

# **ControlSpace Designer 3.1**

## **Software Guide**

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# Introduction

## Welcome

Welcome to ControlSpace® Designer™ software, used for the set up, configuration and control of Bose® Professional system electronics. ControlSpace Designer software simplifies system configuration and programming through the use of standard drag and drop programming methods, and Smart Simulation, which allows you to instantly preview system programming without being connected to system hardware.

Click [here](#) to get started with the ControlSpace Designer help system.

## New in this release

ControlSpace Designer software version 3.1 includes the following major feature and function improvements:

- Support for a new CobraNet® input card for PowerMatch™ amplifiers
- New System Status displays for PowerMatch amplifiers
- Updated USB drivers for operation on both X86 and 64-bit operating systems
- USB lockout function for PowerMatch amplifiers
- Serial Protocol update to improve monitoring and fault reporting of PowerMatch amplifiers

For additional information on fixes and enhancements in this release, see the ControlSpace® Designer software version 3.1 release notes.

## Training, application, and support

Additional information on the design, configuration, and control of systems using Bose Professional electronics, and the ControlSpace Designer software can be found at [pro.Bose.com](#).

A number of application examples are included with the ControlSpace Designer help system:

- [City Council Chamber](#)
- [House of Worship](#)
- [Surround Sound Decoder](#)
- [Youth Multi-purpose Facility](#)
- [CobraNet Application Examples](#)

The most recent application guides are always available at [pro.Bose.com](#).

The ControlSpace User's Forum is a private forum for ControlSpace Users to share with other users, request new product features and functions, report issues with both software and hardware, and interact with the product development team. To join the ControlSpace User's forum go to [proforum.Bose.com](#).



# **Getting Started**

## **System Requirements**

The following are the minimum system requirements for ControlSpace® Designer™ 3.0

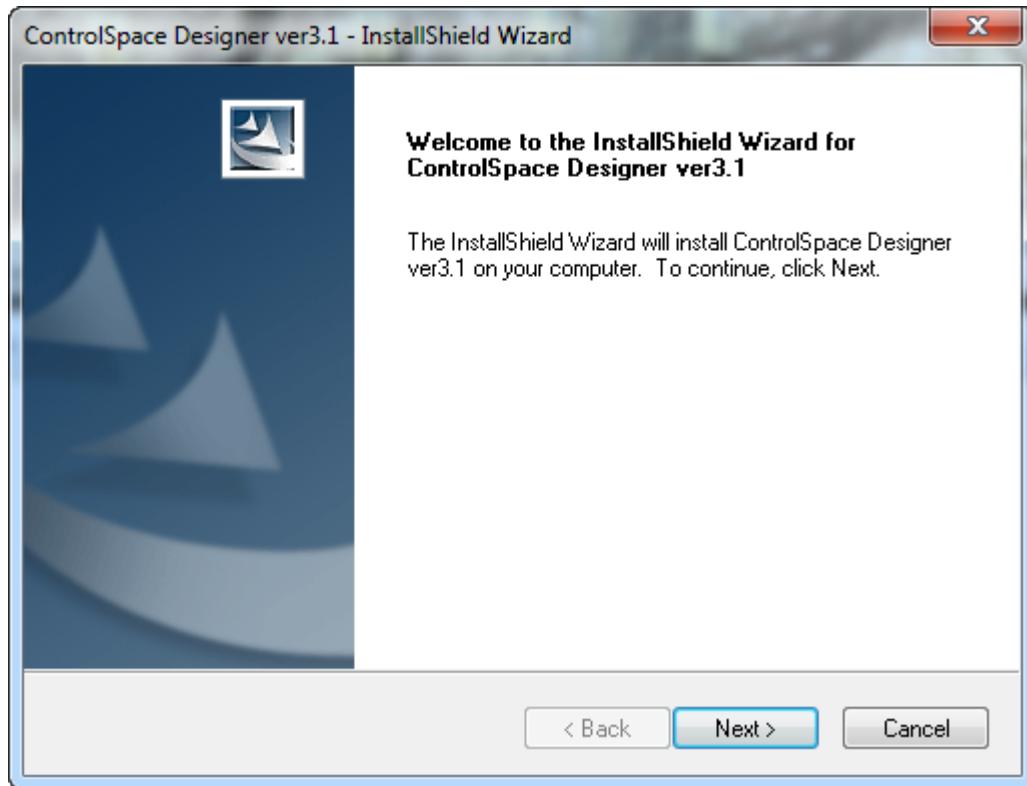
- Microsoft® Windows® XP Professional, Service Pack 2 (or later)
- Microsoft Windows 7 (Professional or Ultimate)
- Microsoft® .NET™ Framework version 3.5 or later
- Intel® Pentium® 4 850Mhz processor (or newer)
- 512 MB RAM
- 100 MB disk space available
- CD-ROM Drive
- 1024x768 32 bit XGA color video display adapter

## **Software installation**

NOTE: You must have Microsoft® .NET™ Framework v3.5 installed on your computer to run ControlSpace® Designer software.

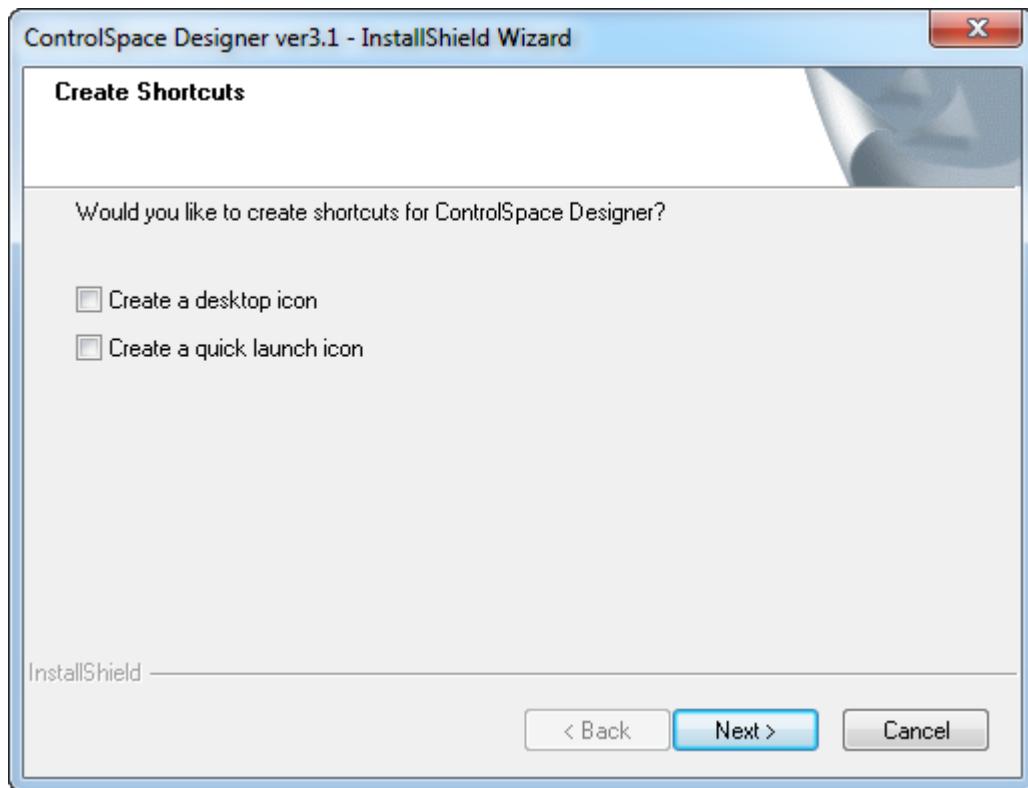
[Click here to download Microsoft® .NET™ Framework v3.5.](#)

1. Double-click on Setup.exe to install ControlSpace Designer software.



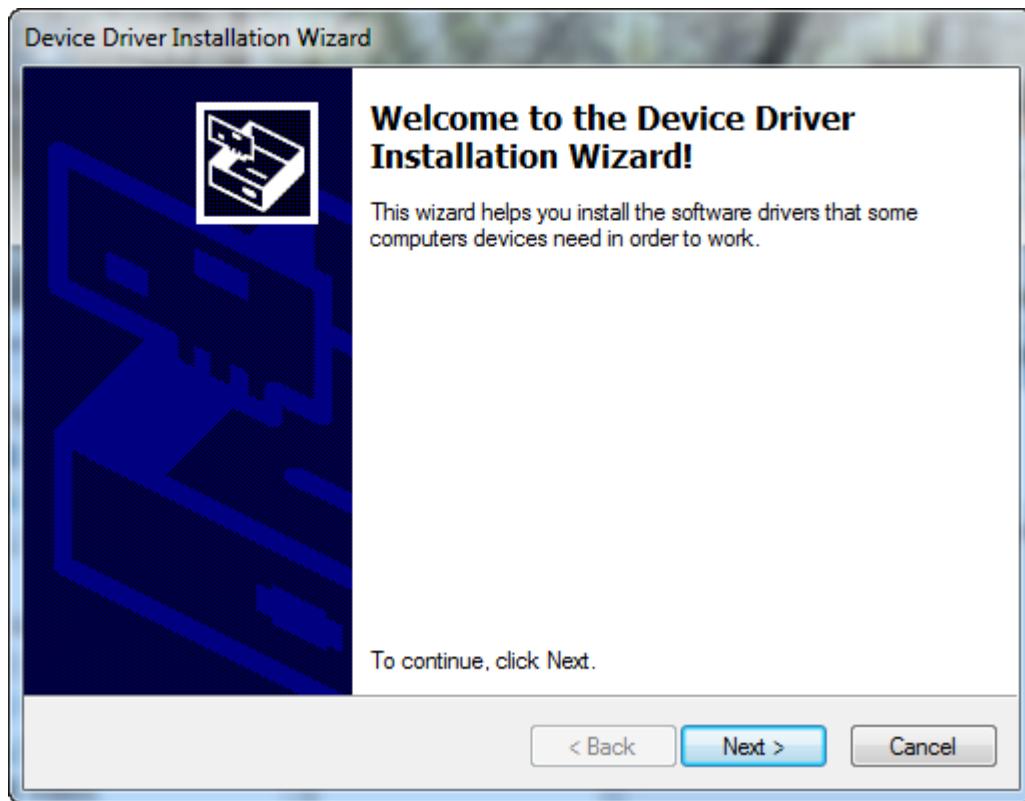
*Application Installer Dialog*

2. Click Next to begin installation.
3. Follow the prompts to install ControlSpace Designer software onto your computer.
4. When prompted, specify whether you would like to create desktop or quick launch icons.



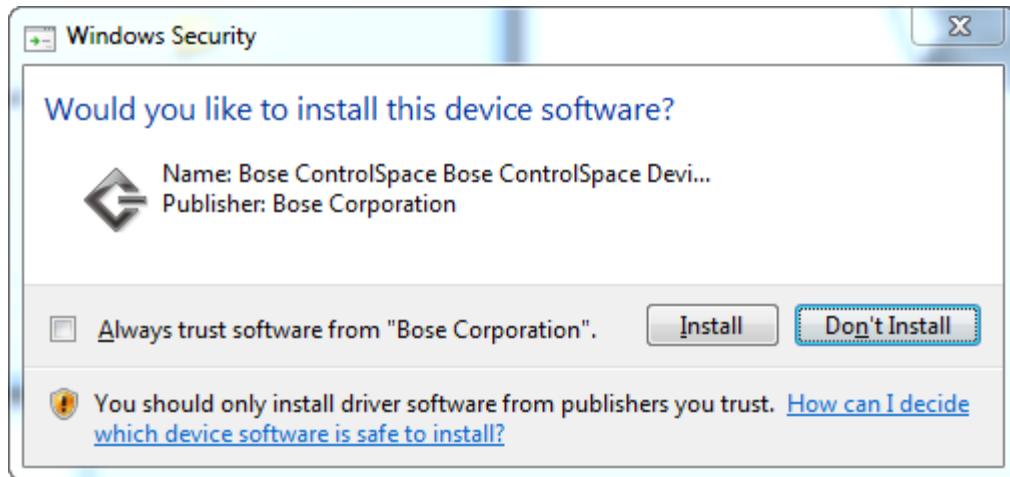
*ControlSpace Designer shortcut selection*

5. Once the application installation is complete, the Bose® USB device driver installer is automatically started.



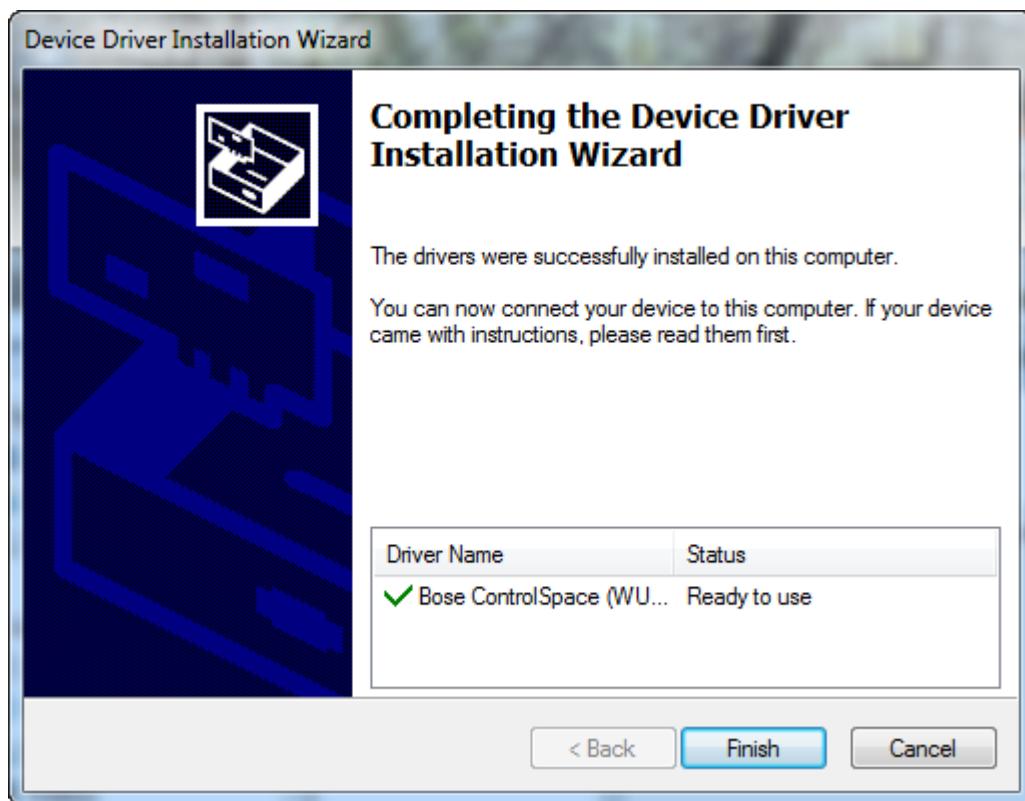
Bose USB device driver installation screen

6. Click Next to begin the Bose USB driver installation.
7. Depending on your Windows® security settings, you may be prompted to approve the installation of the Bose USB driver. Select Install to continue the installation.



Windows security warning dialog

8. When the Bose USB device driver installation is complete, click Finish to complete the installation.



Final installation screen for the Bose USB device driver

9. The installation of ControlSpace Designer and its associated components is complete. Click Finish to complete the installation.

## Working with Networks

### Using a network

All ControlSpace devices, and the ControlSpace Designer software, are pre-configured to operate on the same Ethernet network using Internet Protocol (IP) addressing.

When using devices on a private network there is no need to change the network or subnet addresses for either ControlSpace Designer or the system devices; in this case the default subnet of 192.168.0.xx is used.

See the following topics for assistance in the initial network set up and configuration of the system electronics:

- [Managing device addresses](#)
- [Network configuration](#)
- [Connecting to a system](#)

- [Disconnecting from the system](#)

## Managing device addresses

In a standard Ethernet network where Internet Protocol, (IP), addressing is used, the network address defines the network, subnet, and device address for each device on the network. This address facilitates the routing of data traffic within the local network and across multiple networks.

The ControlSpace Designer software will automatically assign an IP address to each device as it is added to a project. However, because each device is shipped with the same default IP address you must configure each device to use the proper IP address. Once this is complete it is possible to connect to the system, and upload the system configuration.

The following table shows the pre-assigned IP address, and device address range for all ControlSpace devices:

Default IP Address Ranges		
Device	Default Address	Address Range
ESP-00/88	192.168.0.160	192.168.0.160-175
PM8500/PM8500N	192.168.0.80	192.168.0.80-159
CC-64	192.168.0.176	192.168.0.176-207
ControlSpace Designer	192.168.0.10	Recommended - set by user

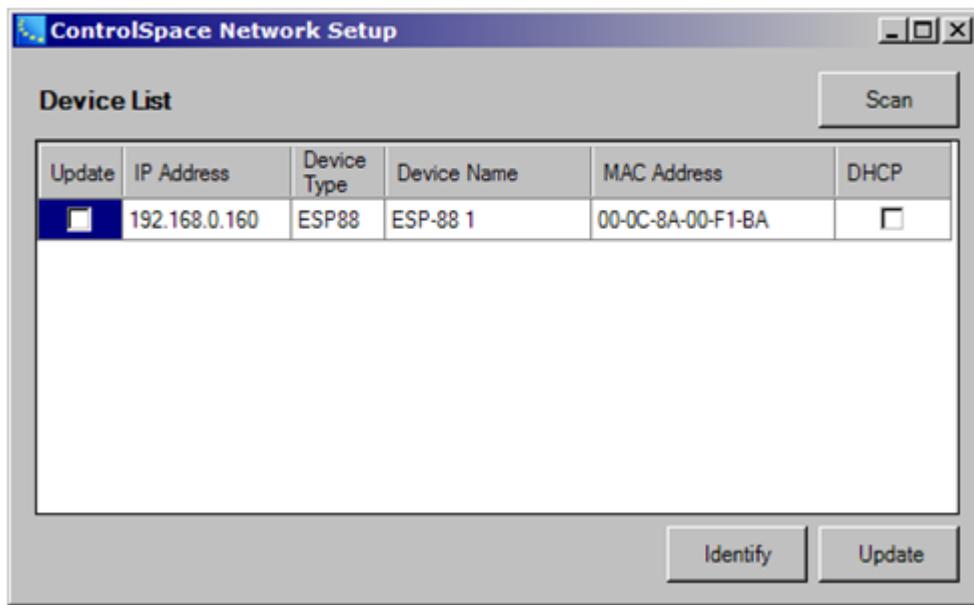
### To change the IP address of a device

When you are using more than one of any type of device on the network you will need to configure the IP addresses of the devices.

**Note:** It is not necessary to have a Project open within ControlSpace Designer to change IP addresses. However, the address you assign to the devices should be consistent with the addresses in your design.

1. Verify that the device is properly connected using a network between the PC and the device.
2. Verify that your PC is configured using the default IP address for ControlSpace Designer
3. Power-On the first device

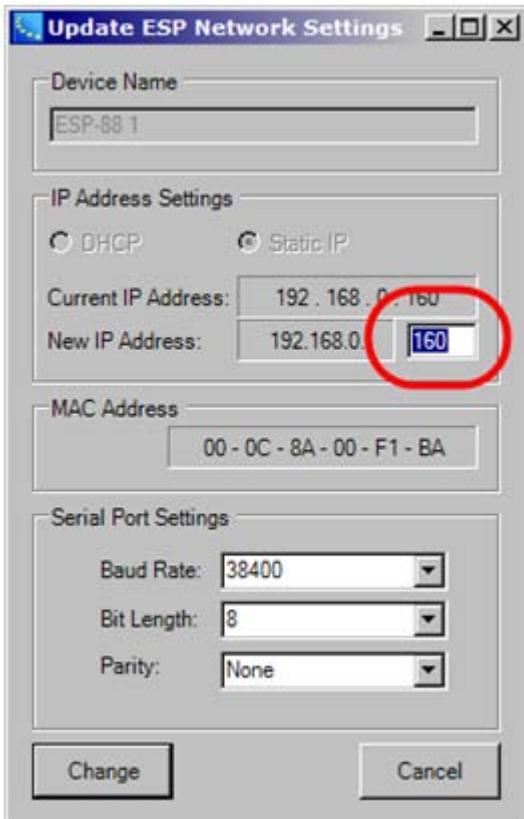
From within the ControlSpace Designer software choose System > Network Setup to open the Network Setup window. When the Network Setup is invoked all active devices are shown in the device list.



*Network Setup Dialog*

**NOTE:** If your device does not appear in the Device List check the cable connection, network address of the PC and the network address of ControlSpace Designer software.

4. Select the device whose IP address will be changed, and select Update. This will cause the Network Settings for the device to be displayed. From within the Network Settings dialog the IP address can be changed:

*Network Settings Dialog*

5. Select Change to apply the new IP address the device.
6. Power Cycle the device for the new IP address setting to take effect.
7. Repeat this process for all network devices.

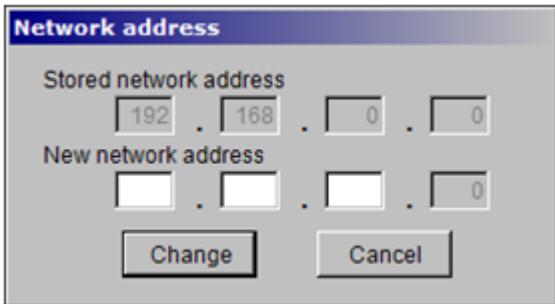
## **Network configuration**

ControlSpace Designer software is configured for operation on the default network 192.168.0.xx. This simplifies the process of connecting to new devices to configure them for operation. For example, when connecting to an ESP-88 for the first time, you will need to set your PC's IP address to 192.168.0.xx, and verify that ControlSpace Designer is configured to connect to the 192.168.x.xx network.

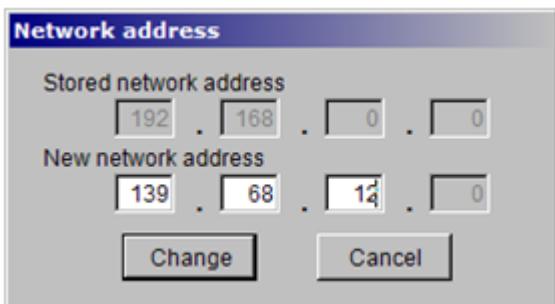
If you are configuring the system for operation on a unique private network, first configure the devices for operation on the new network, and then configure both ControlSpace Designer and the PC for operation on the new network.

To configure the network settings within ControlSpace Designer software specify the domain and sub domain addresses of the network.

1. From within the Tools Menu select the Set Network Address item (or press Alt + T, N). The Network address dialog box appears.



2. The Network Address dialog is used to define the address of the network that will be used for the system. Enter the new Net, Subnet and Gateway address here.



3. Select Change to apply the network address settings.

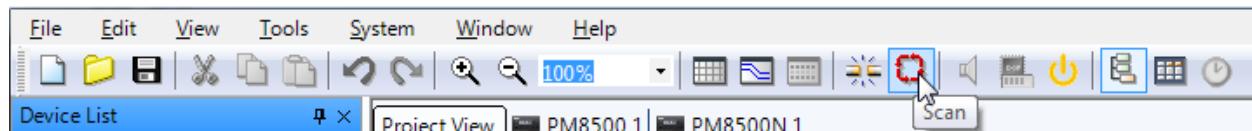
**NOTE:** Any devices added to the Project View will use the new network address.

## Network Scan

The Scan button in ControlSpace Designer software is used to detect hardware on your local network, without actually connecting to the system.

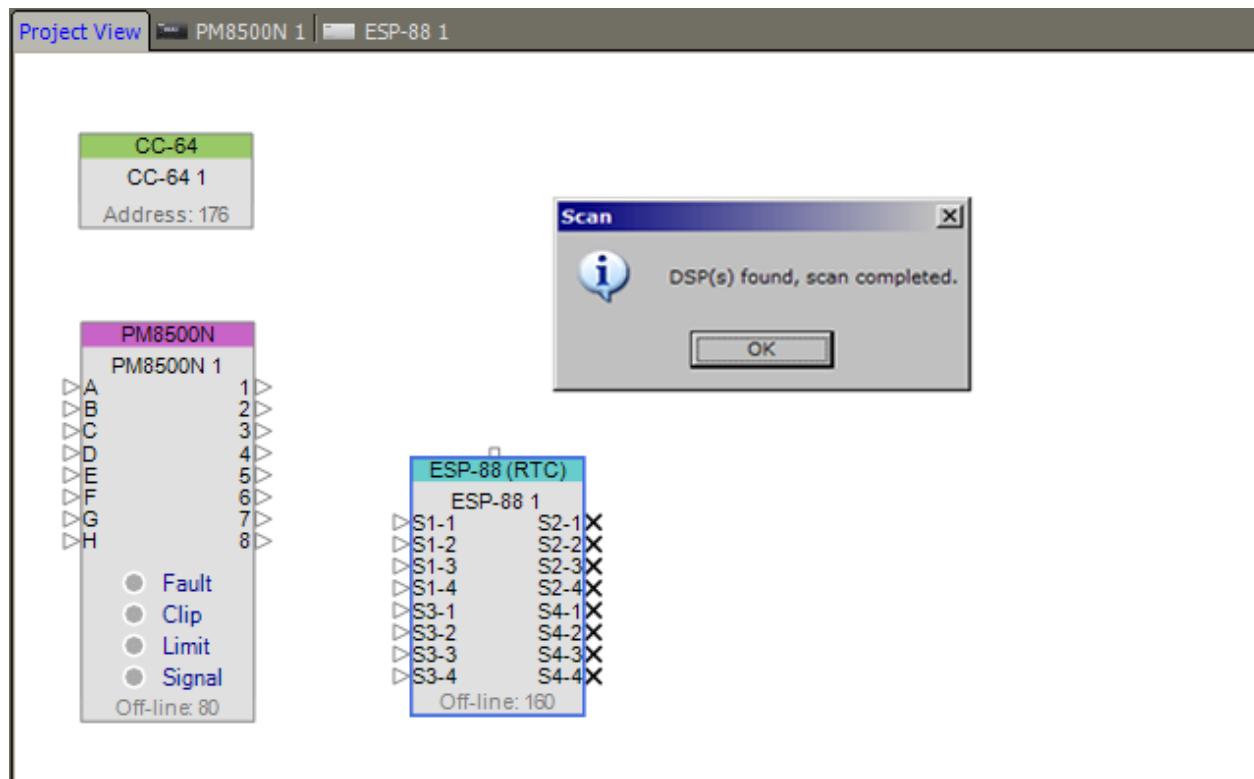
In general, the Network Scan should only be used with a new, blank project as a means to identify what hardware already exists on the local network. The following steps describe using the Network Scan function in this way.

To identify the devices on the network, go to the main toolbar and click on the Scan button (or press Alt + T, S).



*Location of Scan button*

When ControlSpace Designer software completes the scan, the Project View is automatically populated with the devices in your local network.



*Scanning for devices*

**NOTE:** Network scan only detects devices on the network. The network scan does not retrieve the signal processing's control settings of the devices.

When you initially scan the network for compatible devices, you will receive an error when no devices are found on the network.



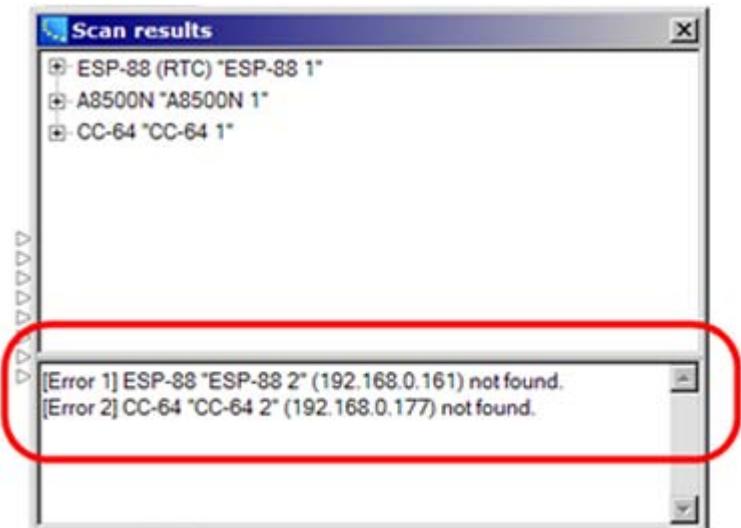
*Devices not found error*

This error is caused by one of the following reasons:

- No network connection between the PC and ControlSpace devices.
- ControlSpace devices are not powered on.
- The ControlSpace Designer software is configured for operation on a different network than the one to which you are currently connected.

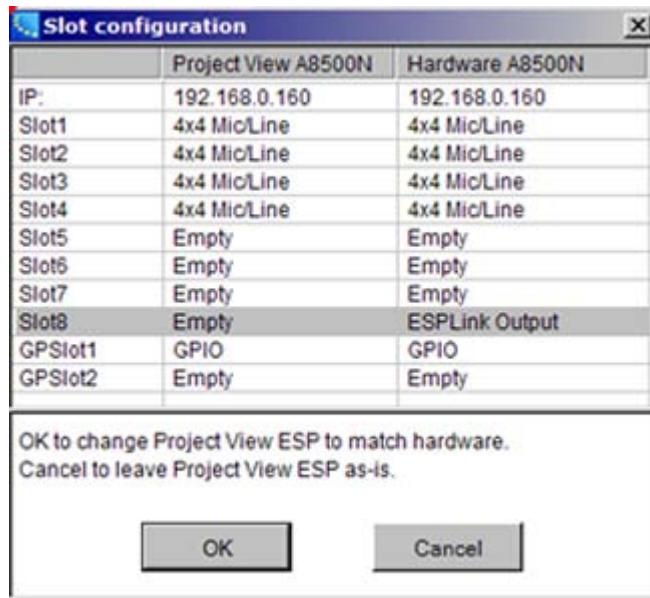
When performing a Network Scan with devices already added to the project additional errors may be generated. During the Scan process ControlSpace Designer uses the device address to determine if the devices in your project match those on the network.

When the project file contains devices that are not active on the network you will receive a Scan results error message to notify you of the devices that are present on the network, and the devices in your design which cannot be located.



*Scan Error - Devices not found*

When the Scan function detects devices on the network whose device addresses match those in the design a second check is performed to confirm that the hardware configuration of the devices matches those in the project file. For example, an ESP configured as a 16x16 device in the project file has the matching I/O configuration in hardware. When the device configurations do not match a dialog is presented to describe the differences in the configurations.



Select OK to use the configuration of the hardware, and replace the device within the Project View, or Cancel to cancel the operation.

**NOTE:** When selecting OK the device within the project view will be removed from the design. Any signal processing or control programming associated with this device will also be removed.

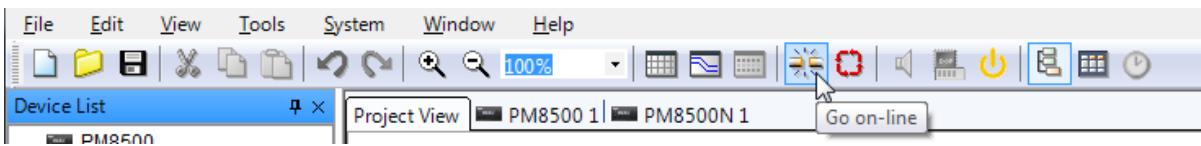
## Connecting to a system

Once system devices are configured for operation on the network you can connect to the system, upload a configuration, and control the system's operation. ControlSpace Designer offers the option of either sending the current configuration to the hardware, or getting the configuration from the hardware when connecting to the system.

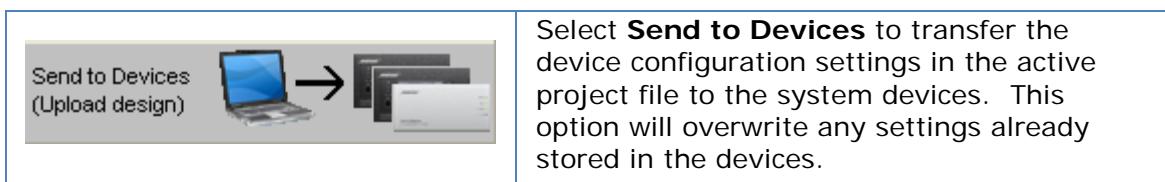
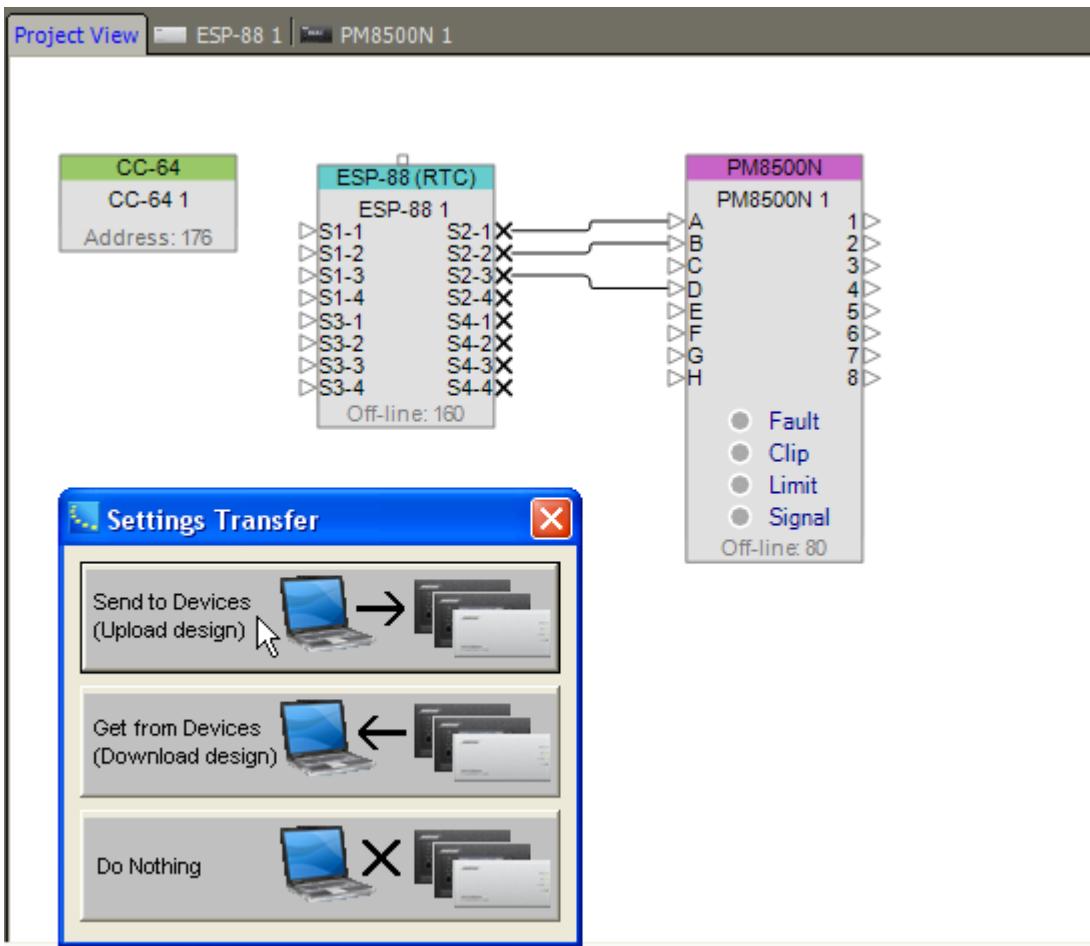
When connecting to the system ControlSpace Designer compares the quantity and configuration of devices in the design to the devices connected to the network. For example, when an ESP assigned address 192.168.0.80 is found both in the project, and on the network the hardware configuration of the two is compared and will need to be reconciled. When the project has an ESP assigned address 192.168.0.80, and the system has an ESP addressed 192.168.0.81 the new ESP will be added to the project view.

When you are ready to connect to the system use the following steps:

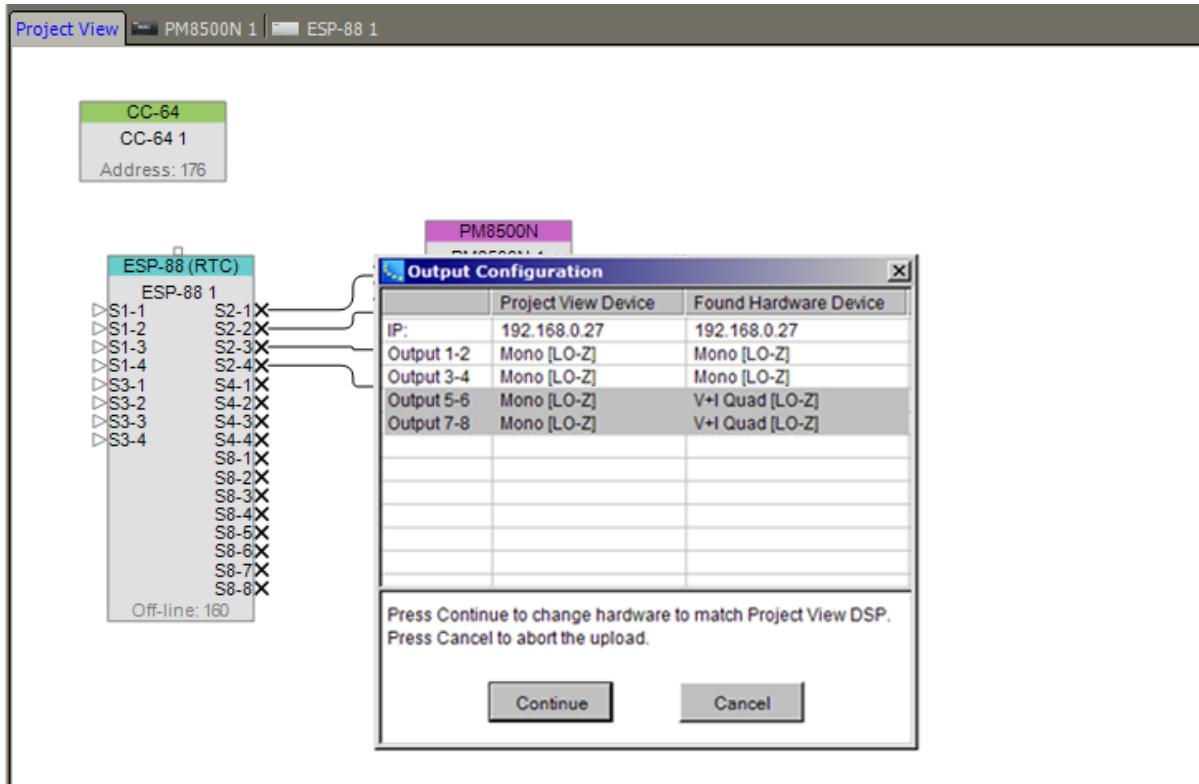
1. Open the ControlSpace Designer project file which contains your system devices, signal processing and control functions.
2. Select the Go on-line button (or press Alt + T,G) on the main toolbar.



3. Select the connection method: **Send to Devices** or **Get From Devices**:



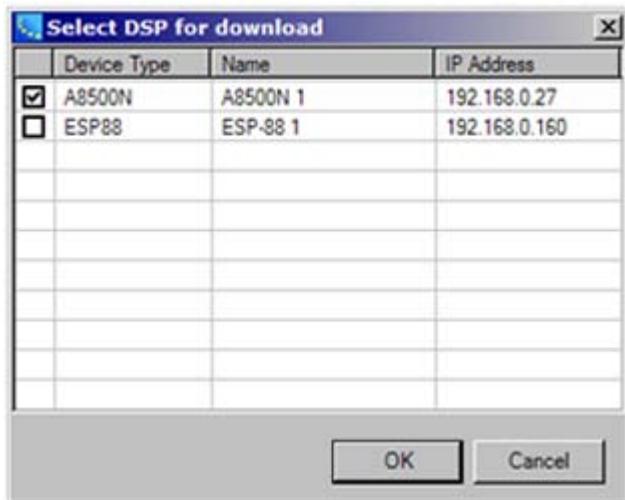
**NOTE:** In the event that the configuration within the project does not match the configuration of the hardware you will receive a Configuration Mismatch error. You must either modify the hardware to match the configuration, or modify the configuration to match the hardware before continuing.



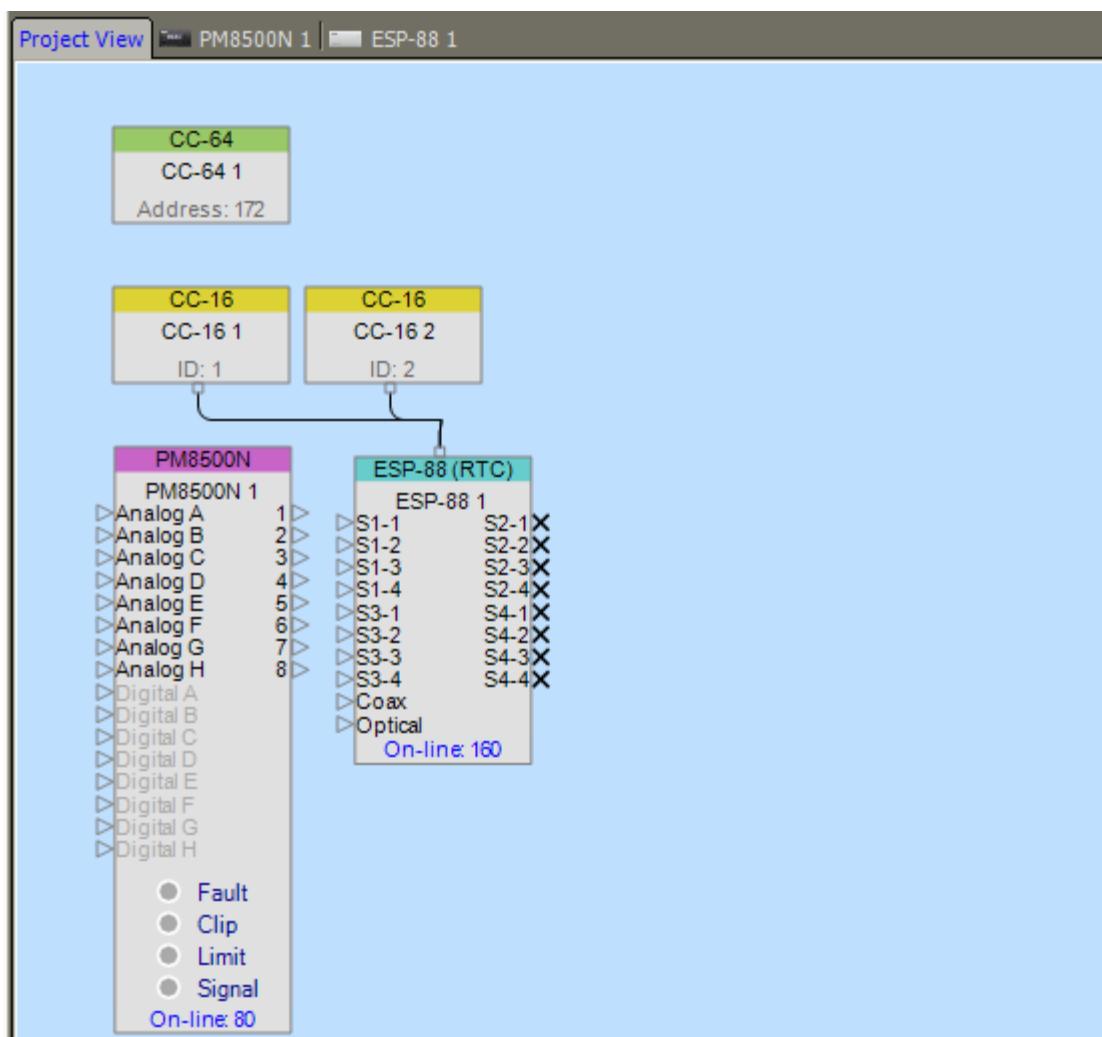
Select **Get From Devices** to transfer the configuration settings within the devices to the project file. This option will overwrite any settings already stored in the project file.

**NOTE:** you will be prompted to save changes to the current project file before the network devices are added.

4. Select the device that contains the system configuration file you wish to retrieve.



5. The connection to the system is now established, and is indicated by the light blue background (green if a USB connection is used); you are ready for system operation.

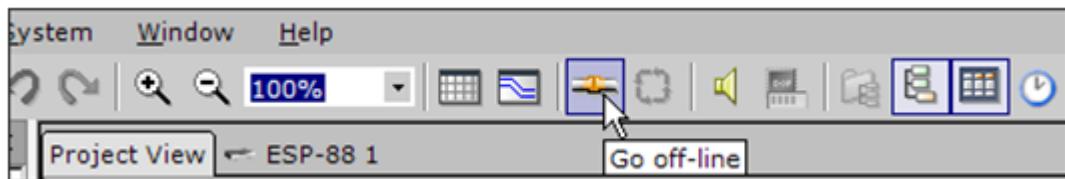


**NOTE:** ControlSpace Designer will only establish a connection with those devices that are included in the configuration file. If you do not see a device once the connection is established it must be added to the configuration file, and the new configuration must be uploaded to the system.

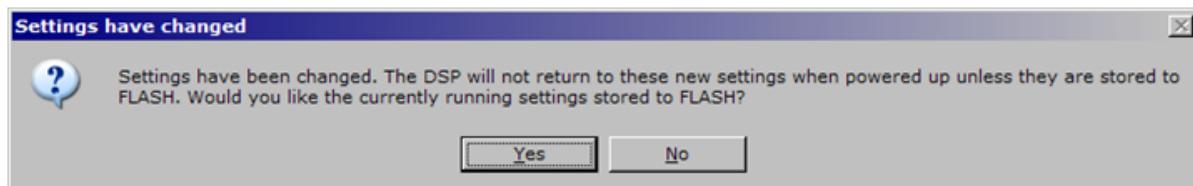
## Disconnecting from the system

When you are ready to disconnect from the system, perform the following steps:

1. Select the Go off-line button (or press Alt + T,G) on the main toolbar.



2. If any controls have been modified you will be prompted to save the changes within the hardware. Doing this will ensure that the setting persist after power down.

