

Roku BrightSign HD600 Hardware Guide

PCBA: Rev C & D
Version: 2.1



Table of Contents

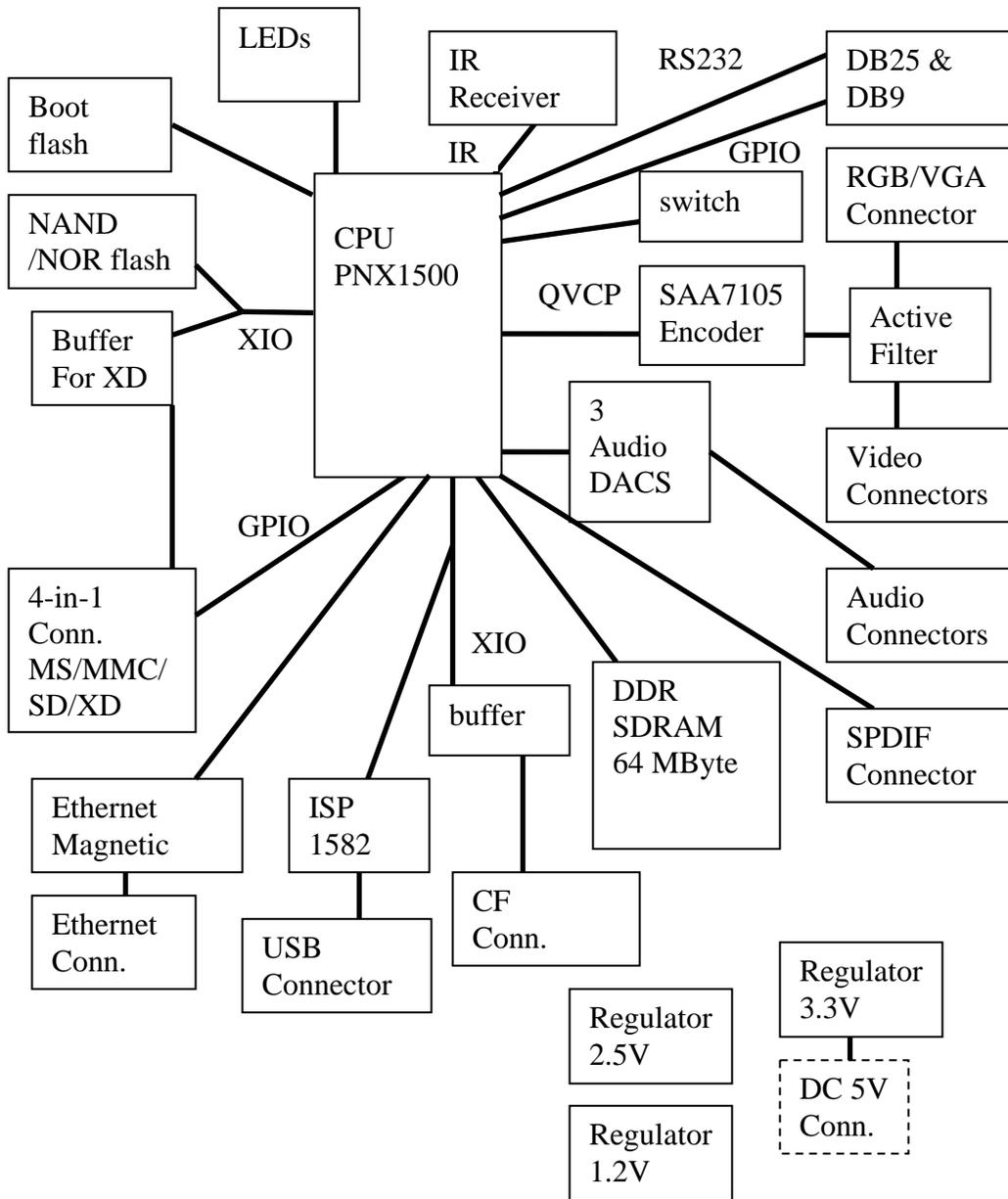
| | |
|---|-----------|
| OVERVIEW | 3 |
| HD600 BLOCK DIAGRAM | 4 |
| PORTS | 5 |
| POWER CONNECTOR | 5 |
| OPTICAL SPDIF CONNECTOR..... | 5 |
| DB9 RS232 CONNECTOR | 5 |
| DB25 SWITCH/LED CONNECTOR | 6 |
| ETHERNET | 7 |
| USB | 8 |
| DB15 VGA CONNECTOR..... | 8 |
| TRIPLE RCA COMPONENT HD VIDEO CONNECTOR | 8 |
| 1/8" AUDIO CONNECTORS | 9 |
| MECHANICAL..... | 10 |
| THEORY OF OPERATION | 12 |
| POWER SUPPLY | 12 |
| RESET | 12 |
| PNX1500 CPU..... | 12 |
| BUILT IN FLASH..... | 12 |
| SDRAM | 12 |
| SERIAL PORT | 12 |
| VIDEO ENCODER AND FILTER | 13 |
| AUDIO OUTPUTS | 13 |
| SPDIF OUTPUT | 13 |
| ON BOARD LEDs | 13 |
| ON BOARD SWITCH | 13 |
| IR RECEIVER..... | 13 |
| CF FLASH SLOT | 14 |
| 4 IN 1 FLASH SLOT..... | 14 |
| OPTIONAL BUILT IN NAND FLASH | 14 |
| ETHERNET | 14 |
| USB | 14 |
| FLOW CHART: (FOR REPAIR CENTER USE) | 15 |
| (1) POWER START | 15 |
| (2) POWER LED COMES ON, NO SERIAL PORT OUTPUT..... | 16 |
| (2) POWER LED COMES ON, 1 OR MORE GREEN LEDs COME ON IN SEQUENCE FROM LEFT TO RIGHT | 17 |
| (3) POWER LED COMES ON, RED LED COMES ON PLUS 1 OR MORE GREEN LED STAYS LIT. | 18 |

