Ethernet Audio/Video Server
Model 2453
Hardware Manual

Ver.1.1.1 | May 2018

SENSORAY | embedded electronics

Designed and manufactured in the U.S.A

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Limited warranty

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The warranty provided herein does not cover equipment subjected to abuse, misuse, accident, alteration, neglect, or unauthorized repair or installation. Sensoray shall have the right of final determination as to the existence and cause of defect.

As for items repaired or replaced under warranty, the warranty shall continue in effect for the remainder of the original warranty period, or for ninety days following date of shipment by Sensoray of the repaired or replaced part, whichever period is longer.

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Introduction

Model 2453 is an audio/video network streaming device. It takes composite video input from any standard NTSC or PAL source, and optional audio input from a line source or a microphone. Using state of the art H.264 compression, the device allows streaming high quality video over an Ethernet connection. Configuration settings are easily accessible through the web page interface with optional password protection. Network settings (IP address, ports) can be changed to accommodate various network configurations. All settings are stored in non-volatile memory and restored after power up.

Model 2453 is capable of providing 2 simultaneous streams (from a single video source), for example, a high quality stream for archiving on the remote server and a lower bitrate stream for live viewing on hand-held devices. With the help of an optional breakout board (model 2453TA) model 2453 can act as a USB host, allowing use of external storage or a WiFi dongle.

Model 2453 can also act as a video decoder, converting a network stream into analog video and audio. This feature is guaranteed to work only with the streams encoded by the 2453.

Model 2453 is available in several configurations:

2453 – a board version;

2453S – model 2553 in metal enclosure;

2353TAS – model 2453 + model 2453TA in metal enclosure.

A miniature version of the product, model 2454, weighing less than one ounce, provides the same functionality as 2453 using high density headers instead of standard connectors.

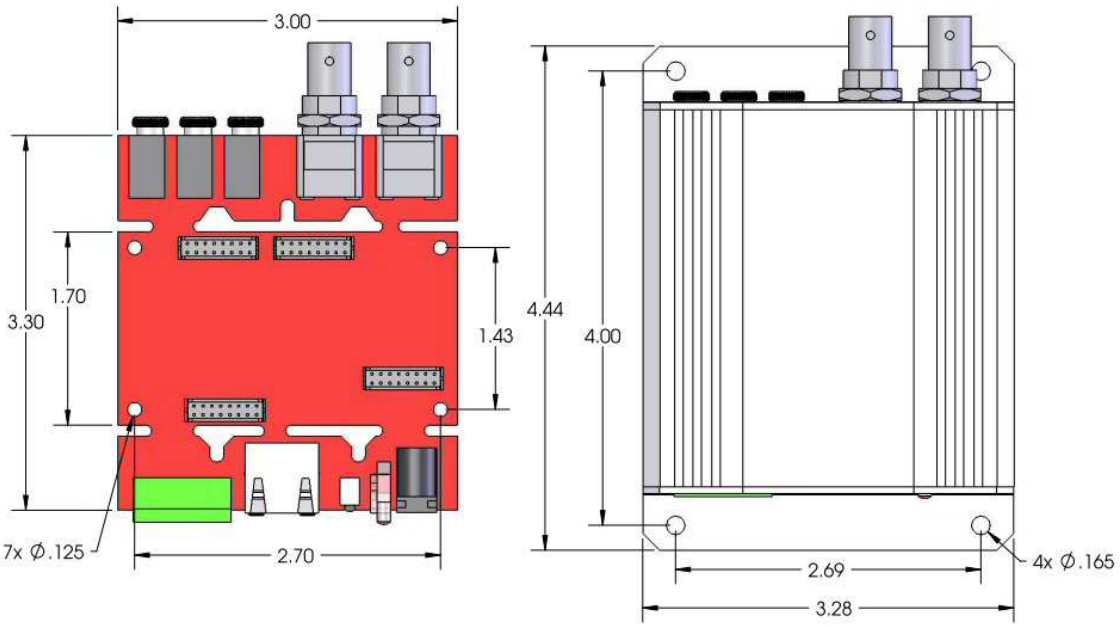
Important

In case a nework connection with the 2453 cannot be established because an IP address is unknown, there are 2 ways to resolve this situation. One is described in the "Network Configuration" chapter, and allows gaining access to the unit while keeping all other settings that differ from their default values intact.

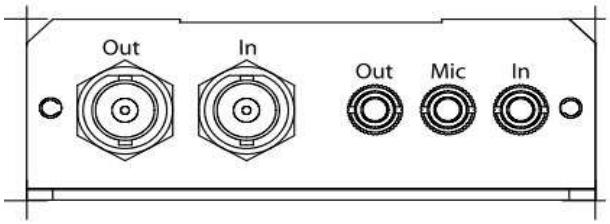
It is also possible to reset all settings to factory default values, including the IP address of 192.168.24.53. Please refer to "Settings recovery mode" in "Configuration switches" chapter. To access the configuration switches of the 2253S (enclosed unit) it is necessary to unscrew 2 screws on the front panel (the one with video and audio connectors), and slide the board out of the enclosure. Please remove protective film from the switch, if present.

Connectors and Dimensions

Models 2453 and 2453S

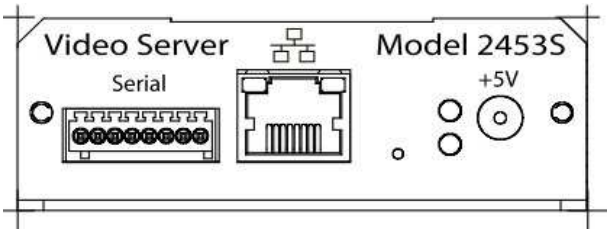


Model 2253S Front and Back Panels



Left to right:

- Composite video out;
- Composite video in;
- line audio out;
- microphone in;
- line audio in.



Left to right:

- Serial interfaces (see Table 1 for pinout);
- Ethernet;
- Configuration button;
- LED indicators: green (top) – power, red (bottom) – special function;
- Power (5 V DC, + on center).

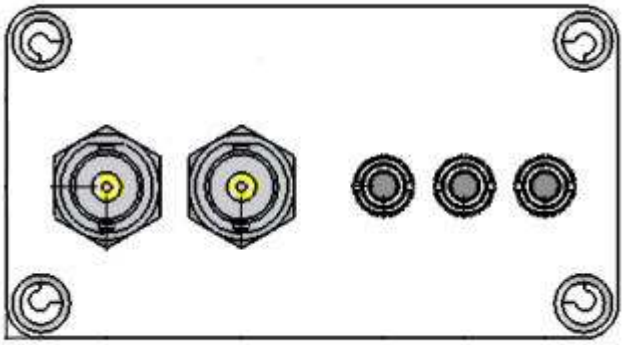
Table 1. Serial interfaces terminal block pinout (left to right):

1	RS-232 TX
2	RS-232 RX
3	Ground
4	Ground
5	RS-422 RX+
6	RS-422 RX-
7	RS-422 TX+
8	RS-422 TX-

Note: for RS-485 connect B (+) line to contact 5 or 7; A (-) line – to contact 6 or 8.

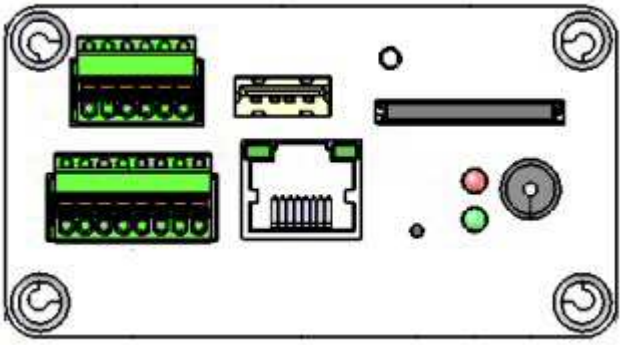
Mating part for the terminal block: Phoenix Contacts 1881383.

Model 2453TAS Front and Back Panels



Left to right:

- Composite video out;
- Composite video in;
- line audio out;
- microphone in;
- line audio in.



Top row (left to right):

- GPIO (see Table 2 for pinout);
- USB host;
- SD card.

Mating part for the terminal block: Phoenix Contacts 1881367.

Bottom row (left to right):

- Serial interfaces (see Table 1 for pinout);

- Ethernet;
- Configuration button;
- LED indicators: green (top) – power, red (bottom) – special function;
- Power (5 V DC, + on center).

Mating part for the terminal block: Phoenix Contacts 1881383.

GPIO

Model 2453 provides one general purpose input that could be either optically insulated or galvanically coupled, and one general purpose optically insulated output. The simplified schematic of the GPIO is shown on Fig.1.

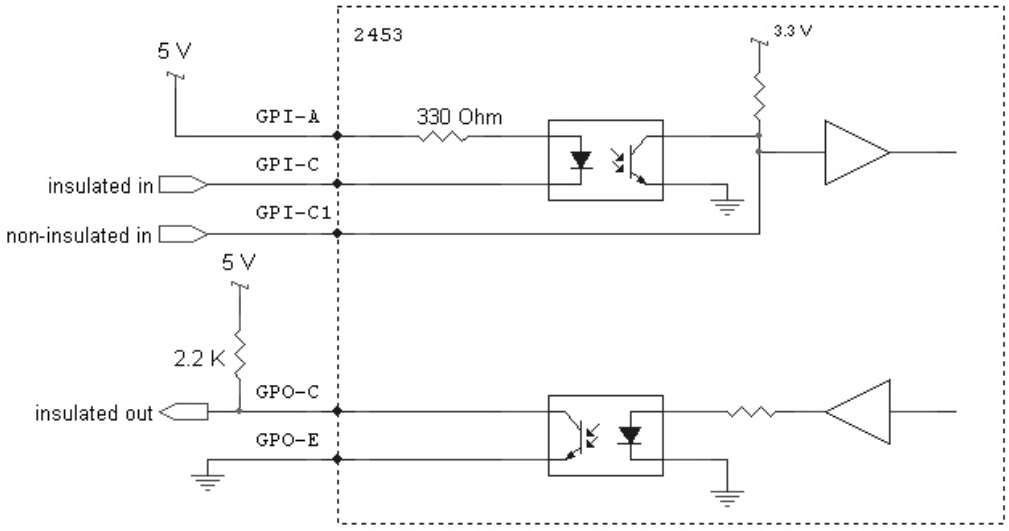


Figure 1. Example of GPIO connections.

