SONY®

Training Manual

Computer Monitor

F99 Chassis
CPD-G400

Circuit Description and Troubleshooting

Course: MON-04

Sony Service Company
A Division of Sony Electronics Inc
Printed in U.S.A.

Circuit Description and Troubleshooting:

Model: CPD-G400/F99 Chassis

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

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Appendix

Sony Monitor Model CDP-G400 Specifications

Trinitron Picture Tube
0.24 mm aperture grill (fine) pitch
19 inches measured diagonally
90 degree deflection (low distortion)

Viewable Area
14 3/8” x 10 7/8 “ (18” viewable image)

Standard Image Area
13 7/8” x 10 ½”

Maximum Resolution
1800 dots = Horizontal
1024 dots = Vertical

Deflection Frequency
30 to 107 kHz = Horizontal
48 to 120Hz = Vertical

AC Input
120V AC; 50/60 Hz
140W (1.17amps)
6 Amps initial surge (measured)

Operating Temp
10 to 40 degrees C

Mass
57 lbs. 5 oz.

Plug and Play
DDC1 / DDC2B / DDDC2Bi / GTF*

Power Saving
4 Power Modes (3 power saving):
Normal – 140Watts
Standby – 15 Watts
Suspend (Sleep) – 15 Watts
Active Off – 6 Watts

Circuit Protection
+200V
Flyback Voltage
Vertical Output
Automatic Beam Current Limiting (ABL)

* Plug and Play Abbreviations		
Level	Name	Communications
DDC1	Display Data Channel Uni-directional data @ V sync intervals	PC reads monitor EDID operational info. Protocol V. Sync
DDC2B	Display Data Channel Bi-directional data	PC reads/writes monitor EDID operational info. Protocol IIC Bus
DDC2Bi	Display Data Channel Bi-directional data	PC reads/writes monitor EDID operational info. And adjustment data. Protocol Access Bus

NOTES

Normal Operation / Features

Power ON

Initial Conditions: No video input. 120Vac input. Cold start.

1. Press power ON switch.
2. Front panel indicator LED is green.
3. Degassing coil receives AC current, causing the picture tube's aperture grill to vibrate (humming sound).
4. The AC surge current is about 6 AC amps.
5. Current drops down to 0.6 AC amps.
6. The following black lettered graphic appears at the center of the screen with strips of the color indicted:

INFORMATION
NO INPUT SIGNAL
INPUT 1
WHITE
RED
GREEN
BLUE

Active Off Low Power Mode (no input)

1. Two minutes after pressing the power ON switch, the monitor automatically enters the standby mode when there is no input signal detected. The monitor shuts down and the graphic disappears into a dark screen.
2. The front panel indicator LED changes from green to orange.
3. Activating any front panel user function will return the monitor to the ON mode where the graphic will reappear. The front panel functions are:
    - Input switch (input 1 or 2)
    - Menu control – Any direction (up, in, outward, left, right)
    - Reset button

Note: During testing you may return from the Active Off Mode without an input by pressing any front panel button. As the monitor powers up, it is normal for the power supply's oscillator to run at one of two frequencies. The oscillator may run at the lower oscillator frequency of 21kHz instead of the full power mode of 65kHz. It will sense an increase in load and switch automatically when necessary.

Power OFF

Initial conditions: Unit is in standby mode. No video input.

1. Press the power OFF button.
2. The orange LED goes dark after three seconds.

Aging Mode

This mode is commonly found in Sony monitors and warms up the CRT in preparation for the technician to perform color temperature adjustments. By pressing a series of front panel buttons (different for each model), this mode can be activated. The CPU detects this button combination and places a DC bias on the CRT cathodes to produce a white screen. The procedure in the CPD-G400 is as follows:

1. Disconnect the video cable from the computer or shut off the computer so there is no sync input the monitor.
2. Press the monitor switch in. A no video-input message will appear on the screen when the CRT warms up.
3. Move the ball type control button to the left and hold it there for two seconds. This must be done before the monitor goes into the Active Off Low Power Mode (two minutes after power ON).
4. The entire screen will turn white and the power indicator will alternately blink green and orange. This is the aging mode.
5. The monitor will exit from the aging mode if:

- The control button is moved to the right and held for two seconds.
- Input sync is detected (computer turned on).
- The input switch is changed.
- The power button is pressed again (off).

Image Restoration

This circuit is operated by the customer to automatically white balance the picture. This is achieved by adjusting the RGB drive (signal) levels to compensate for reduced cathode emission. At the factory, the "Ik" voltages corresponding to each RGB cathode current are stored into memory. When this circuit is activated from the menu, the screen turns white for one second as the gain of the R, G or/and B drive levels are increased. When the measured Ik voltages are matched to the ones in memory, the operation is complete and the new drive levels are stored. The circuit details are in the Video Output text where the Image Restoration circuit resides.

Lock Control

All customer functions can be inhibited from the Option menu except the front panel Input and Power switches. This is used to prevent children from resetting all your monitor settings.

S RGB

This is a preset industry standard color setting used with information from the internet and with a sRGB compliant printer. When a sRGB standard color object is indicated on the internet, you may view it in that true color by selecting sRGB from the menu's color group. If you have a sRGB printer you may print the object at that color too.

The sRGB setting just fixes the brightness and color levels to pre-established settings.

Customer Convergence

The customer can move the red and blue centering adjustments from the menu. This can be done in the horizontal and vertical plane.

Moiré Adjustment

When fine lines are viewed though other fine lines, additional patterns are developed when the lines do not coincide. For example if you were looking at a window blind through a box fan (with a grill), some lines would not be visible and others would appear distorted. This is the Moiré effect. In a monitor it corresponds to picture lines presented on a vertical slotted CRT internal aperture grill.

The Moiré adjustment affects high frequency video response.

Reset All User Adjustments

You can reset all user adjustments by pressing and holding the front panel RESET button in for two seconds when there is NO menu displayed on the screen. All menu customer settings are then reset to default levels except:

- The menu language
- The menu position
- The Control Lock function if it was ON. The reset button does not work when the lock is ON.

Reset Just One User Adjustment

Entering the menu setting you wish to reset with the control button and pressing the RESET button does this.

Self Diagnostic Function

The front panel orange/green LED is used to determine what section caused the monitor to enter the protection state. This is explained in the Self-Diagnostic Function section of this book.

Overall Block

The overall block diagram shows the major sections of the Sony model CPD-G400 monitor that house a F99 chassis. The following blocks are listed by operational importance:

- Power Supply
- Deflection
- High Voltage
- Video Processing

Power Supply

The power supply block consists of the voltage generating and regulating power supply and the managing CPU IC1001. The power supply delivers standby +5V to the CPU to keep it alive. In turn, CPU IC1001 uses two outputs to select the power supply's operating modes. The mode decided by the CPU is based upon the input sync and protection circuit (Protect 1-3) signals.

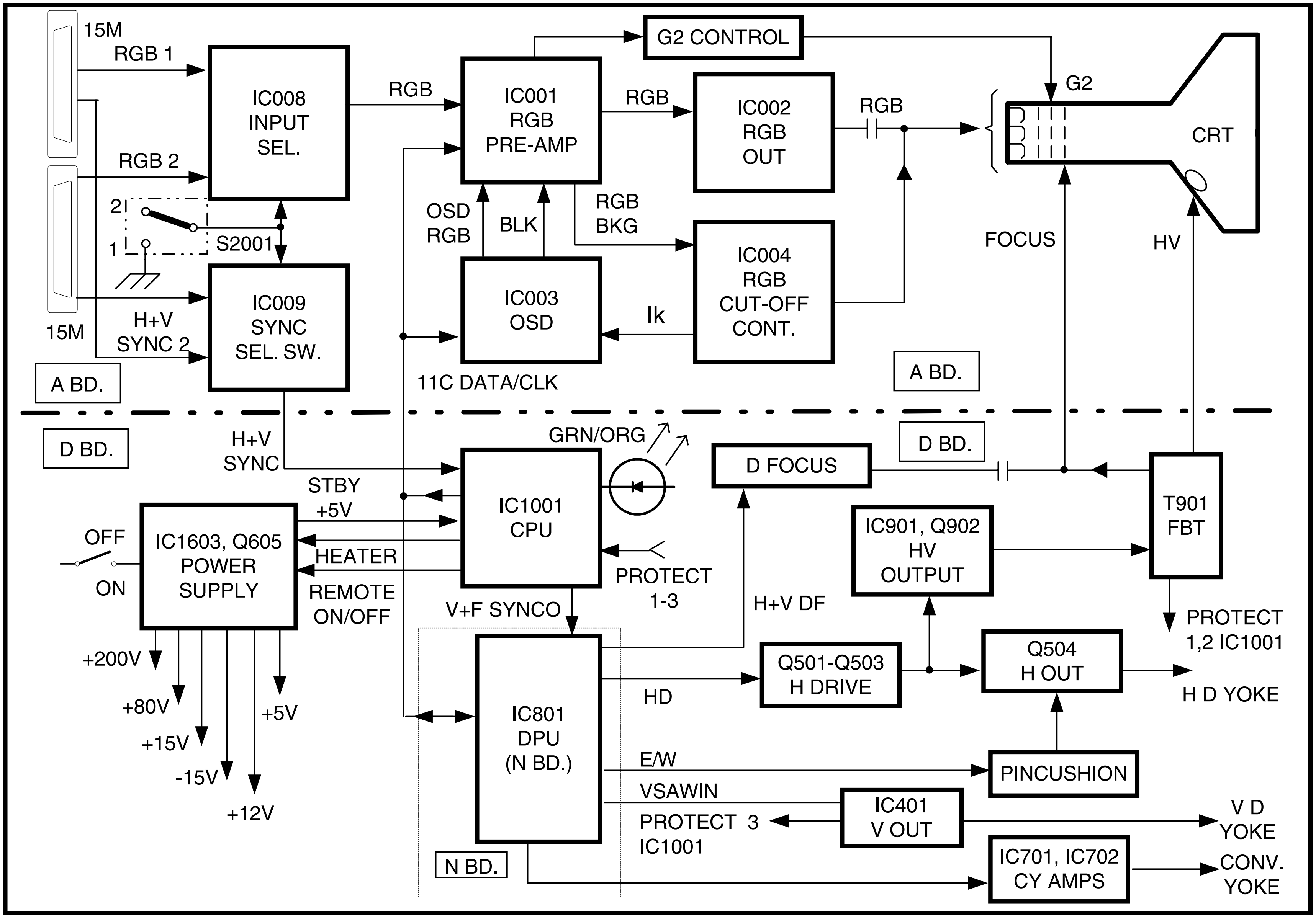
CPU Power Supply Control Lines		
Output	Purpose	Modes used
Heater	Shuts off CRT filaments and enters Active Off low power burst Mode.	• Active Off (no H & V sync input) • Protection (latched in the Active Off Mode)
Remote On/Off	Switches the +5V and +12V OFF.	• Standby (no H sync input) • Suspended (no V sync input) • Active OFF (no H & V sync input) • Protection (latched in the Active Off Mode)

Deflection

The deflection block consists mainly of the oscillator, the vertical and the horizontal deflection stages. These stages generate the signal required to make the magnetic field in order to move the electron beams across the screen.

Main Deflection Blocks		
Stage	Parts	Function
Oscillator	IC1001	• Make horizontal and vertical signals at a default frequency. • Matches its oscillator frequency to the computer s sync signal when input.
Vertical Deflection	IC801 IC401 Vert D Yoke	• Shape the oscillator pulse into a ramp waveform. • Amplify the vertical ramp to drive the yoke coil.
Horizontal Deflection	IC801 Q501-Q504	• Shapes the oscillator signal into the correct width. • Amplifies the signal to drive the horizontal yoke coil.

Stages that support Vertical and Horizontal Deflection are the dynamic focus, pincushion, and convergence stages. These stages ensure that the beam is uniformly focused, fills the entire screen and that all three beams land at the right place on the screen.



OVERALL BLOCK

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Deflection Support Stages		
Stage	Parts	Function
Dynamic Focus	IC1001	Oscillator signal for beam location
	IC801	Signal shaping
	Q701-5,	Horizontal dynamic focus amp.
	IC503, Q706.	Vertical dynamic focus amp.
Pincushion	IC1001	Oscillator signal for beam location
	IC801	Signal shaping
	Q506, Q508-9	Amplifier and output driver
Convergence	IC1001	Oscillator signal for beam location
	IC801	Signal shaping
	IC701	Static convergence amplifier
	IC702	Dynamic convergence amplifier

High Voltage

The high voltage block uses a flyback transformer and some of the later horizontal deflection circuits. This block's primary purpose is to develop and maintain the high voltage for the final beam acceleration across the picture tube bell. Two additional high voltages are also made from the flyback T901. The static focus voltage is used for focus at the center of the screen and the G2 voltage is necessary to accelerate the beam after the focus grid slows down the electrons.

Video Processing

The video-processing block consists of an input switch, amplifier and output stage. An on screen display IC003 is added to provide visual feedback about the monitor functions and features.

Video Processing Block		
Stage	Parts	Function
Input Switch	IC008	RGB input switch
	IC009	Sync input switch
RGB Amp	IC001	Preamp of the input signal
Output	IC002	Higher voltage amplifier
OSD	IC1001	Selects OSD pattern based upon user selection
	IC003	Generates the OSD picture/graphic

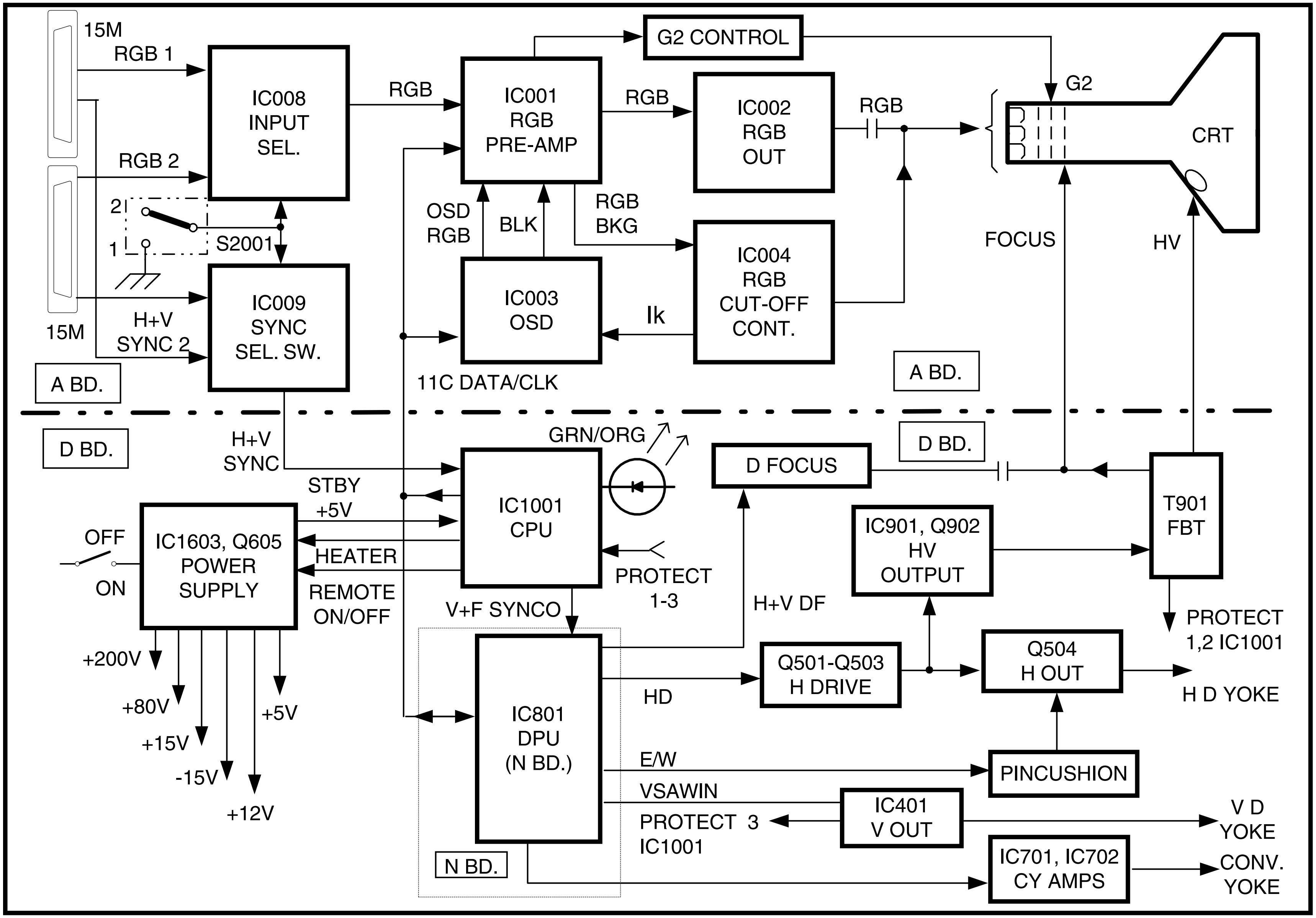
DAS Control

An external alignment computer controls many parts of the monitor's alignment. The alignment is achieved using a special computer to monitor communications connection on the D board. The 4 pin internal jack connects to the monitor's CPU IC1001.

- TXD – Transmits signal to DAS computer
- RXD – Receives signal from the DAS computer
- Stby +5V – Monitors power - Present when the monitor is ON.
- Gnd – Common ground.

A computer loaded with DAS software permits monitor adjustments by changing the data stored in memory (IC005 not shown) via CPU IC1001. The DAS software will permit the technician to change this memory data which affects these stages:

DAS Control via CPU IC1001	
Adjustment	Circuits used
CRT background and G2 level	IC001
H & V Position (centering)	IC001 Video signal positioning
H & V Size	IC801 Deflection size
Pincushion	IC801, Pin Output transistors
Convergence	IC801, Conv Outputs



OVERALL BLOCK

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Power Saving Modes

This monitor has four power modes. The CPU monitors video input sync to select the monitor's power mode of operation.

Normal Operation

When CPU IC1001/pins 20 and 30 detects both vertical and horizontal sync or Sync On Green is detected at IC1001/pin 28, the power supply operates normally and the monitor is unblanked. The front panel combination orange/green LED only lights green.

Standby Power Mode

When there is only a loss of horizontal sync at IC1001/pin 30, the monitor shuts down some of its circuitry. CPU IC1000/pin 7 goes LOW, shutting off the +5V supply line to the monitor. At the same time IC1001/pin 52 causes the orange LED to blink continuously while the green LED remains ON.

Suspended Power Mode

When Vertical sync is lost at IC1001/pin 20, the monitor shuts down some of its circuitry. CPU IC1001/pin 7 goes LOW, shutting off the +5V supply line to the monitor, just as above. At the same time IC1001/pin 52 causes the orange LED to also turn ON. Both LED on means the monitor is in the Suspended Power Mode.

Active OFF Power Mode

A loss of both horizontal and vertical sync causes the monitor to enter a very low power consumption mode. The CPU responds to no sync by placing the outputs at IC1001/pins 7 and 8 LOW. The LOW from pin 7 shuts off the 5 and 12 volt supply lines to the monitor causing blanking as in the previous standby and suspended modes.

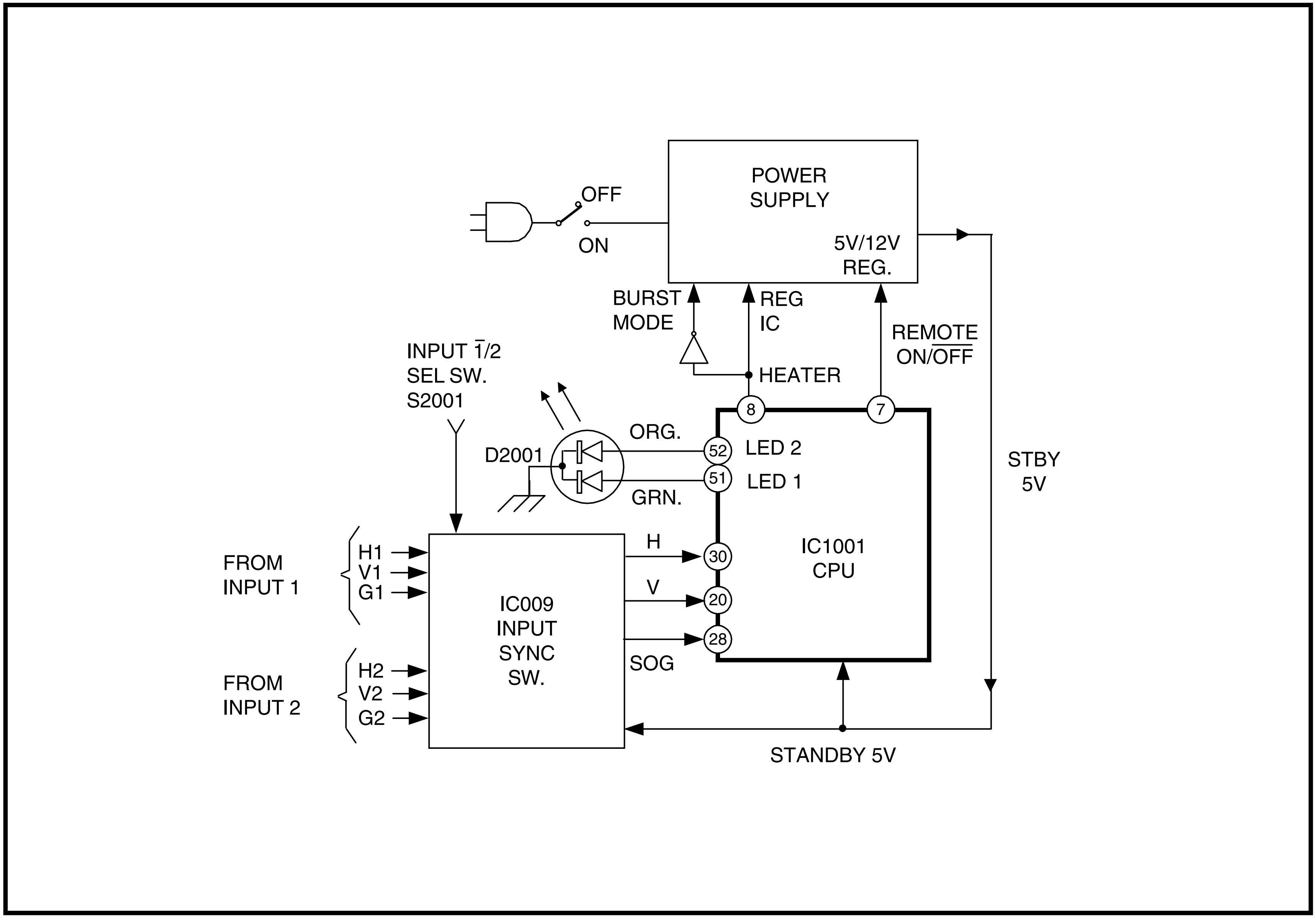
When IC1001/pin 8 goes LOW, the power supply enters the burst mode of operation. In this mode the power supply is only powered up in bursts. As a result, all the monitor supply voltages are Low or absent depending upon the severity of the load. There is sufficient energy to power standby regulator IC609 (not shown) to the CPU. This is because the CPU needs little current, so the standby 5V is normal while the remaining voltages to the monitor are extremely low.

In this Active Off power mode, the green and orange LEDs are both ON as in the suspended power mode. The difference is that in the Active OFF mode, the +15 from the power supply is no longer active and the surge relay can be heard de-energizing as it enters this mode.

Power Mode Summary

Six seconds after the monitor is powered ON, the degaussing circuit relay de-energizes. A display then appears showing the video-input status. After one minute the monitor will enter one of four power modes if sync is missing. The CPU monitors video input sync to implement the power mode.

Monitor Power Modes				
Power Mode	Cause	Green LED Indicator	Orange LED Indicator	Audible Indicator
1. Normal	H and V sync input to the monitor	ON	OFF	Surge relay energizes one second after pressing the power ON button.
2. Standby (115 ac mA.)	No Horizontal sync	ON	Blinks	None
3. Suspend (115 ac mA.)	No Vertical sync	ON	ON	None
4. Active Off (52 ac mA.)	No Vertical or Horizontal Sync	ON	ON	Surge relay de-energizes 60 seconds after pressing the power ON switch.



POWER SAVING CIRCUIT

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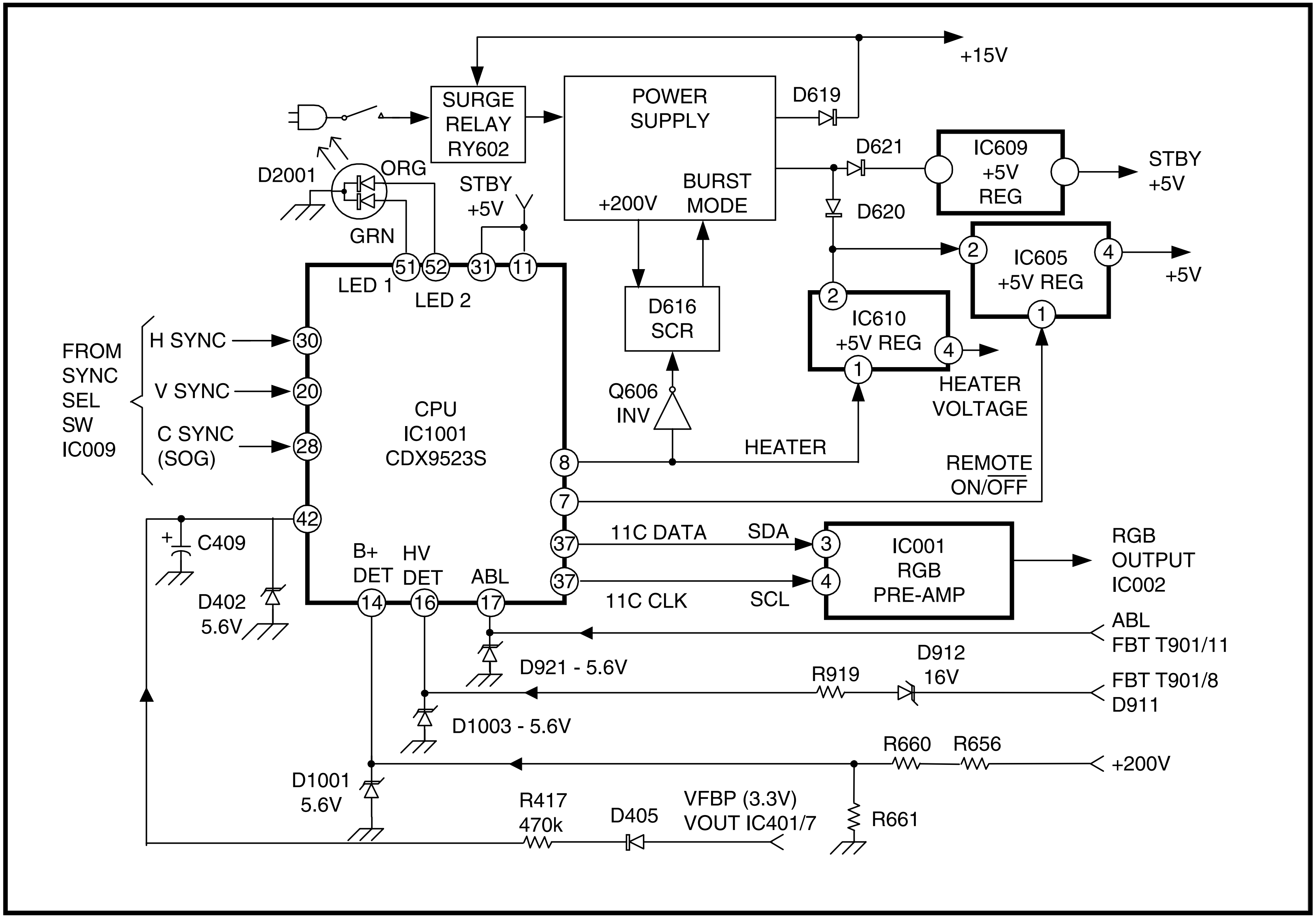
Power Mode Circuit Activity

The front panel combination green/orange LED identifies the lack of H or V sync input. The monitor power operating modes relating to the circuitry is summarized this chart:

Monitor Mode Details									
Power Mode after one minute	Power Indicators *	AC Power Consumption *	Video Blanking	Main Power Supply	CRT Heater IC610	Surge Resistor Bypass Relay RY602	5V Regulator IC605	Standby 5V IC609	IC1001 CPU input
1. Normal	Green ON	140W (1.16A.) Nominal. Surge to 6 amps.	Unblanked	Active	Active	Relay energized. Resistor bypassed.	Regulator ON	Active	H & V input sync.
2. Standby	Green = ON Orange = blinks	15W (0.115 A. measured)	Blanked	Active	Active	Relay energized. Resistor bypassed.	Regulator OFF	Active	No H sync input.
3. Suspend	Green = ON Orange = ON	15W (0.115 A. measured)	Blanked	Active	Active	Relay energized. Resistor bypassed.	Regulator OFF	Active	No Vertical Sync input.
4. Active Off	Green = ON Orange = ON	3W (0.052 A. measured)	Blanked	Bursts only	OFF	Relay OFF	Regulator OFF	Active	No Vertical or Horizontal Sync.



