Integrating Polycom® SoundStructure with Clockaudio® CS 2S-RF and CS 3S-RF microphones with built-in Electronic Touch Switch

This application note describes how to integrate the Clockaudio CS 2S-RF and CS 3S-RF multi-element boundary microphones with Polycom's SoundStructure products to support push-to-talk microphone applications.

Definition of csThe CS 2S-RF and CS 3S-RF are accessories from Clockaudio that have a touch sensitive surface and green and red LEDs that can be used to indicate state information. The CS 2S-RF and CS 3S-RF's touch-sensitive interface allows users to easily mute microphones and the green and red indicators make it easy to see the mute status. By integrating the CS 2S-RF and CS 3S-RF with a SoundStructure system for muting applications, the CS 2S-RF and CS 3S-RF are able to also control the mute of a Polycom HDX video system.

The SoundStructure configuration file described in this application note will use the SoundStructure device's general purpose input and output (GPIO) pins and SoundStructure events. This application note will design a project with one CS 2S-RF and one CS 3S-RF microphone, a Polycom HDX video codec, and a stereo audio amplifier. The GPIO will be designed so that touching either microphone will toggle the mute state of all microphones. The CS 2S-RF and CS 3S-RF will light red when the microphones are muted and green when unmuted. This behavior may be easily customized if the requirements for the installation are different. SoundStructure Studio 1.3 or higher must be used to create the configuration file and SoundStructure device firmware 1.3 or higher is required to implement this configuration.

Figure 1. A Clockaudio CS 3S-RF (Clock Audio).

The project in this application note will be designed following these steps:

- The baseline project with one CS 2S-RF and two CS 3S-RF microphones will be used.

- The specific logic input and output pins required to support the red and green LED will be added

- The wiring of the GPIO inputs and outputs will be reviewed and adjusted if necessary

- The SoundStructure events required to support the green and red LED behavior will be added

- The configuration file will be saved, uploaded, and the behavior of the system will be verified

- This resulting SoundStructure configuration file is available on the Polycom website.

SoundStructure Logic Connections

Each SoundStructure device has two rear-panel DB25 connectors and each connector supports 11 GPIO/logic inputs, 11 logic outputs, a signal ground, and a +5V supply. Each SoundStructure therefore supports a total of 22 logic inputs and 22 logic outputs. SoundStructure logic inputs have a default value of 1 (high) when the contact closure is open, and have a value of 0 (low) when the contact closure is closed and tied to ground. SoundStructure logic outputs are open collector circuits that when set to 1 connect the logic pin to ground (allowing current to flow) and otherwise act as open circuits (no current flows).

Within SoundStructure Studio, logic input and output pins are defined as virtual channels. This means that there is a virtual channel name associated with each logic pin and that virtual channel name is used when programming the behavior of the logic pin and querying the status of logic pins associated with the underlying physical input or output connection (Polycom).

Within the SoundStructure Studio software environment, the wiring page shows all the logic input and output pins as shown in Figure 2. In this figure, logic input pins 1 through 22 are shown expanded and the logic output pins are shown collapsed under the Digital GPIO Out area.
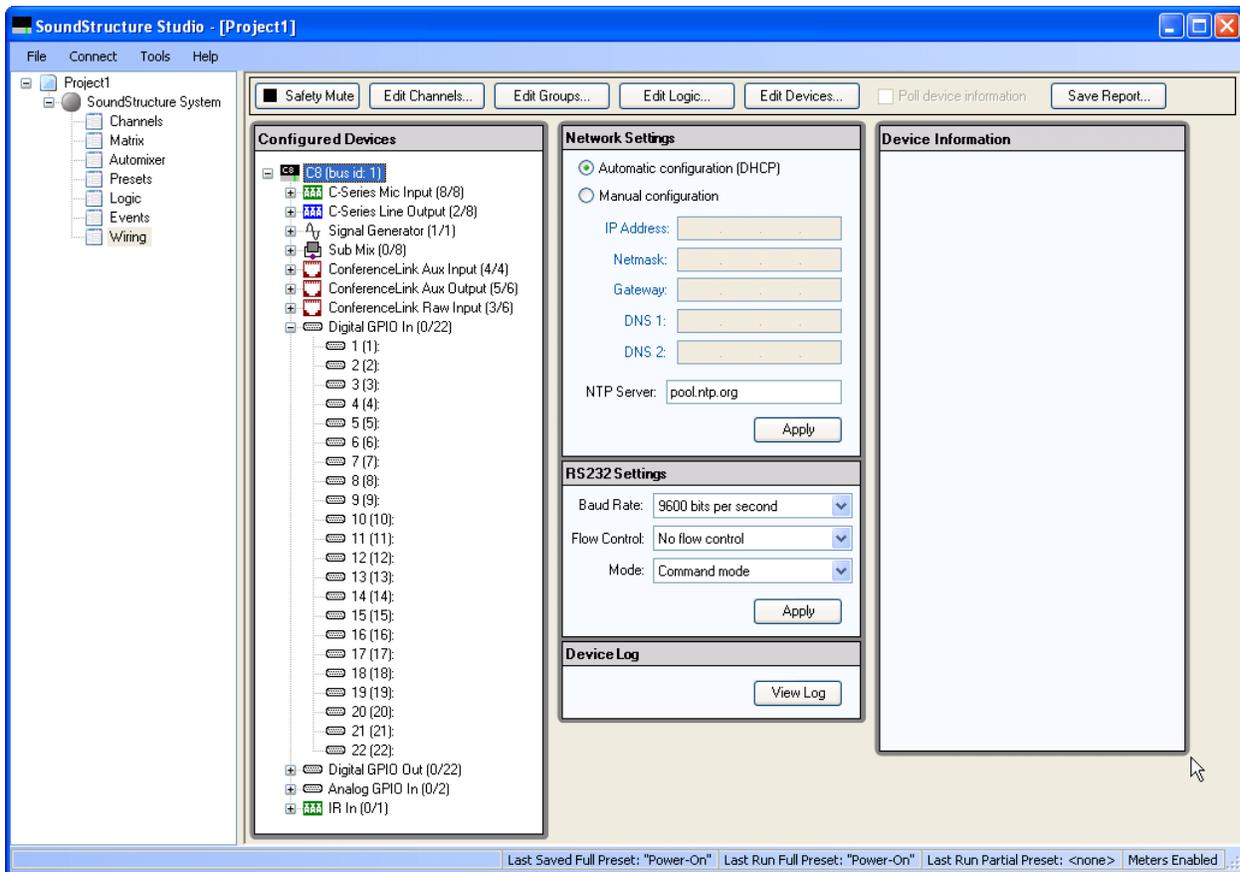
Figure 2. Example wiring page showing the 22 logic inputs for a particular SoundStructure device.

