

Sentinel

surround sound audio monitor



User Manual

Version 2.5

July, 2013

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Qualis Audio, Inc.
Lake Oswego, Oregon



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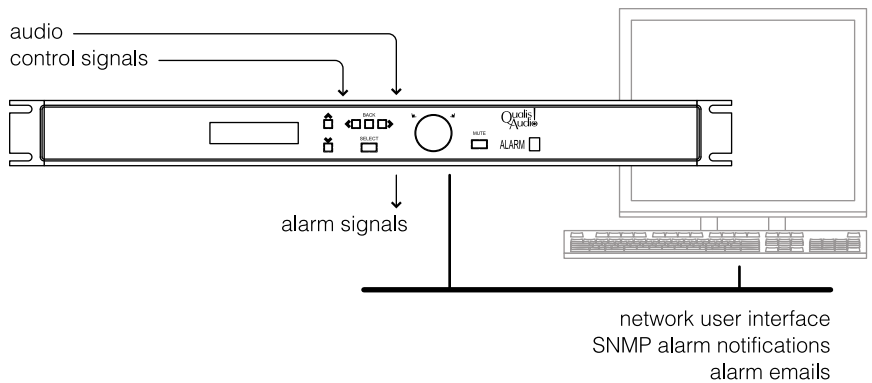
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1 Overview

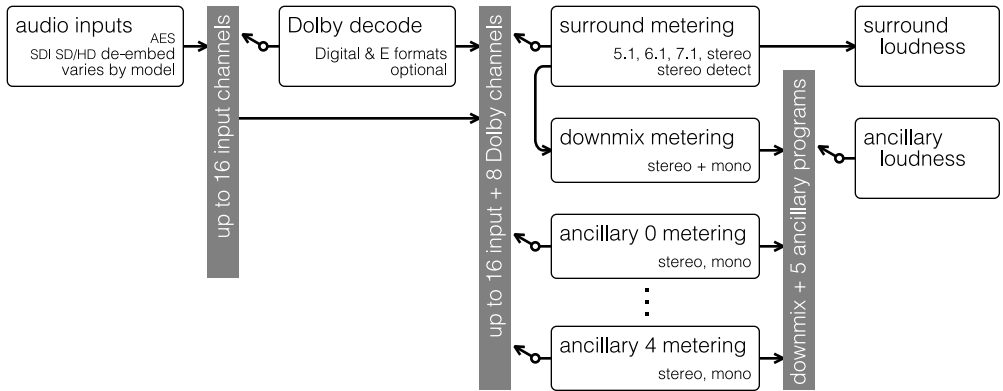
The Qualis Audio Sentinel surround sound audio monitor performs a comprehensive suite of audio measurements. It uses advanced signal processing algorithms to directly answer broadcast user's fundamental questions, rather than merely displaying information requiring further analysis by experienced personnel. It logs all measurement data. Its metering displays can view both live and logged measurements, providing equal convenience for active and unattended operation.

Connectivity



The Sentinel accepts audio input from either SDI SD/HD or AES sources, or Dolby-encoded inputs from these sources, depending on configuration. It is designed to operate in a networked environment, for local or remote access to its graphical user interface by multiple users, and for archival storage of its logged measurement data. When errors occur, it can provide audible or visual alarms, or deliver notifications by email or SNMP.

Measurement Features



The Qualis Audio Sentinel monitors a surround program in 5.1, 6.1, 7.1 or stereo format, and up to 5 ancillary stereo or monaural programs, for a total of up to 16 monitored input channels. The Sentinel also derives stereo and monaural downmix programs from the surround program.

Measurements common to all programs include:

- Individual channel signal levels with user selectable ballistics
- True peak levels to ITU-R BS.1770-3
- Over-level conditions
- Dead channel detection
- Hum detection of fundamental plus 2 harmonics

Measurements of the surround program also include:

- Dialog balance
- Surround balance
- Downmix Compatibility, directly answering "will my program change when reproduced in stereo or mono?"
- LFE bandwidth & phase compatibility
- Spectrum with one-octave resolution

The Sentinel provides two loudness monitors; one for the surround program, and another that may be assigned to the stereo downmix or any of the ancillary programs. Loudness measurements include:

- Loudness to ITU-R BS.1770-1, BS.1770-2/3 (LKFS)
- Loudness differential between surround and downmixed program (surround monitor only)

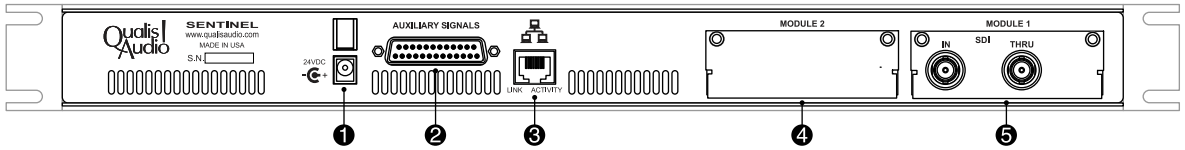
The Sentinel also provides other measurement functions including:

- Six DC inputs for monitoring external parameters (line voltage, security sensors, transmitter power, etc.)
- Internal clock / calendar for time & date reference
- LTC for correlating results with program
- Internal temperature for monitoring equipment rack conditions

2 Installation

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Getting organized



The Qualis Audio Sentinel monitors a surround audio signal through digital inputs. A networked instrument, it provides its user interface through your browser and delivers alarms via email and SNMP notifications.

1. Power. Input from universal input voltage external power supply.
2. Auxiliary Signals. Linear Time Code input, loudness control input pair, 6 DC inputs, 4 contact closure outputs.
3. Network. RJ45 connector for 10BASE-T Ethernet. LEDs indicate connectivity and network activity.
4. Audio Module 2. Optional second audio input module.
5. Audio Module 1. Primary audio input module: 16-channel SDI, 8-channel SDI+AES, or 8-channel AES.

To install the Qualis Audio Sentinel, you mount it where it will be used, connect it to power, network, audio source and auxiliary signals, and configure it for operation.

For a basic installation, you can typically make the connections using standard cabling, and you can configure the Sentinel through its user interface on your browser. You'll need to view the Sentinel's front panel to determine its network address; you can also use the front panel to view configuration settings, and modify network, time and security settings.

If this is the first time you have installed a Sentinel, we suggest you perform a basic installation to confirm that your unit is working correctly and to gain familiarity with its operation. Once you're comfortable with the basics, finish your permanent installation.

Pay particular attention to these configuration steps, should they apply to you. The instructions that follow provide more detail.

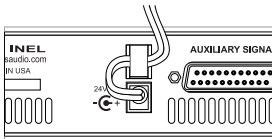
- **Static IP address.** By default, the Sentinel gets its network address automatically using DHCP services. You may prefer a static address (you use the address to access the Sentinel, and a static address won't change on you). You will need to contact your network administrator to determine appropriate settings for your network.

- Auxiliary signals. Linear Time Code input, loudness controls, alarm outputs and DC inputs are grouped together on a single connection. To gain access to any of these, you will need to fabricate a custom connector. To make this easier, an adaptor which brings these connections out to screw terminals is included with the Sentinel.
- Log repository. The Sentinel downloads its measurement data to a log repository. If you are using this data as an archival record, you may need to consider procedures for managing the data.

Mounting and operating environment

The Sentinel is designed for rack mounting and comes with integral rack ears. The instrument dissipates relatively little heat, under 10 Watts for digital input units. No special cooling is required for operation within the specified temperature range. However, the instrument should always be used indoors in a non-condensing environment.

Power connection and grounding



The Sentinel is supplied with a universal input voltage external power supply. It is designed to plug into any standard outlet strip and occupy only one space. This avoids the “fit” problems typically encountered when attempting to use multiple external supplies in one system. Outside North America, units are shipped with a universal power supply which has replaceable blades for all major mains power outlets..

This instrument is not grounded through its power supply. Grounding of the metal enclosure will occur through the equipment rack, audio connections (shield or individual pins) or through the auxiliary signals connector.

Do not depend upon or attempt to use the enclosure as a safety ground.

A strain relief is provided for the power supply cord to prevent accidental removal of power. After plugging the low voltage power cord into the Sentinel power input connector, loop the cord through the supplied strain relief.

Network connection

The Sentinel provides a 10BASE-T Ethernet network interface through an RJ45 connector on the rear panel.

By default, the Sentinel determines its TCP/IP network settings using the Dynamic Host Configuration Protocol (DHCP). This requires a DHCP server on your network to supply the settings.

Alternatively, you can configure static network settings through the network setup section of the Front Panel menus (p. 17). Static settings are stored in non-volatile RAM, so they are preserved if power is interrupted.

The configured IP address (dynamic or static) is shown on the front panel LCD display.

User interface configuration and use

The Sentinel provides its user interface through your browser. It is accessible from wherever you have network access to the Sentinel.

Connect your browser to the user interface by using the Sentinel's IP address. You'll use the interface to verify the installation, and to perform several configuration steps.

Browser compatibility

The user interface is compatible with these browsers:

Chrome	v6.0 or later, <i>not compatible with Java 7</i>
Firefox	v3.5 or later
Internet Explorer	8 or 9, <i>IE7 Compatibility View off</i>
Safari	v5.0 or later

Your browser must have JavaScript and cookies enabled for the user interface to operate correctly.

The log data features require the Java SE Runtime Environment 6 or later to be installed and enabled in your web browser settings. JRE 7 is supplied only as a 64-bit runtime, and is not compatible with 32-bit browsers, such as Chrome.

If the user interface is unresponsive or the displays are fragmented or corrupted, check your browser version and compatibility settings. Indicators on the Time & Status panel (p. 33) can also help you diagnose user interface problems.

The Sentinel user interface performs substantial processing in the browser. Browser performance is continually improving, and you will find the interface is most responsive with the latest browser versions.

System requirements

As mentioned above, the Sentinel user interface performs substantial processing in the browser. Your choice of workstation or laptop can make a significant difference in the smoothness and responsiveness of the user interface – faster, current-generation systems will perform better. While differences in processor architectures make it difficult to give specific numbers, 2.5 GHz or greater dual or quad-core processor with 4-8 GB memory is baseline for acceptable performance of the full user interface.

Storage requirements for the Sentinel log data are 19.5 MB per day (7 GB per year).

Modifying settings

The user interface is divided into two main pages. The Readings page (p. 21), initially visible, displays measurement panels. The Settings page (p. 61) displays settings panels, where you can view and modify settings. On the left of each page is a navigation panel that lets you select which information panels are visible, and lets you switch pages.

Briefly, to modify settings, you:

1. Switch to the Settings page (click Show Settings in the navigation bar),
2. Unlock the settings (click Modify Settings in the navigation bar, respond to the security prompt with a blank username and your Sentinel's password – *audio* is the default),
3. Select panels and change settings as required,
4. Save changes (click Save Settings in the navigation bar),

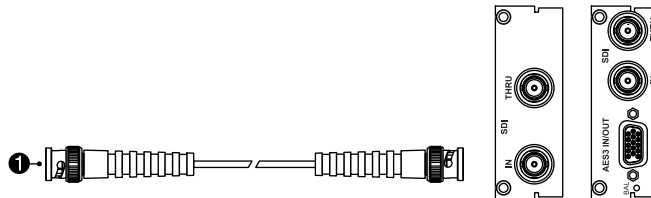
5. Return to the Readings page (click Show Readings in the navigation bar).

SDI digital audio connection

Audio input modules that support SDI input provide two BNC connectors for SDI signals. SDI In accepts an SD or HD input, and SDI Thru outputs a reclocked version of this input.

SDI In and Thru connections

SDI SD or HD input stream.



The SDI Input accepts both SD and HD signals up to 2.97 GB. The receiver automatically locks to the applied input and creates a reclocked version which drives the output.

The SDI input and reclocked output both use high performance BNC connectors. Particularly when monitoring HD-SDI signals it is essential to use high quality 75 Ω BNC cables.

Input-to-channel assignment

You assign digital input connections to internal Sentinel channels through the user interface. Select the channel assignments on the Input & Sources settings panel (p. 63) with the Use Input From field.

There are input modules supporting both 8 and 16 channels of input. The resulting 8 or 16 channels can be assigned to any of the internal channels. Appendix A, *Specifications* (p. 95) describes specific input module capabilities in detail.

When monitoring coded audio streams, any channel from the decoder may be routed to any internal channel. The description of the Dolby

Metadata panel (p. 56) lists channel orders for common channel configurations.

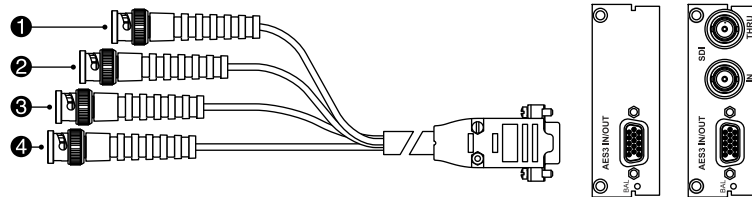
AES digital audio connection

Audio input modules that support AES input provide an HD15 connector for audio connections.

AES In/Out connection

Discrete PCM or coded audio input channels, compatible with VGA monitor cable pinout.

1. Input 1 (red).
2. Input 2 (green).
3. Input 3 (blue).
4. Input 4 (h-synch).



The AES In/Out jack accepts up to 4 balanced or unbalanced input streams in PCM or coded audio format. A PCM stream carries 2 channels which may be directly monitored. A coded audio stream carries up to 8 channels which may be routed to the internal Dolby decoder.

The input module automatically adjusts impedance to match either balanced or unbalanced inputs. Unbalanced inputs use standard VGA monitor cables. Qualis Audio provides an optional HD15 to XLR cable for balanced inputs.

Specifications for fabricating custom cabling are provided in AES digital audio connections (p. 88).

Input-to-channel assignment

You assign digital input connections to internal Sentinel channels through the user interface. Select the channel assignments on the Input & Sources settings panel (p. 63) with the Use Input From field.

When monitoring PCM inputs in AES-3 format, any channel from the AES In/Out connector can be assigned to any of the internal channels. Appendix A, *Specifications* (p. 95) describes specific input module capabilities in detail.

When monitoring coded audio streams, any channel from the decoder may be routed to any internal channel. The description of the Dolby Metadata panel (p. 56) lists channel orders for common channel configurations.

Auxiliary signals connection

The auxiliary signals connection combines the Linear Time Code (LTC) input, loudness meter controls, alarm outputs, and DC inputs.

A pair of signals control the operation of the Surround and Ancillary loudness meters in performing integrated loudness measurements (both meters share the same timing). One input switches between active measurement and the paused state, or between measuring program and measuring commercial. The other input completes the current measurement and begins a new measurement.

The four alarm outputs are asserted when the corresponding alarms occur.

The six DC inputs may be used to measure DC voltages, and by appropriate setting of the input comparison thresholds they may be used to monitor low speed logic signals.

Specifications for fabricating custom cabling are provided in Auxiliary connections (p. 89).

DC input thresholds configuration

Error thresholds can be set for the DC inputs in the DC Inputs & Temperature settings panel (p. 73).

Date & time configuration

The Sentinel uses a real-time clock to accurately record the timing of measurements in Coordinated Universal Time (UTC). When times are displayed, they are converted to the local timezone and daylight savings setting.

For the Sentinel to be able to store measurement data for later retrieval, it is essential that the clock be set accurately.

The Sentinel ships with its clock already set. To maintain accuracy, it synchronizes the clock to a Network Time Protocol (NTP) server at 10-minute intervals. This NTP server needs to be a high quality time source, and, in particular, needs to be synchronized with its reference time server often enough to avoid accumulated time errors.

You configure the NTP service and local timezone through the Date & Time settings panel (p. 77). The timezone can also be set through the Front Panel menus (p. 17), and you can manually set the clock through the menus if, for some reason, you're not able to use an NTP server.

Log repository configuration

The Sentinel logs all sampled audio characteristics and all measurements. It stores slightly more than 24 hours of this data internally. However, measurement data is stored in volatile memory and will be lost in the event of a power failure. To preserve and access the data, it must be downloaded from the Sentinel to a storage repository, which resides in a local directory on your system or in a directory on a shared network filesystem. Once data is in the repository, it is protected from loss, and you can use the user interface to review and display it in the same way as live readings.

The simplest way to create and update the repository is to let the user interface do it from your browser. You can also set up scheduled downloading of data to the repository, and this has several advantages over relying on the user interface to update the repository.

