

Technical Guide

LCD High Definition TV

**Models, TC-26LX20, TC-32LX20 and
Combo Model TC-22LR30
LH-34 Chassis**

Functional Overview, Circuit Description and
Troubleshooting



Panasonic Services Company
National Training

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Objective

This technical guide was prepared with the following objectives in mind:

- Provide the servicer with a brief overview of the concepts of operation for new circuits employed in this line of models
- Provide drawings with emphasis on the signal path to simplify the task of signal tracing and to locate the cause of a defect
- Furnish troubleshooting procedures that contribute to a expeditious repair of the product
- Provide examples of typical problems that may have occurred in similar types of circuits
- Provide updated information about changes reflected in the newer versions of LCD High Definition TVs. The TC-22LR30 LCD TV /DVD Ram combo is basically a TC-26/32LX20 model with the addition of a DVD Ram.

The DVD Recorder that has been incorporated in the LCD TV High Definition Combo unit is basically the same as that of the DMR-E65. The equipment used for servicing the DMR-E65 is same as the one used for servicing this model's DVD-RAM Drive .The only difference is that the DVD Recorder (DMR) has been downsized to a physically smaller drive.

Features

LCD Technology

The LCD AI (Artificial Intelligence) technology incorporated within this model is very similar to that covered in previous LCD models. The Pixel Control IC, in conjunction with the Main Microcontroller IC, located on the DG Board, is responsible for controlling the backlighting and the active matrix display addressing.

Backlight Brightness Control

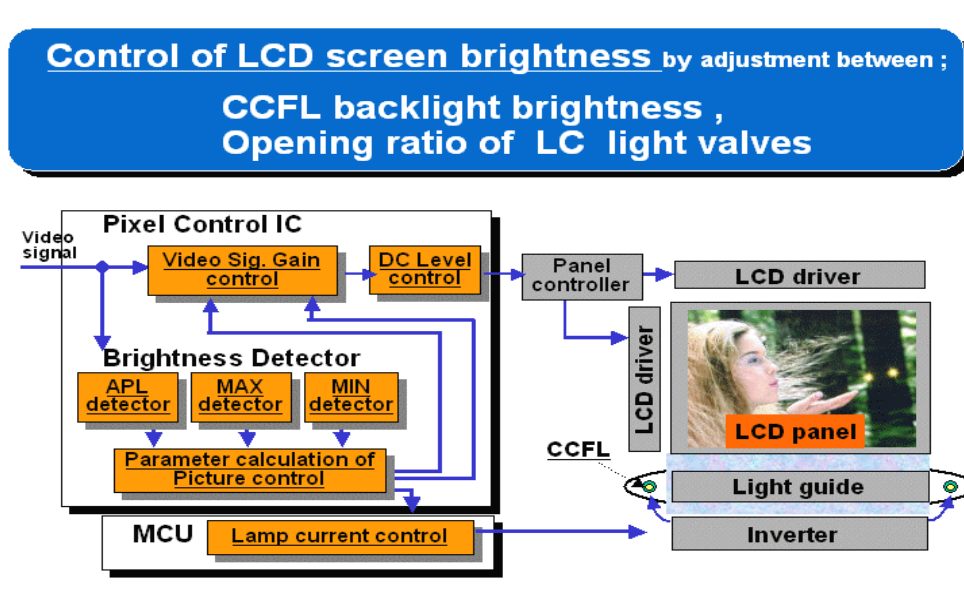


Figure 1

Dynamically balancing the white light produced from the backlight produces a clearer and crisper image.

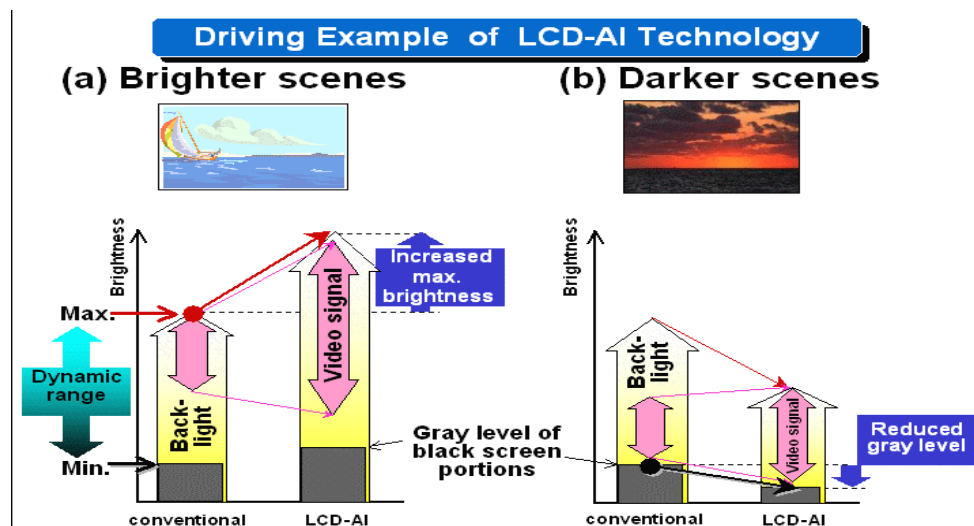


Figure 2

Dynamic Image Balancing

Enhancements have been made in the LCD AI technology as newer units evolve. This is an example of the improvements made in the luminance distribution in real time.

Dynamic Image Enhancement

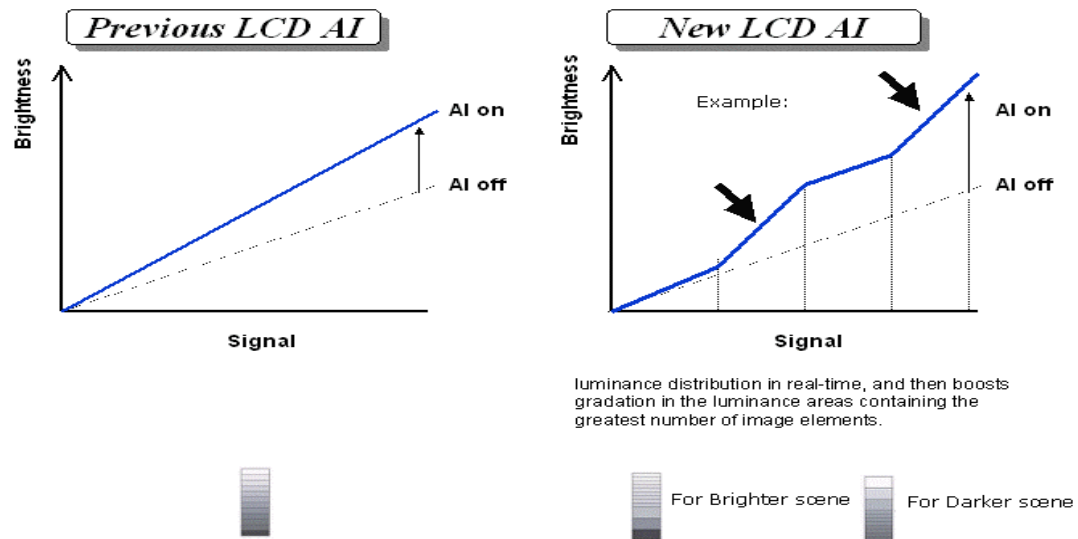


Figure 3

3D Y/C Separation

The luminance and chrominance of the composite video signals are separated using a three dimensional Y/C separation circuit commonly known as a Comb Filter. Dot noises or phenomena known as dot crawl and cross colors are reduced.

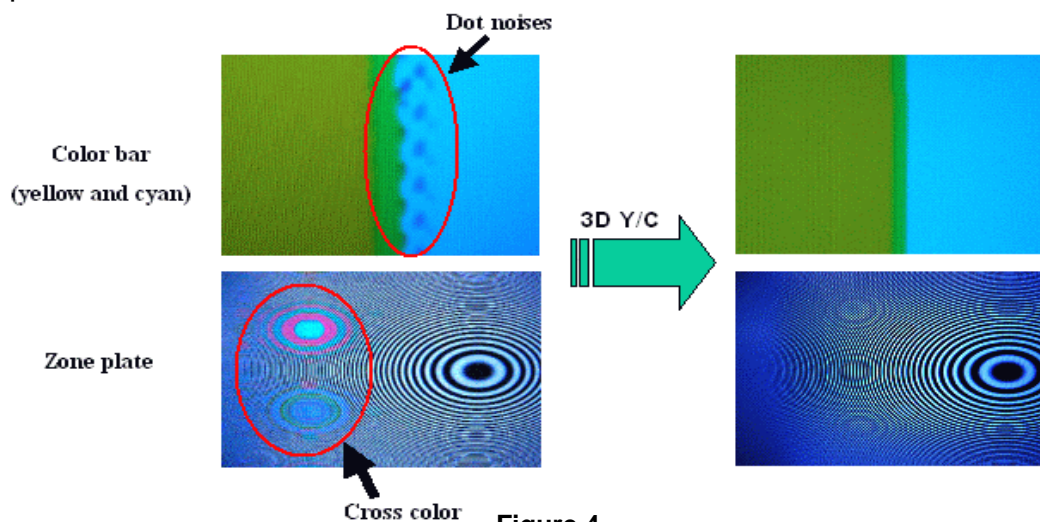


Figure 4

LCD High Definition TV Model Differences

Differences between Models

The significant differences between models associated with the TC-22LR30 combo unit (TC-26/32LX20 series) can be found in the following areas.

LCD TV Section

The GC3 Global core IC series that are used for the Video Signal processing, the Microcontroller, the Video SW, and the Audio SW are same as that of the LCD TV (TC-26/32LX20).

DVD-RAM Section

The DVD Digital C.B.A. (Circuit Board M8) is the same as that of the DVD Recorder (DMR-E65). However, the software that resides in (IC6702) is different.

The equipment used for servicing the DMR-E65 is same as the one used for servicing this model's DVD-RAM Drive .The only difference is that the DVD Recorder (DMR) has been downsized to a physically smaller drive.

Circuit Board A

The input and output signal lines for the DVD Recorder Circuit were added to the Video SW (IC3101).

The input and output signal lines for the DVD Recorder Circuit were added to the Audio SW (IC3102).

The MTS/SAP Audio Signal Process (IC3299) was added to record SAP to the DVD.

Circuit Board DG

The Main Micro controller (IC1106) software was modified from the previous model to incorporate communication with the DVD Recorder Circuit.

Circuit Board RD (Main DVD Bd.)

This Circuit Board was added to accommodate DVD Recorder.

Circuit Board M8 (DVD Digital Bd.)

This Circuit Board was added to accommodate the DVD Recorder. The Microcontroller (IC6001) on this Board is identical to the one that resides on the DMR-E65 Controller board and functions accordingly.

Circuit Board DV (HDMI Interface)

This Circuit Board was added to accommodate the High Definition Multimedia Input (HDMI).

Circuit Board P and AP

The Primary (P) and Secondary Power Circuit Board (AP) were changed to incorporate the voltages required to power the DVD Recorder.

Circuit Board Layout

TC-22LR30 Circuit Boards

The TV portion of the combo unit is very similar to that of the TC-26/32LX20 and is comprised of the following boards along with their associated part numbers as shown in this figure. Disassembly of this unit is much easier than the disassembly of the unit covered in the previous online course because the stand or base doesn't have to be removed for removing the rear cover.

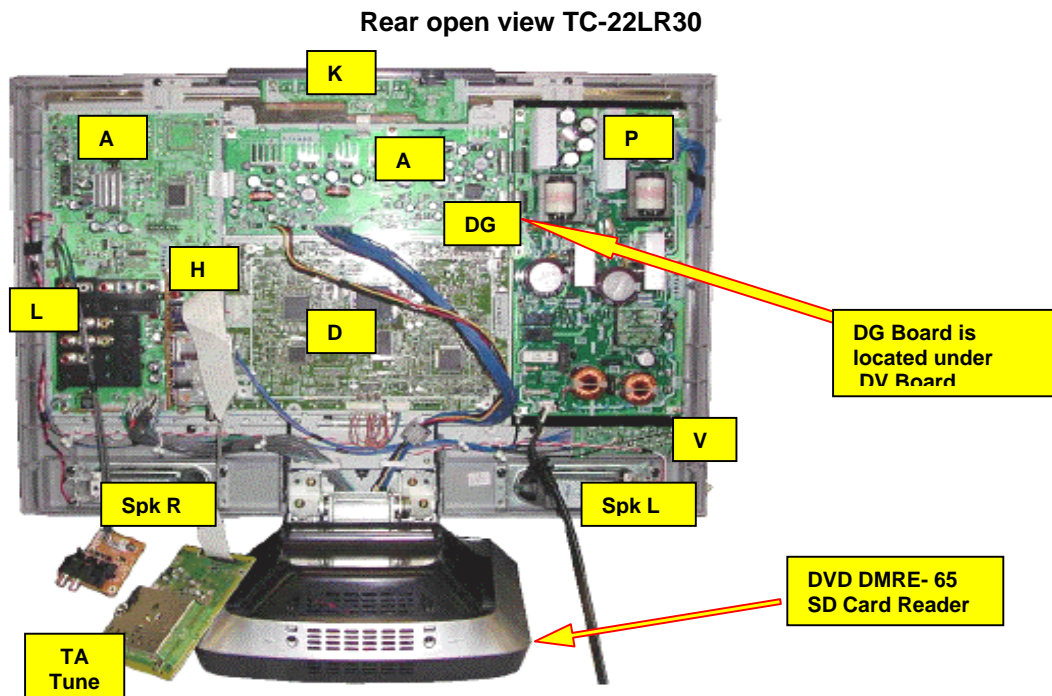


Figure 5

TV Portion Circuit Board Description

Board Name	Part Number	Description
	RFKZ0214	Extension Cable
DG	LSEP2163AE	Digital Core PCB
A	LSEP2164B	Input/Output Switching PCB
TA	LSEP2191A	Tuner PCB
L	LSEP2233A	Digital Audio Jack PCB
V	LSEP2169B	Front PCB
P	LSEP2189A	AC-DC Power PCB
AP	LSEP2232A	DC-DC Power PCB
HA	LSEP2199A	HDMI Audio Jack PCB
DV	TNPA3162AB	HDMI PCB
K	LSEP2170B	Top Operation PCB

Table 1

Circuit Board Interconnection

This diagram is intended to provide an overview of the interconnection of the various circuit boards of the TC-22LR30 LCD Combo Unit.

Circuit Board Interconnection

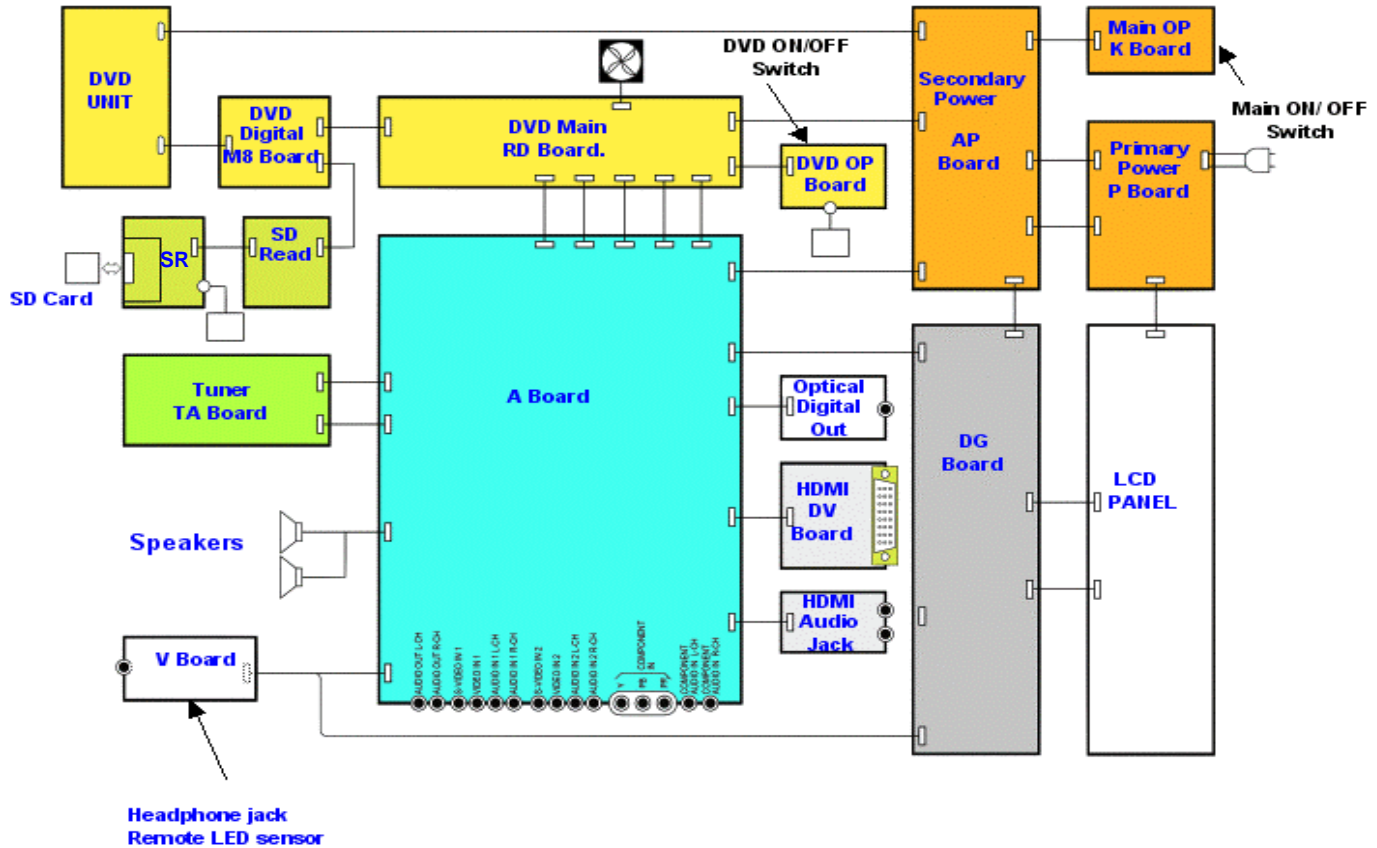


Figure 6

DVD Portion Circuit Board Description

Board Name	Part Number	Description
RD	LSEP2171B	DVD MAIN PCB
OP	LSEP2175A	DVD OPERATION PCB
SD	LSEP2234A	SD PCB
SR	LSEP2235A	SD JOINT PCB
M8	RD-DKK005-	DVD DIGITAL PCB

Table 2

System Control Block

The control signals responsible for the overall operation and control of both units are shown in this diagram along with their designated termination points.