SELF DIAGNOSTIC BLOCK

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Power Supply Block

The power supply develops various voltages required by the monitor. The CPU works with the switching power supply to enter a very low (energy star compliant) power saving mode when the external computer is turned Off but the monitor switch is still ON. The CPU also activates this same power saving mode when a circuit failure occurs. The monitor has several major power supply sections:

Power Supply Sections	
Sections	Function
Degaussing Circuit	Demagnetizes the picture tube at power ON.
Surge Protection Circuit (Q607)	Prevents a momentary short circuit to the AC line at power ON. Reduces voltage fluctuations at power ON.
Switching Power Supply (IC603, Q605, T602)	Develops multiple voltages needed by he monitor.
H Centering Control (IC502, Q519)	Centers the picture by adding a DC voltage onto the H yoke winding.
Shunt & Stby Regulation IC608, Q609)	Sets the switching power supply pulse width to maintain a stable power supply output voltage.
CPU Control (IC1001)	Switches the power supply into one of four power modes: 1. Normal All voltages are operational 2. Standby - +5V & +12V regulators = OFF, screen blanked. (No H sync input) 3. Suspend - +5V & +12V regulators = OFF, screen blanked. (No V sync input) 4. Active Off All power supply voltages very low except standby +5V to CPU. (No H & V sync).
Heater Regulator	Regulated voltage to CRT filaments. Switched Off in the Active Off Mode.

Power Supply Output

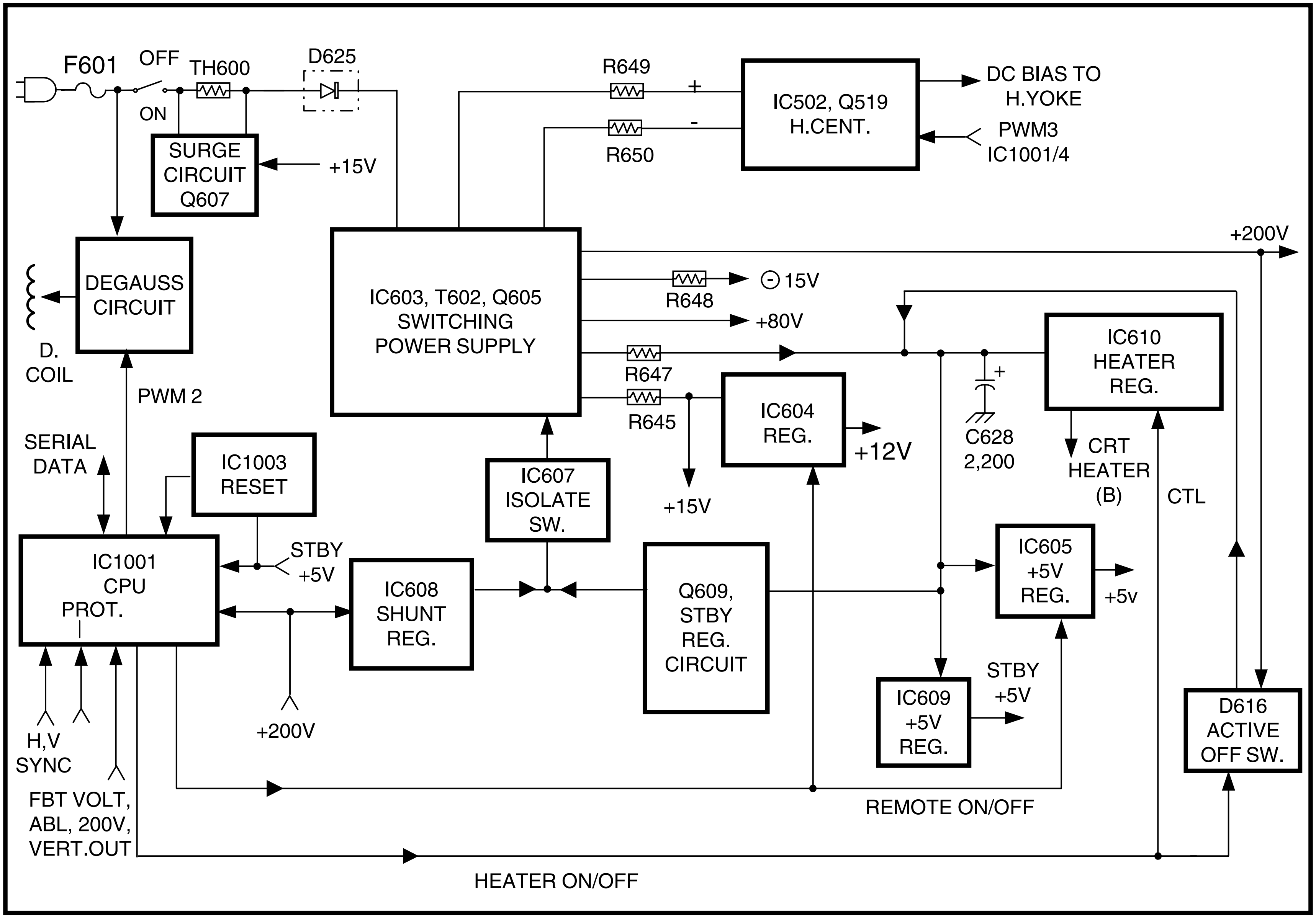
This power supply has outputs that are fused and unfused:

Fused Switching Power Supply Outputs		
Voltage	Fusible Resistor	Destination
± 6.5V	R649, R650	Horiz. Centering
-15V	R648	H Drive Q504, Rotation Drive IC703, Vert. Out IC401, Converge Amp IC701, IC702,
+15V	R645	12V Regulator IC604, Surge relay RY602, Rotation Drive IC703, Vert. Out IC401, Converge Amp IC701, IC702,
+8V	R647	Heater Regulator IC610, Sw +5V Reg. IC605, Standby Reg. IC609, Stby Reg. Circuit Q609.

Unfused Switching Power Supply Outputs	
Voltage	Destination
+200V	Active Off Switch D616, RGB Cutoff Control IC004, Pin Out Q506, HV Regulator Q901, CPU IC1001/pin 14.
+80V	RGB Output IC002, Dynamic Focus Circuit Q704/5,

Active Off, Low Power Mode

When the computer connected to the monitor is shut off, horizontal and vertical sync input signals stop. CPU IC1001 senses this loss and turns off both the Remote ON/OFF and Heater output lines. The Remote ON/OFF line shuts off the +5 and +12V power lines to the monitor (via IC605 and IC604). The Heater output line turns off the CRT filament voltage (IC610) and at the same time turns ON SCR D616 to activate the Active Off Power mode.



POWER SUPPLY BLOCK

Active Off Mode Entry

SCR device D616 starts the Active Off Power Mode. The 200V and 8V lines are connected when D616 turns ON. The increased voltage on the 8V line requires an immediate correction by the switching power supply (IC603).

If the 8V line is not restored to 8V within a period of time, the power supply (IC603) enters the Active Off Power Mode. In this mode, the oscillator is only operated for a few cycles in bursts. This reduction in power drops almost all the switching power supply output voltages.

The 8V-output line to the CPU (via IC609) requires so little power it can operate in this low power mode with sufficient voltage. Standby regulator circuit (Q609) is used to maintain the standby voltage in this Active Off Power Mode.

Active Off Exit

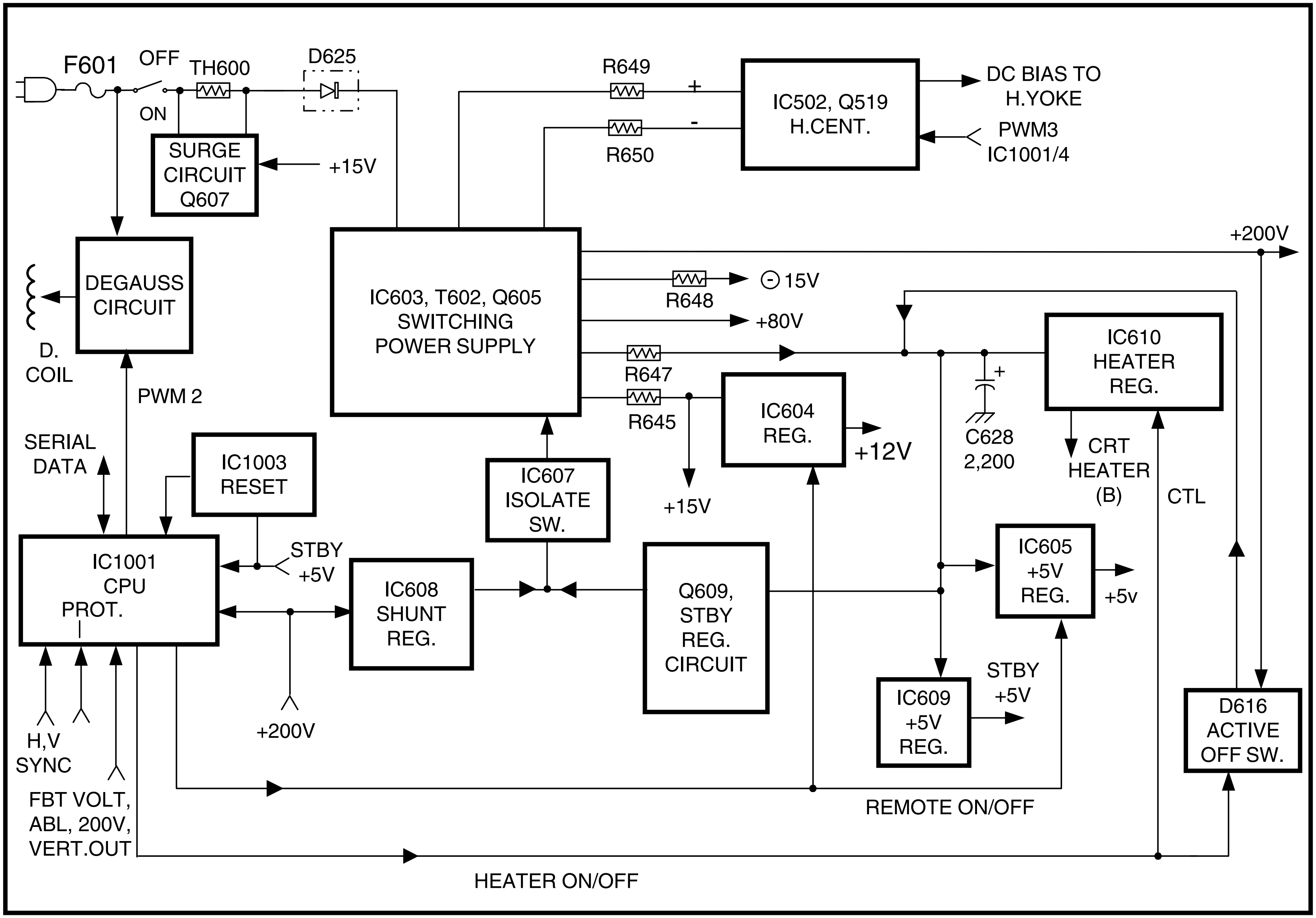
When the computer is turned ON, the CPU IC1001 detects sync. To wake up the monitor from the Active Off Mode, CPU IC1001 turns ON the Remote On/Off output. This places a load on the 8V line. The load is sensed by the switching power supply via Q609 (IC603 turns on) the oscillator full time instead of in bursts. This continuous oscillator output provides sufficient power to maintain the 8V line with a full load.

Protection

The CPU monitors several sections and enters the Active Off Low Power Mode to drop power for protection. The CPU monitors the following circuits:

Circuits Monitored	
Circuits	LED Indication
HV Regulator Circuit (Excessive Flyback voltage)	Both Green and Orange LEDs blink at 1 Hz.
RGB Cutoff Circuit (Excessive ABL Voltage)	Both LEDs blink : ON = 1 sec, OFF = 2 sec.
Vertical and Horizontal Output	Both LEDs ON = 2 sec. OFF = 1 sec

Although a failure in any one of these circuits can trigger the Active Off Power Mode, the CPU will indicate the defective circuit using the front panel LED.



POWER SUPPLY BLOCK

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Degaussing/Surge Protection

AC Input

There are several parts between the AC input and the bridge rectifier D625. The function of these parts are explained in the chart below:

AC Input Parts		
Part / Name	Function	Possible Symptoms if defective
F601 / Input fuse	Current limit	Monitor is dead.
R674 / Resistor	Bleeder	Arcing at plug when unplugged from AC.
LF602 / Choke	Line noise canceling	Intermittent noise on monitor screen and/or radio/TV interference. Monitor is dead.
VA601 / VDR * (375pf)	Clips incoming voltage spikes	Intermittent failure of monitor s power handling parts. Shorted Open fuse
C636 & C637 / Capacitors	Reduces the amplitude of incoming/outgoing noise spikes.	Constant radio/TV interference Repetitive VDR failure
TH600 / Thermistor (6.5 ohms cold)	Limits the monitor s turn ON surge current	Open Dead set Shorted D625 failure
S601 / ON/Off Switch	Passes AC to monitor	Unreliable power ON

VDR VA601 Operation

The resistance of a VDR will drop from infinity to a low value (depending upon the construction) when the voltage applied to its terminals exceeds the trigger voltage. This reduction in resistance will reduce a high voltage, but low energy (pulse width), voltage spike and prevent it from puncturing (damaging) semiconductors in the monitor. The VDR returns to infinite resistance when the applied voltage disappears. VDRs will not shunt a high-energy pulse from a direct lightning hit on the power line. Hopefully the VDR will short and take out the fuse, saving other parts within the monitor.

VDR Testing

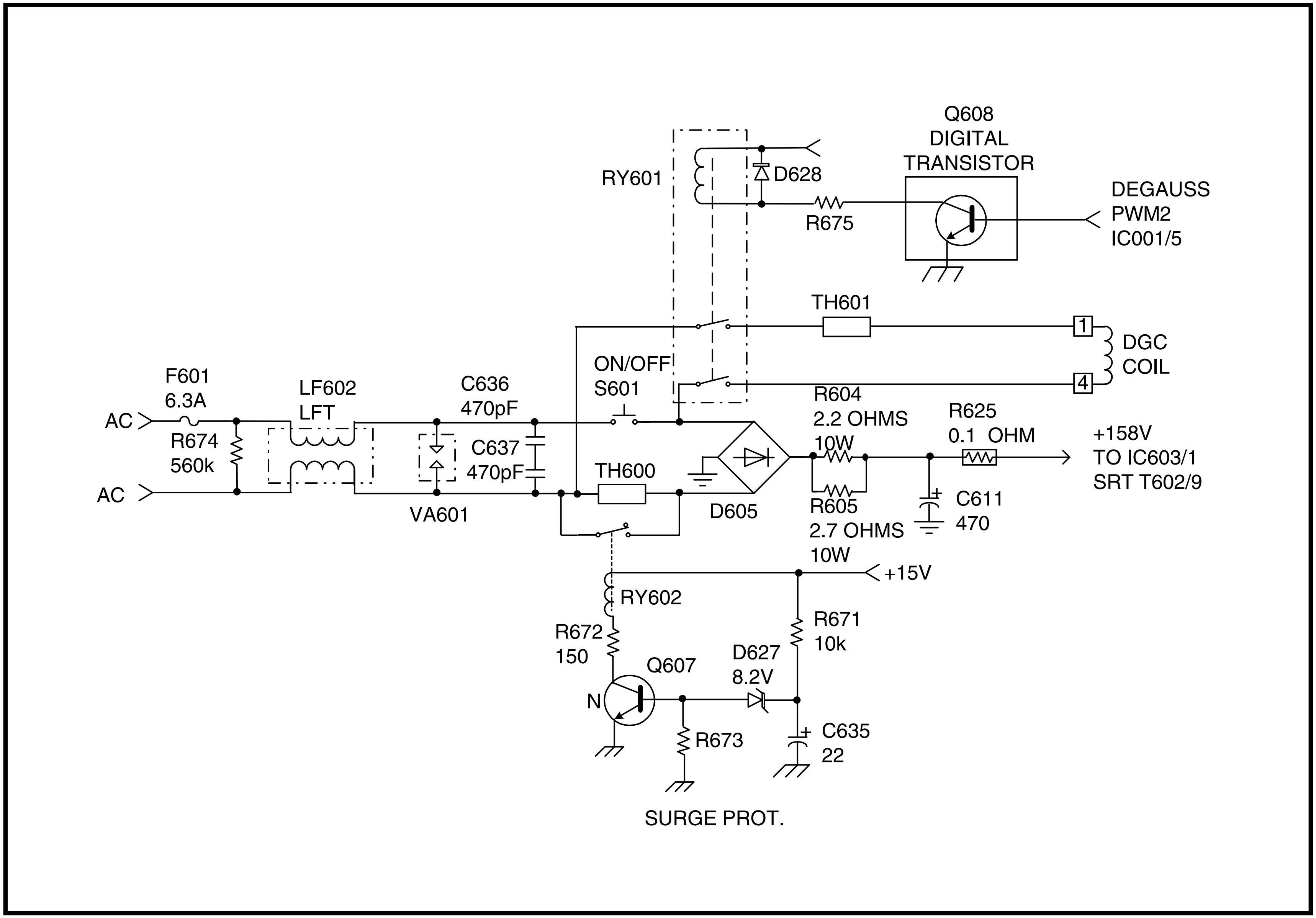
1. Measure the resistance across the VDR terminals. A good one will read infinity (open).
2. To ensure the VDR is not open internally, measure its capacitance. The capacitance will vary depending upon the construction and vendor, but none should be open (no capacity) unless bad. The trigger voltage is usually related to the part number that is stamped on the VDR. In this unit, VA601 is stamped 471K (470 Volts) and measures 375pf (out of the circuit). For comparison, a different vendor VDR taken from a TV is stamped 430NR and measures 198pf.
3. Having a capacitance only proves the VDR is not open. It does not prove that it will operate at the trigger voltage. When the monitor’s power handling parts periodically fail without cause, the VDR is in doubt. Replace it.

Degaussing Circuit

Purpose

Color TV sets and color monitors have electron beams that are targeted to a specific location on the screen. An external magnetic field can move the beam to an undesired location on the screen, changing the desired color near the source of the magnetism. This can occur when a part of the picture tube’s metal structure is magnetized in transportation or by placing an unshielded speaker magnet nearby. Applying a strong AC field about the tube at turn ON can demagnetize the tube. This picture tube demagnetizing is called degaussing.

Degaussing is characterized by a strong humming noise at power on that only lasts approximately one second. During this second, the picture tube is engulfed with a strong AC field and the AC current consumption is about 6 AC amps. If the magnet is external to the monitor, the undesired color will return. Remove the external magnet.



DEGAUSSING / SURGE PROTECTION

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Circuit Operation

Degassing only occurs after the front panel power is pressed. The sequence of operation is as follows:

1. Press the power ON button (not shown).
2. 158V is applied to the power supply stage (not shown).
3. The power supply stage makes standby +5V for the CPU IC1001 and reset IC1003 (not shown).
4. Once the CPU is reset, IC1001/pin 5 outputs a HIGH to activate the degaussing circuit.
5. The CPU HIGH turns on relay driver digital transistor Q608 (has internal resistors to operate with 5V input).
6. Q608 grounds degaussing relay RY601, energizing it.
7. RY601's contacts close passing 120VAC through TH601 to the degaussing coil around the bell of the picture tube. The AC demagnetizes the internal metal parts of the picture tube.
8. Within two seconds TH601 has increased resistance from 4.2 ohms cold to a few 100k ohms hot.
9. In approximately six seconds after the power button was pressed, CPU IC1001 discontinues the HIGH from pin 5 so the degaussing relay contacts open, removing power from the degaussing coil.
10. CPU IC1001/pin 5 will remain LOW as long as there is standby +5V applied to it (power switch is ON).

Surge Protection Circuit

At power ON this monitor consumes power in two places:

- Degaussing coil circuit = About 6 AC amps.
- Monitor power supply = About 0.5 to 1 amp depending upon the charge of the filter capacitor (C611).

The surge protection circuit reduces the amount of power and voltage fluctuations to the monitor's power supply until the degaussing circuit has completed its task. This is accomplished by placing a current limiting resistor (thermistor TH600) in series with the bridge rectifier D625. 1.8 sec after the power button is pressed, the current limiting resistor is jumped out of the circuit.

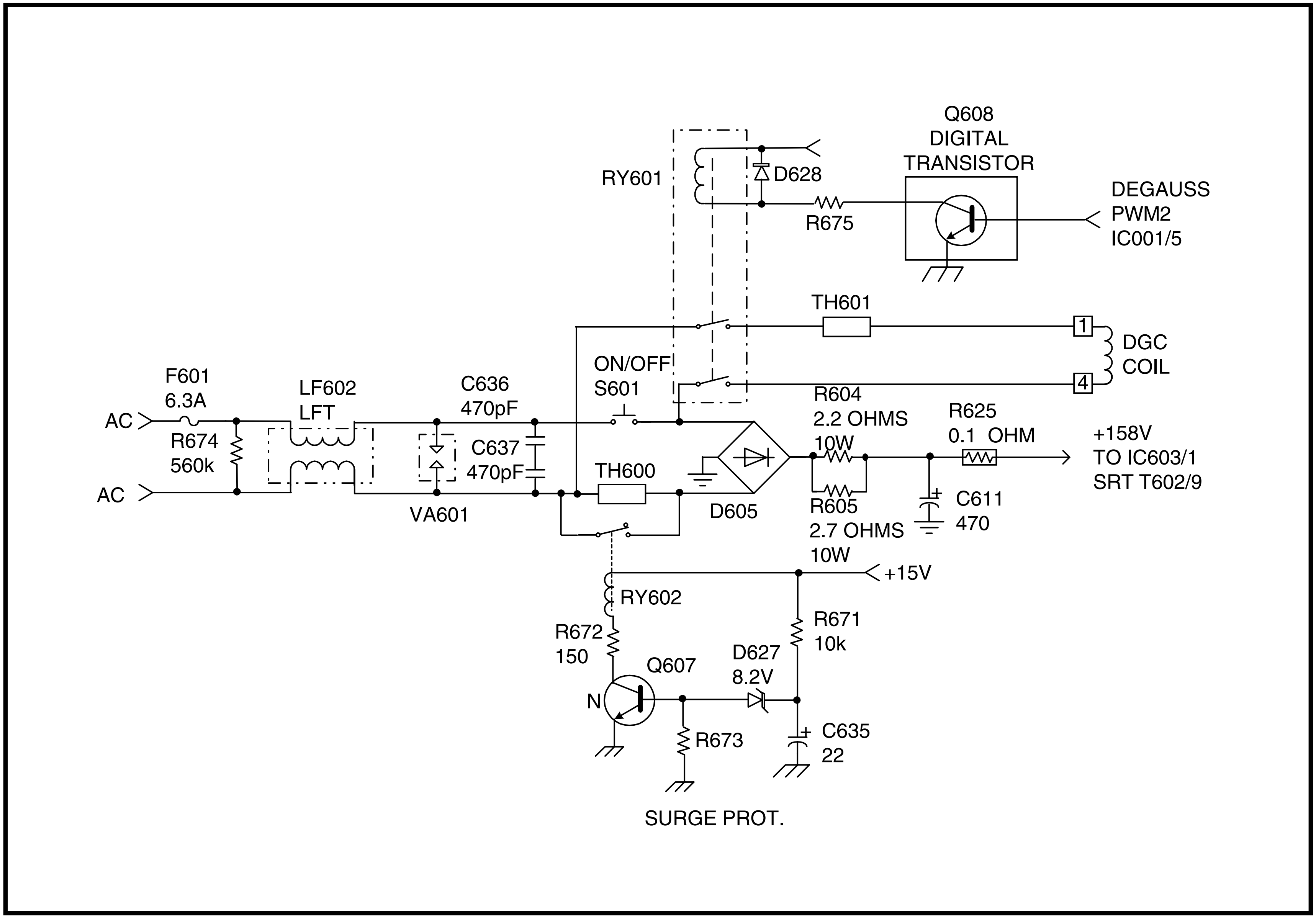
The sequence of operation is as follows:

1. Power ON button is pressed.
2. Heavy current goes to the degaussing circuit.
3. The monitor's power supply is current limited by TH600 (6.5 ohms cold). Although delayed, the power supply voltages come up.
4. +15V is one of the power supply voltages. This voltage is applied to the surge protection circuit at RY602 and C635 via R671.
5. At +15V, C635 takes about 0.2 milli-seconds to charge to 8.6V.
6. Zener diode D627 conducts, turning ON Q607.
7. Q607 in turn energizes the surge relay RY602.
8. RY602's contacts jumper (short) out current limiting thermistor TH600 so the monitor will have full power.

Operating Voltages and Resistances

Circuit Voltages		
Location	At Power ON	After 2 seconds
IC1001/pin 5	4.9V	0V
Q608/Collector	0V	11.8V
D628/Anode	2.3V	11.8V
D627/Cathode	0V	8.6V
Q607/base	0V	0.72V
Q607/Collector	0V	0V
R672/RY602	0V	2.92V

Selected Part Values		
Part	Function	Measured Resistance
TH600	Surge Resistor	6.5 ohms cold
TH601	Degauss Thermistor	4.2 ohms cold
DGC Coil	Degaussing	15.6 ohms



DEGAUSSING / SURGE PROTECTION

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Switching Oscillator

This switching oscillator stage generates seven voltages for the monitor to operate normally. The stage consist of three major parts:

- Switching Regulator IC603 – Contains an oscillator that runs at 63kHz, 26kHz or at bursts of 18kHz. Duty cycle regulation.
- Power Handling Q605 – A MOSFET can control the high current at the wide operating frequency of the oscillator.
- Sine Resonate Transformer T602 – Produces the various voltages required by the monitor.

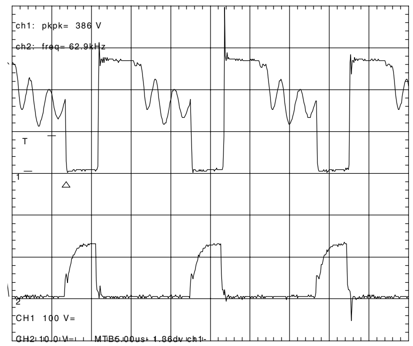
This monitor's power supply has three operating modes. One mode is selected depending upon the amount of load. When the load has changed, measuring the current needed to restabilize the output voltage permits IC603 to select the same or another operating mode.

Power Supply Operating Modes		
Mode	Oscillator Frequency	Characteristic
1. Normal (e.g. bright screen)	63kHz	Continuous 63kHz oscillator signal. Duty cycle is changed for regulation.
2. Light (e.g. screen saver)	26kHz	Continuous 26kHz oscillator signal. Duty cycle is changed for regulation.
3. Active off	18.2kHz 6Hz = burst rate	18.5msec. bursts of 18.2kHz, 6 times/second. The 18.2kHz is PWM.

Start Up – Normal Mode

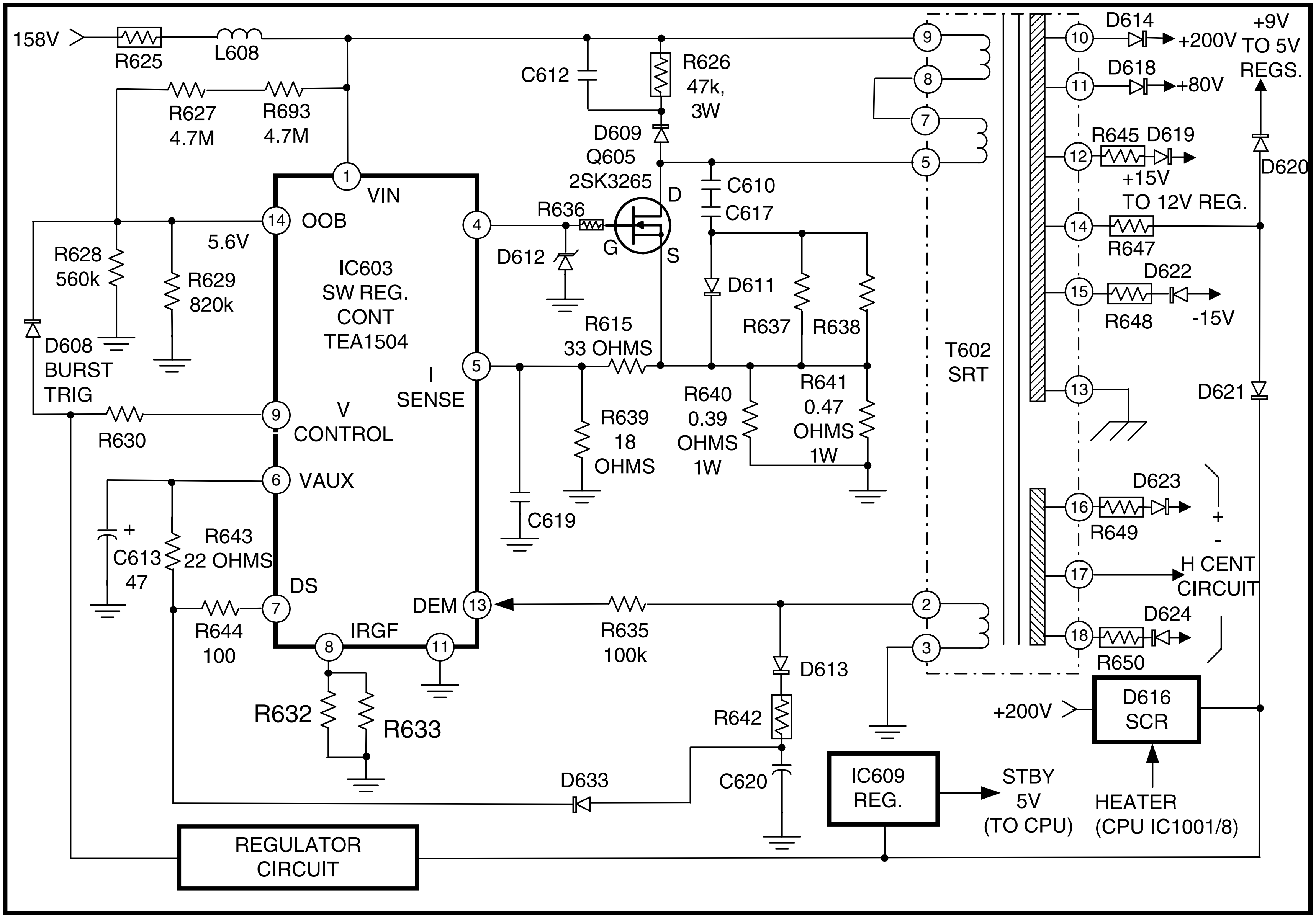
When the front panel power switch is pressed, +170V is applied through fusible resistor R625 to the switching oscillator stage. This voltage is evident at the SRT T602 transformer primary windings, Q605/D, and IC603/pin 1. Oscillation does not start until IC603/pin 14 receives voltage. The following start up sequence occurs to power the monitor:

1. Switching Regulator IC603/pin 14 receives a voltage above 2.5V. IC603/pin 14 is labeled OOD for "On/Off Data".
2. Voltage input from IC603/pin 1 is permitted to leave Vaux IC603/pin 6 to charge external capacitor C613 until IC603's oscillator runs. Vaux is the supply input for the IC like Vcc. C613 must continue to supply power to the IC until the power supply stage develops voltage to keep C613 charged.
3. IC603's internal oscillator starts and approximately 65kHz is output IC603/pin 4.