An example of connecting 2453's GPIO is shown on Fig.1. The optoisolators are Avago ACPL-217. Please refer to the manufacturer's documentation for complete electrical specifications.

Table 2. GPIO terminal block pinout (left to right).

1	GPI-C1
2	Ground
3	GPI-A
4	GPI-C
5	GPO-C
6	GPO-E

Configuration Switches

A block of DIP switches allows configuration of 2453's serial interface. Individual switch numbers and On/Off positions are indicated on the block.

The interface can be configured for RS-232, RS-422 or RS-485 modes. Additionally a 120 Ohm termination can be turned on or off on RS-422/485 receive and transmit lines individually.

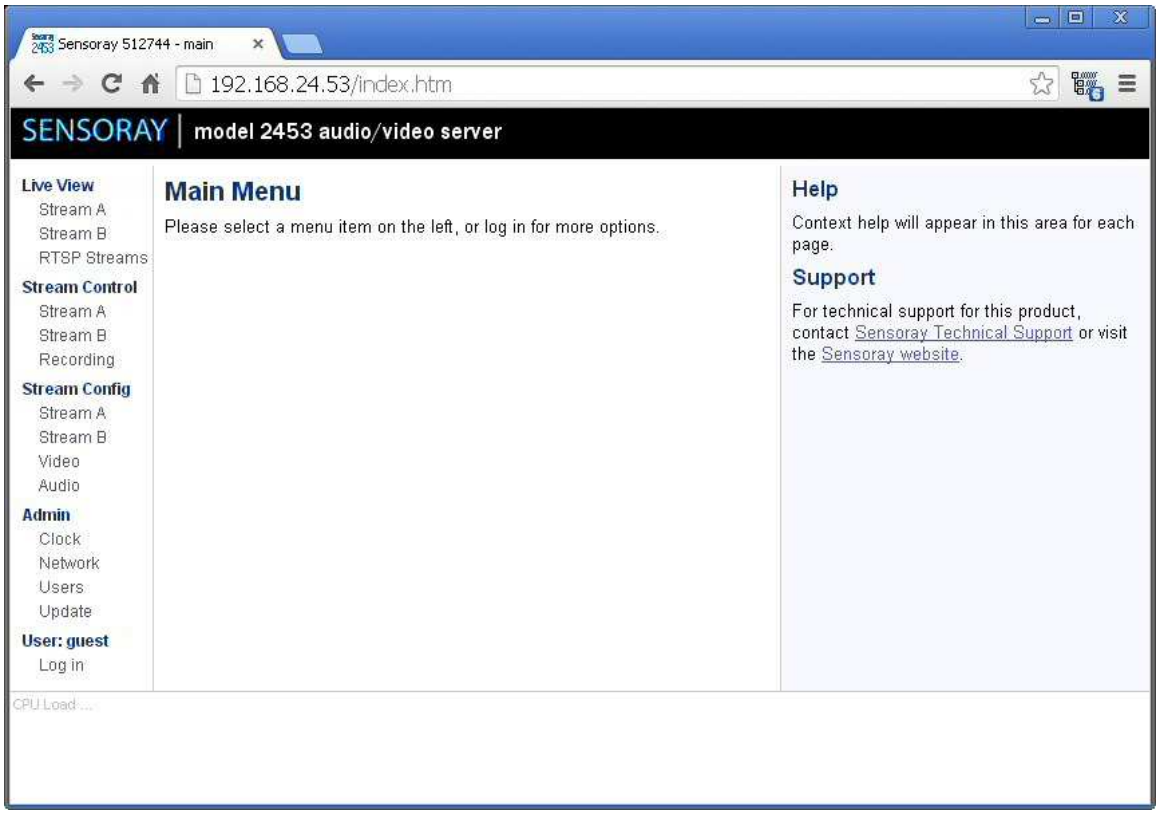
The default switch settings are all Off (RS-232 mode).

Switch #6 can be used to reset all settings to factory defaults in case there is no Ethernet access to the unit. Set switch #6 to On, power the board on. Turn the power off after approximately 10 seconds. Set switch #6 back to Off. All settings will be reset to the factory defaults.

Position	On	Off
1	RS-485	RS-422
2	RS-485	RS-422
3	RX termination ON	RX termination OFF
4	TX termination ON	TX termination OFF
5	RS-4xx mode	RS-232 mode
6	Settings recovery mode	Normal mode

Web page interface

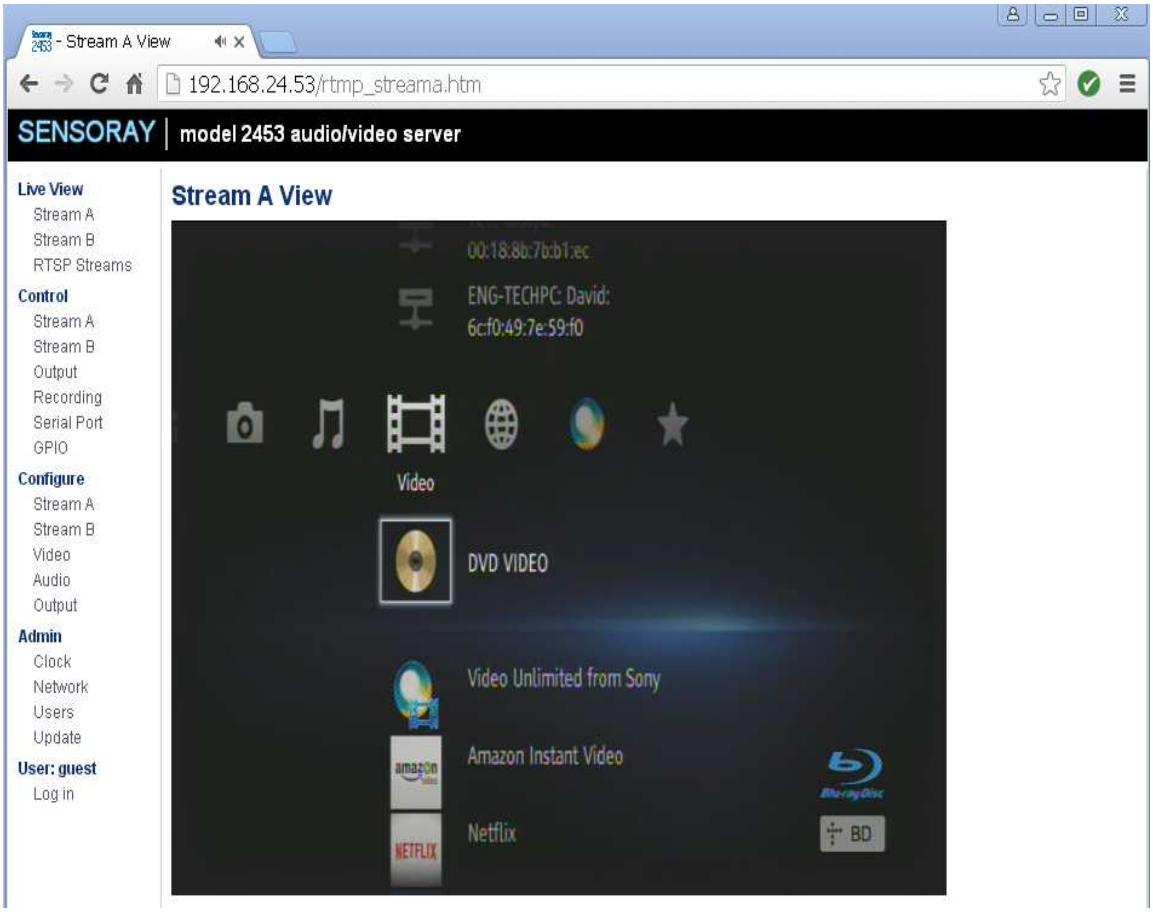
Main menu



Main Menu is the default screen displayed when the browser connects to the 2453. The default IP address as shipped is `192.168.24.53`. Connect to the board by typing this address in the browser address bar.

Note: if the default IP address can not be accessed on your network, please refer to the Network Configuration section below.

