

Automated Control of Loudness Measurements

Summary

The Qualis Audio Sentinel performs loudness measurements conformant to ITU BS.1770. One aspect of this standard is the requirement that measurements start and stop coincident with the beginning and end of the program or commercial being measured. It also requires that measurements of a program be suspended when the breaks occur in the program. The Sentinel provides this capability. It also includes a mode which will continue measuring during program breaks but which treats the input as a commercial and treats the data as a new measurement. Both of these modes may be controlled manually through the browser interface, via logic level hardware input signals, or via software control over the network interface. This note describes the control methods available for automated applications.

Real Time Monitoring and Logging

The audio portion of a typical television broadcast consists of sequential programs which are separated and/or interrupted by commercial advertisements. The standards specify, and commercial equipment implements, the ability to start, stop, pause and reset loudness measurements. This allows the user to begin measurement of a selected program, pause it during measurements of commercial breaks, resume measurement when the program resumes, stop the measurement when the program concludes and reset the meter to allow another measurement. This control can be effected manually or through hardware connections to the measurement equipment. This suits measurement of file based content but has limitations when applied to real-time measurement.

Real-time monitoring and logging requires independent assessment of program material and of the commercials which separate or interrupt it. Performing independent assessment of both the program and the commercials requires multiple measurement meters or convoluted and error prone manipulation of the data provided by a single meter.

The problem posed by a typical broadcast audio stream is illustrated in Figure 1. The signal consists of multiple programs broadcast sequentially, identified in the figure as P1, P2, etc. These programs are interrupted by commercials, identified in the figure as C1, C2, etc.

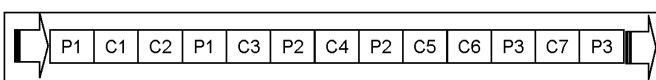


Figure 1 A typical broadcast audio stream

The interruptions may consist of a single commercial or several sequential commercials as illustrated in the figure. When one program concludes it is typically followed by one or more commercials, identified in the figure in the same manner as the commercials cited earlier. When the inter-program commercial break concludes the next program is transmitted. It is interrupted and followed by commercials in the same manner as the preceding program.

For a loudness meter to measure and log this stream it is generally told when to begin a measurement by a start signal provided either manually or automatically by the user. When a commercial break occurs the meter is paused using a second control signal provided by the user. At the program conclusion the measurement is stopped and the measurement value is obtained. With previously available loudness meters, if the intervening commercials are to be measured and logged, an additional meter is required with its own set of start and stop controls and a means of merging the log data with the other meter.

The audio stream may be viewed as consisting of a program stream and a commercial stream. One or the other is always being broadcast. There are some relationships between these two streams that allow simplification of the measurements. These are:

1. The programs are always sequential.
2. Programs may be interrupted by commercials.
3. The commercials are always sequential.
4. Commercials are not interrupted.
5. Commercials may occur between programs.

Since commercials are not interrupted, it is not necessary to pause measurement of the commercials. If a pause occurs during a program it must be for a commercial. If the meter understands this we no longer need a pause control, just a control to select "program" or "commercial". Since there is always content being broadcast the start/stop control can be replaced with a "measurement reset" or "new" control.

Qualis Audio Implementation

Figure 2 illustrates how this is implemented. The measurement is controlled by two signals; a stream select and a measure/reset. Control can be achieved using soft buttons on the instruments GUI, logic level inputs or software commands received over the instruments Ethernet port.

