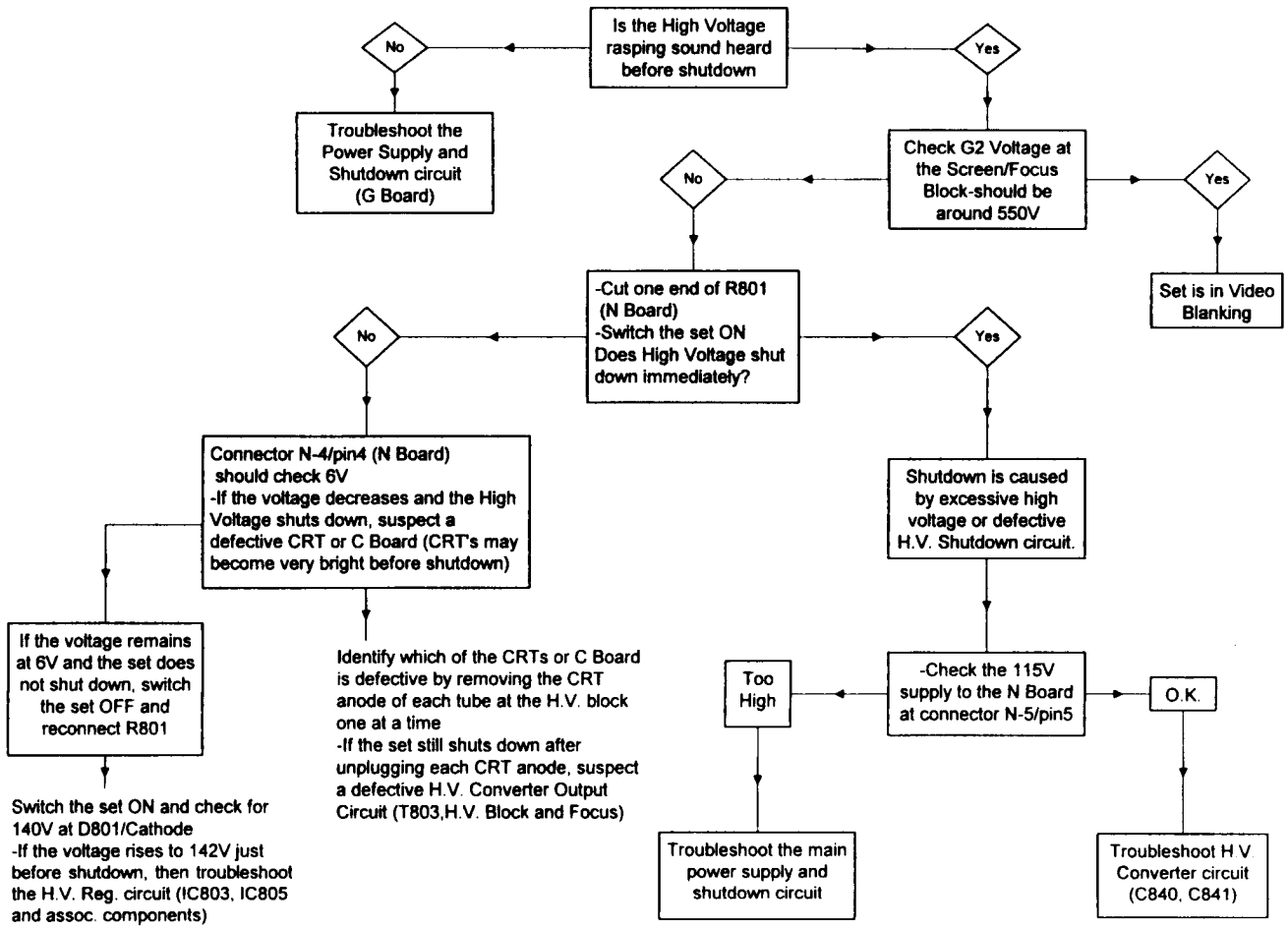
Q807 Effect:

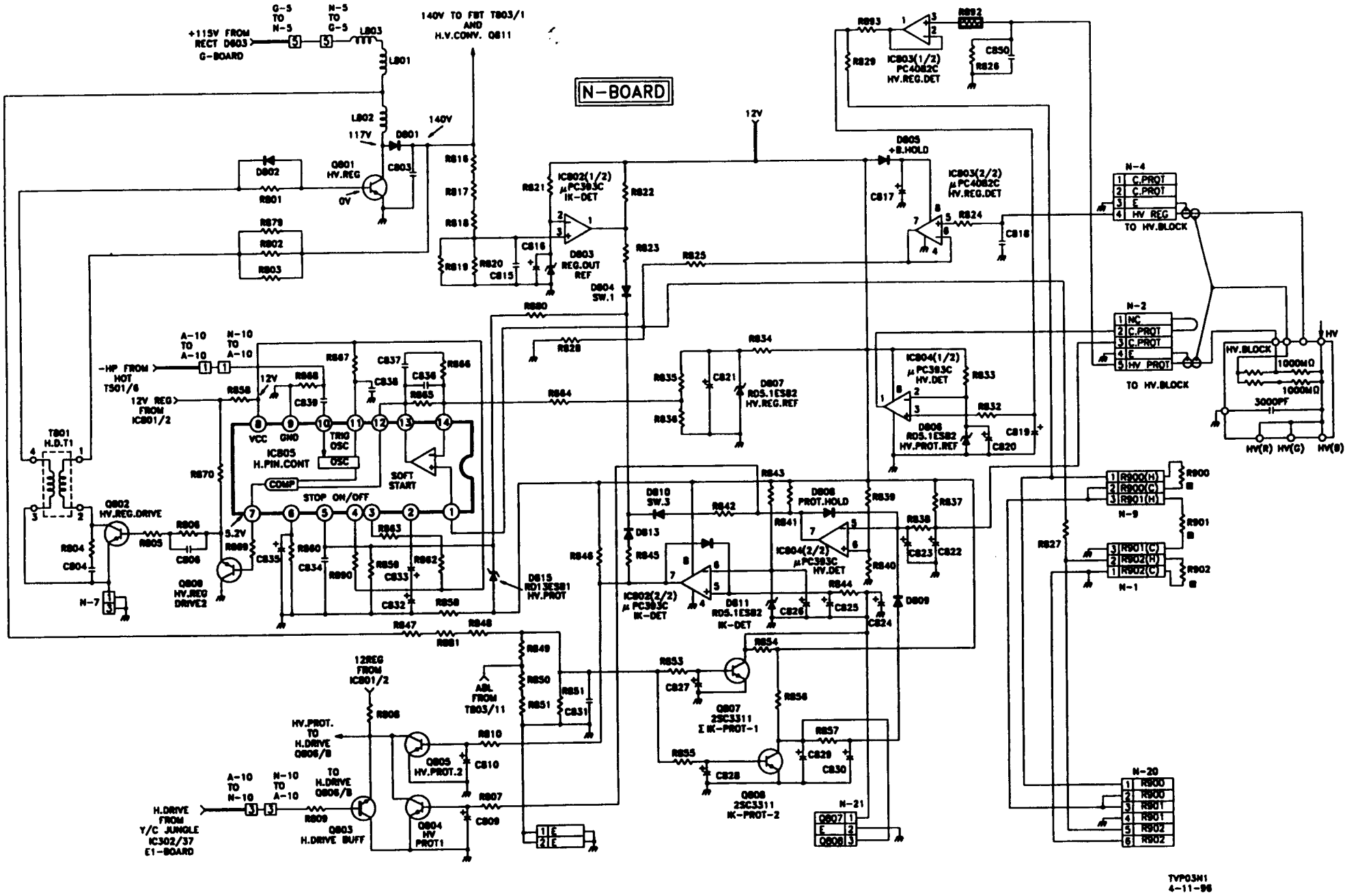
1. With Q807 OFF, its collector goes HIGH causing IC802/pin 7 to go HIGH and turn ON HV Protect Q805. This disables the H. Drive circuits to shut down the high voltage.
2. The HIGH at IC802/pin 7 also disables Regulator IC805 via D813.