The 22 logic input and output pins are associated with the physical logic pin connections on the connectors as shown in Figure 3. Each DB25 connector has 11 digital logic inputs and 11 digital logic outputs. In Figure 3, logic input 1 (pin 14 of the top DB25 connector) corresponds to the first logic input pin on the wiring page, logic input 2 (pin 15 on the top DB25 connector) corresponds to the second logic input pin on the wiring page, etc.
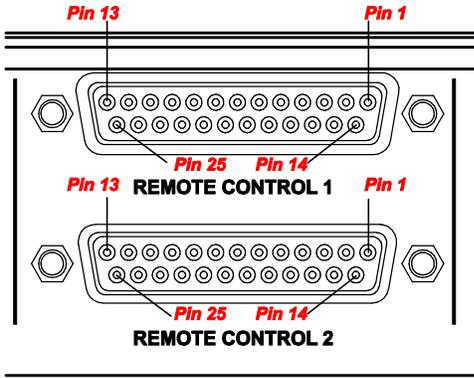
SoundStructure Logic			
Pin	Signal	Pin	Signal
REMOTE CONTROL 1			
1	+5V	14	Logic input 1
2	Logic output 1	15	Logic input 2
3	Logic output 2	16	Logic input 3
4	Logic output 3	17	Logic input 4
5	Logic output 4	18	Logic input 5
6	Logic output 5	19	Logic input 6
7	Logic output 6	20	Logic input 7
8	Logic output 7	21	Logic input 8
9	Logic output 8	22	Logic input 9
10	Logic output 9	23	Logic input 10
11	Logic output 10	24	Logic input 11
12	Logic output 11	25	Ground
13	Analog gain input 1		
REMOTE CONTROL 2			
1	+5V	14	Logic input 12
2	Logic output 12	15	Logic input 13
3	Logic output 13	16	Logic input 14
4	Logic output 14	17	Logic input 15
5	Logic output 15	18	Logic input 16
6	Logic output 16	19	Logic input 17
7	Logic output 17	20	Logic input 18
8	Logic output 18	21	Logic input 19
9	Logic output 19	22	Logic input 20
10	Logic output 20	23	Logic input 21
11	Logic output 21	24	Logic input 22
12	Logic output 22	25	Ground
13	Analog gain input 2		

Figure 3. Pin out of the two rear panel DB25 connectors on each SoundStructure device.

CS 2S-RF and CS 3S-RFConnections to SoundStructure

Each CS microphone requires five wires for supporting the logic input and logic output applications and utilizes two logic output pins and one logic input pin. The definitions of the different conductors are summarized in Table 1.

Table 1.   Physical connections to the CS 2S-RF and CS 3S-RF.

Conductor Colors	CS Microphone Connection	SoundStructure Connection
Brown	+12V	None
Blue	Ground	Pin 25 (logic ground)
Red	Red LED logic connection	A logic output pin
Green	Green LED logic connection	A logic output pin
Yellow	Touch sensitive logic switch output	A logic input pin

Connect each CS 2S-RF and CS 3S-RF to the SoundStructure device as shown in Figure 4 utilizing two logic output pins and one logic input pin per CS microphone.

