SONY®

Training Manual

Projection TV - RA Chassis

Circuit Description and Troubleshooting

Course TVP-05

Projection TV - RA Chassis

Models: KP-41T15, 46S15, 53S15, 46V25, 53V25, 61V25, 53XBR45, and 61XBR45

Circuit Description and Troubleshooting

Prepared by
National Training Department
Sony Service Company
A Division of Sony Electronics, Inc.

Course presented by ______________________

on ______________________

Attended by ______________________

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Introduction

The 1995 projection TV product line consists of eight new models, in 41", 46", 53", and 61" screen sizes. The new models use the new RA chassis design. All have the following new features:

- ◊ Advanced PRO-OPTIC™ system. This system contains a short-focus 4-element hybrid lens assembly, color calibrated lenses, and an improved dual component screen which contains both a TFF (Thin Film Fresnel) screen and a fine pitch lenticular screen. This allows for a smoother, less grainy appearance.
- ◊ A MICRO-BEAM™ CRT which has a shorter neck and a wider 150° deflection angle.

Board Descriptions

All of these models (except the 61" models) contain 9 circuit boards mounted on a plastic chassis. In addition, six boards are mounted to the CRTs. This configuration differs from the previous AP chassis in which the circuit boards and the CRTs were removed together.

The list below describes the circuits found on each board. This is followed by lists of the features found in each model. Finally, the diagram on the facing page illustrates the location of each board.

Name	Description
A	Audio circuits, H. def, Tuner, Pincushion.
CR,CB,CG	CRT drive and IK feedback.
ZR,ZG,ZB	Hor. and Vert. deflection coils, velocity modulation
D	Vert. deflection, Electronic convergence,
E	High voltage, Dynamic focus, H.V protection.
G	Power supply
HA,HB	Front panel controls, SIRCS.
M	MI-COM, Y/C jungle, Caption Vision, Velocity modulator
P	Picture in Picture (same as AA-1 chassis)
U	A/V switching, I/O panel, Y/C separation.

Model Features

The model numbers are: KP-41T15, /46S15, /53S15, /46V25, /53V25, /61V25, /53XBR45, and /61XBR45. The following features are common to all models.

- ◊ Wideband VIF
- ◊ Auto white balance
- ◊ New Dynamic Picture
- ◊ Dynamic Focus
- ◊ Video Noise Reduction
- ◊ Auto pedestal clamp
- ◊ High Voltage Regulator
- ◊ Shading Compensation
- ◊ TFF Screen with 150° view angle.
- ◊ Front panel A/V input
- ◊ MTS
- ◊ PIP position, swap, freeze.
- ◊ New program palette
- ◊ Video Label
- ◊ EDS
- ◊ Caption Vision
- ◊ Progammable Timer
- ◊ Multi-language
- ◊ Pre-programmed Remote
- ◊ SIRCS I/O

The following features are model specific.

Horizontal Resolution

KP-41T15 = 760 lines.

All 46" models = 850 lines.

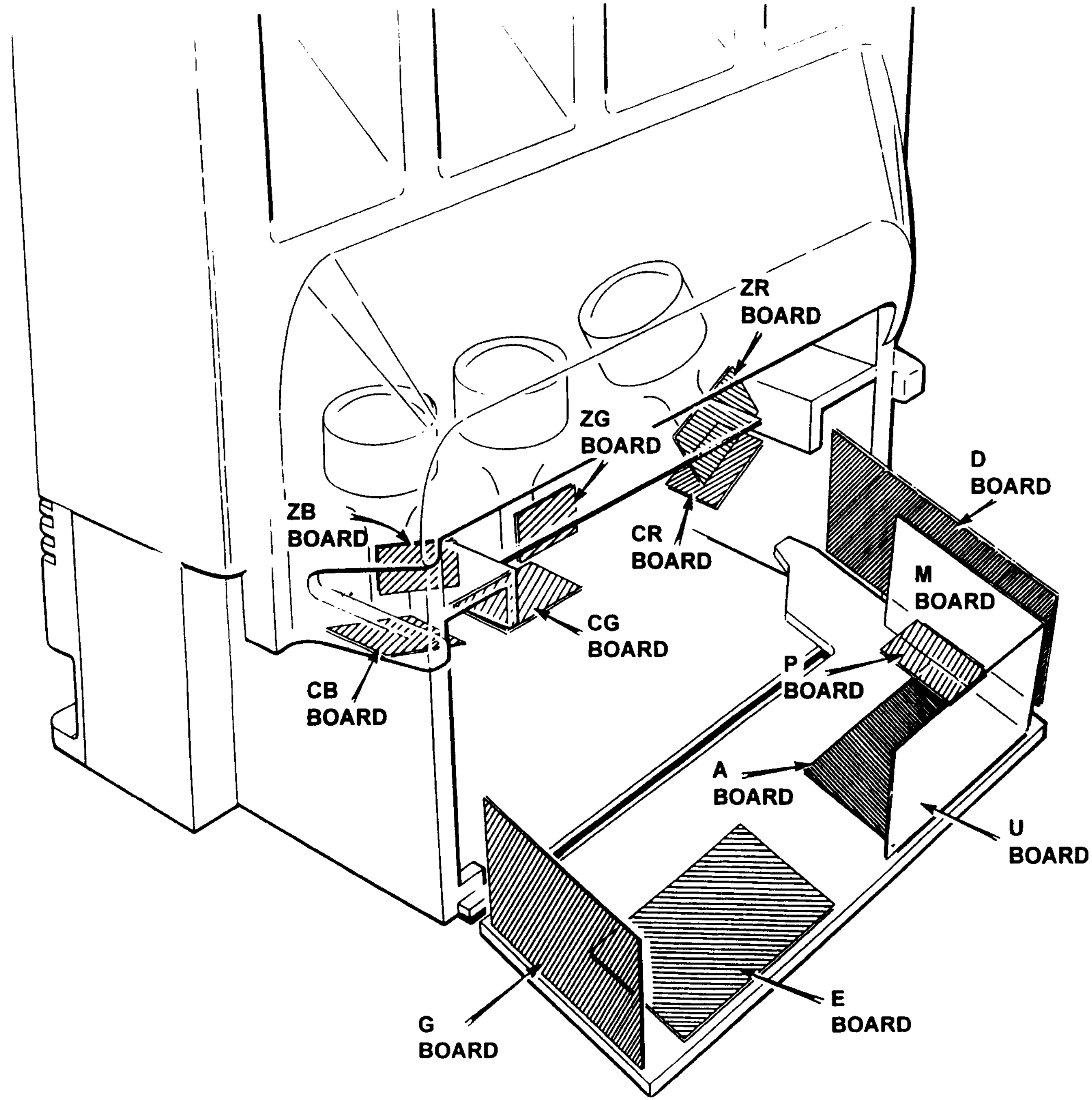
All 61" models = 1100 lines.

All 53" models = 900 lines.

Video

Glass Comb filter - "S" and "T" models.
Digital Comb Filter - "V" models.
3D comb filter - XBR models.

Velocity Modulation - **All models except KP-46/53S15.**



BOARD LOCATIONS page 3

Audio

Main Speaker Audio Power - 7Wx2 for "S/"T" models.
10Wx2 for "V" models
20Wx2 for XBR models.

Center Speaker Audio Power - 20Wx2 for XBR models.
Rear Speaker Audio Power - 10Wx1 for XBR models.
Dolby® PRO-LOGIC - XBR models only.
Matrix surround - All models except XBR.
Variable and Fixed Outputs - All models except XBR.
Variable or Fixed Outputs - XBR models.
BBE® Sonic Maximizer - "V" models only.

Picture In Picture

Tuner - "T" and "S" models have 1, all others have 2.

PIP Size - All models have 1/9 and 1/16. XBR has 1/4 in addition.

Function - XBR Only

Graphic Interface, PRO-Palette, Direct Play, Favorite Channel.

Terminal

A/V inputs - "T", "S", and "V" models have 3 inputs, XBR models have 5.

S Video - "T", "S", and "V" models have 1 input. XBR models have 5.

Monitor outputs - All models except XBR.

Select Out - XBR models only.

Loop out - "V" and XBR models only.

RF Inputs - "T" and "S" models have 1, "V" and XBR models have 2.

To Converter Output - "V" and XBR models only.

Cabinet Style

Table top - KP-41T15.

Slim Style - "S" models

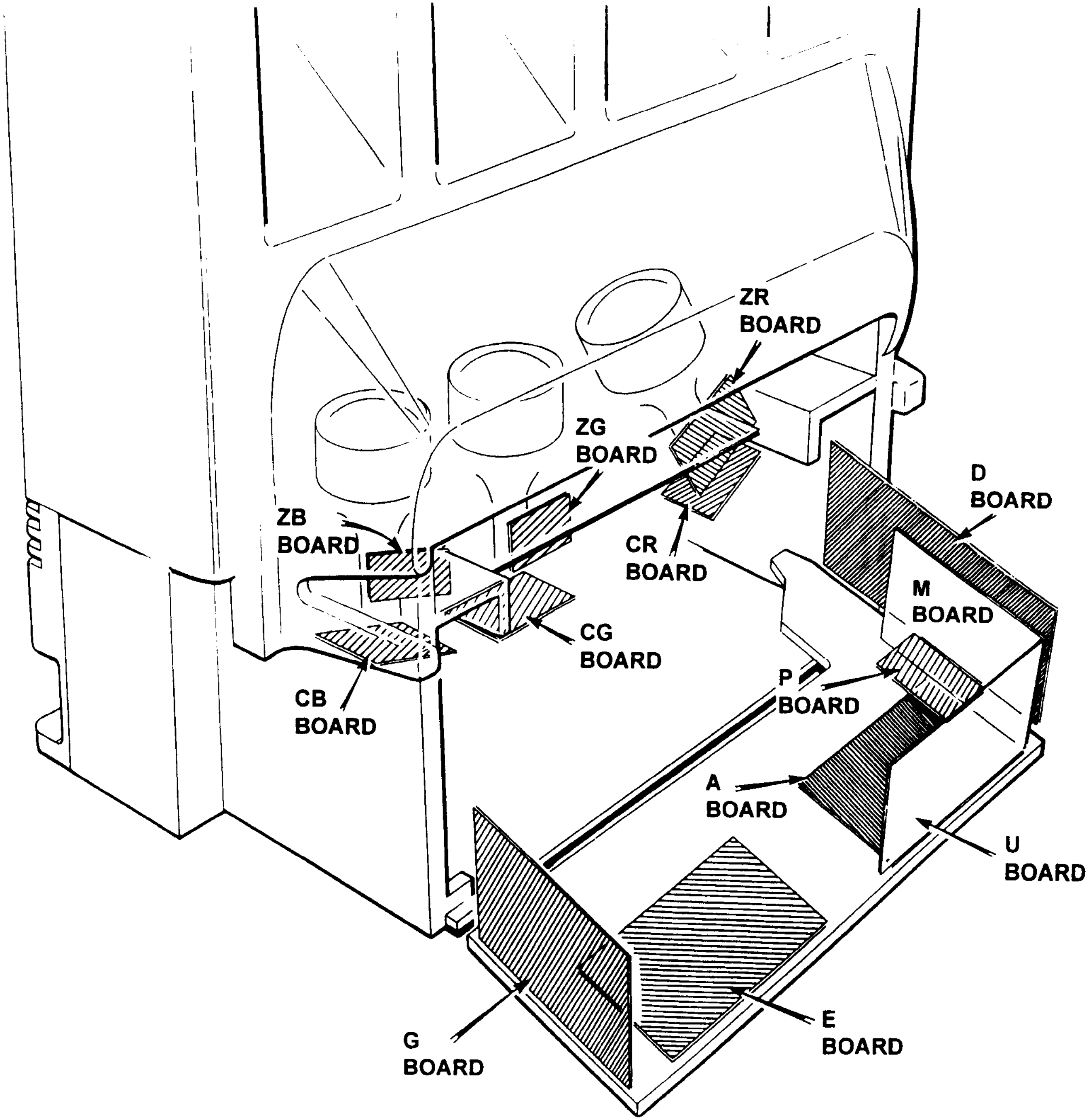
A/V Storage - "V" models.

Note: The XBR models utilize a pull-out chassis similar to the AP chassis.

Format of This Book

This book is intended as a troubleshooting guide for both In-Home repair and bench repair. This has been done because of the RA chassis design in which the CRTs are mounted to the frame, not to the chassis.

Each section of the book begins with a summary, followed by a circuit description and troubleshooting for fault isolation.



BOARD LOCATIONS page 5

Overall Block

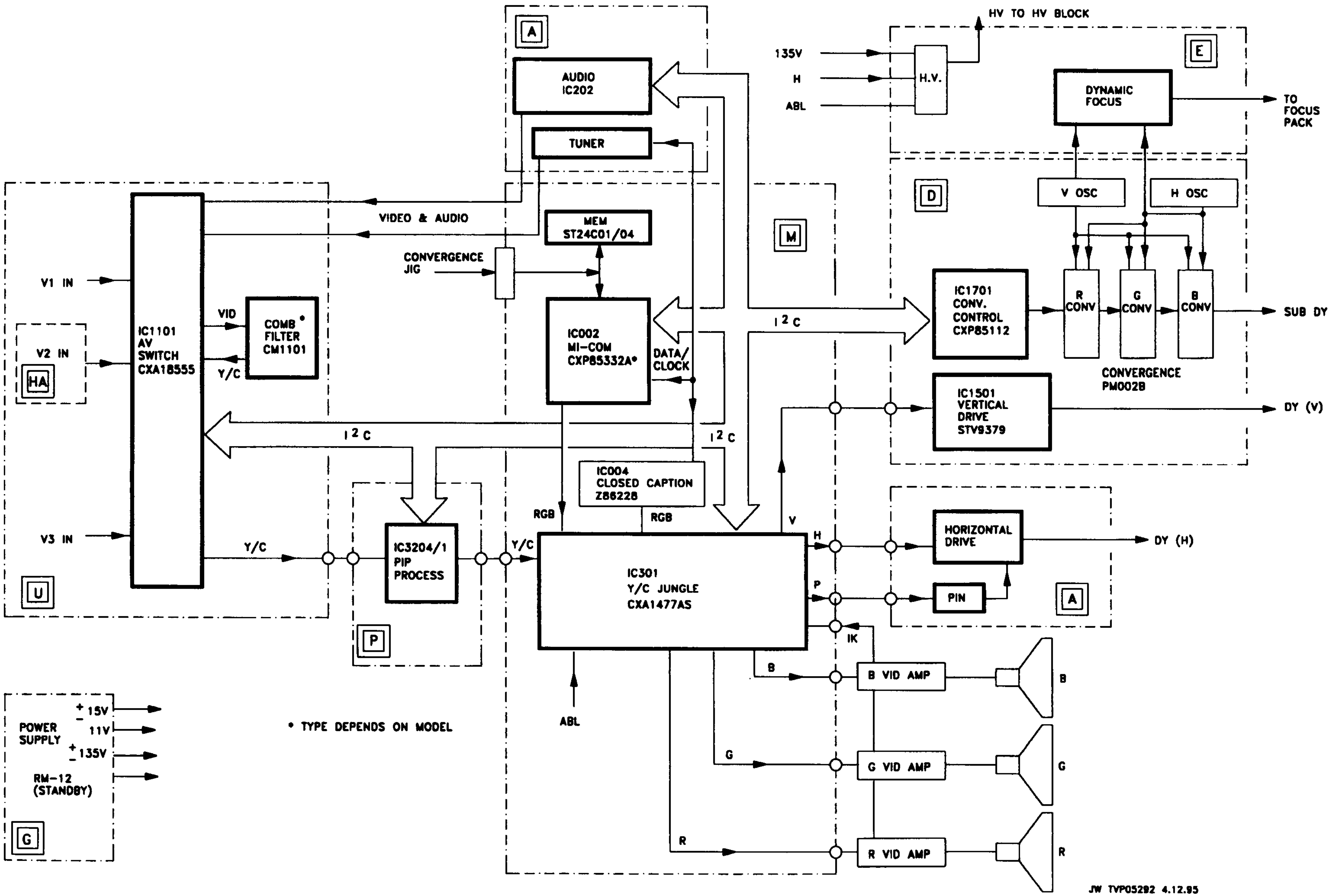
This diagram shows circuit and board location. There are 11 major circuit groups in the diagram below. These are:

1. MI-COM.
2. Y/C jungle.
3. A/V switching and Y/C separation.
4. Picture in Picture.
5. High Voltage.
6. Registration (Convergence).
7. Dynamic Focus.
8. Vertical Drive.
9. Horizontal Drive and Pincushion.
10. Audio
11. Power Supply

Six additional block diagrams in this book can be used to isolate problems in their respective sections. These diagrams are:

1. Power Supply block.
2. Power Distribution
3. Data Communications.
4. I/O signal flow.
5. Deflection Block.
6. HV Block.

When troubleshooting a defective set, start with a block diagram to generally isolate the problem to a particular area. Then use the detailed circuit diagram to isolate the problem to the component. You will find pertinent waveforms and dc voltages throughout this book.



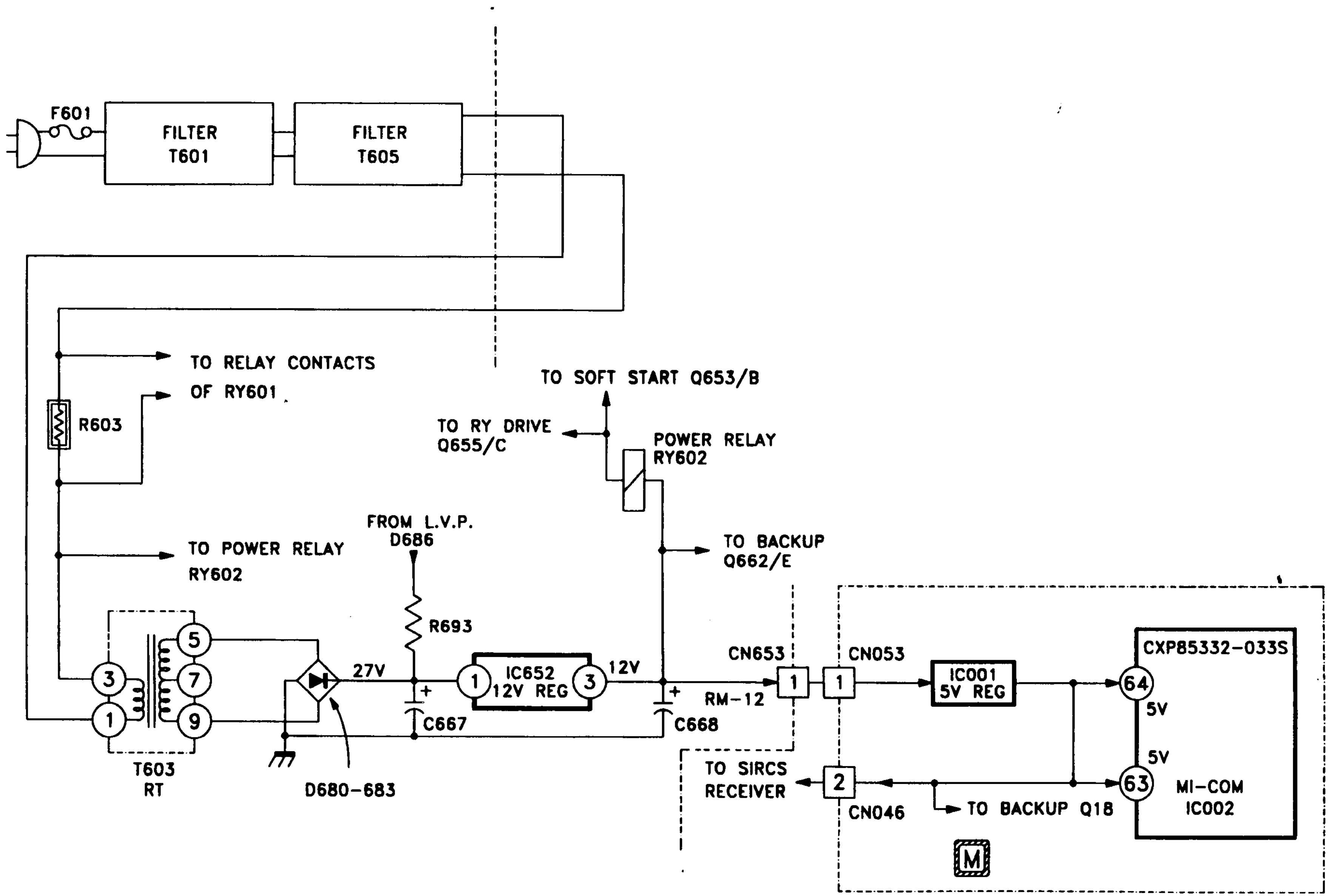
OVERALL BLOCK page 7

Standby Power Supply

When the unit is plugged in, AC is applied to RT Transformer T603/pins 1 and 6. T603 drops the line voltage and applies it to Bridge Rectifier D680 - D683 which produces 27V. This is applied to the 12V Regulator IC652/pin 1. Therefore, only the 12V Standby voltage will be present. Regulated 12V from IC652/pin 3 is applied to three circuits.

1. **The 5V Regulator on the M Board.** This develops the operating voltages for the MI-COM IC002 and the Sircs Receiver on the H Board. These circuits must always be ON in order to receive and execute Power ON commands from the remote commander and the power switch.
2. **Power ON Relay RY602.** During standby, Power ON Relay RY602 is OFF. 12V from 12V Regulator IC652/pin 3 is applied to it, but the ground return path via Relay Drive Transistor Q655 is open. (Q655 is OFF).
3. **Q662 Collector.** Q662 is OFF during Standby.

It should also be noted that at this time, the 12V from Relay RY602 is dropped to 0.7V across R666 and applied to Limit transistor Q653/B.



STANDBY POWER SUPPLY (G BOARD) page 9

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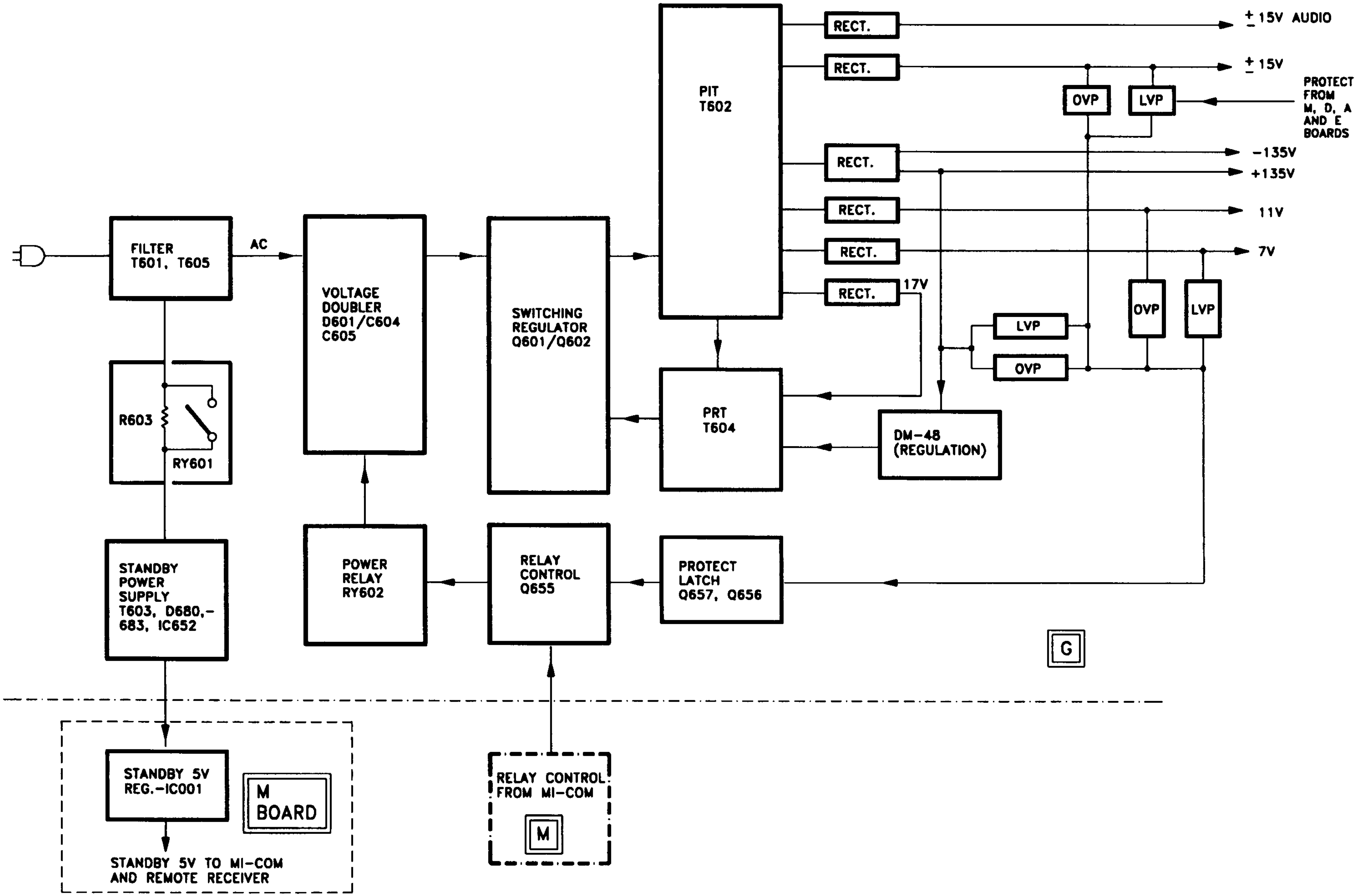
Power Supply Block

The RA chassis uses a switching regulator power supply located on the vertically mounted G board on the left side of the plastic chassis. The switching regulators (Q601, Q602) use two tuned tank circuits fed by a voltage doubler (D601, C605, C604) to produce a 600Vp-p 70kHz output at T602/pin 6 (under a normal load). This voltage is with reference to hot ground, Q602 Emitter. A power input transformer (T602) produces the secondary voltages. A power regulating transformer (T604) controls the frequency of the tank circuits, regulating the secondary voltages. The 135V line is applied to the DM-48 module which provides the feedback for regulation.

Five over-voltage and over-current protect circuits are located on the G board. In addition, an over current protect line from other circuit boards is input to the 15V LVP circuit.

The power supply can be divided into these four sections. Each of these sections is listed below and described on the following pages using separate diagrams.

- Standby Operation
- Switching Regulator operation
- Power supply regulation
- Protect circuits on the G board.
- Protect circuits on all other boards.



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POWER SUPPLY BLOCK page 11

Switching Regulator Operation
Power ON

Primary Rectifier

When the set is turned ON, System Control IC002/pin 4 (not shown) places a high, via D671, on the Base of Relay Drive Transistor Q655. Q655 turns ON and provides the ground return path for Power Relay RY602. With the relay closed, AC is applied to a voltage doubler circuit comprising bridge rectifier D601, C604 and C605. This produces 260V with respect to the **Hot Ground**

Oscillator

Q601, C610, C611 and the winding between T604/pins 4 and 5 form one section of the oscillator for the switching regulator. Q602, C612, C613 and the winding on T604 between pins 2 and 3 form the other leg. T604 is the Power Regulating Transformer (PRT). The arrangement of the circuit can be considered a "Dual Tank Oscillator". The operating frequency is determined by the two LC circuits: C614, and T604 winding between pins 4 and 5; C613, and T604 winding between pins 2 and 3. Q601 and Q602 share in producing the oscillator signal. Q601 produces the positive half, and Q602 produces the negative half. The oscillator frequency is 77kHz when the TV produces a white raster, and at 81kHz with a black raster.