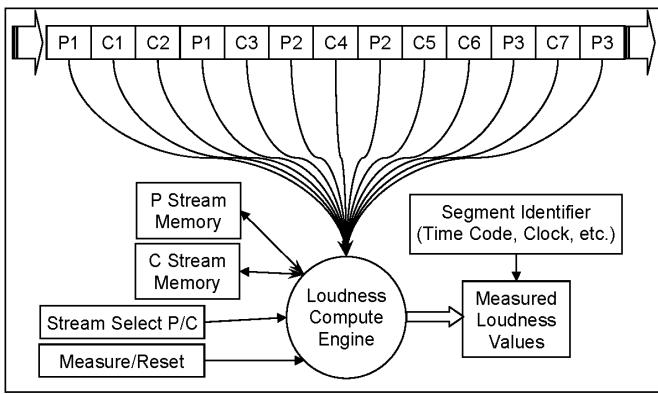


Figure 2 The Qualis Audio dual loudness measurement architecture

The stream select signal depicted in figure 2 causes the loudness measurement engine to measure the program stream (Pn) when in one state, for example when high, and the commercial stream (Cn) when in the other state, in this example when low. The engine always measures one stream or the other. However, there is additional functionality built into the way the measurement engine uses this control signal. When the signal transitions from the P state to the C state the program stream measurement is paused. The program stream measurement memory is not cleared or affected in any way. When the signal transitions from the C state to the P state the current loudness measurement is saved and logged as a final result and written to the results memory. The commercial stream memory is then cleared to prepare for another measurement and the loudness measurement engine now continues measurement of the ongoing program stream.

The measure/reset input causes the loudness measurement engine to save and log the current measurement value as a final result and clear the stream memory to begin a new measurement. This is done regardless of which stream is being measured. If the engine is measuring the program stream when reset is asserted the current reading is written to the result memory and the program stream memory is cleared. If it is measuring the commercial stream when reset is asserted the current reading is written to the result memory and the commercial stream memory is cleared.

Instrument Details

The Sentinel measures up to 8 audio channels. If the surround signal being measured has less than 8 channels, the unused channels may be treated as a second audio stream. This is controlled by the “format” setting, with the 5.1+2 and 6.1+1 selections implementing the second stream. To accommodate this, the Sentinel implements two loudness meters, one for the surround stream and one for the remaining channels. The surround loudness meter is called “meter 0” while the second meter is called “meter 1”.

The Sentinel's loudness meters are each controlled by two signals. In “P/C” mode one is called P/C, for Program or Commercial measurement context. The other is called Reset, which is asserted to terminate one integrated loudness measurement interval, and to begin a new measurement interval.

When making a transition from a Program to a Commercial measurement context, the integrated Program measurement is paused and a new Commercial measurement is started. When making a transition from a Commercial to a Program measurement context, the Commercial measurement is terminated, and the Program measurement is resumed.

In a situation where you want separate integrated measurements for back-to-back commercials, you will need to provide a 'Reset' signal to the Sentinel at each point in time where a Commercial-to-Commercial break is occurring. An explicit Reset signal is not required at the end of the last commercial before the Program measurement is resumed. The transition from a Commercial back to a Program context will perform an implicit Reset for the Commercial measurement.

To start a new Program measurement segment, assert the Reset signal while the P/C context signal is in the Program state. Alternatively, you can assert the Reset signal while the P/C context signal is in the Commercial state, and hold Reset asserted while the P/C signal is transitioned back to the Program state.

In “Measure/Pause” mode the P/C signal becomes Measure/Pause. As its name implies, this signal temporarily stops loudness measurement. In this mode only one measurement may be performed at a time for each meter. This mode is less flexible than P/C mode and offers no advantages. It is provided solely to allow complete conformance with ITU BS.1770 specifications should that be required.

Control

There are 2 ways to control the Sentinel loudness measurement from an automated play-out system.

1. Control using Hardware GPI (General Purpose Input) pins

Set GPI control by setting “Controls” (green outline in Figure 3) on the Loudness Measurement panel to “GPI only”.