The downloading of data is time-consuming when the amount of downloaded data is large. Scheduled downloads to a shared repository can minimize delays in displaying logged data in the user interface.

In a production environment, where you require a continuous record of Sentinel measurement data, relying on the user interface to update the repository is not a robust solution. For reliable record-keeping, you must set up scheduled downloading.

In the user interface, configuration options for defining the log repository and scheduling downloads are located in the pulldown menu on the Time & Status panel (p. 33).

Create a log repository using the Select Repository... option and set Save Log Continuously to let the user interface store data in the repository.

Log Repository (p. 79) provides additional information. In particular, it describes how to schedule the downloading of log data separately from the user interface.

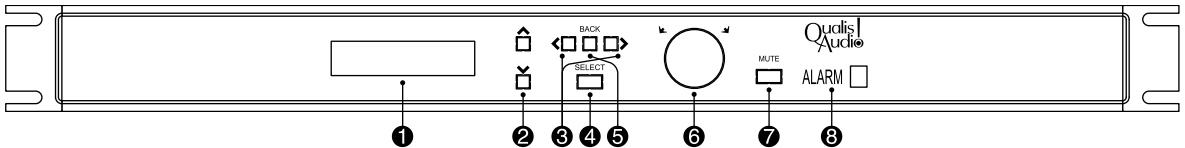
3 Front Panel

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The Qualis Audio Sentinel is intended to be controlled over a network connection from a standard Javascript enabled browser. However, some of the settings are only accessible from the front panel, principally those relating to network operation. All settings affecting instrument operation, alarming and reporting are stored in non-volatile RAM to ensure proper operation after power failure.

Front panel displays and controls



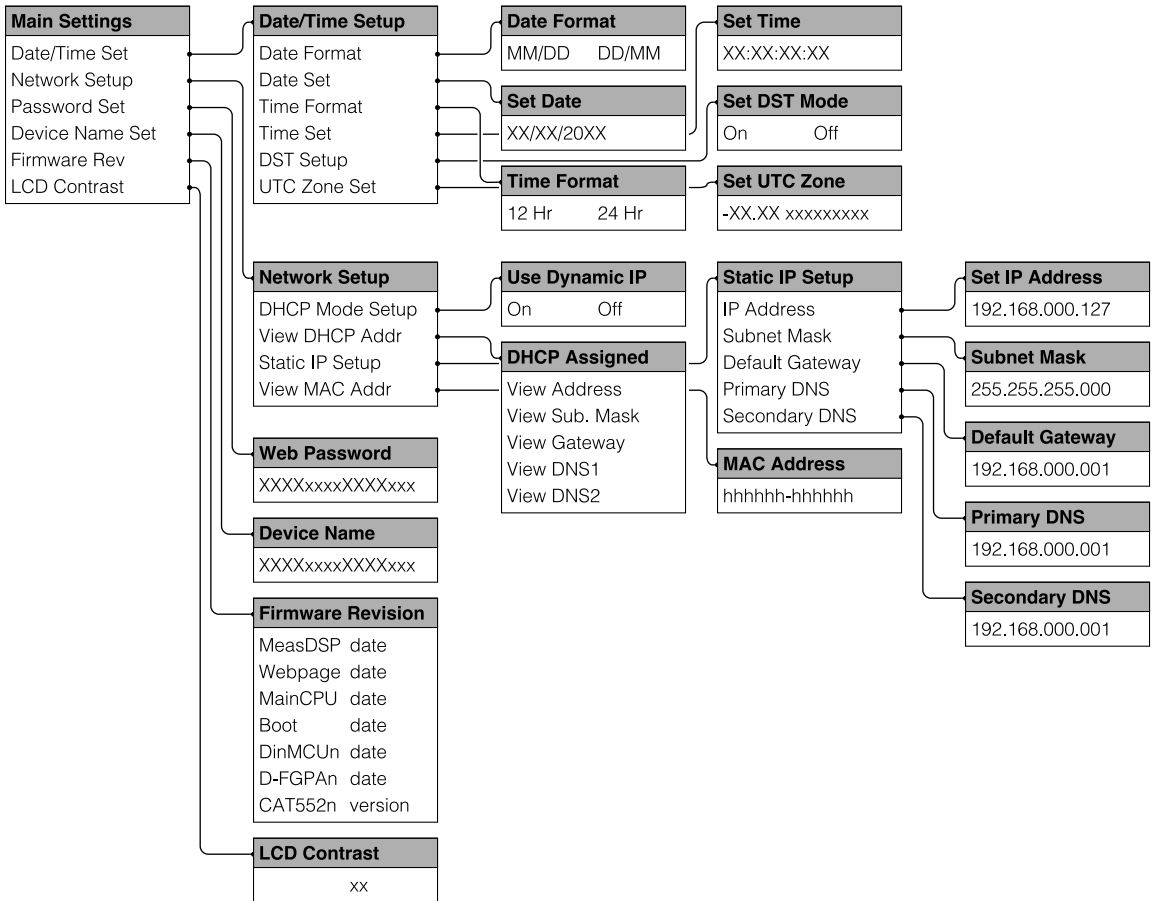
Buttons and knob are used to navigate the configuration menus and change settings. Backlit labels identify each control's function and operability – lit when functional, off when inoperative.

1. LCD display. During operation, shows date and time, and IP address. On input, line 1 shows the selection title, line 2 shows the setting.
2. Up/Down. Scroll through choices in current line 2 list.
3. Left/Right. Step through values or fields of current line 2 setting – active value is underlined.

4. Select. Enters configuration menus, confirms setting of current selection.
5. Back. Moves back in menu hierarchy. Discards setting unless SELECT is pressed first.
6. Knob. Rotate to change active setting value or field. Press to confirm setting of current selection.

7. Mute. Silences audible alarm.
8. Alarm. Lights when one or more alarms are active, cycles through active alarm numbers.

Front Panel menus



Date & time setup

These menu items set the Sentinel's real-time clock, the date and time formats for the front panel display, timezone, and daylight savings time. The Sentinel does not automatically switch to or from daylight savings.

The date and time entered via the Front panel menus are in local time, and converted to UTC time internally by the Sentinel. It is important to

set the time zone and daylight savings time first, before entering a date or time setting.

As an alternative to setting the date and time manually, the Sentinel can also be synchronized to a Network Time Protocol (NTP) server. The NTP service is configured from the user interface, using the Date & Time settings panel (p. 77). This setup panel also lets you set the date and time formats, timezone, and daylight savings time.

Network setup

These menu items let you allow the Sentinel to determine its TCP/IP network settings automatically using DHCP services, or to configure it with static settings. There are also menu items to display the network settings in use, and the Sentinel's Ethernet MAC address.

By default, the Sentinel will use DHCP for network settings.

When entering an IP address, use the left/right buttons to select an octet and use the knob to scroll through values.

Password setup

The web access password must be entered from the user interface in order to change Sentinel configuration settings.

Up to fifteen characters can be entered. The default password is *audio*.

Use the knob to scroll through characters. Entering the → character truncates the password string without having to set subsequent characters to blanks.

Device name setup

The device name is used in alarm email messages to identify the Sentinel from which the alarm originated.

It may also be set from the user interface, using the Alarm Actions settings panel (p. 76).

Use the knob to scroll through characters. Entering the → character truncates the device name string without having to set subsequent characters to blanks.

Firmware revision display

Displays revision dates for the field-upgradeable ROMs in the Sentinel. Dates are in mm/dd/yy format (month, day, year).

There are separate listings for the two digital input module ROM slots, M1 and M2. Only occupied slots are listed.

LCD contrast setup

Adjusts the LCD contrast on the front panel.

Use the knob to scroll through values.

4 Readings page

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The main Sentinel display in your browser is the Readings page, where all the measurement data collected by the Sentinel is displayed. A separate Settings page (p. 61) allows you to view and modify settings.

The Readings page is organized as a collection of panels, each panel showing a group of related measurements. On the left of the page, a *navigation panel* lets you select which measurement panels are visible, and also lets you switch to the Settings page.

By default, the navigation panel is always visible, but it can be hidden to save screen space. The hidden panel slides into view when the cursor is moved to the left edge of the window.

Here, briefly, are the panels that appear on the Readings page:



Channel Meter panels (p. 24) Bargraph displays of measurements for surround, ancillary and downmix channels.



Balance panel (p. 29) Plan view of listening space showing relative loudness of surround input channels.



Spectrum & Downmix Compatibility panel (p. 30) Octave-band graphs of the mono downmix channel spectrum and the stereo and monaural downmix compatibility (power loss compared to original).



Dialog Balance panel (p. 33) Bargraph display of dialog balance.



Loudness Meter panels (p. 34) Bargraph displays of continuous and integrated loudness measurements for surround, ancillary and downmix channels.



Readings Timeline panel (p. 40) Timeline traces of recorded readings. Allows you to review and replay readings recorded by the Sentinel.



Errors panel (p. 49) Error and alarm state for all eight inputs, downmixes, auxiliary inputs.



Digital Interface panel (p. 53) Interface characteristics and metadata for AES or SDI input.



Dolby Metadata panel (p. 56) Metadata for Dolby coded audio.



DC Inputs & Temperature panel (p. 59) Auxiliary input DC Voltage readings and Sentinel internal temperature.



Signal Histogram panel (p. 48) Summary graphical display of selected ranges from recorded readings.



Time & Status panel (p. 33) Health and activity status indicators, Sentinel identification, current time.



Settings page (p. 61) Panels for configuring Sentinel measurements and error reporting.

Arranging the panel navigation bar

You can reorder the contents of the navigation bar by dragging elements to reposition them.

When you've dragged an element to a new position in the navigation bar, you'll see a blue line highlighting the position.

Arranging the readings panels

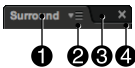
Panel positioning controls allow you to group, position within the display window, and hide or reveal the Sentinel's display panels.

A *panel group* at its simplest consists of a single panel. You can combine multiple panels alongside or above/below each other to form a compound panel group. The individual panels appear as non-overlapping tiles within the group.

The controls to hide and display panels operate on panel groups – all the panels in a group hide or display as a unit. This applies to the panel entries in the navigation panel, and the hide button on the group itself.

You arrange panels into panel groups and position panel groups by dragging. The draggable region of a panel is the labelled tab at the top of the panel. For a panel group, it is the background area at the top of the group (the area not covered by panel tabs). For a group consisting of a single panel, both regions can be used interchangeably.

When you've dragged a panel or group to a position where it will combine with another group, you'll see a blue line highlighting the position.



1. Panel tab. Drag to move panel, remove it from panel group or move it to another group.
2. Panel configuration popup menu.
3. Panel group background. Drag to move panel group or combine it with another group.
4. Hide button. Click to hide panel group.

Configuring the readings panels

You can configure many of the readings panels to adjust their appearance to match your preferences. For these panels, an icon to access a configuration popup menu appears at the right end of the panel tab. Clicking the icon causes the configuration menus to appear.

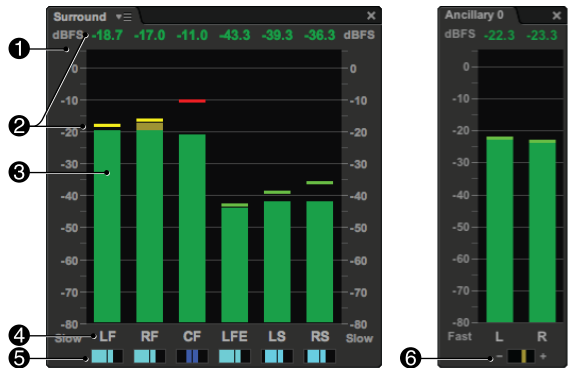
Persistence of user interface settings

Your navigation bar and panel arrangements are tracked from one session to the next, as are settings made through the configuration menus associated with the readings panels. These preferences are all associated with your browser – other users accessing the same Sentinel can set their own preferences.

The web interface saves preferences in your browser's local storage. You'll need to reenter the settings if they're lost for some reason – if you clear cookies on your browser, change browsers, or change the IP address of the Sentinel.

Channel meter panels

1. Meter axis. Meter units at top, meter type at bottom.
2. True peak. Indicator bar and numeric value.
3. Level bar.
4. Channel.
5. Bandwidth bar.
6. Phase bar.



Each channel meter panel displays a group of bargraphs for a set of input channels monitored by the Sentinel. There are separate panels for: the channels of the main surround program, each of the ancillary programs, and the downmix channels created by the Sentinel. Each channel bargraph includes a numeric display which shows the true

peak level of that channel. Channel bargraphs for the surround program also include an indicator which shows the approximate signal bandwidth for the channel. The pairs of channel bargraphs for stereo ancillary programs include an interchannel phase indicator.

Surround and ancillary input channels

The Sentinel accepts 8 or 16 input channels, depending on input module configuration. From these, channels are selected for a 5.1, 6.1, 7.1 or stereo format surround program. Additional channels may be assigned to up to five stereo or monaural format ancillary programs.

The surround format and input channel sources, as set in the Input & Sources settings panel (p. 63), determine the channels for which bar meters are displayed. The surround format determines which channels appear in the surround panel program, and the input channel source assignments indicate which ancillary programs are present and their format. The configuration pulldown menu for the Meters panel allows you to change the Channel Order of the bar meters.

Downmix channels

The internal downmix channels are created from the input signals as:

Lo sums LF, CF, LS and LB (or CB in 6.1 mode), if present.
Ro sums RF, CF, RS and RB (or CB in 6.1 mode), if present.
M sums *Lo* and *Ro*.

The gain coefficients applied to the center, front, surround and back channels when summing into the *Lo* and *Ro* downmix are selectable. They are set in the Downmix Compatibility settings panel (p. 71). These downmix gains are also used when performing the Compatibility measurements.

After summing, an overall attenuation or normalization scaling may be applied. A setting on the Downmix Compatibility settings panel (p. 71) controls this scaling. The downmixed channels may be unscaled, scaled so the peak amplitude of the downmixed channels will not exceed full scale, or scaled so peaks may exceed full scale by up to 3dB (as recommended in ATSC A/52b).

If digital inputs are used, the gain coefficients may be automatically set using information contained in the metadata, if present. If automatic setting is selected and the metadata downmix coefficients are set to “Not Indicated” or if the metadata is missing, the manually set values will be used.

Bargraph ballistics

The input and downmix channel bargraph levels are measured with user selected metering ballistics. The Meter Type in use sets the displayed scale and units. See Levels & Metering settings panel (p. 64) for descriptions of meter types.

Display colors

As is common for bargraph level meters, the indicator color changes with level. From top to bottom:

Red Signal is at or above Overload level

Yellow Signal is above Alignment Level and below Overload Level

Green Signal is below Alignment Level

The Alignment, Overload and Clipping Levels are set in the Levels & Metering settings panel (p. 64). For most meter types these parameters are defined in the appropriate standards document. In all cases these standards based values may be overridden with user selected values.

Warning Messages

A red vertically-written error message appears over the bargraph if certain errors are detected in that channel. They are not displayed for downmix channels. When multiple errors are present, the highest priority error is displayed. The possible errors, from highest to lowest priority, are:

UNLOCK The AES or SDI receiver has lost lock. This is usually due to a missing signal, a signal below the minimum amplitude required by AES or SMPTE specifications, or interfering noise of a level which prevents proper decoding of the bitstream.

- LINK* There is a parity or encoding error on the AES audio stream. This is usually caused by excessive cable length or interfering noise on the interface.
- VALID* The VALIDITY bit is asserted in the bitstream carrying audio data. This usually indicates the interface carries coded audio such as Dolby Digital or Dolby E encoded data. Suppressed if Coded Audio mode is selected for the channel.
- CLIP* The true peak level is above the User Clip Level set in the Levels & Metering settings panel (p. 64).
- OVER* The true peak level is above the Overload Level set in the Levels & Metering settings panel (p. 64).
- UNDER* The true peak level is below the allowed threshold set in the Levels & Metering settings panel (p. 64).
- HUM* There is an AC mains frequency component present above the threshold set in the Channel Analysis settings panel (p. 70).
- REPEAT* The audio stream repeats a constant value across consecutive samples exceeding a repeat threshold set in the Channel Analysis settings panel (p. 70).

These errors are also reported in the Errors panel (p. 49), where it is possible to simultaneously view all errors, regardless of priority.

True peak meters

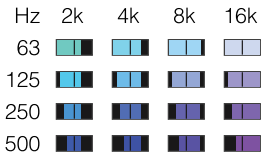
The numeric displays above the input and downmix channel bar-graphs are true peak meters. True peak meters interpolate the amplitude between samples for a more accurate reading of level. Rather than display the peak sample value, True-Peak meters display the amplitude which will result when the signal is converted to analog form.