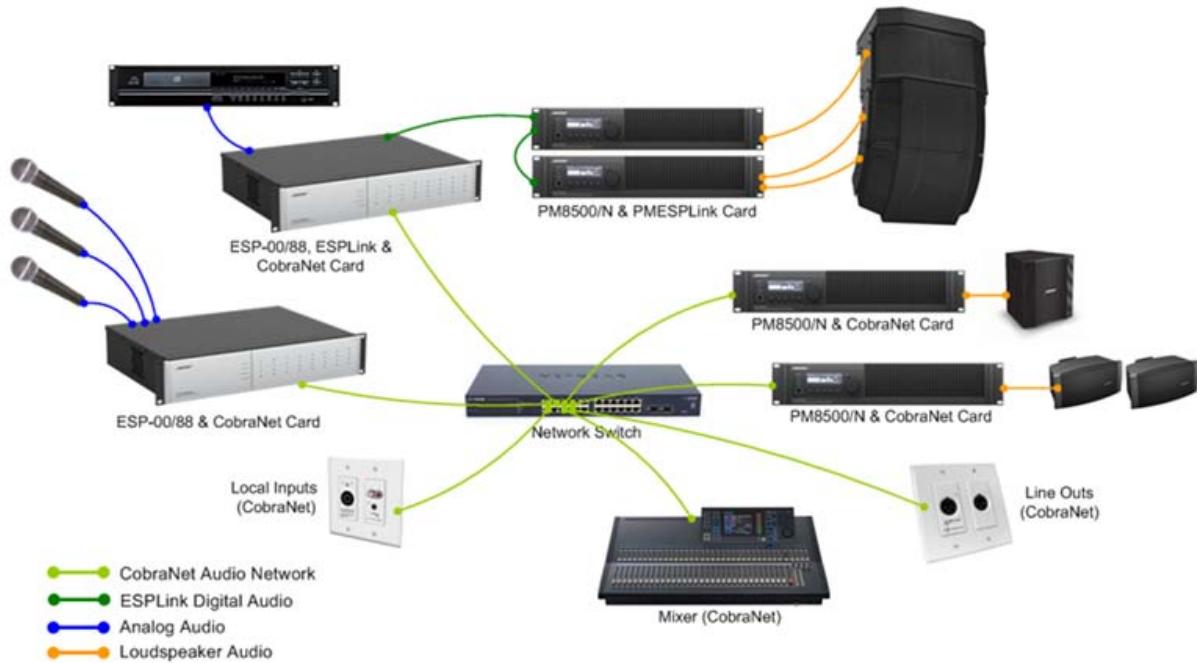


**NOTE:** If you have not made any changes to the hardware you will not be prompted to save the system settings.

## Working with CobraNet® Networks

### CobraNet Network Audio

CobraNet network audio expansion cards are available for both the ESP-88/00 engineered sound processors and the PowerMatch™ PM8500/N configurable professional power amplifiers. The cards use industry-standard CobraNet technology to transport multiple channels of high quality, uncompressed digital audio in real time across a standard Ethernet network. CobraNet network audio distribution is typically used in systems which require signal processors and amplifiers are in different parts of a large building or complex, or to interlink multiple devices within an equipment rack to reduce analog cabling and connections.

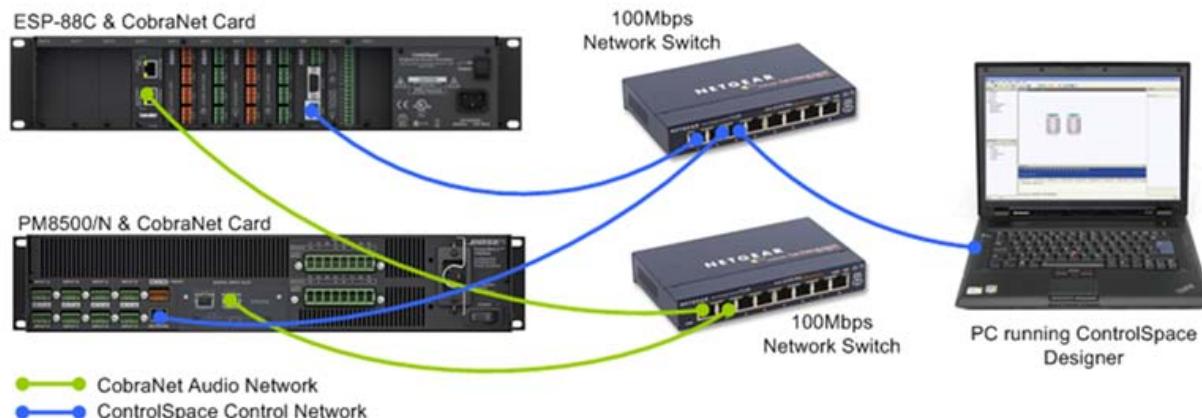


*Example system using CobraNet network audio distribution*

A CobraNet audio network is built using a standard 100Mbit (Fast Ethernet) or 1000Mbit (Gigabit) Ethernet network and can utilize industry-standard structured network cabling (CAT5E/CAT6), Ethernet switches and other network components.

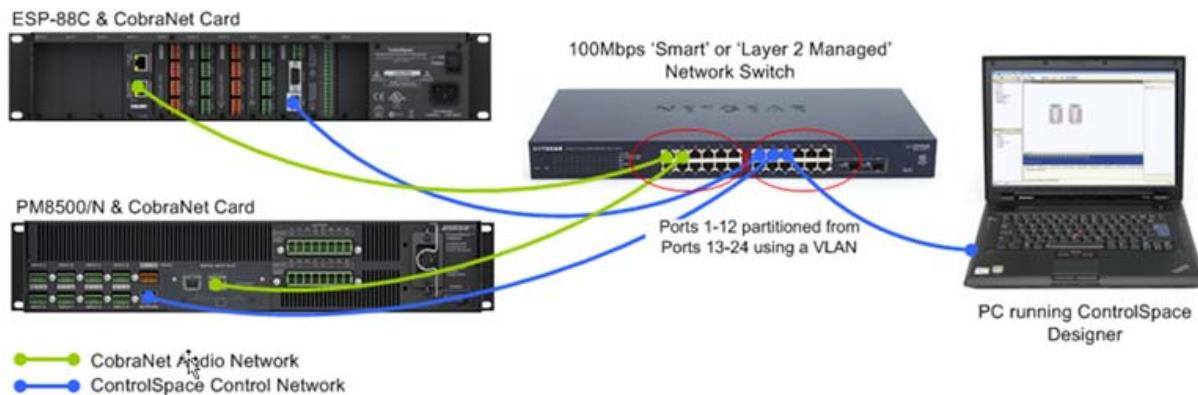
While systems using less than 8 CobraNet audio ‘bundles’ may use a standard Fast Ethernet router, we recommend that a standard Ethernet switch is used to avoid complications. For Larger systems, and in systems which require quality of service, QoS, management a managed switch is recommended. The use of repeaters/hubs, however, is not recommended and should be avoided.

When using CobraNet with ControlSpace devices, the CobraNet audio data and the ControlSpace control data must be isolated from each other either as physically separate networks, as the volume of traffic produced by CobraNet is incompatible with the 10Mbit control connection found on some ControlSpace devices.



*Example implementation of audio and control networks using physically separate networks*

If a managed switch will be used in the system, the creation of a separate VLAN for one of the two networks is acceptable. Using a 'Smart' or 'Layer 2 Managed' Ethernet switch that supports VLANs, it is possible to partition the networks within a single switch as illustrated below.

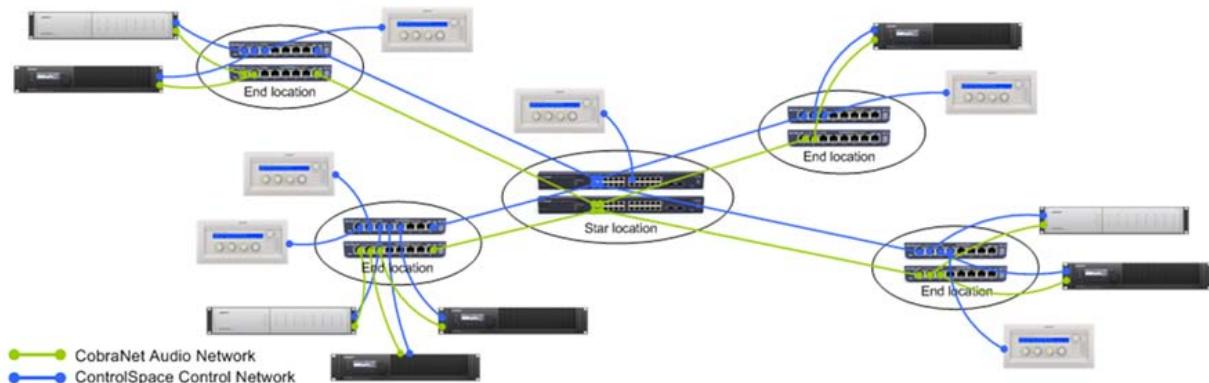


*Example implementation of audio and control networks using a VLAN*

In order to avoid unwanted audio artifacts and drop-outs the CobraNet network relies on the timely delivery of audio data and therefore has some fairly strict network requirements.

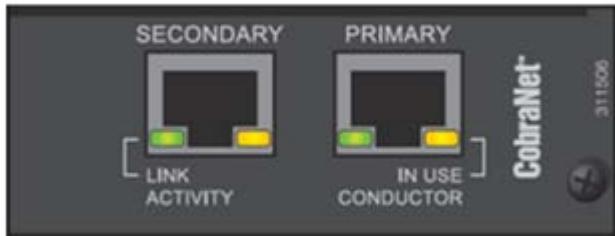
Each time a switch is inserted in the transmission path between the sending and receiving device, known as a 'switch-hop', a small amount of propagation delay occurs. In order for this delay to not affect correct operation a maximum of six 'switch-hops' is recommended for 100Mbit networks, (when using the Standard [5.33mS] latency option). Since 1000Mbit network switches are designed to operate at faster speeds their propagation delay has less significance.

Consistent with most computer based Ethernet networks (and the ControlSpace control network), CobraNet networks typically use a 'Star' or 'Star of Stars' layout. In the example shown below a maximum of three switch-hops is required to reach any other device on the network.



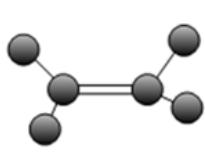
*Typical 'Star of Stars' network topology*

Each CobraNet network audio interface includes two physical connections, Primary and Secondary, but only use one at any given time. The Secondary port adds redundancy and is used automatically should the Primary connection to the network fail.

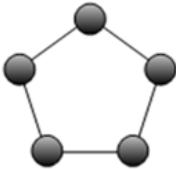


*CobraNet Audio Network Card*

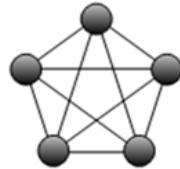
While the two ports provide redundancy for the connection between the CobraNet card and the network, the resilience of the complete connection between CobraNet devices will depend on the network design. Various techniques and protocols exist to provide automatic backup and redundancy for Ethernet networks. Some of these are shown below:



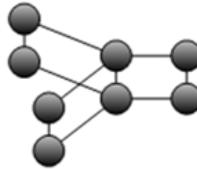
Link aggregation/Trunking



Ring (with Spanning Tree)



Meshing



Dual Link (with Spanning Tree)

*Redundant network topologies*

## CobraNet Network Audio Routing

Within a CobraNet network, audio is passed between devices in 'Bundles'; each Bundle is capable of carrying up to eight audio channels. Each CobraNet device may be configured as a transmitter, receiver or both. The exact channel count capabilities of the device are somewhat dependent upon the hardware and are typically pre-determined by the manufacturer.

A CobraNet receiver may only be connected to one transmitter which must be on a different device. The CobraNet 'Bundle' assignment is the method by which devices determine the routing of audio data throughout the system. The Bundle address also is used to determine the method of transmission for the audio data. A transmitting device may broadcast its audio data to the network and any receiving device may receive the audio; this method is called 'Multicast'. It is also possible for the transmitting device to broadcast its audio data to a single receiving device, which is termed 'Unicast'.

The bundle address given to a transmitting device determines whether the data will be broadcast using the Multicast or Unicast method. Bundle numbers are normally in the range 1-65,279 with 1-255 defined as Multicast and 256-65,279 usually defined as Unicast.



*Examples of Unicast and Multicast audio routing.*

The type of broadcast method used will directly affect the amount of data being transmitted via the network. While both types can only be sent by a single transmitter, a Unicast Bundle can typically only be received by one receiver, but adds additional network traffic and should only be used if required. A Multicast Bundle will normally be sent to every port on the network irrespective of whether any receivers are requesting it. Whereas a Unicast Bundle is only sent to a network port leading to the CobraNet device requesting it, otherwise it is not transmitted. Eight bundles on any port (including all the Multicast Bundles on the network) will consume all the available bandwidth on a 100Mbit network and hence a maximum of four Multicast Bundles is generally accepted good design practice.

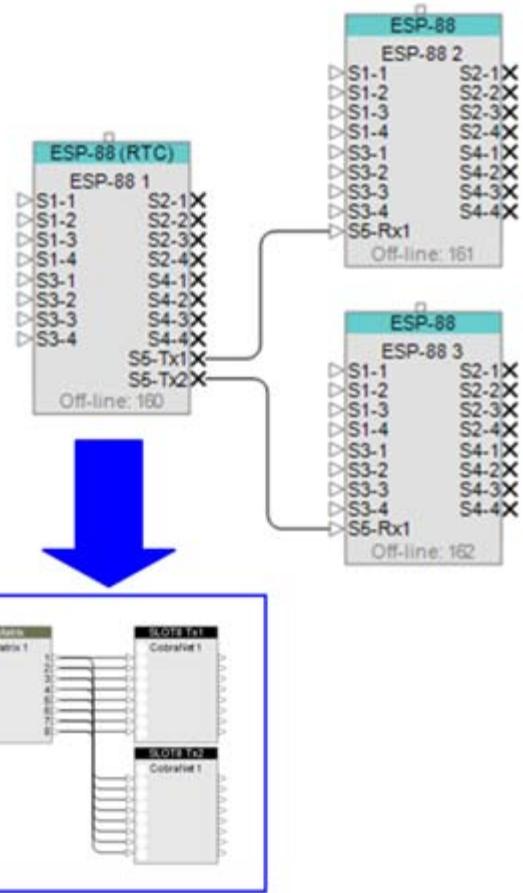
**NOTE:** It is possible for Bundles in the Unicast range (256-65,279) to be set to Multi-Unicast (allowing a copy to be received by up to four devices) or Multicast, but these modes are rarely used and are not currently supported within ControlSpace Designer software.

The following are several CobraNet audio routing examples for typical applications.

**Example 1 – audio distribution between multiple processors.**

The CobraNet card in ESP-88 1 is configured as '16 out' and the others as '8 in'. One Bundle of eight channels passes from ESP-88 1 to ESP-88 2 and a different Bundle of eight channels passes from ESP-88 1 to ESP-88 3.

If desired some or all of the channels in each Bundle can be the same simply by linking the same paths to each CobraNet output module. This has the benefit that both connections are still from a single transmitter to a single receiver hence Unicast Bundles (256-65,279) can be used, preserving network bandwidth.



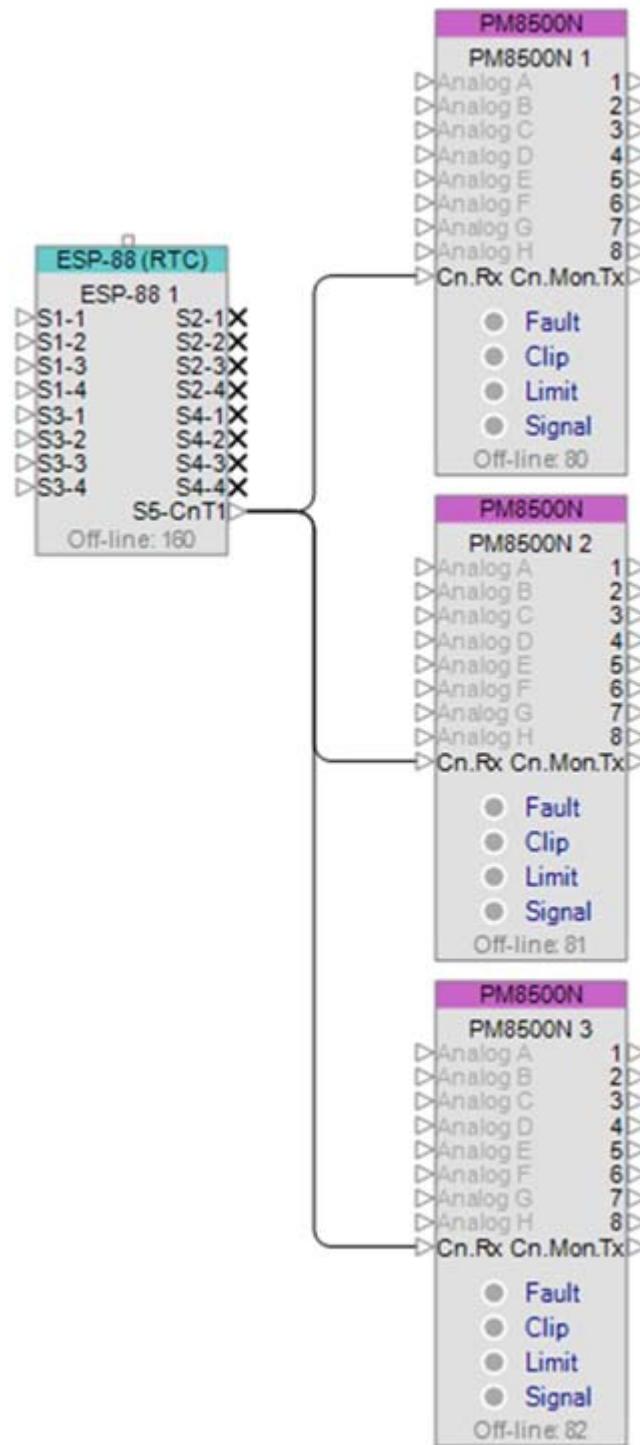
#### Example 2 – audio distribution to a remote amplifier rack.

In this example audio is routed from a single ESP to a remote amplifier rack, containing four PowerMatch™ amplifiers.

With this design a single Bundle of eight channels is passed from ESP-88 1 to all of the other devices. Since these connections are from a single transmitter but to multiple receivers a Multicast Bundle (1-255) would be required.

Since this will be a common scenario, the configuration is supported 'out-of-the-box' with minimal setup required.

PowerMatch CobraNet cards come factory set to receive Bundle '100' and with ControlSpace Designer v3.1 or later the first ESP CobraNet transmitter in the design will be set automatically to the same Bundle. Hence once the cards have been physically added and connected, simply uploading the design file to the ESP is all that is required to establish the link. Routing audio to the CobraNet output module in the ESP and selecting the 'Digital' source on the amplifiers will then allow audio to pass.



## CobraNet Network Status

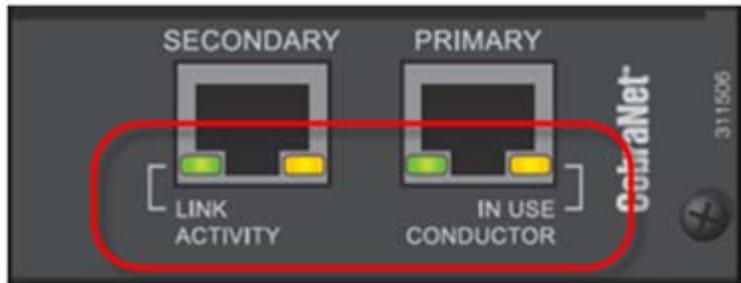
The most critical component to any networked audio system is that audio is reproduced simultaneously from all system devices. In a situation where a single transmitter is configured for Multicast operation, all receiving devices must synchronously reproduce the audio. If this does not occur the quality of the audio at the listener has the potential to be greatly reduced. To keep all the CobraNet devices synchronized, one node takes on the role of 'Conductor' and generates regular 'Beat' packets that are broadcast to all of the other devices, 'Performers', on the network. Performers use the beat packets to synchronize audio playback and to synchronize their digital clocks locally.

Only one device on the network can be the Conductor, all other devices are performers. If the device identified as the Conductor drops out, after a period of time a new device will step up and fill the role of Conductor to ensure seamless, synchronous operation.

A second important aspect of the network status is that transmitting and receiving devices are configured properly. For example two devices transmitting on the same Bundle number or the presence of a large number of Multicast bundles can lead to network errors.

Normally, the settings provided within ControlSpace Designer software will help ensure a proper setup and normal operation. However, it is possible to modify settings using other CobraNet network utilities and create issues with the audio routing, affecting the network status.

Each CobraNet port has two LEDs to indicate the current network status:



<b>Green LED</b>	Solid	Link established with another node or networks switch
	Blinking	CobraNet activity on the network
<b>Orange LED</b>	Solid	Power applied, node is a Performer (default)
	Blinking - single port	Node is the Conductor
	Blinking - both ports	Error on the network

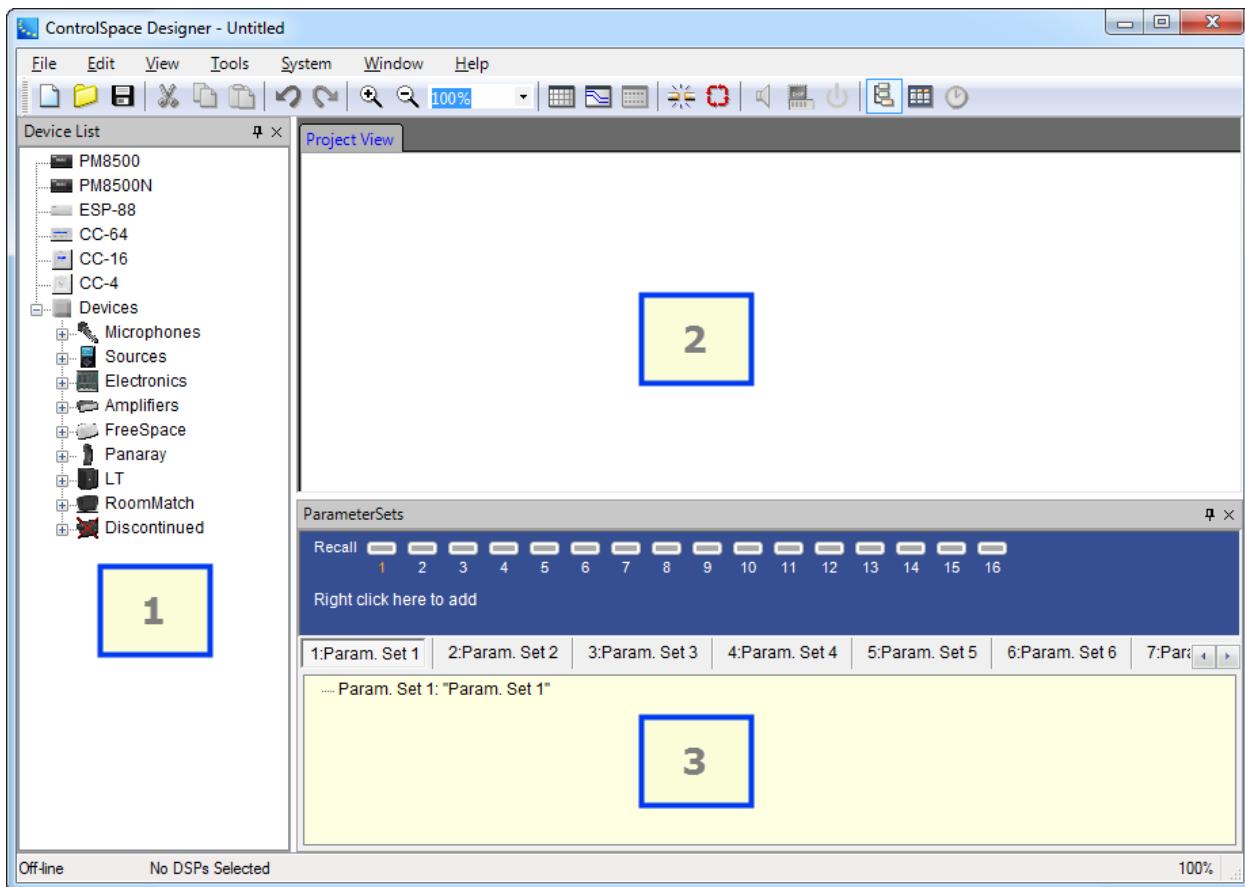


# User Interface

## Interface overview

The ControlSpace Designer software interface contains three primary components:

- Device Lists (1)
- Design Workspace (2)
- Control Library (3).



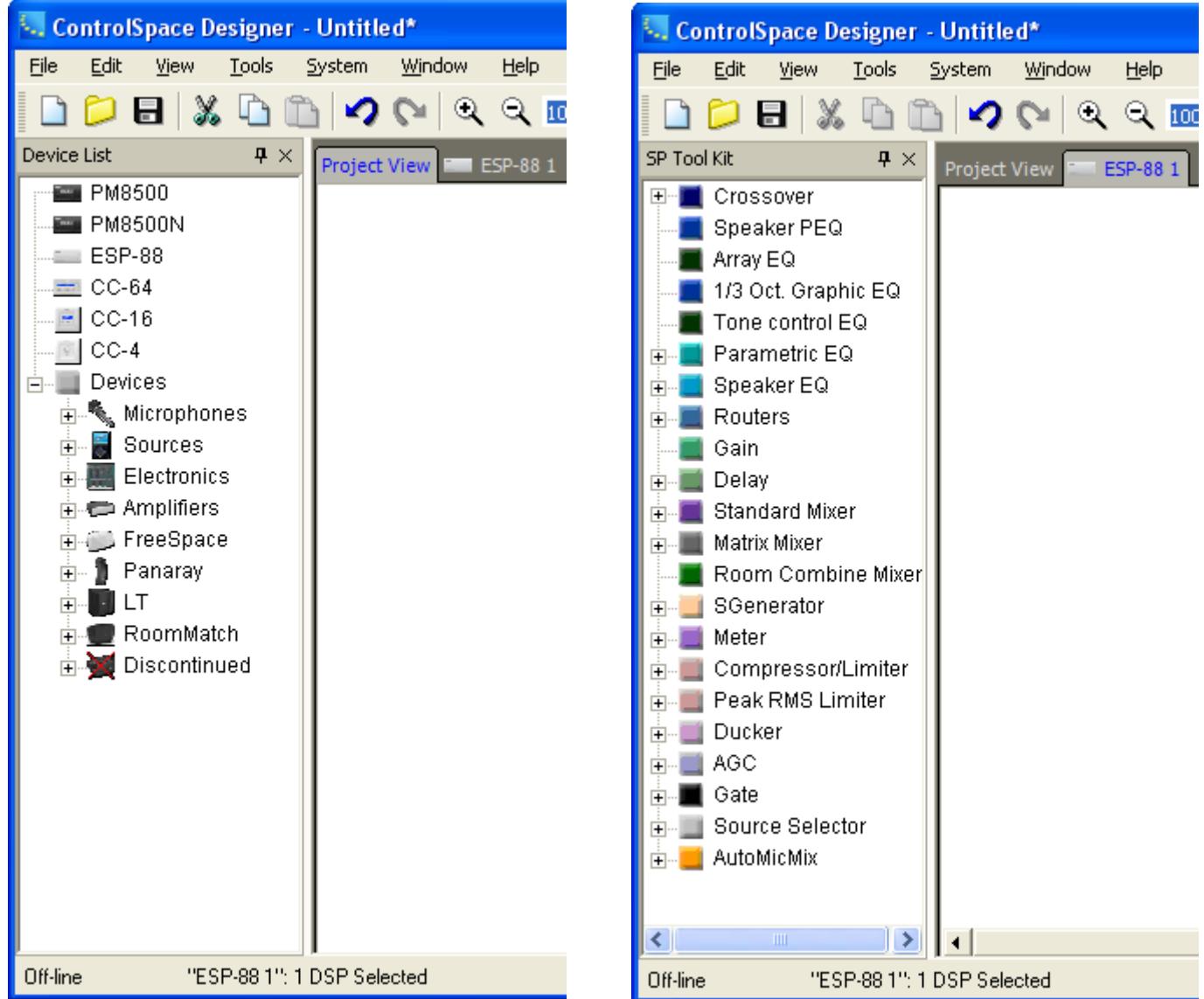
While a number of additional views, and windows are available, these three elements are the primary work areas.

## Windows Reference

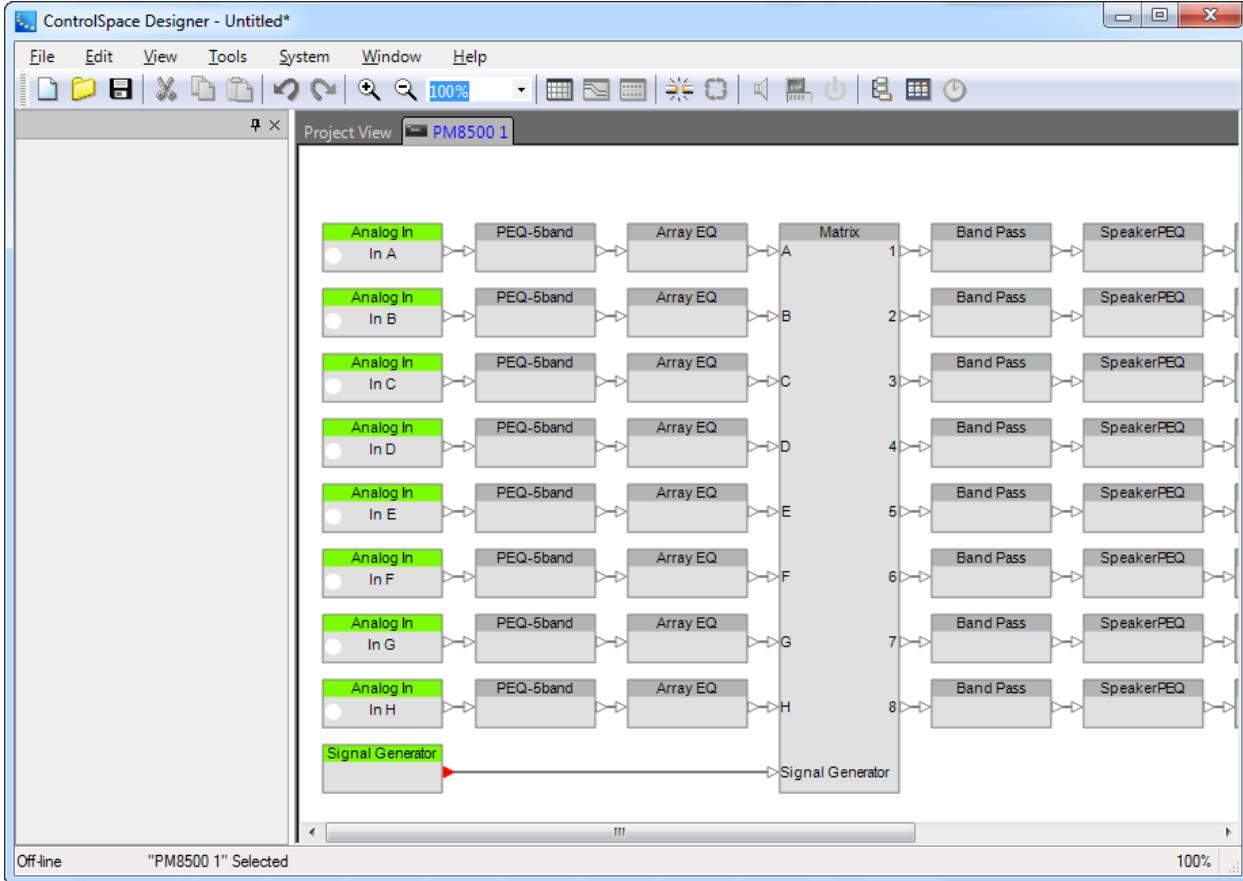
### Device list

The **Device List** contains a list of devices which may be added to the Design Workspace. The available devices in the Device List are dependent upon the tab selected in the Design Workspace.

## ControlSpace Designer 3.1 Software Guide



Some devices, such as the PM8500 have a fixed, non-configurable, signal processing diagram. When the Signal Processing View for a fixed block diagram device is active the SP Toolkit is empty – indicating that no additional signal processing may be added to this device.

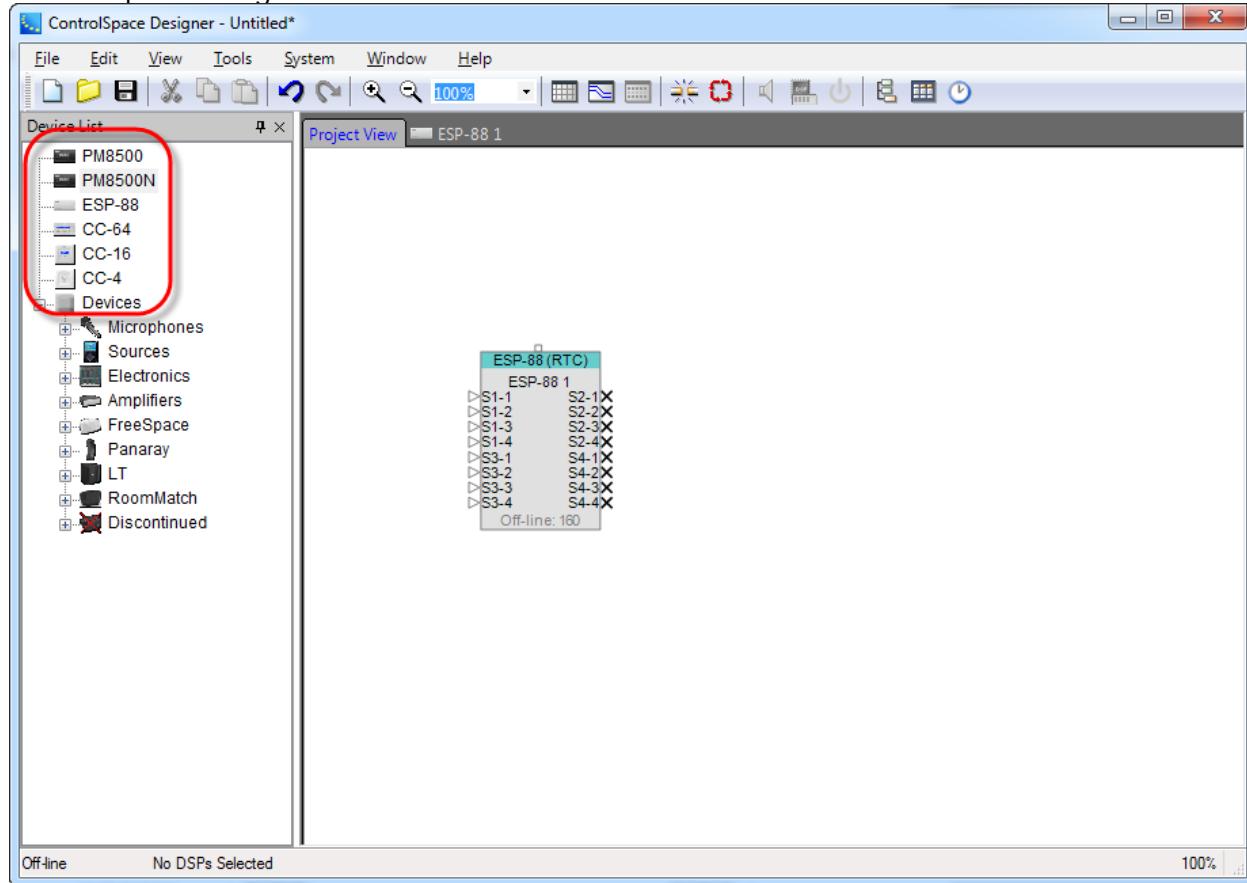


## Design workspace

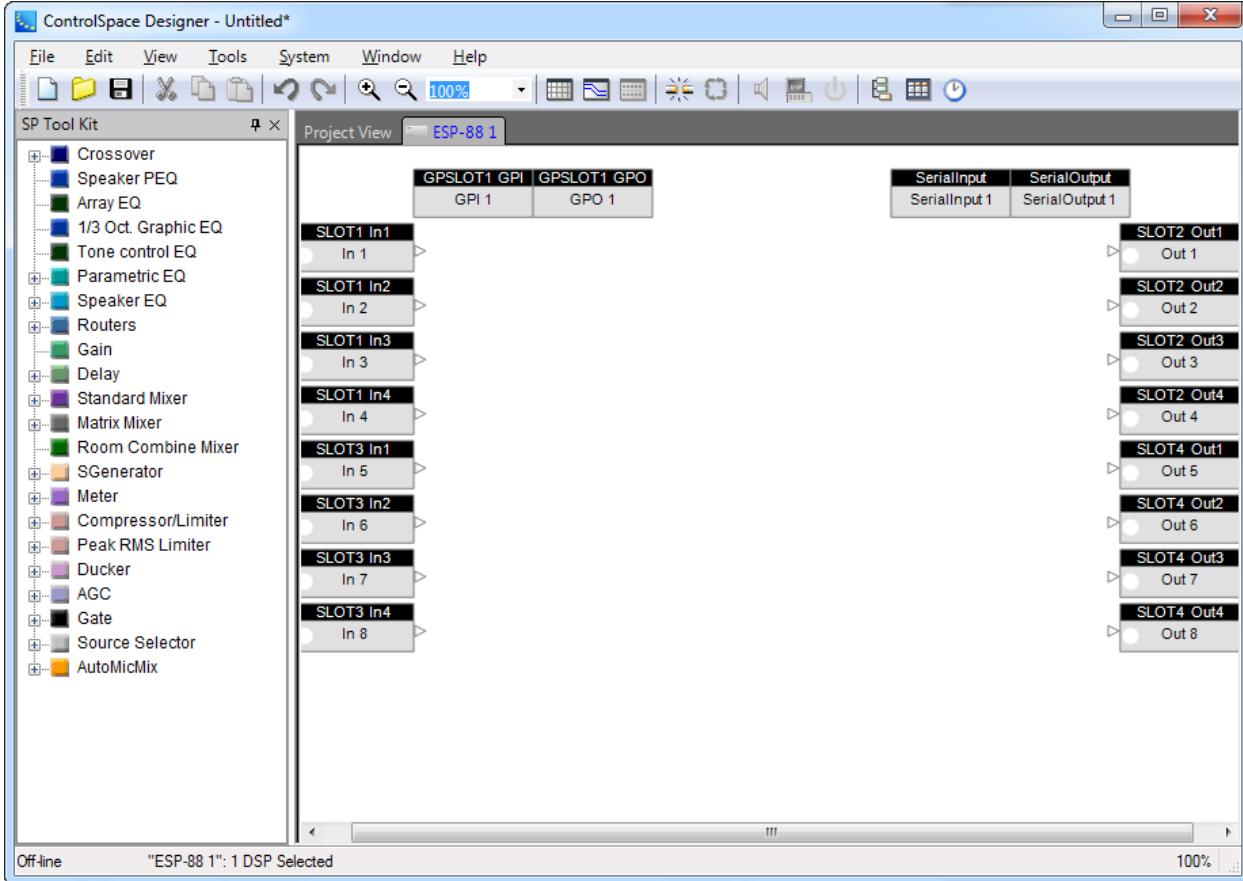
The **Design Workspace** is used to define the system devices, create the signal processing diagram that will be implemented within the ESP, and to access the operational screens for various devices and signal processing objects.

Create your system design by selecting, dragging and dropping individual processing and control components from the **Device List** into the **Project View**. The **Project View** represents a block diagram of all system components and their interconnection.

## ControlSpace Designer 3.1 Software Guide

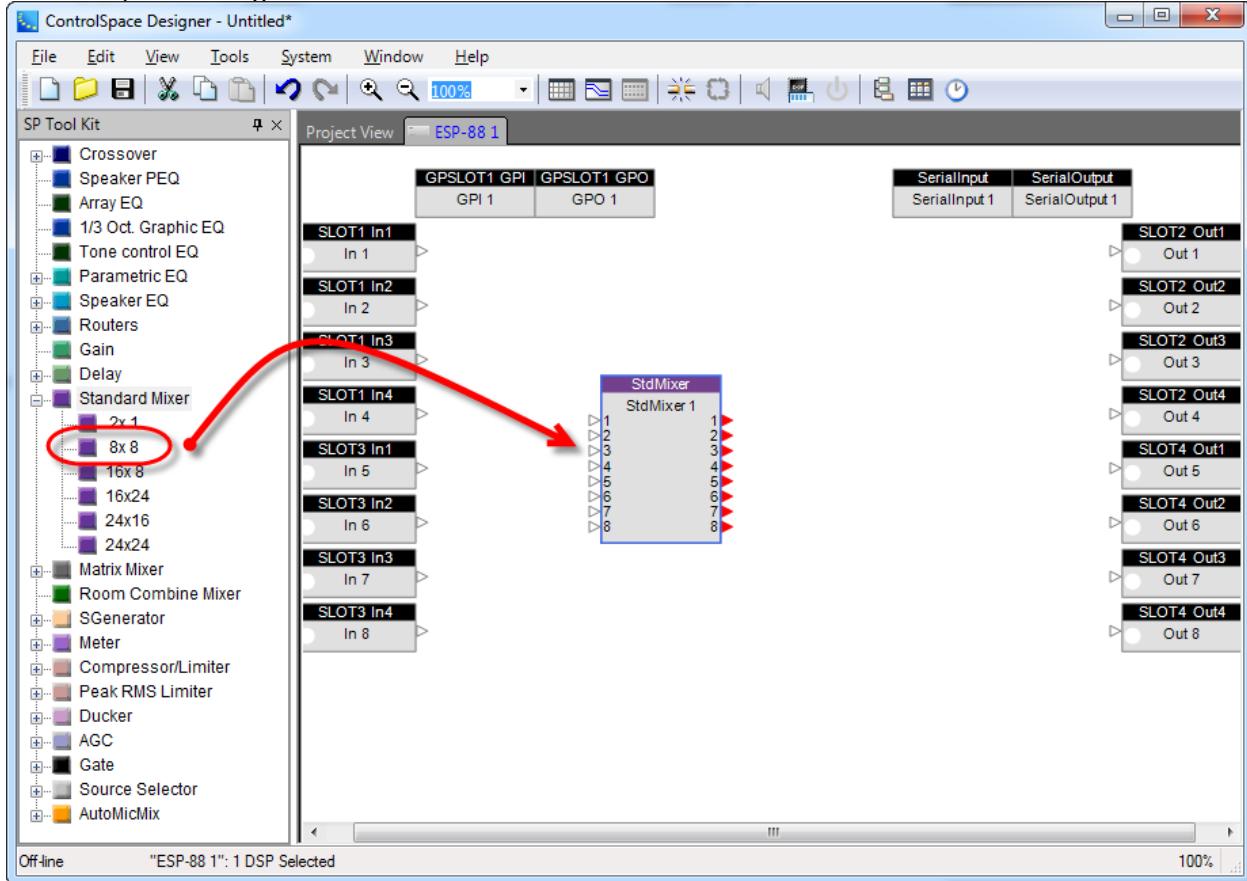


Once a system component is added to the design, a new **Device Tab** for the component is created. Selecting the **Device Tab** displays the signal processing diagram for the device.

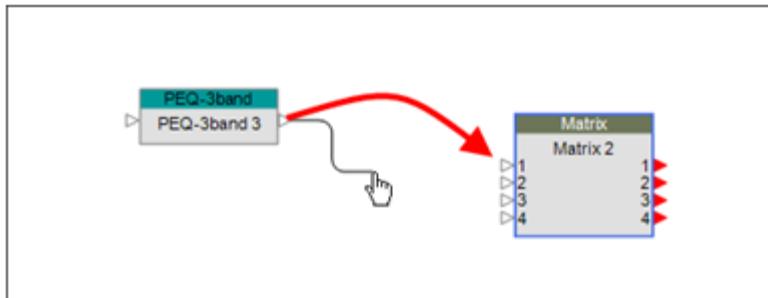


The **SP Tool Kit** contains all the available signal processing blocks for use in the selected device. Simply drag and drop these blocks into the **Signal Processing View** on the right to configure your system.

## ControlSpace Designer 3.1 Software Guide



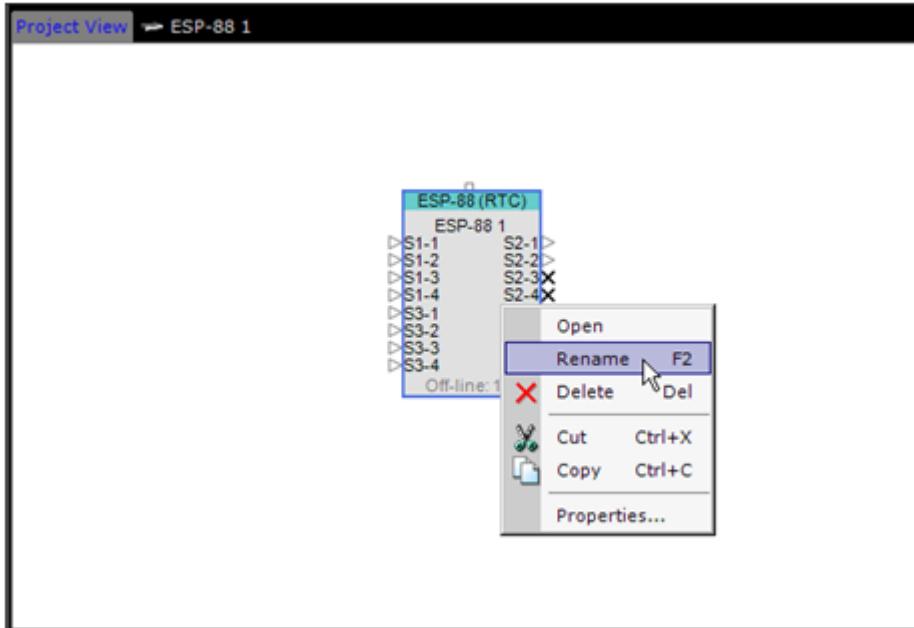
Wiring devices between inputs, outputs and signal processing blocks is accomplished by selecting the output node of the sending device and dragging it to the input block of the receiving device.