Q808 Effect:

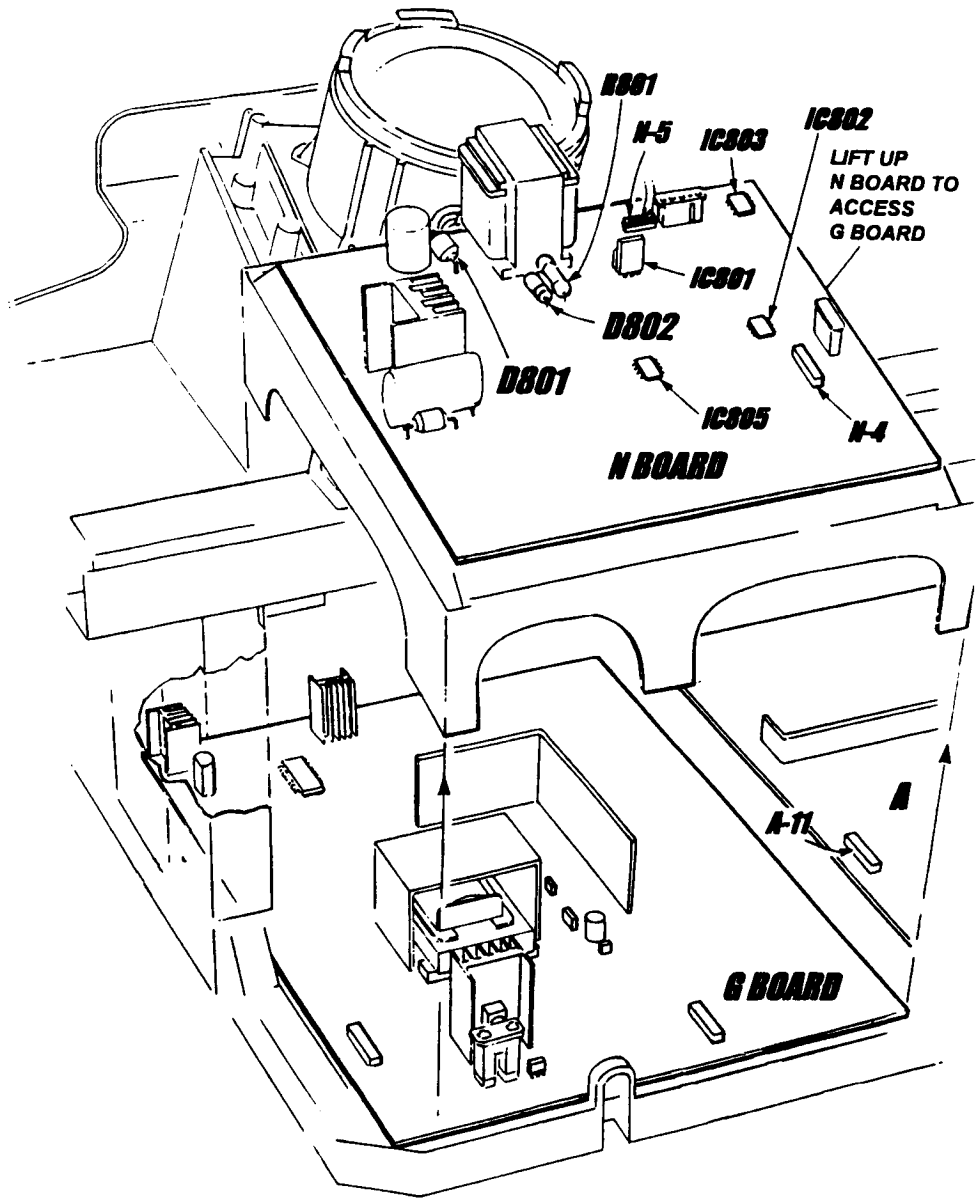
1. With Q808 OFF, its collector goes HIGH causing IC804/pin 7 to go HIGH. This disables Regulator IC805 via D810.
2. Turns HV Protect Q804 ON. This disables the H Drive circuits to shut down the high voltage.

