

# HALOGEN



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# CHAPTER 1: Overview

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## About This Document

This guide explains how to use a HAL DSP Processor with Crestron control systems. It is divided into three major sections:

- "Introduction to Using External Control Systems with HAL" on page 4 (Chapter 2)
- "Example HAL1x Configuration" on page 6 (Chapter 3)
- "Integrating Crestron Control Systems with HAL" on page 16 (Chapter 4)

Chapter 2 explains the general approach for configuring a HAL for use with any external control system and how to connect and communicate with the HAL Control Server. The second section, Chapter 3, walks you through the construction of an example Halogen configuration that includes one or two common uses for each type of external control. Chapter 4 shows you how to set up and program a Crestron control system to work with a HAL that is running the example configuration.




The appendices provide helpful reference information about the HAL external control message protocol and how to use a telnet client to monitor and troubleshoot the operation of a control system at the message protocol level.

## Using the HAL System Documentation

A variety of documentation is available to help you get started with and use your HAL System:

### Halogen Help System

A comprehensive help system is installed with the Halogen software. It contains all the information you need to work with the system. There are several ways to access the Help System:

- Click the **Help** icon on the application toolbar:  Clicking the icon itself opens the Help System. Clicking the down arrow displays a list of options including such things as access to the Rane website, checking for updates to the Halogen software, and sending an email to Rane.
- Click the Help icon  that appears in the upper right corner of Halogen dialog boxes. Clicking this icon opens the Help topic related to the specific dialog box. From there you can access the entire Help System, if needed.
- Right-click on different elements in the user interface. A **Help** option appears in the context menu. Click this option to open the relevant Help topic. Pressing F1 when an area of the user interface has focus also displays its relevant Help topic.
- To search for information within the Help System, you can use the tabs on the Help Viewer's left pane to search the index (click the **Index** tab) or perform a full-text search (click the **Search** tab). You can also use the **Quick search** box in the Help System toolbar to search for text within the currently displayed topic: 

### HAL System Design Guide

This guide is offered as a PDF file and contains a product overview, details about the HAL System's key features, and best practices for designing a HAL audio system. Note that the information in this guide is also available in the Halogen Help System. You can find this guide on the Rane website (<http://rane.com/hal>) as

well as on the product DVD.

## **HAL System Installation Guide**

This guide is offered as a PDF file and includes step-by-step instructions on installing the HAL hardware, loading a configuration, and testing the system. This information is also included in the Halogen Help System. You can find this guide on the Rane website (<http://rane.com/hal>) as well as on the product DVD.

## **AMX Control Systems Guide**

This guide, includes an introduction to using external control systems with HAL. It also discusses an example HAL1 configuration and how to set up an AMX controller and touch panel to communicate with a Halogen/HAL Control Server. In addition, an appendix is included with reference information on the HAL external control message protocol and how to use a telnet client to monitor and troubleshoot the operation of a control system at the message protocol level.

The guide is designed to be used in conjunction with the files found in the AMX Support Package. The contents of this support package include:

- AMXControlSystems\_Guide.pdf - The AMX Guide pdf file
- ControlSystemSample.hal - Halogen configuration file intended for loading in Halogen or your HAL1x
- Rane\_HAL.apw - NetLinx Studio program project file
- Main.axs - NetLinx program source file
- Rane\_HAL\_TP.TP4 - TPDesign4 touch panel project file

The AMX Support Package is installed with the Halogen software and can be accessed from the Windows Start Menu under Halogen -> Guides. If you want to access the files directly they are available on the product DVD or from the Halogen install directory:

- C:\Program Files (x86)\Rane Corporation\Halogen\Guides\Support Packages\AMX directory

You can also download the most up-to-date version of this support package from the Rane website (<http://rane.com/hal>).

## **Crestron Control Systems Guide**

This guide, includes an introduction to using external control systems with HAL. It also discusses an example HAL1x configuration and how to set up a Crestron controller and virtual touch panel to communicate with a Halogen/HAL Control Server. In addition, an appendix is included with reference information on the HAL external control message protocol and how to use a telnet client to monitor and troubleshoot the operation of a control system at the message protocol level.

The guide is designed to be used in conjunction with the files found in the Crestron Support Package. The contents of this support package include:

- CrestronControlSystems\_Guide.pdf - The Crestron Guide pdf file
- ControlSystemSample.hal - Halogen configuration file intended for loading in Halogen or your HAL1x
- Rane\_HAL.smw - SIMPL Windows program project file
- Rane\_HAL\_TP.vtp - VisionTools Pro-e touch panel project file
- Rane HAL Level Processor.usp - SIMPL+ user module source file
- Rane HAL Level Processor.ush - Compiled user module

The Crestron Support Package is installed with the Halogen software and can be accessed from the Windows Start Menu under Halogen -> Guides. If you want to access the files directly they are available on the product DVD or from the Halogen install directory:

- C:\Program Files (x86)\Rane Corporation\Halogen\Guides\Support Packages\Crestron directory

You can also download the most up-to-date version of this support package from the Rane website (<http://rane.com/hal>).

### **Stardraw Control Systems Guide**

This guide, includes an introduction to using external control systems with HAL. It also discusses an example HAL1 configuration and an example Stardraw Control application and driver that communicates with a Halogen/HAL Control Server. In addition, an appendix is included with reference information on the HAL external control message protocol and how to use a telnet client to monitor and troubleshoot the operation of a control system at the message protocol level.

The guide is designed to be used in conjunction with the files found in the Stardraw Control Support Package. The contents of this support package include:

- StardrawControlSystems\_Guide.pdf - The Stardraw Control Guide pdf file
- ControlSystemSample.hal - Halogen configuration file intended for loading in Halogen or your HAL1x
- HAL1 Stardraw Example Project.s03 - Stardraw Control Project
- HAL1 Example Driver.cs - Stardraw HAL1 driver source code. This is part of the Stardraw Control Project but is included separately here for reference.

The Stardraw Control Support Package is installed with the Halogen software and can be accessed from the Windows Start Menu under Halogen -> Guides. If you want to access the files directly they are available on the product DVD or from the Halogen install directory:

- C:\Program Files (x86)\Rane Corporation\Halogen\Guides\Support Packages\Stardraw Control directory

You can also download the most up-to-date version of this support package from the Rane website (<http://rane.com/hal>).

## **Getting Started**

Read this document in sequence if you are completely new to learning about and using external control systems with HAL and the Halogen software. Chapters 2 and 3 appear in other control systems guides so you can skip these if you've already read them. The Crestron example in chapter 4 refers to the example HAL1 configuration often, so you may want to familiarize yourself by reading chapter 3 before starting on chapter 4.

# CHAPTER 2: Introduction to Using External Control Systems with HAL

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This section is a brief overview of the support that the HAL system provides for external controls and how your system can connect to and use these controls. For more information on this topic, please see the Halogen Online Help.

## Configuring External Controls in Halogen

Halogen provides the ability to configure controls for use with external control systems. These controls can be of any of the four types that Halogen supports: Level, Toggle, Selector, and Command. Once you create an external control in Halogen using the Control Systems dialog, you can then link it to any other linkable control of the same type in your Halogen configuration. This lets your external control system set and monitor any linkable parameter in your HAL configuration. Since the external controls can link to any other linkable control in a configuration, you have tremendous flexibility in the access that you provide to end users and seamless integration of your control system with internal controls, such as those in DSP block parameters and Rane Digital Remotes.

Each control that you configure for external access includes a unique number that allows external control systems to identify each control. For example, you might define a level control to be number 1 while a toggle control is number 2.

## Connecting to a Halogen/HAL Control Server

The HAL system contains a Control Server to provide a way for your control system to connect and use the configured external controls. To integrate your external control system with a HAL system, your control system simply connects to the Control Server over TCP/IP. In the spirit of allowing you to configure and test your HAL system as much as possible without needing actual HAL hardware present, there are two ways that you can connect to a HAL Control Server to develop, test and use your external control system.

First, when developing and testing your system, the Halogen software includes the Control Server, which runs whenever Halogen is not connected to a HAL. Even though the configured HAL system hardware is not present, using the Control Server built into Halogen allows you develop your configuration, including all of the external controls, and test them with your external control system. Of course, because the actual hardware is not present, you cannot process audio or use physical devices such as Digital Remotes.



**NOTE:** To use the Control Server built into Halogen, connect to port 4996 on the TCP/IP address of the PC that is running Halogen.

The other way to use the Control Server is to connect to a HAL DSP Processor itself. This server is always available on a HAL at port 4996 on any of its TCP/IP addresses. Once you have created and applied a HAL configuration that contains external controls, these controls are available to your external control system via the Control Server. We recommend that you configure a static IP address on your HAL when using the HAL Control Server, so that the server is always available to your control system at a stable address.



**NOTE:** To use the Control Server built into HAL, connect to port 4996 on the TCP/IP address of the HAL.

## Communicating with a Halogen/HAL Control Server

Once connected to either the Control Server built into Halogen or to the server in an actual HAL, your external control system communicates with the Control Server using the HAL system External Control Message Protocol. This is an ASCII text based protocol that allows one or more control systems to access the external controls in your HAL configuration. Appendix A "HAL External Control Message Protocol" on page 49 fully defines these messages, but an example would be: <L&4&510>. This message is a 'set level' message that tells the HAL to set external level control number 4 to a new value of 51.0%. The protocol provides similar messages for getting and setting values for each of the four control types.

In addition to responding to messages it receives, the Halogen/HAL Control Server also sends messages to connected control systems whenever one of the external controls configured in HAL changes. This helps all of the connected external control systems remain up to date as values or links change.

## Using a Telnet Client to Test and Monitor the System

Because the message protocol is ASCII text, you can use a standard telnet client to connect to a Halogen or HAL Control Server and send/receive messages. This can be a great way to initially test your control system and to troubleshoot any problems that occur while developing and deploying your system. Appendix B "Using PuTTY to Test External Control Systems" on page 60 provides complete information for you to use a simple public domain Windows telnet client, PuTTY, with the Halogen/HAL Control Server.



## CHAPTER 3: Example HAL1x Configuration

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The external control system example uses a HAL1x configuration that includes a set of external controls linked to processing block and preset controls that demonstrate some common uses of the end user external controls. There is at least one control of each type: Command, Level, Selector, and Toggle. We've also constructed this configuration using only inputs and outputs available on the HAL1x so that you can load and apply this configuration to any HAL1x without having to attach and configure other devices such as RADs or DRs.

*"Creating the Example Configuration" below shows how to build the complete configuration from scratch. Of course, we also provide the configuration file for you so you don't have to go through all of the work, but it's your choice. You can either follow the directions below to create the configuration or open the file we provide and use the instructions below to learn about what's in the configuration.*

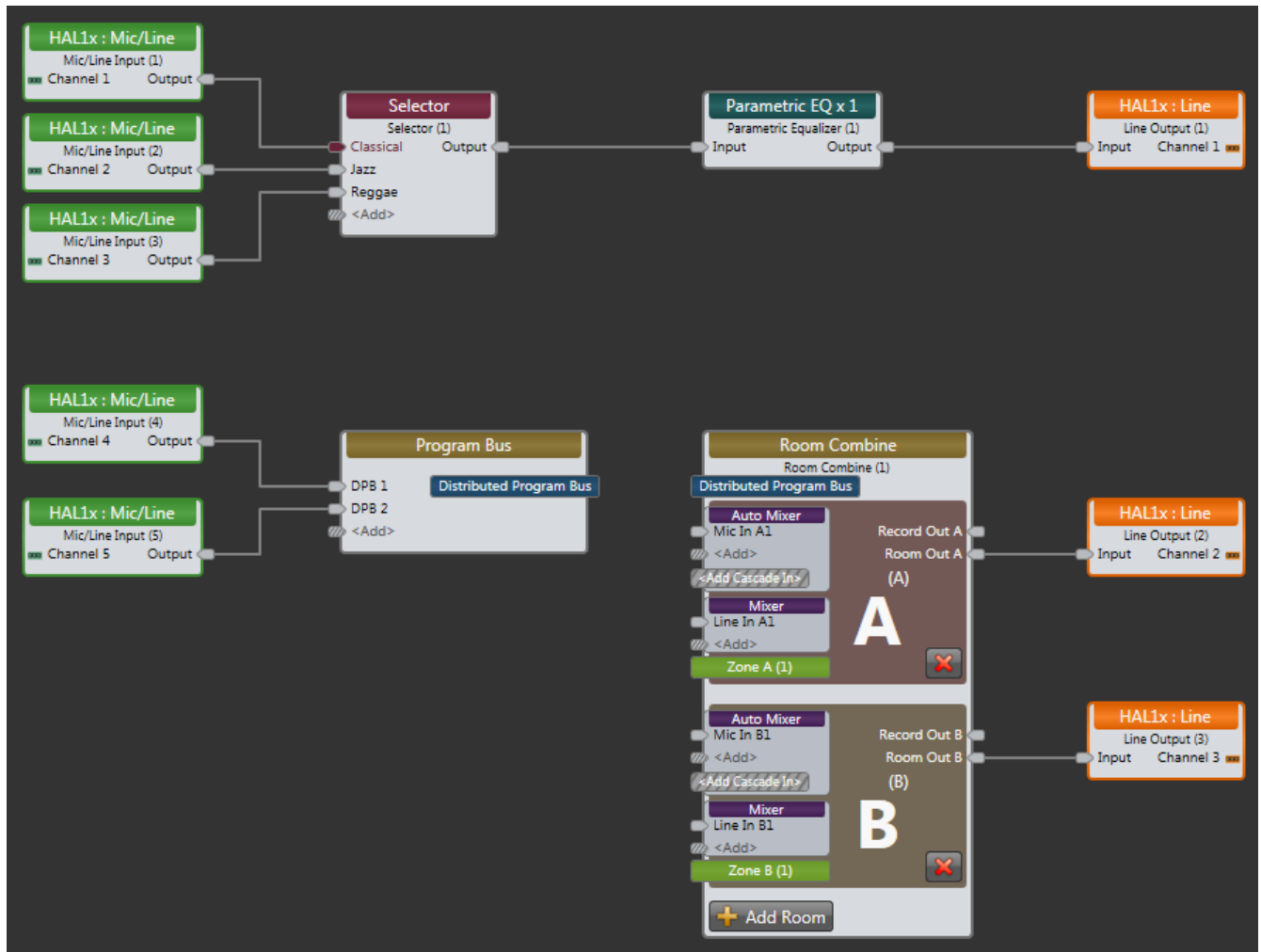
Alternatively, you can just read the "Configuration Summary" on page 15 to learn what external controls this configuration provides.

### Creating the Example Configuration

To get started, all of the work is done in the processing workspace, so click on the **Processing** tab in the upper right section of the Halogen application.

Click on the tab for the **I/O** palette and drag the first five HAL1x Mic/Line inputs from the palette and drop them on the left side of the processing map. In a similar way, drag the first three HAL1x Line Outputs from the palette and drop them on the right side of the processing map.



Next, fill in the middle processing area by clicking on the **DSP** palette tab and dragging four processing blocks to the processing map: Parametric EQ, Distributed Program Bus, Room Combine, and Selector. For the selector block, create one additional input and set the input names to Classical, Jazz, and Reggae. Also, delete room C from the Room Combine Processor by clicking the red 'X' in room C. Wire these together with your I/O blocks so that your processing map looks like this:





The top row of blocks provides audio for a lounge that has three program source inputs and some PEQ processing and the bottom row is a simple room combine configuration.

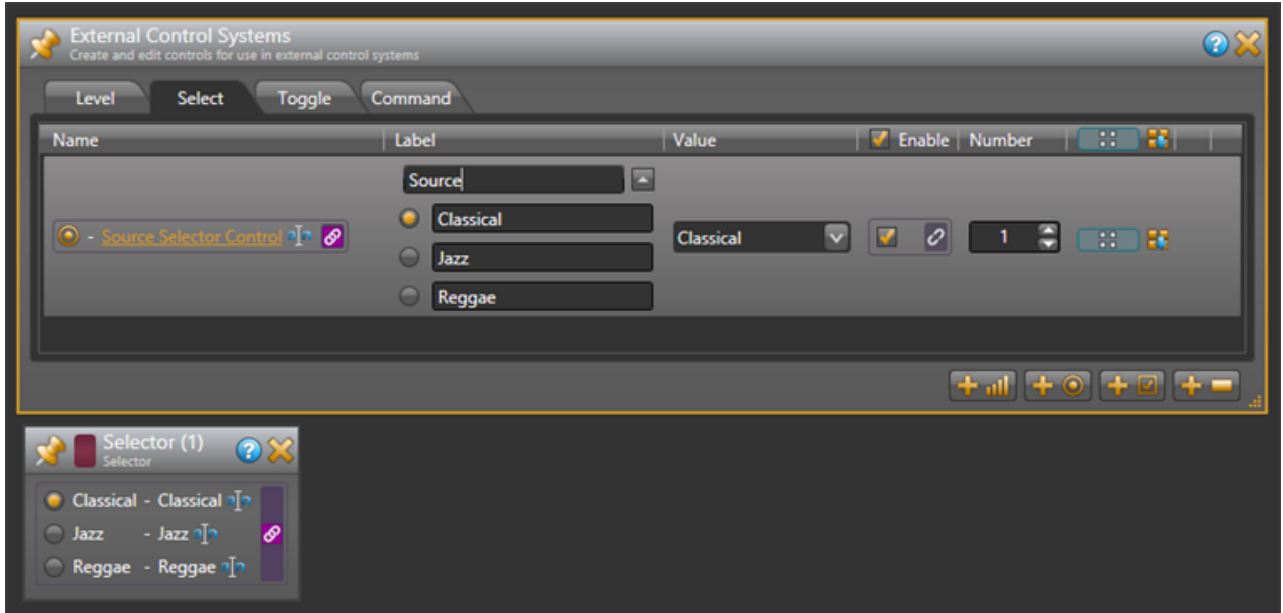
Next, we'll add some external controls using the External Control Systems dialog and link them to some of the controls available in the processing blocks we are using.

First, we'll create a control for the lounge input program selector:

1. Just above the upper left of the Processing Workspace, click on the **Control Systems** button then select **External Controls** to open the External Control Systems property dialog.
2. In the External Control Systems dialog, click on the **Select** tab.
3. Create a new Selector control by clicking on the  button.
4. Change the name of this new control by clicking the edit icon  and entering *Source Selector Control* followed by the Enter key.
5. Set its number to *1*.
6. Double click the Selector block in the Processing Map to open its property dialog




## CHAPTER 3: Example HAL1x Configuration

7. Link the new Selector control in the External Control dialog to the selector block's selector control. Do this by dragging the link icon  in the External Control Systems dialog to the right of the control name and dropping it on the link icon  for the Selector Block's selector control.
8. Change the Label in the Source Selector Control to "Source". Together, the selector property dialogs are as follows:

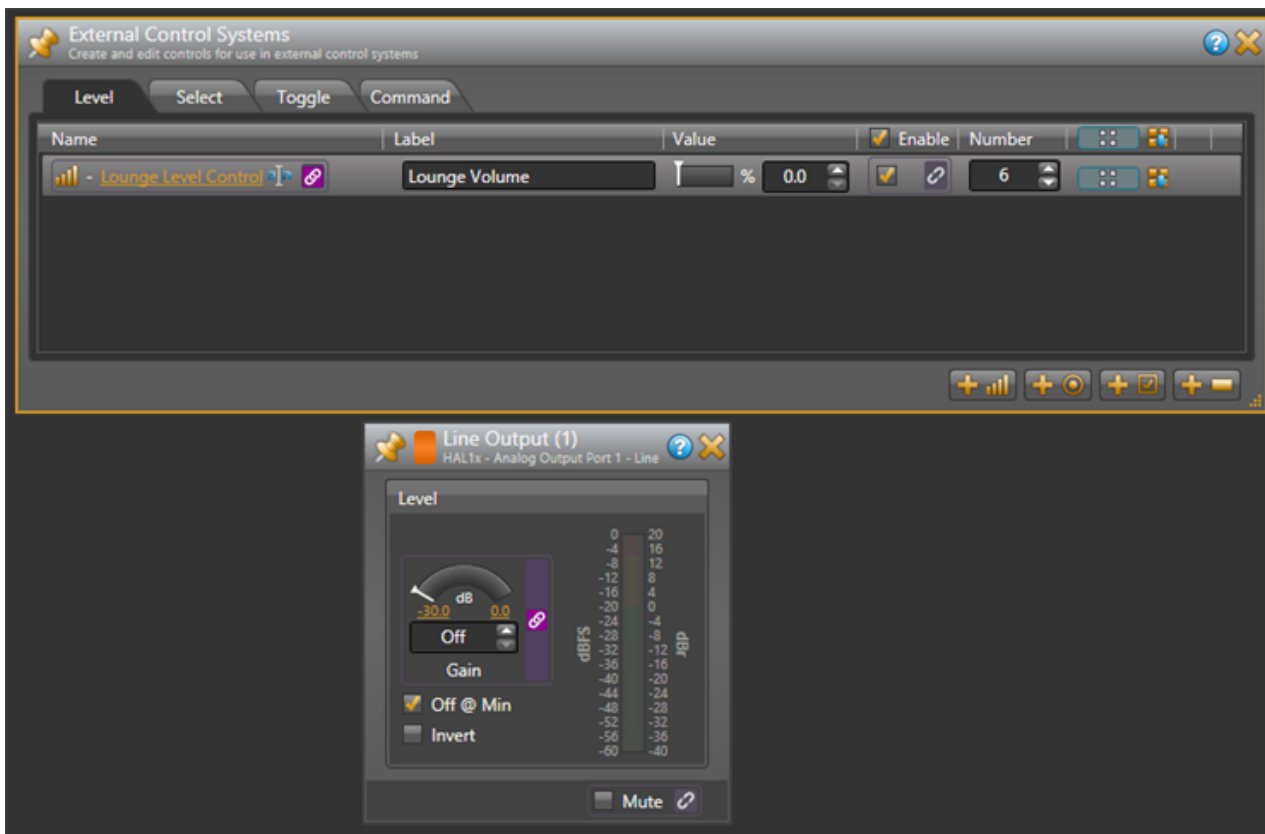


Your external control system can now get and set the lounge input source using the External Control Message Protocol.




Next, we'll add a control for the lounge volume level:

1. In the External Control Systems dialog, click on the **Level** tab.
2. Create a new Level control by clicking on the  button.
3. Change the name of this new control to *Lounge Level Control* and set its number to 6.
4. Open the property dialog for the lounge output block, HAL1x Line Output (1).
5. Link the new Level external control to the level control in the Line Output block property dialog. Do this by dragging the link icon  in the External Control Systems dialog to the right of the control name and dropping it on the link icon  for the Line Output Block's level control.

- Change the Label for the Lounge Level Control "Lounge Volume". The dialogs appear below as follows:

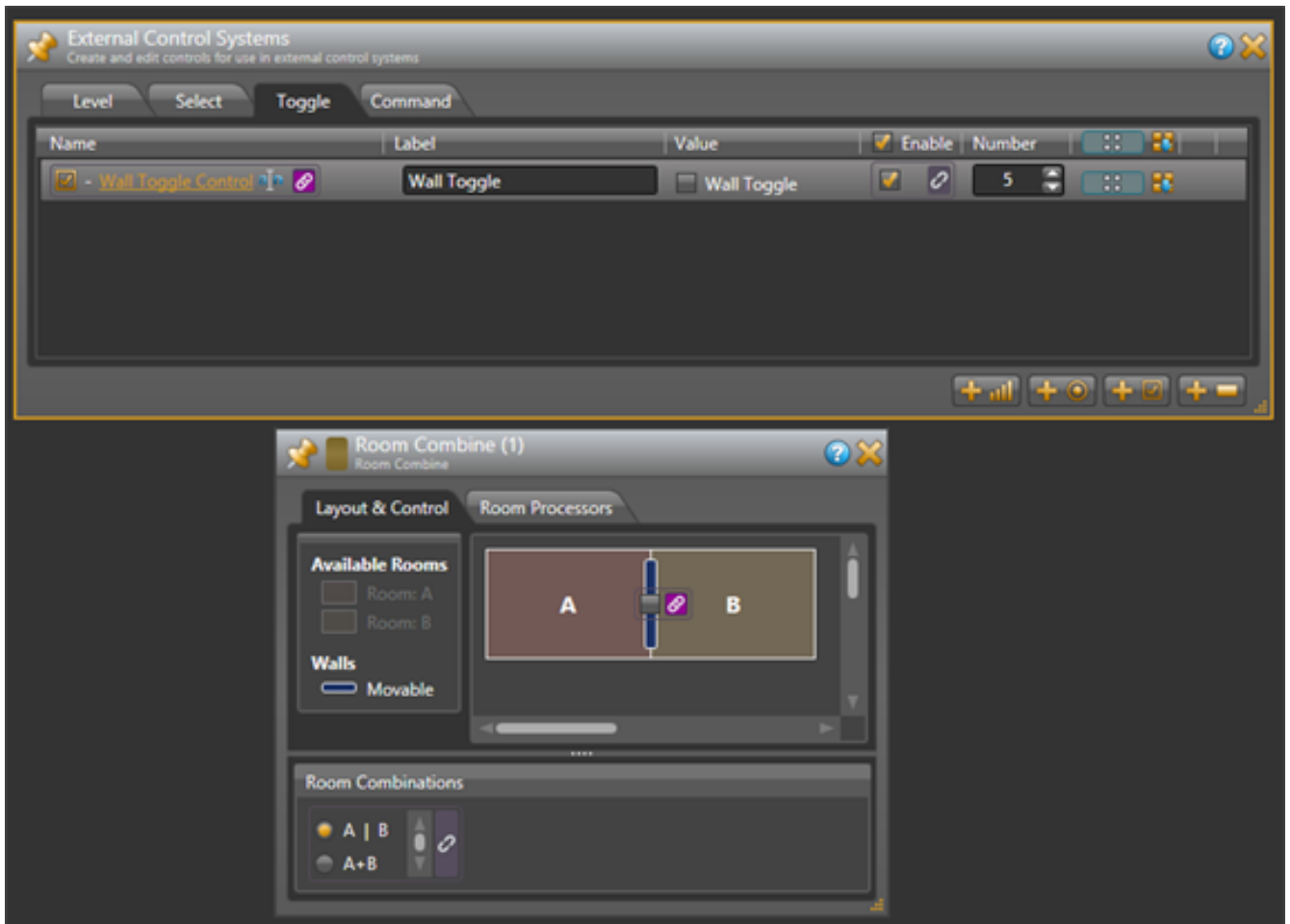


In a Room Combine application, end users typically need to let the audio system know when they open or close a movable wall. To create a Toggle control for this:

- Open the Room Combine Processor property dialog.
- Drag both Room A and Room B onto the Layout & Control area and arrange them so that they are next to each other.
- Add a movable wall between them by dragging the movable wall icon between the rooms until the wall highlights, then dropping the wall to create a wall toggle control.
- In the External Control Systems dialog, click on the **Toggle** tab.
- Add a new Toggle control by clicking on the  button.
- Change the name of the new control to *Wall Toggle Control* and set its number to 5.
- Link the new Toggle external control to the wall toggle control in the Room Layout & Control area. Do this by dragging the link icon  in the External Control Systems dialog to the right of the control name and dropping it on the link icon  for the wall toggle control between the two rooms.