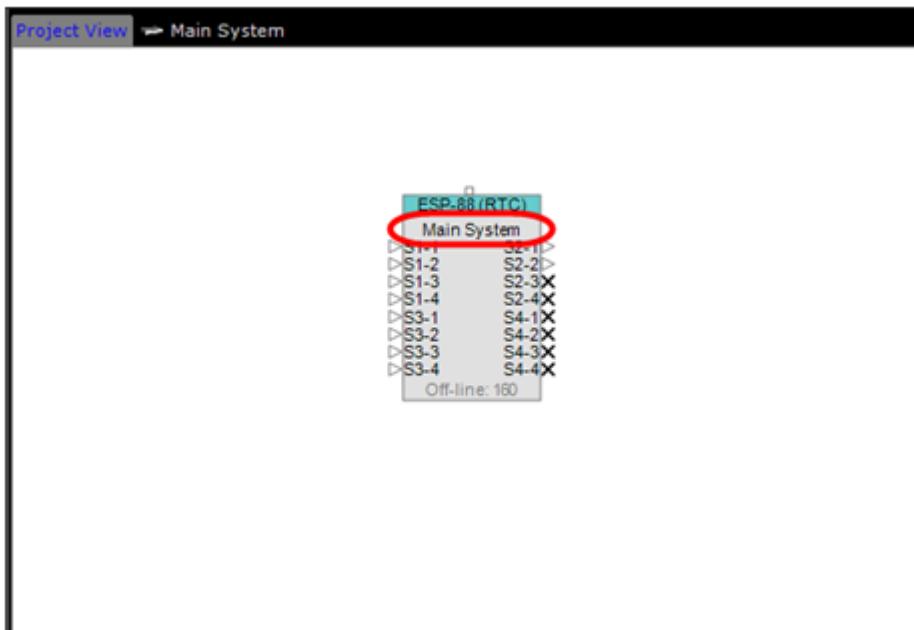
**NOTE:** The wiring shown in the Project View is representative and it does not affect the signal path. As such, not including wiring in the Project View will not affect the operation of your design. However, the devices within the Signal Processing View must be wired together to successfully route audio from inputs to outputs.

All devices displayed in the Project and Signal Processing Views have a user definable label. To **rename a device**, select and right click on the device to display the context menu, and select "Rename".

**NOTE:** Only I/O functions can be renamed in PM8500/PM8500N systems.



Once the new label is entered it is displayed on the device.



## Control Library

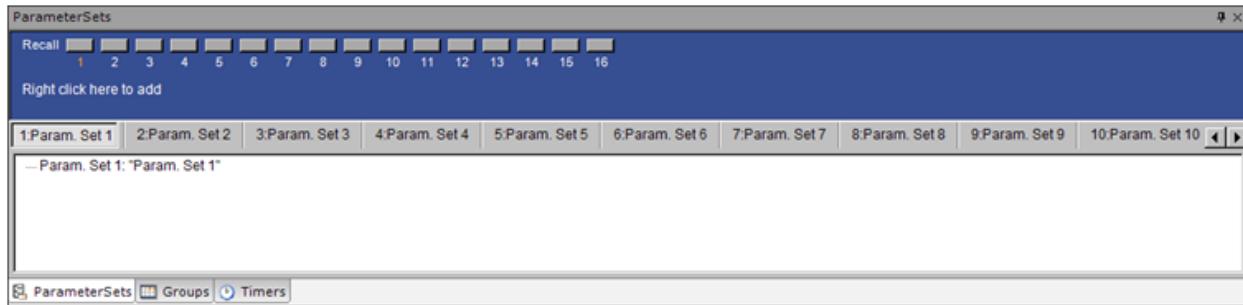
### Control Library functions

A ControlSpace system may be controlled through a variety of methods – ControlSpace Control Centers, general purpose interfaces, serial data control, etc. The commands issued by the control devices either directly control signal processing objects, such as a gain control, or trigger a state change to one or more signal processing devices. The **Control Library** contains four types of control functions: Groups, Parameter Sets, Timers and Presets.

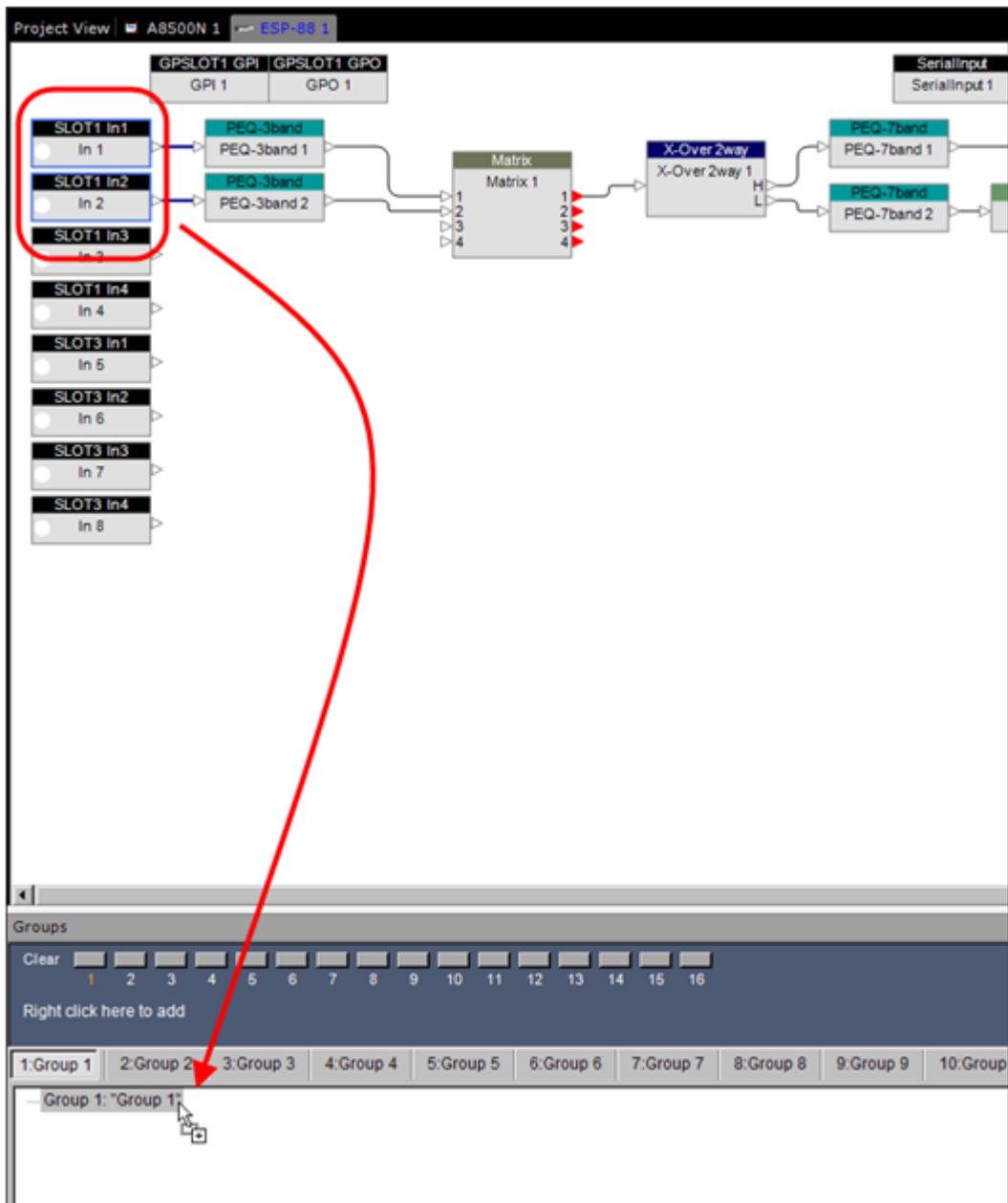
## ControlSpace Designer 3.1 Software Guide

**NOTE:** Presets are no longer supported in ControlSpace Designer 3.0, but are supported in legacy systems where this function was employed.

Access the Control Library from the Window menu; from here you can open the Parameter Sets, Groups, Timers, and Presets windows.



**Control** Programming is done through drag and drop. For example, to control two input gains using a single master gain, select the two input gains within the Signal Processing View, and then drag them to the next available Group within the Group Tab of the Control Library.

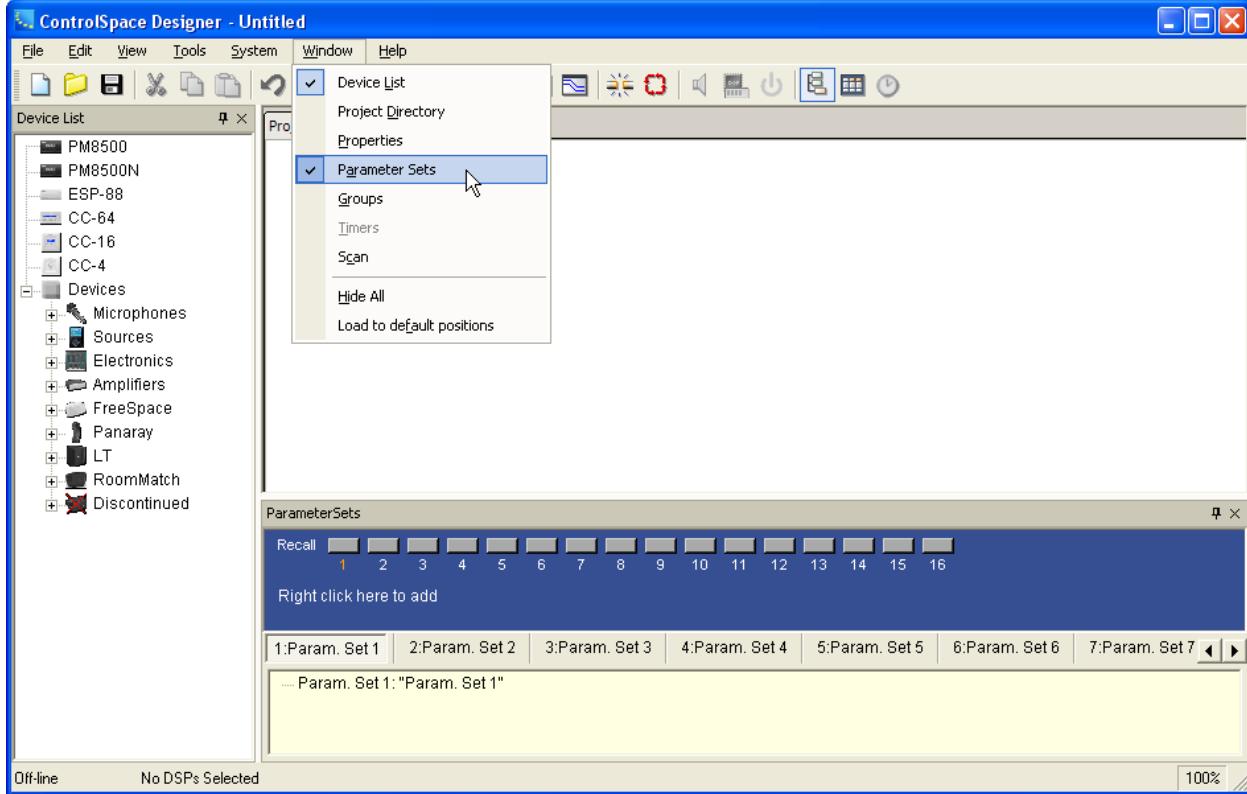


For more information on programming Groups, Parameter Sets and Timers see section [section reference/link].

## Parameter Sets Window

Parameter Sets store the current state of selected devices or signal processing blocks. When recalled the saved state is restored. All programming associated with Parameter Sets is stored within the ControlSpace Project file. Once the file is uploaded to the system, Parameter Set programming is stored within individual system devices.

To create new and view active Parameter Sets, select **Parameter Sets** from the **Window** menu.



Parameter Set programming is accomplished using drag and drop. Individual devices, signal processing objects or object properties may be dragged to a specific Parameter Set. When the Parameter Set is invoked, or recalled, the state of the object at the time of programming will be restored.

From within the Parameter Sets window the following functions are available:

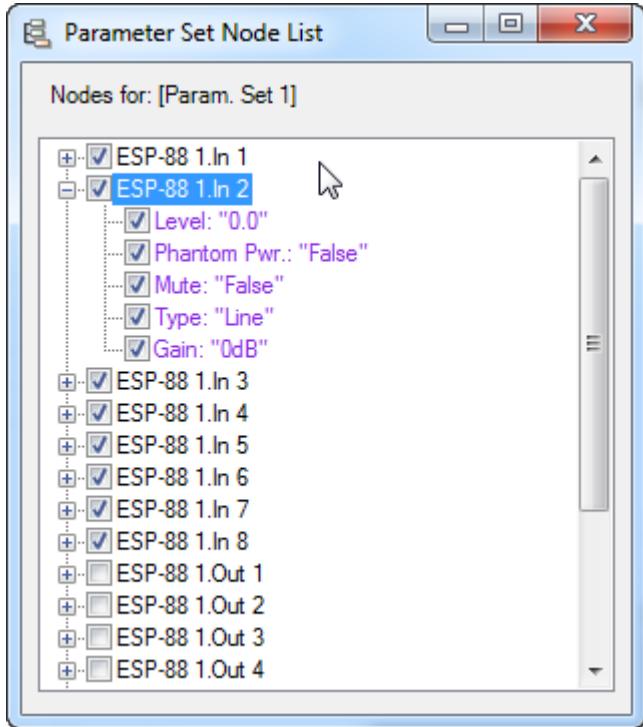
**Recall Parameter Set** – Selecting this item recalls the stored Parameter Set settings.

**Add Parameter Set** – Right-click anywhere on the blue area of the Parameter Set window to add a new Parameter Set

**View Parameter Set** – Select the desired Parameter Set Name to view the device settings associated with the Parameter Set

**Edit Parameter Set** – expand the tree view of the selected Parameter Set to view and edit device settings.

Double-clicking on the top level of the tree view for a Parameter Set will display the Parameter Set Node List. This tree view shows all available system devices and their settings available to be used within a Parameter Set. Selected items are those that are included within the Parameter Set.



**NOTE:** It is possible to streamline Parameter Set programming by only including those device settings which will be affected by the Parameter Set. For example, when including an output gain change in a Parameter Set the mute property can be removed. This simplifies programming and reduces file size in systems with a large number of Parameter Sets.

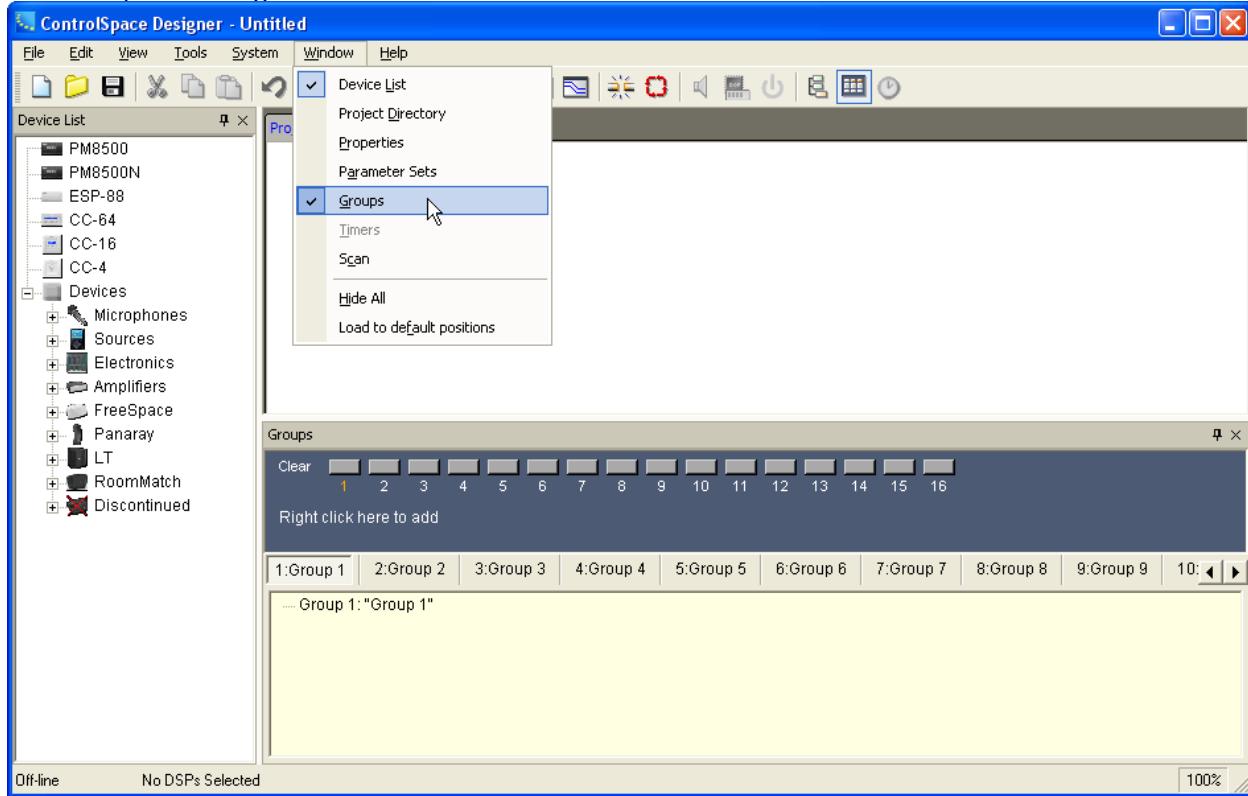
## Groups Window

Groups provide for the control of multiple like control panels from a single control. An effective use of groups is the combining of multiple gains into a single master gain, or multiple crossovers into a single group crossover.

When creating groups it is important to remember that only like processing blocks may be grouped to a single control.

To create new and view active Groups, select **Groups** from the **Window** menu.

## ControlSpace Designer 3.1 Software Guide



Group programming is accomplished using drag and drop. Multiple signal processing objects of the same type, input gains, output gains or gain blocks may be dragged to a specific Group. When a Gain group is invoked a master gain control will be displayed. Signal processing object groups operate using linked controls – changes made to any one member of the group is reflected in all members.

From within the Groups window the following functions are available:

**Clear Group** – Selecting this item removes all signal processing devices or gains from the selected group.

**Add Group** – Right-click anywhere on the blue area of the Groups window to add a new Group.

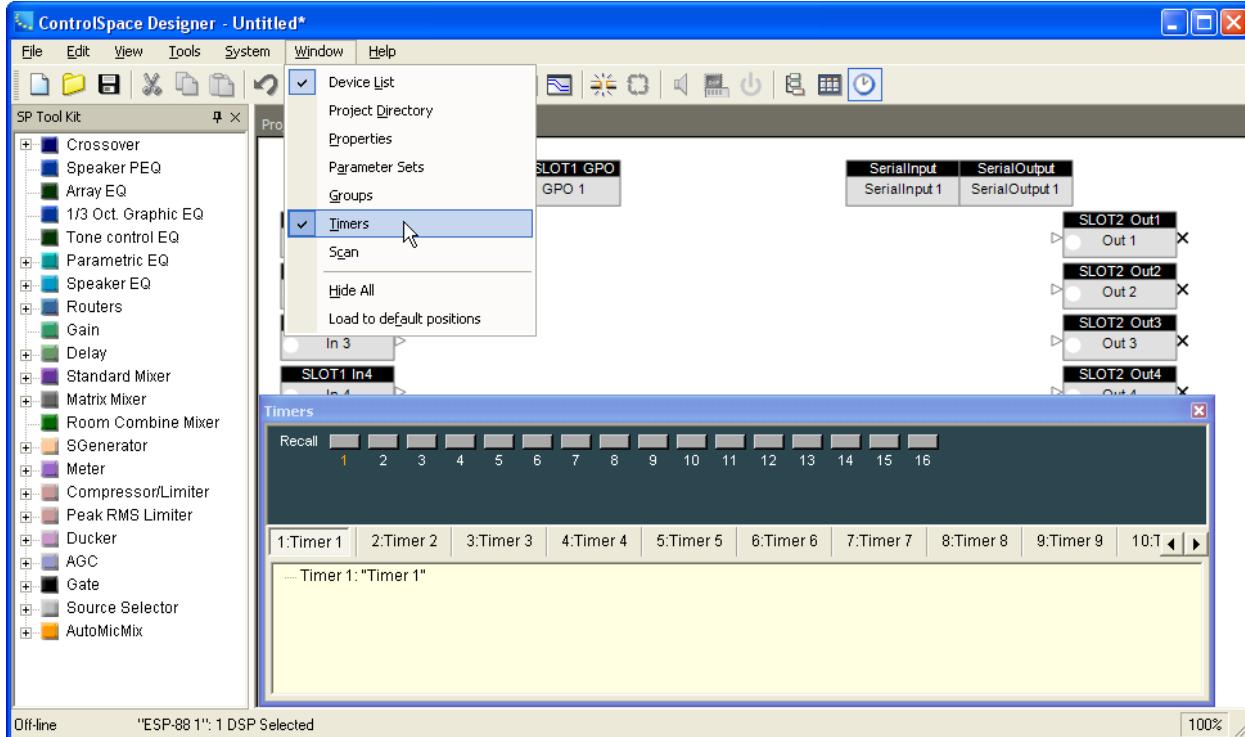
**View Group** – Select the desired Group name to view the signal processing devices or gains associated with the Group. Double click on the top level of a gain group's tree view to display the master volume control panel.

**Edit Group** – expand the tree view of the selected Group to view and edit its settings.

## Timers Window

Timers are used to invoke a specific signal processor state, or Parameter Set at a specific day or time. Timers are only available when the system includes an Engineered Sound Processor, (ESP).

To create new and view active Timers, select **Timer** from the **Window** menu.



Timer programming is accomplished using drag and drop. Individual signal processing objects, object properties or Parameter Sets may be dragged to a specific Timer. When the Timer is invoked, or recalled, the state of the object at the time of programming will be restored.

From within the Timers window the following functions are available:

**Recall Timer** – Selecting this item recalls the settings associated with the Timer.

**View Timer** – Select the desired Timer name to view the signal processing devices or Parameter Sets associated with the Timer. Double click on the top level of a Timers tree view to display the Timer Settings for this timer.

**Edit Group** – expand the tree view of the selected Group to view and edit its settings.

When an object is initially dragged and dropped on a Timer the Timer Settings window appears. This displays the time and recurrence settings for the individual Timer:



**Recurrence** – Determines the frequency of the Timer. Available options are Only Once, Daily or Weekly.

**Week Day** – Determines the frequency of the timer. This option is only available when the Recurrence is set to Weekly.

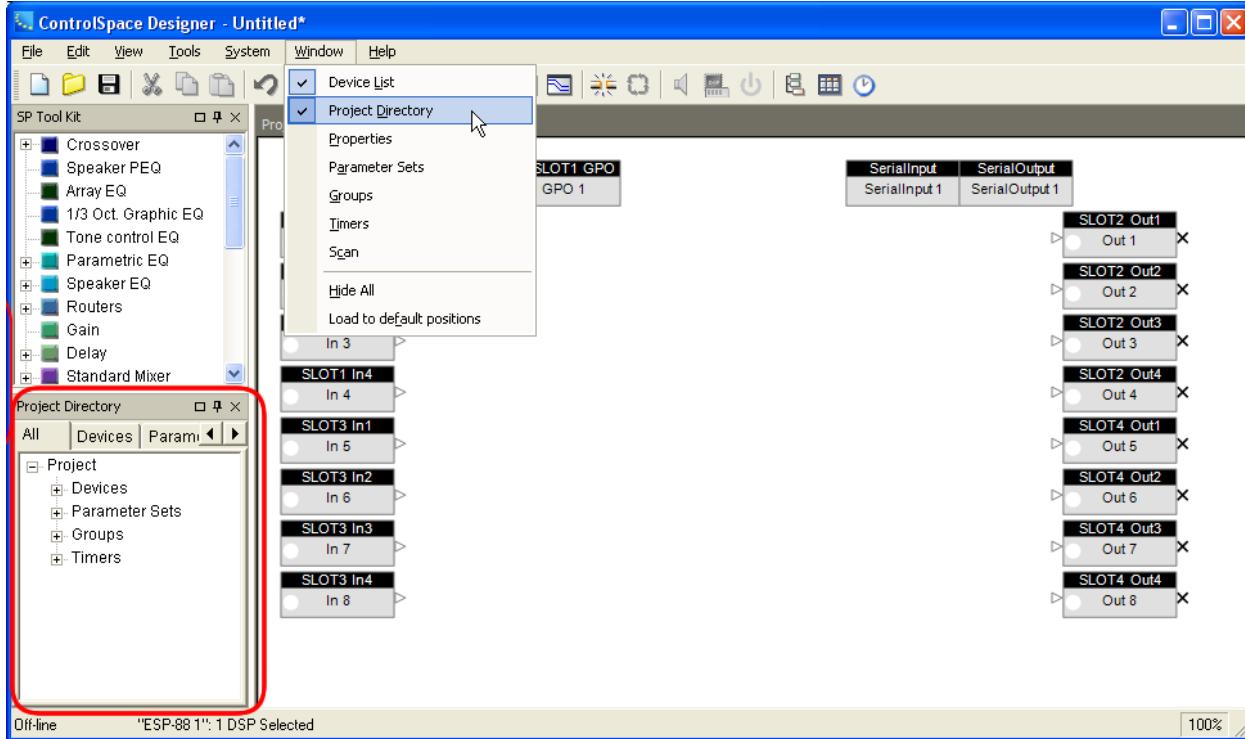
**Time** – displays the time of day the timer will be invoked.

**Date** – displays the date the timer will occur. This option is only available when the Recurrence is set to Only Once.

## Project Directory

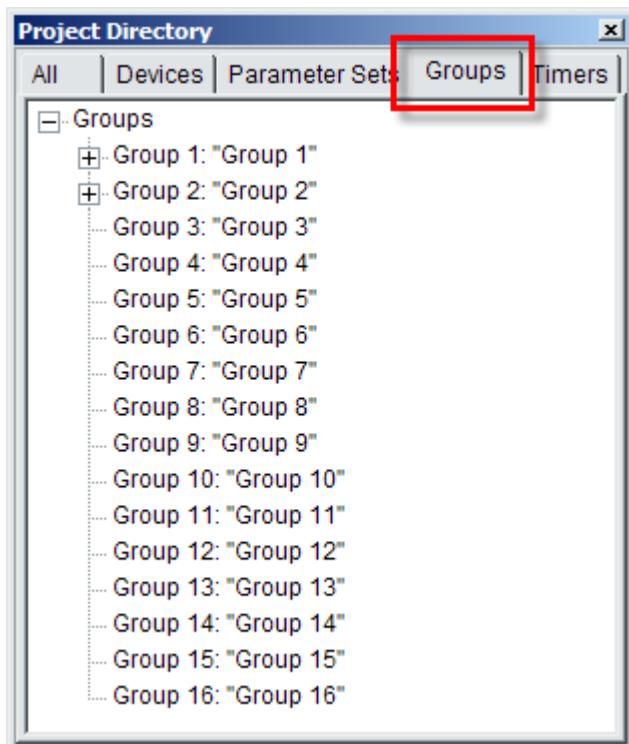
An advanced method to program a system is to use the Project Directory. The Project Directory is the master directory of all components, signal processing objects, and control functions in the system design. Visibility to all devices, signal processing blocks, inputs, outputs, control centers, and programming functions is provided in this single location.

To access the Project Directory, select **Project Directory** from the **Window** menu.



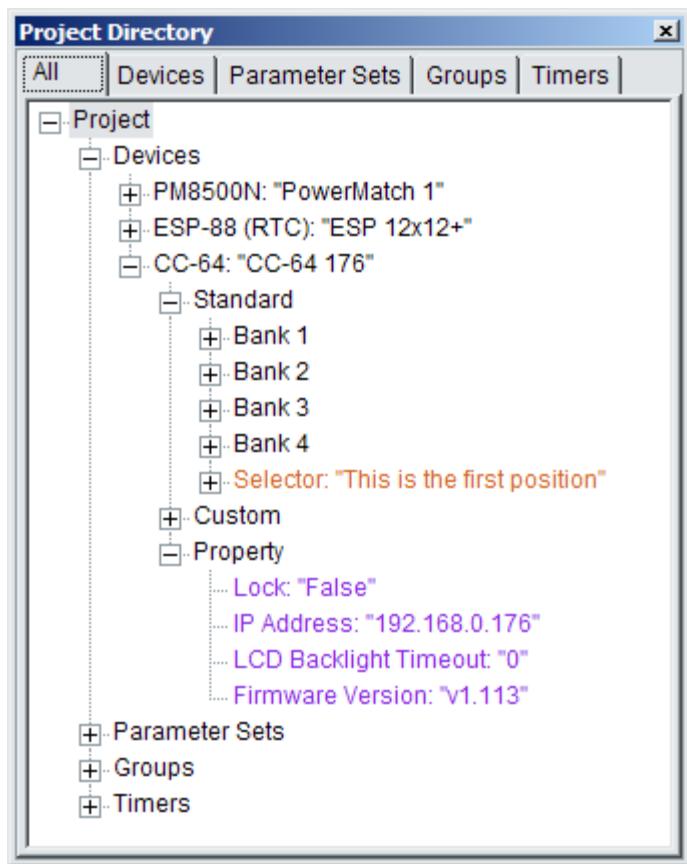
The Project Directory Window

Use the tabs at the top of the project directory window to select a sub category of objects in your design. By default, the **All** tab is selected at the top of the project directory window to display all objects in your design. You may select different tabs to isolate sub categories of objects. For example, select the **Groups** tab to view all defined Groups in a design.



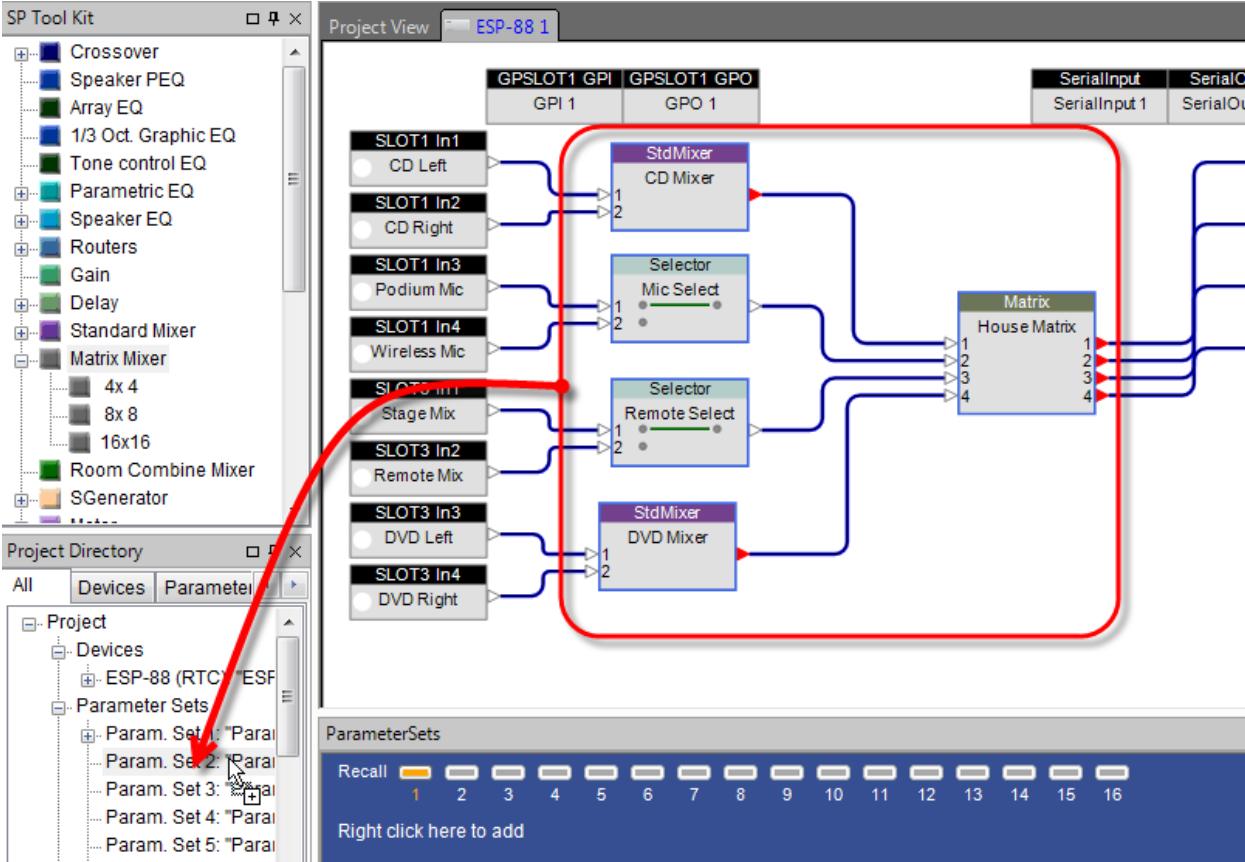
Groups Tab of the Project Directory

The project directory window contains all objects in your system design and displays them in a tree structure. To see a particular object in your design, expand this tree structure until you reach the settings of interest. For example, to view the IP Address of a CC-64 Control Center, expand the directory to Project > Devices > CC-64 > Property.



*Project Directory Tree Expanded*

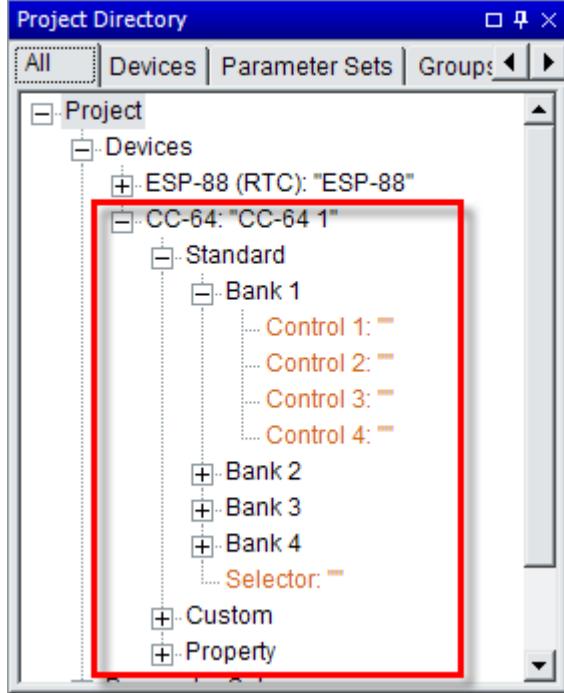
You may program parameter sets, groups, and timers by dragging and dropping signal processing blocks from ESP View into Project Directory locations. For example, to program a parameter set, select signal processing blocks and drag those into the parameter set tree structure.



*Drag and Drop Processing Blocks into the Project Directory*

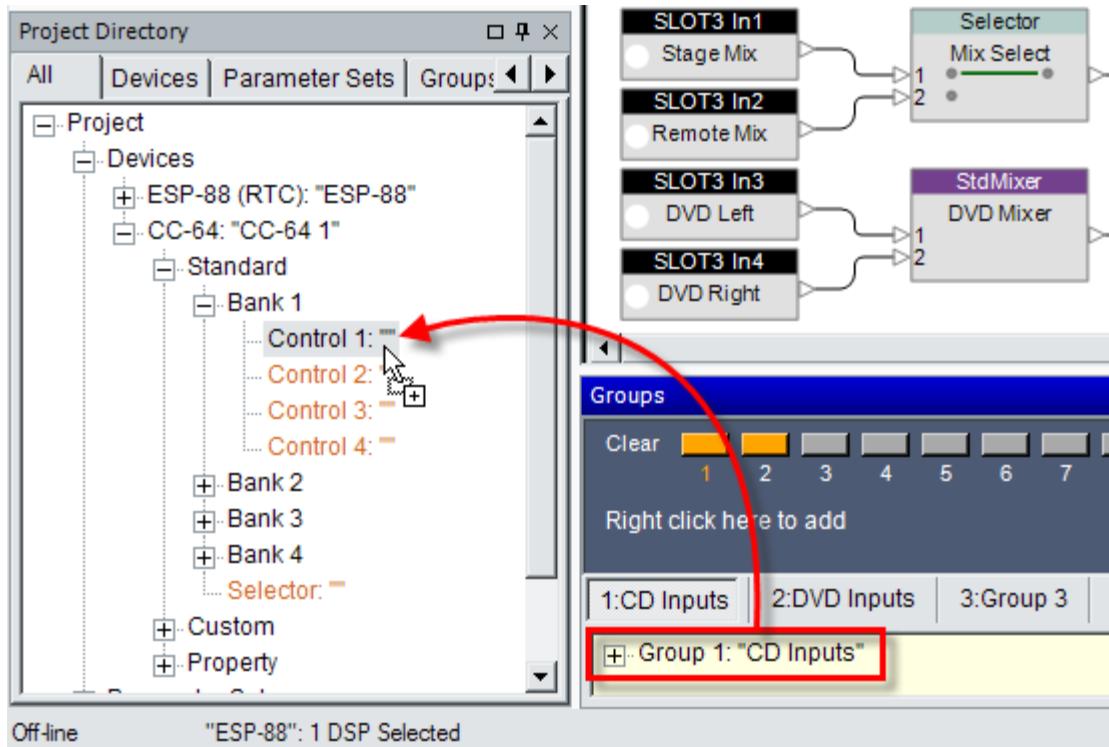
You may also use the Project Directory to program user controls without opening the Smart Simulators or GPI control panels. For example, to access the CC-64 controls, select the Devices tab in the Project Directory window, then click on the CC-64 > Standard.

## ControlSpace Designer 3.1 Software Guide



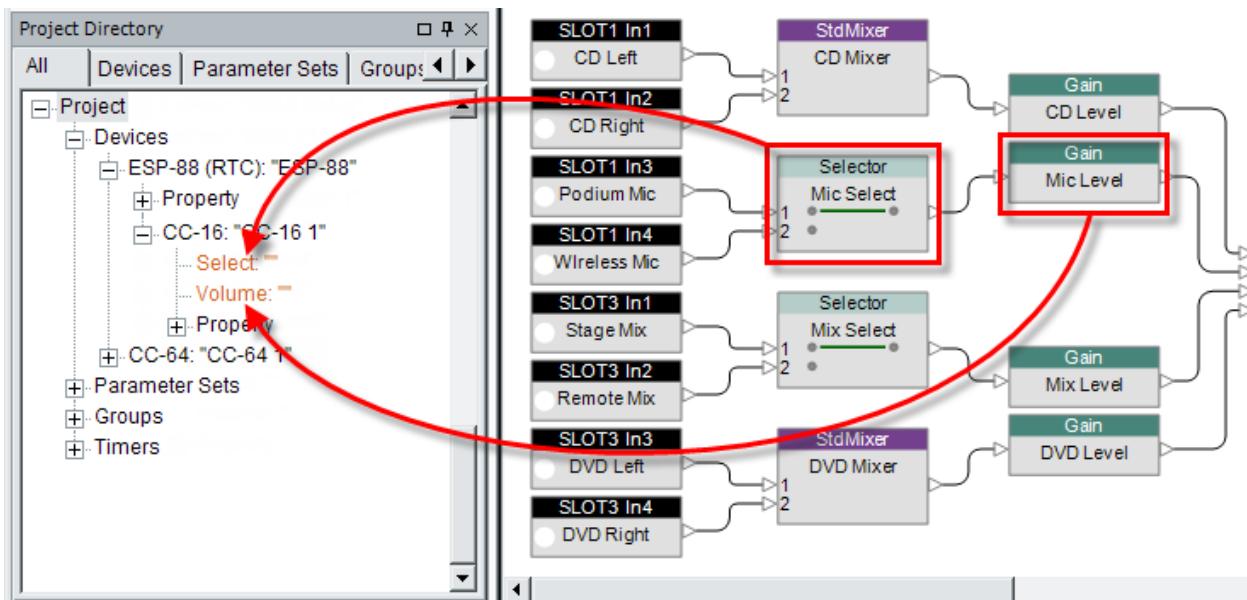
*Accessing CC-64 controls in the Project Directory*

Once the Project Directory window is open, you may drag and drop into the banked controls, Selector, and Custom controls just as you would with the CC-64 Smart Simulator.



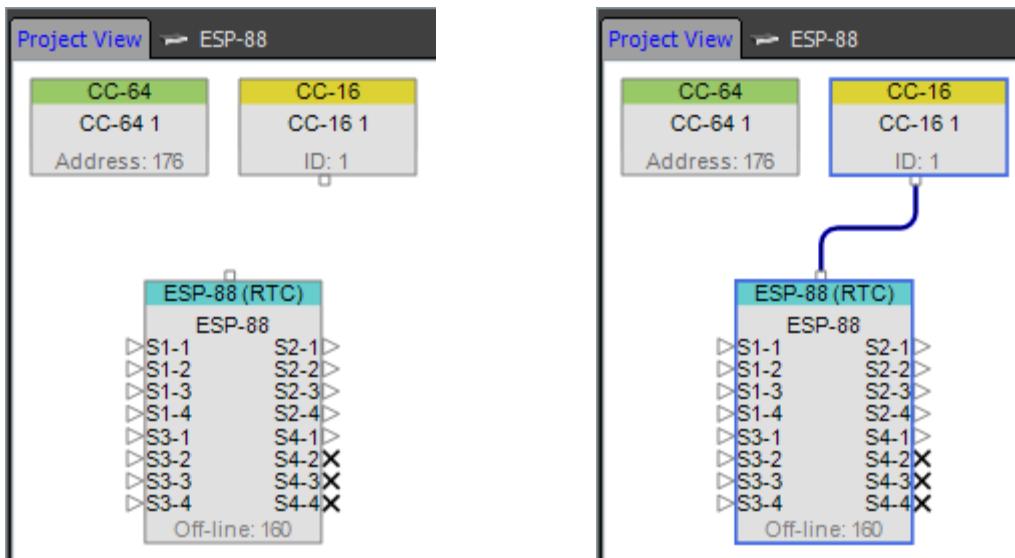
*Assigning Groups to CC-64 using the Project Directory*

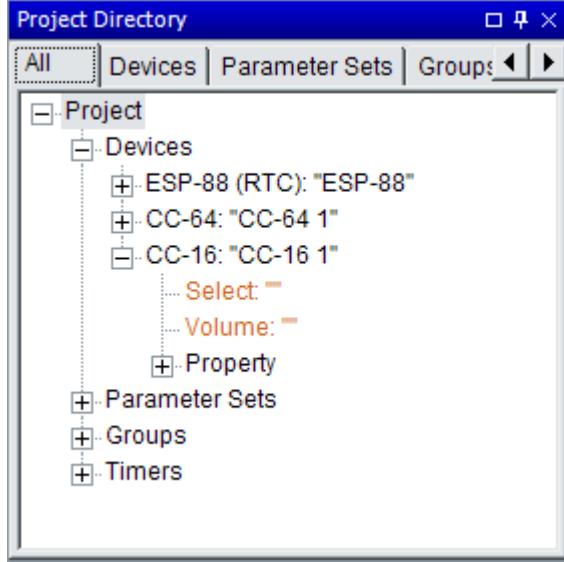
In the same manner, you may directly assign selector and gain functions to CC-16 controls using the Project Directory window.



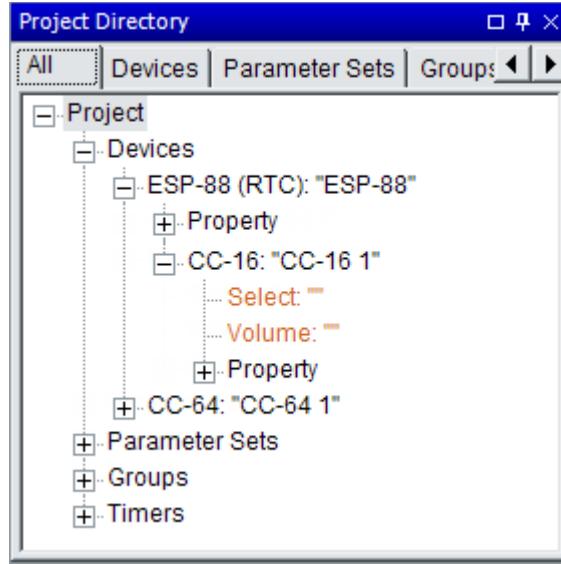
Assigning Blocks to CC-16 using the Project Directory

**Note:** The position of CC-16 Zone Controller in the Project Directory is dependent on the ESP to which it is connected. Before a wiring connection is made from a CC-16 to its associated ESP in the Project View, it appears in the top level of the Devices tree. After a wiring connection is made to an ESP, each CC-16 appears within its associated ESP tree structure.