Live stream view



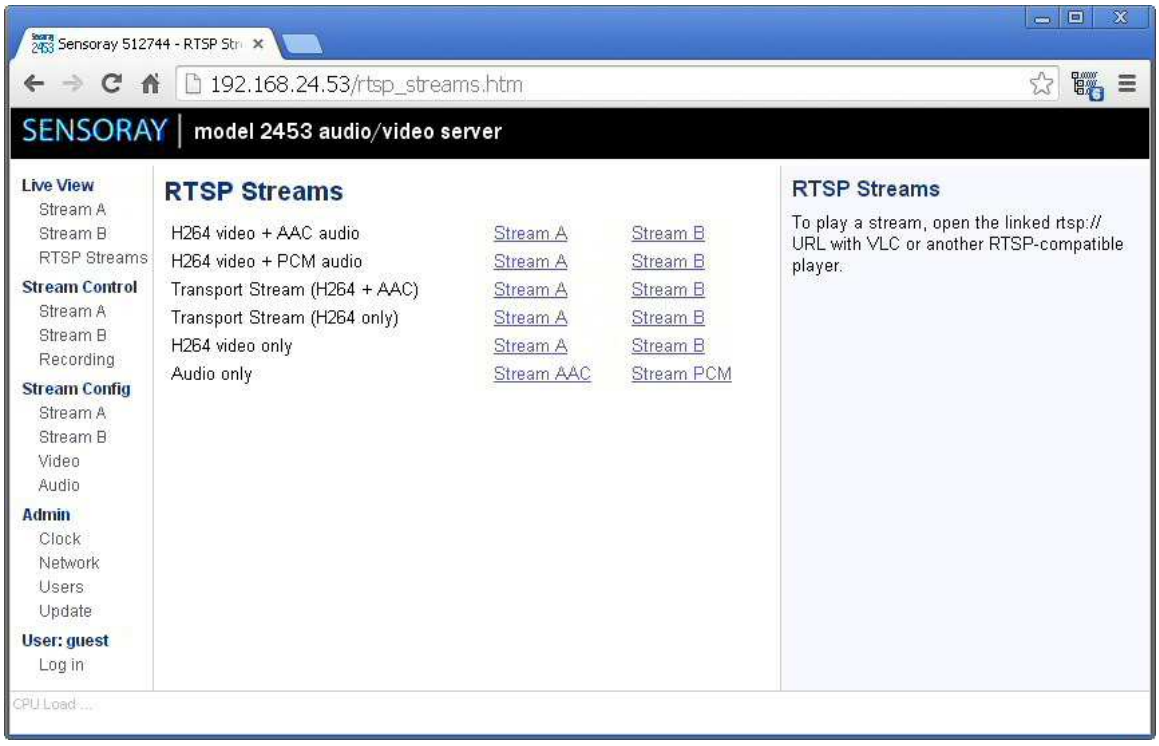
Live stream view windows display the live view of one of the two streams available from the 2453. To access the window click on one of the links (Live View/Stream A or Live View/Stream B) in the navigation bar. Streams are configured as described below in sections “Stream Controls” and “Stream Configuration”.

Live View will display a Multipart-Replace JPEG image if the stream is configured a MJPEG VES. This mode is not supported in Microsoft Internet Explorer browser.

Live View will display a Flash video player with H264 video and AAC audio if the stream is configured as H264. Flash video player introduces significant latency due to buffering. Lower latency may be achieved using RTSP streaming to a standalone player application.

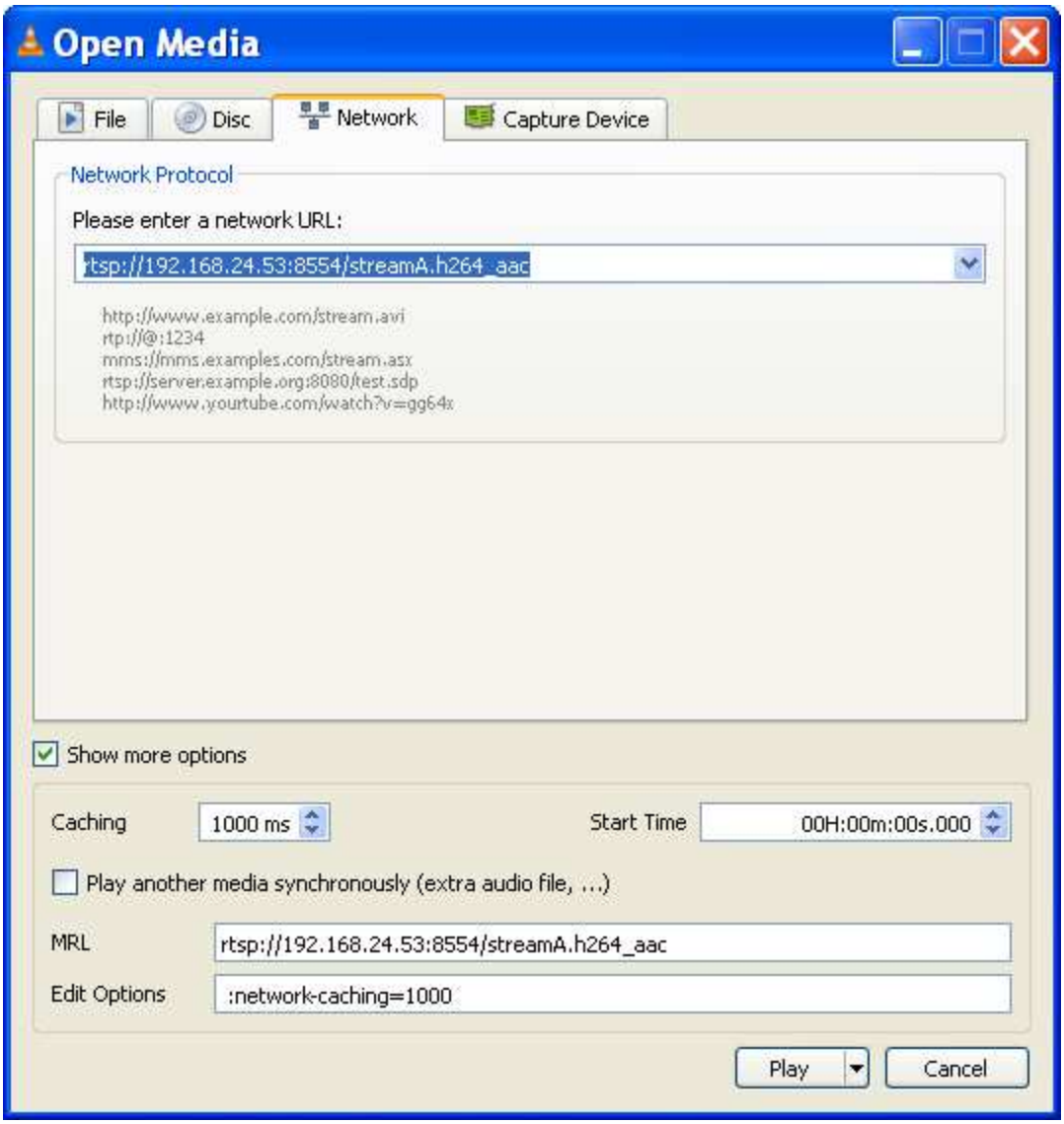
Live View is not supported when the stream is configured as MPEG4.

RTSP streams



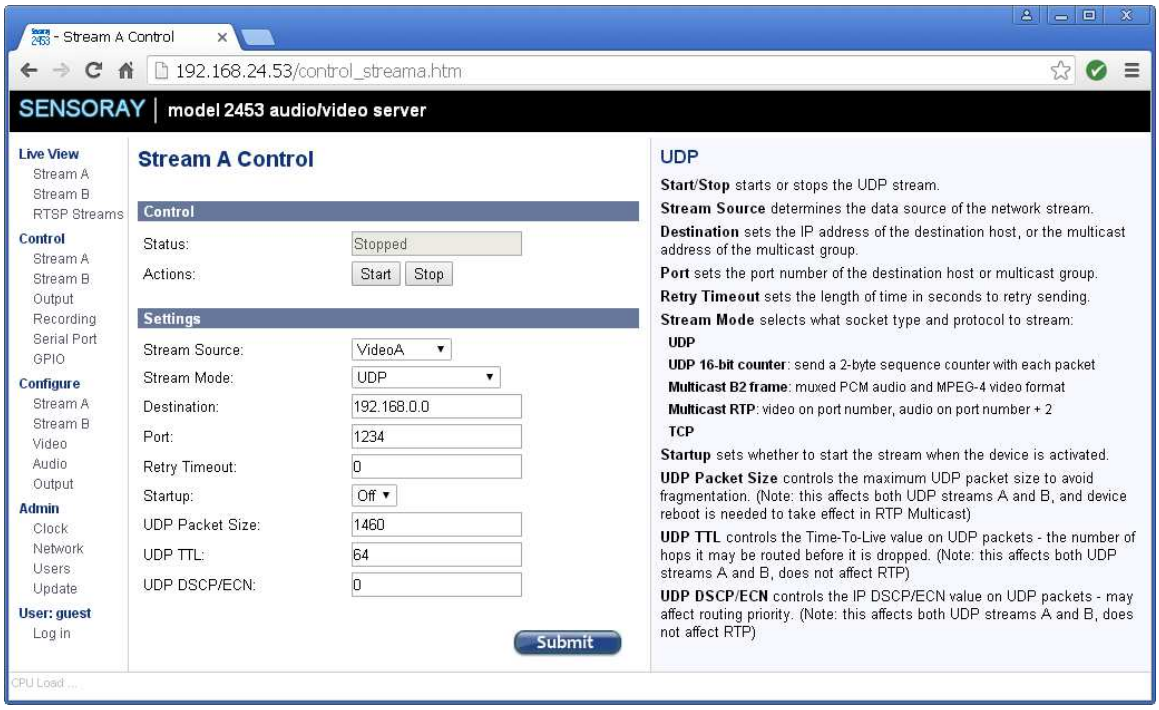
Live View / RTSP Streams page provides a list of rtsp:// URLs which can be viewed using VLC or another RTSP-compatible player. The player is responsible for requesting the video and starting and stopping the stream.

Right click on the link that corresponds to current configuration of selected stream (A or B), copy link address, and paste it into the player's stream address field, as shown below for VLC.



Preview latency may be reduced by reducing the buffer size ("caching").

Stream Control



Stream control window allows individual network configuration and control of one of the two streams.

The "Control" section displays the stream status and allows starting and stopping the stream.

The "Settings" section configures the following stream parameters:

Stream Source: determines the data source of the network stream.

Stream Mode: selects socket type and protocol for streaming.

Destination: an IP address of the destination host.

Port: network port of the destination host.

Retry timeout: determines the length of time (in seconds) during which the 2453 tries to obtain destination's ARP entry.