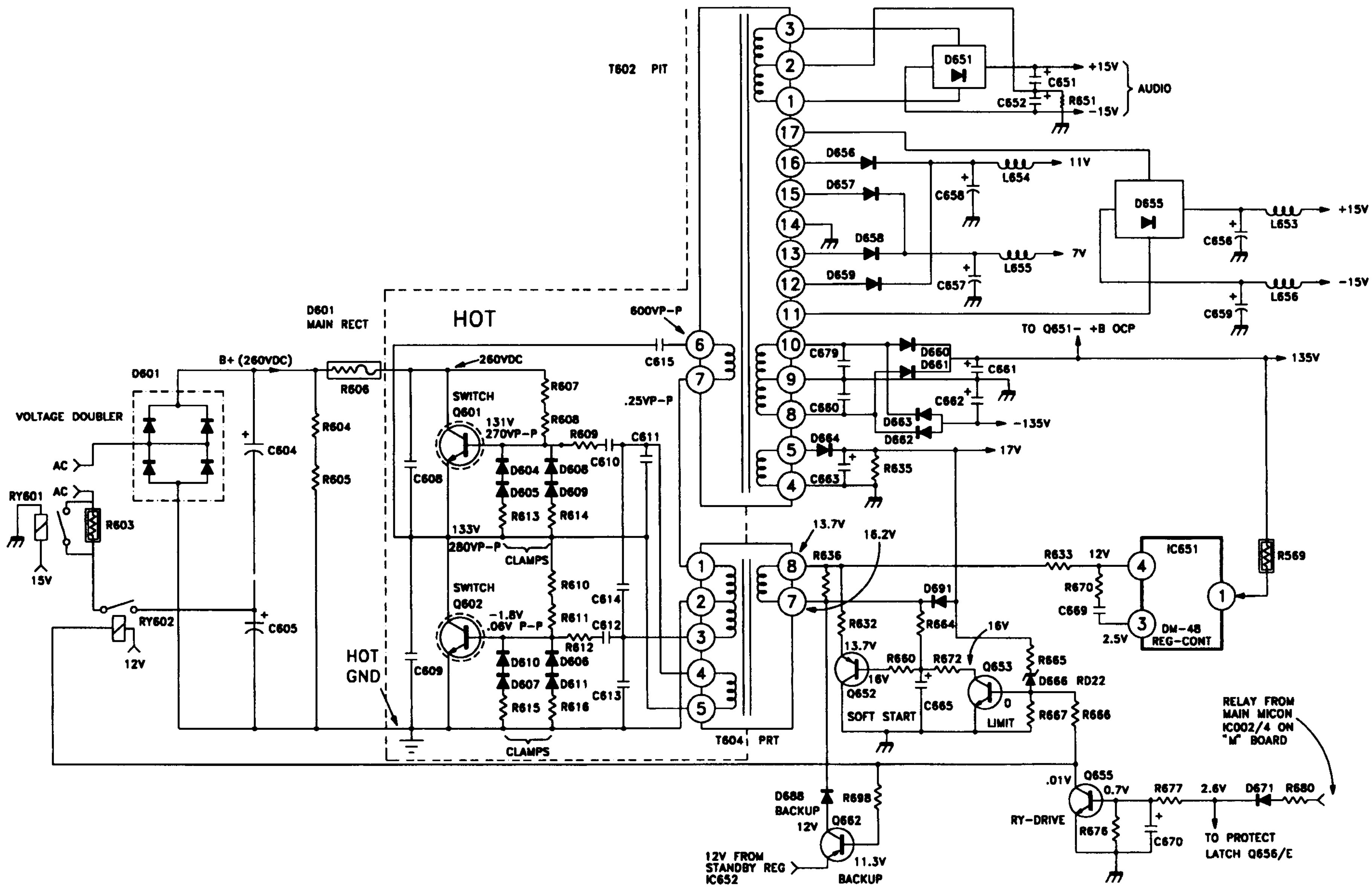
As the circuit oscillates it produces a 600Vp-p waveform at Power Input Transformer T602/pin 6. This waveform is induced into the secondary windings of the T602, producing all of the secondary voltages. The secondary voltages are:

- 15V Audio Circuits
- -15V Audio Circuits
- 17V
- 15V
- -15V
- 11V
- 7V
- 135V
- -135V

Regulation

The power supply is regulated by the control winding of PRT T604/ pins 7 and 8, in the following manner:

- Increased dc current flow through the control winding reduces the inductance of T604, thereby increasing the oscillator frequency. This decreases the efficiency of T602 (places it further away from resonance), causing the secondary voltages to drop. Decreased current flow through the control winding has the opposite effect.
- A regulated 12V reference is produced by IC651/pin 4 from the 135V line and R569. This reference will vary inversely with the load on the 135V line. Pin 8 of the transformer control winding is connected to the reference voltage via R633. The other leg of the control winding (pin 7) is connected to the +17V line by D691. The voltage differential across the control winding causes a dc current to flow through the winding.
- A rise in the 135V line will cause the voltage at IC651/pin 4 to decrease. This will cause the voltage at the control winding of T602/pin 8 to also decrease. This increases the current flow through the winding. The increased current flow decreases the transformer inductance. As a result, the oscillator frequency increases and the efficiency of T602 decreases. Therefore, the secondary voltages are lowered. A reduction of the secondary voltages has the opposite effect.



SWITCHING REGULATOR OPERATION/POWER ON page13

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Soft Start

The soft start circuit prevents discharged capacitors on the secondary lines from drawing excessive current during power "start up" and shorting the oscillator transistors. The soft start circuit brings the secondary voltages up slowly.

1. At power ON, C665, which is discharged, has a 0V potential at its positive terminal. This biases Q652 ON via R660. With the transistor ON, it allows more current to flow through the control winding of T604/pins7 and 8. (Pin 8 is brought closer to ground potential). This increases the oscillator frequency and reduces efficiency. Therefore, the start up secondary voltages will be reduced considerably.
2. As soon as the 17V supply begins to rise, C665 starts charging up through R664 and D691. This causes the voltage at the positive capacitor terminal to rise causing Q652 to decrease conduction. Less current flows through the transformer control winding and the oscillator frequency decreases causing the secondary voltage to increase further.

C665 continues to charge and the secondary voltages continue to rise until the capacitor charges to the point that its voltage potential is the same as Q652/E. At this point, the transistor stops conducting, allowing the output voltages to rise to normal levels.

Limit

The Limit transistor has two functions:

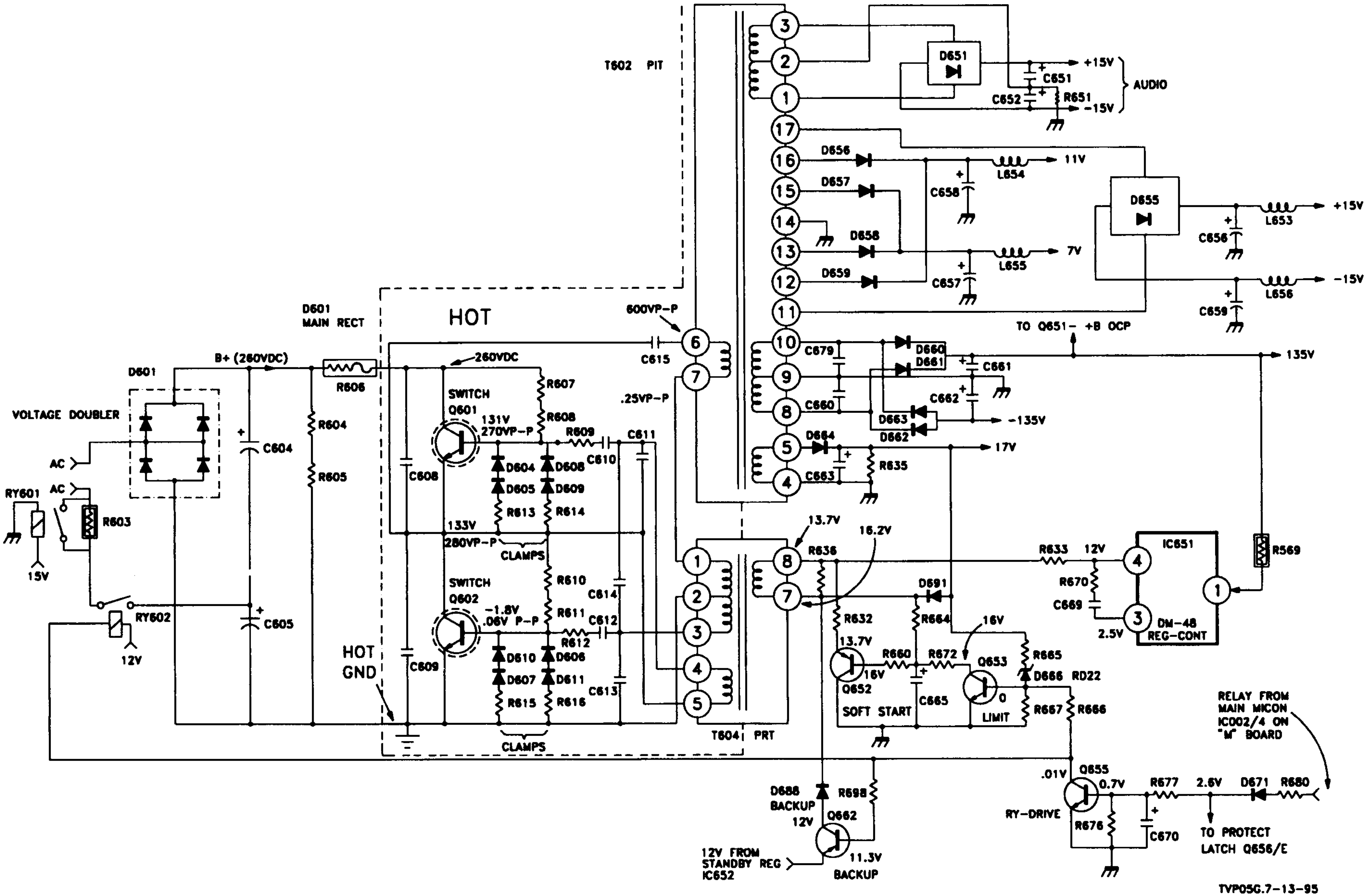
1. It acts as a non latching over voltage protector (OVP)
2. It is a soft start reset since it discharges C665 when the unit is turned OFF, preparing it for the next turn ON.

OVP:

1. Zener D666 is a 22V zener that is connected between Q653/B and the 17V line (via R665). During normal operation, the potential across the zener is lower than the zener voltage. Therefore, the zener is OFF and cannot supply a base voltage to Q653 which will be OFF
2. Should a defect cause the 17V line to rise above 22V (the other secondary voltages will rise proportionally), the zener diode breaks over and applies a bias to Q653/B, turning it ON. This turns Q652 ON; the current through the transformer control winding increases (T604/pin 8 drops to 3.7V) and the oscillator frequency increases to 136kHz. The end result is a decrease in transformer efficiency and a drop in the secondary voltages (the 135V line drops to 85V).

Soft Start Reset:

1. Relay RY602 is powered by 12V produced by the Stand-by power supply. The relay is turned ON by Q655.
2. Q655 is OFF when the unit is turned OFF. This removes the ground path from the relay, opening it up. It also allows the 12V from the relay to flow through the relay coil, through R666, to Q653/B. This turns the transistor ON, and discharges C665.



SWITCHING REGULATOR OPERATION/POWER ON page15

Protection - G Board

Most of the supply voltages from Power Input Transformer T602 have a protection circuit. Some are located on the G Board and the others are on the M, D, A and E Boards. The protect circuits on the M, D, A and E Boards will be discussed in a succeeding section.

Shut Down

Shut down occurs whenever a condition in the protect circuits causes Latch Q657/B to go HIGH. A HIGH on Q657/B turns it ON, causing it to also turn ON Q656. This drops the drive voltage to Relay Drive Q655/B, turning it OFF. This removes the ground return path for RY602 and the unit shuts OFF. A reduced voltage is applied to the latch from CN653/pin3. At shutdown, this line is maintained at 3V by MI-COM IC002. The 3V at CN653/pin 3 is not high enough to turn relay drive transistor Q655 ON.

It should also be noted that at this time Shut down Relay RY601 opens because the 15V line that keeps it ON is now absent. The current to Standby Transformer T603 is now through surge resistor R603, dropping the standby voltage from 12V to 8V.

+135V Supply Over Voltage Protection

The OVP for the 135V line is triggered by 18V Zener Diode D673; R661 and R662. If the voltage on the 135V line rises to 139V, the zener will break over and apply a voltage to latch transistor Q657, turning it ON and latching it.

The -135V line doesn't need voltage protection. Since it is produced by the same windings of PIT T602 (pins 8, 9, and 10), any changes in the -135V line will also be reflected in the +135V line.

135V Over Current Protection

Over current Protection (OCP) is provided by R656, Q651, D665, and the associated components. All of the 135V line current flows through R656, setting up a voltage potential across the resistor proportional to the current flow. During normal operation the B-E potential of Q651 is only 0.1V, not enough to turn the transistor ON. An over current condition on the 135V line increases the voltage drop across R656, and turns Q651 ON. With Q651 ON, a HIGH is brought to Latch Q657/base which activates the latch circuits that turn OFF Relay Drive Q655.

The 15V Low Voltage Protection.(A, D and E Boards)

The 15V supply that powers circuits on the A, D and E Boards is Low Voltage Protected by Q660, Q658, D674, D672 and associated components. During normal operation Q660 is ON and Q658 is OFF. 2.2V Zener Diode D672 is On and operating just at its zener point. A voltage drop in the 15V line to 14 volts will remove the Q660 B-E forward bias, causing this transistor to open. Current will now flow through R685, D674, and the Q658 B-E junction, turning the transistor ON. This pulls its collector HIGH; D675 zeners and activates the latch circuits of Q657 and Q656 as explained earlier. Power Relay RY602 is disabled and the unit shuts OFF.

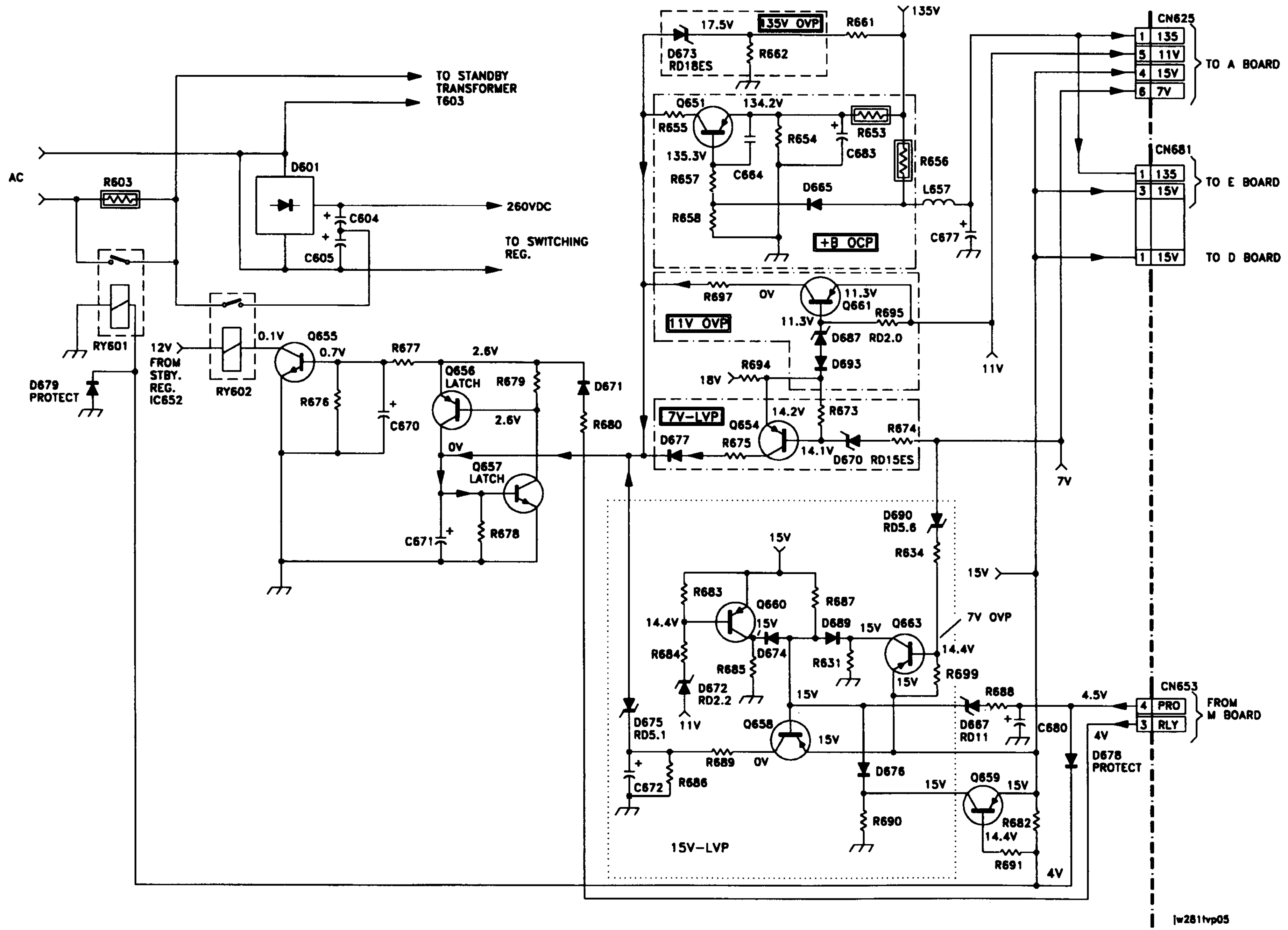
In a similar manner, the 15V line is also referenced to the 7V line via Q663. Its operation with respect to the 15V line is identical to the 11V line.

-15V Supply (A, D and E Boards)

Low Voltage protection is provided on the E Board. This is explained in the "Protect Circuits - M, D, A, and E Board" section of this book.

11V Supply Over Voltage Protection

The 11V supply is over voltage protected by Q661, D687 and associated components. Normally Q661 is OFF with 11.3V on the Base and Emitter. An abnormal voltage increase on the 11V line will cause D687 to zener and turn ON Q661. With Q661 ON, a HIGH is placed on Latch Q657/B. Q657 turns ON and disables the Power Relay Drive : the unit shuts down.



PROTECTION - G BOARD page 17

7V Supply Over Voltage Protection

This voltage measures 7.5V when the unit is operating. Over voltage protection for the 7V supply is provided by Q663, Q658, D690 and associated components. Normally Q663 is ON with 14.4V on the Base, 15V on the Emitter and 15V on the Collector. 5.6V Zener Diode D690 has 13V on the Cathode and 7.5V on the Anode. It is conducting very near the zener point, and maintains Q663/B voltage. Should the 7.5V line increase, D690 shuts OFF and Q663/B rises to the Emitter voltage and the transistor turns OFF.

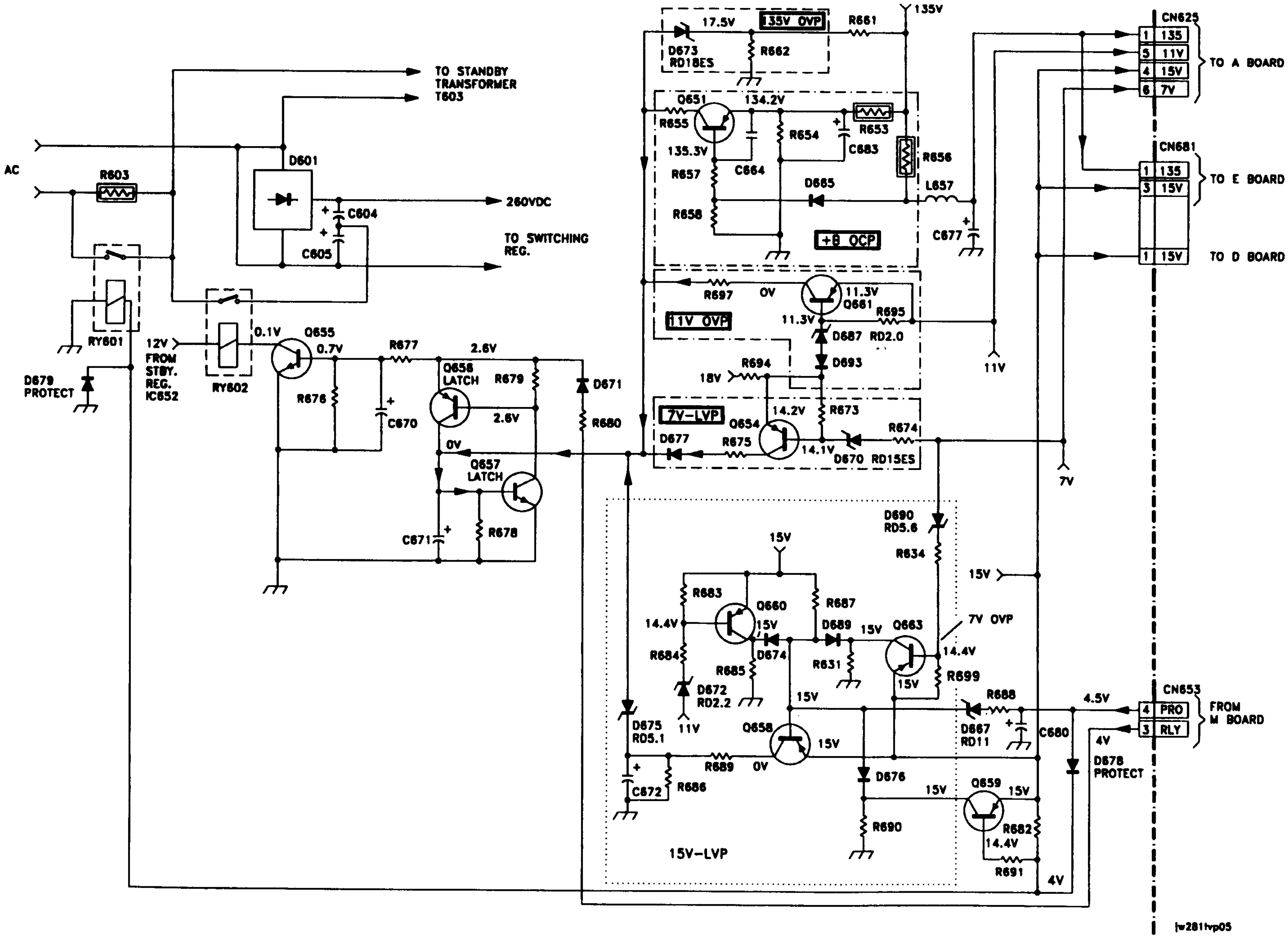
With Q663 OFF, Q658 turns ON and develops a voltage across R686 which zeners D675 to turn ON Latch Q657. This disables Relay Drive Q655 and the unit shuts down.

7V Supply Low Voltage Protection

Q654, D670 and associated components make up the 7V Low Voltage Protection Circuit. Normally, D670 operates below its zener point and is OFF; therefore, base bias is not available to Q654 and it will be OFF. A severe drop or loss of the 7V line will cause the zener D670, to break over and conduct; Q654 will also conduct and the protection latch circuit will turn ON.

17V Supply Over Voltage Protection

This operation is discussed on page 14.



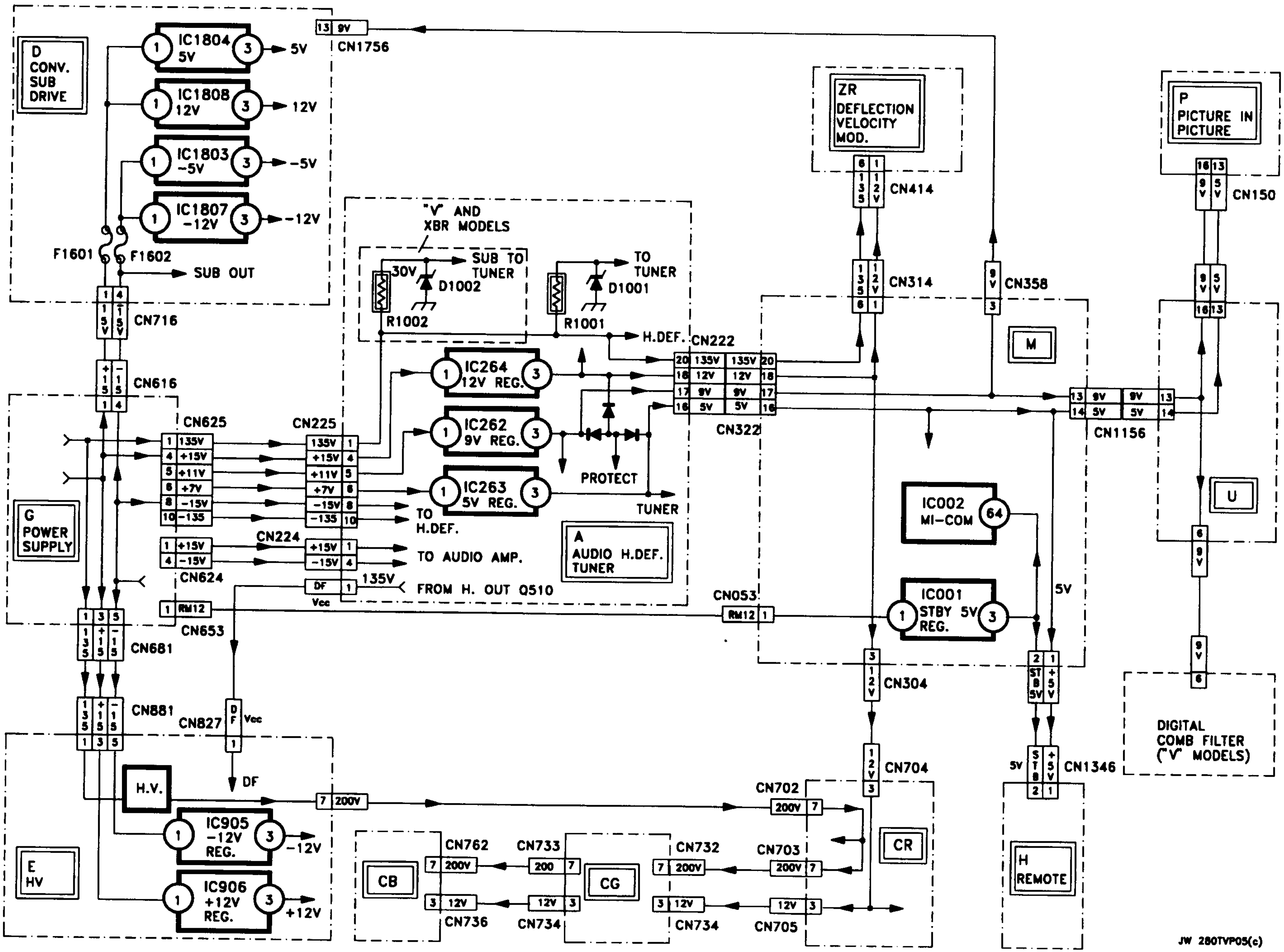
PROTECTION - G BOARD page 19

Power Distribution

The purpose of the Power distribution diagram is to identify the location of all regulators and show the board to board wiring.

The resistance table to the right lists resistance measurements at various connectors. The measurements were taken with the connectors unplugged, after the pins were first grounded. The DMM was set to the 2kΩ and 200kΩ position for these measurements.

connector/pin	resistance	connector/pin	resistance
CN225/1,5,6,8,10	∞	CN224/1,4	∞
CN225/4	978Ω		
CN625/1,5,6	∞	CN624/1	∞
CN625/4	328Ω	CN624/4	185Ω
CN625/8	150Ω	CN881/1	1kΩ→∞
CN625/10	560Ω	CN881/3	48kΩ
CN653/1	∞	CN881/5	16kΩ
CN1716/1	40kΩ	CN681/1	∞
CN1716/4	13kΩ	CN681/3	327Ω
CN616/1	328Ω	CN681/5	149Ω
CN616/4	149Ω		



POWER DISTRIBUTION page 21

Protect Circuits - 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:

M Board: 5V Standby Regulator (Low voltage protection).

D Board: 12V, -12V, 5V and -5V Regulators (Low voltage and over-voltage protection).

A Board: 12V, 9V and 5V Regulators (Low voltage protection). Speaker Protection.

E Board: 12V and -12V Regulators (Low voltage and over voltage protection).

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 (not shown). There, it activates the Low Voltage Protect Circuit of Q658 and D675, (explained in the G Board section), which shuts down the unit.

M Board Protect Circuit:

The protect circuit on the M Board is used to protect the Standby 5V supply developed off Standby Regulator IC001. This voltage is used primarily for maintaining power to the System Control IC002 and the remote receiver. It is monitored by D001. D001 is connected via the Protect Line to R688, which is in series with 11V Zener Diode D667 on the G Board. All of the other low voltage protection circuits from the other boards are also connected to this Protect Line via the M Board at CN053/pin4.

D001 is reversed biased during normal operation because 5V from Standby Regulator IC001 is on its Cathode. Its Anode is normally at 4.5V. Should the 5V supply drop to 3.9V, D001 forward biases and lowers the voltage at Zener D667/Anode. This turns LVP Q658 ON and shut down is activated.

D Board Protect Circuit

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 IC808; and to 5V by Regulator IC804. Similarly, -12V is produced by Regulator IC807; and -5V by Regulator IC803.

A low voltage on the 12V line will forward bias D1825. This lowers the Protect Line 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.

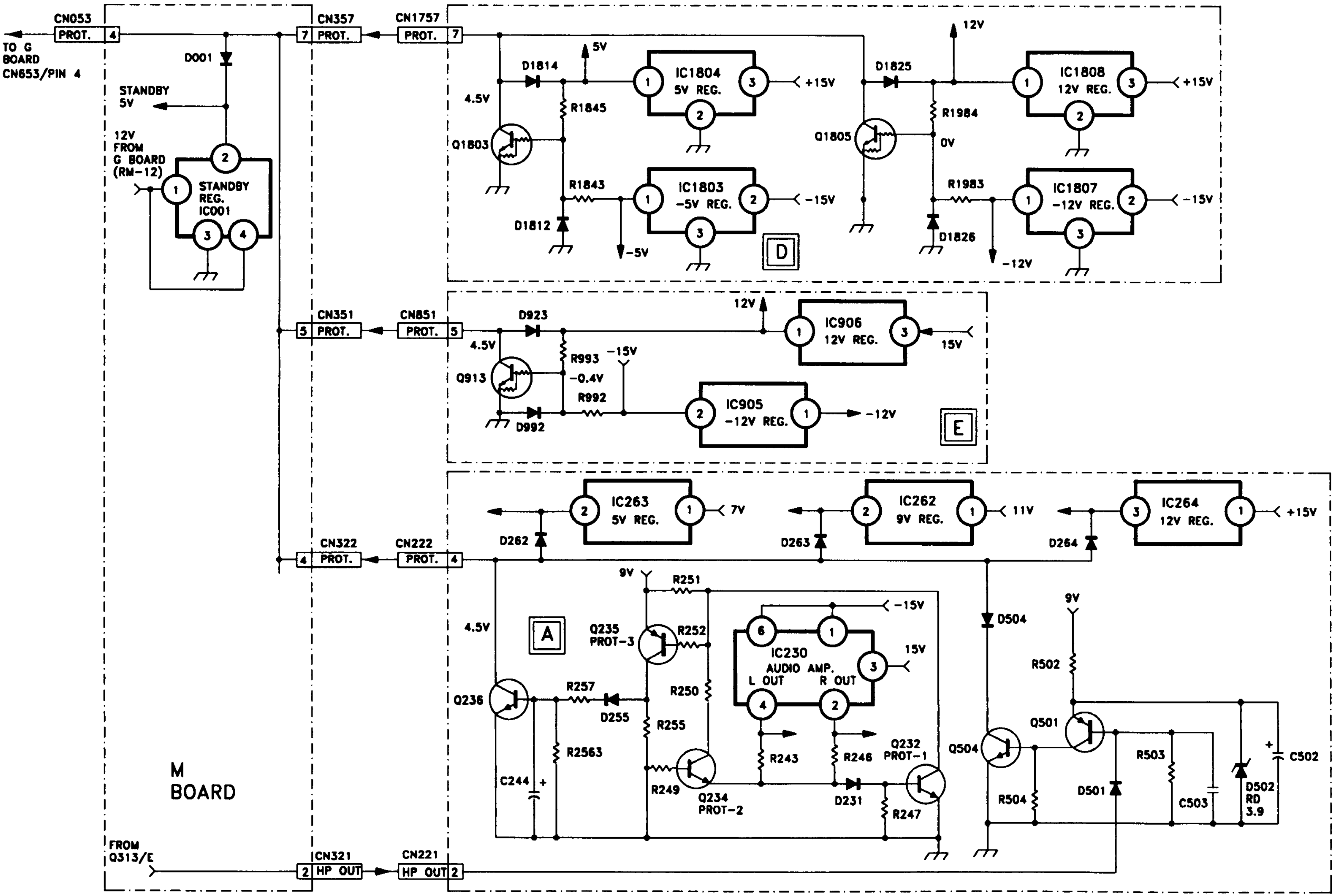
A low voltage on the -12V will turn ON Q1805. This lowers the Protect Line and activate shut down.