AP Chassis
High Voltage Shutdown Troubleshooting





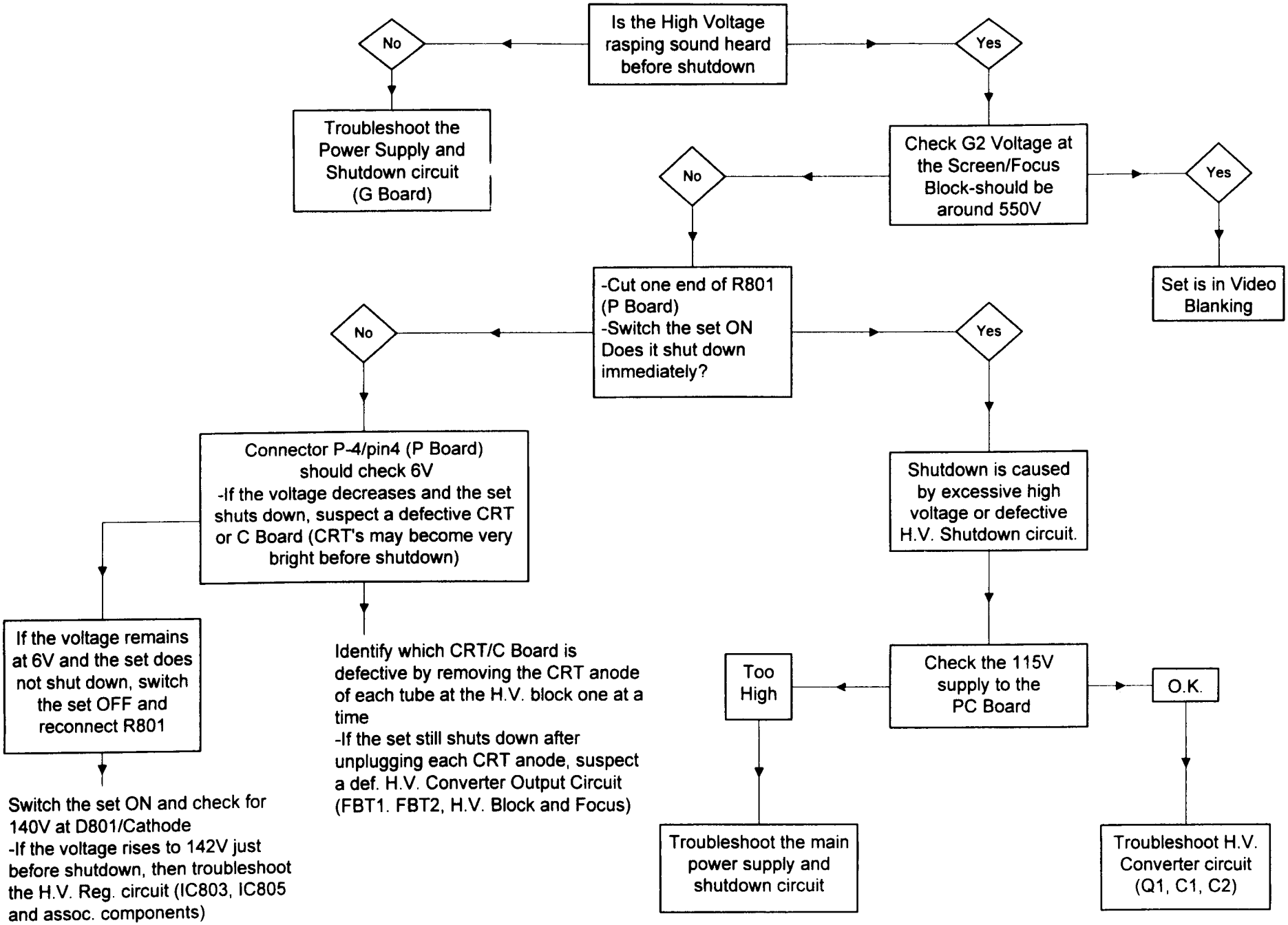
AP CHASSIS - H.V. SHUTDOWN



AP CHASSIS G AND N BOARD LAYOUT

NOTES

KPR-46CX10 Chassis
High Voltage Shutdown Troubleshooting



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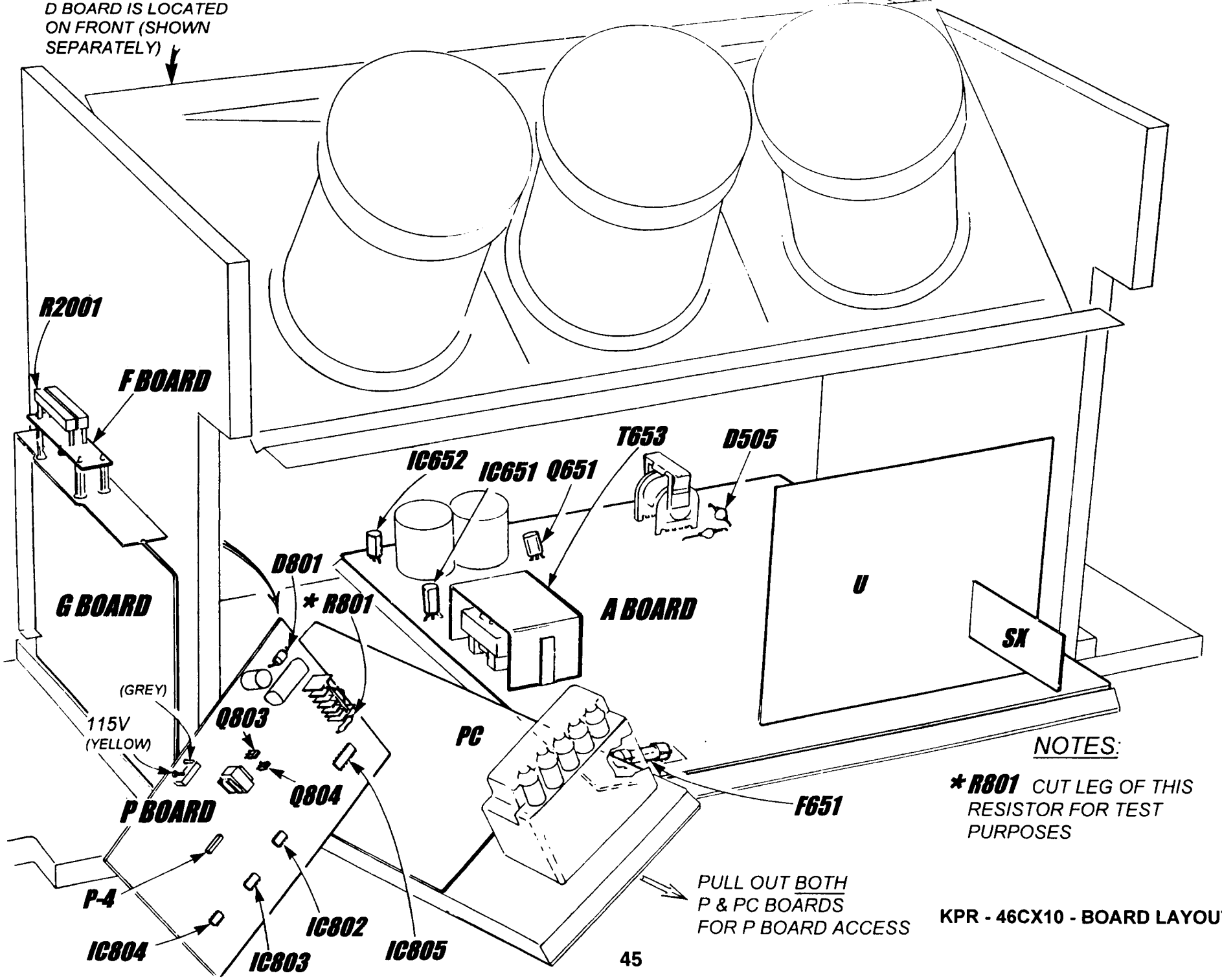
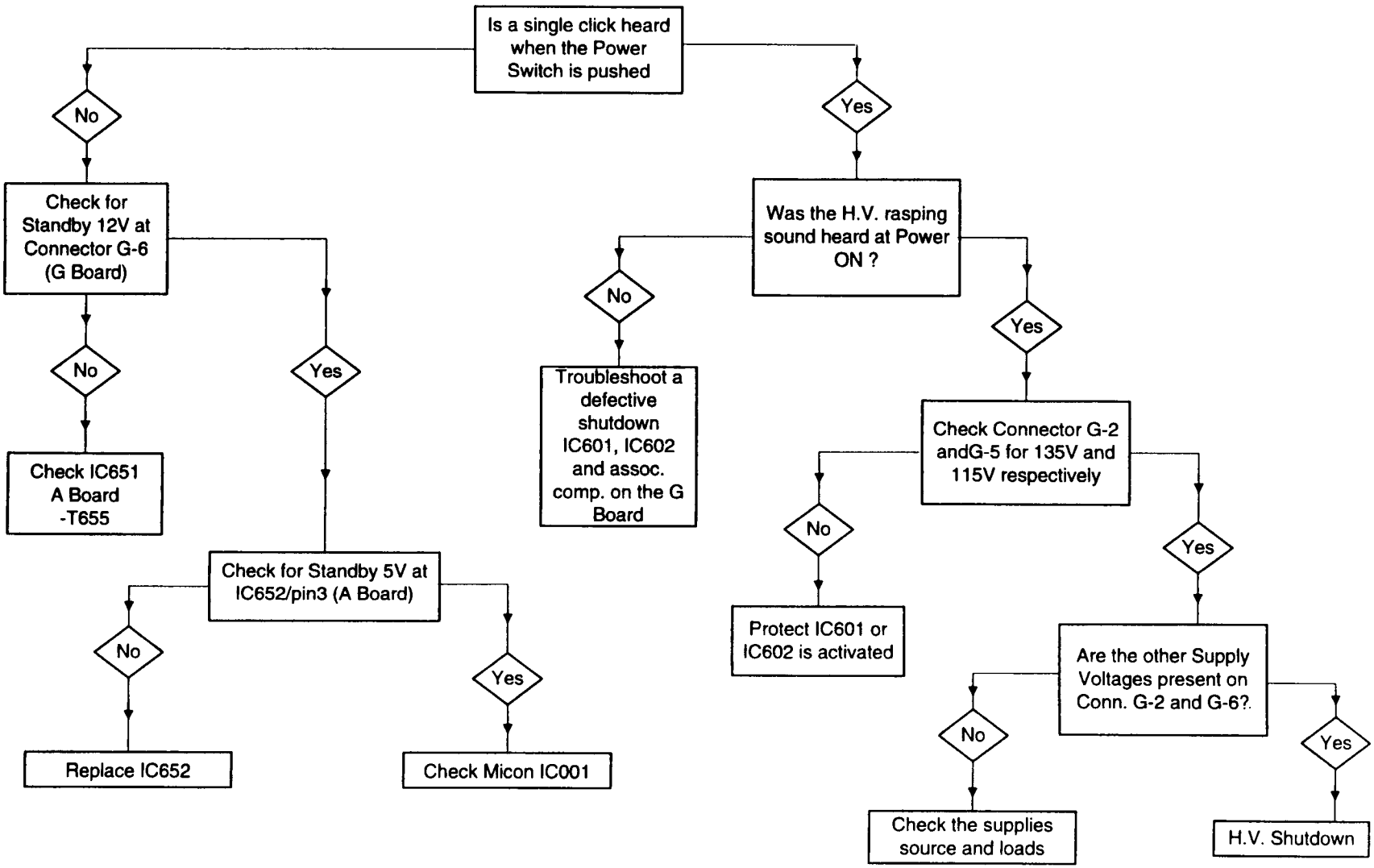


KPR - 46CX10 - BOARD LAYOUT

Troubleshooting KPR-46CX10 Chassis Dead Set (No Picture)

The following flowchart will help isolate the circuit or components responsible for a dead set. If the 'SLEEP' led on the front panel stays ON, the set is either in power supply shutdown, high voltage shutdown or video blanking.

No Picture - KPR-46CX10 Chassis



Pre Power ON Test

After repairing a dead set, especially when the converter transistors were shorted, do the following test before full AC power is applied to the set, to verify that the G Board is without problems.

1. **Plug the set into a variac/isolation transformer set to 0V.**

2. Unplug connectors G-2, G-3, G-4 and G-5 from the G Board.

3. Use an alligator clip jumper and connect the right side of F651 on the A Board to R2001 on the F Board (mounted above the G Board).

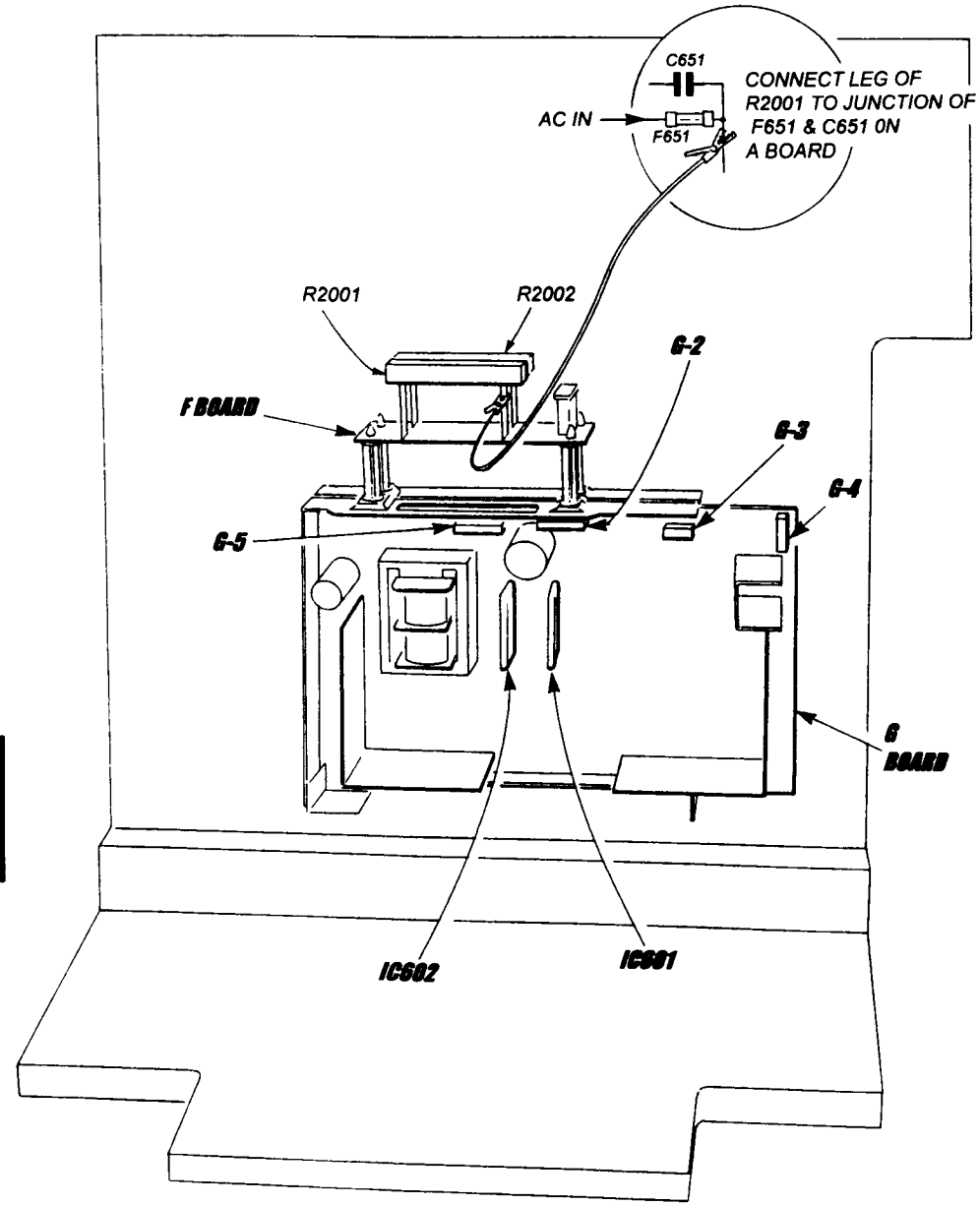
4. Switch ON the variac and **gradually increase the voltage to 30VAC MAXIMUM**, while monitoring the ampmeter of the variac. The current should not rise above 0.275Amps. If it does, check the capacitors and diodes in the converter circuit, a short still exists on G Board.