An external regulated 12V power supply is required and should be sized appropriately to supply 40mA at 12V for each CS microphone (Clock Audio). A power supply that provides 400mA of current at 12V will support 10 CS microphones.

While each SoundStructure device will support a maximum of 11 CS 2S-RF or CS 3S-RF microphone logic connections since each CS microphone requires 2 logic outputs and 1 logic input to operate the green and red LED rings independently, the audio processing capacity of each SoundStructure device will support up to 16 analog microphones on a SoundStructure C16 where each CS 2S-RF counts as two microphones and CS 3S-RF counts as 3 microphones.

Note: You may use the +12V power connection on the IR interface port on the SoundStructure rear panel to power only one CS 2S-RF and CS 3S-RF microphone for testing and prototyping. If your design requires more than one CS microphone, you must use an external power supply.

For proper operation the negative lead of the power supply must be connected to the ground pin (physical pin 25) of either DB25 connector on the SoundStructure device as shown in Figure 4.
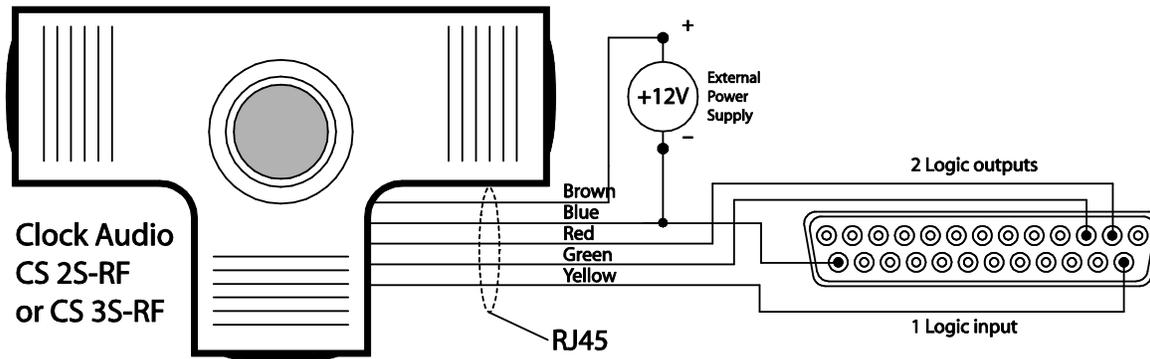
Figure 4.   Wiring example of a CS 3S-RF to a SoundStructure device connected to logic output 1 (physical pin 2) and logic output 2 (physical pin 3) and logic input 1 (physical pin 14). Each CS microphone requires 2 logic outputs and one logic input pin from the SoundStructure device.

SoundStructure Studio Configuration

As described earlier, the SoundStructure configuration file for this application note assumes that regardless of the number of CS 2S-RF and CS 3S-RF microphones, the desired behavior is to have any of the CS 2S-RF and CS 3S-RF microphones mute all the microphones in the system. When the microphones are muted, the red LEDs on the CS 2S-RF and CS 3S-RF microphones will be illuminated and when the microphones are unmuted the green LEDs will be illuminated. Other operationing modes, such as having microphones individually mute and unmute, may be supported by modifying the underlying SoundStructure events. See (Polycom) for additional training streams on how to create SoundStructure configuration files that support push to talk microphones.

Defining SoundStructure Logic Input and Output Pins

The easiest way to add support for CS 2S-RF and CS 3S-RF microphones is to create a new SoundStructure configuration file and then customize the logic outputs and events to support both the green and red LED behavior.

To create this project, select New Project from the SoundStructure Studio File menu. SoundStructure Studio version 1.3 or higher is required.

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As highlighted in Figure 5, follow these steps:

1. Select Microphone
2. Select Table,
3. Enter 8 microphones (remember each CS 3S-RF counts as 3 microphones and each CS 2S-RF counts as two microphones)
4. Leave the Logic Input and Output Mode at the default setting
5. Click Add.