The units are in dB relative to the maximum input level. With Analog inputs this is either +28 or +22 dBu as set in Levels & Metering settings panel (p. 64). With a digital source dBFS units are used. No meter ballistic is applied.

True peak readings which reach the user defined clip level will produce a CLIP indication on the bar meter of the corresponding input channel.

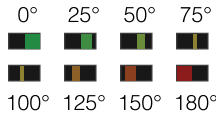
The configuration pulldown menu for the Meters panel allows you to set the Peak Hold Time from 1 to 30 seconds.

Bandwidth indicators



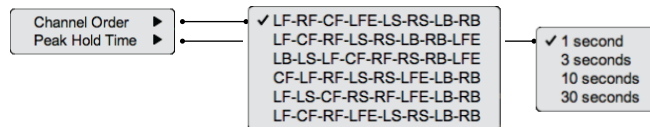
The input channel bargraphs have a graphic below the channel label which indicates signal bandwidth. This allows a quick assessment of which channels are dominated by dialog and which have extensive music or effects content. The left edge of the graphic is controlled by the low frequency signal content. The right edge of the graphic is dependent on the high frequency signal content. The color also changes with the low and high frequency energy, giving two equivalent methods of interpreting the information.

Phase indicators



The input channel panels for stereo format ancillary programs have a graphic centered below the channel bargraphs which indicates the phase relationship between the channels. This provides an indication of inverted channels and of potential downmix compatibility issues.

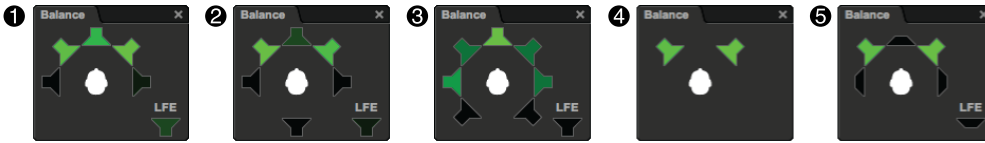
Configuration



Channel Order selects the order of channels in the multichannel meter display. The Surround Format setting (set in the Input & Sources settings panel (p. 63)) constrains which channels are actually displayed. If the Surround Format is 5.1, LB and RB are not shown; for 6.1, LB is replaced by CB and RB is not shown.

Peak Hold Time sets the time for which the graphical peak level indicators on the bargraphs display a recent maximum. It does not affect the True Peak meter numeric displays. The hold time may be set to 1, 3, 10 or 30 seconds.

Balance panel



Balance panel. Displays a plan view of the listening space with listener at center surrounded by loudspeakers. The LFE channel is an additional loudspeaker to the right.

1. 5.1 format.
2. 6.1 format.
3. 7.1 format.
4. stereo format.
5. 5.1 format with stereo signal format detected.

The brightness of the loudspeaker icons on the balance display changes in proportion to the relative loudness of the audio signals on their respective channels, with the loudest channel brightest. This creates an intuitive view of the sound space balance. For example, a phantom monaural sound appears as equal brightness in both the left and right front speaker icons.

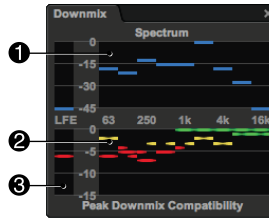
The arrangement of speaker icons in the balance display matches the channel layout of the surround format. If the Sentinel determines that the signal is actually stereo it will shrink the speaker icons in the unused channels.

The brightness changes in 1.25 dB steps giving a 20 dB range from full brightness to black. The display automatically adjusts to give a proper indication regardless of the average loudness down to -70 LKFS. Below this point the brightness of the loudest channel will decrease until all icons are black at -90 LKFS.

The loudness computations used to drive the balance display are shared with the program loudness measurement. Consequently, the surround channel balance display is frequency weighted according to the same ITU standard. However, the LFE channel icon is driven from an unweighted loudness computation with its gain adjusted for accurate relative loudness assessment. As per international standards, the LFE is not included in the overall loudness measurement.

Spectrum & downmix compatibility panel

1. Spectrum display. Shows the spectrum of the mono downmix channel in octave bands.
2. Downmix compatibility display. Shows stereo and monaural downmix compatibility (power loss compared to original) in octave bands.
3. LFE compatibility display.



Spectrum display

The spectrum display shows the surround program spectrum in octave spaced band-center frequency values. The display is updated at and averaged over 0.68 second intervals.

This display has several important applications:

It allows verification that the signal spectrum is consistent with the type of program being monitored. For example, there should not be significant high or low frequency content in a program that is supposed to be dominantly dialog.

It enables assessment of the relative level of spectral components which are experiencing downmix cancellation. If the downmix compatibility display shows significant cancellation at 4 kHz but the 4 kHz octave band is 20 dB below the 1 kHz octave, the cancellation is likely to be unimportant. However, if the dominant spectral components are the ones showing cancellation then a smaller degree of cancellation may be cause for concern.

Downmix compatibility display

The downmix compatibility display shows stereo and monaural downmix compatibility in octave spaced band-center frequency values. Octave band power measurements are made for each input channel and each of the downmix channels. The input channel measurements

used for a specific downmix are summed and compared to a downmix channel measurement.

The loss in each octave is displayed in a manner similar to a frequency response graph where the “rolloff” represents the signal loss at each octave band. The graph may be interpreted as the frequency response of downmixed content. If there are cancellations which drop the level in a particular frequency range, it is equivalent to passing the audio through a filter which attenuates that range.

There are separate indicators for left and right stereo channels and monaural:

- Monaural downmix loss.
- Left stereo downmix loss.
- Right stereo downmix loss.

As these go down, away from the 0 dB line, it means that the signal has cancelled more completely and more is missing from the mono or stereo mix.

The display changes color as the loss increases: green when there is little loss, yellow when loss is within 3db of the downmix error threshold, red when it equals or exceeds the threshold. The downmix error threshold is set in the Downmix Compatibility settings panel (p. 71).

Downmix compatibility calculations in detail

The Sentinel takes a radically different approach to quantifying compatibility from that used in other products. Other products characterize interchannel phase relationships and show these to the user as multi-dimensional Lissajous patterns. They typically produce complex multicolor shapes which must be studied and require much experience to correctly interpret.

Instead, the Sentinel measures the program channels to approximately 1/30th octave resolution. It also performs downmixing and measures the downmix channels in the identical manner. The frequency domain power measurements of the individual channels are summed and compared to the frequency domain power of the downmix channels. They

should be equal. However, if there are cancellations in the stereo or mono downmix signals their power will be reduced. This reduction is exactly the amount of signal which will be missing from the program heard by stereo or mono listeners. The result is a direct assessment of the change in the program experienced by these listeners.

The internal Downmix channels are created from the input signals as follows:

Lo Sums LF, CF, LS and LB (or CB in 6.1 mode), if present.
Ro Sums RF, CF, RS and RB (or CB in 6.1 mode), if present.
M Summed from *Lo* and *Ro*.

The *Lo* and *Ro* downmix attenuation values for center, surround and back-surround are set in the Downmix Compatibility settings panel (p. 71).

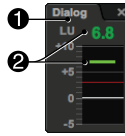
Frequency range filters

The frequency at which cancellations occur is important when assessing the severity of a compatibility problem. Cancellations in the voice band are generally of the highest concern because of their potential effect on intelligibility. Downmix problems at low or high frequencies, though potentially of concern, cause changes in effects or ambience and are generally less problematic. The horizontally arranged frequency domain view makes such distinctions immediately evident.

Calculation of losses by frequency also simplifies application of error conditions to the data. The Downmix Compatibility settings panel (p. 71) provides settings that control what downmix measurements constitute an error. Comparisons may be limited at both high and low frequencies and the amount of loss considered acceptable may all be set, along with a minimum time that the error must persist before being reported.

Dialog balance panel

Meter bar shows dialog loudness relative to remainder of program.



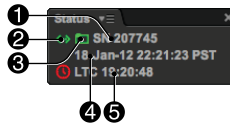
1. Meter axis. Meter units at top.
2. Loudness difference. Indicator bar and numeric value.

Dialog balance is a measurement of the loudness of the CF channel relative to the total loudness of the remaining program channels, gated based on the presence of signal in the CF channel. It provides an indication of dialog intelligibility. It can be used in mixing surround programs to keep the dialog louder than other content so it remains intelligible, or to detect mixes without adequate separation.

The dialog balance is compared to a user-defined threshold, displayed on the bargraph as a thin red line. When this threshold is exceeded for a user-specified duration an error is generated. When this error condition exists, both the graphical and numeric balance displays will be red. If the loudness remains above the threshold, the displays will be green. Gating level, error threshold and duration are set in the Loudness settings panel (p. 67).

Time & status panel

Displays health and activity status indicators, Sentinel identification, current time.



1. Serial number.
2. Network status icon.

3. Log repository status icon.
4. Real-time clock date, time, timezone and status icon.
5. Linear time code and status icon.

Status icons are green (or hidden) when there are no problems, yellow to indicate a warning, and red to indicate more serious conditions. If you move the cursor over a status icon, a detailed description of the status condition will be displayed.

The log repository status icon is animated with a moving dot when data is being downloaded from the Sentinel to the repository.

When the user interface is displaying live readings, the displayed time and linear time code are the latest values reported by the Sentinel. When paused or displaying logged data, they are recorded values that indicate the time at which the displayed measurements were taken. See the Readings Timeline panel (p. 40) for more details.

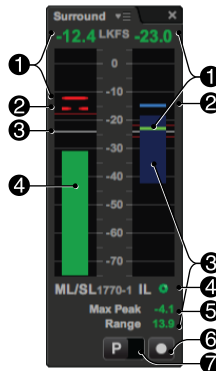
Configuration

Entries in the Time & Status configuration pulldown menu pertain to log repository handling. They are described in more detail in Log repository setup in the user interface (p. 81).

Loudness meter panels

Left meter bar displays loudness measurements continuously updated from the audio signal.

1. Short-Term loudness.
2. Downmix loudness. (Surround program only.)
3. Loudness reference level.
4. Momentary loudness.



Right meter bar displays integrated measurements computed across an extended time segment.

1. Integrated loudness.
2. Maximum momentary loudness.
3. Loudness range.
4. Loudness integration indicator.
5. Maximum true peak.
6. Integration restart button.
7. Program/commercial segment select button.

There are two loudness meter panels. Loudness measurements for the surround program are always displayed in one panel. The second panel displays the downmix program or one of the ancillary programs, according to the Secondary Meter set in Loudness settings panel (p. 67).

The loudness meter panel is organized around a pair of meter bars: continuously updated measurements (continuous readings) on the left, those computed across a specific time segment of the audio signal (integrated readings) on the right.

The measurement gating for the integrated readings may be controlled by hardware signals applied to the rear panel auxiliary signals connector or by software control through the buttons at the bottom of the loudness meter panel. Both meters share the same timing. The selection of hardware or software control is made in the Loudness settings panel (p. 67).

Continuous loudness measurements

The continuous measurements are the Momentary Loudness (ML) and Short-Term Loudness (SL). The momentary loudness is displayed as a bar and updated 10 times per second. The short-term loudness is displayed graphically as a line on the bargraph and numerically above it.

The surround program loudness display shows, in addition, the down-mix loudness as a broken line.

The short-term loudness is compared to a user-defined threshold, displayed on the bargraph as a thin red line. When this threshold is exceeded for a user-specified duration an error is generated. When this error condition exists, both the graphical and numeric short-term loudness displays will be red. If the loudness remains below threshold the displays will be green. This threshold is set relative to the Target loudness value in the Loudness settings panel (p. 67).

The short-term loudness corresponds to a listener's perception of program loudness. The ability to set an upper limit on this measurement allows an early warning of listener dissatisfaction with loudness control.

The short-term loudness is also displayed graphically on the Readings Timeline panel (p. 40).

Integrated loudness measurements

The right-hand meter bar displays integrated loudness readings. The displayed readings depend on which loudness standard is configured, indicated at the bottom of the meter axis.

The display provides an indicator bar for an integrated loudness level, an indicator bar for a maximum loudness level, and a pane that shows the loudness range.

The background of the bar shows the loudness error range, as configured in the Loudness settings panel (p. 67). The numeric accumulated loudness value is displayed above the bar. Numeric values for maximum true peak and loudness range, if defined, are displayed below the bar.

Integrated loudness measurements require a minimum segment length of 3.2 seconds.

Loudness integration status indicator

The loudness integration status indicator shows the state of integrated loudness measurements:

- Loudness calculation in progress (animated).
- || Loudness calculation paused.
- ✓ Final values, loudness is within specified tolerance.
- Final values, loudness is outside specified tolerance.

Conventional and Dual Stream™ loudness measurements

The Sentinel can measure integrated loudness exactly as specified in the ITU-R BS.1770-1, BS.1770-2 and BS.1770-3 standards. These standards, along with the ATSC and EBU variants, require the ability to run, pause, stop and reset the loudness measurement. The Sentinel rear panel auxiliary signals connector provides two GPI pins for this purpose. One serves as a RUN/PAUSE control and the other as a RESET control over the measurement. There are also equivalent soft buttons on the Loudness Meter panels and network accessible software commands for the same functions.

The conventional mode of operation specified in these standards was developed with measuring a single program or commercial being produced or broadcast. The pause feature allows the portions of a pro-

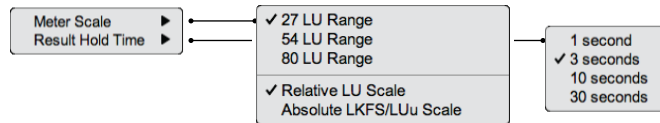
gram during commercial or other break periods to be ignored and an accurate measurement of the program obtained.

In a broadcast stream there is no “pause.” When a program is paused the time is occupied by a commercial or other interstitial content. The loudness of these interleaved segments is just as important, possibly more so, as the program. However, the way the loudness measurements are defined it is not possible to measure the individual pieces of a program separately, the measurement must be paused and measurement must resume when the break is over. Therefore to measure both the program and the commercial loudness independently requires two loudness meters, one for the program and one for the commercials. The control lines for these two meters must be interconnected so that they operate synchronously.

Dual Stream™ loudness measurement is Qualis Audio’s patent pending solution to this problem. The Sentinel is designed to handle a program stream with interleaved commercial segments. When the instrument is told that the program being monitored has gone to commercial it pauses the program measurement. However, it continues measuring and allocates the measured energy to a separate results buffer for the commercial. When the instrument receives a reset command it finalizes the readings and begins measuring another commercial. If instead it is told that the stream has returned to the original program it finalizes the commercial loudness reading and resumes measuring the program exactly as a conventional meter coming out of pause would do. When the program is complete, assertion of the reset command will finalize the program measurement and the instrument will immediately begin making a new measurement of program loudness.

These program and commercial loudness measurements are displayed, logged and reported, along with the program/commercial identifier, the time and the timecode. Each measurement is compared to the specified loudness limits and alarms are issued if required.

Configuration



Meter Scale sets the scale used to display the loudness measurement bargraphs, and selects between relative and absolute display units.

The bargraph scale may be set to either of the EBU required ranges of 27 or 54 LU, or an 80 LU range. The larger ranges allow monitoring of wider dynamic range material at the expense of display resolution. The 27 and 54 LU EBU meter ranges are positioned relative to the loudness reference, with 1/3rd of the scale above the reference and 2/3rds below. The reference may be a fixed target value, or the dialnorm value from the Dolby metadata. The reference selection is set in the Loudness settings panel (p. 67). The 80 LU meter range has its maximum at 5 LKFS.

The numeric loudness values may be displayed in either relative or absolute units. (Except loudness range, which by definition is a relative value.) The relative display shows measurements in loudness units (LU) relative to the loudness reference.

Result Hold Time sets the time for which the panel displays the results of completed integrated loudness calculations. The hold time may be set to 1, 3, 10 or 30 seconds.

The integrated loudness, loudness range, maximum momentary loudness and the maximum true-peak amplitude are all measured during a defined time period, with definite beginning and end events. Although the measurements are updated in real time, they are not final until the end time is reached. In a real time measurement application, another measurement follows immediately after a completed measurement. The hold time gives an operator a chance to read the values before they disappear and a new measurement begins.

Hardware loudness gating control

In the Dual Stream measurement mode there are still just two control signals: one to select the measurement context (called P/C), and one to reset the meter (called RESET). The same control line is used for RUN/PAUSE and for P/C, its function changes with the mode.