Overview

This hardware reference manual specifies the hardware interfaces on the HD600, as well as providing a guide to troubleshoot the hardware of the HD600 for in-field service. This manual will not describe any software functions.

The BrightSign HD600 is a device that can be used to drive a variety of HDTV and computer monitors for digital sign and kiosk applications. As well as driving the Video Display, the HD600 has many different control interfaces built in to allow the sign to be controlled.

HD600 Block Diagram



Ports

- Optical SPDIF audio output.
- DB9 Male RS232.
- DB25 Female for LED output and Switch input, as well as supplying 100mA of 3.3V power.
- 10/100 Ethernet Auto-MDIX and Auto-polarity switching.
- Two high speed USB host ports.
- DB15 VGA video connector.
- Triple RCA jacks for Component Hi-Def output (Y-Pr-Pb). This port can also output composite video and S-Video.
- 3 stereo 1/8" mini plugs for audio output
- 2.5MM Power plug for 5V power input at 2.8A.
- IR receiver for 38KHz IR reception.
- Front panel LEDs for status.
- Front panel Switch for user input (Typically used to switch screen resolutions)
- 4 in 1 flash slot for SD/MMC/XD/MemoryStick flash cards.
- Compact Flash slot for CF cards.

Power Connector

The power connector on our board is rated at 5V @ 2.8A. The plug to go into our connector is standard 5.5MM plug, center positive, with a 2.1MM center pin hole. The power is over voltage protected and reverse polarity protected with a 5W 5.6V zener diode.

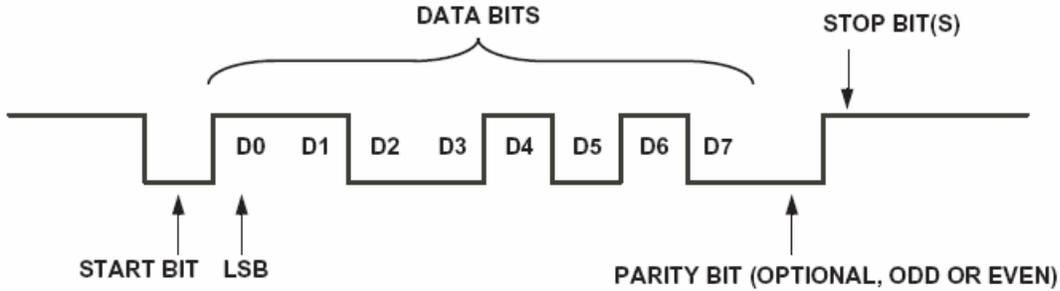
Optical SPDIF connector

This connector accepts a standard SPDIF optical cable.

DB9 RS232 connector

RS232 connector is a male DB9. The HD600 is a DTE device (like a PC). The input to our chip accepts up to +25V and -25V, so it is compatible with standard +12 and -12 volt signaling. The output of our chip is rated at +5.4V and -5.4V typical which exceeds the voltage required by the RS232 specification. The chip we use for RS232 only enables the RS232 transmit function when a valid RS232 voltage level is detected on the receive line. This implies that the RS232 connector cannot be used for RS232 output only.

The baud rate is 9600, No parity, 8 data bits, 1 stop bit. No hardware or software flow control. The TX and RX signal will look like this:



The pinout of the DB9 on the REVB HD600 board is as follows (NC=No Connect):

| pin | Description | pin | Description |
|-----|----------------------------|-----|-------------------------|
| 1 | NC | 2 | Receive data into HD600 |
| 3 | Transmit data out of HD600 | 4 | NC |
| 5 | Ground | 6 | NC |
| 7 | NC | 8 | NC |
| 9 | NC | | |