The result of clicking Add is shown in Figure 6.
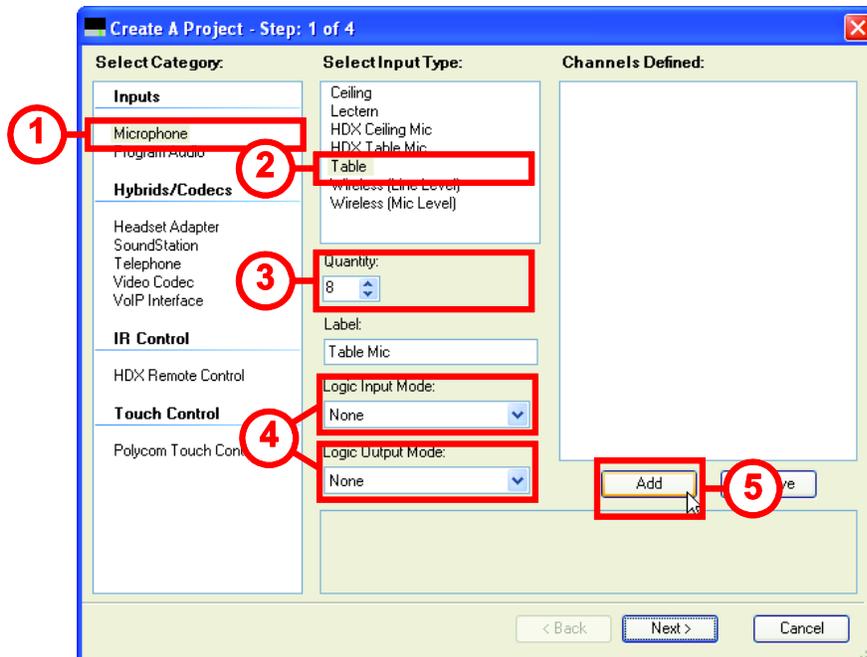
Figure 5. Options required in Step 1 of creating a project to support Clockaudio CS 2S-RF and CS 3S-RF.

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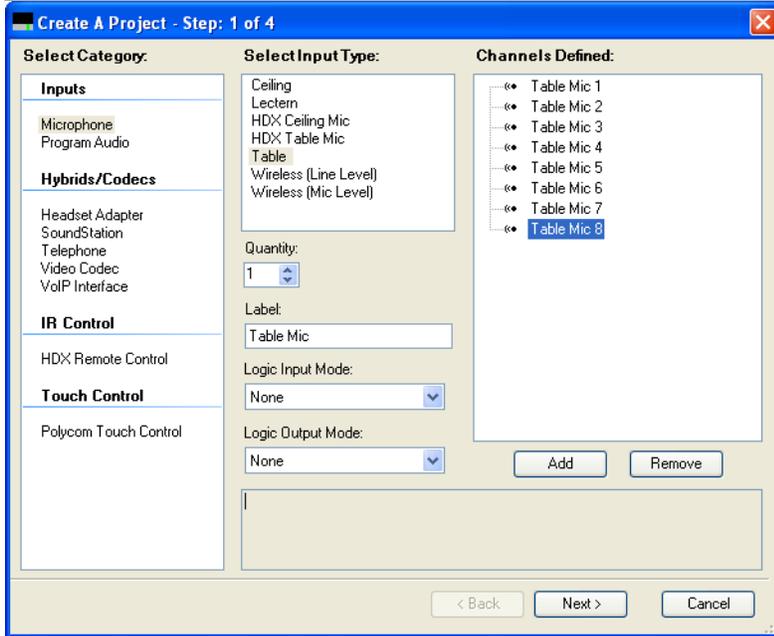
Figure 6. The result of adding the 8 table top microphones in Figure 5.

Complete the project with the other audio inputs (in this case an HDX video codec) and the desired output sources (in this case, a stereo audio amplifier) and click **Finish** to complete the project. In this example, an HDX video codec and a stereo audio amplifier are added to the system. Examples of how to create SoundStructure configuration files may be found in (Polycom) and (Polycom).

Once the project has been created, navigate to the logic page to create the logic inputs and outputs required. Click the Edit Logic button from the Logic page add select three digital logic inputs as follows:

1. From the Logic Inputs field Select Digital Logic Input
2. From the Select Type field select Digital Logic Input
3. Adjust the quantity to 3 (remember we have three CS 2S-RF and CS 3S-RF microphones in the system)
4. Select Add

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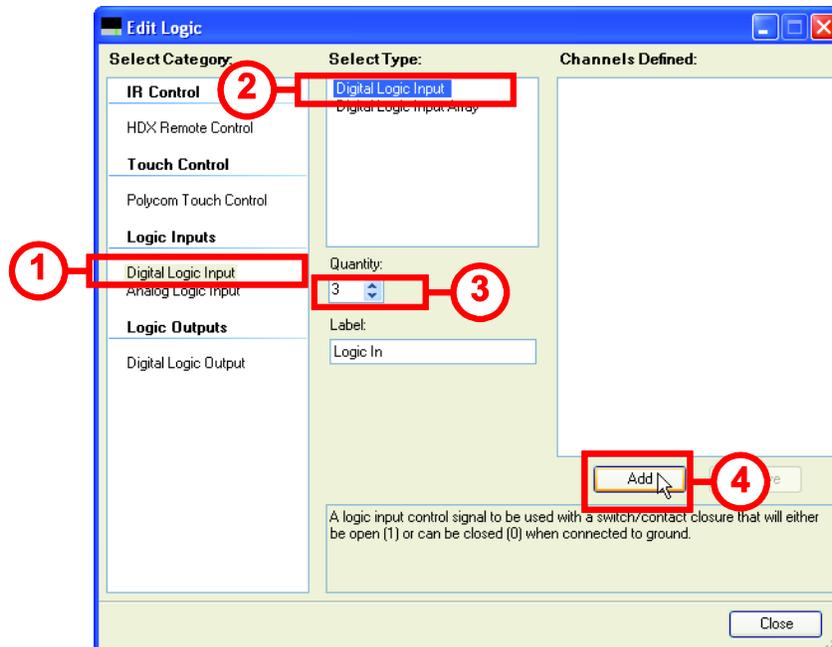
Figure 7. Adding the digital logic input pins, one for each CS microphone.