   The reduced voltage readings of the various supplies at G-2, G-3 and G-5 on the G Board with 30VAC input should be as follows:

Normal Voltage	135V	15.5V	-15.5V	-135V	45V	115 V	15V
Reduced Voltage	72V	9V	-10V	-85V	30V	43V	6V

If all the voltages are OK, turn the variac down to 0V and switch it OFF. Reconnect the connectors.

Perform the test for an over current condition outlined under the heading **" Troubleshooting an Over current condition"** .



KPR-46CX10 Power Supply Protection Circuits

Regulation Operation

This chassis has two independent switch mode power supplies. One supply develops the 135V, -135V, 15V, -15V, 45V and he CRT heater voltage. The other switch mode power supply develops the 230V, 115V, and another 15V supply.

Voltage regulation for the first power supply is accomplished by sampling the 135V supply at IC601/pin 7 (DM-38). Fluctuations on this supply will be reflected at IC601/pin 9. These voltage fluctuations are used to control the current in PRT T602, and so control the frequency of the converters in the switch mode power supply. (Q601 and Q602). Varying the converter frequency, varies the output voltages from PIT T605.

Voltage regulation for the second power supply is accomplished in a similar manner. The 115V line is sampled at IC602/pin 7 (DM-37). The voltage fluctuations at pin 9 control the current in PRT T603 to control the converter frequency. (Q603 and Q604) and so control the output voltages of PIT T604.

Over Voltage Protection

Over voltage protection in both power supplies is monitored at pin 6 of IC601 and IC602. Should the 135V line rise to about 148V, the circuits within IC601 will latch pin 1 LOW. This LOW turns OFF Relay Driver Q651 on the A Board, and the set shuts down.

A voltage increase on the 115V line to about 125V, will trigger similar circuits in IC602 to latch pin 1 LOW and shut down the set.

Additional over voltage protection for the first power supply is provided by CT T606. Pulses from PIT T605 are coupled to T606 and rectified to produce about 6V at Zener Diode D625/Cathode. Should a condition arise to cause these pulses to create a voltage greater than 7.5V, IC601/pin 2 will go HIGH. Q607 will also turn ON. The HIGH at IC601/pin 2 will latch pin 1 LOW. The set shuts down.

In the event that the voltage at pin 2 does not activate the latch in IC601, Q607 will turn ON and activate it via pin 12.

Over Current Protection

Excessive current on the 135V line will lower the voltage at IC601/pin 7. Pin 9 will go LOW, thereby removing its control of the converter's frequency. The amplitude of pulses to CT T606 will increase causing the voltage at D625/Cathode to rise above 7.5V. (Normally 3.6V). D625 zeners, and IC601/pin 2 goes HIGH. This triggers an internal latch that pulls pin 1 LOW and activate shut down.

Excessive current on the 115V line will activate similar circuits in IC602 to hold pin 1 LOW. Q605 and associated components will pull pin 12 LOW to ensure a LOW at pin 1.

Troubleshooting

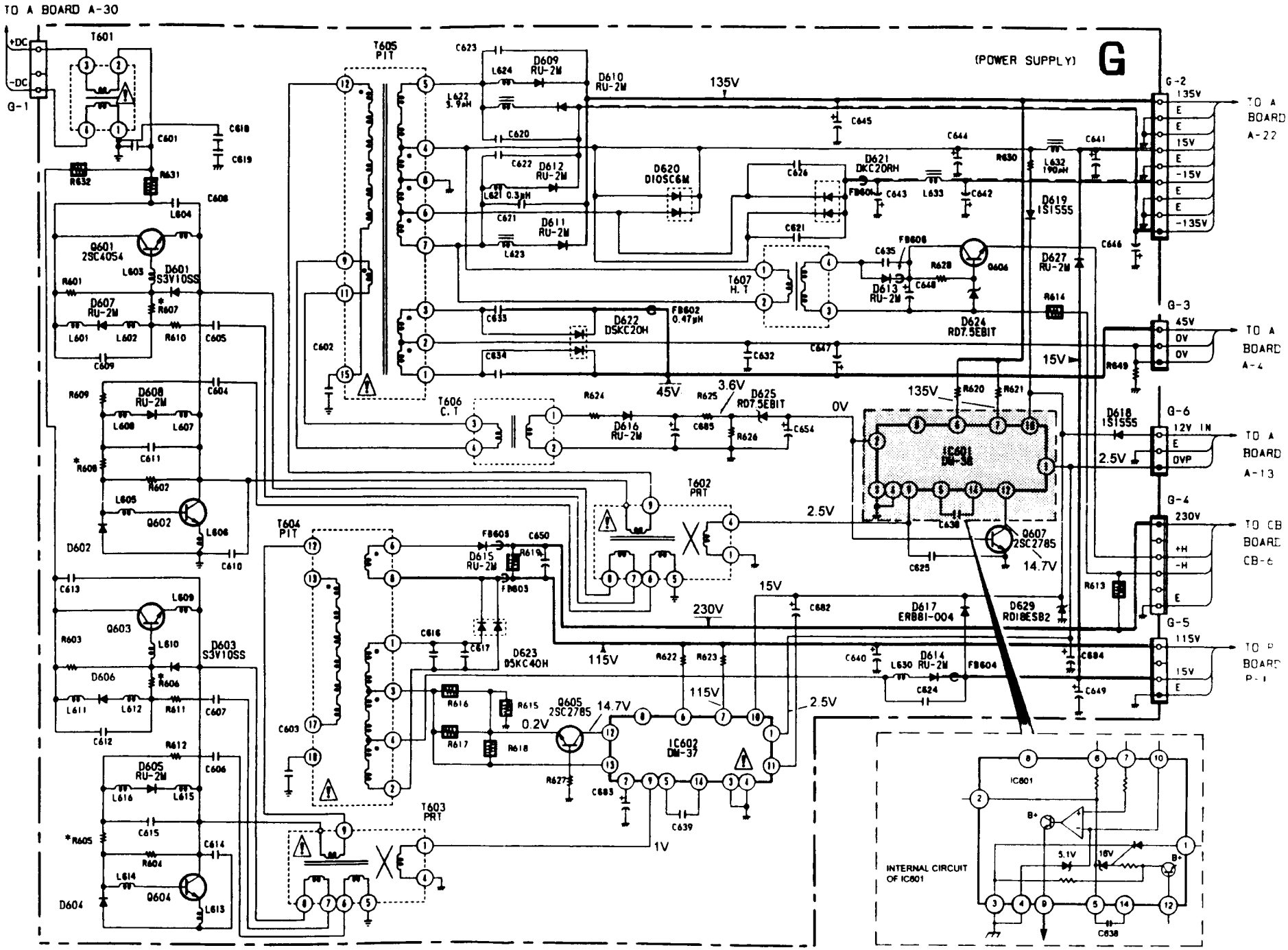
Plug the set into a switched variac / isolation transformer.

Because only over voltage and over current conditions on the 135V and 115V supplies will trigger the protect circuit, an abbreviated form of the PrePower ON test can be used to identify which power supply triggers shutdown.

Never operate the set with full power with the 135V line unloaded, or the OVP circuit disabled.

1. Use an alligator clip jumper and connect the right side of F651 on the A Board to R2001 on the F Board (mounted above the G Board).
2. Switch ON the variac and gradually increase the voltage to 30VAC while monitoring the ampmeter. The current should not rise above 0.75Amps. If it does, check the 135V supply and 115V supply at Connector G-2 and G-5 respectively. The voltage on the defective supply will be very much lower than that shown in the following table.

