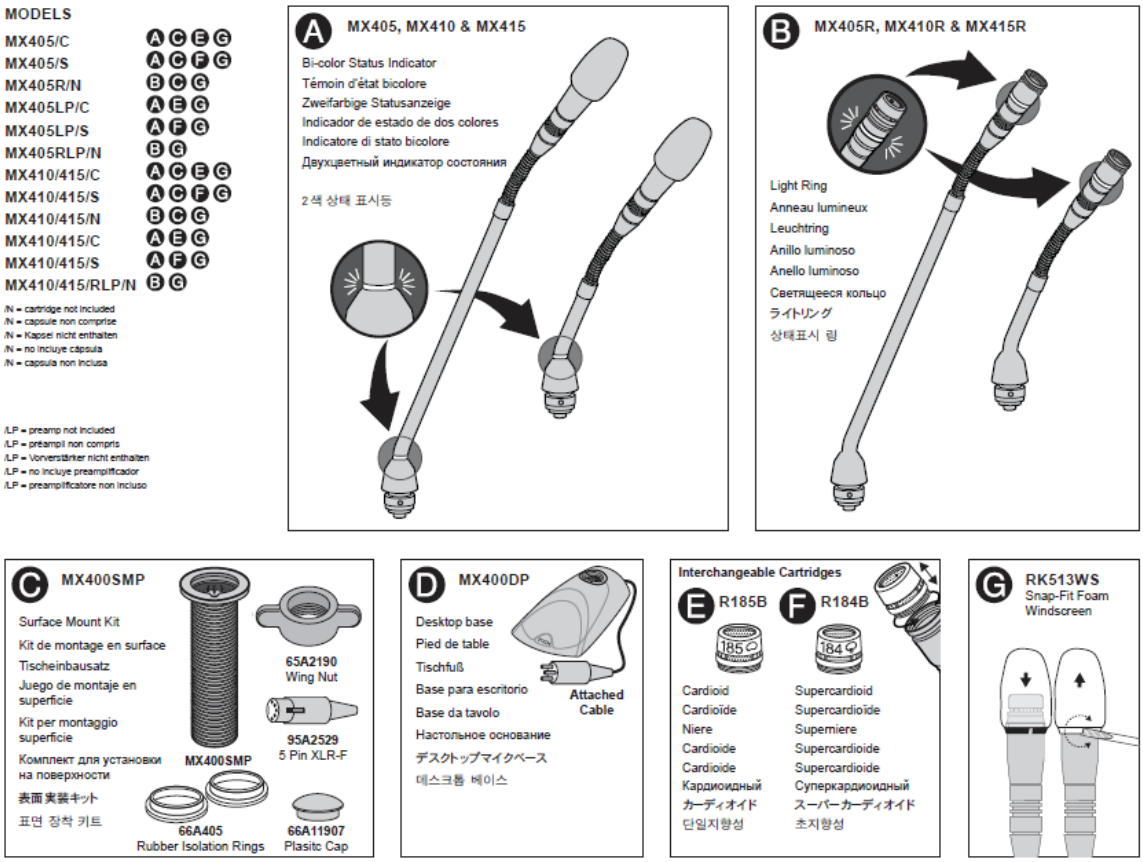
Interfacing the Shure® MX405-MX410-MX415 Microphones with Polycom® SoundStructure®

Engineering Advisory 1022

Introduction

The MX405/410/415 User Guide lists the following microphone options to choose from.