clock_audio_adding_mics_cs3srf-03.eps

Now that the logic inputs have been defined, we'll add the logic outputs to drive the Green LEDs and then we'll add the logic outputs to drive the Red LEDs.

1. From the Logic Outputs field Select Digital Logic Output
2. From the Select Type field select Digital Logic Output
3. Adjust the quantity to 3 (remember we have three CS 2S-RF and CS 3S-RF microphones in the system)
4. Change the name to Green LED
5. Select Add

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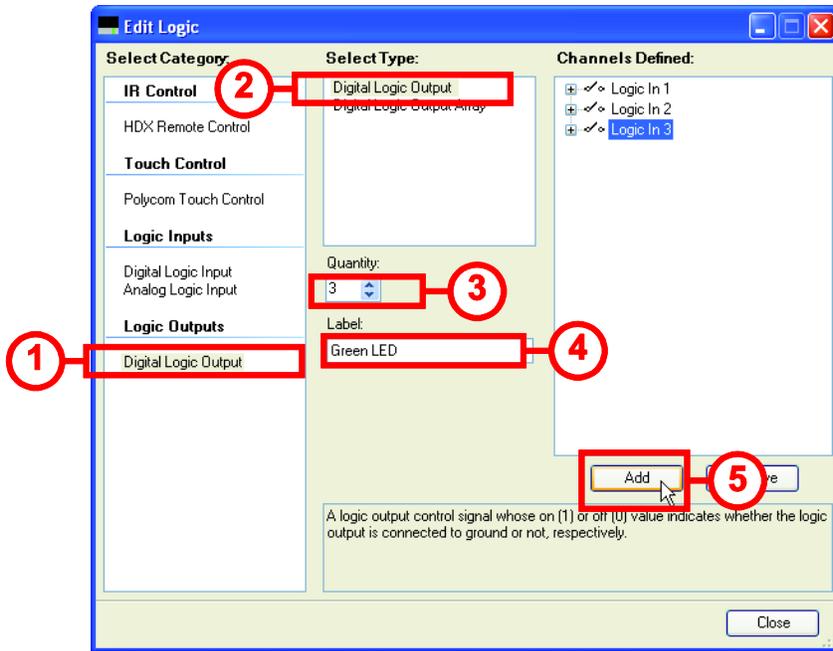
Figure 8. Adding the Digital Logic Output pins to drive the Green LEDs

Follow these steps again with the name Red LED instead of Green LED in step 4 to create the Red LED logic output pins.
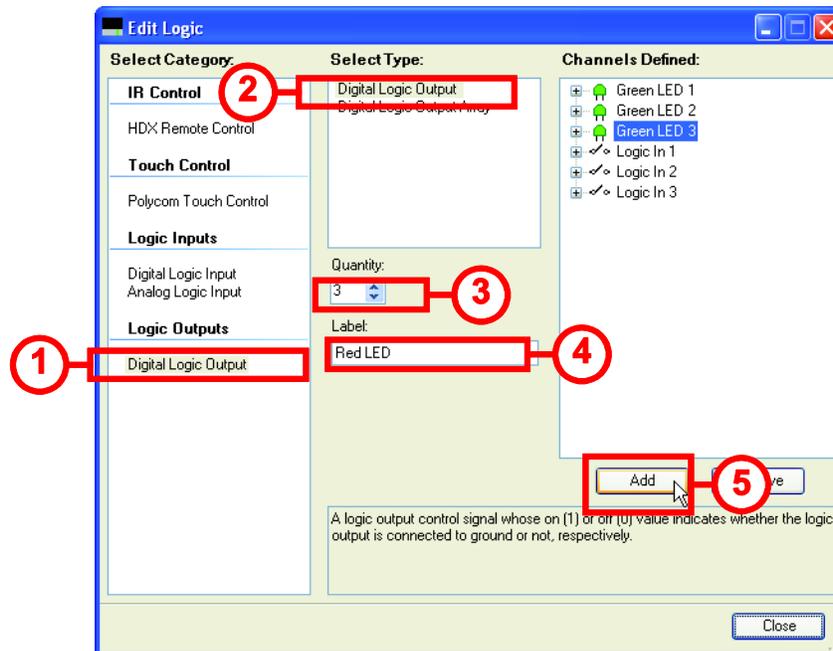
Figure 9. Adding the Digital Logic Output pins to drive the Red LEDs.