CC-16 Disconnected in Project View

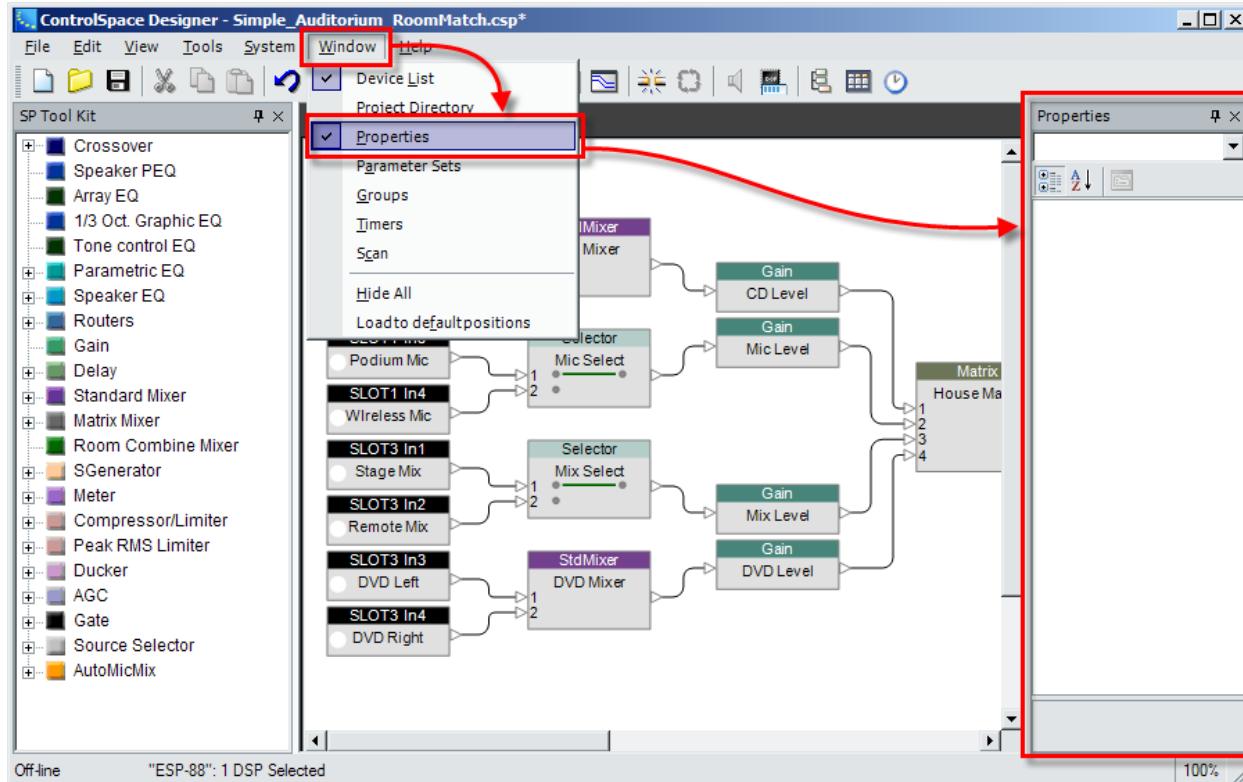


CC-16 Connected in Project View

CC-16 Position within the Project Directory

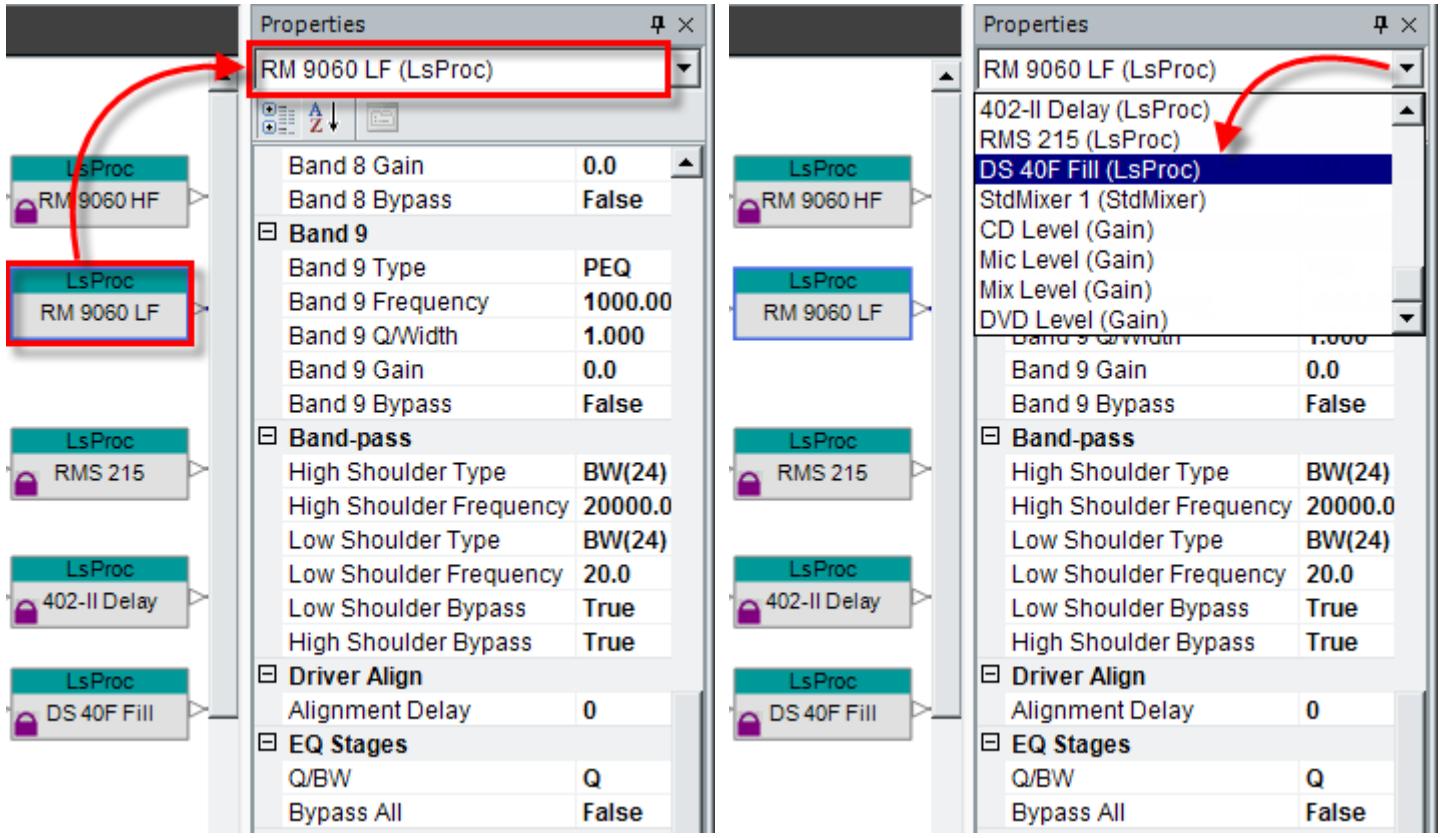
## Properties Window

The Properties window allows you to view and update settings for a selected object without opening its control panel. Open the Properties window by selecting **Properties** from the **Window** menu.



Properties Window

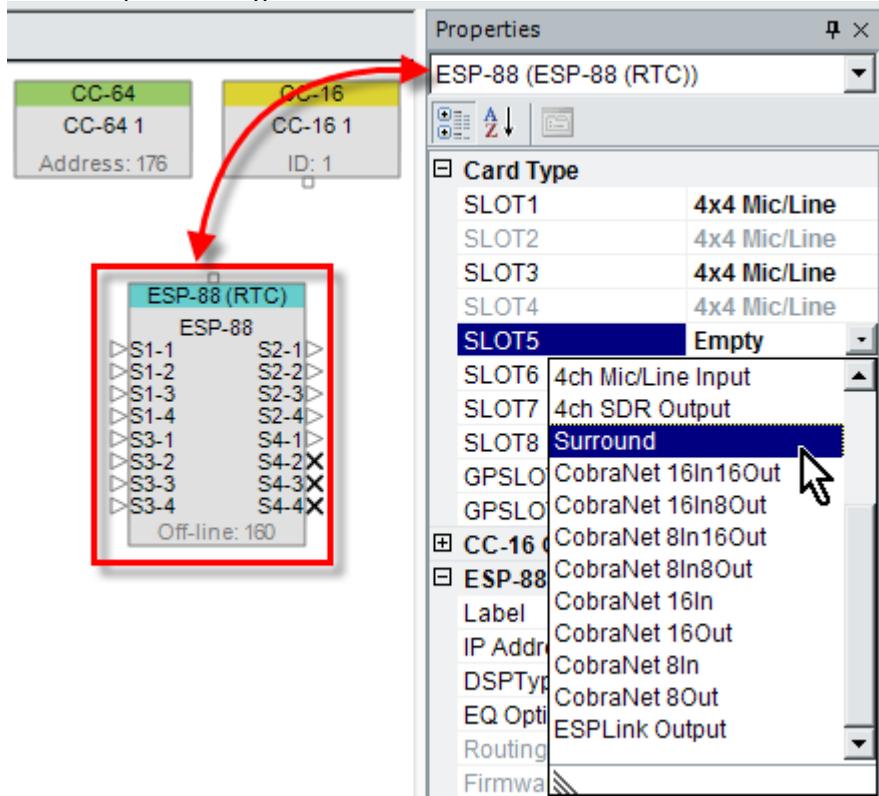
Once the Properties Window is open, select an object in Project or ESP Views to see all its properties. You may also use the dropdown menu at the top of the Properties window to select a different device.



#### Managing the Properties Window

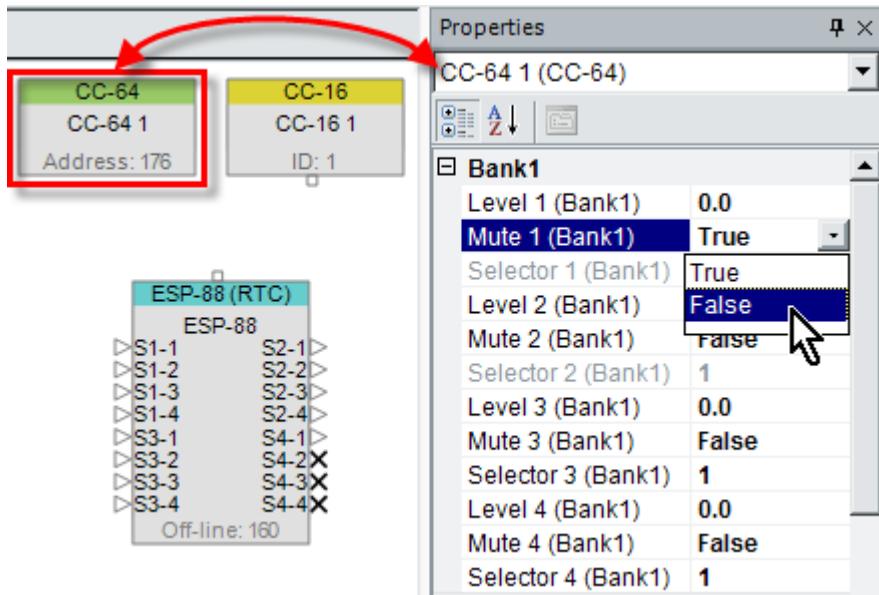
The Properties window may be used to change card assignments or any other setting for an ESP within Project View. Select the ESP icon, and then choose a new card for the desired slot in the Properties window.

## ControlSpace Designer 3.1 Software Guide



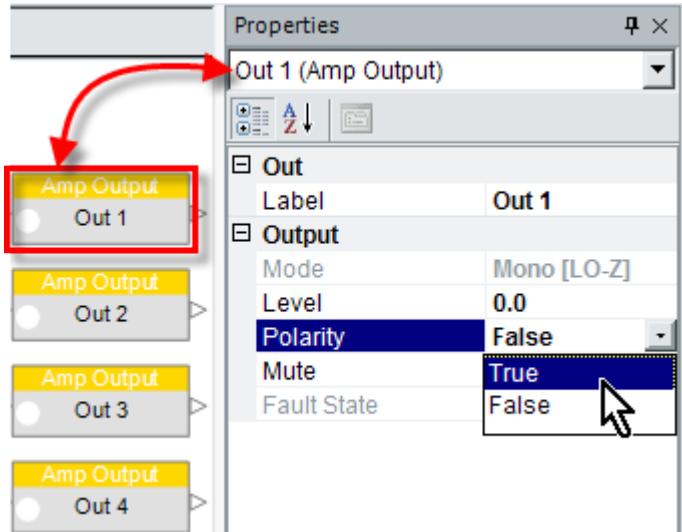
*Adjust ESP Card Assignments within the Properties Window*

You may also adjust control panel settings using the Properties Window. Select the desired control panel to view or change its properties within the Properties Window.



*Adjust CC-64 Settings within the Properties Window*

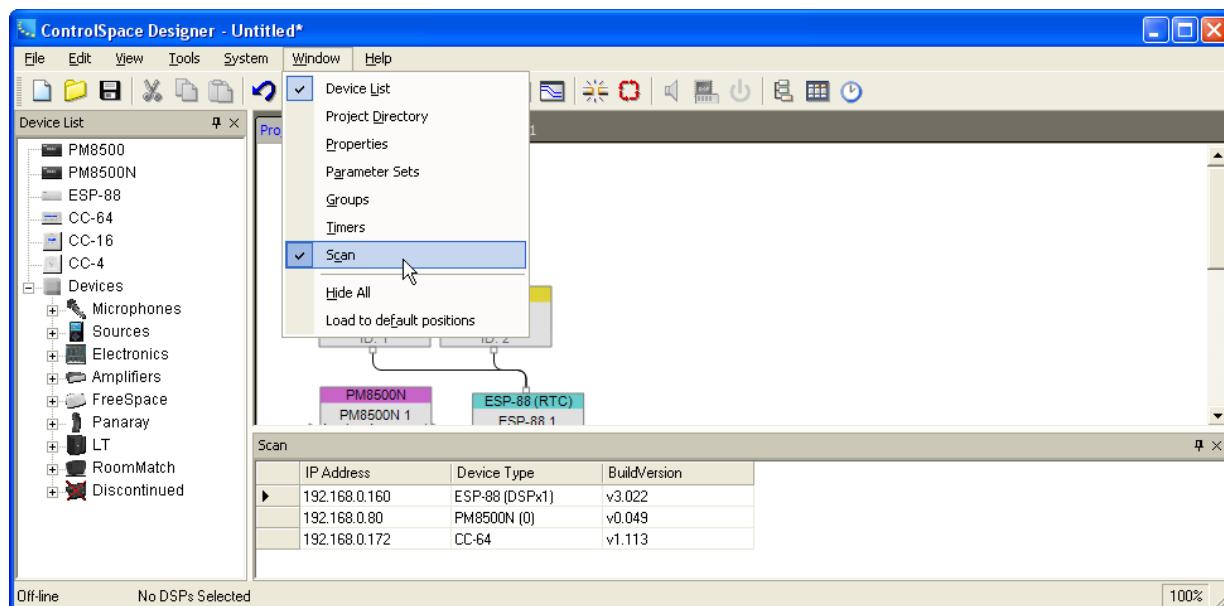
Processing blocks within Project, ESP, or PowerMatch views are equally accessible using the Properties Window. Simply select the desired object to view or change its properties within the Properties Window.



*Adjust PowerMatch Settings within the Properties Window*

## Scan Window

The Scan window is used to determine which system devices are available on the ControlSpace Network, and their firmware version, without initiating a connection to the system. To view active system devices, select **Scan** from the **Window** menu.



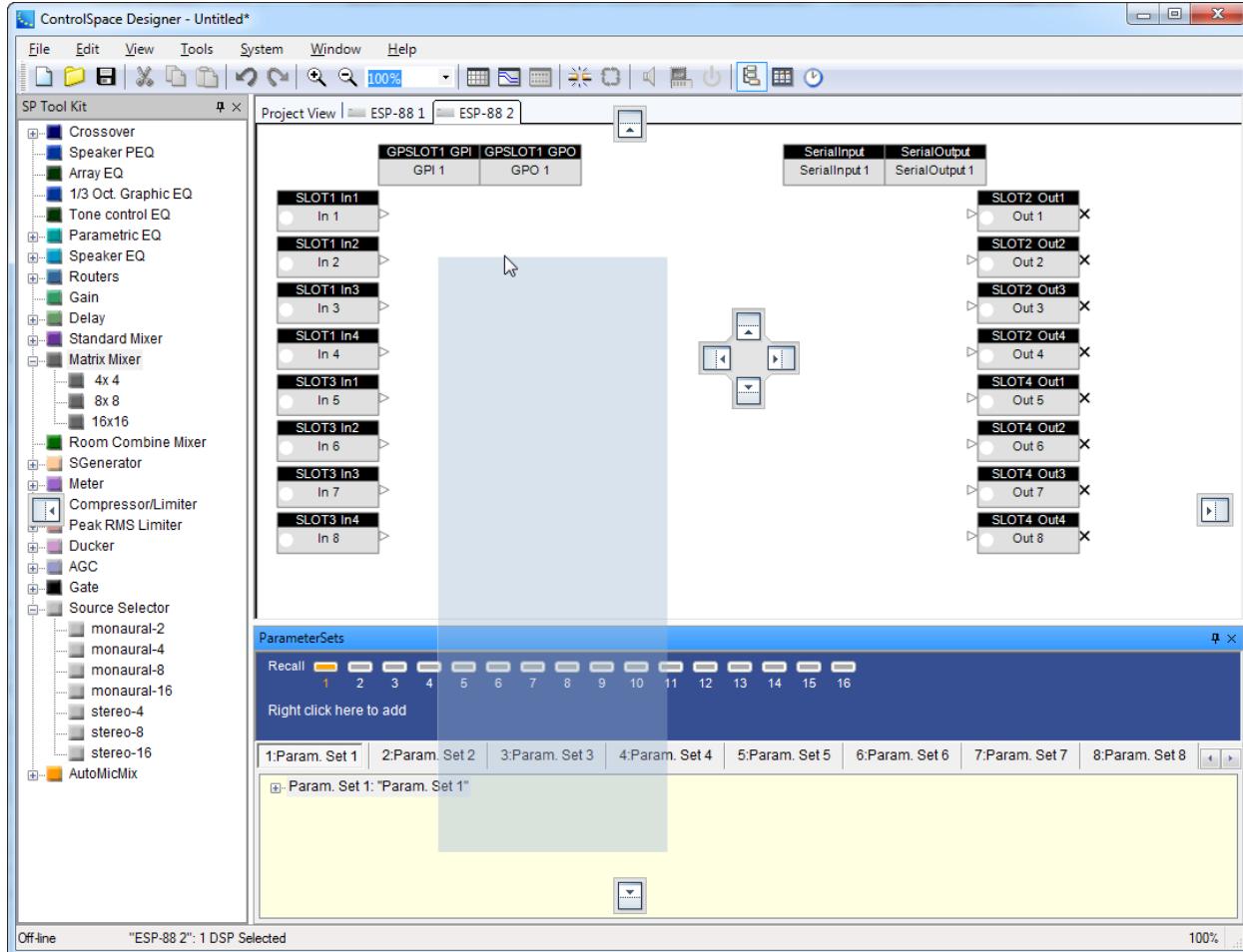
Once the Scan window is active, select the Scan item within the Tools Menu. All active ControlSpace Devices, are then displayed in the Scan window.

## Window Controls

All major windows within the ControlSpace Designer interface may be configured as either floating, docked or docked, but minimized. By default windows, when made active, are docked.

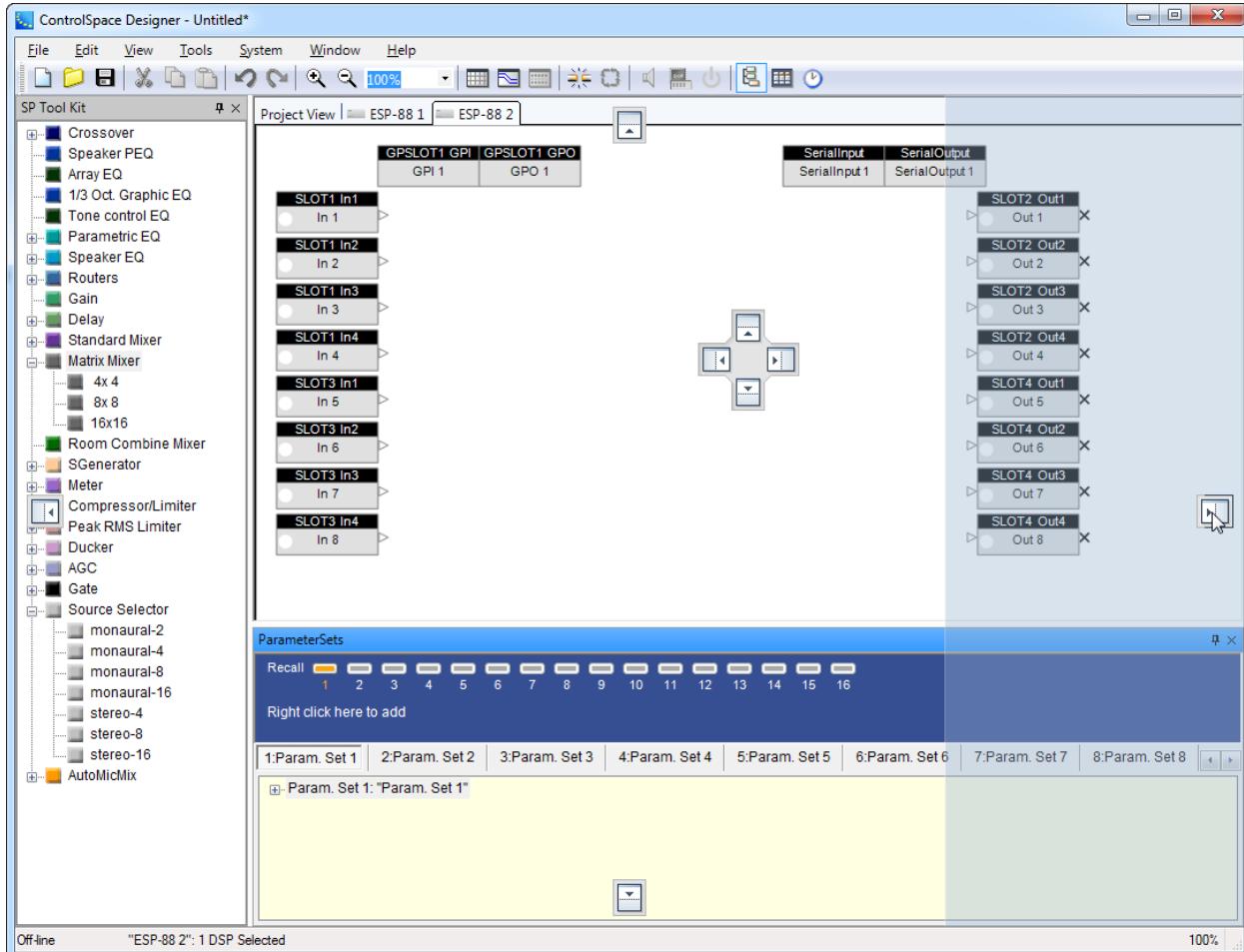
## Floating Windows

To float a window within the application, simply select the window's title bar and move it to another location within the application. Windows, when floated, may be placed anywhere on the monitor area.



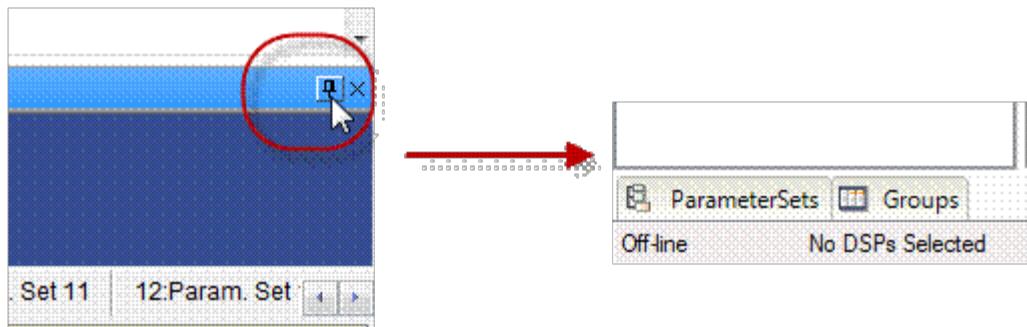
## Docking Windows

Windows may be docked anywhere along the edges of the main application window. To dock a floating window drag and drop the window on any of the docking targets along the edge of the application window.



## Minimizing Docked Windows

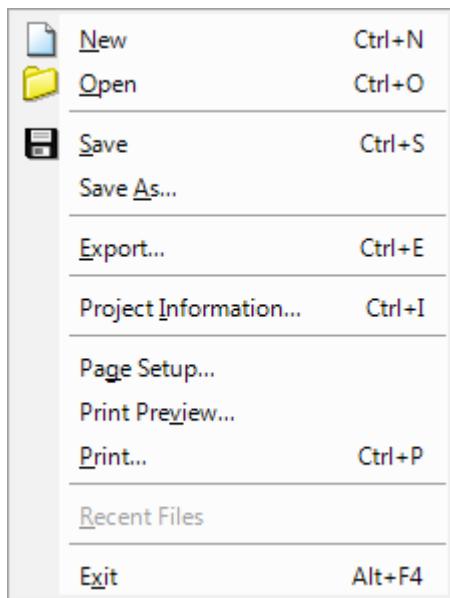
A docked window may be minimized using the Pin tool located in the upper right section of the window's title bar. When selected the window is minimized to a tab along the edge of the application window.



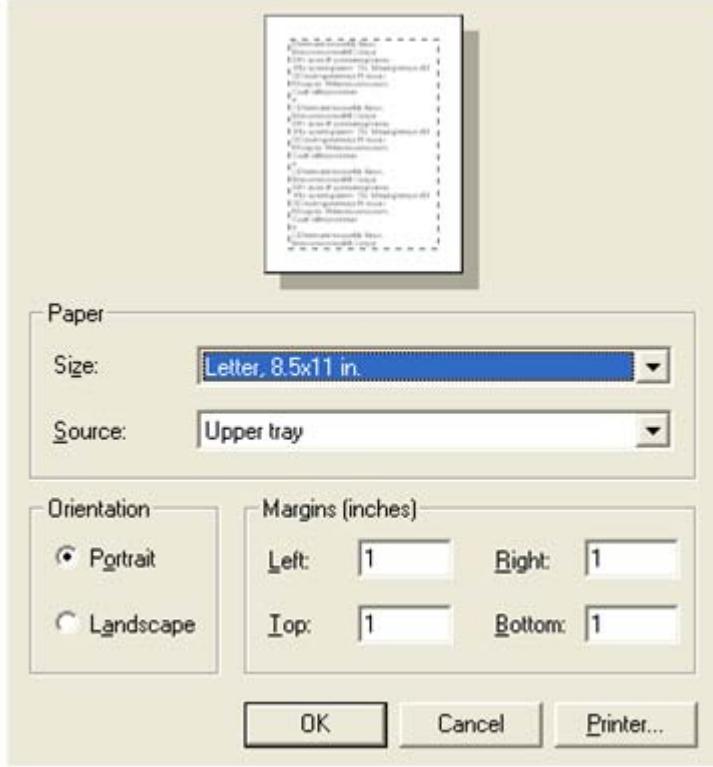
When minimized, selecting the tab will cause the window to be temporarily maximized.

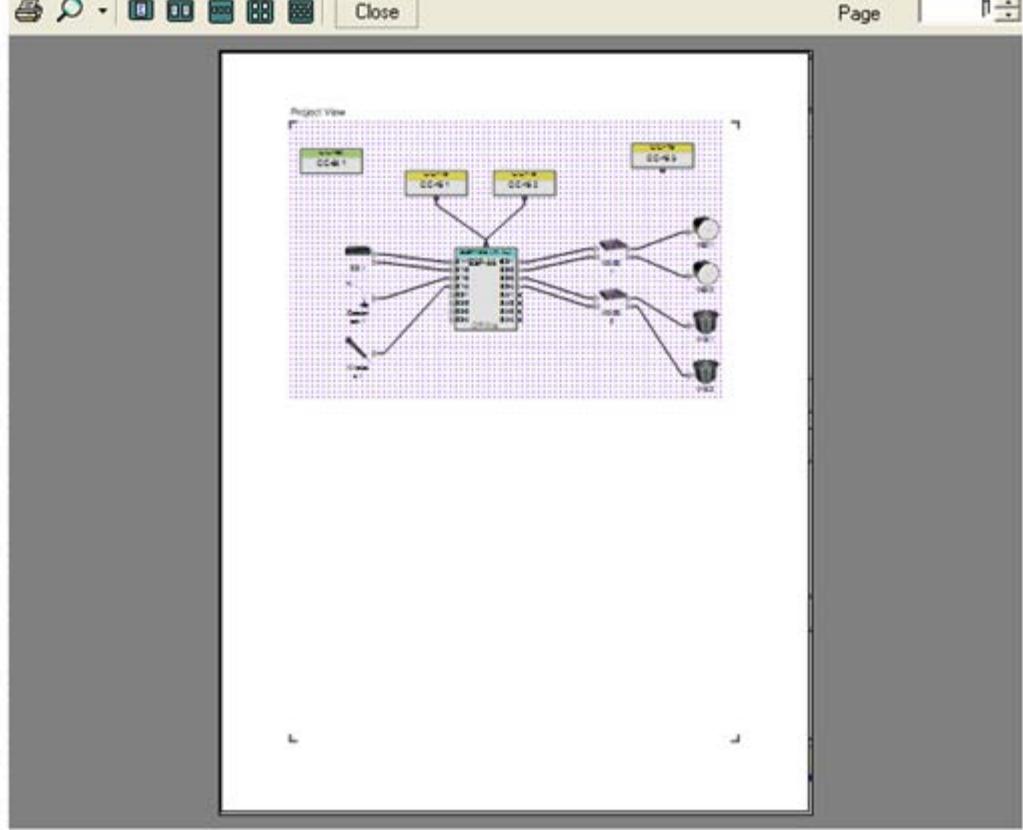
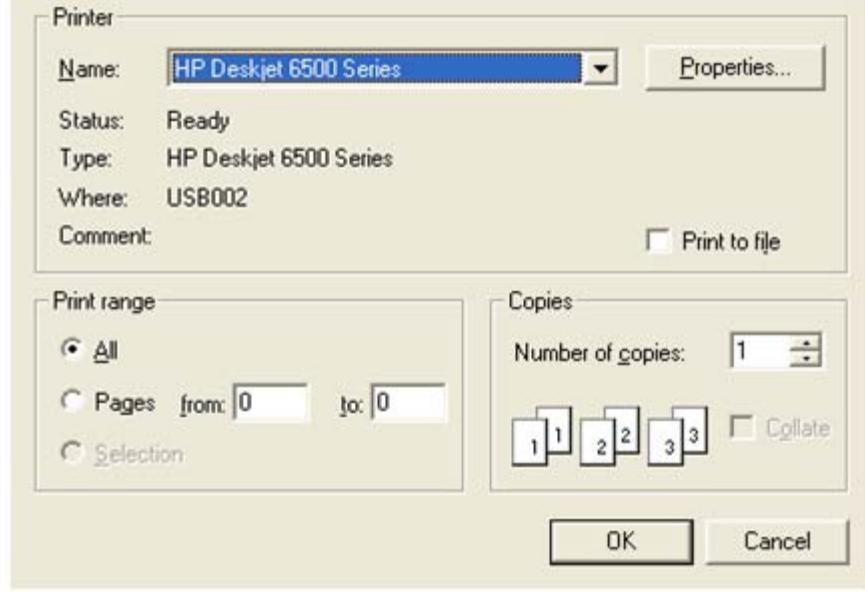
## Menus Reference

### File menu



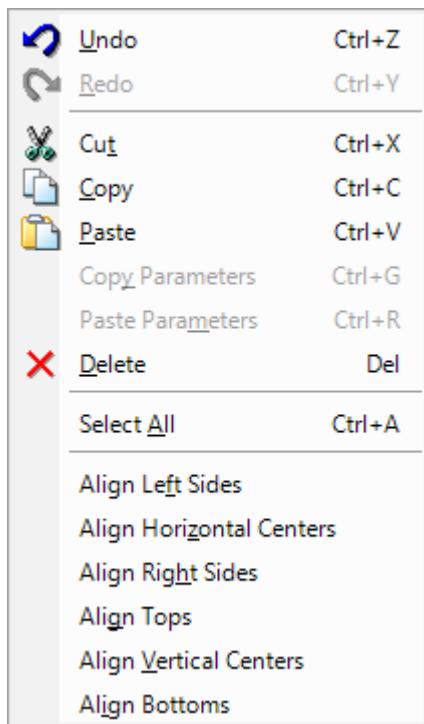
Menu item	Function
New	Creates a new project file (.csp). If a project is currently open and unsaved, you will be prompted to save it before creating a new project.
Open	Opens an existing project by locating it on the hard drive and choosing the .csp file. If a project is currently open with unsaved changes, you will be prompted to save it before opening a new project.
Save	Saves changes to the project. If you have not yet saved the project, you will be prompted to name and save the project.
Save As	Creates a copy of the project and saves it with a different name. The new saved project will remain open and the original project will be closed.
Export	Exports the contents of your project to a comma delimited (.csv) file. This file contains the entire tree structure of your project, similar to the <b>Project Directory</b> window.

<b>Project Information</b>	 <p>Opens the <b>Project Information</b> window, where you can record contact information and comments related to the design.</p>
<b>Page Setup</b>	 <p>Opens the <b>Page Setup</b> window, where you can change the Paper Size, printer paper source, orientation, and margin sizes.</p>

<b>Print Preview</b>	 <p>Opens the <b>Print Preview</b> window to view what your design will look like when printed.</p>
<b>Print</b>	 <p>Opens the <b>Print</b> window to select a printer, and specify which pages to print, and number of copies.</p>
<b>Recent Files</b>	<p>Lists the four most recently active projects. Select one to open the project file.</p>

<b>Exit</b>	Closes ControlSpace Designer software. If a .csp file is open you will be prompted to save changes.
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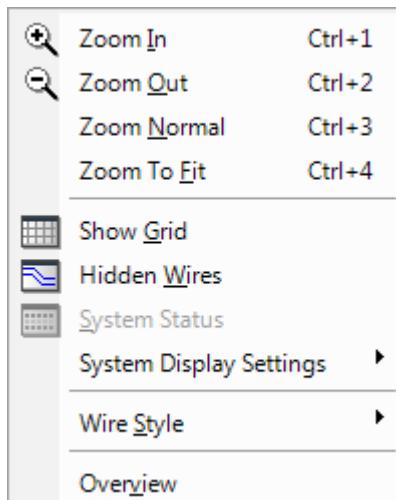
## Edit menu



Menu item	Function
<b>Undo</b>	Undo your last action or undo multiple actions for each Project View Tab.
<b>Redo</b>	Redo your last action (after undo) or redo multiple undo actions up to the most recent action within the selected Project View Tab.
<b>Cut</b>	Deletes the selected item and copies it to the clipboard (standard Windows editing function).
<b>Copy</b>	Copies the item to the clipboard (standard Windows editing function).
<b>Paste</b>	Pastes the contents of the clipboard (standard Windows editing function).

<b>Copy Parameters</b>	Copies the parameters, or settings, for a signal processing block in the Signal Processing View. The parameters can be copied to another signal processing block of the same type.
<b>Paste Parameters</b>	Pastes the copied settings from one signal processing block to one or more other blocks of the same type.
<b>Delete</b>	Deletes the selected item.
<b>Select All</b>	Selects all items in the active window.
<b>Align Left Sides</b>	Aligns the left sides of all selected signal processing blocks in <b>Project View</b> or the Signal Processing View.
<b>Align Horizontal Centers</b>	Aligns the horizontal centers of all selected signal processing blocks in <b>Project View</b> or the Signal Processing View.
<b>Align Right Sides</b>	Aligns the right sides of all selected signal processing blocks in <b>Project View</b> or the Signal Processing View.
<b>Align Tops</b>	Aligns the tops of all selected signal processing blocks in <b>Project View</b> or the Signal Processing View.
<b>Align Vertical Centers</b>	Aligns the vertical centers of all selected signal processing blocks in <b>Project View</b> or the Signal Processing View.
<b>Align Bottoms</b>	Aligns the bottoms of all selected signal processing blocks in <b>Project View</b> or the Signal Processing View.

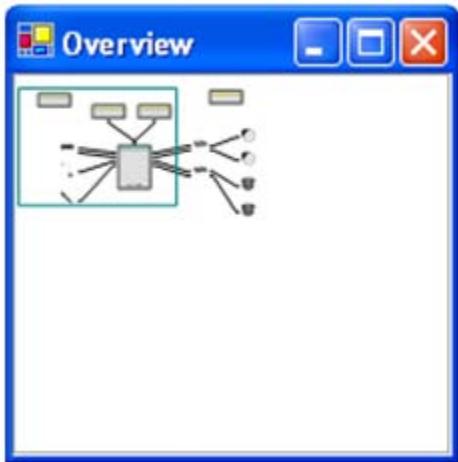
## View menu



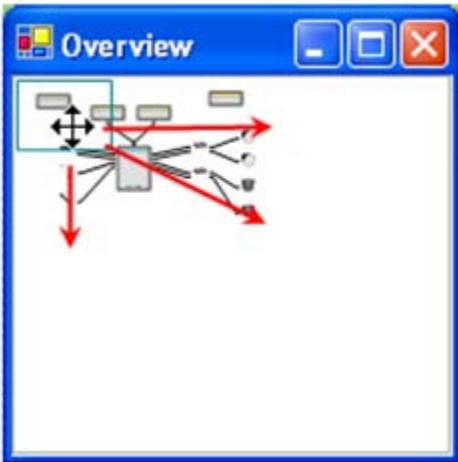
Menu item	Function
<b>Zoom In</b>	Magnifies your view in the <b>Design Workspace</b> .
<b>Zoom Out</b>	Displays a larger area of the <b>Design Workspace</b> .
<b>Zoom Normal</b>	Sets the zoom level to 100%.
<b>Zoom To Fit</b>	Sets the zoom level so that all objects can be seen in <b>Project View</b> , or the Signal Processing View.
<b>Show Grid</b>	Switches the background grid in <b>Project View</b> , or the Signal Processing View window between two different patterns, or no grid.
<b>Hidden Wires mode</b>	Toggles the wiring between show and hide.
<b>System Status</b>	Displays the monitor panels for all PowerMatch amplifiers.
<b>Status Settings</b>	Displays the default settings for how monitor panels appear within the application. Select AutoTile to toggle the auto tiling function on and off. Select Collapsed View to toggle the initial display state of all PowerMatch amplifier monitor panels between collapsed and expanded.
<b>Wire Style</b>	Selects Line, Orthogonal, or Bezier style of wiring.

**Overview**

Opens the **Overview** window. The **Overview** window contains a high level view of your signal processing design in the Signal Processing View. Use your mouse cursor to draw a box around an area of your design that you would like to zoom in on.

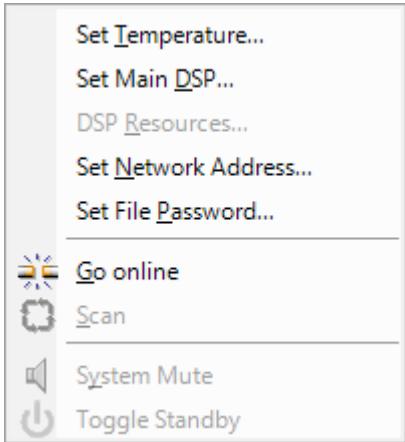


Use the mouse to drag the zoom window around your design.

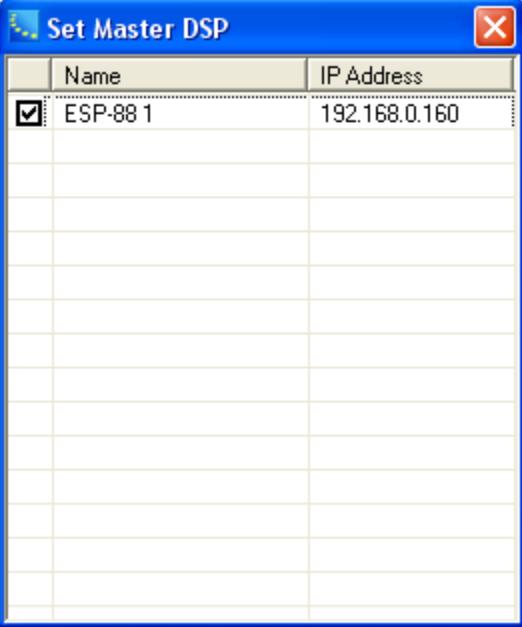
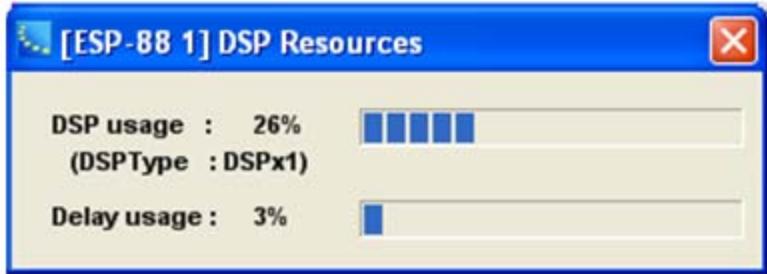


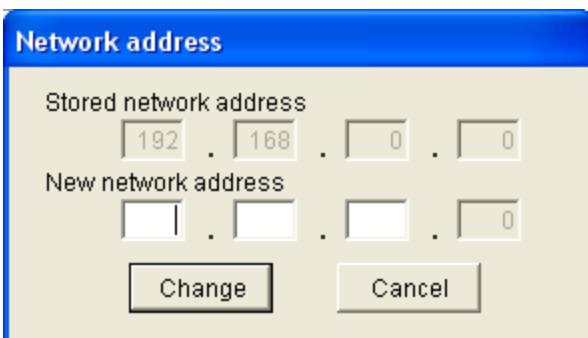
The overview window can be kept open while making changes to your designs.

**Tools menu**

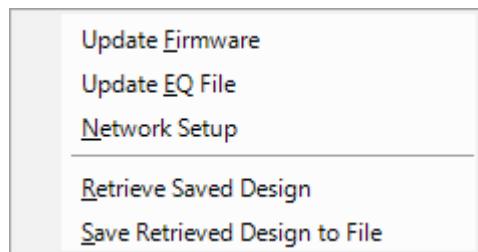


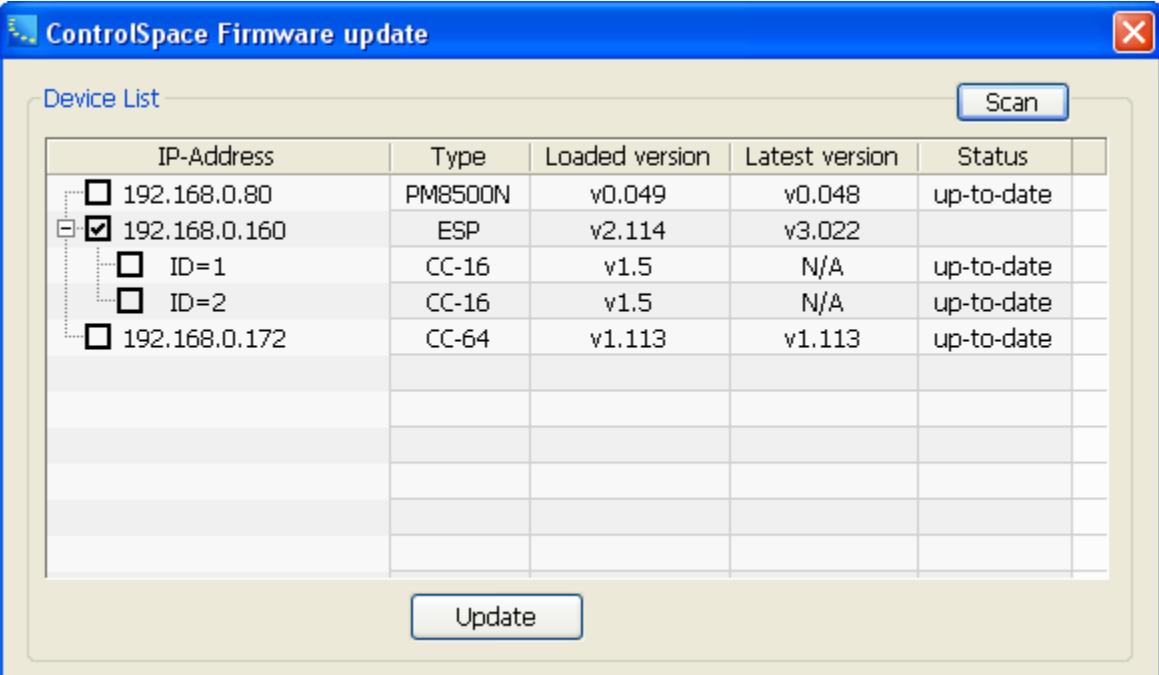
Menu item	Function
<b>Set Temperature</b>	Opens the <b>Temperature</b> window to set the ambient temperature for which you would like to calculate delay times, in degrees Fahrenheit, or degrees Celsius. Alternately you can set the speed of sound at your design location in ft/s or m/s. ControlSpace Designer software uses this value to calculate loudspeaker delay times. 

<b>Set Main DSP</b>	Opens the Set Main DSP window. In a design with multiple devices, use this window to specify which device is the Real Time Clock (RTC) for your system. Only one device can act as the RTC unit.
	
<b>DSP Resources</b>	Opens the DSP Resources window to view the processing and delay memory usage for the selected ESP.
	
<b>Toggle Standby</b>	Places a connected device into or out of Standby. Only works with devices which support a standby mode.
<b>Set Network Address</b>	Displays the Network Address dialog. Allows you to define a new default network and subnet. All devices added to the Project View use the stored network address.

	
<b>Set File Password</b>	The ControlSpace project file may be password protected to prevent modification. Once the project file is protected, all subsequent connections to the system via ControlSpace Designer will require the entry of the password before the connection is established. 
<b>Go online/ Go offline</b>	Connects/disconnects a device. When connected to the ControlSpace hardware, click <b>Go online</b> to upload your system design, or download it from the hardware, and to adjust settings in real time. The background in <b>Project View</b> , and the Signal Processing View turn blue to indicate that you are now working online. When you are online, click <b>Go offline</b> to disconnect.
<b>Scan</b>	Detects hardware on your local network. When ControlSpace Designer software completes the scan, the <b>Project View</b> is automatically populated with the hardware devices that are properly connected in your local network. Do not use <b>Scan</b> while an existing project is open. This may result in a conflict that can cause a change in your system design configuration. Scan should be used only with a blank new project, as a means to identify what hardware exists on the local network.
<b>System Mute</b>	Mutes all audio output when working online.