## CHAPTER 3: Example HAL1x Configuration


8. Change the Label for the Wall Toggle Control to "Wall Toggle". The dialogs appear below as follows:





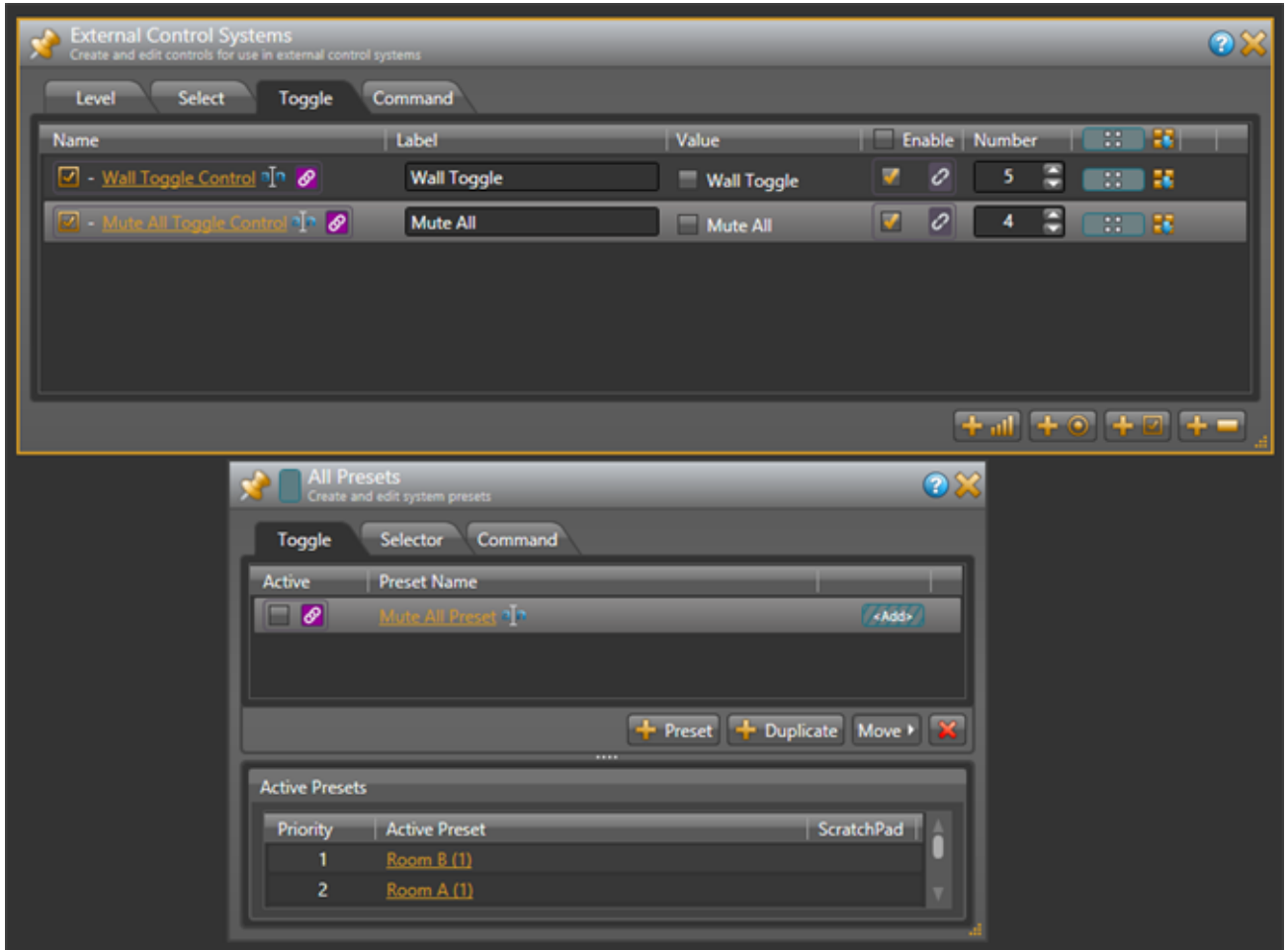
At this point, your external control system has access to three controls – a selector to get and set the lounge input program source, a level to control the lounge volume and a toggle to open and close the room combine wall.


Now we'll add some controls and link them to presets of various kinds to show how you can provide access to presets to your external control system.

First, we'll add a toggle control to mute all of the outputs in our configuration:

1. On the Processing Workspace Toolbar, click on the **Presets** button to open the All Presets property dialog.
2. In the All Presets dialog, click on the **Toggle** tab.
3. Add a new toggle preset by clicking on the **+Preset** button.
4. Rename this preset to *Mute All Preset*.
5. In the External Control Systems dialog, click on the **Toggle** tab if it is not already displaying the toggle controls.
6. Add a new Toggle external control by clicking on the  button and set its number to 4.
7. Rename this new control to *Mute All Toggle Control*.

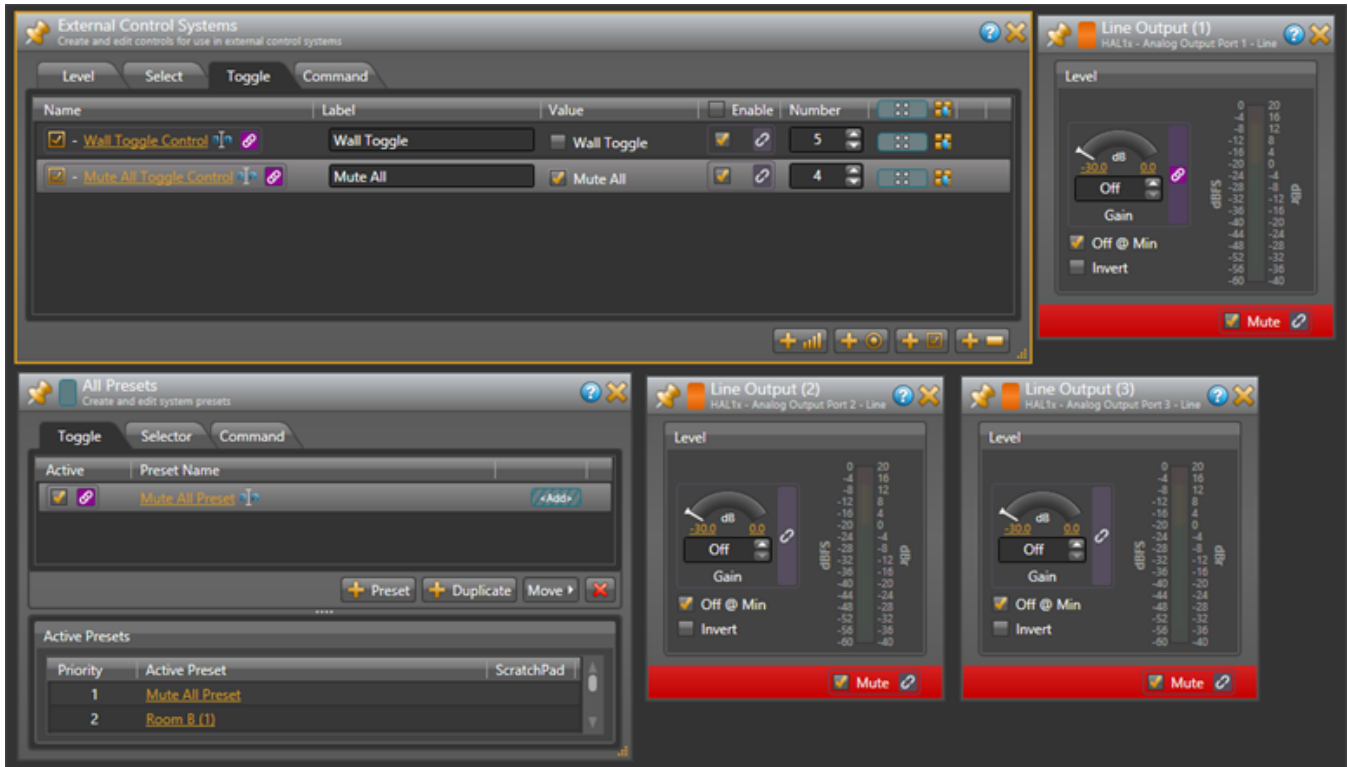
8. Link the new Mute All Toggle Control to the toggle control for the Mute All Preset. Do this by dragging the link icon  in the External Control Systems dialog to the right of the control name and dropping it on the link icon  for the Mute All Preset's toggle control.
9. Change the Label for the Mute All Toggle Control to "Mute All". The dialogs appear below as follows:






10. Open the three HAL1x output blocks, set each of the mute checkboxes to checked (muted) and set their level controls all the way down (Off).
11. Add the three HAL1x output blocks to the Mute All Preset. To do this, hover your mouse over the HAL1x output block for the lounge. Drag the blue preset icon  that appears and drop it on the blue rectangle for the Mute All Preset in the All Presets dialog. Repeat for the other two HAL1x output blocks.

## CHAPTER 3: Example HAL1x Configuration

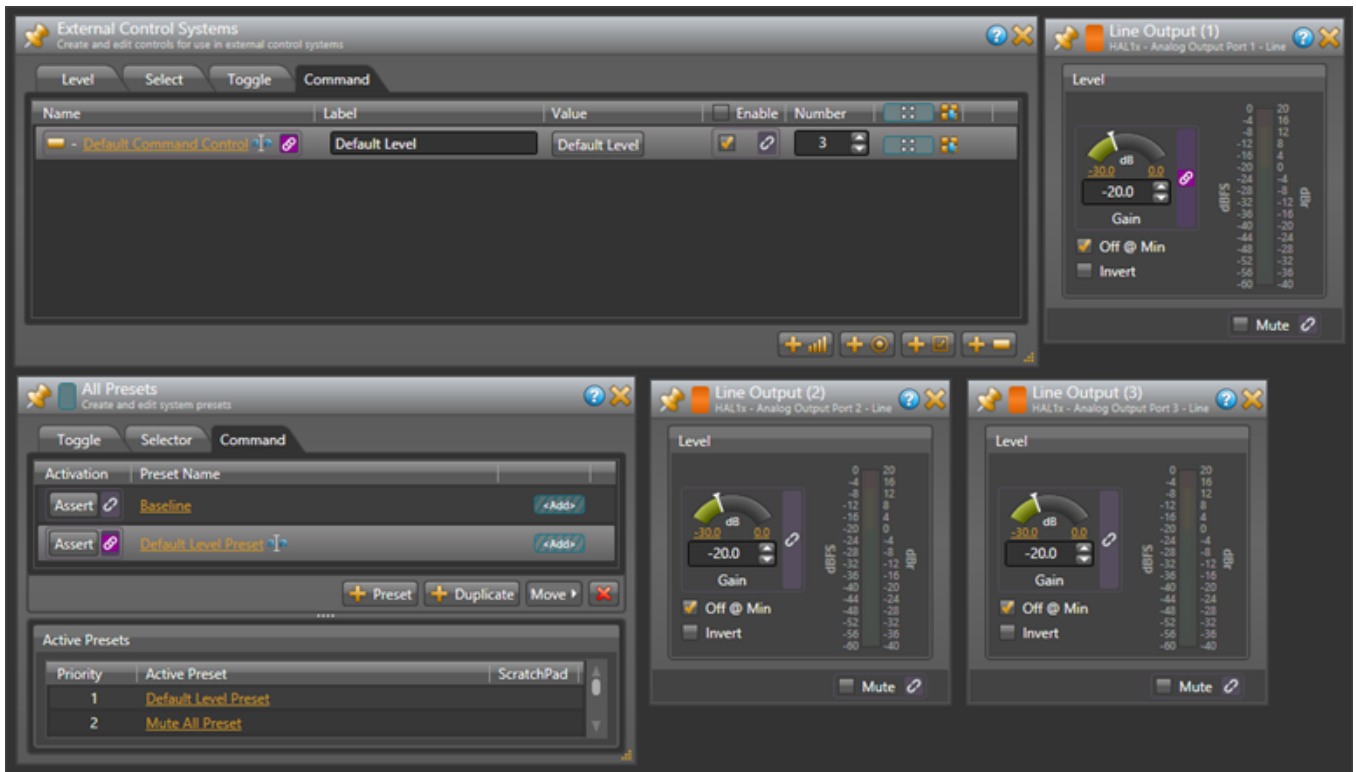
12. Test this by activating and deactivating the Mute All Preset from the All Presets dialog. All three HAL1x output blocks mute when the preset is active and un-mute when the preset is not active.




Now, we'll add a Command control to reset all outputs to a default operating state:

1. In the All Presets dialog, click on the **Command** tab.
2. Create a new command preset by clicking on the **+Preset** button.
3. Rename this new preset to *Default Level Preset*.
4. In the External Control Systems dialog, change to the **Toggle** tab if it is not already selected.
5. Make sure the **Mute All Toggle Control** toggle Value is un-checked.
6. Open the three HAL1x output blocks and set the level for each to *-20.0 dB* and un-check the mute toggle control.
7. Add the three HAL1x output blocks to the new Default Level Preset by dragging the blue preset icon next to each HAL1x output block and dropping them on the blue rectangle for the Default Level Preset in the All Presets dialog.
8. In the External Control Systems dialog, drag the blue preset icon for the Mute All Toggle Control and drop it on the blue rectangle for the Default Level Preset in the All Presets dialog. This ensures that the Mute All toggle is reset (unmuted) when the Default Level Preset is asserted.
9. In the External Control Systems dialog click on the **Command** tab.
10. Add a new Command external control by clicking on the  button.
11. Rename this new control to *Default Command Control* and set its number to 3.
12. Link the Default command control to the Default Level Preset's Assert button. Do this by dragging the link icon  in the External Control Systems dialog to the right of the control name and dropping it on the link icon  for the Default Level Preset's Assert button.

13. Change the Default Command Control's Label to "Default Level". The dialogs appear below as follows:





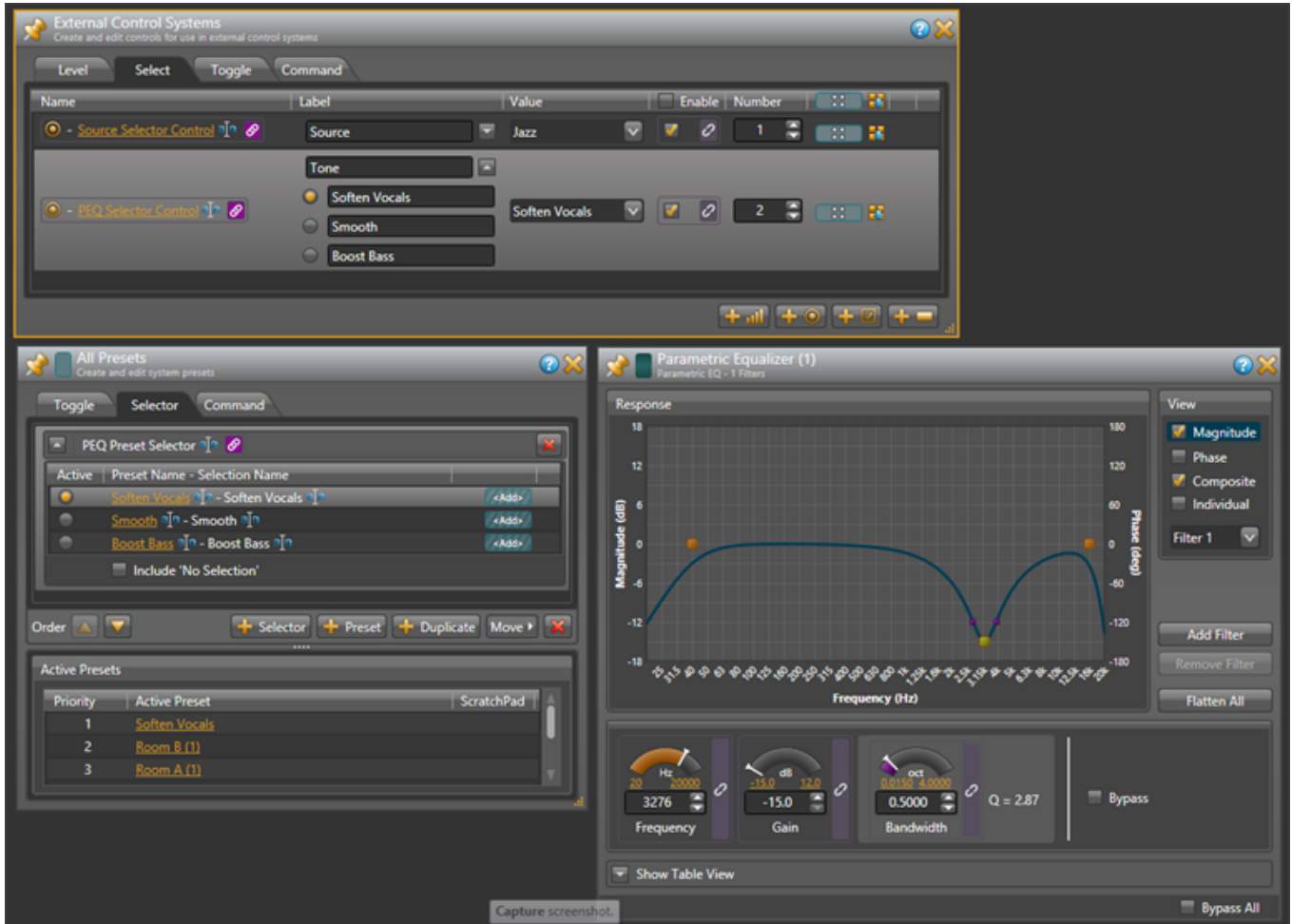
Finally, we'll create a selector preset to provide three options for the PEQ settings in the lounge

1. In the All Presets dialog, click on the **Selector** tab.
2. Create a new Selector preset by clicking on the **+Selector** button.
3. Rename this selector preset to *PEQ Preset Selector*.
4. Add three presets to this selector by clicking the **+Preset** button three times.
5. Change the names of these presets to *Soften Vocals*, *Smooth*, and *Boost Bass*.
6. Activate the *Soften Vocals* preset by clicking on the radio button to the left of its name in the All Presets dialog. Then uncheck the *Include 'No Selector'* checkbox at the bottom of the PEQ Selector Preset.
7. Open the property dialog for the PEQ block and set the Gain to *-15.0* and the Frequency to *3276*.
8. Add the PEQ block to the *Soften Vocals* preset – that is the first preset in the selector preset. To do this, drag the blue Preset icon next to the PEQ block in the processing map and drop it on the blue '<Add>' rectangle for the *Soften Vocals* preset.
9. Set the PEQ frequency to *1589* and add the PEQ block to the *Smooth* preset.
10. Set the PEQ frequency to *393*, the Gain to *+12.0* and add the PEQ block to the *Boost Bass* preset.
11. Test the preset selector by clicking on the Active radio buttons and observing the PEQ change.
12. In the External Control Systems dialog click on the **Select** tab.
13. Create a new Selector external control by clicking on the  button.
14. Rename this new control to *PEQ Selector Control* and set its number to *2*.



## CHAPTER 3: Example HAL1x Configuration

15. Link the PEQ Selector Control to the PEQ Preset Selector control in the All Presets dialog. Do this by dragging the link icon  in the External Control Systems dialog to the right of the control name and dropping it on the link icon  for the PEQ Preset Selector control.
16. Change the PEQ Selector Control's Label to "Tone". The dialogs appear below as follows:



Wow, that's the whole configuration. Be sure to save your configuration before quitting Halogen.

## Configuration Summary

The example configuration provides the following external controls:

1. A Selector for lounge program source – control number 1

There are three selections: Classical, Jazz, and Reggae

2. A Selector for lounge tone (PEQ) – control number 2

There are three selections: Soften Vocals, Smooth, and Boost Bass.

3. A Level for lounge volume – control number 6

This changes the output block's level for the lounge.

4. A Toggle to mute all audio outputs – control number 4

This mutes all output blocks and sets their levels to Off. While setting the levels is not necessary, we've included it here to cause the lounge output level to change so the Halogen/HAL Control Server will send a 'set level' message.

5. A Toggle to open and close the wall of a room combine block – control number 5

6. A Command to reset audio outputs to default levels – control number 3

This sets the three outputs to -20.0dB and un-mutes them. In addition, it sets the Mute All toggle control to unchecked so the state is consistent with the outputs being un-muted.

# CHAPTER 4: Integrating Crestron Control Systems with HAL

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## Overview

This guide describes how to setup a Crestron controller and virtual touch panel to communicate with a Halogen/HAL Control Server. It is designed to be used in conjunction with the files found in the Crestron Support Package. The contents of this support package include:

- CrestronControlSystems\_Guide.pdf - The guide you are reading now
- ControlSystemSample.hal - Halogen configuration file intended for loading in Halogen or your HAL1x
- Rane\_HAL.smw - SIMPL Windows program project file
- Rane\_HAL\_TP.vtp - VisionTools Pro-e touch panel project file
- Rane HAL Level Processor.usp - SIMPL+ user module source file
- Rane HAL Level Processor.ush - Compiled user module

The Crestron Support Package is installed with the Halogen software and can be accessed from the Windows Start Menu under Halogen -> Guides. If you want to access the files directly they are available on the product DVD or from the Halogen install directory:

- C:\Program Files (x86)\Rane Corporation\Halogen\Guides\Support Packages\Crestron directory

You can also download the most up-to-date version of this support package from the Rane website (<http://rane.com/hal>).



**NOTE:** You do not need to connect your controller to an actual HAL in order to test your control system. A PC running Halogen can simulate all the feedback your controller would get from a HAL running the same configuration.

This guide walks you through the configuration of a Crestron TCP/IP client, e-Control and XPanel. It then describes how to wire logic symbols for serial communications with a Halogen/HAL Control Server using a **Serial Buffer** and **Serial I/O**. After explaining our general communications strategy, we then turn our attention to the HAL's specific control types.

The HAL system has four types of controls: toggles, commands, levels and selectors. All four are accessible to external TCP/IP clients like a Crestron controller. This guide covers each of these control types in depth one-by-one. First we dive into the logic symbols and signal flow for the control type. Then we use the control type in some touch panel applications. The applications are:

- Toggle button to activate and deactivate a preset.
- Toggle button to open and close a wall in a room combine block.
- Command button to assert a preset.
- Slider to adjust the level on an output.
- Radio buttons to select between input sources.
- Radio buttons to select between presets.

## CHAPTER 4: Integrating Crestron Control Systems with HAL

The guide concludes with a troubleshooting section that covers the most common problems encountered when configuring a target system for the examples.

### Checklist

To use the files from the Crestron Support Package and follow along with the examples you will need:

- A Windows desktop or laptop with an Ethernet port and the latest Rane Halogen (1.1.0 or higher) and Crestron SIMPL Windows and Vision Tools Pro-e software installed.
- A Crestron controller with Ethernet. The example project is configured for an MC2E but you can replace this with another Crestron Ethernet controller.
- An Ethernet switch and cables for the PC and controller.

Although you will ultimately connect a HAL to your control system all of the integration and testing can be accomplished without a HAL.