- **Main Power switch** signal is derived from the power on switch, which is located on the K board. The Main Micro (TV Microcontroller), located on the DG board, sees this as a “key scan” input signal and issues a **TV ON** and **AC_On** to the control circuitry within the Primary and secondary power supply.
- **DVD Power switch** signal is derived from the DVD operation switch, located on the DVD OP board. This signal is responsible for initiating the power on sequence for the DVD operation. The Main Micro sees this as a “key scan” input signal.
- **Panel ON** signal appears on pin 28 of the DG board connector DG2. This is equivalent to an on/off switch for the LCD Panel.
- **Backlight ON /OFF (B/L On/Off)** signal provides the enable for the DC to AC backlight inverter power supply which is incorporated within the LCD Panel.
- **OSD Timing Compensator** synchronizes the OSD with the incoming video.
- **System Shutdown**
The Main Micro on the DG board is responsible for monitoring the various shutdown conditions. The Main Micro monitors the SOS and main voltage (Zero X Detect) detection signals via the DG2 connector.
- **LED Functions**
 - The Time Warp Led indicates that the DVD is recording at twice the normal record mode (operator's choice)
 - The SD LED indicates that the SD card is being accessed either for a read or a write operation
 - The DVD LED indicates that the DVD unit is being accessed either for a read or a write operation
- **TV Data In/Out** are DVD control lines used for playback and record.
- **DVD Play** switches the audio monitor output from all audio inputs to the DVD Output.
- **Wake Up** provides Serial data communication between the DVD Micro and Main Micro.
- **Fan Control** is accomplished through the use of a fan control circuit located on the DVD main circuit board. A PWM output signal from sub processor IC 7501 controls the speed of the fan, based on the internal ambient temperature of the unit

System Control Signals

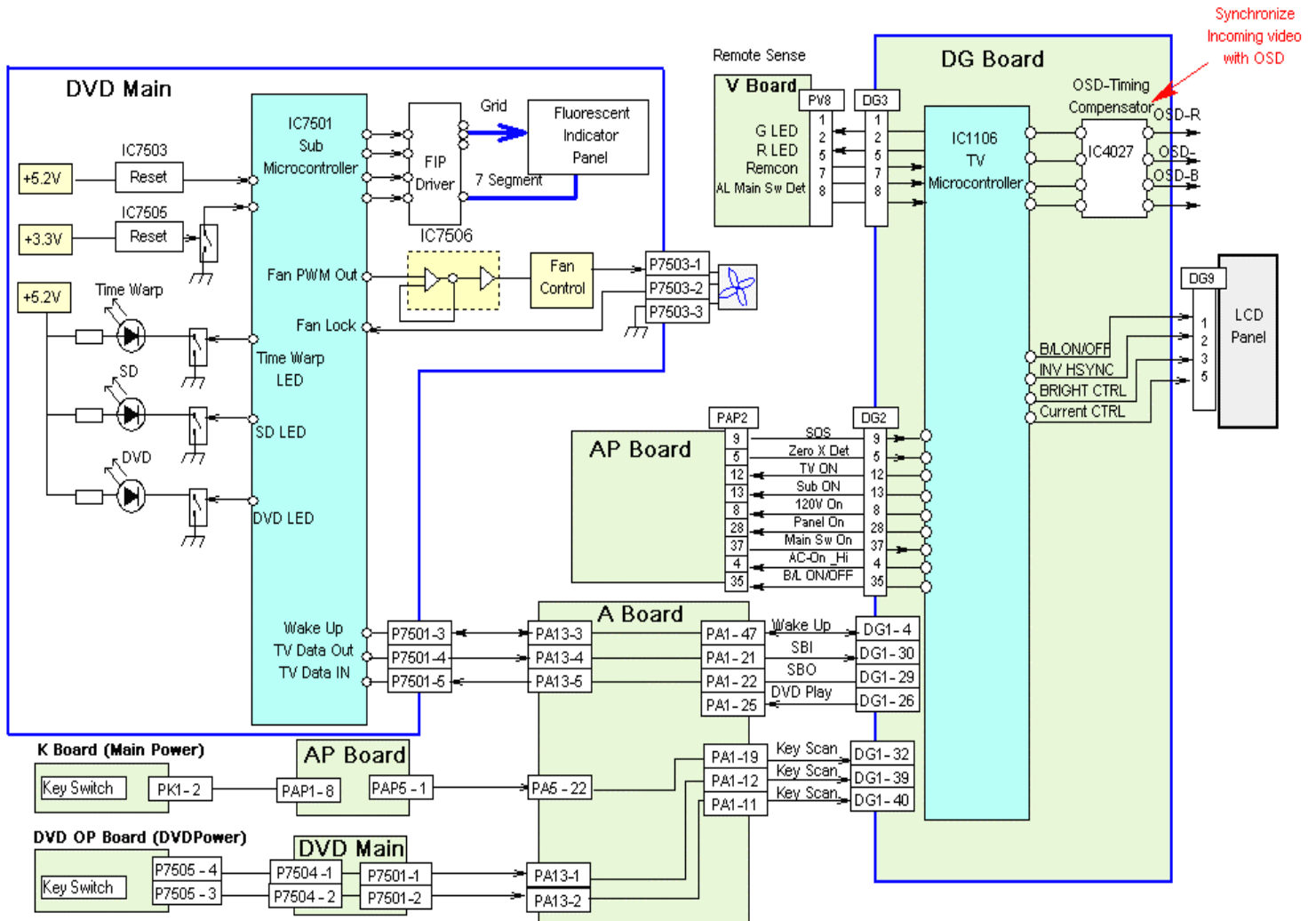


Figure 7

Circuit Board Description

A Board (TC-22LR30)

The A board serves as the main board and is comprised of the following:

- The Video Switch IC3101 is responsible for selectively switching all video inputs (Component, Composite, S-Video and HDMI). The selected input is fed to the DG Board via the connector A1.
- The Audio Switch (IC3102) selects the desired audio input for processing by the Sound Control (IC2301). The MTS (IC3103) performs stereo separation of the tuner's multiplex signal and sends the output to the audio switch.
- The TA tuner board on the TC-22LR30 provides the same functionality as the B tuner board found on the TC26/32LX20. The output is connected to the A board via connector PA7.
- The HDMI interface, which resides on the DV board, processes and converts the digital video and audio signals to analog and outputs them to the DG board via the video switch.

A board TC22LR30

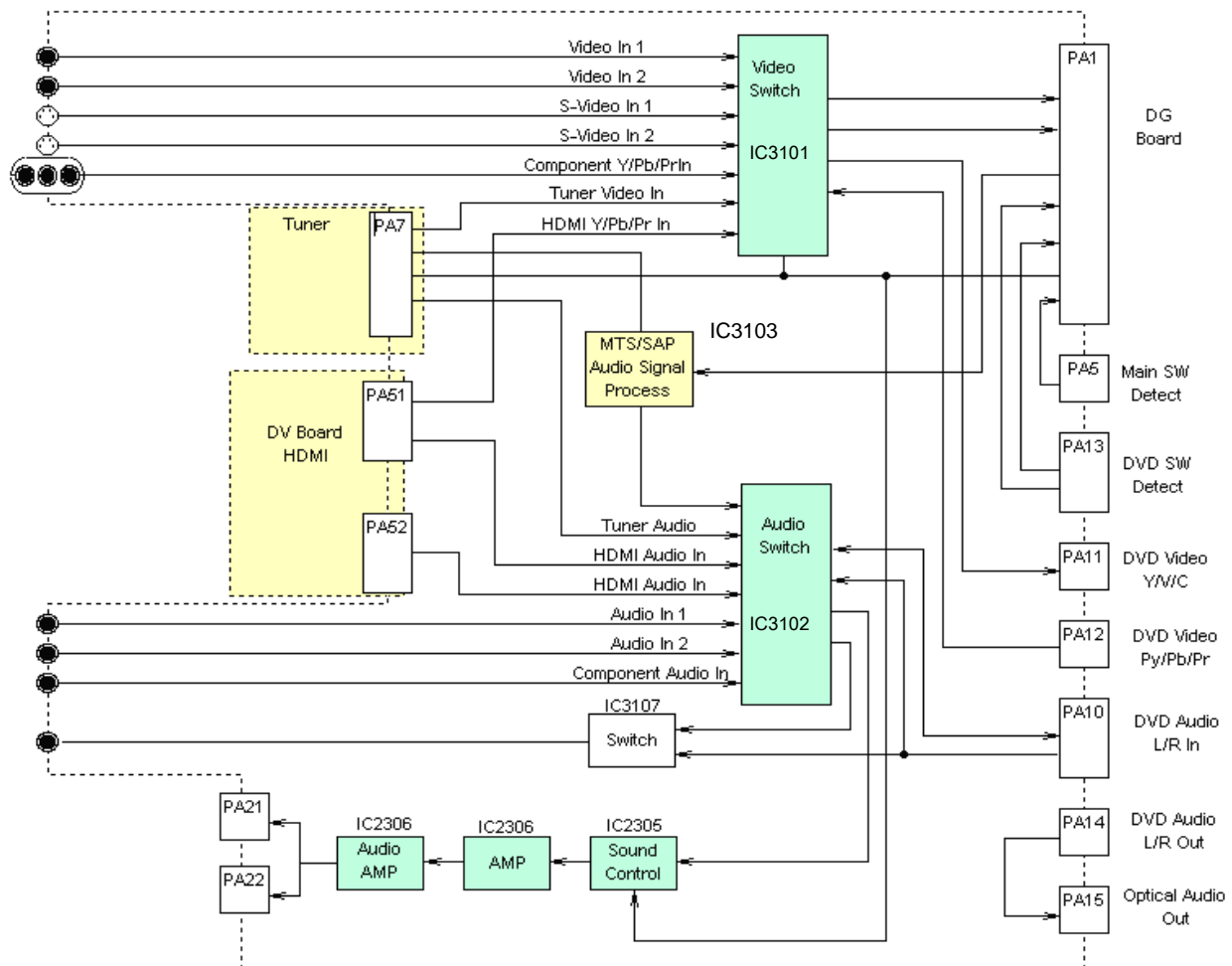


Figure 8

H Board (TC-26/32LX20)

The H Board on models TC-26/32LX20 is comprised of an S - Video and Composite video input connection, two Component video inputs, a DVI audio input and an Audio output connection. This board has been merged onto the A board of the TC-22LR30 Combo unit.

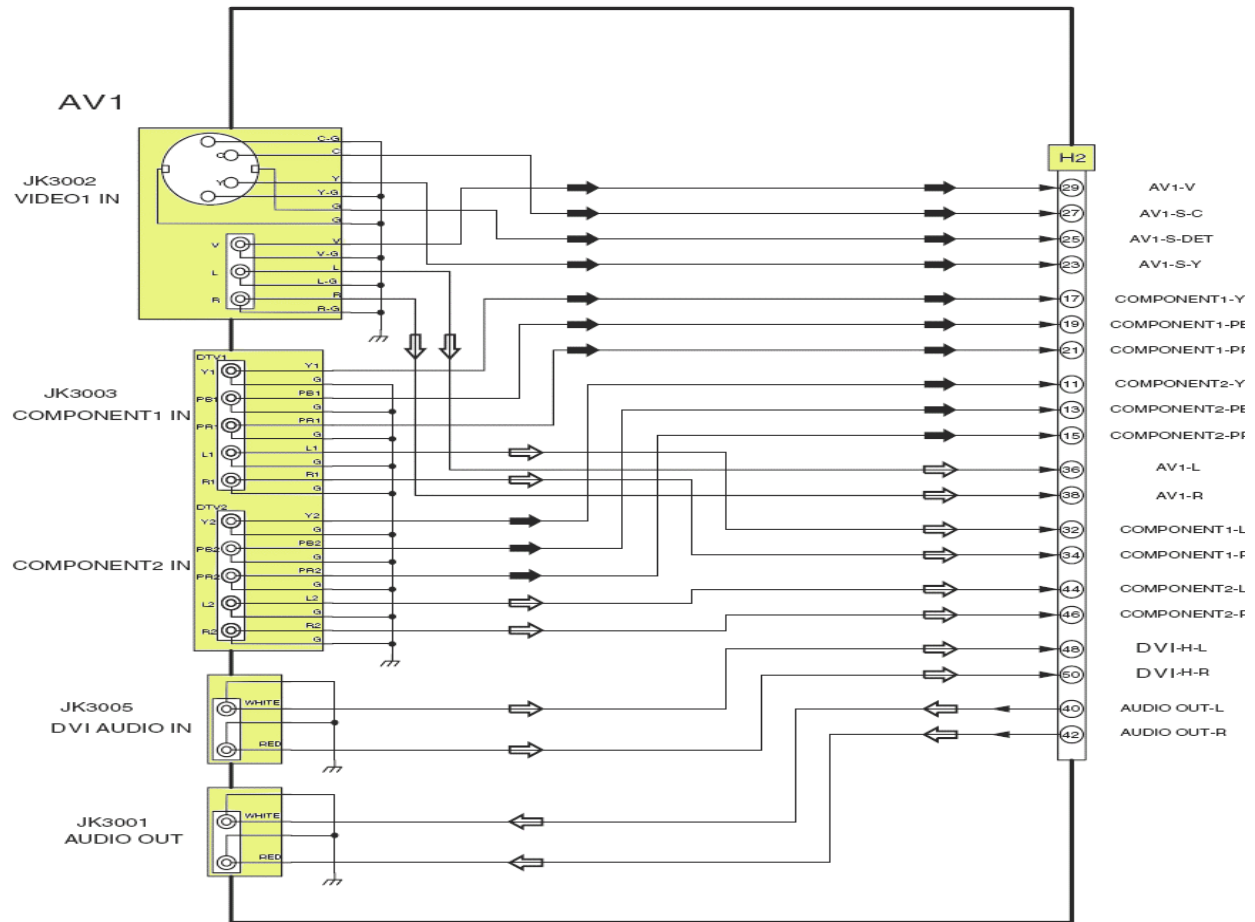


Figure 9

K board (TC-22LR30, TC-26/32LX20)

The K board contains the TV ON/Off, Volume, and Channel select buttons, and an additional S-Video and Composite video input connector and headphone jack. It connects to the A board via connector K3.

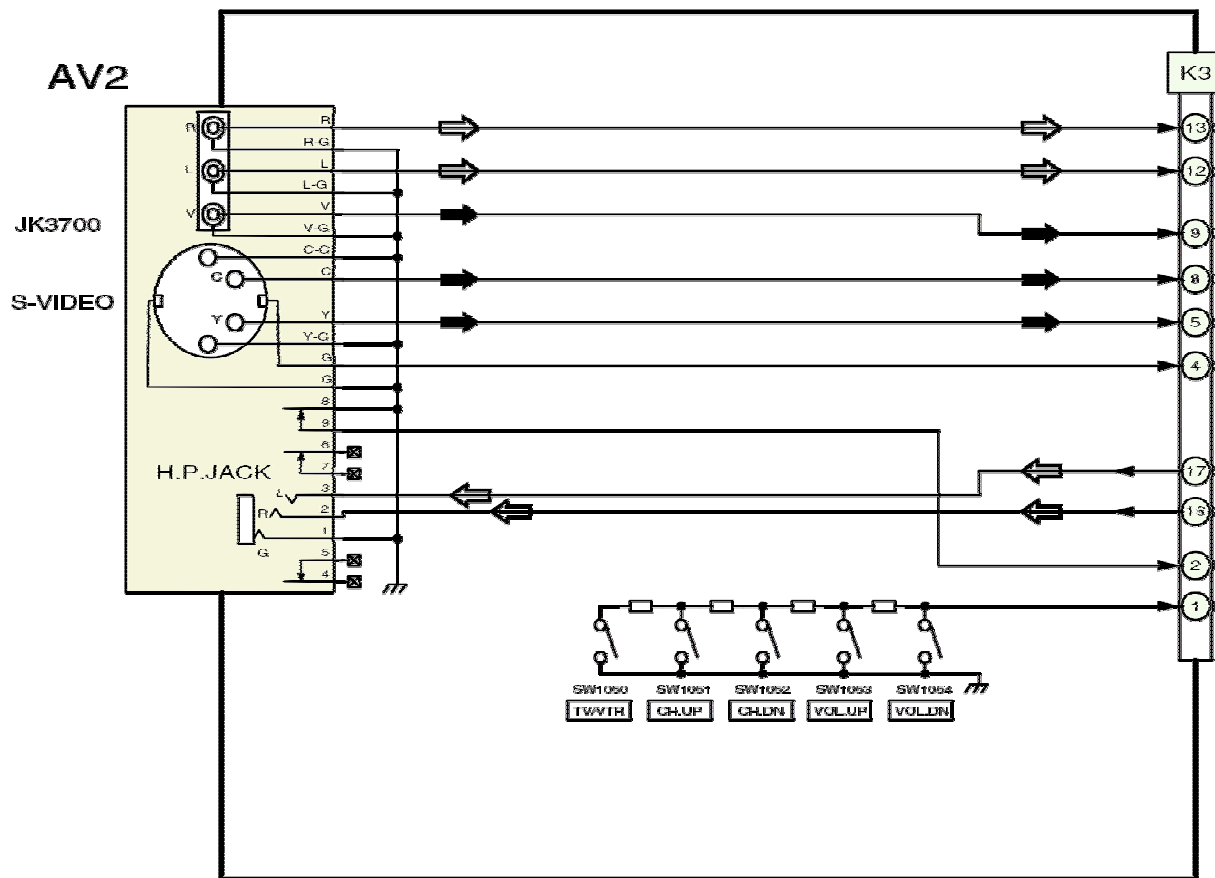


Figure 10

A Board (TC-26/32LX20)

The A board for the TC-22LR30 Combo unit is very similar to that of the TC-26/32LX20 model. The H board has been merged onto this model's A Board.

A Board TC26/32LX20

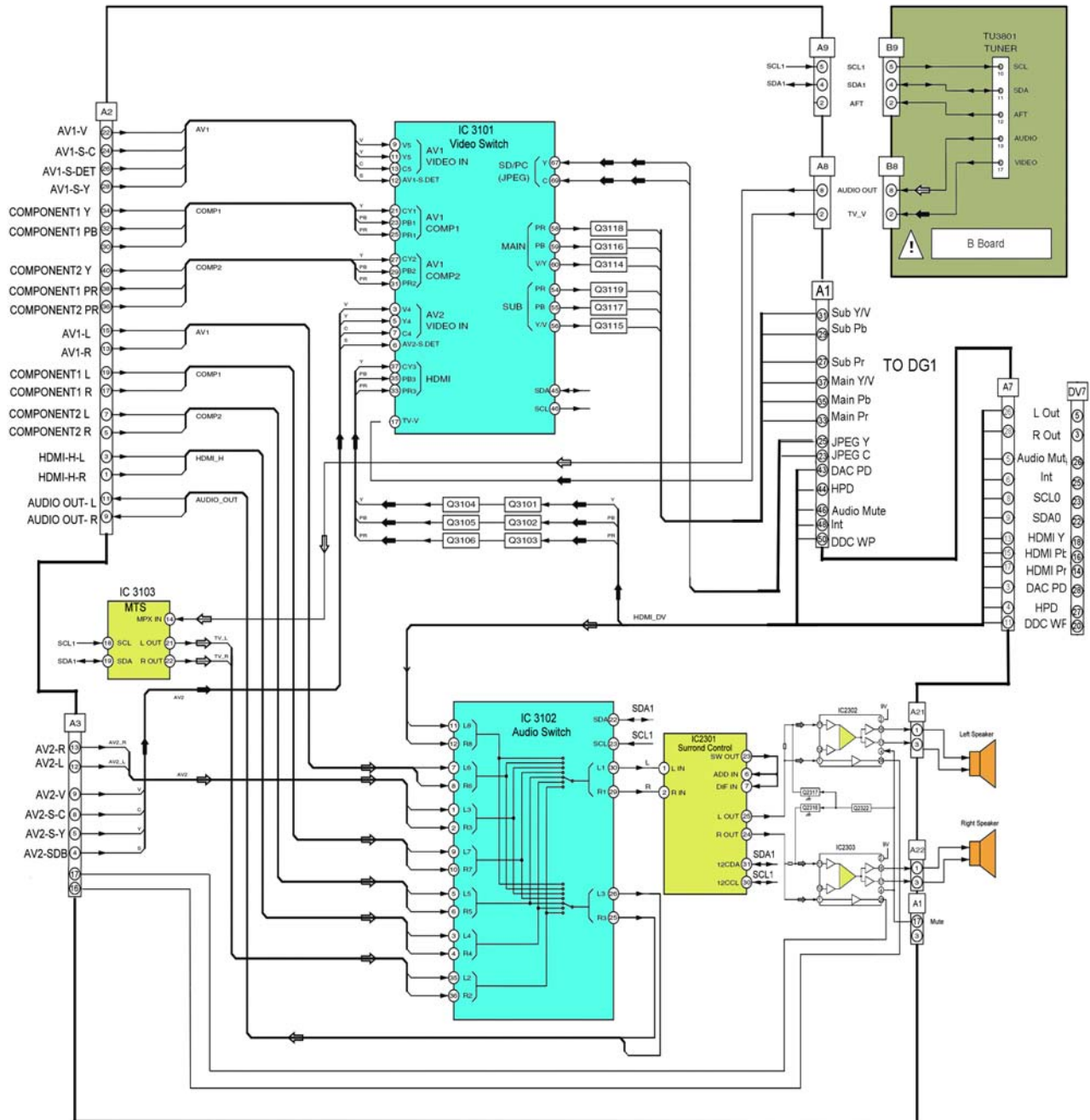


Figure 11

P Board - Primary Power

The Primary power supply is responsible for generating the following:

1. The standby power supply
2. The primary source voltage (14volts) for the secondary power supply.
3. Backlighting voltage (15 Volts) for the TC-22LR30

STANDBY POWER Circuit

The incoming AC voltage passes through the inrush current resistor R7001 and enters the rectifier circuit consisting of D7015, D7022, D7023, and D7024 for conversion to DC. The output is then applied to IC7005, a 7volt regulator. The 7volt output of the regulator is sent to the AP board for conversion into 3.3V. This 3.3V is provided to the DG board via pin 44 of the connector PAP2 to serve as standby voltage for the system control circuit.

14V POWER SUPPLY

When a power up command is sent by the system control IC (Main Micro IC1106 on the DG board), the AC_ON pin 47(connector PAP4 pin 13) sends a high to transistors Q7002 and Q7003 to activate the power relay RL7001. AC passes through the relay and enters the bridge rectifier consisting of D7005, D7007, D7008, and D7011. The diodes convert the AC voltage into DC, which is then applied to pin 3 of IC7003 via the transformer T7001. The voltage on pin 3 of this IC causes it to oscillate and output a PWM pulse to drive the transformer T7001. As a result, energy is built and released from the transformer.

The AC output at pin 11 and 14 of the transformer is rectified into 14 volts to serve as the primary source for all other voltages. After the power supply starts running, the Run Supply for IC7003 is supplied by diode D7033 connected to pin 8 of a secondary winding of T7001. AC voltage from pin 8 of the transformer is also rectified by D7034 and applied to a switching control (regulator) circuit consisting of Q7005. Output of the switching control IC is tied to pin 4 of IC7003 where it is monitored for over voltage conditions. Voltage regulation is achieved via the 14V Error Detection circuit, which consists of IC7006 and IC7008. The output of IC7006 is connected to pin 1 of IC7003, the same input as the Run Supply.

15V POWER SUPPLY

This circuit generates +15Vdc used on the AP board. This voltage is also used to power up the DC to AC converter for the backlight of the LCD Panel. The switched 14Volts (sw+14V., which is generated when the unit is powered up), in conjunction with the MAIN_ON_ACT (signal (H): approx.3.0V), allows Q7001 to turn on and activate the Relay (RL7002). The rest of the operation is exactly the same as that of the 14 Volts power supply.