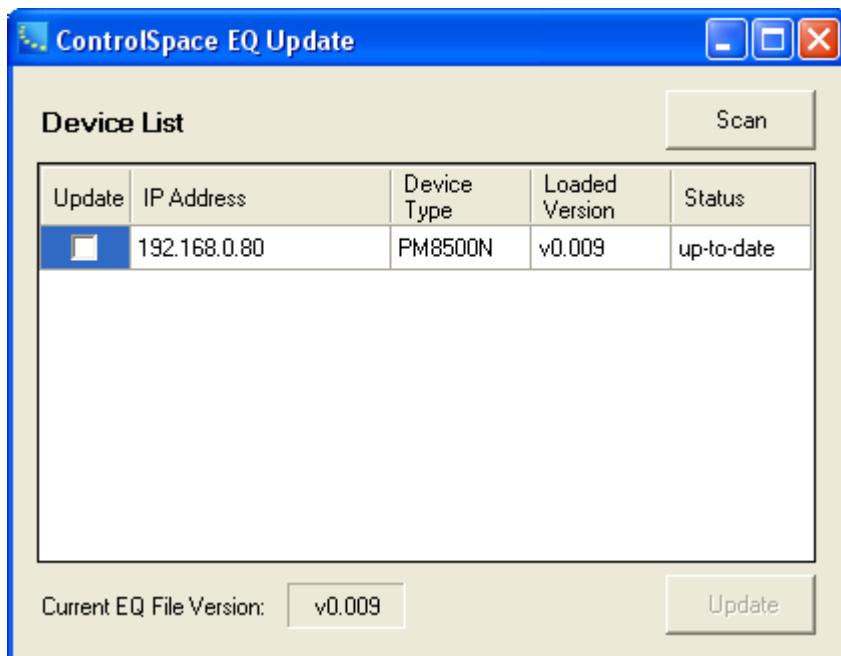
## System menu



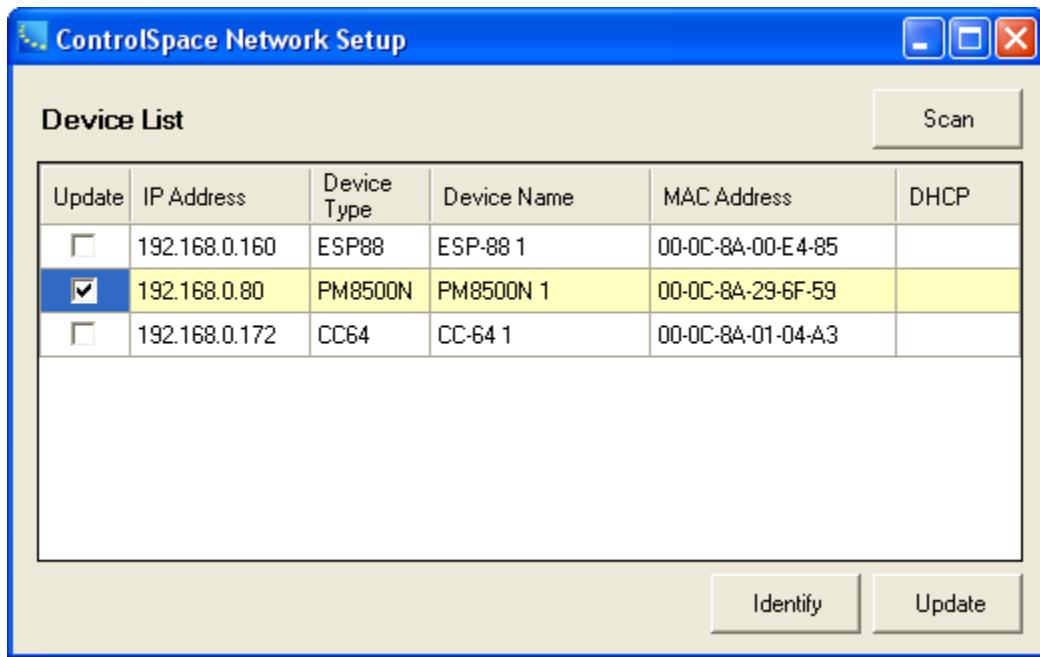
Menu item	Function																														
<b>Update Firmware</b>	<p>Opens the <b>Update Firmware</b> window. While connected to the ControlSpace hardware, you can view the version of the currently loaded firmware and update the firmware for the devices on your local network.</p>  <p>The screenshot shows the 'ControlSpace Firmware update' window. It has a 'Device List' table with the following data:</p> <table border="1"><thead><tr><th>IP-Address</th><th>Type</th><th>Loaded version</th><th>Latest version</th><th>Status</th></tr></thead><tbody><tr><td>192.168.0.80</td><td>PM8500N</td><td>v0.049</td><td>v0.048</td><td>up-to-date</td></tr><tr><td>192.168.0.160</td><td>ESP</td><td>v2.114</td><td>v3.022</td><td></td></tr><tr><td>ID=1</td><td>CC-16</td><td>v1.5</td><td>N/A</td><td>up-to-date</td></tr><tr><td>ID=2</td><td>CC-16</td><td>v1.5</td><td>N/A</td><td>up-to-date</td></tr><tr><td>192.168.0.172</td><td>CC-64</td><td>v1.113</td><td>v1.113</td><td>up-to-date</td></tr></tbody></table> <p>At the bottom of the window is a large 'Update' button.</p>	IP-Address	Type	Loaded version	Latest version	Status	192.168.0.80	PM8500N	v0.049	v0.048	up-to-date	192.168.0.160	ESP	v2.114	v3.022		ID=1	CC-16	v1.5	N/A	up-to-date	ID=2	CC-16	v1.5	N/A	up-to-date	192.168.0.172	CC-64	v1.113	v1.113	up-to-date
IP-Address	Type	Loaded version	Latest version	Status																											
192.168.0.80	PM8500N	v0.049	v0.048	up-to-date																											
192.168.0.160	ESP	v2.114	v3.022																												
ID=1	CC-16	v1.5	N/A	up-to-date																											
ID=2	CC-16	v1.5	N/A	up-to-date																											
192.168.0.172	CC-64	v1.113	v1.113	up-to-date																											

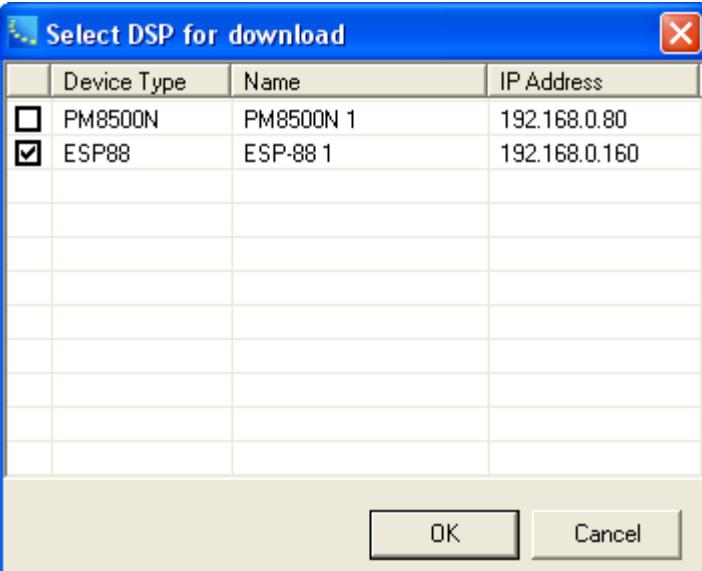
**EQ Update**

Opens the **EQ Update** window. While connected to the ControlSpace hardware, you can view the version of the currently loaded Bose loudspeaker EQ database, and update the device to use the latest EQ database.

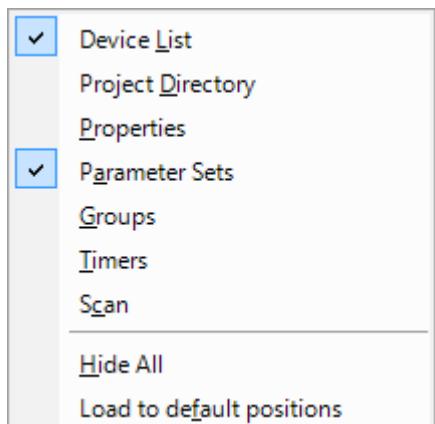
**Network Setup**

Opens the **Network Setup** window. While connected to the ControlSpace hardware, currently assigned network address, and change the IP address of a component on your system.



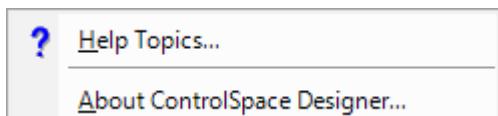
<b>Retrieve Saved Design</b>	Allows you to retrieve the .csp file from a device on the network without initiating a control connection to the device.																				
	 <table border="1" data-bbox="285 285 987 707"> <thead> <tr> <th></th> <th>Device Type</th> <th>Name</th> <th>IP Address</th> </tr> </thead> <tbody> <tr> <td><input type="checkbox"/></td> <td>PM8500N</td> <td>PM8500N 1</td> <td>192.168.0.80</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>ESP88</td> <td>ESP-88 1</td> <td>192.168.0.160</td> </tr> <tr><td colspan="4"> </td></tr> <tr> <td colspan="2" style="text-align: center;">OK</td><td colspan="2" style="text-align: center;">Cancel</td></tr> </tbody> </table>		Device Type	Name	IP Address	<input type="checkbox"/>	PM8500N	PM8500N 1	192.168.0.80	<input checked="" type="checkbox"/>	ESP88	ESP-88 1	192.168.0.160					OK		Cancel	
	Device Type	Name	IP Address																		
<input type="checkbox"/>	PM8500N	PM8500N 1	192.168.0.80																		
<input checked="" type="checkbox"/>	ESP88	ESP-88 1	192.168.0.160																		
OK		Cancel																			
<b>Retrieve Saved Design</b>	<p>Retrieves the project file without establishing a network connection to the system. Note that you must have an active network connection to enable this function.</p> <p>For additional information on when and how to use this function, see <a href="#">Retrieving System Configurations</a> in the Maintaining Your System section.</p>																				
<b>Save Retrieved Design</b>	<p>Retrieves the project file without establishing a network connection to the system, and immediately saves it as a file. Note that you must have an active network connection to enable this function.</p> <p>For additional information on when and how to use this function, see <a href="#">Retrieving System Configurations</a> in the Maintaining Your System section.</p>																				

## Window menu



Menu item	Function
<b>Device List</b>	Toggles the <b>Device List</b> window between show and hide. When working in the Project View, toggles the System Components, and when working in Signal Processing View, toggles the <b>SP Tool Kit</b> window between show and hide.
<b>Project Directory</b>	Toggles the <b>Project Directory</b> window between show and hide.
<b>Properties</b>	Toggles the <b>Properties</b> window between show and hide.
<b>Presets</b>	Toggles the <b>Presets</b> window between show and hide.
<b>Parameter Sets</b>	Toggles the <b>Parameter Sets</b> window between show and hide.
<b>Groups</b>	Toggles the <b>Groups</b> window between show and hide.
<b>Timers</b>	Toggles the <b>Timers</b> window between show and hide.
<b>Scan</b>	Toggles the <b>Scan</b> window between show and hide.
<b>Hide All</b>	Closes all windows except <b>Project View</b> and the Signal Processing View.
<b>Set to default positions</b>	Returns all open windows to their default location in ControlSpace Designer software.

## Help menu



Menu item	Function
<b>Help Topics</b>	Opens the ControlSpace Designer help.
<b>About ControlSpace Designer</b>	Opens the About ControlSpace Designer software window.



# Connecting to Devices

## Connection methods

The ControlSpace Designer software supports three methods of connection to Bose system electronics and control devices:

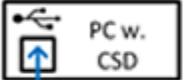
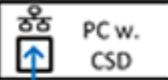
- USB
- Direct Ethernet Connection
- Networked Ethernet connection utilizing network switches or hubs

The connection method you use will vary based on the capabilities of the hardware device. The following summarizes the supported connection methods for the Bose system electronics that are configured using the ControlSpace Designer Software.

Device	Connection Method		
	USB	Direct Ethernet	Network Ethernet
PM8500 Amplifier	Yes		
PM8500N Amplifier	Yes	cat-5*	DHCP or Fixed IP
ESP 00/88	No	cat-5 xover	Fixed IP
CC 64	No		Fixed IP

\*Auto-MDIX devices resolve Tx/Rx pairs and support direct connections between a PC and the hardware using either standard or crossover ethernet cables.

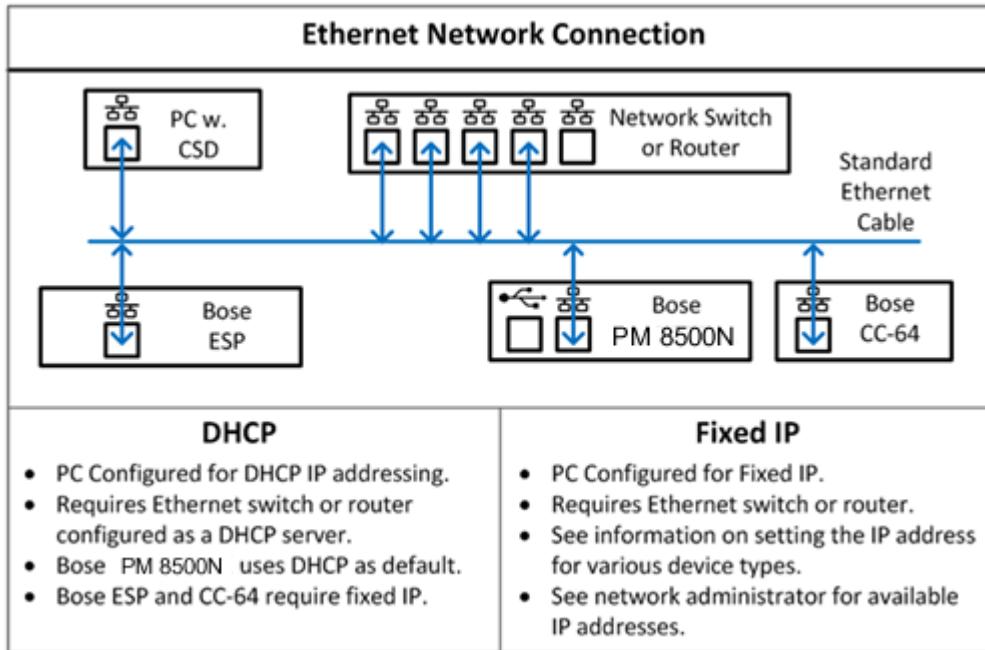
Each of the connection methods described above uses a unique connection and PC configuration. When connecting to the hardware first determine the method of connection that will be used, and use the following reference information to determine the PC and hardware cabling, and communication settings.

Direct Connection Methods		
USB	Ethernet Auto MDIX	Ethernet Crossover
 <p>Standard USB A → B Cable</p>	 <p>Standard Ethernet or Crossover Cable</p>	 <p>Standard Crossover Cable</p>
<ul style="list-style-type: none"> <li>• PC must support USB 1.0 or greater.</li> </ul>	<ul style="list-style-type: none"> <li>• PC Configured to use TCP/IP networking.</li> <li>• Set PC Network Address to: 192.168.0.10</li> <li>• PM 8500N Default Address is 192.168.0.80</li> </ul>	<ul style="list-style-type: none"> <li>• PC Configured to use TCP/IP networking.</li> <li>• Set PC Network Address to: 192.168.0.10</li> <li>• ESP Default Address is 192.168.0.160</li> </ul>

Multiple devices can be configured for operation on an Ethernet network that utilizes network switches or routers to manage data communications between the devices. ControlSpace software is configured for operation within a single local area network (LAN) and is not designed for operation across multiple networks (i.e. communication via network gateways). In applications with large wide area networks, this requires creating a dedicated subnet for the various system processing, amplification, and control devices that will be installed.

**NOTE:** Bose system electronics are designed for installation on a private Ethernet network, and are not intended for a direct connection to the internet.

If you are adding your devices to an existing network, contact the network administrator for information about how the IP addresses are assigned for the network. Based on this information you will need to configure the devices for either DHCP or Fixed IP operation as shown below:



## Device connection status

Within the ControlSpace Designer software the background color of the Project View, and title bar of devices within the Project View are used to indicate the current status of the device when a connection to the system is established.

<b>Project and Signal Processing View Device Status</b>	
<b>Status</b>	<b>Background Color</b>
Offline	[white]
USB Connection Established	[green]
Ethernet Connection Established	[blue]
Ethernet Connection Established, Device Offline	[gray] Signal Processing View only
Connection Established, Device in Standby	[yellow] Signal Processing View only

<b>Project View Icon Device Status</b>	
<b>Status</b>	<b>Background Color</b>
Offline	Default color
Connection Established	Default Color
Device Offline	[gray]
Device in Standby	[yellow]

## Using USB

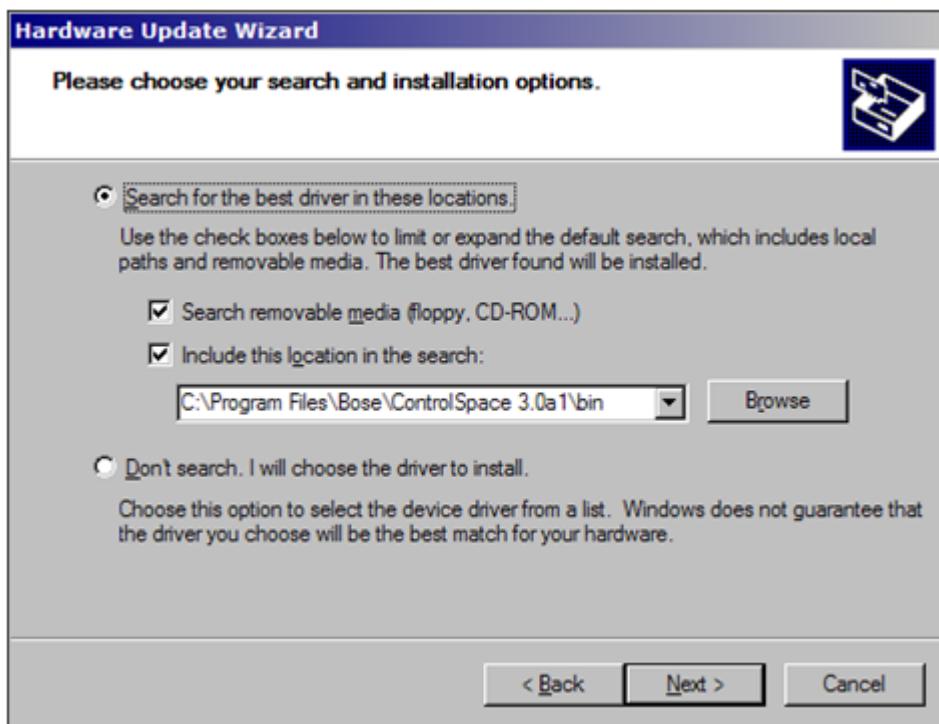
ControlSpace Designer software supports the control of devices which are configured for USB control. The first time a USB enabled hardware device is connected to the PC you will be prompted to locate and load the correct USB driver for the device. Once this step is performed all subsequent connections via USB will occur automatically.

**NOTE:** USB connection is only supported on Windows XP and Windows 7, 32 bit operating systems.

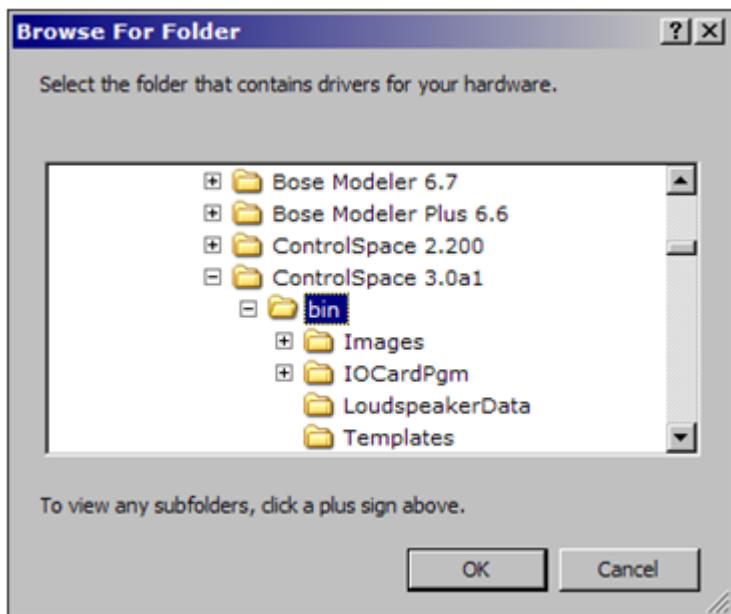
1. With the PM8500 amplifier powered up and operating, connect the PM8500 to the PC using a standard USB cable.
2. You will open the Found New Hardware Wizard. Select "Install from a list or specific location" and click **Next**.



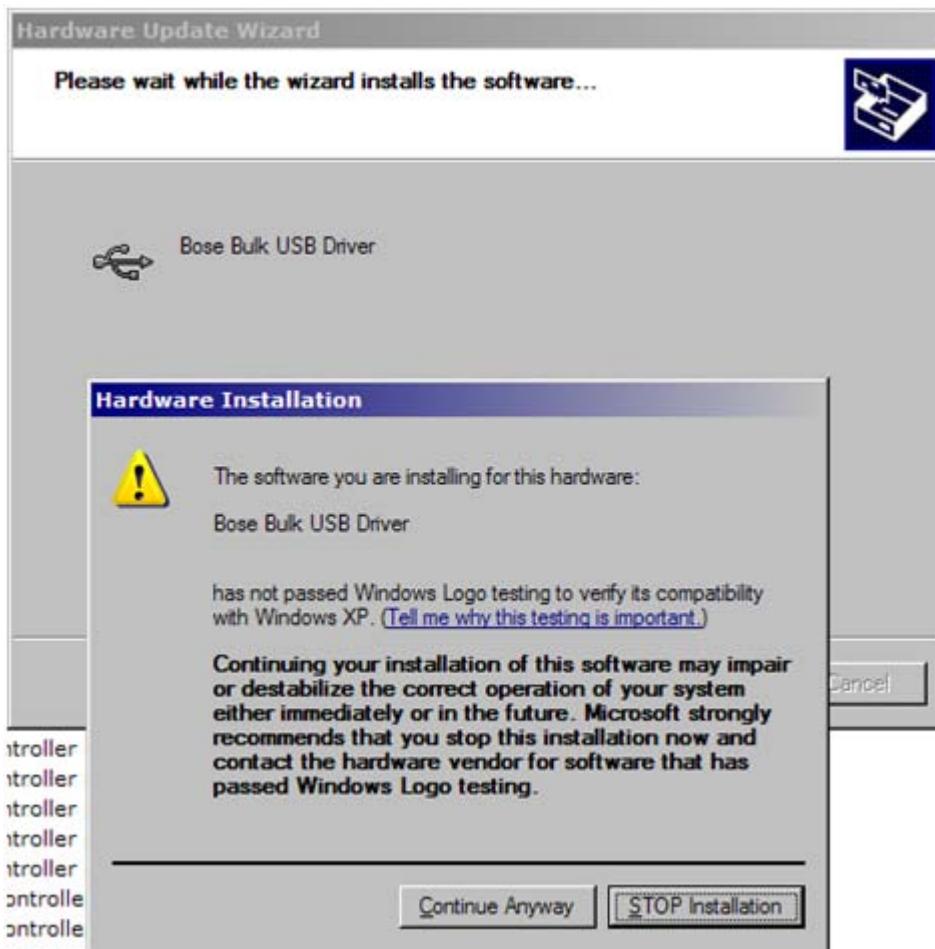
3. Select "Include this location in the search" and click **Browse**.



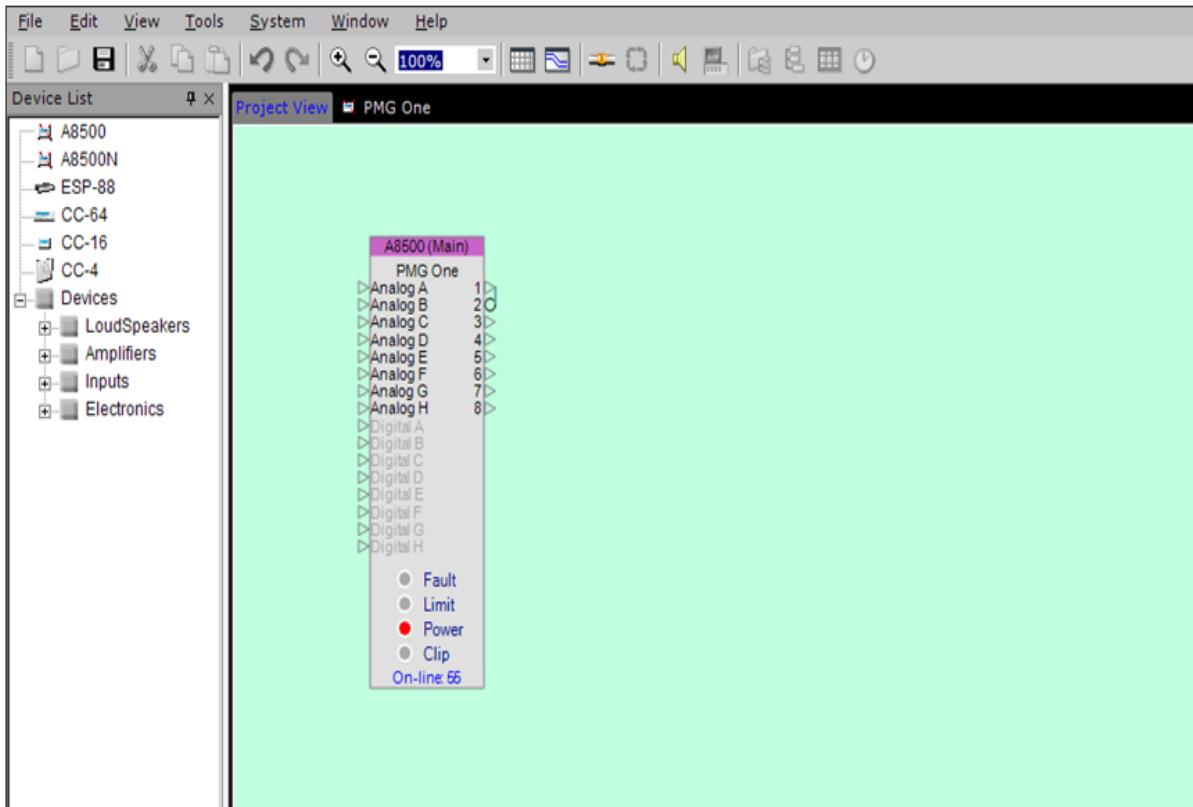
4. Browse to the bin directory within the ControlSpace Designer application directory and click **OK**.



5. Click **Next** from the Hardware Update Wizard.
6. The Bose Bulk Driver will be recognized, and you will be asked to continue with the Installation. Click **Continue Anyway**.



7. The installation will be completed, and you can select **Finish** on the Hardware Update Wizard.
8. Launch the ControlSpace Designer application. During the launch process the PM8500 amplifier will be recognized and a new connection will be established.



The USB connection is indicated using the blue-green background color. At this point it is possible to modify the signal processing settings in real time.

For more information on connecting to and controlling devices via USB, see [USB connection](#).

## Direct Ethernet

### Auto-MDIX

The Bose PM8500N amplifier uses network hardware which automatically corrects for the cable type used for the network connection. With this hardware, it is possible to use either a standard or crossover Ethernet cable and accomplish a direct connection between the PC and the hardware.

In this configuration, the only difference in the set up is that a standard Ethernet cable is used between the PC and the hardware, all other network configuration parameters are identical to those used for a direct connection with a crossover cable.

### Crossover Cable

When connecting the PC directly to either a single ESP or PM8500N an Ethernet crossover cable is used. This connection does not require the use of a network management device,

(switch, router or hub), but does require that you properly configure your PC for communication with the device.

## Configuring your PC's network adapter

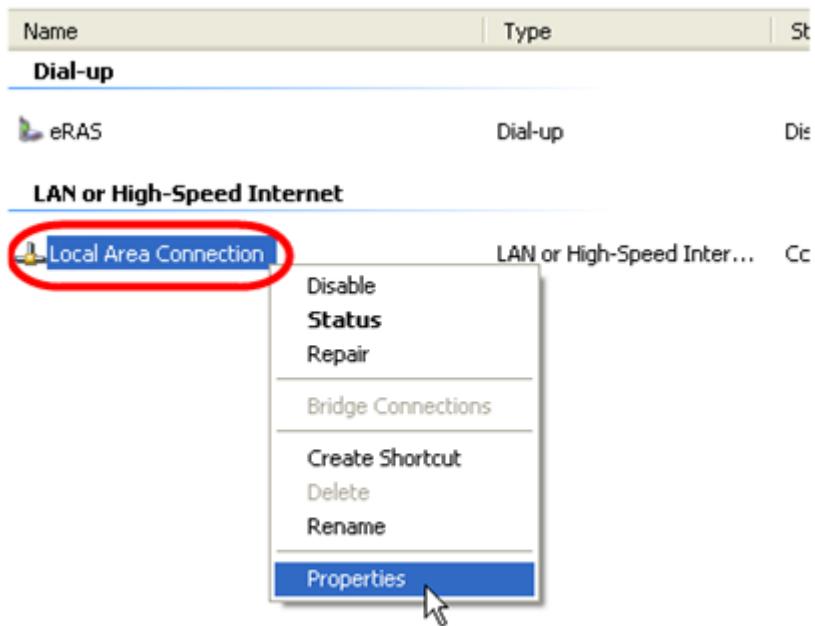
Bose network devices are assigned a default IP address to simplify the process of connecting directly to the device. Before connecting to the device configure your PCs network operation as follows (the steps are shown in Windows XP):

1. Go to **Start > Control Panel**.
2. Open the **Network Connections** control panel.

Name	Type	Status	Device N
<b>Dial-up</b>			
eRAS	Dial-up	Disconnected	Lucent Te
<b>LAN or High-Speed Internet</b>			
Local Area Connection	LAN or High-Speed Inter...	Connected	Intel(R) F

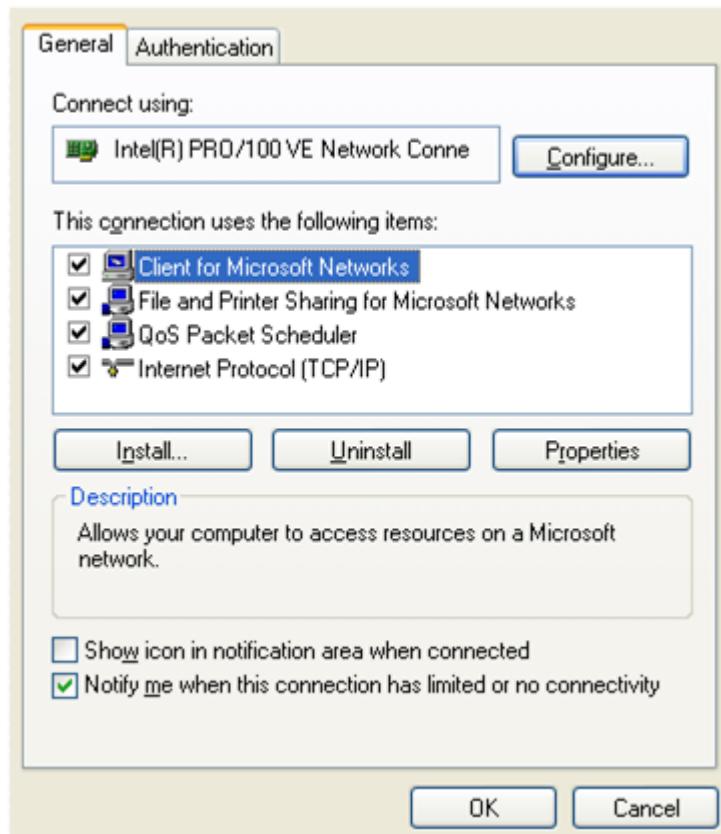
*Network Connections control panel*

3. Right click on **Local Area Connection** and choose **Properties**.



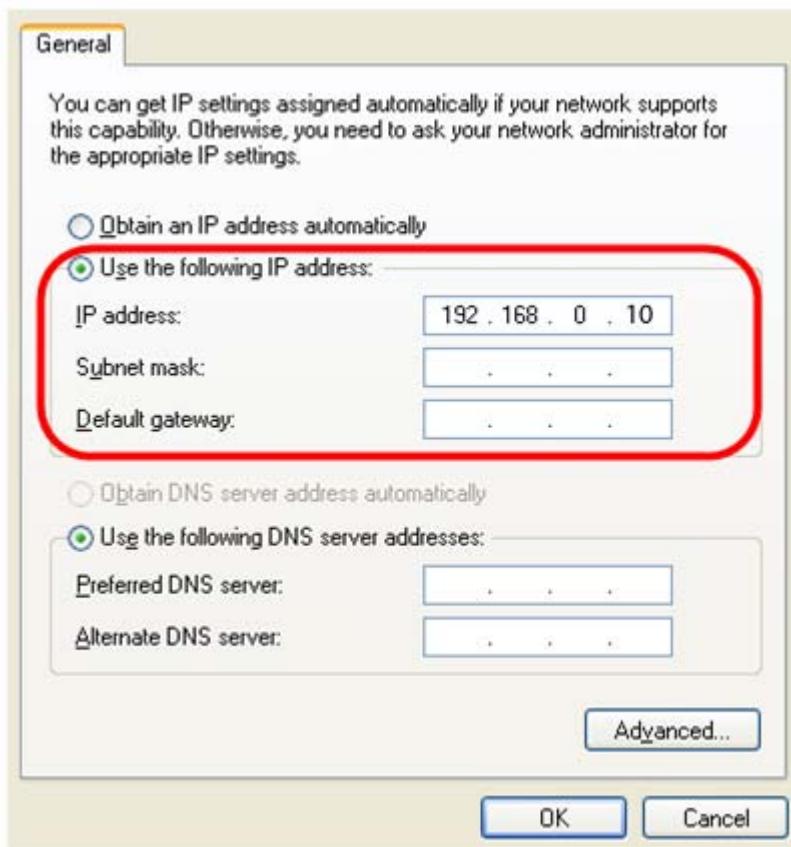
*Choosing Local Area Connection Properties*

4. In the **Local Area Connection Properties** window, select **Internet Protocol (TCP/IP)** and press the **Properties** button.



*Local Area Connection Properties window*

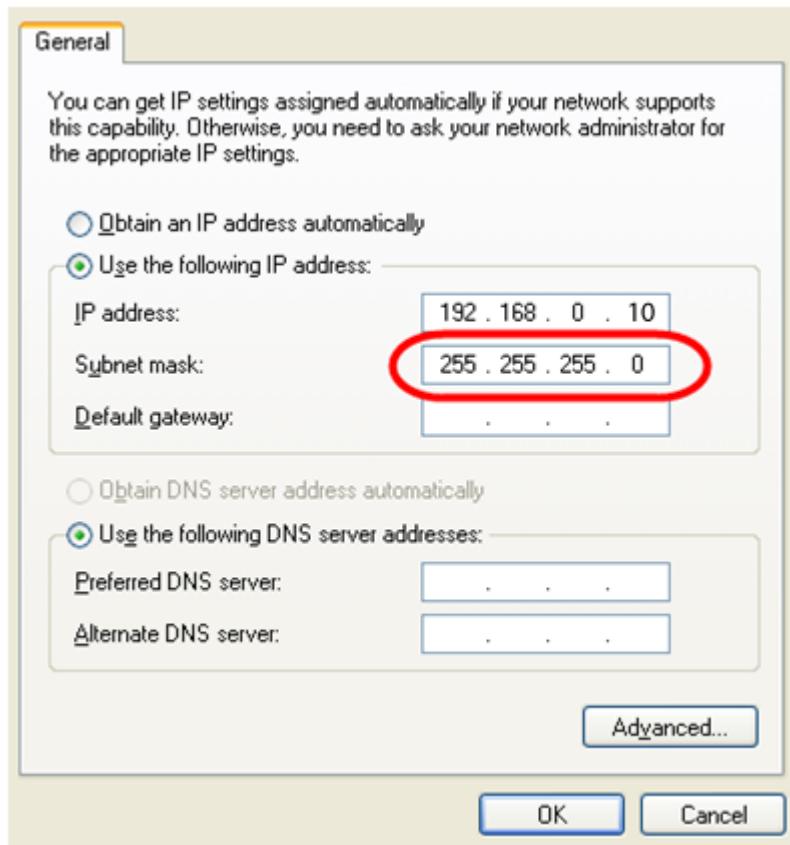
5. In the **Internet Protocol (TCP/IP) Properties** window, click on the **Use the following IP address** button and specify an IP address for your network adapter. In the IP address field, enter **192.168.0.10**.



Entering the IP address

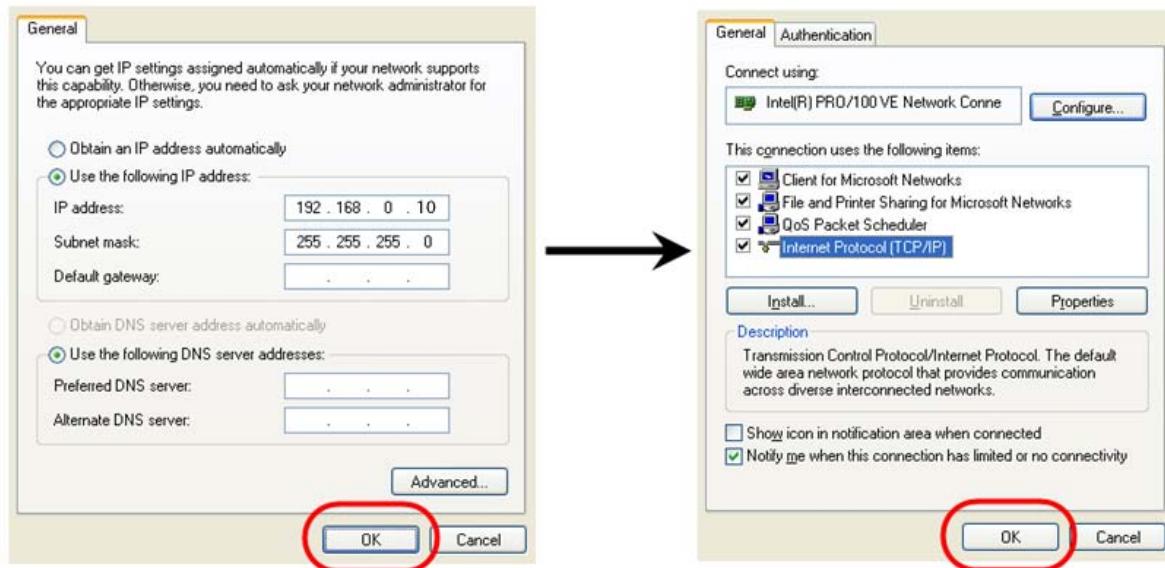
**NOTE:** We recommend using the IP address 192.168.0.10 for your computer to avoid conflicts with other network devices, such as Ethernet routers. Do not use 192.168.0.40 through .255 for your computer's IP address as these addresses are reserved for ControlSpace devices.

6. After entering the IP address, press the **Tab** key on your keyboard. The **Subnet mask** is automatically filled in.



*Subnet mask automatically entered*

7. Press **OK** in the **TCP/IP Properties** window, then press **OK** again in the **Local Area Connection Properties** window to effect the change to your network settings.



*Effecting TCP/IP changes: Press **OK** in both windows*

**NOTE:** You must press OK in both the TCP/IP Properties window AND the Local Area Connection Properties window to affect your IP address change.

You are now ready to connect to the device. [Click here](#) for the recommended connection steps within ControlSpace Designer software.

## Network Ethernet

### Ethernet Network Connection – DHCP

The Bose PM8500N amplifier uses network hardware which supports the automatic addressing of network devices, DHCP. In this case the devices receive their network address from the network switch or router. The PM8500N is configured for DHCP addressing in the factory to simplify the initial set up and configuration and testing of the amplifier, prior to installation.

**NOTE:** We recommend that you use DHCP addressing for in shop testing and configuration of temporary installations. In permanent installations Fixed IP addressing is the preferred option.

### Configuring your PC's network operation

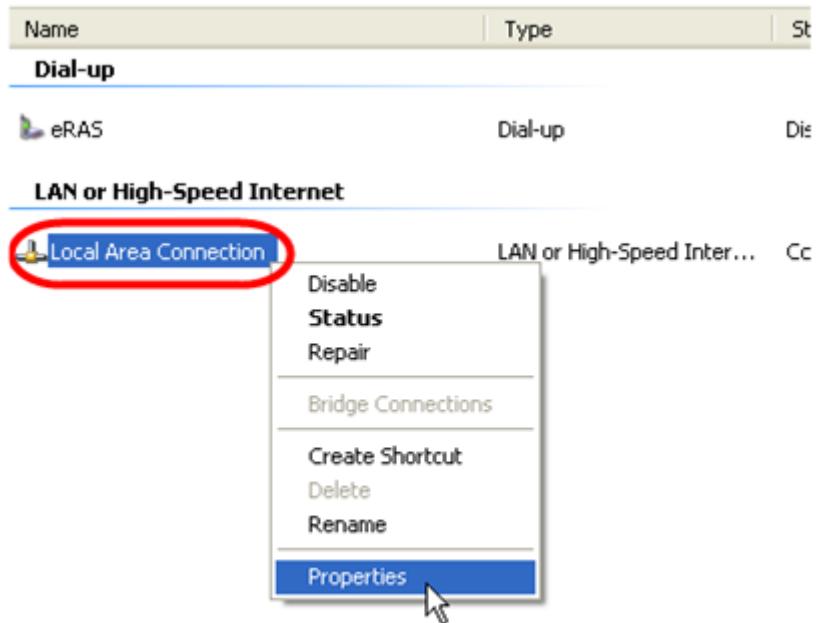
Before connecting to the device, configure your PCs network operation as follows (the steps are shown in Windows XP):

1. Go to **Start > Control Panel**.
2. Open the **Network Connections** control panel.

Name	Type	Status	Device N
<b>Dial-up</b>			
eRAS	Dial-up	Disconnected	Lucent Te
<b>LAN or High-Speed Internet</b>			
Local Area Connection	LAN or High-Speed Inter...	Connected	Intel(R) F

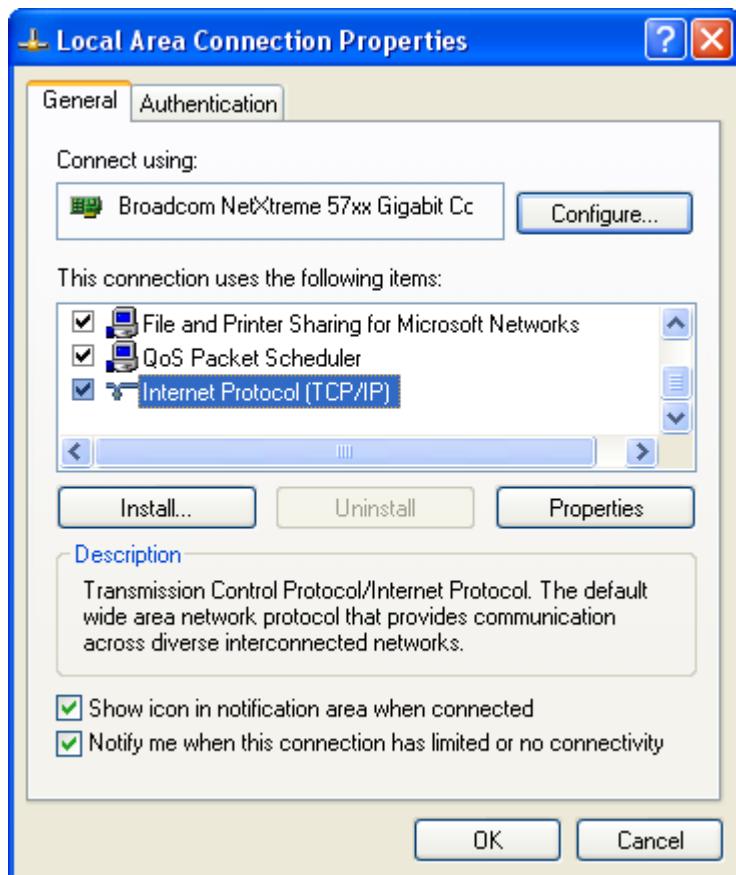
*Network Connections control panel*

3. Right click on **Local Area Connection** and choose **Properties**.



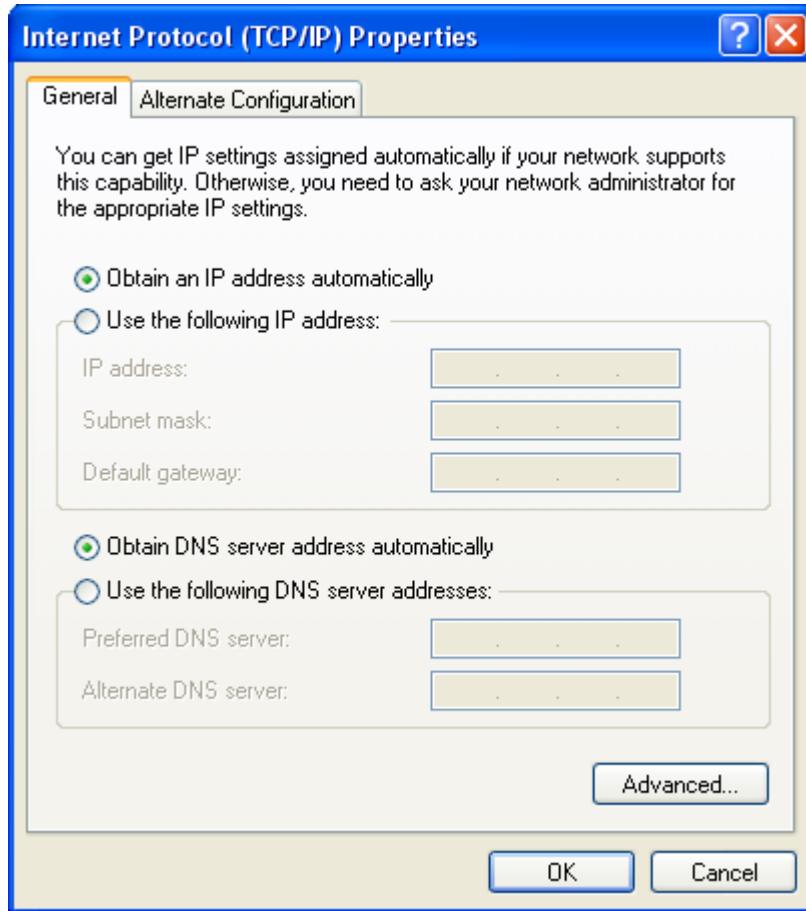
*Choosing Local Area Connection Properties*

4. In the **Local Area Connection Properties** window, select **Internet Protocol (TCP/IP)** and press the **Properties** button.