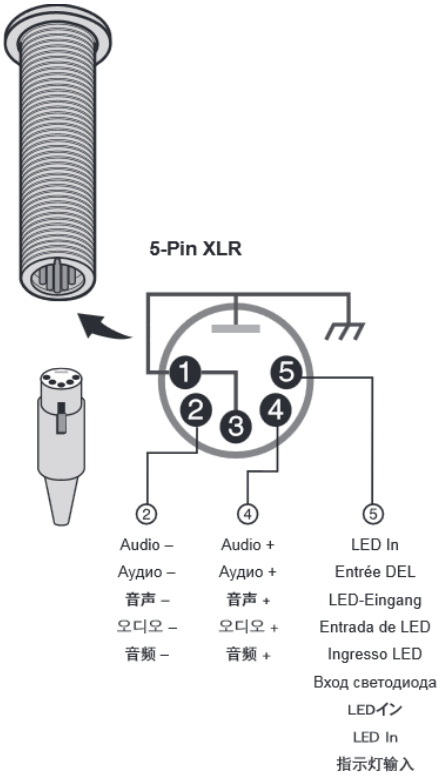


This engineering advisory provides information on using the MX405, MX410, and MX415 microphones; MX405R, MX410R, and MX415R microphones; and MX400SMP pre-amp. The MX400DP pre-amps that contain the LED and logic controls in the base and the output cable offered on the analog (+ and -) and ground. Thus, while it can be used to connect to the Polycom® SoundStructure®, no logic from the SoundStructure is used to control the LED on the microphone.

Pre-amps and Pinout

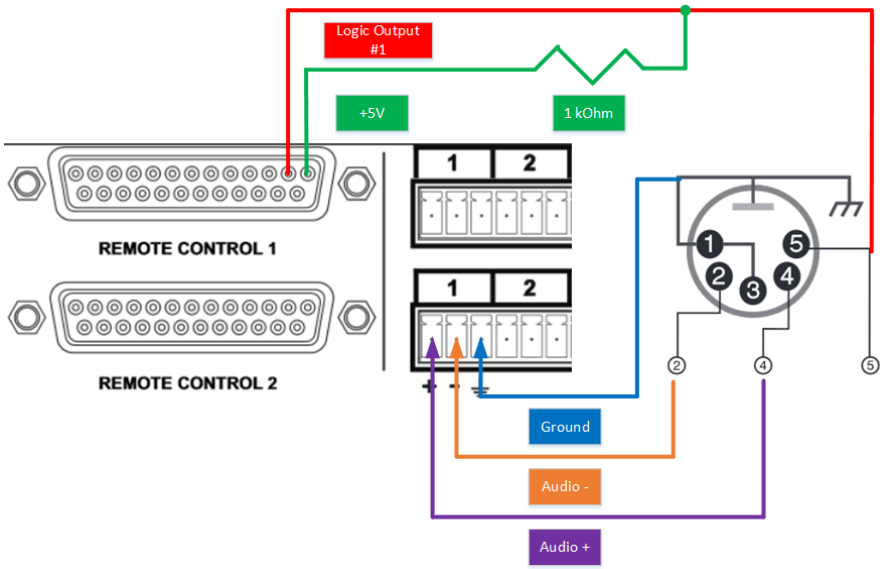
This engineering advisory focuses on the MX405-MX410-MX415 microphones that are supposed to be mounted to the MX400SMP pre-amp, as shown in the following figure.

MX400SMP pre-amp



Wiring to SoundStructure

Each microphone needs to connect to a separate analog channel and a separate logic channel. In the following figure, the purple and orange signals represent the analog signals from the microphone. The ground signal in blue represents ground for both the analog and the logic signals. The Logic Output LED In signal is red and the +5V 1 kOhm pull-up resistor is shown in green:



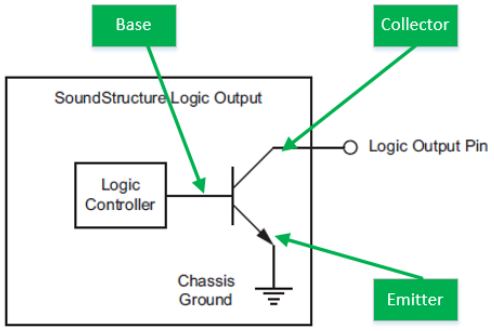
The connection to the +5V Logic Output pin through the pull-up resistor is needed due to the design of the microphone. When the LED In is shorted to ground, the MX405-MX410-MX415 LED is Green. When the LED In is tied to +5V, the MX405-MX410-MX415 LED is Red, as shown in the following figure from the MX405/410/415 User Guide:

	MX405 MX410 & MX415	MX405R MX410R & MX415R
0 Vdc	Green	Red
	Vert	Rouge
	Grün	Rot
	Verde	Rojo
	Verde	Rosso
	Зеленый	Красный
	緑色	赤色
	녹색	빨간색
	绿色	红色
5 Vdc	Red	Off / flashing*
	Rouge	Éteint / clignotant*
	Rot	Aus / blinkt*
	Rojo	Apagado / destellando*
	Rosso	Spento / lampeggiante*
	Красный	Выключено или мигает*
	赤色	オフ / 点滅*
	빨간색	꺼짐 / 단시간 점등*
	红色	灭 / 闪烁*

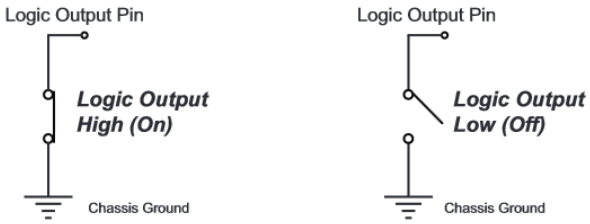
The pull-up resistor is needed for the following reasons:

- To bias the Logic Output to +5V when the Logic Output is off.
- To current limit the +5V supply from the SoundStructure when the +5V pin on the logic port is shorted to ground to prevent excessive loading of the +5V supply and possible damage to the Logic Output.

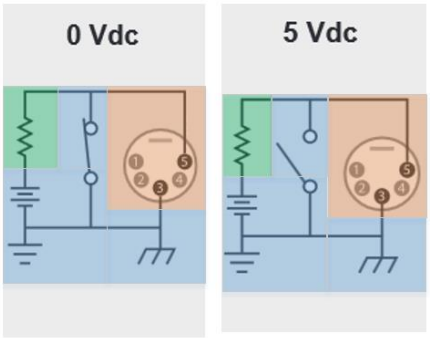
SoundStructure uses an Open-Collector Logic Output such that the collector pin of the bi-polar junction transistor is open and not actively connected when there is no active connection on the Logic Output. The pull-up resistor is needed to create a voltage that is compatible with the MX405-MX410-MX415 microphone in order to change the internal LED to red, as shown in the following figure from the Hardware Installation Guide for the Polycom SoundStructure.



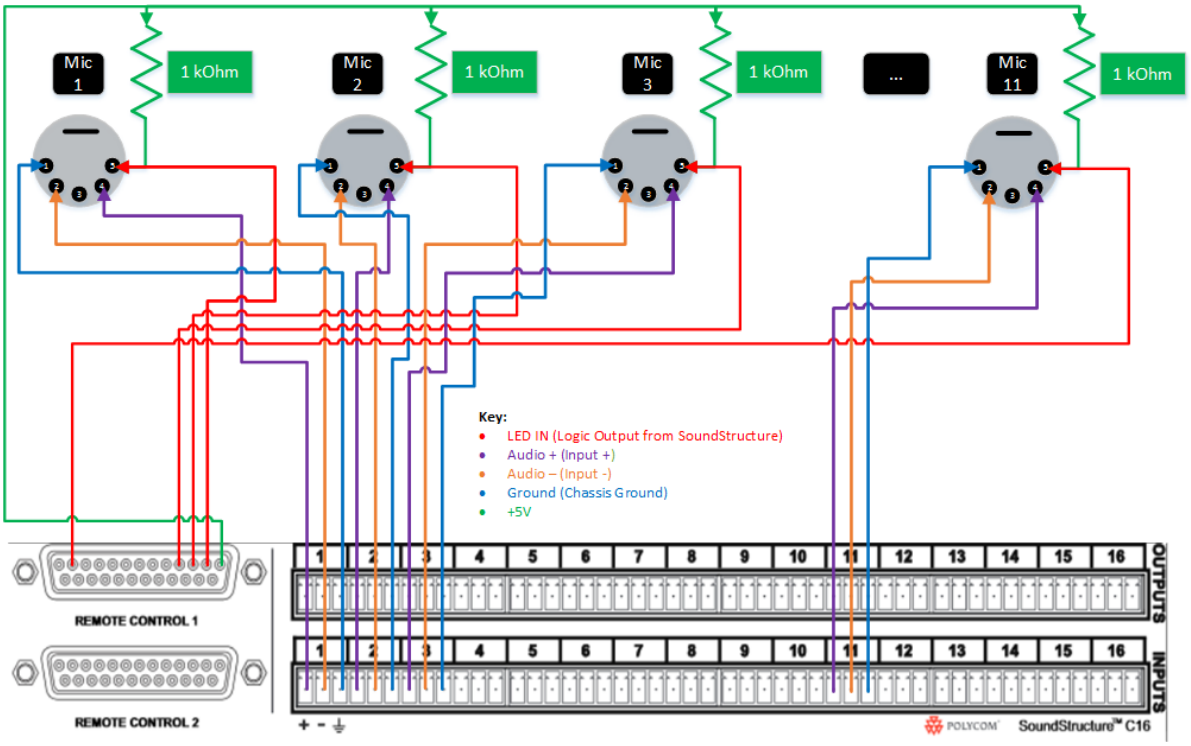
Based on the Logic Controller voltage, the transistor is either on or off, as shown in the following diagram in the Hardware Installation Guide for the Polycom SoundStructure.