DB25 Switch/LED connector

The Switch/Led connector is a DB25 Female. This connector is used to allow the HD600 to control external LEDs or other devices requiring 15mA of current or less. Connect the LED outputs to the LED ANODE and connect LED CATHODE to ground. If you want to connect up some other device then the output is capable of sourcing or sinking up to 24mA at 3.3V, but we do have a series resistor of 100 Ohms in each line. This connector also allows connecting up external contact closures to ground. In order to connect a switch, connect one side of the switch to the switch input, and connect the other side of the switch to one of the ground pins on the DB25 connector. Finally the connector can also supply 3.3V at up to 100mA to an external device. The 3.3V output is polyfuse protected. The DB25 has the following pinout:

| pin | Description | pin | Description |
|-----|-----------------|-----|-----------------|
| 1 | LED 5 output | 2 | Ground |
| 3 | LED 2 output | 4 | LED 0 output |
| 5 | Button 11 input | 6 | Button 9 input |
| 7 | Ground | 8 | Button 6 input |
| 9 | Button 5 input | 10 | Button 3 input |
| 11 | Ground | 12 | Button 1 input |
| 13 | +3.3V output | 14 | LED 4 output |
| 15 | LED 3 output | 16 | LED 1 output |
| 17 | Ground | 18 | Button 10 input |

| | | | |
|---|--------------|---|--------------|
| 3 | RX+ | 4 | RC to ground |
| 5 | RC to ground | 6 | RX |
| 7 | RC to ground | 8 | RC to ground |

USB

The HD600 has two high speed (400 mbit) USB host ports. The ports have the following pinout:

| pin | Description | pin | Description |
|-----|-------------|-----|-------------|
| 1 | VBUS | 2 | D- |
| 3 | D+ | 4 | Ground |

DB15 VGA connector

The VGA connector is able to output 1280 X 720 and 1024 X 768 computer RGB video. The connector has the following pinout (NOTE: This pinout is only accurate for REVC and later. REVB has a hardware bug on the pinout):

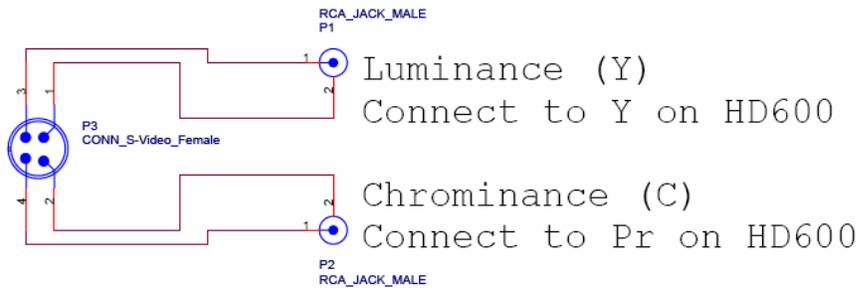
| pin | Description | pin | Description |
|-----|--------------------------|-----|---------------------------|
| 1 | RED analog video output | 2 | GREEN analog video output |
| 3 | BLUE analog video output | 4 | NC |
| 5 | Digital ground | 6 | Analog ground |
| 7 | Analog ground | 8 | Analog ground |
| 9 | NC | 10 | Digital ground |
| 11 | NC | 12 | NC |
| 13 | HSYNC output | 14 | VSYNC output |
| 15 | NC | | |

Triple RCA Component HD video connector

The component triple RCA connector is able to output the following formats:

- Composite video – from Blue jack.
- S-Video: Luma from Green jack and Chroma from Red jack
- 480P video: Y from Green jack, Pr from Red jack, and Pb from Blue jack.
- 720P video: Y from Green jack, Pr from Red jack, and Pb from Blue jack.
- 1080i video: Y from Green jack, Pr from Red jack, and Pb from Blue jack.

To use the S-Video mode, you can use an adaptor that is wired as in this diagram:



Roku HD600 S-Video adapter

1/8" Audio connectors

The HD600 has three 1/8" female audio connectors. Each connector has a stereo audio signal. The full scale voltage output of the audio is 3.06V PP, with no load. The minimum load resistance that should be connected to the audio output is 3K Ohm.

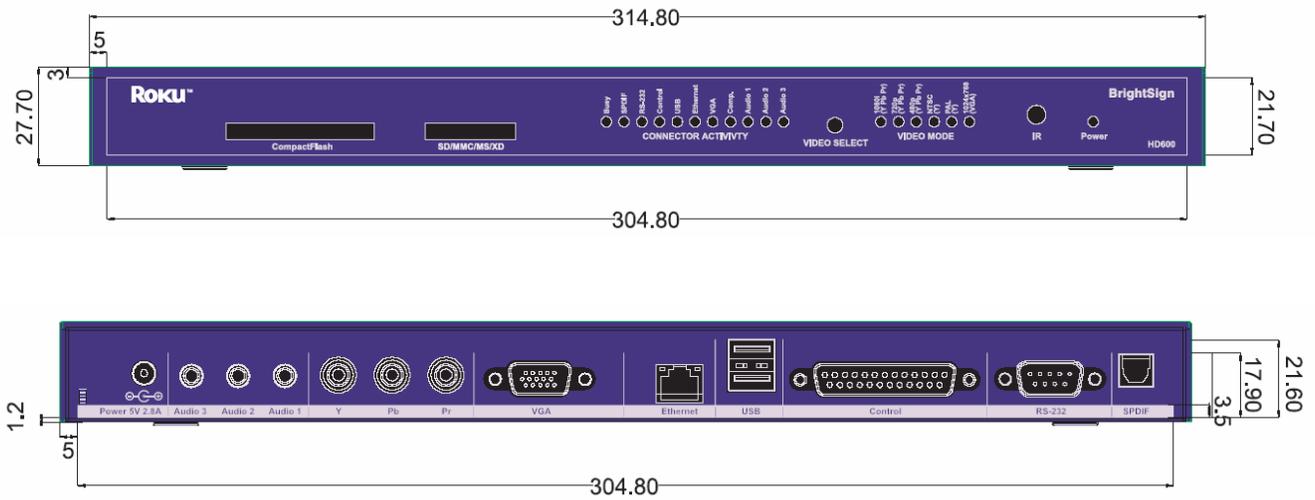
The connectors have the following pinout:

Tip: Left audio

Ring: Right audio

Base: Ground for audio signal

BrightSign HD600



Theory of operation

Power Supply

The HD600 has a four voltages present. These are 5V, 3.3V, 2.5V, and 1.2V. 5V comes in from the power connector and is used directly for USB, the video filter chip, and the optical SPDIF chip. 3.3V is created from 5V by a AMC2596-ADJDDF switching regulator. Similar regulators are used to create 2.5V for the DDR SDRAM, and 1.2V for the PNX1500 core voltage.

Reset

The HD600 has a Low Voltage Reset circuit made up of a ADM809SART. This circuit will hold the RESET_L signal low until a valid 3.3V power is present.

PNX1500 CPU

The HD600 has a Philips PNX1500 Multimedia CPU in it. This CPU runs on 3.3V, 2.5V, and 1.2V. The PNX1500 runs from a 27MHz oscillator. The PNX1500 is reset by the signal RESET_L from the low voltage reset circuit going into the POR_IN_N pin on the PNX1500. When the POR_IN_N pin goes from low to high, then the PNX1500 will look at the bootstrap pins GPIO0 and GPIO1, which are both pulled low on the PNX1500. This forces the PNX1500 to boot from IIC serial flash.

Built in Flash

The HD600 contains two flash devices. One of the devices is denoted to be the IIC BOOT flash. This flash is write protected from the factory and it contains the MAC address for the 10/100 Ethernet chip, as well as the boot code and the SRB bytes. The boot code in the IIC serial flash instructs the PNX1500 to continue the boot process by reading additional code from the on board RUN MODE NOR flash. This flash can be updated in the field, either from on the flash slots or 10/100 Ethernet. Part of the RUN MODE flash is also used to hold non-volatile parameters. The contents of the boot flash is copied into the SDRAM, then the PNX1500 jumps to the boot code.

SDRAM

The HD600 contains two DDR SDRAM devices. When the PNX1500 boots, it will copy the code from the NOR flash device into SDRAM, and then execute the code from SDRAM.

Serial Port

The HD600 uses two GPIO lines to communicate with the RS232 level shifter. GPIO58 is the RXD line, and GPIO0 is the txd line. The MAX3221 creates valid RS232 voltage levels for the transmit pin by using a capacitive voltage switcher. The TXD pin on the MAX3221 is disabled until a valid RS232 voltage is detected on the RXD pin.

Video Encoder and Filter

The PNX1500 streams decoded video out of the VDO port using a double data rate clock. In other words, 12 bits of video data is clocked out of the PNX1500 on the rising edge of the VDO_CLK signal, and on the falling edge as well. This allows the PNX1500 to output 24 bits of data at a 74.25MHz rate, using only a single 74.25MHz clock and 12 data lines. The SAA7105 video encoder takes the VDO data in and sends the data straight to the video DACs in HD mode. In Composite or S-Video mode then the encoder creates the proper signals in internal blocks for each type of video. The SAA7105 also has an internal SYNC engine that is only used in HD mode to add video sync to the GREEN component signal. In VGA mode, the sync signals from the PNX1500 and are passed through the SAA7105. The SAA7105 mode is controlled by IIC from the PNX1500. Analog video comes out of the SAA7105 and is connected to the Fairchild FMS6346MTC20 video filter chip. This chip has a programmable cutoff frequency of either 8MHz or 32MHz. When the HD600 is outputting Composite or S-Video, the filter chip is in 8MHz cutoff mode. When outputting all other modes, then the filter is in 32MHz cutoff mode. Since the video filter has a low impedance output, we can drive both VGA and COMPONENT 75Ohm terminated cables at the same time with no degradation (with the same signal).

