BrightSign®

# HARDWARE MANUAL

BrightSign XD232, XD1032, XD1132

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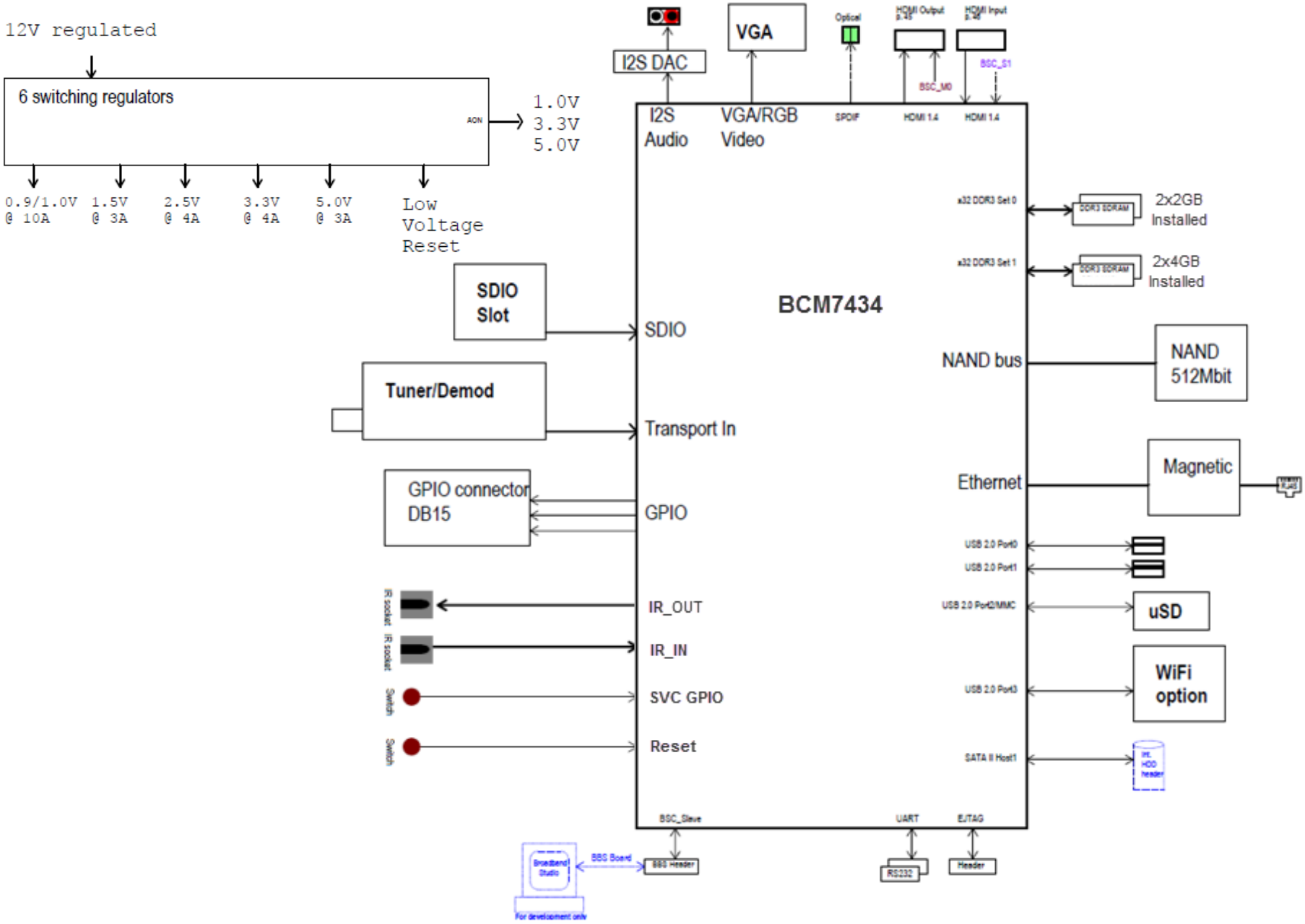
# OVERVIEW

The BrightSign XD232, XD1032, and XD1132 players can be used to decode images, audio, and up to two HD video streams for digital sign and kiosk applications. In addition to driving video and audio displays, these players can be controlled with various networked and built-in interfaces.