This guide assumes that the reader has had some exposure to Crestron programming and is able to navigate the Crestron software. A typical workflow for developing a Crestron application is:

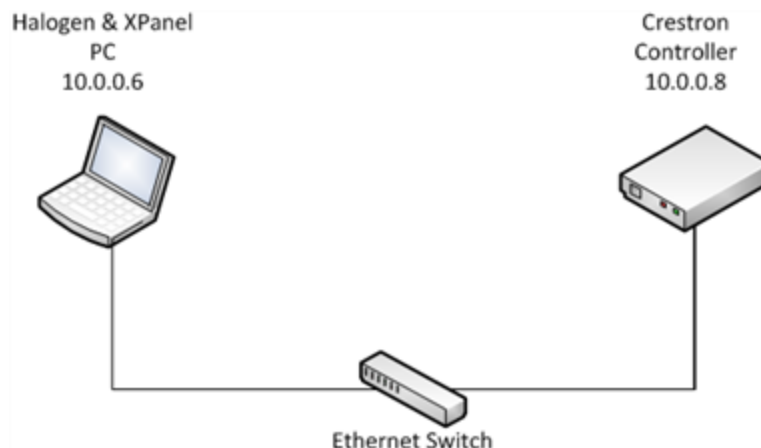
- Configure your Crestron controller, touch panel[s] and TCP/IP connections to other devices in the SIMPL Windows **Configuration Manager**.
- Add logic symbols to the SIMPL Windows **Program View** and name their signals so that the routing results in the desired program.
- Compile the program and transfer it to your controller.
- Draw a custom touch panel user interface in Vision Tool Pro-e.
- Join button and slider numbers in the user interface with digital and analog inputs and outputs in the program.
- Compile the user interface and transfer it to your touch panel[s].

Once your application is running you can use the SIMPL debugger in Crestron Toolbox to pinpoint mistakes in your program by watching how signal states change as you interact with your touch panel[s].

### Getting Started

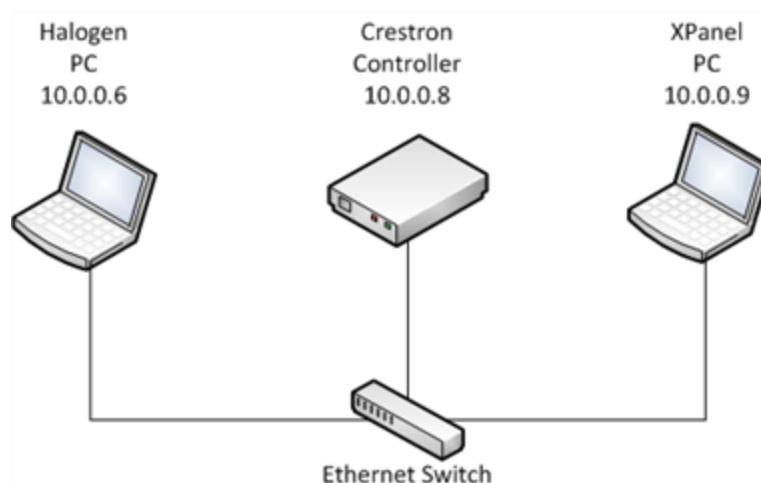
This section shows how to set up your system so that you can get the most out of the examples. The principal components of your system are the Windows PC and Crestron controller. Both should reside on the same network so that they can communicate easily. Configure their IP settings and plug them into the Ethernet switch using the Ethernet cables.

Launch Halogen on the PC so that it can pretend to be a HAL. A virtual HAL starts running on your PC when you launch Halogen. This process goes away when you exit Halogen. Make sure to have the right configuration file open in Halogen when testing your system. Use the ControlSystemSample.hal file that came with the Crestron Support Package when working with the examples.



### Minimal Example Network

In addition to substituting for a HAL, the PC will also act as a touch panel by using the standalone XPanel desktop application generated by Vision Tools Pro-e. The XPanel executable should be targeted for Windows PCs.



Later on you can choose to run the XPanel on a different PC to simulate a more realistic installation environment. For now, run Halogen and the XPanel on the same PC as shown in the Minimal Example Network diagram.

Run the example program on the controller so that it can talk to Halogen Control Server and the XPanel. Open the Rane\_HAL.smw program file in SIMPL Windows. Switch to the **Configuration Manager**. If your controller is not an MC2E, right-click on the MC2E node in the lower **System Views** pane and select **Replace “MC2E”** from the context menu to bring up the **Select New Device** dialog. Select the model of your controller from that dialog and click the OK button. Change the server address of the TCP/IP client and the IP address of the XPanel so that they both match your PC’s IP address. Compile the program and transfer the resulting Rane\_HAL.spz file to your controller.

Compile and run the XPanel on the PC so that it can talk to the controller. User interface widgets on the XPanel are assigned to specific outputs in the program so the two depend on each other. Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e and hit F12 to compile it. This will generate a Rane\_HAL\_TP.exe folder in the same directory as the project. Double-click the LaunchXPanel.exe file located in this new directory to run the XPanel.

## CHAPTER 4: Integrating Crestron Control Systems with HAL

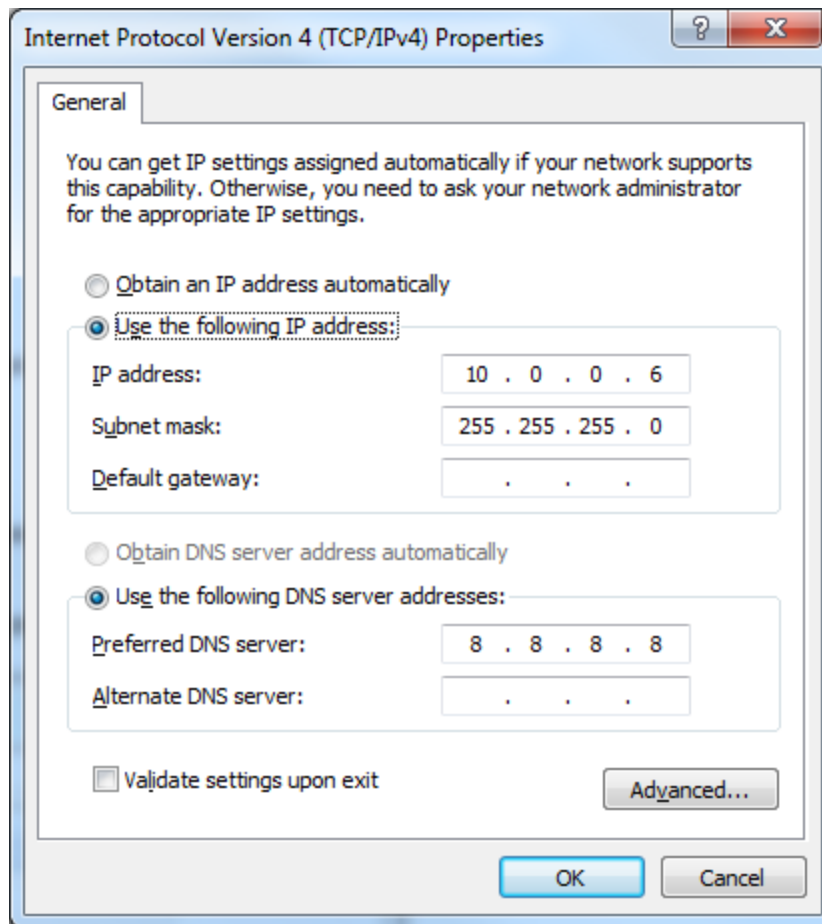
You know all of the components of your system are communicating properly when the **Connected** status indicator in the upper right corner of the XPanel is blue. If the XPanel fails to connect to the controller on startup, an error pop-up dialog saying “Control System Connection: Disconnected” will eventually appear. If this dialog does not come up but the connected status indicator is still blacked out then the controller is not connecting to Halogen. Refer to "Troubleshooting" on page 47 if you find yourself struggling to establish communications.

### Configuring IP Addresses

A Crestron controller connects to a HAL or PC running Halogen via TCP/IP. The easiest way to accomplish this connectivity is by assigning the HAL or PC a static IP address.



You configure a HAL's static IP addresses from the **Host Device Settings** dialog in the **Hardware** workspace. To access this dialog, connect to your HAL, hover your mouse over the **HAL bar** at the top of the Hardware Map, then click on the gear icon that appears. The Host Device Settings dialog is only available when Halogen is connected to a HAL. Host Device Settings like static IP assignments reside solely on that HAL and do not travel with the Halogen configuration file.



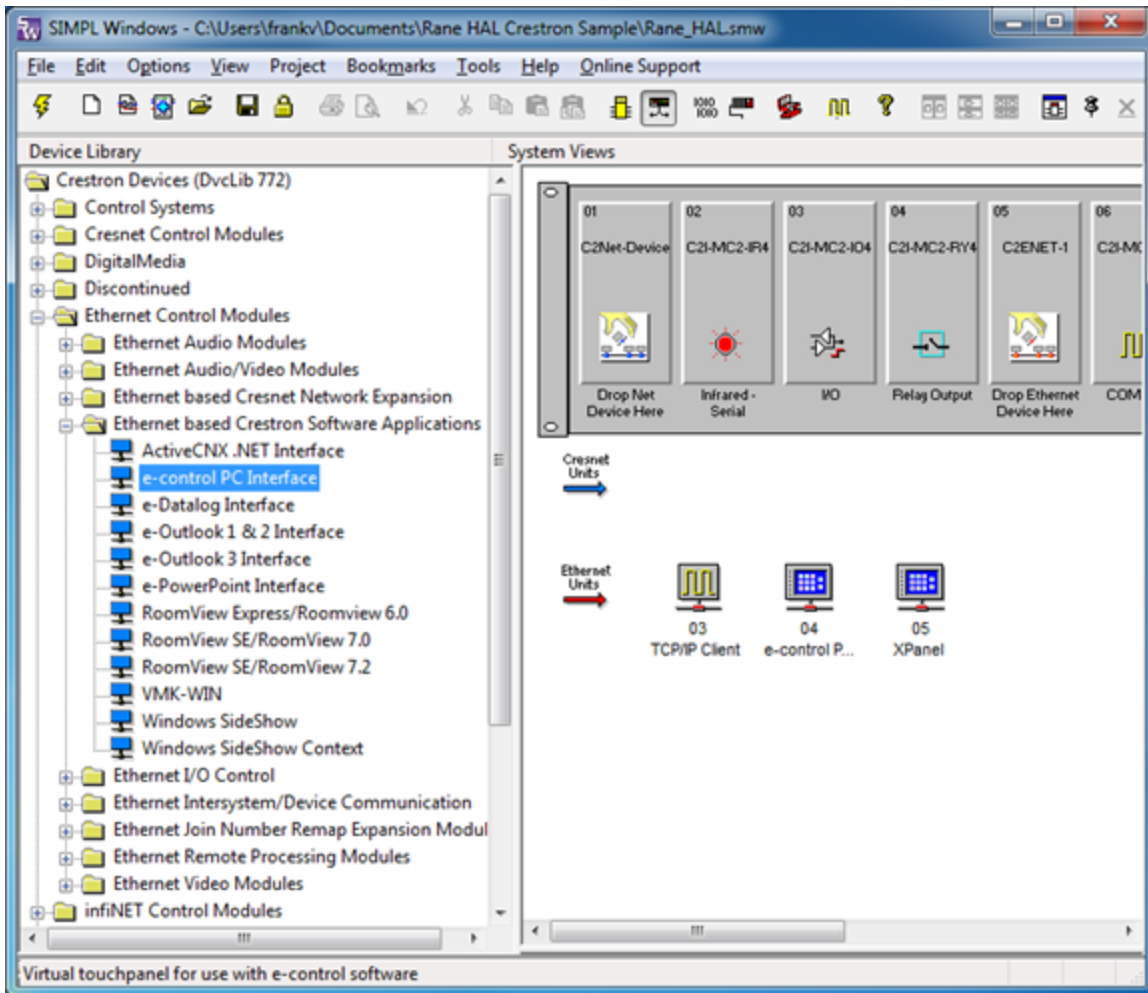
PCs are frequently setup to use dynamic IPs but a static IP is preferable if you want to use your PC in place of a HAL during development. The controller tries to connect to a TCP server (your PC in this case) at a specific IP address. If your PC has a dynamic IP address assigned to it that address may change if it is disconnected from the network or the DHCP lease expires. You also probably do not want to configure your PC with the same static IP as your HAL in the event that both are connected to the same network.

Control system networks are typically private networks with no direct route to the Internet except through a gateway or proxy server. Certain IP address ranges are reserved for private networks. 10.0.0.0 to 10.255.255.255 is one of those address ranges. Start with a small self-contained network. Plug your Halogen PC, controller, XPanel PC and HAL into the same Ethernet switch and assign each one a unique static IP in the 10.0.0.0 network.

## Ethernet Units

This section shows you how to set up the Ethernet Units in the Crestron system configuration so that the examples work.

## CHAPTER 4: Integrating Crestron Control Systems with HAL



Open the Rane\_HAL.smw program file in SIMPL Windows. Switch to the **Configuration Manager**. Below the large controller device block in the upper **System Views** pane you will see a row of Ethernet Units. The row contains the following device icons: **TCP/IP Client**, **e-control PC Interface** and **XPanel**. These devices originated from different folders in the **Device Library** tree. Here are their locations so you can drag and drop them into system configurations that you build yourself.

- Ethernet Intersystems/Device Communication -> TCP/IP Client
- Crestron Software Applications -> e-Control PC Interface
- Touchpanels -> Touchpanels (Ethernet) -> XPanel

To add an e-Control and XPanel to the list of Ethernet Units remember to drop them on the Ethernet slot of the large controller device block in the upper **System Views** pane.

Double-click the **TCP/IP Client** icon in **Ethernet Units** to bring up its **Device Settings** dialog. Select the **IP Net Address** tab. The **Default Address** field should contain the IP address of your control systems server. This server could be running on your HAL or it could be running on your PC when Halogen is open. The example program file comes with the Default Address set to 10.0.0.6. Change this address to match the IP address of your PC for now.

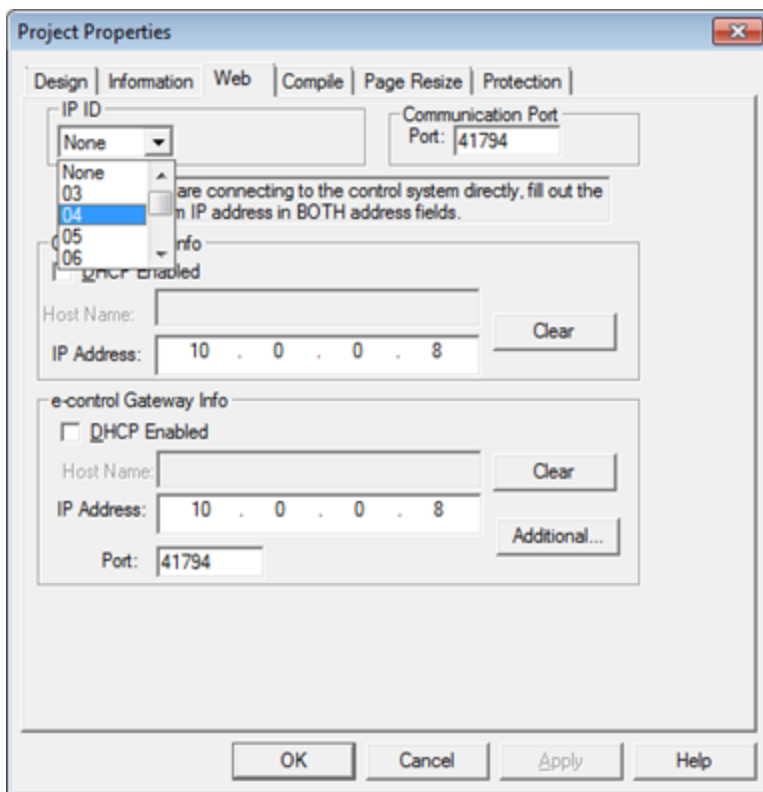


Double-click on the **e-Control PC Interface** icon in Ethernet Units to bring up its Device Settings dialog. Select the **IP Net Address** tab. The Default Address field should be set to 127.0.0.1. This is the loopback address of any PC so there should be no reason to ever change it. An e-control is what enables a PC to act like an Ethernet touch panel. Remember the e-control's IP ID of 4. You will need it for the **XPanel Project Properties** dialog in Vision Tools Pro-e.

Double-click the **XPanel** icon in Ethernet Units to bring up its Device Settings dialog. Select the IP Net Address tab. The Default Address field should contain the IP address of the PC where the XPanel is going to be executed. The example program comes with the Default Address set to 10.0.0.6. Change this address to match the IP address of your PC. For now, this should be the same PC running Halogen. You can change it again later if you decide you want to try running the XPanel from a different PC.

## XPanel

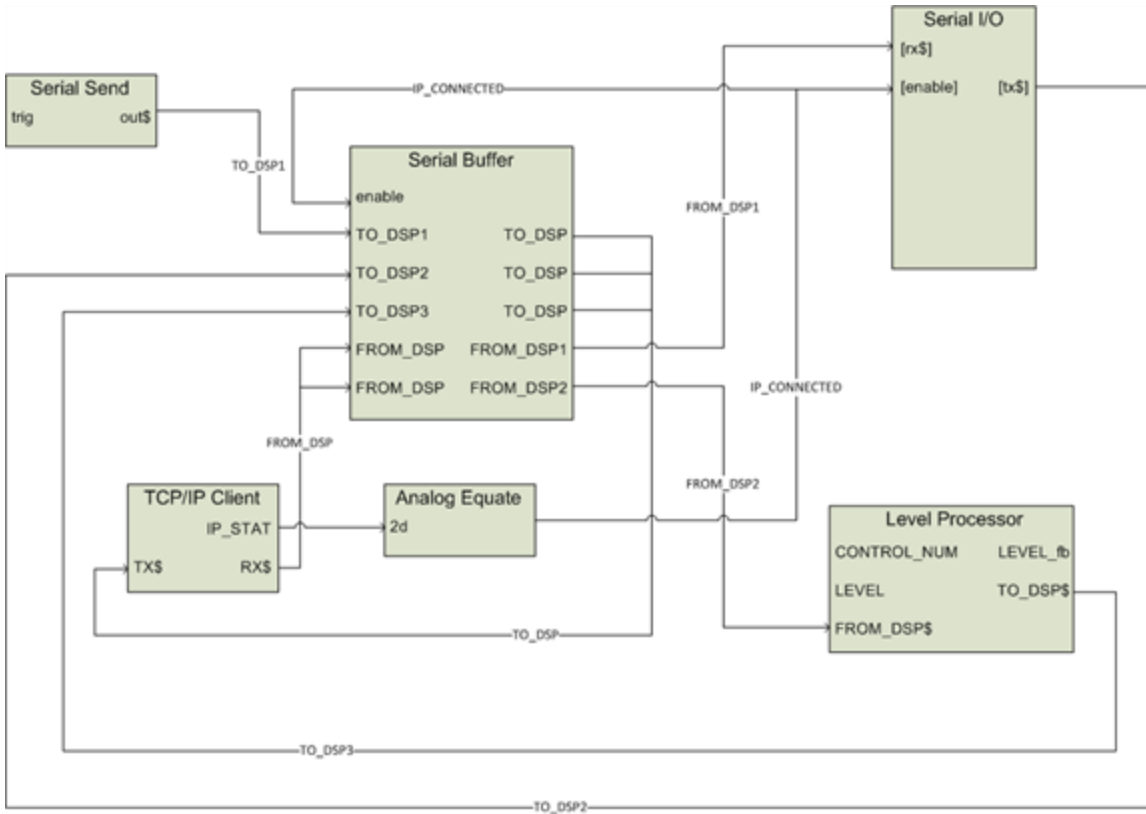
This section shows you how to set up the XPanel executable's communication settings so that the examples work. Have the IP address of your controller and the IP ID of the e-control handy before proceeding.



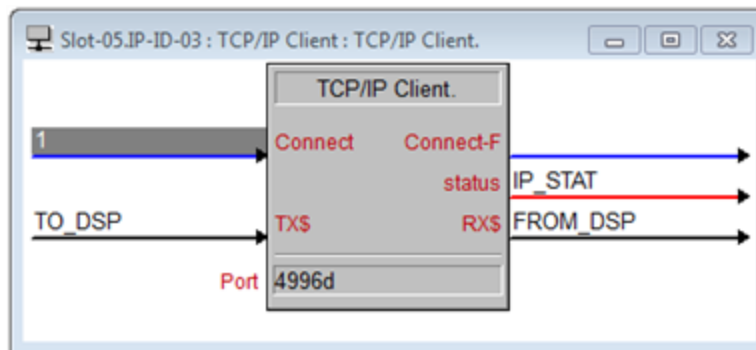
Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e. Right-click on the Rane\_HAL\_TP project in the **Project View** and select Properties. Select the **Web** tab in the **Project Properties** dialog. Enter your controller's IP address for both **Control System Info** and **e-control Gateway Info**. Make sure that the IP ID of the e-control, not the IP ID of the XPanel, is selected. Recompile the XPanel to apply the new settings to the executable.

### Ethernet Communication Symbols

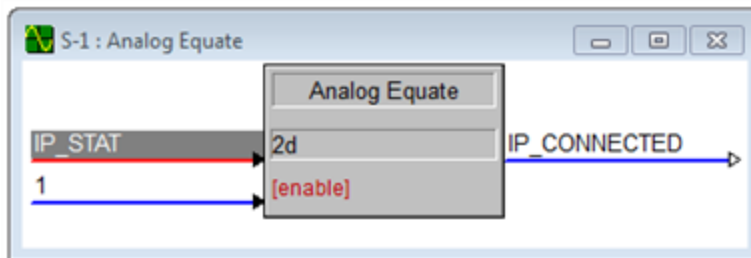
A number of symbols in the example program are wired for TCP/IP communications with Halogen/HAL and e-control. Trace through the TCP/IP Serial Signal Flow diagram to get an overview of how these symbols work together. You will probably use these same symbols to connect to Halogen/HALs in your own programs so now let's look at them up close.



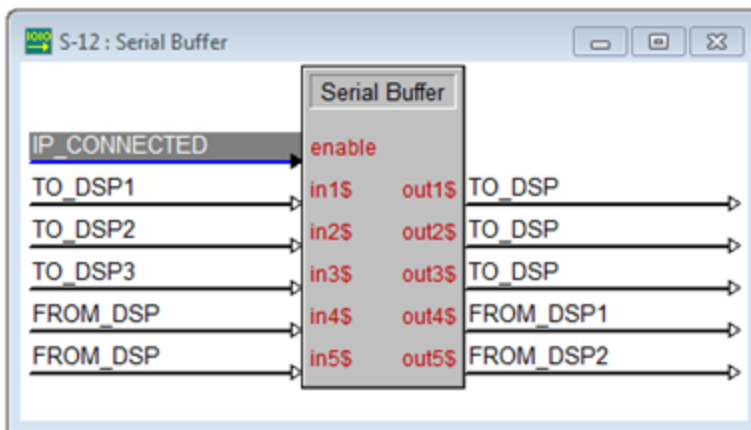
Open the Rane\_HAL.smw program file in SIMPL Windows and switch to the **Program Manager**. Click on the **Program View** pane so that it is in focus and select Expand All from the View menu. Double-click the **TCP/IP Client** and **e-control Touchpanel** symbols under the Ethernet slot of the controller to open their details dialogs. Then double-click on the **Analog Equate** and **Serial Buffer** symbols under **Logic** to open the details for those up.



The **Port** parameter for a **TCP/IP Client** connecting to a HAL should always be set to 4996. The same goes for a client connecting to a PC that is impersonating a HAL. Data gets sent to Halogen/HAL via the symbol's serial **TX\$** input. Data from Halogen/HAL comes out the symbol's serial **RX\$** output. The **Connect** digital input is held high so that the client keeps trying to reconnect if the connection is lost.



When a connection attempt succeeds, the outgoing analog *IP\_STAT* signal becomes a 2. This triggers the **Analog Equate** symbol's outgoing digital *IP\_CONNECTED* signal to go high. The **Serial Buffer** and **Serial I/O** symbols are only enabled when *IP\_CONNECTED* is high. They are disabled when the client is disconnected since both symbols only deal with strings traveling to and from Halogen/HAL.

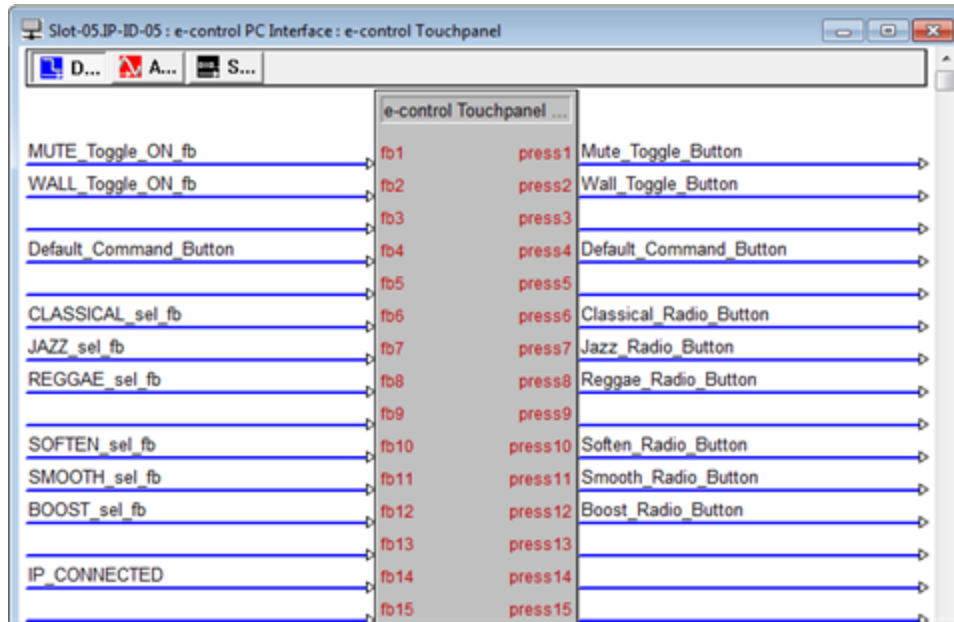


The **Serial Buffer** symbol protects the program from problems that can occur when serial signals coming from Halogen/HAL are jammed (driven by multiple outputs).