Compare the MX400SMP recommendations to the SoundStructure implementation of the Logic Output where the SoundStructure internal components are shaded in blue, the external resistor is shaded green, and the external mic is shaded orange:



The following figure shows all the required connections for up to 11 microphones off of one logic port. The ground from the logic port is not needed, as noted in the section Grounding.



SoundStructure Configuration

After the mics are wired to the chassis, use SoundStructure Studio to configure the chassis. Note that the process is the same regardless of the number of microphones or the number of chassis linked via One Big Audio Matrix (OBAM).

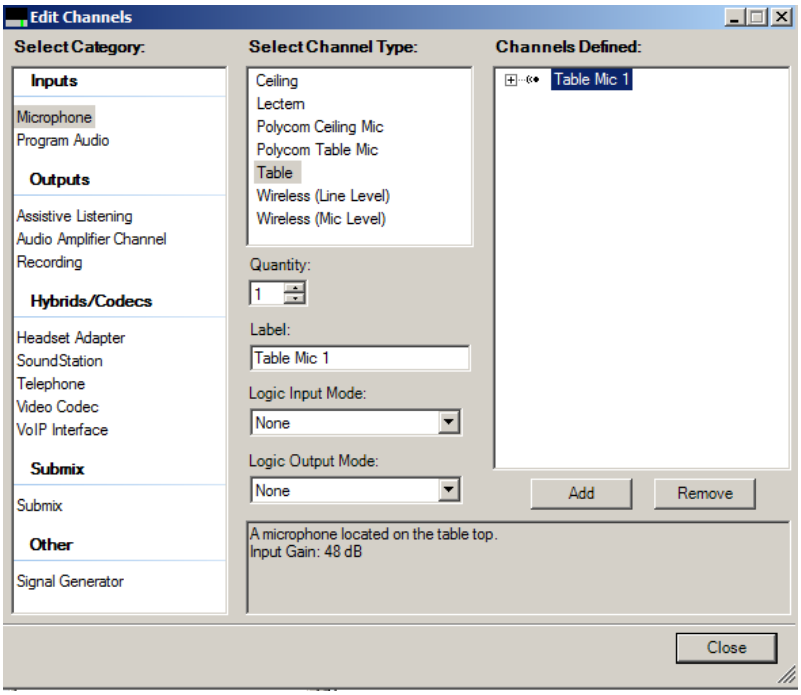
Example SoundStructure Microphone Configuration

In this example, we are adding a Table Mic. Optionally, you could change the Logic Output Mode from None to either Activate on Mute, Activate on Unmute, or Activate on Gate, and that populates the Logic and Events quicker. In this engineering advisory, these steps are done manually so as to better explain what is needed to make the design work.