Audio outputs

The HD600 has three audio DAC devices, which are Philips UDA1334. These devices take in digital audio signals from the PNX1500 for AO_SCK, AO_WS, and AO_SDX. The AO_WS signal is the framing signal for the audio, running at the frame rate of the audio source. The frame rate is usually either 44.1KHz or 48KHz. AO_SCK signal is typically 64 times higher than AO_WS. The PNX1500 The UDA1334 device has a built in PLL so it can generate the internal 4X oversampling clock from the AO_SCK. The output of the UDA1334 device is left and right analog audio.

SPDIF output

The PNX1500 can generate the SPDIF audio signal internally. This signal, called SPDIF_OPT is connected to a OPTICAL SPDIF transmitter chip on the board.

On Board LEDs

There are 18 on board LEDs. One of the LEDs is red in color and is designated to be the BUSY LED. Six of the LEDs are the resolution LEDs, intended to tell the user what resolution the HD600 is currently outputting. The other LEDs are intended to tell the user which output connectors are active. All the LEDs are controlled by a set of 3 74HC574 latches. Data is latched into the latches under GPIO control.

On Board Switch

The on board switch is connected to a GPIO55. There is a pullup on the button so that GPIO55 is high normally, and it is pulled low when the button is pressed.

IR Receiver

The IR receiver receives a 38KHz IR signal. The IR signal is filtered and demodulated and then sent into the PNX1500 on GPIO60. The signal is called IR_DAT on the schematic.

CF flash slot

The CF flash slot is connected up in TRUE IDE mode, and it uses the PNX1500 IDE mode on the XIO bus. The chip select for the CF slot is XIO_SEL1. two 74LVC245 bidirectional buffers isolate the databus of the CF from the XIO databus, so that the CF card can be hot plugged. A 74LVC244 chip buffers the other CF signals, again so that the CF card can be hot plugged. The PNX1500 won't attempt to access the CF slot unless it first detects that a CF card is present. The signal CF_CD_L goes low when a CF card is inserted. This signal is connected to GPIO52. Power to the CF slot is controlled by a MOSFET, and it is not turned on until the PNX1500 detects that a CF card has been inserted into the CF slot.

4 in 1 Flash Slot

The 4 in 1 flash slot supports 4 different formats of flash cards: MMC/SD/XD/MS. MMC/SD use the same physical pins on the connector. Each of the 3 physical formats have its own card detect pin connected to GPIO, so that the PNX1500 can detect which kind of card is connected. The MMC/SD/MS formats are 4 bit wide serial formats and the HD600 uses GPIO to communicate with the 4 cards. The XD format is the same as NAND flash, and so the built in PNX1500 NAND flash controller on the XIO bus is used for XD. The XD interface has buffers to isolate the databus and control signals from the XIO bus so that the XD card can be hot plugged and un-plugged. Power to the 4 in 1 slot is controlled by a MOSFET, and it is not turned on until the PNX1500 detects that one of the MMC/SD/XD/MS cards has been inserted into the 4 in 1 slot.

Optional built in NAND flash

The HD600 has a spot on the board to support loading a built in NAND flash. This could be used to give the HD600 a large amount of on board storage. The NAND flash is connected to the XIO on the PNX1500.

Ethernet

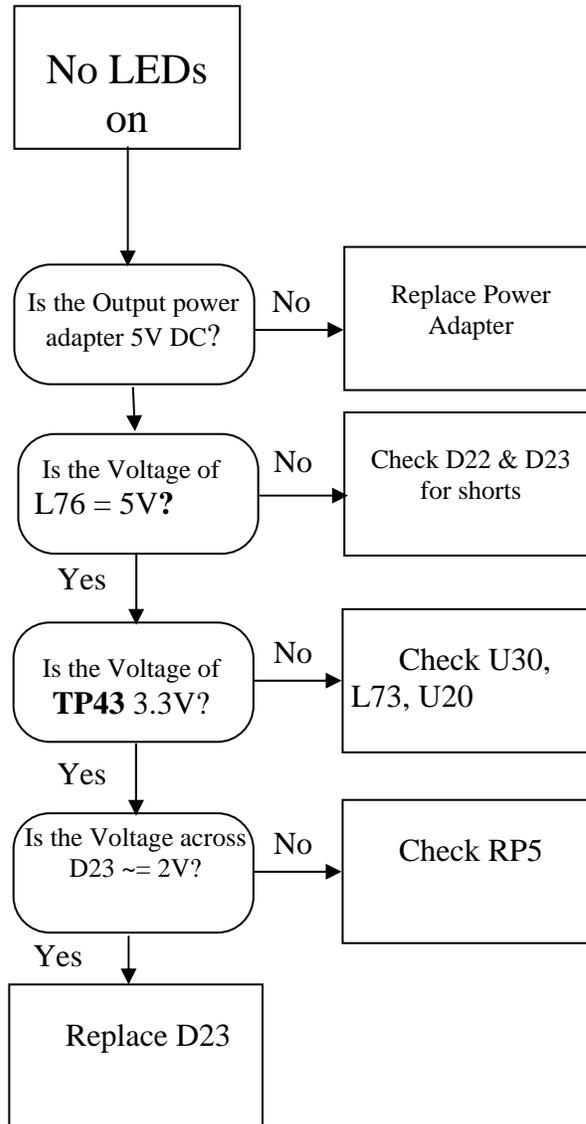
10/100 Base T Ethernet is implemented on the HD600 by a Davicom DM9161AE PHY controller. This device takes the PNX1500 Ethernet signals and converts them to the differential Ethernet signals. The PHY chip is also connected to an on-board Ethernet magnetic and a RJ45 for cable termination. The DM9161 chip is able to signal to the PNX1500 that its state has changed by toggling the ETH_PHY_INT_L line, which is connected to GPIO11.