Local Area Connection Properties window

5. In the **Internet Protocol (TCP/IP) Properties** window, click on the **Obtain IP address automatically** button.



Entering the IP address

6. Press **OK** in the **TCP/IP Properties** window, then press **OK** again in the **Local Area Connection Properties** window to effect the change to your network settings.

**NOTE:** You must press OK in both the TCP/IP Properties window AND the Local Area Connection Properties window to affect your IP address change.

You are now ready to connect to the system. [Click here](#) for the recommended connection steps within ControlSpace Designer software.

## Ethernet Network Connection – Fixed IP

When working with a Fixed IP network each device on the network must be configured with a unique network address. Bose system electronics and control devices are all configured for a default IP address at the time of manufacture. This simplifies the initial connection and configuration.

**NOTE:** In applications where multiple devices of the same type will reside on the network they must be assigned a unique address before successful communications between the devices and the PC can be accomplished. [Click here](#) [link to content] for additional information on changing the IP address of a device.

The default IP address of Bose electronics and control devices are as follows:

- Bose PM8500N Amplifier: 192.168.0.80
- Bose ESP Processor: 192.168.0.160
- Bose CC-64 Control Center: 192.168.0.176

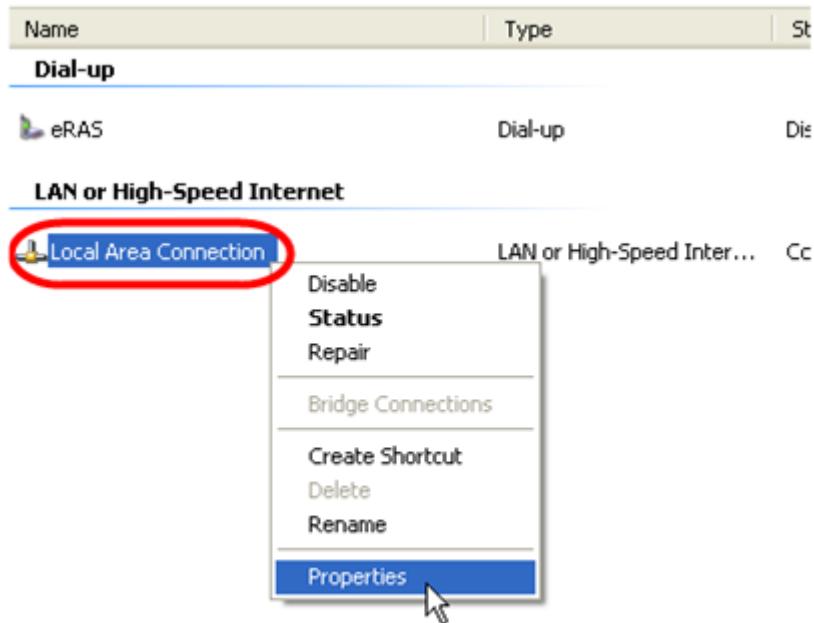
Before connecting to the device, configure your PC's network operation as follows,(the steps are shown in Windows XP):

1. Go to
2. Go to **Start > Control Panel.**
3. Open the **Network Connections** control panel.

Name	Type	Status	Device N
<b>Dial-up</b>			
eRAS	Dial-up	Disconnected	Lucent Te
<b>LAN or High-Speed Internet</b>			
Local Area Connection	LAN or High-Speed Inter...	Connected	Intel(R) F

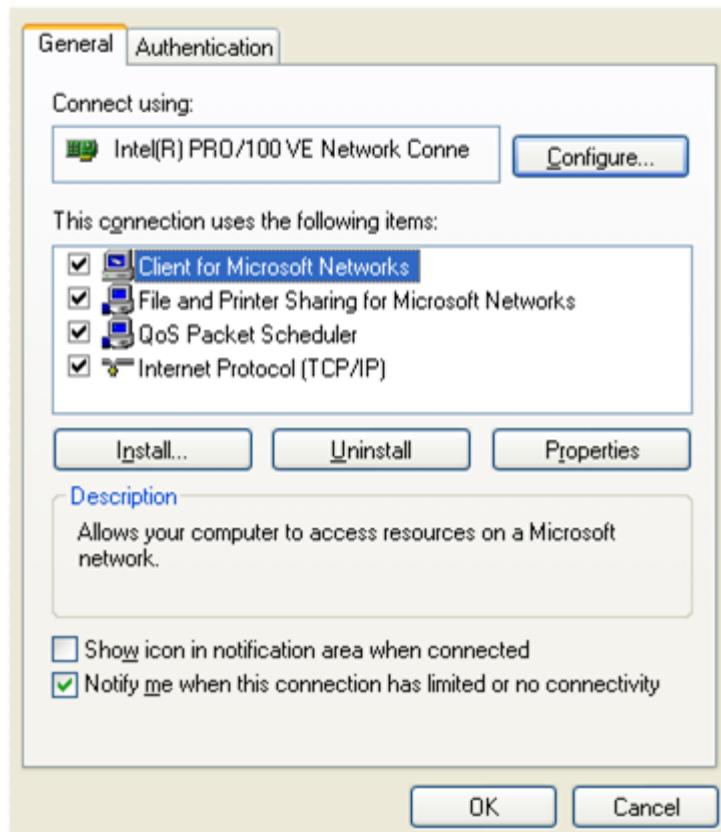
*Network Connections control panel*

4. Right click on **Local Area Connection** and choose **Properties**.



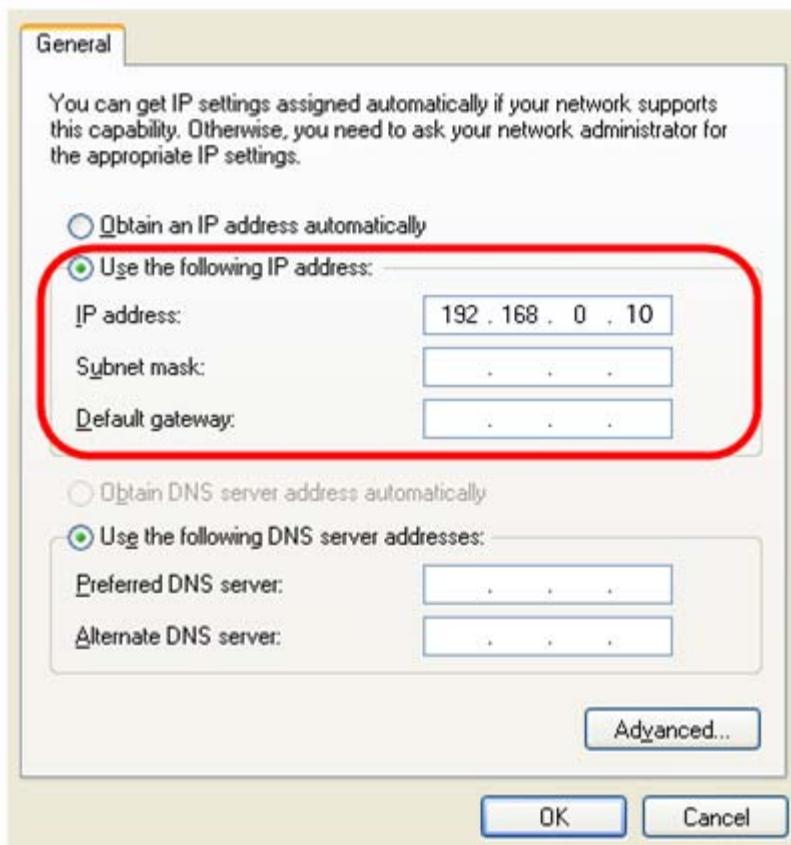
*Choosing Local Area Connection Properties*

5. In the **Local Area Connection Properties** window, select **Internet Protocol (TCP/IP)** and press the **Properties** button.



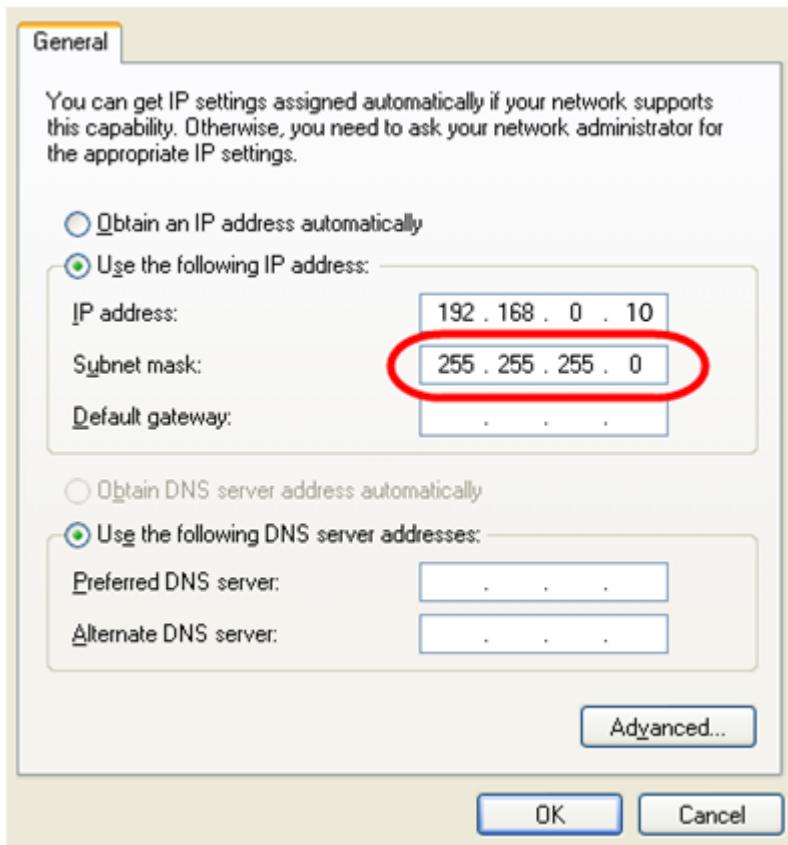
*Local Area Connection Properties window*

6. In the **Internet Protocol (TCP/IP) Properties** window, click on the **Use the following IP address** button and specify an IP address for your network adapter. In the IP address field, enter **192.168.0.10**.

*Entering the IP address*

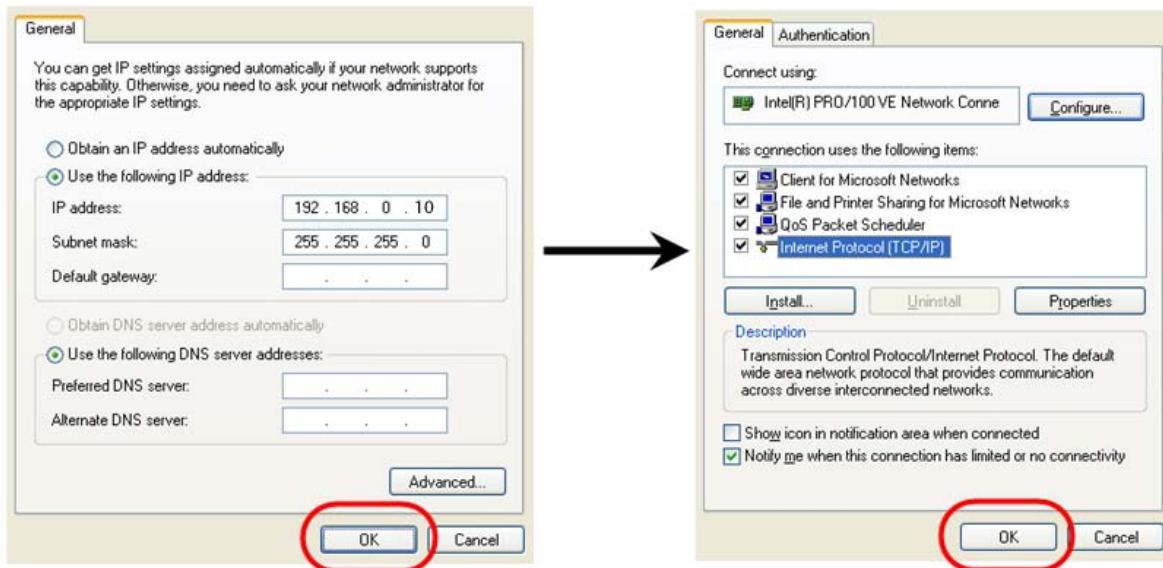
**NOTE:** We recommend using the IP address 192.168.0.10 for your computer to avoid conflicts with other network devices, such as Ethernet routers. Do not use 192.168.0.40 through .255 for your computer's IP address as these addresses are reserved for ControlSpace devices.

7. After entering the IP address, press the **Tab** key on your keyboard. The **Subnet mask** is automatically filled in.



*Subnet mask automatically entered*

8. Press **OK** in the **TCP/IP Properties** window, then press **OK** again in the **Local Area Connection Properties** window to effect the change to your network settings.



*Effecting TCP/IP changes: Press **OK** in both windows*

**NOTE:** You must press OK in both the TCP/IP Properties window AND the Local Area Connection Properties window to affect your IP address change.

You are now ready to connect to the system. [Click here](#) for the recommended connection steps within ControlSpace Designer software.



# Configuring Devices

## Building a project file

The first step in creating a ControlSpace system design is to specify the hardware components you intend to use. In ControlSpace Designer software this is accomplished by launching the program and adding new devices to a project.

### Project files

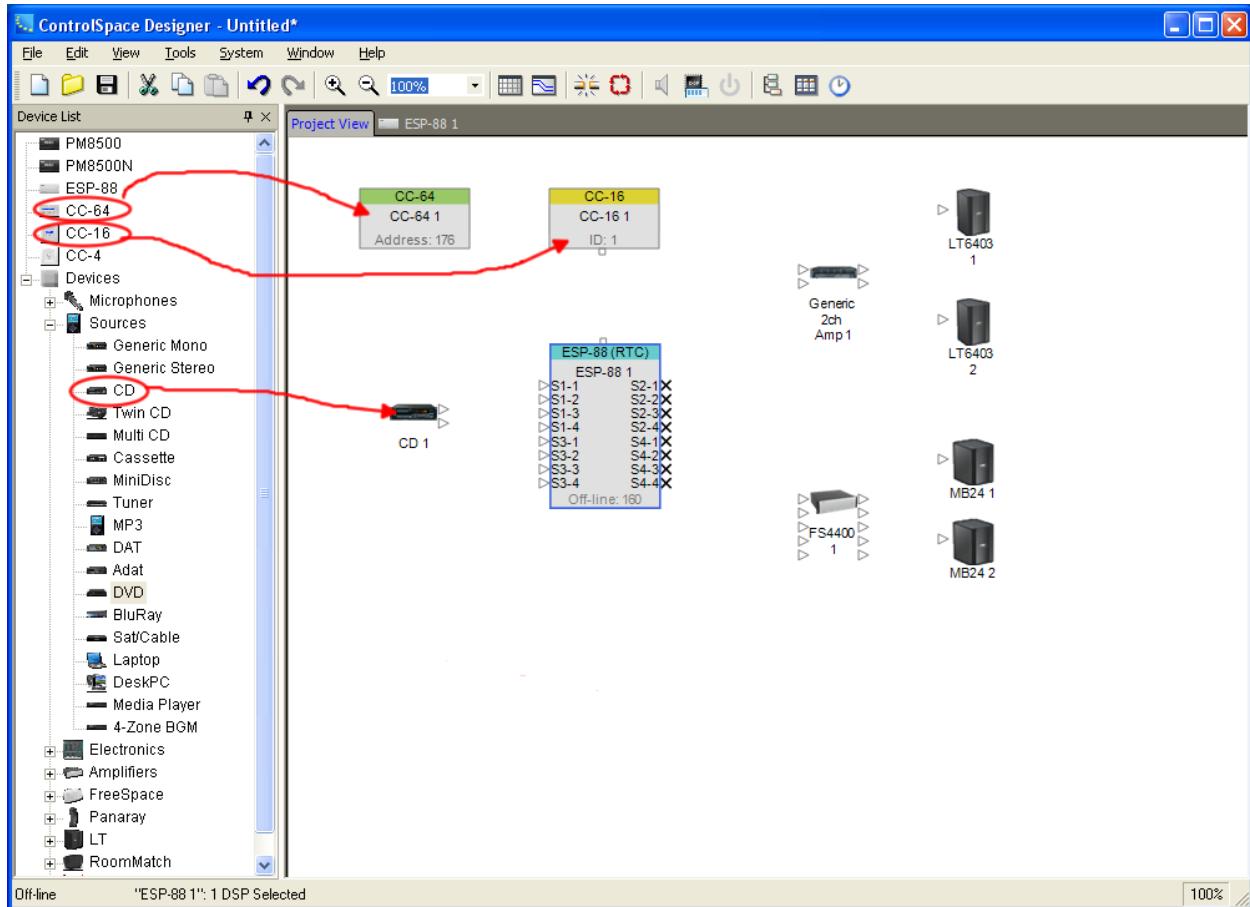
Each system design is stored in a file with the file extension .csp. When you launch ControlSpace Designer software, a new project is automatically created in temporary working memory and named "Untitled". You must save this information to disk to store the file for use in the event of a power loss. The first time you save a project, you are prompted to provide a name for it.

**Note:** The system configuration stored in a device can be downloaded to a project file at any time. This is helpful if you are working on a system that you did not create, or if you do not have the original .csp file.

### Adding Devices

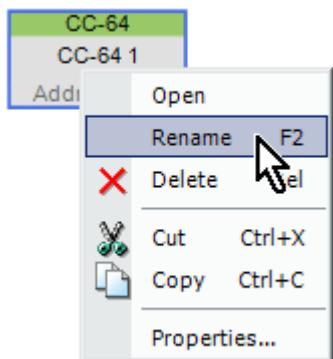
Devices are added to your system design by dragging the device icons in the Device List on the left into the Project View on the right. The Project View is a workspace that allows you to graphically lay out the system design. In the following example, the ESP-88 and any CC-64s and CC-16s are part of the design. Although you can add other components, such as microphones and loudspeakers, they are for reference only and do not perform any function in ControlSpace Designer software.

## ControlSpace Designer 3.1 Software Guide



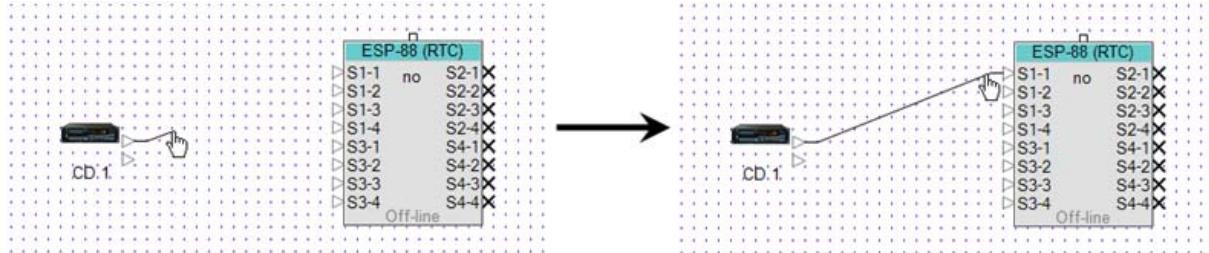
*Dragging and Dropping devices into Project View*

Any component in your design can be renamed. Select the icon and press F2, or right click and choose Rename.



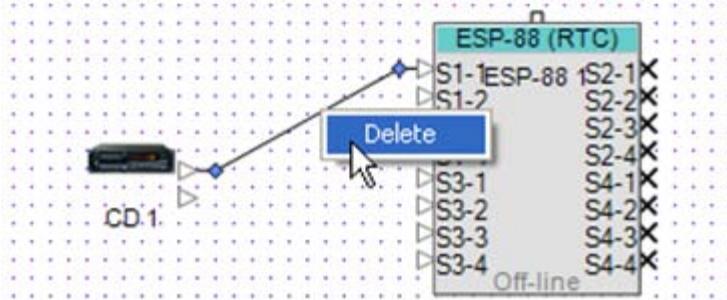
*Renaming a component in Project View*

Devices are wired together by dragging and dropping wires from output nodes to input nodes, as shown:



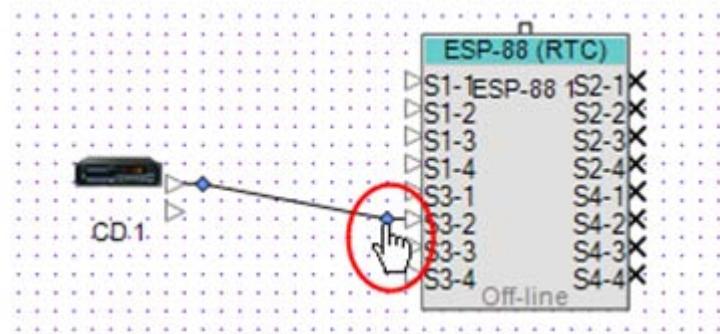
*Clicking and dragging a wire from output to input.*

To delete a wire, select the wire and press the Delete key, or right click and choose Delete.



*Deleting a wire*

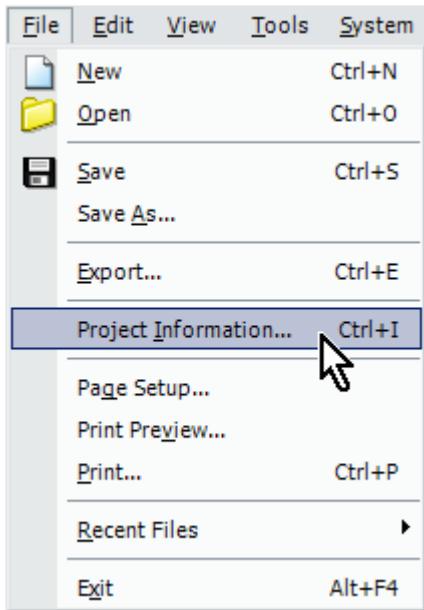
To move a wire, click anywhere on the wire to select it, then click and drag the blue node to the new location.



*Dragging the blue node to move a wire*

## Adding project notes

ControlSpace Designer provides a feature for recording contact information and comments related to the project design. This is an especially helpful feature for service technicians accessing the system in the future. To access this feature, Select the File Menu and choose Project Information or by using the (CTRL + I) hot key.



The Project Information Window supports entry of contact information for multiple project participants as well as six multi-line comment fields. There is no limit to the amount of text you may enter in the comment fields, and all information stays with the design when the project file is saved to disk or uploaded to the system.

**Project Information**

BusinessManager	Email	Telephone
Engineer	Email	Telephone
Customer	Email	Telephone
	Address	Fax
		Cell Phone

Comment1	Comment2

Comment3	Comment4

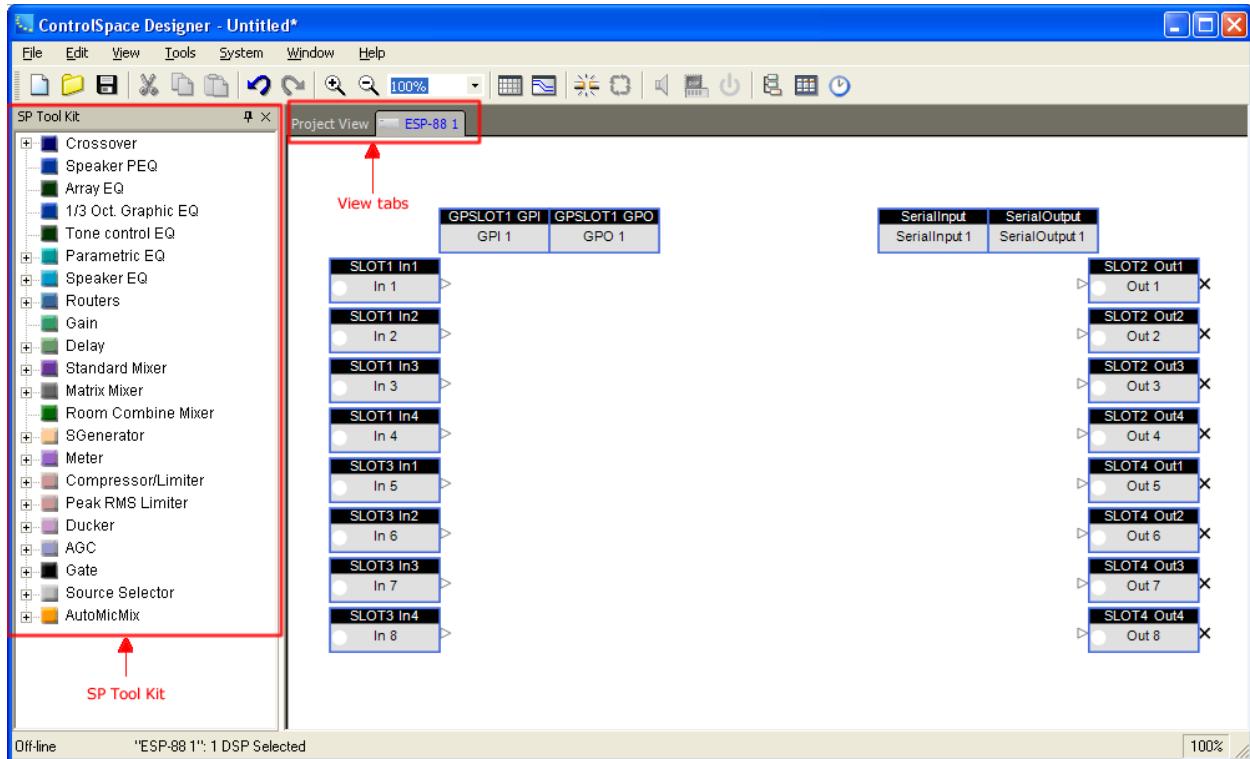
  

Comment5	Comment6

*Project Information Window*

## Accessing signal processing

Each device that has signal processing functions has a Signal Processing View indicated by a tab to the right of the Project View.



*Signal Processing View and SP Tool Kit*

The first time you access the **Signal Processing View** you will notice that it is essentially a clean slate. Default input and output blocks are visible for the audio, general purpose, and serial ports of an ESP chassis.

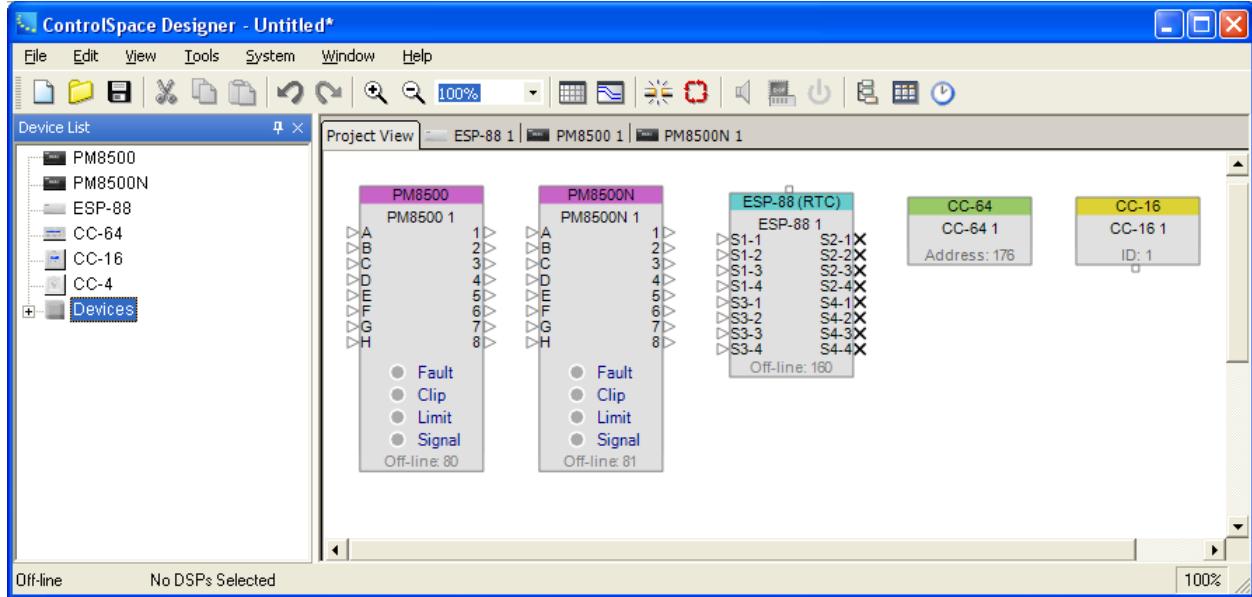
The Signal Processing (SP) Toolkit includes the various signal processing blocks which may be used within the selected device.

## Configuring ESP-88

### Engineered Sound Processor (ESP-00 & ESP-88)

The Device List includes all of the devices which may be added to your system design. Bose system electronics and control devices are shown at the top of the list, while generic devices are included within the Devices directory. These generic devices are used to illustrate system components and connectivity.

**NOTE:** Wiring within the project view is for informational purposes only and does not affect the audio signal path between devices.

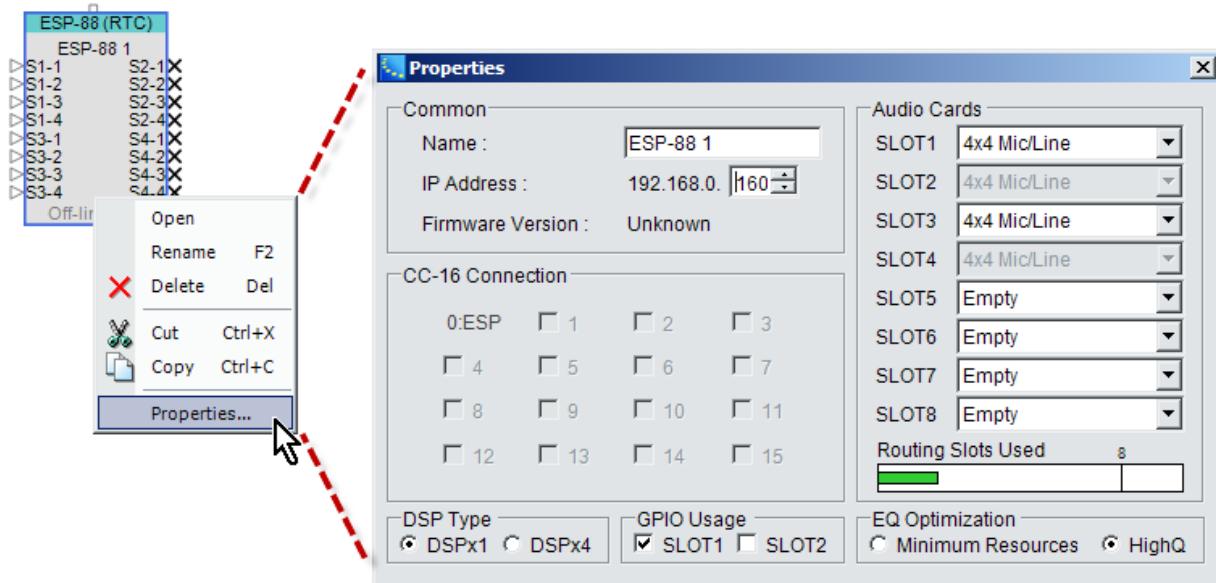


Available Bose system devices and their associated Project View icons.

## ESP-88 Input/Output

The ESP signal processor is available in two versions the ESP-88 a pre-configured 8x8 processor, and the ESP-00 and open configuration processor which requires the installation of project specific input/output cards.

The ESP-88 is the default signal processor available within the Devices List, but may be easily modified to adjust the input/output cards used for the design. This is accomplished through the ESP properties window. To access the ESP properties window, right-click on the ESP's Project View icon and select Properties.



Accessing the ESP properties.

The ESP properties display shows all of the items which determine the configuration of an Engineered Sound Processor.

The following options are available within the ESP properties:

**Common** – Contains functions which are common to all ESP devices.  
Included in this section are:

**Name** – The unique name of the ESP that is displayed within the Project View. This unique name is also used in serial protocol programming.

**IP Address** – Sets the device address of the units IP address.

**Firmware Version** – Displays the current firmware version within the ESP. This item is only available when on-line with the ESP.

**CC-16 Connection** – Displays a check mark beside numbers 1 through 15 matching the device ID of each CC-16 connected to the ESP.

**DSP Type** – Indicates the current DSP capacity of an ESP.  
Included in this section are:

**DSPx1** – The standard DSP card supplied with all ESP systems.

**DSPx4** – The presence of an optional DSP expansion card. This daughter card for the main DSP increases performance by 300%.

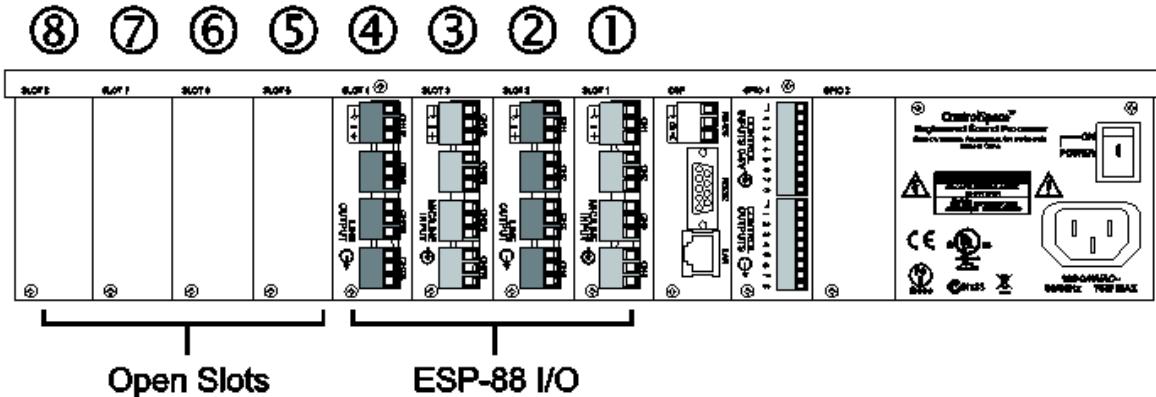
**GPIO Usage** – Check boxes to enable the general purpose input and output capabilities of an ESP.

Included in this section are:

**Slot1** – Eight control inputs and eight control outputs are provided in each ESP system as standard equipment.

**Slot2** – An optional connector card and cable to add eight control inputs and eight control outputs to an ESP.

**Audio Card Overview** - Hardware slots are numbered one through eight and represent physical locations for expansion cards to occupy within the ControlSpace ESP architecture.



*ControlSpace ESP-88 Rear I/O Panel*

Within the audio card options, a drop down list shows the audio cards which may be installed in a card slot.

Available options include:

- Empty
- 4x4 Mic/Line
- 4ch EDR Input
- 4ch EDR Output
- 8ch AES3 In
- 8ch AES3 Out
- 4ch Mic/Line Input
- 4ch SDR Output
- Surround
- CobraNet 16In16Out
- CobraNet 16In8Out
- CobraNet 8In16Out
- CobraNet 8In8Out
- CobraNet 16In
- CobraNet 16Out
- CobraNet 8In
- CobraNet 8Out
- ESPLink Output

**Routing Slots Used** – A single ESP can accommodate up to 64 channels of audio. Each card uses some quantity of the 64 channels. The bar graph indicates the current channel usage, and will turn red if the 64 channel maximum has been exceeded.

**EQ Optimization** – Provides a selection between two different equalization methods for signal processing blocks. Included in this section are:

**Minimum Resources** – Enables standard-Q low-frequency filters.

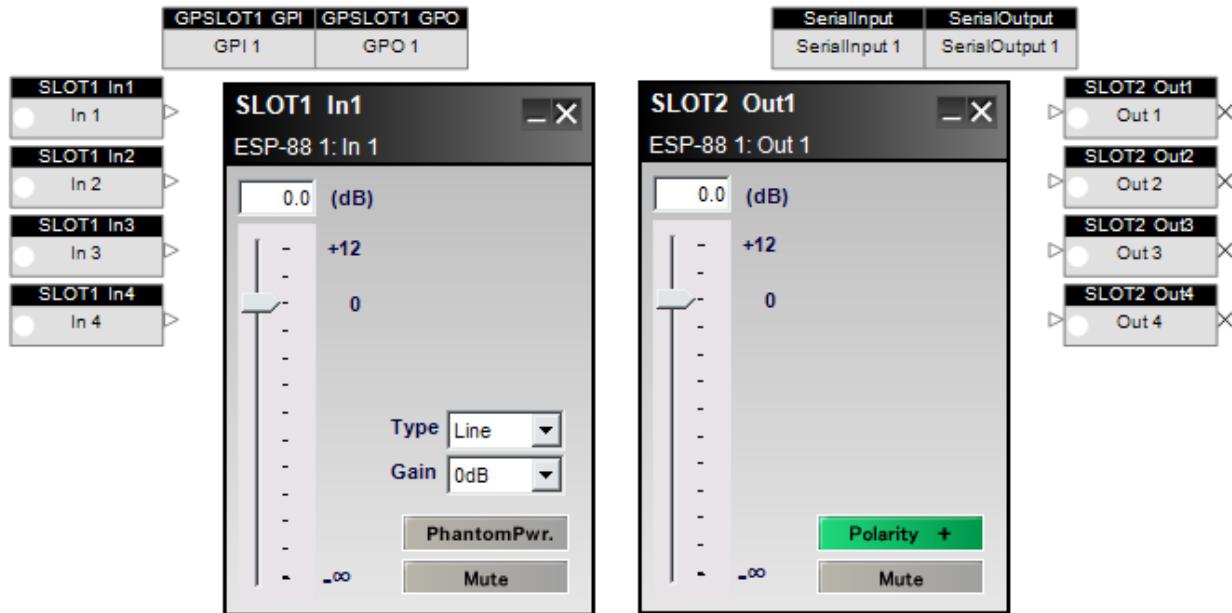
**HighQ** – Enables high-Q, low-frequency filters (default setting).

## Audio Card Control Panels

### 4x4 Mic/Line Input/Output Card

This expansion card provides four channels of software selectable microphone or line-level standard dynamic range (SDR) inputs with four channels of SDR line-level outputs.

Adjustable options for this card are accessed by double clicking on the appropriate input or output block within the **ESP View** to open an individual channel's control panel.



4x4 Mic/Line Input and Output Control Panels

The **input control panel** provides the following options:

**Input Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

**Input Gain Value** – permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

**Input Type Selection** – provides a selector to configure the range of input pre-gain values for typical **Line** and **Mic** input signal types. This adjustment is in the analog domain, pre analog to digital conversion.

**Input Pre-gain** – offers selectable gain options based upon the input type selection. The gain values for **Line** inputs are, 0dB (no additional gain), 14dB, and 24dB. Gain values for **Mic** inputs are, 42dB, 48dB, 54dB, and 64dB.

**Phantom Power** – enables +15 Volts DC on the input connector to power elements of condenser microphones. When *Phantom Power* is enabled, the control panel button is Green.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

The **output control panel** provides the following options:

**Output Gain Slider** – adjusts the output signal level delivered to the next *device* in the system design. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.

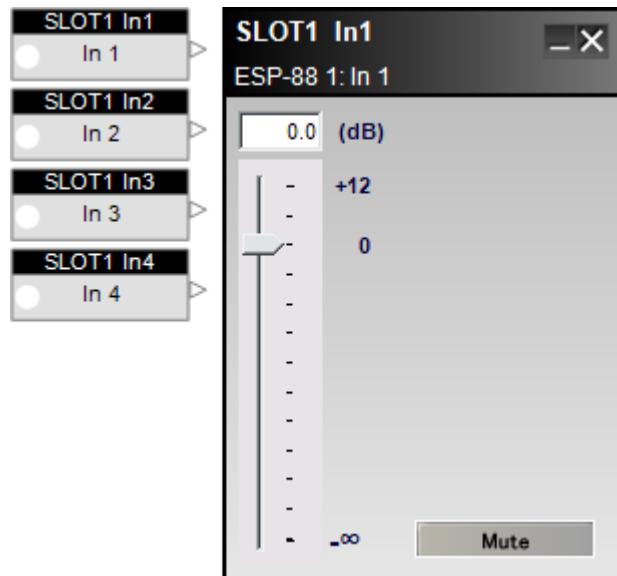
**Polarity** – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a “+” sign is present. When Polarity is reversed, the control panel button is Red and a “-” sign is present.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## 4ch EDR Input Card

This card provides four channels of enhanced dynamic range (EDR) highest quality line-level input.

Adjustable options for this card are accessed by double clicking on the appropriate input block within the **ESP View** to open an individual channel control panel.



*EDR line-level input card control panel*

The **input control panel** provides the following options:

**Input Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

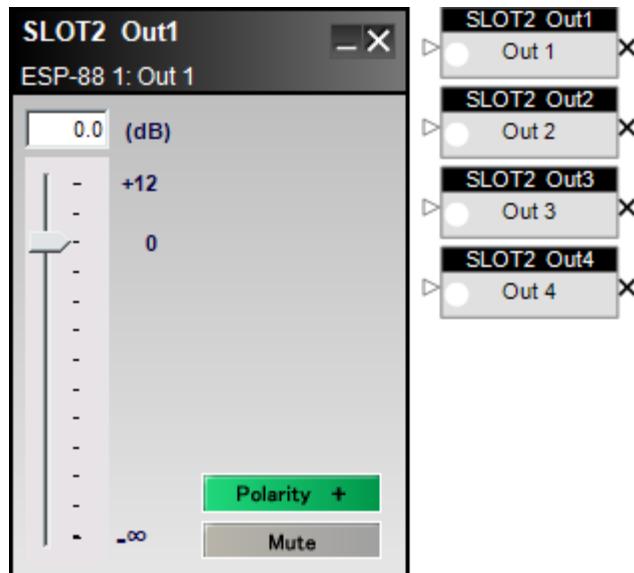
**Input Gain Value** – permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## 4ch EDR Output Card

This card provides four channels of line-level enhanced dynamic range (EDR) highest quality output.

Adjustable options for this card are accessed by double clicking on the appropriate output block within the **ESP View** to open an individual channel control panel.



EDR output card control panel

The **output control panel** provides the following options:

**Output Gain Slider** – adjusts the output signal level delivered to the next device in the system design. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.

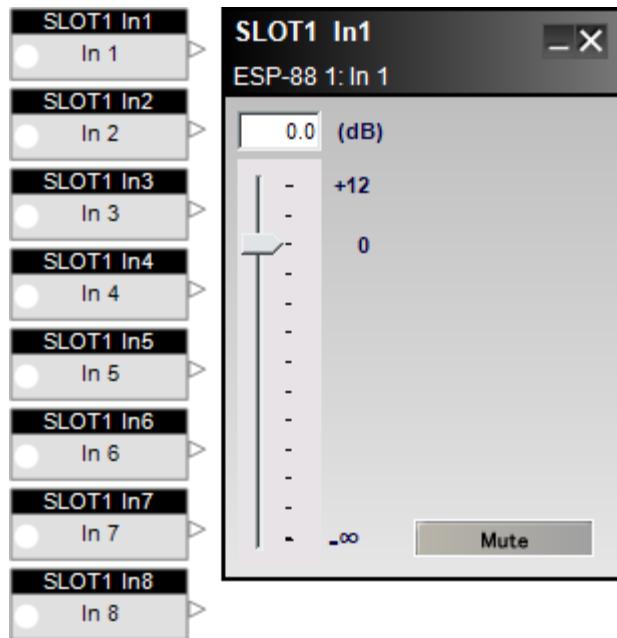
**Polarity** – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a "+" sign is present. When Polarity is reversed, the control panel button is Red and a "-" sign is present.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## 8ch AES-3 Input Card

This expansion card provides eight channels of AES-3 digital audio input.

Adjustable options for this card are accessed by double clicking on the appropriate input block within the **ESP View** to open an individual channel control panel.



*AES-3 eight-channel input card control panel*

The **input control panel** provides the following options:

**Input Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

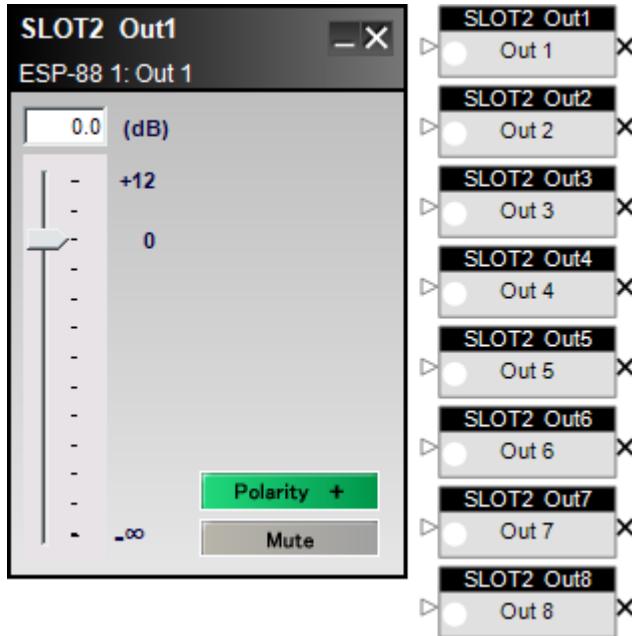
**Input Gain Value** – permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## 8ch AES-3 Output Card

This expansion card provides eight channels of AES-3 digital audio output.