AP Board - Secondary Power

The Secondary power supply is responsible for producing the various voltages that are required to power the DG board, the A board, the DVD unit and the LCD Panel VCC. These voltages appear on connectors PAP2, PAP5 and PAP6.

- The 15V supplied from the P Board Connector PAP4 is converted to the MAIN 12V, which supplies this voltage to the Audio AMP Circuitry located on the A board.
- When a MAIN_ON signal (3.3V) from Pin 69 of Microcontroller (IC1106) is issued to this board to turn off the Main power (MAIN 12V, 9V, 3.3V, 2.5V), the MAIN_ON signal is converted to MAIN_ON_ACT to turn off Regulators (IC801, IC806, Q801, Q803) which in turn terminates the Main power.

During normal operation the MAIN_ON_ACT signal (L) provides an enable to regulators IC801, IC806, Q801, and Q803, which provides for the appropriate output of the Main power.

AP Board Secondary Power Supply TC - 22LR30

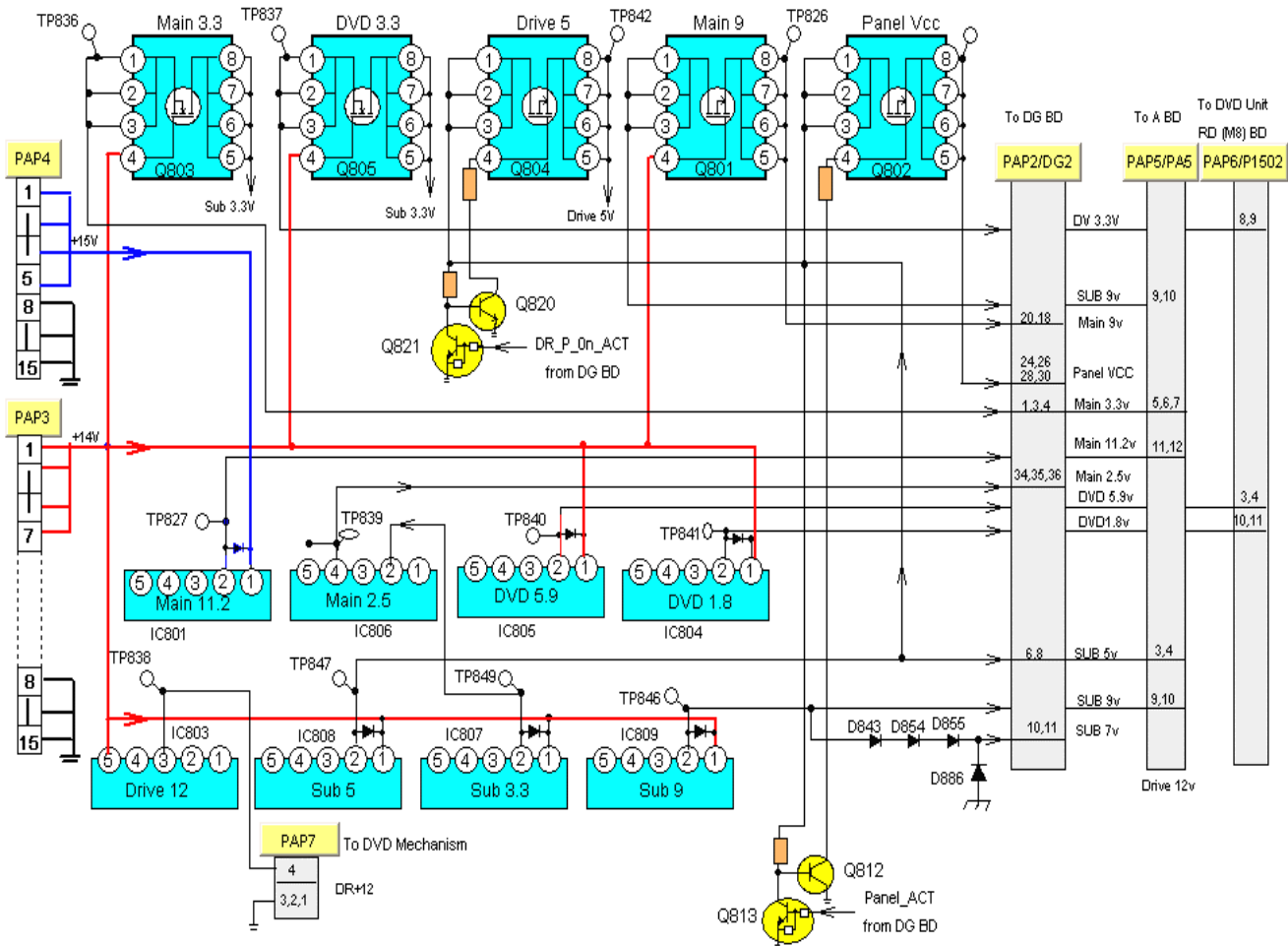


Figure 13

Tuner / FIP Power Supply (AP Board)

The circuit below, located on the AP board, is the power source for the NTSC tuner and the FIP. At power up, the 14Vdc created on the P board is applied to the collector of Q808 via pin 4 of the transformer T802. Instantaneously, The SUB_ON output of the microprocessor, converted into SUB_ACT, outputs a Low to the base of Q809 to turn it off. As a result, the transistor Q808 turns on via the startup resistor R815. Current flow through Q808 and the primary of the transformer causes a magnetic buildup in the transformer. When the transistor reaches saturation and current stops to flow, the output current at the other windings of the transformer is rectified into DC voltages that are used by the tuner and the FIP. To restart the operation of the circuit, feedback current is provided to Q808 via the capacitor C823 and resistor R820. Over-voltage protection is provided when the -30Vdc of the FIP circuit exceeds the reverse breakdown voltage of zener diode D811.

30-Volt Tuner Power Supply Circuit

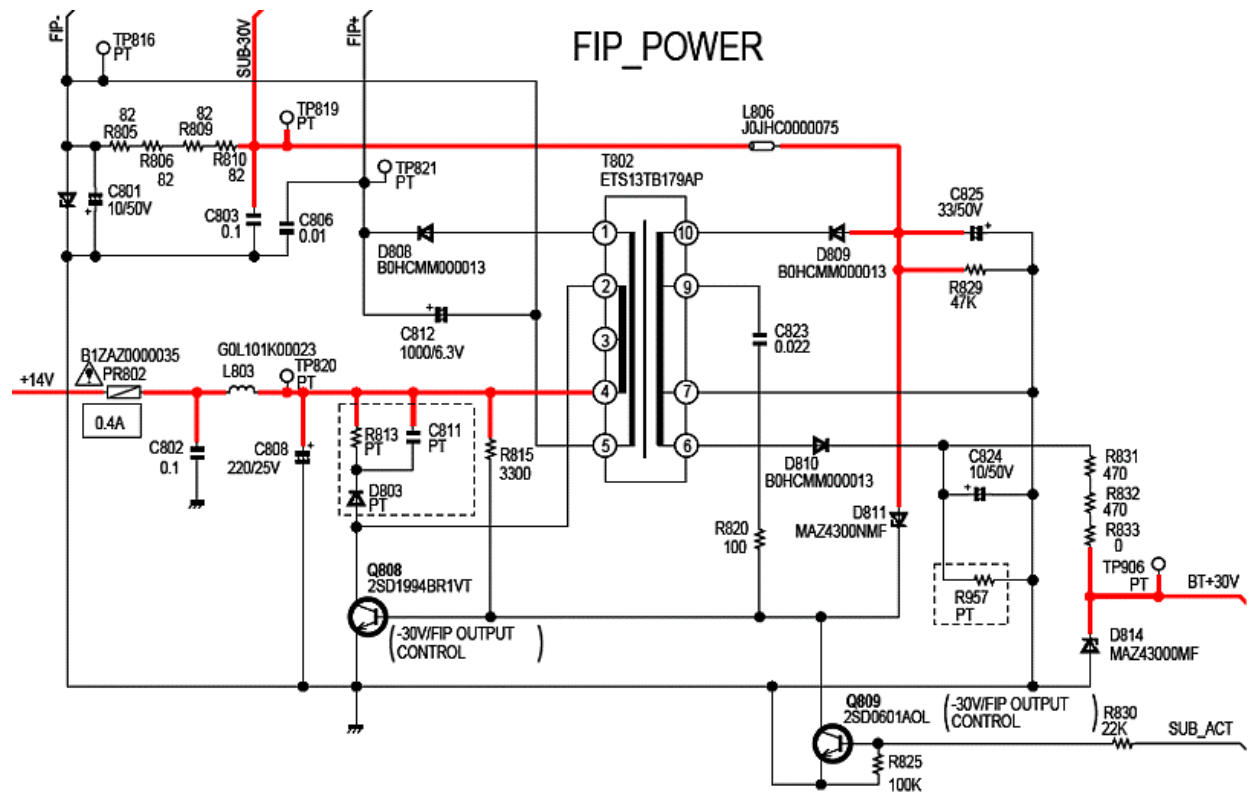


Figure 14

Over Current Protection Shutdown Circuits

There are several protection (shutdown) circuits that monitor the voltage sources for over voltage and over current conditions. They prevent the occurrence of catastrophic failures by shutting down the unit. The circuit below is used to prevent catastrophic failures if the Sub_5V, Sub_9V, Main_9V, or DR_12V becomes shorted. These are voltage loss detection circuits that have the same method of operation. Let us analyze the main 9V source as an example.

The circuit consists of a diode whose cathode is connected to a positive B+ source. Under normal conditions, the diode is reverse biased, which keeps the base of Q832 high. However, if there is a short or excessive load on the Main 9V line that is being monitored, the diode conducts, creating a current path for the base bias of Q832. The transistor turns on and allows 3.3V to output at the collector. This voltage is then provided to the base of transistor Q829 via the diode D874, forcing its collector to go low. This low enters the SOS input of the MPU via pin 42 of the connector PAP2/DG2. The MPU reacts by having AC ON (H) go Low. This, as you may recall, is supplied to the SUB POWER CIRCUIT of the P board to shut off the SUB Power (14V) and the MAIN Power (15V) voltage sources.

SOS Shutdown

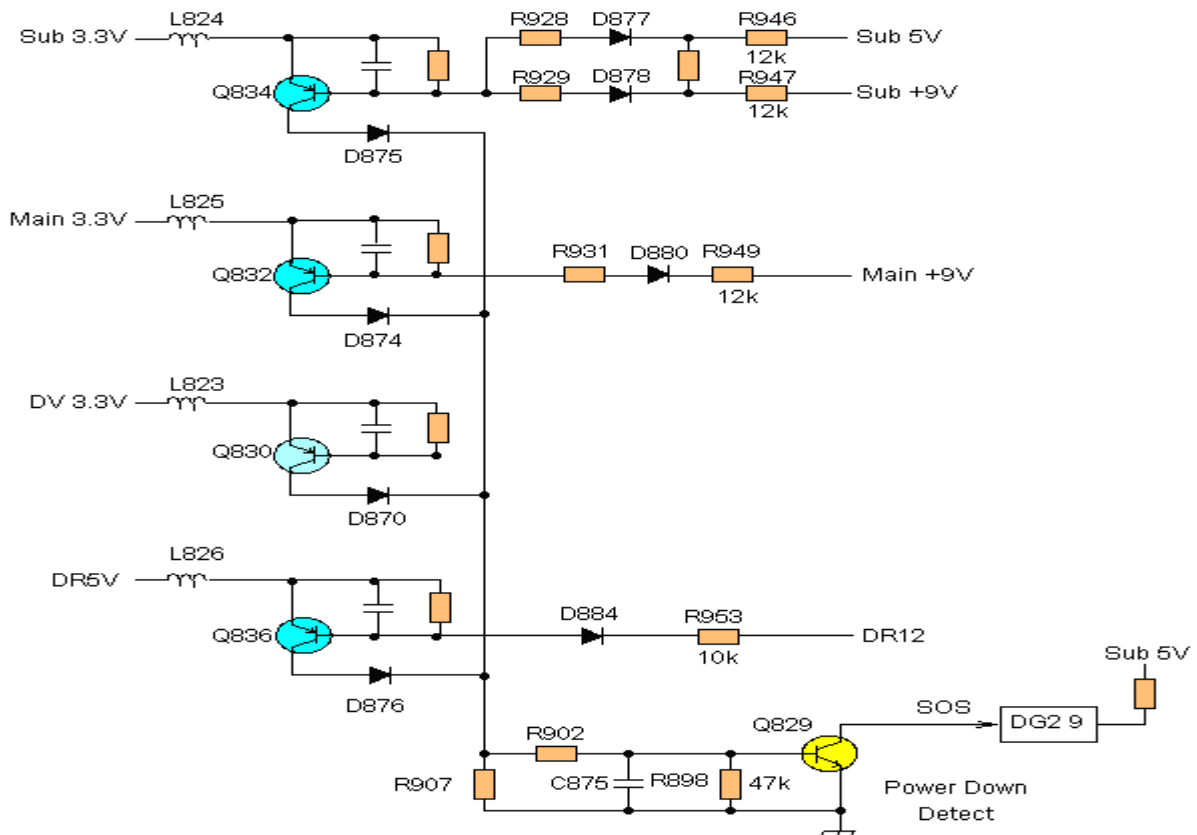


Figure 15

14-Volt Power Down Detect Circuit

The Zero X Detect circuit monitors the presence of the 14 volts source of the main power supply (P board) and the Sub_5V of the AP board. Under normal operation, pin 5 of the connector DG2 supplies a High to pin 61 of the MPU, IC1106. If, for any reason, the Sub_5V or 14 Volts lines drop or disappear, pin 5 of the connector DG2 becomes low level to trigger a complete shut down of the unit

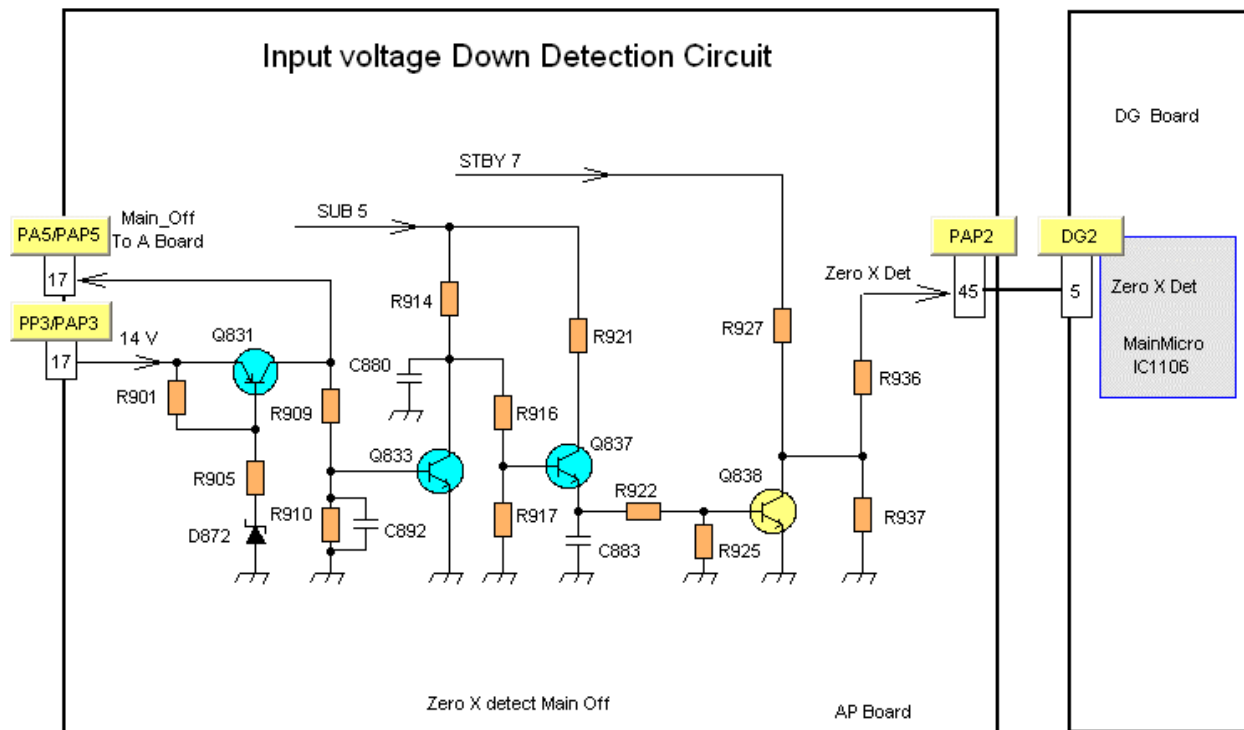


Figure 16

Over Voltage Protection _ AC Shutdown Latch Circuit

This protection circuit is responsible for forcing the AC _On voltage to a low if any of these protected voltages mentioned in the next paragraph become excessive. The AC _On voltage is used to activate the relay RL7001, which is used to power up the unit.

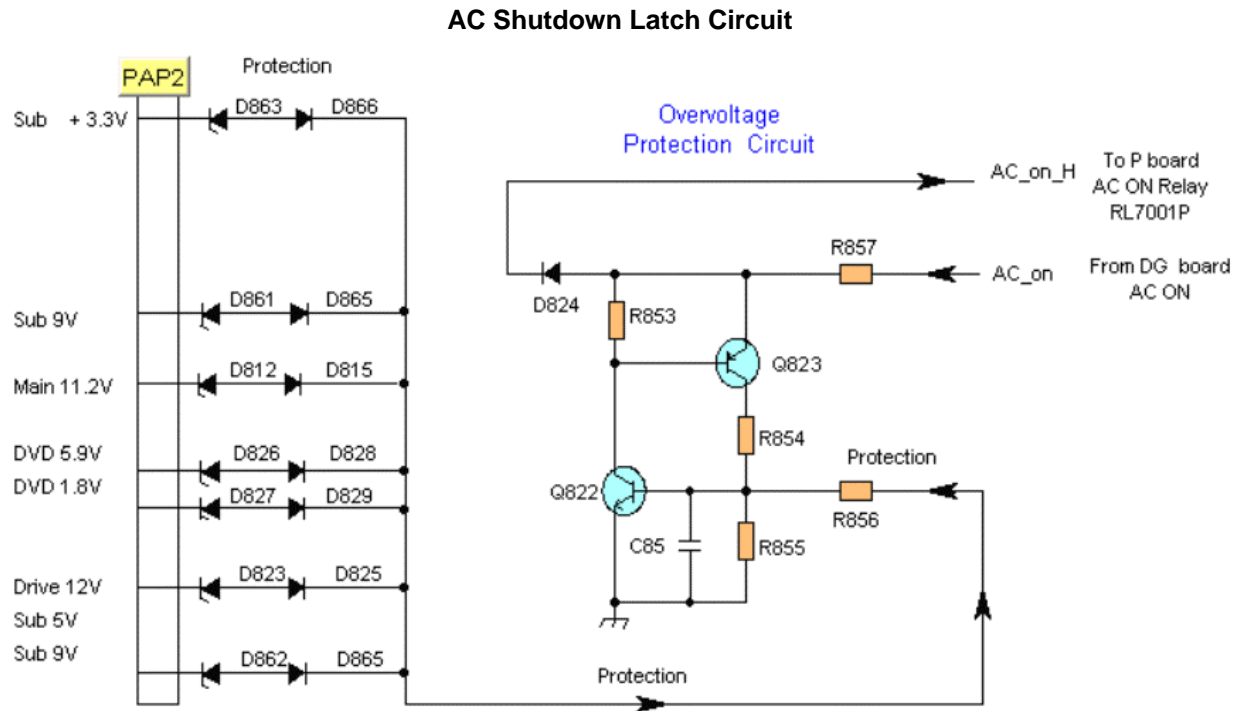


Figure 17

Transistor Q822 monitors the Sub_+3.3V, Sub_9V, Main_11.2V, DVD_5.9V, and DVD_1.8V; Drive 12V, Sub_5V, and Sub_9V lines. If any of these supply lines increase in voltage, transistor Q822 goes into conduction causing its collector to go low. As a result, Q823 conducts causing the AC _On voltage to drop. Transistor Q822 and Q823 form a latch that keeps the unit from being turned back on until it is unplugged from the AC outlet and plugged in again.

Power Supply (TC-26/32LX20)

The power source for all models is comprised of a Primary and Secondary power supply. The **P Board** is responsible for generating the primary source voltage used to supply power to the secondary power supply, located on the AP board. It also supplies the voltage that feeds the backlighting circuitry, which is incorporated on the LCD panel. Newer models such as the TC-22LR30 use a 15volt source that feeds this circuit (DC to AC inverter). However, the TC-26/32LX20 and TC-32LH models use 120 volts as input to this circuit.