4. This signal is amplified by Q605 and applied to the primary winding of SRT transformer at T602/pin 5.
5. The SRT transformer has three groups of secondary windings:
   - Pins 10-15 supply power to the monitor.
   - Pins 16-18 supply voltage to the Horizontal centering circuit.
   - Pins 2-3 return a sample of the transformer voltage to IC603.
6. The secondary voltage from T602/pins 2 and 3 are separated into two paths before fed back to IC603, pins 13 and 7 for control.

- IC603/pin 13 – The R635 path is used to monitor changes to the secondary load for mode changes between Normal, Light and Active off operation.
- IC603/pin 7 – The path through D613, R642, D633, and R643 is used to coarse regulate the output voltage. IC603 uses this information to change the oscillator pulse width (duty cycle) for output voltage control. A second regulation path into IC603/pin 9 is used for fine voltage correction.



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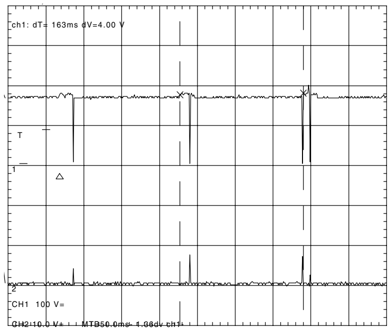
Active off Mode

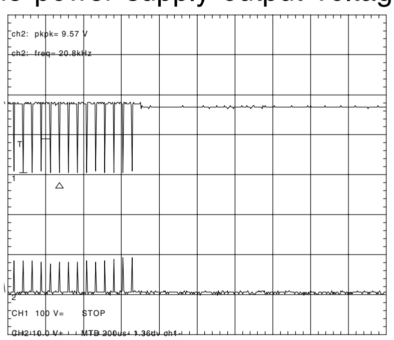
The monitor can also operate in an Active Off mode. When the computer is turned OFF, there is no video sync input the monitor. Within the monitor, this loss is detected by the CPU (not shown). The CPU turns ON SCR D616, which increases the error voltage. This increase to 6.5V is detected by IC603/pin 14 via D608 and the oscillator stops to lower the output voltage. Since it takes a longer time for the voltage to return to normal, the oscillator resumes in the low output Active Off or Burst mode.

In the Active Off mode IC603 turns ON the power supply's oscillator in bursts, every 163msec (6 times/second). The bursts last 18.5msec.



Active Off Power Supply Burst Intervals			
	Name	Location	Voltage
Channel 1	Amplified OSC	Q605/D	180Vp-p
Channel 2	Oscillator Output	IC603/pin 4	11Vp-p
Time base	50msec/div		

Each burst consists of oscillator pulses at 18.2kHz. These pulses change in width to regulate the power supply output voltages in the Active Off mode.



Active Off Power Supply Burst			
	Name	Location	Voltage
Channel 1	Amplified Osc	Q605/D	180Vp-p
Channel 2	Oscillator Output	IC603/pin 4	11Vp-p
Time base	200usec/div		

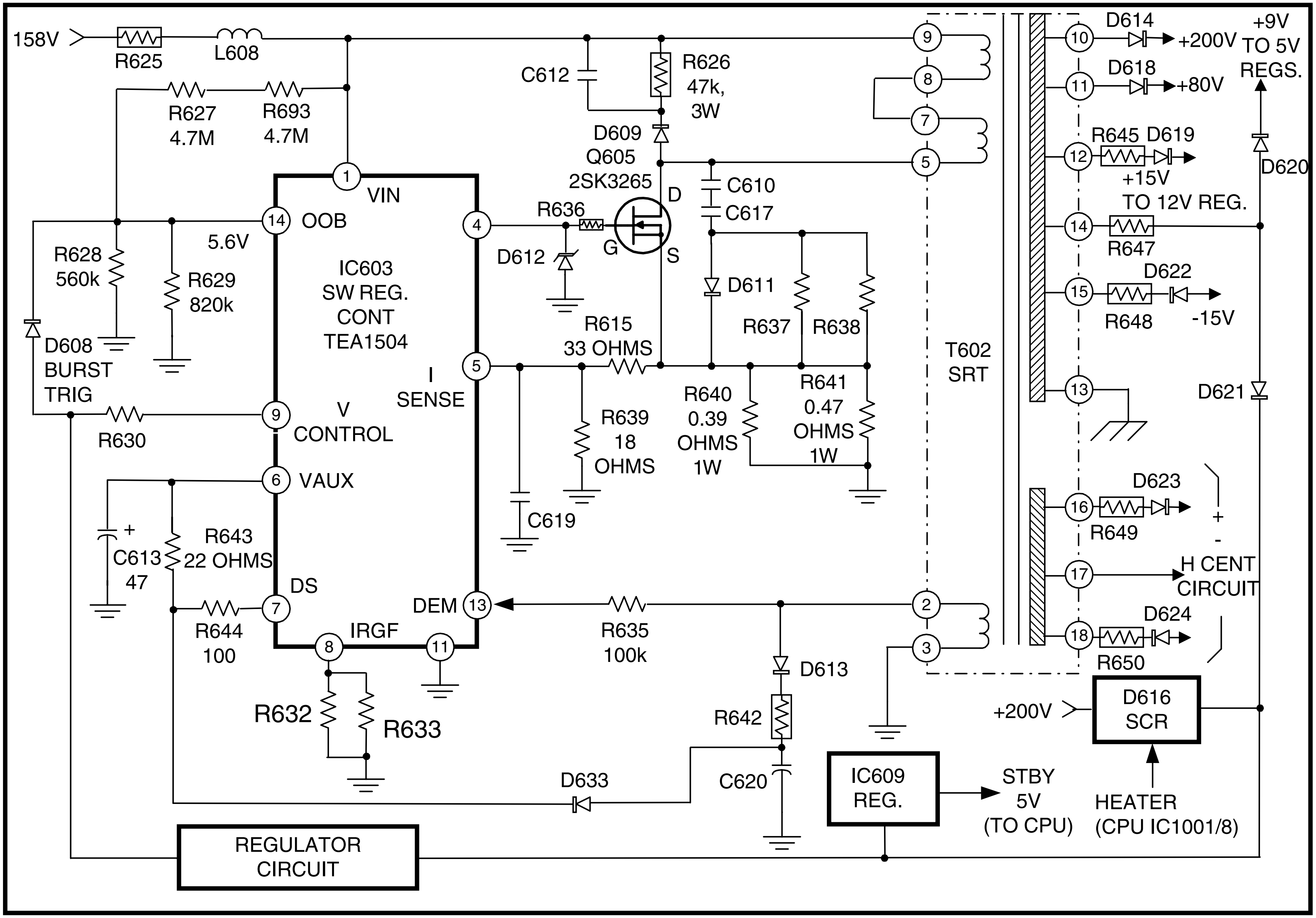
These bursts provide sufficient voltage at T602/pin 14 to only regulator IC609. IC609 powers the CPU, IC1001. The SCR is reset because there is insufficient current to keep it latched.

Light Mode

From the Active Off mode, the monitor can return to the ON mode when input video sync is detected or if a front panel input has been selected. Both inputs are monitored by the CPU. The CPU discontinues the SCR (Heater) signal and turns ON both regulators. The regulators immediately load the power supply stage.

The decrease in peak to peak feedback voltage from T602/pin 2 causes IC603 to power up. IC603 first eliminates the bursts and provides a continuous oscillator signal from pin 4 (Light Operating Mode). If the Light Operating Mode does not bring the secondary voltage up fast enough, IC603 increases the frequency and pulse width to meet the power demand (normal mode).

When the power demand is minimal, such as in screen saver or a front panel input in triggered with no video input, the power supply may choose the Light-operating mode. The monitor current is measured at IC603/pin 5. In this light mode, the power supply does not have to work as hard to maintain the secondary voltages that are used to drive the monitor. As a result, the oscillator frequency is only 26KHz in the light mode, instead of the normal 63kHz.



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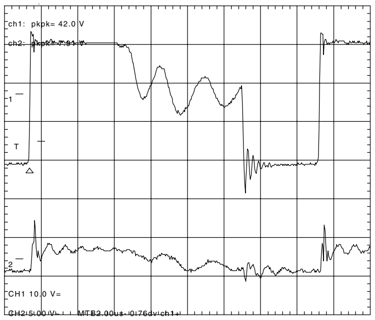
Mode Switching

By using three operating modes to maintain the output voltages, the power supply is more efficient. The correct operating mode is selected by IC603/ pin 14 for the Active Off Mode and maintained by using feedback from transformer T602/pin 2. This signal is reduced considerably by R635 as seen in the next waveform:



Mode Sensing			
	Name	Location	Voltage
Channel 1	Feedback	T602/pin 2 (D613/A)	30Vp-p
Channel 2	DEM	IC603/pin 13	5Vp-p
Time base	2usec/div		

Operating Voltages

IC603 DC Voltages					
Pin	Normal Mode	Stby Mode	Pin	Normal Mode	Stby Mode
1	158V	165V	8	2.4V	2.5V
2	0	0	9	2.7V	0.06-0.2V
3	0	0	10	0	0
4	2.6V	0.06V	11	0	0
5	.02V	0	12	0	0
6	11.4-12.5V	9.1-9.7V	13	0.8-1V	0.07-.2V
7	12.2V	9.1-9.7V	14	5.2V	5.6V

Power Supply Output Voltages		
Line @ Location	Normal/Light Mode	Active Off Mode
200V @ D614/C	200V	16.5V
80v @ D618/C	77.5V	6.82V
15V @ D619/C	14.9V	1.07V
9V @ D620/C	8V	1.75V
9V @ D621/C	9.2V	**13.5V for CPU**
-15V @ D622/A	-14.8V	-1.2V
± V @ D623/C & D624/A	±6.5V	±1.1V

Forced Normal Operating Mode

If the power supply will not enter the Normal Operational mode (stays in the Active Off / Burst Mode) this is because:

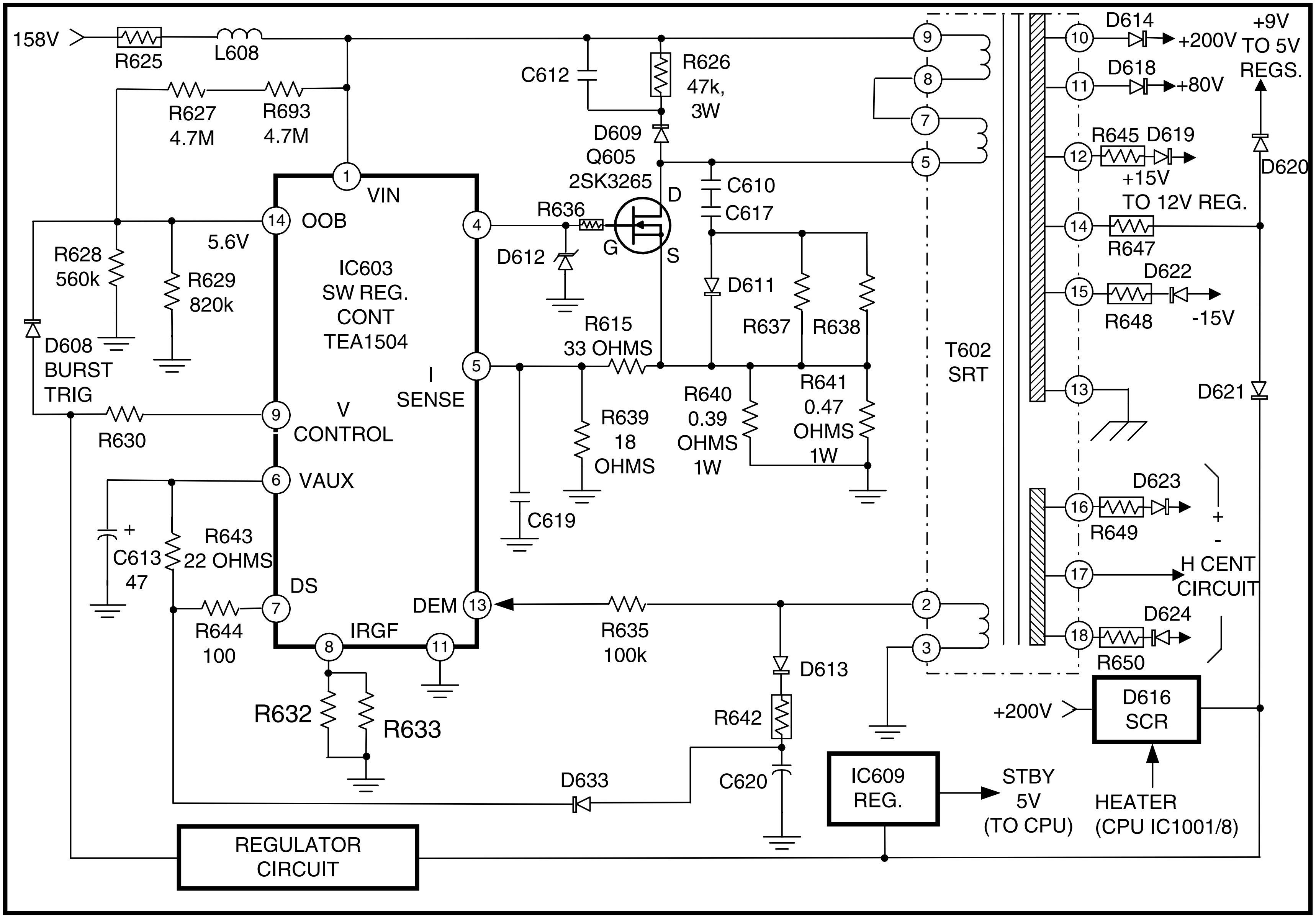
- There is a short on one of T602 or FBT secondary loads.
- Standby 5V is missing or CPU is defective.
- SCR D616 is shorted.
- The regulating circuit is defective.

If you cannot find a short in one of the power supply loads or FBT loads, you can force the power supply to enter the Normal mode. This is done by:

- Disabling the HV for your own safety.
- Disabling the SCR on the +200V line.
- Turning ON the +5V and +12V regulators.

A service manual to locate the parts, a jumper wire to force the power supply into the Normal Power Mode and a 5V-power supply is needed to turn on the regulators.

Warning - When repairing any electronic product, DO NOT PLUG THE PRODUCT DIRECTLY INTO AC. Plug the product into an isolation transformer and the transformer into AC to reduce damage and the danger to you when servicing.



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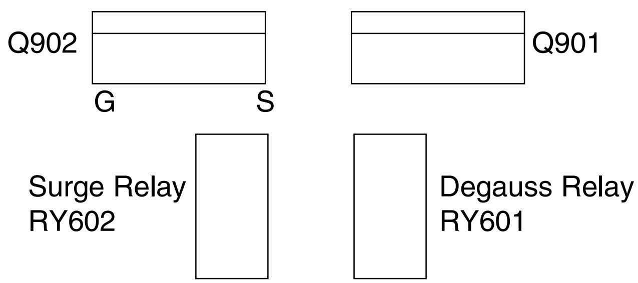
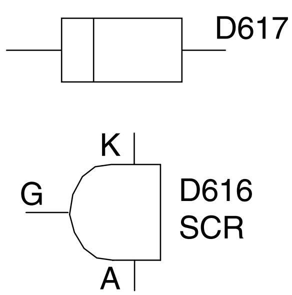
The procedure is as follows:

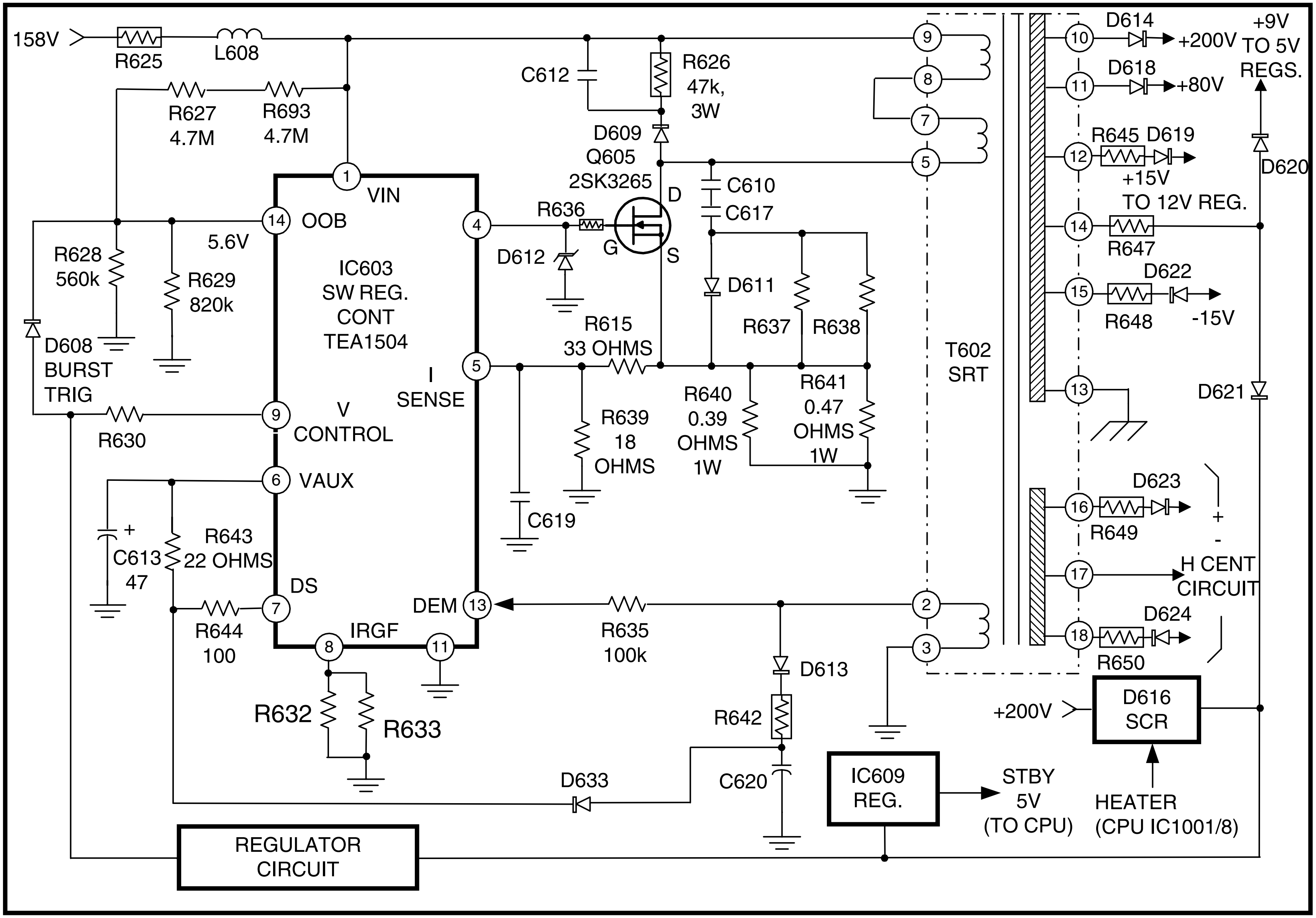
1. Position the main board to access the power supply. You will not need the picture tube nor degaussing coil. You will need the +5 volt loads on the D board and the CRT's A board.
2. Disable the HV by shorting Q902's Source and Gate leads. Q902 is on the large heat sink on the main D board near the relays. The Source and Gate are the outer leads on this TO-220 case FET.



3. Disable SCR D616 by shorting diode D617 nearby. D617 is connected to the SCR's gate and cathode.



4. Keep the Yoke connected to the D board (CN1 to CN501) so the unit will not go into ABL shutdown.
5. Keep the CRT's A board connected at CN306, CN309 and CN311 for CPU communications and power.
6. Apply external +5Vdc in series with a diode to IC605/pin 1. This turns ON 5V regulator IC605 and 12V regulator IC604. You may want to place a diode in series with the external +5V power supply to prevent damaging your test equipment. Use the shield as a cold ground. Alternate procedure: If you do not want to use an external power supply, the monitor will normally enter the Active Off Mode after one minute. At that time, press a front panel mode button to return the Monitor to the Normal Power Mode.
7. Press the power ON button and the monitor's power supply will come up in the Normal mode and remain in that mode. After one minute without sync input, the CPU will turn ON the front panel Orange indicator, but the monitor voltages are active except for the final HV, Heater voltages and FBT voltages.



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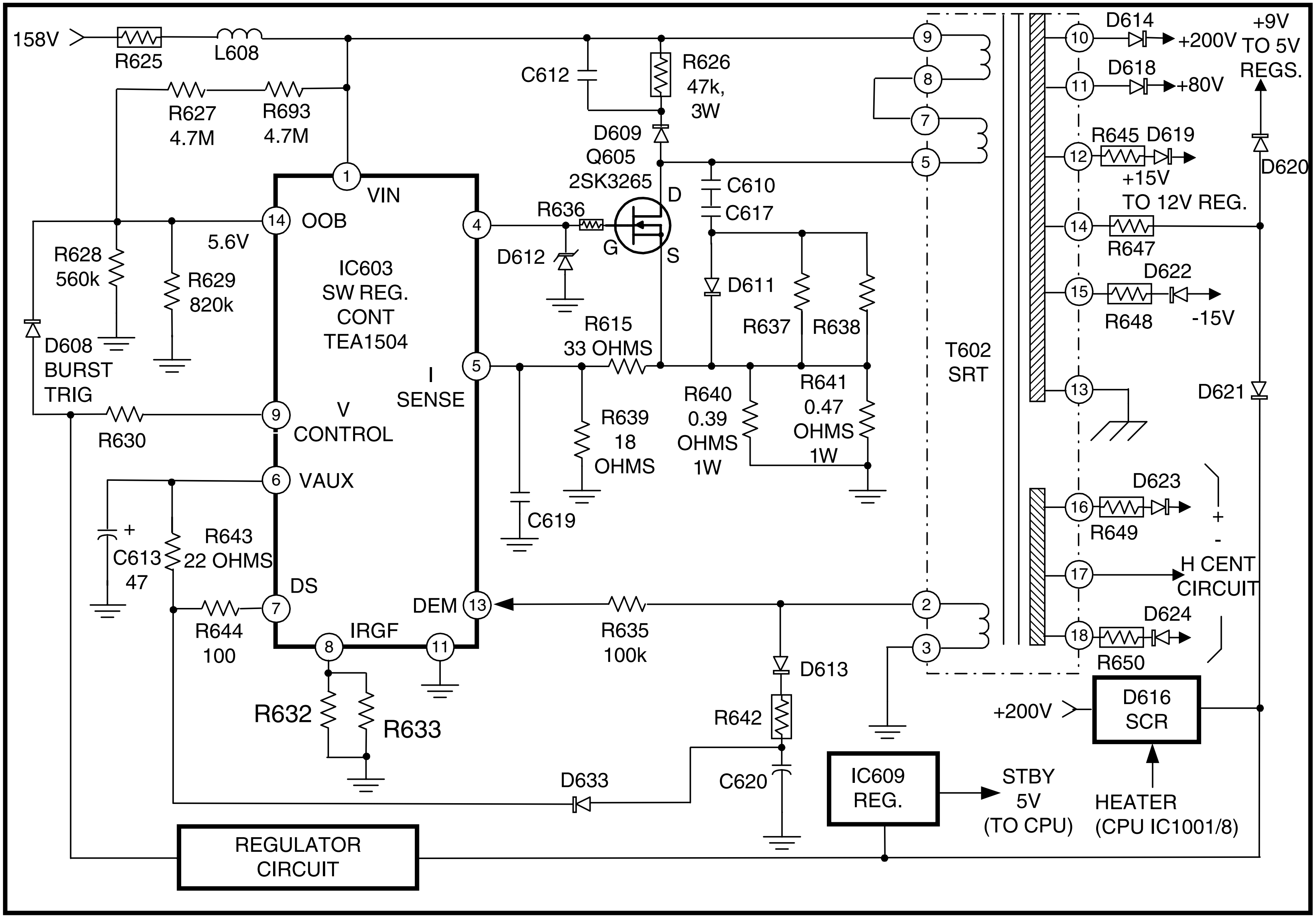
Switching Oscillator Part Functions

Power Supply Parts Functions		
Defective Parts	Purpose of Parts	Possible symptoms
D609, C612,	Q605 Protection	Immediate Q605 failure
C610, C617, D611, C619.	Q605 Protection	Intermittent Q605 failure
R640, R641	Q605 Protection	Power supply oscillator stops
R630 open (no error signal),	Error detection circuit	Power supply cycles between Normal and Active Off Modes.
R632, R633	Oscillator frequencies off	Blooming, Q605 gets too hot.
D612 (18V zener)	IC603 protection	Monitor dead, Repeated failure of IC603 and Q605.
D613, R642, D633	Powers IC603	Oscillator at IC603/pin 4 starts for a few cycles and stops.
Standby 5Vregulator for CPU.	CPU power	Monitor momentarily powers up, then enters the Active Off mode.
R693, R627	Oscillator Starting	Monitor dead.



SWITCHING OSCILLATOR

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Low Voltage Regulating Circuit

Although the switching power supply oscillator runs while there is voltage at Vaux (IC603/pin 6), the power supply stage will not maintain the correct output voltage without the following:

- T602 Feedback (DEM into IC603/pin 13) for low or over voltage protection
- The Regulator Circuit (from D621 to V Ctrl @ IC603/pin 9) for voltage stability

T602 Feedback

The DEM p-p feedback (fdbk) voltage from the Sine Resonate Transformer (SRT) T602 is used in the Normal Power Mode for protection. A peak voltage above or below limits will change the oscillator to lower T602's output voltage for safety.

Low Voltage

A severe short at a T602 secondary will drastically lower the DEM feedback voltage. For example, if this DEM feedback voltage were removed or shorted at IC603/pin 13, the following output voltages would reduce to these new levels: +200V ⇨ +145V, +80V ⇨ +56V, 8V ⇨ +6V.

High Voltage

If the +200V output voltage rose to 220V, the oscillator would be momentarily inhibited. The oscillator would start and stop, causing the CPU voltage and green LED to also start and stop.

The Regulator Circuit

The regulator circuit has three major parts:

- IC607 – Optical Isolator IC transfers correction voltage from the cold ground side to the oscillator's hot ground side.
- Q609 – Used to regulate the oscillator during the Active Off (Burst) Mode so the standby regulator IC609 can produce standby +5V.
- IC608 – Samples the +200 V B+ from T602 for voltage regulation in all power modes except Active Off.

The regulator operates differently in:

- The Normal, Standby, Suspended modes; and
- The Active Off (Burst) Power Mode.

Regulator Operation - Normal Mode

Regulation is performed by predominately IC608 in the normal, standby and suspended power modes. The voltage from a secondary winding of T602 at D621 is used for regulation. This sample voltage is reduced by resistor string R676, R681 and R682, then applied to IC608. IC608 (TL1431) is a error regulator IC designed to shunt (lower) its output voltage to ground until its input voltage returns to 2.5V. Capacitors C642, C641 and resistor R679 are used to slow the response time of shunt regulator IC608 and prevent oscillation.