Normal Voltage	135V	115V
Reduced Voltage	45V	48V


TO A BOARD A-30
(POWER SUPPLY) G
G-1
G-2
G-3
G-4
G-5
G-6
TO A BOARD A-22
TO A BOARD A-4
TO A BOARD A-13
TO CB BOARD CB-6
T601
T605 P1T
T606 C.T
T607 H.T
T602 PRT
T603 PRT
T604 P1T
135V
45V
15V
2.5V
230V
115V
1V
0V
3.6V
14.7V
0.2V
IC601
IC602 DM-37
INTERNAL CIRCUIT OF IC601

NOTES

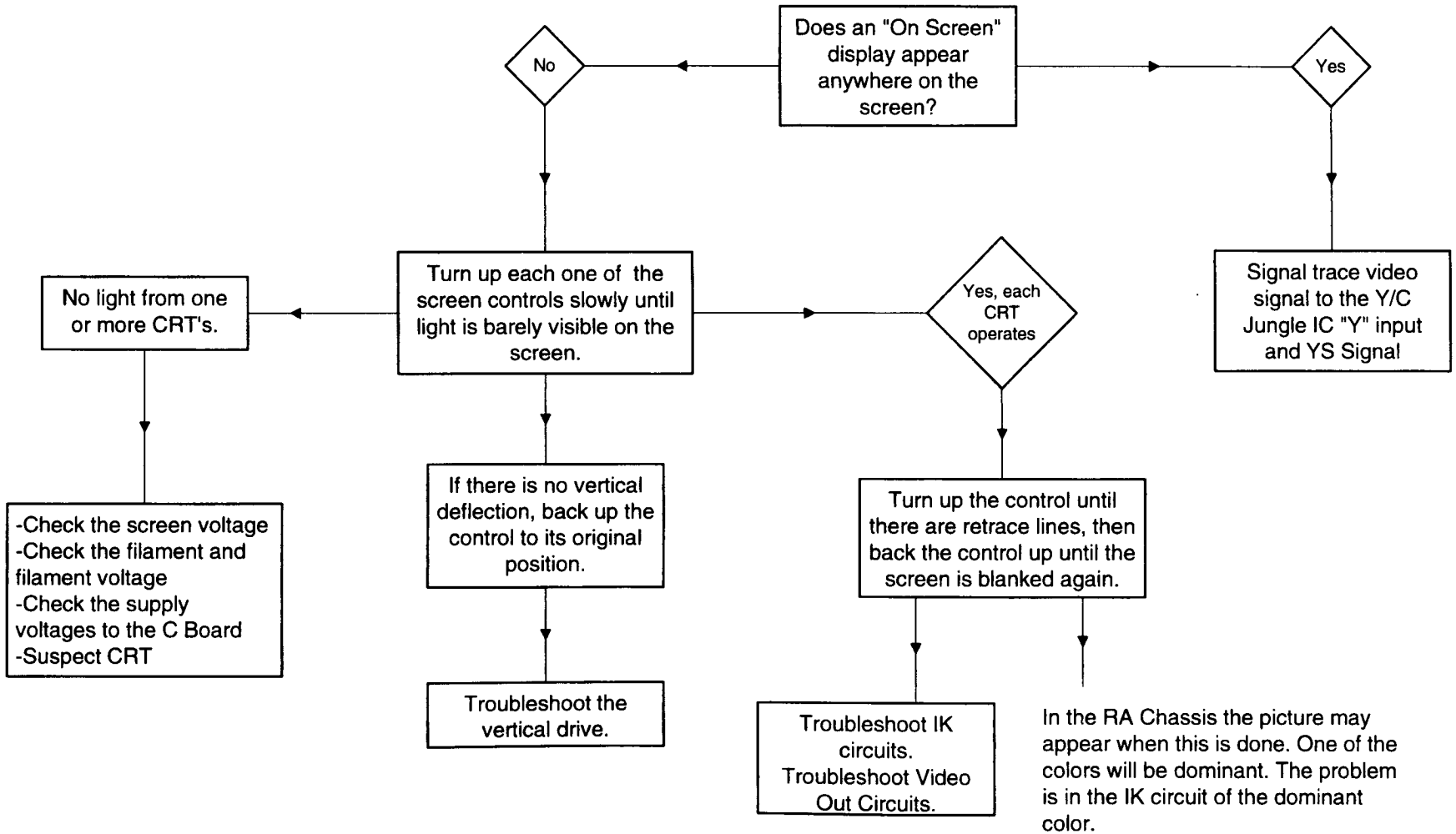
Troubleshooting Video Blanking Problems

The following flowchart applies to the RA, AP and KPR-46CX10 chassis. It will guide the servicer to the section most likely to cause the video blanking problem. Additional flowcharts and texts to help troubleshoot IK and other problems that may cause video blanking are presented on succeeding pages.

The main causes of video blanking are:

1. IK problems. (Except 46CX10 Chassis).
   - G-2 voltage missing or improperly adjusted.
   - Missing filament voltage.
2. Defective Y/C Jungle IC.
3. Loss of vertical drive signals.
4. No Data to Y/C Jungle IC.

NO VIDEO TROUBLESHOOTING



IK Detect Circuits

The purpose of the IK Detect circuits is to provide Automatic Cathode Bias to the CRTs. This is accomplished in the RA and AP chassis by having the Y/C Jungle generate three 1Vp-p IK pulses on lines 25, 26 and 27 after vertical blanking. One pulse each for Red, Green and Blue. These pulses turn ON the cathode of each tube and are fed back to the Y/C Jungle. The amplitude of the each fed back pulse reflects how much each tube is conducting. The Y/C Jungle then adjusts the drive signal to the tubes accordingly. A varying voltage about 5V is normal at the feedback input to the Y/C Jungle. When there is no input signal to the set, the fed back pulses to the Y/C Jungle IC produce about 3.7V at the feedback input pin. The CRTs are blanked when the IK feedback voltage falls below 3.7V.

In the RA Chassis the feedback path is via pin 5 of the three video amp ICs on the CR, CB and CG boards, to Buffer Q701 on the CR Board, then on to Y/C Jungle IC301/pin 25 on the M Board. A similar circuit is used in the AP chassis, however, discrete components are used in the video out circuit.

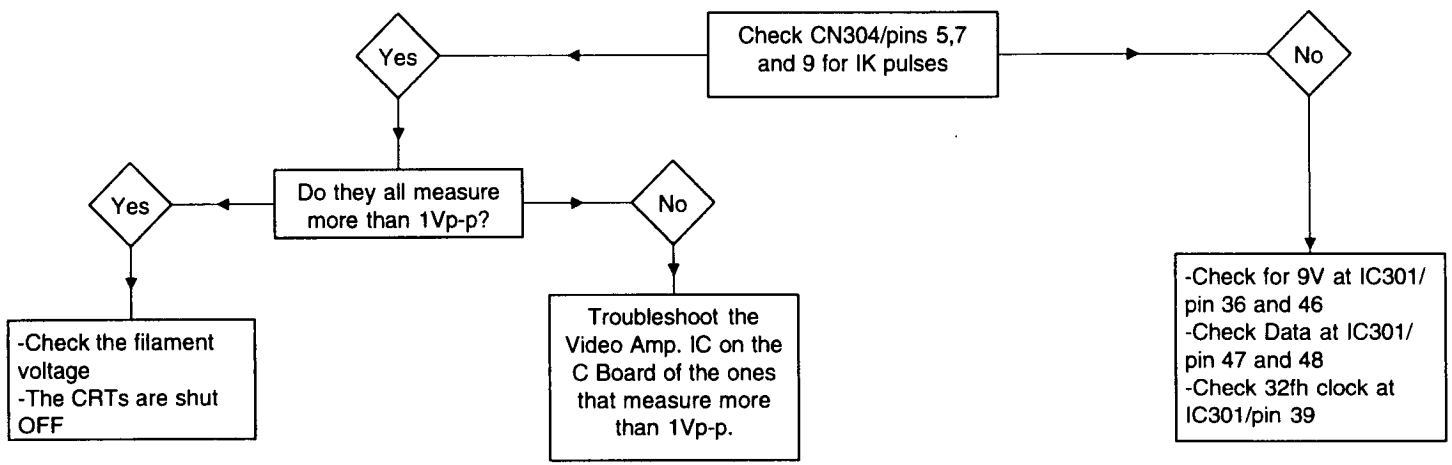
In the 46CX10 chassis, no pulses are generated by the Y/C Jungle IC. A feedback voltage from the cathode is fed back to a summing circuit, the output of which is used by the Y/C Jungle IC to adjust RGB output levels.