USB

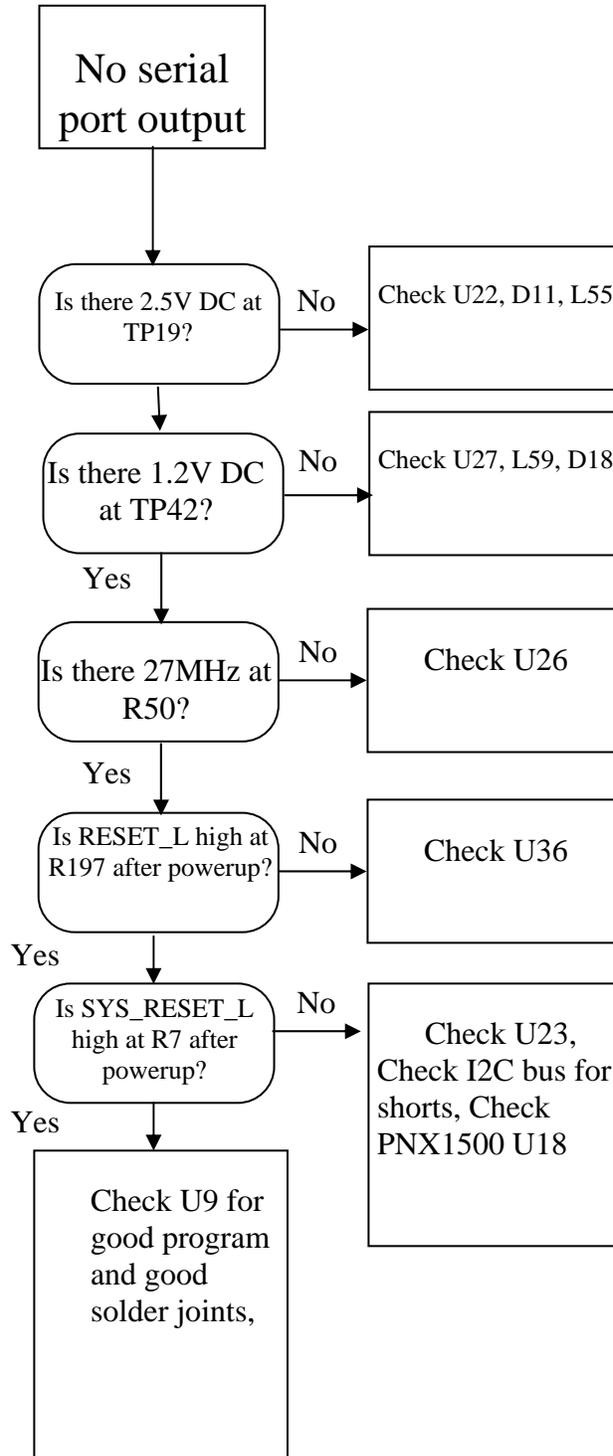
USB is implemented by a PCI ISP1562 USB dual host controller chip. There is also a dual over-current protected switch TPS2042BD device, which is used to turn on and off power to the USB device, and to detect over-current situations.

Flow Chart: (for Repair Center Use)