The polarity of each control line is defined on the Loudness settings panel (p. 67). This is also where the selection of conventional or Dual Stream mode is made, along with selection of hardware or software control.

In Dual Stream mode there is interaction between the P/C control line and the RESET control line. A Reset event finalizes an Integrated Loudness measurement, and starts a new measurement. An explicit Reset event occurs whenever the RESET control line transitions from False to True. An implicit Reset event occurs under the following conditions: 1) A Reset of a Commercial segment occurs when the P/C control line makes a transition from the Commercial state to the Program state. 2) A Reset of a Program segment occurs when the P/C control line makes a transition to the Program state, while the RESET control line is True.

The loudness control lines must be asserted for a minimum width of 40 ms and are debounced for 20 ms following the last transition. The polarity of each control line can be defined in the Loudness settings panel (p. 67).

Loudness gating control buttons

Located at the bottom of the loudness meter panel, the loudness gating control buttons let you control integrated loudness measurement.



Program/Commercial button Slider that switches between program and commercial segment measurement. Button appearance alternates between program (P) and commercial (C) graphics.



Measure/Pause button Pauses or resumes measurement. Button appearance alternates between measure and pause graphics. This button replaces the program/commercial button when the Sentinel is in measure/pause mode.



Restart button Restarts loudness measurement.

Readings timeline panel

1. Readings timeline. Loudness, program/commercial, error/alarm traces shown.
2. Programming segment table.
3. Timeline scroll bar.
4. Play/Pause button.
5. Skip backward button.
6. Skip forward button.



The Readings Timeline panel is a summary display of the history of readings from the Sentinel, from the latest readings back through the stored log data. The timeline panel also allows you to identify and work with programming segments within the readings history. The two major components of the panel are the timeline itself, which displays a set of signal traces, and the segment table.

The web interface saves a temporary record of readings as it receives them from the Sentinel. These readings, combined with readings downloaded and saved in the Log Repository (p. 79), provide a continuous record, limited only by your retention period for the log repository.

Timeline

What is visible on the timeline display is typically only a portion of the history. When the user interface is displaying live data, the timeline displays the most recent readings, the right end of the display tracks the current time, and older readings move off the left end. When browsing or replaying logged readings, the timeline display can be moved through the range of logged data.

Signal traces

The timeline displays your choice of measurement traces. You can select from:

- Surround Loudness
- Ancillary/Downmix Loudness
- Downmix Differential
- Dialog Balance
- Maximum Downmix
- Surround True Peak
- Ancillary/Downmix True Peak

The Ancillary/Downmix Loudness and True Peak traces display measurements for the program to which the ancillary loudness meter is assigned, according to the Secondary Meter set in Loudness settings panel (p. 67).

For each trace, you can choose either a compact display format suitable for a quick overview, or a more detailed format with an expanded vertical axis more suited to detailed analysis.

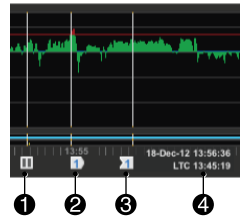
The loudness traces display short-term loudness. The downmix differential trace displays the difference between surround and downmix short-term loudness. The dialog balance trace displays the difference between dialog loudness and the remaining program content. The maximum downmix trace displays the maximum of left and right downmix values within the frequency range configured in the Downmix Compatibility settings panel (p. 71). The true peak traces display the maximum true peak measurement across channels.

A programming segment trace appears below these traces. It shows the breakdown of the readings into programming segments for integrated loudness measurements. The lower half of the trace indicates program segment measurements; it's shadowed wherever the measurement was paused. The upper half indicates commercial segments. Breaks in the traces mark the positions where measurements were reset.

A summary trace of errors and alarms is also always visible as the last trace. It shows a yellow marker at each reading that records an error. If the error resulted in an alarm, a red marker appears above the yellow.

Cursors

1. Current position cursor.
Appearance changes to indicate play/paused state (paused shown).
2. Left bound cursor.
3. Right bound cursor.
4. Right position flag (appears when cursor is dragged).



Trace cursors consist of a single current position cursor, which is always present, and zero or more pairs of segment bounds cursors.

Current Position cursor

Displays the current play position. When the cursor is positioned at the current time, the display shows live readings and the cursor position advances automatically. Dragging the cursor away from current time changes to paused state, freezing the motion of the meter and timeline displays. Dragging when replaying saved readings changes the replay position, and replay continues when the cursor is released.

The readings at the current position are displayed on the meters and secondary readings panels. When displaying live data, these are current readings as they are received from the Sentinel; at other positions in the timeline, saved readings are displayed. When dragging the current position, the readings update as the cursor moves.

The current position cursor always stays within the visible portion of the timeline display. When repositioning of the display would move the cursor out of view, it sticks at the end of the displayed range – that is, it moves to the position within the display area that is closest to its prior position. This can have the side-effect of pausing the display. (To resume showing live readings, you can press the Skip Forward button to advance the position to the current time.)

Segment bounds cursor pairs

Segment bound cursor pairs indicate the bounds of programming segments. Each pair corresponds to an entry in the segment table. Both bounds cursors display the segment number, which also appears on the segment table entry.

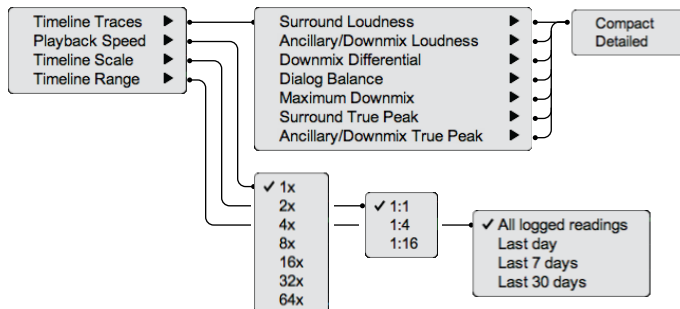
Bounds cursor pairs are created and deleted as segments are added and removed from the segment table, using the segment add/remove buttons provided by the segment table (p. 46). You can also remove a pair (and its associated segment) by dragging either cursor off the timeline vertically.

Dragging the left bound of a pair moves both cursors, maintaining their separation. Dragging the right bound does not move the left. In other words, you position a segment by dragging its left bound, and change its duration by dragging its right bound.

Bounds cursors move independently when dragged, except that neither cursor can be dragged past the other, and instead pulls the other cursor along with it. The cursors are adjacent when a new segment is created – you can separate them by dragging one back and forth.

Dragging when playing logged readings changes to paused state. Dragging while playing live readings does not change state, and live play resumes when dragging stops.

Configuration



Timeline Traces selects the data traces displayed on the timeline. It allows a choice of measurement traces and compact or detailed display format.

Playback Speed selects rate at which readings are displayed during playback.

Timeline Scale lets you view the timeline at varying levels of detail – from 1:1, where each mark on the timeline represents a single reading, to 1:16, where each mark combines 16 readings.

Timeline Range restricts the range of the timeline scroller bar – to the last day of data, 7 days, or 30 days.

Timeline scroll bar

The timeline scroll bar and its scroller, below the timeline traces, indicate the position the visible timeline segment within the readings history, and allow you to reposition the segment of readings data displayed on the timeline. By default, the scroll bar spans your full readings history, but, for convenience, you can restrict its range to 1, 7, or 30 days (see below).

Dragging the scroller moves the timeline display. Clicking at a position on the scroll bar moves the timeline toward that position. You can also move the timeline using mouse scroll wheel movements or touch gestures on the scroll bar or timeline itself, if your system support them.

Transport control buttons

Located in a cluster at the right of the timeline panel, the transport control buttons let you control the play of live or logged readings.



Play/Pause button If paused, starts play; if playing live or logged readings, pauses play. Button appearance alternates between play and pause graphics. If play is started within a defined programming segment, it begins at the beginning of the segment.



Skip backward button Moves current position to closest preceding beginning segment bound. (If the current position is at

a beginning bound, moves to the previous one; does nothing if no bound precedes the current position.) If clicked while displaying live or logged readings, it pauses the display.



Skip forward button Moves current position to closest following beginning segment bound. (If the current position is at a beginning bound, moves to the next one.) If no bound follows the current position, it moves to the current time and resumes play of live readings.

Replaying of logged readings continues until it reaches a segment bound or the current time. If replay reaches the current time, it then switches to displaying live readings. If it reaches a segment bound, it pauses. Pressing the play button will cause play to restart at the beginning of the segment.

In effect, there are two patterns for playing logged readings. You can repeatedly play a defined programming segment. Or you can work without setting up segments, moving the current position and starting and stopping play directly.

Segment table

A segment is an interval of time within the Sentinel's readings history. Measured segments are created in real time by the Sentinel; defined segments are created retrospectively through the user interface.

The segment table displays all defined segments, and a selection of measured segments centered on the current timeline position.

	BEGIN	END	DURATION	SURROUND	LTC	LOUD PEAK RANGE	DOWNMIX	LOUD PEAK RANGE		
1	28-Dec-12 01:22:38	28-Dec-12 01:38:21	00:15:43	01:08:52	-23.0	-3.6	4.8	-22.3	-5.6	5.6
2	28-Dec-12 01:30:00	28-Dec-12 02:00:00	00:30:00	01:16:16	-23.0	-2.0	4.7	-22.4	-5.0	5.8
3	28-Dec-12 01:31:00	28-Dec-12 01:32:00	00:01:00	01:17:16	-23.0	-6.0	5.8	-22.4	-7.3	5.2
	28-Dec-12 01:58:00	28-Dec-12 01:59:00	00:01:00	01:44:14	-23.3	-8.7	5.8	-22.3	-5.3	6.2
	28-Dec-12 01:38:23	28-Dec-12 02:34:24	00:56:01	01:24:36	-23.2	-2.2	6.7	-22.2	-4.4	7.8
					-23.0	-2.0	4.7	-22.4	-5.0	5.8

- Selected defined segment. Clicking arrow positions timeline to segment.
- Summary. Combined integrated measurements for defined segments.
- Segment add/remove buttons. Define new segment or delete selected segment.
- Segment index. For defined segments, matches segment bounds cursors.
- Segment status. Activity indicator for current measured segment, summary error indication for completed segments.
- Segment category. Program/commercial for measured segment, Include/exclude/ignore for defined segment.
- Begin/End times and duration. Editable for defined segment.
- Begin LTC.
- Integrated measurements. Loudness, maximum true peak and loudness range for surround and ancillary loudness metering.

Segments – specified intervals of time within the Sentinel's readings history – are of two kinds, *measured segments* and *defined segments*. The segment table displays both types of segments in chronological order.

Measured segments

Measured segments are created in real time by hardware or software inputs to the Sentinel. The associated loudness measurements are generated by the hardware and displayed on the loudness meter panel as they occur. These measurements, their beginning and ending times, along with their context (program or commercial) are stored in the log data.

The segment category setting for a measured segment is either:

- P** Program segment.
- C** Commercial segment.

Defined segments

You create defined segments through the user interface. Loudness measurements for defined segments are calculated within the user interface from saved log data and are recalculated when the segment's bounds change, so they update in real time.

Each has a corresponding pair of bounds cursors displayed on the readings timeline. You can change a segment's beginning and ending times by moving its bounds cursors or by editing the begin time, end time or duration displayed on its segment table entry.

Defined segments may also appear on the Signal Histogram panel (p. 48).




Defined segments are numbered for identification. These numbers are displayed both in the segment table and on the segment's bounds cursors. Numbers are assigned consecutively, starting at one. Adding or deleting segments can cause renumbering. Changing a segment's beginning or ending time can change its position in the table, which can also cause renumbering.

Combined measurements for defined segments are displayed as a final entry in the segment table. The segment category setting for a defined segment specifies how the segment contributes to these summary measurements:

- Add to summary.
- Exclude from surrounding segment.
- Ignore.

Segment status

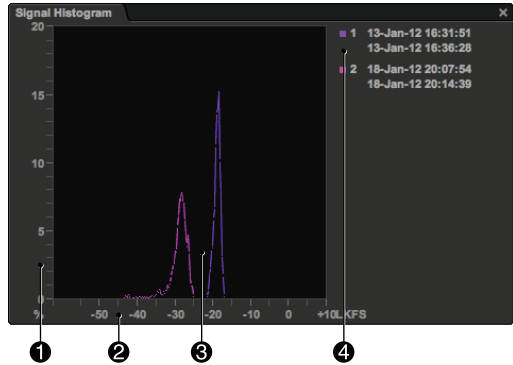
The status indicator shows activity for measured segments, and flags completed segments with errors:

-  Segment calculation in progress (animated).
-  Segment calculation paused.
-  Completed segment, error detected.

In addition, the integrated loudness and maximum true peak measurements are highlighted in red if they exceed error limits.

Signal histogram panel

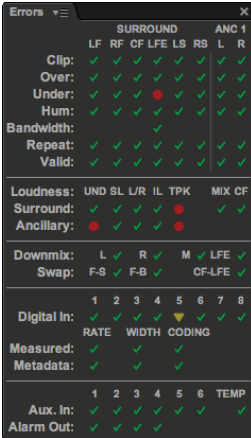
1. Y axis. Units are percentages.
2. X axis. Units are full-scale loudness.
3. Histogram traces.
4. Segment key.



The Signal Histogram panel summarizes loudness measurements for programming segments selected using the Readings Timeline panel (p. 40). The display updates as you add or remove segments from the timeline, or adjust their limits.

Bars of the histogram represent the proportion of readings in 1 dB intervals, arranged along the X axis of the histogram from lowest measured loudness to highest. The height of a bar is the percentage of the readings in its interval.

Errors panel



The Errors panel provides a concise view of all potential errors measured by the Sentinel. Unlike the warnings overlaid on the bargraphs, there is no prioritization applied to the error summary.

These are the icons used to indicate error conditions:

- ✓ No active error.
- Active error.
- ▾ Recent error. Hold time set in the configuration pulldown menu for the Errors Panel.

Channel Errors

The Channel Errors section displays a matrix of per-channel errors. There is a column for each channel in the configured surround and ancillary programs and a row for each error. The displayed errors and their sources are:

- Clip* The true peak level is above the User Clip Level set in the Levels & Metering settings panel (p. 64).
- Over* The true peak level is above the Overload Level set in the Levels & Metering settings panel (p. 64).
- Under* The true peak level is below the allowed threshold set in the Levels & Metering settings panel (p. 64).
- Hum* There is an AC mains frequency component present above the threshold set in the Channel Analysis settings panel (p. 70).
- Bandwidth* The LFE channel bandwidth exceeds the maximum set in the Channel Analysis settings panel (p. 70).
- Repeat* The audio stream repeats a constant value across consecutive samples greater than the threshold set in the Channel Analysis settings panel (p. 70).
- Valid* The VALIDITY bit is asserted in the bitstream carrying audio data. This usually indicates the interface carries coded audio such as Dolby Digital or Dolby E encoded data. Suppressed if Coded Audio mode is selected for the channel.

Loudness Errors

The Loudness Errors section displays errors related to program loudness. The first row shows errors in the surround program, and a second row shows errors in the ancillary program. These errors and their sources are:

- UND* Program channels are under-level based on thresholds and durations as set in the Levels & Metering settings panel (p. 64).
- SL* The short-term loudness differs from the loudness target by a specified tolerance and duration as set in the Loudness settings panel (p. 67).
- L/R* The loudness levels for a left-right pair of channels differ by more than a specified tolerance and duration as set in the Loudness settings panel (p. 67).
- IL* The integrated loudness differs from the loudness target by a tolerance specified in the Loudness settings panel (p. 67).
- MIX* The short-term downmix loudness differs from the short-term surround loudness by more than a specified tolerance and duration as set in the Loudness settings panel (p. 67). (Shown only on surround program row.)
- CF* The CF channel loudness differs from the loudness of the remainder of the program by more than a specified tolerance and duration as set in the Loudness settings panel (p. 67). (Shown only on surround program row.)