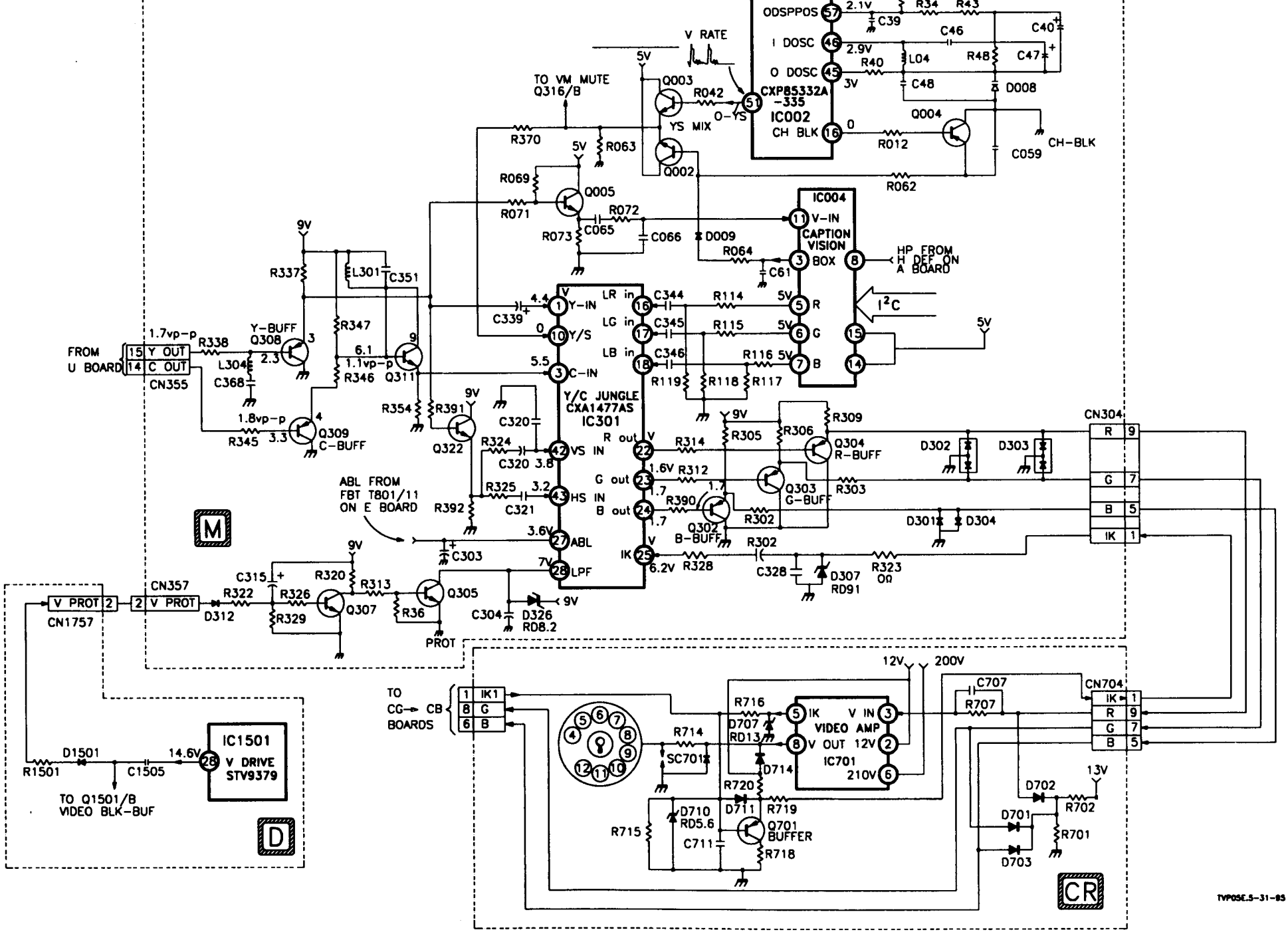
Troubleshooting IK in the RA Chassis.

A quick way to isolate an IK problem in the RA Chassis after following the steps in the "No Video Troubleshooting" flowchart is as follows:

1. Connect an input video signal and turn the set ON.
2. Connect a 1K resistor between CN704/pin 1 and pin 3 on the CR Board, for a couple of seconds. A picture should appear on the screen and remain when the resistor is removed.
3. **If the picture remains**, the white balance will gradually change to the color of the IK Detect circuit that is defective. Check the Video Amp ICs on the C Boards.
4. If the picture disappears when the resistor is removed, troubleshoot the components between Y/C Jungle IC301/pin 25 and R770 on the C Board. No IK signals from any of the video out circuits are reaching IC301/pin 25.
5. **If a picture does not appear**, check the components between CN304/pin 1 and Y/C Jungle IC301/pin 25. Also check D710 and Q701 on the CR Board.

TROUBLESHOOTING IK
BLANKING RA CHASSIS



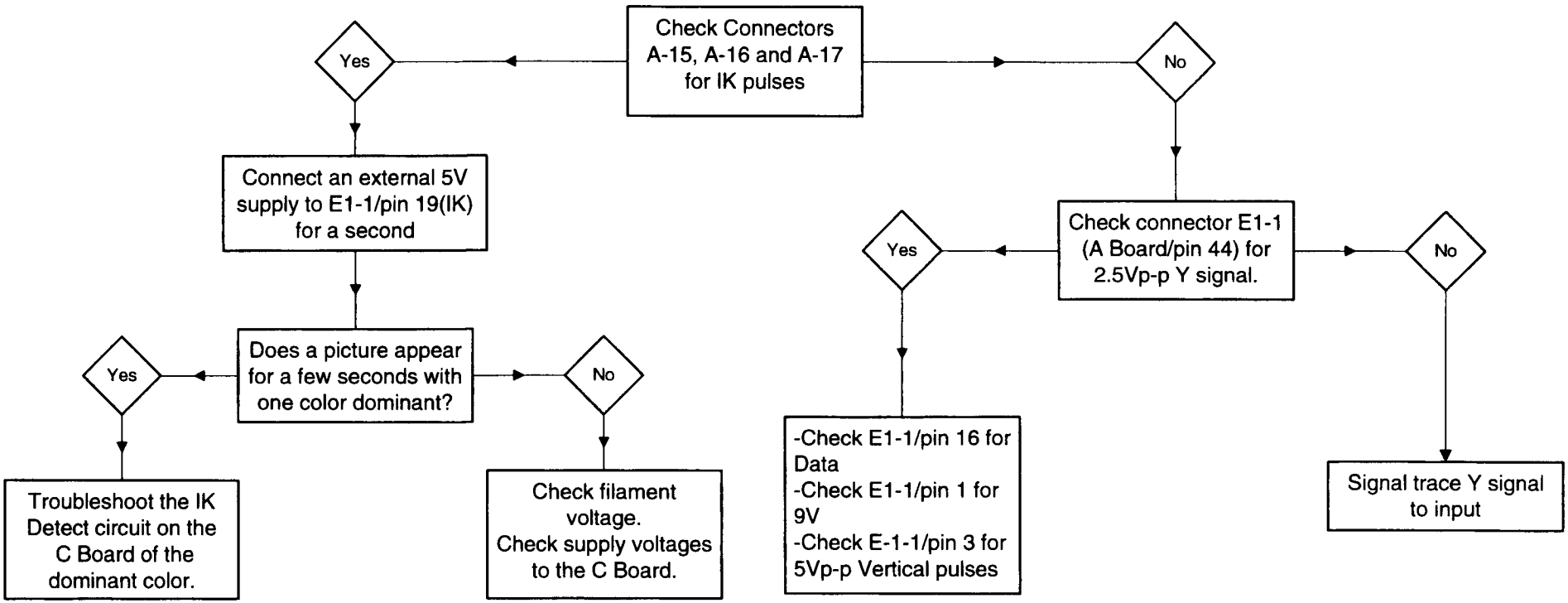


VIDEO SIGNAL PROCESS

Troubleshooting IK in the AP Chassis

Although there are similarities in the IK operation in this chassis to that of the RA Chassis, the board lay out prohibits testing at the Y/C Jungle pins on the E1 Board. Checks can only be made at the E1-1 connector on the A Board.