Multiple symbols send strings to Halogen/HAL, so the **Serial Buffer** keeps them from stepping on each other. Each symbol that wants to write to the **TO\_DSP** signal gets its own input on the Serial Buffer: *TO\_DSP1*, *TO\_DSP2*, *TO\_DSP3*, etc. The Serial Buffer routes these inputs to the same **TO\_DSP** output. If multiple inputs are issued simultaneously the output is generated in successive order. The end result is the same as giving each output a unique name and routing them to a **Serial Concatenation** symbol.

The strings coming from Halogen/HAL are forwarded to different symbols for processing. The Serial Buffer duplicates the signal coming from Halogen/HAL across multiple outputs. The *FROM\_DSP* signal is forked into separate *FROM\_DSP1* and *FROM\_DSP2* signals going out to the **Serial I/O** and **Rane HAL Level Processor** symbols.

## CHAPTER 4: Integrating Crestron Control Systems with HAL



The e-control PC interface enables an XPanel to connect to the LAN that its PC host is on. The **e-control Touchpanel** symbol looks just like an **Ethernet Touchpanel** symbol in terms of ins and outs. All of the signals that are on the **XPanel** symbol should be applied to the same inputs and outputs on the e-control Touchpanel. This allows signals to flow out from the XPanel through the e-control over the LAN to the controller and vice versa.

### Signal Names

A few signal naming conventions are used throughout the example program. It helps to familiarize yourself with them before delving further into the logic and signal flow of the program.

A button press signal from a touch panel output has the *\_Button* suffix at the end of its name. A button feedback signal to a touch panel input has the *\_fb* suffix at the end of its name. Take the **Wall Open** button that appears on the XPanel for example. The signal from its **press2** output is named *Wall\_Toggle\_Button* and the signal to its **fb2** input is named *Wall\_Toggle\_ON\_fb*.

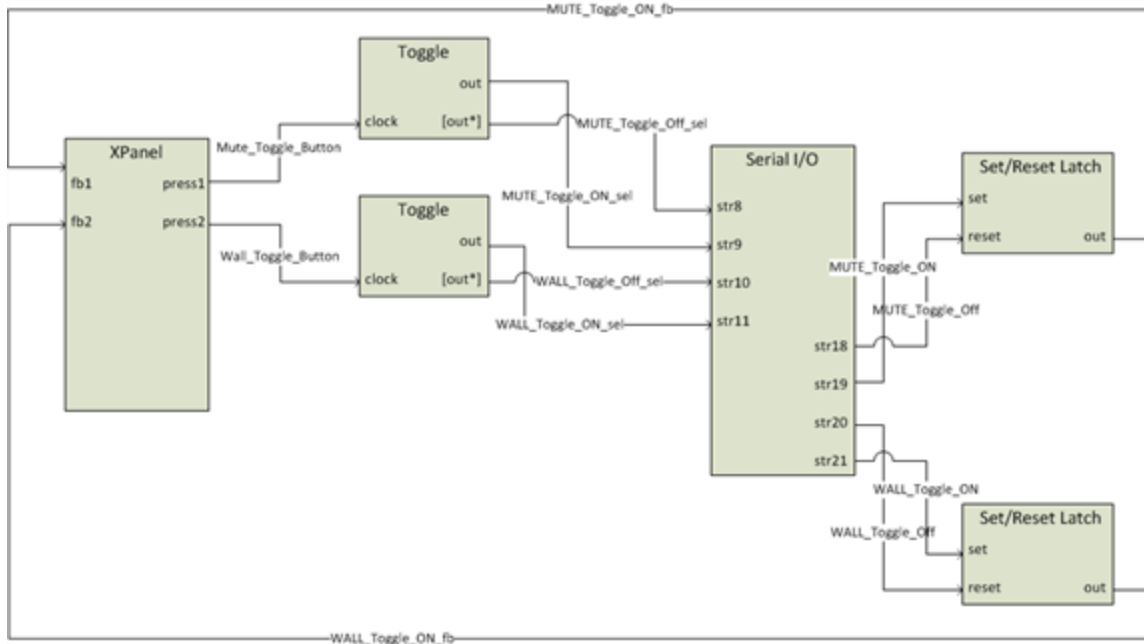
The *\_ON* and *\_Off* substrings appear in the names of some of the digital signals used for toggles. A toggle button press could be turning a toggle on or off depending on its previous state. A press signal is transient so other signals are needed to capture and maintain the toggle's state. When a signal with an *\_ON* suffix goes high that always indicates a toggle ON event. When a signal with an *\_Off* suffix goes high that always indicates a toggle Off event.

Several touch panel button press signals have a *\_Radio\_Button* suffix at the end of their name. The suffix is intended for radio buttons that operate together as members of a group. Take the **Source** selector group of radio buttons on the XPanel for example. If the **Classical** radio button is selected then the **Jazz** and **Reggae** radio buttons must be deselected. Because they are so closely related the signals for radio buttons belonging to the same group are arranged close to one another throughout the program.

A *\_sel* substring is used in digital signal names to indicate that signal is part of a selector. It takes the place of the *\_Radio\_Button* suffix in selector signals that aren't driven by the touch panel. Take the **Source** selector as an example. The **Serial I/O** has outgoing *CLASSICAL\_sel*, *JAZZ\_sel* and *REGGAE\_sel* signals for the three different source selector positions that can come from Halogen/HAL. The *\_sel* substring also appears in the names of certain toggle

signals. In that context the toggle is viewed as a 2-way selector with a toggle ON selection and a toggle Off selection.

## Toggles

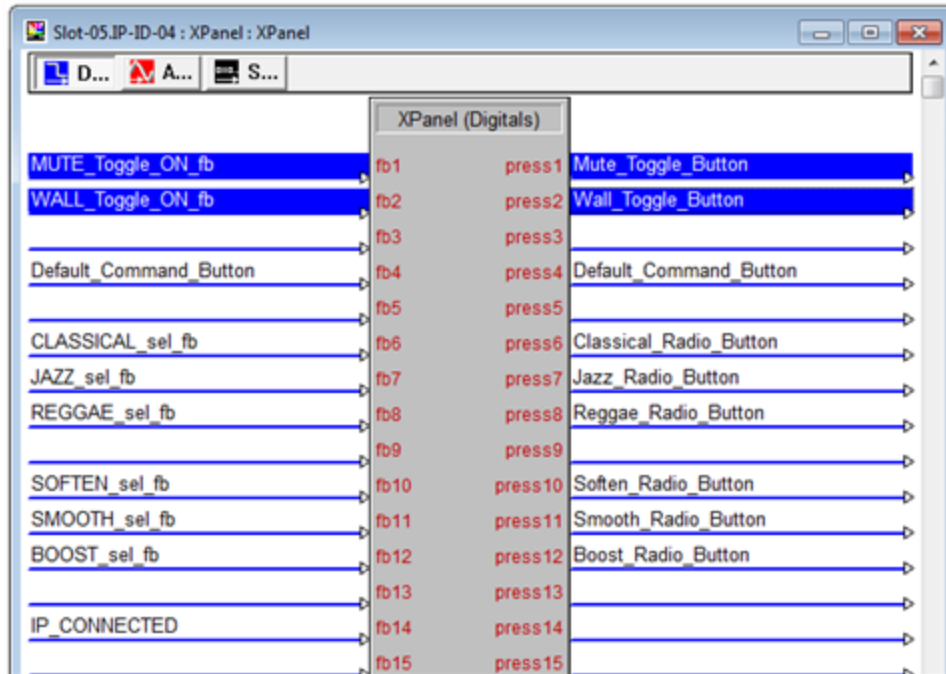


This section explains how to integrate HAL toggle controls with buttons on an XPanel by examining a couple of touch panel applications: a preset toggle button and a wall toggle button. We start by breaking down the logic symbols and signal flow for the HAL toggle controls. Then we examine how to bind the HAL toggle controls to toggle buttons in the touch panel user interface.

Toggles in a HAL system have only an on or off state. They are represented as checkboxes in the Halogen software and DR remotes. Because toggles only have two states, they are modeled as digital signals in SIMPL. The example program has symbols to deal with toggle button presses on a touch panel and toggle messages from a Halogen/HAL. Trace through the Toggle Control Signal Flow diagram to get an overview of how these symbols work together before we look at them up close.

Open the Rane\_HAL.smw program file in SIMPL Windows. There are two HAL toggle controls in this program uniquely identified by HAL control numbers 4 and 5. These HAL control numbers appear in the **Toggle** tab of Halogen's **External Control Systems** dialog as *Mute Toggle Control* and *Wall Toggle Control*.

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Double-click the **XPanel** symbol under Slot-05 of the MC2E in the **Program View**. The *Mute Toggle Control* maps to the digital **fb1** input and **press1** output on the XPanel. The *Wall Toggle Control* maps to the digital **fb2** input and **press2** output on the XPanel. The outgoing press signals for the two toggle buttons on the XPanel are named *Mute\_Toggle\_Button* and *Wall\_Toggle\_Button*. A press signal from an XPanel goes high when that touch panel button is pressed and falls back down to low as soon as it is released.

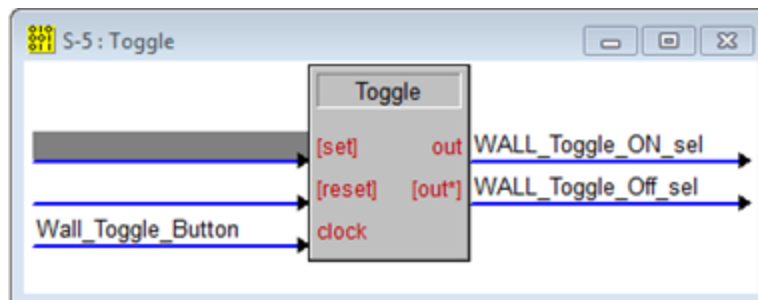
Double-click the **Serial I/O** and **Serial Send** symbols under **Logic** in the **Program View** to bring up their details. The controller modifies HAL toggle control values by sending message strings to Halogen/HAL. These 'set toggle' messages are strings comprised of a toggle control type, HAL control number and value. The valid 'set toggle' messages for the two HAL toggle controls in this program are <T&4&0>, <T&4&1>, <T&5&0> and <T&5&1>.

The controller also requests HAL toggle control values by sending message strings to the Halogen/HAL. These 'get toggle' messages are comprised of a toggle control type and HAL control number. The valid 'get toggle' messages for the two HAL toggle controls in this program are <T&4> and <T&5>. Halogen/HAL responds to these 'get toggle' messages with corresponding 'set toggle' messages.

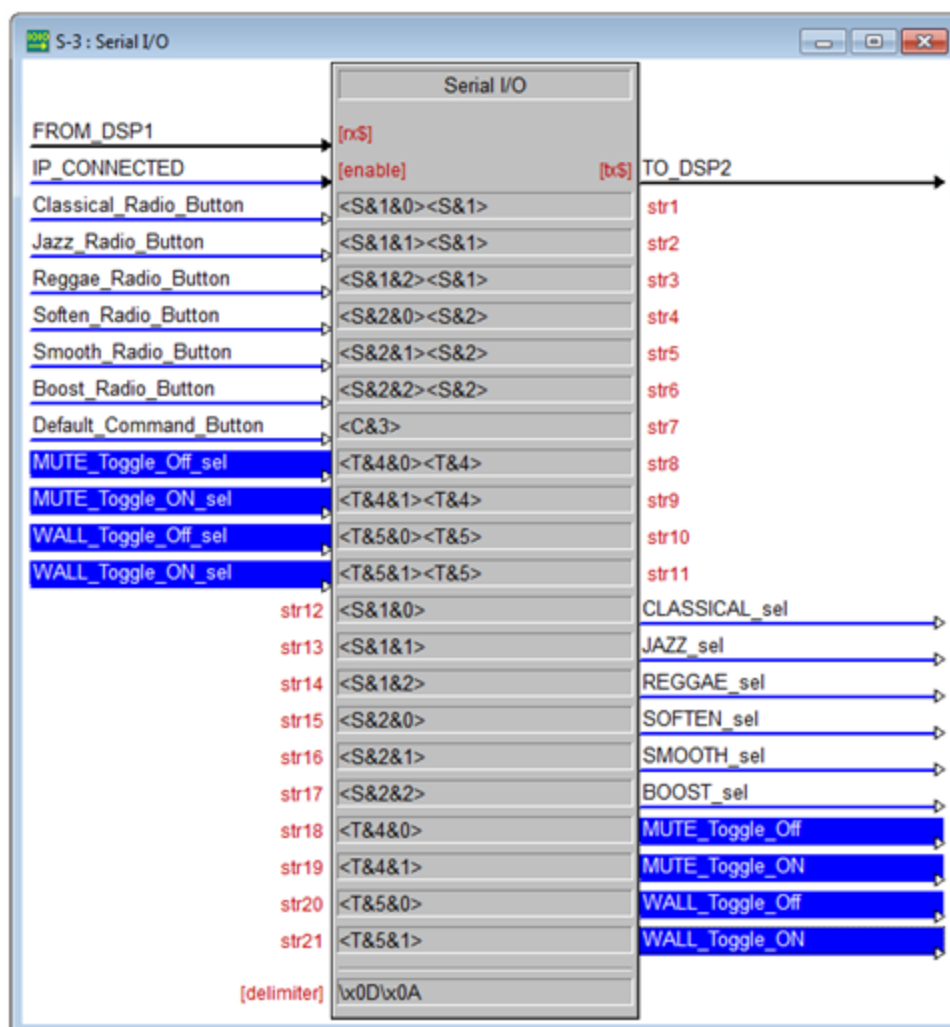


**NOTE:** Refer to Appendix A "HAL External Control Message Protocol" on page 49 for more information on toggle messages.

The 'get toggle' messages for the two HAL toggle controls appear in the string parameter of the **Serial Send** symbol that is triggered whenever the **TCP/IP Client** connects to Halogen/HAL. Requesting the toggle values on connect ensures that the toggle buttons on the **XPanel** are in sync with the live toggle values on Halogen/HAL.



Double-click one of the two **Toggle** symbols under **Logic** in the **Program View** to bring up its details. Each toggle button press signal from the **XPanel** drives a clock input on a **Toggle** symbol. The Toggle symbol translates the button press into separate toggle *ON\_sel* and toggle *Off\_sel* signals. When the toggle *ON\_sel* signal is high the toggle *Off\_sel* signal is low and vice versa. These signals are latched by the Toggle symbol so that when you let go of a toggle button on a touch panel it stays in its new on or off state.

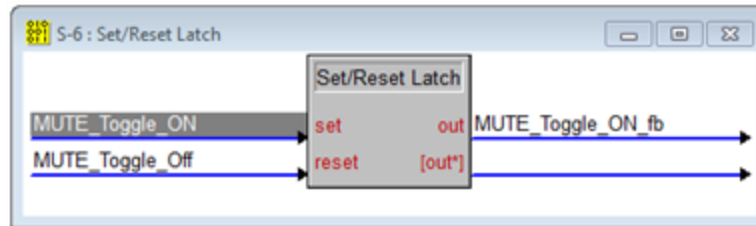


The two Toggle symbols -- outgoing toggle *ON\_sel* and toggle *Off\_sel* signals -- are what trigger the 'toggle set' messages sent by the **Serial I/O**. Take the *Mute\_Toggle\_Off\_sel* signal, for instance. When that signal goes high, a 'set toggle' message to turn HAL toggle control 4 off is sent. The 'set toggle' message is immediately followed by

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a 'get toggle' message for the same HAL toggle control. Remember to include a 'get toggle' message with any 'set toggle' message because Halogen/HAL does not echo a 'set toggle' message back to the client that sent it. This is needed because the visible state of a touch panel toggle button is determined by its feedback signal and feedback is only generated from incoming 'set toggle' messages.

Signals coming out of the **Serial I/O** go high when matching message strings are received from Halogen/HAL. Take the *Mute\_Toggle\_Off* signal, for example. This signal goes high when a 'set toggle' message string of <T&4&0> is received. The signal won't go low again until another character is received and a match with the right-most characters of the input string no longer exists. The same technique applies to the *Mute\_Toggle\_On* signal when a 'set toggle' message string of <T&4&1> is received.



Double-click one of the two **Set/Reset Latch** symbols under **Logic** in the **Program View** to bring up its details. Notice that *Toggle\_ON* and *Toggle\_Off* signals from the **Serial I/O** drive the **set** and **reset** inputs. The Set/Reset Latch merges the two inputs into a single *Toggle\_ON\_fb* signal. This outgoing feedback signal is latched so that when a toggle value change is received the toggle button stays in its new on or off state.

The feedback signals from the **Set/Reset latches** drive the **fb1** and **fb2** feedback inputs for the two toggle buttons on the XPanel. These feedback signals are generated by the 'set toggle' message the **Serial I/O** receives from Halogen/HAL. These 'set toggle' messages are the same strings sent by the Serial I/O when toggle buttons are pressed on the XPanel. They may arrive unsolicited or in response to a 'get toggle' message.

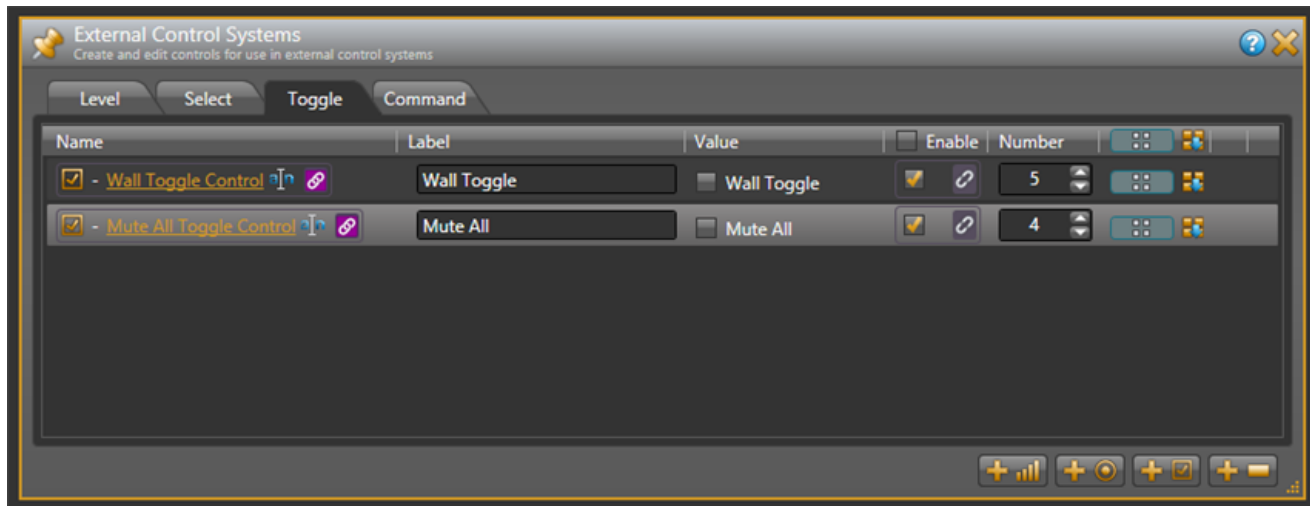


**NOTE:** Refer to Appendix A "HAL External Control Message Protocol" on page 49 for more information on toggle messages.

### Toggle Presets

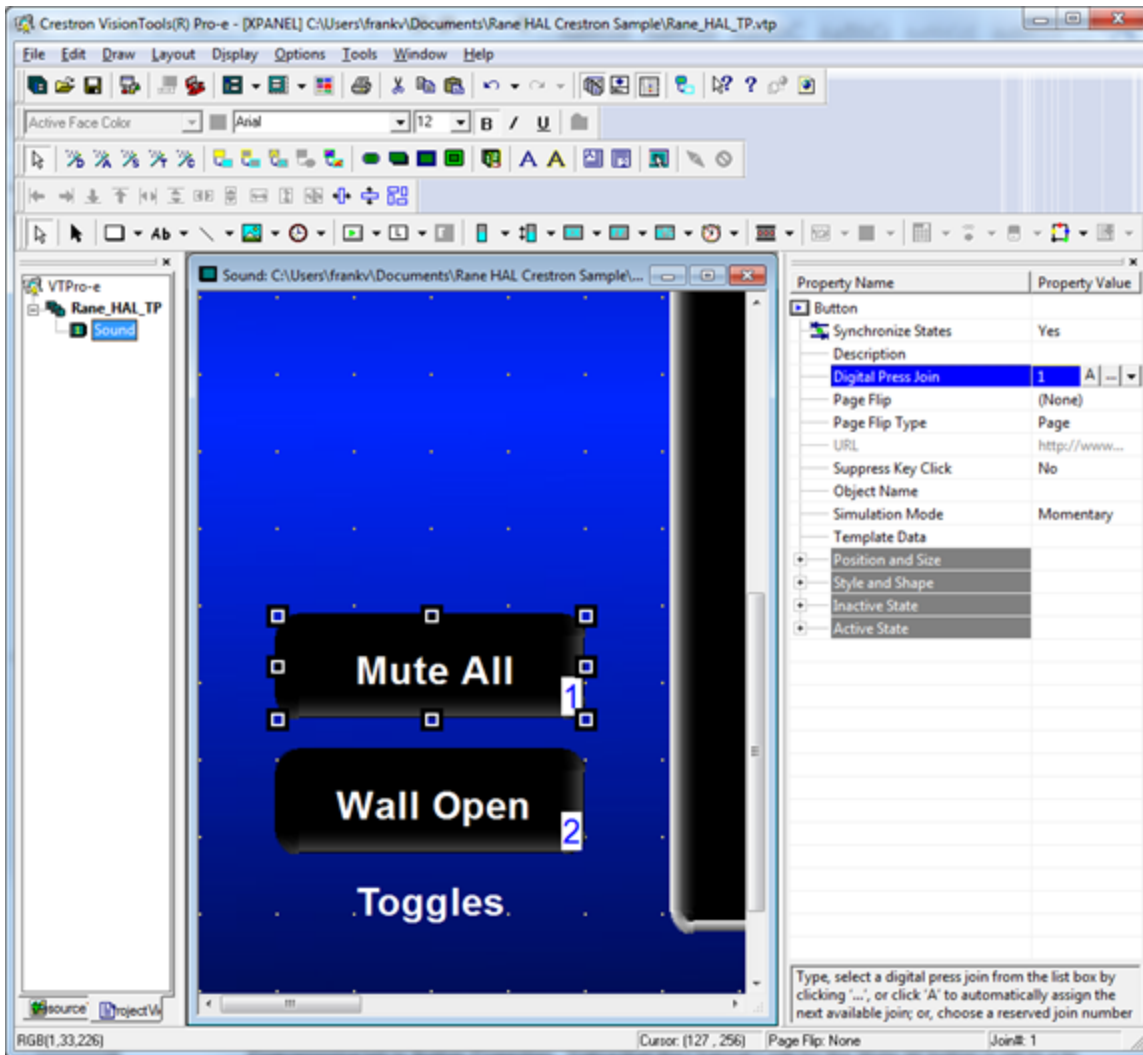
This example demonstrates how to get a toggle button on a touch panel to activate and deactivate a Halogen/HAL preset. The example Halogen configuration file contains a toggle preset for muting and unmuting all the outputs on a HAL. This **Mute All Preset** is linked to a Control Systems toggle control named **Mute All Toggle Control**. Toggling this HAL control activates or deactivates the preset.





Open the ControlSystemSample.hal example configuration file in Halogen. Then open the **External Control Systems** dialog and select the **Toggle** tab. The **Value** checkbox for the **Mute All Toggle Control** reflects the current state of that HAL toggle control.

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Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e. Next, open the **Sound** page window to view the example touch panel design. Select the **Mute All** button in the Sound page window. Notice that the **Digital Press Join** number for the Mute All button is set to 1 to match the **fb1** input and **press1** output on the XPanel symbol in the program. The button will appear raised when it is in its inactive state and depressed when it is in its active state.

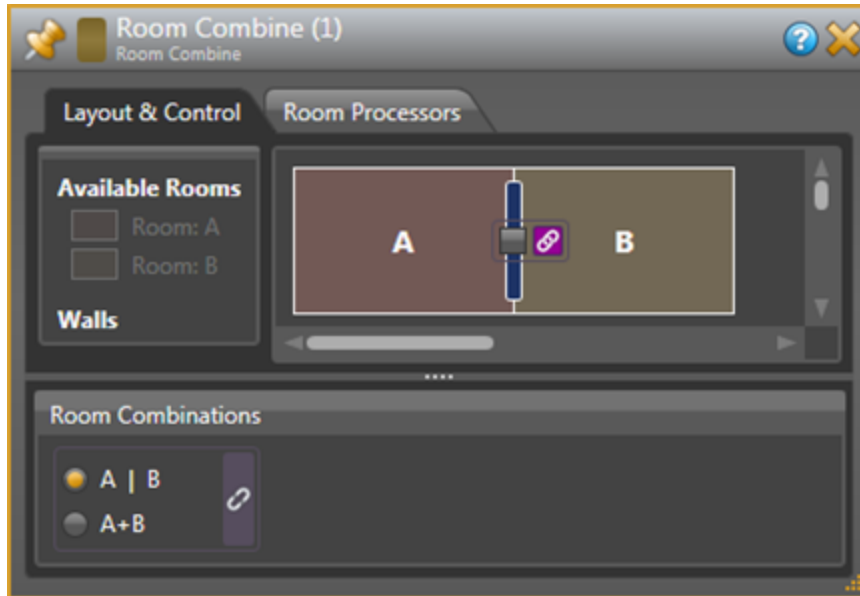
Launch the XPanel and verify that the **Connected** status indicator shows you are connected. Refer to the "Troubleshooting" on page 47 section if the status indicator says **Disconnected**. Click the **Mute All** button on the XPanel on and off. The touch panel button will remain in its new active or inactive state after you release the mouse button. This is the latching behavior alluded to earlier. Now watch the Active state of the **Mute All Preset** in Halogen as you click the Mute All button on the XPanel. Lastly toggle the **Mute All Preset** from Halogen to see that the Mute All button and Lounge slider on the XPanel respond.