Interchannel Errors

The Interchannel Errors section displays errors which involve multiple channels. These errors and their sources are:

- Downmix* Errors are asserted when any of the downmix compatibility measurements within a specified range of octave bands exceed a threshold and duration as set in the Downmix Compatibility settings panel (p. 71).
 - L* Cancellations on Lo (Left) channel exceed the limits
 - R* Cancellations on Ro (Right) channel exceed the limits

	<i>M</i>	Cancellations on M (Monaural) channel exceed the limits
	<i>LFE</i>	Cancellations on LFE channel exceed the limits
<i>Swap</i>		Errors are asserted when there is a suspected interchange of channels, persisting longer than a duration as set in the Channel Analysis settings panel (p. 70).
	<i>F-S</i>	Probable swap of front (LF and RF) and surround channels (LS and RS). Asserted if the surround loudness exceeds the front.
	<i>F-B</i>	Probable swap of front (LF and RF) and back channels (LB and RB) in 7.1 mode. Asserted if the back loudness exceeds the front.
	<i>CF-LFE</i>	Probable swap of CF (center front) and LFE channels. Asserted if the LFE bandwidth exceeds the CF bandwidth.

Digital Errors

The Digital Errors section displays errors involving the digital input channels and digital metadata.

Digital In Columns 1-4 show the receiver lock status for each of the four 2-channel PCM inputs. Column 5 shows the receiver lock status for coded audio.

Interchannel Errors The sample rate and word width (number of active bits) are measured for each channel of the surround program, and the values are checked for differences between channels.

Channel metadata is extracted and checked for differences in similar fashion. This metadata is also checked for differences with measured values for each channel.

The differences are displayed in tabular format, with columns for sample rate and word width. There are rows for differences between measured values, and between measured and metadata values.

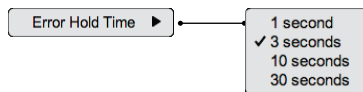
Auxiliary I/O

The Auxiliary I/O section displays the status of the signals on the rear panel auxiliary signals connector.

Auxiliary Inputs These indicate errors on each of the six DC inputs and the Sentinel internal temperature measurement. The upper and lower comparison thresholds are set in the DC Inputs & Temperature settings panel (p. 73). Unlike other errors there is no duration setting associated with the DC inputs or temperature. If one of these exceeds threshold the error will be asserted immediately. However, these inputs are tested approximately 3 times per second so a transient whose duration is less than 330 ms may be missed.

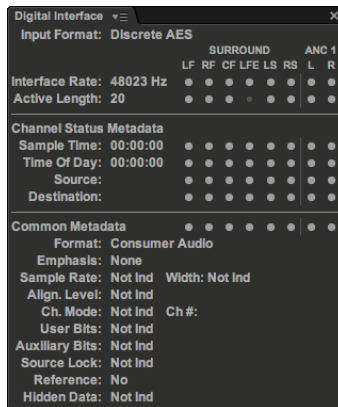
Alarm Outputs Any of the errors outlined above may be used to trigger an Alarm condition as set in the Alarms settings panel (p. 74). The state of the four Sentinel alarms is shown at the bottom of the Errors panel. Unlike the error indicators, these are not subject to the Hold Time setting. Their state is directly reflected in the indicators.

Configuration



Error Hold Time sets the time for which the panel indicators display a recent error. This setting only affects errors displayed on this panel, not on other panels or the bargraphs. It also does not affect the Alarm Out status display at the bottom of the panel. The hold time may be set to 1, 3, 10 or 30 seconds.

Digital interface panel



The Digital Interface panel displays signal characteristics and metadata for the signals applied to the digital inputs.

Input Characteristics

The Input Characteristics section displays format, rate and length.

Input Format Discrete AES, coded AES, or an SDI format. For SDI, the video format is also indicated.

Interface Rate Sample rate of each audio channel carried in the interface; for SDI input, includes synchronous or asynchronous indication.

Active Length Measured word width for each audio channel carried in the interface.

Channel Status Metadata

Sample Time Time referenced to the start of the recording, providing the same function as a recording index counter.

Time of Day Time of day, referenced to midnight, during the source encoding of the signal. It should remain unchanged during subsequent operations.

Source Four-character representation of the audio source.

Destination Four-character representation of the intended destination.

Common Metadata

- Format* Professional or consumer format interface; audio (PCM) or non-audio (coded audio) content.
- Emphasis* Pre-emphasis (if any) applied to the audio signal: None, 50/15 us, ITU-T J17 or Not Indicated.
- Sample Rate* Audio sample rate.
- Width* Active word length.
- Alignment Level* Alignment level used when creating the audio signal.
- Not Indicated*
 - 18 dB* As specified in SMPTE RP155
 - 20 dB* As specified in EBU R68
 - Reserved* Metadata is set to an undefined bit pattern
- Channel Mode* Usage of the two audio streams carried on the interface:
- Not Indicated*
 - 2 Channel* Streams are independent channels
 - 1 Channel* Only one stream is used
 - Primary/Secondary* Streams are a primary and related secondary channel
 - Stereo* Streams are a stereo pair
 - 1 Channel 2Fs* Streams are interleaved samples of a single channel at double the interface frame rate
 - L Channel 2Fs* Streams are interleaved samples of left channel content at double the interface frame rate
 - R Channel 2Fs* Streams are interleaved samples of right channel content at double the interface frame rate
 - Multi Channel* Streams are part of a multichannel (more than two) signal
 - User 5, User 6* Streams are a non-standard user-defined format.
 - Reserved* Metadata is set to an undefined bit pattern
- Channel Number* Channel identification number, used only in the multichannel mode listed above.
- User Bits* Format of the interface user (U) bit stream:
- Not Indicated*
 - 192-bit* Framed synchronous to the channel status (S) bits, remaining formatting undefined
 - AES-18* Follows AES-18 standard

AES-52 Follows AES-52 standard

IEC60958 Follows IEC60958 standard

IEC62537 Follows IEC62537 standard

User Defined

Reserved Metadata is set to an undefined bit pattern

Auxiliary Bits Allocation of 4 least significant bits of the 24 audio bits in each sample:

Not Indicated

Audio All 24 bits represent the same audio sample

Talkback Bits are part of a 12-bit, one-third sample rate talkback channel

User Defined Bits are not associated with the remaining 20 bits in each sample

Reserved Metadata is set to an undefined bit pattern

Source Lock Indicates whether source is locked to a master reference clock: Locked or Not Indicated.

Reference Identifies digital audio reference (DARS) signal. These signals do not carry audio and are used solely as a sample rate and time alignment reference.

Not Indicated

No Signal is not DARS

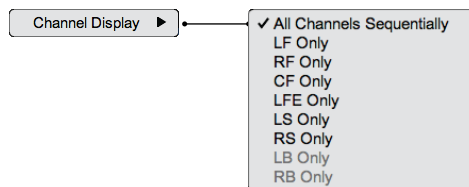
Grade 1 ± 1 ppm accuracy reference re AES-11

Grade 2 ± 50 ppm accuracy reference re AES-11

Reserved Metadata is set to an undefined bit pattern

Hidden Data Indicates whether LSB of the audio contains hidden information as specified in AES-55: Present or Not Indicated.

Configuration



Channel Display sets the Channel Display to display data for a particular channel, or to cycle through all channels sequentially.

Dolby metadata panel

Dolby Metadata	
Format:	D 32-bit
Rate:	192kbps 48kHz
Frame Rate:	Not E
Stream #:	8
ID:	16
Configuration:	res. Use: CM
Coding Mode:	stereo LFE: off
Errors:	1
Dialnorm:	-27 dB
Dyn. Range:	-0.9 dB
Compression:	-1 dB
CF:	La/Ra
Standard:	-3 dB -3 dB
LoRo:	
LiRt:	
DC Filter:	off
Surround Lev.:	0 dB
Phase:	0°
BW Limit:	Main: off LFE: off
Mix Level:	105
Room:	Irg
Copyright:	yes
Original:	yes
Surround Enc.:	yes
EX Enc.:	
Headphone:	A/D:

The Dolby Metadata panel displays metadata information carried in each Dolby Digital or Dolby E data packet.

Format metadata

Format Indicates whether stream is PCM, Dolby Digital or Dolby E encoded. If Dolby encoded, shows how data is packed into the audio samples:

D 32-bit Dolby Digital encoded, data in both channels

D 16-bit Ch 1 Dolby Digital encoded, data in only the first (left) channel

D 16-bit Ch 2 Dolby Digital encoded, data in only the second (right) channel

D 16-bit Ch 1&2 Two Dolby Digital encoded signals, one in each channel

E 24-bit Dolby E encoded, data packed in all 24 bits of both channels

E 20-bit Dolby E encoded, data packed in the 20 most significant bits of both channels

E 16-bit Dolby E encoded, data packed in the 16 most significant bits of both channels

PCM Not Dolby encoded; PCM or other coding

Rate Bit rate of data in Dolby packets.

Frame Rate Rate of data words in the interface.

Stream Number Stream (from 0 through 7) being decoded. A standard 2-channel 24-bit 48 kHz digital audio stream can contain up to 8 Dolby E encoded streams.

ID Version of Dolby stream format.

Configuration Assignment of audio channels (up to 8) within the bit-stream into individual programs, defined only for Dolby E streams. Input channels may be grouped into up to eight separate mono, stereo or surround programs, each with its own metadata.

Here are the assignments of input channels to program channels (program number and channel name) for the more common configurations:

	1	2	3	4	5	6	7	8
5.1	1 LF	1 RF	1 CF	1 LFE	1 LS	1 RS		
5.1+2	1 LF	1 RF	1 CF	1 LFE	1 LS	1 RS	2 LF	2 RF
5.1+2x1	1 LF	1 RF	1 CF	1 LFE	1 LS	1 RS	2 CF	3 CF
7.1	1 LF	1 CF	1 LS	1 LB	1 RF	1 LFE	1 RS	1 RB
7.1 screen	1 LF	1 CF	1 Lc	1 LB	1 RF	1 LFE	1 RS	1 Rc
2x2	1 LF	1 RF					2 LF	2 RF
3x2	1 LF	1 RF	3 LF	3 RF			2 LF	2 RF
4x2	1 LF	1 RF	3 LF	3 RF	4 LF	4 RF	2 LF	2 RF

Use Type of main or associated audio service contained within the bitstream:

- CM* Complete Main
- ME* Main Music & Effects
- VI* Associated Visually Impaired
- HI* Associated Hearing Impaired
- D* Associated Dialog
- C* Associated Commentary
- E* Associated Emergency
- VO* Associated Voice Over

Coding Mode Indicates which channels are present in the bitstream:

- 1+1* (dual mono)
- mono* CF
- stereo* LF, RF
- LCR* LF, CF, RF
- LRS* LF, RF, Surround
- LCRS* LF, CF, RF, Surround
- LRLsRs* LF, RF, LS, RS
- LCRLsRs* LF, CF, RF, LS, RS (all standard surround channels)

LFE Indicates whether low bandwidth channel devoted to low frequency effects is present within the bitstream.

Errors Number of received coded audio packets containing errors. The count rolls over at 255.

Normalization

Dialnorm Indicates the average loudness of the audio stream. This is a nominal value, set when the program is encoded, and it may not correspond to the actual loudness of the stream.

Downmix metadata

The gain coefficients applied to the surround channels when downmixing to a 2 channel or mono format are displayed as a table with two columns: CF for the center front channel, LsRs for the surround channels. Rows indicate each coefficient:

Standard Present in all Dolby packets, used by decoders which do not support Dolby Digital Plus and by all decoders when processing Dolby Digital data. Used only when downmixing to LoRo format; fixed values of -3 dB are used when downmixing to LtRt format.

LoRo Present only in Dolby Digital Plus packets, used by Dolby Digital Plus decoders when downmixing to LoRo format.

LtRt Present only in Dolby Digital Plus packets, used by Dolby Digital Plus decoders when downmixing to LtRt format.

The LoRo or LtRt row may include a *pref* indicator to designate the recommended downmix method. This indication is present only for Dolby Digital Plus packets, and does not appear if the LoRo and LtRt coefficients are not present or if the metadata does not specify a preference.

Filters, Pre-emphasis, Attenuation

Overmod Protect Indicates whether encoder used pre-emphasis when calculating compression values used in RF mode.

HPF Indicates whether encoder applied a DC-blocking filter.

Surround Level Surround channel attenuation (0 or 3 dB).

Phase Phase shift to apply to surround channels when converting to Dolby Digital (0 or 90°). Dolby E only.

Bandwidth Limit Main Indicates whether to apply lowpass filter to main input channels when converting to Dolby Digital. Dolby E only.

Bandwidth Limit LFE Indicates whether to apply lowpass filter to LFE channel when converting to Dolby Digital. Dolby E only.

Other Metadata

Mix Level Peak sound pressure level used in program creation.

Room Relative size of mixing environment and equalization used in program creation:

Large Large room with cinema X-curve equalization

Small Small room with flat equalization

Copyright Indicates whether creator is asserting copyright on bitstream content.

Original Indicates whether bitstream is original master version, not a copy

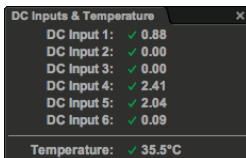
Surround Encoding Bitstream contains Dolby Surround (Lt/Rt) program that requires Pro Logic decoding (yes, no, not indicated).

EX Encoding Bitstream contains Surround EX program, encoded audio has two Surround channels (yes, no, not indicated).

Headphone Indicates whether program has been processed with Dolby Headphone technology for binaural playback.

A/D Analog to digital conversion used (standard or HDCP processing).

DC Inputs & Temperature panel



DC Inputs & Temperature	
DC Input 1:	✓ 0.88
DC Input 2:	✓ 0.00
DC Input 3:	✓ 0.00
DC Input 4:	✓ 2.41
DC Input 5:	✓ 2.04
DC Input 6:	✓ 0.09
Temperature:	✓ 35.5°C

The DC Inputs & Temperature panel displays readings from the Sentinel's six auxiliary voltage inputs. These inputs are updated approximately 3 times per second so a transient whose duration is less than 330 ms may be missed.

This panel also includes a reading of the Sentinel internal temperature in degrees Centigrade. This will typically be a few degrees above that of the rack in which the Sentinel is installed. This allows monitoring temperature of the equipment rack at a remote facility and triggering an alarm if the temperature exceeds allowable limits.

The DC voltage and temperature readings are compared to upper and lower limits set in the DC Inputs & Temperature settings panel

(p. 73). The results of that comparison are shown to the right of each reading using status icons:

- ✓ Reading is within limits.
- Reading is outside limits.

See Auxiliary signals connection (p. 12) for details about connecting these inputs.

5 Settings page

Input & Sources settings panel 63

Levels & Metering settings panel 64

Loudness Settings panel 67

Channel Analysis settings panel 70

Downmix Compatibility settings panel 71

DC Inputs & Temperature settings panel 73

Alarms settings panel 74

Alarm Actions settings panel 76

Date & Time settings panel 77

Configuration settings panel 78

On the left of the Settings page is a navigation panel that lets you select which settings panels are visible. It also lets you make changes to the settings and save them, and switch to the Readings page (p. 21).



Modify/Save settings

Unlocks the settings panels so settings can be modified. A dialog box will appear requesting a password (default is *audio*), and the button will change to Save Settings. To save changes, press the Save Settings button; otherwise, your changes will be discarded.



Readings page (p. 21) Panels displaying Sentinel readings. Switching to the readings panels will discard any unsaved changes to settings.



Input & Sources settings panel (p. 63) Selects input connector, signal format, surround format and assignment of inputs to surround and ancillary channels.



Levels & Metering settings panel (p. 64) Selects meter ballistics and scale, reference level, clip threshold and overload level.



Loudness settings panel (p. 67) Sets parameters for loudness measurement, loudness target, limits for loudness error checking and minimum levels for dead channel indication.



Channel Analysis settings panel (p. 70) Sets hum error threshold, LFE bandwidth threshold, digital repeated sample error threshold, front/surround and CF/LFE swap thresholds.



Downmix Compatibility settings panel (p. 71) Sets parameters for downmix compatibility analysis and thresholds for error checking.



DC Inputs & Temperature settings panel (p. 73) Sets upper and lower limits for error checks on DC inputs and internal temperature.



Alarms settings panel (p. 74) Selects which errors are routed to which alarms.



Alarm Actions settings panel (p. 76) Selects notification actions for each alarm. Includes setup of email server.

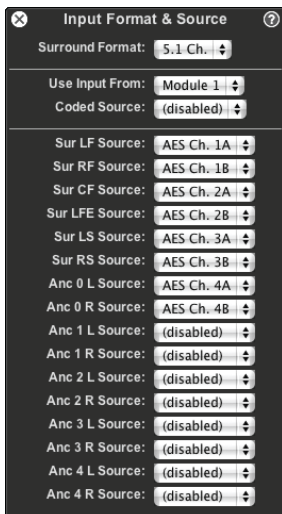


Date & Time settings panel (p. 77) Configures network time service and time zone.