Adjustable options for this card are accessed by double clicking on the appropriate output block within the **ESP View** to open an individual channel control panel.



*AES-3 eight-channel output card control panel*

The **output control panel** provides the following options:

**Output Gain Slider** – adjusts the output signal level delivered to the next *device* in the system design. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.

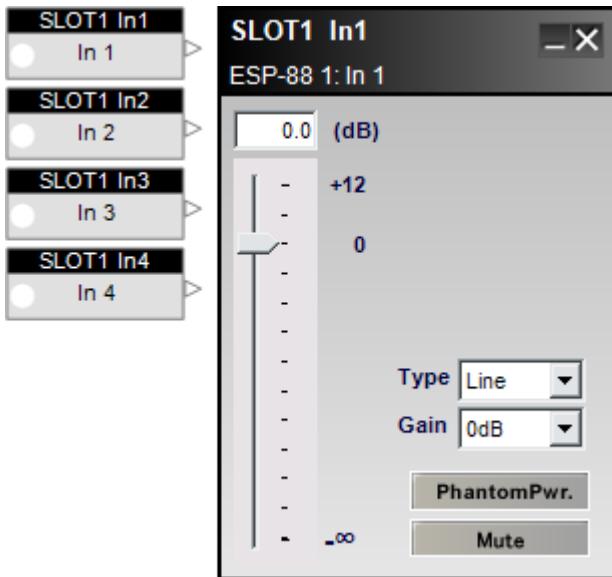
**Polarity** – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a "+" sign is present. When Polarity is reversed, the control panel button is Red and a "-" sign is present.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## 4ch Mic/Line SDR Input Card

This card provides four channels of software selectable microphone or line-level standard dynamic range (SDR) input.

Adjustable options for this card are accessed by double clicking on the appropriate input block within the **ESP View** to open an individual channel control panel.



Four-channel mic/line SDR input card control panel

The **input control panel** provides the following options:

**Input Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, post analog to digital conversion.

**Input Gain Value** – permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input gain slider.

**Input Type Selection** – provides a selector to configure the range of input pre-gain values for typical **Line** and **Mic** input signal types. This adjustment is in the analog domain, pre analog to digital conversion.

**Input Pre-gain** – offers selectable gain options based upon the input type selection. The gain values for **Line** inputs are, 0dB (no additional gain), 14dB, and 24dB. Gain values for **Mic** inputs are, 42dB, 48dB, 54dB, and 64dB.

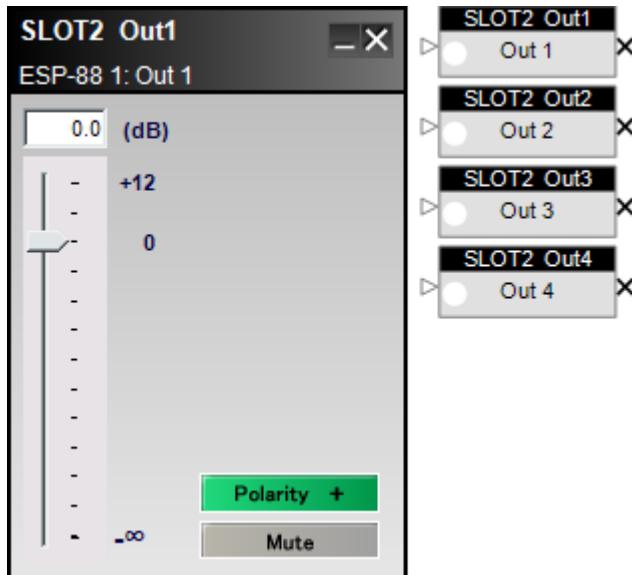
**Phantom Power** – enables +15 Volts DC on the input connector to power elements of condenser microphones. When *Phantom Power* is enabled, the control panel button is Green.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## 4ch Mic/Line SDR Output Card

This card provides four channels of line-level standard dynamic range (SDR) output.

Adjustable options for this card are accessed by double clicking on the appropriate output block within the **ESP View** to open an individual channel control panel.



Four-channel mic/line SDR output card control panel

The **output control panel** provides the following options:

**Output Gain Slider** – adjusts the output signal level delivered to the next device in the system design. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.

**Polarity** – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a "+" sign is present. When Polarity is reversed, the control panel button is Red and a "-" sign is present.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## Surround Sound Decoder Input Card

The surround sound decoder card allows direct connection to the optical or coaxial S/PDIF connection of a CD or DVD player and decodes PCM, Dolby Digital and DTS audio formats.

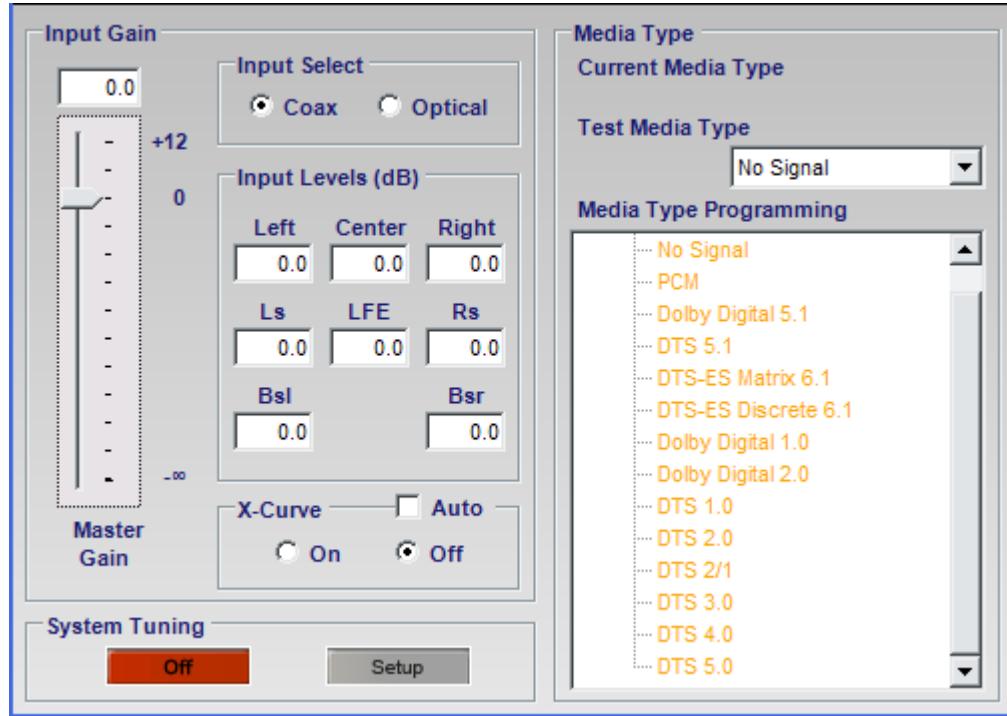
The surround **processing block** provides eight outputs for the various surround channels decoded at its input and are labeled as follows:

SLOT1 In1	L: Left
Surround 1	R: Right
L>	Ls: Left Surround
R>	Rs: Right Surround
Ls>	C: Center
Rs>	LFE: Low Frequency Effect
C>	Bsl: Back Surround Left
LFE>	
Bsl>	
Bsr>	



*Surround Sound Decoder Input Card processing block*

Adjustable options for this card are accessed by double clicking on the appropriate processing block within the **ESP View** to open the surround control panel.



*Surround Sound Decoder Input Card input block and control panel*

The surround **control panel** provides the following options:

**Input Gain** – contains adjustable values for multi-channel surround sound input signals. Included in this section are:

**Master Gain Slider** – adjusts the overall signal level delivered to the next gain stages. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain.

**Master Gain Input Value** - permits direct text entry of desired input signal level in dBu. Range of adjustment matches and tracks the input master gain slider.

**Input Select** – determines which input connector to use for S/PDIF surround sound signal decoding. Options include:

**Coax** – an unbalanced RCA phono connector is used for this type of digital audio input.

**Optical** – a TOSLINK optical connector is used for this type of digital audio input.

**Input Levels (dB)** – permits individual input channel adjustment for each of the eight surround channels. Type a value directly into the level box or right-click on the field to access a gain slider. Individual channels supported are:

Left	Center	Right
Left Surround (Ls)	Low-Frequency Effects (LFE)	Right Surround (Rs)
Back Surround Left (Bsl)		Back Surround Right (Bsr)

**X-Curve** - equalization can be applied to all signal channels without using DSP resources in the ESP. Options in this section include:

**On** – enables the X-Curve to all channels.

**Off** – disables the X-Curve to all channels.

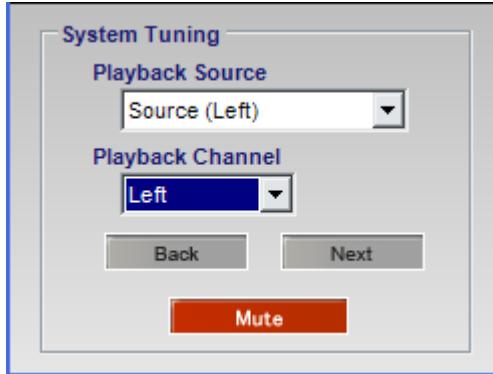
**Auto** - configures the decoder to automatically activate X-Curve equalization based on the room-type encoding in the media.

**Note:** When the decoder detects content with an X-Curve encoding, X-Curve is engaged. The On and Off buttons indicate the current state of the X-Curve EQ when online.

**System Tuning** –assists with surround system setup by sending test sources to individual channels which simplifies surround sound tuning and verification. Options in this section include:

**On / Off** – enables system tuning mode when **On** and routes the current playback source to surround outputs. When **Off**, the current playback source is disconnected from surround outputs.

**Setup** – opens the system tuning control panel.



*Surround Sound Decoder Input Card system tuning control panel*

Options in this control panel include:

**Playback Source** – provides a drop-down list to determine which surround card input channel is routed to the decoder. Input options available are:

- **Source (Left)** – Left channel only
- **Source (Left+Right)** – Both left and right channels

- **Source (Right)** – Right channel only
- **Source (Center)** – Center channel only
- **Source (Pink Noise)** – Pink noise is used as the input signal

**Playback Channel** – provides a drop-down list to determine which individual surround output channels receive the chosen **Source**. The list is ordered in a clockwise direction as shown in the table below:

L:	Left
C:	Center
R:	Right
Rs:	Right Surround
Bsr:	Back Surround Right
Bsl:	Back Surround Left
Ls:	Left Surround
LFE:	Low Frequency Effect

*System tuning playback channel ordering*

**Back** – is a quick-select button to enable the surround output above the currently active output in the list above. When the top of the list is reached, the next button press jumps to the output the bottom of the list and continues moving up the list on each press.

**Next** – is a quick-select button to enable the surround output below the currently active output in the list above. When the top of the list is reached, the next button press jumps to the output the top of the list and continues moving down the list on each press.

**Mute** – when enabled, the button turns red and all surround outputs are muted. This is the default condition when **System Tuning** is turned **ON**. When disabled, the button turns gray and the currently defined **Playback Channel** becomes active.

**Media Type** – this section provides monitoring, programming, and testing of various media-based events. Options available within this area of the surround sound control panel include:

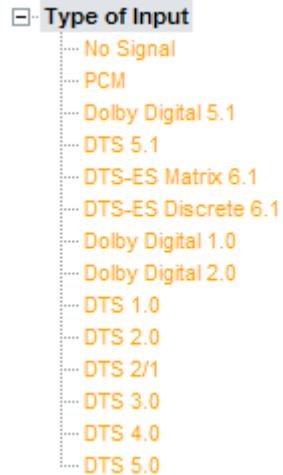
**Current Media Type** - displays the type of media format that is active at the surround card inputs. This state is updated when connected to an ESP and in **on-line** mode. It will appear blank while in **off-line** mode.

**Test Media Type** – is used to a select a media type from the drop-down list to invoke and verify the actions assigned to that Media Type.

**Note:** The Test Media Type drop-down list is disabled when **on-line**.

**Media Type Programming** – is used to trigger a media type-specific parameter sets. When a specific input format is identified and decoded from the digital bitstream, the listed **Media Type** is recalled to perform the actions defined in its programming.

Individual media types are listed in the **Type of Input** tree and programming events are assigned to one or more types while off-line.



*Surround Sound control panel Media Type of Input Tree*

To associate a Parameter Set with a media type, drag the Parameter set onto the desired media type in the list. For example, one Parameter Set can be programmed to change the signal routing and provide some equalization for a stereo CD signal while another can be programmed to signal a projector to power on and lower the projection screen for a Dolby 5.1 DVD demonstration.

To learn more about programming Parameter Sets, see [Parameter Sets](#).

**Media Types** are identified and recalled based upon the signal format table shown below:

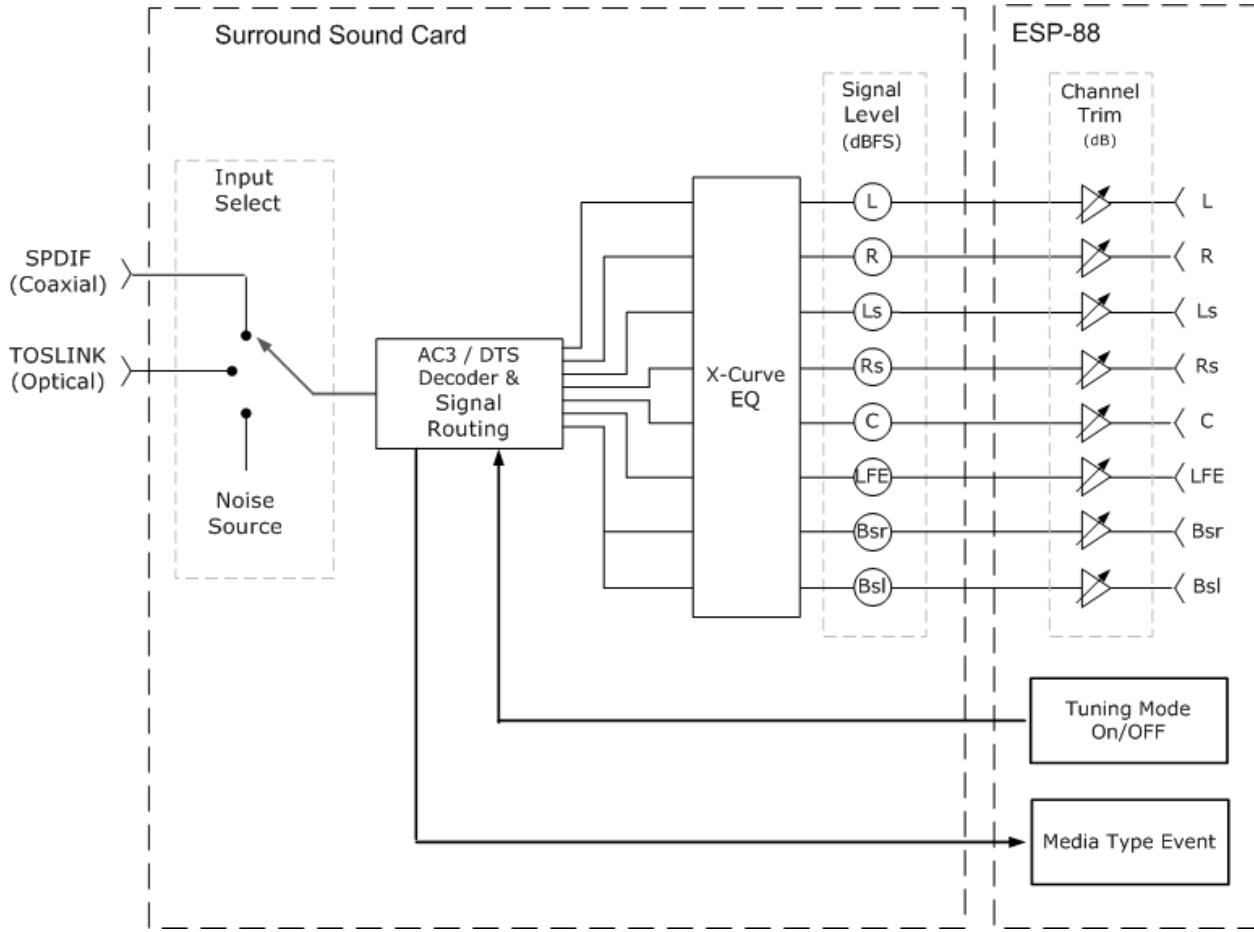
Format	Sample Rate	Media Type
PCM (CD)	44.1 kHz	PCM
PCM (DVD Video)	48 kHz	PCM
Dolby Digital 1.0	48 kHz	Dolby Digital 1.0
Dolby Digital 2.0	48 kHz	Dolby Digital 2.0
Dolby Digital 5.1	48 kHz	Dolby Digital 5.1

DTS 1.0	48 kHz	DTS 1.0
DTS 2/1	48 kHz	DTS 2/1
DTS 3.0	48 kHz	DTS 3.0
DTS 4.0	48 kHz	DTS 4.0
DTS 5.0	48 kHz	DTS 5.0
DTS 5.1	48 kHz	DTS 5.1
DTS ES Discrete 6.1	48 kHz	DTS ES Discrete 6.1
DTS ES Matrix 6.1	48 kHz	DTS ES Matrix 6.1
DTS CD	44.1 kHz	DTS 5.1
DTS-HD/Blu-Ray <sup>1</sup>	48/96 kHz	DTS 5.1
DTS-96/24 <sup>2</sup>	48/96 kHz	DTS 5.1
<sup>1</sup> S/PDIF output; DTS 5.1 audio stream decoded.		
<sup>2</sup> 48 kHz sampling rate bit stream decoded.		

*Media Type formats and sample rates*

### Functional Diagram

The following functional diagram depicts the signal flow and logic operation of the surround decoder input card.



*Surround Sound Decoder Input Card functional diagram*

## CobraNet Input/Output Card



The ESP CobraNet network audio expansion card is only compatible with ESP-88C and ESP-00 processors. Compatibility can be verified by checking the first six digits of the serial number. Compatible ESP-88s will have the first 6 digits '050137' and ESP-00s will have '050138'. Earlier ESP-88s require internal modification in order to support the CobraNet expansion card.

The Bose Engineered Sound Processor is capable of supporting up to 64 audio channels divided into 8 routing slots of up to 8 channels each. Typically, an expansion card occupies one physical slot and provides four to eight channels of audio. One exception is the standard 4x4 input/output card which occupies two physical expansion slots (to allow enough space for the output connectors) but only requires one routing slot (8 channels total).

The CobraNet expansion card is unique as it only occupies one physical slot but can support up to 32 channels (16 in, 16 out) and can therefore utilize up to four of the eight available routing slots. For convenience the card can be configured to provide eight possible I/O

combinations. This allows the card to be configured according to project requirements while leaving the maximum number of routing slots free for other expansion cards.

Depending on the number of routing slots allocated to the CobraNet card the number of additional expansion cards (other than the standard 4x4 card) that can be added may be less than the physical expansion slots available as demonstrated in the table below.

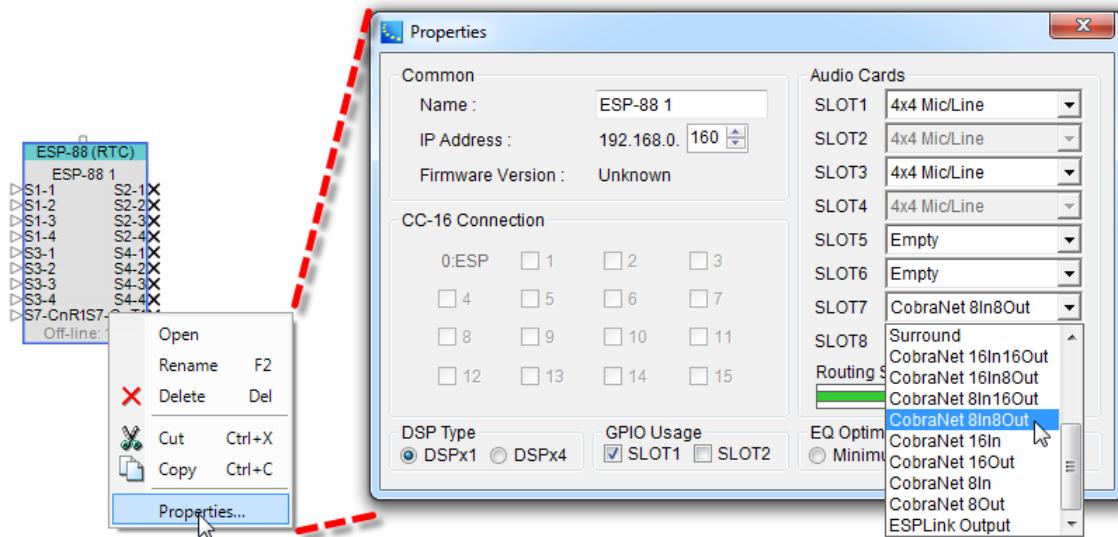
CobraNet I/O Configuration	Routing Slots Used	Additional I/O Card Capacity	
		ESP-88C	ESP-00
16 in, 16 out	4	2	4
16 in, 8 out	3	3	5
8 in, 16 out	3	3	5
16 in, 0 out	2	3*	6
0 in, 16 out	2	3*	6
8 in, 8 out	2	3*	6
8 in, 0 out 1 3* 7	1	3*	7
0 in, 8 out 1 3* 7	1	3*	7

\*Limited by the physical expansion slots available

#### Defining the CobraNet® Input/Output Card Configuration

The CobraNet card is added to the ESP in the same manner as other expansion cards. If the card has already been fitted it will be detected automatically when a hardware scan is performed, otherwise the card can be added manually as follows:

1. Right-click on the ESP in Project View and select 'Properties' to display the ESP 'Properties' dialog box.

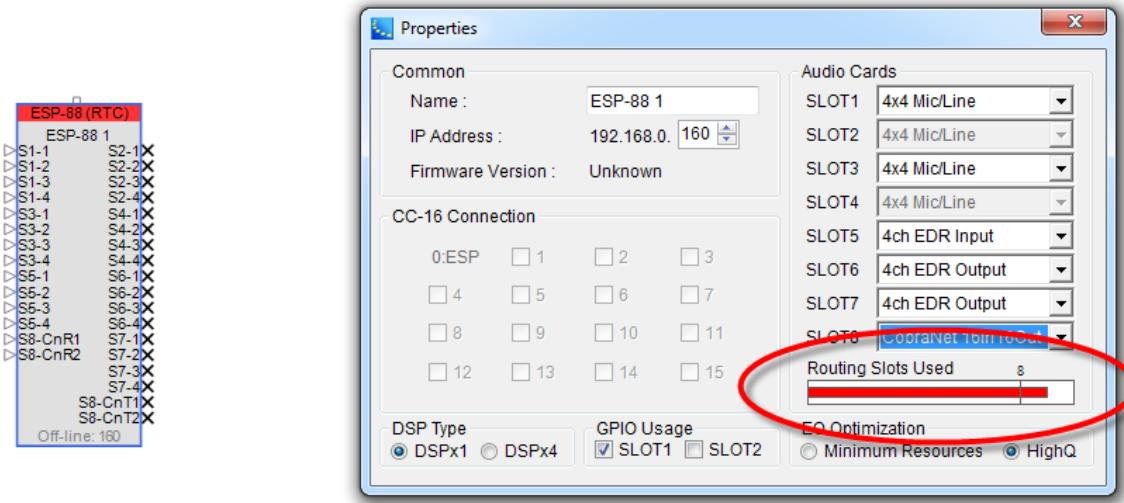


### *CobraNet® Card Configuration within ESP Properties*

2. Select the required CobraNet card variant from the drop-down list presented for the audio card slot where the card will be installed.

**NOTE:** Only one CobraNet I/O card may be installed within an ESP.

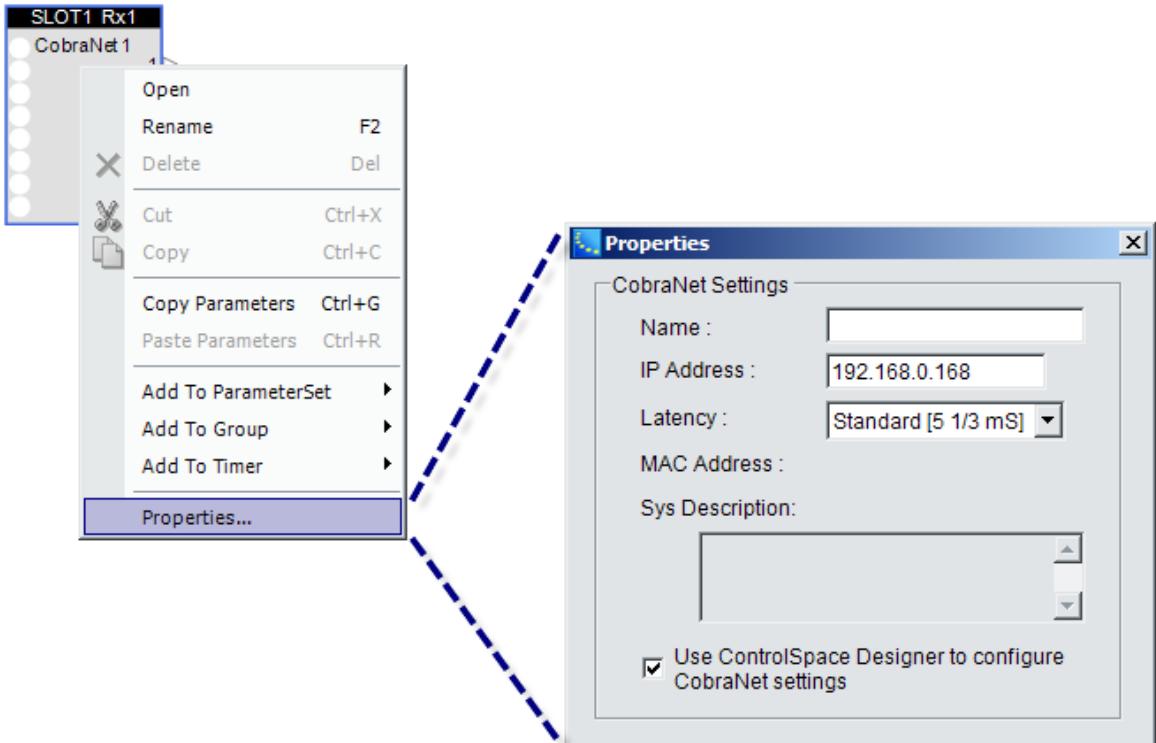
3. When used in conjunction with other expansion cards you will need to ensure that the eight available routing slots are not exceeded. If this occurs the 'Routing Slots Used' meter and relevant ESP icon in Project View will turn red as shown below:



*Indication of available routing slots exceeded*

### **CobraNet Properties**

The global **Properties** control panel for the CobraNet expansion card is accessible by right-clicking on any CobraNet input or output module within the **ESP View** and selecting **Properties**.



CobraNet Input/Output card Properties

**Name** – can be any text description that is appropriate for the system design.

**IP Address** – is equal to that of the host ESP plus eight (e.g. 192.168.0.168 for an ESP address of 192.168.0.160) but may be adjusted to any alternate address if necessary.

Note: An IP address is only necessary when the CobraNet card is managed by SNMP or similar network monitoring devices and is unreferenced in normal operation.

**Latency** – is a drop-down list providing selection between three standard latency modes used in CobraNet networks. Higher latencies provide more tolerance for network propagation delays. The latency modes provided are:

- Standard [5 1/3 mS]
- Low [2 2/3 mS]
- Lowest [1 1/3 mS]

Note: All CobraNet devices on a network must use the same latency mode to transmit and receive audio correctly.

**MAC Address** – is a read-only field displaying the unique MAC address assigned to each individual CobraNet card during manufacture.

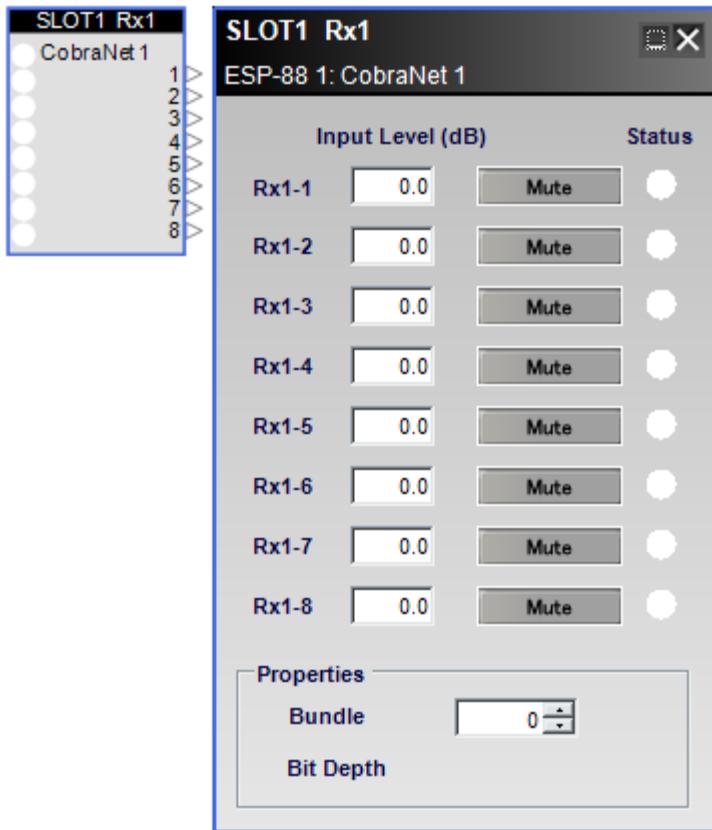
**Sys Description** – provides information about the CobraNet card circuitry version.

**Note:** Both MAC address and Sys Description are visible only after connecting to an ESP in on-line mode. Both fields appear blank while in off-line mode.

**Use ControlSpace Designer to configure CobraNet settings** – is checked by default. However, if access to advanced CobraNet properties is required, remove the check mark to disable ControlSpace Designer access to the CobraNet card.

Thereafter, all configurations are performed via the network using the CobraNet Discovery utility or similar software management tool.

Adjustable options for the *CobraNet Input card* are accessed by double clicking on the appropriate CobraNet block within the **ESP View** to open its channel control panel.



*Eight-channel CobraNet card input control panel*

Each eight channel **input control panel** provides the following options applying to channels, Rx1-1 through Rx1-8, the individually addressable **receivers** (Rx) synchronizing with digital audio sent from other CobraNet **transmitters** (Tx) in the system.

**Input Level (dB)** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital CobraNet domain. Type a value directly into the input level box or right-click on the field to access a gain slider.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

**Status** – indicates the presence of valid CobraNet data for each channel while ControlSpace Designer is on-line. The status colors represent the conditions shown in the table below:

Black	Channel not being received
Green	Channel being received correctly

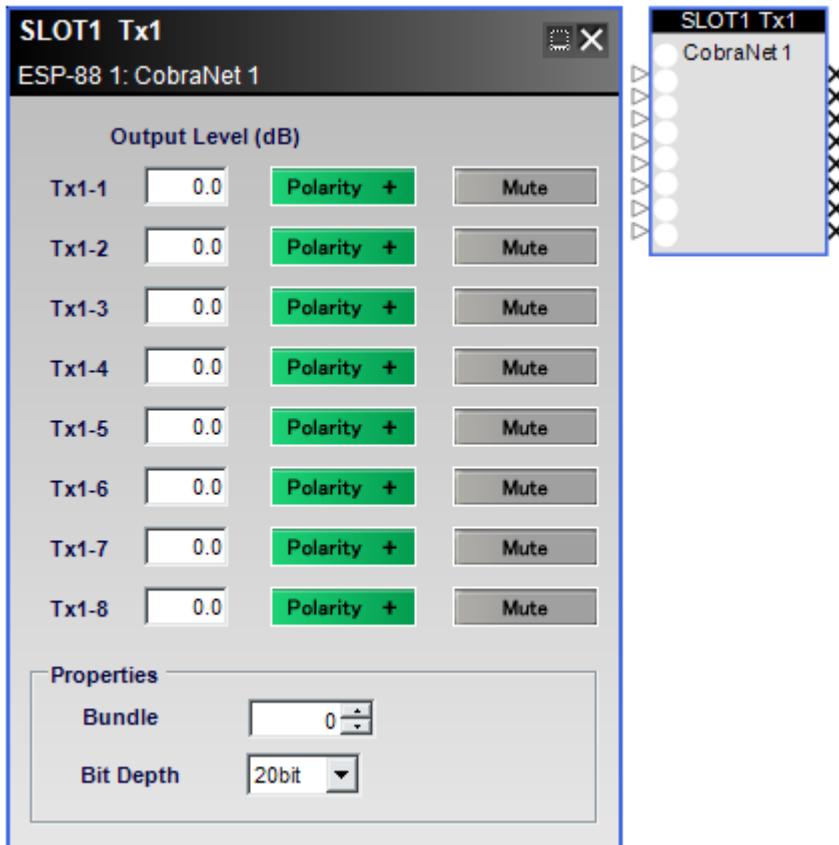
Red	Channel being received with errors (due to incorrect latency or network issues)
-----	--

**Properties** – this area of the input control panel contains an adjustable field for entry of the CobraNet bundle.

**Bundle** – is an identification number from (0) to (65279) which matches the corresponding upstream **transmitter** of synchronized digital audio. The default value of (0) disables reception of network audio for as long as the port is unused.

**Bit Depth** - is read-only field and will be populated whilst ControlSpace Designer is on-line and audio is being received.

Adjustable options for the *CobraNet Output card* are accessed by double clicking on the appropriate CobraNet block within the **ESP View** to open its channel control panel.



Eight-channel CobraNet card output control panel

Each eight channel **output control panel** provides the following options applying to channels, Tx1-1 through Tx1-8, the individually addressable **transmitters** (Tx) sending synchronized digital audio to other CobraNet **receivers** (Rx) in the system.

**Output Level (dB)** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in

the digital CobraNet domain. Type a value directly into the output level box or right-click on the field to access a gain slider.

**Polarity** – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a “+” sign is present. When Polarity is reversed, the control panel button is Red and a “-” sign is present.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

**Properties** – this area of the input control panel contains an adjustable field for entry of the CobraNet bundle.

**Bundle** – is an identification number from (0) to (65279) which matches the corresponding downstream *receiver* of synchronized digital audio. The default value of (0) disables reception of network audio for as long as the port is unused.

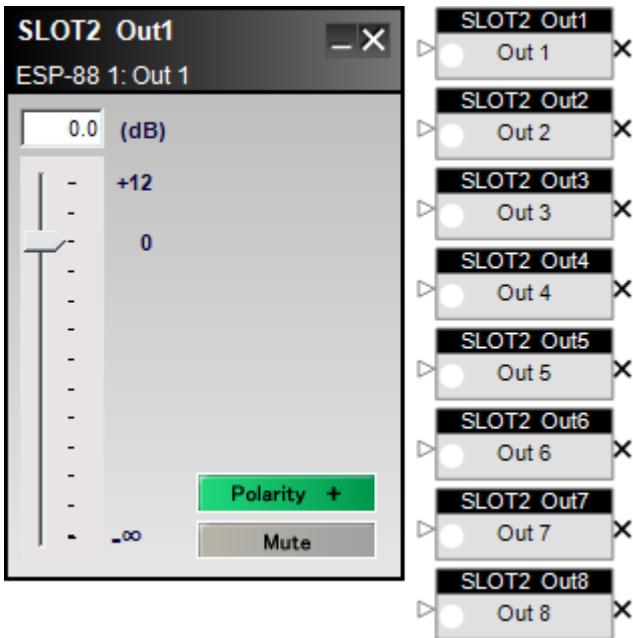
**Bit Depth** - adjusts the sample resolution for transmitted digital audio. The options are 16bit (default), 20bit and 24bit. For proper audio synchronization, same Bit Depth should be used for receivers of the same bundle.

Note: A Bit Depth of 24bit used with Standard [5 1/3mS] latency in the CobraNet card properties, reduces the number of channels in a Bundle to seven (7).

**NOTE:** For more information on configuring Bose professional system electronics for use with CobraNet network audio, refer to the CobraNet application notes available at <http://pro.Bose.com>.

## 8ch ESPLink Output Card

This card provides eight channels of digital audio output via TOSLINK optical connector. Adjustable options for this card are accessed by double clicking on the appropriate output block within the **ESP View** to open an individual channel control panel.



*ESPLink Card output control panel*

The **output control panel** provides the following options:

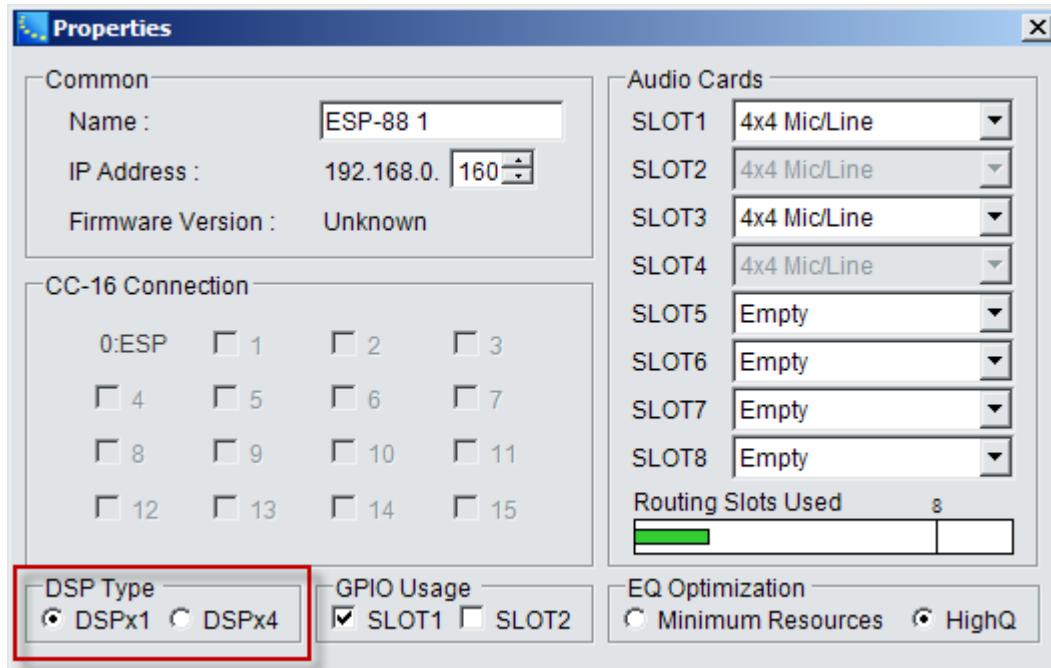
**Output Gain Slider** – adjusts the output signal level delivered to the next *device* in the system design. The range of adjustment is from  $-\infty$  to +12dBu. This adjustment point is in the digital domain, pre digital to analog conversion.

**Polarity** – applies a reversal of polarity to the output signal. When *Polarity* is normal, the control panel button is Green and a "+" sign is present. When Polarity is reversed, the control panel button is Red and a "-" sign is present.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## DSP Expansion

This single daughter card for the main CPU board can be added to increase ESP performance by 300%. Adjustable options for this card are accessed by right clicking on an ESP within **Project View** and selecting **Properties**.



DSP Type section of ESP Properties

**DSP Type** – indicates the current DSP capacity of an ESP. Selectable options are:

**DSPx1** – the standard DSP card supplied with all ESP systems.

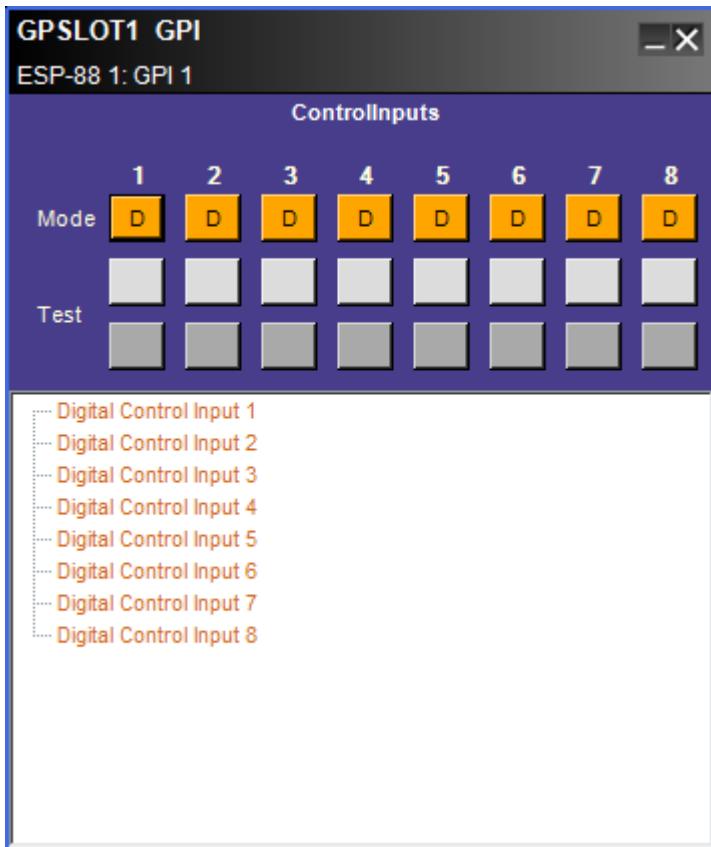
**DSPx4** – activates an optional DSP expansion card when present.

## GPIO

The ESP has 8 GPI *General Purpose Input* and GPO ports which may be expanded to 16 GPI with the addition of a GPIO expansion card. GPI ports are used to connect external hardware such as potentiometers (to control levels or gains) and switches (contact closures) to invoke parameter sets. Functions are assigned to these external controls in the GPI control panel.

Adjustable options for this card are accessed by double clicking on the appropriate **GPI** or **GPO** block within the **ESP View** to open its control panel.

### GPI control panel



*General Purpose Input (GPI) control panel*

The **Mode** and **Test** buttons allow you to configure the input mode and test the control programming:

**Mode** buttons – Determine the operating mode for each general purpose input. Eight input modes are available within each processing block. Left click the operating mode button to toggle through the three supported modes:

Operating Mode	Description
<b>Digital</b> 	Typically used when connecting a switch or push button, this mode expects a normally open switch for operation. Both "on" and "off" actions are supported.
<b>Up/Down</b> 	Up/Down mode uses two adjacent GPI, and is intended to support two push buttons for use as volume up and down. Normally open switches are expected.
<b>Analog</b> 	Analog mode is intended for a 10K linear type potentiometer that can be linked to a gain control or grouped gains. When the potentiometer is at the 10Kohm position the gain is set to minimum, and when the pot is at the 0Kohm position, the gain is set to the maximum level.

**Test** buttons - Permit verification of programmed actions for each input. Appearance and function of the test buttons change dynamically with each operating mode.

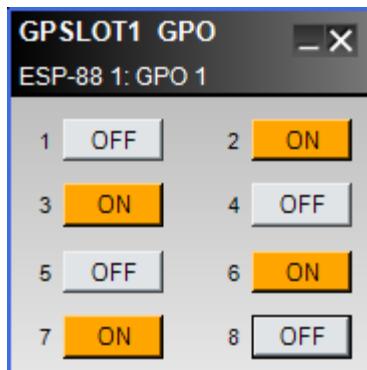
Mode	Test Operation
<b>Digital</b> 	Single left click per test button activates "on" or "off" conditions.
<b>Up/Down</b> 	Single left click per test button activates "up" or "down" conditions.
<b>Analog</b> 	Right click on upper test button displays an adjustable gain slider to test analog conditions.

The lower section of the control panel provides a programming tree to assign functions invoked by the eight General Purpose Inputs. You can drag and drop signal processing blocks, parameter sets, groups, or presets onto the text lines.

See [Programming GPIO](#) for programming examples.

### GPO control panel

Buttons 1-8 correspond to the state of each individual general purpose output port. Click a button to set the state of an output to OFF (default) or ON before assigning the GPO processing block in ESP View to a location in the [Project Directory](#) or [Parameter Set Nodes List](#).



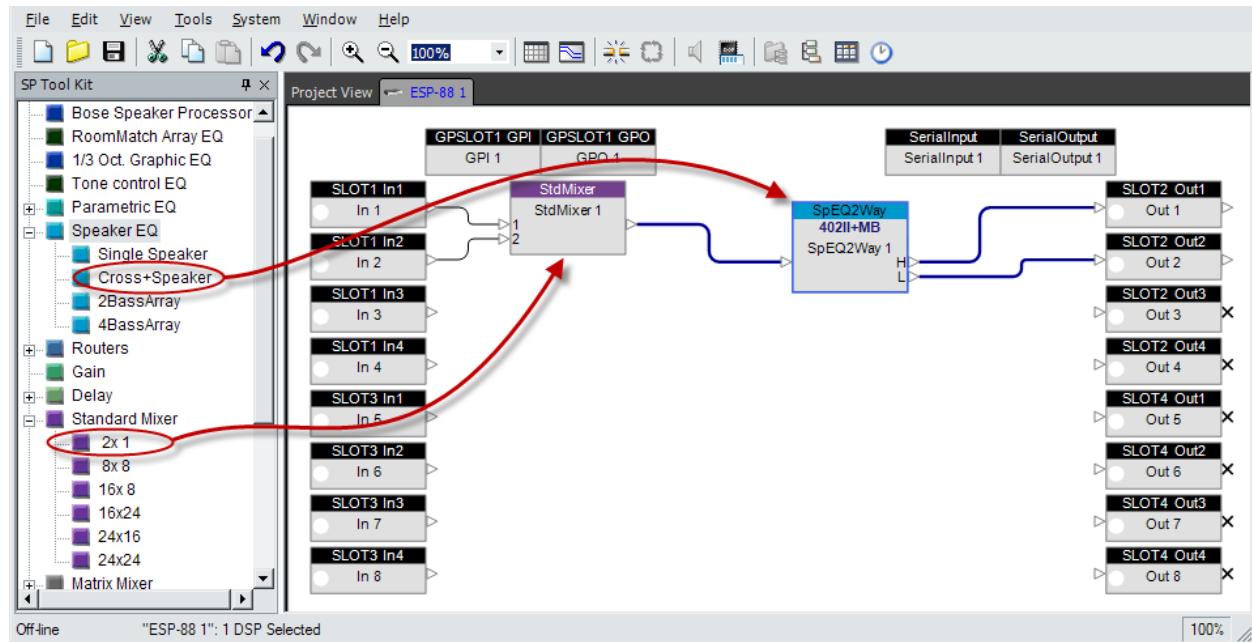
*General Purpose Output (GPO) control panel*

See [Programming GPIO](#) for programming examples.