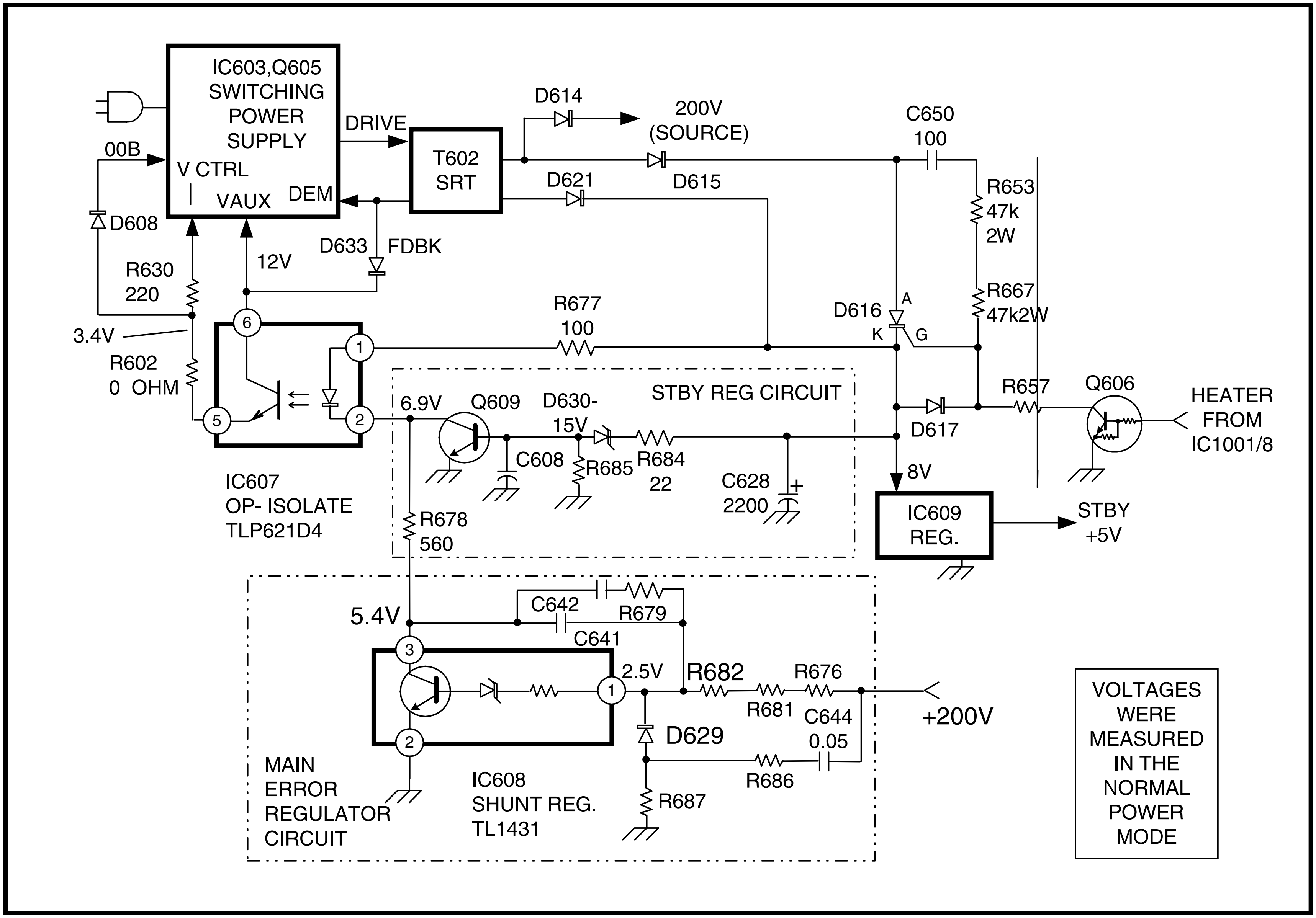
The output voltage from shunt regulator IC608/pin 3 is input to optical isolator IC607/pin 2. IC607 not only inverts the signal, but also provides electrical isolation between the input and output signal. Finally, IC607's output at pin 5 is applied to the switching power supply to adjust the pulse width of the oscillator signal for secondary voltage correction.

If the output of transformer T602 increases, the final correction voltage fed back to the power supply oscillator at V Ctrl will also increase. This is shown in the chart below. In the power supply, as the V Ctrl voltage increases, the oscillator conduction time decreases. This decrease lowers the energy from T602's secondary windings, returning the voltage to normal.

Regulation Correction Path Normal Mode			
Power Supply Output (D621/C)	Shunt Reg. Input (IC608/pin 1)	Shunt Reg. Output (IC608/pin 3)	Opto-Isolator Output IC607/pin 5)
Increases ⇑	Increases ⇑	Decreases ⇓	Increases ⇑

Regulator Defect - Open Circuit

An open circuit in this regulation loop will cause 0V at V Ctrl. The switching power supply will then generate excessive voltage. The larger feedback voltage from T602 into the switching power supply (DEM) will shut off the power supply momentarily. This occurs when the +200V line reaches about +220V. When the voltage drops to about +180V, the oscillator will start again only to be shut off when it reaches +220V. The resultant power supply and front panel green LED will start and stop in unison at about 2 Hz.



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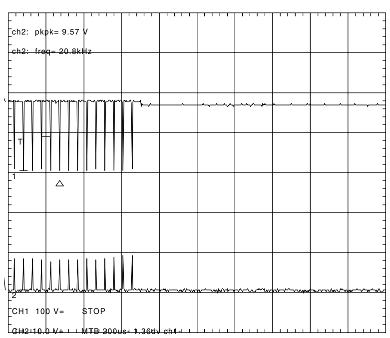
Regulator Operation - Active Off Mode

In the active off mode, only the standby 5V is operational. Q609, IC607 and IC609 are used to maintain standby 5V for the CPU. CPU IC1001 activates the Active Off reduced power mode when both horizontal and vertical sync inputs are missing (computer OFF). The CPU (IC1001/pin 8 = LOW) turns OFF the CRT heater and Q606 after the loss is detected. The path used to enter the Active Off Mode and for Standby 5V regulation are the same:

1. One minute after turn ON, if the CPU IC1001 does not detect H and V sync, IC1001/pin 8 goes LOW. Both the heater regulator IC610 (not shown) and Q606 are turned OFF.
2. With Q606 Off, D616's gate is no longer grounded (enabled).
3. Pulses from D615 pass through C650, R653 and R664 to the gate of D616, turning this SCR ON.
4. When D616 turns ON, the +200V line is connected to the 8V line at D621/Cathode. C628 on the 8V line charges.
5. When the 8V line rises to about 15.6V zener D630, Q608 and IC607 all turn ON. This causes the switching power supply input at V Ctrl to be HIGH.
6. The prolonged HIGH that is applied to the switching oscillator at V Ctrl first reduces the oscillator's ON time (in an attempt to lower the output voltage) and then finally shuts off the oscillator as it enters the Active Off or Burst Mode.
7. In the Active Off / Burst Mode, the oscillator is turned on in groups appearing as bursts every 0.6 seconds. This burst will provide a small amount of power to supply the CPU but not the remainder of the monitor circuits.

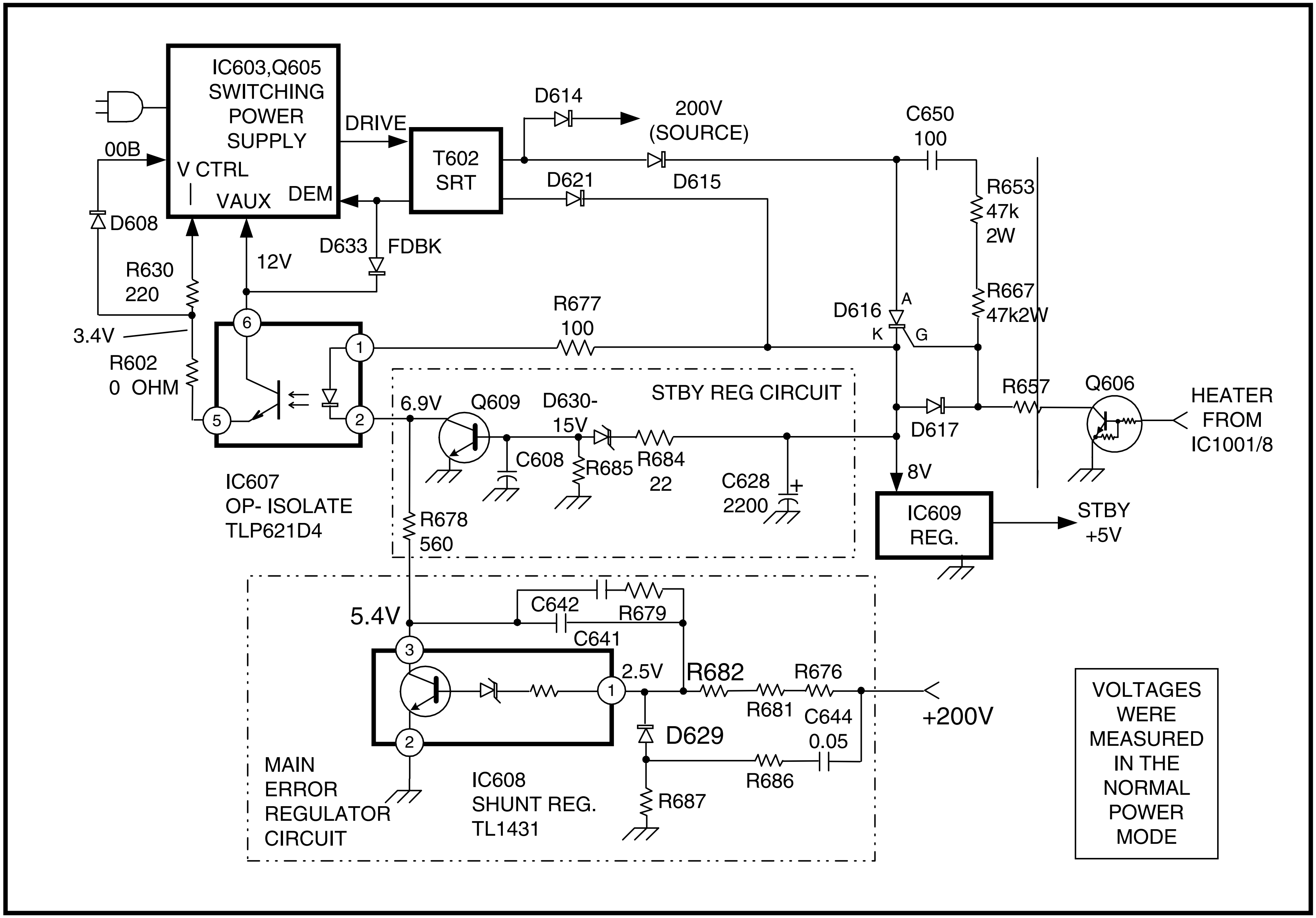


One Oscillator Burst			
	Name	Location	Voltage
Channel 1	Amplified Osc	Q605/D	180Vp-p
Channel 2	Oscillator Output	IC603/pin 4	11Vp-p
Time base	200usec/div		

8. In this Active Off/ Burst Mode, the voltage to standby regulator IC609 must still be regulated or it will become excessive (about 40V). Q609 performs the regulation for the standby 5V. Because the D616 SCR is still turned ON, the input voltage from D621 is increasing but in bursts. When the input voltage at D621/C reaches about 15.6V, zener D630 conducts turning on Q609.
9. Q609 turns on IC607, which outputs an oscillator correction voltage directly proportional to the input voltage from D621/C. The correction voltage corrects the pulse width of the burst signal to keep the average voltage at D621/C at about 12V in the Active Off / Burst Mode.

Measured Voltages

Measured Voltages			
Location	Function	Normal Mode	Active Off Mode
IC607/pin 1	Supply voltage (input)	8.1V	13.3-13.4V
IC607/pin 2	Input	6.9V	12.5-12.7V
IC607/pin 5 hot ground	Output	3.4V	0.18-0.21V
IC607/pin 6 hot ground	Supply voltage (output)	12.5V	9.3-9.5V
Q609/Base	Input	0V	0.1
Q609/Collector	Output	6.9V	12.5-12.7V
IC608/pin 1	Input	2.48V	0.2
IC608/pin 3	Output	5.39V	12.5-12.7V
D616/Anode	+200 B+	199.4V	15.9-16V
D616/Gate	Burst Mode trigger	8.86V	13.2-13.4
D616/Cathode	Regulator input	9.53V	13.4-13.5V



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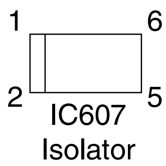
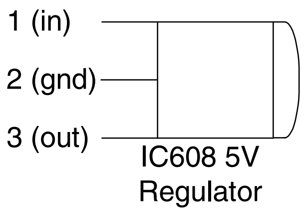
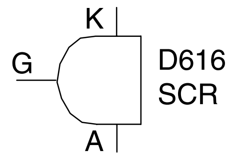
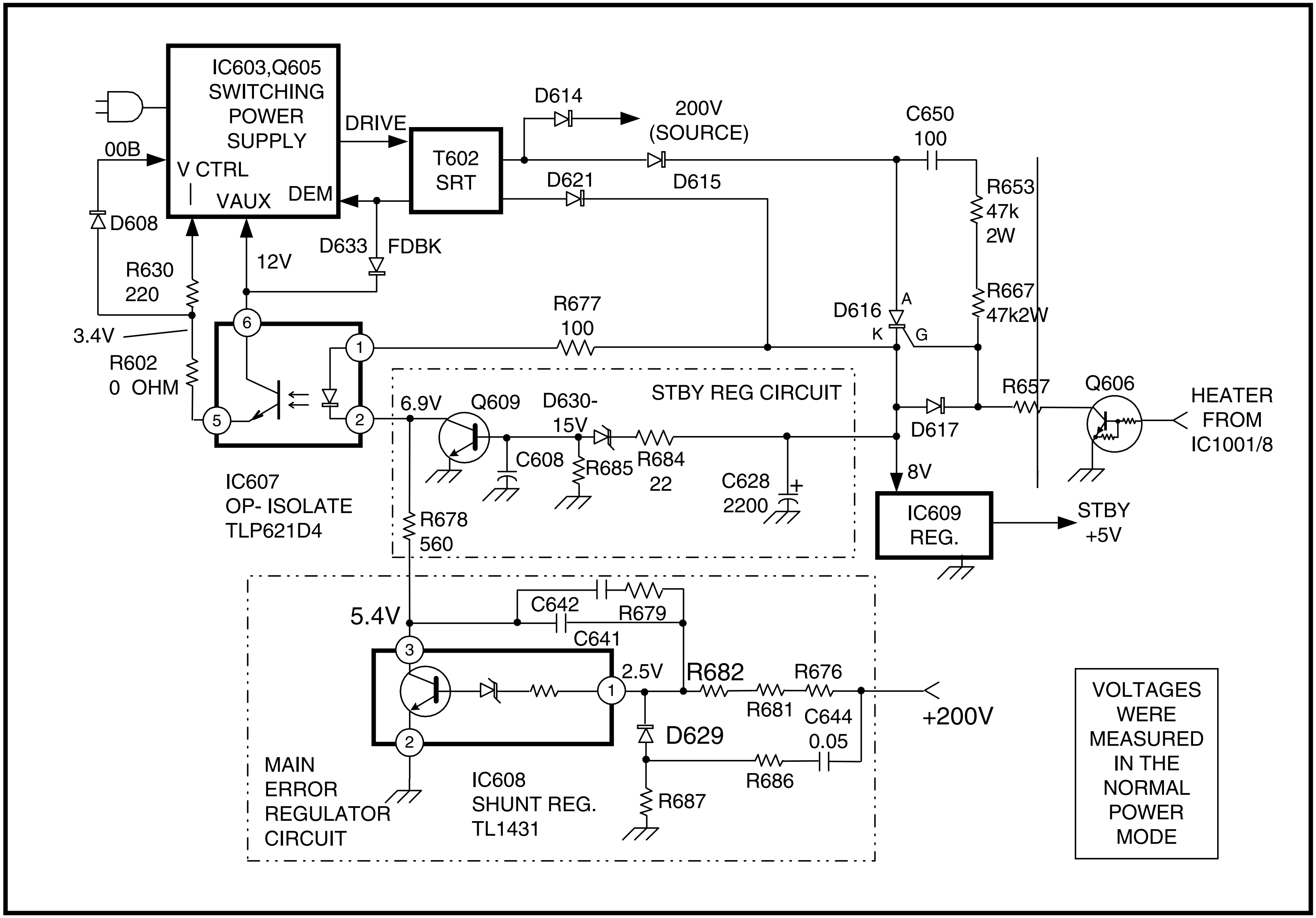






Simulated Defects and Symptoms

Simulated Defects		
Symptoms	Cause	Troubleshooting
Picture is dim or dark. All LV PS voltages are low (+200V = 145V)	1. Short or excessive load in T602 s secondary winding. 2. No DEM feedback voltage to PS oscillator.	Measure all secondary voltages. The one that is very low is being loaded down. If they are all proportionally low, IC603/pin 13 (DEM) is not getting feedback signal.
Green LED flashes. PS oscillator chirps as it powers up and shuts down.	Power Supply voltages are high. The regulation loop is open.	Test D616 for shorts and disable if good by shorting G-K. Measure voltages in Regulation Correction Path chart to see what voltage does not change while the oscillator is chirping.
Green LED is ON. Only the standby voltage is present.	CPU is functioning in the Normal Power Mode but the power supply is in the Active Off Mode.	Test D616 (short) and Q606 (open) or pull D616 out of circuit to see if the Normal mode is possible. Measure D621/C voltage. 8V is normal. Higher voltages means Q609 or D616 is shorted. Lower voltage means D630 is shorted.
Even without the video cable connected, the monitor stays in the Normal Mode (does not go into the Active Off Mode).	There could be noise detected by the CPU and mistaken for sync. The Active Off trigger circuit is not responding.	If the Orange LED lights after one minute, the CPU senses no sync and it is responding normally. The problem is in the Active Off trigger circuitry about Q606, D616 and D617.
Repeated Stby 5V IC609 regulator failure. Input measures 40V instead of 12V in the Active Off Mode.	Standby regulator input voltage is not being regulated. Q609 and D630 are suspect.	Original IC609 was open. A replacement IC609 gets hot before failing.



L.V. REGULATOR CIRCUIT

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Video Block

The Video Processing Block contains several stages:

- RGB signal processing from the computer to the CRT cathodes
- OSD for Menu features
- CRT Bias

RGB Signal Process

Two computers can be connected to the CPD-G400 monitor. A front panel switch selects the input used. The switch signal is applied to IC008, which selects the RGB signal. The input switch is also connected to IC009 to simultaneously select the sync. The selected horizontal and vertical sync signals are used to lock the oscillator inside CPU IC001.

The RGB signal is amplified by RGB Pre-amplifier IC001 and will output this IC unless the alternate OSD signal containing menu information is switched in. The Input/OSD switch is controlled by IC003's Blk signal.

IC002 amplifies the input or/and OSD input to a high level to drive the CRT cathodes.

OSD

The OSD IC003 makes the menu characters, white screen (for the Aging Mode and the Image Restoration feature) and translates the analog cathode current levels (Ik) into digital data for CPU IC1001.

IC003 needs serial data, clock and the H & V oscillator inputs to support the RGB and Blk outputs. These two outputs are used to make a menu display or white screen. The Ik input is used when the image restoration feature is activated from the menu. The Ik voltages are then sent out as data to the CPU for computation.

CRT Bias

Memory IC1005 stores the CRT bias parameters. They are loaded into the CPU when the CPU is reset at the time the power switch is pressed. G2 and cathode DC threshold (background/cutoff) voltage data are sent along the IIC bus into RGB Preamp IC001. IC001 translates the data into analog voltages to make G2 and background voltages for the CRT. Additional G2 and background driver ICs are needed to make the high voltages necessary. Adjustments to this data are made using an external computer using DAS software.

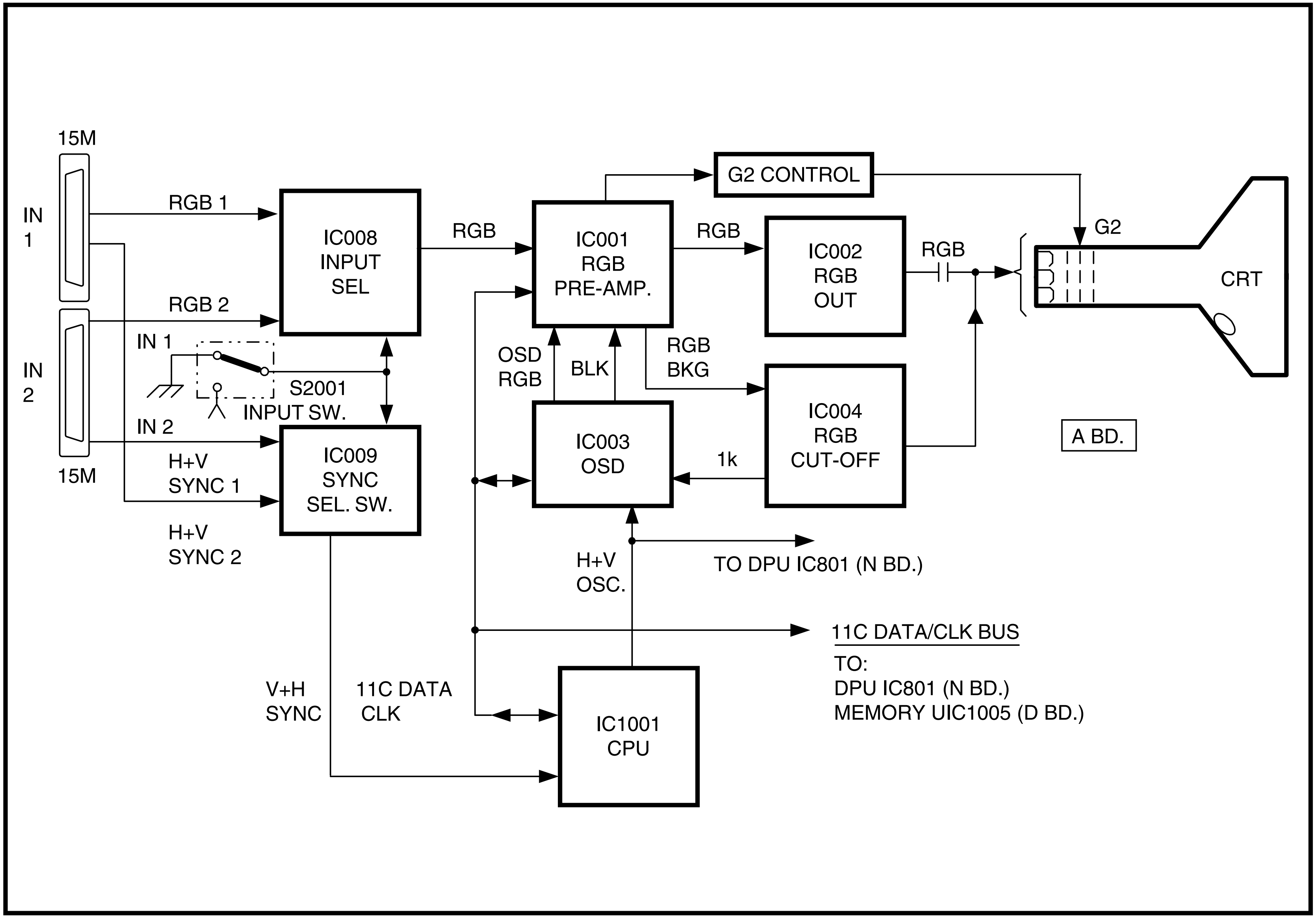
Troubleshooting

Dark screen - Even if RGB video is input, the monitor the signal can be inhibited at several ICs along the path:

RGB Signal Inhibited causing a Dark Screen		
Blockage Location	Reason for blockage	Check for
IC008 Input Switch	Input not selected.	Slide front panel input switch to correct position
IC001 RGB Preamp	CPU detects no input sync. No IIC data input IC003. IC003 Blanking output line held HIGH	Blk signal from IC003. LOW = Normal. HIGH = OSD/blk interval. Data/Clk from CPU to OSD IC003. H & V sync input CPU.
IC002 RGB Output	+80V B+ missing.	Check for +80V from LV power supply.
CRT	No G2 voltage. Cutoff voltage set too high.	G2 voltage from FBT. IC004 in and out voltages. IC001 Bkg output voltages.

No Menu Messages

No OSD or White Screen in the Aging Mode		
Location	Reason	Check for
IC003 OSD	Blk output held HIGH No H or V input No Data or Clock	OSD RGB output from IC003 when Blk is HIGH. H & V sync, data and clock input.
IC1001 CPU	No H or V osc output No Data or Clock out	H & V oscillator, data and clock input.



VIDEO BLOCK

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Input

Input/Output Signals

This monitor can be connected to two computers. A front panel switch selects input 1 or input 2. Each input is identical except for the Plug and Play communications. Input 2 only sends unidirectional plug and play monitor information to the computer (DDC1 format). Input 1 has bi-directional Plug and Play communications (supporting DDC1, DDC2B, & DDC2Bi formats). An explanation of Plug and Play can be found in the appendix of this book.

The signals at the two inputs can be summarized in these charts:

Input 1				
Inputs from computer	RGB video signal	Horizontal Sync	Vertical Sync	Sync on Green
Outputs to computer	Plug and Play DDC1, Unidirectional data or DDC2B / DDC2Bi Bi-directional data. If the CPU receives the appropriate DDC commands, it will operate in the bi-directional mode. Otherwise it will assume the DDC1 read only mode when triggered by vertical sync.			

Input 2				
Inputs from computer	RGB video signal	Horizontal Sync	Vertical Sync	Sync on Green
Outputs to computer	Plug and Play DDC1, Unidirectional data from the monitor. DDC1 data is only output when Vertical Sync is received.			

Signal Levels

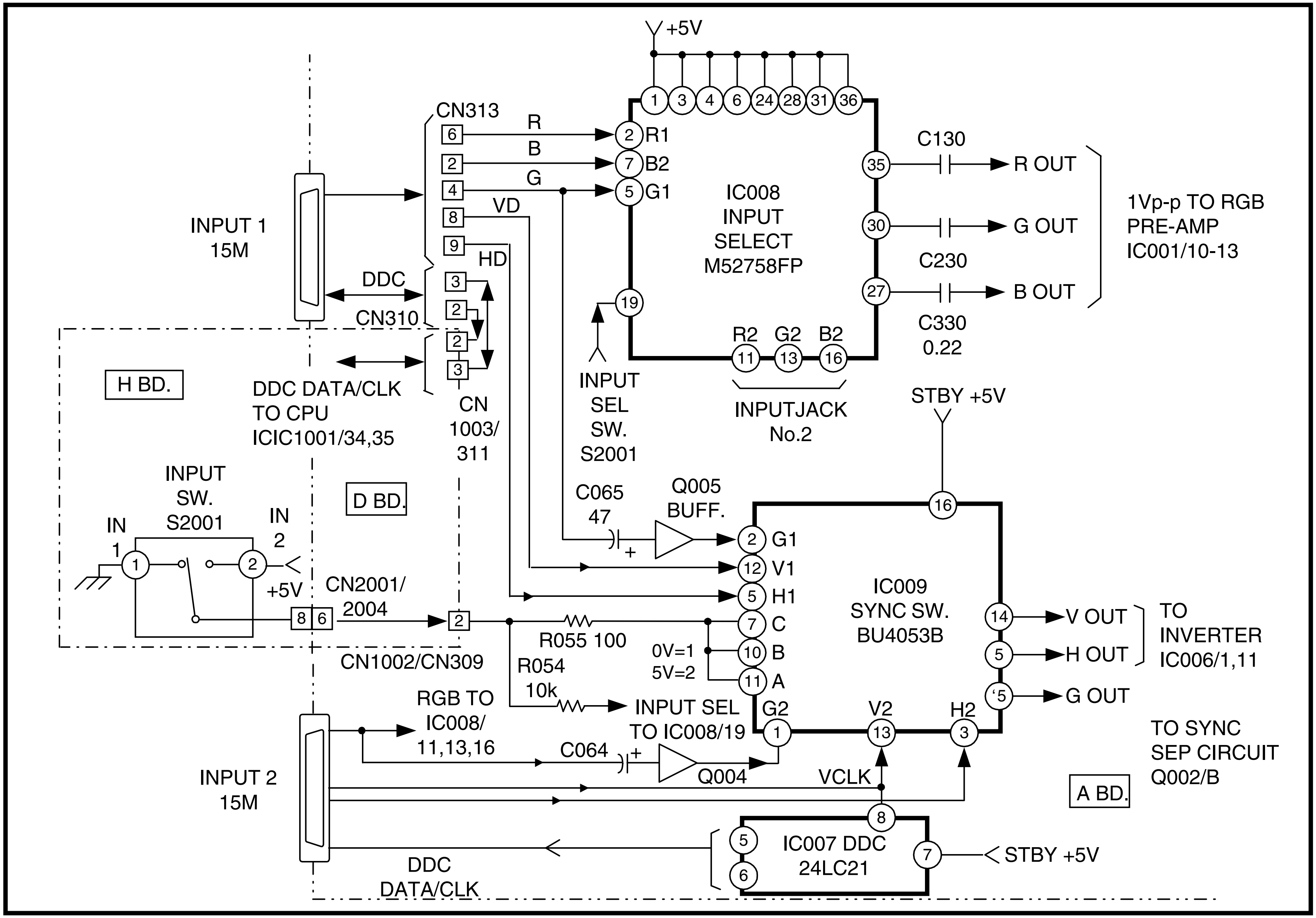
For signal tracing, the signal levels in this stage are shown in the charts for each IC. IC008 and IC009 are used to select one of two RGB and sync inputs the monitor will use. The S2001 input switch is located under the bezel and its voltage is applied to both ICs.

IC007 contains Plug and Play information about the monitor's resolution and sync speeds. This information is sent to the computer so the computer will only choose a sync speed the monitor can support (no loss of sync when entering a software program).

Input Select Switch IC008				
Name	Input		Output	
	Location	Level	Location	Level
RGB input 1	Pins 2, 5, 7	1Vp-p	Pins 27, 30, 35	1Vp-p
RGB input 2	Pins 11, 13, 16	1Vp-p		
Input Sw	Pin 19	Low = input 1 High = input 2		

Sync Switch IC009				
Name	Input		Output	
	Location	Level	Location	Level
Horiz & Vert Sync input 1	Pins 5, 12.	4p-p	Pins 5, 14	45Vp-p
Horiz & Vert Sync input 2	Pins 3, 13.	4Vp-p		
Sync on Green Input 1	Pin 2	4p-p	Pin 15	4Vp-p
Sync on Green Input 2	Pin 1	4Vp-p		
Input Sw	Pins 7, 10, 11	Low = input 1 High = input 2		

DDC1 IC007			
Name	Location	Signal Level	Comments
V Clock	Pin 7	4p-p	Input sync
DDC Data	Pin 5	4.5Vp-p	Output when V clock is input
DDC Clk	Pin 6	5Vp-p	Only input when timing is needed.



INPUT

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Video Output

Overview

The video output stage consists of several ICs that:

- Amplify the computer RGB signal; and
- Provide CRT bias to display the RGB signal.

Two features result in additional usage of ICs in this video output stage:

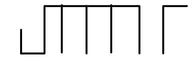
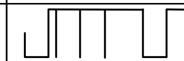
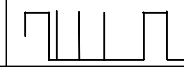
- An onscreen messages (CPU IC1001, OSD IC003, and RGB Preamp IC001)
- Image Restoration (CPU IC1001, Cutoff Control IC004, OSD IC003, and RGB Preamp IC001)

RGB Amplification

RGB Signal

The RGB signal from the computer is amplified by two ICs before being capacitor coupled to the three cathodes of the CRT. RGB Preamp IC001/ pins10-12 receives the computer RGB signal selected from inputs 1 or 2. IC001 amplifies the 1Vp-p signal input to 4Vp-p output at pins 20, 23, and 27 respectively. IC001 also serves to switch to the OSD signal input pins 13-15 and use serial data input pins 3-4 to control the G2 voltage from pin 29.