**NOTE:** Refer to Appendix B "Using PuTTY to Test External Control Systems" on page 60 for help with debugging if the system does not behave as described here.

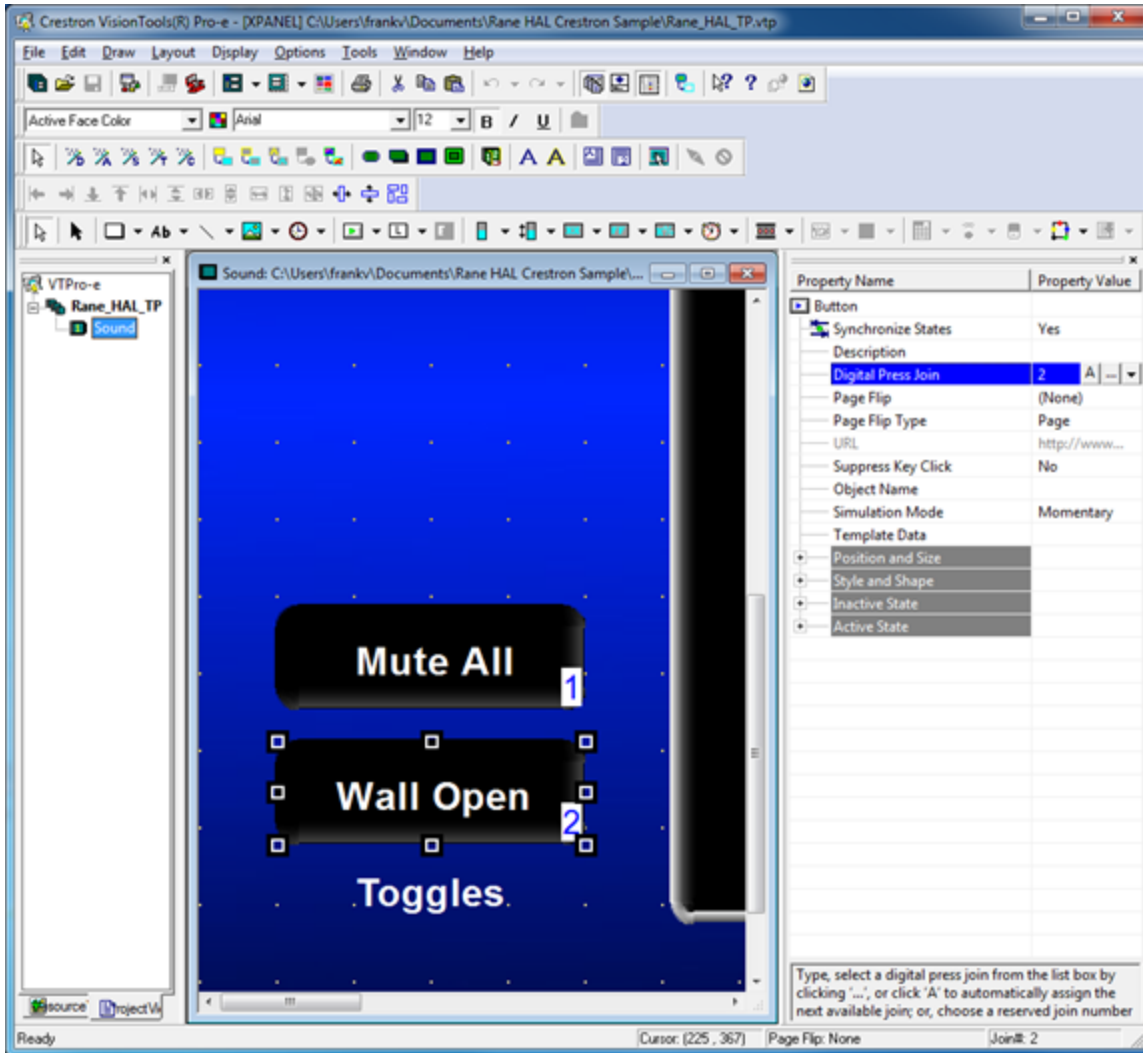
## Wall Toggles

This example demonstrates how to get a toggle button on a touch panel to open and close a movable wall in a Halogen/HAL Room Combine block. The example Halogen configuration file contains a Room Combine block with two rooms A and B. The movable wall in between these two rooms is linked to a Control Systems toggle control named **Wall Toggle Control**. Toggling this HAL control opens and closes the wall.



Open the ControlSystemSample.hal example configuration file in Halogen, then open the **External Control Systems** dialog and select the **Toggle** tab. The **Value** checkbox for the **Wall Toggle Control** reflects the current state of that HAL toggle control.

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Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e. Next, open the **Sound** page window to view the example touch panel design. Select the **Wall Open** button in the Sound page window. Notice that the **Digital Press Join** number for this button is set to 2 to match the **fb2** input and **press2** output on the **XPanel** symbol in the program. The touch panel button will appear raised when it is in its inactive state and depressed when it is in its active state.

Double-click the **Room Combine (1)** block in the Halogen **Processing** map to open its properties dialog. Select the **Layout and Control** tab in the **Room Combine (1)** dialog. Launch the **XPanel** and verify that the **Connected** status indicator shows that you are connected. Refer to the "Troubleshooting" on page 47 section if the status indicator says **Disconnected**. Watch the wall between rooms A and B appear and disappear as you click the **Wall Open** button on the XPanel open and closed. Now toggle the wall open and closed from the **Room Combine (1)** dialog and watch that same button turn on and off on the XPanel.



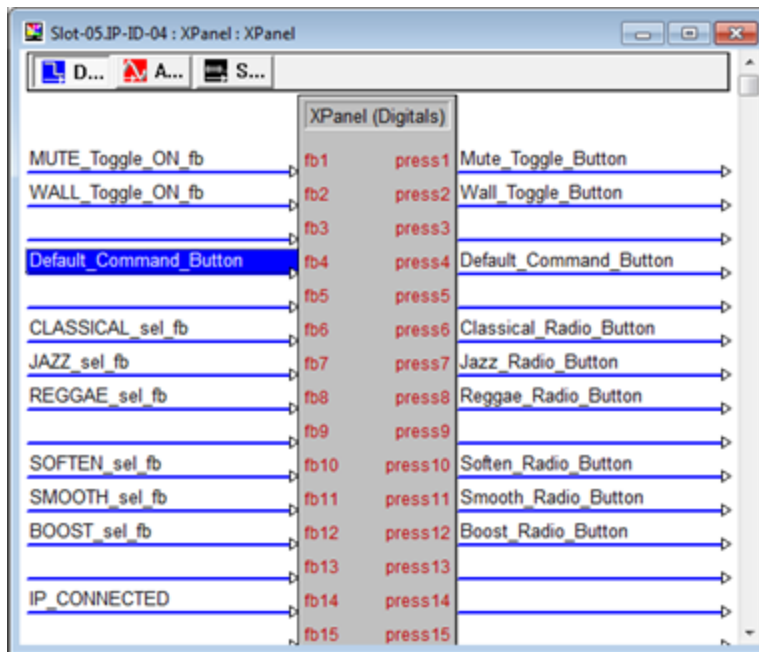
**NOTE:** Refer to Appendix B "Using PuTTY to Test External Control Systems" on page 60 for help with debugging if the system does not behave as described here.

## Commands

This section explains how to integrate a HAL command control with buttons on an XPanel by examining a single application: a touch panel button that asserts a HAL preset. We start by breaking down the logic symbols and signal flow for the HAL command control. Then we examine how to bind the HAL command control to a button in the touch panel user interface.

Command controls are stateless in a HAL system. Unlike toggles, they have no on or off values. HAL Command controls are merely triggers for predefined actions like command presets. Think of them as "Fire and forget." Because they are stateless, the feedback for a command button on a touch panel must be momentary. The example program has symbols to deal with command button presses from a touch panel. Let's take a look at them.

Open the Rane\_HAL.smw program file in SIMPL Windows. Double-click the **XPanel** symbol under the Ethernet slot of the controller and the **Serial I/O** symbol under Logic in the **Program View** to bring up their details.



There is one HAL command control in this program uniquely identified by HAL control number 3. This control number appears in the **Command** tab of Halogen's **External Control Systems** dialog as *Default Command Control*.

Whenever the **Default Level** button on the **XPanel** is clicked the **Serial I/O** sends a message string to Halogen/HAL. These 'command' messages contain a command control type and a HAL control number. The only valid 'command' message for the HAL command control in this example is <C&3>.



**NOTE:** Refer to Appendix A "HAL External Control Message Protocol" on page 49 for more information on command messages.

When a client sends a 'command' message, Halogen/HAL echoes it back to all its other clients. The **Serial I/O** in this program currently ignores unsolicited <C&3> 'command' messages but you can add a string parameter to parse them if you want your touch panel to exhibit feedback when they arrive.

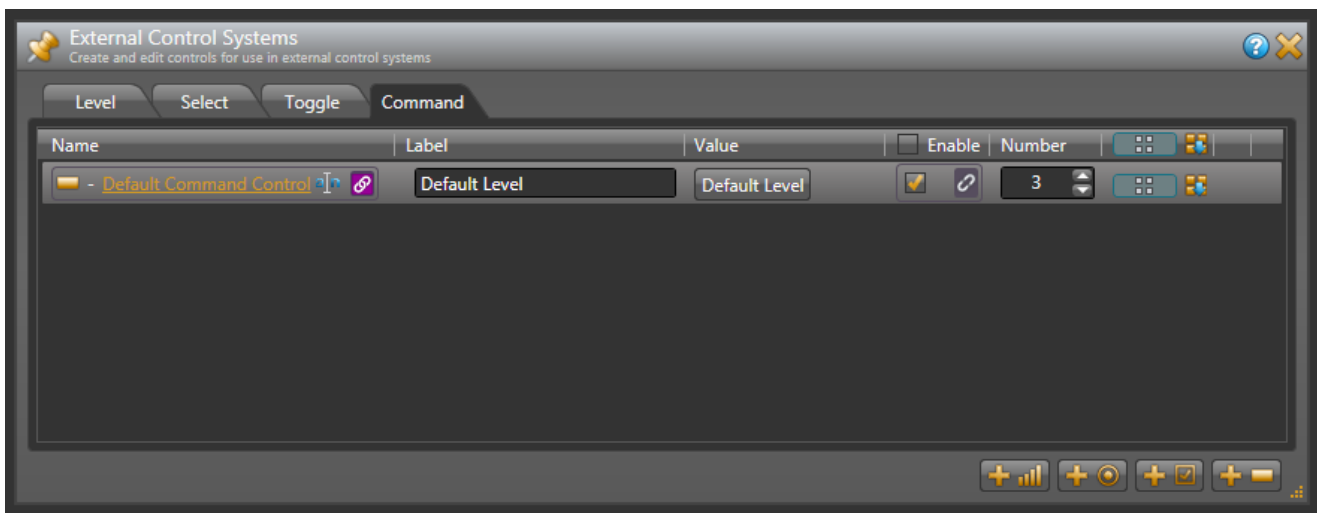
## CHAPTER 4: Integrating Crestron Control Systems with HAL

The momentary nature of a HAL command control makes generating feedback for a button on a touch panel very simple. Just route the touch panel button's press output signal to the feedback input signal. That's all there is to it. The button on the XPanel will only appear active when you hold it down.

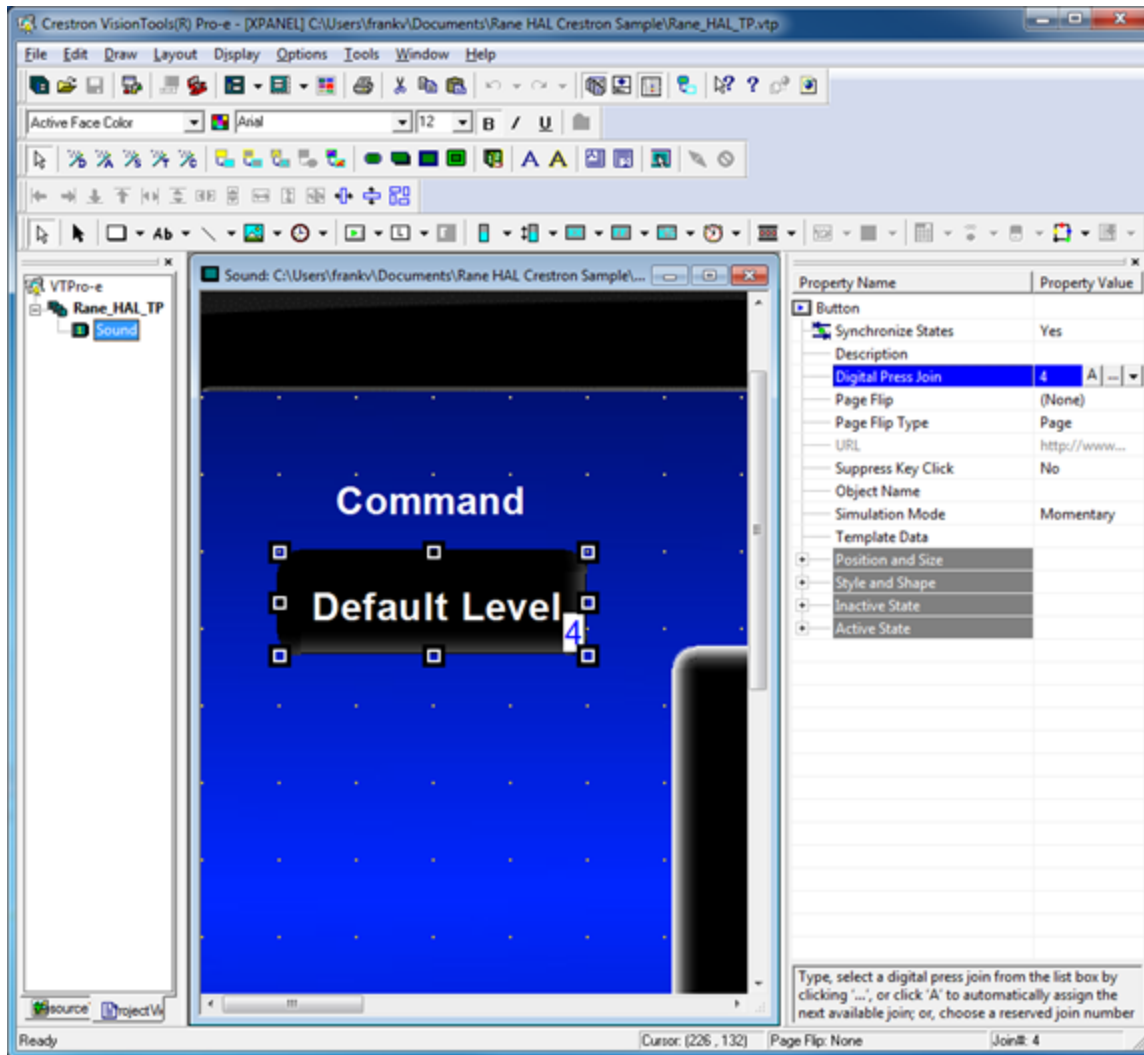
### Command Presets

This example demonstrates how to get a button on a touch panel to trigger a command preset on a HAL. The example Halogen configuration contains a command preset that sets the levels of all the HAL line outputs to a default level of -40.0 dB. A preset like this is handy when a user wants to revert undesired audio settings back to their original defaults. The preset is linked to a Control Systems command control named **Default Command Control**. Invoking the HAL command control asserts the preset.

Open the ControlSystemSample.hal example configuration file in Halogen. Then open the **External Control Systems** dialog and select the **Command** tab. Clicking on the **Default Level** button in this dialog fires the HAL command control.



Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e. Next open the **Sound page** window to view the example touch panel design. Select the **Default Level** button in the Sound page window. Notice that the **Digital Press Join** number for this button is set to 4 to match the **fb4** input and **press4** output on the **XPanel** symbol in the program. The touch panel button will appear raised when it is in its inactive state and depressed when it is in its active state.

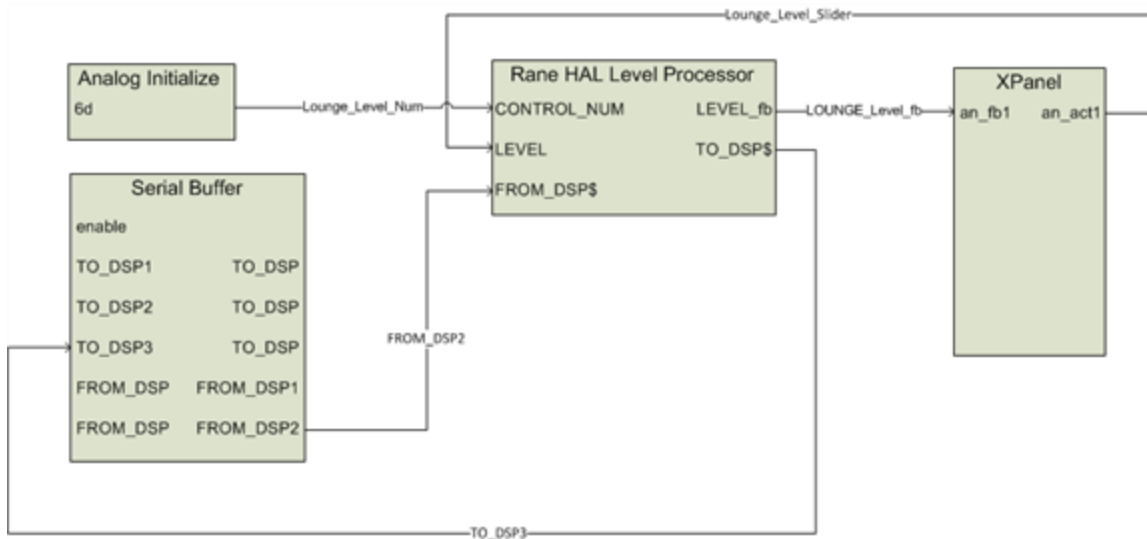


Launch the XPanel and verify that the **Connected** status indicator shows that you are connected. Refer to the "Troubleshooting" on page 47 section if the status indicator says **Disconnected**. Drag the *Lounge* slider on the XPanel up to about 90%. Now press the **Default Level** button on the XPanel. The slider jumps to 50%. Also notice this command button doesn't stick like the previous toggle buttons. Now adjust the Lounge slider down to 10% and assert the **Default Level Preset** from Halogen. The slider on the XPanel jumps back to the center again.



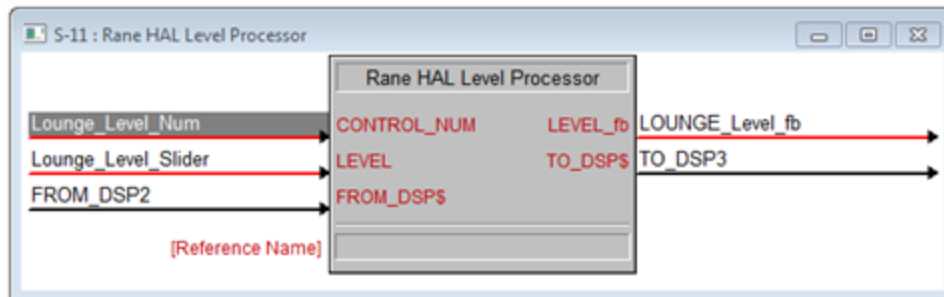
**NOTE:** Refer to Appendix B "Using PuTTY to Test External Control Systems" on page 60 for help with debugging if the system does not behave as described here.

### Levels



This section explains how to integrate HAL level controls with sliders on an XPanel by looking at a volume slider on a touch panel. We start by breaking down the logic symbols and signal flow for the HAL level control. Then we examine how to bind the HAL level control to a slider in the touch panel user interface.

The level controls on a HAL that are accessible to an external controller have a value range of 0 to 1000. Compare that with the 0 to 65535 range of Crestron analog signals. This discrepancy requires a Crestron controller to convert the level values it gets from and sends to a HAL. HAL levels map naturally to sliders on Crestron touch panels. The example program contains symbols to deal with slider movements on a touch panel and level messages from a HAL. Let's take a look at them.



Open the Rane\_HAL.smw program file in SIMPL Windows. Double-click the **Rane HAL Level Processor** symbol under **Logic** in the **Program View** to bring up its details. There is one HAL level control in this program uniquely identified by HAL control number 6. This control number appears in the **Level** tab of Halogen's **External Control Systems** dialog as *Lounge Level Control*. It is also fed to the **CONTROL\_NUM** input of the Rane HAL Level Processor by an **Analog Initialize** symbol.

The **Rane HAL Level Processor** has two more inputs and two more outputs. The **FROM\_DSP** input is driven by the **\$RX** output on the HAL's **TCP/IP Client**. The **TO\_DSP** output drives the **\$TX** input on the HAL's **TCP/IP Client**. The **LEVEL** input is driven by the analog output from a slider on the **XPanel**. The **LEVEL\_fb** signal drives the analog feedback input for that same slider. Dragging the slider on the touch panel causes the Rane HAL Level Processor to convert changes in the **LEVEL** analog input to appropriate HAL Level values and send 'set level'



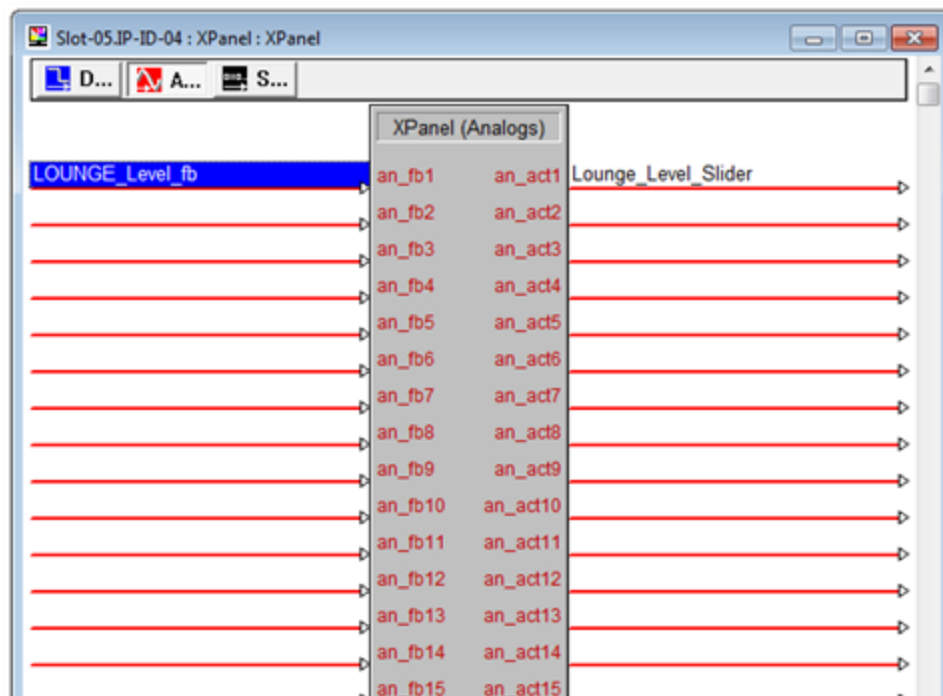
messages to Halogen/HAL. These 'set level' messages contain a level control type, HAL control number and level value. Valid 'set level' messages for the HAL level control in this example program are <L&6&0>, <L&6&1>, <L&6&2> all the way to <L&6&1000>.

Halogen/HAL sends these same 'set level' messages to the controller whenever another client changes a HAL level control value. These 'set level' messages from Halogen/HAL are processed by the Rane HAL Level processor which converts them from the HAL level range to Crestron analog signal range, resulting in feedback to the touch panel slider.

The controller also requests HAL level control values by sending message strings to Halogen/HAL. These 'get level' messages are comprised of a level control type and HAL control number. The 'get level' message for the HAL level control in this program is <L&6>. Halogen/HAL responds to this 'get level' message with a corresponding 'set level' message.



**NOTE:** Refer to Appendix A "HAL External Control Message Protocol" on page 49 for more information on level messages.



Double-click the **XPanel** symbol under Slot-05 of the MC2E in the **Program View** to bring up its details. Click on the **Analogs** button on the top bar of the **XPanel details** window. The **Rane HAL Level Processor** for the *Lounge Level Control* maps to the *an\_fb1* input and *an\_act1* output on the XPanel. The incoming feedback signal is named *Lounge\_Level\_fb*. The outgoing touch panel slider signal is named *Lounge\_Level\_Slider*.