The Sentinel has a 25 pin D-sub connector on the rear panel, labeled 'Auxiliary Signals'. If no signals are connected to these control pins, weak internal pull-up resistors will ensure that the control lines are in a high state. Do not depend on the internal

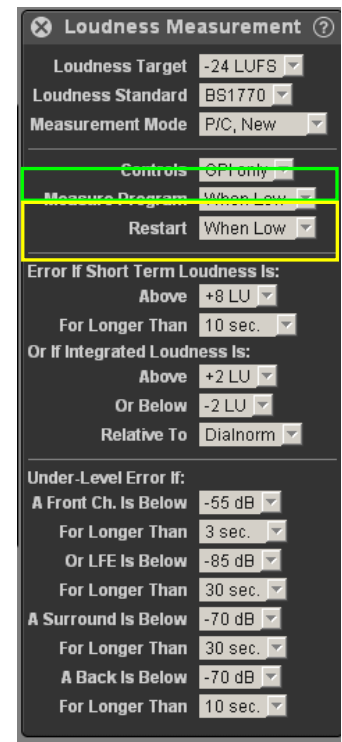


Figure 3 Loudness Settings

resistors as the sole source of pull-up when driving the lines through any significant length of cable. The DB25 to screw terminal adaptor supplied with the Sentinel includes internal pull-up resistors which should be adequate for most applications.

The loudness meter GPI inputs occupy the pins described in the following table:

Loudness control pins on Auxiliary Signals connector			
Pin	Meter	Function	
		P/C mode	Meas/Pause mode
1	0	Program/commercial	Measure/Pause
2	0	Ground	Ground
14	0	Reset	Reset
3	1	Program/commercial	Measure/Pause
16	1	Ground	Ground
15	1	Reset	Reset

The polarity of these signals can be changed in the Loudness Measurement settings panel (highlighted in yellow in Figure 3). The factory default settings are:

Default control signal polarity		
Bit	Value	Function
P/C	H	'Program' is being measured
	L	'Commercial' is being measured
Meas/Pause	H	Meter is measuring
	L	Meter is paused
Reset	H	Reset is not asserted
	L	Reset is asserted

2. Control using HTTP POST messages over Ethernet.

Set the Sentinel for software control by setting "Controls" (outlined with green in Figure 3) on the Loudness Measurement panel to "SW only".

The Sentinel can receive the P/C and Reset signals in an HTTP POST message, as long as that HTTP message also contains the basic authentication header with the base 64 encoded password for that Sentinel unit. The POST message uses an ASCII string that specifies a numeric argument. The format of the POST message is as follows:

POST <HTTP headers> ctrl.txt?meter0=X&meter1=Y

The 'meter0' and 'meter1' refer to the 2 different loudness meters in the Sentinel. You are not required to send a control value for both meters - you can send a control value for only one meter by omitting the other meter's value.

The control value (the 'X' or 'Y' in the example string) is a numeric value that ranges from 0 to 15 decimal. Although this value must be expressed as a single decimal number, you create it as a 4-bit binary integer, with the following bit definitions:

POST message bit definitions. P/C mode		
Bit	Value	Function
3	1	Request reset of Commercial measurement
	0	No reset requested
2	1	Request reset of Program measurement
	0	No reset requested
1, 0	0	No change in measurement context
	1	Change to Measure Program
	2	Change to Measure Commercial
	3	invalid value

For example, to reset the Program measurement, and change the context to measure a Commercial with meter 0, use the following POST message string:

meter0=6

To reset the Commercial measurement, without changing the P/C measurement context, use the following POST message string:

meter0=8

When operating in Measure/Pause mode the bit definitions change slightly. They are:

POST message bit definitions. P/C mode		
Bit	Value	Function
3		Ignored
2	1	Request reset of Program measurement
	0	No reset requested
1, 0	0	No change in measurement context
	1	Change to Measure Program
	2	Change to Pause
	3	invalid value

For example, to reset the Program measurement, and change the context to measure a Commercial with meter 0, use the following POST message string:

Timing Considerations

There are timing specifications which must be observed when controlling the loudness measurement. The hardware control lines have a minimum pulse width and recognition of changes in state will be delayed by a debounce time. All control modes, hardware and software, impose a minimum duration on measured segments.

Timing Specifications	
HW control line debounce time	20 ms
HW control line Minimum pulse width	40 ms
Minimum duration of a measured segment	3.2 s

These are met with wide margins in most applications and will rarely be of concern.

Also of interest

The Sentinel User Manual and Quick Start Guide are available for download from the Qualis Audio web site.

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