The 4Vp-p RGB output IC001/pins 20, 23, and 27 are sent to second amp IC002. The sole function of this IC is to increase the 4Vp-p input to about 56Vp-p output at pins 1, 3, and 5, using +80V from the low voltage supply. IC002 is protected from CRT voltage spikes due to internal arcing by diodes D104 and D105. Similar diodes protect the G & B outputs at IC002/ pins 1 and 2, but they are not shown for simplicity. The 56Vp-p RGB signal is capacitor coupled to the CRT cathodes.

RGB Signal Path Signal input from computer			
Location	DC	AC	Wave Shape
IC001/pins 10-12	1.9V	1Vp-p	
IC002/pins 8, 9 & 11.	2.8V	4Vp-p	
IC002/pins 1, 3 & 5.	43V	56Vp-p	

Aging Signal

The aging mode is used to warm up the monitor prior to adjustments. In this warm up mode, the screen is bright and the front panel LED alternates between green and orange. The Aging Mode is entered when there is no computer signal input to the monitor and the control button is moved to the left and held for two seconds. When the CPU detects no sync input and the control button was held left, the Active Off Mode is suspended and the Aging Mode begins. CPU IC1001 sends data and clock to the instruct OSD IC003/pins 3 and 4 to generate a white screen.

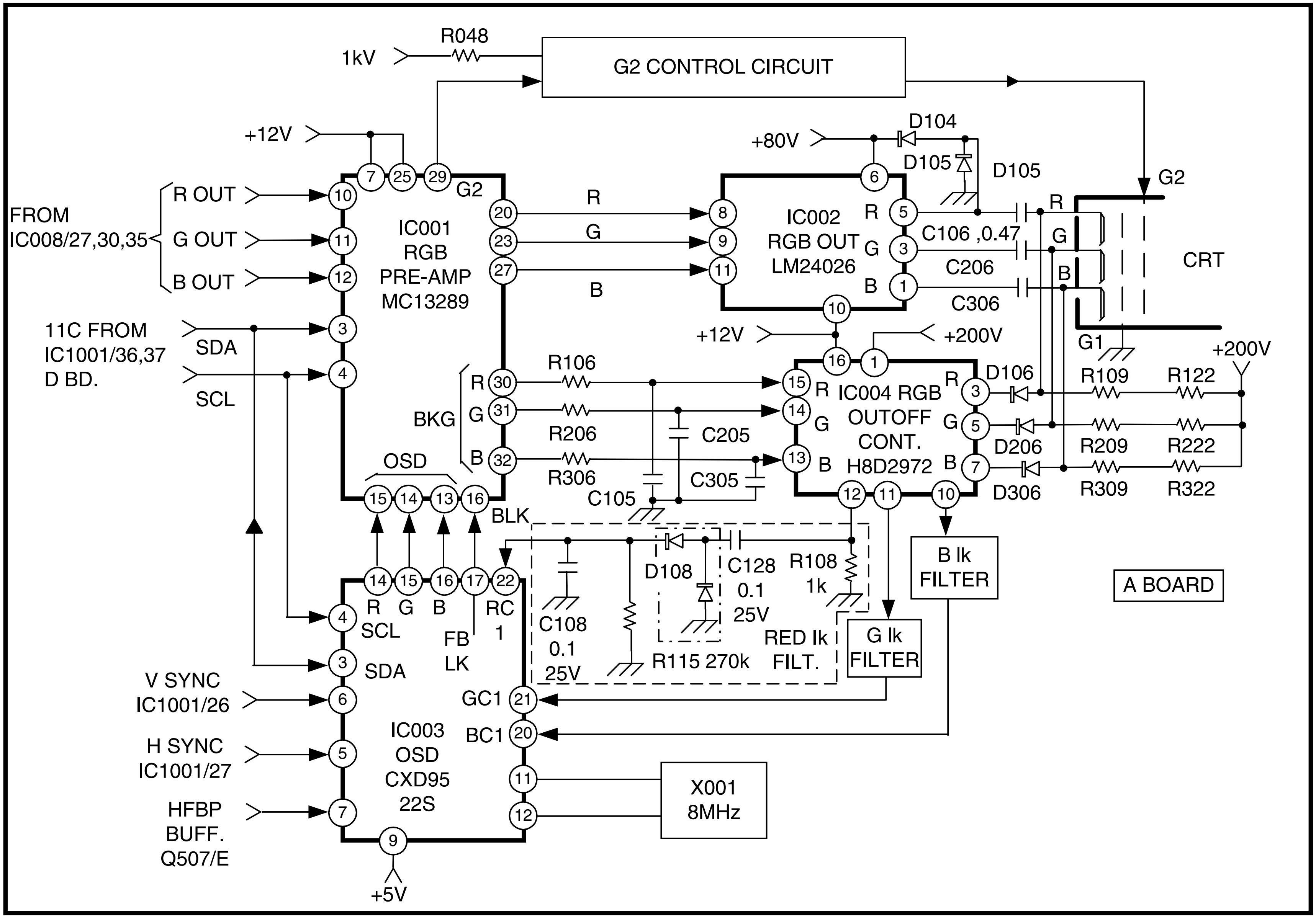
The white screen aging signal leaves as pulses from the RGB outputs at IC003/pins 14-16. They are accompanied by blanking signal of the same polarity at IC003/pin.

Aging Signal Output		
Name	Location	Wave Shape
OSD/Aging signal	IC003/pin 14-16	 bright
FBlk (switching/unblanking)	IC003/pin 17	

The RGB Preamp IC001 serves as an RGB preamp and a switch. The blanking signal goes HIGH to disable the RGB signal and enable the OSD signal from IC001/pins 13-15.

CRT Bias

Even though there may be signal at the RGB cathodes, the signal will appear very dark unless the CRT is biased properly. IC001 and IC004 set the cathode and G2 bias voltages for the CRT. At power ON, pertinate data stored in memory IC005 (not shown) is selected by the CPU and sent to RGB Preamp IC001.



VIDEO OUTPUT

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Part of IC001 serves as a D/A converter. The data from CPU IC1001/pin 26 is input IC001 to make the analog (background) cathode bias voltages and the G2 voltage. DC background voltages leaving IC001/pins 30-32 will correspond directly to the CRT cut off voltages. IC004 amplifies the analog background voltages from IC001 and applies them to the three diodes. Diodes D106, D206, D306 and associated pull up resistors (e.g. R109, R122) establish the cut off voltage threshold for the CRT cathodes at about 110V in this monitor. The RGB signal capacitor coupled to the cathodes reduces the DC cutoff voltage to brighten the screen with information/lettering.

Sample Background Control Voltages Aging Mode *			
Location	DC Voltage		
IC001/pins 3, 4	5V + data and clock is present all the time except when the unit is Off or in the Active Off Mode.		
IC001/pins 30-32	3.8V	3.7V	3.2V
IC004/pins 15, 14 & 13.	4.77V	4.7V	4.5V
IC004/pins 3, 5 & 7.	111V	110V	101V
CRT cathodes RGB.	80V	80V	80V

* The Aging Mode is set by unplugging the monitor's video input, turning the monitor ON, and holding the control button to the left. The screen will be all white while the front panel LEDs blink green/orange.

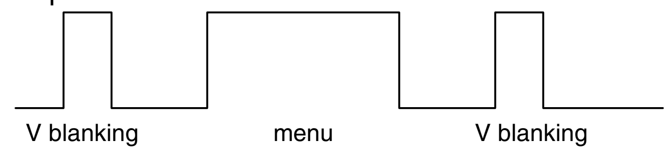
RGB Preamp IC001 also serves to make the G2 voltage. Data from the CPU IC1001 is translated into a DC voltage to represent the G2 voltage that leaves IC001/pin 29. This voltage is directly proportional to the final G2 voltage applied to the CRT G2 grid.

On Screen Message Display

OSD IC003 generates the monitor's on-screen display graphics and the white screens used in the imager restoration and aging modes. When the CPU IC1001 (not shown) detects a front panel control button menu entry, IIC (I^2C) serial data and clock signal is applied to OSD IC003/pins 3 and 4. IC003 generates the requested color menu signal that leaves the RGB signal from pins 14-15. This OSD signal is accompanied by switching signal Fblk from IC003/pin 17.

The OSD signal replaces the RGB video signal using the switch inside RGB Preamp IC001. The switch is controlled by the Fblk signal from IC003/pin 17. Normally without an OSD, the switching voltage input IC001/pin 16 is HIGH, permitting this IC to pass the normal RGB signal form the computer.

When the monitor menu is requested, the menu appears in the middle of the screen. The Fblk signal goes HIGH at this interval to switch the computer RGB signal out of the video signal path and insert the OSD signal into the video path.



The horizontal blanking interval is also provided by this Fblk signal in all modes of operation when the monitor has deflection. H & V deflection sync is necessary for IC003 to place an OSD message on the screen. If either sync signal pulse were missing, there would be no OSD and the picture width would not be at the right place.

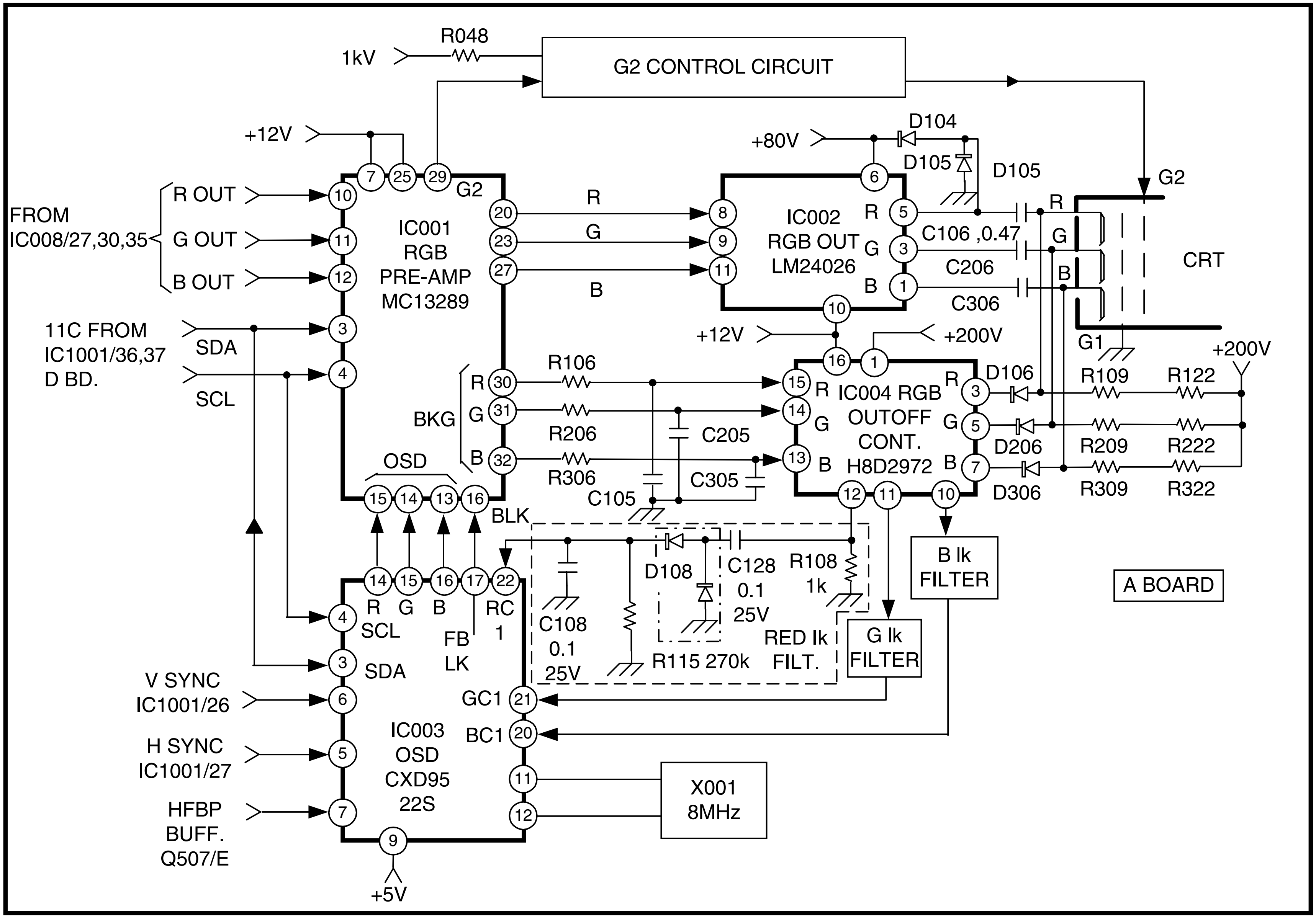
Image Restoration

This user feature can be menu (manually) activated after the monitor's green LED is ON for at least 30 minutes. The purpose of the image restoration feature is to detect the present cathode efficiency and increase the RGB drive signal to return the CRT to the same brightness level when new. This compensates for reduced CRT cathode efficiency due to aging. Image restoration operation occurs in three steps:

- White screen implementation
- CRT Cathode current Measurement
- Drive level balancing

<u>White screen</u>

When image restoration is activated, the screen is turned white using the OSD IC003 output that is inserted into the video signal path. CPU IC1001 sends data to IC003 to create the full white screen for a few seconds during the operation. IC003 inserts the white screen information into the IC001-IC002-CRT video signal path. This white video signal should represent peak white. Meanwhile the R, G and B cathode current is monitored by IC004.



VIDEO OUTPUT

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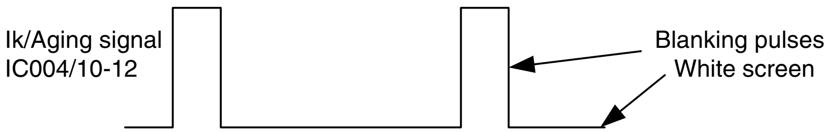
CRT Cathode current Measurement

All CRT cathode current must flow through IC004. A sample of this current is represented by a signal at IC004/pins 10-12. Although this signal consists mostly of a DC voltage that corresponds to a white screen, the addition of a blanking pulse makes this an AC signal.



Each cathode's signal is rectified and the corresponding DC voltage is applied to IC003/pins 20-22.

Drive Level Balancing

During the Ik measurement mode, IC003 translates the Ik analog voltages that represent a white screen and sends them to CPU IC1001 one color at a time. The original Ik voltages were stored as data in memory when the monitor was new. The CPU compares the old and new Ik data. If they do not match, data is output the CPU into IC001. IC001 increases the R, G or B gain that correspondingly increases the Ik voltage from IC004. IC003 sends new Ik data to CPU IC1001 for a second comparison. The process repeats until the new and old Ik voltages in IC1001 match. The gain level is stored into memory and used every time the monitor is turned on. The procedure is then repeated for the other colors.

At the conclusion of image restoration, the CPU IC1001 sends IC003 data to discontinue the white screen and disregard the Ik voltages input pins 20-22.

Summary of Video IC Operations & Voltages

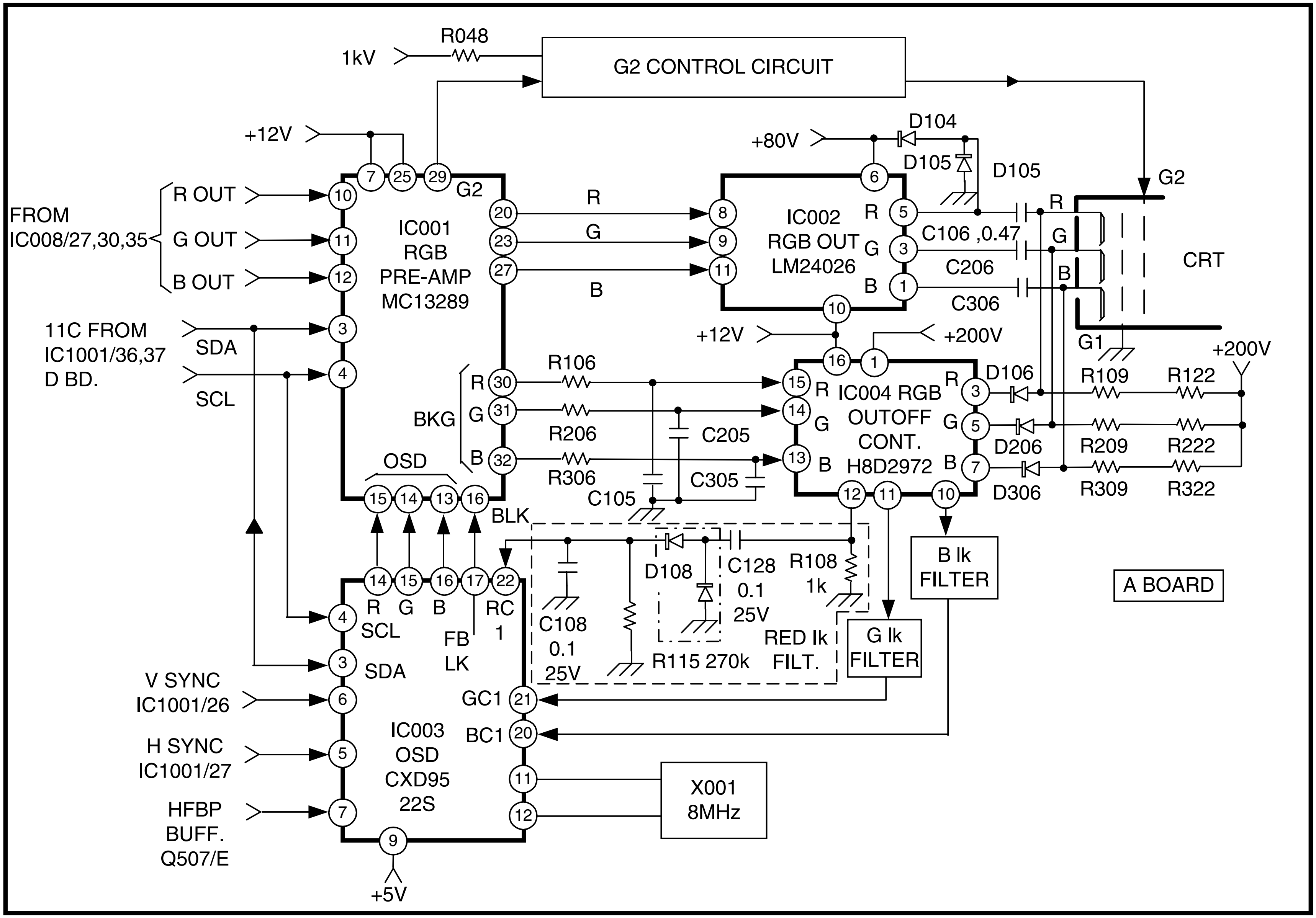
IC	Used In Modes	Function
RGB Preamp IC001	Normal Display OSD (Menu) Aging Ik image restore	RGB Preamplifier RGB/OSD switch Background Voltage D/A Conv G2 Voltage D/A Conv
Output IC002	Same as above	RGB Output voltage amplifier
OSD IC003	OSD (Menu) Aging Ik image restore	Makes menu, graphics and a white screen. Performs Ik image restore calculations. Horiz & Vert video Blanking
RGB Cutoff IC004	Normal Display OSD (Menu) Aging Ik image restore	Sets CRT cutoff voltage level Measures Ik cathode voltage

DC Voltages Aging Mode *				
Function	Location	Red *	Green	Blue
RGB signal Input to IC001	IC001/pins 10-12 (no signal is input in the aging mode)	1.9V	1.9V	1.9V
RGB signal Output from IC001	IC001/pins 20, 23, 27.	2.7V	2.7V	2.7V
RGB Background Output from IC001	IC001/pins 30-32 Background Out	3.8V	3.7V	3.2V
RGB Output from IC002	IC002/pins 5, 3, 7	43V	43V	43V
Background Input at IC004	IC004/pins 13-15	4.77V	4.7V	4.6V
Background Output from IC004	IC004/pins 3, 5, & 7.	111V	110V	101V
Ik Output from IC004	IC004/pins 10-12	0.35V*	0.507V	0.53V
Ik Input to IC003	IC003/pins 20-22	1V*	1.95V	2V
OSD Output from IC003	IC003/pins 14-16	0.16V	0.16V	0.16V

* The RED cathode was unsoldered for measurement comparisons. Red drive voltages are unaffected but Ik voltages are lower.

Troubleshooting

See the troubleshooting checklist in the appendix portion of this training manual.



VIDEO OUTPUT

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G2 Control

CRT Brightness

The CRT brightness is determined by:

- High Voltage
- Cathode Voltage
- G2 Voltage

The High Voltage is fixed and regulated by the HV regulating stage. The cathode voltage carries the RGB picture signal from the computer. This RGB signal arriving at the cathode varies from 20V (bright) to 200V (dark/cutoff). The G2 voltage is used to set the maximum brightness of the picture. This brightness (white level) is measured in degrees Kelvin and adjusted using the CATS software.

G2 Circuit

IC1005 – IC1001

The voltage at the G2 CRT grid is set with data stored in ROM IC1005. When the monitor is turned ON, CPU IC1001 using the IIC (I2C) bus retrieves this information (along with other data). When CPU IC1001 communicates with RGB Preamp IC001, the data pertaining to this IC is transmitted using the same IIC data and clock lines.

IC001 – IC005

Some of this transmitted data sets the G2 voltage. IC001 uses this data to make an analog voltage that outputs pin 29. This is applied to inverter Op-Amp IC005/pin 5. The output at pin 7 is applied to buffer Q001/emitter. The conduction of buffer Q001 reduces the voltage at the CRT G2 pin, reducing overall picture brightness.

Start Up Brightness Reduction

The G2 voltage is reduced slightly at power ON to provide a gradual picture brightness increase as the monitor warms up. When the monitor is first turned ON, a large capacity 470 mfd C095 charges slowly, keeping the base of Q006 initially LOW. This turns ON Q006, which slightly reduces the control voltage at IC005/pin 5. This voltage is applied to buffer Q001, producing alower G2 voltage. The slightly lower G2 voltage keeps the picture dimmer at turn ON.

When the monitor is turned ON from a cold start, the CRT filaments take a while to stabilize. As a result, the picture is not as bright as when they reach normal operating temperature and the monitor has stabilized. The "G2 start" circuit using Q6, increases the picture brightness slightly at power ON and then very gradually shuts itself OFF.

When the monitor is first turned ON, a large capacity 470-mfd C095 charges slowly, keeping the base of Q006 initially LOW. This turns ON Q006, which reduces the control voltage at IC005/pin 5. The LOW control voltage is applied to IC005, producing a slightly lower G2 voltage. The lower G2 voltage keeps the picture brighter at turn ON.

In about a half-hour after turn ON, C095 charges enough to turn Q006 OFF so Q006 is electrically removed from the G2 circuit. By then the CRT brightness has reached normal.

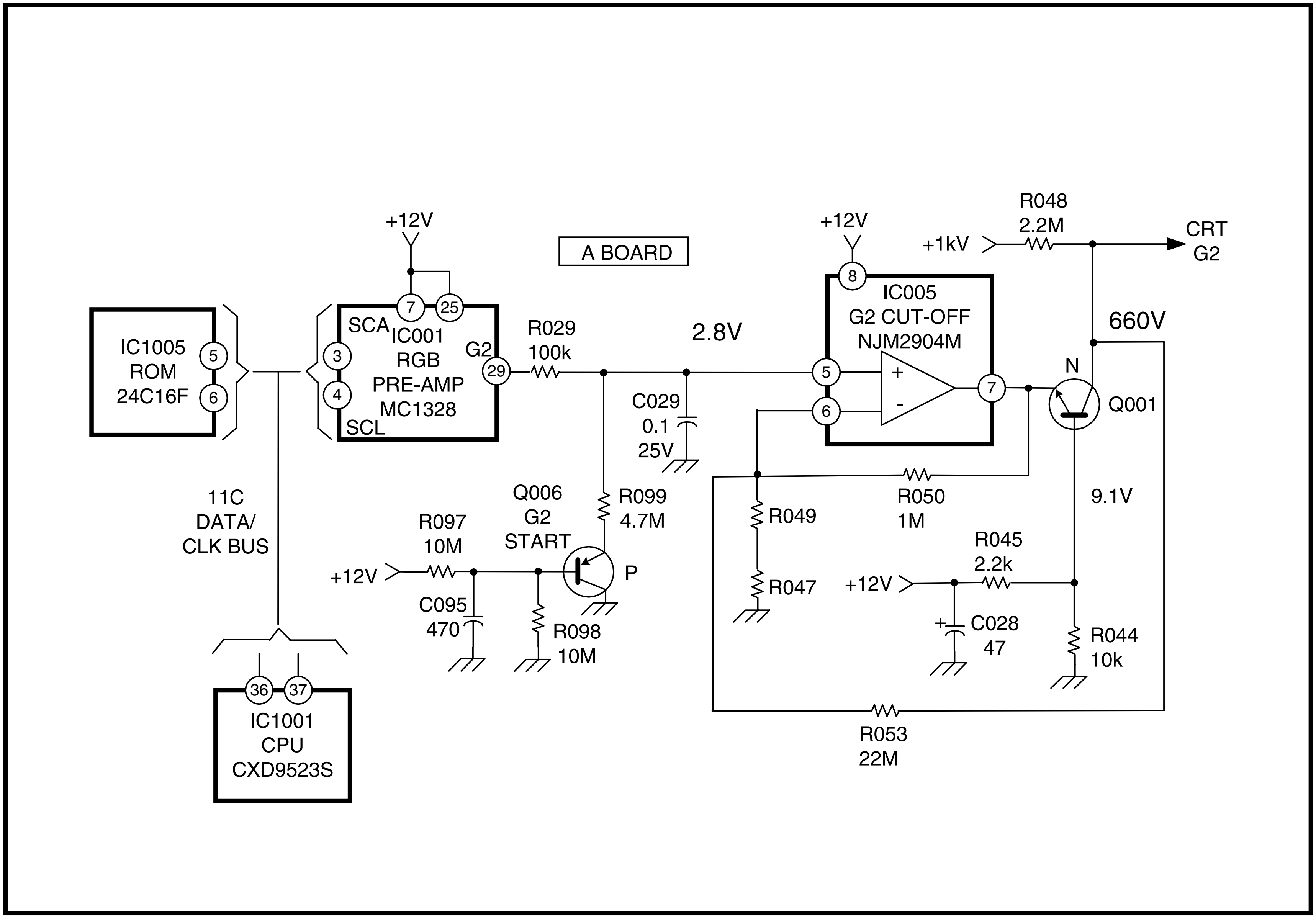
Circuit Voltages

Normal Operating Voltages at turn ON *		
Name	Location	Voltage
G2 Control	IC001/pin 29	2.38V
Inverter input	IC005/pin 5	2.74V
Inverter reference	IC005/pin 6	2.88V
Inverter Output	IC005/pin 7	8.46V
Buffer reference	Q001/base	8.46V
Buffer output / G2	Q001/collector	660V
Brightness reduction	Q006/base	0.35V
Reduction control	Q006/emitter	0.75V

* Voltages taken in the Aging Mode within 5 mins after turn On

Normal Operating Voltages after 1/2 hour in the Aging Mode		
Name	Location	Voltage
Buffer output / G2	Q001/collector	667V
Brightness increase	Q006/base	4.2V
Increase control	Q006/emitter	1.9V

G2 & Cathode Voltage when Blanked (no video input)		
Location	Normal	Pix Blanked
G2 CRT pin	667V	0V
R, G, or B cathode pin	80V	15V



G2 CONTROL

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Sync / Deflection Block

Several stages can be grouped together to provide the CRT with basic operating signals. These stages run independent of the video circuitry and are self-sustaining. The main stages in this block are:

Deflection Block	
Stages	Function
CPU IC1001	Horizontal & Vertical Oscillator, Protection circuit, Data control.
DPU IC801	• H & V waveform shaping for each monitor mode • Pincushion correction signal • Picture rotation • Dynamic Focus • Convergence signals
High Voltage	Generation and regulation.
Horizontal Deflection	CRT beam sweep left to right
Pincushion	Corrects for black left and right bowed areas
Vertical Defection	CRT beam sweep top to bottom

CPU IC1001 & DPU IC801

When the monitor is turned ON, the horizontal and vertical oscillators inside the CPU IC1001 produce an output. These oscillators run at default frequencies of 70kHz and 80Hz respectively until sync is input to change these two frequencies. The DPU IC801 shapes the horizontal signal into the correct pulse width (picture size) and the vertical signal into the correct ramp size and linearity.

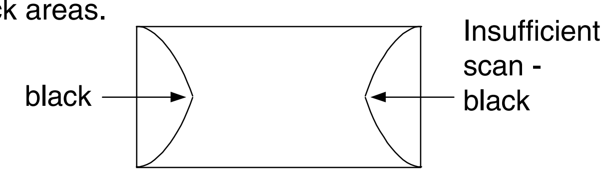
High Voltage

The HD signal from the DPU IC801 is used for horizontal sweep and high voltage generation. The HD signal is amplified and buffered in the drive stage (Q501-Q503) before being spit into two paths. The first path is into the High Voltage stage (IC901, Q901-2). This stage uses the horizontal signal to generate high voltage. The high voltage level is regulated using a sample of fly back (FBT T901) voltage. The fly back causes the remainder of the voltages for the CRT to operate. The CPU uses a sample of the HV voltage and ABL voltage (CRT current) from the FBT for protection. The CPU will latch the monitor into the low power mode when there is excessive voltage or current.