Similarly, the 5V and -5V supplies are protected by D1812, D1814 and Q1803.

E Board Protect Circuits

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 Page 23

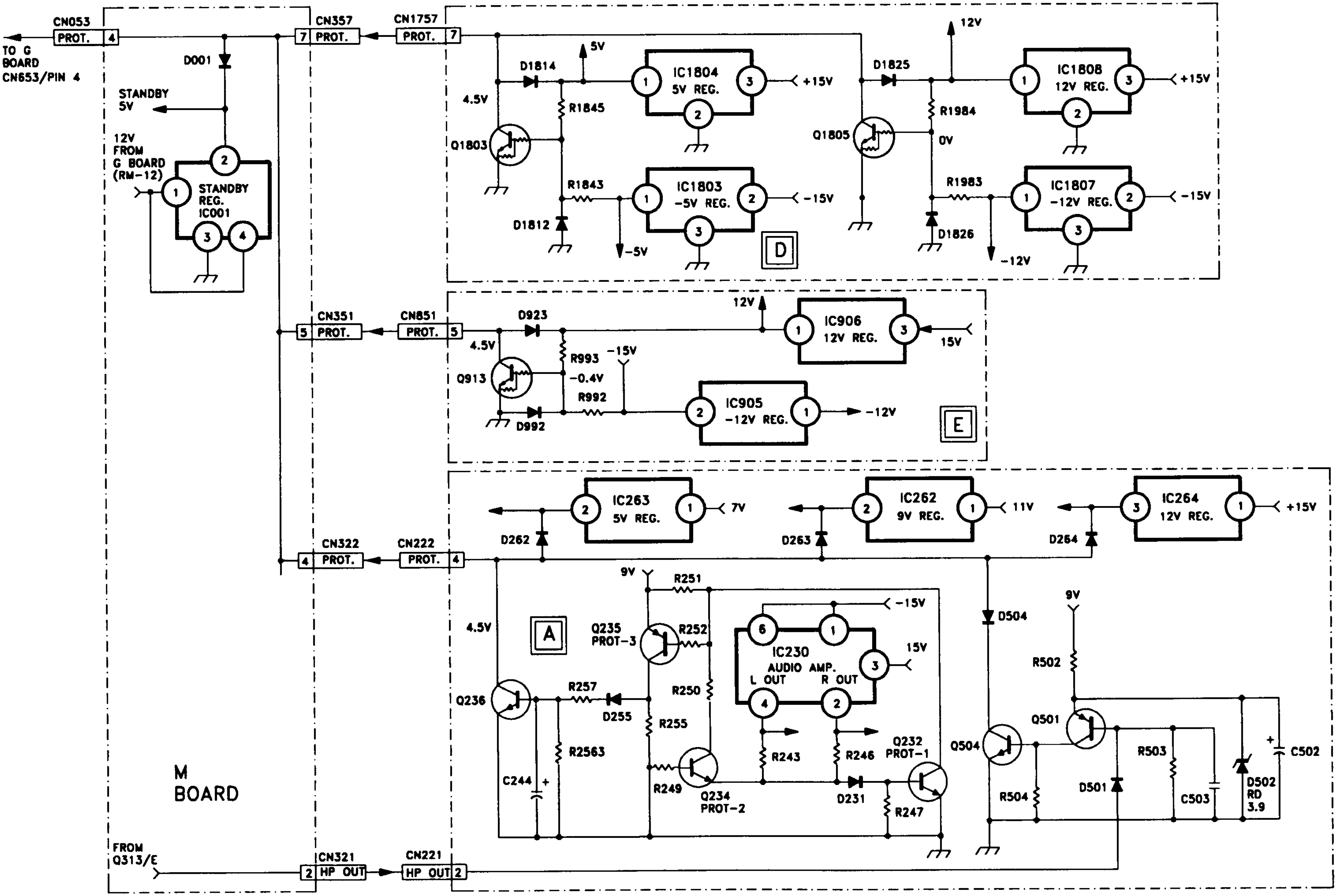
A Board Protect Circuits

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 low voltage protection is provided for these regulators.

Low Voltage 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 Q235 and Q236 ON to activate 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. H. Pulses from the Horizontal Output circuit on the M board are fed to D501/C503 which rectify and filter them to produce 4V on Q501/B. Q501/E is held at 3.9V by Zener Diode D502. Q501 and Q504 are therefore OFF. A loss of H Pulses will cause the 4V on Q501/B to fall, turning ON Q501 and Q504 in the process. This activates shutdown via D504..



PROTECT CIRCUITS – M, D, A, E BOARDS Page 25

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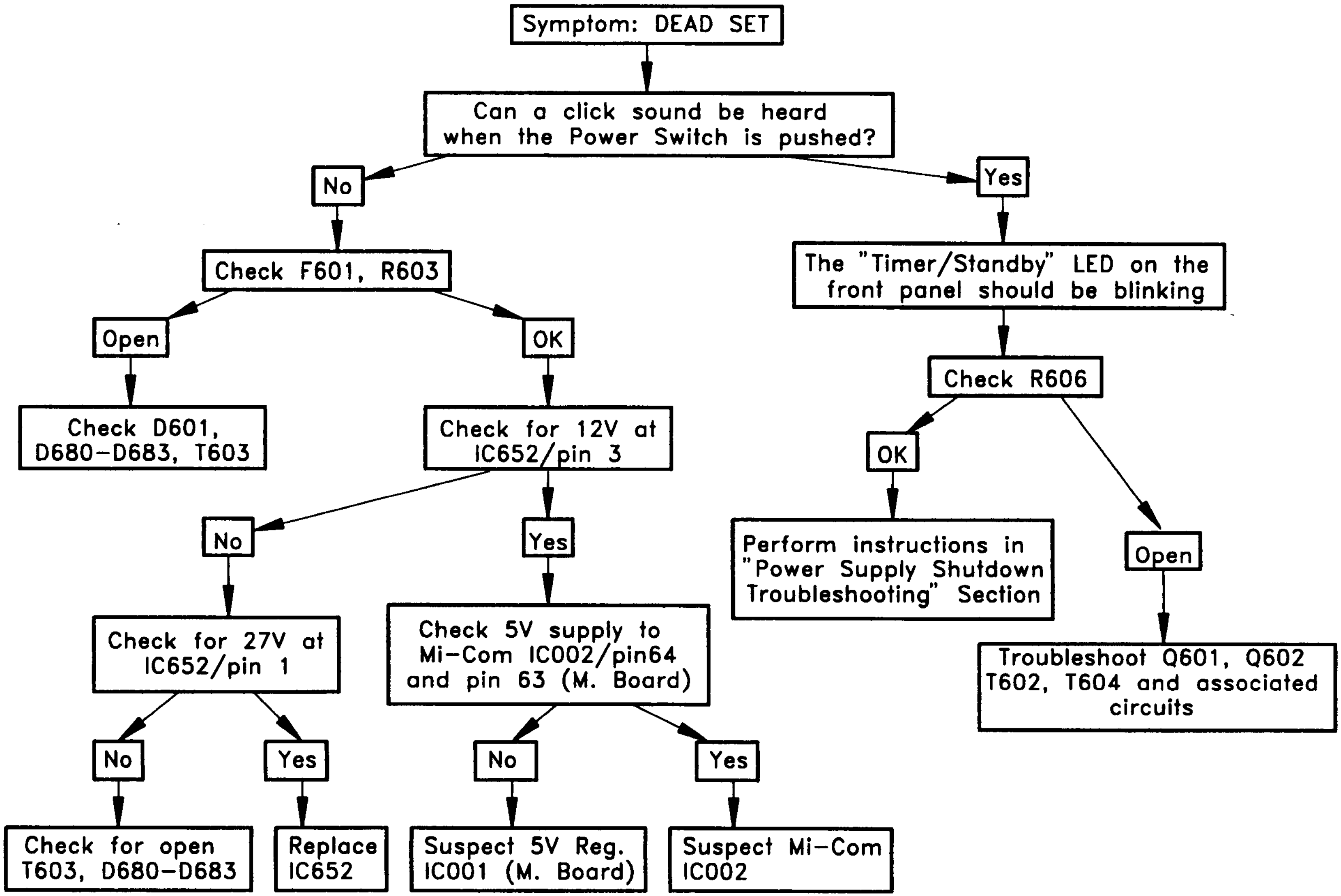
Notes

(All tests must be performed with the unit plugged into an isolation transformer)



Power Supply Troubleshooting

Troubleshooting the power supply is not difficult if the circuit operation is fully understood. In troubleshooting the circuit for a "Dead set" or "Set shuts off as soon as it is switched ON", one has to determine whether the problem is caused by a defective power supply, a problem elsewhere in the unit that is triggering the protect circuits, or if one of the protect circuits is defective and is activating shutdown.

Power Supply Shutdown Troubleshooting

In shutdown the "Timer/Standby" Led blinks continually after the "Power" button is pushed. **This indicates that the Standby Supply circuits are operative.**

Shutdown may be caused by any of the following conditions:

1. A loss of, or a drastic reduction of any of the voltages developed off PIT T602 (Overcurrent).
2. An over-voltage condition on any of the supply lines (Open circuit).
3. An over-voltage or Over-current condition originating from any of the voltage regulators on the M, D, A and E boards.
4. A defective over-voltage or Over-current sensing circuit on the G, D, A or E boards.

Troubleshooting Procedure:

- Plug the unit into an isolation transformer that has a power switch. Place the switch in the ON position.
- Push the power switch on the TV front panel to turn it ON. The TV will turn ON then OFF.

Note: If there is a constant relay clicking, troubleshoot for an open circuit on the 15V supply. If the relay just clicks momentarily, continue to the Overcurrent Check procedure.

Overcurrent Check:

- Switch the isolation transformer OFF.
- Place the positive terminal of a voltmeter at CN625/Pin 1 (135V) and switch the isolation transformer ON. The 135V line should rise momentarily to 135V, then fall off as relay RY602 is disabled.
- Repeat the above test for the 15V, 11V and 7V supplies at CN625/Pins 4, 5 and 6 respectively.
- Check for an open circuit between the supply source and the test point on CN625 if the tested voltage remains at 0V.
- Check for short circuit in the circuits directly connected to the supply line that does not rise momentarily to its normal voltage.
- If each voltage line rises momentarily to its normal voltage before falling off, proceed to the following test procedure; "Identifying reason for shutdown."

Identifying reason for shutdown (G, D, A or E Boards):

D667 on the G Board is used to monitor the "Protect" line on CN653/Pin 4. This line is normally at 4.5V when the supply voltages on the M, D, A and E Boards are OK. An Over-current or over-voltage condition on any one of these boards will activate the protect circuit on that board causing the protect line to fall to 0V. This turns Q658 ON which activates shutdown by turning ON Q657. Check H. Pulse Buffer Q313 on the M Borad. If it is OK the M Board is not the source of the problem. Also the M board is Ok because the regulator on this board regulates the standby voltage.

The protect circuits on the G Board do not affect the Protect line. However, if one of the protect circuits on the G Board becomes defective, Q657 will also turn ON via another line.

One method of identifying whether protect shutdown is activated by protect circuits on the G Board or by protect circuits on the D, A or E boards is as follows. **These tests should only be done after performing the Over-current check described earlier.**

Procedure:

1. Switch the isolation transformer OFF.
2. Unplug CN1757 from the D Board.
3. Switch the isolation transformer ON. If the rasping sound of the high voltage is heard, followed by the clicking/switching sound of Relay RY602 for about 8 to 10 seconds, the protect circuits on the G Board are OK. The problem is with the protect circuits on the D Board.
4. If the unit goes into shut down after the isolation transformer is switched ON in Step 3, the problem is in either the A or E or G board.
5. Switch the isolation transformer OFF.
6. Replace CN1757 on the D Board and unplug CN851 on the E Board.
7. Switch the isolation transformer ON. Check CN625/pins 1, for 135V. If the 135V is present, the problem is with the protect circuits on the E Board. If the unit still goes into shutdown with CN851 removed, the problem is with either the A Board or G Board.

Checking the Protect Circuits on the G Board

1. Switch the isolation transformer OFF.
2. Unplug connectors CN616, CN624, CN625 and CN681 from the G Board.
3. Short E/C of Q655
4. Switch the isolation transformer ON and check for the following voltages at the protect circuit.

Protect Voltage Chart

	Q651	Q661	Q663	Q660	*Q658	Q659	Q654
Collector	0V	0V	15.1	15.1	0	15.1	0
Base	134	11.3	14.4	14.4	15.1	14.4	16.3
Emitter	134	11.3	15.1	15.1	15.1	15.1	16.3
Normal State	OFF	OFF	ON	ON	OFF	ON	OFF
Protect State	ON	ON	OFF	OFF	ON	OFF	ON

Because the power supplies are all running without loads, the Protect line at CN653/pin 4 will be LOW. This will turn ON Q658, causing its collector voltage to be 15V. **Q658 should be the only transistor in the 'protect state' during this test procedure.**

Please note that there may be variations in the nominal voltages outlined above. The important observation in the tests is the operating state of the transistor. The transistor that is not in the normal state should be investigated, as it may be the cause of the shutdown problem.

If no problem is found after the above test, troubleshoot the protect circuits on the A Board.

Reset/Data Communications

The diagram below is designed to allow troubleshooting of the reset circuit and signal tracing of the three data communications buses throughout six boards in this set.

Reset

Reset occurs when the set is plugged in. At this time, the standby power supply on the G board outputs 12Vdc to Standby 5V regulator IC001 on the M board. The output of the regulator is applied to reset IC006, MI-COM IC002/pin 64, and to SIRCS receiver IC1301/pin 2 on the HA board.

The RC network of C005 and R058 provides the delay which constitutes reset.

Symptom If Reset Is Missing

If the MI COM IC is not reset (reset line stays HIGH), the set will turn ON and function normally when the power button is pressed. However, if power is removed and reapplied quickly (during a momentary black-out, for example), the set will not turn ON again, nor will the power switch or the remote commander function.

Data Communications

The MI-COM IC002 uses one data bus to communicate with the Memory ICs and the convergence jig (the convergence jig is discussed in the convergence section of the manual); another bus to communicate with the caption vision IC and the Tuner; and a I^2C bus to communicate with the following ICs.

- Audio Process IC202
- D/A converter IC271
- A/V switch IC1101
- Y/C jungle IC301
- Convergence control IC1701
- PIP control IC3201

All data buses are active at all times. The following oscillographs show examples of correct data bus waveforms. Remember, when troubleshooting a suspected communication problem, look for 5Vp-p data only since you cannot distinguish "good" data from "bad" data. Figure 1 shows the I^2C bus.

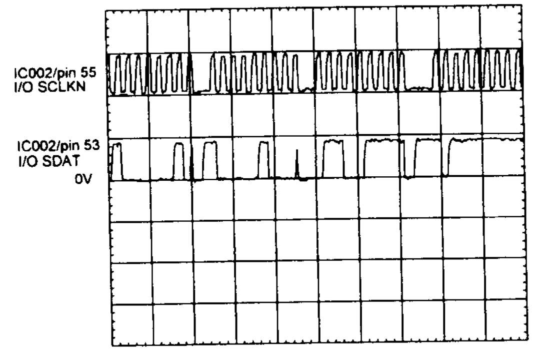


Fig. 1 5V/div. 50usec/div.

Figure 2 shows the data and clock lines for the memory ICs and the convergence jig. The data on this bus is used to set the user parameters such as: picture brightness and contrast; station memory; and audio parameters. When the convergence jig is connected to CN054 (this can only be done when the set is ON and a picture has appeared on the screen), MI-COM IC002/pin 43 (B-INT) goes LOW; data from the jig is recognized and loaded into the MI-COM IC.

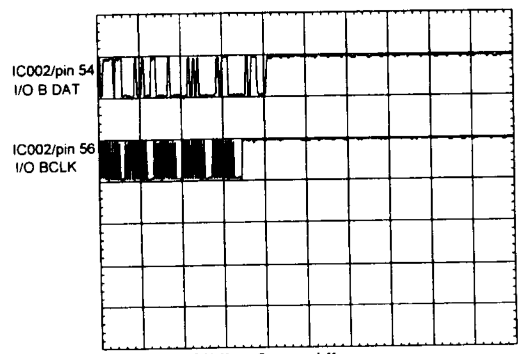
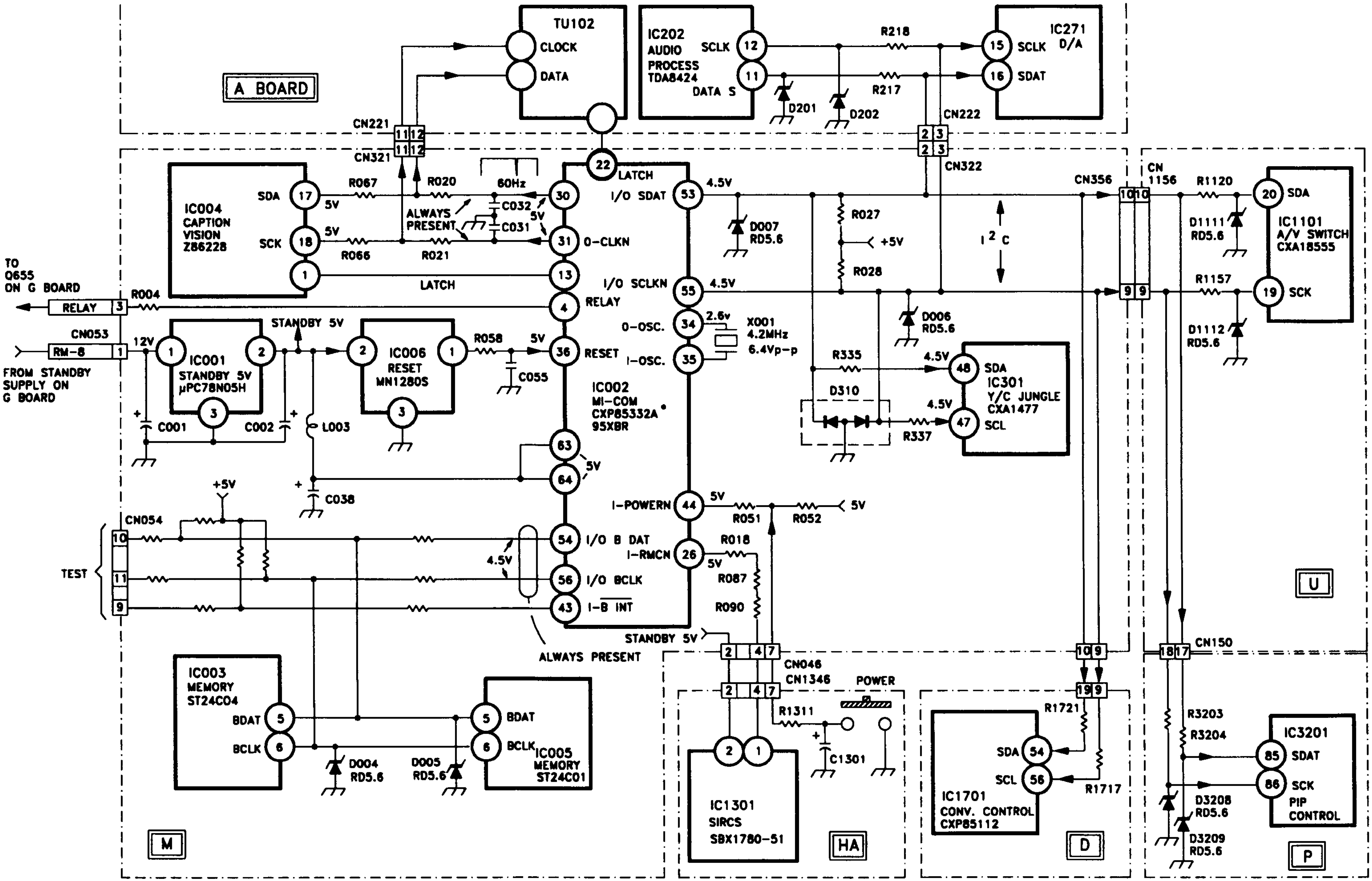


Figure 2 5V/div .2msec/div



* TYPE DEPENDS ON MODEL

RESET /DATA COMMUNICATIONS Page 31

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MI-COM Clocks

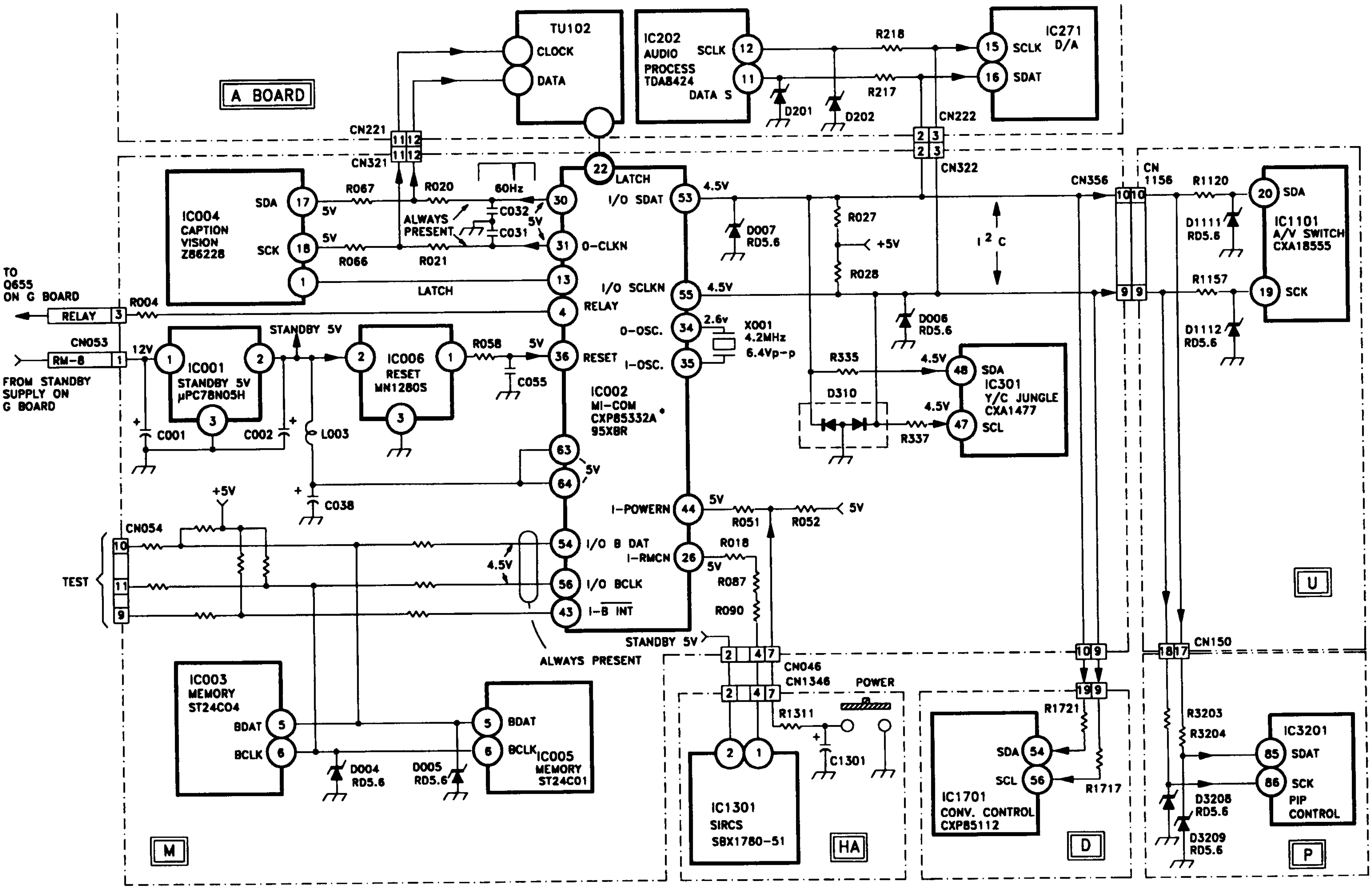
Two clocks are connected to the MI-COM IC002. The 4.2MHz system clock is connected between pins 34 and 35. A second clock, connected between pins 45 and 46 (not shown, refer to the Video Signal Process diagram) contains a 5.3MHz signal packet repeated at the horizontal rate. This clock is used to insert the "on-screen" menu data into the video signal..

Turning The Set ON

This set will turn ON under the following conditions.

- The power button on the HA board is pressed. This will make MI-COM IC002/pin 44 (I-POWERN) LOW.
- The power ON command is received by remote receiver IC1301 on the HA board. SIRCS data is then input to MI-COM IC002/pin 26 (I-RMCN)
- The power cord is removed and then plugged in again while the set is running.

When one of these conditions occur, MI-COM IC002/pin 4 (relay) will go HIGH to turn ON Q655 (on the G board). This turns on the power relay which turns ON the power supply. For details on how the power supply turns ON, refer to the Power Supply section.



* TYPE DEPENDS ON MODEL

RESET /DATA COMMUNICATIONS Page 33

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Deflection Block

The deflection block contains three sections:

- Horizontal Deflection and Pincushion
- Convergence
- Vertical Deflection

Horizontal Deflection And Pincushion

The horizontal deflection circuit is located on the A board. It is driven by the horizontal pulse from the Y/C jungle on the M board. The circuit consists of a horizontal driver Q505, horizontal drive transformer and horizontal output Q510. The horizontal output is developed using the -135V line through the pincushion circuit. The collector of Q510 is grounded through a load coil. The three deflection coils are connected in parallel at the collector. The horizontal pulse is taken off the collector and used for feedback to the MI-CON and sync for the horizontal convergence oscillator.

The pincushion circuit is driven by the parabolic wave from the Y/C jungle. The signal is amplified and waveshaped, then used to modulate the horizontal output.

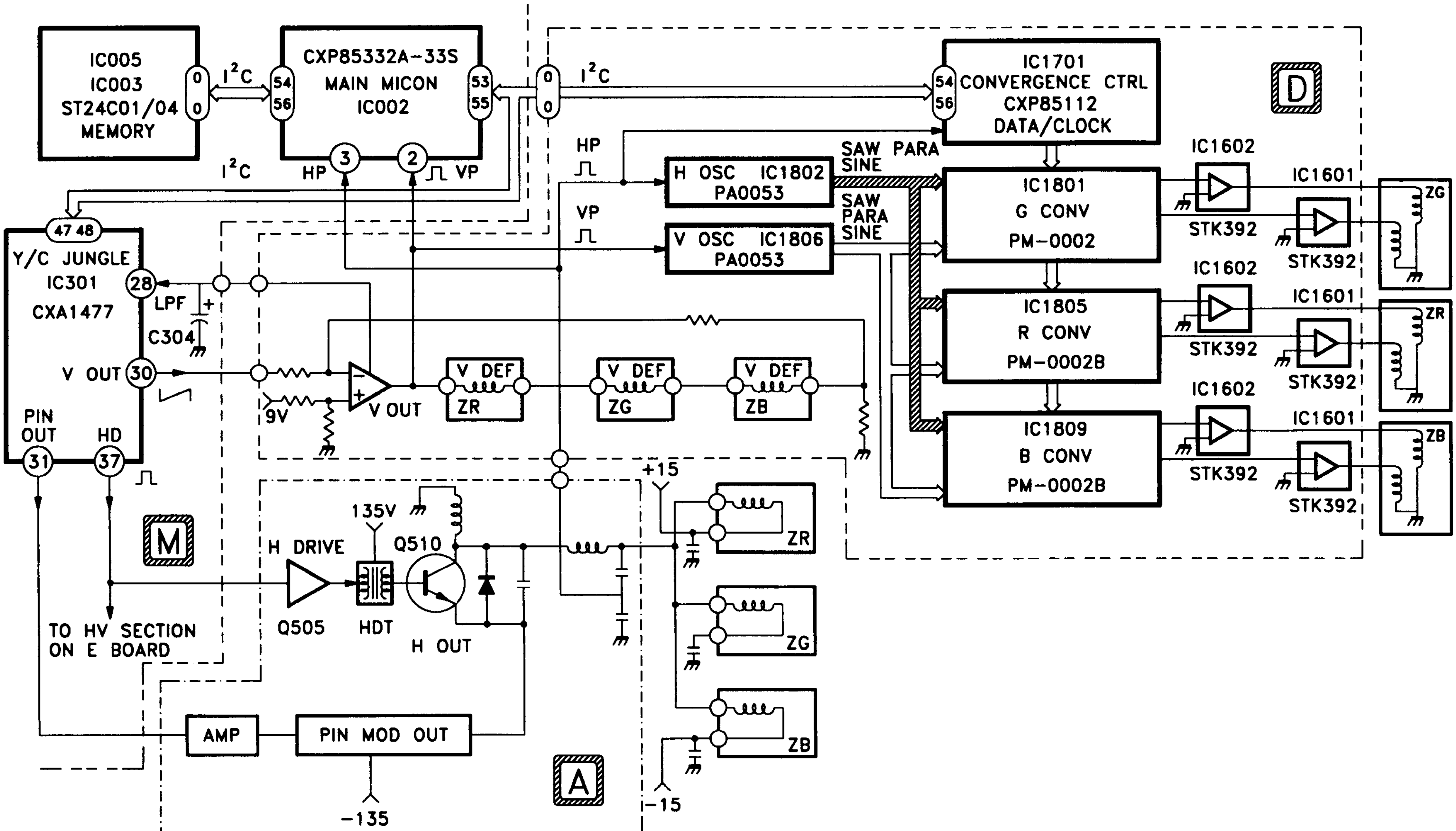
Convergence

The electronic convergence circuit is located on the D board. The circuit has four parts to it.