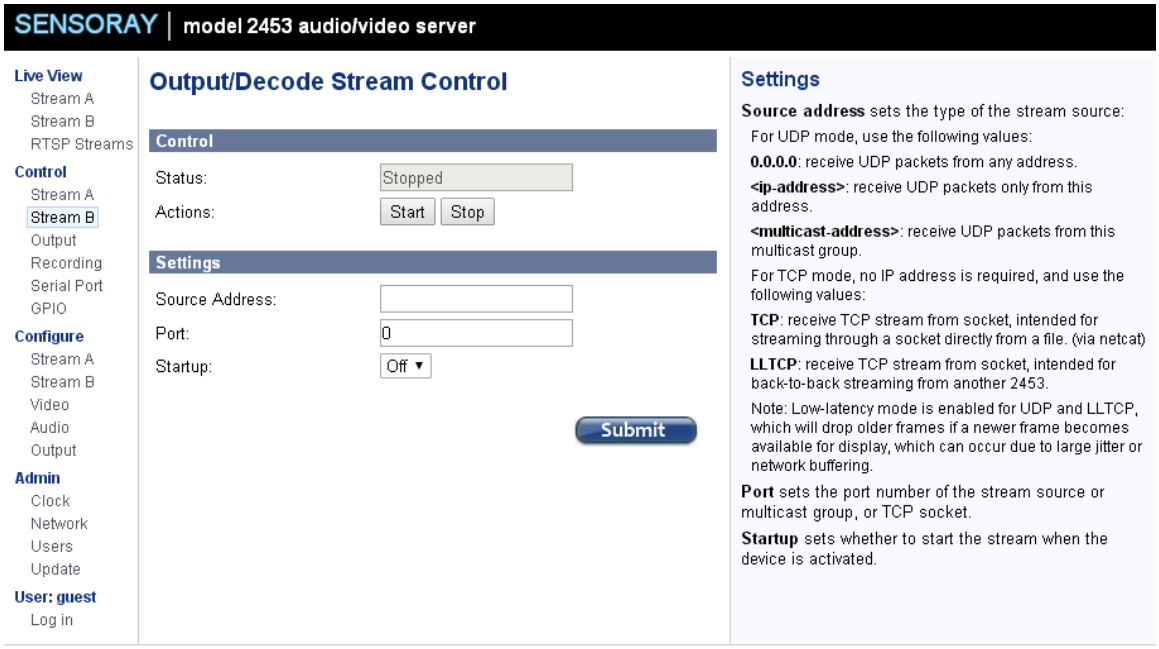
Startup: if set to On, the stream will start automatically when the 2453 is powered up.

UDP Packet Size controls the maximum UDP packet size to avoid fragmentation. (Note: this affects both UDP streams A and B, and device reboot is needed to take effect in RTP Multicast).

UDP TTL controls the Time-To-Live value on UDP packets - the number of hops it may be routed before it is dropped. (Note: this affects both UDP streams A and B, does not affect RTP).

UDP DSCP/ECN controls the IP DSCP/ECN value on UDP packets - may affect routing priority. Note: this affects both UDP streams A and B, does not affect RTP.

Output stream control



Controls the 2453 decoder functions.

The "Control" section displays the stream status and allows starting and stopping the stream.

The "Settings" section configures the following stream parameters:

Source address: sets the IP address of the stream source.

0.0.0.0: receive UDP packets from any address.

<ip-address>: receive UDP packets only from this address.

<multicast-address>: receive UDP packets from this multicast group.

TCP: receive TCP stream from socket, intended for streaming through a socket directly from a file.

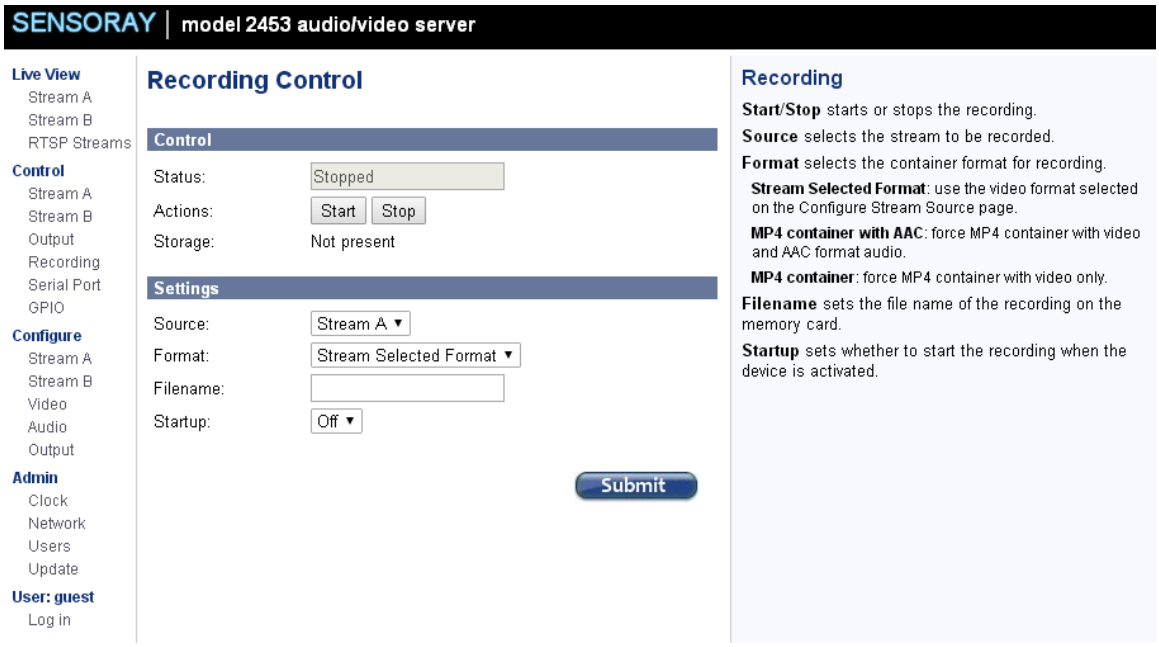
LLTCP: receive TCP stream from socket, intended for back-to-back streaming from another 2453.

Note: Low-latency mode is enabled for UDP and LLTCP, which will drop older frames if a newer frame becomes available for display, which can occur due to large jitter or network buffering.

Port sets the port number of the stream source or multicast group, or TCP socket.

Startup sets whether to start the stream when the device is activated.

Recording control



The Recording Control page allows the stream to be recorded on the SD card. Recording requires a 2453TA board with an SD card to be connected to the 2453.

Start/Stop starts or stops the recording.

Source selects the stream to be recorded.

Format selects the container format for recording.

Stream Selected Format: use the video format selected on the Configure Stream Source page.

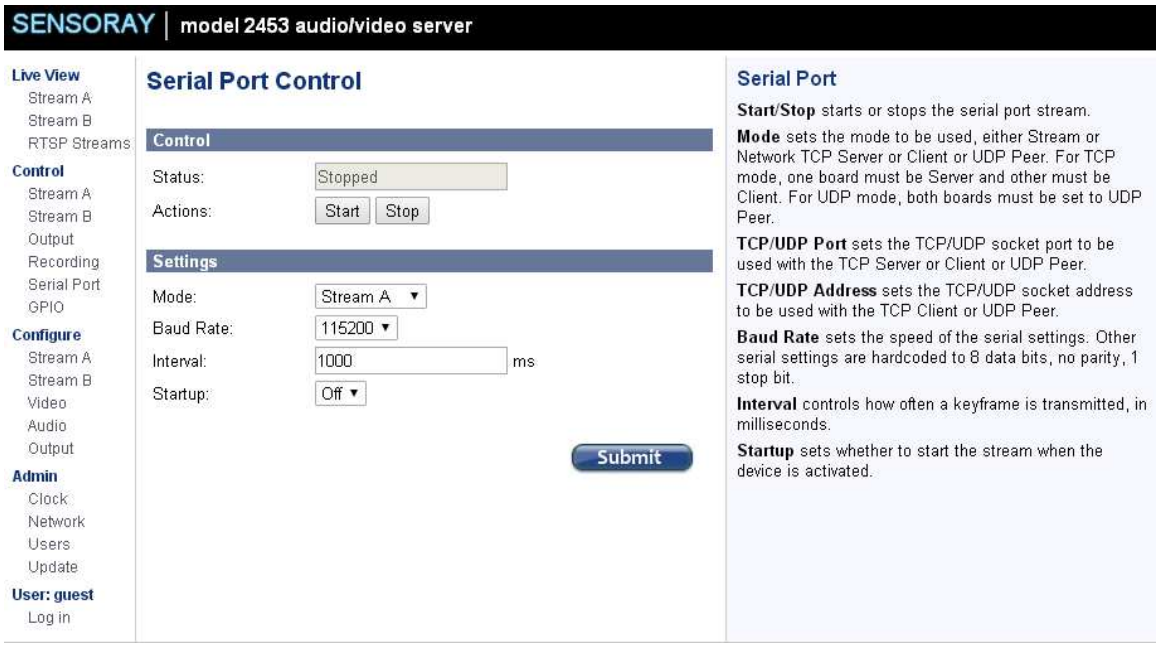
MP4 container with AAC: force MP4 container with video and AAC format audio.

MP4 container: force MP4 container with video only.

Filename sets the file name of the recording on the memory card.

Startup sets whether to start the recording when the device is activated.

Serial port



Model 2453 can forward serial port data over Ethernet to another 2253, where this data is converted to serial port output. The communication can be bidirectional.

Start/Stop starts or stops the serial port stream.

Mode sets the mode to be used, either Stream or Network TCP Server or Client or UDP Peer. For TCP mode, one board must be Server and other must be Client. For UDP mode, both boards must be set to UDP Peer.