Configuration settings panel (p. 78) Displays hardware and firmware configuration information.

Input & Sources settings panel



The Input & Sources settings panel selects the surround and ancillary program formats, input module configuration and channel mapping.

Surround Format Selects the format for the surround program and the presence or absence of additional channels. The choices are:
5.1 Ch. 5 surround channels with LFE
6.1 Ch. 6 surround channels with LFE
7.1 Ch. 7 surround channels with LFE
stereo 2 stereo channels

Input module configuration

Use Input From Selects the input module to use for measurements. The module in the slot closest to the side of the Sentinel is Module 1, in the middle is Module 2. The menu only allows installed modules to be selected. Following menu items are tailored to match the selected module's type.

Coded Source Selects which input channel pair is used as input to the Dolby decoder. Appears only if the selected input module includes a Dolby decoder.

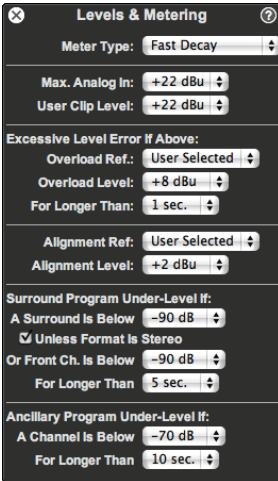
Input channel sources

Channel Source Selects the source of signal for the indicated channel. (*Channel* is one of LF, RF, CF, LFE, LS, RS, LB, RB.) It is possible, though not advised, to assign the same numeric channel to more than one surround channel.

Some combinations of channel sources may not be allowed, due to limitations of the input module in use. If this occurs, disallowed source selections are flagged with a warning icon. For

more information, see Appendix A, *Specifications* (p. 95), which describes specific input module capabilities in detail.

Levels & Metering settings panel



The Levels & Metering panel selects the metering ballistics and signal levels used in metering and error detection.

Meter Setting

Meter Type Selects the ballistics used for the bargraphs and for detection of OVERs in the program. Also sets the displayed meter scale and unit. All commonly used metering standards are provided, along with two proprietary meters.

Fast Decay 0 s attack, 0.1 s decay.

Slow Decay 0 s attack, 1.5 s decay.

The following meter types reference the Alignment Level setting (below).

VU <300 ms attack, 300 ms decay (IEC 60268-17). 0 VU at the Alignment Level.

IEC I (Nordic PPM) 5 ms attack, 1.5 s decay (DIN 45406).

IEC IIa (BBC PPM) 0 to 7 numeric scale, otherwise the same as IEC IIb.

IEC IIb (EBU PPM) 10 ms attack, 2.8 s decay (IEC 268-10).

DIN (German PPM) 1 ms attack, 1.5 s decay.

Levels

Max Analog In Sets the gain of the analog input, thereby setting the maximum input signal level. Using the lowest possible value maximizes the signal to noise ratio.

+28 dBu Recommended for professional equipment.

+22 dBu Recommended for consumer or other equipment without the ability to exceed +22 dBu output.

Clip Level Any level above this value for a channel produces a Clip error and an indication on the channel's bargraph meter. For analog inputs, settings are 1 dBu increments below the Maximum Analog In. For digital inputs, settings are 1 dBFS increments below

0 dBFS. This setting has no effect on a digital input Clip level indication (always 0 dBFS).

Overload Ref. Sets the reference source for the Overload indication.

User Selected Allows you to set the Overload Level. (The two proprietary meter types always use this setting.)

Meter Default Follows the Meter Type setting.

Overload Level Any level above this value for a channel produces a Overload error and an indication on the channel's bargraph meter. Only applies if Overload Ref. (above) is User Supplied. For analog inputs, settings are 1 dBu increments starting 2 dBu below the Maximum Analog In. For digital inputs, settings are 1 dBFS increments below -2 dBFS. This setting provides an indicator that can be calibrated to your system maximum level. For example a modulation index or an A-D converter's digital full-scale value.

For Longer Than Sets the duration an Overload condition must be present before it represents an error. Settings range from 1 to 30 seconds.

Alignment Ref. Sets the reference source for the Alignment level.

User Selected Allows you to set the Alignment Level. (The two proprietary meter types always use this setting.)

Meter Default Follows the Meter Type setting.

Metadata/User (digital only) Determines the level from metadata in the digital input signal if present; if not, uses the Alignment Level you set.

Metadata/Meter (digital only) Determines the level from metadata in the digital input signal if present; if not, follows the Meter Type setting (above).

Alignment Level Channel bargraph meters change color to yellow when they exceed this level. Only applies if Alignment Ref. (above) is User Supplied or Metadata/User. For analog inputs, settings are 2 dBu increments starting 12 dBu below the Maximum Analog In. For digital inputs, settings are 2 dBFS increments below -12 dBFS. A typical setting for an analog Broadcast or Pro audio system is +4 dBu. For Consumer equipment, with the Max Analog In set to +22 dBu, the Alignment Level is typically

at -10 dBV (~-8 dBu). Common digital settings are -20 dBFS (SMPTE RP200(2002)) or -18 dBFS (EBU R68-2000).

Surround Program Under-Level If

A Surround is Below Sets the minimum surround channel true peak level allowed before issuing an under-level error. The choices are -70, -80, -90 and -100 dB.

Unless Format Is Stereo Suppresses comparison of surround channels when stereo format is detected.

Or A Front Channel is Below Sets the minimum front channel true peak level allowed before issuing an under-level error. The choices are -70, -80, -90 and -100 dB.

For Longer Than Sets the duration that the front channel true peak level must be below the specified minimum to generate an under-level error. The choices are 2, 5, 10 or 20 seconds.

Ancillary Program Under-Level If

A Channel is Below Sets the minimum ancillary channel true peak level allowed before issuing an under-level error. The choices are -70, -80, -90 and -100 dB.

For Longer Than Sets the duration the channel true peak level must be below the specified minimum to generate an under-level error. The choices are 2, 5, 10 or 20 seconds.

Loudness Settings panel

Loudness Measurement

Loudness Target: -24 LKFS

Error if Dialnorm ≠ Target

Loudness Standard: BS1770-2

Measurement Mode: Prog/Comm

Secondary Meter: Downmix

Controls: SW only

Measure Program: When High

Restart: When Low

Error if Short Term Loudness Is:

Above +4 LU

For Longer Than 3 sec.

Or if Integrated Loudness Is:

Above +2 LU

Or Below -2 LU

Relative To Target

Error if Surround Loudness Differs From:

Downmix Loudness By +2.0/-1.0 LU

For Longer Than 10 sec.

Error if CF Loudness Does Not Exceed:

Program Loudness By 0 dB

For Longer Than 2 sec.

When Above -35 dB

Error if Left/Right Channel Imbalance:

Exceeds 6 dB

For Longer Than 10 sec.

The Loudness settings panel controls the loudness measurement functions of the Sentinel. It controls the measurement method and the error testing parameters.

Loudness errors are based on comparison of loudness measurements with a reference level. The reference may be a fixed target level or may be the dialnorm value extracted from a Dolby Digital or Dolby E encoded stream. Both the fixed target and the selection of whether to reference it or the dialnorm are set on the Loudness settings panel. If the dialnorm value is not available (as occurs if a PCM signal is received) the fixed target will be used.

Loudness measurement

Loudness Target Sets a target level to which loudness measurements are compared in determining loudness errors. Used when the Relative To setting is Target or when metadata containing dialnorm is unavailable.

Loudness Target is also used as the reference level for loudness displays.

Loudness Standard Sets the weighting filter and measurement method used. The choices are the ITU-R BS.1770-1 standard referenced by the ATSC, and the ITU-R BS.1770-2 standard referenced by EBU.

Measurement Mode Determines how the loudness measurement controls are interpreted. When set to Measure/Pause the Loudness meter control enables or pauses measurement. When set to P/C, New the loudness meter control identifies the audio as program material or commercials.

Secondary Meter Selects the program measured by the ancillary loudness meter, either the downmix program or one of the ancillary programs.

Integrated loudness control

- Controls* Selects the source of loudness meter control and restart inputs. Choices are hardware inputs on the rear panel auxiliary signals connector, and buttons on the Loudness Meter panels (p. 34).
- Measure program* Sets the polarity of the rear panel loudness meter control input.
- Restart* Sets the polarity of the rear panel loudness meter restart input.

Loudness errors

- Error If Short Term Loudness Is* Configures short-term loudness error detection.
- Above* Sets the maximum short-term loudness allowed, relative to the loudness reference level, before issuing an error. The choices are +2, +4, +6 and +8 LU.
 - For Longer Than* Sets the duration that the measured loudness must be above the maximum value for an error to be issued. The choices are 0, 3, 10 or 30 seconds. A zero duration gives an immediate indication if the loudness exceeds the maximum.
- Or If Integrated Loudness Is* Configures integrated loudness error detection. Errors are issued at the completion of an integrated loudness measurement.
- Above* Sets the maximum integrated loudness allowed, relative to the loudness reference level, before issuing a loudness error. The choices are +1, +2, +3 and +4 LU.
 - Or Below* Sets the minimum integrated loudness allowed, relative to the loudness reference level, before issuing a loudness error. The choices are -1, -2, -3 and -4 LU.
- Relative To* Selects either the Loudness Target or the Dolby dialnorm setting as the preferred loudness reference level. Dialnorm is available only for Dolby coded audio source that specifies dialnorm in its metadata. If dialnorm is preferred but not available, the Loudness Target will be used.
- Error If Surround Loudness Differs from Downmix Loudness* Configures downmix loudness error detection.

By Sets the maximum difference between surround and downmix loudness, before issuing an error. The choices are +1.5/-0.5, +2.0/-1.0, +2.5/-1.5, and +3.0/-2.0 LU.

For Longer Than Sets the duration that the difference must exceed the tolerance for an error to be issued. The choices are 3, 10, 30 or 60 seconds.

Error If CF Loudness Does Not Exceed Program Loudness Configures dialog balance error detection.

By Sets the minimum amount CF loudness must exceed the remaining program loudness, before issuing an error. The choices are 0, 3, 6, and 9 LU.

For Longer Than Sets the duration that the difference must remain below the threshold for an error to be issued. The choices are 3, 10, 30 or 60 seconds.

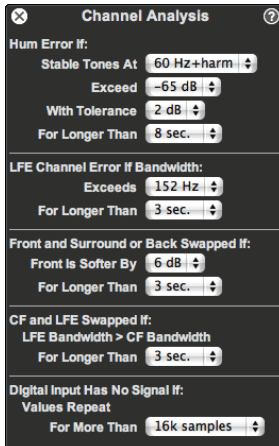
When Above Sets a minimum CF loudness level for error detection (presumably dialog is not present below this threshold). Error detection is suspended when CF is below this level – the duration doesn't increase, but it is not reset. The choices are -35 and -45 LU.

Error If Left/Right Channel Imbalance Configures left-right balance error detection.

Exceeds Sets the minimum difference between loudness levels of a left-right channel pair that must be exceeded, before issuing an error. The choices are 6, 9, 12, and 15 dB.

For Longer Than Sets the duration the difference must exceed the threshold for an error to be issued. The choices are 10 and 30 seconds.

Channel Analysis settings panel



The Channel Analysis settings panel sets the thresholds used for hum detection, channel swap detection and LFE bandwidth checking. It controls all channel related measurements that are not level or loudness related.

Hum Error if

Stable Tones at Sets the frequencies used for hum detection measurements. Measurements are made at the fundamental frequency and two harmonics.

Exceed Sets the level at which a HUM error will be generated. This may be set in 5 dB increments from -50 to -85 dBFS.

With Tolerance Sets the maximum level variation a signal may have before it is considered program and not hum. The choices are ± 2 and ± 4 dB.

For Longer Than Sets the duration that a signal must exceed the specified limits to generate a HUM error. The choices are 4, 8, 15 or 30 seconds.

LFE Channel Error If

Bandwidth Exceeds Sets the LFE bandwidth above which an LFE BW error will be generated. The choices range from 80 to 250 Hz.

For Longer Than Sets the duration that a signal must exceed the specified bandwidth to generate an LFE BW error. The choices are 1, 3, 10 or 30 seconds.

Front and Surround or Back Swapped If

Front is Softer for Longer Than Sets duration that the surround or back channels must exceed the front channels to generate a Front/Surround Swap or Front/Back Swap error. The choices are 1, 3, 10 or 30 seconds.

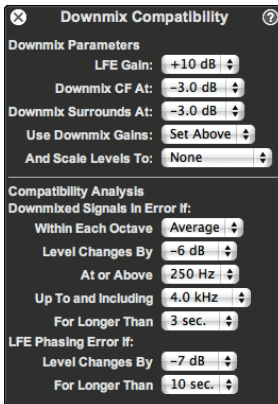
CF and LFE Swapped If

LFE Bandwidth > CF Bandwidth For Longer Than Sets duration that the LFE bandwidth must exceed the CF bandwidth to generate a CF/LFE Swap error. The choices are 1, 3, 10 or 30 seconds.

Digital Input Has No Signal If

Values Repeat For More Than Sets the number of samples in a row that must have the same value to generate an error. The choices are 16k, 32k, 64k or 128k.

Downmix Compatibility settings panel



The Downmix Compatibility settings panel sets the downmix parameters and the thresholds used for compatibility checking. It controls the downmix gains used for deriving the downmix channels. These downmix channels are used for both the meter displays and the compatibility analysis.

Downmix Parameters

LFE Gain Sets the gain applied to the LFE signal when performing downmix compatibility measurements. It does not affect the LFE meters, which always reflect the actual electrical level of the LFE signal, not its final reproduction level. The choices are 0 and +10 dB.

Downmix CF at Sets the gain applied to the center front signal when downmixing to stereo. The choices are +3, +1.5, 0, -1.5, -3, -4.5, -6 dB, and none.

Downmix Surrounds at Sets the gain applied to the surround and back channels when downmixing to stereo. The choices are +3, +1.5, 0, -1.5, -3, -4.5, -6 dB, and none.

Use Downmix Gains Selects between the specified downmix gains and the values specified in the metadata. If the metadata is missing or if the values are not indicated, the software will revert to the values set above.

And Scale Levels To Selects scaling applied to downmix levels. The choices are:

None

Peaks Prevents downmixed levels from exceeding full scale when all input channels are at full scale.

Peaks – 3 dB ATSC A/52b standard recommendation.

Downmixed Signals In Error If

Within Each Octave Controls the way 1/30th octave bins are combined and compared to the level threshold. Peak uses the worst case signal loss for any bin. Average uses the average loss within each octave.

Level Changes By Sets the error threshold for changes in the program when downmixed. If the level in any included octave band is reduced by this amount or more an error will be generated. The value may be set between –4 and –15 dB in 1 dB steps.

At or Above Sets the lowest octave included in the compatibility analysis. Downmix compatibility problems are assessed in this octave and above. The choices are 63, 125, 250 and 500 Hz. Since these are octave centers, 500 Hz will include frequencies beginning at approximately 350 Hz, 250 Hz will include components as low as 175 Hz, etc.

Up To and Including Sets the highest octave included in the compatibility analysis. Downmix compatibility problems are assessed in this octave and below. The choices are 2, 4, 8 and 16 kHz. Since these are octave centers, the 2 kHz selection includes frequencies through approximately 2.8 kHz, the 4 kHz selection will extend to approximately 5.6 kHz, etc.

For Longer Than Sets the duration that a signal must exceed the specified level to generate a downmix error. The choices are 1, 3, 10 or 30 seconds.

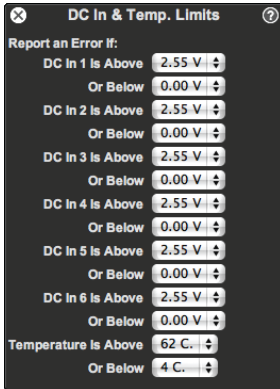
LFE Phasing Error If

Level Changes By Sets the error threshold for changes in the low frequency program content when the LFE is summed with the surround channels, as occurs when reproducing surround in typical size rooms. If the level between 20 Hz and 200 Hz is

reduced by this amount or more an error will be generated. The value may be set between -4 and -15 dB in 1 dB steps.

For Longer Than Sets the duration that LFE phasing problems must exist to generate an error. The choices are 1, 3, 10 or 30 seconds.

DC Inputs & Temperature settings panel



The DC Inputs & Temperature settings panel sets the limit thresholds for the 6 DC inputs and the internal temperature sensor. These have no duration setting – if a threshold is crossed, an error is immediately asserted.

