BrightSign®

HARDWARE MANUAL

BrightSign HD120, HD220, HD1020

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OVERVIEW

The BrightSign HD120, HD220, and HD1020 players can be used to drive a variety of HDTV and computer monitors for digital sign and kiosk applications. In addition to driving a video display, these players have many different built-in interfaces that allow them to be controlled.

This reference manual specifies the hardware interfaces on the BrightSign HD120, HD220, and HD1020. This manual does not describe any software functions.

Block Diagram
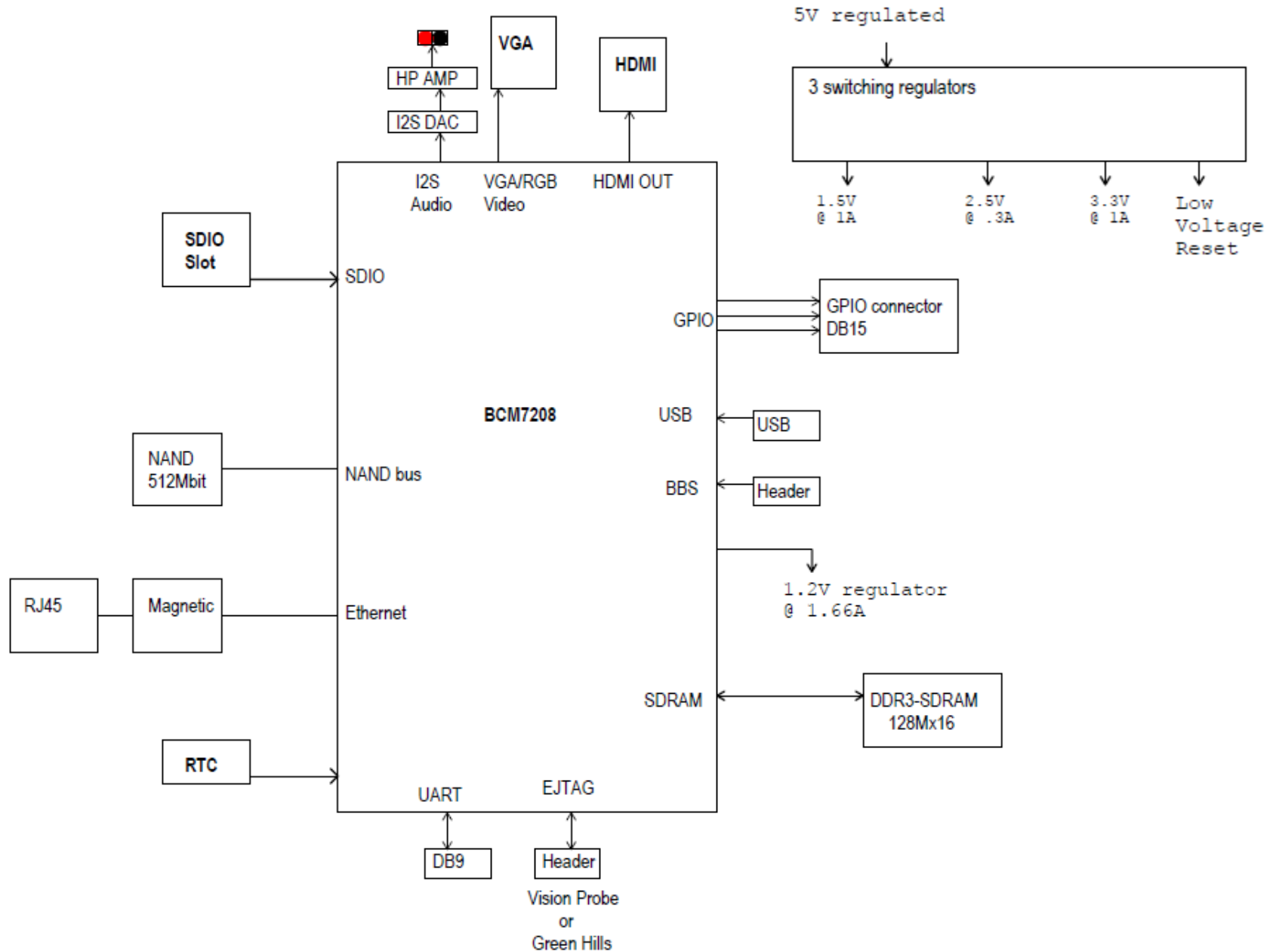
Ports

HD120

Front

- DA15 female for GPIO, IR in/out, and 3.3 V power

Left

- GPIO button
- Stereo 3.5mm mini plug for audio output

Right

- SD/SDHC flash card slot
- Red status/error LED
- Yellow update LED
- Green power LED
- Green flash activity LED

Back

- Reset button
- DE15 VGA video connector
- HDMI connector
- Power plug for 5 V power input at 3 A

HD220

Left

- GPIO button
- Stereo 3.5mm mini plug for audio output

Right

- SD/SDHC flash card slot
- Red status/error LED

- Yellow update LED
- Green power LED
- Green flash activity LED

Back

- Reset button
- 10/100 Ethernet jack
- DE15 VGA video connector
- HDMI connector
- Power plug for 5 V power input at 3 A

HD1020

Front

- DE9 male RS-232
- DA15 female for GPIO, IR in/out, and 3.3 V power

Left

- GPIO button
- USB connector
- Stereo 3.5mm mini plug for audio output

Right

- SD/SDHC flash card slot
- Red status/error LED
- Yellow update LED
- Green power LED