This reference manual specifies the hardware interfaces and operational theory of the BrightSign XD232, XD1032, and XD1132.

In this manual, the term "XDx32" is often used to denote the XD232, XD1032, and XD1132 models and differentiate them from the XD230, XD1030, and XD1230 models.

## Block Diagram



## XD232

### Front

- 3.5mm IR in/out
- DA15 GPIO

### Left

- GPIO service button

### Right

- SDHC/SDXC flash card slot
- Status/error LED (red)
- Update LED (yellow)
- Power LED (green)
- SD activity LED (green)
- MicroSD presence LED (green)
- Ethernet activity LED (green)
- WiFi activity LED (green)
- Server connection (green)

### Back

- 12V Molex power connector (4-pin)
- DE15 VGA video connector
- Stereo 3.5mm mini plug for audio output
- HDMI Out
- RJ45 Ethernet (PoE)
- GPIO reset button

**Internal**

- MicroSD slot
- WiFi Module connector

## XD1032

### Front

- 3.5mm IR in/out
- DE9 RS232 serial (male)
- DA15 GPIO
- SPDIF out

### Left

- USB 2.0 (2x)

### Right

- SDHC/SDXC flash card slot
- Status/error LED (red)
- Update LED (yellow)
- Power LED (green)
- SD activity LED (green)
- MicroSD presence LED (green)
- Ethernet activity LED (green)
- WiFi activity LED (green)
- Server connection (green)

### Back

- 12V Molex power connector (4-pin)
- DE15 VGA video connector
- Stereo 3.5mm mini plug for audio output
- HDMI Out

- RJ45 Ethernet (PoE)
- GPIO reset button

**Internal**

- MicroSD slot
- WiFi Module connector

## XD1132

### Front

- 3.5mm IR in/out
- DE9 RS232 serial (male)
- DA15 GPIO
- SPDIF out

### Left

- USB 2.0 (2x)

### Right

- SDHC/SDXC flash card slot
- Status/error LED (red)
- Update LED (yellow)
- Power LED (green)
- SD activity LED (green)
- MicroSD presence LED (green)
- Ethernet activity LED (green)
- WiFi activity LED (green)
- Server connection (green)

### Back

- 12V Molex power connector (4-pin)
- DE15 VGA video connector
- Stereo 3.5mm mini plug for audio output
- HDMI Out

- HDMI Input
- RJ45 Ethernet (PoE)
- GPIO reset button

**Internal**

- MicroSD slot
- WiFi Module connector

# HARDWARE INTERFACES

## Power Connector

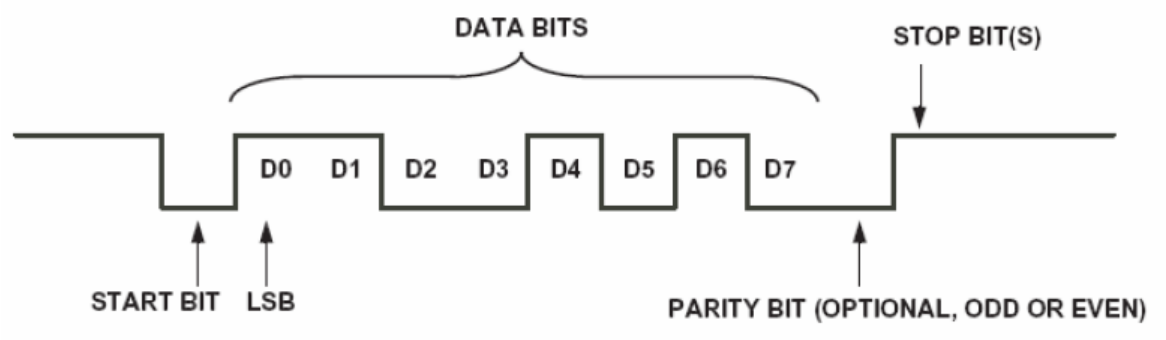
The power connector for the XDx32 series is rated for 12V @ 3A. The plug is a right-side positive, keyed and locking 4-pin connector.

## DE9 RS-232 Connector

The RS-232 interface is a male DE9 connector. The BrightSign XDx32 players are DTE devices, similar to a PC. The input to the chip accepts a range between +25V and -25V, so it is compatible with +12V/-12V signaling.