Report An Error if

DC In # Is Above Sets the maximum DC value allowed on that input before issuing an error. The value may be set between 0.30V and 2.55V in 0.15V steps. Set this to 2.55V to disable this comparison.

Or Below Sets the minimum DC value allowed on that input before issuing an error. The value may be set between 0.0V and 2.25V in 0.15V steps. Set this to 0.0V to disable this comparison.

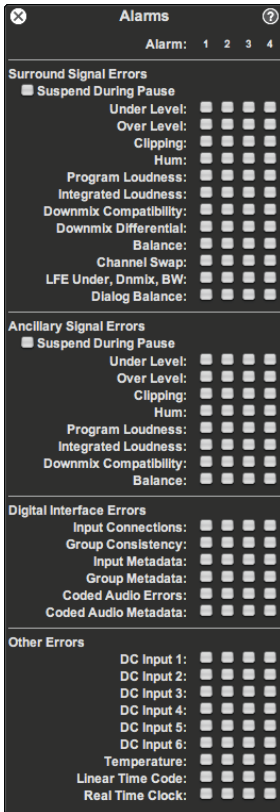
Temperature Is Above Sets the maximum temperature allowed before issuing an error. The value may be set between 32° C and 62° C in 2° steps.

Or Below Sets the minimum temperature allowed before issuing an error. The value may be set between 4° C and 19° C in 1° steps.

See Auxiliary signals connection (p. 12) for details about connecting these inputs.

Error reporting for each auxiliary input is enabled in the Alarms settings panel (p. 74).

Alarms settings panel



Alarms are the result of one or more error conditions. Four alarms are available, numbered 1-4, and each may have any combination of errors assigned to it. When an error occurs, it triggers any alarms to which it is assigned. Triggering an alarm results in actions based on settings in the Alarm Actions settings panel (p. 76).

The Alarms settings panel has a column for each of the four alarms. It has a row for each type of detected error. Within each column, checked boxes indicate the errors assigned to the alarm.

Surround and Ancillary Signal Errors

Suspend During Pause Disable reporting of signal errors when metering is paused.

Under Level Enables reporting of under-level errors.

Over Level Enables reporting of levels exceeding the specified operating level.

Clipping Enables reporting of channel clipping.

Hum Enables reporting mains hum errors.

Program Loudness Enables reporting of short-term loudness exceeding the maximum allowed.

Integrated Loudness Enables reporting of integrated loudness being outside the allowable tolerances.

Downmix Compatibility Enables reporting of stereo and mono downmix compatibility errors.

Downmix Differential Enables reporting of the differential between surround and downmix loudness being outside the allowable tolerances.

Balance Enables reporting of surround channel balance errors.

Channel Swap Enables reporting of interchanged channels. (Surround only.)

LFE Under, Downmix, Bandwidth Enables reporting of LFE under-level, downmix and bandwidth errors. (Surround only.)

Dialog Balance Enables reporting of dialog balance errors. (Surround only.)

Digital Interface Errors

Input Connections Enables reporting of digital input link errors.

Group Consistency Enables reporting of cross channel format inconsistencies.

Input Metadata Enables reporting of individual channel metadata errors.

Group Metadata Enables reporting of cross channel metadata inconsistencies.

Coded Audio Errors Enables reporting of packet coding errors.

Coded Audio Metadata Enables reporting of errors in the coded audio metadata

Other Errors

DC Input n Enables reporting of DC Input n being out of bounds.

Temperature Enables reporting of temperature errors.

Linear Time Code Enables reporting of linear time code errors.

Real Time Clock Enables reporting of errors in synchronizing the real-time clock with the Network Time Protocol (NTP) server.

If the Sentinel detects a synchronization error that indicates the NTP server is potentially providing an incorrect time value, it disables NTP synchronization to avoid corrupting logged measurement data with invalid times. If this occurs, you must reboot the Sentinel to clear the real-time clock error and re-establish NTP synchronization. To avoid losing log data, synchronize your log repository before rebooting.

Alarm Actions settings panel

Alarm Action

1: Beep Manually Assert
 Email To: [text field]
 SNMP Trap To: [text field]
Community Name: public

2: Beep Manually Assert
 Email To: [text field]
 SNMP Trap To: [text field]
Community Name: public

3: Beep Manually Assert
 Email To: [text field]
 SNMP Trap To: [text field]
Community Name: public

4: Beep Manually Assert
 Email To: [text field]
 SNMP Trap To: [text field]
Community Name: public

Email Delivery Settings

Server: smtp.lan1.com
User ID: test@qualisaudio.com
Password: [masked]
From: test@qualisaudio.com
Port: 25
Delay First Email for: 1 sec.
Mask Repeat Email For: 10 min.
Test Enabled Email Actions: send

SNMP Settings

Read Community Name: [text field]
Mask SNMP Trap For: 10 sec.

Sentinel Identification

Name: Sentinel #1

When an alarm occurs the Sentinel will assert an open-collector output on the rear panel auxiliary signals connector and will display a visual warning on its front panel. It may also be programmed to sound an audible alarm or send an email or SNMP notification. Alarm Action settings panel has a row for each of the four alarms, specifying the actions taken when that alarm occurs.

Alarm Actions

Beep Check the box for an audible indication at the Sentinel chassis location.

Manually Assert Forces the auxiliary alarm outputs to a low state (useful for testing connections). This overrides the alarm controls.

Email To Check the box to enable email notifications of this alarm. Enter addresses to receive emails about this alarm. Separate multiple addresses with commas (,) or semicolons (;). Limited to 124 characters.

SNMP Trap To Check the box to enable SNMP notifications of this alarm. Enter the IP address to receive the notifications and the Community Name to be sent with the notification. Leaving the Community Name blank will cause the default *public* name to be sent.

Email Delivery Settings

Server DNS name of the email server hosting the Sentinel's email account. Limited to 34 characters.

User ID User ID (usually the email address) of the Sentinel's email account on the server. Limited to 30 characters.

Password Password of the Sentinel's email account on the server. Limited to 16 characters.

From Sender email address to use for notification messages. Limited to 30 characters.

Port Server port number for sending email, 0 to 65535.

Delay First Email For The Sentinel will wait this long before sending email notification of any error. This allows faults which might cause multiple errors to be combined into a single notification email.

Mask Repeat Email For Disables repeat emails about the same error for the specified duration. This prevents a steady stream of emails from a single fault.

Test Enabled Email Actions Pressing this button will send a test email to all email addresses. To prevent this for some addresses, uncheck the corresponding Enable box. This button is disabled while modifying settings.

SNMP Settings

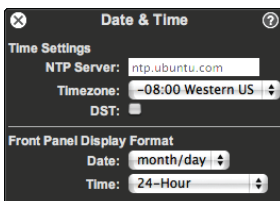
Read Community Name Sets the Community Name that must be specified in SNMP GET operations interrogating the Sentinel MIB. Leaving this field empty will match any community name that is received.

Mask SNMP Trap For Sets the minimum interval between SNMP notifications. Allowed settings range between 1 and 60 seconds.

Sentinel Identification

Device name The device name is used in alarm email messages to identify the Sentinel from which the alarm originated. Limited to 16 characters.

Date & Time settings panel



The Date & Time settings panel configures the network time service and time zone settings.

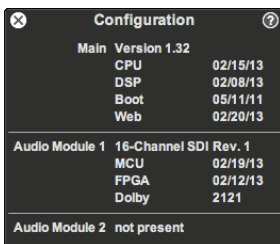
The Sentinel has an internal real-time clock, used to accurately record the timing of measurements. To provide an unambiguous reference, times are recorded in Coordinated Universal Time (UTC), and the Sentinel can synchronize the clock to a Network Time Protocol server. UTC times are converted to local time for display using configured timezone settings.

Server DNS name of the NTP server that will supply time information to the Sentinel. An IPv4 address is also allowed. An empty name disables NTP clock synchronization. Limited to 34 characters.

Timezone Local timezone for the Sentinel.

DST Checked if Daylight Savings Time is in effect for the local time zone. The Sentinel does not automatically switch to or from daylight savings.

Configuration settings panel



Configuration	
Main Version 1.32	
CPU	02/15/13
DSP	02/08/13
Boot	05/11/11
Web	02/20/13
Audio Module 1 16-Channel SDI Rev. 1	
MCU	02/19/13
FPGA	02/12/13
Dolby	2121
Audio Module 2 not present	

The Configuration settings panel displays configuration information for the Sentinel hardware and lists the revisions of the firmware components installed in field-upgradeable ROMs on the device.

Revision dates are in mm/dd/yy format (month, day, year), the same as on the front panel firmware revision display.

The panel displays warning icons and messages when inconsistencies are detected in the hardware or firmware configuration. Firmware components are flagged if they do not match the expected revision for the overall software version. Input modules are flagged if they have incompatibilities with the installed software version.

Main Overall software version number; CPU, DSP, Boot and Web firmware revisions.

Audio Module 1, 2 Installed audio input module types; MCU and FPGA firmware revisions for digital modules.

6 Log Repository

Log repository setup in the user interface 81

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Scheduled downloading of log data 83

The Sentinel logs internally slightly more than 24 hours of readings data. The data includes all audio characteristics sampled by the Sentinel and all measurements. To save space, logged data is saved at approximately 1.4 second intervals (a 4-to-1 merging of the original readings data).

To access and preserve this data, you need to download it from the Sentinel to a storage repository. Once data is in the repository, you can review and display it in the same way as live readings through the Readings Timeline panel (p. 40). The downloaded data is available indefinitely, limited only by storage limits and your archive policies.

You can download the logged data through the Sentinel's web interface for longer term storage. You can also perform this downloading as a separate command, independent of the web interface.

Downloading of log data takes from 1 to 5 minutes per hour of logged data, so downloading the full amount of data that can be stored on the Sentinel can take from 25 minutes to two hours. Windows systems and remote connections have the slower data rates.

Repository organization

The repository is organized as a sequence of daily log files, stored in a single directory. The directory can be located on any file system to which you have access – local, or on a shared server.

Each daily log files starts at 00:00:00 UTC (midnight, UTC time), and is associated with a particular Sentinel. This information is coded in the name of the file:

`XXXXXX-yyyyymmdd0000.qa3`

Where `XXXXXX` is the Sentinel serial number, `yyyy` is year, `mm` is month (01-12), and `dd` is day of month (01-31).

There are two additional files that provide a record of log repository activity:

`XXXXXX-repository.log`
`XXXXXX-exceptions.log`

The first contains a record of updates to the log repository. (It includes scheduled updates and other updates from the command line, but does not include updates performed through the user interface.) The second contains a record of unexpected exceptions in the log handling, and is a source of diagnostic information if failures occur.

For example, the log file for Sentinel 20C148 for September 21, 2012, and the associated activity logs would be:

```
20C148-201209210000.qa3  
20C148-repository.log  
20C148-exceptions.log
```

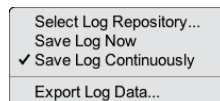
Repository access

Log data downloading and log repository access are managed by a Java applet loaded from the Sentinel. For this to work correctly, you should have Java SE Runtime Environment 6 or later installed on your system, and you need to have Java applets enabled in your browser.

Log repository setup in the user interface

To allow access to logged data, you need to configure the Sentinel web interface with the location of the log repository. Normally, you will also configure the web interface to download data from the Sentinel to the log repository, so that all logged data is available for display.

Configuration



Configuration options for defining the log repository and scheduling downloads are located in the pulldown menu on the Time & Status panel (p. 33).

The Select Repository option presents a file browser that lets you select the location of the log repository.

Save Log Continuously enables automatic downloading of log data from the Sentinel to the repository while the user interface is active. The Save Log Now performs an immediate download of all new log data to the repository.

Set Save Log Continuously to ensure all logged data is available for display.

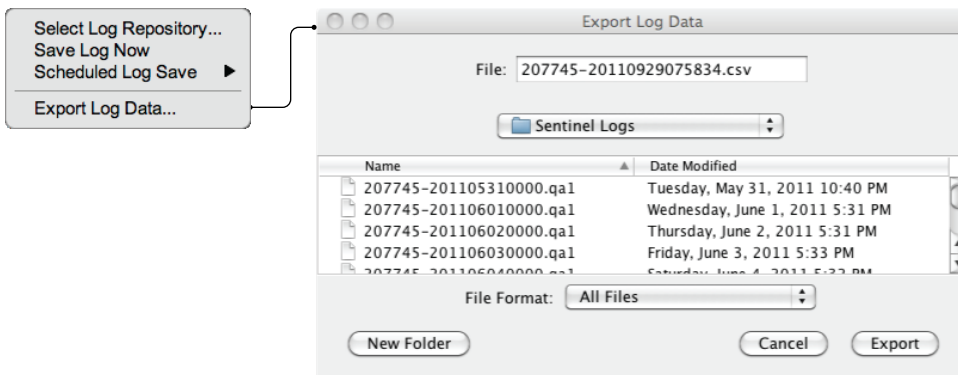
The downloading of log data by the web interface operates only while the web interface remains active. For alternative strategies that provide reliable archiving of continuous log data in a production environment, see the repository maintenance notes below.

Repository status

There is a status icon that provides an active indication of log repository problems. This small folder-shaped icon is located on the left of the main meter panel Time & Status panel (p. 33).

Exporting repository data

You can export data from the log repository in CSV format. The export operation saves data for all defined segments. See defined segments (p. 47) for information on using the readings timeline to define these segments.



The log export operation is located in the pulldown menu on the readings navigation panel (at the left of the readings page). It presents a file

browser menu that lets you select the name and location for the CSV export file. If there are no defined segments, the export menu item is disabled.

The default name provided by the browser menu identifies the starting time of the exported data and the Sentinel which performed the measurement:

XXXXXX-yyyymmddhrmns.csc

Where *XXXXXX* is the Sentinel serial number, *yyyy* is year, *mm* is month (01-12), *dd* is day of month (01-31), *hr* is hour (00-23), *mn* is minute (00-59), and *sc* is second (00-59). For example, an export file for Sentinel 20C148 for June 21, 2010, 3:30, would be:

20C148-20100621033000.csv

Purging and archiving repository data

Each daily log file in the repository holds about 19.5 MB of data; a month of data is about 600 MB. The strategy for purging or archiving these files is your choice – the Sentinel software doesn't delete log files, and it provides access to whatever files are in the repository. If you want to retain an extended record of repository data, but are sensitive to storage requirements, the daily log files will compress to a fraction of their original size if placed in a ZIP or similar archive.

Scheduled downloading of log data

In a production environment, you will want to schedule downloading of data to the log repository, rather than relying on the browser to update the repository.

The download service can be invoked independently, without the browser being active. This allows you to perform the download in scripts, or include it in scheduled batch operations. It provides reliable archiving of continuous log data in a production environment.

This separate download operation uses the same Java applet as is used to provide access in the Sentinel web interface. However, in this case, it is invoked using Java Web Start (JavaWS). JavaWS is a stan-

standard part of the Java Runtime Environment, and it handles the transfer of the application to your computer for execution (and caches it for future use).

Invoking the download operation

When you configure a new log repository, the Sentinel software creates a script file that performs the repository download operation. The script name has the form *XXXXXX-download*, where *XXXXXX* is the Sentinel serial number. The file type varies depending on system type – *.bat* on Windows systems, *.sh* on UNIX systems.

The script itself is also tailored to the system type. On a Windows system, it looks like this:

```
javaws -wait -Xnosplash http://address/logrepository.jnlp \  
-open "directory-path\serial-number"
```

Where *address* is the IP address or DNS name of the Sentinel, *directory-path* is the full path to the log repository directory, and *serial-number* is the serial number of the Sentinel. (The serial number is displayed on the Sentinel front panel as the last 6 digits of the MAC address, and, in the Sentinel web interface, on the status line of the main meter panel.)

The UNIX command is similar, with adjustments to the format of the directory path. Normally, you can use the download script as-is. However, if you change the IP address of the Sentinel or prefer to use a DNS name, or if you move the log repository, you will need to edit the download script. (Or you can delete it, and let the Sentinel software create a new script with the modified settings.)

Download schedules

The Sentinel stores slightly more than 24 hours of log data internally, so a daily download will preserve all logged data. However, a shorter interval provides additional protection against data loss and interruptions. Hourly downloads are a recommended schedule.

Scheduled download on Windows XP systems

To perform scheduled downloads on a Windows XP system, you create a scheduled task that runs the .bat file described above.