TCP/UDP Port sets the TCP/UDP socket port to be used with the TCP Server or Client or UDP Peer.

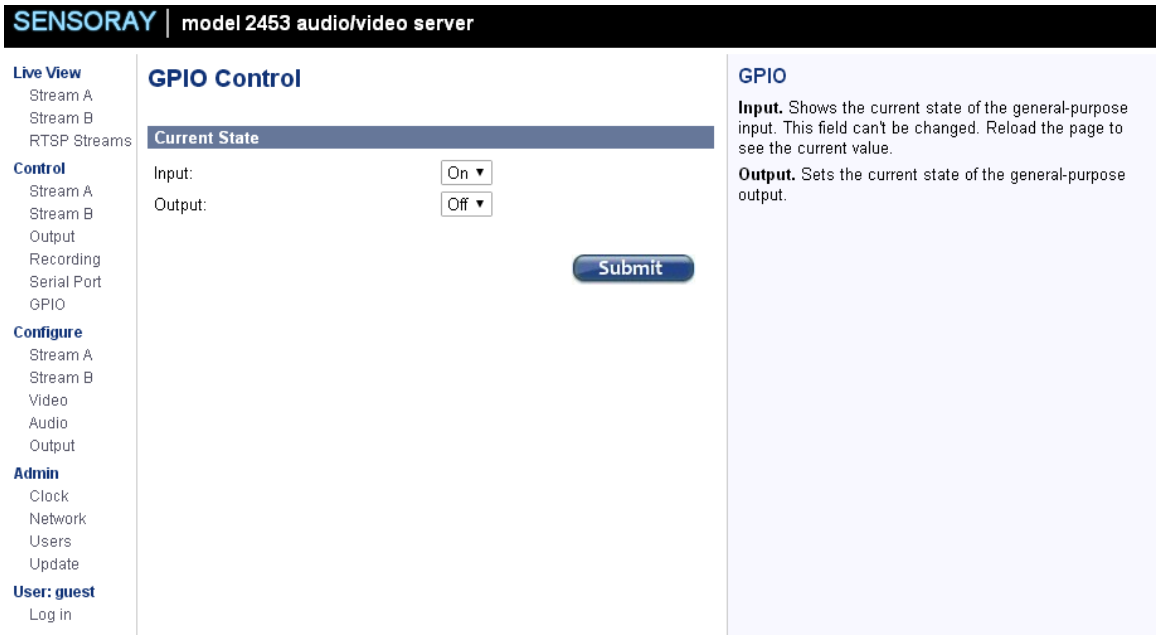
TCP/UDP Address sets the TCP/UDP socket address to be used with the TCP Client or UDP Peer.

Baud Rate sets the speed of the serial settings. Other serial settings are hardcoded to 8 data bits, no parity, 1 stop bit.

Interval controls how often a keyframe is transmitted, in milliseconds.

Startup sets whether to start the stream when the device is activated.

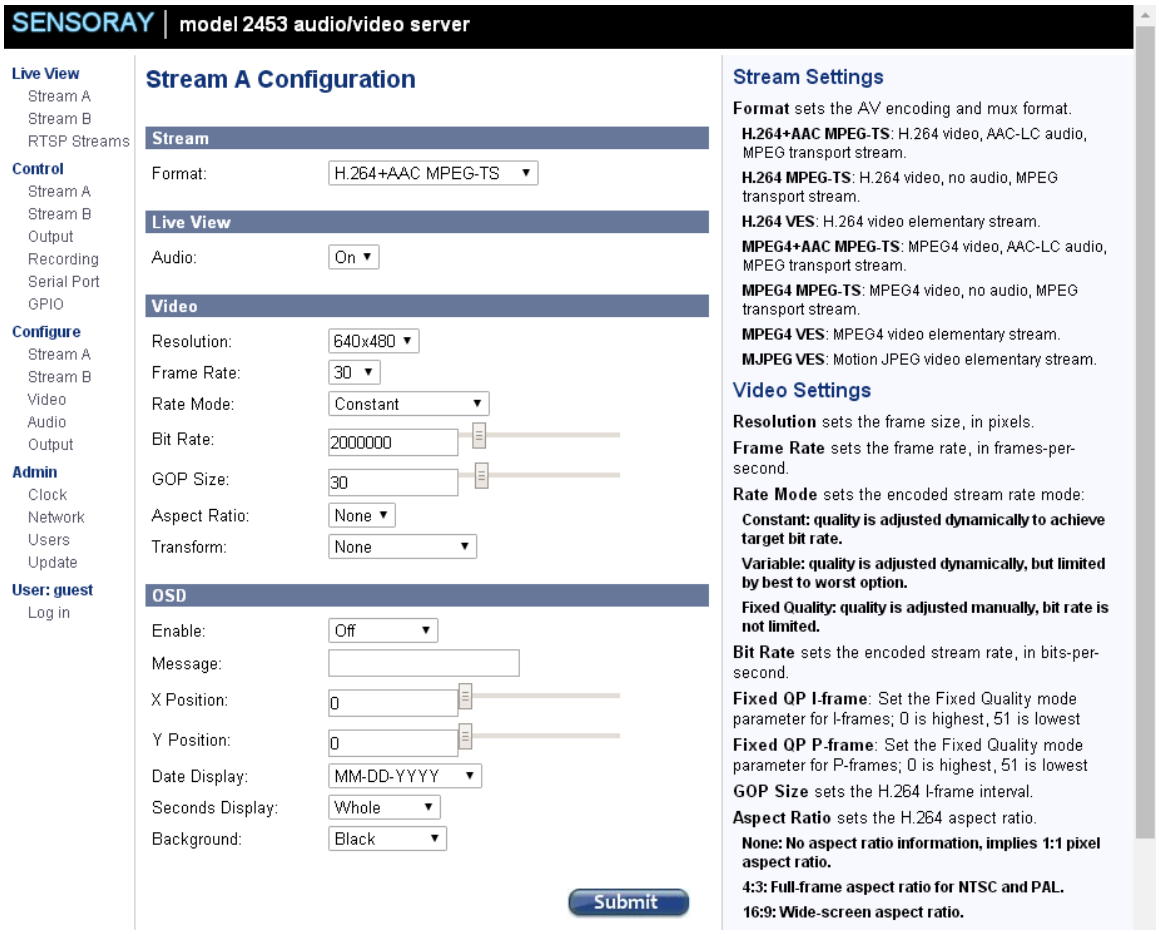
GPIO



Input. Shows the current state of the general-purpose input. This field can't be changed. Reload the page to see the current value.

Output. Sets the current state of the general-purpose output.

Stream Configuration



Stream configuration window allows configuring individual stream parameters which may differ between streams A and B.

Format sets the AV encoding and mux format.

H.264+AAC MPEG-TS: H.264 video, AAC-LC audio, MPEG transport stream.

H.264 MPEG-TS: H.264 video, no audio, MPEG transport stream.

H.264 VES: H.264 video elementary stream.

MPEG4+AAC MPEG-TS: MPEG4 video, AAC-LC audio, MPEG transport stream.

MPEG4 MPEG-TS: MPEG4 video, no audio, MPEG transport stream.

MPEG4 VES: MPEG4 video elementary stream.

MJPEG VES: Motion JPEG video elementary stream.

Video Settings

Resolutionsets the frame size, in pixels.

Frame Rate sets the frame rate, in frames-per-second.

Rate Mode sets the encoded stream rate mode:

Constant: quality is adjusted dynamically to achieve target bit rate.

Variable: quality is adjusted dynamically, but limited by best to worst option.

Fixed Quality: quality is adjusted manually, bit rate is not limited.

Bit Rate sets the encoded stream rate, in bits-per-second.

Fixed QP I-frame: Set the Fixed Quality mode parameter for I-frames; 0 is highest, 51 is lowest

Fixed QP P-frame: Set the Fixed Quality mode parameter for P-frames; 0 is highest, 51 is lowest

GOP Size sets the H.264 I-frame interval.

Aspect Ratio sets the H.264 aspect ratio.

None: No aspect ratio information, implies 1:1 pixel aspect ratio.

4:3: Full-frame aspect ratio for NTSC and PAL.

16:9: Wide-screen aspect ratio.

JPEG Quality sets the JPEG quality setting, ranged 10 to 90.

Transform sets the image transformations.

None: No transformation.

Mirror Vertical: Mirror the video image vertically.

Mirror Horizontal: Mirror the video image horizontally.

Rotate 180: Rotate the video image 180 degrees.

OSD Settings

Enable sets the on-screen-displayed text on/off.

Messagesets the text to be displayed. Control codes may be used:

^d: Insert the current date.

^t: Insert the current time.

^i: Insert the current IP address.

^c: Insert the current frame counter.

^n: Insert a newline.

X Position sets the left edge of the displayed text, in pixels.