P board (TC-32LH, TC-26/32LX20) - Primary Power

The Primary power supply is responsible for generating the following:

- The primary source voltage (24 volts) for the secondary power supply
- The 7-volt standby voltage for the system control circuit
- Backlighting voltage 120 Volts for the TC-32LH, TC-26/32LX20

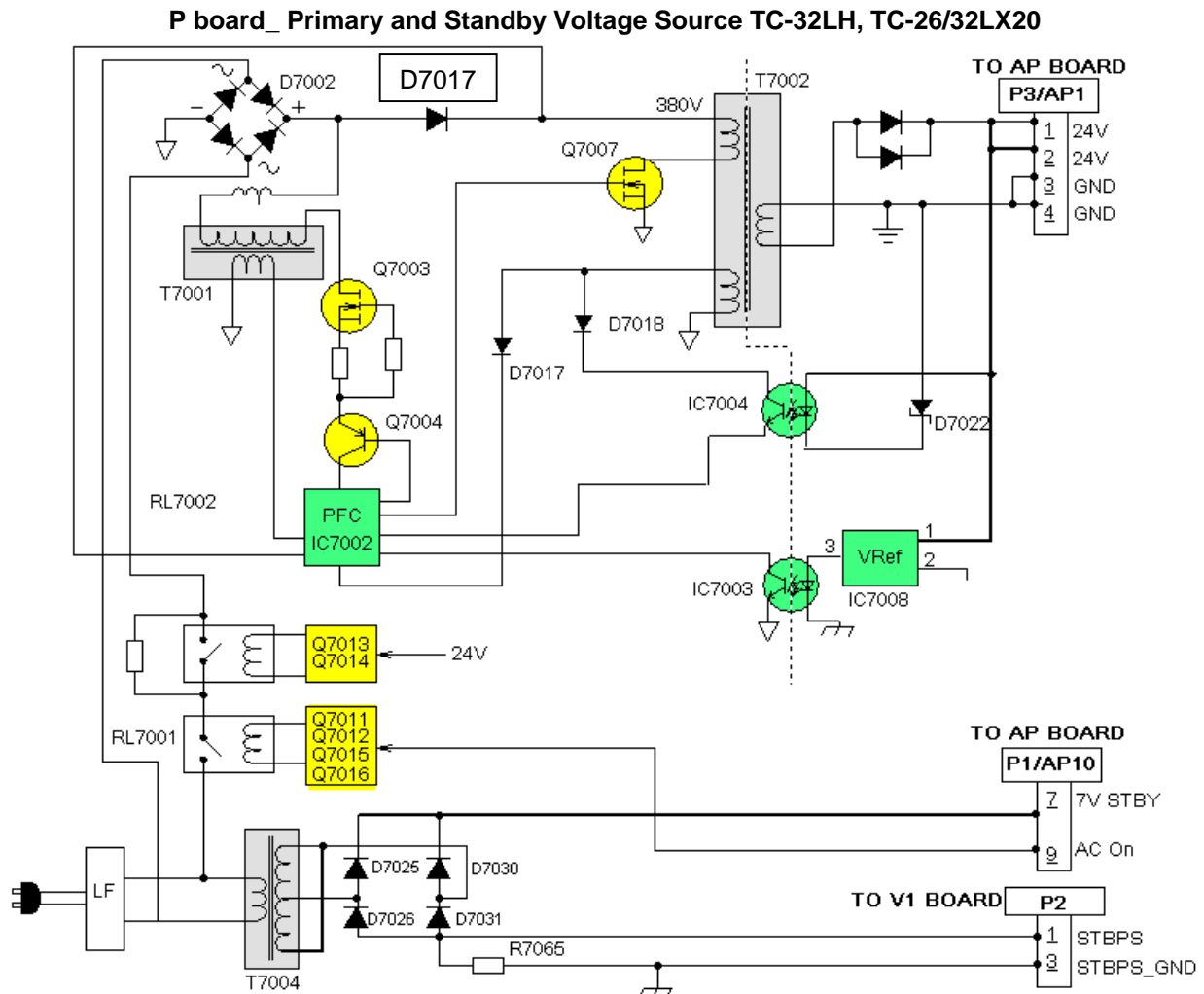


Figure 18

Standby Power Supply

The standby power supply provides the necessary DC voltage to the system control Microprocessor, the Reset circuit and the EEPROM. A.C. voltage is supplied to the Full Wave rectifier (D7025, D7026, D7031, D7030), through the Line Filter and Transformer T7004. The 7volts standby voltage produced by the rectifier is present as long as the unit is plugged in.

The 7volts output passes through the AP board and enters the DG board where it is regulated to 3.3V and fed to the system control circuit. Although the unit is plugged into the wall outlet, the main power switch located on the front face of the unit must be in the ON position for the unit to enter and remain in the standby mode.

Primary Power Supply

When the system control circuit obtains a power up command from the operator, the AC_ON pin of the MPU, IC1105, outputs a high to the relay control circuits Q7011, Q7012, Q7015 & Q7016 to activate the relay RL7001. The AC voltage enters D7002 for rectification into 24 volts DC where it activates the relay control circuits Q7013 and Q7014 to activate relay RL7002. The DC level is then boosted to 380Vdc by the Power Factor Control (PFC) circuit, IC7002. The power factor control circuit is made up of an oscillator used to control the charge and discharge time of the transformer T7001. Start up voltage for the circuit is obtained at the output of the D7002.

As the PWM pulses are output from IC7002, the transistors Q7003 and Q7004 are switched ON/OFF to allow the charge and discharge of the transformer T7001. The charge of T7001 is added to the rectified voltage of D7002 to create 380V. IC7002 also outputs a PWM output that turns the transistor Q7007 on and off to control the charge and discharge time of the transformer T7002. The secondary output of the transformer is rectified to 24Vdc and supplies the AP board. The diode D7017 rectifies the AC output of one of the secondary windings of the transformer T7002 to serve as Run Supply for IC7002. The 24Vdc output is monitored via IC7008 and IC7003 for voltage regulation. The output of this power supply is also monitored for excessive voltage by D7022 and IC7004. If the output rises to 30 volts or more, the zener diode D7022 goes into conduction, causing the photo-coupler to conduct and stop the operation of IC7002.

Power Supply Operation (TC-32LH, TC-26/32LX20)

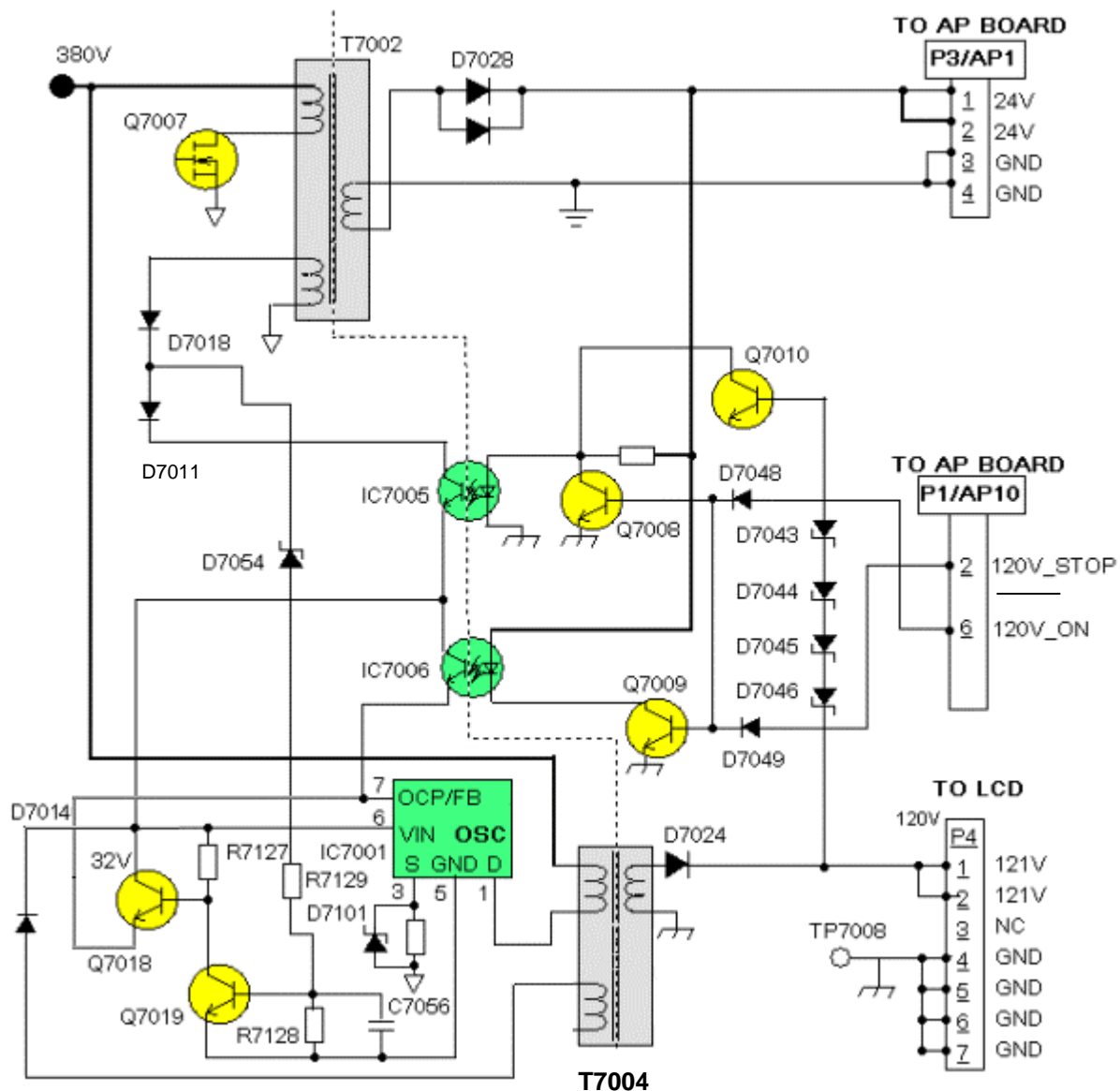


Figure 19

Power On Operation of the DC-to- DC converter

The P board contains the drive voltage oscillator circuit that develops the 121 volts needed to drive the LCD backlight. Operation begins with the discharge of transformer T7002. The diode D7018 rectifies the AC voltage from the secondary of the transformer. Approximately 30.1Vdc from the diode passes through the photo-coupler IC7005 and

enters pin 6 of IC7001 to begin the oscillation. The pulses that are output at pin 1 of the oscillator enter the transformer T7004, causing it to build a magnetic field. The output of the transformer is rectified into 121Vdc and provided to the LCD panel via the connector P4. When the rectified output of the transformer reaches 90Vdc, the diodes D7043, D7044, D7045, and D7046 go into conduction, turning on transistor Q7010 and thereby, turning off IC7005. This eliminates the start up voltage of IC7001. The oscillator continues to operate using the run supply created by a secondary of the transformer T7004 and the diode D7014. See Figure 19.

Power Off Operation of the DC-to-DC converter

When the unit is turned off, the 120V_Stop command is provided at pin 2 of the connector P1/AP10. This causes the transistors Q7008 and Q7009 to turn on and stop the conduction of IC7005 and IC7006. See Figure 20.

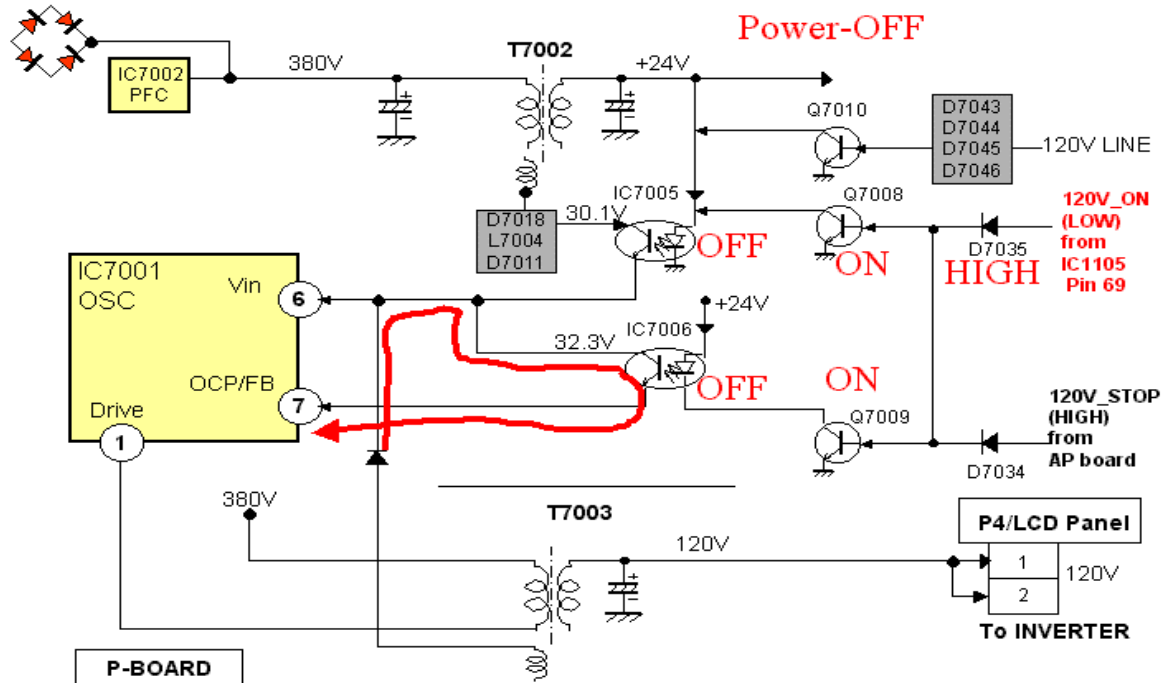
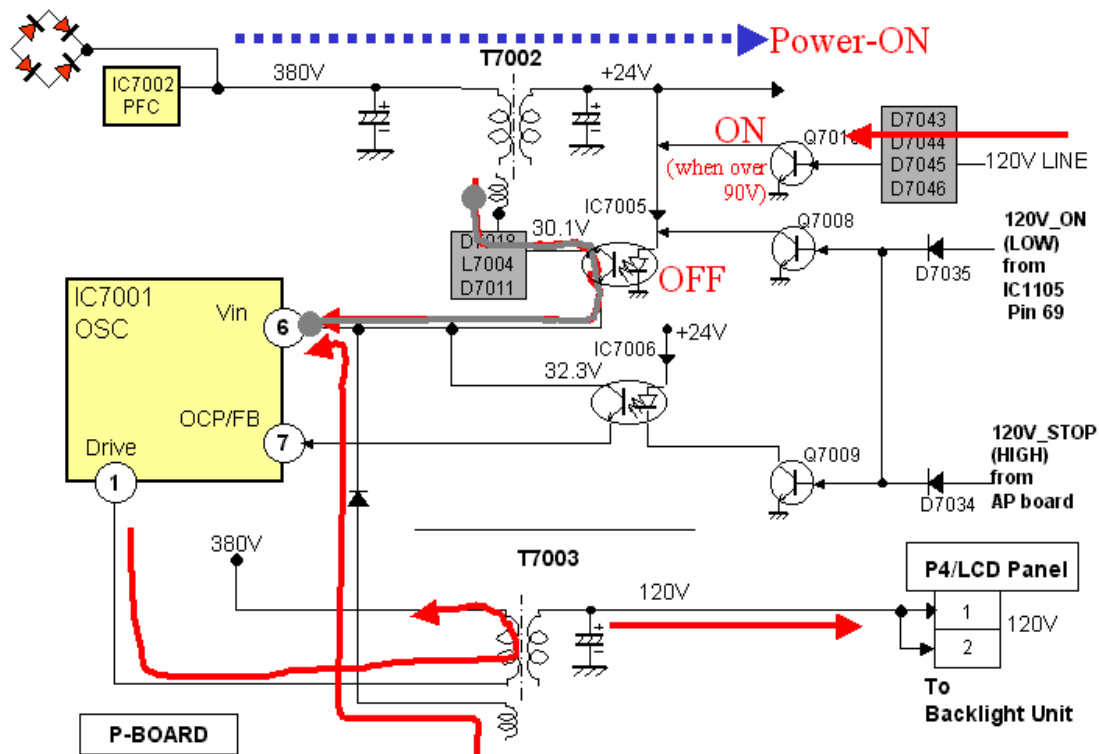
The 120V_Stop line is designed to stop the operation of the backlight DC-to-DC converter if there is a drop or an increase in the 24 volts supply to the AP board. Pin 2 of the connector P1/AP10 inputs a High to the P board causing the transistors Q7008 and Q7009 to turn on. This causes IC7006 to immediately turn on and short pins 6 and 7 of IC7001. This action stops the oscillation of IC7001. To keep the oscillation of the IC from starting again, the DC supply is grounded through Q7008.

Protection of the DC-to-DC converter

Over-current protection of the circuit is provided at pin 7 of the IC7001 from the emitter output of Q7018.

Over-voltage protection of the primary is provided via the diode D7054. If the rectified voltage of D7018 exceeds the operating voltage of IC7001, the diode D7054 conducts and applies DC to the base of Q7019. The transistor Q7019 turns on and causes Q7018 to turn off, effectively removing the feedback voltage to pin 7 of IC7001. This action stops the operation of the oscillator.

This is a simplified overview of the activity that occurs within the primary power supply section when the unit is turned on.



AP Board - Secondary Power Supply

The 14 volts derived from the primary power source on the P board enters the AP power board, on the designated connector. The various voltages derived are used to power the DG board, the Audio Control circuitry and the Tuner. If the 24volts shuts down, a 120volt stop signal is generated which causes the unit to shutdown.

AP Board TC-26/32LX20

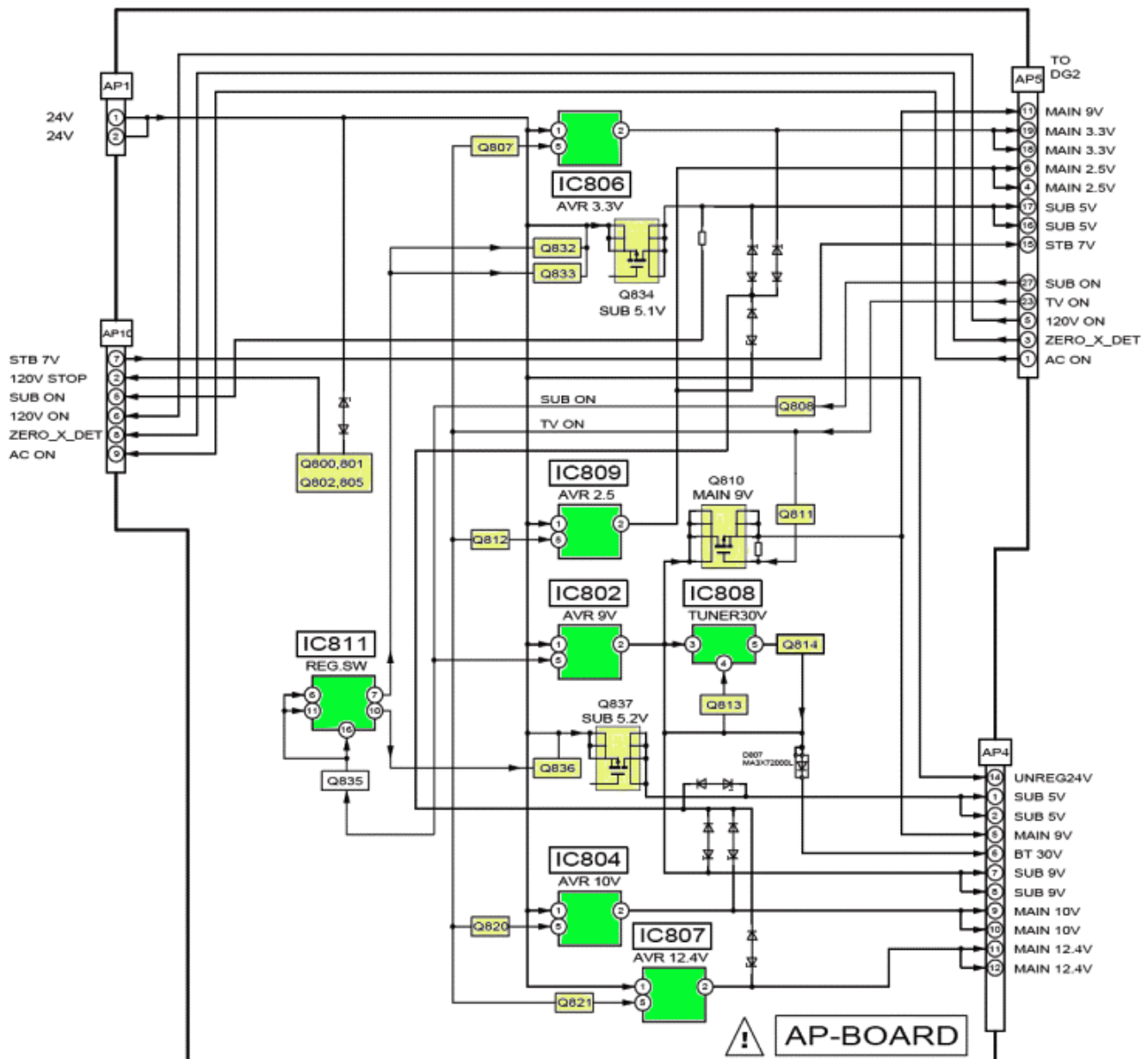


Figure 22

Secondary Voltages

The Main 3.3V, 2.5V and Sub 5V, are used to provide power to the DG board. IC802 provides a regulated 9 volts to IC808, which serves as the voltage source for the tuner. Its output is 30 volts. The Main 9,10 and 12.4 volts supply the secondary source voltage to the rest of the unit.