Horizontal Deflection & Pincushion

The Horizontal Output stage (Q504) uses the amplified HD signal to provide sufficient sweep to deflect the electron beam across the CRT screen. The CPU monitors the output in case of a sweep failure (protect) and enters the low power mode without a sweep signal.

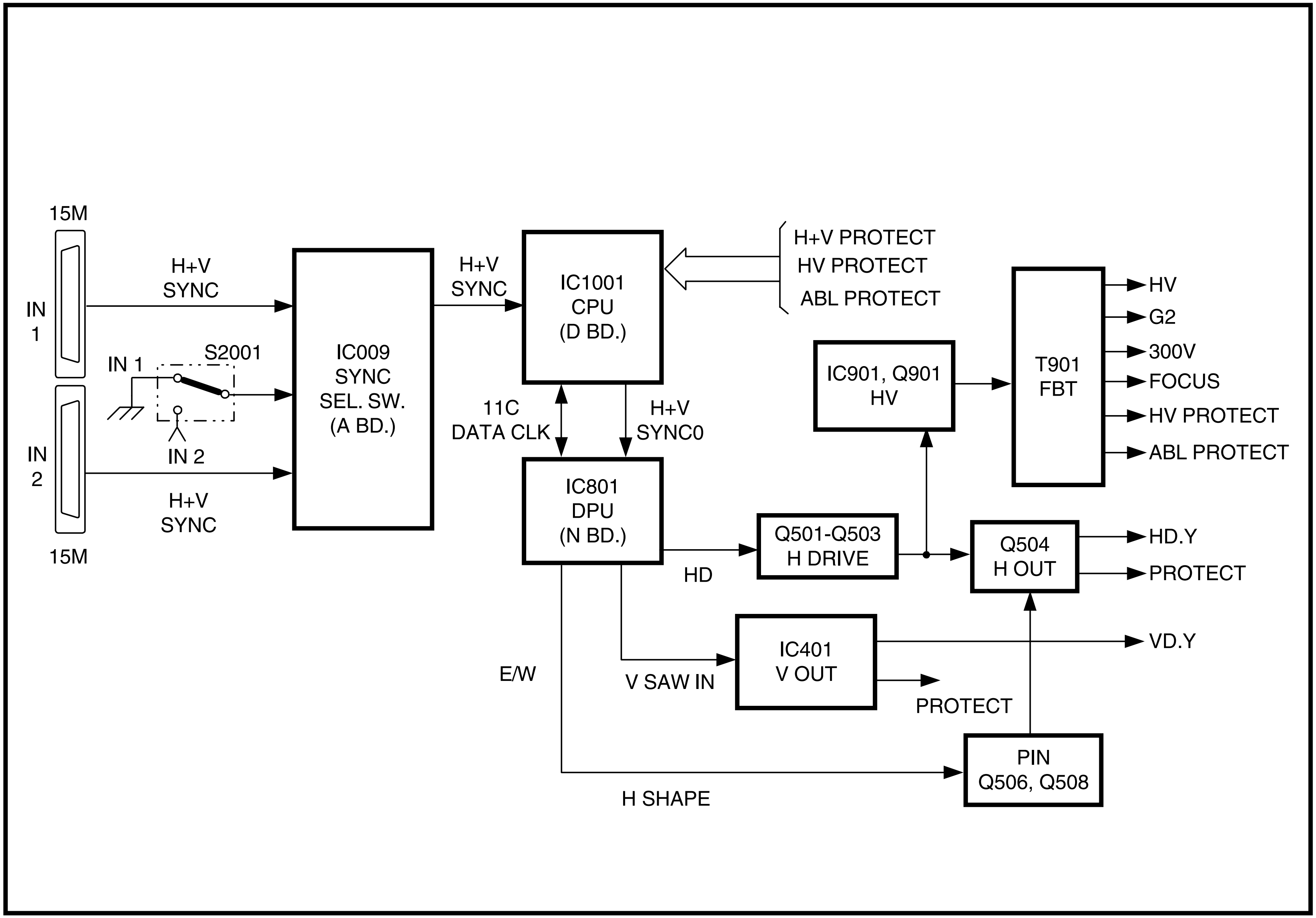
The H Shape signal from the DPU IC801 is used in the pincushion stage (IC501, Q506, Q508, Q509). This signal is also known as "E/W" (east/west) because it is used to correct the inability of tordial yokes to provide extra deflection at the middle of the picture. This is why early picture tubes were round. East and west were used to designate the black areas at the left and right sides of the screen that required correction. Extra sweep current from the pincushion stage is applied to the yoke to eliminate the black areas.



Pincushion Distortion

Vertical Deflection

The V Saw In signal from the DPU IC801 is used in the Vertical Output stage. This stage sweeps the CRT electron beam from top to bottom. The oscillator in the CPU (IC10101) controls the speed. The DPU (IC801 controls the vertical size and linearity by shaping the sawtooth signal that is output. IC401 has its own internal voltage generator to make extra voltage required during vertical retrace when the output voltage is double the main ramp voltage. A failure in this internal voltage generator will cause no deflection or poor linearity. A line will be burned into the CRT within a second during a vertical or horizontal deflection failure. For protection from a CRT line burn, the internal voltage generator pulse represents vertical output operation. The CPU monitors this signal and latches the monitor into the low power when there is a loss of the protect signal.



SYNC/DEFLECTION BLOCK

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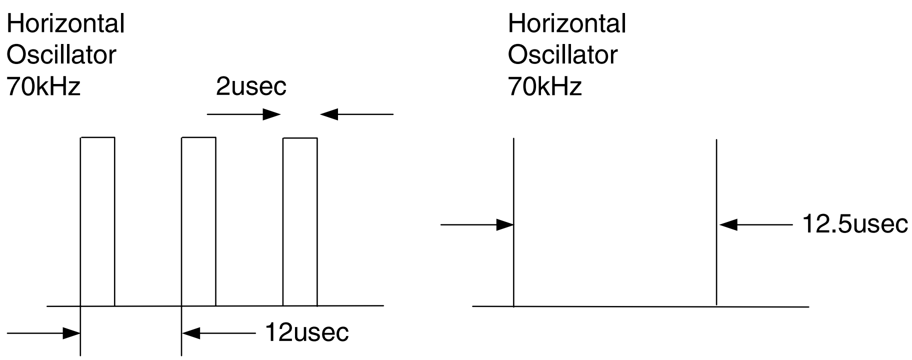
Horiz / Vert Oscillator

Oscillator Activity

CPU IC1001 houses the horizontal and vertical oscillator. The internal oscillators operate as long as there is standby 5V supplied to the CPU (even during the low power Active Off / Burst Mode). When sync is input, the oscillator frequency will match the input sync frequency if it is within operating range.

Oscillator Frequency				
Mode	Horiz Freq	Location	Vert. Freq	Location
Sync range	30-107kHz	CN309/pin 7	48-120Hz	CN309/pin 5
No Sync input	70kHz 4Vp-p	IC1001/pin 27	80Hz 5Vp-p	IC1001/pin 26

Oscillator waveform – No input sync



Main H and V Sync Path

Horizontal and vertical sync entering the monitor are selected by switch IC009 and buffered by IC006. These signals pass from the input A board to the CPU at the front of the D deflection board under the picture tube bell. The sync levels are all at 5Vp-p negative polarity up to CPU IC1001.

Main Sync Input		
	Horizontal	Vertical
Signal input levels	5Vp-p	5Vp-p
Sync polarity	negative	negative

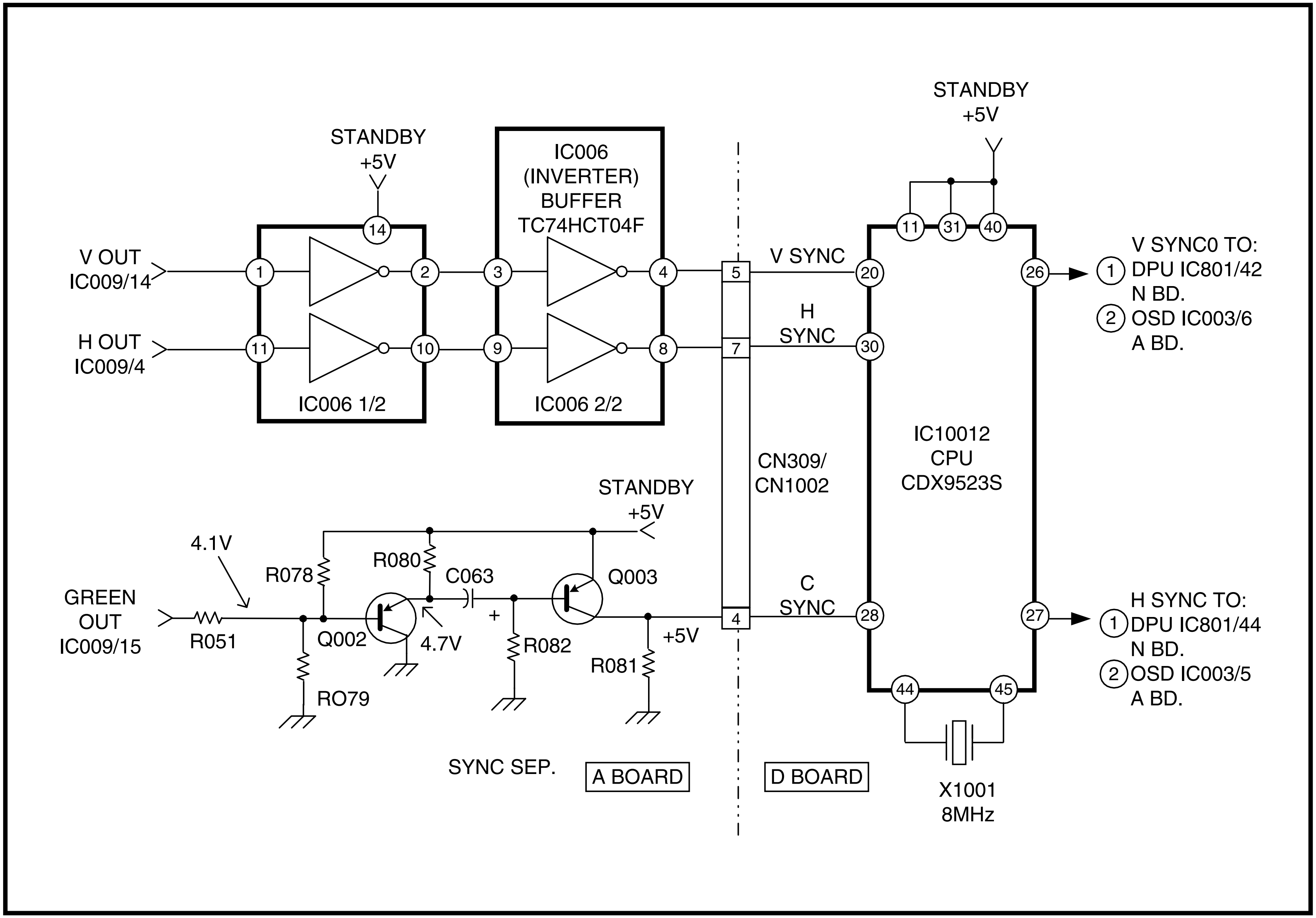
Sync On Green Path

This method of supplying vertical and horizontal sync on the green video signal line to the monitor is still popular today simply because there are less connections to make. Q002 and Q003 remove the vertical and horizontal sync from the green video signal.

The transistors are pre-biased to buffer (Q002) and permit only the negative sync pulse part of the signal to be amplified (Q003). The output of this sync separator stage is 5Vp-p positive polarity H & V sync pulses that are applied to IC1001/pin 28.

If Vertical and horizontal sync are detected at IC1001/pins 20 and 30, the sync on green input at pin 28 is disregarded.

Sync On Green Input		
Signal	Location	Voltage
Green input with negative sync	Q002/base	1Vp-p
Green input with negative sync	Q002/emitter, Q003/base	1Vp-p
Positive going H & V sync	Q003/collector	5Vp-p



HORIZ/VERT OSCILLATION PATH

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Vertical Output

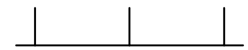
Vertical Stages

The vertical stage consists of three ICs:

IC Name	IC Number	Location	Function
CPU (not shown)	IC1001	Main D board behind bezel.	1. V Oscillator free runs at 80Hz or locked to input sync. 2. CRT protection - Monitors V Output voltage (VFBP).
DPU	IC801	Small N board on the D board.	1. V Drive 2. Sets vertical size (saw amplitude) 3. Limited range DC centering
Vertical Output	IC401	On a heat sink near the FBT.	Vertical Amplifier Vertical Flyback voltage boost circuit is monitored by the CPU for protection.

Vertical Oscillator

CPU IC1001 houses the vertical oscillator. It runs as long as there is Standby +5V applied. The vertical oscillator free runs at 80 Hz and is locked to sync when input from the computer.

IC1001		
	Inputs	Outputs
CPU IC1001	1. V Sync (not required for an output) 2. Standby +5V 3. 8Mhz Xtal 4. VFBP V output signal for shutdown protection	Oscillator output @ 5Vp-p 

Vertical Drive

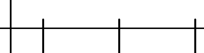
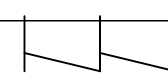
The DPU IC801 serves as the vertical driver. Input are positive vertical pulses and output are sawtooth pulses and a DC reference voltage (DCC2). The sawtooth signal is also used for convergence and geometry control within IC801 (not shown).

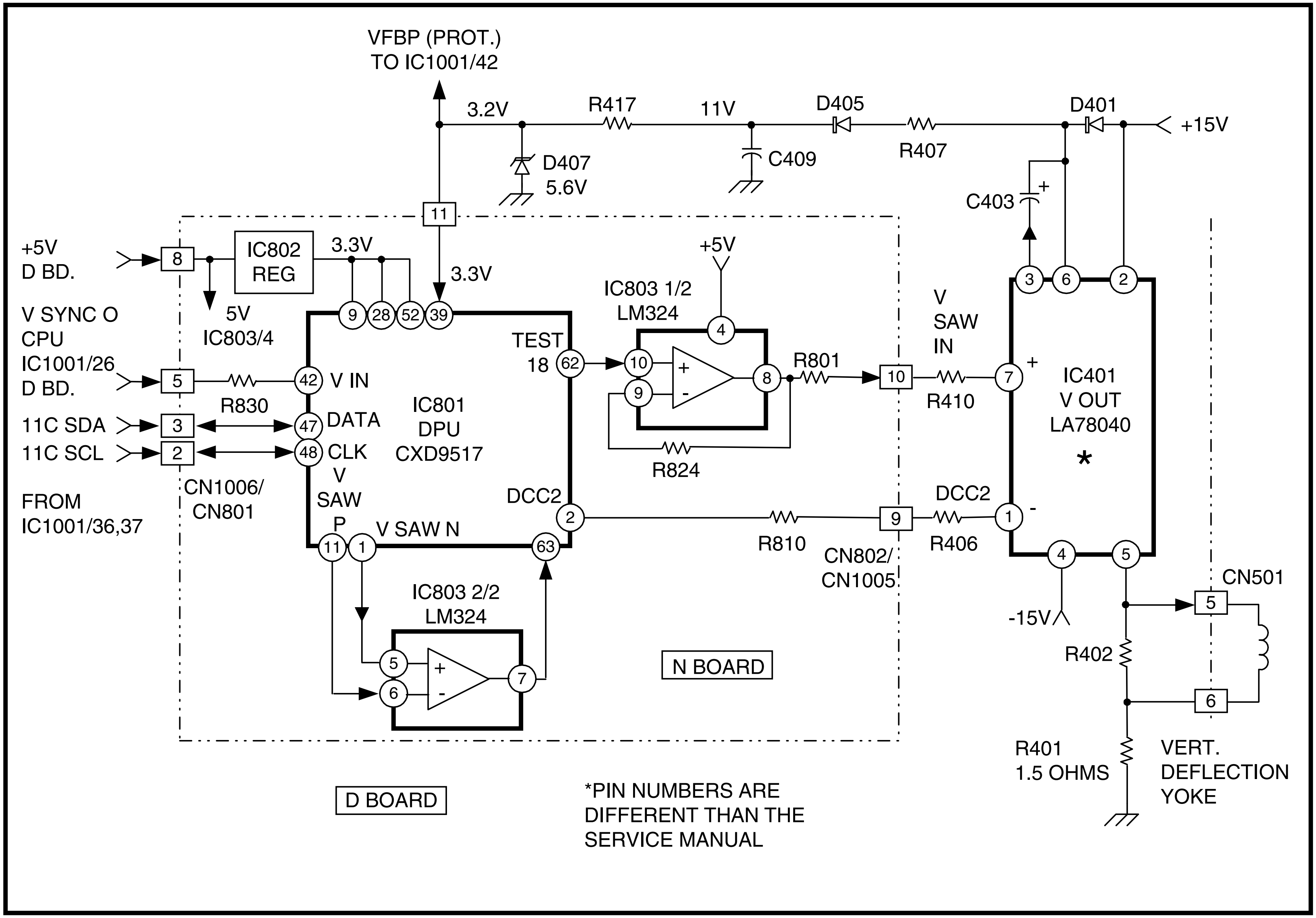
IC801		
	Input	Output
DPU	+ Oscillator pulses Serial data & clock	V Sawtooth pulses DC offset voltage

Vertical Output

This output amplifier amplifies the signal and supplies sufficient current to drive the 8.7ohm yoke.

The voltages about IC401 are found in the chart below:

IC401				
Pin #	Function	DC Voltage	Peak Voltage	Wave Shape
1	DC ref input	0V	1Vp-p	
2	B+	+14V		
3	Flyback input	-13V	25Vp-p	
4	B-	-14V		
5	Saw Output	0V	20V saw + 40V spike	
6	Flyback out	+14V	25Vp-p	
7	Saw Input	0V	1Vp-p	



VERTICAL OUTPUT

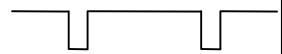
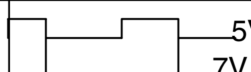
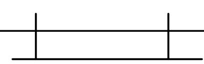
11MON04 1212 1/24/00

Horizontal Output

Main Horizontal Drive Circuit

The purpose of this stage is to create a signal, amplify it and feed it to the yoke to magnetically drive or "sweep" the electron beam across the screen from left to right.

The computer's horizontal sync signal is input the monitor's CPU to lock (match) its internal oscillator. The DPU receives the CPU's oscillator signal and determines the duration (length) of the sweep. The DPU output is amplified to drive the deflection yoke (H DY).

Main Drive Signal Levels				
Signal*	Location	DC	AC	Waveshape
Serial Clock	CN1006/pin 2	5V	72kHz @ 5Vp-p	
Input Sync	CN1006/pin 4	0.6V	70kHz @ 5Vp-p	
HD Out	CN1006/pin 13	+1.6V	70kHz @ 4Vp-p	
Driver Input	Q504/Gate	-9.7V	70kHz @ 4Vp-p	
Driver Output	Q504/Drain	0V	70kHz @ 30Vp-p	
H Out	Q505/Base		70kHz @ 5V & 7V - spike	 5V 7V
H Out	Q505/Collector		1.1KV	

* Measured without the computer connected to the monitor (no sync). The monitor is set in the Aging Mode or the measurements are made before the unit enters the power save mode. The CPU's horizontal output is always present, even in the Active Off power saving mode.

Sweep Width Compensation Circuits

The basic left to right sweep duration is set by the DPU, but its final sweep width (and linearity) is different for each horizontal frequency. As this main sweep (H. drive) signal is processed, it passes through L/C (inductors and capacitors) and the deflection yoke (H DY). Since the output of the L/C components in the drive path will change with frequency, compensation circuits are needed. These circuits make sure the sweep will be a uniform length and position at all operating frequencies:

- Pincushion compensation circuit
- S Capacitors for width compensation circuit
- Centering compensation circuit

Failures such as insufficient width, poor linearity and shutdown do occur in this stage but are difficult to pinpoint since that operating frequency (mode) must be duplicated. The complaint is usually intermittent monitor failure (shutdown) or width reduction.

Testing

Each mode can be simulated by selecting it from the DAS Control Signal Generator (under Adjustments). You should find a pincushion waveform from the DPU in all modes but at different frequencies at CN1005/pin 14. In the aging mode, the waveform is 0.4Vp-p @ +1.8Vdc. The waveshape is a parabola:

Capacitors are switched into the horizontal output circuit by Q511-Q516 for linearity and width correction. The caps and MOSFET devices can be removed from the circuit and checked. See the section under MOSFET Testing in this book.

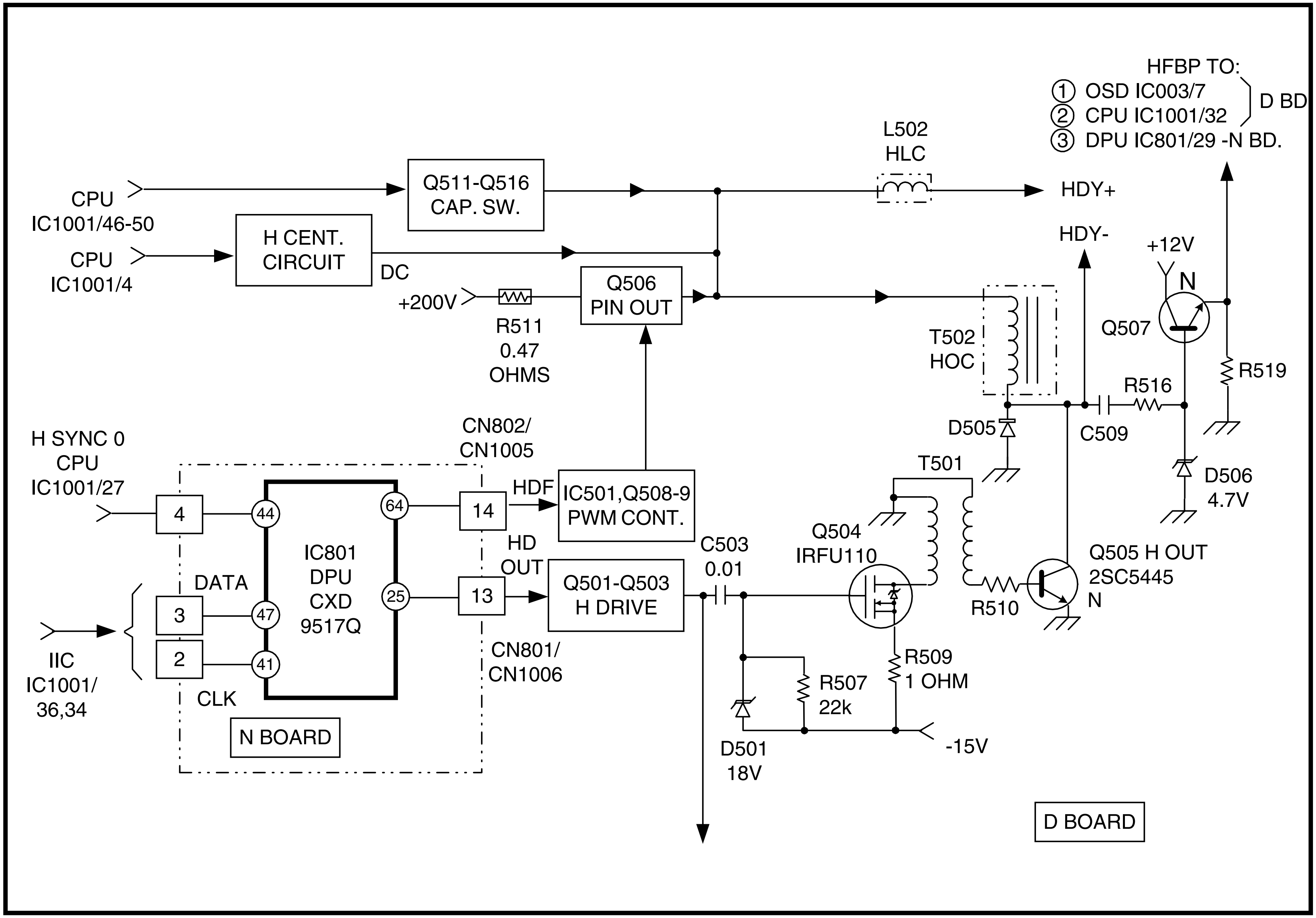
Protection Circuitry

A loss of main horizontal drive to the yoke will cause a vertical line to be burned into the middle of the CRT within one second. Q507 monitors the horizontal drive pulses and feeds a representative DC voltage back to the CPU to protection the monitor.

Q507 Voltages Normal Operation			
Location	DC	AC	Wave Shape
Base	-0.17V	5Vp-p	
Emitter	+0.38V	4Vp-p	

Q507 also feeds this horizontal pulse to two other locations:

- OSD IC003/pin 7 to provide OSD character positioning.
- DPU IC801/pin 29 to reset the geometry signals generated.



HORIZONTAL OUTPUT

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High Voltage

Overview

The purpose of this stage is to use the horizontal drive signal to manufacture high voltage. High voltage is used in various areas.

High Voltage Usage		
Voltage	Purpose	Where
27kV	CRT screen accelerating	CRT anode
Focus (about 4kV)	CRT Focus	CRT socket
1kV	CRT G2 accelerating	CRT socket/D board
300V	Vertical dynamic focus output circuit	Q706, D board

This stage consists of a HV manufacturing part and a regulating part. The regulating part keeps the HV constant when there are changes in brightness.

HV Manufacture

HV Control IC901 makes two signals from the horizontal drive signal input pin 14:

- Fixed drive signal from IC901/pin 5
- PWM signal from IC901/pin 3

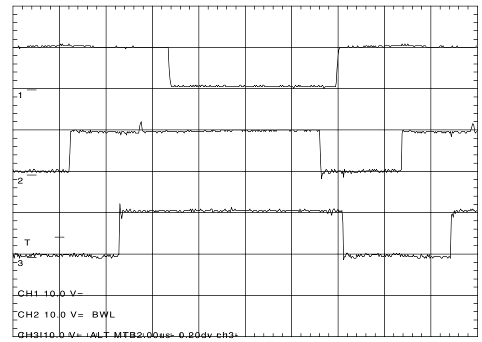
Fixed Drive Signal

IC901 takes the horizontal drive signal that is input pin 14 and makes a positive going signal (9.6usec. in the aging mode). The width is a function of the input horizontal frequency. This positive going signal outputs IC901/pin 5 and is used to turn ON and OFF (drive) HV Output MOSFET Q902. MOSFETs are often used in monitors because they have an even gain for a large frequency range.

Q902 amplifies the drive signal and the signal from the Drain is applied to the flyback's primary winding. The flyback's secondary windings produce the various high voltages needed by the monitor.

PWM Signal

The PWM signal from IC901/pin 3 is used to control the high voltage from the T901 flyback transformer. IC901's PWM output directly controls the conduction time of switching MOSFET Q901. A LOW going pulse applied to its gate turns on Q901. When Q901 is turned ON, voltage is applied through T902 to HV Output transistor Q902/Drain to serve as B+. The longer Q901 is turned ON, the higher the B+ voltage is at Q902. As Q902"s B+ increases, so does its gain and the T901 flyback voltage (HV).

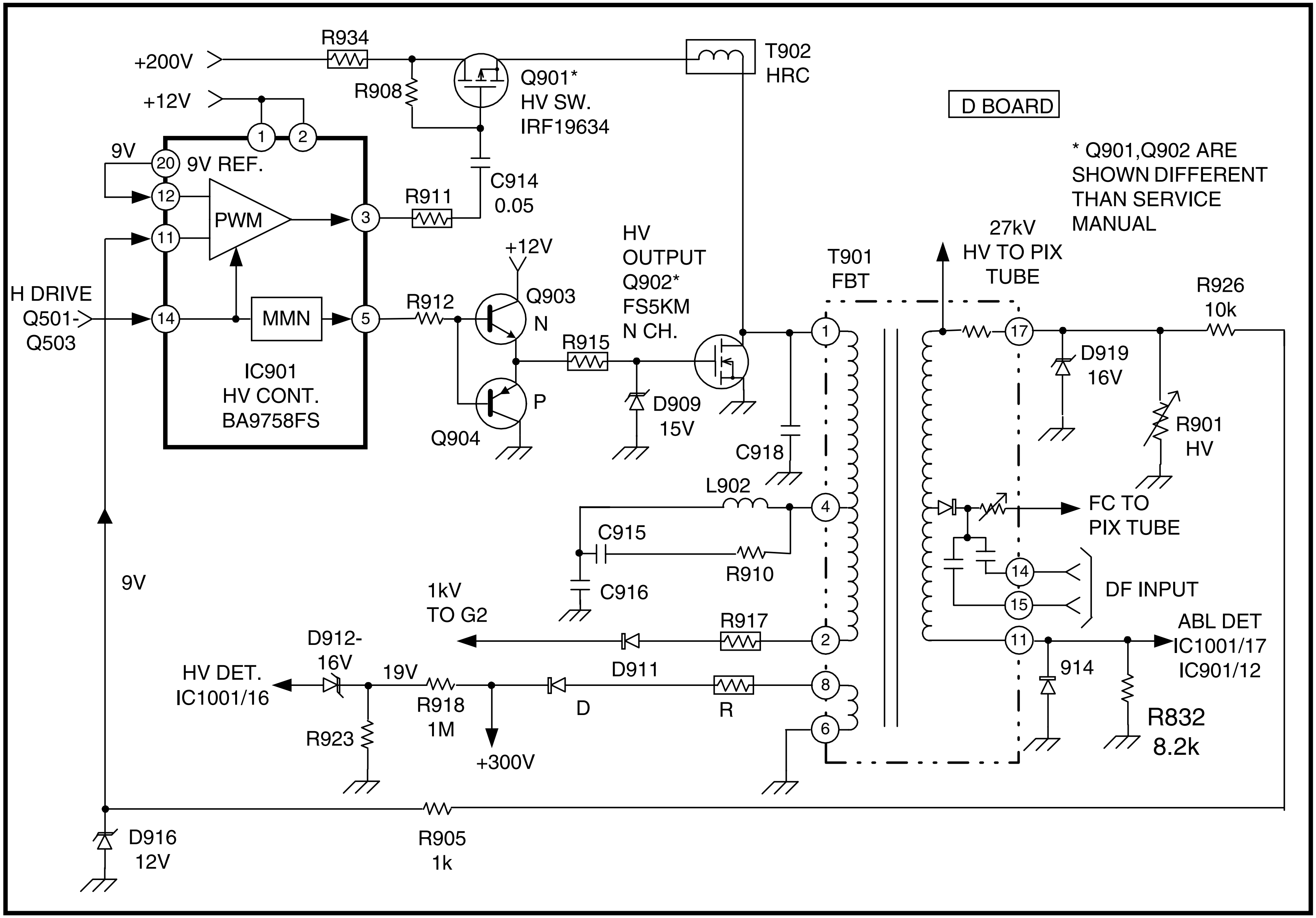


IC901 Waveforms Aging Mode *			
	Name	Location	Voltage/div
Channel 1	H Drive input	IC901/pin 14	10Vp-p
Channel 2	PWM Output	IC901/pin 3	10Vp-p
Channel 3	MMV Output	IC901/pin 5	10Vp-p
Time base	2usec/div		

* The pulse widths will be different when sync is input the monitor.