The baud rate of the RS-232 interface (which is controlled by system software) is 115200, with no parity, 8 data bits, and 1 stop bit. The RS-232 interface supports RTS/CTS hardware flow control, but no 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 serial connector on the XDx32 series:

| 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 | NC | 8 | NC |
| 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 24mA 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 3.3V at 24mA, but there is a series resistor of 100Ω 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 3.3V at up to 500mA to an external device. The 3.3V output is polyfuse-protected and can source up to 500mA.

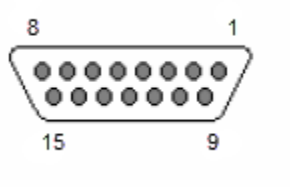
If one BrightSign player is driving the inputs on another BrightSign player, then you can drive at most three inputs from one output. The following calculations explain this limitation:

**Note**: *The GPIO outputs have 100Ω series resistors; the GPIO inputs have 1K pullup resistors to 3.3V; and the input threshold on the 541 chips is 2V high and .8V low. The high voltage is not problematic, 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 XDx32 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 a XDx32 playes.

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

BrightSign XDx32 players have an RJ45 connector for 10/100 base-T Ethernet, as well as Power over Ethernet (PoE) capabilities. The maximum Ethernet-cable length is 91 meters for PoE applications and 100 meters for non-PoE applications. To operate using PoE, XDx32 players require type-2 PoE supplying a minimum of 25W.

**Important**: *The equipment should be connected only to PoE networks without routing to the outside plant.*

The following table illustrates the pinout of the RJ45:

| pin | Description | pin | Description |
|---|---|---|---|
| 1 | TX+ | 2 | TX- |
| 3 | RX+ | 4 | BI+ |
| 5 | BI- | 6 | RX- |
| 7 | BI+ | 8 | BI- |

## USB

The XD1032 and XD1132 have two high-speed (480 Mbit) USB host ports, which also support USB 2.0 powered devices (up to 500mA for each 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

Component video is provided over the VGA connector. To display component video, you will need to use a VGA-to-component converter. See this FAQ for more details.

## 3.5mm Audio Connector

All XDx32 models have a single 3.5mm female audio connector, which transmits an analog stereo signal. The full-scale voltage output of the audio is 2V RMS. The minimum load impedance of the audio connector is 32Ω.

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

The audio connector has the following pinout:

- **Tip**: Left audio
- **Ring**: Right audio
- **Sleeve**: Ground for audio signal

## HDMI Out Connector

The HDMI-out 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 | HPD (Hot Plug Detect) | -- | |

## HDMI In Connector

The HDMI-in connector is used to receive digital video and audio from HDMI-enabled source devices. It accepts inputs of up to 1920x1080@60p, with 24-bits RGB. The signaling conforms to the DVI 1.0, HDMI 1.4, and HDCP 1.2 standards.

The HDMI signaling has CEC (but no ARC or HEC) functionality. The CEC channel is electrically coupled to the corresponding signal on the HDMI output, and the CEC commands will pass through the player even when it does not have power.

## 3.5mm IR Out

The IR blaster generates or receives a space-encoded NEC or Pronto Hex signal. The two transported bit values of the signal (0 and 1) are encoded using differing lengths of low-time IR pulses.

The 3.5mm IR in/out port has the following pinout:

- **Tip**: 3.3V
- **Ring**: IR Input
- **Sleeve**: IR Output

**Note**: *The sleeve is used as a ground during input operations.*

## S/PDIF Out

The SPDIF_OPT signal is generated within the BCM7421 CPU, which has a direct connection to the S/PDIF port.

## Wireless

BrightSign XDx32 players feature a six-pin connector on top of the printed circuit board (PCB) within the case. This connector allows installation of a peripheral wireless module that supports 802.11 a/b/g/n WiFi protocols.

# ENVIRONMENTAL AND POWER USAGE

BrightSign XDx32 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 XDx32 series is 36W and 12V at 3A. These players will use approximately 1A of power when playing a 720p or 1080i MPEG2 HD source file.

An additional 2A of power is available for peripherals connected to the player. The user should not connect any combination of peripherals that will exceed 2A draw. If more than 2A is drawn, the external power supply may shut down due to over-current conditions. The unit will not be damaged, but it may reboot or not operate properly until the overload is removed.