- The vertical and horizontal oscillators (IC1806,1802) produce the simple waveforms which are used for convergence.
- The Convergence Control (IC1701) uses data from the MI-CON (IC002) to control the D/A converters to produce six complex convergence waveforms (two for each tube).
- The D/A converters (IC1801,1805,1809) act as a mixer and modulator for the oscillator outputs.
- The deflection amplifiers (IC1601,1602) provide the current drive for the deflection coils on the Z boards.

Vertical Deflection

The vertical deflection circuit is located on the D board (with the convergence circuit) It is driven by the vertical sawtooth waveform from the Y/C jungle on the M board. The vertical sawtooth is amplified by a single IC and applied, in series, to the vertical deflection coils on the Z boards. The vertical sawtooth is also used for feedback to the MI-CON and the Y/C Jungle; and for sync to vertical convergence generator.



DEFLECTION BLOCK page 35

Horizontal Deflection

The Horizontal Deflection circuit is primarily responsible for driving the three horizontal deflection yokes. In this section we will discuss the two circuits responsible for providing the current needed to drive the three windings. They are:

1. The Horizontal Drive Circuit
2. The Pincushion Circuit

Horizontal Drive Circuit

The timing and drive pulses (Horizontal Drive Pulse) used in the circuit originate in the Y/C Jungle IC301. (Fig. 1).

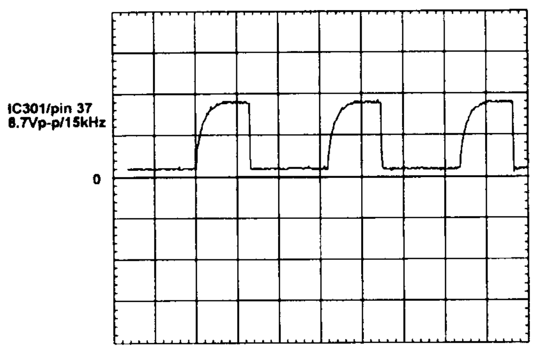


Figure 1 5V/div. 20usec/div

They exit the IC at pin 37 as 8.7Vp-p pulses. Within the IC, the H. pulses are developed by counting down a 32fh signal from the crystal at pin 39. If the set is ON without a video signal applied, the H. pulses free run at 15.7kHz to maintain horizontal deflection. When a video signal is applied, the H pulses are synched to the H sync pulses of the video signal. Sync is separated and used to synchronize the H. Pulses to the incoming video signal. Zener Diode D305 clips any signal excursions above 9.1V.

The H. Pulses are buffered by Q301; attenuated to 2.4Vp-p; and coupled to H. Drive Q505/B on the A Board. (Fig. 2).

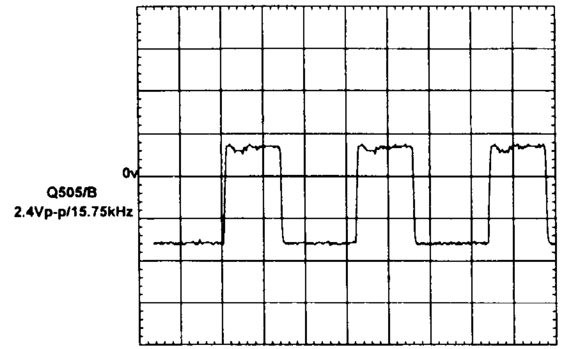


Figure 2 1V/div 20usec/div

H. Drive Q505 is switched ON/OFF with this signal, thereby creating the 75Vp-p signal on its collector, in Fig. 3.

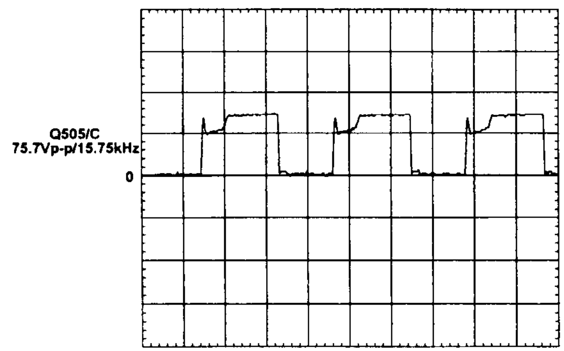
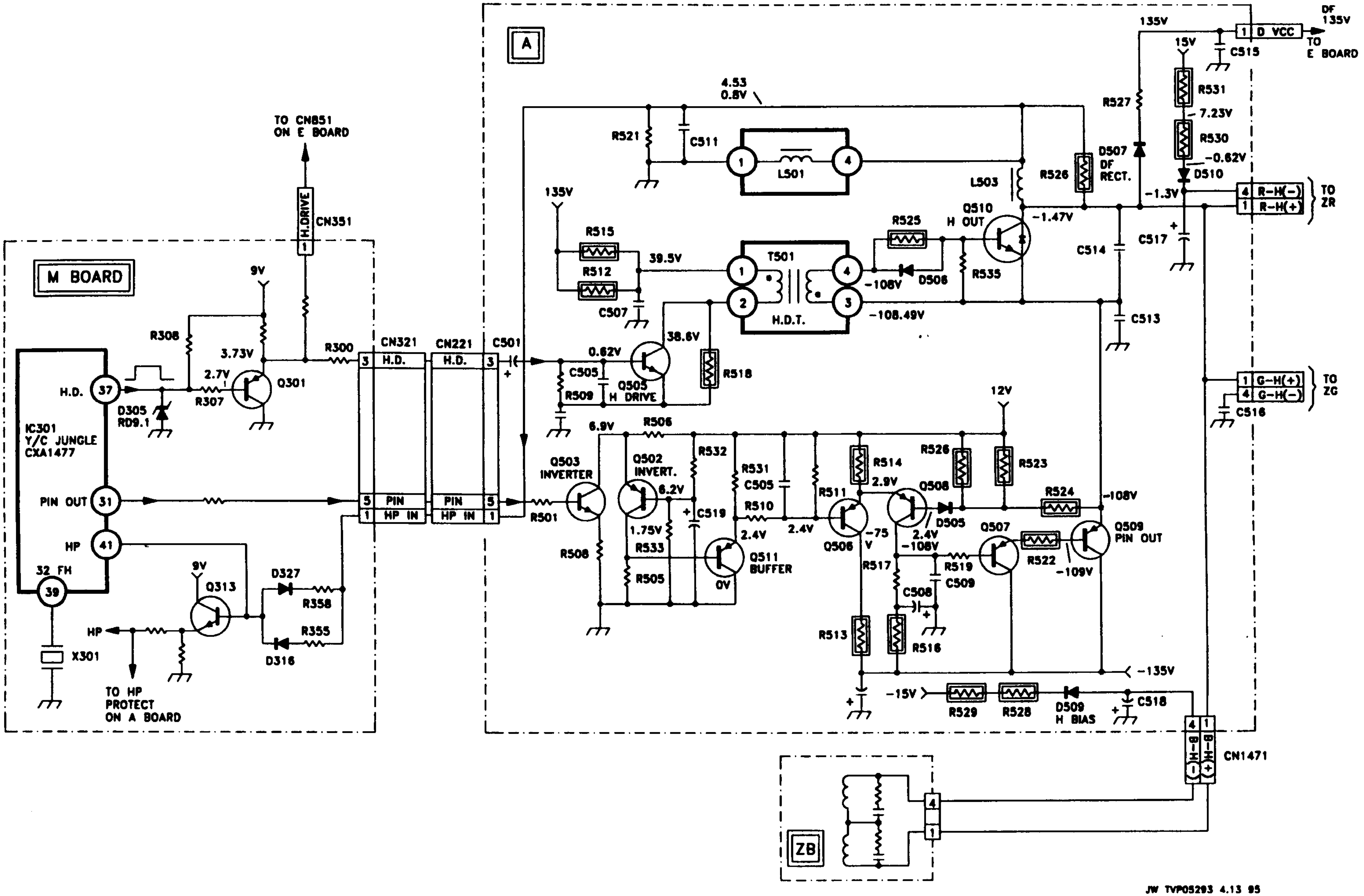


Figure 3 50V/div 20usec



HORIZONTAL DEFLECTION page 37

This action causes Horizontal Drive Transformer T501 primary winding to induce a 10Vp-p drive (Fig. 4) to its secondary winding and drive Horizontal Output Transistor Q510.

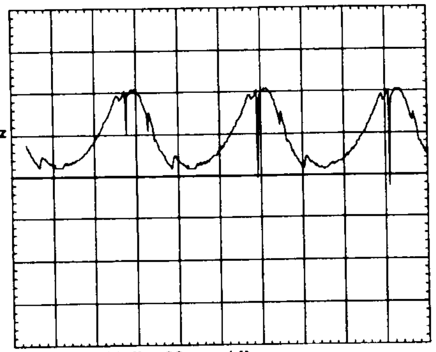


Figure 4 5V/div 20usec/div

Horizontal Output Transistor Q510 amplifies the signal further then drives the horizontal deflection coils. Horizontal Linearity Coil L503 wave shapes the deflection signal to make the horizontal scan linear. Due to the combined switching action of Q510 and the deflection coils, 962Vp-p pulses are developed on the transistor collector.

A sample of the deflection pulses are fed back to Y/C Jungle IC301/pin 41 via D327 and D316. IC301 compares the timing of this sample to the one developed from the 32fh crystal and Horizontal Sync for phase error. If the sample pulses are missing, Y/C Jungle IC301 shuts OFF the CRTs (circuits not shown).

Pincushion Circuit

The purpose of the pincushion circuit is to correct for deflection distortion. This distortion occurs because the screen is not spherical with respect to the horizontal and vertical arcs swept by the picture tube electron beam. As a result the distance traveled by the beam to the corners of the screen is longer than that traveled in the center of the screen. Therefore, the beam scans a pincushion shaped raster. (Bowed at the sides and top and bottom). To correct this problem pincushion correction is need in the horizontal and vertical scanning circuits. Here we will discuss correction in the horizontal scanning circuits.

Pincushion correction is achieved by modulating the horizontal scan current with the vertical scan current. The resulting signal is a parabolic waveform that causes the horizontal scan current to be least at the top of the raster, but to gradually increase to maximum as the beam reaches the vertical center of the screen. As the beam continues to move towards the bottom of the screen, the horizontal scan current gradually decreases. The result is a raster with straight sides. A similar system is used in the vertical deflection circuit to correct for the top and bottom of the raster.

Within the Y/C Jungle IC301, the parabolic signal is developed by modulating a signal at the horizontal rate with one at the vertical rate. The resulting parabolic signal exits as the PIN signal at pin 31 (Fig. 4) and is used to control the current through H. Output Q510.

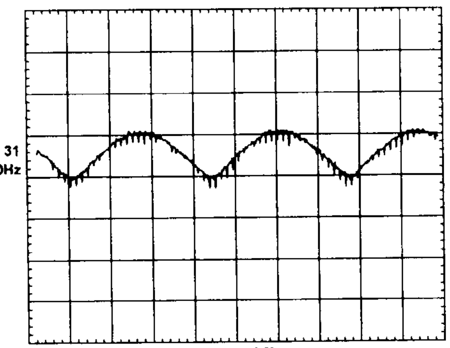
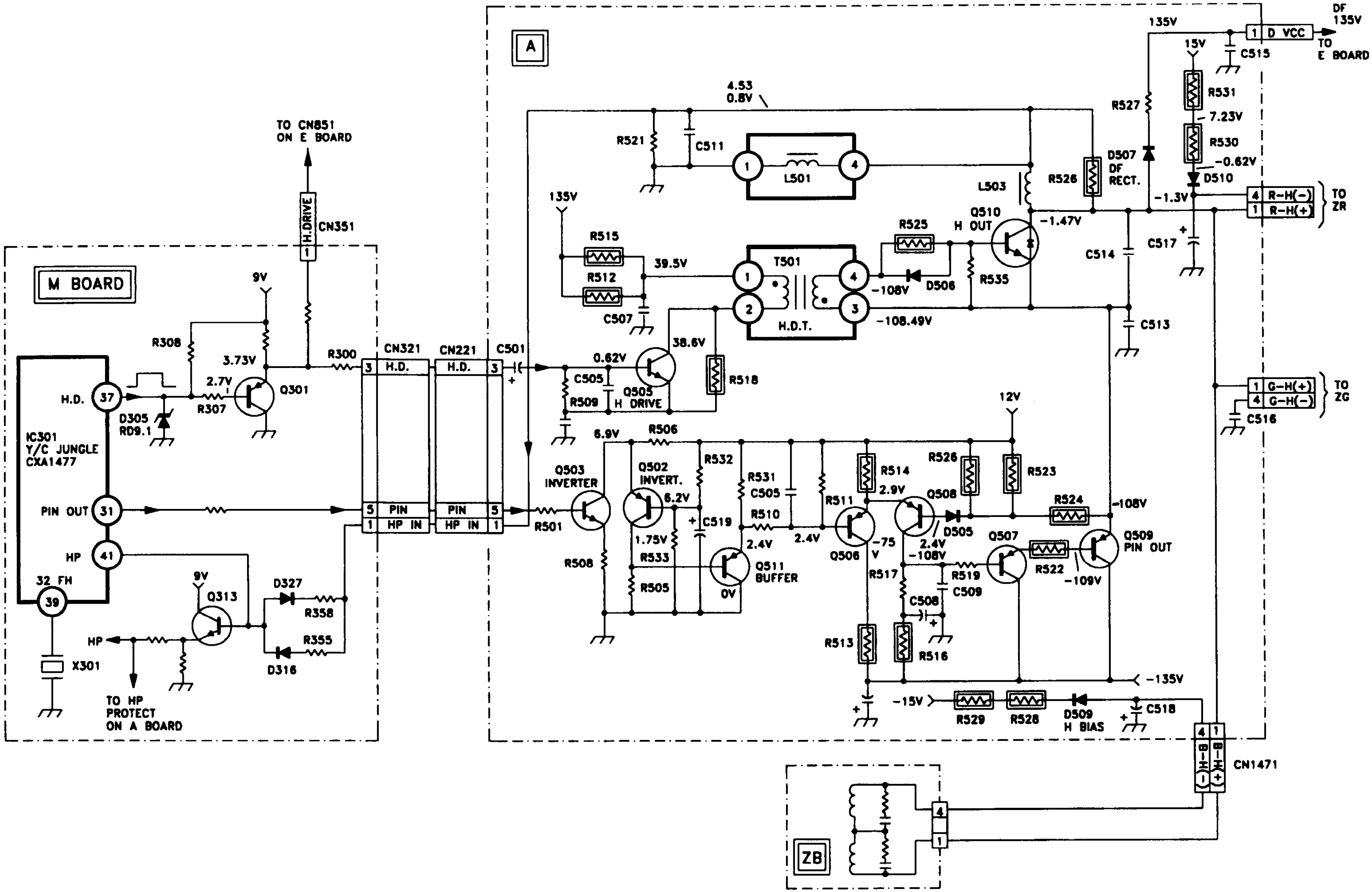


Figure 4 0.5V/div 5msec/div

The parabolic signal begins as a 688mV signal at IC301/pin 31. However, Transistor Q503 provides the only stage of inverting the signal, while Q502, Q511, Q506, Q508 and Q507 buffer and amplify the signal without phase inverting it before applying it as the drive signal to Pin Out Current Amp Q509/Base.



HORIZONTAL DEFLECTION page 39

The conduction of Q509 affects the current pattern through H. Out Transistor Q510 in the manner described above to correct pincushioning.

The following waveforms can be used when trouble shooting the pincushion circuit.

Q502/C
1.3Vp-p

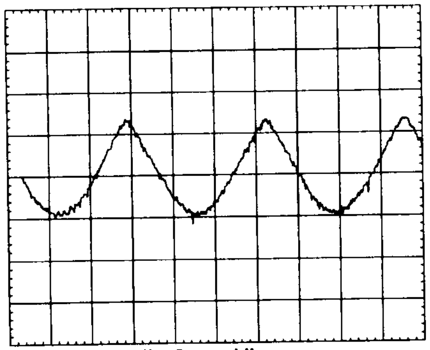


Figure 5 0.5V/div 5msec/div.

Q506/B
1.2Vp-p

0V

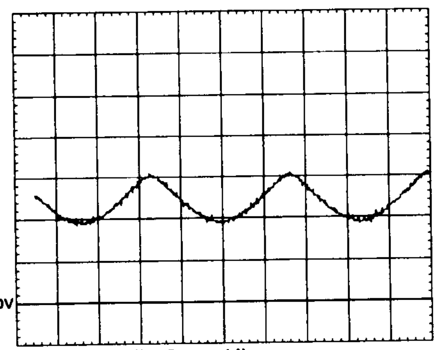


Figure 6 1V/div 5msec/div

Q508/E
1.3Vp-p

0V

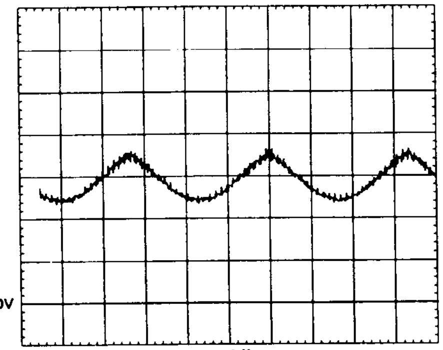


Figure 7 1V/div 5msec/div

Q507/B
11.5Vp-p

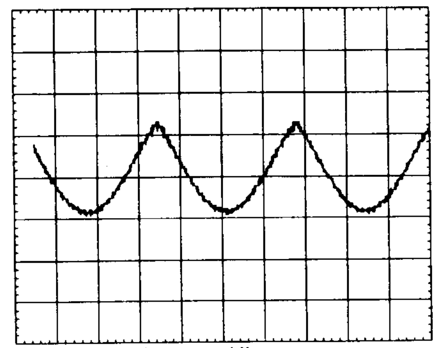


Figure 8 5V/div 5msec/div

Q509/B
23Vp-p/60Hz

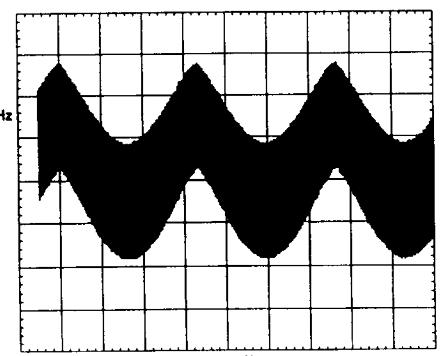
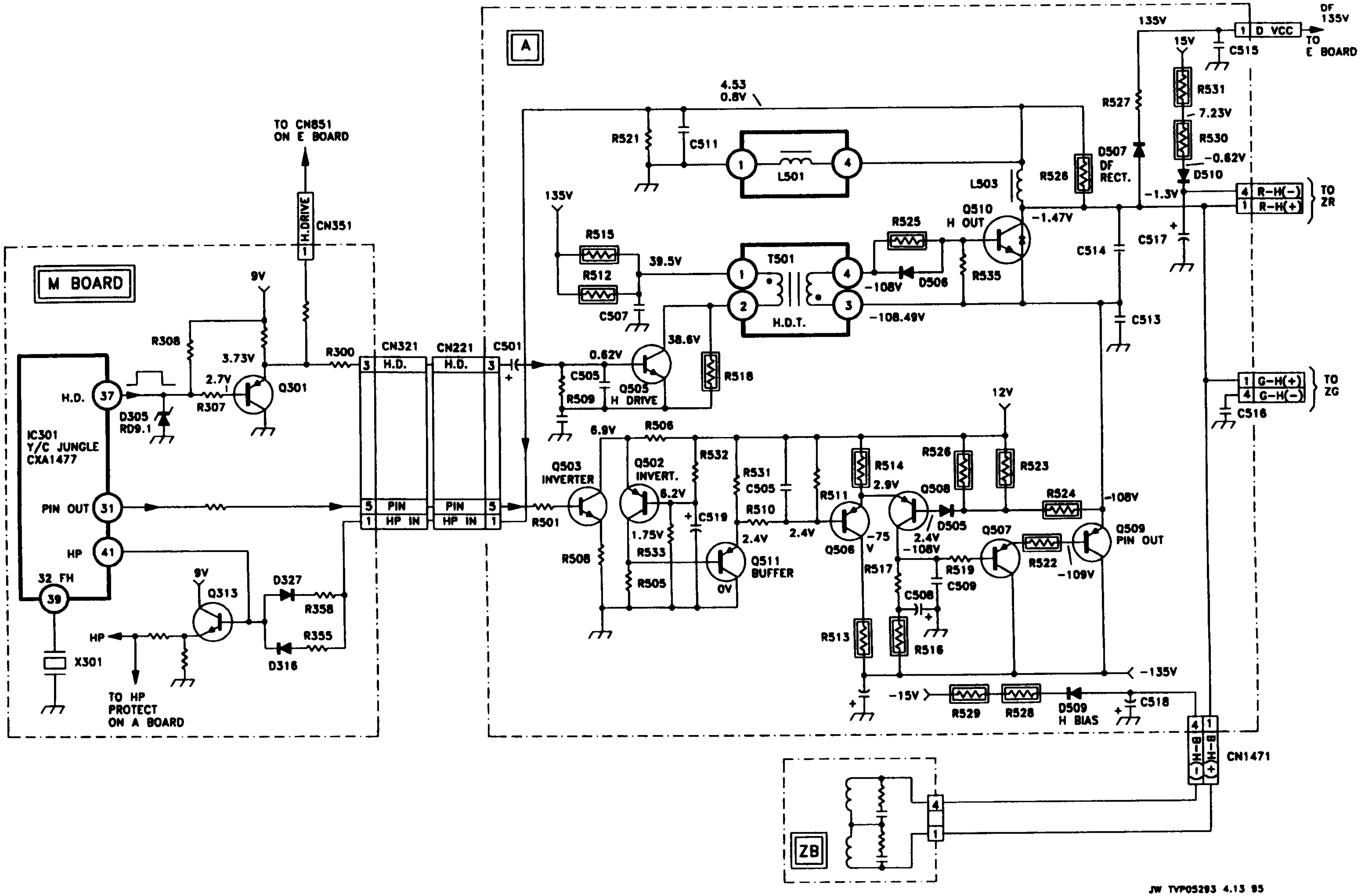


Figure 9 5V/div 5msec/div



HORIZONTAL DEFLECTION page 41

Convergence

The RA chassis uses an electronic convergence system. Three D/A converters, IC1801, IC1805, and IC1809 (both not shown), controlled by a microcomputer (IC1701), produce six correction waveforms which drive the three sub-deflection coils (only one is shown). Two waveform generators, IC1802 and IC1806 produce four vertical and four horizontal waveforms that are applied to the D/A converters. REGI-CONTROL IC 1701 receives data from the MI-COM. This data is stored in two EPROMs, IC003 and IC005. This data is applied to the D/A converters. The outputs of the D/A converters are amplified and applied to the sub-deflection yokes. Since the three D/A converters are wired in parallel, only the green convergence circuit is shown below. A block diagram of the convergence circuits showing all three circuits is in the Deflection Block diagram.

This section covers three convergence topics.

1. Convergence circuit.
2. Performing convergence using the remote commander and the convergence jig.
3. Convergence troubleshooting.

Convergence Circuit Description

1. When the unit is turned ON, the stored convergence settings from EPROMs IC003 and IC005 on the M board are down-loaded to the Regi-Control IC1701, via the I²C bus (SDA and SCL). Regi-Control IC1701 is a CMOS 8-bit microcomputer with a system clock (X1701) of 4.2MHz.

Reset

Reset is provided by IC1702 which has an internal delay circuit. Reset occurs each time the power is turned ON.

Convergence Control Data

The Regi-Control IC1701 uses three output signals, Clock, Data, and CEB (chip enable), to send data to the three D/A converters. These signals are applied to the G-CONV IC1801. These three signals are daisy-chained to the remaining ICs (not shown). Each IC has a hard-wired address code and will only respond when the data signal contains the proper address for that IC. A sample of output data is shown in figure 1 below.

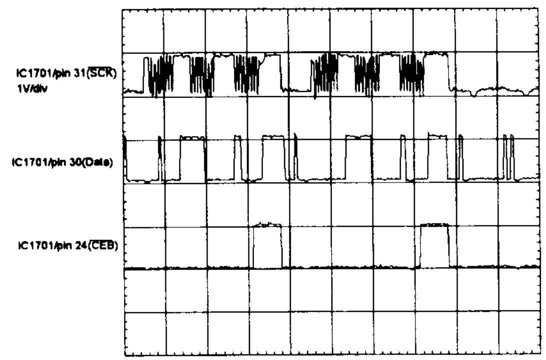
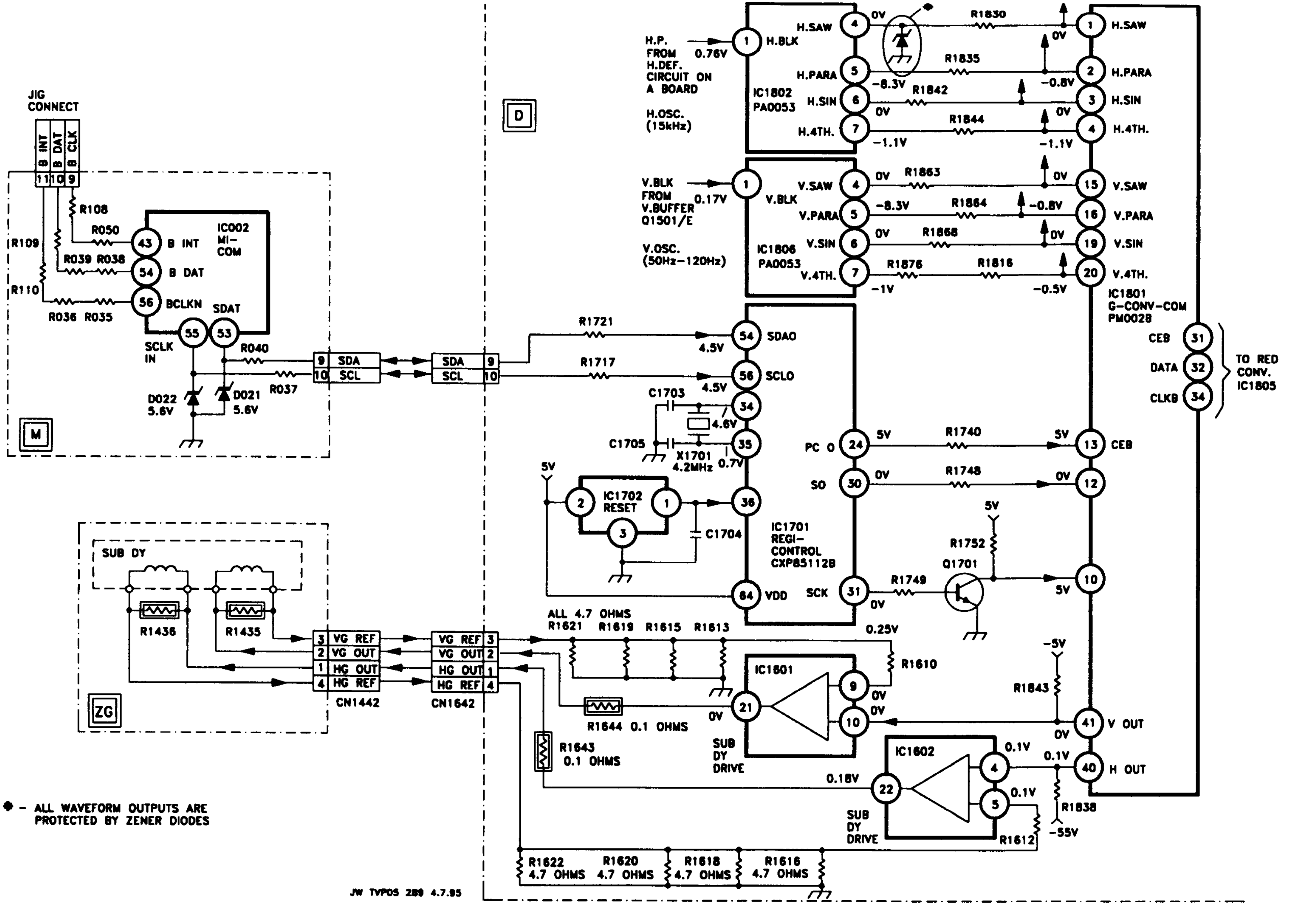


Figure 1 5V/div 50usec/div



CONVERGENCE (G SHOWN) page 43

Convergence Waveform Generation

The eight waveforms that produce the convergence drive signals are developed by H. osc. (IC1802) and V. osc (IC1806). Each IC is synchronized at pin 1. The output waveforms are shown in the following figures. These waveforms can be used as a comparison when a convergence defect is suspect.