The Scheduled Tasks control panel provides a wizard to create a scheduled task. However, a daily schedule is the shortest interval allowed by the wizard. To set a shorter interval, you need to edit the task once you've created it.

To edit the task, display the created task (it should be listed in the Schedule Tasks control panel). Select the Schedule tab and set the task Schedule to Daily, and the Start time to 12:00 AM.

Then click the Advanced... button, select Repeat task, and set the repeat interval and duration.

Scheduled download on Windows 7 systems

To perform scheduled downloads on a Windows 7 system, you create a scheduled task that runs the .bat file described above.

To create the scheduled task, select the Create Task... option from the Actions subpanel of the Task Scheduler control panel. (The Task Scheduler is one of the Administration control panels.) You set the download times by creating a Trigger from the Triggers tab. Set the Trigger to begin the task on a daily schedule. In the advanced settings section, set the task to repeat every hour for the full duration of the day. If you set the option to stop the task if it runs longer than 55 minutes, it will keep a slow or stalled download from overlapping with the next scheduled download.

Scheduled download on UNIX systems

On UNIX systems, you can perform scheduled downloads using cron. In general terms, you create a crontab file that specifies the task and schedule, and then install the task using the crontab utility. The following notes provide additional detail.

There is considerable variability among UNIX systems, so you'll need to consult local documentation in addition to these notes.

In the crontab file, tasks are specified by lines that have a sequence of tab-separated fields:

minute (0-59)
hour (0-23)
day of month (1-31)
month (1-12, or names)
day of week (0-7, or names)
command name

An asterisk (*), indicating *any*, may be specified for any of the time fields.

For example:

```
30 0-23 * * * ~/Sentinel\ Logs/xxxxxx-download.sh
```

You install the crontab task using:

```
crontab crontab-file
```

7 Connections and cabling

AES digital audio connections 88

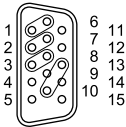
Auxiliary connections 89

Breakout adapter 90

The Sentinel's audio and auxiliary signals connectors are designed to work with standard cables for typical configurations. The following specifications and guidance are provided for those cases where custom cabling is necessary.

AES digital audio connections

AES connections appear on an HD15 connector.



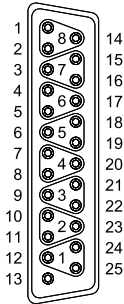
- | | | |
|----------------------|------------------------|-----------------------|
| 1. Channels 1-2 high | 6. Channels 1-2 low | 11. Ground |
| 2. Channels 3-4 high | 7. Channels 3-4 low | 12. Ground |
| 3. Channels 5-6 high | 8. Channels 5-6 low | 13. Channels 7-8 high |
| 4. Ground | 9. Balanced/Unbalanced | 14. Unused |
| 5. Ground | 10. Channels 7-8 low | 15. Ground |

The AES input and input/output connectors on the AES audio module, and the AES input/output connector on the SDI audio module share a common pin configuration and electrical characteristics.

The AES audio connections by default operate with unbalanced inputs. The inputs are terminated in $75\ \Omega$ and accept up to $1V_{pp}$. Pin 9 on the connector must be shorted to ground to invoke balanced operation. This changes the input impedance to $120\ \Omega$ and pads the amplitude to accommodate $5V_{pp}$ signals. Both modes are transformer isolated, allowing operation without concern for ground loop issues.

Auxiliary connections

Auxiliary connections appear on a DB25 connector.



- | | |
|--------------------------|---------------------------|
| 1. Sur. loudness control | 14. Sur. loudness restart |
| 2. Ground | 15. Reserved |
| 3. Reserved | 16. Ground |
| 4. Alarm output 3 | 17. Alarm output 4 |
| 5. Ground | 18. Alarm output 1 |
| 6. Alarm output 2 | 19. Ground |
| 7. DC input 5 | 20. DC input 6 |
| 8. Ground | 21. DC input 3 |
| 9. DC input 4 | 22. Ground |
| 10. DC input 1 | 23. DC input 2 |
| 11. Ground | 24. Linear Time Code high |
| 12. Linear Time Code low | 25. Ground |
| 13. +3.3V, 50mA limited | |

Qualis Audio supplies a Breakout Adapter (p. 90) which converts the 25 pin connector to 24 screw terminals. This provides a convenient way of connecting auxiliary signals.

The LTC input is a differential input that may be wired for either balanced or unbalanced operation. The input impedance is 22 k Ω , each side to ground, allowing bridging operation in most applications.

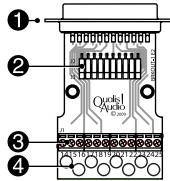
The alarm outputs are rated to switch up to +24V at a maximum current of 50 mA each, 200mA total.

A current limited +3.3V supply is provided on pin 13 of the connector. This may be used to power pull-up resistors for the DC inputs (useful for sensing contact closures) or for the open-collector outputs (useful when interfacing to logic level inputs).

The loudness meter control inputs have internal pull-up resistors and do not need an external pull-up to function.

Breakout adapter

1. DB25 connector.
2. Pull-up resistor networks.
3. Screw terminals, pins
14-25 (1-12 on back).
4. Strain-relief holes.



The Qualis Audio screw terminal breakout adapter avoids the soldering normally involved with making DB25 connections. It routes all pins to screw terminals and provides a pair of pull-up resistor networks.

It is the most convenient way to make connections to the auxiliary signals connector. It also provides a convenient way of adapting the analog audio connector to plenum cable or other fixed installation applications.

The socketed resistor networks may be used to pull any or all of the pins to +3.3V. If some pull-ups are desired and others are not, the leads of the unwanted ones may be clipped and the network reinserted into the socket. The adapter shell includes a place to note the presence or absence of a resistor network.

8 Firmware updates

As with any product with heavy software content, the Sentinel on occasion requires updates. This may be to add or enhance features, or to correct problems. The Sentinel is designed to allow firmware updates over the network from a web browser. The process is as follows.

Obtain the updates

The latest updates can be obtained from the Qualis Audio web site (www.qualisaudio.com). The site also provides an archive of older firmware revisions.

Updates are packaged as zip archives, containing documentation and the firmware images required to update the Sentinel.

Unzip the archive, verify its contents

Use the unzip command or whatever command you normally use for unpacking zip archives.

There are seven separate field-upgradeable ROMs in the Sentinel:

SentinelDSP base

SentinelCPU base

SentinelWeb base

SentinelDINMCU digital input module (8-channel AES or AES/SDI only)

SentinelFPGA digital input module (8-channel AES or AES/SDI only)

SentinelSDI2MCU digital input module (16-channel SDI only)

SentinelSDI2FPGA digital input module (16-channel SDI only)

Images are identified by date. Make sure you have firmware images for all the ROMs you're planning to update.

You can check your Sentinel's installed firmware versions on the Configuration settings panel (p. 78) or on your Sentinel's front panel Firmware revision display (p. 19).

Dates in the firmware image filenames are in yyyyymmdd format (year, month, day); this differs from the setup and front panel firmware display format, which is mm/dd/yy (month, day, year).

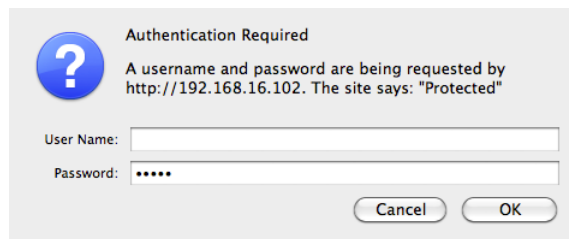
Load the Firmware Update page in your browser

Navigate to the Firmware Update page:

`http://address/fwupdate`

Replace the *address* with actual address of the Sentinel you're updating.

The Sentinel will display a pop-up menu that prompts you for a User Name and Password:



The image shows a dialog box titled "Authentication Required". It features a blue question mark icon on the left. The text inside the dialog box reads: "A username and password are being requested by http://192.168.16.102. The site says: 'Protected'". Below the text, there are two input fields: "User Name:" followed by a text box, and "Password:" followed by a text box with four dots. At the bottom right of the dialog box, there are two buttons: "Cancel" and "OK".

Leave the User Name blank; the default password is *audio*.

Once you are authenticated, the Sentinel will display the Firmware Update page.

Select the firmware image to update

Sentinel Firmware Update



The image shows a form titled "Sentinel Firmware Update". It consists of a text input field followed by two buttons: "Browse..." and "Update".

Use the Browse... button to select the firmware image file, then press the Update button to upload the file to the Sentinel.

The Sentinel will display a message indicating the Firmware Update is in progress. Wait for the Sentinel to update the ROM and restart.

When the update completes, the Sentinel will restart and the Sentinel Firmware Update page will again appear.

If you are updating multiple firmware images, select and update the next image. Normally, you will repeat the update process for each image file provided in the zip archive.

If the update fails due to a corrupted firmware image, the Sentinel will display a Firmware Update File Invalid message. If you see this message, you'll need to get a new copy of the image file.

Restart your browser and clear its cache

If you've updated the SentinelWeb firmware, you'll need to quit and restart your browser, and clear the browser's cache when you restart it. Otherwise, the browser will use stale copies of the Sentinel web pages from its cache – the resulting errors can be quite confusing.

For Firefox, go to the Tools menu, select Clear Recent History, and make sure the Time range to clear is set to Everything and Cache is checked.

Other browsers have similar options. For Chrome, use the Clear Browsing Data... in the Tools menu. For Internet Explorer, use the Delete Browsing History... in the Tools menu. For Safari, use Empty Cache... in the Safari menu.

A Specifications

Analysis

Surround Format	5.1, 6.1, 7.1, stereo
Ancillary Format	stereo, monaural
Metering Standards	VU, Nordic PPM, BBC PPM, EBU PPM, DIN PPM, proprietary 85 dB range meters, 12 updates/second
Peak Amplitude	True peak responding with 4x interpolation, 340 ms update rate
Dialog Balance	CF loudness relative to total loudness of other channels, gating based on presence of signal in CF channel, 680 ms update rate
Downmix Compatibility	Computes energy lost during downmixing to both stereo and mono formats. Analysis performed in 1/30th octave resolution, displays L, R, M results in octave bands, 680 ms update rate
Channel Balance	Channel loudness relative to the loudest channel, 340 ms update rate
LFE Analysis	Measures LFE BW, LFE downmix loss
Channel Interchange	Detects front/surround reversal by level comparison, detects CF/LFE interchange by bandwidth comparison
Spectral Analysis	Measures program energy in octave bands, 680 ms update rate
Interchannel Phase	Measures average correlation of ancillary channel pairs, 680 ms update rate

Loudness analysis

Measurements	Momentary, Short-Term, Integrated Loudness, Loudness Range
Standards	ATSC A/85; ITU-R BS.1770-1, BS.1770-2/3; EBU R-128, tech 3341, tech 3342
Classification	Signal may be classified as program or commercial, allowing one meter to continuously monitor a broadcast stream
Segment Duration	3.2 seconds minimum
Channel Allocation	Up to 16 channels, depending on input module configuration, allocated between surround and ancillary meters
Control	2 hardware signals shared by both loudness meters (surround and ancillary)

Channel analysis

Channel Loss	Compares individual channel loudness to user specified threshold and duration
Excessive Level	Compares individual channel levels to user specified threshold and duration
Hum Detection	Detects stable 50/100/150 Hz or 60/120/180 Hz tones and harmonics

Digital analysis

Interface	Measures sample rate Detects loss of lock, parity errors Detects cross-interface inconsistency
Data	Detects digital zero and digital clipping Measures bit activity, active word length Detects cross channel inconsistency
Metadata	Analyzes status bit metadata Detects metadata inconsistency

Other analysis

DC Inputs	Compare to independent min & max values
Temperature	Compare to min & max temperature

Auxiliary signals

Connection	25 pin female D-sub
LTC Input	Balanced, AC coupled, 22 k Ω , each side to ground, 5Vpp max
Auxiliary Inputs	6, 0 to 2.55VDC, unbalanced, 340 ms sampling interval
Control Inputs	4, 2 per Loudness meter, 0.6V low, 2.7V high, 5V max input, 40 ms minimum width, 20 ms debounce after last transition
Alarm Outputs	4, open-collector, 24V/100mA max

Miscellaneous

Network	10BASE-T Ethernet, RJ45 with status LEDs
Chassis	1.75" H (1U) x 17" W x 7" D (8.9 cm x 54.2 cm x 17.8 cm)
Power	24V at 0.5 A max from external adaptor
Power adaptor	100V/120V/240V, 50/60 Hz, 15W

S-16 SDI 16-channel digital input module

Input Format	SD/HD/3G-SDI
SDI Channels	De-embeds 8 channel pairs from 4 audio groups
SDI Word Width	16 to 24 bit
SDI Sample Rate	32 kHz to 96 kHz, de-embedded SDI channel pairs must be synchronous to each other
Connector A	SDI input on 75 Ω BNC
Connector B	Re-clocked SDI output on 75 Ω BNC
Dolby option	Option 552 Dolby Decode module, if present, can decode from any SDI channel pair

D-8 AES 8-channel digital input module

Input Format	AES-3 120 Ω Balanced or 75 Ω Unbalanced
Word Width	16 to 24 bit
Sample Rate	32 kHz to 192 kHz, each stream asynchronous to all others

Connector	4 AES-3 inputs (8 ch.) on one 15 pin high density female D-sub
Cable	Unbalanced inputs use a VGA to BNC cable, Balanced inputs use a
Compatibility	custom DB15HD to 4 XLR cable (available as an option)
Dolby option	Option 552 Dolby Decode module, if present, can decode from any of the first 3 AES inputs

SD-8 SDI/AES 8-channel digital input module

Input Selection	Up to 4 channel pairs from combination of AES and SDI inputs
SDI Input Format	SD/HD/3G-SDI
SDI Channels	De-embeds 4 channel pairs from 2 audio groups
SDI Word Width	16 to 24 bit
SDI Sample Rate	32 kHz to 96 kHz, de-embedded SDI channel pairs must be synchronous to each other, may be asynchronous to AES inputs

Connector A	SDI input on 75 Ω BNC
Connector B	Re-clocked SDI output on 75 Ω BNC
AES Input Format	AES-3 120 Ω Balanced or 75 Ω Unbalanced
AES Word Width	16 to 24 bit
AES Sample Rate	32 kHz to 192 kHz, each stream asynchronous to all others
Connector C	4 AES-3 inputs (8 ch.) on one 15 pin high density female D-sub
Cable	Unbalanced AES inputs use a VGA to BNC cable, Balanced inputs
Compatibility	use a custom DB15HD to 4 XLR cable (available as an option)
Dolby option	Option 552 Dolby Decode module, if present, can decode from any of the first 3 AES inputs or from any of the 4 de-embedded SDI channel pairs

Option 552 Dolby Decode module

Input Selection	One coded stream from a selected AES-3 or SDI input channel pair
Input Format	Dolby Digital or Dolby E
Mixed Inputs	PCM audio on remaining channel pairs may be used in combination with decoded audio subject to channel count limitation of input module

B Warranty

Qualis Audio warrants the Sentinel audio monitor to be free from defects in materials and workmanship for a period of three (3) years from the date of shipment.

During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty within the United States, contact Qualis Audio directly. Outside the United States, contact the distributor from whom you purchased the product. You will be given prompt assistance and return instructions. Send the product, transportation prepaid, to the indicated service facility. Repairs will be made and the product returned, transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days.

Limitation of Warranty

This warranty does not apply to defects resulting from misuse or product modification.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE. THE REMEDIES PROVIDED HEREIN ARE BUYER'S SOLE AND EXCLUSIVE REMEDIES.

C Safety information

Use this product only as described in this manual. Any other use or application may damage the instrument, void the warranty or pose a safety risk to personnel.

This product is intended for indoor use in a non-condensing environment.

This product is not grounded through its power supply. Grounding of the metal enclosure is obtained through the audio connections (shield or ground pins) or through the auxiliary signals connector. Do not depend upon or attempt to use the enclosure as a safety ground.

This product is not intended to be serviced by the user. Do not attempt service unless you are a qualified technician operating under the direction of the factory. If qualified and you are authorized to service the unit, please keep the following in mind at all times:

This product is designed to operate from an external low voltage power supply. Although this means there are no mains-voltage hazards in normal operation, it is possible for the signal connections to present a safety hazard if they are connected to voltage sources which present a safety hazard. Consequently: **All signal input and output connections should be removed before opening the cover.**

Do not make any modifications to this product.

Do not replace any components with brands, types, models or part numbers other than those originally used when manufactured. Doing so may create a safety hazard and will void the warranty.

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