- Green flash activity LED

Back

- Reset button
- DE15 VGA video connector

- HDMI connector
- Power plug for 5 V power input at 3 A

Power Connector

The power connector on this board is rated for 5 V at 3 A. The plug for the connector is a standard, center-positive 5.5mm plug with a 1.65mm center pin hole.

DE9 RS-232 Connector

The RS-232 connector is a male DE9. Like PCs, the BrightSign HD series of players are DTE devices. The input to the chip accepts a range between +30V and -30V, so it is compatible with standard +12V and -12V signaling. The output from the chip is rated at a typical +7V and -7V, which exceeds the voltage required by the RS-232 specification.

The baud rate is 115,200, with no parity, 8 data bits, and 1 stop bit. There is no hardware or software flow control. The maximum cable length is 50 meters, and the total cable capacitance is 2500pF.
Note: *A lower capacitance cable allows you to use cable lengths beyond 50 meters.*

The following diagram illustrates the behavior of the TX and RX signal:
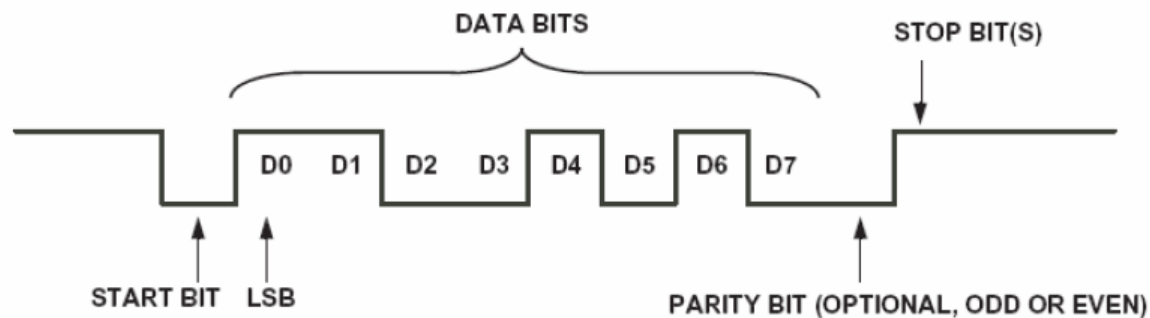
The following table illustrates the pinout of the DE9 on the HD series of players:

pin	Description	pin	Description
1	NC	2	Receive data into the player
3	Transmit data out of the player	4	Available 5V@500mA
5	Ground	6	NC
7	Optional TX 2nd channel	8	Optional RX 2nd channel
9	NC	--	--

DA15 Switch/LED Connector

The switch/led connector is a DA15 female. This connector is used to allow the player to control external LEDs or other devices requiring 24 mA of current or less.