The resulting system will appear as shown in Figure 10.
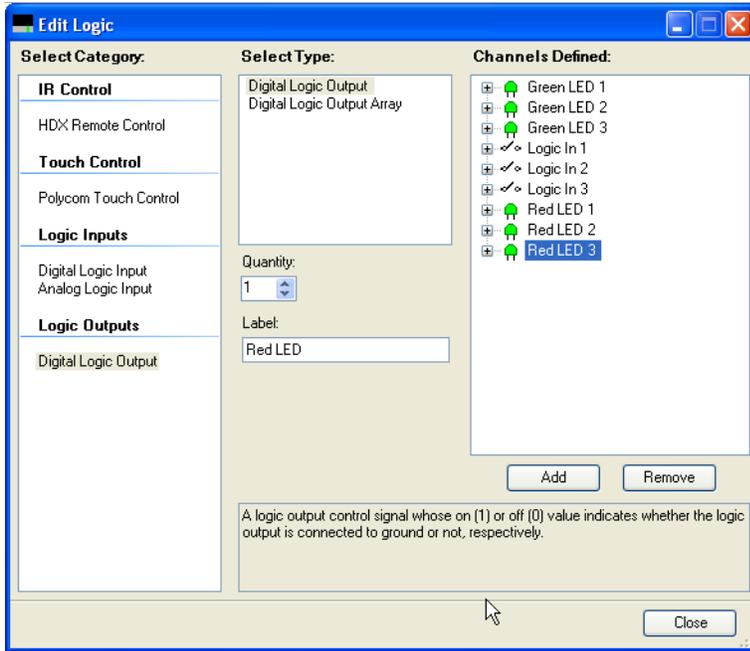
Figure 10. The resulting logic inputs and outputs.

Once the logic input and output pins have been defined, confirm the wiring of the logic inputs and outputs on SoundStructure Studio's wiring page and, if necessary, click and drag the logic pins to the appropriate logic input and output locations that match the desired physical wiring of the DB25 connector. The current wiring for the logic pins of this project is shown in Figure 11. See Figure 3 for how the logic input and output pin numbering on the wiring page map to the physical DB25 connections on the SoundStructure rear panel.
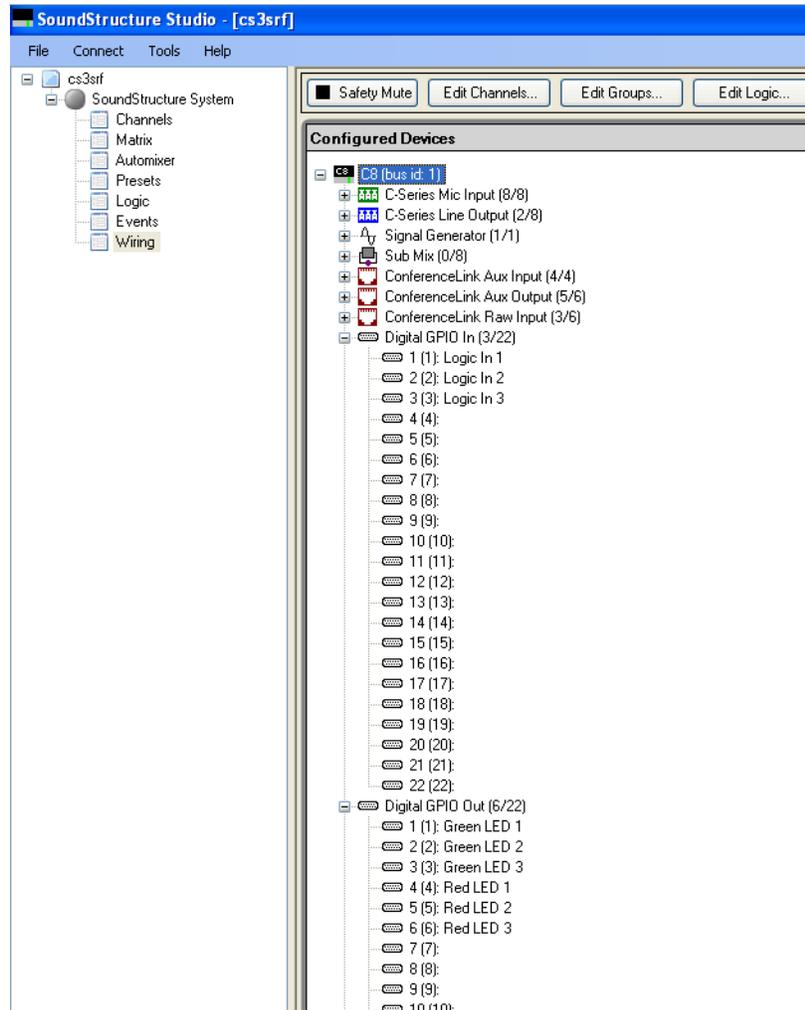
Figure 11. Wiring page showing the logic input and output connections.