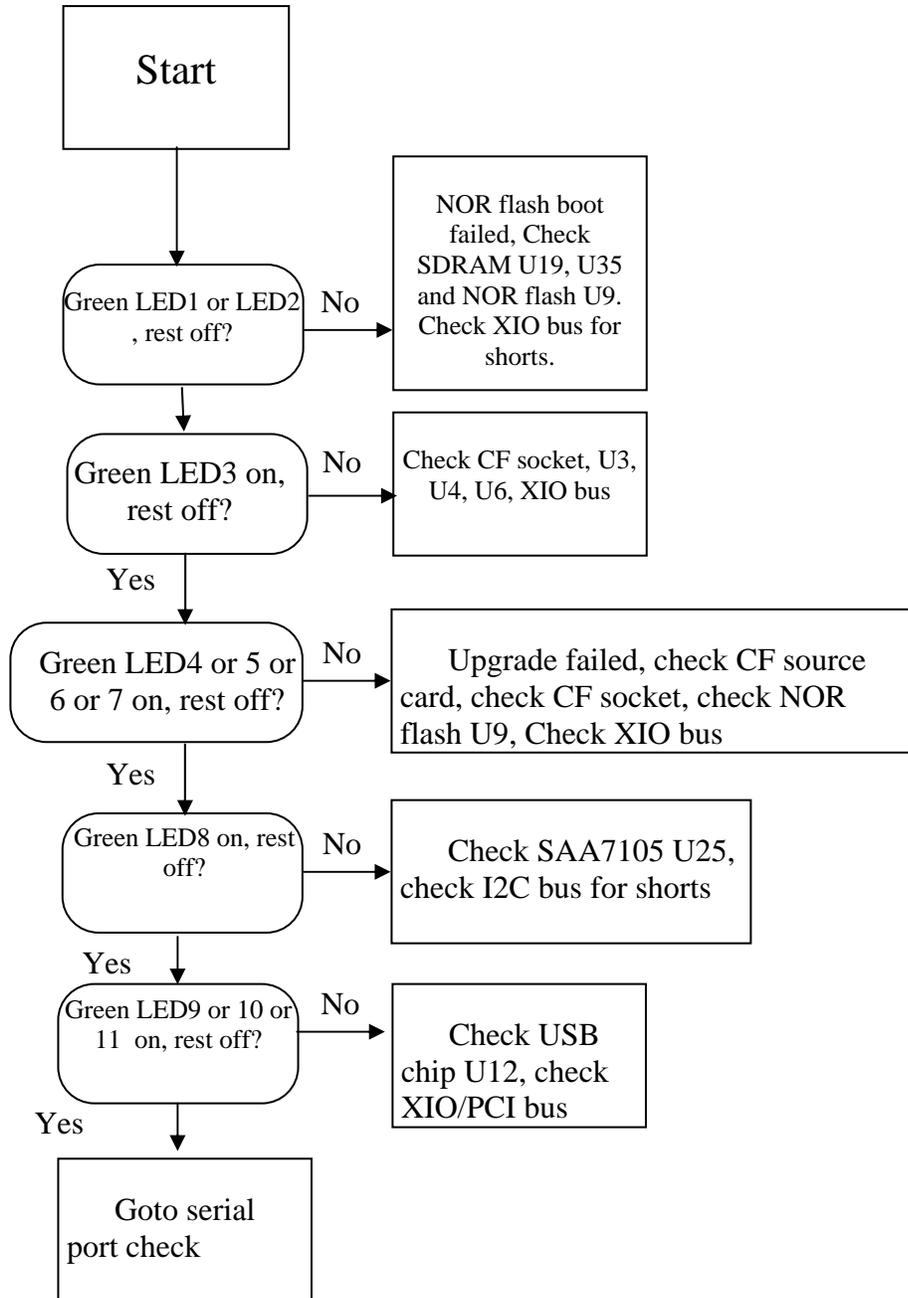
(1) Power Start



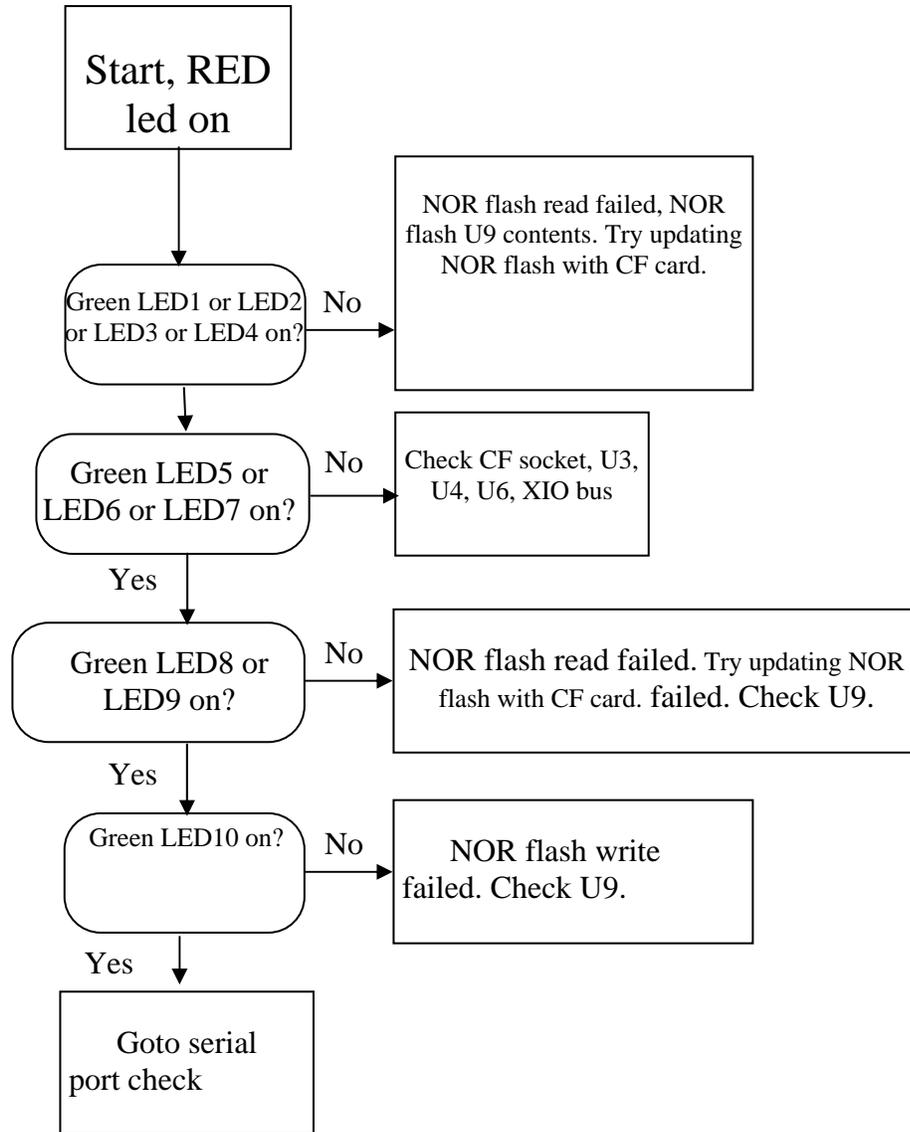
(2) Power LED comes on, no serial port output