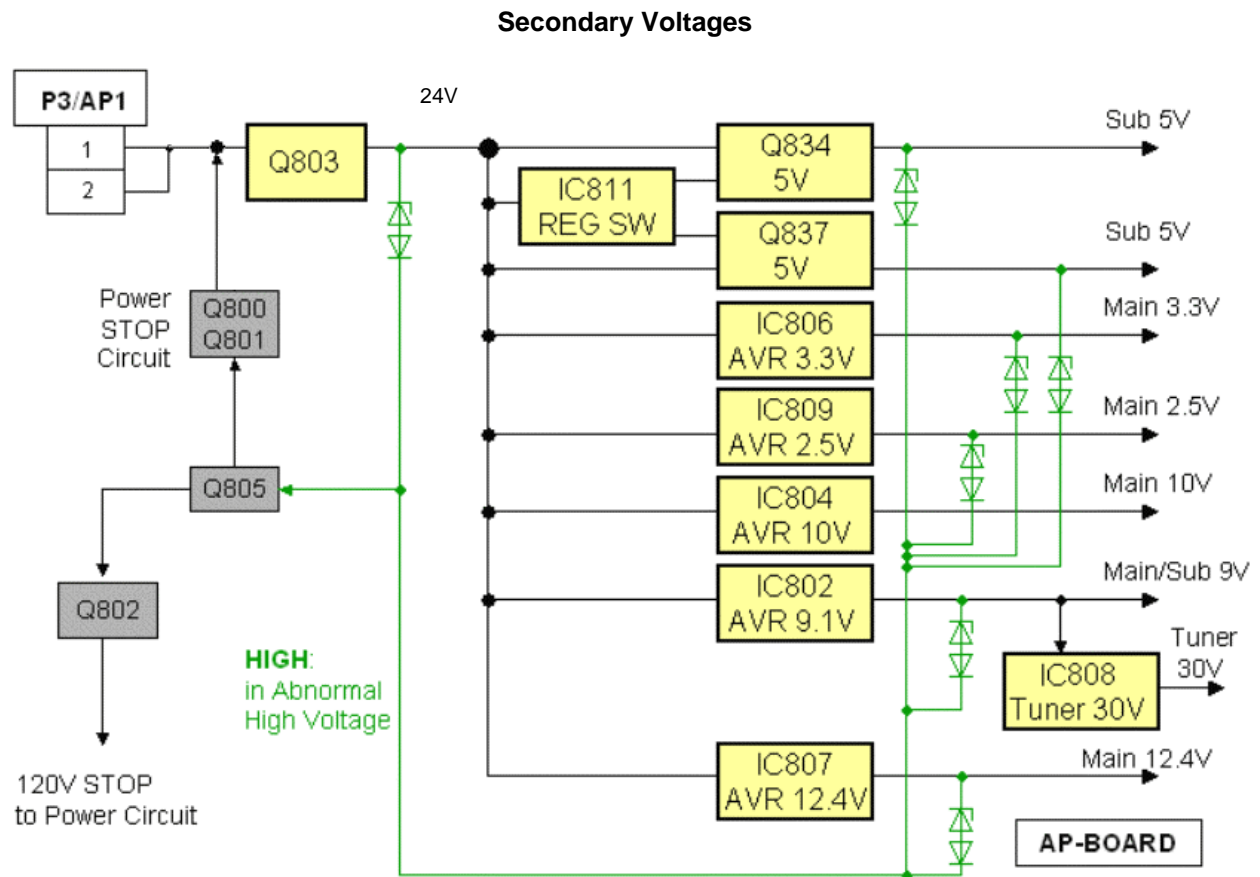


Figure 23

Video Circuit Explanation

A Board

The A board serves as the entry point for all video signals that will be selectively processed by the DG board via Video Switch IC3101. The main microcontroller, which resides on the DG Board, is responsible for the selection of the designated video input through the use of the I²Bus select lines. Two composite, two S-Video inputs, a Component, a single Tuner, an HDMI video, and a DVD video interface are selectively switched for video processing on the DG board. Connectors PA1 and DG1 serve as the signal access point.

- Video read from the SD Card is processed by the DVD main unit (M8 and RD) where it enters the Video switch as DVD component Y/Pb/Pr video. Its output appears on connector PA1 as Main Y/Pb/Pr video where it enters the DG board on connector DG1 pins #37, 35, and 33.
- HDMI video from the DV board enters the video switch as HDMI Y/Pb/Pr and is also switched to the Main Y/Pb/Pr video input on the A Board
- The NTSC tuner inputs, and the S-video and composite inputs to the video switch appear on DG1 pin 37.

Video Path.

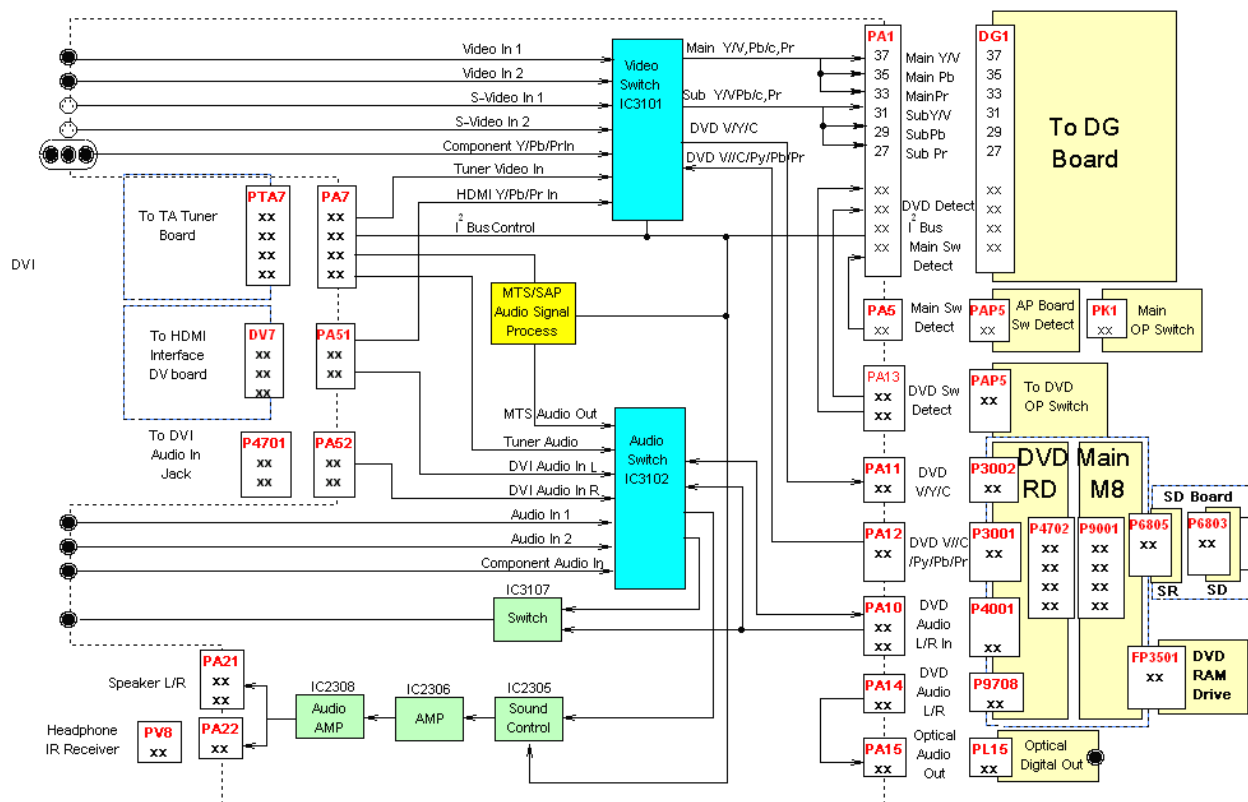


Figure 24

DG Board

The DG Board is responsible for processing all incoming video signals from the A board. The Video input signals are processed and converted into the LCD format required to drive the LCD Panel. This is accomplished by the main global core IC GC3FM (IC4011) and Video Signaling Processing IC4002.

The Microcontroller, IC1106 (DG board), controls the incoming video signals on the Combo Unit (TC22LR30) in the same way as it does on the TC-26/32LX20. The difference, however, is the addition of a serial data line between IC1106 and the Microcontroller IC7501, located on the DVD RD board.

The main Microcontroller IC1106 is responsible for the following:

- Decodes the remote control input code
- Provides Channel selection
- Global Core control
- Sound volume control
- OSD Display. The OSD data that pertains to the DVD recorder is processed by Microcontroller (IC6001), which resides on the M8 board. The TV OSD is mixed with the DVD OSD on this board and is fed to the Video Switch (IC3101), which is located on the A Board.

DG Board Layout

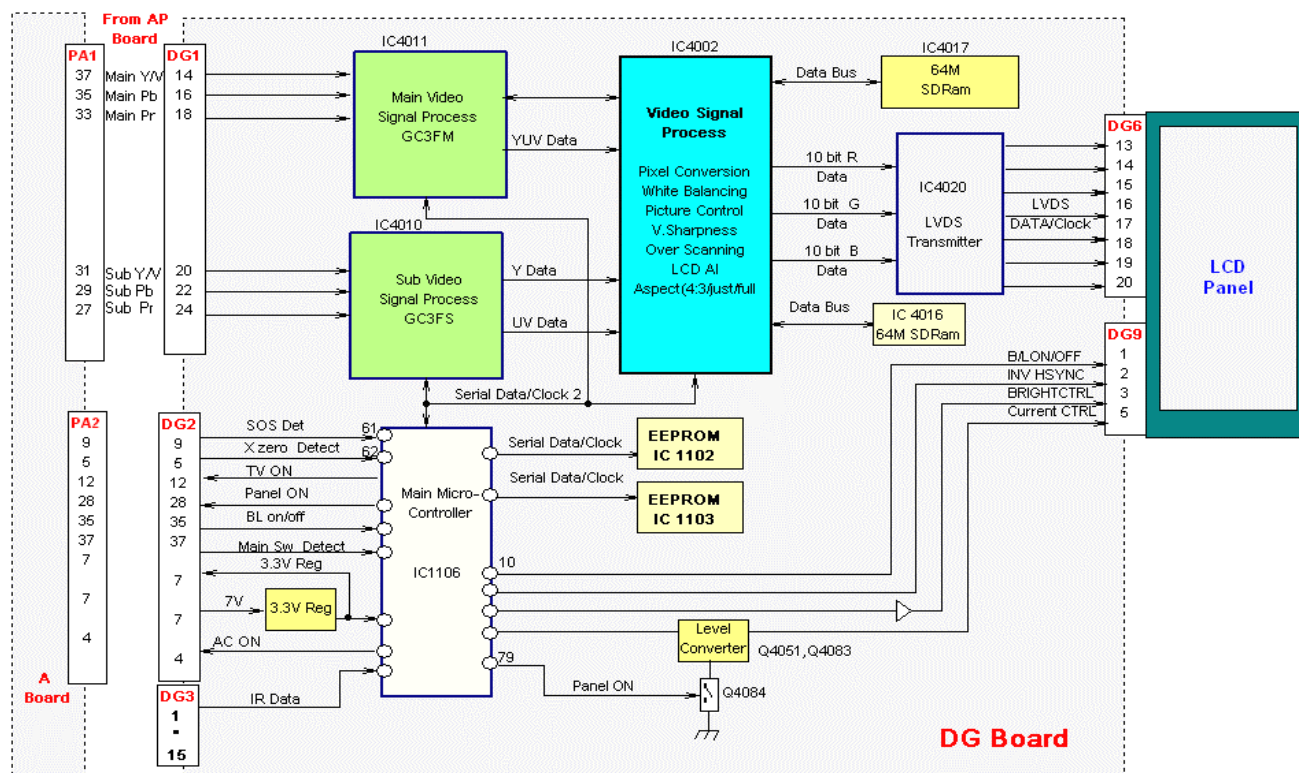


Figure 25

Video Signal Processing

All NTSC video signals are converted to digital data by the analog to digital (A/D) converter circuit located inside the Global Core IC, IC4011. The comb filter in IC4011 converts the composite video signal of the main picture to Y and C separated video data. The S-Video signal, which is already Y/C separated, bypasses the comb filter. The Chroma information is then applied to the Chroma Demodulator circuit that separates the color signal into PB and PR data.

The Component inputs, which are already Y/C, separated; are converted to digital and bypass the comb filter section of this IC4011. The 480p and 1080i ATSC Video signals simply pass through the IC (which IC) and are output to the main global core IC, IC4011.

Interlace to progressive (I/P) conversion for the 480i video format is accomplished via the Video Signaling Processing IC, IC4010, and SDRAM IC4018 which serves as a temporary buffer during the interlaced to progressive conversion process. The Video Signal Processing IC is responsible for Pixel conversion, White Balance, Aspect Ratio I/P conversion, Image resizing and LCD Panel control.

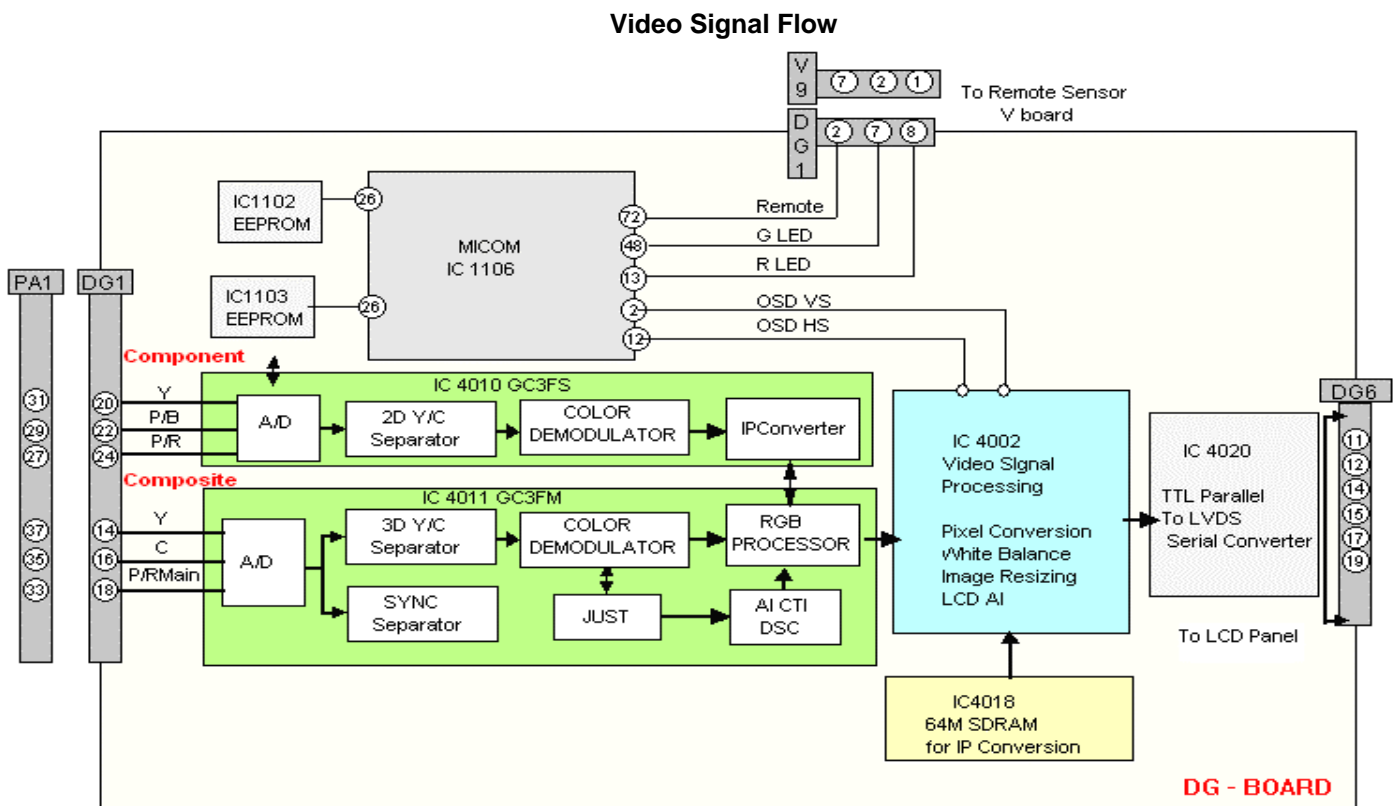


Figure 26

Low Voltage Differential Signaling

The method used to transfer the video information from the Main circuit board to the LCD drive circuit is called Low Voltage Differential Signaling (LVDS). LVDS devices typically consume less power than other signaling systems such as TTL. LVDS devices use a constant current driver. Therefore, power consumption is independent of frequency. The LVDS interface voltage is much less than TTL, approximately 2V. The voltage swing is typically 350mV with an offset of 1.25V. Integrated circuits based on LVDS technology distribute signals with low-jitter, while creating little noise.

In this application, three 8-bit streams of data are converted from parallel to serial and interleaved. The interleave process makes the data less susceptible to noise. The peak-to-peak voltage level is reduced as well. The lower voltage level reduces the power consumption and the generated noise from data transmission. Another benefit of the LVDS standard is minimal concern for cable length. The data rates for LVDS are 110 Mbps for a 1-meter distance, dropping to 90 Mbps over a 10-meter distance.

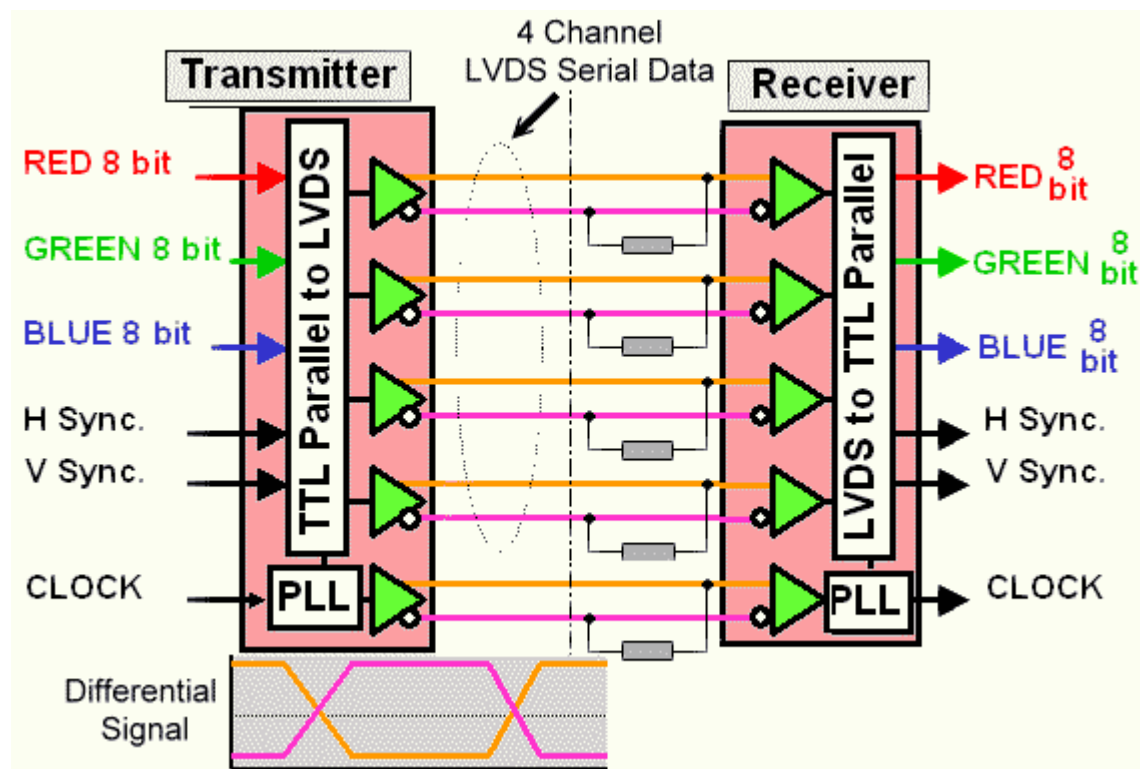
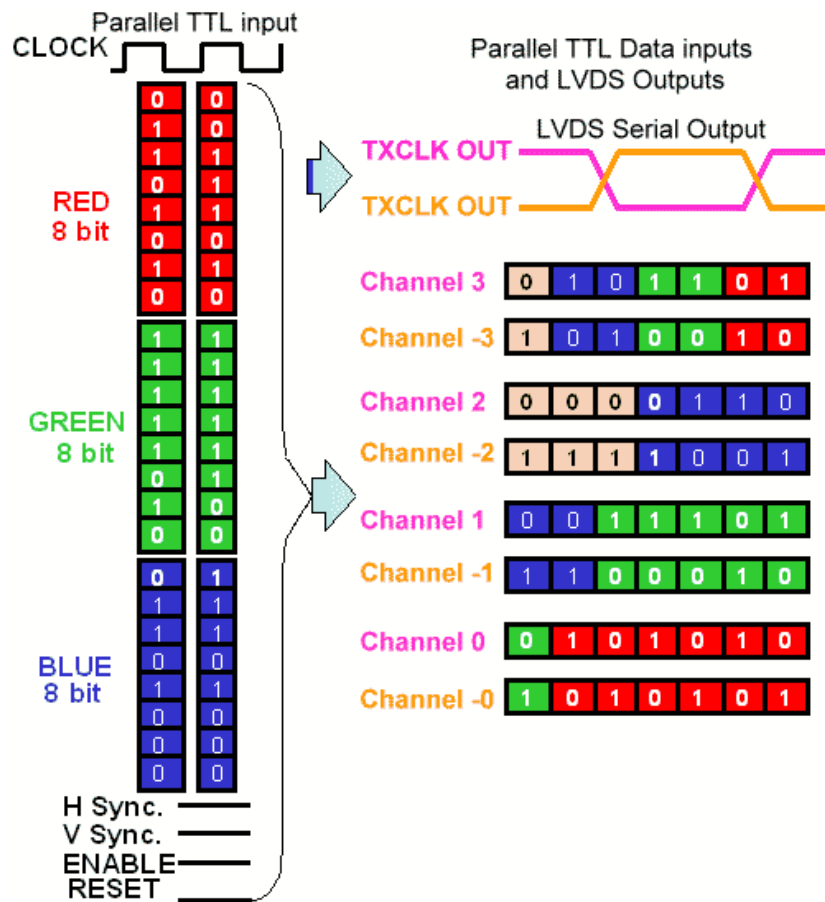


Figure 27



HDMI Signal Path

The HDMI (High Definition Multimedia Interface) resides on the DV board as depicted in Figure 29 and serves as an input port designed to receive digital video and audio from a set-top box, a DVD player or other digital devices. IC5003 converts the digital video to parallel analog RGB video. The outgoing audio is converted to analog via IC5006 and IC5007. EEPROM IC5001 serves as the content protection circuit and monitors the HDMI signal for copyright protection. IC5005 selects between HDMI and DVI audio.