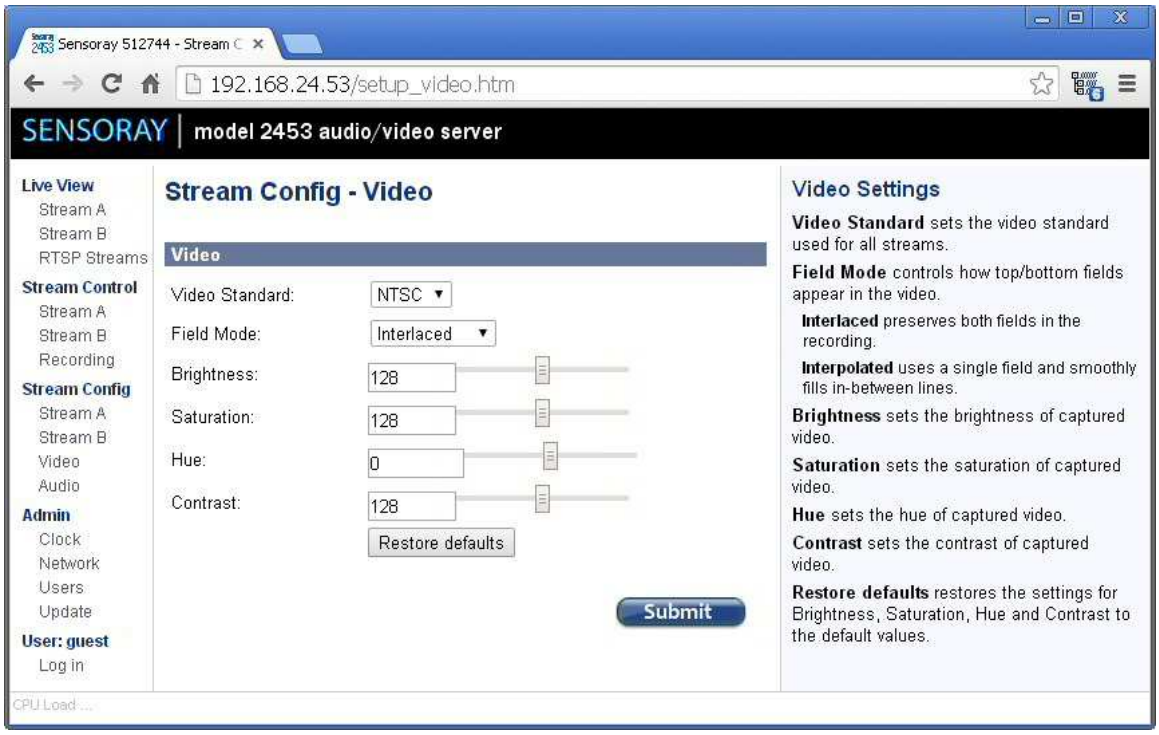
Y Position sets the top edge of the displayed text, in pixels.

Date Display sets the display format of the inserted date.

Seconds Display sets the display format of the inserted time.

Background sets the transparency of the text background.

Stream Configuration - Video



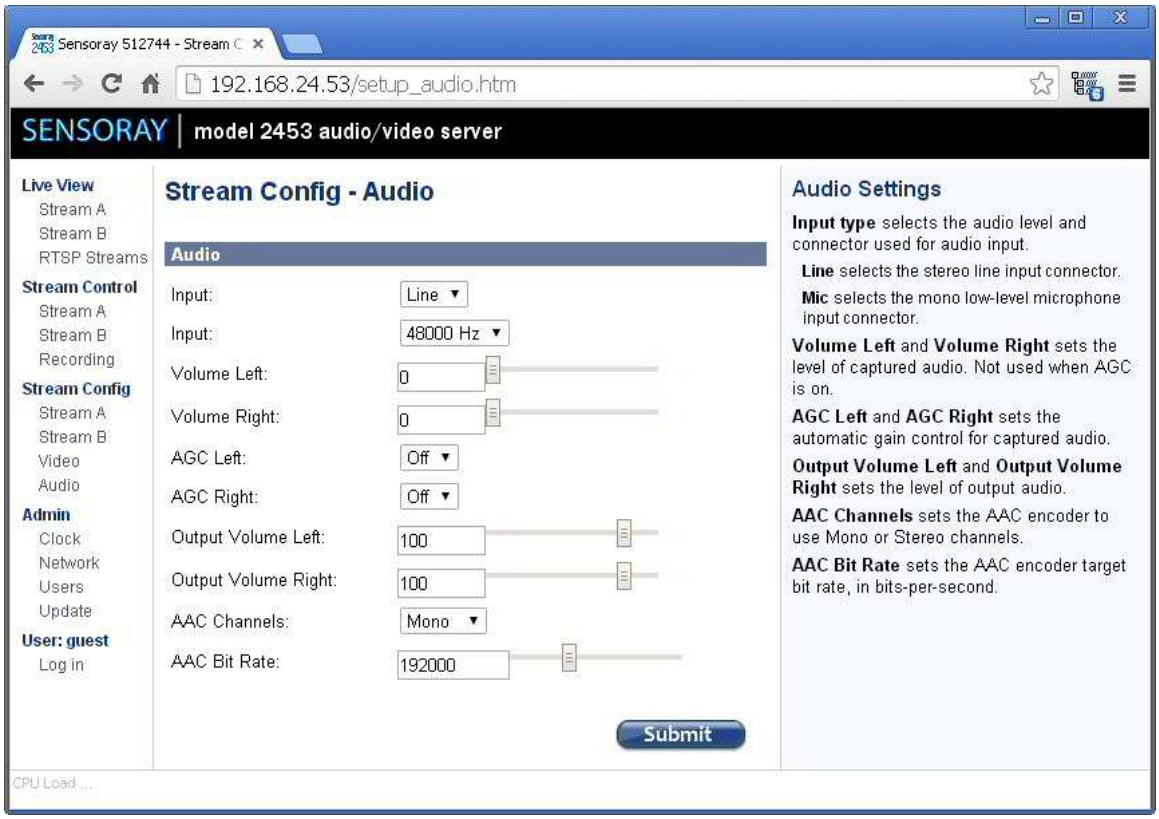
Stream Configuration – Video window allows configuration of video parameters common to both streams A and B.

Video standard: NTSC or PAL.

Field mode: interlaced or interpolated. This setting is relevant for full frame resolutions (480 or 576 lines). Interlaced mode preserves both video fields, resulting in highest vertical resolution, but possible motion artifacts. Interpolated mode uses one field, recreating the other using interpolation. This approach eliminates motion artifacts by somewhat sacrificing vertical resolution.

Brightness, saturation, hue, contrast: video adjustments. Hue only affects NTSC video.

Stream Configuration - Audio

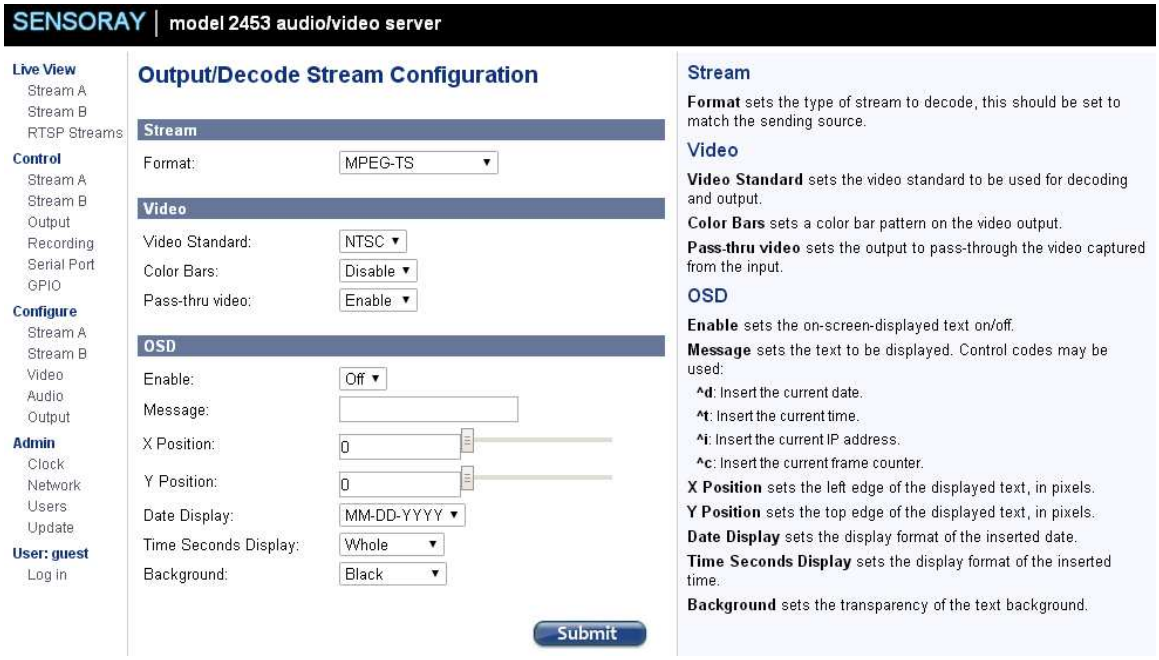


Audio parameters control input source (line or microphone), sampling rate, volume (input and output), and some other settings. Audio parameters are common to both streams A and B. An online help in the right section of the web page contains details.

The 2453 Serial Port page has several modes that control how the serial port operates. The Video Stream Mode sends video I-frames at the specified interval as raw byte data. The network TCP/UDP modes allow IO on the serial port from a network socket. The TCP server requires a port number and listens on a TCP socket at the specified port. The TCP client requires a port number and IP address, and when started will open a TCP socket and connect to the IP at the specified port. The UDP peer requires a port number and IP address, and when started will open a UDP socket and connect to the IP at the specified port. All socket connections provide bidirectional data transfer. To bridge a serial port connection between two 2453 boards, configure the boards to use one of the following: one as TCP server and the other as TCP client, or both as UDP peer. In either configuration, one board's socket IP address should be that of the other board. The serial port baud rate may be selected between: 230400, 115200, 57600, 38400, 19200, 9600, 4800, 2400. The other serial settings are hard-coded to 8 data bits, no parity, 1 stop bit.

Stream Configuration – Output

The 2453 can act as a video decoder, converting the encoded video stream into composite video and audio. Please note that decoding is guaranteed only for the streams encoded with the 2453.



Format sets the type of stream to decode, this should be set to match the sending source.

Video

Video Standard sets the video standard to be used for decoding and output.

Color Bars sets a color bar pattern on the video output.

Pass-thru video sets the output to pass-through the video captured from the input.