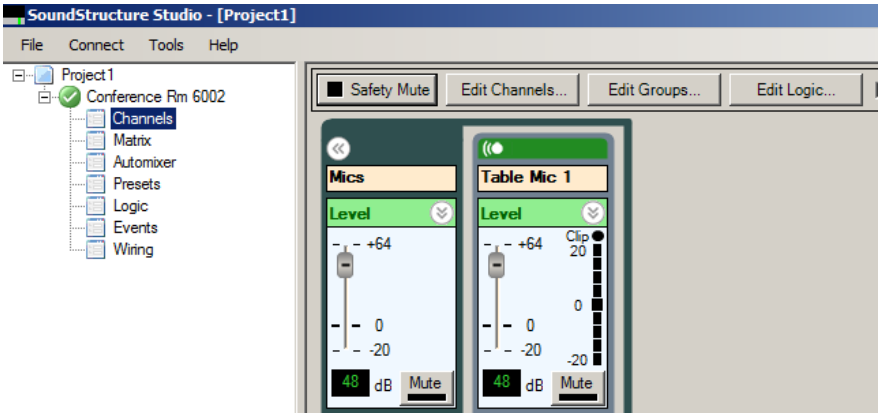
To configure microphones for SoundStructure:

1. Select a **Channel Type** and click **Add**.

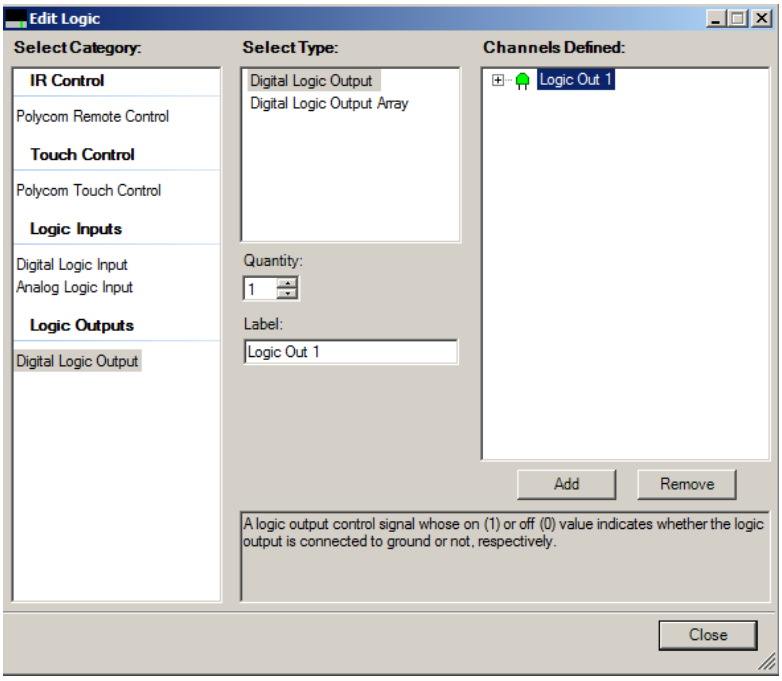
   The microphone is displayed in the **Channels Defined** box, as shown next.



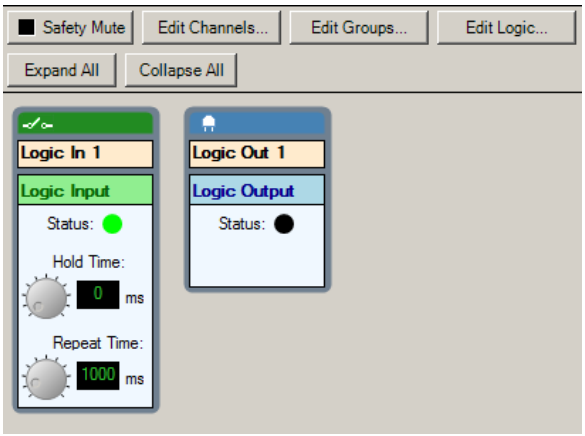
2 Navigate to the **Channels** page and verify that **Table Mic 1** was added.