The <L&6> 'get level' message appears in the string parameter of the **Serial Send** symbol that is triggered whenever the **TCP/IP Client** connects to Halogen/HAL. Requesting the level value on connect ensures that the slider on the XPanel is in sync with the live level value on Halogen/HAL.

The **Rane HAL Level Processor** is a user module written in SIMPL+. Right-click on it under **Logic** in the **Program View** and select **Edit User Module** to view its source code. The user module parses and encodes 'set level'

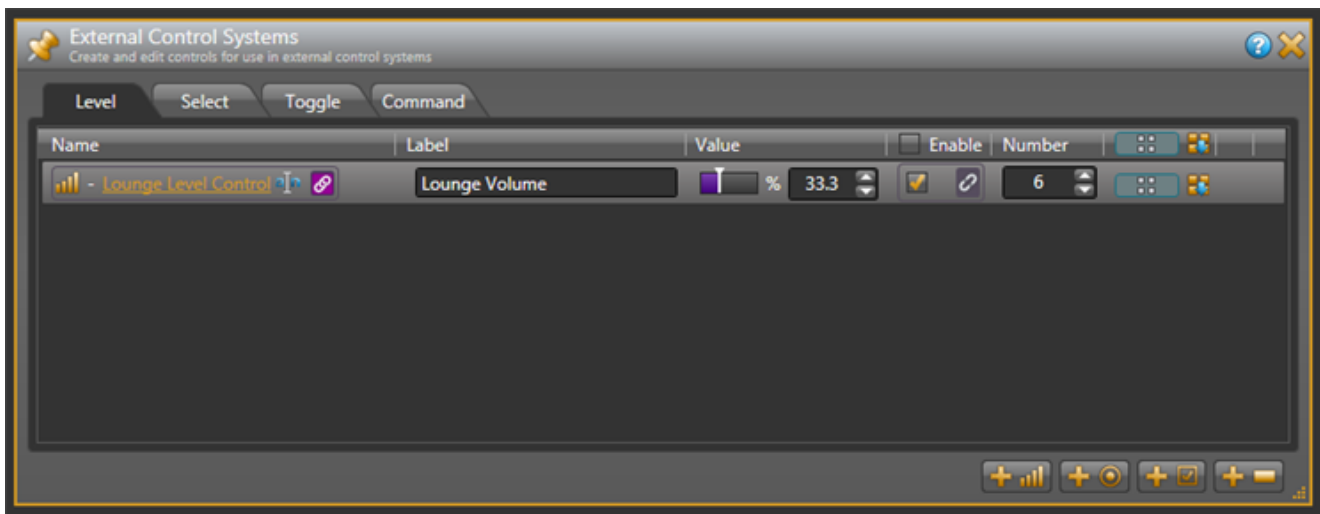
## CHAPTER 4: Integrating Crestron Control Systems with HAL

messages and converts from Crestron analog to HAL level values and back. A full listing of the user module source code is available in Appendix C "Crestron Source Code" on page 66.

Because the **Rane HAL Level Processor** is a user module, you can add multiple instances of this symbol to your own programs for more HAL levels. First, drag it from the **Symbol Library** and drop it into your **Program View** as you would any of the stock logic symbols. Then initialize the **CONTROL\_NUM** input and route the rest of the ins and outs to the **XPanel**, **e-control TouchPanel** and **TCP/IP Client**.

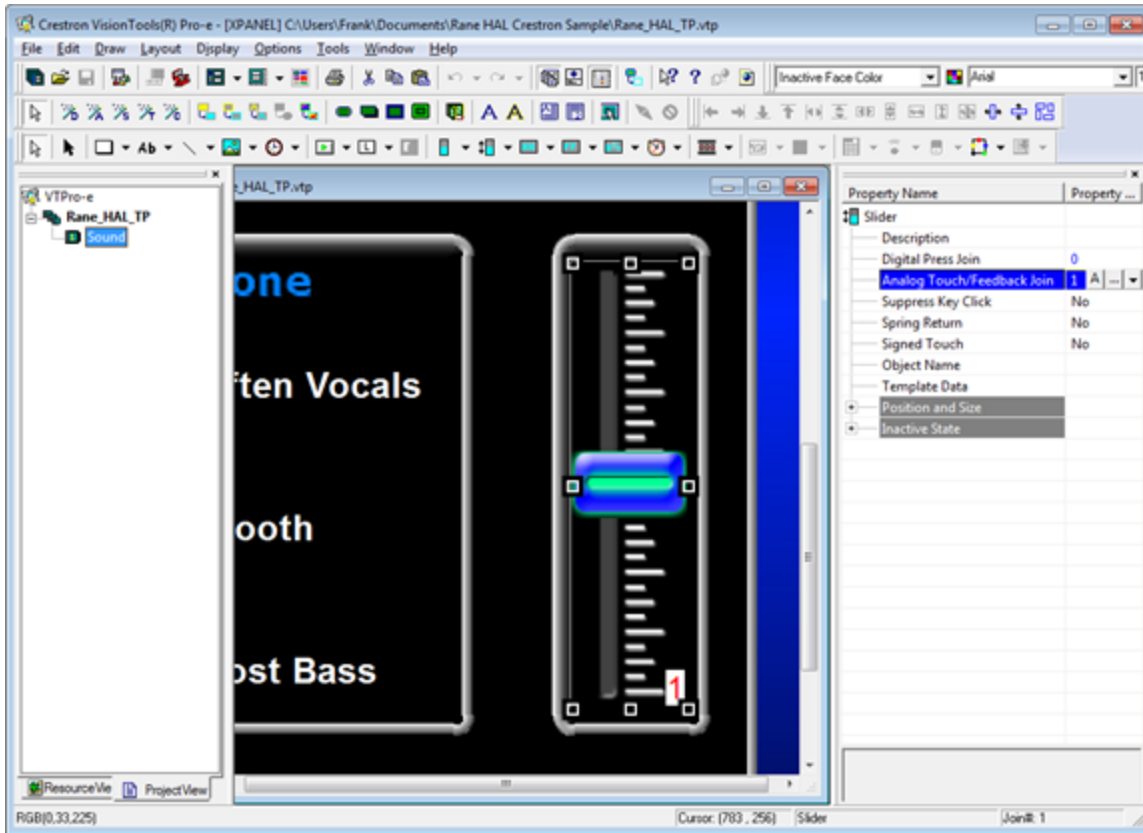
### Sliders

This example demonstrates how to get a slider on a touch panel to manipulate the level on a HAL output. The example Halogen configuration contains a HAL line output wired to a lounge. The remaining HAL line outputs go to rooms A and B. The level on the lounge output is linked to a HAL Control Systems level control named **Lounge Level Control**. Adjusting the HAL level control alters the level.



Open the **ControlSystemSample.hal** example configuration file in Halogen. Then open the **External Control Systems** dialog and select the **Level** tab. The percentage shown in the **Value** column for the **Lounge Level Control** is the live value of that level in the system. Drag the level slider in that dialog and the number shown in the edit field changes accordingly.

Open the **Rane\_HAL\_TP.vtp** project file in Vision Tools Pro-e. Then open the **Sound page** window to view the example touch panel design. Select the **Lounge** slider on the right side of the Sound page window. Notice that the **Analog Touch/Feedback Join** number for this slider is set to **1** to match the **an\_fb1** input and **an\_act1** output on the **XPanel** symbol in the program. The slider's output is routed to the **LEVEL** input of the **Rane HAL Level Processor**. The slider's input is driven by the **LEVEL\_fb** output of the **Rane HAL Level Processor**.



Launch the **XPanel** and verify that the **Connected** status indicator shows that you are connected. Refer to the "Troubleshooting" on page 47 section if the status indicator says **Disconnected**. Drag the **Lounge** slider up and down on the XPanel to adjust the level continuously. The percentage shown for the **Lounge Level Control** in Halogen fluctuates with your slider movements. Double-click the **HAL Line Output (1)** block in the Halogen Processing map to bring up its properties dialog. Now drag the slider for the level in **HAL Line Output (1)** block dialog back and forth in Halogen. The slider on the XPanel moves up and down in conjunction with the level.

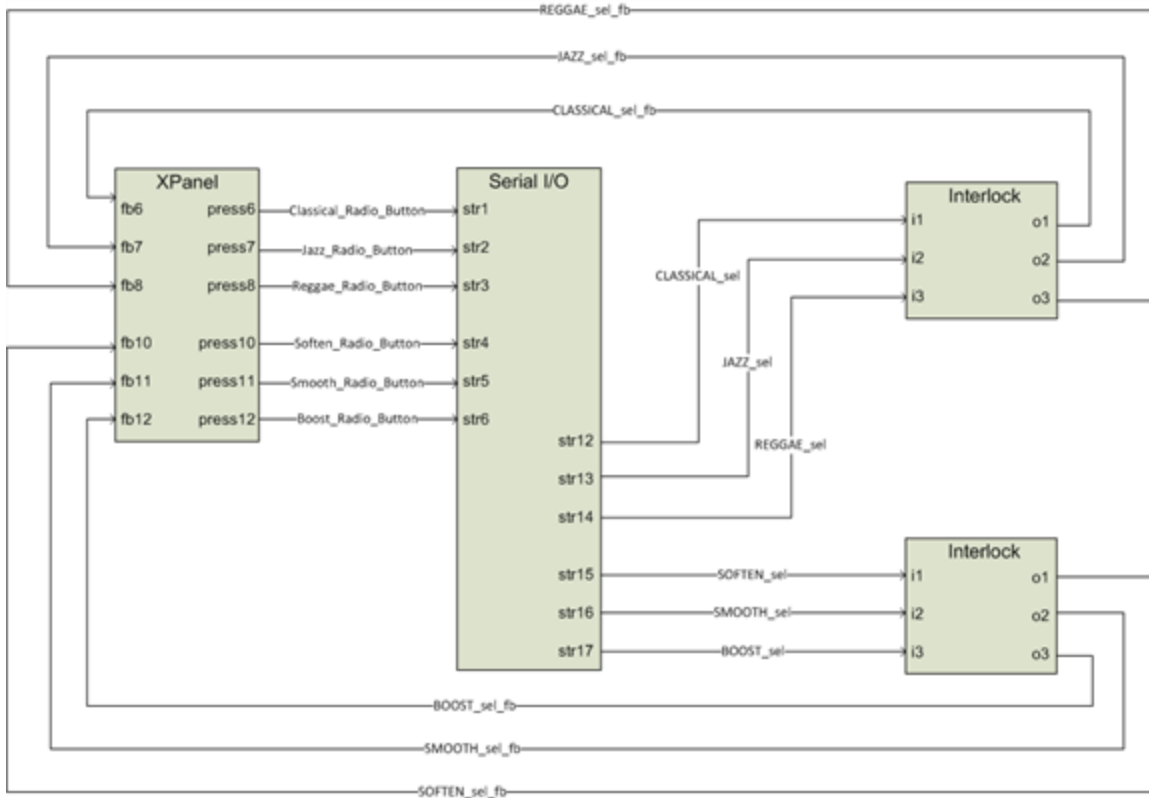


**NOTE:** Refer to Appendix B "Using PuTTY to Test External Control Systems" on page 60 for help with debugging if the system does not behave as described here.

## Selectors

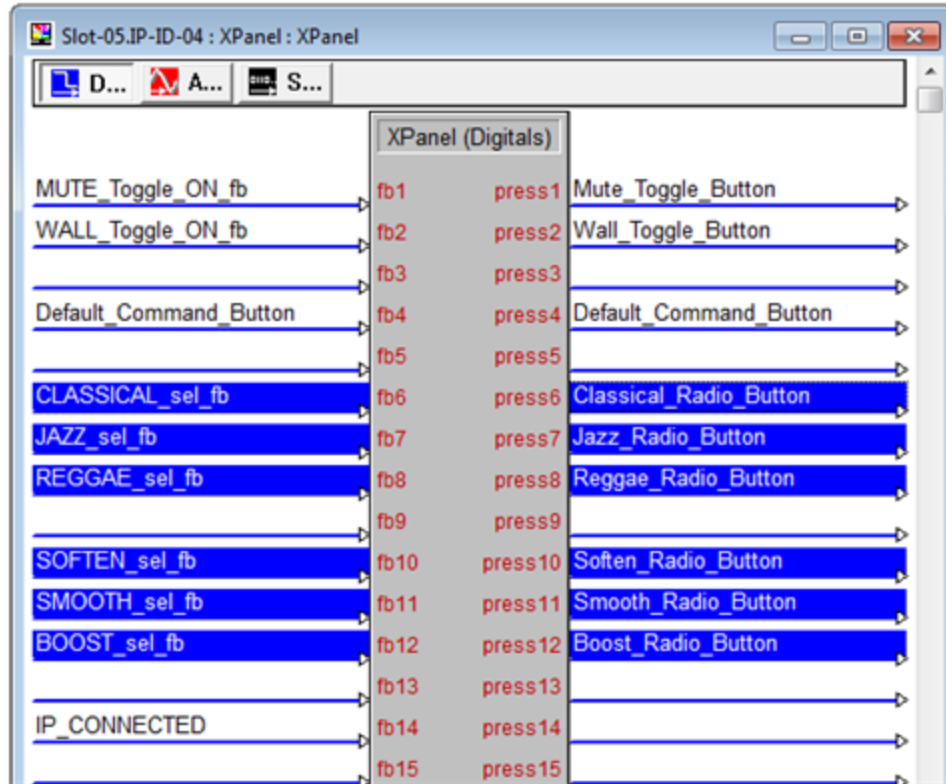
This section explains how to integrate HAL selector controls with buttons on an XPanel by examining a couple of touch panel applications: input source selector radio buttons and preset selector radio buttons. We start by breaking down the logic symbols and signal flow for the HAL selector controls. Then we examine how to bind the HAL selector controls to radio buttons in the touch panel user interface.

## CHAPTER 4: Integrating Crestron Control Systems with HAL



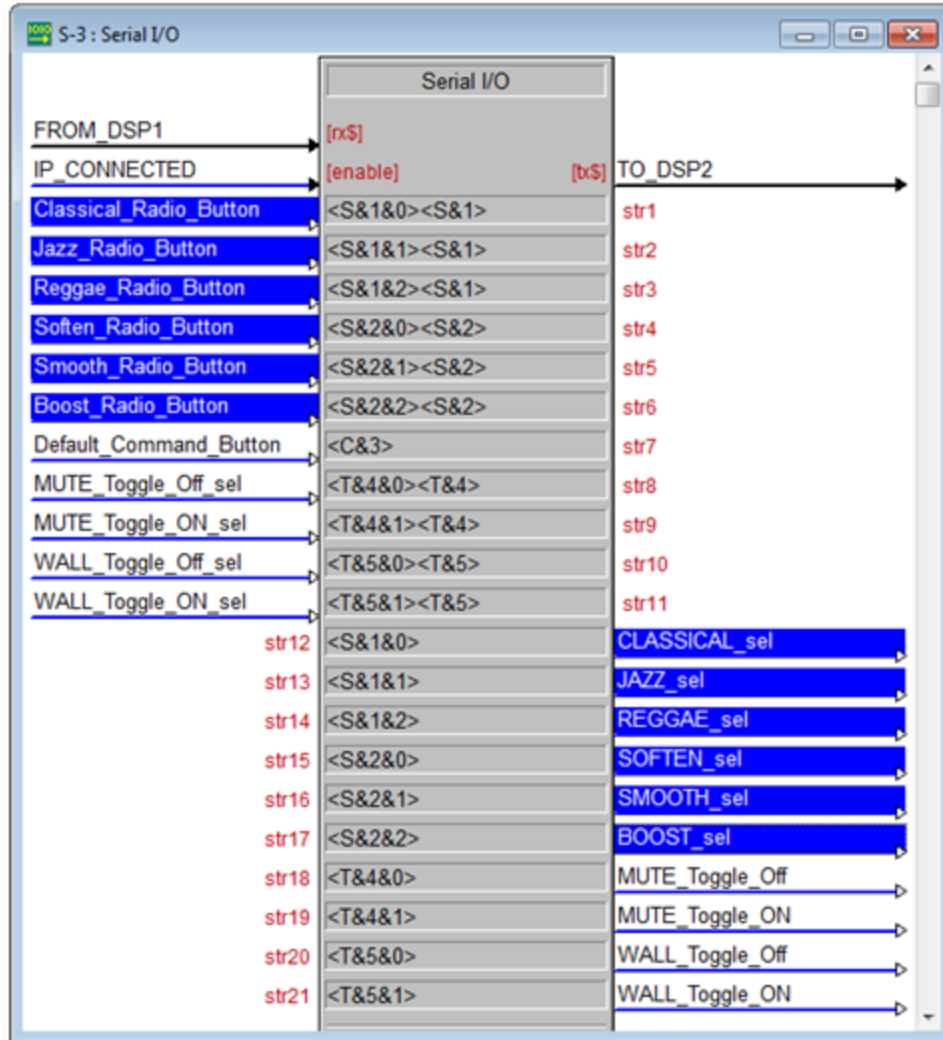
At its simplest, a HAL selector control is just a selection integer value. The range of this selection value is constrained by the number of positions on the selector. For instance, a HAL three-way selector can only have a value of 0, 1 or 2. The example program contains symbols to deal with radio buttons on a touch panel and selector messages received from Halogen/HAL. Trace through the Selector Control Signal Flow diagram to get an overview of how these symbols work together before we look at them up close.

Open the Rane\_HAL.smw program file in SIMPL Windows. There are two HAL selector controls in this program uniquely identified by HAL control numbers 1 and 2. These HAL control numbers appear in the **Selector** tab of Halogen's **External Control Systems** dialog as *Source Selector Control* and *PEQ Selector Control*. (PEQ stands for parametric equalizer.)



Double-click the **XPanel** symbol under Slot-05 of the MC2E under **Logic** in the **Program View** to bring up its details. The radio buttons for the two selectors are divided into two groups on the XPanel. The **Classical**, **Jazz** and **Reggae** radio buttons assigned to digital signals 6, 7 and 8 make up the Source selector group. The **Soften**, **Smooth** and **Boost** radio buttons assigned to digital signals 10, 11 and 12 make up the Tone selector group.

## CHAPTER 4: Integrating Crestron Control Systems with HAL



Double-click the **Serial I/O** and **Serial Send** symbols under **Logic** in the **Program View** to bring up their details. Clicking a selector radio button on the XPanel sends a message string to Halogen/HAL. These 'set selector' messages are comprised of a selector control type, HAL control number and value. The valid 'set selector' messages for the source selector in this program are <S&1&0>, <S&1&1> and <S&1&2>. The valid 'set selector' messages for the PEQ selector in this program are <S&2&0>, <S&2&1> and <S&2&2>.

The controller also requests HAL selector control values by sending message strings to Halogen/HAL. These 'get selector' messages are comprised of a selector control type and HAL control number. The valid 'get selector' messages for the two HAL selector controls in this program are <S&1> and <S&2>. Halogen/HAL responds to these 'get selector' messages with corresponding 'set selector' messages.

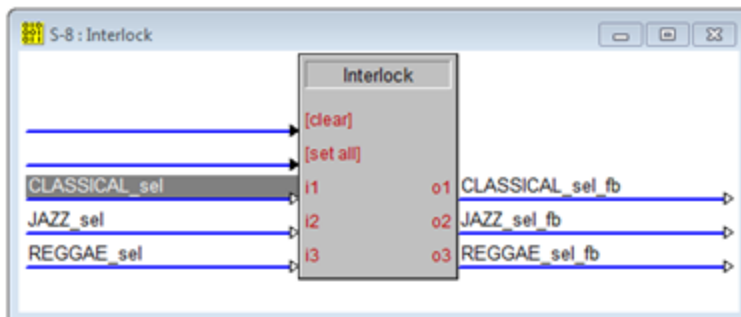


**NOTE:** Refer to Appendix A "HAL External Control Message Protocol" on page 49 for more information on selector messages.

The <S&1> and <S&2> 'get selector' messages appears in the string parameter of the **Serial Send** symbol that is triggered whenever the **TCP/IP Client** connects to Halogen/HAL. Requesting the selector values on connect ensures that the radio buttons on the XPanel are in sync with the live selector values on Halogen/HAL.

Append 'get selector' messages to the 'set selector' messages that the **Serial I/O** sends out because Halogen/HAL does not echo a 'set selector' message back to the client that sent it. For instance, clicking on the Reggae radio button on the XPanel sends <S&1&2> followed by <S&1> to Halogen/HAL. Upon receipt of the resulting <S&1&2> from Halogen/HAL the **Serial I/O's** outgoing *REGGAE\_sel* signal goes high. The program relies on the response triggered by the 'get selector' message to drive the feedback for a selector's radio buttons.

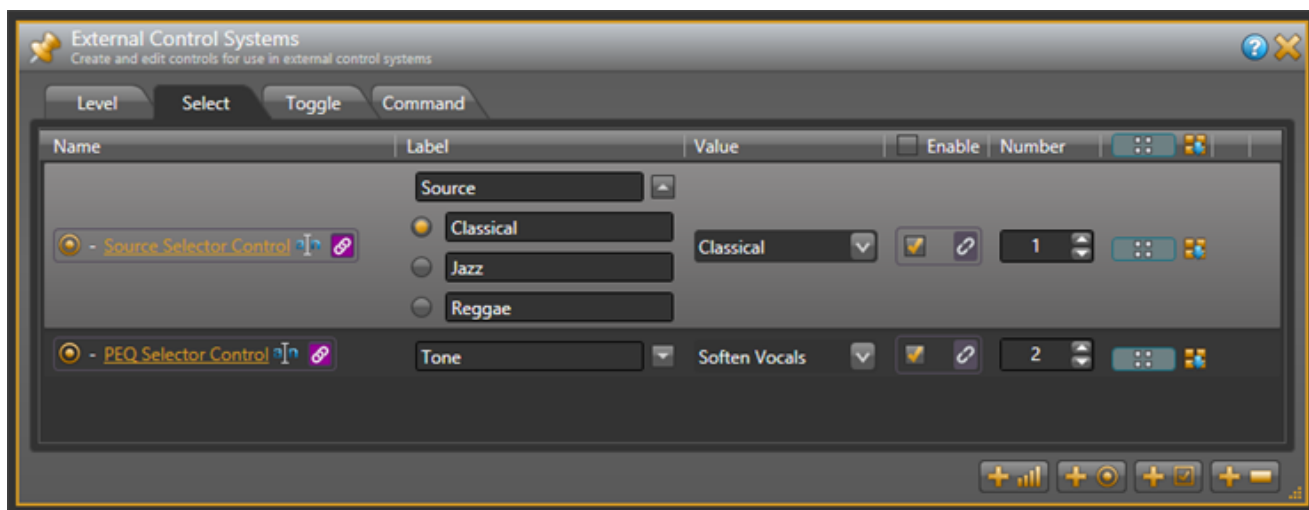
Double-click one of the two **Interlock** symbols under **Logic** in the **Program View** to bring up its details. An Interlock latches an output signal high on the rising edge of its input while forcing all the other outputs low. The last input to go high determines which output gets latched high. An Interlock is the simplest way to achieve mutual exclusion needed for a group of selector radio buttons.



Take the source selector's **Interlock**, for example. It handles the *CLASSICAL\_sel*, *JAZZ\_sel* and *REGGAE\_sel* signals from the **Serial I/O**. When the *REGGAE\_sel* signal goes high the *REGGAE\_sel\_fb* signal gets latched high and the *CLASSICAL\_sel\_fb* and *JAZZ\_sel\_fb* signals are latched low. The end result is that the **Reggae** radio button on the **XPanel** is activated and the **Classical** and **Jazz** radio buttons are deactivated.