OSD

Enable sets the on-screen-displayed text on/off.

Message sets the text to be displayed. Control codes may be used:

^d: Insert the current date.

^t: Insert the current time.

^i: Insert the current IP address.

^c: Insert the current frame counter.

X Position sets the left edge of the displayed text, in pixels.

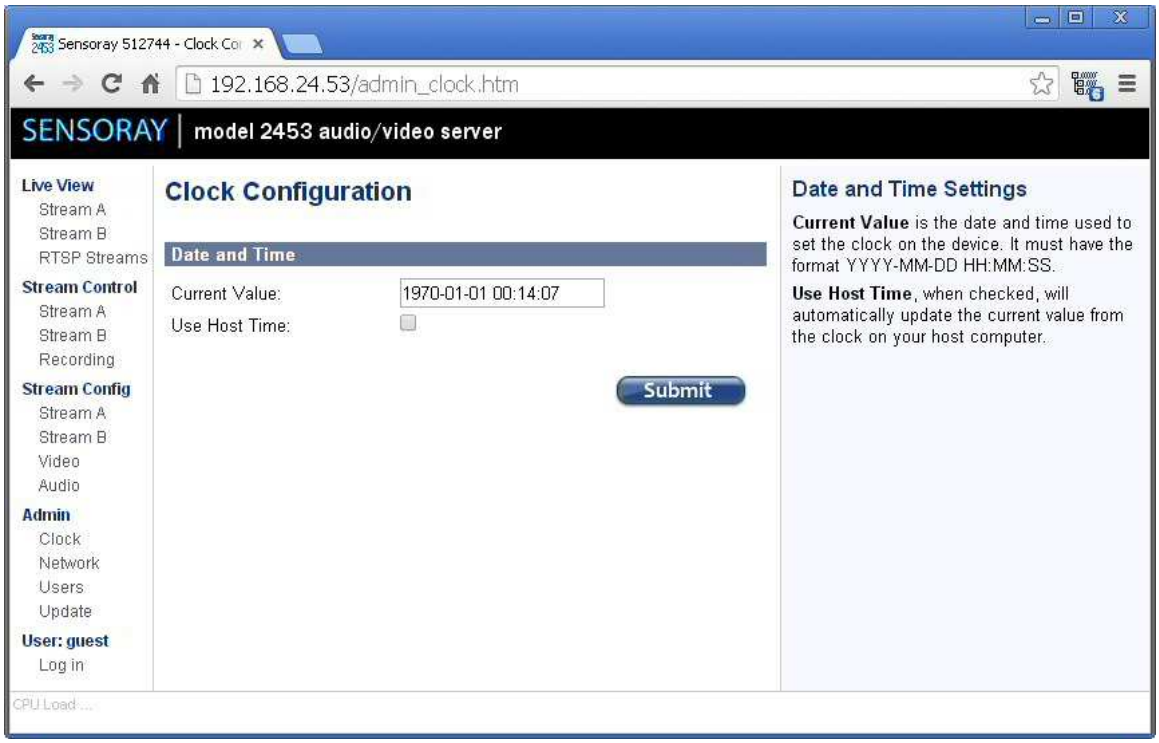
Y Position sets the top edge of the displayed text, in pixels.

Date Display sets the display format of the inserted date.

Time Seconds Display sets the display format of the inserted time.

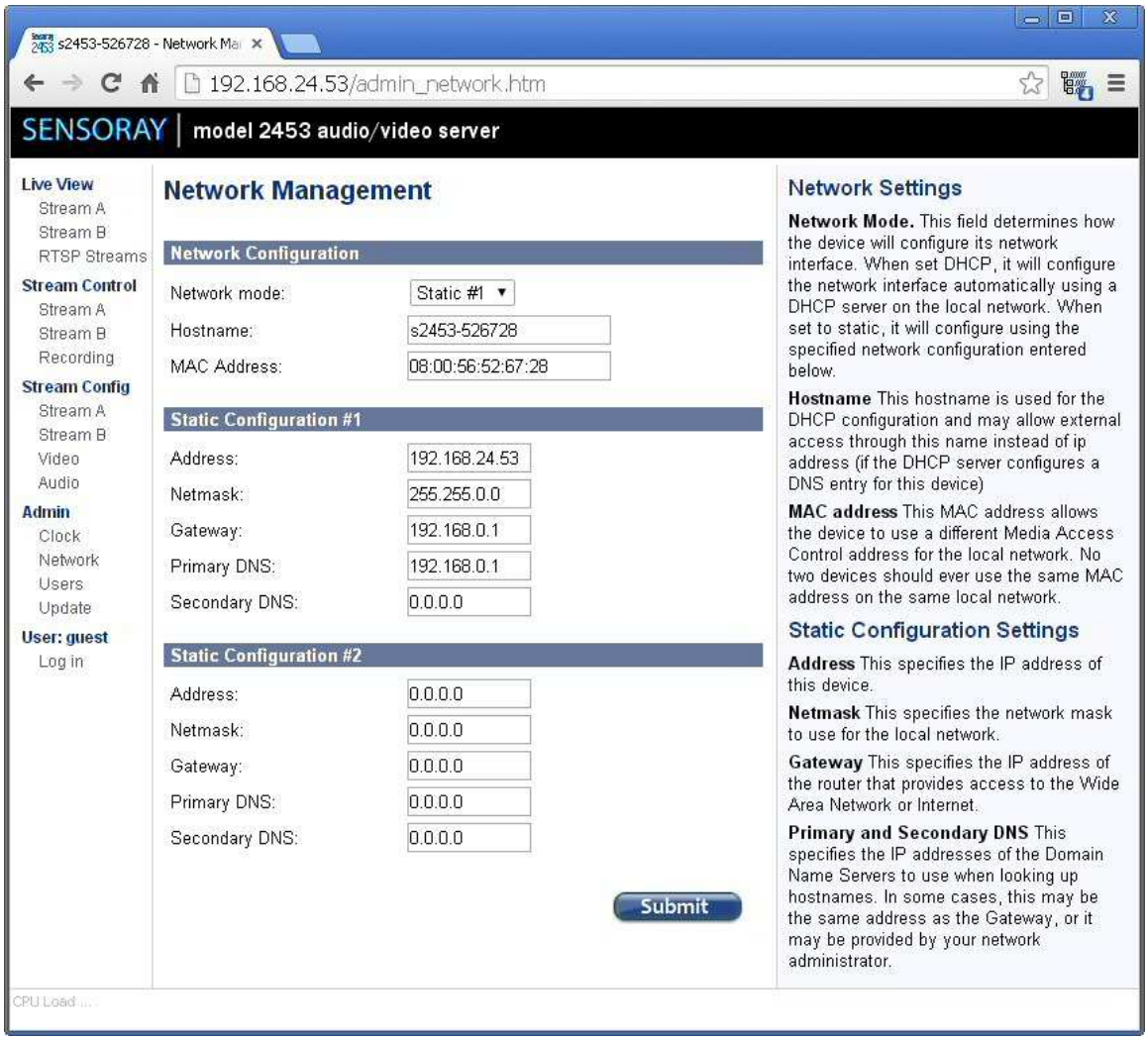
Background sets the transparency of the text background.

Clock Configuration



The Clock Configuration page allows setting the 2453 internal clock either manually (using a 24-hour format), or to the host's time. With a battery installed on the optional 2453TA board the 2453 will keep time when powered down.

Network Configuration



Each 2453 is shipped with a default IP address `192.168.24.53` and a netmask `255.255.0.0`. Those settings can be modified using a Web page interface. The unit has to be powered up and connected to the LAN using an Ethernet patch cable, Cat5 or better. The 2453 automatically detects the type of the host interface, so it can be connected both to the computer and to a switch (hub) using the same type of cable.

When DHCP mode is selected, it may be unknown what IP address is given to the device. The IP address may be discovered by querying the router/DHCP server for the hostname.

Depending on the network restrictions one or two steps may be necessary to set a new IP address. If the network used to configure the unit can not access `192.168.x.x` IP address range, start with Step 1, otherwise go directly to Step 2.

Step 1 - Setting up a temporary IP address

This step is only necessary if the network used to configure the unit can not access the default IP address (`192.168.24.53`). In this case the unit must be switched into the Configuration Mode which allows setting up a *temporary* IP address accessible from the current network. The temporary IP address should be selected such that it is:

1) accessible on the network;
2) is not already used by any other device on the same network.

First, run ARP on the computer that is connected to the same network with the following command line:

```
arp -s <temporary_address>  08-00-56-ff-ff-ff
```

Please use colons (:) instead of dashes (-) in MAC address on Linux systems.

For example,

```
arp -s 10.135.1.61 08-00-56-ff-ff-ff
```

In Windows either navigate to Start/Run and type the command line in the "Open" box, or start a Command Prompt window and type the command line followed by Enter.

In Linux type the command line in the terminal window at the shell prompt followed by Enter. Please use colons (:) instead of dashes (-) in MAC address.

Note: it is recommended to use a temporary IP address that is different from the target permanent address to be assigned to the unit.

Now switch the 2453 into the Configuration Mode by pressing the configuration button. The red LED starts blinking.

Note: you need to wait 15 seconds after the 2453 is powered up before the board is able to switch to Configuration Mode.

Once the 2453 receives a network packet addressed to it, the temporary IP address will be in effect. To send a packet either ping the board or connect to it with a browser. Using an IP address from the example, either run

```
ping 10.135.1.61
```

or type `http://10.135.1.61` into the address bar of your browser

on the computer connected to the same network as the 2453. Once the temporary address is enabled the red LED will blink fast several times and go off.

Once the unit is accessible using a temporary IP address, the standard Web page procedure (Step 2) can be used to set up the desired permanent IP address and other settings.

Step 2 – Setting up a permanent IP address

Connect to the unit with a Web browser by typing the unit's temporary IP address in the address field.