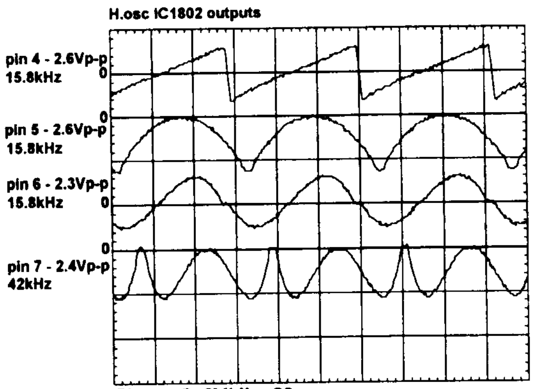


Figure 2 2V/div 20usec

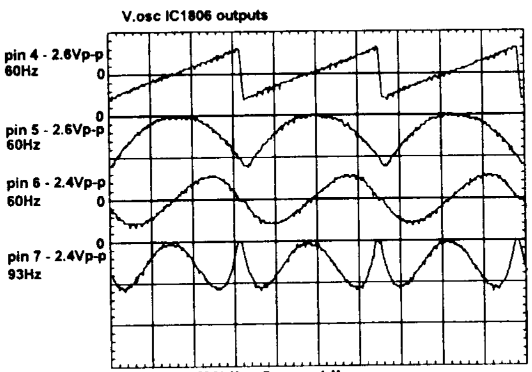


Figure 3 2V/div 5msec/div

The vertical and horizontal outputs from the convergence ICs are complex waveforms, shaped to compensate for the wide deflection angle of the projection TV. Each output is unique for that set. The settings are pre-adjusted in the factory. They are re-adjusted in the customers home following a repair.

The 12 waveforms on the following two pages are examples of what the convergence outputs can look like. A sample of the vertical and horizontal correction output waveforms for the green tube is shown in figure 4.

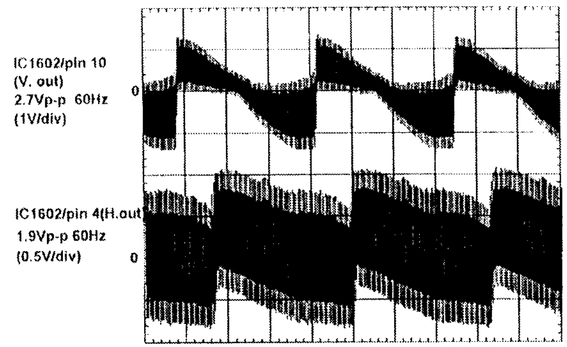


Figure 4 5msec/div

The vertical waveform is applied to current amplifier IC1601/pin 10, output at pin 21, and applied to the green sub deflection yoke on the ZG board. The return path to ground is through four 4.7 ohm parallel resistors. The voltage drop across these resistors provides negative feedback to the current amplifier. The following page contains six pairs of drive and return signals for the three tubes (three pairs for horizontal and three pairs for vertical). These signals can be used as a reference when aligning a unit.

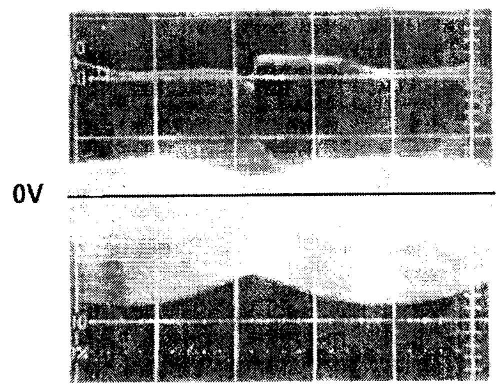


Figure 1. RH out from IC1602/pin 21
5V/div

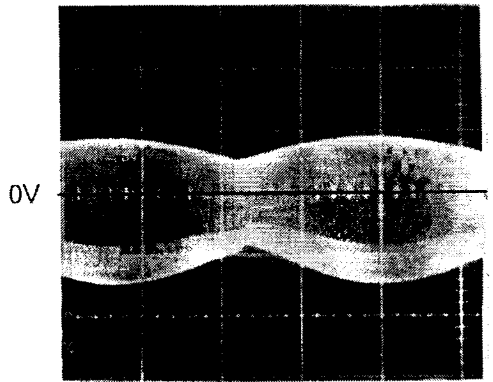


Figure 2 RH return from IC1602/pin 9
0.5V/div. 2msec

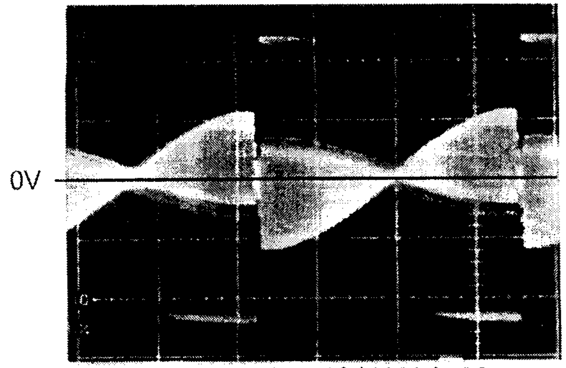


Figure 3 RV out from IC1602/pin 20
5V/div. 5msec/div.

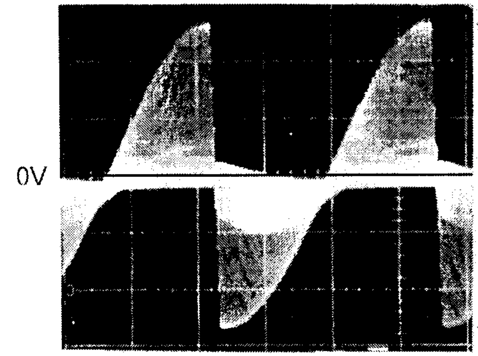


Figure 4 RV return from IC1602/pin
0.5V/div. 5msec/div.

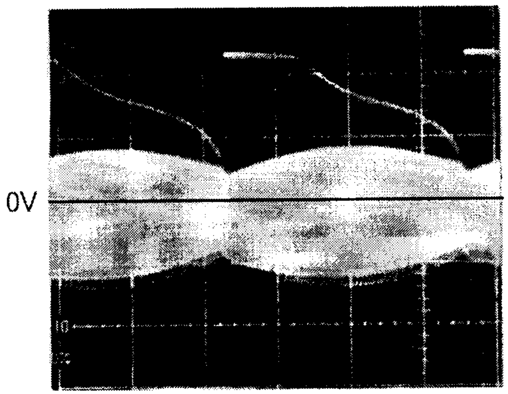


Figure 5 GH out from IC1602/pin 22
5V/div 5msec/div.

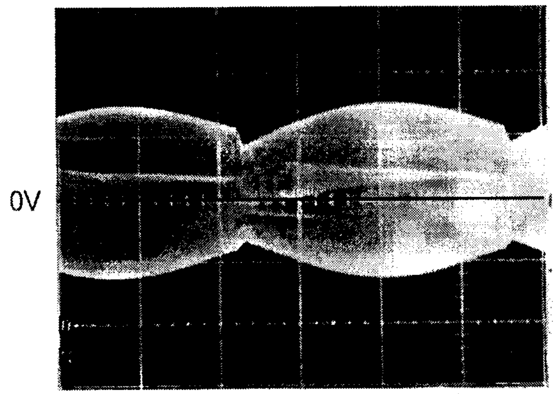


Figure 6 GH return from IC1602/pin 5
0.5V/div 5msec/div.

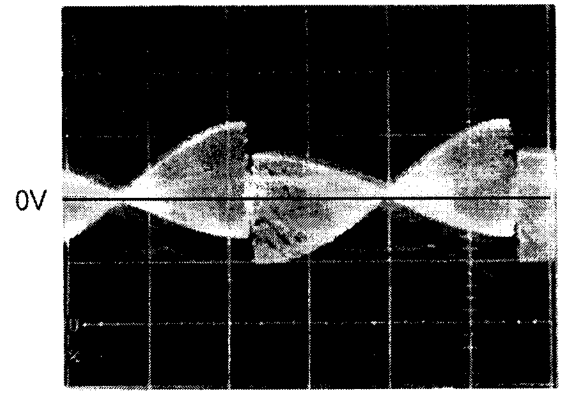


Figure 7 GV out from ICI601/pin 21
5V/div. 5msec/div

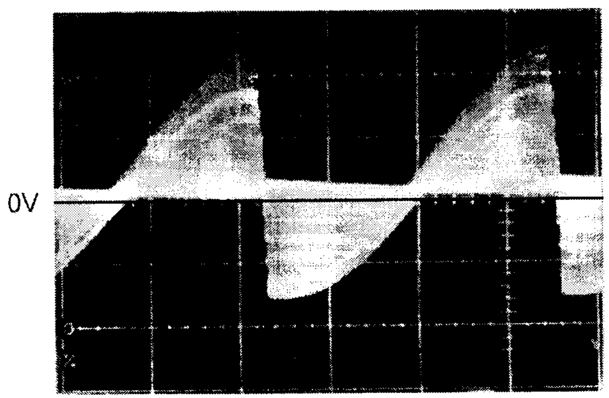


Figure 8 GV return from IC1601/pin 10
0.5V/div. 5msec/div

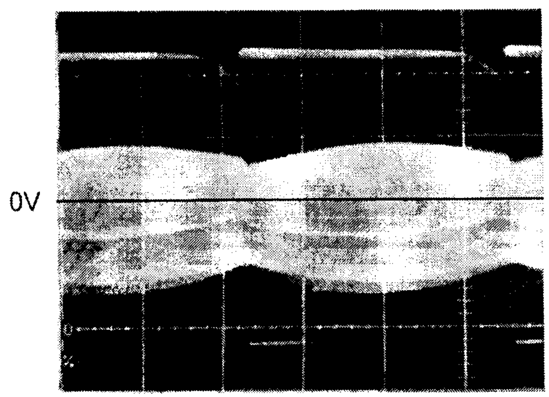


Figure 9 BH out from IC1601/pin 20
5V/div. 5msec/div.

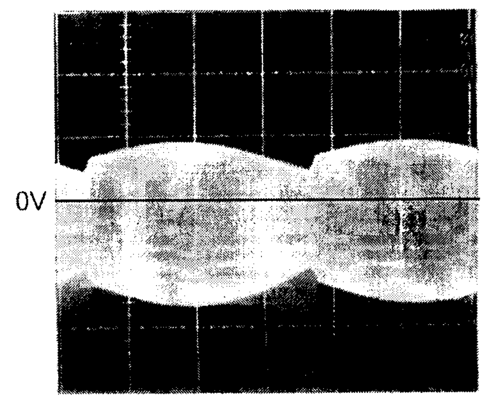


Figure 10 BH return from IC1601/pi
0.5V/div 5msec/div.

0V

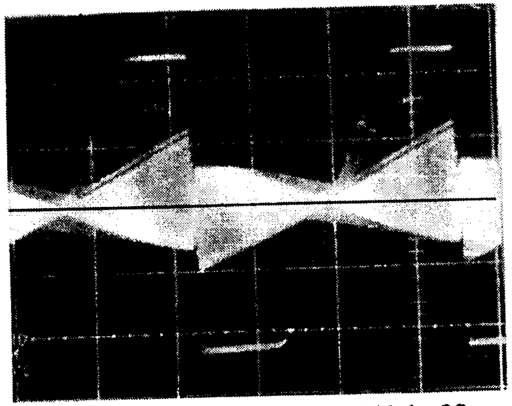


Figure 11 BV out from IC1601/pin 22
5V/div. 5msec/div.

0V

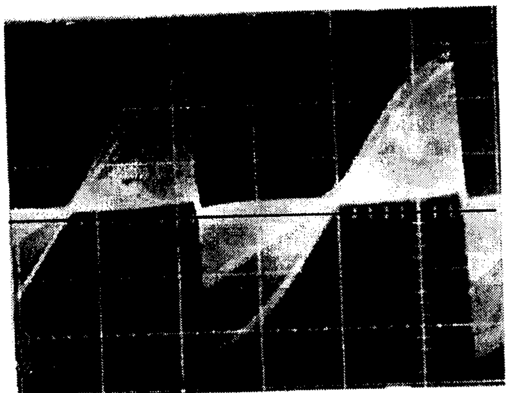


Figure 12 BV return from IC1601/pin 5
0.5V/div. 5msec/div.

Adjusting Convergence

Convergence can be adjusted with either the remote commander or the convergence jig. The availability of the convergence jig will be indicated through a service bulletin which will be distributed to all authorized servicers.

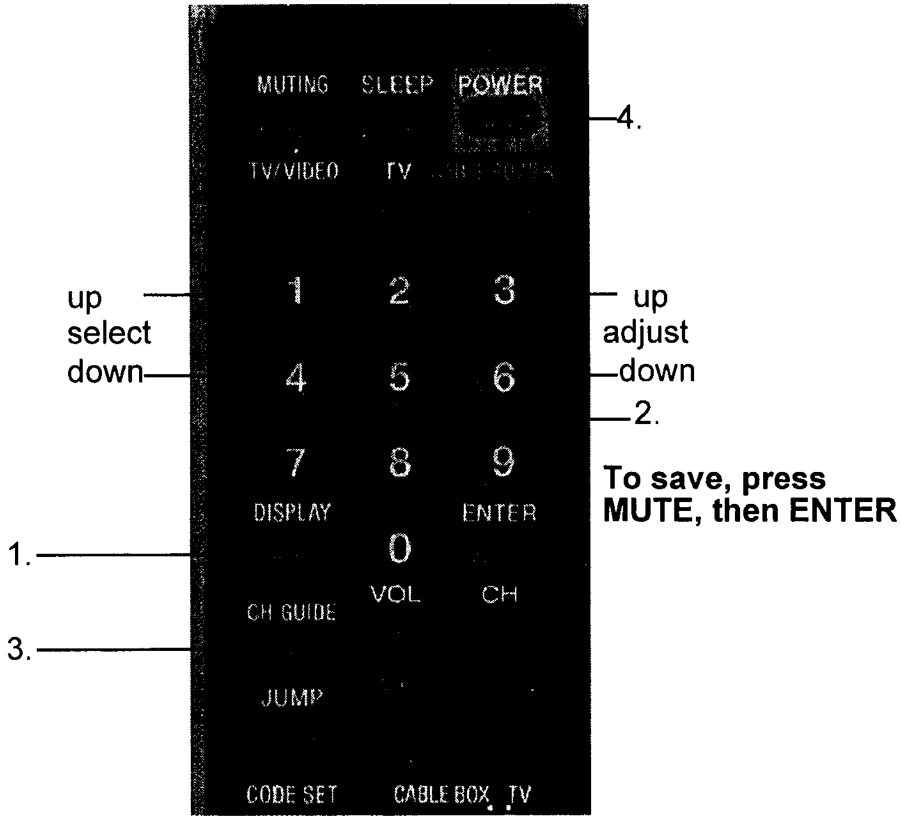
Using Remote Commander

When using the remote commander to adjust convergence, the set must be placed in service mode using the following steps:

1. Turn the set OFF.
2. Press the DISPLAY, 5, VOL +, and POWER buttons in sequence.
3. The set will turn ON and the words "SERVICE MODE, PJTV, "1"" will appear in the upper portion of the picture. The second line of text will contain a Microcomputer programming code, used primarily at the factory. Normally, this code should contain all zeros.
4. Input a cross hatch pattern into the set.
5. Use the "1" and "4" buttons to select the parameter to be adjusted, and use the "3" and "6" buttons to make the adjustment. Press the "MUTING" button followed by the "ENTER" button to save the adjustment.

Main Picture Adjustment

1. The main picture is adjusted by turning OFF the red and blue tubes, and adjusting the green tube. This can only be done using the remote commander, not the convergence jig. Perform the adjustments in the following sequence.
2. Alternately select **ROFF** and **BOFF** and set both to "0". A green cross hatch will remain.
3. Select and Adjust **VPOS** to center the picture vertically.
4. Select and adjust **VLIN** to make the top and bottom row of boxes equal in height.
5. Select and set **VZOM** to "0".
6. Alternately select and adjust **VSIZ** and **VSCO** until all boxes are of equal height.
7. When done, save the settings to memory by pressing the "MUTING" and "ENTER" buttons.



Entering service mode using the Remote Commander

Horizontal Settings

1. Select and adjust **HPOS** to center the picture horizontally.
2. Select and roughly adjust **HSIZ**.
3. Select and set **HZOM** to "0".
4. Select and roughly adjust **PAMP**.
5. Select and Adjust **UPIN** so that the top end of the outer most vertical lines are straight.
6. Select and Adjust **LPIN** so that the bottom ends of the outer most vertical lines are straight.
7. Select and adjust **VANG** and **VBOW** so that the center horizontal line is straight.
8. Select and Adjust **PPHA** so that the whole picture is straight.
9. When done, save the settings to memory by pressing the "MUTING" and "ENTER" buttons.

Convergence Adjustments.

There are a total of 90 convergence adjustments, 30 for each color. The following table lists five groups of adjustments in the order that they are performed. Groups are separated by double lines. Horizontal adjustments in each group are performed first, followed by the vertical adjustments. An "X" indicates adjustments that should **not** to be done. Start with the green horizontal (HG) and vertical (GV) adjustments. After each adjustment, press the MUTING button followed by the ENTER button to save the adjustment. When all green adjustments are completed, turn ON the red tube (ROFF = 1) and adjust it to the green pattern. Then turn OFF the red tube, turn ON the blue tube and perform the blue adjustments. Remember: turn on the all tubes when done.

Item	GH	GV	RH	RV	BH	BV
CENT	O	O	O	O	O	O
SKEW	O	O	O	O	O	O
BOW	O	O	O	O	O	O
4BOW	O	X	O	X	O	X
MLIN	O	X	O	X	O	X
LIN	O	O	O	O	O	O
MSIZE	O	O	O	O	O	O
SIZE	O	O	O	O	O	O
SSKEW	O	O	O	O	O	O
KEY	O	O	O	O	O	O
WAVE	X	O	X	O	X	O
4PIN	O	O	O	O	O	O
4SBOW	O	X	O	X	O	X
MBOW	O	X	O	X	O	X
SBOW	O	O	O	O	O	O
MPIN	O	O	O	O	O	O
PIN	O	O	O	O	O	O
MKEY	X	O	X	O	X	O

Using The Convergence Jig

The convergence jig provides a quick and easy method of touching up the convergence settings in the customers home. This jig should be used in conjunction with the remote commander since the jig cannot disable the individual tubes or perform centering and linearity. To disable the tubes, use the remote commander to select BOFF and ROFF, set these to "0" and save the settings. Then turn the set OFF, and enter the service mode as follows.

1. Turn ON the set and wait until a picture appears.
2. Connect the convergence jig cable to connector CN054 on the M board. This connector is accessible from the rear of the unit, on the bottom rear edge of the vertically mounted M board.
3. Apply power to the convergence jig. The CENT and RH buttons will be illuminated. Select GH and begin adjustment. Use the rocker switch to perform the adjustment. After each adjustment, press the SAVE button to store the adjustment.

Note: Adjustments in the chart that are marked with an **X** cannot be performed using the jig.

Troubleshooting The Convergence Section

There are two aspects to the convergence section, the hardware and the software. Either one can cause a problem which result in mis-convergence. A circuit problem (hardware) is indicated when the set cannot be converged using either the remote commander or the jig. If this is the case, the first step in troubleshooting is to verify the "must-have's" for this section. Turn ON the power and input a crosshatch pattern. Use the waveforms on the preceding pages and the diagram below to verify the following.

1. Vcc, data and reset to IC1701.
2. Output data to IC1801 and subsequent output data to IC1805 and IC1809.
3. The eight generated waveforms from IC1802 and IC1806 (refer to figures 2 and 3 on the second page of this section).
4. The sync inputs at pin 1 of the waveform generators.

If all of these signals are correct then the problem is either,

A) An adjustment problem, in which case the set will not respond to the adjustments made with the remote commander or the jig.

B) A defective convergence drive amplifier. The amplifiers can be checked by comparing the waveforms on the preceding page, and the dc levels in the diagram with the suspected ones.

C) An open/shorted yoke or signal return resistors. All yokes should measure approximately 1Ω in or out of circuit.

Rule out "B" and "C" before acting on "A".

Vertical Deflection

The drive signal for the vertical deflection originates in the Y/C Jungle IC301/pin 30. It free-runs at approximately 60Hz to maintain a raster under no signal conditions, however, when a video signal is present its frequency and phase are controlled by the vertical sync pulses of the video signal.

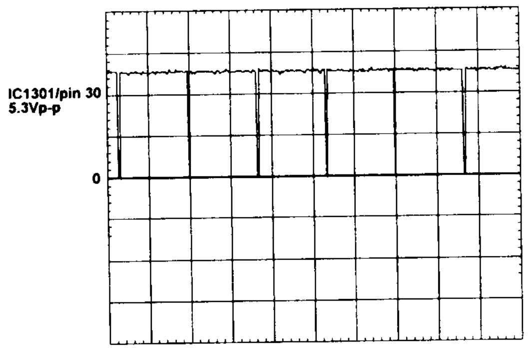


Figure 1 10msec/div

Fig. 1 shows the vertical drive waveform at Y/C Jungle IC301/ pin 30. It is then wave shaped by integrator R1502, R1503 and C1506, and applied to the inverting input of V-OUTIC1501/pin 1 via R1506. Non-Inverting pin 7 is biased at 1.5V by R414, R1515, R1517, R1518, and D1504. The deflection drive pulses are amplified by IC501 to 57V p-p and output at pin 5. They are then sent via L513 to the three deflection coils which are connected in series. The return path for the signal is through RR1510, R1511, R1513, R1516 and TH1501. The return path also applies negative feedback to the input via R1507.

Since a loss of vertical deflection will damage the CRTs, protection is provided in the event of deflection loss; Y/C Jungle IC301 monitors a V. pulse from IC1501/pin 3. This pulse (Fig. 2), is coupled by C1505, rectified by D1501, buffered by Q307 and Q305, filtered by C304, and applied to Jungle IC301/pin 27, as a 7V dc level signal.

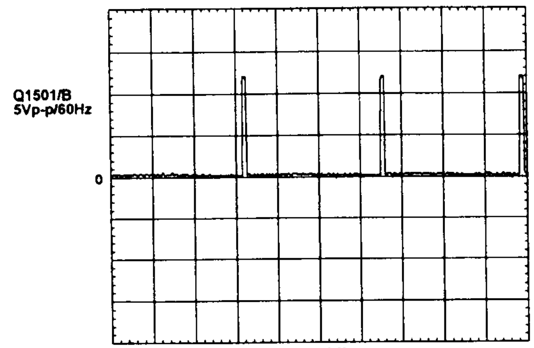


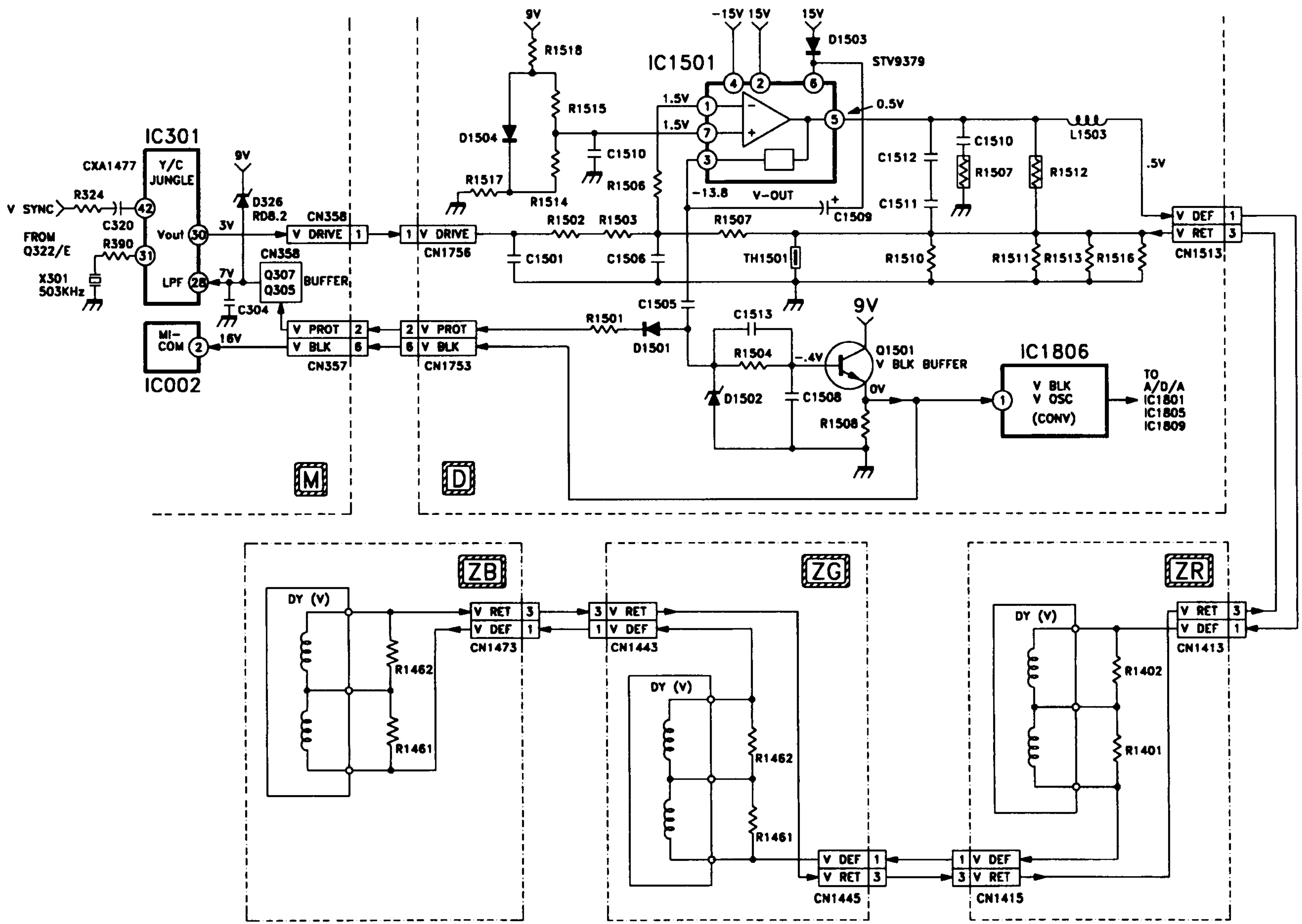
Figure 2 2V/div 5msec/div

If the V. pulse from IC1501/pin 3 is missing, the 7V level at IC301/pin 28 will drop, causing IC301 to blank all three tubes.

The pulses from V-Out IC1501/pin3 are also used to:

A. Sync the oscillator in IC1806 to the V. Deflection . This oscillator is used in the convergence circuit.

B. Inform MI-COM IC002 (at pin 2) when vertical retrace occurs. IC002 communicates with the Jungle IC301 only during vertical blanking. To prevent data noise from interfering with the picture, data communications occurs only during vertical retrace (when the picture is blanked).