HV Regulation

HV regulation is accomplished by controlling the B+ applied to Output MOSFET Q902/Drain. This is done using IC901 and Q901 in a closed loop regulation system. IC901 samples the flyback output voltage at T901/pin 17. This voltage is returned to IC901/pin 11 for comparison to a 9V reference at pin 12. The LOW going pulse that is output IC901/pin 3 is changed in width based upon this comparison. A wider LOW going pulse



HV GENERATION/REGULATION

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will increase the HV. This LOW going pulse is applied to switching MOSFET Q901's gate. The longer the LOW going pulse duration, the longer Q901 stays turned ON. As Q901 stays ON longer, its output voltage increases. This results in a higher B+ voltage for Q902 that increases the HV from flyback T901.

The regulating loop is closed when 9V from the FBT T901/pin 17 is applied to IC901/pin 11. A lower input voltage at pin 11 will cause Q901 to conduct longer and increase the B+ and corresponding flyback voltage until T901/pin 17 is at 9V again. RV901 adjusts the voltage at IC901/pin 11 and consequently the HV. In the aging mode, the HV is set to 27kV $\pm$0.2kV.

Protection

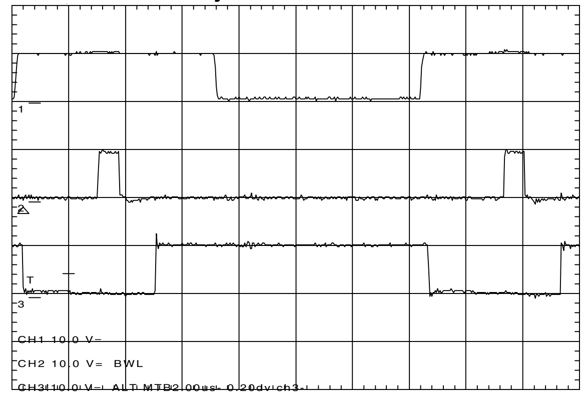
IF the regulating is defective and the flyback voltage rises too high, the CPU will enter the low power Active OFF Mode for protection. The CPU monitors the +300V flyback output at T901/pin 8 via zener D912 to detect excessive HV. Normally there is 19V at D912/cathode and 3V at D912/Anode (16V zener). Excessive HV causes the cathode voltage to rise proportionally. If the cathode rises to 21 volts, the CPU IC1001/pin 16 will receive a trip voltage of 5V to activate the Active OFF Mode for protection. The front panel LED will blink at a 1 Hz rate to indicate excessive HV has caused the monitor shutdown.

Troubleshooting

Checking the regulation loop:

Assuming you have replaced both Q901 and Q902 and there is still a problem with the circuit, you can test this regulating circuit without HV by following this procedure. First you will disable the HV, then use a power supply to simulate regulation in the following steps:

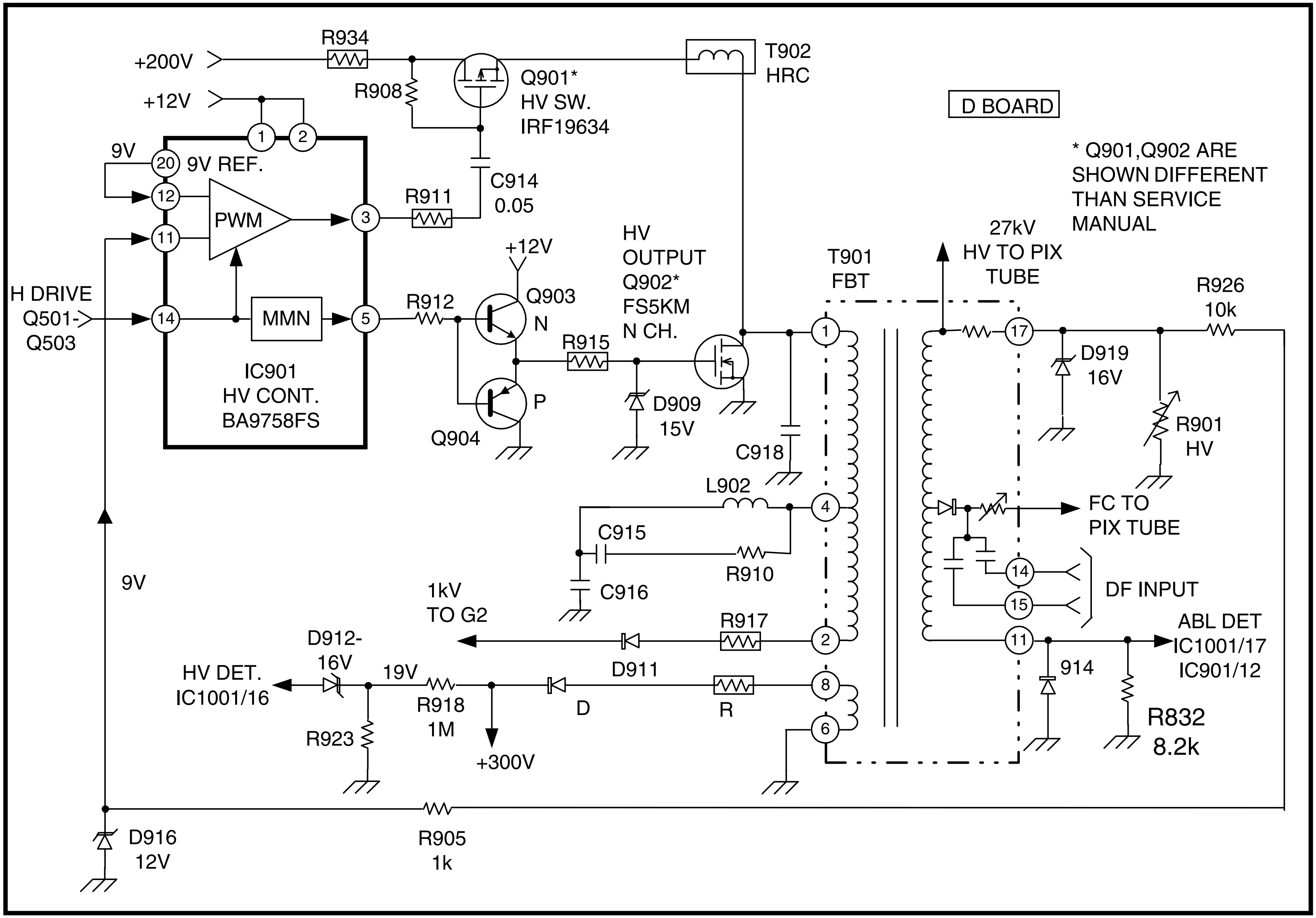
1. Disable the HV by shorting Q902's Gate to Source (ground).
2. Place a scope probe on IC901/pins 3 and 5.
3. Turn the monitor ON without video input and move the front panel control button to the left. This will activate the Aging Mode and keep the monitor powered ON.
4. In the Aging Mode you should see a 9.6usec positive going pulse at IC901/pin 5. The pin 5 pulse is present when there is input at pin 14 and IC901 is good. (Scope set to 2usec time base.)
5. Without HV, IC901/pin 3 should be LOW except for a 2msec positive pulse. Pin 3 is LOW to try to increase the disabled HV.



IC901 Waveforms HV disabled, Aging Mode			
	Name	Location	Voltage/div
Channel 1	H Drive input	IC901/pin 14	10Vp-p
Channel 2	PWM Output	IC901/pin 3	10Vp-p
Channel 3	MMV Output	IC901/pin 5	10Vp-p
Time base	2usec/div		

6. Through a blocking diode for test equipment safety, apply voltage to the cathode of D916 (IC901/pin 11). Watch the waveform at IC901/pin 3. As you reach 9V on the external power supply, the LOW will change into +5Vdc without a waveform. This proves the IC901 regulator is OK.
7. The remaining parts in this regulating loop that must be manually checked or replaced are:

- D913 16V zener
- RV901 100k ohm HV control measures 53k ohms, adjusted.
- The circuit foil path between FBT T901/pin 17 and IC901 can also be checked when the external power supply is connected to D916/C. Just check for voltage at destination T901/pin 17.



HV GENERATION/REGULATION

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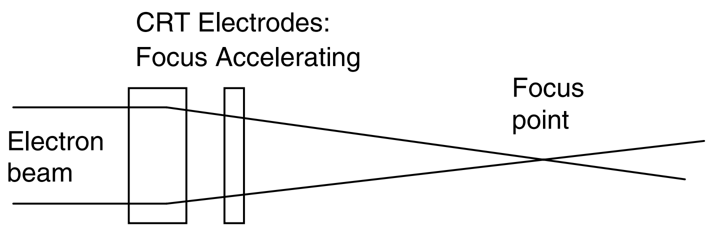
Dynamic Focus Concept

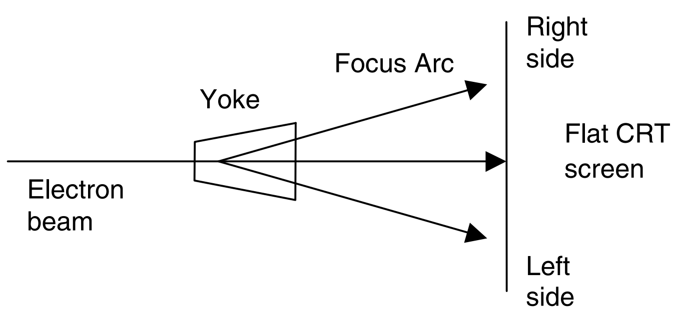
Static Focus

An electron beam within the picture tube consists of many electrons that are slowed down by the focus electrode. After passing through the focus electrode, the accelerating electrode brings the beam to a fine point on the screen. This focus point is positioned by adjusting the voltage at the focus electrode relative to the accelerating voltage. The accelerating voltage is usually fixed at the HV potential from the flyback secondary.



Picture Tube Electron Beam

As the electron beam is moved from side to side (swept) by the magnetic field created by the external horizontal deflection yoke, the focus points form an arc as shown by the arrowheads. Early picture tube glass screens were made into a similar arc to maintain focus at the left and right sides of the screen.

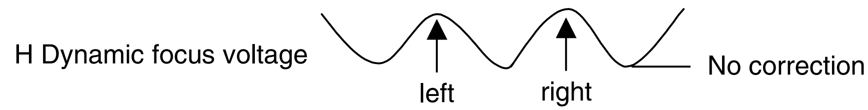


Picture Tube Top View

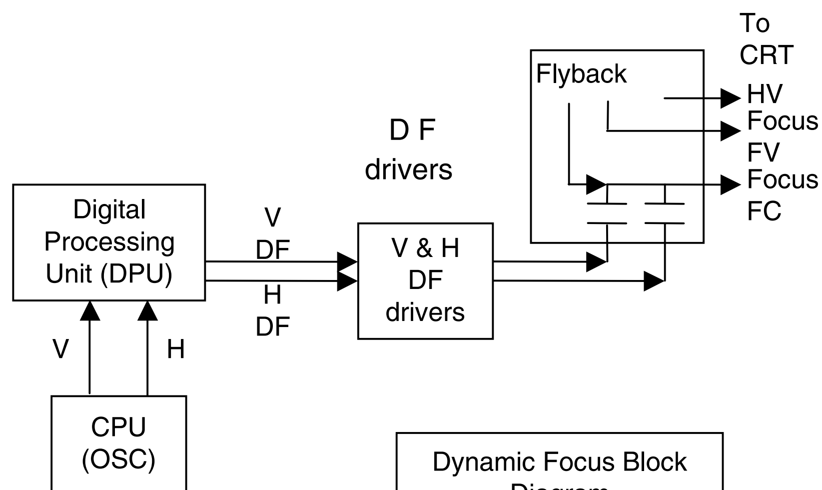
Modern picture tube screens are flat to reduce annoying room glare. This means the focus point must be moved up at the left and right sides to meet the flat picture tube screen.

Dynamic Focus

The job of the dynamic focus circuit is to change the focus points to meet the flat picture tube screen. This is done by increasing the static focus voltage when the beam at the left and right sides of the screen. This correction voltage is in the shape of a parabola to match the focus arc.



Focus correction must be done in the vertical plane for the same reason. A vertical dynamic focus waveform is needed as well.



Dynamic Focus Block Diagram

Notes

Dynamic Focus Circuit

The job of the dynamic focus circuit is to change the focus points to match the flat picture tube screen. This is done in the horizontal plane by increasing the DC focus voltage when the beam at the left and right sides of the screen. A similar correction is required in the vertical plane when the beam is at the top and bottom.

Although the dynamic focus correction circuitry is an independent process, the same IC801 (DPU) makes the vertical and horizontal dynamic focus correction signals. The separate VDF and HDF outputs feed individual amplifiers before being capacitor-coupled to the static (DC) focus voltage at the flyback transformer T901.

Horizontal Dynamic Focus Correction

The main input needed by IC801 to construct the horizontal dynamic focus signal is the flyback pulse (HFBP) at CN1006/pin 15. The vertical sweep signal (VFBP at CN1005/pin 11) is also needed for additional correction when the beam is at the corners of the screen. The DPU (IC801) uses both of these inputs to make a HDF signal that leaves the N board at CN1005/pin 14.

The HDF signal is amplified and inverted by Q701 – Q705. Transformer T701 couples the signal to the flyback's static focus voltage for horizontal focus correction.

Horizontal Dynamic Focus Signals				
Name	Location	DC	AC	Wave Shape
HDF	CN1005/14	1.81V	0.8Vp-p	
	Q701/base	1.25V	0.8Vp-p	
Amplified HDF	Q701/ collector	23.2V	44Vp-p	
	T701/pin 2	24.2V	44Vp-p	
Final HDF signal	T701/pin 8	0V	500Vp-p	

* All voltages and wave shapes taken in the Aging Mode.

Amplifier Stage DC Voltages			
	Emitter	Base	Collector
Q701	0.6V	1.25V	23.2V
Q702	24.5V	24.8V	77.1V
Q703	23.7V	23.1V	0V
Q704	24.2V	24.5V	77V
Q705	24.0V	23.75V	0V

Vertical Dynamic Focus Circuit

The vertical dynamic focus correction signal is made in DPU IC801 using vertical and horizontal sweep signals from CN1005/pin 11 and CN1006/pin 15. The simple parabola shaped VDF correction signal is amplified by IC503 and driver Q706. The resultant 200V VDF signal is capacitor coupled to the FC focus voltage inside FBT T901/pin 15.

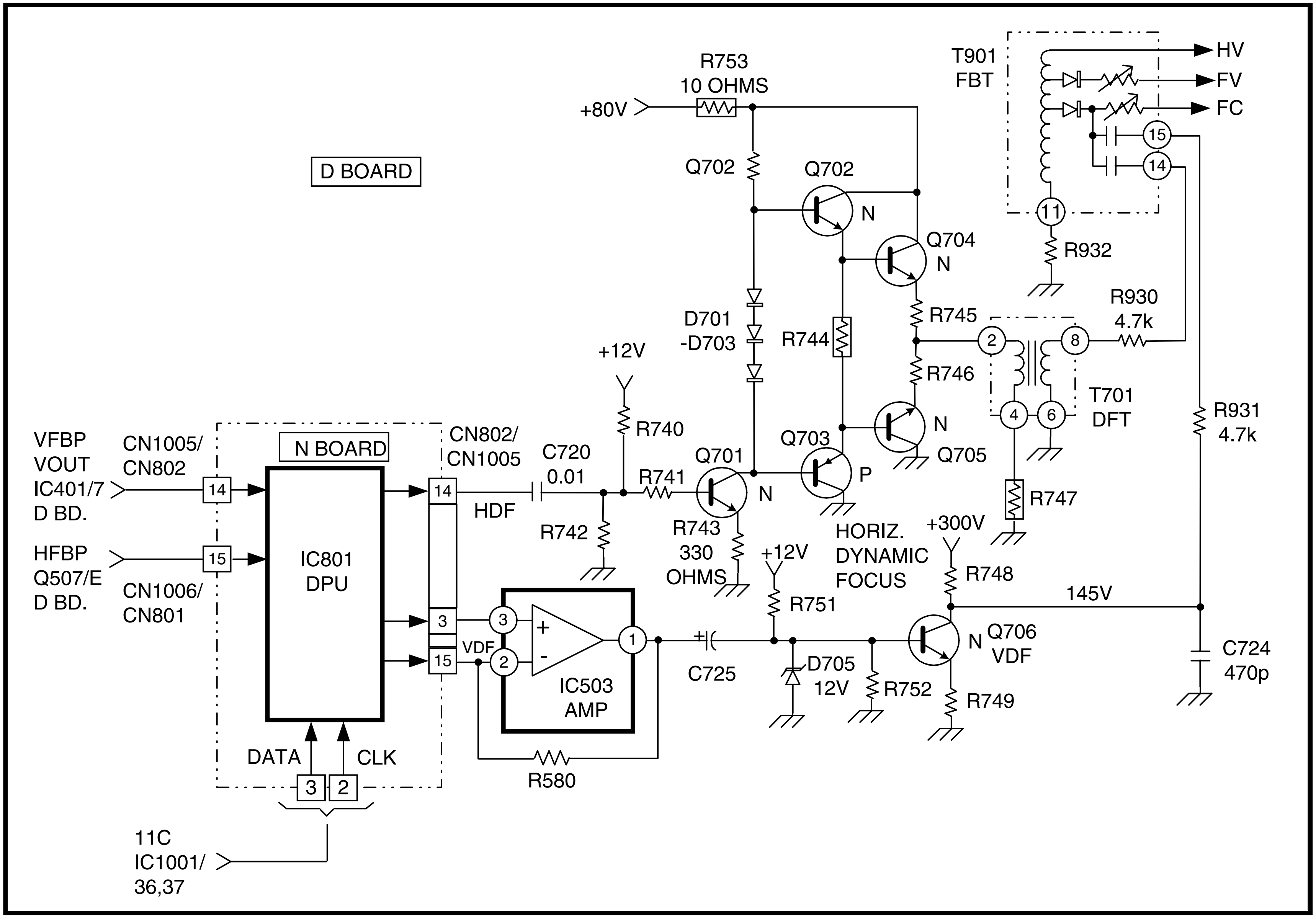
Vertical Dynamic Focus Signal Path			
Location	DC	AC	Wave Shape
CN1005/pin 15	1.8V	1Vp-p	
Q706/base	4V	9Vp-p	
Q706/emitter	3.5V	9Vp-p	
Q706/collector	145V	200Vp-p	

All voltages and wave shapes taken in the Aging Mode.

Troubleshooting

When you are only able to focus the monitor at the center of the screen and not the sides or corners, the dynamic focus stage is not working. In all operating modes of this monitor, HDF and VDF signals will be output from IC801. Trace these signals to the FBT T901.

Note: If you disable the HV (short Q902/G-S) for signal tracing, the +300V and the final VDF signal at Q706/Collector will not be present.



DYNAMIC FOCUS CIRCUIT

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Digital Convergence

Circuitry

Using data stored in the EEProm memory IC1005, DPU IC1701 manufactures the static and dynamic convergence signals. All of the memory data is transferred to the CPU at power ON. The CPU then sends the data to pertinent ICs. The convergence data is sent to IC801.

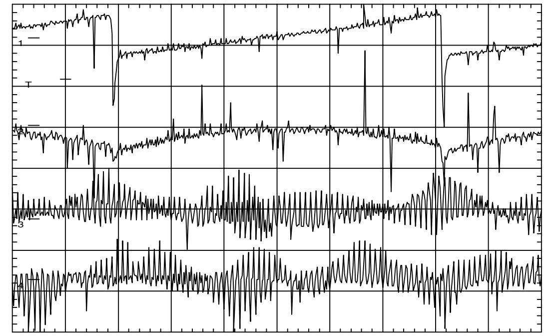
The static convergence signals created by IC801 affect the center of the picture. The two convergence signals XSC and YSC are amplified by IC701 and applied to convergence coils that affect the beams in the X and Y-axis respectively.

The dynamic convergence signals are also made by IC801, but they affect the convergence along the perimeter of the screen. These complex signals from IC801 (XDC and YDC) are amplified by IC702 and applied to convergence coils 1 and 2.

Static Convergence Signals from DPU IC801*				
Location	DC	AC - Vert	AC - Horiz	Wave Shape
CN1005/pin 2	1.57V	0.2Vp-p	0.8Vp-p	 V
CN1005/pin 3	1.43	0Vp-p	1Vp-p	
CN1005/pin 4	1.65	0.2Vp-p	0.8Vp-p	 V
Dynamic Convergence Signals from DPU IC801*				
Location	DC	AC - Vert	AC - Horiz	Wave Shape
CN1005/pin 5	1.69	0Vp-p	1Vp-p	Complex
CN1005/pin 6	1.65	0Vp-p	1Vp-p	complex
CN1005/pin 7	1.61	0.5Vp-p	2Vp-p	complex

* All voltages and wave shapes taken in the Aging Mode.

Convergence Output Waveform:

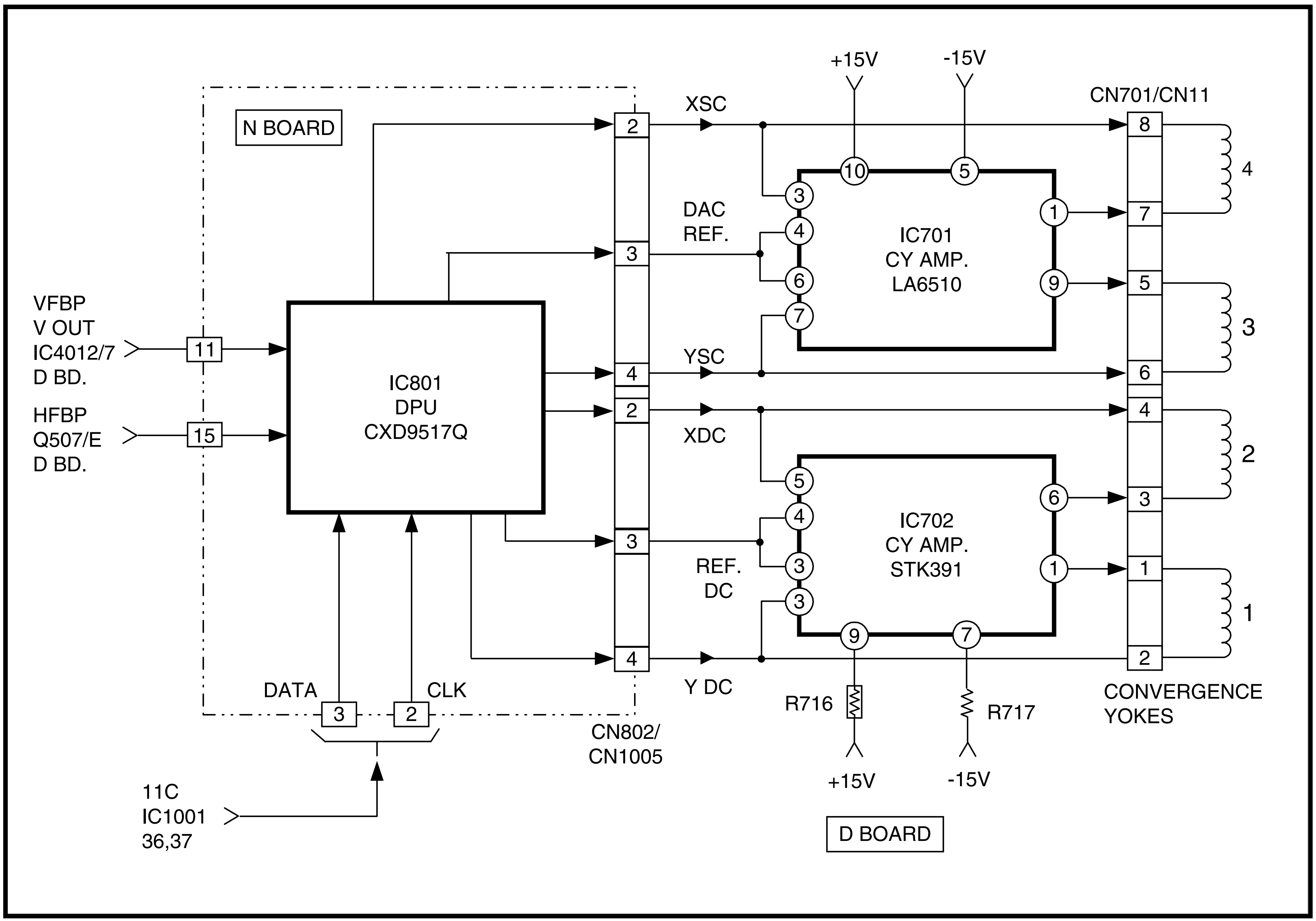


Convergence Output Signals			
Scope	Name	Location	Voltage/div
Channel 1	Static Conv. Yoke 4	IC701/pin 1	2.2Vp-p
Channel 2	Static Conv. Yoke 3	IC701/pin 9	0.5Vp-p
Channel 3	Dynamic Conv. Yoke 2	IC702/pin 6	2Vp-p
Channel 4	Dynamic Conv. Yoke 1	IC702/pin 1	2.5Vp-p
Time base	2msec/div		

* All voltages and wave shapes taken in the Aging Mode.

Alignment

The Digital Convergence data stored in memory IC1005 (not shown) is changed during convergence using DAS software. During this alignment, an on-screen grid is displayed. A cursor identifies a point on the grid to be converged. At that point each color can be moved to converge all three colors, producing a white grid. The cursor is then moved to the next alignment location.



DIGITAL CONVERGENCE CIRCUIT

Self Diagnostic Function

The front panel combination green/orange LED is used to indicate the following:

- Loss of input sync (see Power Saving Modes)
- Failure in the High Voltage and Vertical Output Stages
- Excessive ABL current (picture tube or drive failure)

The following chart shows the LED indications and what level of voltage at CPU IC1001 will activate (enter) this protection mode. Once the trip voltage is exceeded, the CPU enters the Active Off power mode and remains latched in this state until you press the power button to reset the CPU.

Self Diagnostic Indication Function

Indication	Defective Stage	Sensed at IC1001	IC1001 Normal Voltage	IC1001 Trip Voltage	Power Mode	Latched
Only the Green LED blinks at about 2 Hz.	B+ (200V) excess	N/A	N/A	N/A	PS restarts	N/A
Both LEDs are dark. PS beeps @ 2 Hz.	B+ shorted	N/A	N/A	N/A	PS restarts	No
Both LEDs blink at 1 Hz.	HV Detection	Pin 16	2.8V	5.0V	Active Off	Yes
Both LEDs ON = 2 sec. OFF = 1 sec	V Output / H Output	Pin 42	3.3V	0.6V	Active Off	Yes
Both LEDs blink ON = 1 sec, OFF = 2 sec.	ABL (CRT current)	Pin 17	5.0V	5.2	Active Off	Yes
LEDs alternately blink @ 1 sec each	None Aging Mode					

B+ Detection

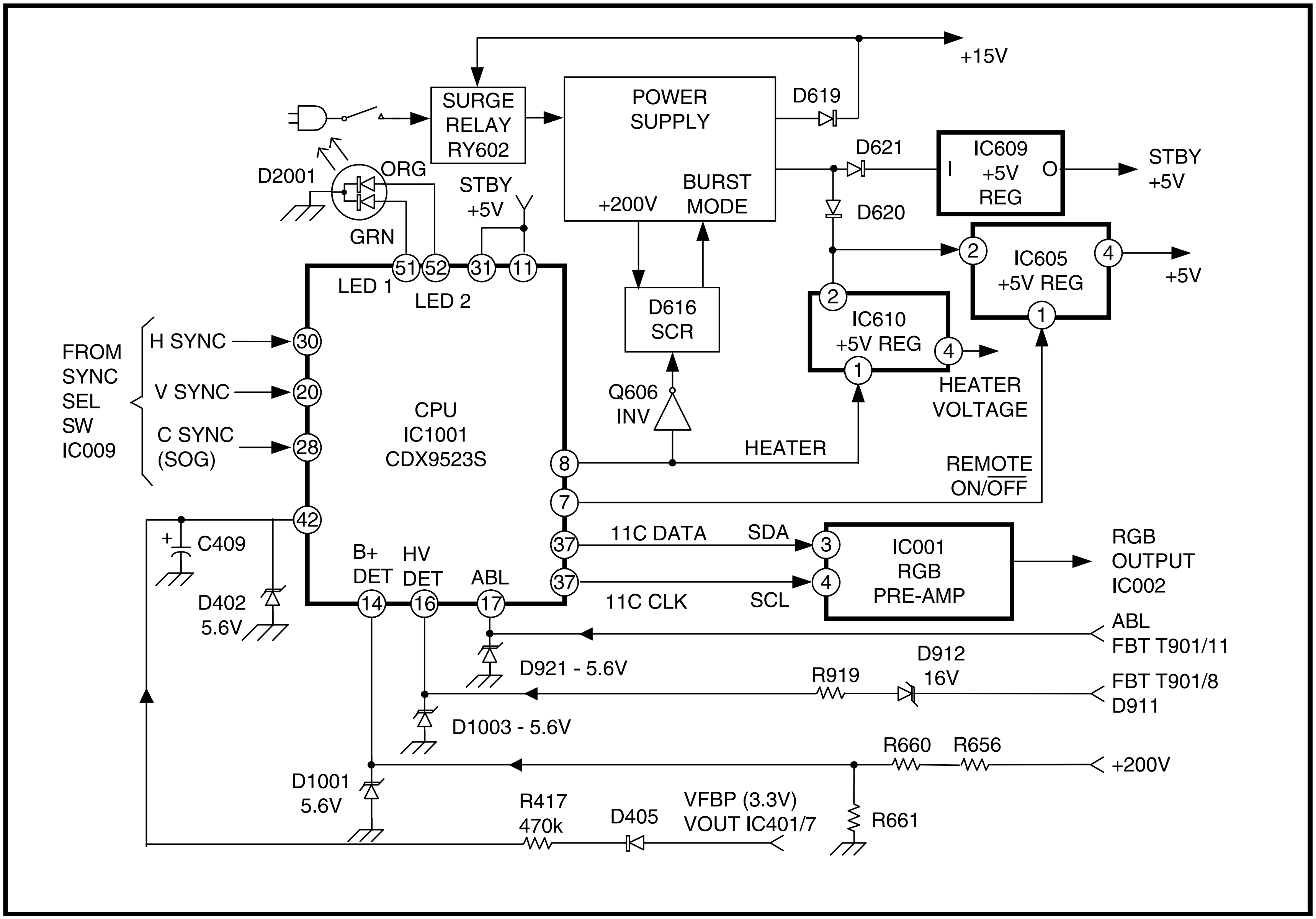
B+ 200V is sampled by the CPU IC1001/pin 14, but the CPU is not programmed to respond. Perhaps this is because the monitor is well protected at the power supply itself where the power transformer's secondary is fed back directly to the control IC. A higher voltage will cause the power supply control IC to momentarily stop the oscillator. The oscillator will start again, causing the front panel green LED to cycle on, then off, then on repeatedly as the power supply switches on and off. See the Regulating Circuit for details.