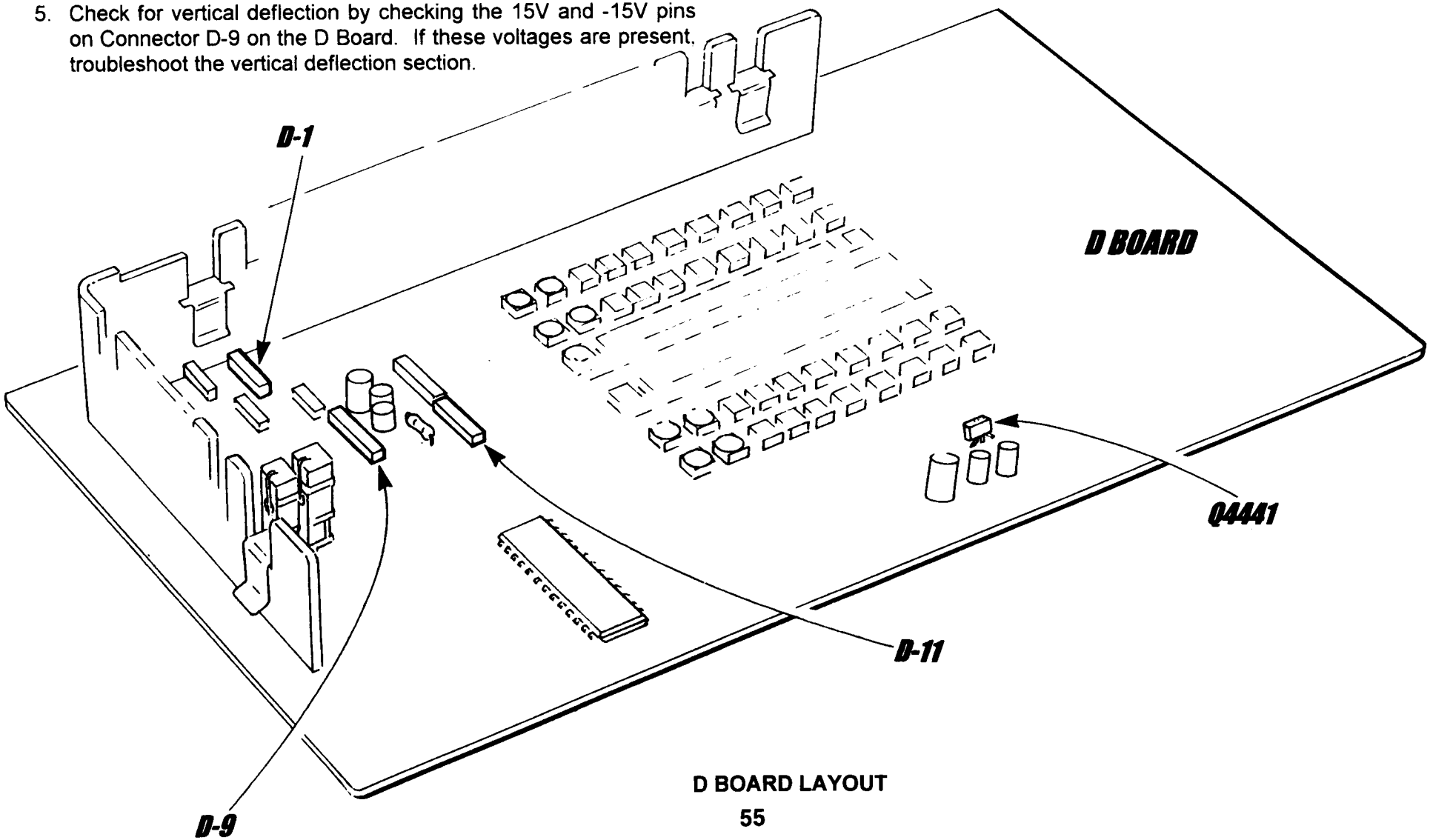
TROUBLESHOOTING IK PROBLEMS-AP CHASSIS



KPR-46CX10 Chassis

The following steps may be taken to point the servicer in the right direction for a No Video problem in the 46CX10 chassis:

1. Remove the front cover.
2. Check for 135V at Connector D-11 on the D Board.
3. Q4441/Collector on the D Board, should be LOW. If it is HIGH the set is in Video mute. Go to step 5.
4. Check the main G2 voltage at the Screen/Voltage block. It should be 550V.
5. Check for vertical deflection by checking the 15V and -15V pins on Connector D-9 on the D Board. If these voltages are present, troubleshoot the vertical deflection section.



D BOARD LAYOUT

Other Causes of Video Blanking

In the **AP Chassis and 46CX10 chassis**, the video will blank if vertical deflection is lost.

If there is a loss of vertical deflection in the RA chassis, the set may cycle ON/OFF continually.

The purpose of the Vertical Protect circuit is to prevent damage to the CRT phosphors in the event vertical deflection is lost. The vertical protection circuits monitor the vertical deflection output signals. When they are missing, a sample voltage to the Y/C Jungle is removed and signals to the RGB output pins are removed. The CRT blanks.

Vertical Protection in the AP Chassis.

The operation of the protection circuit centers around the red vertical deflection signal. The vertical protect circuit, in the following diagram, is comprised of Q906 and Q907. The red vertical output deflection signal, from IC1706/pin 2, is coupled through R1775, voltage divider R1795 and R1791 to the base of Vertical Protect buffer Q906. During normal operation the signal applied to the base of Q906 is reduced from 62Vp-p to 13Vp-p through the voltage divider.

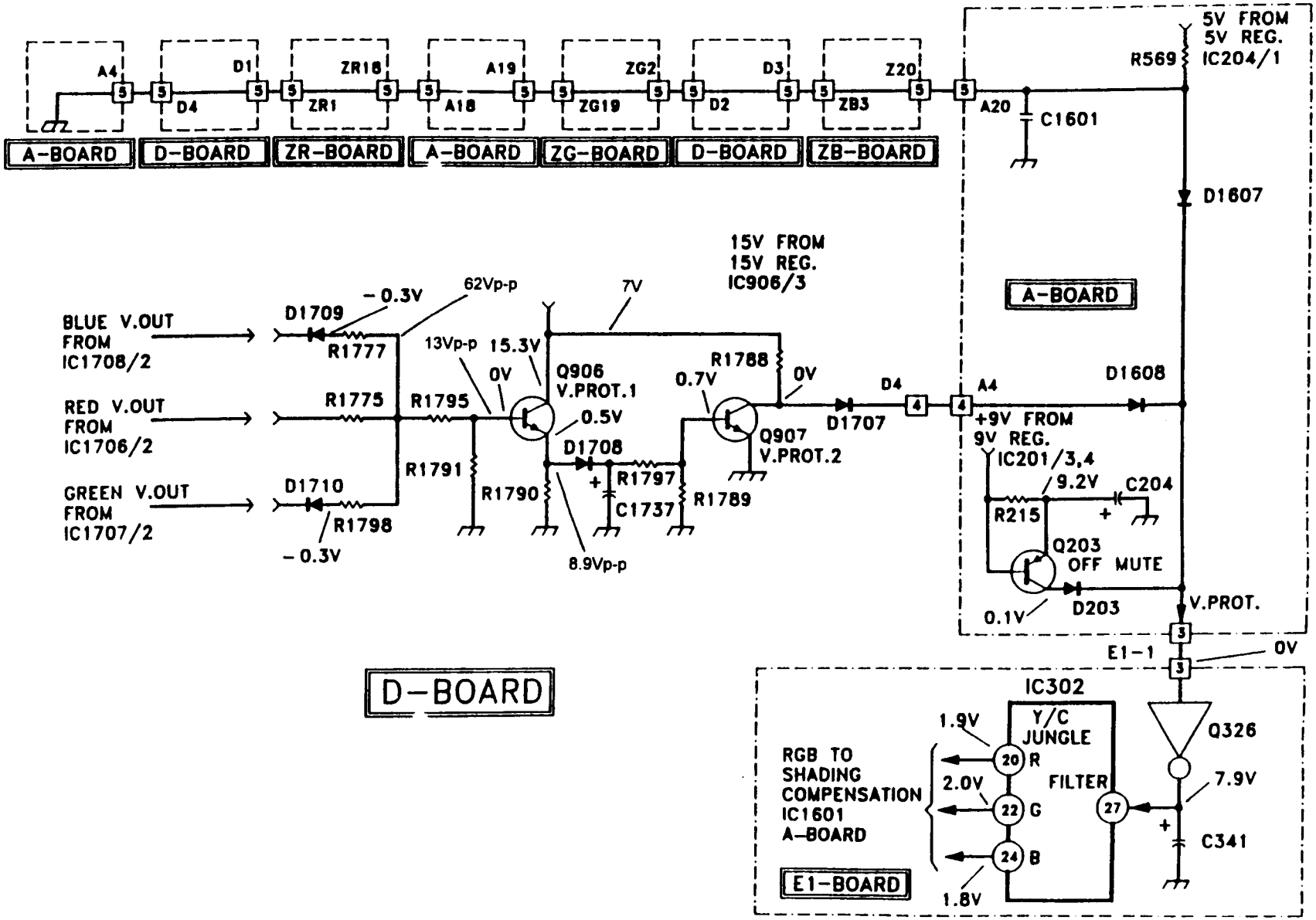
The deflection signal is output from its emitter at 8.9Vp-p. D1708 and C1739 rectify and filter the signal to produce 7.2Vdc. This voltage is coupled through R1797 and R1789 to forward bias Q907. Its collector is held LOW.

The components on Q326/B (E1 Board) keeps it OFF, therefore it places 8V on Y/C Jungle IC302/pin 27 (FILTER).

A loss of vertical deflection will remove drive pulses from Q906/Base resulting in Y/C Jungle IC302/pin 27 going LOW. The IC will disable the output signals at pins 20, 22, and 24.

Deflection Yoke Ground Interrupt.

CRT blanking is activated when the connector to any one of the deflection yoke is unplugged, or any of the ground connections shown on the A and D Boards is opened. Each yoke board provides part of the ground circuit that keeps D1607 OFF. As long as the path to ground is not broken, the anode of the D1607 will remain grounded and the Y?C Jungle IC302 processes video signals. If any yoke is unplugged, or the ground path opens, D1607 forward biases. This causes Q326 to pull Y/C Jungle IC302/pin 27 LOW and blanks the video.