(2) Power LED comes on, 1 or more green LEDs come on in sequence from left to right



(3) Power LED comes on, RED led comes on plus 1 or more green led stays lit.



(4) Power LED comes on, 1 or more green LEDs come on in sequence from left to right, and then go out.

Red LED stays out. Serial port tests are in order. Connect a PC to the HD600 using a null modem cable (Wire up 2-3, 3-2, 5-5). Set the terminal program to 115,200 N,8,1.

- A) If the serial port is not working, then check U2 and P2.
- B) Use LEDTEST command to test each LED. For example:
Ledtest 0 1
Turns on the left most (red) led
If any LED fails to come on, then check U15, U16, U17 and the resistors on the outputs of these.
Note that you can test the 6 LED outputs on the DB25 by using ledtest 17 1 through ledtest 24 1
- C) Use the SWITCHTEST command to test each switch. If any switch fails to read, or is stuck on, then check U5, U7 and the resistors and beads on the inputs to U5 and U7. The switchtest command will show the status of the front panel switch as well as the switches connected to the DB25.
- D) Use the MEDIADIR command to test reading the CF card. For example:
Mediadir ATA:/
If the CF card fails to read, check U3, U4, U6 and the CF socket, and associated resistor packs.
- E) Use the SINETEST command to test the audio outputs. The SINETEST command will put a sine wave on each of the stereo outputs. If the audio fails to work, check U28, U31, U32. Check for the audio master clock on R25, should be 11.288MHz. Check for audio bit clock R26, should be 2.82MHz. Check for audio data on R159, R160, R161. Check passives on outputs of U28, U31, U32. The voltage output of the audio during this test (fullscale) is 3.06V PP, with no load.
- F) Use the SPDIFTEST command to test the SPDIF output. This will put a digital sinewave on the output of the SPDIF connector. If SPDIF is not working, check U1.
- G) If you have a REVC or newer HD600, Connect a Ethernet cable to a switch, and run the ETHTEST command. The switch should show link on, and the yellow LED should light on the HD600 showing link on. If this does not work, check U14, T1, P8 and associated passives.
(NOTE: If you are using a REVA or REVB HD600 then you must use a mirror image wired Ethernet cable (1-8, 2-7,3-6,4-5,5-4,6-3,7-2,8-1)
- H) Insert a USB mass storage device in either of the USB host slots. The HD600 should configure these and print out information automatically about the mass storage device. If this does not work, then check U12, U34, P7, and associated passives. Also check the XIO/PCI bus.
- I) To test the SDIO slot, us the CARDTEST command. Insert a SD card, then issue CARDTEST and the HD600 should print out the model of the card. If this does not work, check P6, U18, and associated passives.
- J) To test the RGB, issue the following sequence of commands (This assumes you have some test video and image files available):

VIDEOMODE 1024x768x60p

VIDEOTEST ATA:/true.vob

(You can use your own VOB file or MPEG2 file for this test, on the CF card)

If the RGB video fails to play, check the following: U25, U24, U21, P9. While playing RGB in 1024x768 mode, the following signals should be present:

- Videoclock at pin 20 of U25 should be 65MHz.
- HSVGC and HSYNC should have 48.35KHz
- VSVGC and VSYNC should have 60Hz

K) To test the Component video, issue the following sequence of commands (This assumes you have some test video and image files available):

VIDEOMODE 1920x1080x60i

VIDEOTEST ATA:/true.vob

(You can use your own VOB file or MPEG2 file for this test, on the CF card)

If the Component video fails to play, check the following: U25, U24, U21, P9. While playing component video in 1920x1080x60i mode, the following signals should be present:

- Videoclock at pin 20 of U25 should be 74.25MHz.
- HSVGC and HSYNC should have 31.47KHz
- VSVGC and VSYNC should have 59.95Hz