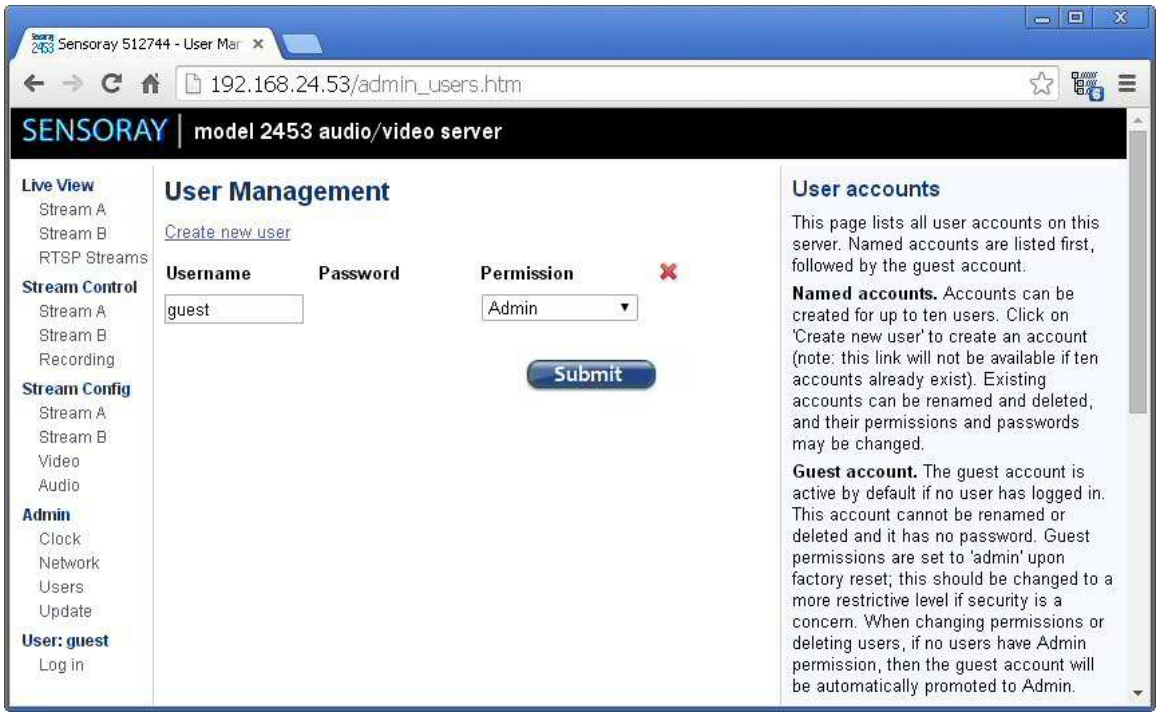
Example:

`http://10.135.1.61`

Once the Main Menu page is displayed, select Admin/Network.

Type in the desired permanent IP address and subnet mask values into corresponding fields. Please note that there are 2 static configurations available. Make sure that the one that you need is selected in the “Network mode” list-box before clicking on Submit. Now the unit's new IP address is set. The browser redirects to the new address automatically.

User management



User Management window allows access to the device to be limited to certain users with an associated permission level. The permissions levels are:

- None (guest user only);
- Stream View (may only access live view or RTSP streams);
- Stream Control (Stream View permissions, plus Stream Control and Recording);
- Stream Config (Stream Control permissions, plus Stream Config and Common Config);
- Admin (full access).

To create a new user account, click the Create new user link.

To delete a user account, check the checkbox below the red X in the user row and click submit.

The change a user password, type the new password in the password box and click submit. The password "password" is not allowed.

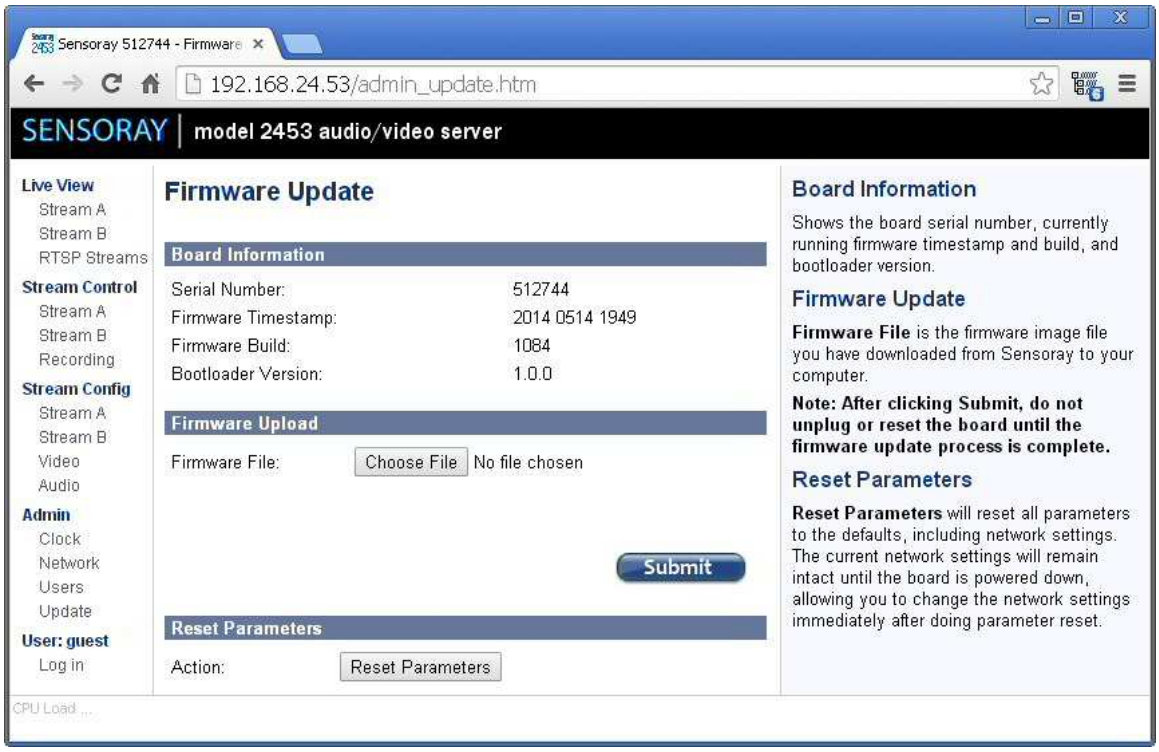
When changing permissions or deleting users, if no users have Admin permission, the guest user will automatically be promoted to Admin, preventing the device from locking out Admin privileges. The guest privileges are reduced to "None" as soon as an Admin account is created.

To create a new user, enter the user name and password, select the desired permission level and then click Create User.

Both user name and password are case-sensitive.

The password “password” is not allowed.

Firmware update



The Firmware Update window displays the versions of the device's firmware components and the serial number.

To update the firmware, choose the file (`s2453.fw` provided by Sensoray) and press Submit. The firmware update should take about 30 seconds to complete. Do not unplug the device while the firmware update is in process. If a firmware update is interrupted, the device will attempt to load from a backup firmware image. During the update the red LED flashes and update status is displayed in the Firmware Status field of the web page. If the update has completed successfully a message "Firmware result: ok" is displayed in a pop-up window. All device settings are preserved across the firmware update.

To reset the all parameters on the device, click the Reset Parameters button. That will reset the network settings as well, but the change to those will take effect only after the power is cycled. This allows setting an IP address different from the default even after parameters reset, if necessary.

Specifications

A/V Inputs	video: NTSC/PAL composite, 75 Ohm; audio: line stereo, microphone mono.
A/V Outputs	video: NTSC/PAL composite, 75 Ohm (decoder or pass-through mode); audio: line stereo.
Video compression	H.264 (HP@L3), MPEG4, Motion JPEG
Audio compression	G.711 (A-law, μ-law), 8 kHz, 8 bits/sample; AAC-LC, 48 kHz, 32-512 kbps bitrate.
Video capture resolutions	704x480, 352x240, 176x120 (NTSC); 640x480, 320x240, 160x120 (NTSC); 720x480, 360x240, 180x120 (NTSC); 704x576, 352x288, 176x144 (PAL); 720x576, 360x288, 180x144 (PAL)
Frame rate	H.264: 30/15/10/6 fps (NTSC), 25/12.5/8.3/5 fps (PAL).
Video streaming	Up to 2 video streams with individually configurable compression types, bitrates, resolutions and frame rates.
Output stream formats	MPEG-TS, H.264 VES, MJPEG
Image adjustments and processing	Brightness, contrast, saturation, hue (NTSC); rotation (90°, 180°, 270°), mirroring; interlacing artifacts removal; text overlay with optional auto timestamps; privacy mask.
Network security	Password protection, IP address filtering, digest access authentication, user access log.

Network protocols	HTTP, RTP, RTSP, UDP
Alarm triggers	Video loss, GPI
Alarm actions	GPO activation, e-mail notification, HTTP, FTP upload.
General purpose I/O	1 optically isolated or galvanically coupled input, 1 optically isolated output (Requires optional 2453TA board).
Serial interface	RS-232/422/485
Network interface	10/100Base-T(X)
Power	1.7 W (typical), 2.2 W max, 5 V DC.
Operating temperature	0 to 70°C
Dimensions	3“ x 4.125“ (without enclosure)
Options	2453TA termination board adds GPIO, USB host interface, real-time clock backup battery holder, SD card socket.

Revision history

Version	Notes
1.1.1, May 2018	Clarification of decoding feature.
1.1.0, October 2017	Manual updated to reflect added features and changes in user interface.
1.0.1, October 2014	Configuration switches description updated to include settings recovery mode.
1.0.0, May 2014	Initial release.