Note: If the external device has DVI output only, use a DVI to HDMI adaptor cable in order to connect to the HDMI jack to the DV HDMI connector. Also, connect the Audio Out signal from the external device (set top box or DVD player) to the Audio In jacks. An HDMI to DVI conversion cable (TY-SCH03DH) is available at the Panasonic parts department.

DV Board HDMI Interface

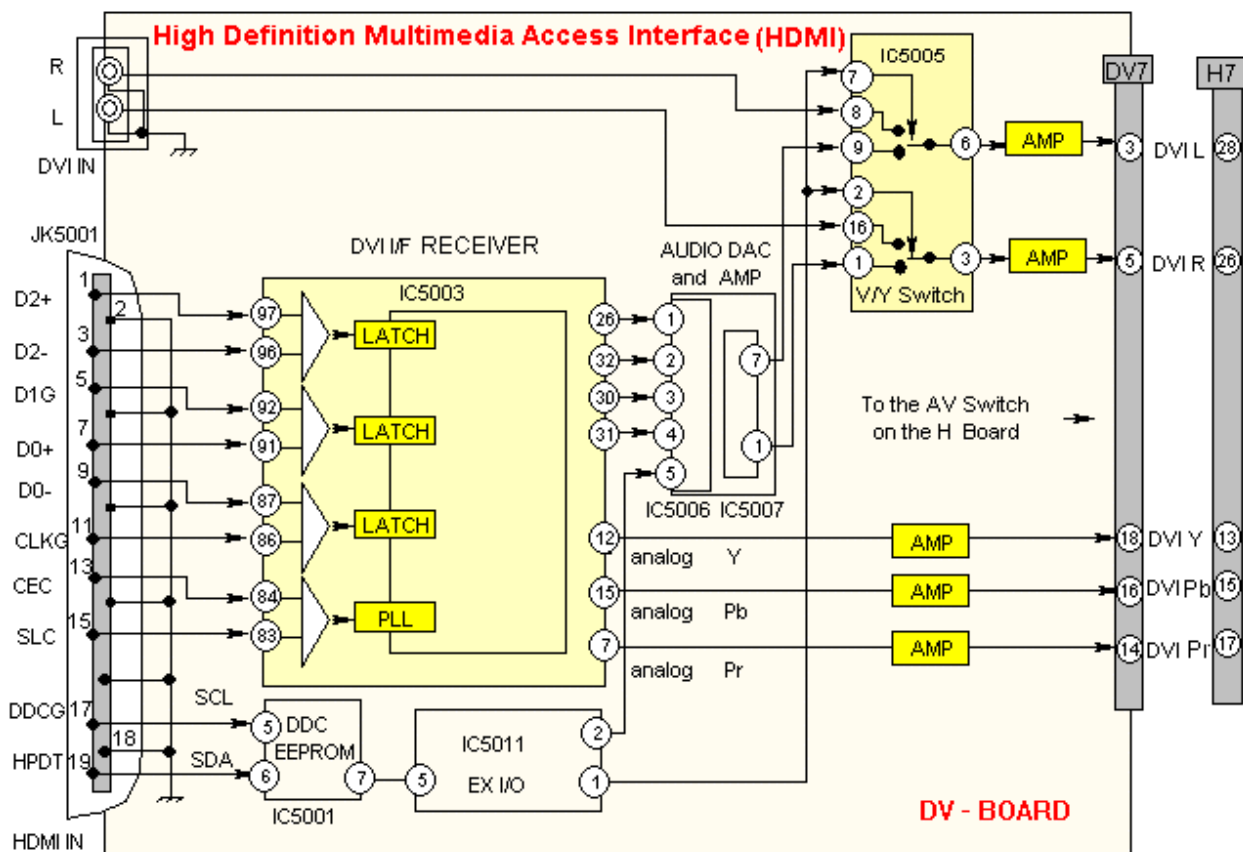


Figure 29

Self-Check Function for TV Section

The self-check feature is designed to check if a particular component is functioning and it does not actually diagnose the problem .For example “Tuner Check OK” doesn’t necessarily mean that it is OK. It pings or selectively addresses that particular device via the I² Bus to determine if it exists. The same holds true for the Global Core IC’s, the MTS, the Sound circuit, and the Audio/Video switches. However, it should be noted that the displayed results could be misleading by indicating that it is OK.

The troubleshooting section of this document is intended to provide the necessary guidance and assistance in the fault isolation of a particular problem and will serve as a diagnostic tool for troubleshooting.

Self-Check Access

To access the self check mode:
Press the VOLUME-Down Button on the unit and SLEEP button on the remote at the same time. To exit press any key.

Self-Check Display

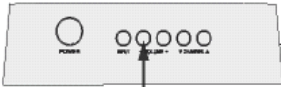
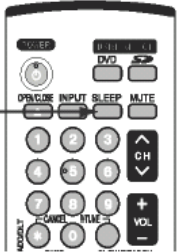
How to Display	Display on Screen																								
<div><div><p>VOLUME -</p></div><div><p>+</p></div><div><p>SLEEP</p></div></div>	<div><div>SELF CHECK</div><table><tr><td>MEMORY</td><td>OK</td><td>TNR1</td><td>OK</td><td>SOUND</td><td>OK</td></tr><tr><td>MTS</td><td>OK</td><td>MTS-R</td><td>OK</td><td>AVSW-V</td><td>OK</td></tr><tr><td>AVSW-A</td><td>OK</td><td>GC3FM</td><td>OK</td><td>GC3FS</td><td>OK</td></tr><tr><td>GC3I</td><td>OK</td><td>HDMI</td><td>OK</td><td>DVD</td><td>OK</td></tr></table><div><p>INCH 22</p><p>PROG 1.01.02 CHECKSUM 6DCC</p><p>EEPROM 1.00.00 TIMER 0112</p><p>ROM COR 0.00.00 MAIN 0102</p></div></div>	MEMORY	OK	TNR1	OK	SOUND	OK	MTS	OK	MTS-R	OK	AVSW-V	OK	AVSW-A	OK	GC3FM	OK	GC3FS	OK	GC3I	OK	HDMI	OK	DVD	OK
MEMORY	OK	TNR1	OK	SOUND	OK																				
MTS	OK	MTS-R	OK	AVSW-V	OK																				
AVSW-A	OK	GC3FM	OK	GC3FS	OK																				
GC3I	OK	HDMI	OK	DVD	OK																				

Figure 30

Servicing the TV Portion

Service Adjustment Mode for TV

Purpose of Adjustment mode

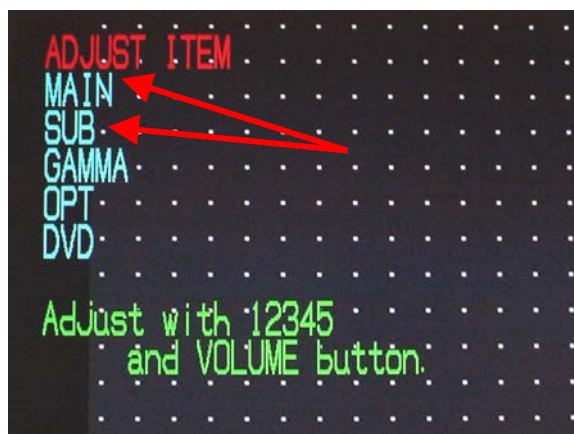
Adjustment mode provides the technician with the ability to perform standard video and audio adjustments.

How to enter the Adjustment mode

While the unit is powered on, hold down the “Volume Down” button on the unit while pressing the “Display” button on the remote three times (within 2 seconds).

The service adjustment mode menu will appear on screen as shown on the right.

Service mode is broken down into two categories, **Main Items**, which are all displayed on the menu screen and **Sub Items**. Refer to the chart on page 35 to see the relationship between the Sub Items and the Main Items.

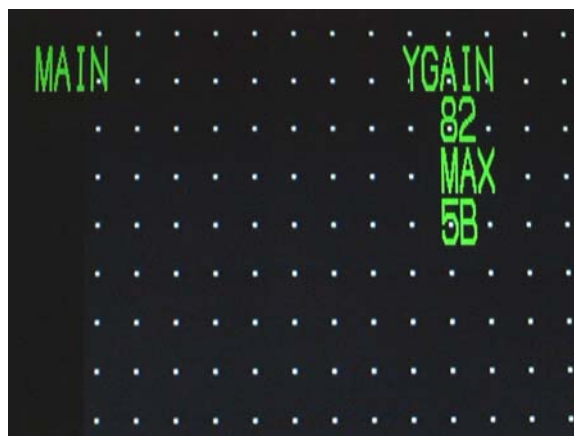


How to navigate the Adjustment mode

Use the number buttons “1” and “2” on the remote control to change the Main Item. The number “1” button will cycle from the MAIN option down to the DVD option. The number “2” button will cycle in reverse direction.

Use the number buttons “3” and “4” on the remote control to cycle through the Sub Items until the proper adjustment is reached.

Adjustment of the Sub Item is made using the “Volume” buttons on the remote control.



Data changes are saved automatically when you switch Sub or Main Items, or if you exit the service mode.

Note: When the DVD adjustments are accessed, the unit switches to the DVD mode. The software version of the DVD Player can be displayed here.

How to exit Adjustment mode

Switch off the “Power” button on the main unit or press the “Power” button on the remote control.

Warning: If you are making adjustments in the service mode, keep a record of the data value before making the adjustment.

Service Adjustment Mode Chart

Main Item	Sub Item	Remarks	Sample Data
MAIN	YGAIN	Video level (RF, Video, Component, DVD)	7D
	B-Y	Video level (RF, Video, Component, DVD)	96
	R-Y	Video level (RF, Video, Component, DVD)	52
SUB	ANGL	(R-Y demodulation axis)	20
	BYGN	(B-Y gain)	A6
	BRIGHT	(Sub-bright)	7B
	COLOR	(Sub-color)	54
	TINT	(Sub-tint)	6A
	BACK-L	(Sub-backlight)	C0
	R-CUT		3C
	G-CUT		3C
	B-CUT		3C
GAMMA	RED	Panel Luminance (Color Temperature)	AD
	GREEN	Panel Luminance (Color Temperature)	AD
	BLUE	Panel Luminance (Color Temperature)	AD
OPT	OPTOO	(TV)	00
	OPTDO	(DVD)	00
DVD	CHROMA		13
	CB GAIN		1C
	CR GAIN		01
	VOLMAX		F0

Table 3

Servicing the DVD

Service Tools

This is a list of the service equipment that will be required for the repair of the DVD portion of the LCD TV Combo

- DVD Test Disc DVDT-S01 and DVDT-S15 (Supplied from SPC.)
- Extension Cable REKZ0214 (Supplied from SPC)
- Shakanabi Software: Not supplied as service parts. (This software is used for the repair of Circuit Board M8.)
- Data change CD-R: Not supplied as service parts. (This CD-R is used for the repair of Circuit Board M8.)

M8 Circuit Board Repair

1. Change what is referred to as the model setting data for the software that resides in IC6702. This converts TC-22LR30 (DVD portion) to that of a DMR-E65 for ease in troubleshooting. This is accomplished through the use of the Shakanabi Software.
2. Repair Circuit Board M8 as you would repair the Digital C.B.A. that resides in the DMR-E65 DVD Recorder. Upon completion of repairs, change (return) the model setting data back to that of the TC-22LR30.
Use the Data change CD-R to accomplish this task!

Use the Extension Cable (RFKZ0214) between the M8-Board and the RD-Board.
Extension Cable (RFKZ0214) has A/V Output Signal switches.
Output signals can be switched from the M8-Board side or the RD-Board side.
When checking the M8-Board, turn the switches to the M8-Board side.
When checking the RD-Board, turn the switches to the RD-Board side.

Extension Cable

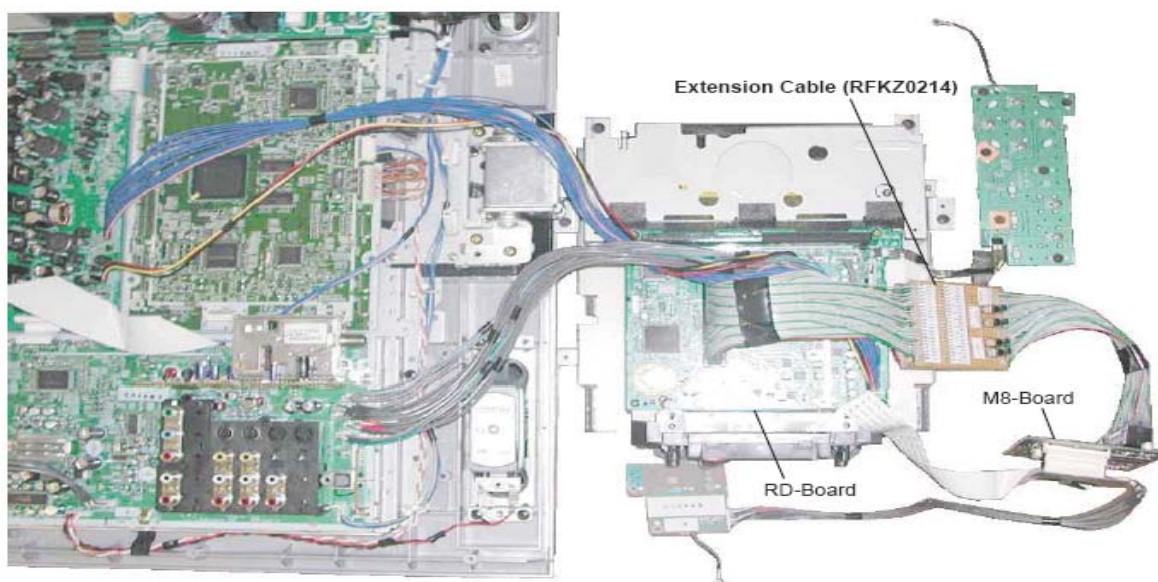


Figure 31

Troubleshooting

This section is intended to serve as an aid in the fault isolation, troubleshooting, and repair of the LCD TV combo or LH34 chassis type in general. These include the TC-22LR30 and TC-26/32LX20 models. These are some of the screen display symptoms and conditions that may arise as a result of an error or a problem that may occur either during operation or while entering Self Check mode.

Symptom Display Chart

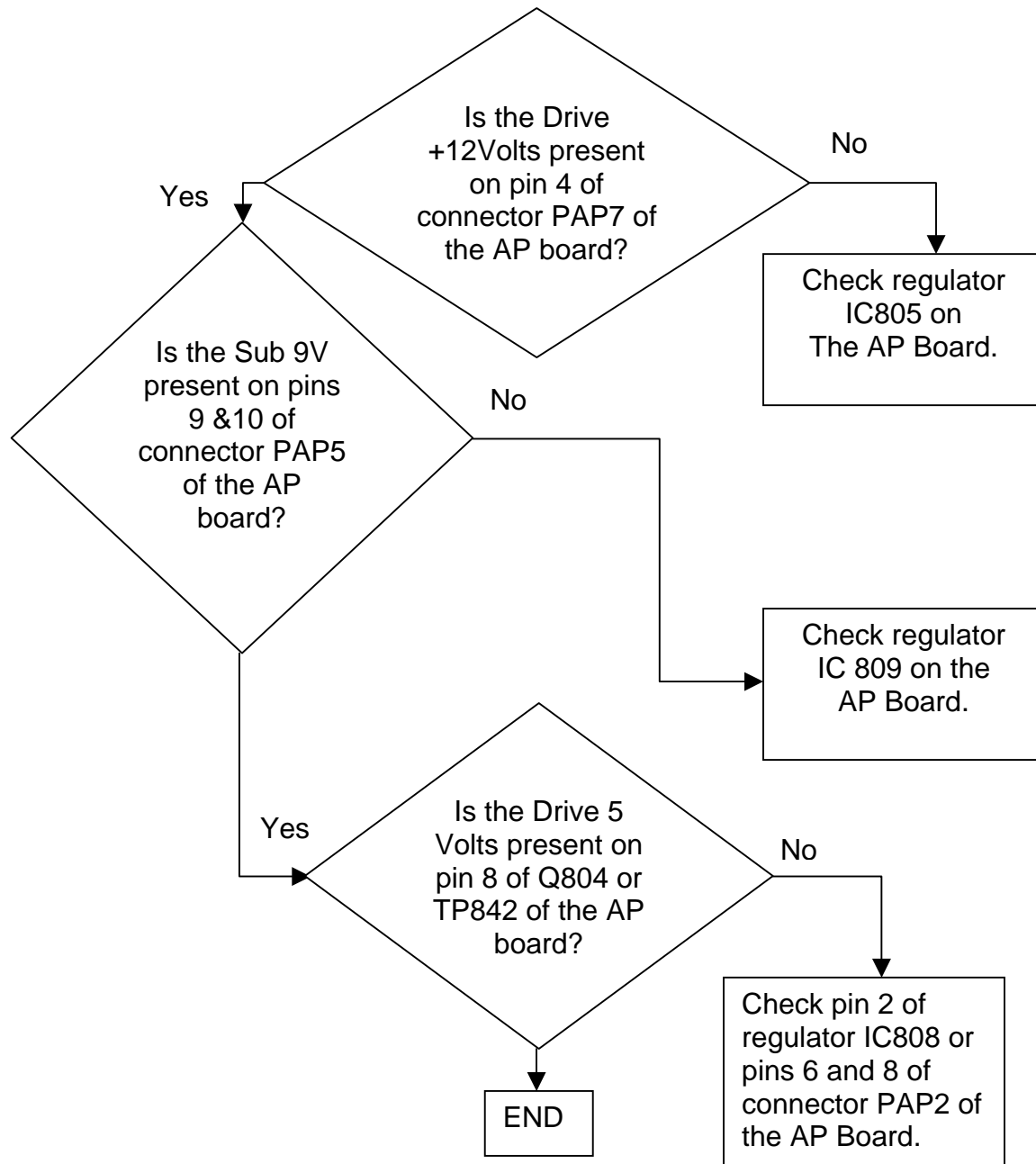
Screen Display	Symptom/Condition	Remedy
MEMORY	No Picture/No Audio	Replace the DG Board
TNR1	No Picture/No Audio from Tuner	Check the TA tuner board
SOUND	No Audio from Speaker/Earphone Terminal Adjustments for Bass/Treble/Balance/Surround/Audio Compensation does not work.	Check the Audio circuitry on the A Board.
MTS	No Audio from Tuner Switching of STEREO/SAP/MONO for Audio from Speaker does not work.	Check the TA tuner and the 30v.
MTS-R	Audio from Tuner can not be recorded. Switching of STEREO/SAP/MONO for recording does not work.	Check the MTS IC3299 and Audio Circuitry on the A board.
AVSW-V	No Picture	Check Video Switch on A Bd
AVSW-A	No Audio	Check Audio Switch on A Bd
GC3FM	No Picture from Tuner and Video In signal	Replace the DG Board
GC3FS	No Picture from Component Input Signal	Replace the DG Board.
GC3I	No Picture	Replace the DG Board.
HDMI	No Digital Picture/No Digital Audio from HDMI Input Signal	Check the DV Board.
DVD	Recording/Playback does not work. Clock does not work. DVD Menu can not be displayed.	Check the RD Board.

Table 4

Shutdown Problems

If a problem occurs in either the unit or power supply a protection circuit is activated and the unit shuts down. The Power indicator on the front of the unit will flash red several times indicating an error code. Error codes vary for different models and will be included in this document.