Connect the LED outputs to the LED ANODE and connect the LED CATHODE to the ground. If you want to connect another device, then the output is capable of sourcing or sinking up to 3.3 V at 24 mA, but there is a series resistor of 100 Ohms in each line.

The connector also allows the connecting of external contact closures to the ground. In order to connect a switch, connect one side of the switch to the switch input, and connect the other side to one of the ground pins on the DA15 connector. The connector can also supply 3.3 V at up to 500 mA to an external device. The 3.3 V output is polyfuse-protected and can source up to 500 mA.

If one BrightSign player is driving the inputs on another BrightSign player, then you can drive at most three inputs from one output. The following calculations explain this limitation:

Note: *The GPIO outputs have 100 Ohm series resistors; the GPIO inputs have 1K pullup resistors to 3.3 V; and the input threshold on the 541 chips is 2 V high and .8 V low. The high voltage is not a problem, but the low voltage can be if there are too many inputs connected to one output.*

1 out driving 1 in	V=3.3*100/(100+1,000)=0.3
1 out driving 2 in	V=3.3*100/(100+500)=0.55
1 out driving 3 in	V=3.3*100/(100+333.3)=0.76
1 out driving 4 in	V=3.3*100/(100+250)=.94 (This is too high, so 1 output driving 3 inputs is the maximum)

The following table illustrates the pinout of the DA15 on the HD series of players:

pin	Description	pin	Description
1	IR blaster input	2	Ground
3	Button 6 I/O	4	Button 5 I/O
5	Button 3 I/O	6	Ground
7	Button 1 I/O	8	+3.3V output at 500mA
9	Ground	10	Button 7 I/O
11	Ground	12	Button 4 I/O
13	Button 2 I/O	14	Ground
15	Button 0 I/O	--	--

Here is the DA15 female as viewed from the front of the BrightSign HD120 and HD1020:
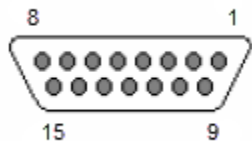
A button/LED/IR board can be used to demonstrate the GPIO and IR functions on a BrightSign player. This board is built by a third-party manufacturer and can be purchased upon request.

Ethernet

The BrightSign HD220 has a standard RJ45 connector for 10/100 base-T Ethernet. The maximum length for the Ethernet cable is 100 meters. The following table illustrates the pinout of the RJ45:

pin	Description	pin	Description
1	TX+	2	TX-
3	RX+	4	RC to ground
5	RC to ground	6	RX
7	RC to ground	8	RC to ground

USB

The HD1020 has a high-speed (480 Mbit) USB host port. The maximum length for the USB cable is 5 meters. The following table illustrates the pinout of the USB host port.

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

DE15 VGA Connector

The VGA connector is able to output RGB video. The following table illustrates the pinout of the DE15 VGA connector:

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	+5V DDC supply	10	Digital ground
11	NC	12	DDC SDA
13	HSYNC output	14	VSYNC output
15	DDC SCL	--	--

Triple RCA Component HD Video Connector

Using a component cable adaptor on the VGA port, the component triple RCA connector is able to output the following formats:

- 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
- 1080p video: Y from Green jack, Pr from Red jack, and Pb from Blue jack

3.5mm Audio Connector

The HD120, HD220, and HD1020 each have one 3.5mm female audio connector, which transmits a stereo signal. The full scale voltage output of the audio is 2 V RMS, with no load. The minimum load resistance connected to the audio output should be 5K Ohms.

Note: *The BrightSign expansion module allows you to drive up to three sets of 5 Ohm headphones directly.*

The audio connector has the following pinout:

- Tip: Left audio
- Ring: Right audio

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- Base: Ground for audio signal

HDMI Connector

The HDMI connector is used to send digital video and audio to HDMI-enabled sink devices. The following table illustrates the pinout of the HDMI connector:

pin	Description	pin	Description
1	TX2p	2	Ground
3	TX2n	4	TX1p
5	Ground	6	TX1n
7	TX0p	8	Ground
9	TX0n	10	TXCp
11	Ground	12	TXCn
13	CEC	14	NC
15	DDC SCL	16	DDC SDA
17	Ground	18	+5V DDC
19	HDP (Hot Plug Direct)	20	Ground

ENVIRONMENTAL AND POWER USAGE

The HD120, HD220, and HD1020 players are designed to be used between 0°C and 40°C, at 90% maximum relative humidity, non-condensing.