If the device is being powered by the power supply, the 2A can be shared in any way among the following connectors:

| Connector | Maximum Power Usage |
|---|---|
| Ethernet | Approx. 180mA (when transferring data) |
| USB | 500mA (on each connector) |
| DE9 5V | 500mA |
| DA15 3.3V | 500mA |
| HDMI 5V | 500mA |
| IR blaster output | 300mA |

If the device is being powered by PoE, only 1A is available for all connectors (or possibly less if the device is running a resource-intensive presentation). It can be shared in any way among the following connectors:

| Connector | Maximum Power Usage |
|---|---|
| Ethernet | Approx. 180mA (when transferring data) |
| USB | 500mA (on each connector) |
| DE9 5V | 100mA |
| HDMI 5V | 500mA |
| IR input/output | 300mA |

# THEORY OF OPERATION

This section describes how specific components operate on the XD232, XD1032, and XD1132.

## Power Supply

There are seven voltage levels present in the player: 12V, 5V, 3.3V, 2.5V, 1.8V, 1.5V, and 1V.

## Reset

BrightSign XDx32 players have a Low Voltage Reset circuit. This circuit will hold the RESET_L signal low until a valid 3.3V power source is present.

## BCM7434 CPU

BrightSign XDx32 players utilize a BCM7434 Multimedia CPU. This CPU runs on 3.3V, 2.5V, and 1V and runs from a 27MHz oscillator. The CPU is reset by the RESET_L signal from the low voltage reset circuit going into the RESET_IN pin on the CPU. When the RESET_IN pin goes from low to high, the BCM7434 will boot from the NAND flash.

## Built-in Flash

The boot code in the BCM7434 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 a SDHC/SDXC flash card or a USB mass-storage device. 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

BrightSign XDx32 players contain four banks of DDR SDRAM (two 2GB banks and two 4GB banks). When the CPU 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 800MHz, with a data rate of 1600MHz.

## Serial Port

The XD1032 and XD1132 have a built in UART that communicates with the RS-232 level shifter. The MAX232 uses a capacitive voltage switcher to create valid RS-232 voltage levels for the transmit pin.

## Video Encoder and Filter

The BCM7421 streams decoded video using a single-data rate clock. It also streams the same video out of the on-board DACs.

## Audio Outputs

BrightSign XDx32 players each have a single high quality audio DAC device, which takes in digital audio signals from the CPU 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 32 times higher than the AUD_LRCIN.

The audio output is fed through an amplifier and sent directly to the audio output jack. It can drive a 32Ω load with a 2V RMS signal.

## On-Board LEDs

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

| LED | Indication |
|---|---|
| Green power (**Pwr**) | Displays when the board is powered up and not in reset mode. |
| Green file-system activity (**Bsy**) | Flashes any time there is file-system activity (on any storage device) |
| Green MicroSD activity (**µSD**) | Displays when a MicroSD card is present. |
| Green network activity (**Svr**) | Displays when the player is connected to the BrightSign Network. |
| Green Ethernet activity | Flashes when the player is connecting to the network. Displays when connected. |

| | | |
|---|---|---|
| (**Eth**) | | |
| Green WiFi activity | Flashes when the player is connecting to the wireless network. Displays when connected. | |
| Yellow update (**Upd**) | Flashes when the board is being upgraded. | |
| Red status (**Err**) | 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 | A piece of on-board hardware is not working correctly |
| | 8 | Problem related to the storage device (either the USB drive or SD card) |
| | 9 | Problem related to the registry/NAND |
| | 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-Board Switch

The on-board switch is connected to the GPIO02. The GPIO02 is pulled low when the service (SVC) button is pressed. Conversely, a pull-up on the button normally sets the GPIO02 to be pulled high.

## Reset Switch/GPIO Button

The on-board switch is connected to the reset circuit. Pressing down the reset button will cause the GPIO07 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/SDXC and MicroSD Slots

The XDx32 series has one SDHC/SDXC and one internal MicroSD card slot, both capable of transferring a 25 Mbit/sec video stream, one 5.1 AC3 stream (pass-through), and three stereo PCM tracks simultaneously. There is no inherent limit on the storage capacity of SD cards used for XDx32 players.