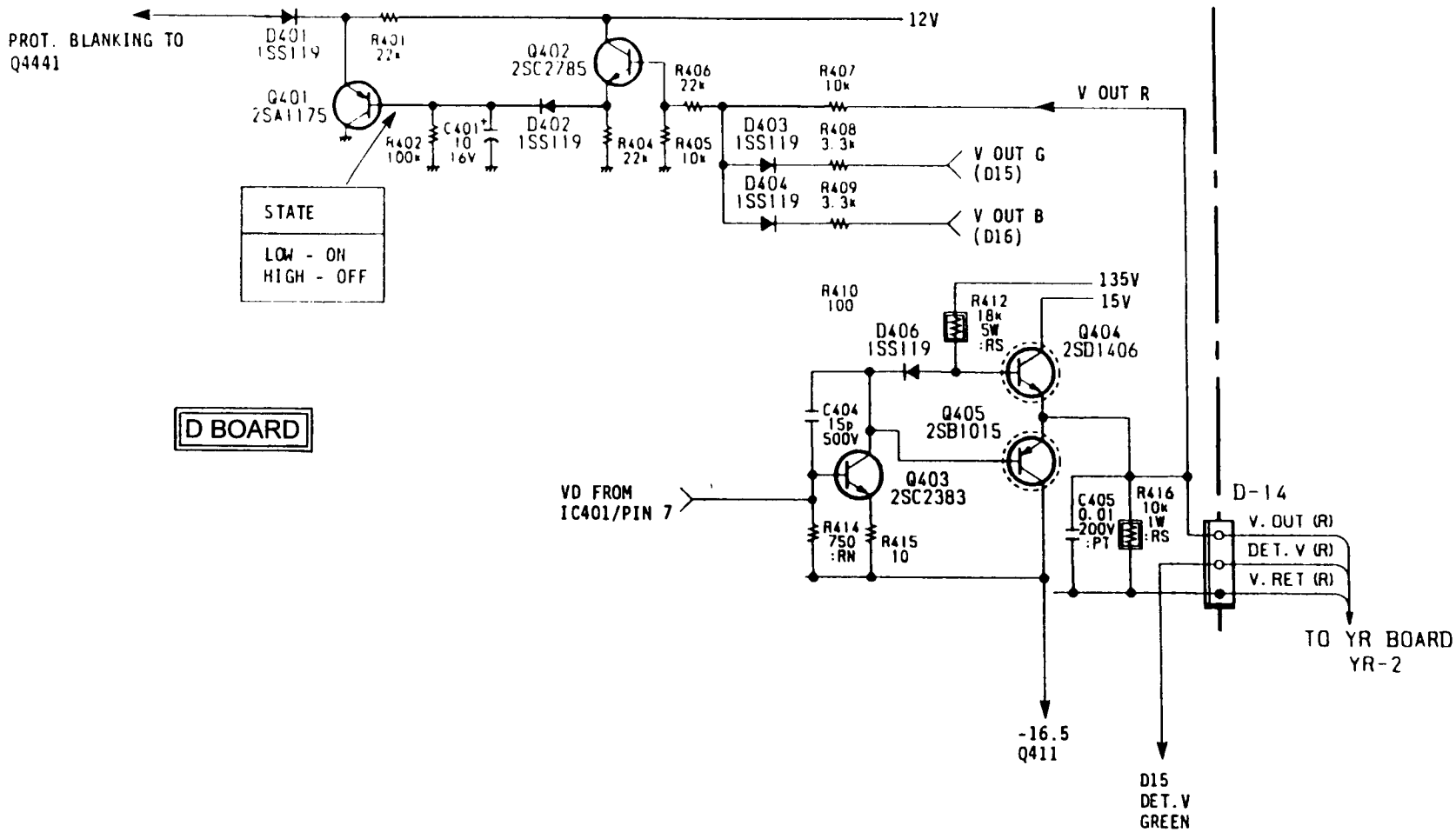
AP CHASSIS - VERTICAL PROTECT.

Vertical Protection in the KPR-46CX10

Loss of Vertical Drive

During normal operation, the red vertical drive signal is reduced to 14Vp-p and applied to Q402/Base. The pulses are rectified and filtered by D402 and C401 and the resulting voltage holds Q401 OFF. D401 is reversed biased.

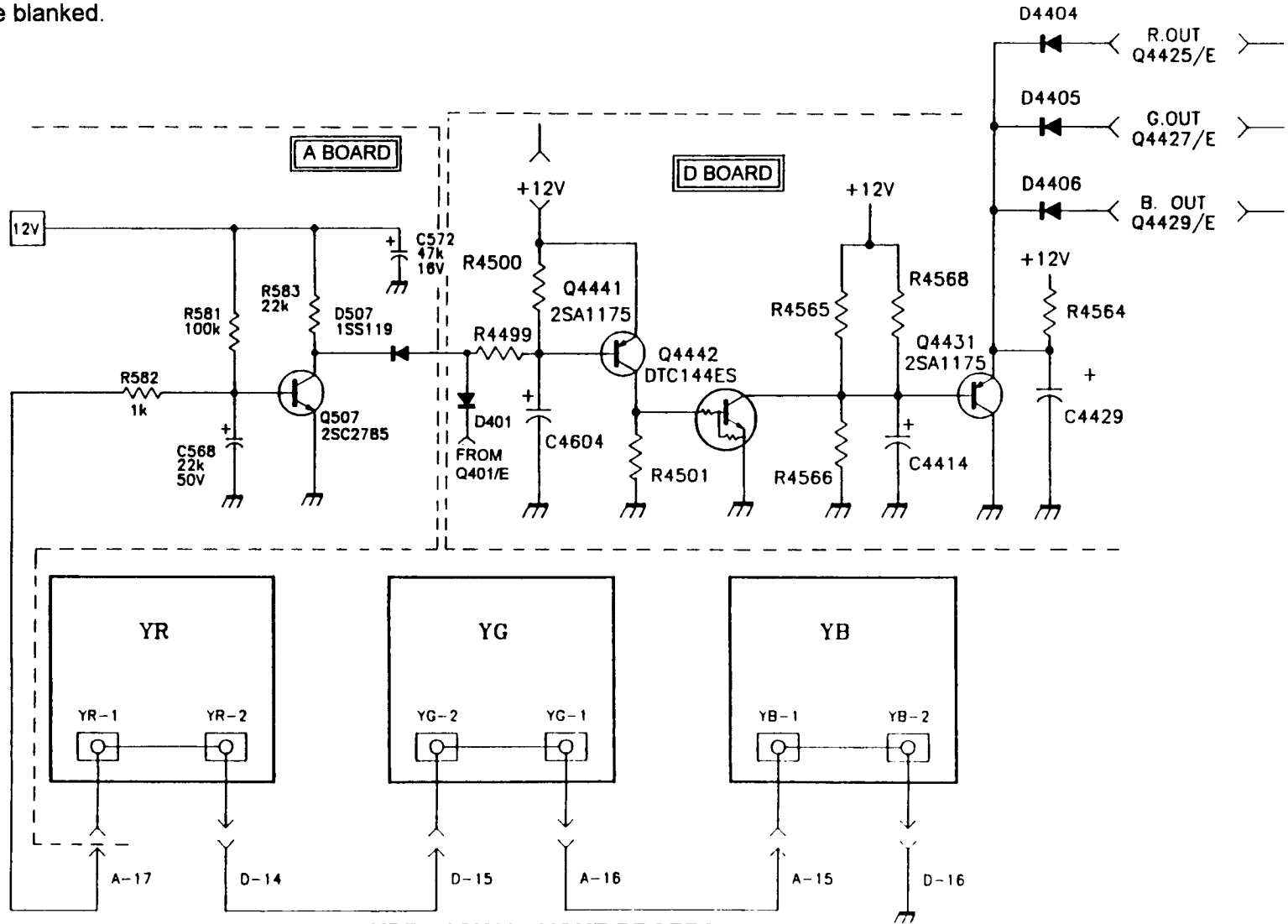
A loss of vertical drive signals will remove the voltage from Q401/Base causing it to turn ON and forward bias D401. This forward biases Q4441 in the Protection Blanking circuit (diagram on the following page), which disables the RGB output amplifiers.



KPR-46CX10 - VERTICAL PROTECTION

Yoke Detect Circuit.

The three deflection yokes are mounted on the YR, YG and YB Boards. Q507, part of the detect circuit on the A Board, is kept OFF by the ground path provided by the series connections of the three yoke boards. If one of the boards is unplugged, the ground connection opens. Q507 turns ON and places a LOW on Q4441/Base (D Board). The final result is Q4431 turning ON and pulling the bases of RGB Out Transistors Q4425, Q4427 and Q4429 LOW. The CRTs are blanked.



KPR-46CX10 - YOKE PROTECTION

Parts Most Used in Service

PARTS MOST USED IN SERVICE

Reference	Board	Description	Part No.
RA CHASSIS			
Audio Amp IC230	A Board	TDA7265	8-759-190-89
Audio Processing IC202	A Board	TDA8424	8-759-090-21
Switching Regulators Q601, Q602	G Board	2SC4834M	8-729-019-49
Fuse Resistor R606	G Board		1-202-933-61
Video Out IC701, 731, 761	CR, CG, CB Boards	TDAG101Q	8-759-168-72
Y/C Jungle IC301	M Board	CXA1477AS	8-752-063-50
Red CRT		O7MAB05	8-736-080-05
Remote Commander			1-407-059-21
Speaker			1-504-785-11
AP CHASSIS			
Sub-Out IC1 and 2, IC1704, IC1705	D Board	STK4278-L	8-749-923-16
Transistor		2SA1261	8-729-103-90
1/4W 0.47Ohm Resistor			1-249-377-11
Green CRT		07MK(G)	8-736-631-05
0.27uf Capacitor			1-136-121-00
G, MCB			A-1316-134-A
Transistor		2SC4582-N	8-729-011-15
Thyristor D630	G Board	CSM2B4A10	8-719-913-64