The power supply on the BrightSign HD series is 15 W and 5.0 V at 3 A. These players will use approximately 1 A of power when playing a 720p or 1080i MPEG2 HD source file.
**Note**: *1 A at 5.0 V is approximately 5 W.*

There is 2 A of additional available power that can be used by peripherals connected to a player. Do not connect any combination of peripherals that will exceed 2 A of draw. If more than 2 A is drawn, then the external power supply will shut down due to overcurrent conditions. The unit will not be damaged, but it may reboot or not operate properly until the overload is removed.

The remaining 2 A can be shared in any way among the following connectors:

Connector	Power Usage
Ethernet	Approx. 180 mA (when transferring data)
USB	Max 1500 mA*
DE9 5V	500 mA
DB25 3.3V	500 mA
HDMI 5V	Max 55 mA
6 LED outputs on DB25	Up to 24 mA (each)

*The USB spec is 500mA, but more current has been placed on the USB connector to be able to use the BrightSign Expander, in some cases without an additional 5V power supply.

MECHANICAL
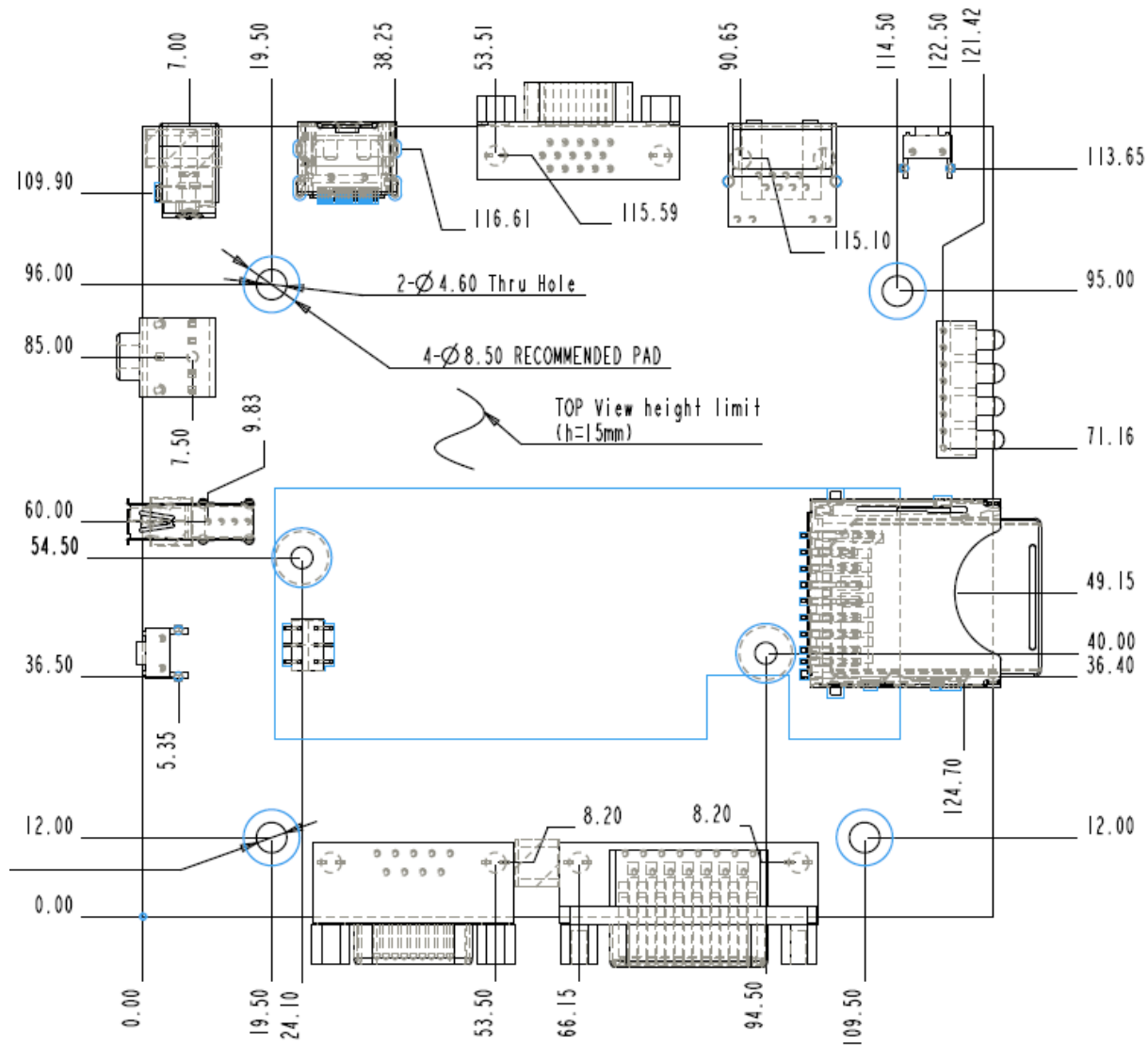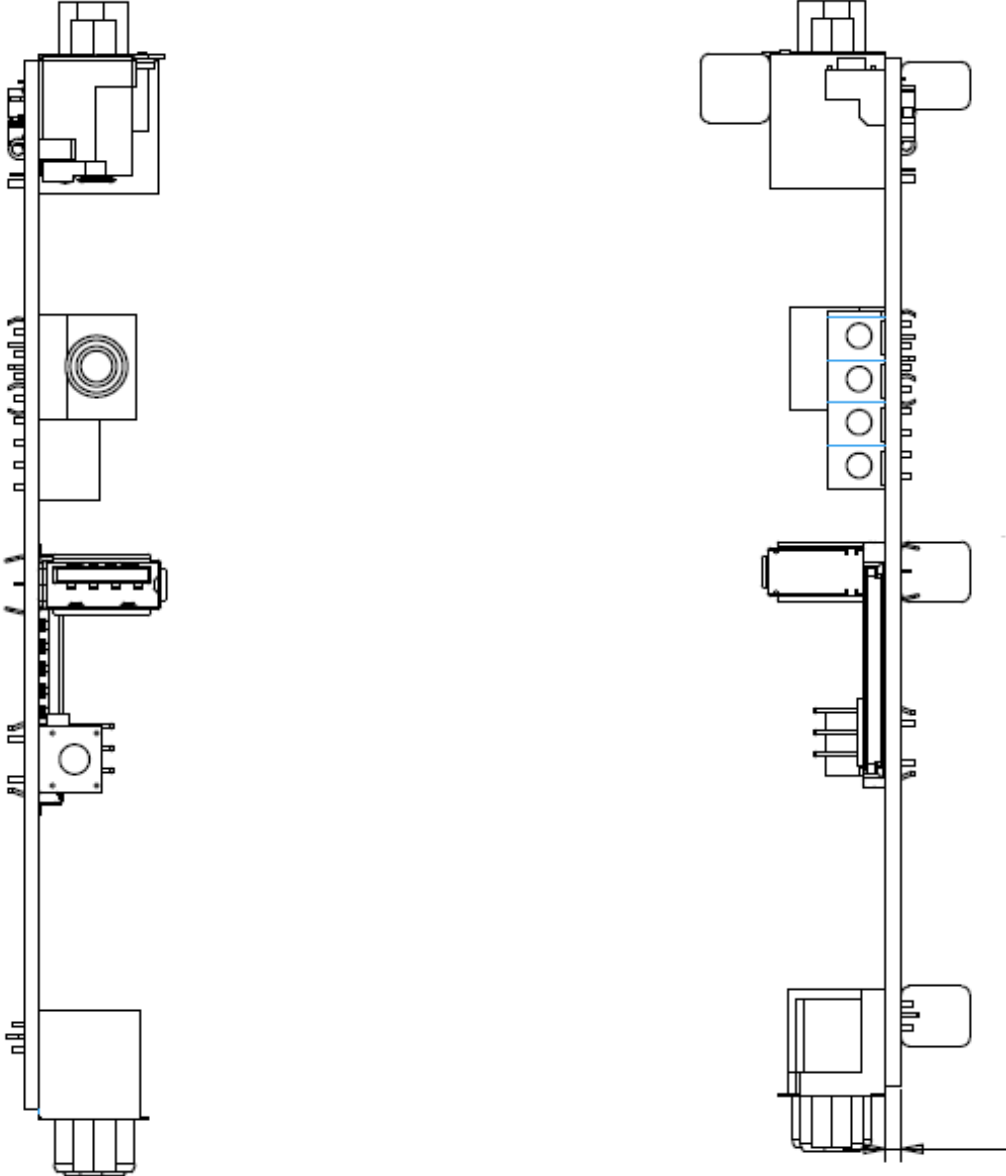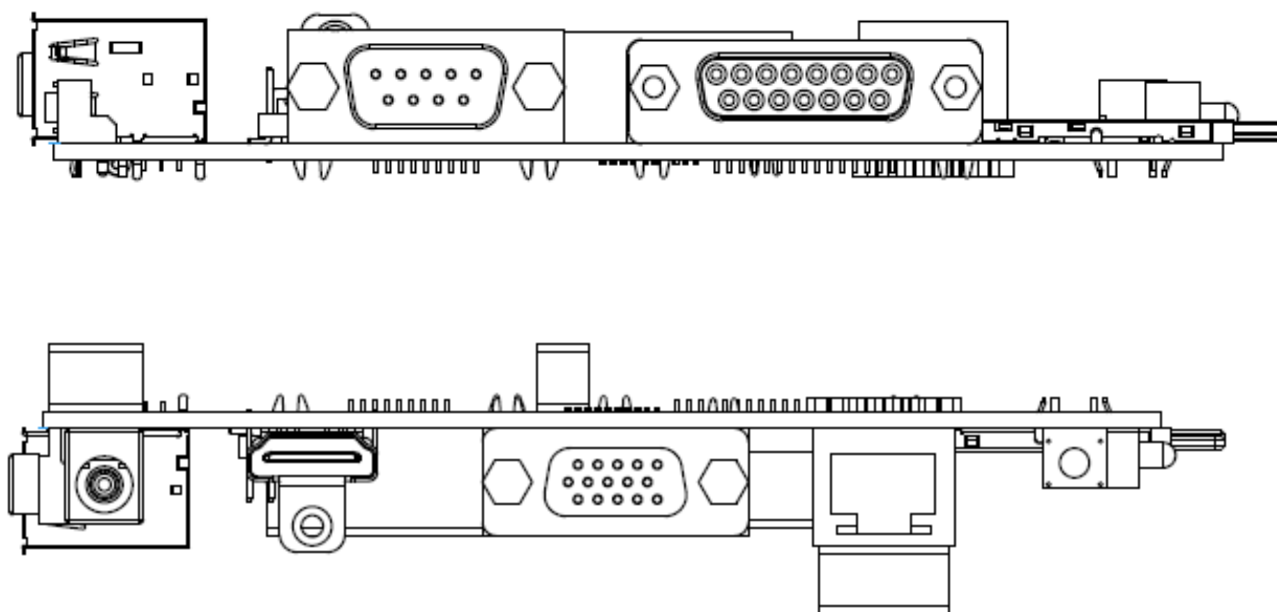
THEORY OF OPERATION