## 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 CPU.

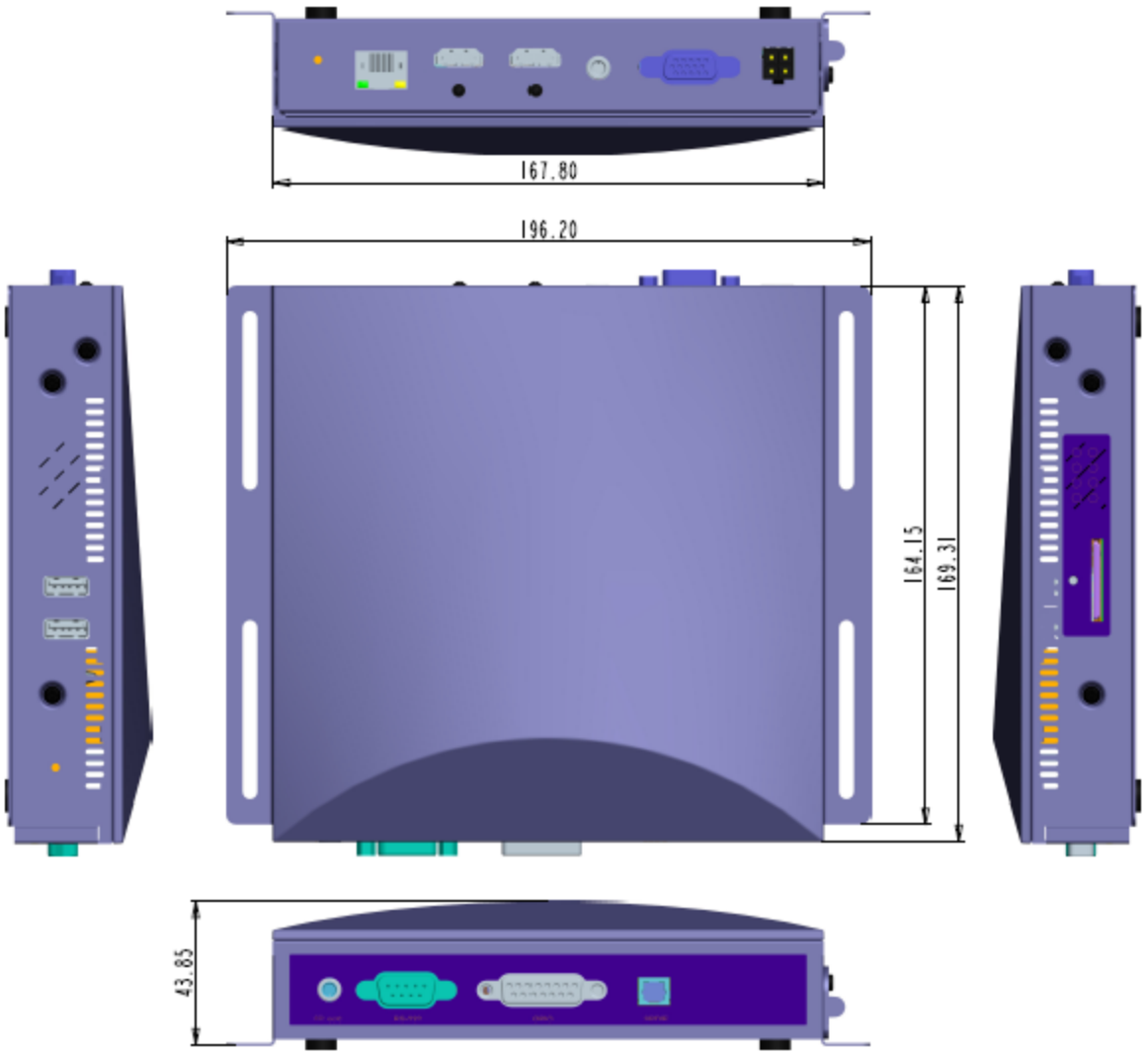
## Ethernet

The 10/100 Base-T Ethernet is implemented on XDx32 players by directly interfacing with the BCM7434. 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 BCM7434 SOC. The board utilizes over-current protected switches that can be used to turn the power to USB devices on or off or to detect over-current situations.

# DIMENSIONS



# MOUNTING PROCEDURE

A BrightSign XDx32 player can be mounted on a wall using the brackets attached to each side. It is recommended that you mount the device using four screws (one for each bracket slot). The screws should have a major diameter between 3.5mm and 4.2mm.

**Important**: *Nails should not be used to mount the device.*