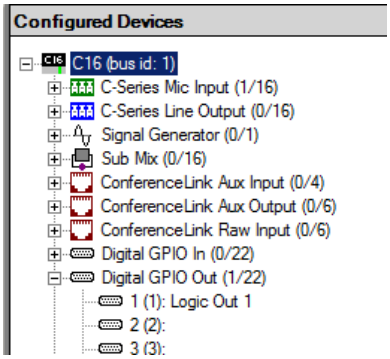
3 Click the **Edit Logic** button and add a **Digital Logic Output** into the system, as shown in the following example where the input is labeled as *Logic Out 1*.



4 Navigate to the **Logic** page and verify that the Digital Logic Output was added.



5 Navigate to the **Wiring** page and verify that *Logic Output* 1 is on the correct Logic Output pin. If not, drag *Logic Out 1* to another pin.

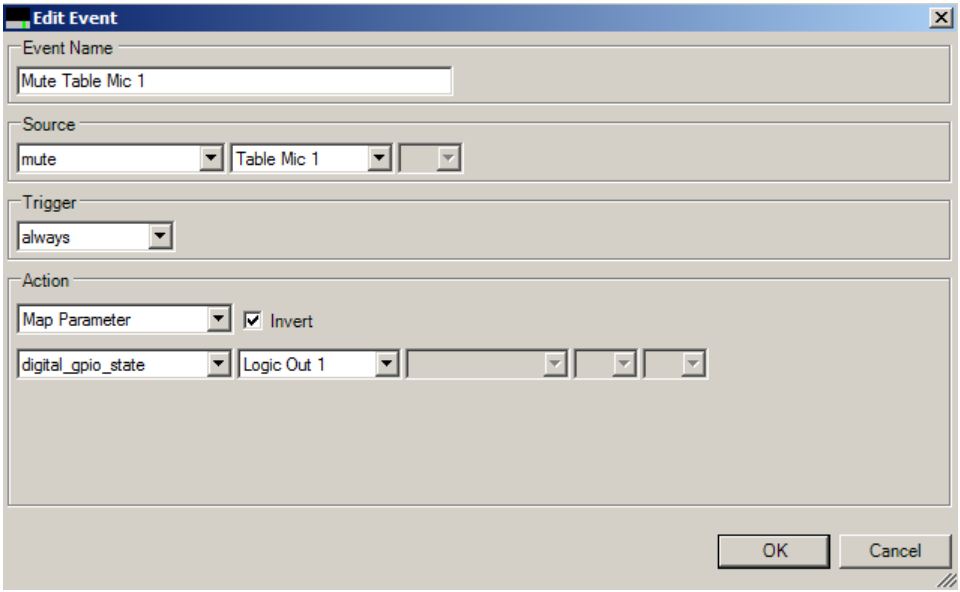


6 Navigate to the **Events** page and click the **Add Event** button and add an event for the Logic Input.

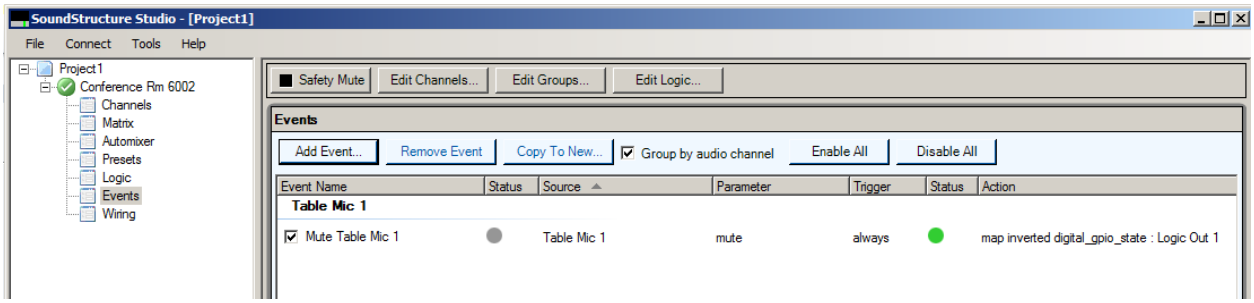
7 On the **Events** page, make the following changes:

- Rename the **Event Name** to something that is descriptive. In the following figure, the event is named *Logic In – Mute Table Mic 1*.
- Make sure the source event is correct. For this microphone**, muting (mute)**, **gating (am_gate)**, or **camera gating (am_camera_gate)** are the most ideal sources to use.
- Verify that the channel assigned to the source is correct. In this example, Table Mic 1 is the channel we want to use.
- Confirm the trigger is set to **Always**.
- Confirm the action is set as **Map Parameter**.
- Confirm the **Invert** check box is checked. This is explained further in the section Explanation of the Invert Check Box and Negative Logic Output.
- Set the parameter to **digital_gpio_state** in order to route the source event to the correct output.

  The resulting action should be tied to the *Logic Out 1* logic event previously defined.



Your event should be similar to the following figure.



To verify that the SoundStructure logic is working correctly, note the Status indicators. Since the source was the mute command, we can easily toggle the mute to verify that the state is changing. When the

mute is off, this is the expected result. Note that the Source status is off and displays gray and the Action status is on and displays green.

Event Name	Status	Source	Parameter	Trigger	Status	Action
Table Mic 1						
☑ Mute Table Mic 1	●	Table Mic 1	mute	always	●	map inverted digital_gpio_state : Logic Out 1

When the mute is on, this is the expected result. Note that the Source status is on and displays green and the Action status is off and displays gray.

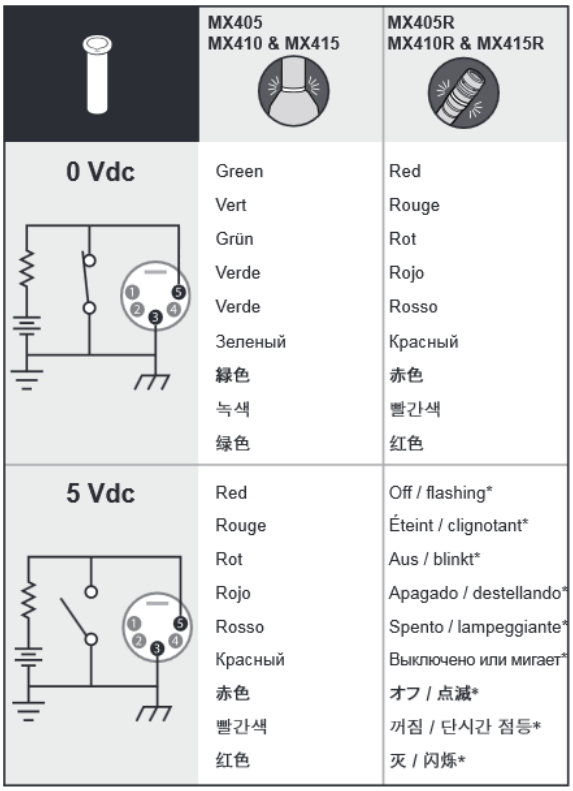
Event Name	Status	Source	Parameter	Trigger	Status	Action
Table Mic 1						
☑ Mute Table Mic 1	●	Table Mic 1	mute	always	●	map inverted digital_gpio_state : Logic Out 1

If the function of the Status indicators is unclear, see the section Additional Notes.