Defining Logic Input Events

For each of the three logic **inputs** defined earlier, create an event where any time the logic input is closed (connected to the logic ground), the state of the clink_mute parameter on SoundStructure device 1 is toggled.
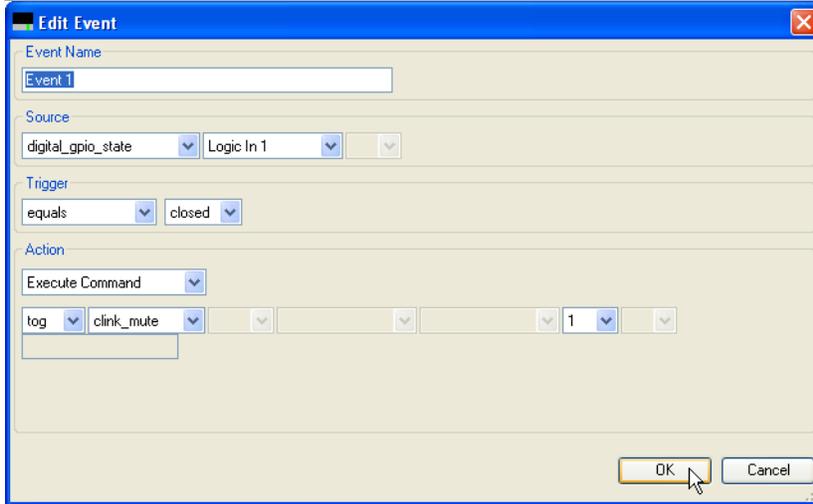
Figure 12. Adding and event for the first logic input pin.

Once all three events are created, the events page will appear as follows.
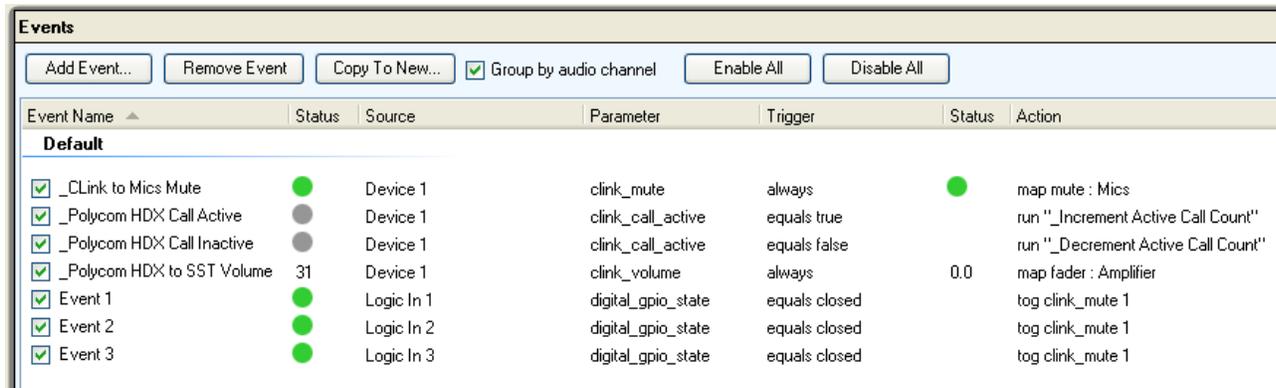
Figure 13. The resulting events page after the three logic input pins have been defined.

By default the event _Clink to Mics Mute will map the state of clink_mute to the mute state of the group "Mics". This means that any time clink_mute is set to 1, the group "Mics" will be muted. Similarly when clink_mute is set to 0, the group "Mics" will be unmuted.

Next, create the three events to drive the Green logic outputs on when the microphones are unmuted. For this, we'll use the clink_mute state and we'll map the state of the clink_mute to the Green Logic Outputs using the invert function.   With these new events, any time clink_mute is set to 0, the logic output for the Green LED's will be set to 1 which will turn on the Green logic outputs. When clink_mute is set to 1, the logic outputs for the Green LED's will be set to 0 which will turn off the Green logic outputs.

The first event will look like the figure below.