## Source Selector

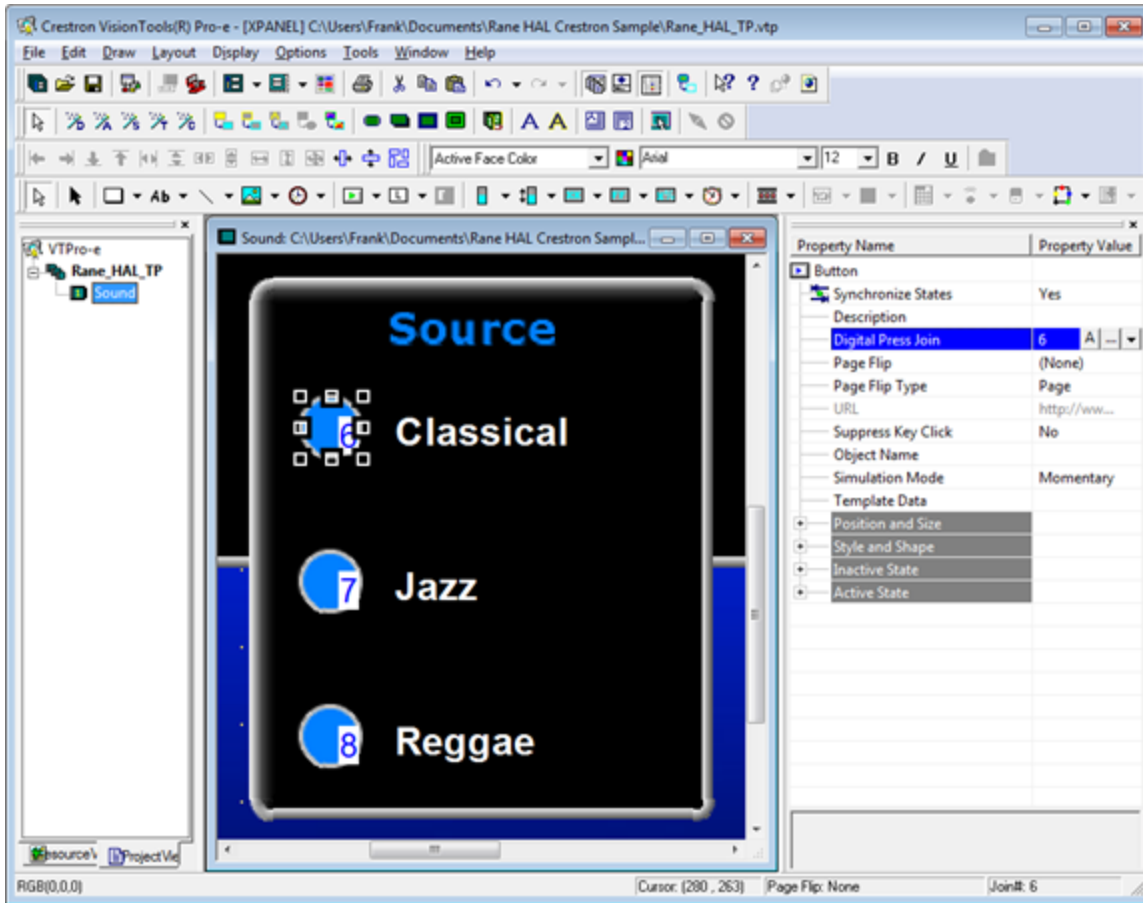
This example demonstrates how to get radio buttons on a touch panel to switch between input source selections on a HAL. The example Halogen configuration file contains a selector block wired to three HAL mic/line Inputs. The input nodes on the selector block are named **Classical**, **Jazz** and **Reggae** for the genre of music being fed into each of them. This selector block is linked to a HAL Control Systems selector control named **Source Selector Control**. Switching selections on the **Source Selector Control** switches the selected input on the selector block.



## CHAPTER 4: Integrating Crestron Control Systems with HAL

Open the ControlSystemSample.hal example configuration file in Halogen. Then open the **External Control Systems** dialog and select the **Selector** tab. The selected item in the **Value** column for the **Source Selector Control** is the input currently selected by that selector in the system. The set of radio buttons also reflects the current selection. Select a different item for the **Source Selector Control** to choose a different input.

Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e. Next, open the **Sound** page window to view the example touch panel design. Select the circular **Classical** radio button in the Sound page window. Notice that the **Digital Press Join** number for that button is set to 6 to match the **fb6** input and **press6** output on the **XPanel** symbol in the program. The Digital Press Join numbers for the other two source selector radio buttons are 7 and 8. A radio button will appear blue when it is in its active state and blacked out when it is in its inactive state.



Launch the **XPanel** and verify that the **Connected** status indicator shows you are connected. Refer to the "Troubleshooting" on page 47 section if the status indicator says **Disconnected**. Double-click the **Selector (1)** block in the Halogen Processing map to bring up its properties dialog. Click on the **Jazz** radio button in the **Selector (1)** Block dialog. Then click on the **Classical** radio button on the XPanel. The selected input in Halogen switches from **Jazz** to **Classical**. Now click on the **Reggae** radio button in Halogen. The **Classical** radio button is selected and the **Reggae** radio button is deselected on the XPanel.

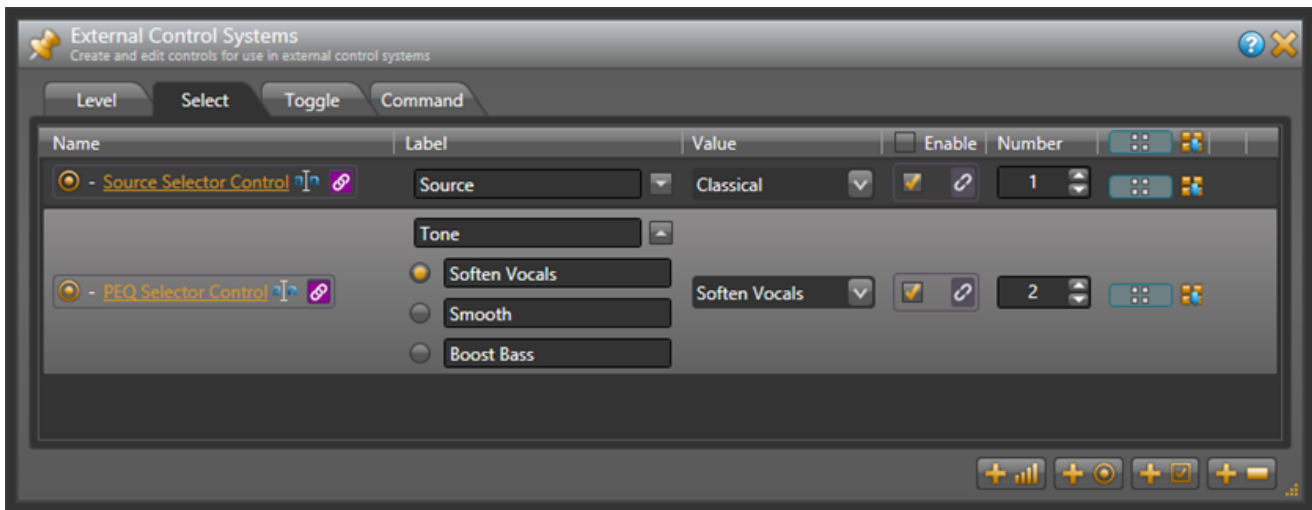


**NOTE:** Refer to Appendix B "Using PuTTY to Test External Control Systems" on page 60 for help with debugging if the system does not behave as described here.



## Preset Selector

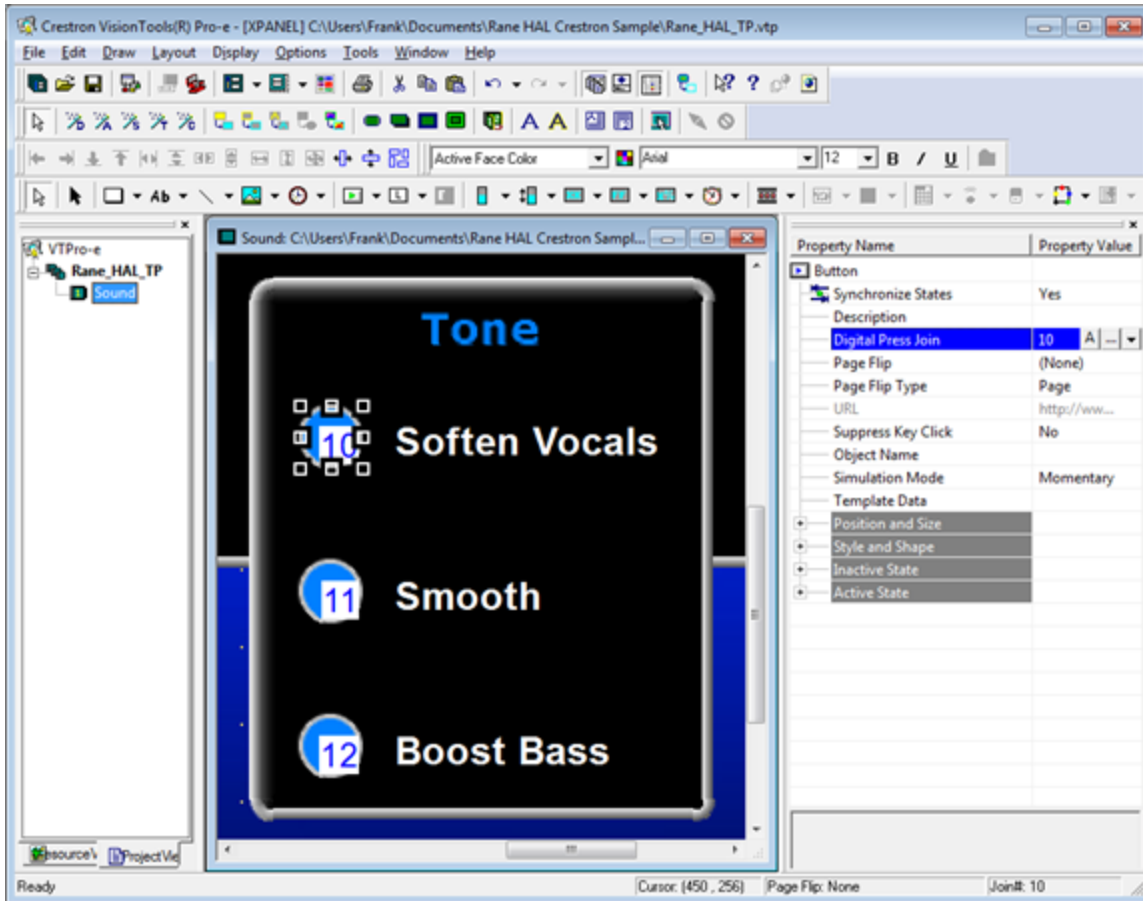
This example demonstrates how to get radio buttons on a touch panel to switch between presets on a HAL. The example Halogen configuration file contains a Parametric EQ block. Different EQ filter settings for this block are saved to different presets. One preset softens vocals, another smooths out the mid-range and a third boosts the bass. These three presets belong to the same **PEQ Preset Selector**. This selector is linked to a HAL Control Systems selector control named **PEQ Selector Control**. Switching selections on the **PEQ Selector Control** switches the active preset in the **PEQ Preset Selector**.



Open the ControlSystemSample.hal example configuration file in Halogen. Then open the **External Control Systems** dialog and select the **Selector** tab. The selected item in the **Value** column for the **PEQ Selector Control** is the preset currently selected by that selector in the system. The set of radio buttons also reflects the current selection. Select a different item for the **PEQ Selector Control** to choose a different PEQ preset.

Open the Rane\_HAL\_TP.vtp project file in Vision Tools Pro-e. Next, open the **Sound page** window to view the example touch panel design. Select the circular **Soften Vocals** radio button in the **Sound page** window. Notice that the **Digital Press Join** number for that radio button is set to *10* to match the *fb10* input and *press10* output on the **XPanel** symbol in the program. The Digital Press Join numbers for the other two tone selector radio buttons are *11* and *12*. A radio button will appear blue when it is in its active state and blacked out when it is in its inactive state.

## CHAPTER 4: Integrating Crestron Control Systems with HAL



Launch the **XPanel** and verify that the **Connected** status indicator shows that you are connected. Refer to the "Troubleshooting" below section if the status indicator says **Disconnected**. In Halogen, click on the **Presets** icon in the **Processing Workspace** toolbar to bring up the **All Presets** dialog. Choose the **Selector** tab in that dialog and expand the **PEQ Preset Selector** so that its contents are visible. Click the **Smooth** radio button in the All Presets dialog. Then click on the **Soften Vocals** radio button on the XPanel. The selected preset in Halogen switches from **Smooth** to **Soften Vocals**. Now click on the **Boost Bass** radio button in Halogen. The Boost Bass radio button is selected and the **Soften Vocals** radio button is deselected on the XPanel.



**NOTE:** Refer to Appendix B "Using PuTTY to Test External Control Systems" on page 60 for help with debugging if the system does not behave as described here.

## Troubleshooting

1. If the XPanel does not connect to the controller:
  - Check to make sure the controller's IP address configured in the **XPanel** is set correctly.
    - You can find and edit the IP address of your controller by using Crestron Toolbox to connect to it via a serial RS-232 interface.
    - Or you can edit XPanel's **Project Properties** in Vision Tools Pro-e so that the **Control System** and **e-Control Gateway** IP addresses are set to your controller's current IP address.

- The XPanel will also fail to connect to the control system if the IP ID it is attempting to use is wrong.
  - The IP ID selected in the XPanel's Project Properties should be that of the e-Control.
  - See the "Ethernet Units" on page 20 section for how to find and modify these XPanel settings.
- 2. If the controller cannot connect to the Halogen Control Server:
  - Make sure the PC and controller are on the same network and have compatible IP addresses.
  - Make sure the IP address configured for the HAL1x in the controller is the IP address of the PC running Halogen and that the port is 4996.
  - Ensure that the firewall on the PC allows TCP/IP communication on port 4996.
- 3. If the controller connects to the Halogen Control Server but the controls do not operate as expected:
  - Make sure you have applied the configuration to the HAL1x (ControlSystemSample.hal). You can also do this by connecting to your HAL1x then loading the example configuration.
  - Use a telnet client to monitor and exercise the external control messages. See Appendix B: "Using PuTTY to Test External Control Systems" on page 60.

# APPENDIX A: HAL External Control Message Protocol

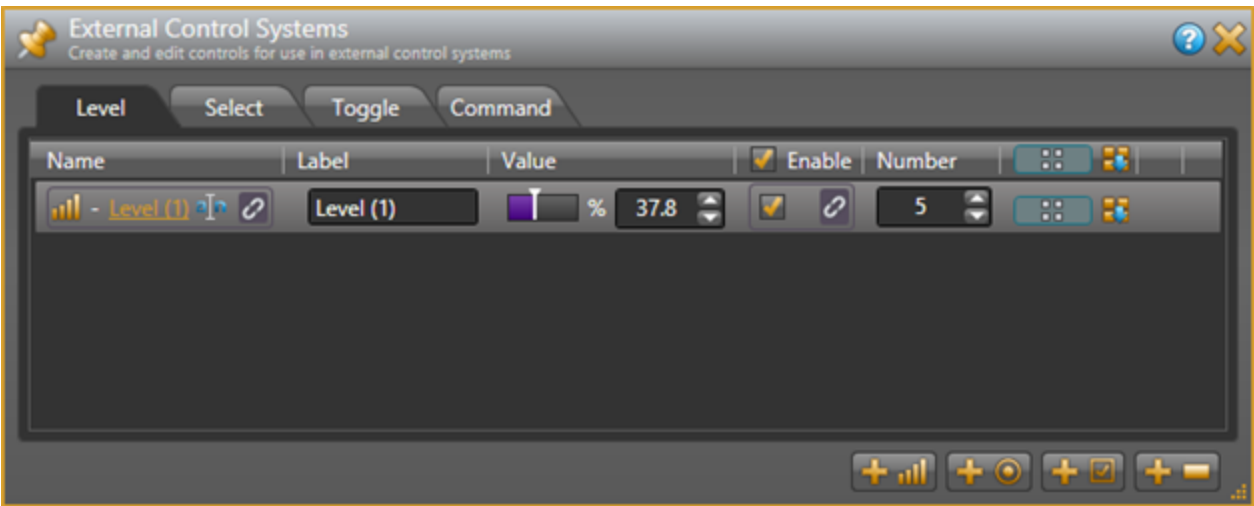
Once you have connected to either the Halogen or HAL external control server, you can communicate with it using simple, text-based messages. This section defines this message protocol.

All messages consist of ASCII text and a single message always starts with a ‘<’ character and ends with a ‘>’ character. Inside the start and end characters is the message body, which always includes at least a message type followed by a control number. Each part of the message body is separated from another part by an ‘&’ character. Messages can also have additional parts depending on the type of message. The table below shows the format for each specific message type.

When sending messages to the Halogen/HAL Control Server, it:

- Allows white space anywhere in the message, which includes space, tab, carriage return, and line feed characters
- Ignores all characters outside of a message (that is, before the start character and after the end character)
- Ignores the case of alpha characters – you can use upper or lower case in any combination

Halogen’s External Control Systems dialog defines the unique control number for each control, which is always ‘n’ in the message table below. For example, suppose you have defined a Level control in the Halogen External Control Systems dialog as follows:



In this instance, the control number is 5, and that is what you use in the ‘set level’ and ‘get level’ messages when developing external control systems. In this case the ‘get level’ message for this control is <L&5>.

## Details of external control messages

In the following tables, normal characters are literal while bold characters are variable and defined in the description.


## APPENDIX A: HAL External Control Message Protocol

### All Controls

Message Format	Description	How Used	Example
<?>	Get all values message.	Send this to HAL to request the current values of all controls.	<?> - request the current values of all controls in the configuration.

### Level Controls

Message Format	Description	How Used	Example
<?&L>	Get all level control values message.  The includes value, enable, and label for every level control.	Send this to HAL to request all values associated with <b>all</b> level controls.	<?&L> - request the current level value, enable, and label of all Level external controls.
<?&L&n>	Get level value, enable and label message, where:  <b>n</b> is the control number.	Send this to HAL to request all values associated with the level control with the specified control number.	<?&L&1> - request the current value, enable, and label of Level external control number 1.
<L&n>	Get level message, where:  <b>n</b> is the control number.	Send this to HAL to request the current value of a Level external control.	<L&1> - request the current value of Level external control number 1.
<L&n&v>	Set level message, where:  <b>n</b> is the control number.  <b>v</b> is the control value.  The range for v is 0 to 1000, corresponding to 0 to 100.0%.	Send this to HAL to set a Level external control to a new value.  HAL sends this:  1. in response to a get level message 2. whenever a Level external control changes value	<L&1&456> - set the value of Level external control number 1 to 45.6%.

Message Format	Description	How Used	Example
<p>&lt;L&amp;n&amp;+v&gt;</p> <p>&lt;L&amp;n&amp;-v&gt;</p>	<p>Increment/Decrement level message, where:</p> <p><b>n</b> is the control number.</p> <p>+ indicates increment.</p> <p>- indicates decrement.</p> <p><b>v</b> is the amount to increment or decrement the current control value.</p> <p>The range for v is 0 to 1000, corresponding to 0 to 100.0%.</p> <div> <p><b>NOTE:</b> When an increment or decrement message would result in setting the level control to a value outside of the allowed range of 0 to 100%, the HAL sets the level to the limit value.</p>  </div>	<p>Send this to HAL to increment or decrement a Level external control.</p>	<p>&lt;L&amp;1&amp;+105&gt; - increment the value of Level external control number 1 by 10.5%.</p> <p>&lt;L&amp;2&amp;-234&gt; - decrement the value of Level external control number 2 by 23.4%.</p>
<p>&lt;LA&amp;n&gt;</p>	<p>Get label message, where:</p> <p><b>n</b> is the control number.</p>	<p>Send this to HAL to request the current label value of a Level external control.</p>	<p>&lt;LA&amp;1&gt; - request the current label value of Level external control number 1.</p>
<p>&lt;LA&amp;n&amp;string&gt;</p>	<p>Set label message, where:</p> <p><b>n</b> is the control number.</p> <p><b>string</b> is the label for the control.</p>	<p>Send this to HAL to set the label for a Level external control to a new value.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get label message</li> <li>2. whenever a label for a Level external control changes value</li> </ol>	<p>&lt;LA&amp;1&amp;-Volume&gt; - set the label value for Level control number 1 to "Volume".</p>

## APPENDIX A: HAL External Control Message Protocol

Message Format	Description	How Used	Example
<LE&n>	Get enable message, where: <b>n</b> is the control number.	Send this to HAL to request the current enable value of a Level external control.	<LE&4> - request the current enable value of Level external control number 4.
<LE&n&v>	Set enable message, where: <b>n</b> is the control number. <b>v</b> is the enable value. The values for v are 0 (disabled) or 1 (enabled).	Send this to HAL to set the enable for a Level external control to a new value.  HAL sends this: <ol style="list-style-type: none"> <li>1. in response to a get enable message</li> <li>2. whenever an enable for a Level external control changes value</li> </ol>	<LA&4&0> - set the enable value for Level control number 4 to 0 (disabled).

### Toggle Controls

Message Format	Description	How Used	Example
<?&T>	Get all toggle control values message.  The includes value, enable, and label for every toggle control.	Send this to HAL to request all values associated with <b>all</b> toggle controls.	<?&T> - request the current toggle value, enable, and label of all Toggle external controls.
<?&T&n>	Get toggle value, enable and label message, where: <b>n</b> is the control number.	Send this to HAL to request all values associated with the toggle control with the specified control number.	<?&T&1> - request the current value, enable, and label of Toggle external control number 1.
<T&n>	Get toggle message, where: <b>n</b> is the control number.	Send this to HAL to request the current value of a Toggle external control.	<T&23> - request the current value of Toggle external control number 23.

Message Format	Description	How Used	Example
<T&n&v>	<p>Set toggle message, where:</p> <p><b>n</b> is the control number.</p> <p><b>v</b> is the control value.</p> <p>The values for v are 0 (unchecked) or 1 (checked).</p>	<p>Send this to HAL to set a Toggle external control to a new value.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get toggle message</li> <li>2. whenever a Toggle external control changes value</li> </ol>	<p>&lt;T&amp;23&amp;1&gt; - set the value of Toggle external control number 23 to 1 (checked).</p>
<TA&n>	<p>Get label message, where:</p> <p><b>n</b> is the control number.</p>	<p>Send this to HAL to request the current label value of a Toggle external control.</p>	<p>&lt;TA&amp;1&gt; - request the current label value of Toggle external control number 1.</p>
<TA&n&string>	<p>Set label message, where:</p> <p><b>n</b> is the control number.</p> <p><b>string</b> is the label for the control.</p>	<p>Send this to HAL to set the label for a Toggle external control to a new value.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get label message</li> <li>2. whenever a label for a Toggle external control changes value</li> </ol>	<p>&lt;TA&amp;1&amp;Mute&gt; - set the label value for Toggle control number 1 to "Mute".</p>



## APPENDIX A: HAL External Control Message Protocol

Message Format	Description	How Used	Example
<TE&n>	Get enable message, where: <b>n</b> is the control number.	Send this to HAL to request the current enable value of a Toggle external control.	<TE&4> - request the current enable value of Toggle external control number 4.
<TE&n&v>	Set enable message, where: <b>n</b> is the control number. <b>v</b> is the enable value. The values for v are 0 (disabled) or 1 (enabled).	Send this to HAL to set the enable for a Toggle external control to a new value.  HAL sends this: 1. in response to a get enable message 2. whenever an enable for a Toggle external control changes value	<TA&4&0> - set the enable value for Toggle control number 4 to 0 (disabled).

### Selector Controls

Message Format	Description	How Used	Example
<?&S>	Get all selector control values message.  The includes selector count, value, enable, label and item names for every selector control.	Send this to HAL to request all values associated with <b>all</b> selector controls.	<?&S> - request the current selector count, value, enable, label and item names of all Selector external controls.
<?&S&n>	Get selector count, value, enable, label and item names message, where: <b>n</b> is the control number.	Send this to HAL to request all values associated with the selector control with the specified control number.	<?&S&1> - request the current selector count, value, enable, label and item names of Selector external control number 1.
<S&n>	Get selection message, where: <b>n</b> is the control number.	Send this to HAL to request the current value of a Select external control.	<S&6> - request the current value of Select external control number 6.


Message Format	Description	How Used	Example
<S&n&v>	<p>Set selection message, where:</p> <p><b>n</b> is the control number.</p> <p><b>v</b> is the control value.</p> <p>The range for v is 0 to one less than the number of selections.</p>	<p>Send this to HAL to set a Select external control to a new value.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get selection message</li> <li>2. whenever a Select external control changes value</li> </ol>	<p>&lt;S&amp;6&amp;3&gt; - set the value of Select external control number 6 to 3 (the fourth item in the set of selections).</p>
<SL&n>	<p>Get selection link message, where:</p> <p><b>n</b> is the control number.</p>	<p>Send this to HAL to request the current number of selections for Select external control.</p>	<p>&lt;SL&amp;7&gt; - get the number of selections for Select external control number 7.</p>
<SL&n&x>	<p>Set selection link message, where:</p> <p><b>n</b> is the control number.</p> <p><b>x</b> is the number of selections. 0 indicates that no selections are available – i.e. the selector link is inactive.</p>	<p>It is not meaningful to send this message to HAL because an external control system cannot change a selection link.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get selection link message</li> <li>2. whenever the link activation changes for the Select external control</li> </ol>	<p>&lt;SL&amp;7&amp;4&gt; - set the number of selections for Select external control number 7 to 4.</p>
<SN&n&i>	<p>Get selection name message, where:</p> <ol style="list-style-type: none"> <li>1. <b>n</b> is the control number.</li> <li>2. <b>i</b> is the selection item. The range for i is 0 to one less than the number of selections.</li> </ol>	<p>Send this to HAL to request the current value of a selection name for a particular selection item of a Select external control.</p>	<p>&lt;SN&amp;12&amp;2&gt; - get the current selection name for selection item 2 of Select control number 12.</p> <p>Selection item 2 is the third item in the set of selections.</p>

## APPENDIX A: HAL External Control Message Protocol

Message Format	Description	How Used	Example
<SN&n&v&string>	<p>Set selection name message, where:</p> <p><b>n</b> is the control number.</p> <p><b>v</b> is the control value. The range for v is 0 to one less than the number of selections.</p> <p><b>string</b> is the current display name for selection <b>v</b>.</p>	<p>It is not meaningful to send this message to HAL because an external control system cannot change a selection name.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get selection name message</li> <li>2. whenever the link activation changes for the Select external control</li> <li>3. whenever one of the selection names change</li> </ol>	<p>&lt;SN&amp;12&amp;2&amp;Jazz&gt; - set the current selection name for selection item 2 of Select control number 12 to "Jazz".</p> <p>Selection item 2 is the third item in the set of selections.</p>
<SA&n>	<p>Get label message, where:</p> <p><b>n</b> is the control number.</p>	<p>Send this to HAL to request the current label value of a Selector external control.</p>	<p>&lt;SA&amp;1&gt; - request the current label value of Selector external control number 1.</p>
<SA&n&string>	<p>Set label message, where:</p> <p><b>n</b> is the control number.</p> <p><b>string</b> is the label for the control.</p>	<p>Send this to HAL to set the label for a Selector external control to a new value.</p> <p>HAL sends this:</p> <ol style="list-style-type: none"> <li>1. in response to a get label message</li> <li>2. whenever a label for a Selector external control changes value</li> </ol>	<p>&lt;SA&amp;1&amp;-Program&gt; - set the label value for Selector control number 1 to "Program".</p>

Message Format	Description	How Used	Example
<SE&n>	Get enable message, where: <b>n</b> is the control number.	Send this to HAL to request the current enable value of a Level external control.	<SE&4> - request the current enable value of Selector external control number 4.
<SE&n&v>	Set enable message, where: <b>n</b> is the control number. <b>v</b> is the enable value. The values for v are 0 (disabled) or 1 (enabled).	Send this to HAL to set the enable for a Selector external control to a new value.  HAL sends this: <ol style="list-style-type: none"> <li>1. in response to a get enable message</li> <li>2. whenever an enable for a Selector external control changes value</li> </ol>	<SA&4&0> - set the enable value for Selector control number 4 to 0 (disabled).