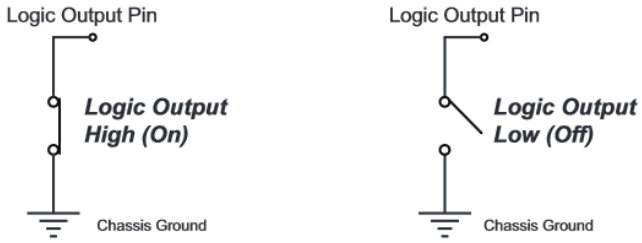
After you are finished making your logic and event changes, save the changes to a full preset.

Explanation of the Invert Check Box and Negative Output Logic

To summarize, 0V = Green and 5V = Red, as shown in the following figure from the MX405/410/415 User Guide.



So, when the Logic Output is On, then the Logic Output pin is shorted to ground, as shown in the following figure from the Hardware Installation Guide for the Polycom SoundStructure. Conversely, when the Logic Output is Off, then the Logic Output pin is open with respect to ground.



One of the functions of the 1 kOhm resistor as shown in the section Wiring to SoundStructure is to act as a pull-up resistor to +5V such that when the Logic Output is off, the LED In wire to the microphone remains at +5V. The other function of the resistor is to limit the current when the Logic Output is on and shorted to ground from the +5V supply.

The Logic Output operates via negative logic such that when the Logic Output is off, the voltage on the LED In wire equals to +5V, and when the Logic Output is on, the voltage on the LED In wire equals to 0V.

Using the previous example where the Source command was mute, when the mute is off, the Source status is off and displays gray, and the Action status is on and displays green. Note that the Action status represents the state of the Logic Output pin, which in this case is on and shorted to ground.

Event Name	Status	Source	Parameter	Trigger	Status	Action
Table Mic 1						
☑ Mute Table Mic 1	●	Table Mic 1	mute	always	●	map inverted digital_gpio_state : Logic Out 1

From a voltage perspective on the LED In wire, the on state of the SoundStructure Logic Output means that the +5V pull-up resistor is grounded so the LED In wire equals +0V which makes the LED in the MX405-MX410-MX415 microphone turn green. The green LED represents the state of the mic when it is unmuted and live.

When the mute is on, this is the expected result. Note that the Source status is on and displays green and the Action status is on and displays green.

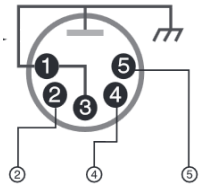
Event Name	Status	Source	Parameter	Trigger	Status	Action
Table Mic 1						
☑ Mute Table Mic 1	●	Table Mic 1	mute	always	●	map inverted digital_gpio_state : Logic Out 1

From a voltage perspective on the LED In wire, the off state of the SoundStructure Logic Output means that the +5V pull-up resistor forces the LED In wire to equal +5V which makes the LED in the MX405-MX410-MX415 microphone turn red. The red LED represents the state of the mic when it is muted.

Additional Notes

Grounding

The following figure from the MX405/410/415 User Guide shows a pinout with pins 1 and 3 shorted together.



As a result, only one ground connection is needed from the SoundStructure to the mic. The easiest way to ground the mic is via the chassis ground connection on each analog input of the SoundStructure. Inside the SoundStructure, the chassis ground and the logic ground are tied together.

LED In

Shure designed the MX395 to power the LED from the Phantom Power, as shown in the following figure from the MX395-LED and MX400SMP page.

Based on development research for the MX395-LED and MX400SMP, RFI immunity improved when XLR pin 4 and pin 2 were used for the audio signal.

Pin 1: cable shield

Pin 2: Audio -

Pin 3: Logic Ground for the LED

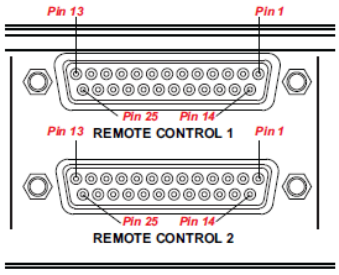
Pin 4: Audio +

Pin 5: Logic Input Control for the LED

Note 1: The LED operating voltage and current is provided by the phantom power. A dim LED indicates insufficient current provided to pin 2 and pin 4.

Reference Drawings

The following figure shows the logic port on SoundStructure.



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		

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