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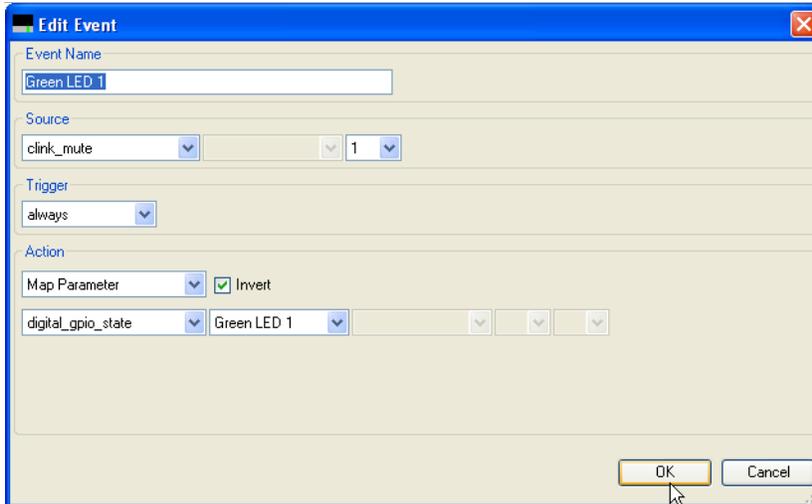
Figure 14. Event that defines how the first Green LED operates.

Use the Copy to New event to copy this event to create the remaining two events – changing the event name and the resulting Green LED 1 name in the Action to the respective logic output pins Green LED 2 and Green LED 3.

For the Red LED's we'll create three similar events, only this time we won't use the invert option. The Red logic outputs will be set to 1 when clink_mute is set to 1 and will be set to 0 when clink_mute is set to 0.

The event for the first Red LED will appear as shown in the following figure.
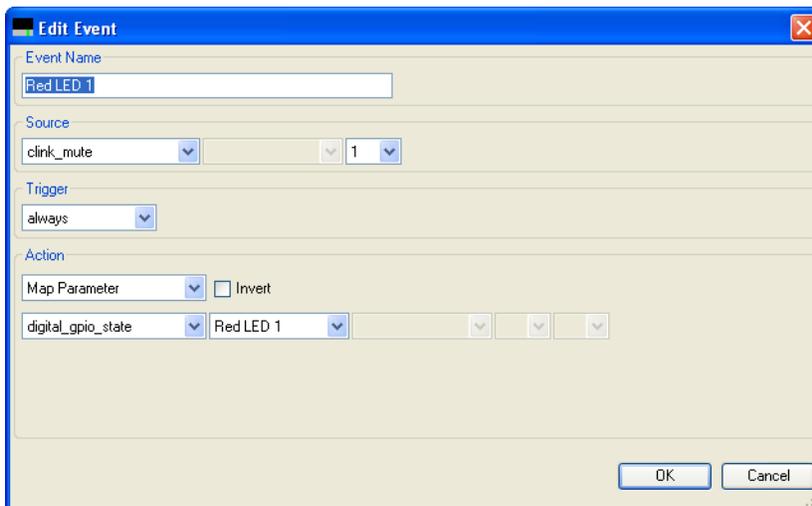
Figure 15. Event used to create the first Red LED output.

Use the Copy to New button to create two additional events mapped to Red LED 2 and Red LED 3, respectively. The final resulting events are shown in the following figure.

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Figure 16. The SoundStructure Studio events page shows all the events that were generated for this project.

Verifying the Operation of the System

To confirm the operation of the system, ensure the logic pins are physically wired as specified on the wiring page, and then upload the resulting configuration file to the SoundStructure system.

Once the system has been wired and the configuration file uploaded, the system may be tested by touching the CS 2S-RF and CS 3S-RF microphones. Assuming the system was unmuted initially (clink_mute set to 0), touching one of the CS microphones will cause the logic input event associated with that microphone to toggle the state of the parameter clink_mute, setting the clink_mute parameter to 1. The Clink to Mics Mute event will then mute all the microphones in the Mics group. As each microphone has been muted, the red LEDs on each microphone will be turned on and the green LEDs will be turned off.

The way the events are defined in this example, independently muting or unmuting the microphone within SoundStructure Studio, or through a control system, will also change the status of all the CS microphones. For example, sending the mute command:

set mute "Table Mic 1" 1

will result in the same behavior as touching the CS microphone – the mute state of the entire system will be set and turn on the red LEDs. Touching any CS microphone again will then cause the microphones to become unmuted which in turn will turn off the red LEDs and turn on the green LEDs.

Summary

This application note detailed the use the Clockaudio CS 2S-RF and CS 3S-RF microphones with SoundStructure using SoundStructure device's GPIO inputs and outputs and events. This SoundStructure configuration file was designed so that touching any CS 2S-RF and CS 3S-RF microphone would toggle the mute state of all the microphones. Due to the flexibility of the SoundStructure events, it is possible to design the system to support other operating modes such as muting individual microphones independently, using the green or red LEDs to indicate microphone gating information, and other options.

References

1. **Clockaudio.** [Online] http://www.clockaudio.com.

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2. **Polycom.** *SoundStructure Design Guide.*

3. **Clockaudio.** TS-001 Specification Sheet. [Online] http://www.clockaudio.com.

4. **Polycom.** SoundStructure Training. [Online]
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