VERTICAL DEFLECTION page 51

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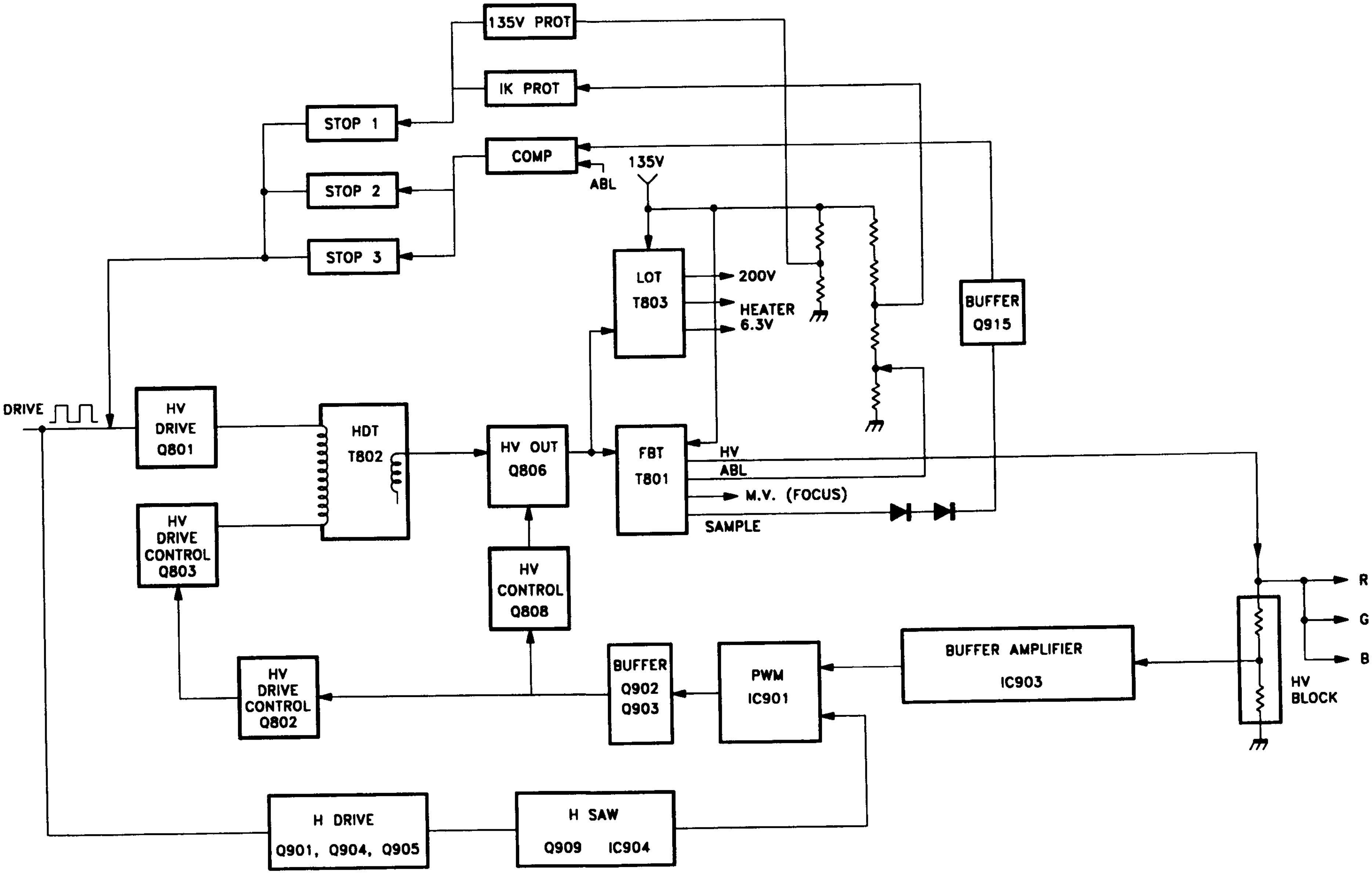
High Voltage Block

The high voltage section consists of three groups of circuits: a circuit that develops the voltages (High Voltage Development section), a circuit that regulates the high voltage (also, High Voltage Development section), and a circuit that protects from over-voltage or over-current conditions. (H.V Protect section).

- The circuits that produce the high voltage, focus voltage, heater voltage and the 200V supply are: HV Drive Q801; HDT T802; HV Out Q806; FBT T801 and LOT T803.
- The HV regulation circuits are: the HV resistor block; Buffer IC903; amp IC903; PWM IC901; buffers Q902 and Q903; and HV control Q808.
- The circuits monitoring for over-voltage and over-current are: 135V PROT; 1K PROT; COMP; and STOPS 1, 2, and 3.

Each of these sections is covered in detail on the following pages.



HIGH VOLTAGE BLOCK page 53

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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 (fig. 1) and applied to HV drive transistor Q801. It is also applied to H. Phase Shift Q901/B.

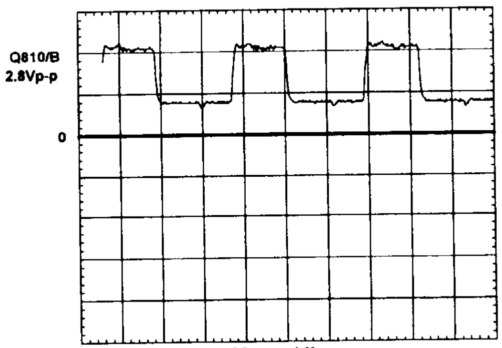


Figure 1 2V/div 20usec/div

Q801 drives the primary of T802. The 140Vp-p secondary voltage of T802 is applied to the base of HV output transistor Q806 (fig. 2).

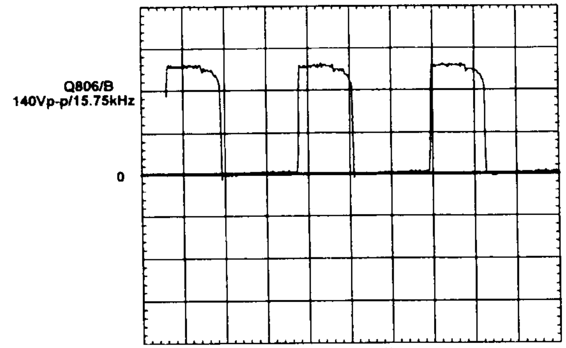


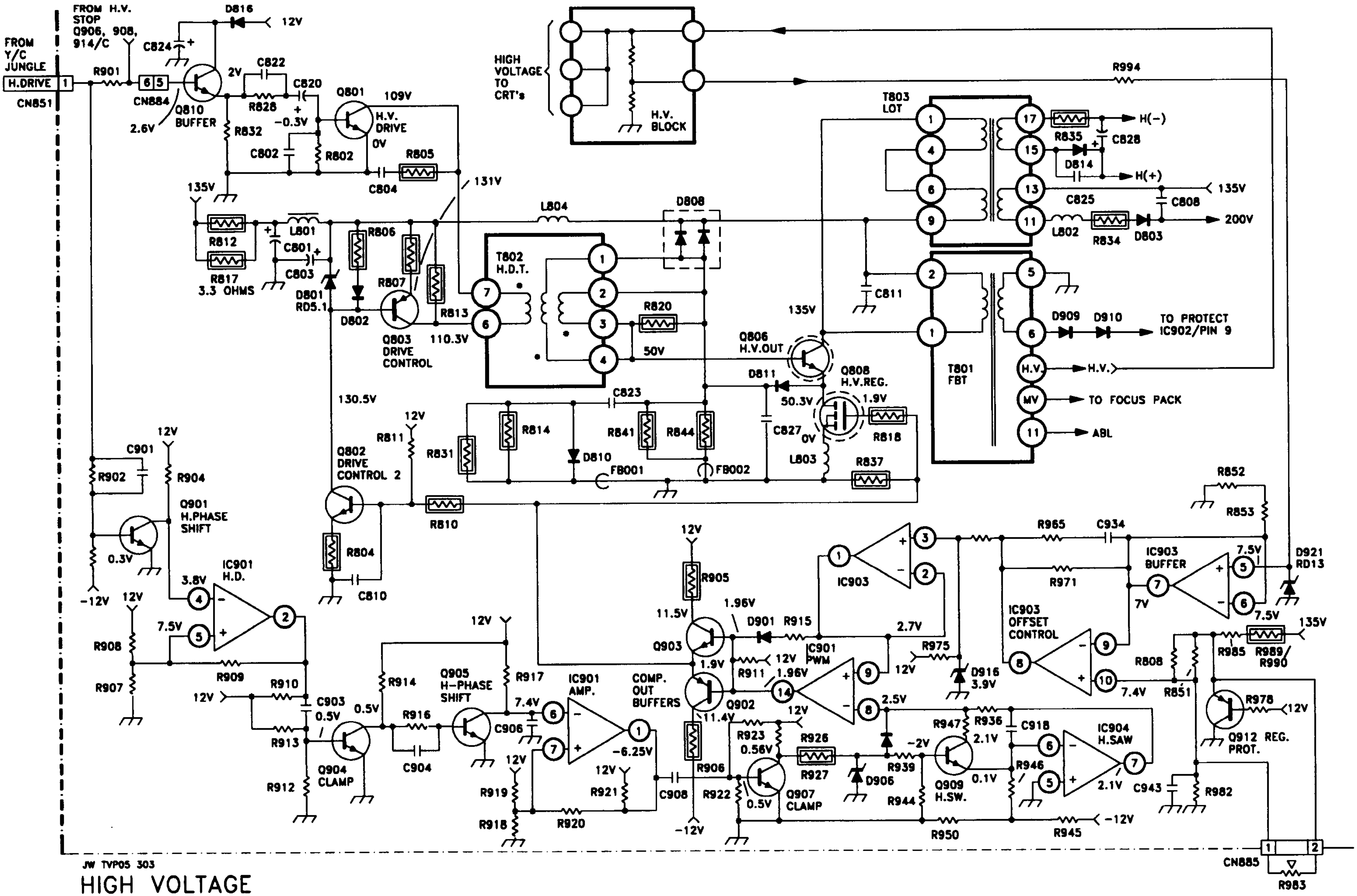
Figure 2 50V/div 20usec/div

The sharp turn-off of Q806 causes 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 using a voltage divided sample from the high voltage block 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. Circuit operation is described as follows.

A sample of the high voltage (7.5V) is tapped off the H.V. 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 the 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 (Fig. 3 A) and Q903/Base. A sawtooth waveform (Fig 3B) 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 at IC901/pin 14.



HIGH VOLTAGE DEVELOPMENT page 55

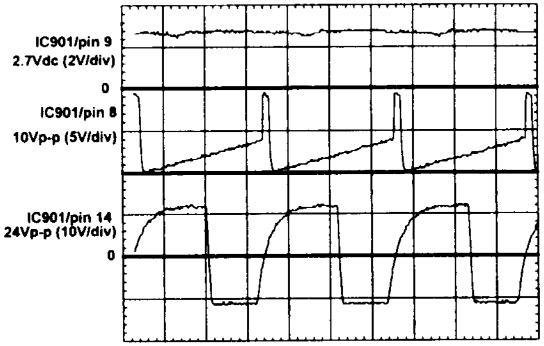


Figure 3 20usec/div

The 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. Fig. 4 represents the signal at the base (fig. 4A) and collector of Drive Control Q802. Due to the large dc offset at the collector (130.5Vdc), figure 4B was taken at 5V/div, AC coupled.

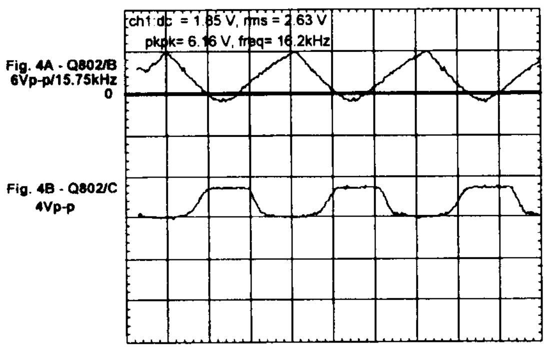


Figure 4 5V/div 20usec/div

Fluctuations in the high voltage will change the PWM reference level and therefore, the pulse width at the base of Q902. This, in turn changes the conduction time of Q802, Q803 (drive control) and Q808 (H.V regulation). Q808 is in series with Q806/E and ground. Therefore, the PWM pulses also 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, in the following manner.

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 (Fig 5A). This IC increases the pulse width of the H. Drive signal pin 4 (biased at 3.8V dc) by comparing it to a reference voltage at the non-inverting input (pin 5), which is biased at 7.5V dc. As a result, the polarity of the output signal does not swing negative until the input signal reaches 3.8V (Fig. 5B).

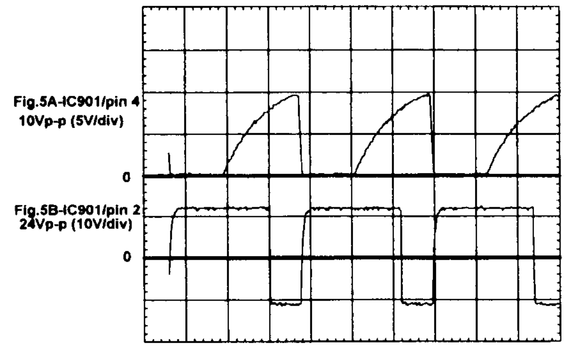
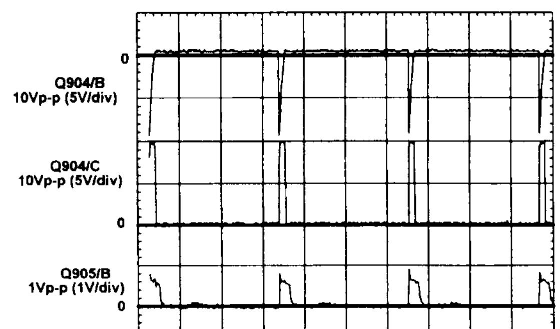
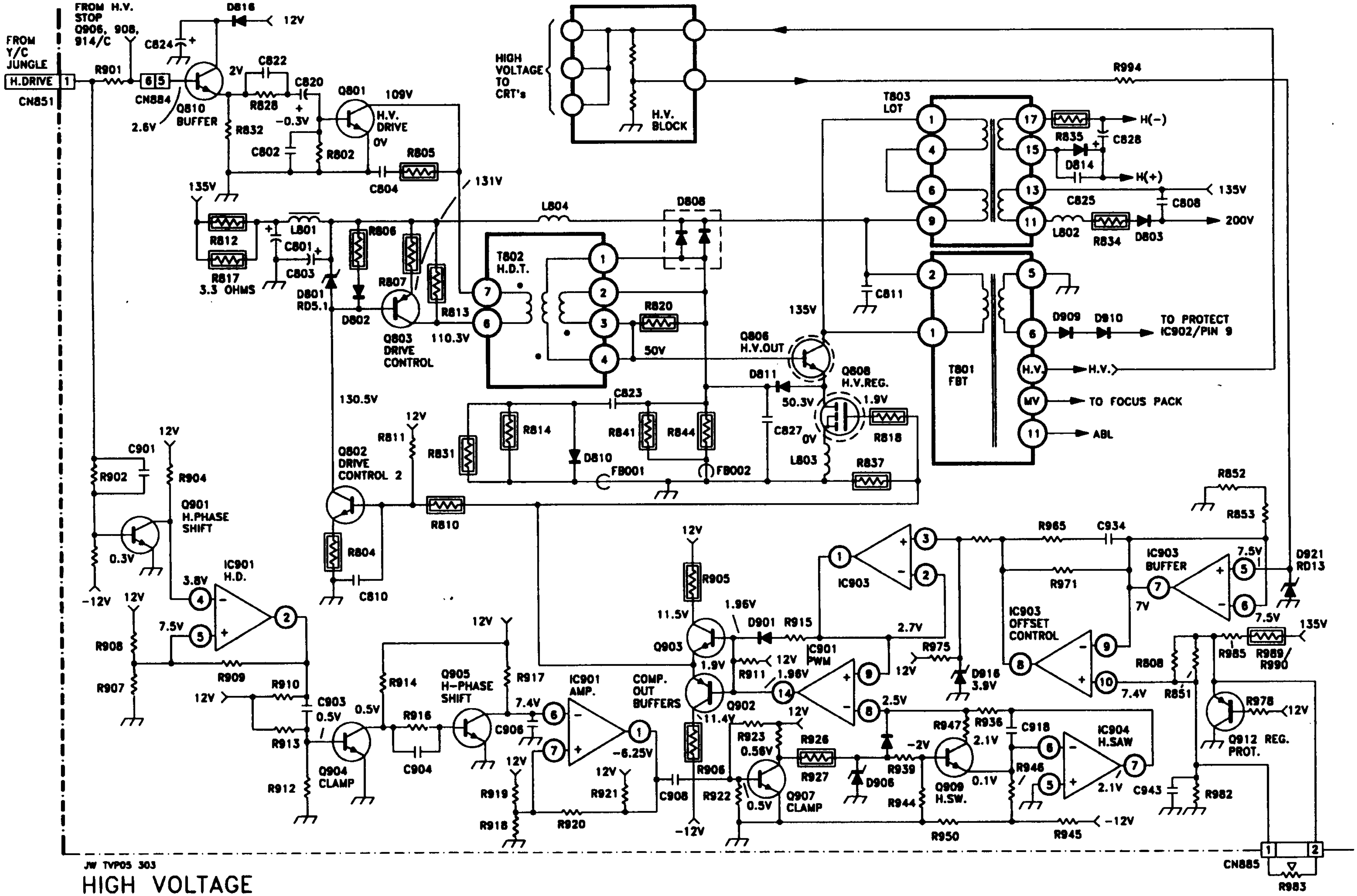


Figure 5 20usec/div

The negative going pulses of this waveform are differentiated and applied to Q904/Base, driving the transistor into cut-off. The resulting rectangular pulses at its collector are widened and attenuated to 1Vp-p by R916 and C904 and are applied to H. Phase Shift Q905/Base (Fig. 6).





HIGH VOLTAGE DEVELOPMENT- page 57

As Q905 is switched ON by the signal at its base, it provides a quick discharge path for C906. However, when it is OFF, C906 charges exponentially through R917. This action creates 12Vp-p integrated pulses at the inverting input of Amp IC901/pin 6. (Fig. 7A). Pin 7, the non-inverting of this amp, is biased at 4.7V. This arrangement produces a pulsed waveform (Fig. 7B) at the output of IC901/pin 1.

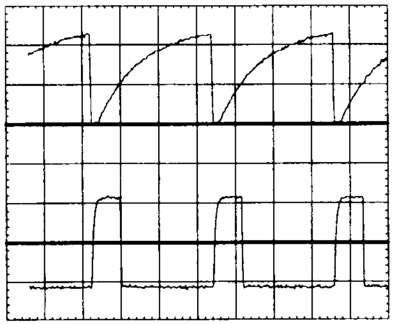


Figure 7 20usec/div.

This waveform, though referenced to the H. Drive signal, has been reshaped and phase shifted so that it occurs during the final 13us of the H. Drive pulse. (Fig 8).

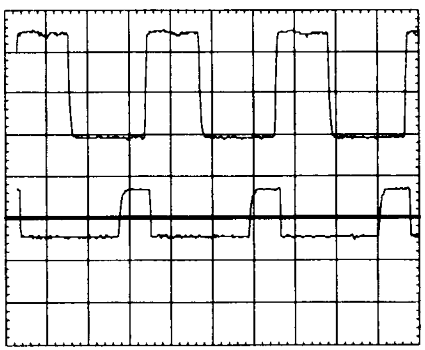


Figure 8 20usec/div

This signal is again differentiated with C908/R922, thereby producing sharp negative pulses at Clamp Q907/Base. After amplification and buffering by Q907 and Q909 respectively, 3.8Vp-p pulses are applied to H. Saw IC904/pin 6. (Fig. 9A). The final output signal at pin 7 (Fig.

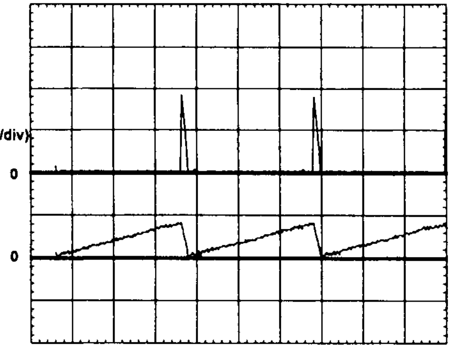
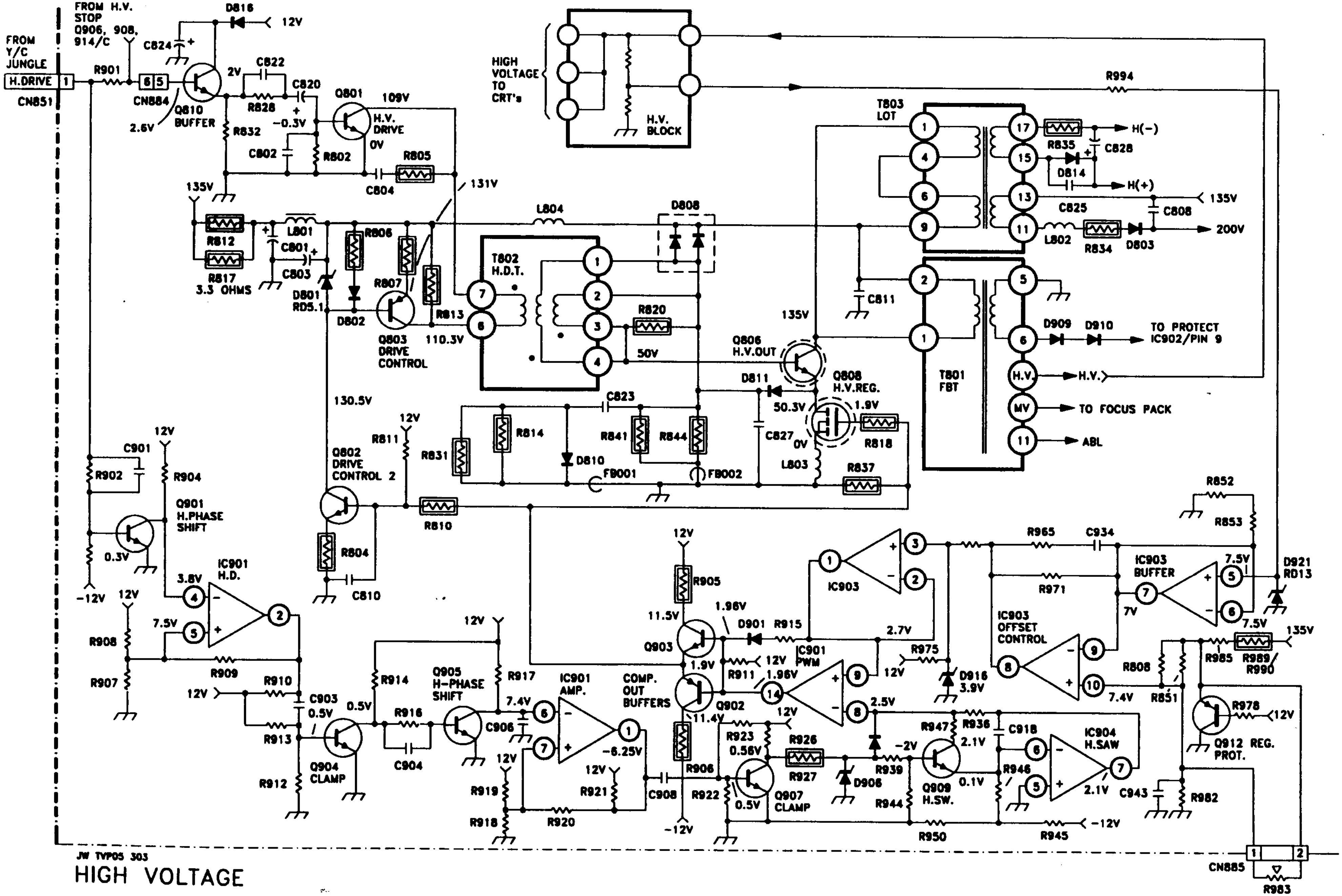


Figure 9 20usec/div

9B) appears as a sawtooth signal because of the charging and discharging action of C918. This signal is compared to the variations of the high voltage sample fed back to PWM IC901/pin 9 to develop the PWM signal used for controlling the conduction of HV Drive Q801 and HV. Out Q806.



HIGH VOLTAGE DEVELOPMENT- page 59

High Voltage Protect

Excessive high voltage can cause damage to the CRTs, video amps and other circuits in the set. Therefore, in addition to normal high voltage regulation (as described previously in the High Voltage Operation section), high voltage protection is provided. The high voltage protection circuits are triggered under the following conditions.

- When the high voltage increases excessively.
- When there is an excessive load on the HV line thereby lowering the voltage.
- When the 135V supply increases excessively. (135V line protection is provided in addition to the protection provided on the Power Supply G Board).

High Voltage Increase/Decrease

The level of High voltage is monitored at FBT T801/pin 11 (ABL) and pin 6. Excessively high or low levels at these pins will cause the high voltage section to shut down.

ABL

The purpose of the ABL (automatic brightness level) signal is to provide feedback to the Y/C jungle so that it can compensate for fluctuations in high voltage which would cause unstable picture brightness. The ABL signal is filtered by D306, C305, R331 and C303. It is then 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 blanking is 1.2Vdc.

ABL pulses at FBT T801/pin 11 are also used by the protect circuits on the E board to sense excessive changes in the high voltage. D804 rectifies ABL pulses to produce 3.9V at the inverting input of IC904/pin 2. Pin 3, the non-inverting input, is held at 3.9V by the voltage divider of R983 and R984. Increased pulses on the ABL line will increase the voltage on IC904/pin 2, causing pin 1 to go LOW. Pin 1 is connected to Comparator IC902/pin 8. Comp. IC902/pin 9 is normally held at 4.8V. This voltage is established by the values of R991, R988, R996 and R809. When pin 8 goes LOW, pin 14 will go HIGH. This will cause IC901/pin 13 to go HIGH and turn ON Q914. With Q914 ON, high voltage is disabled. D924 latches this circuit ON.

Excessive Load

Excessive loads on the Flyback T 801 will result in a lowered pulse amplitude on the ABL line and pin 6. The lowered pulse amplitude on the ABL line will cause the 0.6V at IK-Protect 2 Q911/B, and IK Protect 1 Q910/B to decrease and switch both transistors OFF. With Q911 OFF, a HIGH is placed on Q908/B via D918 and IC902/pins 10, 11 and 13. Q908 turns ON and disables HD Buffer Q810 and high voltage is shut-off. D907 latches this circuit ON.

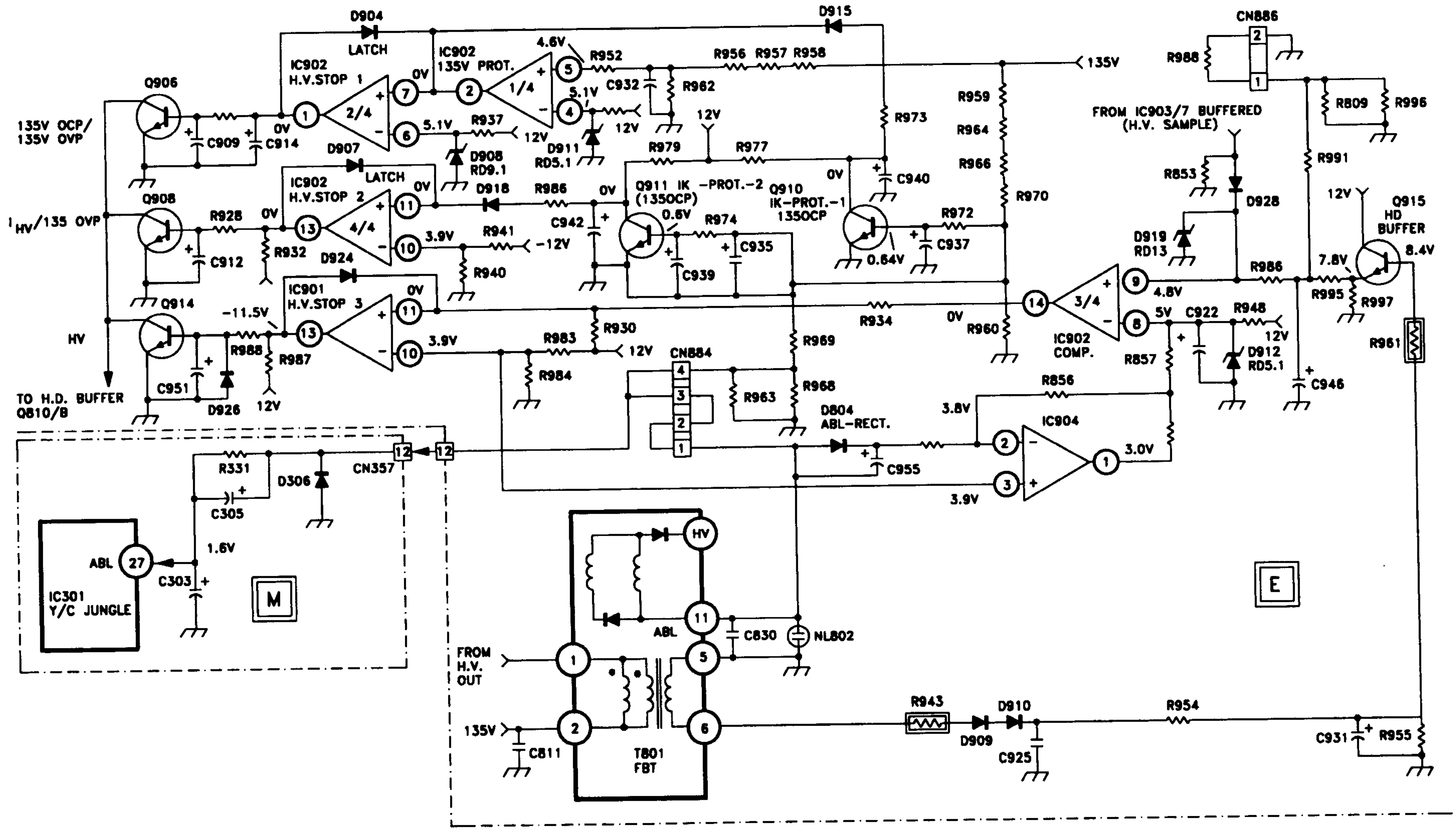
With Q910 OFF, D915 will become forward biased placing a HIGH on IC902/pin 7. This will turn ON Q906 and activate high voltage shut-down.

An excessive amplitude increase of the pulses at pin 6 of the Flyback Transformer, will increase the base voltage of Q915. The Emitter voltage therefore increases, causing IC902/pin 14 to rise higher than the 5V at the inverting input, pin 8. Consequently, IC901/pin 13 goes HIGH and turns ON Q914 which turns OFF Q810 and high voltage is disabled.

135V Line Increase

An abnormal increase of the 135V line will cause the voltage at IC902/pin 5 to rise above the regulated 5V at pin 4. IC902/pin 2 goes HIGH, causing pin 1 to go HIGH and turn Q906 ON. The HD Buffer Q810 is disabled and high voltage is shut down. D904 latches this circuit ON.

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.



H.V. PROTECT

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HIGH VOLTAGE PROTECT- page 61

High Voltage Troubleshooting

The high voltage section provides the picture tubes with their operating voltages (H.V, G2, 200V, 6.3V heater) and produces the ABL (auto brightness level) signal which is fed back to the Y/C Jungle. A defect which will cause high voltage shut-down or power supply shut-down can be located on the E board, the C boards or in the tubes.