HV Detection

This monitor uses the Horizontal pulses from the DPU IC801 (N Board), a regulating circuit and the FBT T901 to make HV. CPU IC1001/pin 16 monitors a winding of the flyback at T901/pin 8 for excessive voltage. Excessive HV causes the CPU's Heater output voltage to be LOW, causing SCR D616 to trip the power supply into the Burst mode. In the Burst mode, the power supply will just be able to supply enough energy to feed the standby regulator IC609. The standby voltage keeps the CPU powered to keep the monitor latched in this Active Off power mode. A HV triggered failure is identified when both green and orange LEDs turn on, blinking on one second and off the next second. This blinking will continue until reset by shutting the monitor OFF or unplugging it from AC.

ABL Detection

The automatic brightness limiting circuit normally reduces the High Voltage when the CRT current is excessive. Excessive ABL voltage causes CPU IC1001 to enter the low power Active Off mode for protection. An ABL triggered failure is identified when both LEDs are turned on and blink ON for one second and OFF for two seconds. Some possible causes are shorted video driver IC004, G2 voltage too high, or a picture tube structural failure.



SELF DIAGNOSTIC BLOCK

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APPENDIX

Power MOSFET Tests

JEIA Transistor Classification

Transistor types are identified in the Japanese Electronic Industry Association by the second letter in their number:

JEIA Nomenclature Standard	
2S**A** = PNP low power	2S**D** = NPN medium to high power
2S**B** = PNP medium to high power	2S**K** = N channel FET or MOSFET
2S**C** = NPN low power	2S**J** = P channel FET or MOSFET

E.g. 2SK3265 is an N channel (MOSFET) device.

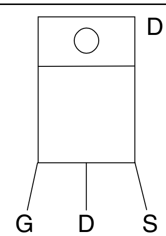
Static MOSFET Resistance Tests

Static MOSFET Out Of Circuit Resistance Tests		
	+ / -	- / +
Gate Source	Infinity	Infinity
Gate - Drain	Infinity	Infinity
Drain - Source	There is often a zener diode connected internally across these terminals	

Power MOSFET

TO 220 case

P or N channel



Static MOSFET Conduction Test

Since the static ohmmeter test across a power MOSFET device normally measures infinity, you can tell if the device is shorted but not open (infinity). To prove this device can conduct (is active), the ohmmeter can be used to charge the gate for a moment and its (Drain to Source) conduction resistance measured.

The test procedure for an out of circuit N channel device is:

1. Connect the negative lead of the ohmmeter to the N channel MOSFET SOURCE terminal.
2. Touch the ohmmeter's positive lead to the MOSFET's gate terminal to charge it.
3. Quickly move the ohmmeter's positive lead to the DRAIN terminal and read the resistance.

If the device is good you will initially measure a resistance of about 400 to 1k ohms. This D-S resistance will increase toward infinity as the gate charge dissipates (leaks off the gate).

The speed of the gate charge dissipation varies depending upon:

- The power MOSFET number (internal construction)l; and
- The charge voltage from your ohmmeter.

For example, the (power supply stage) 2SK3265 MOSFET device will show increasing drain to source resistance values on a Fluke model 8050 digital meter (2k-ohm diode test range) for less than two seconds before over-ranging.

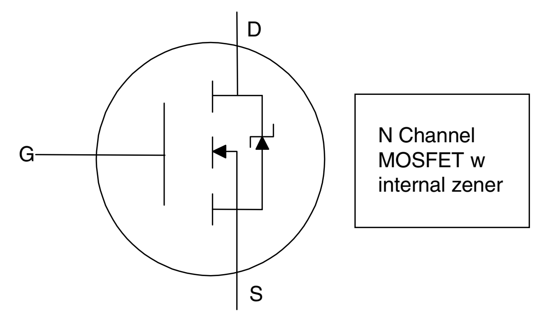
Other power MOSFETs may hold their gate charges longer and their corresponding D-S resistance will very slowly increase, taking minutes or days to over range. Touching the source and gate with your fingers will dissipate the gate charge and cause the D-S resistance to increase rapidly.

The P channel power MOSFET can be tested in the same manner, but you must reverse the ohmmeter leads, e.g. connect the positive ohmmeter lead to the MOSFET's SOURCE terminal.

Prevent MOSFET Damage

To prevent damaging the power MOSFET:

- Do not apply more than $\pm$20 volts to the gate terminal with respect to the source.
- Prevent static electricity from touching the MOSFET.
- Do not forward bias the internal drain – source zener diode with a power supply.



IIC or I^{2}C Bus

Overview

In recent years Sony monitors, television and other Sony and non-Sony consumer products have switched over to a communications bus that has more advantages than disadvantages. The major advantages are:

- One less communications line (no latch, strobe, enable, acknowledge, or chip select line).
- As part of the CPU program, the number of slave IC on the bus is reconfirmed each time at start up (after CPU reset).
- Bi-directional data is commonplace, but unidirectional is possible for drivers.
- Eliminates the need for two communications buses in complicated products.
- Communications (data and clock) are always present as long as the set is ON (active).
- More than one master IC can be programmed into the fixed number of ICs on the bus so one IC does not have to talk to the master to communicate with another IC.

Using this IIC communications format, only parallel data and clock lines connect the ICs. Instead of singling out a slave IC using individual chip select lines to communicate on the bus, the specific device is addressed within the data.

This format makes monitor adjustments possible from an external device using DAS software. The connection to the IIC bus via a connector on the board is usually near the CPU.

Data Format

The IIC bus has several parts:

- Start Bit
- Slave Address
- Read/Write Bit
- Several Acknowledge Bits
- The Data
- Stop Bit

Data Structure

Start bit	Slave Address	Read (H) Write (L)	Ack	Data	Ack	Data

Data	Ack	Data	Ack	Stop bit

Start / Stop Bit

Each device on the IIC bus must be able to recognize its own address. The beginning of any data transfer is a “start bit”. The start bit has no clock pulse. Any time the data lines falls from HIGH to LOW independent on the clock line (usually HIGH), all devices on the bus will begin loading in the data on the bus. The stop bit is conversely a LOW to HIGH transition from the master IC.

Slave Address

The address word consists of a seven bits of an eight-bit word. (Current technology digital communication is often in 8, 16 or 18 bit words). This address identifies the device that this data is for.

Read/Write Bit

The eighth bit of the address word is the direction read/write bit. It is HIGH to accept the pending data for reading and LOW for WRITE into the addressed IC.

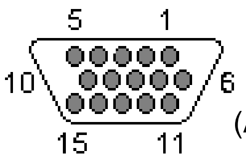
Acknowledge Bit

Following the address from the master IC is an acknowledgement from the destination IC. At this time the master IC’s tri state data output will switch to a high impedance input. As the pull up resistors on the data line bring this line HIGH, the destination IC grounds this line at this time in the clock cycle to indicate an acknowledgement of the address (or data) and verify the presence of the destination IC.

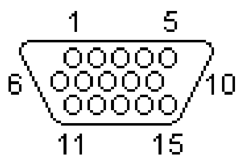
Plug and Play

VGA (VESA DDC)

VGA = Video Graphics Adapter or Video Graphics Array
VESA = Video Electronics Standards Association
DDC = Display Data Channel



(At the video card)



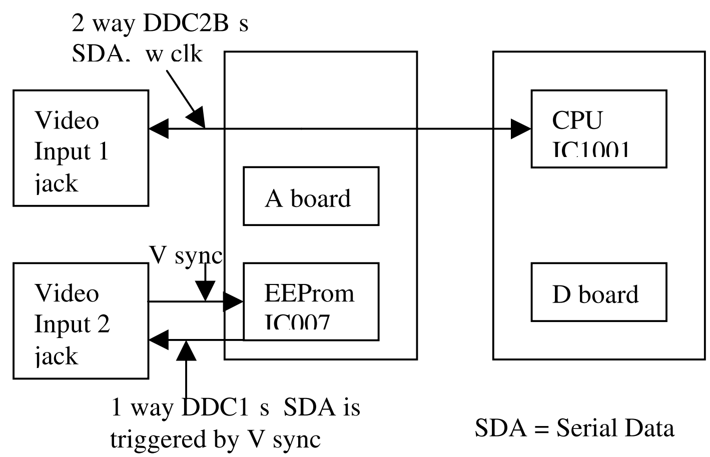
(At the monitor cable)

15 PIN HIGHDENSITY D-SUB FEMALE at the video card.
15 PIN HIGHDENSITY D-SUB MALE at the monitor cable.

Pin	Name	Dir	Description
1	RED	→	Red Video (75 ohm, 0.7V p-p)
2	GREEN	→	Green Video (75 ohm, 0.7V p-p)
3	BLUE	→	Blue Video (75 ohm, 0.7 V p-p)
4	RES	-	Reserved
5	GND	—	Ground
6	RGND	—	Red Ground
7	GGND	—	Green Ground
8	BGND		Blue Ground
9	+5V	→	+5V DC
10	SGND	—	Sync Ground
11	ID0	←	Monitor ID Bit 0 (optional)
12	SDA	↔	DDC Serial Data Line
13	HSYNC or CSYNC	→	Horizontal Sync (or Composite Sync)
14	VSYNC	→	Vertical Sync
15	SCL	↔	DDC Data Clock Line

Note: Direction is Computer relative Monitor.

Plug & Play Communications in Sony model CPD-G400



What is Plug and Play

Currently there are several levels of Plug and Play compliance. DDC1 (Display Data Channel 1) capable monitors can communicate with the display adapter in only one direction through an unused line on the standard VGA cable. The DDC1 type of communication is the type of data channel from the display to the host, continuously transmitting Extended Display Identification (EDID) information. The video adapter is told what monitor is connected and its maximum resolutions and refresh rates.

DDC2B goes one step further by offering bi-directional communications through two unused VGA lines between the monitor and the video adapter. The DDC2B communication channel is based on the I^2C protocol. The host (graphics card) can request EDID or VDIF (Video Information) information over the DDC2B channel. Not only is DDC2B faster, it allows the operating system to query the monitor for supported features and inform you of any configuration changes. For your monitor to be fully Plug and Play compatible, it must have both DDC1 and DDC2B capabilities. With a Plug and Play video adapter, you are able to change resolutions and colors without having to restart your computer.

Designers are developing innovations to keep pace with Plug and Play, such as a communication cable that plugs into a port similar to a telephone jack on the monitor. With the introduction of the ACCESS.bus (or DDC2AB compatibility), include DDC2B bi-directional communication and to add connectivity between many devices. ACCESS.bus peripherals can be daisy chained in any order so that everything plugs into one port on the back of your computer system.

Since the ACCESS.bus conveys information directly to your system, mice and keyboards as well as other compatible components can be plugged and unplugged without having to restart your computer. Especially useful for monitors, the ACCESS.bus allows you to adjust your screens image using a mouse and keyboard. This not only eliminates the need to push buttons on the display, it allows you to store monitor settings under meaningful names that are easily recalled.

The newest standard, USB (Universal Serial Bus), includes all the capabilities of ACCESS.bus, but transmits and receives data at a much faster rate. Instead of 400K/sec., USB will be able to communicate at an incredibly fast 12MB of data per second, which makes it ideal for digital video and telephony. Because of its transmission capabilities, USB is expected to win over the current ACCESS.bus standard and will be the one to watch as Plug and Play continues to mature.

DDC Data Format (EDID)

Basic EDID consist of 128 bytes	
Number	**Description**
8 Bytes	Header
10 Bytes	Vendor / Product Identification
2 Bytes	EDID Version / Revision
5 Bytes	Basic Display Parameters / Features
10 Bytes	Color Characteristics
3 Bytes	Established Timings
16 Bytes	Standard Timings
72 Bytes	Detailed Timing Description
1 Byte	Extension Flag
1 Byte	Checksum

Monitor Problems Checklist

While involved with testing in one circuit, a related circuit can be overlooked. For each 12 symptoms listed in the chart below, there are corresponding items that need to be checked. They are described in the text that follows.

Summary of Symptoms	
1. Green power light ON but no picture (screen dark).	7. Retrace lines present in the picture.
2. Very dark picture.	8. Intermittent Cut Off Control IC failure.
3. Very dark picture and poor focus and/or blooming.	9. Can only focus in the center or at the sides, but not both.
4. A color is too weak or bright.	10. Front panel pushbuttons have no effect.
5. One or more colors flicker intermittently.	11. Two thin black lines are always on the CRT. They never move.
6. Ghosts or shadows in the picture.	12. Picture remains readable only during boot up. Sync is lost after entering a Windows program.

1. Symptom – Green power light ON but no picture (screen dark).

Unlike TV sets, monitors will normally remain dark (blanked) unless there is horizontal and vertical sync input the monitor from the computer. Many things are possible.

a. First try a different computer.
b. Look for CRT filament glow through the vent holes (and shielding).
c. At the CRT socket (with the computer connected and running) look for:
  - G2 screen voltage (approx. 400 – 1kVdc). This voltage comes from the high voltage. Therefore if you have normal screen voltage, you also have high voltage. If the G2 screen voltage is only at B+ level, there is probably no high voltage. **Warning:** The danger is that if you have NO G2 voltage you can still have high voltage because of a defect in the G2 control circuit or an open path from the flyback.
  - Filament voltage = 6Vdc or 6Vrms
  - G, R or B voltage. Should be less than 200V to produce brightness.
  - Focus voltage. A loss of focus voltage will not cause a dark screen, but no high voltage will. The focus voltage is a function of the high voltage and another indication HV is present. Therefore if there is focus voltage, there is high voltage. Focus voltage may be difficult to access in some sets.

2. Symptom – Very Dark Picture

In older monitors a bad CRT will display a dark picture accompanied by poor focus. In newer monitors:

a. Check the drive signal level from the computer by substituting another computer.
b. Measure the CRT filament voltage with the CRT connected. It will be 5.5 to 6Vdc if the voltage comes from the LV power supply, or 6Vrms if the voltage comes from the flyback. Inspect the CRT socket pins for corrosion (white powder) and clean or replace the socket.
c. Compare the G2 voltage at the CRT with the voltage in the service manual. An abnormally low voltage will reduce brightness. The typical G2 voltage varies with screen size.
d. Compare the voltage at the CRT R, G or B terminals to the service manual voltage. The voltage will be a function of the input signal so it will be different. A lower voltage causes a brighter color.
e. The average voltage at these R, G or B CRT terminals is stored in memory, retrieved by the CPU and transferred to the RGB cut off control IC via serial data.

3. Symptom – Very dark picture with poor focus and / or blooming.

- Old monitor – CRT is weak.
- New monitor – High voltage is unregulated or low.
  Break in the CRT filament connections at the socket or at the flyback transformer (if the flyback is used for the filament power).

4. Symptom – A color is too weak or bright.

The problem area can be in the DC bias voltage applied to the CRT cathodes or in the RGB drive signal that is AC coupled to the CRT cathodes. We will stop the drive to see if we can get equal DC bias voltages at the RGB cathodes to produce a white screen.

Procedure: Place the monitor into the aging mode or just feed in a dark screen input (just sync). Increase the brightness and turn down the contrast (picture/drive) level. Increasing brightness just uses the cutoff control IC to bias the RGB CRT cathodes with a DC voltage. These cathode pins should now be at the same voltage.

Problem Area		
RGB Cathode Voltages at the CRT	Monitor Screen	
	White	Color dominant
All the same	RGB drive output problem	CRT is bad
One is different	One CRT cathode is weak	RGB Cut Off IC, its peripheral parts or RGB background memory data is defective/corrupt.

5. Symptom – One or more colors flicker intermittently.

a. Inspect the video cable for bent pins, cuts and stains (liquid damage).
b. Often the solder connections break loose at the video-input jack where it meets the circuit board. Resolder all the connections.
c. Tap the circuit board with an insulated tool like a pencil eraser. The closer you get to the bad solder connection, the more often the problem will appear. Resolder the area.

6. Symptom – Ghosts or shadows in the picture.

Excessively long cables going to the computer or a loop through box is used to run more than one monitor.

7. Symptom – Retrace lines present in the picture.

a. G2 voltage is too high.
b. Cut-off control driver IC or support parts are defective. Check all voltages about the cut-off control IC and compare them to the voltages listed in the schematic.

8. Symptom – Intermittent cut-off control IC failure.

Arcing in the CRT can cause repetitive failure of this cut-off control IC and (zener) diodes that protect the RGB signal from the Output IC.

9. Symptom – Can only focus in the center or at the sides but not both.

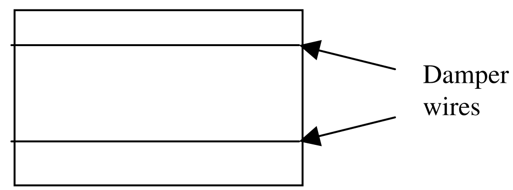
The dynamic focus circuit is not working. Look for a loss of focus waveform in this circuit.

10. Symptom – Front panel pushbuttons have no effect.

One of these buttons is shorted (on) and locking out the others. Liquid/food is solidified, holding a button in.

11. Symptom – Two thin black lines are always on the CRT. They never move.

These damper wires in the CRT are necessary for support. These very thin horizontal lines are normal in a high quality Trinitron picture tube.



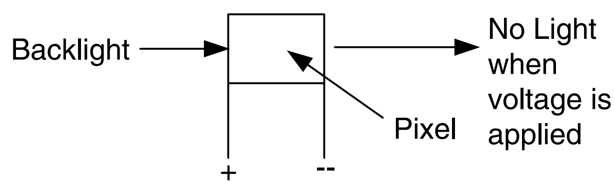
12. Symptom – Picture remains readable only during boot up. Sync is lost after entering a Windows program.

a. The software from the computer is instructing the graphics card to output sync at a higher (or lower) frequency than the monitor's normal operating range.
b. The plug and play (DDC) communication is defective. This serial communication from the monitor tells the computer what frequencies the monitor is capable of. As a result, the computer's video card should not generate a frequency beyond this range to cause this problem.

LCD Concept

Basic Pixel Structure

The pre-assembled LCD panel contains thousands of crystallized electro-chemical structures (one for each pixel). Each structure either blocks or passes light. Transparent membranes at the front and back of the blocks apply voltage to the structure much like a capacitor.



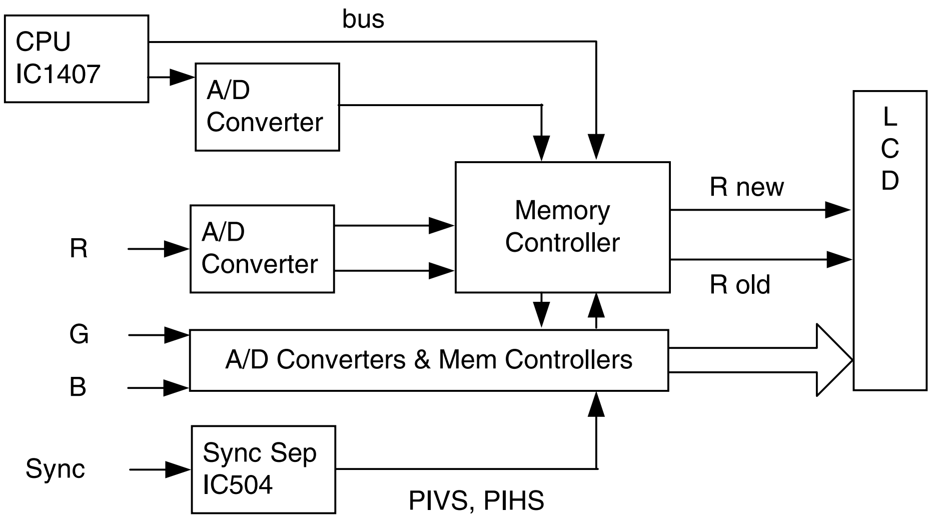
When voltage is applied across the structure, the crystals within will misalign and the structure blocks the backlight (dark pixel). The greater the voltage, the darker the picture is.

Placing a red, a green or a blue filter in front of the pixel to pass that color from the backlight creates color. A set of three different color pixels is placed in a delta array pattern on the LCD screen. White is output when the backlight shines through all three filters and the eye perceives the area as a white light.

When voltage is applied to the pixel for a prolonged period, there is chemical degradation. To avoid structural failure, the voltage across the pixel is reversed periodically. Therefore the voltages at the pixel are both floating above ground so there is a great deal of activity on these drive lines. In most LCD displays the voltage reversal is performed at the end of the field for next field.

RGB Pixel Control

There are various ways the pixels in an LCD panel can be controlled. In model CPD-L181, A/D Converters convert the analog RGB signal to digital format.



The A/D converters output a differential digital signal to the memory controller. The memory and the memory controller store the video information so the correct color pixel can be turned on at the right time. The “old” and “new” voltages to the LCD display correspond to the 8-bit address (location) of each pixel and the voltage applied (brightness) to that pixel. The memory controller requires digital video information, sync, a very high-speed clock for pixel selection, as well as data & clock communications from the CPU.

Backlight

The two fluorescent backlights (labeled LCD in the service manual) are used in model CPD-L181. Each backlight is fed a high frequency AC signal from its corresponding preassembled inverter board. A fan is required to keep the backlights cool.

Service Position

Warning-When repairing any electronic product DO NOT PLUG THE PRODUCT DIRECTLY INTO AC. Plug the product into an isolation transformer and the transformer into AC to reduce damage and the danger to you when servicing.

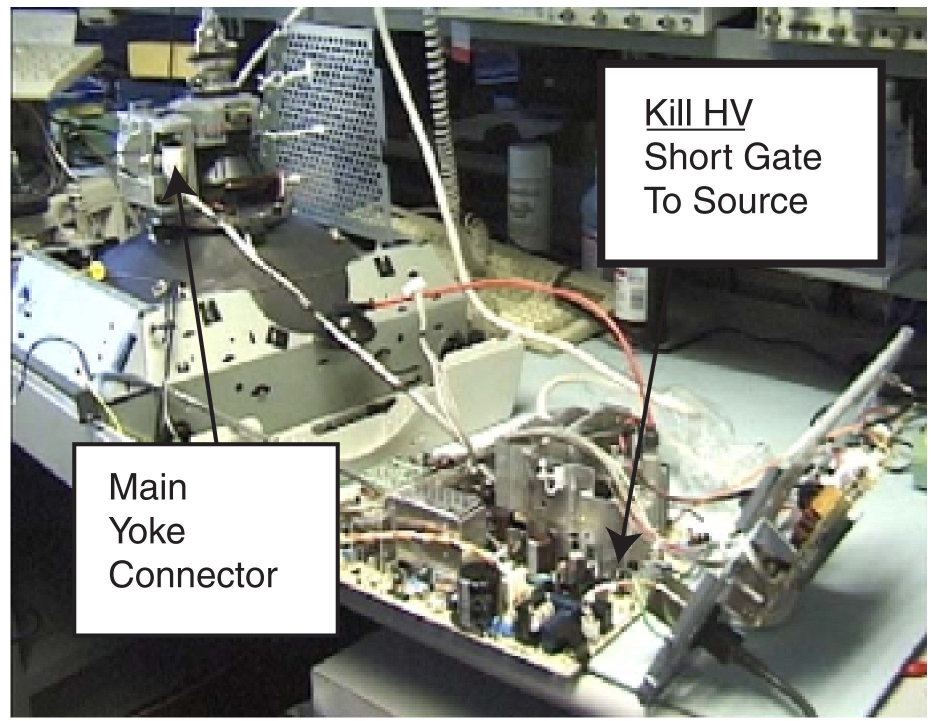
NO High Voltage Testing Position

This position allows you to troubleshoot almost all the stages of this monitor except the HV stages and the sections that are fed voltage from the flyback secondary. These sections can be tested with an ohmmeter or by repositioning the chassis for the full voltage testing.

Sections Tested without HV		
Full Power Testing	Partial Testing	No Power Testing
L.V. Power Supply	Vertical Dynamic Focus	High Voltage stage
Video Processing	G2 Control section	
Vertical Output		
Horizontal Output,		
Pincushion		
Horiz Dynamic Focus		
Convergence		
CPU & DPU		

General Procedure:

1. Remove shielding to expose the area you need to test.
2. Leave the Degaussing coil, convergence yoke, rotation coil, and HV anode lead unplugged.
3. Reconnect the main yoke to prevent the protection circuit from activating.
4. Disable the HV from the top or bottom of the board by shorting the HV Output transistor's Gate to Source leads.
5. Plug the monitor into AC.
6. Move the control button to the left and hold it there for two seconds while the monitor enters the Aging Mode. This will prevent the monitor from entering the (Active Off) Power Save Mode without video input. The Active Off Mode shuts down the power supply.



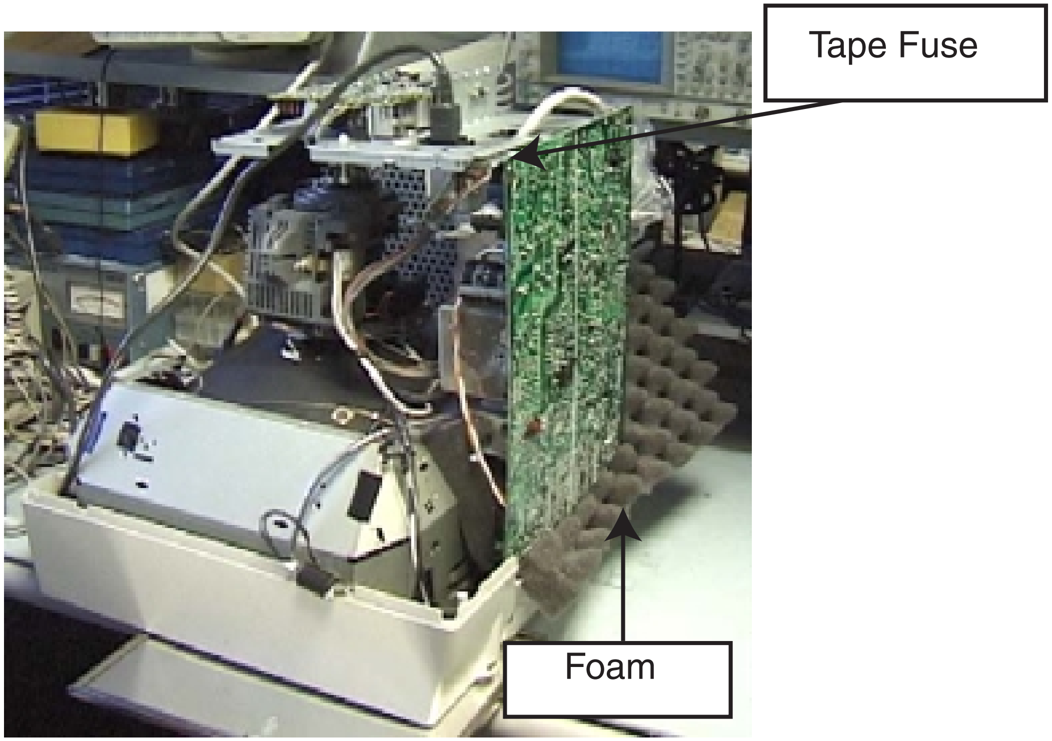
No HV Testing Position

Full Operational Testing Position

When the HV or the remainder of the protection circuits needs to be tested, the monitor must be fully powered.

Hints and Tips

- The D board shield must be removed for access to the D board from the foil side for troubleshooting.
- Rest the D board on a piece of foam, keeping the ON/OFF switch exposed.
- Cover the glass line fuse with tape to prevent it from shorting to the A board metal chassis.
- Make sure all boards have a secure black wire ground connection.
- A clothespin can be placed on the heat sink to improve vertical D board stability when probing.



Full Operation Test Position