Power Supply

There are five voltages present in the player: 5 V, 3.3 V, 2.5 V, 1.5 V and 1.2 V. 5 V comes in from the power connector and is used directly for the USB. 3.3 V is created from 5 V by a switching regulator. Similar regulators are used to create 2.5 V for the DDR SDRAM and 1.2 V for the CPU core voltage.

Reset

The HD120, HD220, and HD1020 players have a Low Voltage Reset circuit. This circuit will hold the RESET_L signal low until a valid 3.3 V power source is present.

BCM7208 CPU

The HD120, HD220, and HD1020 players utilize a BCM7208 Multimedia CPU. This CPU runs on 3.3 V, 2.5 V, and 1.2 V and runs from a 27 MHz oscillator. The CPU is reset by the RESET_L signal from the low voltage reset circuit going into the RESET_IN pin on the BCM7208. When the RESET_in pin goes from low to high, the BCM7208 will boot from the NAND flash.

Built-in Flash

The boot code in the BCM7208 instructs it to continue the boot process by reading additional code from the onboard NAND flash, which can be updated in the field, either from on the flash slots or USB mass storage. Part of the NAND flash is also used to hold non-volatile parameters. The contents of the boot flash are copied into the SDRAM. The CPU then jumps to the boot code.

SDRAM

The HD120, HD220, and HD1020 players each contain one DDR SDRAM device. When the BCM7208 boots, it will copy the code from the NAND flash device into the SDRAM and then execute the code from the SDRAM. The SDRAM runs at a clock rate of 666MHz, with a data rate of 1333MHz.

Serial Port

The player has a built in UART that communicates with the RS-232 level shifter. The MAX232 creates valid RS-232 voltage levels for the transmit pin by using a capacitive voltage switcher.

Video Encoder and Filter

The BCM7208 streams decoded video using a single-data race clock. It also streams the same video out of the on-board DACs.

Audio Outputs

The HD120, HD220, and HD1020 players each have a single Texas Instruments high quality audio DAC device, which takes in digital audio signals from the BCM7208 in an I2S audio format. The AUD_LRCIN is the framing signal for the audio and runs at the frame rate of the audio source (usually either 44.1KHz or 48KHz). The AUD_BITCLK signal is typically 64 times higher than the AUD_LRCIN.

The audio output from the TI amplifier is sent directly to the audio output jack. It can drive a 32 Ohm load with a 2 V RMS signal.

On-Board LEDs

There are four on-board LEDs that indicate the following:

LED	Indication
Green power	Flashes any time the board is powered up and not in reset mode.

Green flash activity	Flashes any time there is CPU activity.	
Yellow update	Flashes when the board is being upgraded.	
Red status	Flashes a certain number of times to indicate which error is occurring. The flash codes are described below.	
	2	Unspecified error
	3	Network recovery script is preparing to run on a device configured for network recovery.
	4	No upgrade file found
	5	Failed to load kernel module
	6	Board is not capable of running the current firmware version.
	7	Problem related to the Ethernet chip
	7	A piece of on-board hardware is not working correctly (on firmware versions 4.1 and later).
	8	Problem related to the storage device (either the USB drive or SD card)
	9	Problem related to the registry/EEPROM
	10	The autorun script encountered a load/run error.
	11	WiFi-related error (mainly, WiFi not found on USB)
	12	Unable to find a bootable image (on firmware versions 4.0 and later)

On-Board Switch

The on-board switch is connected to the GPIO32. A pullup on the button normally sets the GPIO32 to be pulled high. Conversely, the GPIO32 is pulled low when the button is pressed.

Reset Switch/GPIO Button

The on-board switch is connected to the GPIO12. Pressing down the reset button will cause the GPIO12 to go low. Holding the reset button low for approximately 10 seconds will cause a hard reset. When the board goes into reset mode, the power LED will be dark until the reset button is released.

SDHC/SD Flash Slot

The SDHC/SD flash slot supports SDHC and SD flash cards.

NAND Flash

BrightSign players have a built-in NAND flash. All the code for the player is stored on the NAND flash. It may also be possible to store some content on the NAND flash, which is connected directly to the BCM7208.

Ethernet

The 10/100 Base-T Ethernet is implemented on the HD120, HD220, and HD1020 by directly interfacing with the BCM7208. The player has on-board Ethernet magnetics and termination for the RJ-45 cable.

USB

The USB 2.0 high-speed host controller is implemented internally in the BCM2708 SOC chip. The board utilizes the TPS2065 device, which is over-current protected switch: It can be used to turn the power to the USB device on or off or to detect over-current situations.