## Command Controls

Message Format	Description	How Used	Example
<?&C>	Get all command control labels message.	Send this to HAL to request label value associated with <b>all</b> command controls.	<?&C> - request the current label of all Command external controls.
<?&C&n>	Get the label message, where: <b>n</b> is the control number.  <div>  <b>NOTE:</b> Equivalent to the &lt;CA&amp;n&gt; message described below. </div>	Send this to HAL to request the current label value of a Command external control with the specified control number.	<?&C&1> - request the current label of Command external control number 1.
<C&n>	Command message, where: <b>n</b> is the control number.	Send this to HAL to fire a Command external control.  HAL sends this whenever a Command external control fires.	<C&4> - Fire Command control number 4.

## APPENDIX A: HAL External Control Message Protocol

Message Format	Description	How Used	Example
<CA&n>	Get label message, where: <b>n</b> is the control number.	Send this to HAL to request the current label value of a Command external control.	<CA&1> - request the current label value of Command external control number 1.
<CA&n&string>	Set label message, where: <b>n</b> is the control number. <b>string</b> is the label for the control.	Send this to HAL to set the label for a Command external control to a new value.  HAL sends this: <ol style="list-style-type: none"><li>1. in response to a get label message</li><li>2. whenever a label for a Command external control changes value</li></ol>	<CA&1&Flatten> - set the label value for Command control number 1 to "Flatten".
<CE&n>	Get enable message, where: <b>n</b> is the control number.	Send this to HAL to request the current enable value of a Command external control.	<CE&4> - request the current enable value of Command external control number 4.
<CE&n&v>	Set enable message, where: <b>n</b> is the control number. <b>v</b> is the enable value.  The values for v are 0 (disabled) or 1 (enabled).	Send this to HAL to set the enable for a Command external control to a new value.  HAL sends this: <ol style="list-style-type: none"><li>1. in response to a get enable message</li><li>2. whenever an enable for a Command external control changes value</li></ol>	<CA&4&0> - set the enable value for Command control number 4 to 0 (disabled).

**Communications Monitoring**

Message Format	Description	How Used	Example
<PING>	Ping message	Send this to HAL to request a pong message.	<PING>
<PONG>	Pong message	<p>It is not meaningful to send this message to HAL.</p> <p>HAL sends this whenever it receives a ping message from an external control system.</p>	<PONG>

## APPENDIX B: Using PuTTY to Test External Control Systems

The Halogen/HAL external control message protocol is ASCII text based, which means that you can use a standard telnet client to connect to the control server and exchange messages. This is often useful when developing and testing a HAL configuration that contains external controls, either to monitor the operation of your external control system or to serve as a simple form of external control system before the production system is ready or available.

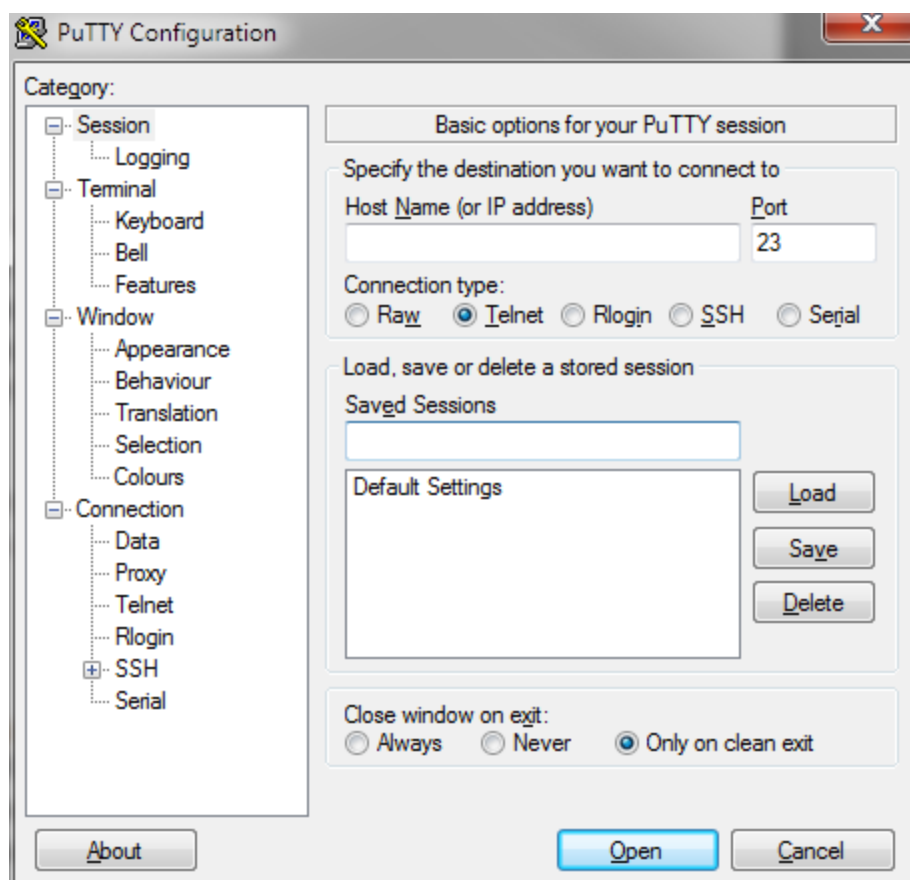
Any telnet client will work, but this section shows how to do this with PuTTY, an open source telnet client application that is free, easy to install and use, and runs on all versions of Windows.

### How to obtain and install PuTTY

The top level web page for PuTTY is <http://www.putty.org>. That page contains a link to a page that has links for downloading the PuTTY application. All you need is the latest release version of putty.exe for Windows on Intel x86. Download this file and put it in an accessible folder on your PC. Since the complete installation is a single file, putting it on the desktop works great.

### Starting PuTTY and configuring it for communications with the Halogen control server

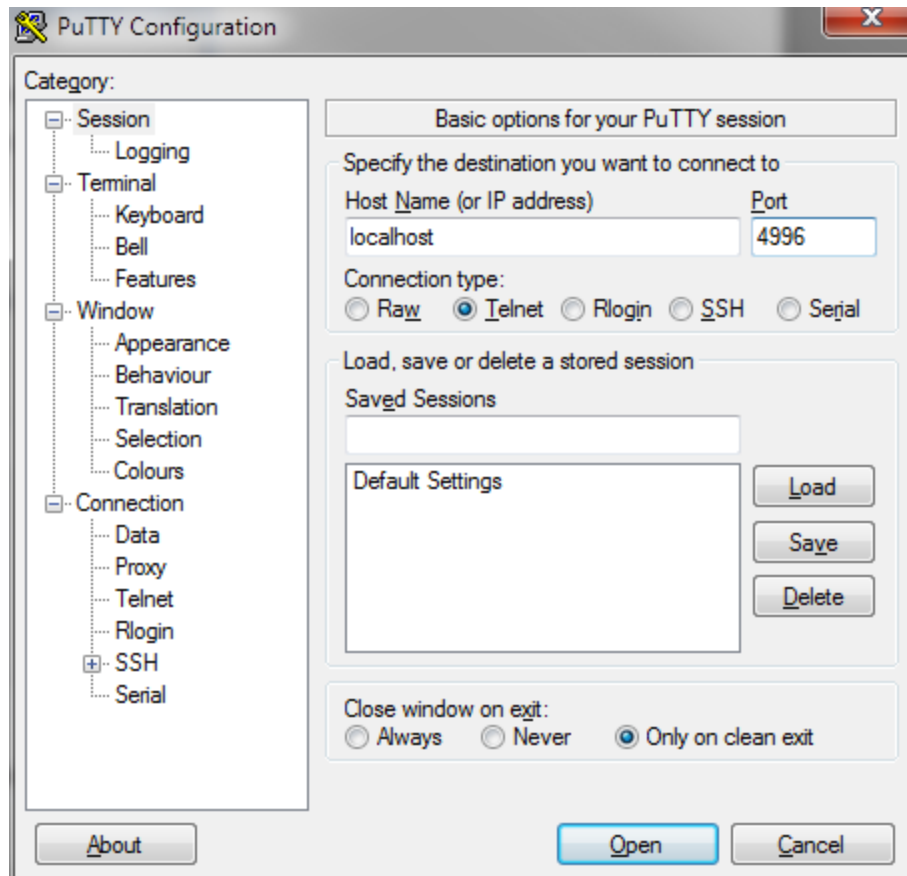
Start PuTTY by double clicking on the putty.exe file. This brings up the PuTTY Configuration window:



**To connect to the Halogen external control server, do the following:**

1. Start Halogen and load your configuration that contains the external controls you'd like to test

2. In the PuTTY configuration window:
  - a. Enter localhost in the Host Name text box
  - b. Change the Connection type to Telnet
  - c. Change the port number to 4996
  - d. Click the Open button



**To connect to the HAL external control server, do the following:**

1. Start Halogen and Apply your configuration that contains the external controls you'd like to test to the HAL.
2. Open the HAL property dialog by double clicking on the HAL title bar in the Halogen Hardware Work-space.

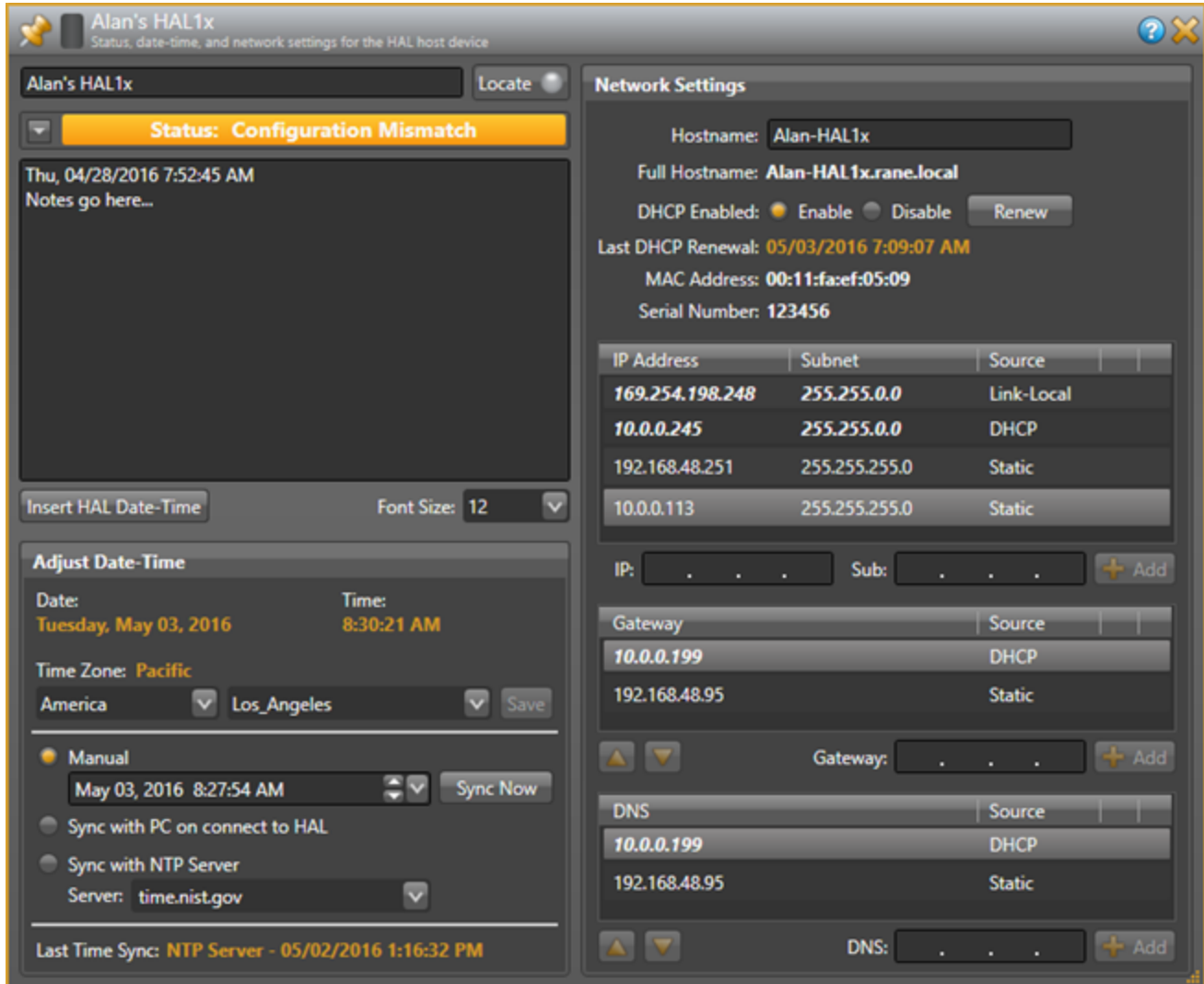


3. Observe the HAL's configured IP addresses and pick one that you want to use with PuTTY. The address you choose needs to be on the same network as your PC that is running PuTTY.
4. In the PuTTY configuration window:
  - a. Enter HAL's IP address in the Host Name text box
  - b. Change the Connection type to Telnet
  - c. Change the port number to 4996
  - d. Click the Open button

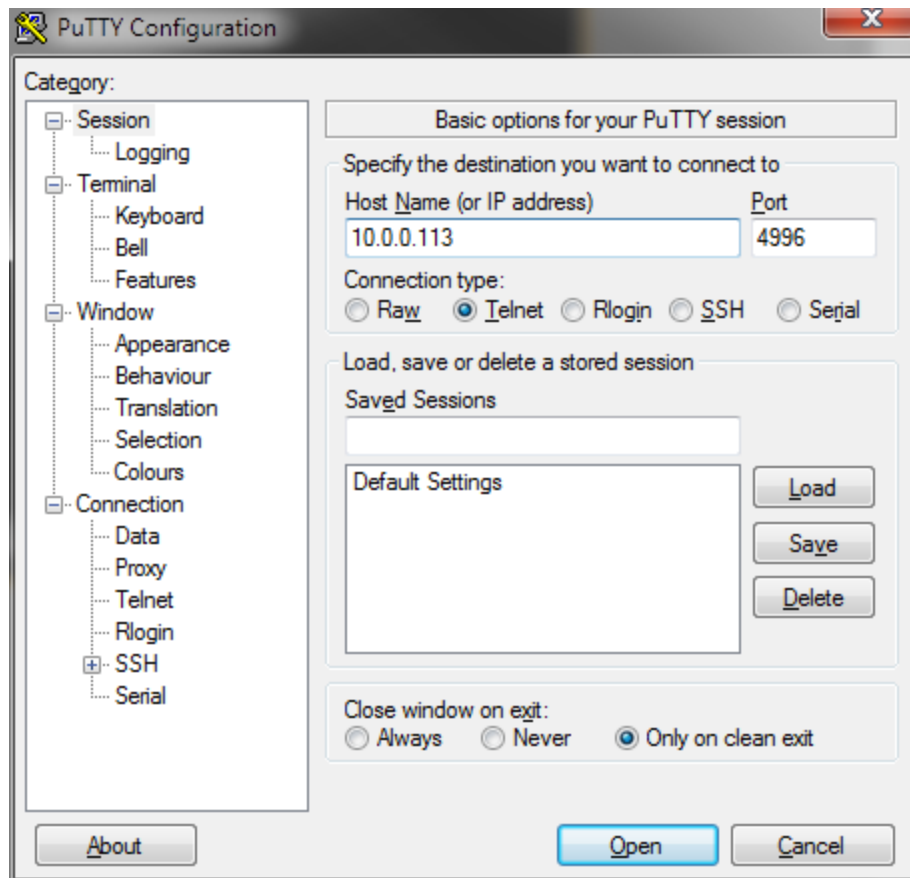


## APPENDIX B: Using PuTTY to Test External Control Systems

For example, the HAL1 host properties dialog will look something like this:

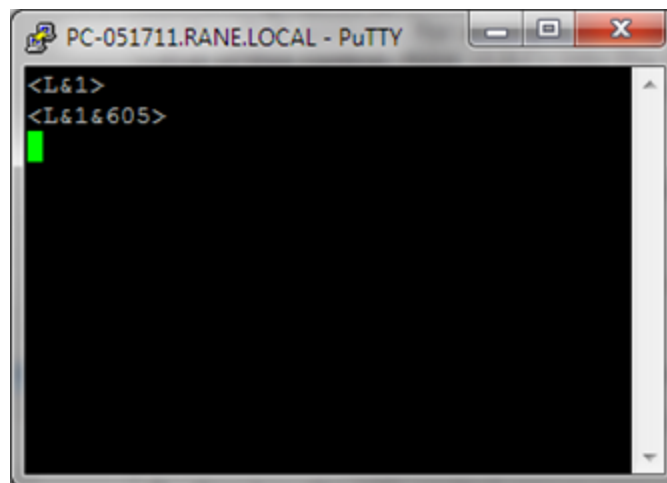


Here, We've added a static IP of 10.0.0.113. We'll use this in the PuTTY Configuration window:



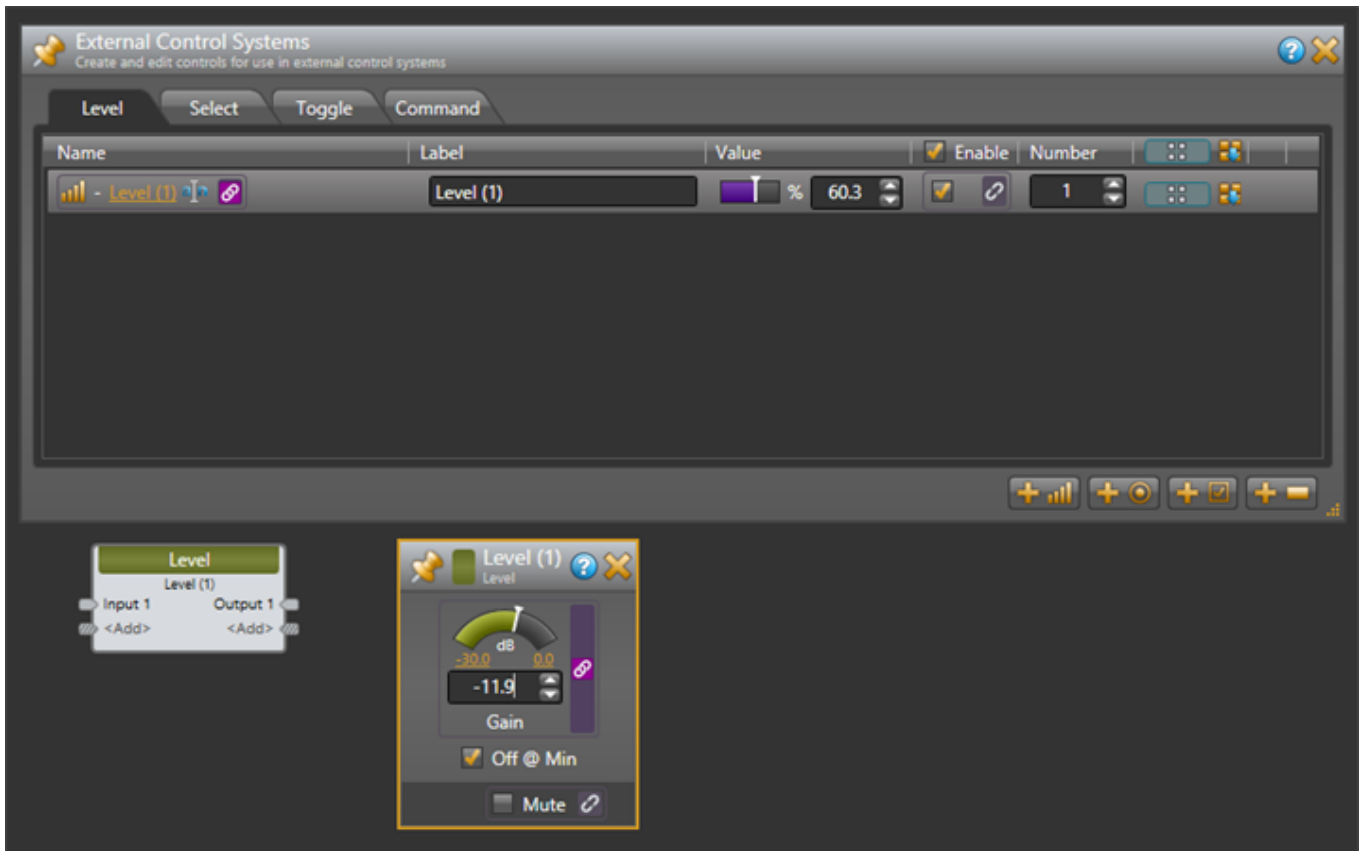
### Communicating with the Halogen/HAL control server

Connecting PuTTY to either Halogen or HAL establishes communication between the telnet client and the control server. Now you can send and receive messages using the PuTTY window that appears. For example, suppose you have a Level control configured in Halogen that is control number 1 and currently has a value of 60.5%. To request the current value of this control, type <L&1> into the PuTTY window and then press Enter. This will send the message to Halogen, which will respond with <L&1&605>. If all is right with your test system, you'll see something like this:



## APPENDIX B: Using PuTTY to Test External Control Systems

Your Halogen configuration will be something like this: (the Level external control is linked to the Level block's level control)



### How to use PuTTY when testing external control systems

Here are a few ideas for what you can do:

1. Test your HAL external controls by sending and receiving external control messages  
To do this, connect PuTTY to your HAL or Halogen external control server and type external control messages into the PuTTY window and observe what HAL sends in response.
2. See how the HAL control server responds when you change external controls either from Halogen or from actual remotes in the HAL system.  
Connect PuTTY to your HAL or Halogen external control server and change external controls from within the HAL system. Observe what the control server sends to PuTTY.
3. See how the HAL control server responds when configured presets activate or deactivate that affect external control values or link activations.  
Connect PuTTY to your HAL or Halogen external control server and activate or deactivate presets that contain blocks or links related to external controls. Observe what the control server sends to PuTTY.
4. Use PuTTY to monitor the operation of your external control system

You can connect any number of external control clients to a Halogen or HAL Control Server. This means that when you are developing and testing your control system with a commercial product, such as an AMX system, you can also connect to the control server using PuTTY.



**NOTE:** This lets you monitor most of the interaction between your external control system and your Halogen/HAL Control Server. This works because when external controls change, the Halogen/HAL Control Server sends these changes to all connected external control clients. So, when your external controller changes a control on the HAL, the HAL control server sends the change to your PuTTY client.

To use PuTTY in this way, first connect PuTTY to the Halogen/HAL Control Server that you want to monitor. Next connect your control system to the same Halogen/HAL Control Server. As your external control system interacts with the HAL system, external control messages will appear in the PuTTY window, giving you information about the operation of your external control system.

## APPENDIX C: Crestron Source Code

---

```
#SYMBOL_NAME "Rane HAL Level Processor"
#DEFAULT_VOLATILE

analog_input CONTROL_NUM;
analog_input LEVEL;
buffer_input FROM_DSP$[255];

analog_output LEVEL_fb;
string_output TO_DSP$;

integer controlNum, prevLevel, nextLevel;
integer nextChar, startIndex, endIndex;
string line[255];

change FROM_DSP$
{
    do
    {
        nextChar = getc(FROM_DSP$);
        line = line + chr(nextChar);
        if (nextChar = 0x0D)
        {
            startIndex = find("<L&", line);
            if (startIndex)
            {
                startIndex = startIndex + 3;
                endIndex = find("&", line, startIndex);
                controlNum = atoi(mid(line, startIndex, endIndex));
                if (controlNum = CONTROL_NUM)
                {
                    startIndex = endIndex;
                    endIndex = find(">", line, startIndex);
                    nextLevel = atoi(mid(line, startIndex, endIndex));
                    if (nextLevel != prevLevel)
                    {
                        prevLevel = nextLevel;
                        LEVEL_fb = nextLevel * 65535/1000;
                    }
                }
            }
            line = "";
        }
    } until (len(FROM_DSP$) = 0);
}

change LEVEL
```

```
{
    LEVEL_fb = LEVEL;
    nextLevel = LEVEL * 1000/65535;
    if (nextLevel != prevLevel)
    {
        prevLevel = nextLevel;
        TO_DSP$ = "<L&" + itoa(CONTROL_NUM) + "&" + itoa(nextLevel) + ">";
    }
}
```

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