LED Flashes Three Times



LED Flashes Once every 5 seconds

Check the Backlight supply voltage from the P board.

- **TC22LR30 -15 volts P2 pin 9-15 Ground pins 1-7.**
- **TC26/32LX20- 120 volts P4 pins 1-2. Ground Pins 4-7**

LED Flashes Five Times

**Check the Main 9Volts Regulator
Q801 on the AP Board**

LED Flashes Eight Times

Check the Sub 5 Volts regulator, IC808.

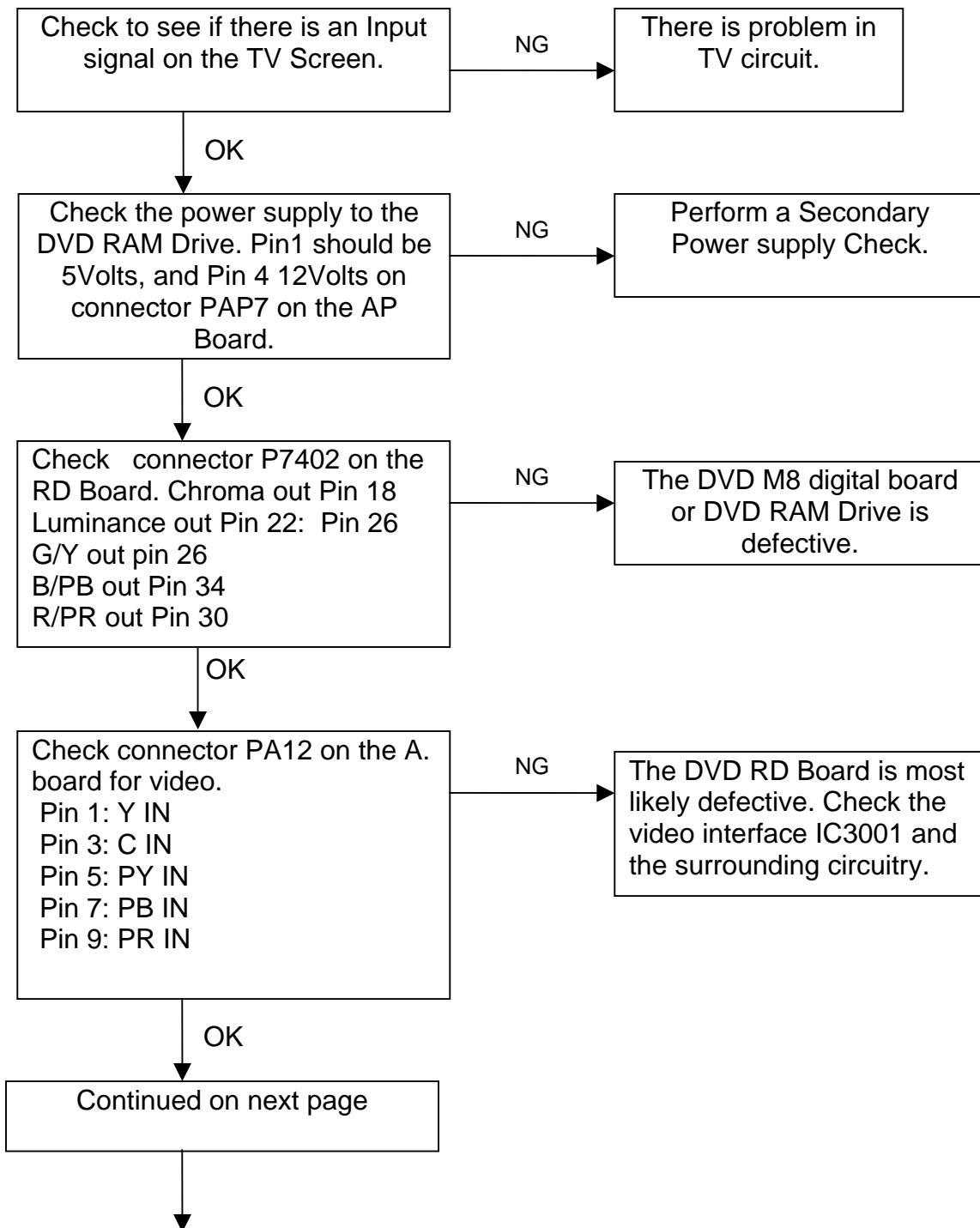
Unit shuts down and the Power on LED is off.

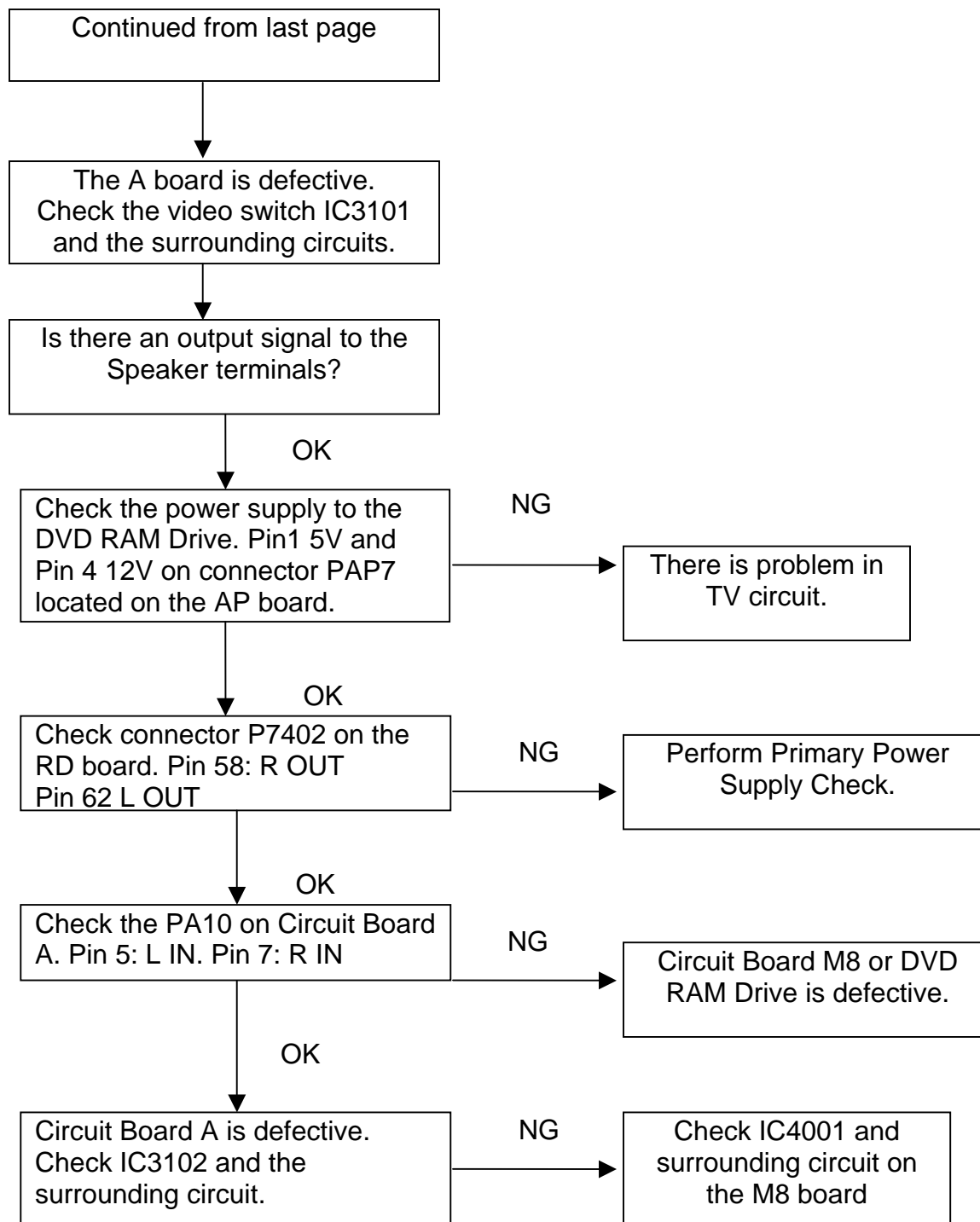
Check the SOS Shutdown and over-voltage protection circuits. Please reference power supply section of this document. Use the troubleshooting flowcharts for the Primary and Secondary power supply checks.

SOS Shutdown Problem

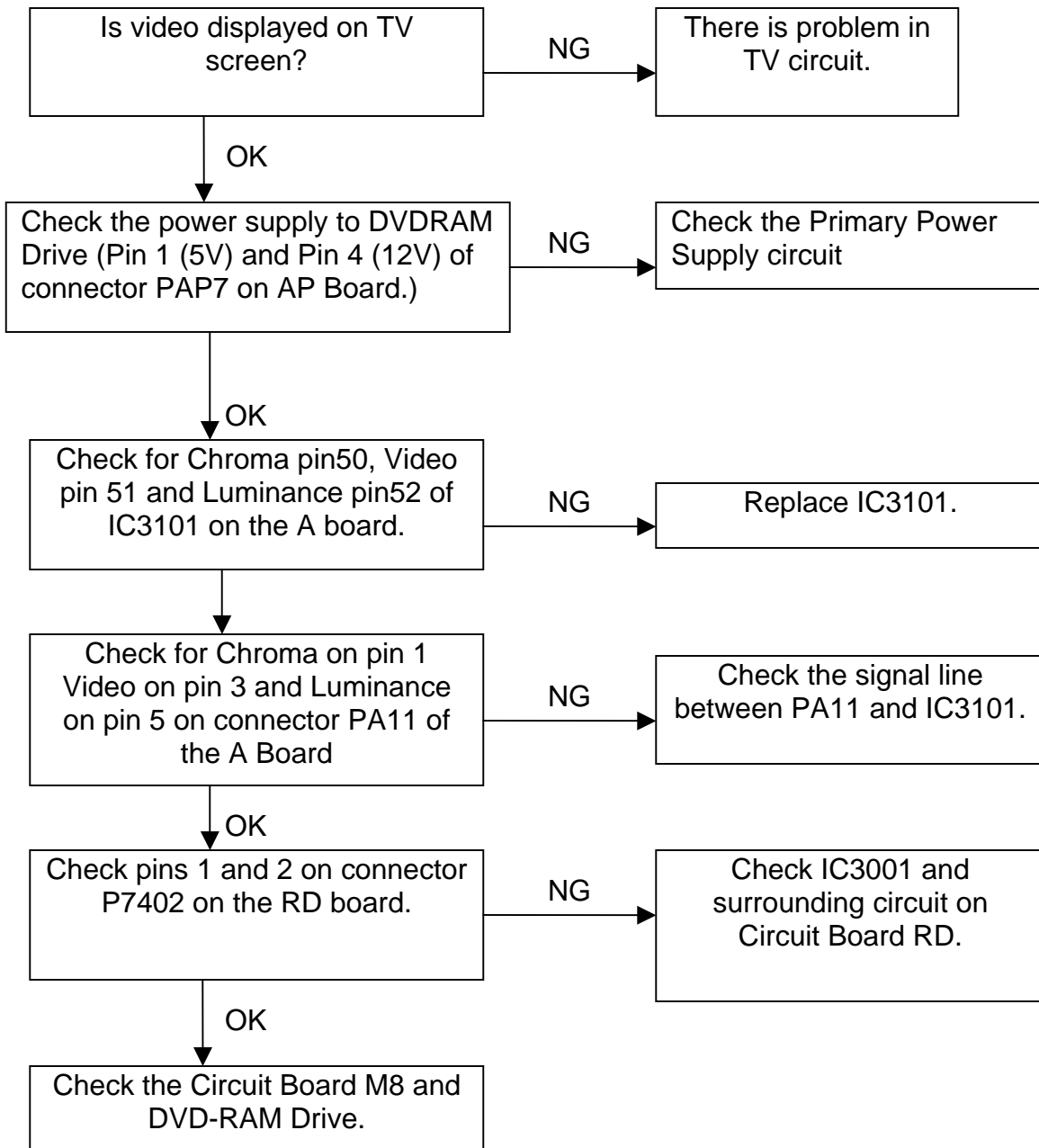
If the unit keeps shutting down, check the SOS Shutdown line at pin 9 of connector DG2. It should be at a high level. Anodes of D877, D878, D880, D844 all should be high.

The Unit Does Not Play Video from Disc .

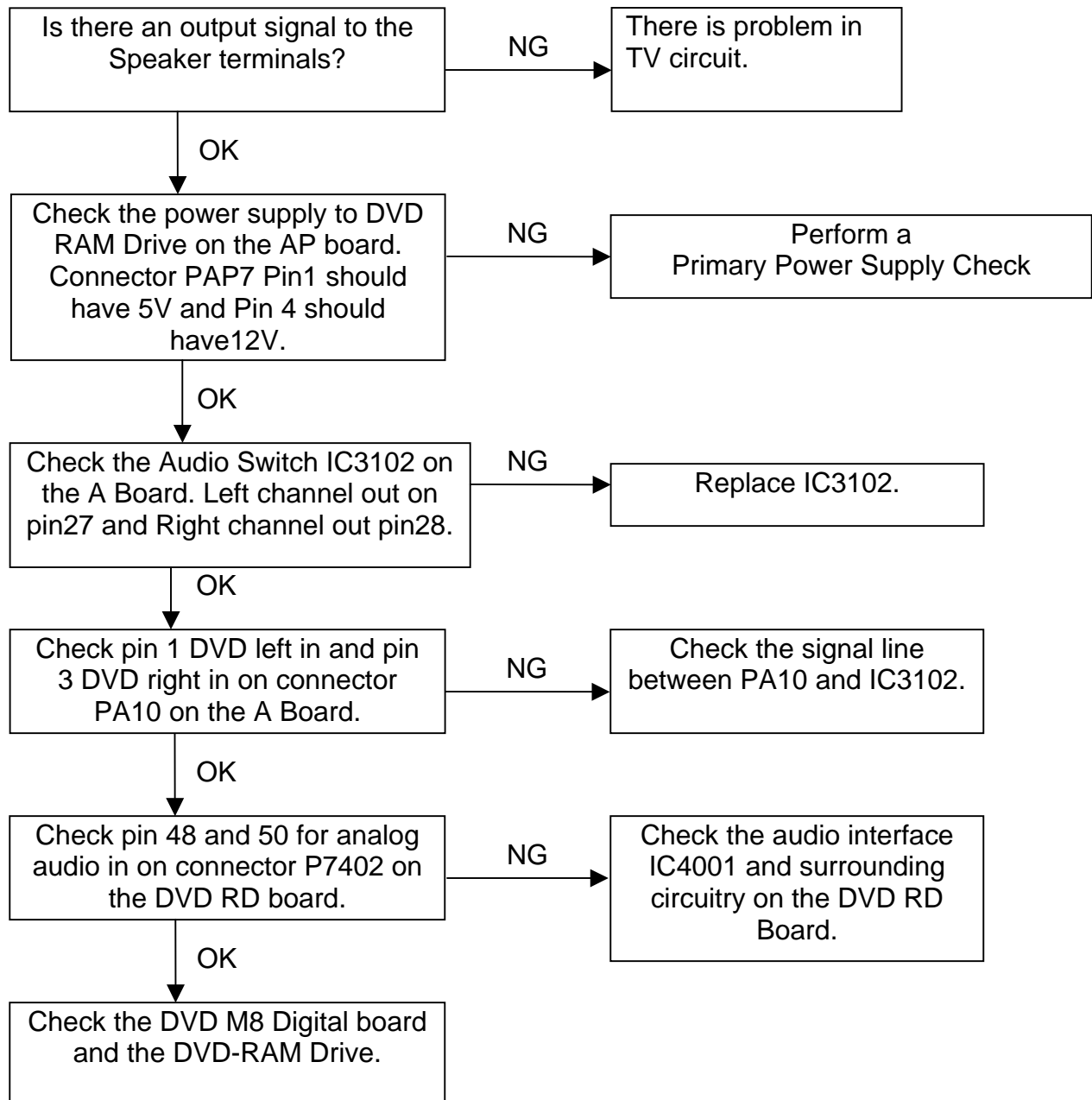




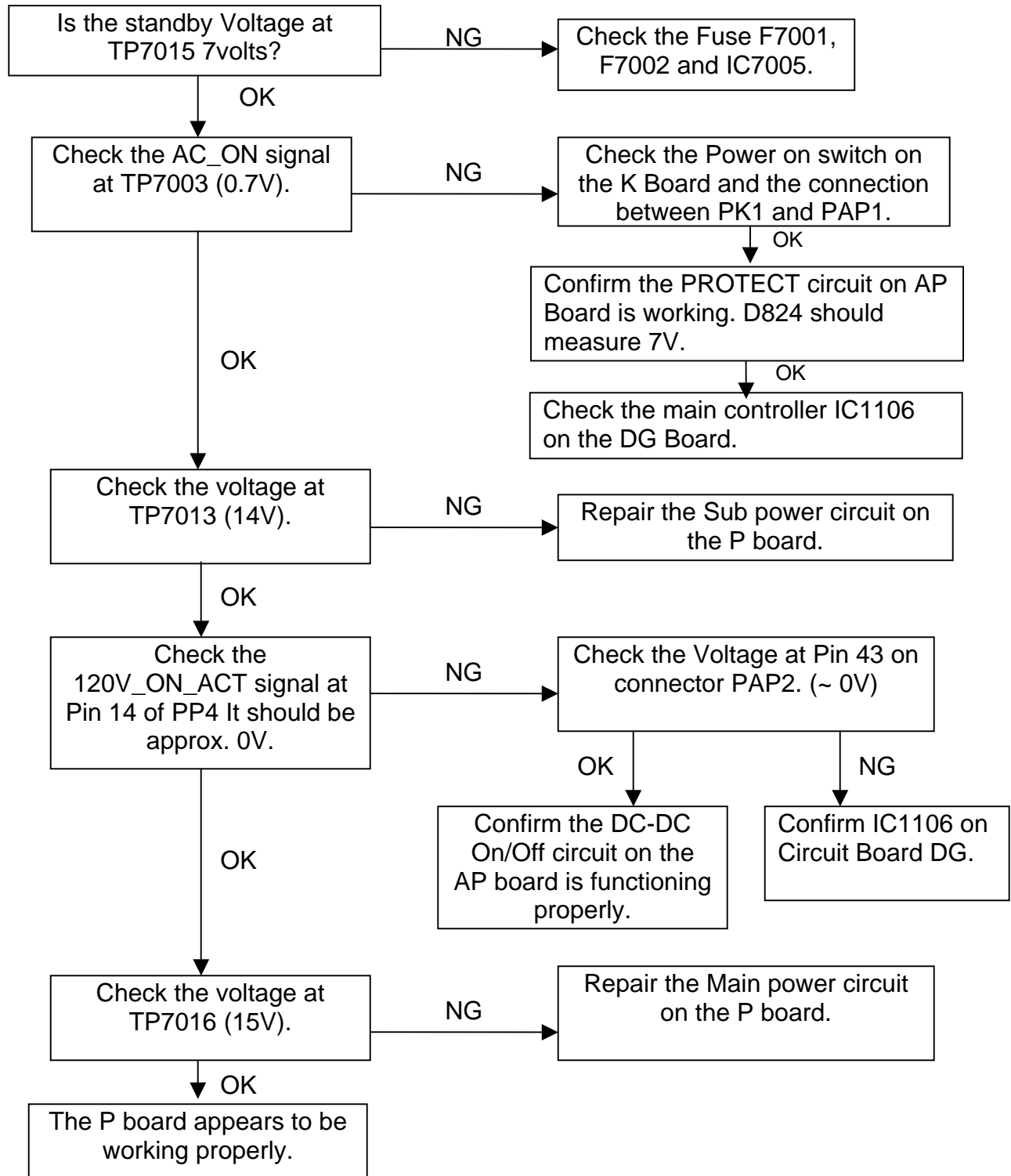
Does Not Record Video to Disc



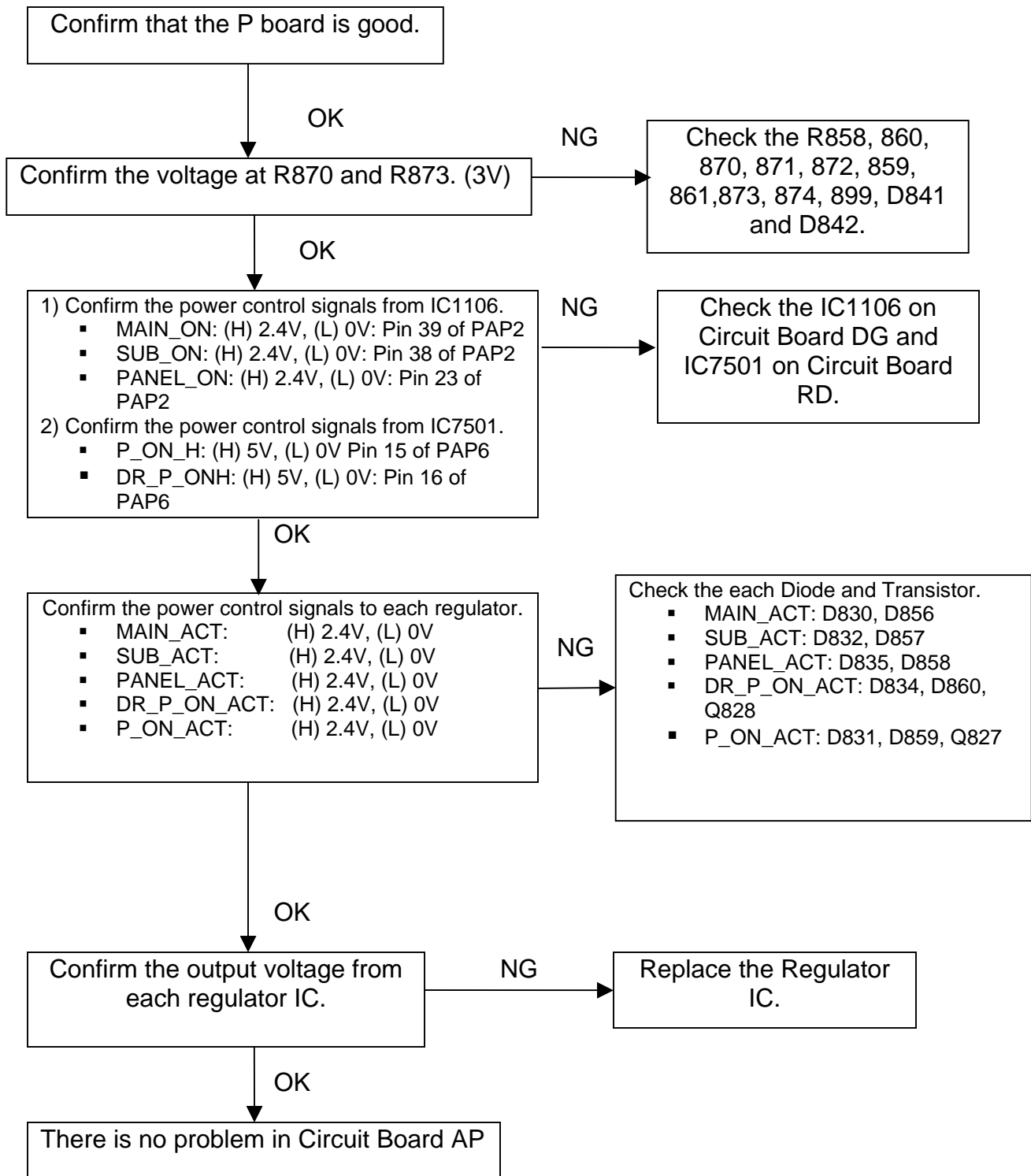
Does Not Record Audio to Disc



Primary Power Supply Check



Secondary Power Supply Check



Appendix

Backlighting

Backlighting Brightness for Panasonic's line of LCD TVs is accomplished through the use of Cold Cathode Fluorescent tubes (CCFT), which is currently the light source of choice, by a number of leading manufacturers.