When high voltage or power supply shut-down occurs, voltage measurements cannot be performed easily. Therefore, a troubleshooting method must be developed to isolate every possible section without causing any further damage to the set. The method depends on the symptom as follows.

Scenario - High Voltage Section Shuts Down When Set Is Turned ON.

When this occurs the problem can't be in the deflection circuits or the power supply because the set did not shut down. This problem can be caused by:

- Excessive high voltage.
- Excessive load.
- A defective protect circuit.
- A defective component in the high voltage development section.

Isolate the cause as follows:

Excessive High Voltage

This can be caused by an increase in the 135V line or a defect in the PWM circuit.

First, check the 135V line. If it is excessive, it means that the power supply is defective and not shutting down. Refer to the power supply section for troubleshooting.

Then, check the waveforms and dc voltages for the PWM section. It will operate without high voltage present. If the horizontal pulse is missing, the protect circuit was triggered.

Finally, Check, Q906, 908, and 914 to see which protect circuit was triggered. Trace the signal to the active component, verifying all dc levels.

Excessive Load

This can be caused by a defective Flyback or a defective picture tube. If a tube is the problem, the high voltage supply will remain ON when the H.V output from the Flyback is disconnected. To disconnect, pull back the rubber boot from the red H.V wire from the H.V block; push, turn and remove the wire. Make sure the wire is not close to any conductive surface and turn the set ON. If the high voltage section operates, one of tubes is defective. Remove the high voltage wires and test one tube at a time to determine the defective one.

If high voltage does not operate, completely unsolder pin 2 of the Flyback to disable it. Then turn ON the set and check the protect circuits as described above. If the Flyback is not the problem, one of the zener diodes is probably shorted.

Defective High Voltage development Section

If one of the components in the drive circuits is defective, the base of Q810 will not be HIGH, indicating that the protect circuits are not activated. This will eliminate the protect circuits as a suspect. Trace the horizontal pulse to the defective component by comparing waveforms and dc levels.

Scenario - Power Supply Turns Off Shortly After The Set Is turned ON; Protect Fault is traced to the E board.

When the power supply shuts OFF, it is an indication that one of the regulators or the 135V line has a short or a heavy load on it. If the troubleshooting procedure in the power supply section leads you to the E board, perform the following steps.

1. Remove CN881. This contains the 15V lines and the 135V line.
2. Check the 12V regulators for shorts and replace if necessary. Then, check the regulator output again. If there is a low ohm reading you will have to isolate the defective component. Check

the zener diodes first, then the electrolytic caps, and finally, the ICs.

3. Remove the 135V pin from CN881/pin 1 (use a paper clip to release the tab in the connector). If the set can turn ON and stay ON, there is an excessive load on the 135V line, on the E board.

   This can be caused by one of the following.

- High voltage drive transistor Q806.
- Damper diodes D805 and D807.
- Excessive load on one of the secondary windings.

The transistors and diodes can be checked easily with an ohmmeter set to the diode scale. The secondary loads can be checked easily by removing CN802 which contains the 200V and heater lines. If the short/excessive load is on one of the C boards, it will show up when this connector is removed. If removing the connector corrects the problem, isolate each C board. They are daisy-chained together.

Scenario - Set Turns OFF When The Tubes Warm Up. Picture Is Extremely Bright.

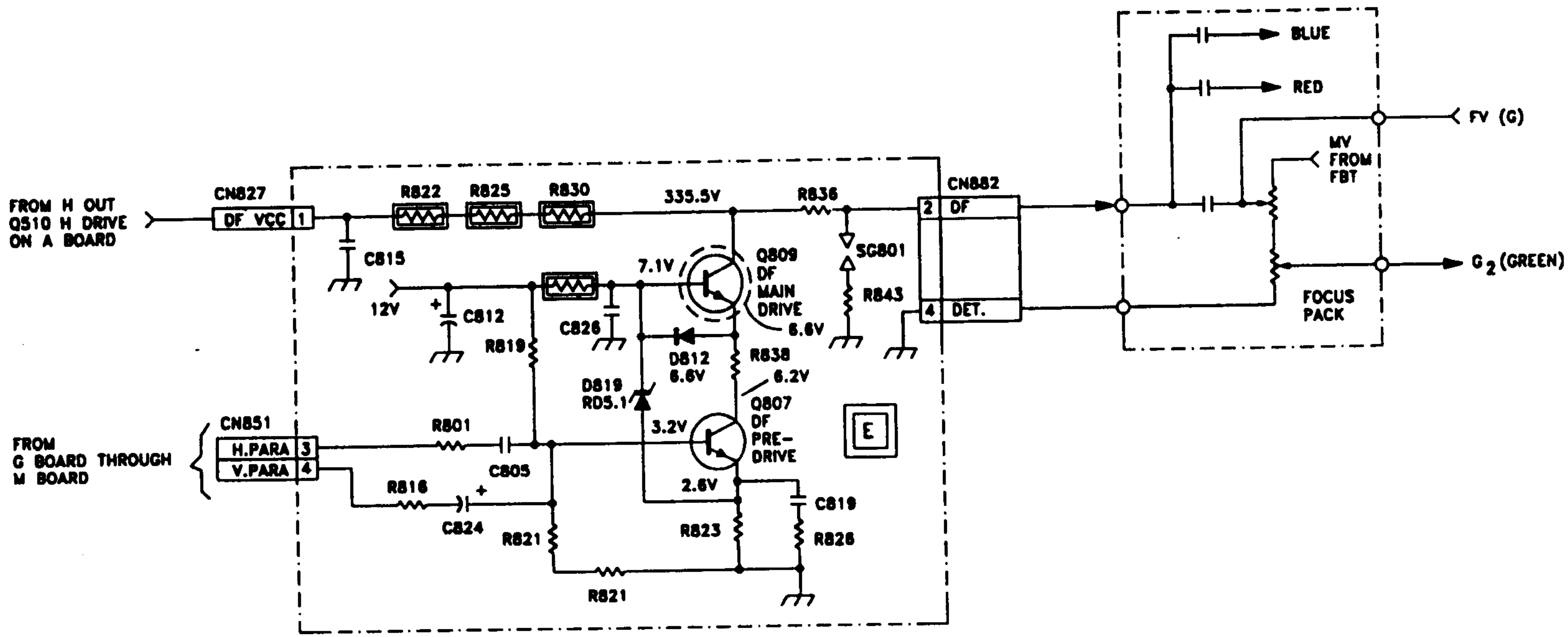
This condition usually indicates either excessive drive in the video amp, or excessive G2. G2 can be eliminated as a problem by removing the G2 connector wire (color coded for each tube) from the C boards, before turning the set ON. If a tube remains ON without G2 present, the video amp for that tube is defective and must be replaced. After replacing the video amp, check the associated components for defects.

NOTE: A high voltage arc can damage all three video amps but spare the high voltage output section.

Dynamic Focus

Dynamic Focus is necessary to maintain beam focus in areas that are near the edges of the screen. To achieve this, the focus voltage is dynamically changed as the beam scans to and from the center of the screen.

Q809 and Q807 form a variable load on the 335V Dynamic Focus line. The conduction of these transistors, and therefore the load, is controlled by the H and V parabola signals from connectors 3 and 4. These signals are applied to Q807/Base via R801 and C805; and R816 and C824. This varies the conduction of DF Pre-Drive Q807, which in turn controls the conduction of DF Main Drive Q809, causing the Dynamic Focus voltage to vary. The dynamic focus signal is fed to the focus pack. Inside the pack, the signal is capacitively coupled to the dc focus voltage causing it to be modulated by the dynamic focus signal, in sync with the beam scan.


FROM H OUT Q510 H DRIVE ON A BOARD
CN827
DF VCC 1
R822
R825
R830
335.5V
R836
CN882
2 DF
4 DET.
C815
12V
C812
C826
R819
7.1V
Q809 DF MAIN DRIVE
6.6V
SG801
R843
D812 6.6V
R838
6.2V
D819 RD5.1
Q807 DF PRE-DRIVE
3.2V
2.6V
E
FROM G BOARD THROUGH M BOARD
CN851
H.PARA 3
V.PARA 4
R801
C805
R816
C824
R821
R823
C819
R826
R821
BLUE
RED
FV (G)
MV FROM FBT
G 2 (GREEN)
FOCUS PACK
JW TVP05291 4.11.95

RA Chassis Signal Flow

The signal flow section consists of three diagrams.

1. The RA Chassis Signal Flow diagram (shown below) provides a general view of the entire A/V signal flow from input to tube.
2. The PIP diagram shows the video signal flow through the P board.
3. The Video Signal Flow diagram shows a detailed view of the video signal flow on the M and C boards.

A/V Switching

The A/V switch IC1101 is located on the U board. The U board is directly connected to the M board. The A/V switch is capable of switching between six sets of A/V inputs. Input selection is performed via data on the I^2C bus from MI-COM IC301 commands. The selected video is output at pin 40 and applied to comb filter CM1101. The comb filter separates the Y and C components from the composite video signal. The separated Y and C signals are input to the A/V switch at pins 37 and 35, and then switched to pins 43 and 45. They are then input to PIP processor IC3204, on the P board, via buffers Q1102 and Q1103. (PIP = Picture in Picture).

The Y and C signals will loop through PIP IC3204 if the PIP feature is not selected.

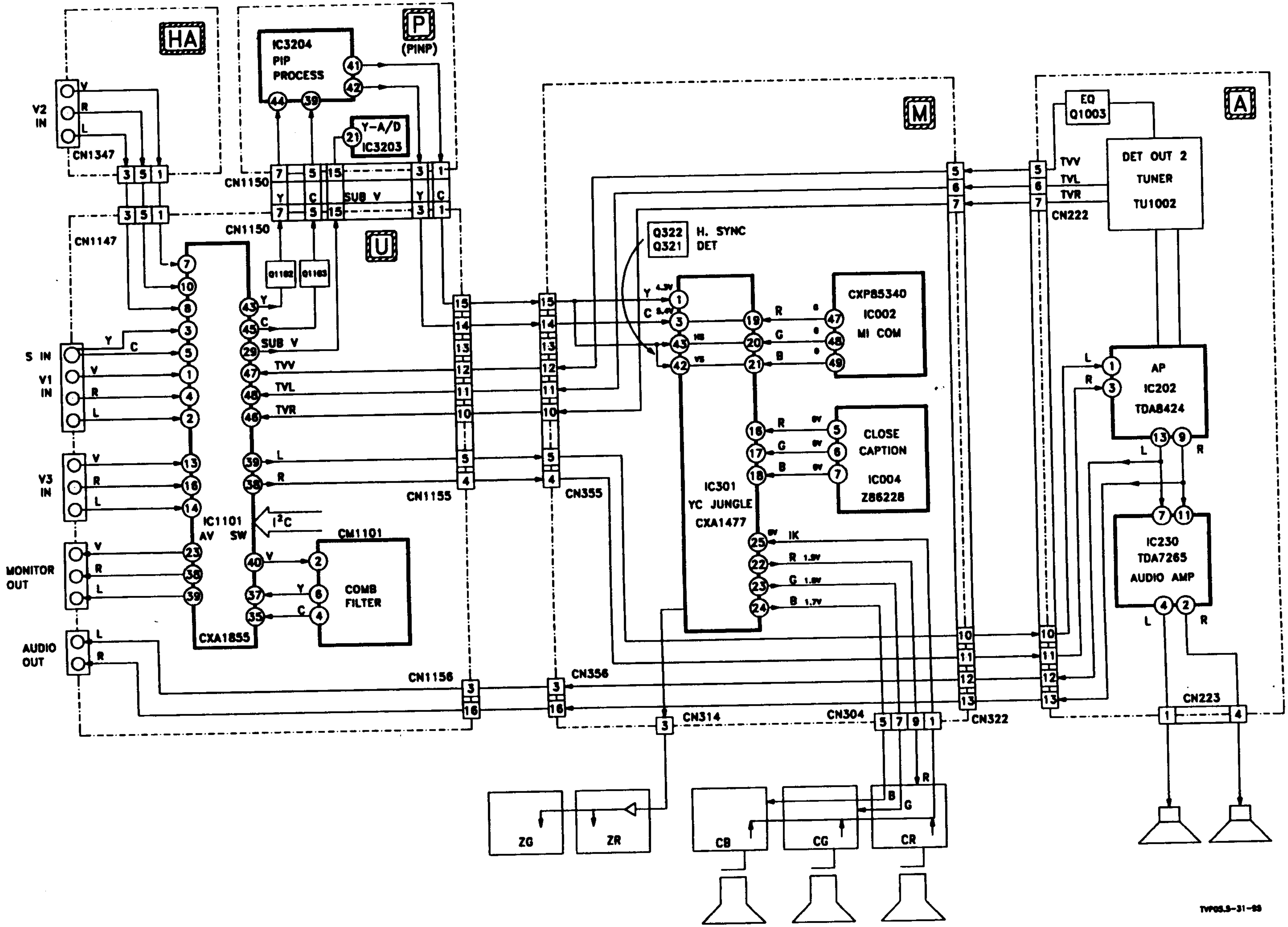
NOTE: ALL VIDEO SIGNALS GO THROUGH THE P BOARD IN ORDER TO REACH THE Y/C JUNGLE. A DEFECT ON THE P BOARD WILL RESULT IN A LOSS OF CHROMA, LUMINANCE, or BOTH.

The output of the PIP process is fed through the U board to the M board and applied to the Y/C Jungle IC301/pins 1 (Y) and 3 (C). In addition, RGB for on-screen menus are input from the MI-COM IC002 and applied to the Jungle IC, at pins 19, 20, and 21. RGB for the closed caption display are input from IC004 to pins 16, 17, and 18. After all of the signals are processed by the Jungle IC, they are fed to the three C boards (CG, CG and CR).

The CRT cathode currents are monitored by the IK line and input to the Y/C Jungle. This is covered in the Video Signal Process section of this manual.

Audio Process

The left and right audio signals are output from the A/V switch IC1101 pins 38 and 39. These signals are routed through the M board to the A board. IC202 controls the volume, bass, treble and balance via the I^2C bus (not shown). The audio signals are then applied to a fixed audio (power) amp IC230, amplified, and applied to the speakers.



SIGNAL FLOW - RA CHASSIS page 67

Picture-In-Picture

The picture-in-picture circuit is located on the P board. This circuitry is necessary for normal television operation. Without it there will be no picture, however, there will be an on-screen display and closed caption information. This board connects to the top of the U board (similar to the AA chassis). All circuit ICs are surface mounted to the bottom of the board. Therefore, an 18 pin extender cable (p/n 3-702-558-01) is necessary in order to examine the signals on the ICs. To eliminate the P board as a problem, without using test equipment: jump CN150 pin 1 to pin 5 (chroma); and and pins 3 to 7 for luminance. If the P board is good, the defect will remain; If the board is faulty, a picture with reduced brightness will appear. This test is very useful when performing in-home service.

The picture-in-picture function is controlled by the MI-CON IC, through the I^2C bus. Synchronization of the child picture is accomplished using the vertical and horizontal sync pulses which are input to the PIP Control IC at pins 48 and 49. The storage of the child picture and the creation of the picture insert is controlled by the PIP CONTROL IC3201.

Four additional ICs are used for storage and picture insertion.

1. **PIP Analog Process IC3204** switches the main and child picture and produces the chroma sync signals.
2. **A/D-D/A Converter IC3202** converts the child picture chroma signal to digital data for storage by the PIP control.
3. **A/D-D/A Converter IC3203** converts the child picture Y signal from the A/V switch IC402 (on the U board) to digital data for storage by the PIP control.
4. **Memory IC3200** stores the child picture, in the PIP mode.

Circuit Operation

The PIP circuit has two modes of operation, normal picture and PIP mode.

Normal Picture Operation

During normal operation, the chroma and luminance signals for the main picture are looped through the PIP Analog Process IC3204 as follows.

Chroma

The chroma signal is input to IC3204/pin 39 (C IN) and is switched to pin 41 (C OUT) at 0.7Vp-p. The chroma signal is also applied to an internal oscillator circuit to provide chroma sync for the child picture. The chroma signal is amplified to 1.3Vp-p by Q3204 and Q3206 and buffered by Q3207. It is then applied to the Y buffer Q308 on the M board (refer to previous or next block diagram).

Luminance

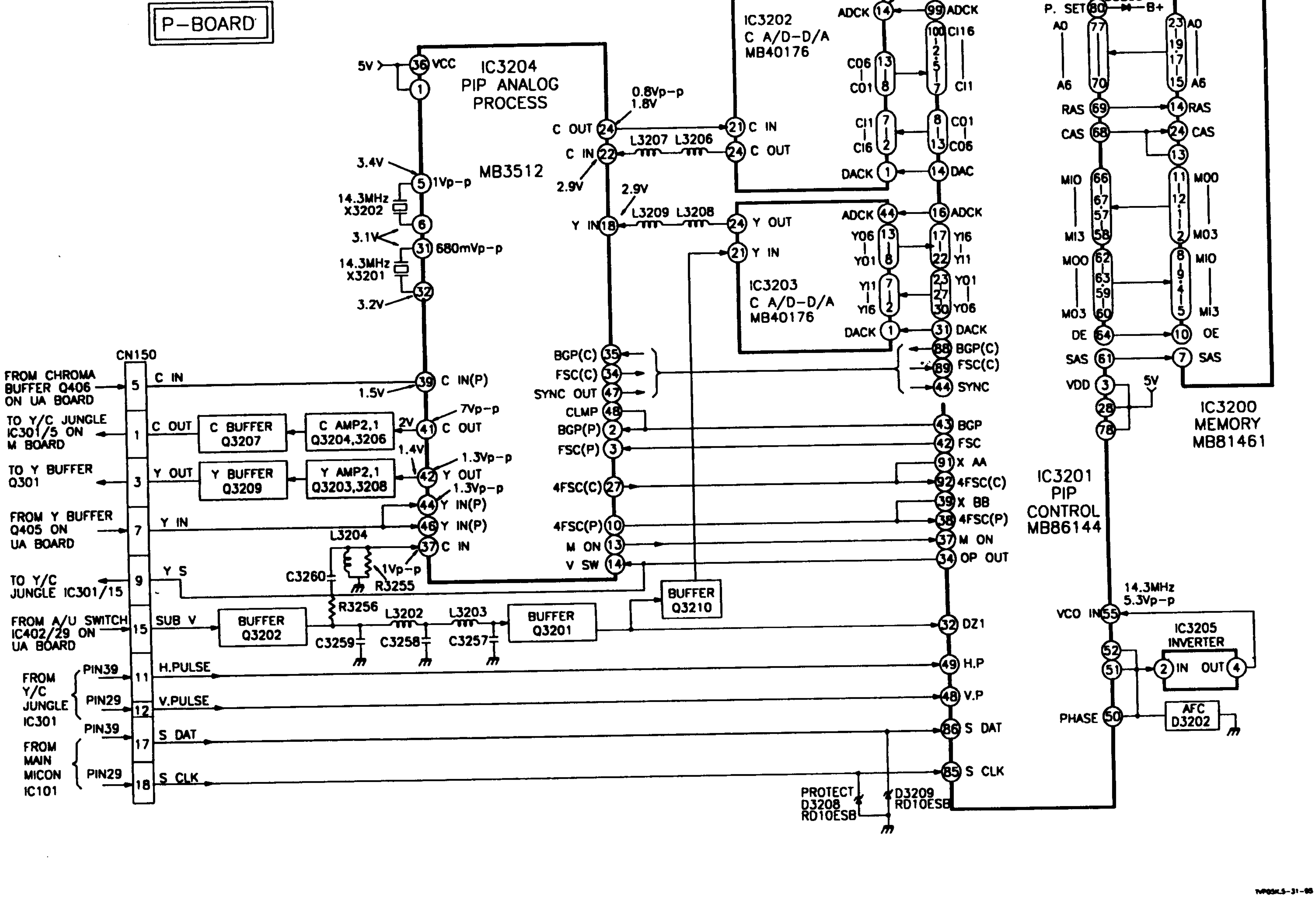
The luminance signal is input to IC3204/pin 44 (Y IN) and is switched to pin 42 (Y OUT) at 1.3Vp-p. The Y signal is then amplified to 2.5Vp-p by Q3203 and Q3208, buffered by Q3209 and applied to the chroma buffer Q309 on the M board.

PIP Operation

When PIP mode is selected from the remote commander, the A/V switch (IC402 not shown) will select the child picture signal and output it to CN150/ pin 15 (SUB V). This composite video signal is buffered by Q3202 and separated into Y and C components on the P board as follows.

Chroma

The chroma signal is separated by C3260 and L3204, and is applied to the PIP Analog Process IC3204 pin 37 (C IN). It is switched internally to pin 24 (C OUT) and is applied to the A/D converter section of IC3202/pin 21. The .8Vp-p chroma signal will then be


P-BOARD
IC3204
PIP ANALOG
PROCESS
MB3512
5V
VCC
3.4V
1Vp-p
14.3MHz
X3202
3.1V
680mVp-p
14.3MHz
X3201
3.2V
C OUT
C IN
0.8Vp-p
1.8V
2.9V
L3207
L3206
L3209
L3208
Y IN
BGP(C)
FSC(C)
SYNC OUT
CLMP
BGP(P)
FSC(P)
4FSC(C)
4FSC(P)
M ON
V SW
C IN(P)
1.5V
7Vp-p
2V
1.4V
1.3Vp-p
Y OUT
Y IN(P)
IC3202
C A/D-D/A
MB40176
ADCK
C06
C01
CI1
CI6
DACK
CI16
DAC
IC3203
C A/D-D/A
MB40176
Y OUT
Y IN
Y06
Y01
Y11
Y16
BGP
FSC
SYNC
X AA
X BB
OP OUT
DZ1
H.P
V.P
S DAT
S CLK
IC3201
PIP
CONTROL
MB86144
P. SET
B+
A0
A6
RAS
CAS
MI0
MI3
MO0
MO3
DE
OE
SAS
VDD
5V
IC3200
MEMORY
MB81461
VCO IN
14.3MHz
5.3Vp-p
IC3205
INVERTER
IN
OUT
PHASE
AFC
D3202
CN150
FROM CHROMA BUFFER Q406 ON UA BOARD
TO Y/C JUNGLE IC301/5 ON M BOARD
TO Y BUFFER Q301
FROM Y BUFFER Q405 ON UA BOARD
TO Y/C JUNGLE IC301/15
FROM A/U SWITCH IC402/29 ON UA BOARD
FROM Y/C JUNGLE IC301
PIN39
PIN29
FROM MAIN MICON IC101
C IN
C OUT
Y OUT
Y IN
Y S
SUB V
H.PULSE
V.PULSE
S DAT
S CLK
C BUFFER Q3207
C AMP2,1 Q3204,3206
Y BUFFER Q3209
Y AMP2,1 Q3203,3208
L3204
C3260
R3255
R3256
BUFFER Q3202
L3202
L3203
C3259
C3258
C3257
BUFFER Q3201
BUFFER Q3210
PROTECT D3208 RD10ESB
D3209 RD10ESB

processed by the PIP control IC and stored in memory IC3200. The memory IC is always processing information and will always have activity on its data and address lines.

Luminance

The Y signal for the child picture is separated by pi filter L3202, L3203 and associated components. It is buffered by Q3201 and Q3210 and applied to the A/D converter section of IC3203/pin 21 (Y IN). The 2.9Vp-p Y signal is then processed by the PIP control and stored in memory IC3200.

Insertion Of Child Picture

The PIP controller is responsible for inserting the child picture into the main picture. It does this by replacing the main picture with the child picture at a predetermined location. This location is selected by the user through the remote commander. The box which the child picture fits into, is switched in and out of the main picture by switching pulses produced by PIP control IC 3201/pin 34 (OP OUT). These pulses are applied to PIP Analog Process IC3204/pin 14 (V SW) and Jungle IC301/pin 15.(on the M board). The switching pulses appear as a packet at the field rate. There will be one packet present for each field. Figure 1 shows the relationship between a field of video and the switching pulses.

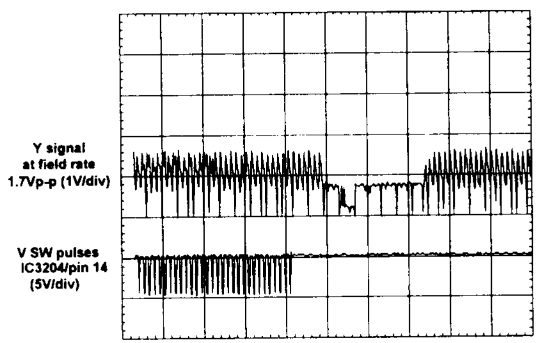


Figure 1 500usec/div

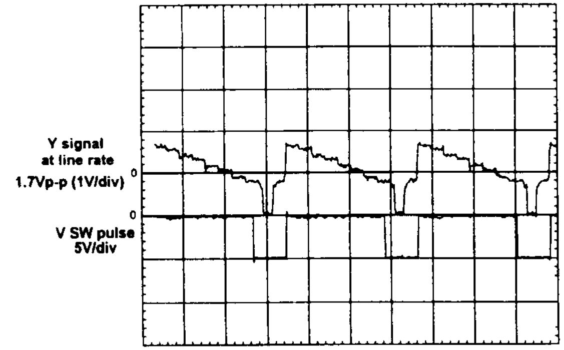
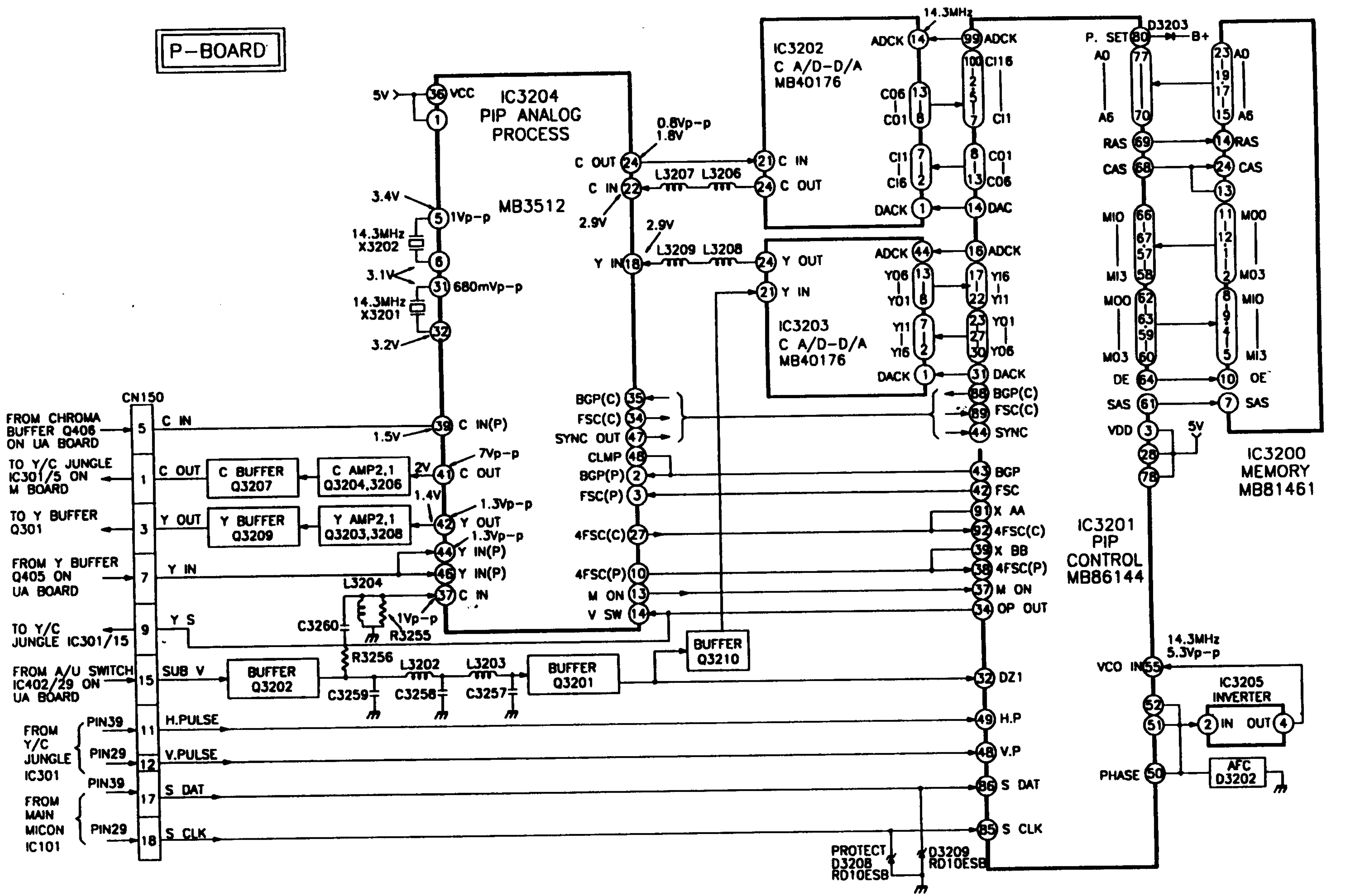


Figure 2 20usec/div

Figure 2 shows the relationship between the Y signal at CN150/pin 7 and the V SW signal at CN150/pin 9. This waveform was taken at H lines 165-167. The results are similar for any line that has PIP information on it (Individual H lines can be selected with an oscilloscope using the delayed sweep feature). The child picture is inserted when the V SW pulse goes LOW. If the V SW signal is defective and stays LOW, the main picture will appear black. If this signal stays HIGH, the child picture will appear as a semi transparent window. The phase and timing of the V SW pulse is determined by the 14.3MHz (4FSC) signal from PIP Analog Process IC3204/pins 27 (4FSC[CI) and 10 (4FSCIP]). If there is no parent picture, the child picture will lose its chroma reference and appear in black and white.