Inverter Power Supply

Pulse width modulation is a very straightforward method for controlling the brightness of the CCF tube(s). The inverter is turned on and off (using the input or an enable/disable line) from the Microprocessor Unit (MPU) to control the brightness. The "on" duty cycle is lengthened to increase the brightness and reduced to decrease the brightness. One of the major advantages of pulse width modulation is the tube is always fully "on" or fully "off" and full starting voltage is always applied to the tube(s) (assuming nominal input voltage). Figure 5 is a simplified diagram of a pulse width modulated DC to AC inverter.

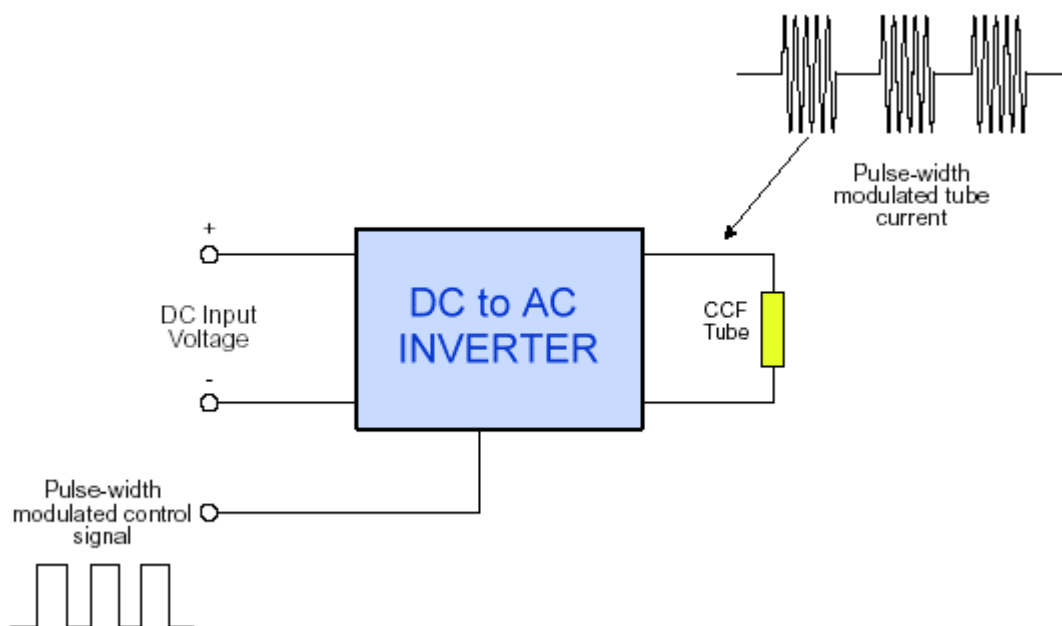


Figure 32

High Voltage Power Supply

A CCF tube needs high voltage. The starting voltage is generally over 1,000 volts and the operating voltage is generally between 200 and 500 volts rms.

Most CCFT DC to AC inverters are tuned switchers designed to produce a specific voltage, frequency and output current when a designated tube is connected to the output. The classic current-fed two-transistor inverter has a tuned resonating output, tuned resonating input and inductive dc input which provides for good power transfer and high operating efficiency.

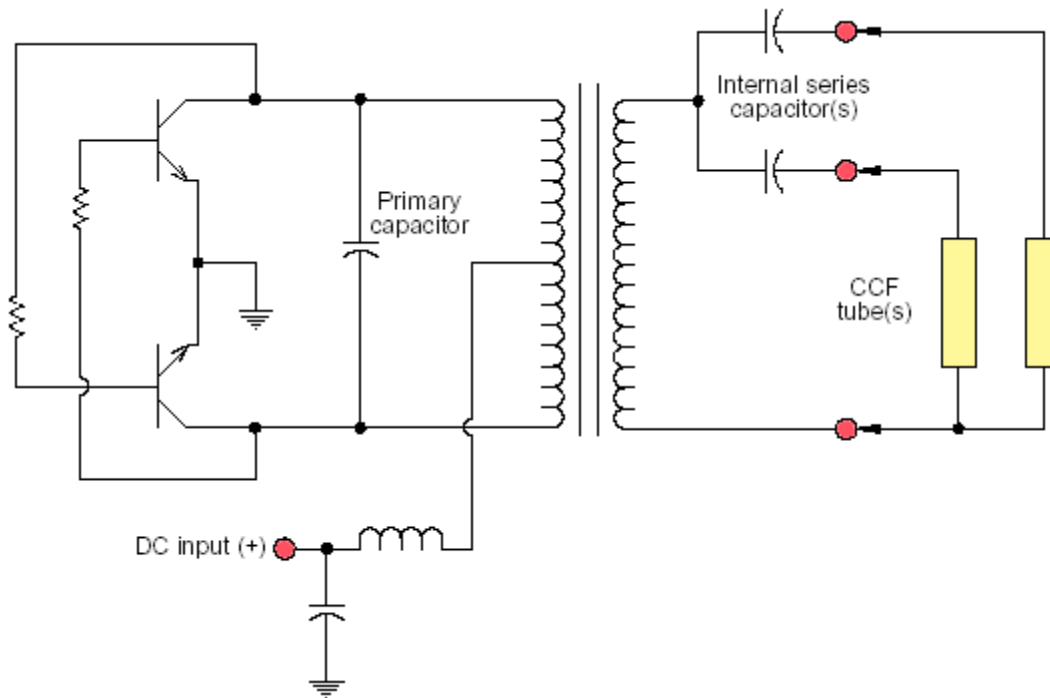


Figure 33

The type of circuit depicted in Figure 6 inherently produces a pure sine-wave output, but the voltage and current waveforms are both distorted when they are applied to a CCF tube, which is a highly nonlinear device. The transition from the starting voltage to the operating voltage in this circuit is implemented by a small internal series output capacitor, which serves as the ballast, providing impedance, and allowing proper tube current after the tube has been ignited.

Test and Measurement

This is a basic test setup for measuring the output voltages of the inverter circuit. The output voltage to the tube can be measured with a dual-channel oscilloscope and two low-capacitance (< 2.5 pf) scope probes. The oscilloscope should be connected differentially, with the probe grounds connected and floating as depicted in the diagram. Figure 7 indicates how an oscilloscope can be used for achieving these measurements.

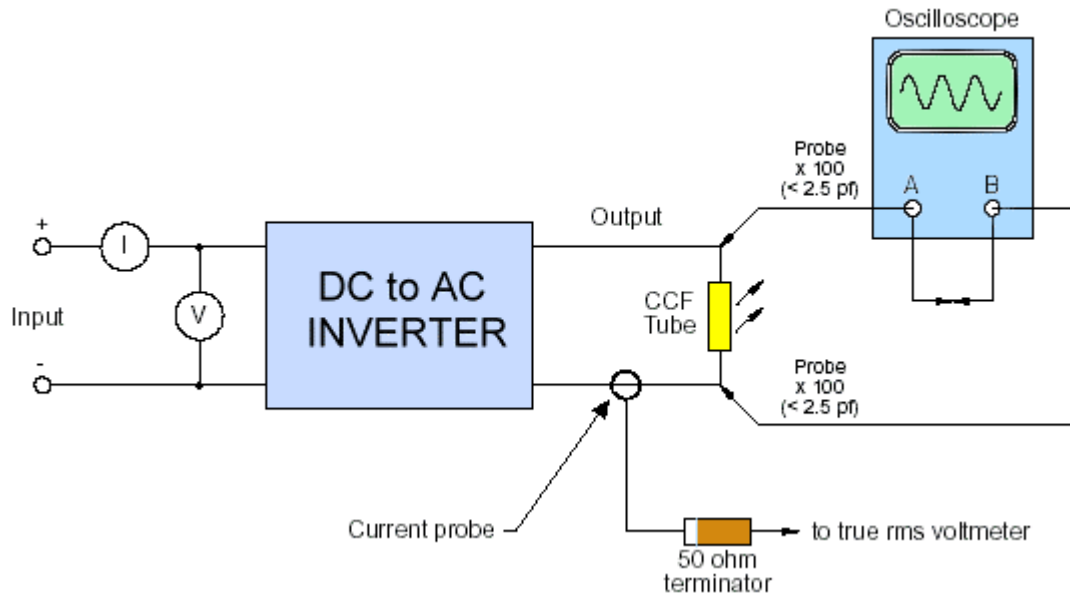


Figure 34

Channel A should be added to the inverse of channel B to produce the complete waveform on the oscilloscope.

Output waveform

This is what the typical output current waveform should look like as viewed in the above test arrangement.

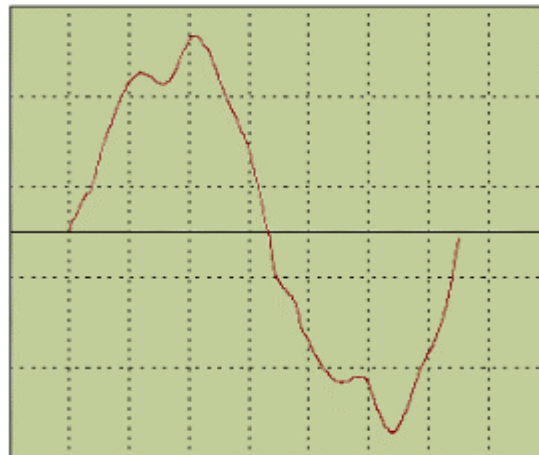


Figure 35

Specifications

Combo Overall Specification

Picture	Screen Size	22,26,32 inch
	Brightness	450 cd/m2
	Response speed	16 M sec.
	Pixel	W-XGA (1280 x 720)
	LCD AI (Adaptive Brightness Intensifier)	New LCD AI
	Other	3D Y/C separation
Disc Type	Discs Played	DVD-RAM, DVD-R, DVD-Video, CD-Audio, Video CD, DVD-AUDIO, CD-R/CD-RW
	Recordable Discs	DVD-RAM, DVD-R
SD Card Slot	Still Picture Play	JPEG, TIFF, DPOF

Table 5

TV Portion

ITEM		SPECIFICATION	ITEM		SPECIFICATION
GENERAL	Power	Source: 120 V AC, 50/60 Hz	DISPLAY	LCD	22-inch, 16:9 aspect ratio LCD panel
		Consumption: Approx. 116 W (Power on), Approx. 0.8 W (Power off)		Screen size (W x H x D)	488 mm x 274 mm x 560 mm
	Speaker	8 W (4 W + 4 W)	DVD	Recording system	DVD video recording standards (DVD-RAM), DVD video standards (DVD-R)
	Operating Condition	5 °C-35 °C (41 °F-95 °F) (Temperature) 10 %-75 % (Humidity)		Recordable discs	12 cm (5") 4.7 GB DVD-RAM discs 12 cm (5") 9.4 GB DVD-RAM discs 8 cm (3") 2.8 GB DVD-RAM discs 12 cm (5") 4.7 GB DVD-R discs (for General Ver. 2.0) 8 cm (3") 1.4 GB DVD-R discs (for General Ver. 2.0)
	Dimensions (W x H x D)	592 mm x 518 mm x 294 mm		Recording time	Max. 8 hours (using 4.7 GB disc) XP: 60 minutes SP: 120 minutes LP: 240 minutes EP: 480 minutes
	Weight	13.3 kg		Discs played	12 cm (5") 4.7 GB DVD-RAM discs 12 cm (5") 9.4 GB DVD-RAM discs 8 cm (3") 2.8 GB DVD-RAM discs 12 cm (5") 4.7 GB DVD-R discs (for General Ver. 2.0) 8 cm (3") 1.4 GB DVD-R discs (for General Ver. 2.0) DVD-VIDEO discs CD-Audio discs (CD-DA) Video CD discs DVD-AUDIO discs CD-R/CD-RW discs (CD-DA, Video CD, MP3 formatted discs)
TUNER	Broadcast Channels	VHF 2-13, UHF 14-69	SD	SD Card Slot	SD Memory Card Slot
	CABLE Channels	Midband A through I (14-22) Superband J through W (23-36) Hyperband AA-EEE (37-64) Lowband A-5-A-1 (95-99) Special CABLE channel 5A (01) Ultraband 65-94, 100-125		Compatible media	SD Memory Card, MultiMediaCard
CONNECTION TERMINALS	INPUT:	VIDEO (RCA PIN Type x 1) x 2: 1.0 Vp-p (75 ohm) S-VIDEO (MINI DIN 4pin x 1) x 2: Y: 1 Vp-p (75 ohm), C: 0.286 Vp-p (75 ohm) AUDIO L-R (RCA PIN Type x 2) x 2: 0.5 Vrms		Format	FAT12 or FAT16
		COMPONENT VIDEO INPUT: Y x 1: 1.0 Vp-p (including synchronization) PB/PR x 1: ±0.35 Vp-p AUDIO L-R (RCA PIN Type x 2) x 1: 0.5 Vrms		Image format	JPEG conforming to DCF (Design rule for Camera File system) (sub sampling: 4:2:2 or 4:2:0) TIFF (Uncompressed RGB chunky) DPOF Compatible
	HDMI INPUT:	HDMI type A Connector AUDIO L-R (RCA PIN Type x 2) x 1: 0.5 Vrms		Number of pixels	320 x 240 to 6 144 x 4 096
	OUTPUT:	AUDIO L-R (RCA PIN Type x 2) x 1: 0.5 Vrms		Solder	This model uses lead free solder (PbF).
	Headphones/Earphones:	Stereo (M3 plug)			
	Optical digital output:	Optical connector: only for DVD/CD x 1			

Weight and dimensions shown are approximate.
Designs and specifications are subject to change without notice.

Table 6

DVD Portion

The LCD Combo unit uses a DVD recorder, very similar to the DMR-E65

Power supply	AC120 V, 60 Hz	Audio system	
Power consumption	28 W	Recording system	Dolby Digital 2ch, Linear PCM (XP mode, 2ch)
Power consumption in standby mode	approx. 15 W	Input	LINE (pin jack) x3 Reference input: 309 mVrms FS: 2 Vrms (1 kHz, 0 dB) Input impedance: 47 k Ω
Recording system	DVD Video Recording format (DVD-RAM), DVD Video format (DVD-R)	Output	LINE (pin jack) x2 Reference output: 309 mVrms FS: 2 Vrms (1 kHz, 0 dB) Output impedance: 1 k Ω (Load impedance: 10 k Ω)
Optical pick-up	System with 1 lens, 2 integration units (658 nm wavelength for DVDs, 795 nm wavelength for CDs)	Digital Audio Out	Optical terminal (PCM, Dolby Digital, DTS)
Recordable discs	<ul style="list-style-type: none"> DVD-RAM: 12cm 4.7GB, 12cm 9.4GB, 8cm 2.8GB, 12cm 4.7GB (Ver. 2.1 /3X-SPEED DVD-RAM Revision 1.0) DVD-R: 12cm 4.7GB, 8cm 1.4GB (for General Ver. 2.0), 12cm 4.7GB (for General Ver. 2.0 /4X-SPEED DVD-R Revision 1.0) 	Channel Number	2ch (L/R)
Recording time	<ul style="list-style-type: none"> Maximum 8 hours (with 4.7 GB disc) XP: Approx. 1 hour SP: Approx. 2 hours LP: Approx. 4 hours EP: Approx. 6 hours or 8 hours 	Card unit	
Region number	Region No.1	Card Slot	SD memory card /PC Card Type II
Playable discs	<ul style="list-style-type: none"> DVD-RAM: 12cm 4.7GB, 12cm 9.4GB, 8cm 2.8GB, 12cm 4.7GB (Ver. 2.1 /3X-SPEED DVD-RAM Revision 1.0) DVD-R: 12cm 4.7GB, 8cm 1.4GB (for General Ver. 2.0), 12cm 4.7GB (for General Ver. 2.0 /4X-SPEED DVD-R Revision 1.0) DVD-VIDEO, DVD-Audio, CD-Audio (CD-DA), Video CD, CD-R/ CD-RW (MP3, CD-DA, Video CD formatted discs) 	Compatible Media	<ul style="list-style-type: none"> SD memory card /Multi Media Card A PC Card adaptor conforming to PC Card Standards ATA Flash PC Card PC Card Adaptor (SD memory Card, Multi Media Card, Compact Flash Smart Media, Memory Stick, XD picture card, Micro drive) Mobile HDD
Drive Unit	High Speed Drive (correspond to 4times speed with DVD-R disc and 3times speed with DVD-RAM disc)	Format	FAT12, FAT16
Video system		Image Format	<ul style="list-style-type: none"> JPEG DCF(Design rule for Camera File system) (subsampling: 4 : 2 : 2 or 4 : 2 : 0) TIFF (Uncompressed RGB chunky) DPOF Compatible Number of Pixels 34 x 34 - 6144 x 4096
Television system	NTSC color signal, 525 lines, 60 fields	Thawing Time	Approx. 7sec (2Mpixels)
Recording system	MPEG2 (Hybrid VBR)	Others	
Input	<ul style="list-style-type: none"> LINE (pin jack x3), 1.0 Vp-p; 75 Ω S connector x3 Y: 1.0 Vp-p; 75 Ω C: 0.286 Vp-p; 75 Ω 	Dimensions	Approx. 430 (W) x 79 (H) x 274 (D) mm [Approx. 16 15/16 " (W) x 3 1/8 " (H) x 10 13/16 " (D)]
Output	<ul style="list-style-type: none"> LINE (pin jack x2), 1.0 Vp-p; 75 Ω S connector x2 Y: 1.0 Vp-p; 75 Ω C: 0.286 Vp-p; 75 Ω 	Mass	Approx. 3.4 kg (7.5 lbs)
Component video output (480P/480I)	Y: 1.0 Vp-p; 75 Ω PB: 0.7 Vp-p; 75 Ω PR: 0.7 Vp-p; 75 Ω	Operating Temperature	5 °C-40°C (41 F-104 F)
Antenna reception input	TV Channel: 2ch-69ch, 75 Ω CATV Channel: 1ch-125ch, 75 Ω	Operating Humidity range	10 %-80 % RH (no condensation)
		Clock unit	Quartz-controlled 12-hour digital display
		LASER Specification (Class I LASER Product)	
		Wave Length	795 nm, 658 nm
		Laser Power	No hazardous radiation is emitted with the safety protection.
		Solder	This model uses lead free solder (PbF)

Notes : Mass and dimensions are approximate.
Specifications are subject to change without notice.

Table 7