PICTURE IN PICTURE page 71

Troubleshooting PIP

The first step in troubleshooting the PIP section is to verify the must-haves. In this case, they are:

- 5V dc, to all ICs.
- 1^2 C data and clock to IC3201 pins 86 (SDAT) and 85.
- 4.3MHz at IC3204 pins 5,6 (X3202) and pins 31,32 (X3201). See diagram for voltage levels.
- The V SW switch pulse (IC3204 pin 14) should be HIGH during normal mode.
- A 5.3Vp-p, 14.3MHz signal at IC3201 pin 55 (VCO IN).

If any of these are missing, troubleshoot that area before proceeding.

Defective Child Picture

If the child picture losses color or has a mosaic effect, the following should be checked.

1. Chroma signal at IC3204/ pins 24 (C OUT) and 22 (C IN).
2. Y signal at IC3204 pin 18 (Y IN).
3. Digital data on all data lines between the D/A converters (IC3202 and 3203) and the PIP control IC3201.
4. Digital data between the control IC3201 and the memory IC3200 at all times.

The output enable line from IC3201/pin 64 (OE) is always active. A change in activity level occurs when the picture is frozen. If the picture cannot freeze, ground the OE line to freeze the picture. If the picture freezes, the PIP control is defective.

Figure 3 shows the output enable line (OE) from IC3201/pin 64 and IC3201/pin 59. These lines should always be active.

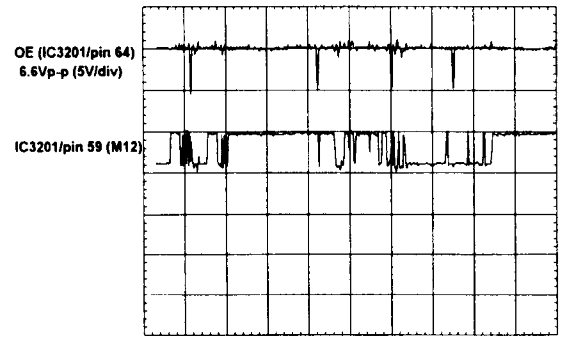
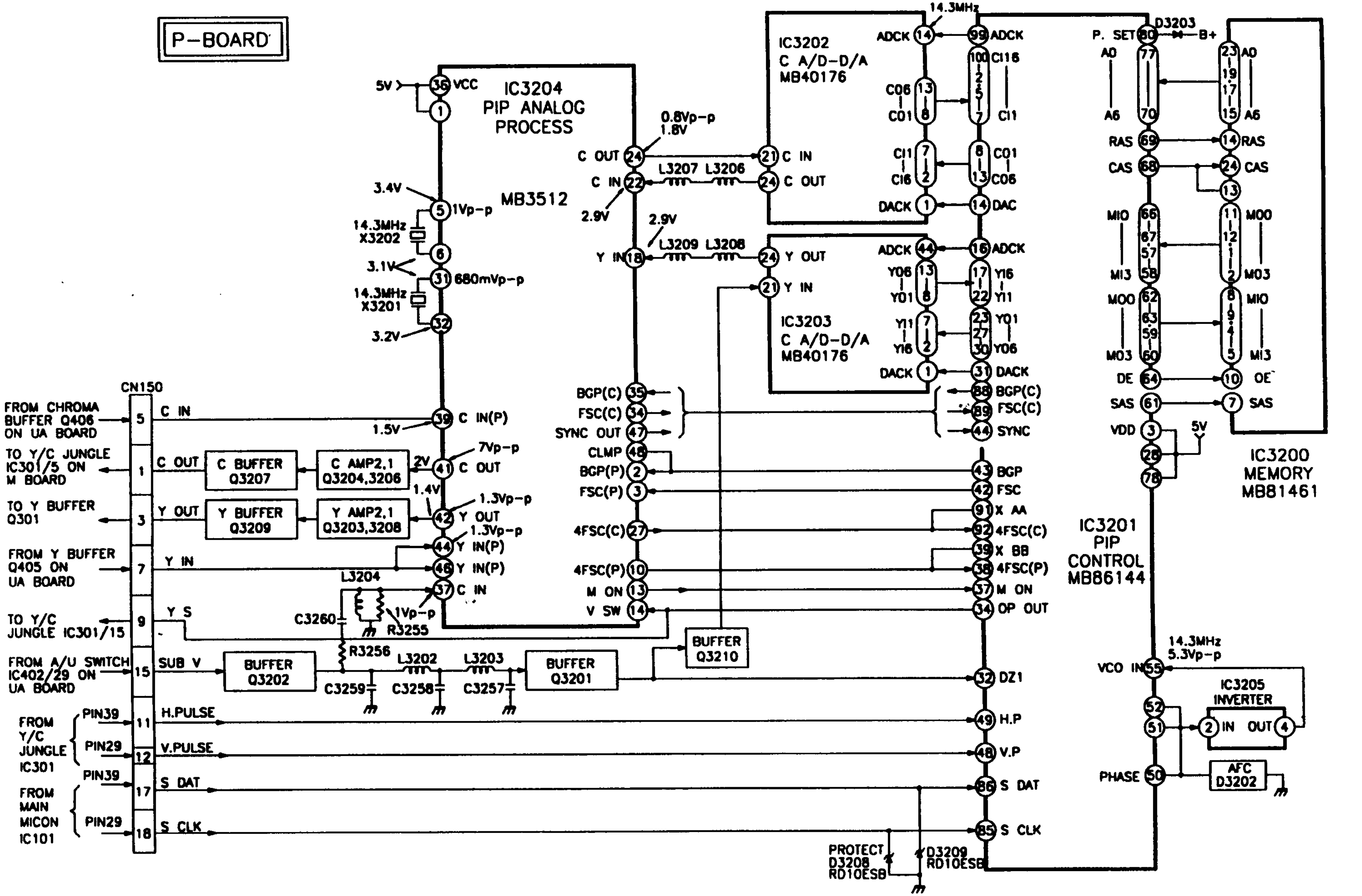


Figure 3 10usec/div



PICTURE IN PICTURE page 73

Video Signal Process

The video signal process diagram provides the technician with a quick reference so that the Y and C signals can be traced from the output of the P (picture in picture) board to the C boards on one diagram. The signal path from the inputs (U board and HA board) through the P board is discussed in the RA Signal Flow section.

Y/C Signal Flow To The Jungle IC

The 1.7Vp-p Y signal is buffered by Q308 and applied to Y/C Jungle IC301/pin 1, buffer Q005, and buffer Q322. The output of Q322 is applied to the H and V sync inputs of the Y/C Jungle IC301/pins 42 (VS in) and 43 (HS in). The output of Q005 is applied to the Caption Vision IC004/pin 11 (V-in).

The 1.8Vp-p chroma signal is buffered by Q309, filtered by Q311 and applied to the Y/C jungle IC301/pin 3. The Y and C signals are shown in figure 1 below.

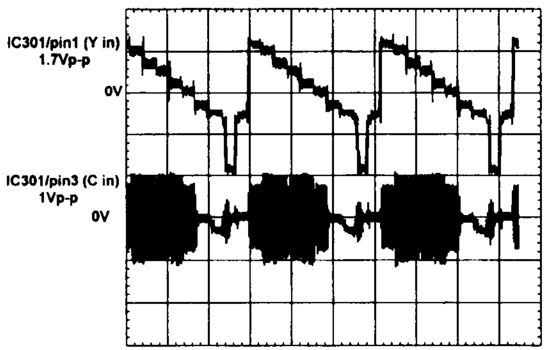


Figure 1 0.5V/div 20usec/div.

In addition to the video and sync signals, two additional feedback signals are necessary to produce an RGB output. The ABL signal at pin 27 is feedback from the Flyback transformer which reflects the changing load. Excessive ABL voltage results in blanking. Normal level for this pin is 1.6Vdc. IC301/Pin 28 (LPF) connects to the integrating cap which filters the ABL pulses. This pin also monitors the vertical deflection drive signal from IC1501/pin 28. If the vertical drive signal is missing, Q307 will turn OFF. As a result, its collector will go HIGH and Q305 will turn ON, grounding IC301/pin 28. This will cause the R, G and B drive signals to turn OFF.

Closed Caption Input

The closed caption IC004 is responsible for extracting the closed caption data (in line 21) from the Y signal, separating it into R, G, and B components. The Closed Caption IC also creates the caption box at pin 3 using a packet of pulses at the vertical rate. These pulses are buffered by Q002 and applied to the Y/C jungle IC301/pin 10 (Y/S). The RGB signals are output from the Closed Caption IC to the Y/C Jungle at pins 16, 17, and 18 respectively. A horizontal sync pulse is input to the Closed Caption IC004/pin 8. The Closed Caption options (box size and position, pop-up or scroll format) is controlled by the MI-COM via the I^2C bus.

Troubleshooting The Closed Caption IC

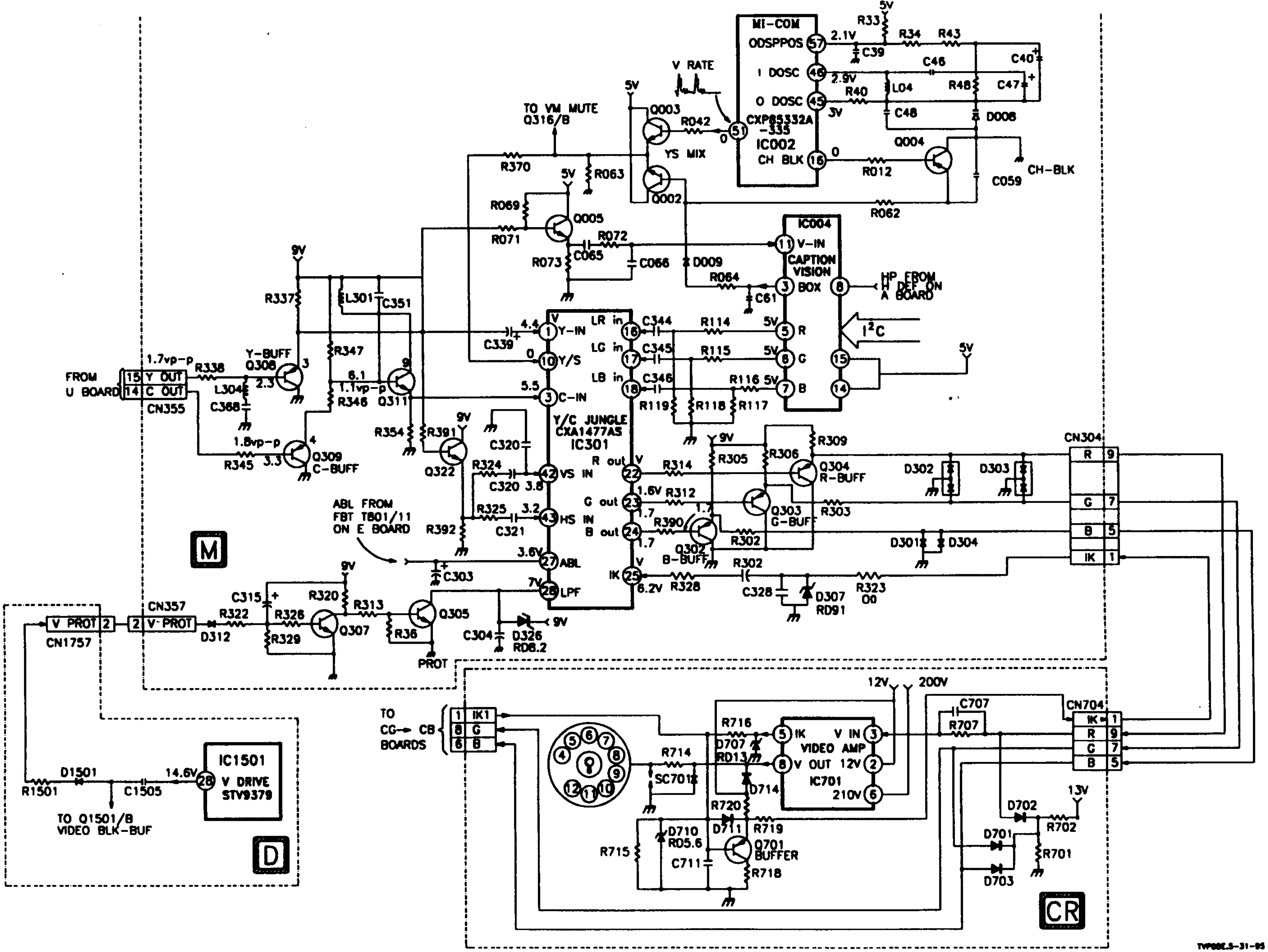
If closed caption information is not being displayed, first verify that the broadcast contains a closed caption signal. This is usually indicated in the local TV program guide. If not, you can check the video signal at IC004/pin 11 as follows.

1. Set the A trace of your scope to the vertical rate (5msec) and sync the waveform.
2. Set the delayed B trace so that the vertical retrace period, and the serrated pulses can be viewed. The closed caption signal begins with 7 cycles of lead-in sine waves. This is followed by the text data.

It is a good idea to keep a sample of a closed caption signal on tape for testing purposes.

Once you have established that a closed caption signal is present check for the following.

- I^2C data at pins 17 and 18.
- 5Vdc (Vcc) at pins 14 and 15.
- RGB output.
- Box output pulses at pin 3 as well as at IC301/pin 10.



VIDEO SIGNAL PROCESS page 75

On screen display Position

The on-screen display information is output from the MI-COM IC002 as shown in the RA Signal Flow block diagram. Insertion pulses for this display are produced by the MI-COM at pin 51. The oscillator for the insertion pulses is formed by the RCL circuit which includes L04, R48, C47, and varactor diode D008. The frequency of the oscillator determines the position of the display. The frequency is changed by varying the capacitance of varactor diode, as a result of pulses applied from pin 57 which charge or discharge D008.

RGB Signal Flow From The Y/C Jungle

R, G, and B signals are output at pins 22, 23, and 24 respectively. These signals are buffered by Q304, Q303, and Q302. The outputs of the buffers are applied to the CR board. On this board, the R signal is applied to the R Video Amp IC701/pin 3 where it is amplified and output at pin 8. This signal is applied to pin 8 of the red tube.

The G and B signals are daisy-chained through the CR board to the CG and CB boards. Each of these boards contain the same video Amplifier IC. Figure 2 shows the R, G, and B signals as they appear at the output of the Y/C Jungle.

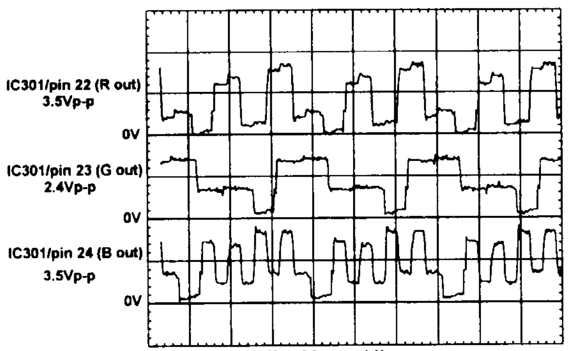


Figure 2 2V/div 20usec/div

IK Signal Detect

Three IK pulses are produced by the Jungle IC on the RGB output lines (one pulse per line). These pulses occur in line 18, during vertical retrace. The purpose of the pulse is to turn on the cathode of each tube and sample the current so that white balance can be performed (within the Y/C Jungle). The cathode current is sampled by each video amp and a pulse is produced at pin 5. The pulse is buffered (Q701 is shown) and applied to the Jungle IC301/pin 25. The three pulses are converted to a voltage within the Jungle and compared to a reference. The result of this comparison is used to control the shift of the RGB outputs as well as the dc level of the IK output pulses. The signal at pin 25 is shown in figure 3.

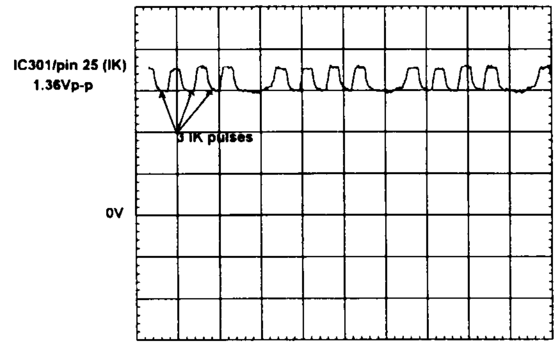
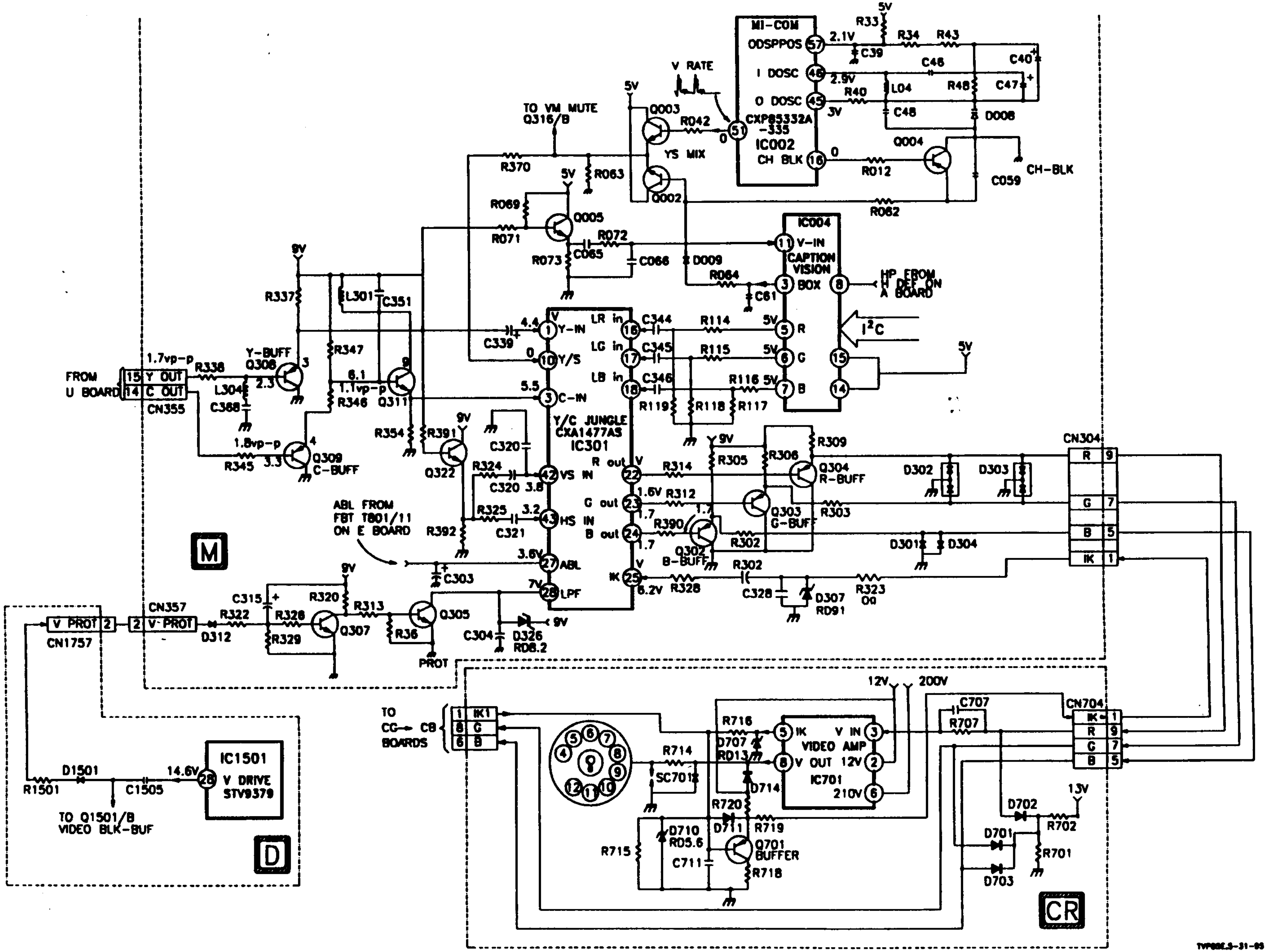


Figure 3 2V/div 20usec/div

If the IK pulses are missing, the RGB drives will be turned OFF. However, as long as there is at least one pulse present, the RGB signals will be produced. Insufficient cathode current also results in no RGB drive. This occurs during warm up, when the set is first turned ON.



VIDEO SIGNAL PROCESS page 77

Troubleshooting

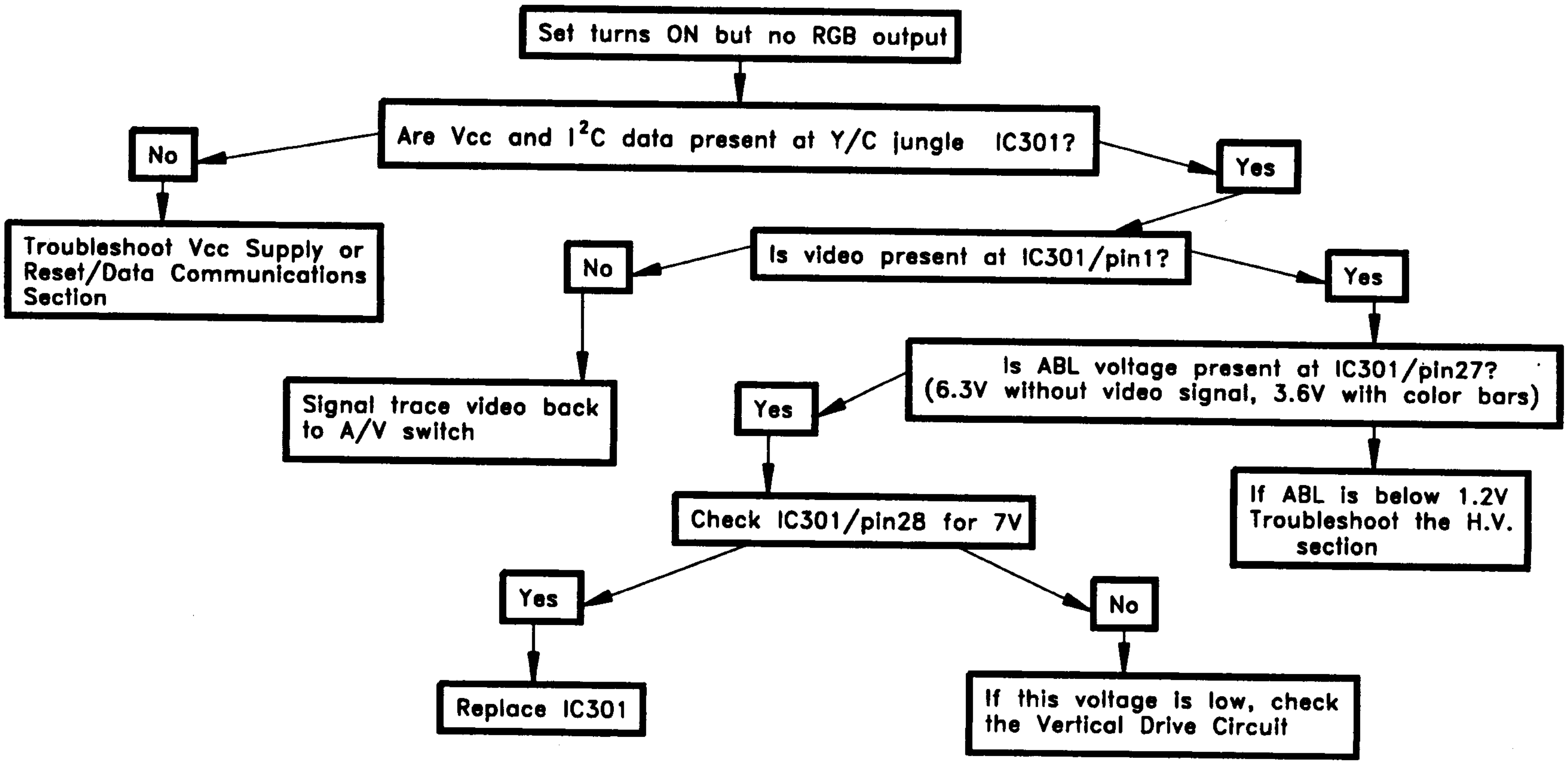
The RA Signal Flow diagram, Video Signal Flow diagram, and the PIP diagram can be used together to trace and diagnose most video problems. One such problem is:

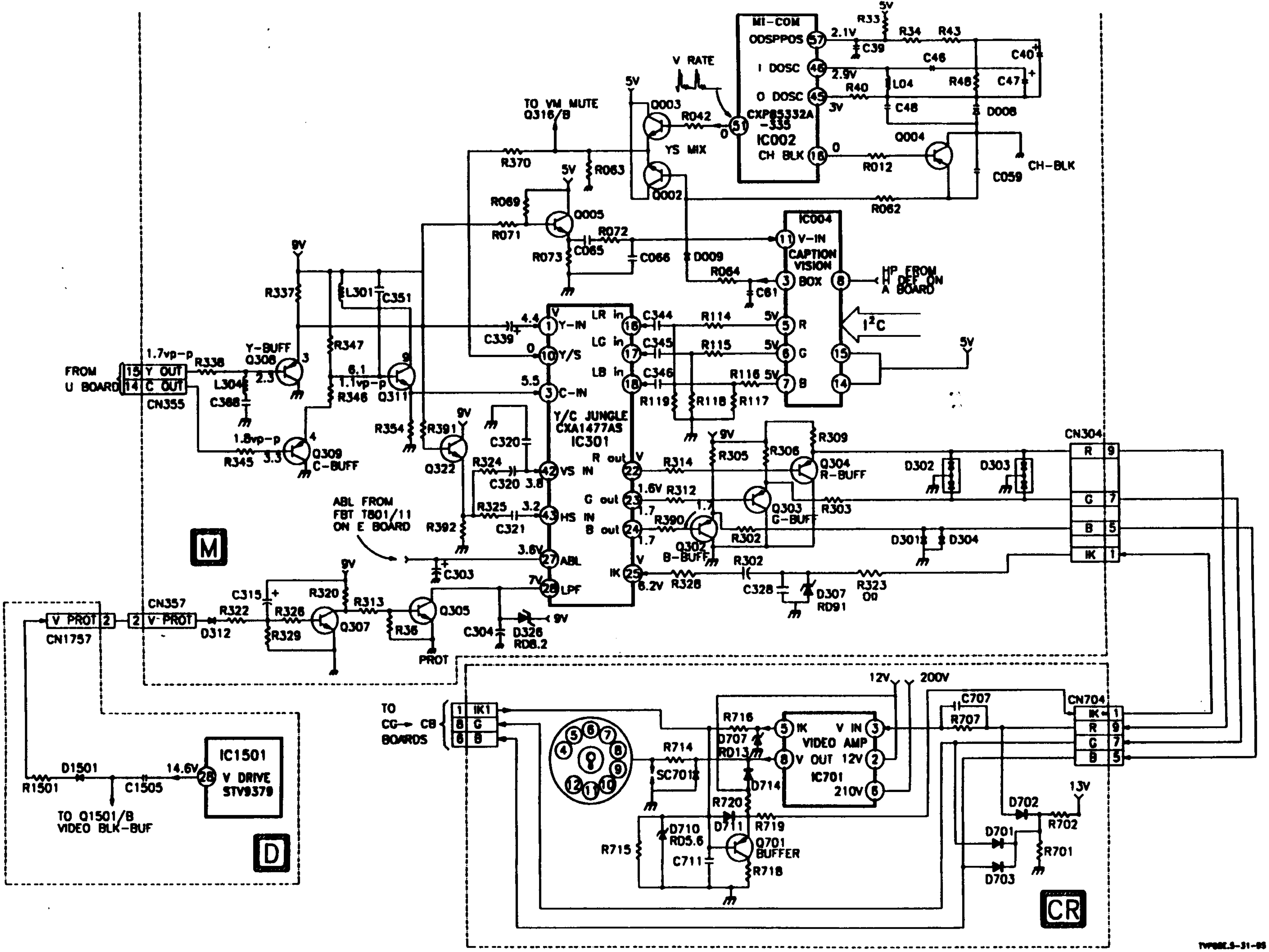
The Set Turns On But No RGB Output

To troubleshoot this scenario, start with the assumption that since the set turns ON and stays ON, there is no protect failure and therefore, the power supply and horizontal sections are operating. Then, check for the following.

- Is Vcc and I2C data present at the Y/C jungle according to the Reset/Data Communications section? If not, troubleshoot that area first.
- Is a video signal present at Y/C Jungle pin 1 (Y-IN), pin 3 (C-IN)? If not, trace the video signal back toward the AV switch.
- Is the ABL voltage at pin 27 present? It should be 6.3Vdc with no video signal present and 3.6Vdc with color bars present. If it is below 1.2Vdc, the RGB drives will shut OFF. Incorrect ABL voltage indicates a high voltage or a video amp problem, not a video drive problem. Refer to the High Voltage Troubleshooting section.
- Is 7Vdc present on pin 28 (LPF) of the Y/C Jungle? If this pin is at or near ground, the RGB drives will be turned OFF. This can occur due to a loss of vertical drive, a defect in the feedback circuitry between Vertical Drive IC1501/pin 28 (on the D board) and the LPF pin 28, or a shorted D326. The vertical waveform can be observed at CN357/pin 2 (V PROT) on the M board.

If these signals are present, there is a good chance that the Y/C jungle is at fault and must be replaced.





VIDEO SIGNAL PROCESS page 79