### Signal Processing (SP)

## SP Tool Kit

The **Signal Processing (SP) Tool Kit** contains all the signal processing blocks available for use in system designs. The SP Tool Kit window is visible when you are working in **ESP View**. To add signal processing functions, simply drag a block from the SP Tool Kit window and drop it into the ESP View.



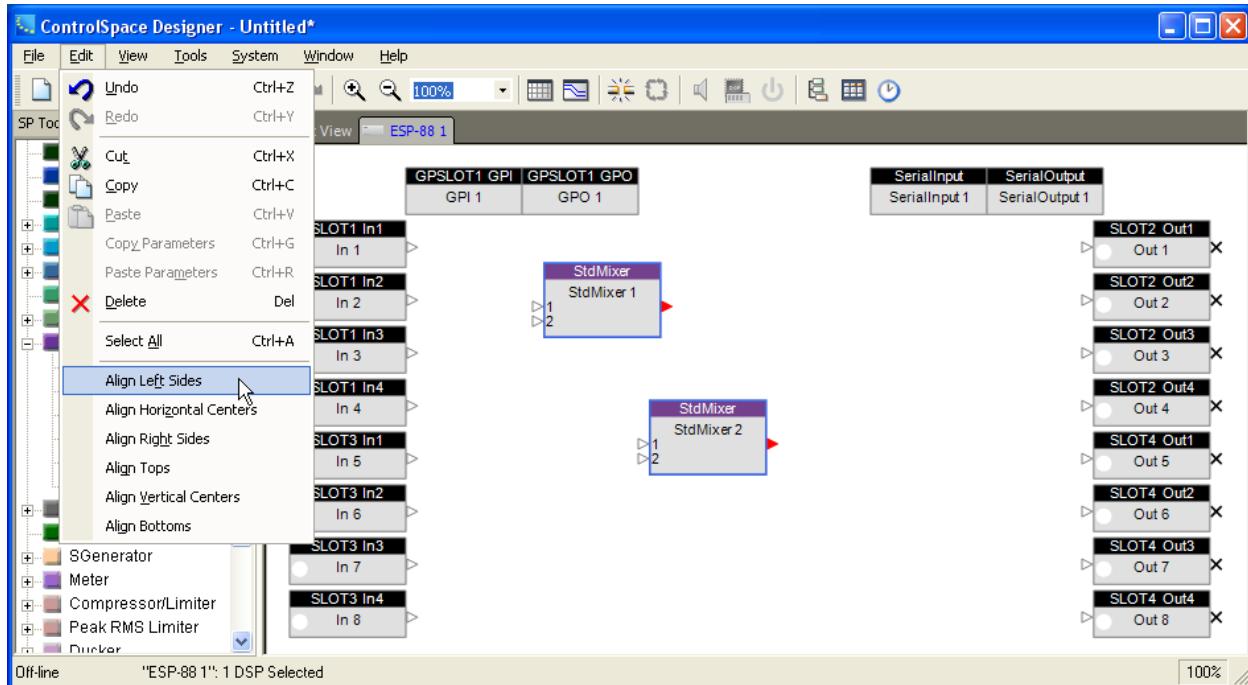
*Adding signal processing*

Signal processing blocks are grouped by type. Click on the “+” next to a group in the SP Tool Kit to view more signal processing blocks. To open the control panel for any signal processing block, double-click on the block after you have added it to the **ESP View**.

## Working With SP Blocks

After dropping signal processing blocks into the **ESP View**, you can move one or more blocks around by selecting and dragging them with the mouse. You may also use the arrow keys on your keyboard to nudge the blocks into position.

To line up blocks, use the options in the **Edit menu**. For example, to vertically align the left borders of a group of blocks, select all the blocks and choose **Edit > Align Left Sides**:

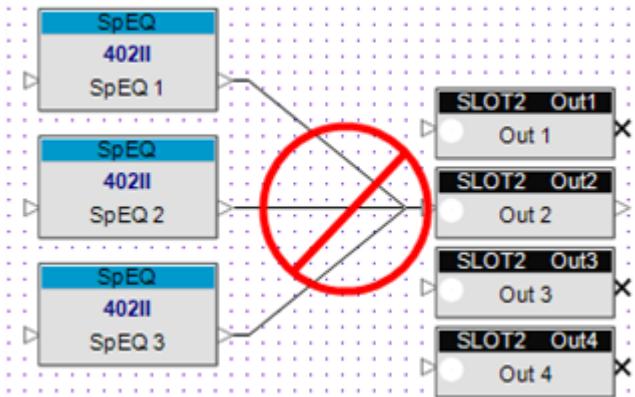
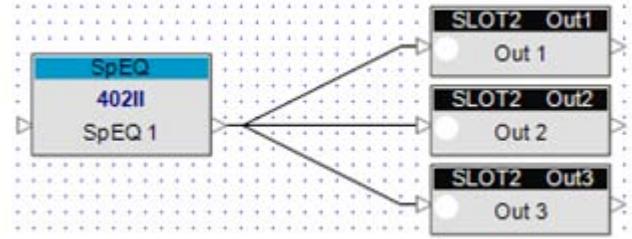


*Aligning left sides*

**NOTE:** See the [Edit Menu](#) for additional alignment options.

## Wiring Blocks

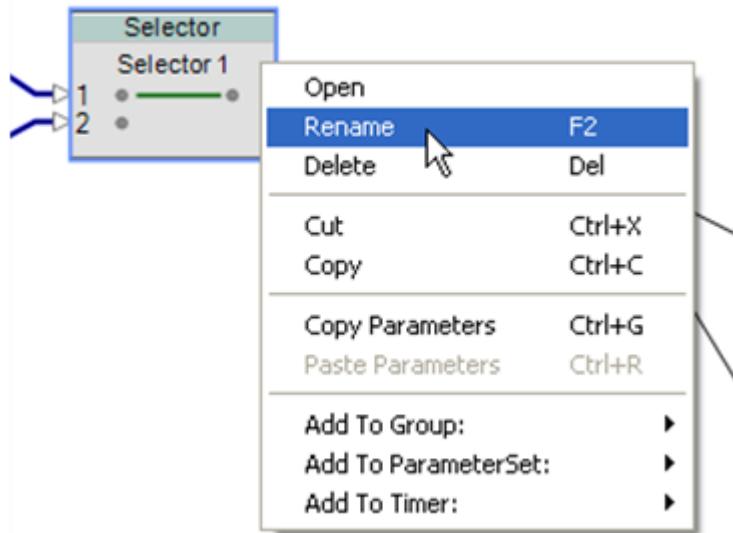
The output of a signal processing block can be wired to more than one input, but a signal processing block can only accept one input wire.



*Wiring Signal Processing Blocks*

### Renaming Blocks

To rename any signal processing block, right-click on the block and select Rename, or press F2.

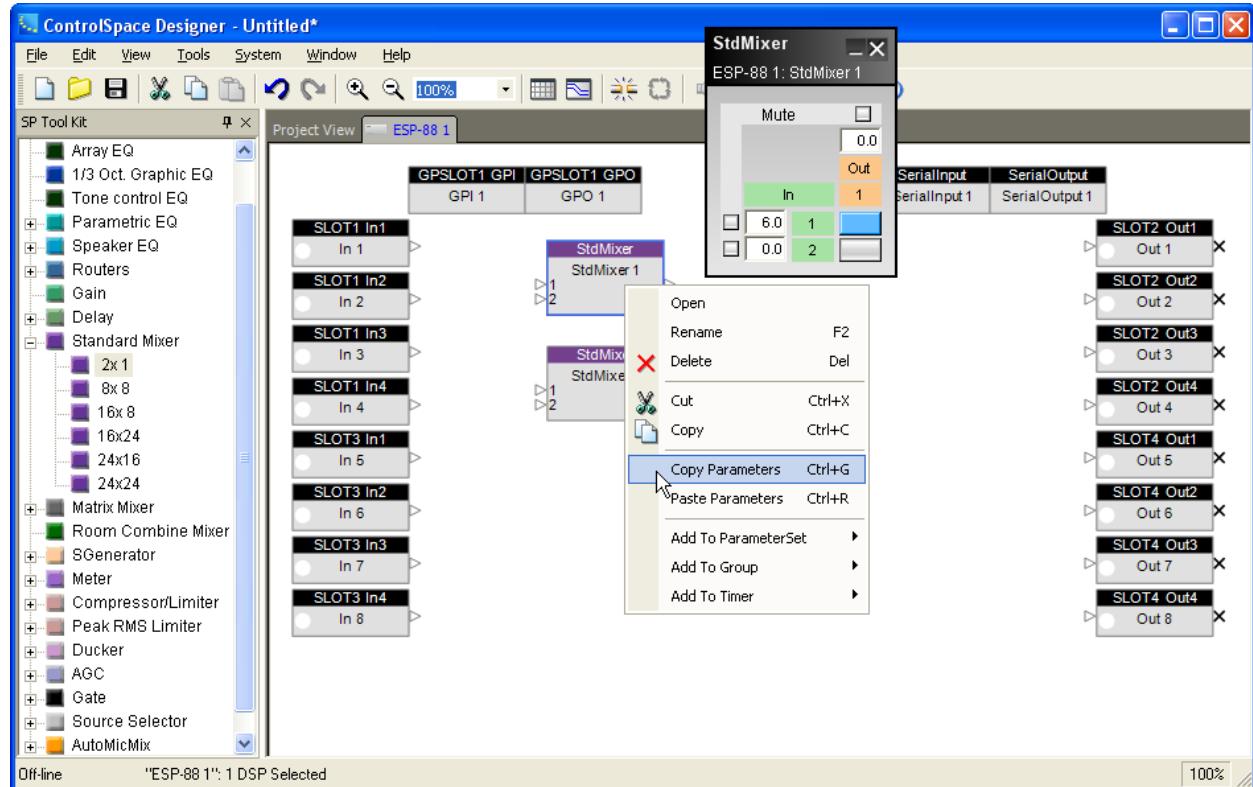


*Renaming a signal processing block*

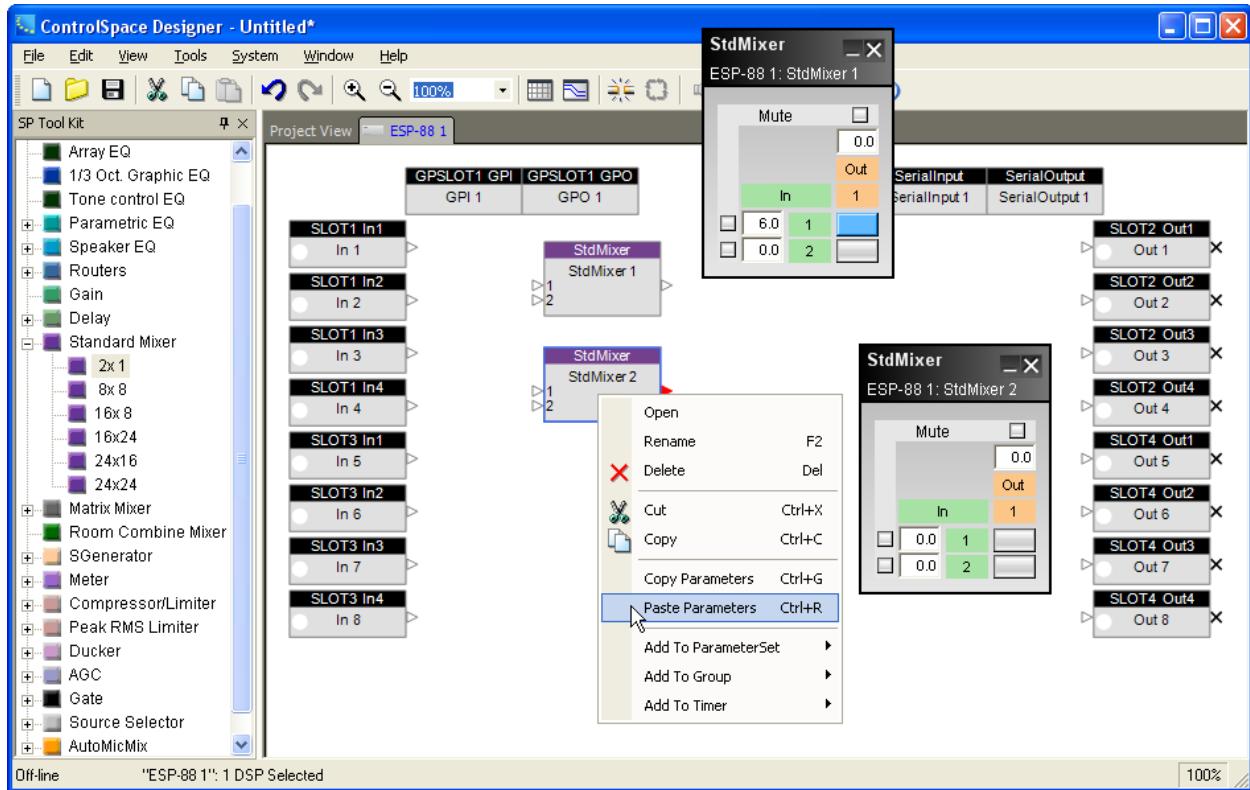
## Copy Parameters

To copy the parameters from one signal processing block to another signal processing block of the same kind:

1. Right-click on the signal processing block and select **Copy Parameters**.



2. Right-click on the other signal processing block of the same kind and select **Paste Parameters**.

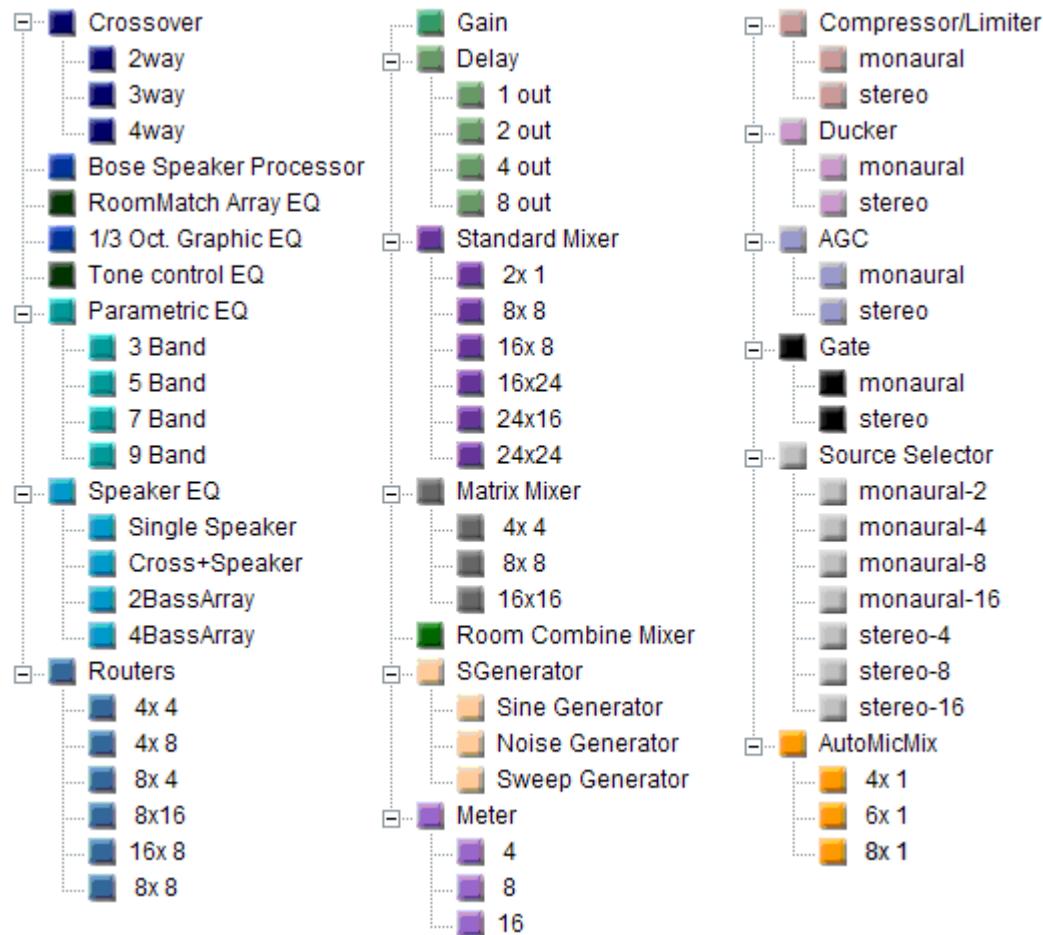


## Supported SP Algorithms

### SP Blocks

The **SP Tool Kit** contains all the signal processing blocks available for use in a system design. The SP Tool Kit is visible any time you are working within ESP View as a vertically scrolling pane on the left hand of the design interface.

The wide range of processing blocks available is shown here in a multi-column composite view.



### Signal Processing Block List

#### Crossover

A crossover divides an input signal into two or more frequency ranges, and sends each frequency range to a separate output. The SP Tool Kit includes a 2-way, 3-way, and 4-way processing block.

##### 2-way crossover

**A 2-way crossover** divides an input signal into two frequency ranges, high and low, and sends these signals to two outputs marked H (high) and L (low). Double-click on the 2 way crossover block within ESP View to open its control panel.



2 way crossover, processing block and control panel

The **2 way crossover control panel** provides the following options:

**Crossover Graph** – displays a graphical representation of adjustable crossover filter settings in both frequency and level. The line to the left represents the low frequency output level and the line to the right represents the high frequency output level.

**LOW** – adjusts the low frequency filter parameters.

**Type** – determines the filter parameters used for the crossover.

Options include:

Type	Slope	Type	Slope	Type	Slope
Butterworth 6	6 dB/oct				
Butterworth 12	12 dB/oct	Bessel 12	12 dB/oct		
Butterworth 18	18 dB/oct	Bessel 18	18 dB/oct	Linkwitz-Riley 12	12 dB/oct
Butterworth 24	24 dB/oct	Bessel 24	24 dB/oct	Linkwitz-Riley 24	24 dB/oct
Butterworth 36	36 dB/oct	Bessel 36	36 dB/oct	Linkwitz-Riley 36	36 dB/oct
Butterworth 48	48 dB/oct	Bessel 48	48 dB/oct	Linkwitz-Riley 48	48 dB/oct

**Freq(Hz)** – provides and input box for entry of a specific crossover filter frequency (default = 100Hz). An up and down spinner control is available to

make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

**Polarity** – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a “+” sign is present. When *Polarity* is reversed, the control panel button is Red and a “-” sign is present.

**Mute** – silences the effect of the filter. When *Mute* is enabled, the control panel button is Red.

**HIGH** – adjusts the high frequency filter parameters.

**Type** – determines the filter parameters used for the crossover. Options are identical to low frequency filter parameters.

**Freq(Hz)** – provides an input box for entry of a specific crossover filter frequency (default = 100Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

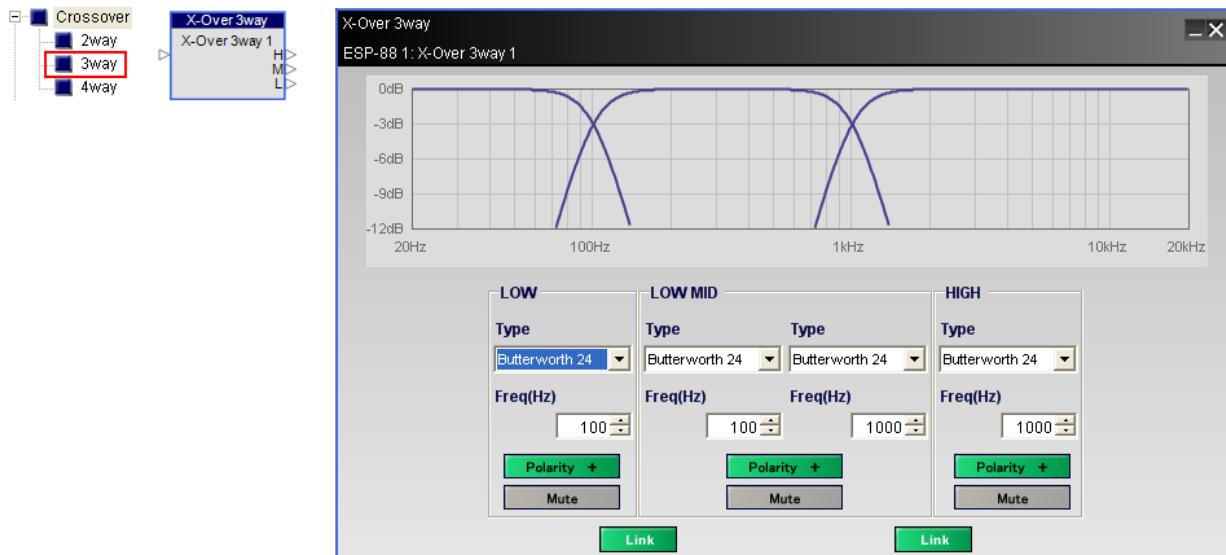
**Polarity** – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a “+” sign is present. When *Polarity* is reversed, the control panel button is Red and a “-” sign is present.

**Mute** – silences the effect of the filter. When *Mute* is enabled, the control panel button is Red.

**Link** - locks the low pass and high pass frequencies to the same number. This is only an option when both the low and high types are set to Butterworth or Linkwitz-Riley. If link is off, the low pass and high pass frequencies can be adjusted independently.

#### 3-way crossover

A **3-way crossover** divides an input signal into three frequency ranges, high, low mid, and low, and sends these signals to three outputs marked H (high), M (mid), and L (low). Double-click on the 3 way crossover block within ESP View to open its control panel.



*3 way crossover, processing block and control panel*

The **3 way crossover control panel** provides all the options of the 2 way crossover plus:

**LOW MID** – adjusts the mid frequency filter parameters.

**Type** – determines the filter parameters used for the crossover. Two sets of Type options are available to represent each end of the filter spectrum. Options include:

Type	Slope	Type	Slope	Type	Slope
Butterworth 6	6 dB/oct				
Butterworth 12	12 dB/oct	Bessel 12	12 dB/oct		
Butterworth 18	18 dB/oct	Bessel 18	18 dB/oct	Linkwitz-Riley 12	12 dB/oct
Butterworth 24	24 dB/oct	Bessel 24	24 dB/oct	Linkwitz-Riley 24	24 dB/oct
Butterworth 36	36 dB/oct	Bessel 36	36 dB/oct	Linkwitz-Riley 36	36 dB/oct
Butterworth 48	48 dB/oct	Bessel 48	48 dB/oct	Linkwitz-Riley 48	48 dB/oct

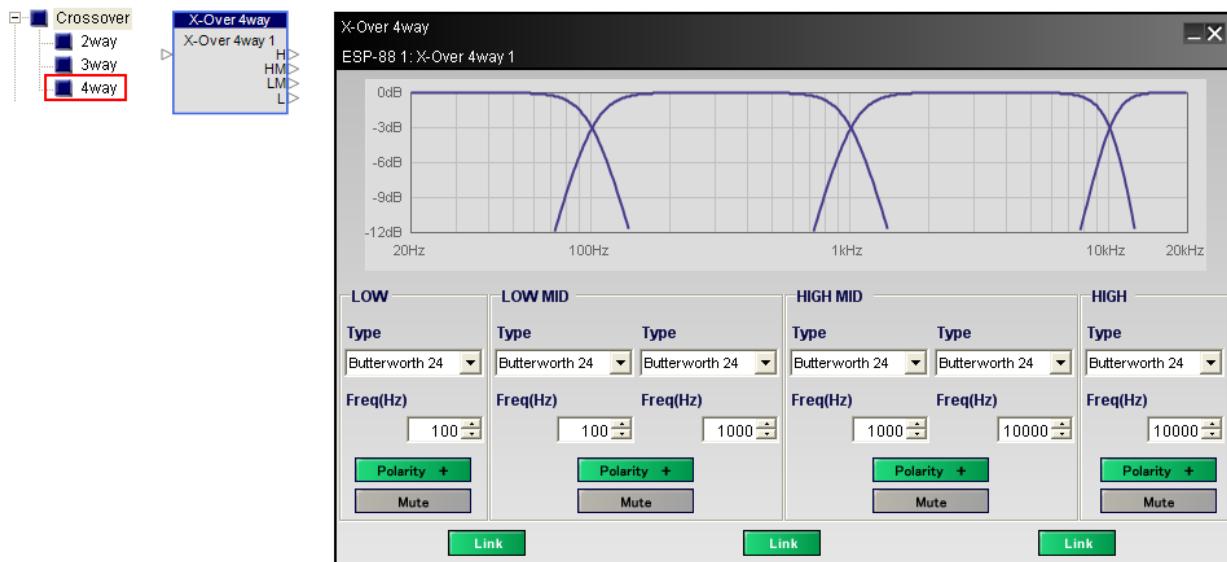
**Freq(Hz)** – provides and input box for entry of a specific crossover filter frequency (default = 100Hz and 1000Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

**Polarity** – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a "+" sign is present. When Polarity is reversed, the control panel button is Red and a "-" sign is present.

**Mute** – silences the effect of the filter. When Mute is enabled, the control panel button is Red.

**4-way crossover**

A **4-way crossover** divides an input signal into four frequency ranges, high, high mid, low mid, and low, and sends these signals to three outputs marked H (high), HM (high mid), LM (low mid), and L (low). Double-click on the 4 way crossover block within ESP View to open its control panel.



4 way crossover, processing block and control panel

The **4 way crossover control panel** provides all the options of the 3 way crossover plus:  
**HIGH MID** – adjusts the mid frequency filter parameters.

**Type** – determines the filter parameters used for the crossover. Two sets of Type options are available to represent each end of the filter spectrum. Options include:

Type	Slope	Type	Slope	Type	Slope
Butterworth 6	6 dB/oct				
Butterworth 12	12 dB/oct	Bessel 12	12 dB/oct		
Butterworth 18	18 dB/oct	Bessel 18	18 dB/oct	Linkwitz-Riley 12	12 dB/oct
Butterworth 24	24 dB/oct	Bessel 24	24 dB/oct	Linkwitz-Riley 24	24 dB/oct
Butterworth 36	36 dB/oct	Bessel 36	36 dB/oct	Linkwitz-Riley 36	36 dB/oct
Butterworth 48	48 dB/oct	Bessel 48	48 dB/oct	Linkwitz-Riley 48	48 dB/oct

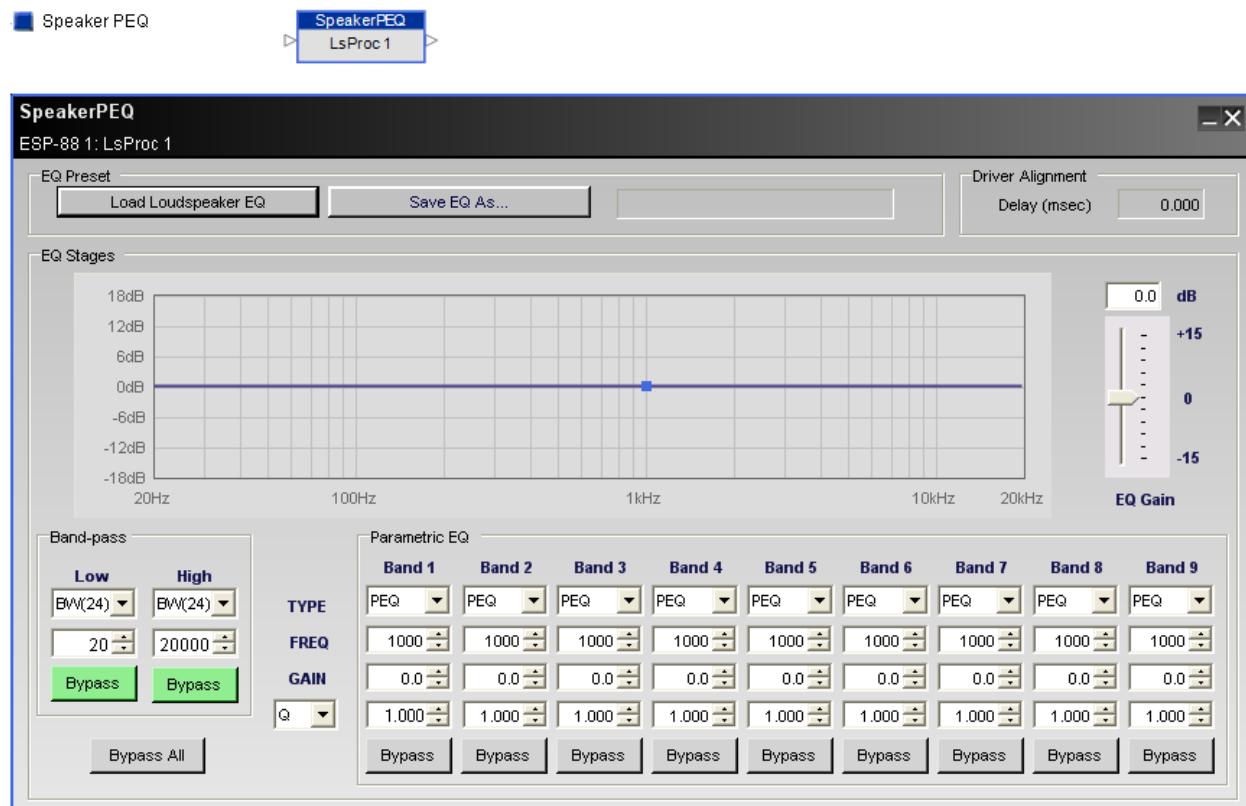
**Freq(Hz)** – provides an input box for entry of a specific crossover filter frequency (default = 1000Hz and 10000Hz). An up and down spinner control is available to make adjustments in 1Hz increments. Adjacent crossover filter frequencies adjust automatically to match values.

**Polarity** – applies a reversal of polarity to the filter. When *Polarity* is normal, the control panel button is Green and a “+” sign is present. When *Polarity* is reversed, the control panel button is Red and a “-” sign is present.

**Mute** – silences the effect of the filter. When *Mute* is enabled, the control panel button is Red.

### Bose Speaker Parametric EQ

The Bose Speaker Parametric EQ is an advanced signal processing block to permit loudspeaker equalization, and bandpass within a single design element. Double click its processing block within ESP View to open its control panel.



Bose Speaker Parametric EQ, processing block and control panel

The **Bose Speaker Parametric EQ control panel** provides the following options:

**EQ Preset** – supports the loading and saving of pre-defined loudspeaker processing values.

**Load Loudspeaker EQ** – populates this signal processing block from pre-defined settings for Bose loudspeakers. Upon loading, all values are de-emphasized to indicate factory-calibration. Adjustments are not permitted to this data.

**Save EQ As** – presents a dialog to save EQ and loudspeaker settings to an external .SEQ file.

**EQ Stages** – displays a graphical representation of adjustable EQ filter settings in both frequency and level. The line varies according to values adjustable within the Band-pass and Parametric EQ sections.

**Band-pass** – determines the low and high pass filter settings for the loudspeaker processor according to filter type and frequency.

**Parametric EQ** – provides adjustable controls for defining individual parametric filters. Available options are:

**Type** – determines the filter parameters used for the EQ. Four types of filters are available to define the filter. Options include:

**PEQ** – establishes a parametric EQ filter approach to remaining settings for this band.

**High Shelf** - establishes a high frequency (low pass) shelf filter approach to remaining settings for this band.

**Low Shelf** - establishes a low frequency (high pass) shelf filter approach to remaining settings for this band.

**Notch** - establishes a filter approach to remaining settings for this band.

**FREQ** – adjusts the filter center point directly by input in the text box or by using the up and down scroll buttons.

**GAIN** – determines the individual filter gain from -20dB to +20dB.

**BW/Q** – sets the field for filter width to either a bandwidth (in octaves) or Q value.

**Bypass** – disables this specific filter from affecting the signal chain.

**Gain** – provides up to +/-15 dB of output gain for the Parametric EQ stage.

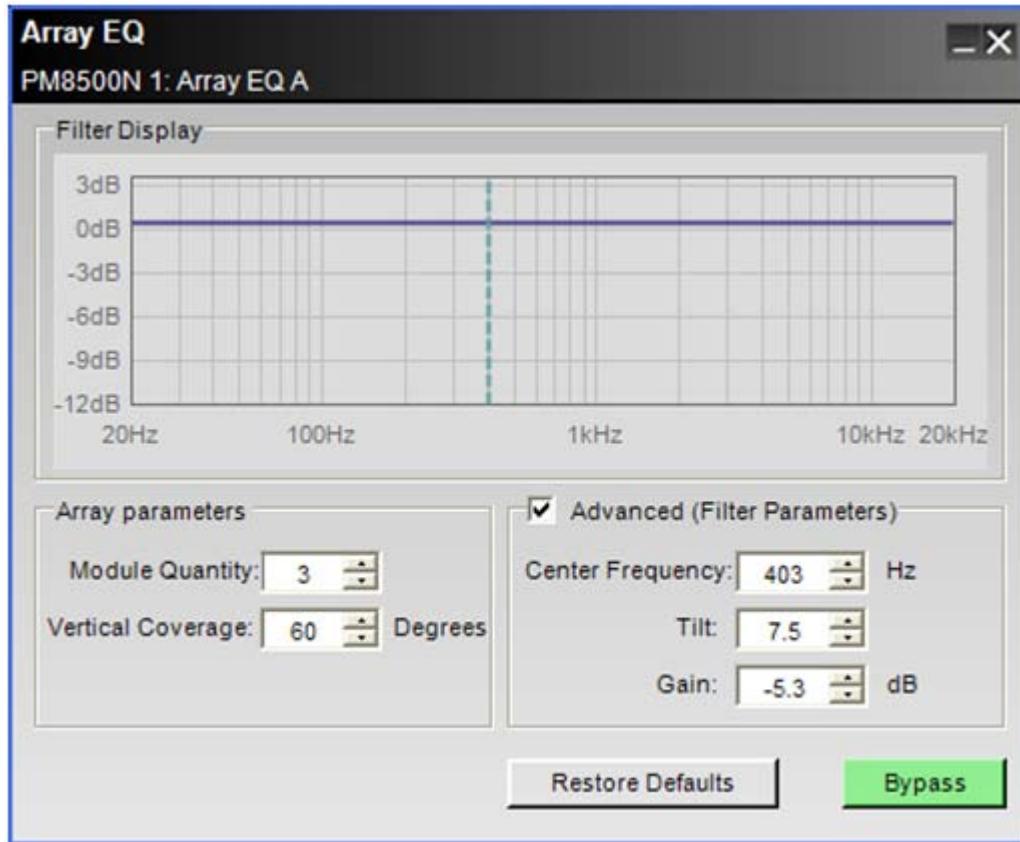
**Driver Alignment** – permits a single delay to add to all loudspeakers connected to this **Bose Speaker Processor** block. This is a read-only parameter for Bose loudspeaker EQs.

### **RoomMatch Array EQ**

The RoomMatch Array EQ is an automated signal processing block to apply global equalization to RoomMatch arrays from two (2) to eight (8) modules in height.

#### *RoomMatch Array EQ Processing Block and Right-Click Menu*

Double click its processing block within ESP View to open its control panel.



*RoomMatch Array EQ control panel*

The **RoomMatch Array EQ control panel** provides the following options:

**Filter Display** – Displays a graphical representation of array equalization settings in both frequency and level. The line represents the composite frequency response of chosen array and advanced filter parameters.

**Array Parameters** – Defined by module quantity and vertical coverage.

**Module Quantity** – Ranges from two (2) to eight (8) modules.

**Vertical Coverage** – Ranges from 20 to 100 degrees.

**Advanced (Filter Parameters)** – Defined by center frequency, tilt, and gain. These values are automatically generated when selecting module quantity and vertical coverage in Array Parameters.

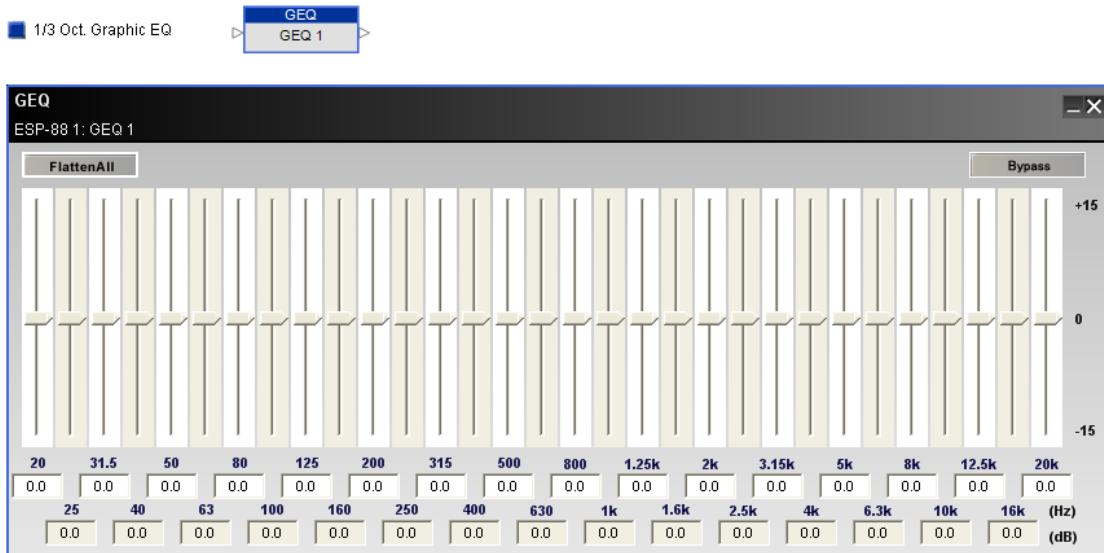
**Center Frequency** – Ranges from 220Hz to 700Hz.

**Tilt** – Defines the start and end points of the slope, effectively making the "tilt" sharper or shallower. Ranges from -10 degrees to +10 degrees.

**Gain** – Ranges from -12dB to +2dB in level.

### 1/3 Oct Graphic EQ

The 1/3 Oct Graphic EQ boosts or cuts the output level at 31 different frequencies and at 1/3 octave intervals from 20 Hz to 20 kHz. Double-click on the 1/3 Oct Graphic EQ block in ESP View to open its control panel.



1/3 Oct Graphic EQ, processing block and control panel.

The **1/3 Oct Graphic EQ control panel** provides the following options:

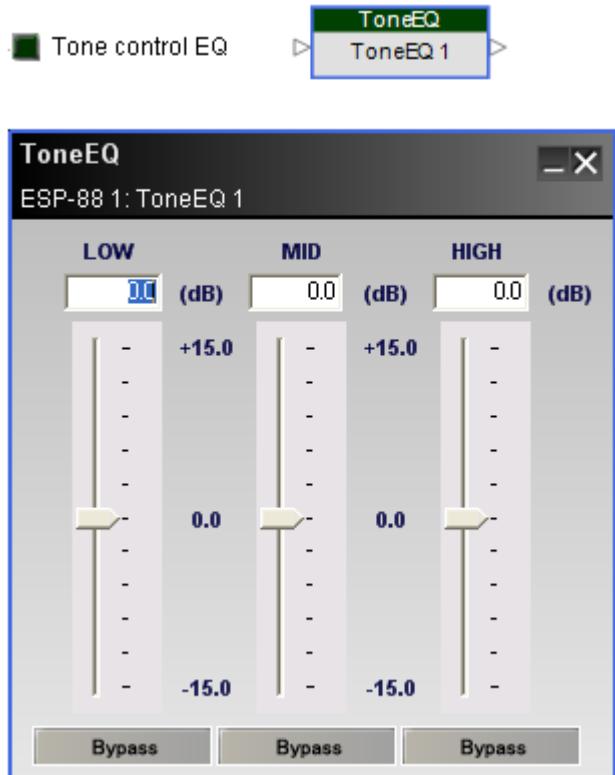
**Flatten All** – resets all gain sliders to zero.

**Bypass** – disables all equalizer settings from affecting the signal.

**Gain Sliders** – are adjustable for each frequency to boost or cut the level from -15 dB to 15 dB. Type in a boost or cut value in the input box below each slider to set the gain.

### Tone Control EQ

The Tone control EQ boosts or cuts the output level at the low, mid, and high frequency bandwidths. Double-click on the Tone control EQ block in ESP View to open its control panel.



*Tone control EQ, processing block and control panel.*

The **Tone control EQ control panel** provides the following options:

**LOW** – controls a 200Hz 6dB per octave filter adjustment to the original signal.

**Gain slider** – is adjustable to boost or cut the level from -15 dB to +15 dB. Type in a boost or cut value in the input box above this slider to set the gain.

**Bypass** – disables this specific filter from affecting the signal chain.

**MID** – controls a 1000Hz ( $Q = 1.414$ ) 6dB per octave filter adjustment to the original signal.

**Gain slider** – is adjustable to boost or cut the level from -15 dB to +15 dB. Type in a boost or cut value in the input box above this slider to set the gain.

**Bypass** – disables this specific filter from affecting the signal chain.

**HIGH** – controls a 5000Hz 6dB per octave filter adjustment to the original signal.

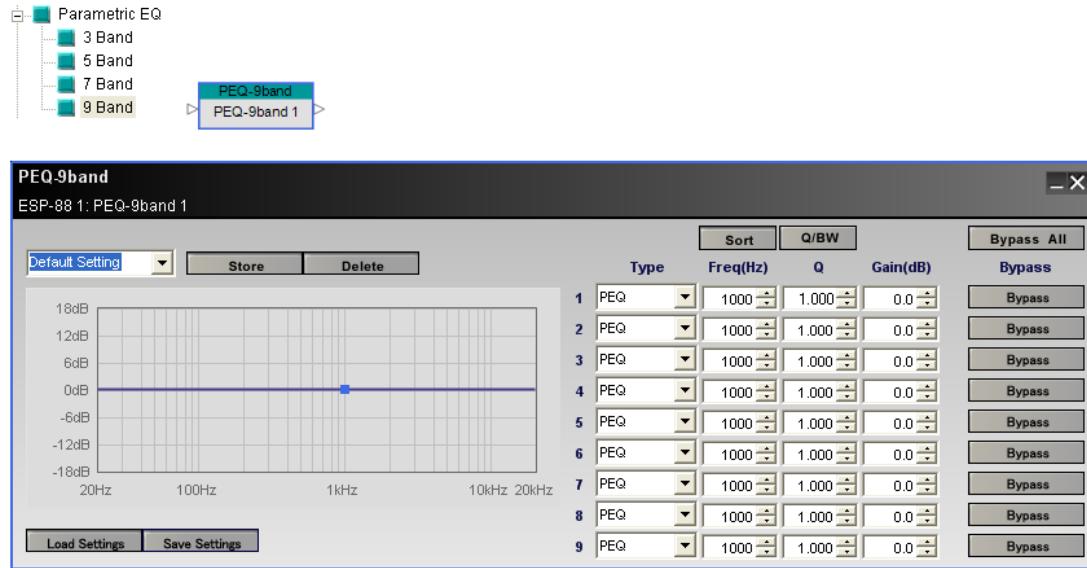
**Gain slider** – is adjustable to boost or cut the level from -15 dB to +15 dB. Type in a boost or cut value in the input box above this slider to set the gain.

**Bypass** – disables this specific filter from affecting the signal chain.

## Parametric EQs

Parametric EQs provide multiple filter bands of adjustment to an input signal. Four different types of Parametric EQs: 3 band, 5 band, 7 band, and 9 band are offered. The control

panels for each differ only in the number of bands available for boost or cut. Double-click on the Parametric EQ block in ESP View to open its control panel.



Parametric EQ, processing block and control panel

The **Parametric EQ control panel** provides the following options:

**Snapshot** – allow you to retain settings of the currently open parametric EQ block for use in other similarly sized PEQ blocks of the system design. Each settings group is called a **Snapshot**.

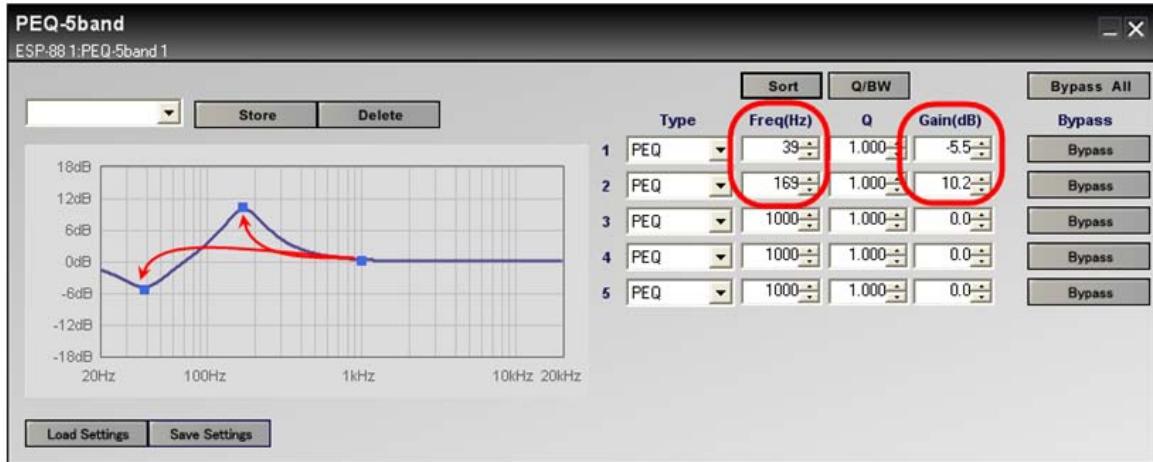
**Name** - provides a text box to enter a familiar name for the current settings. When no name is entered, default system names are automatically generated. To save the current name, press the **Store** button.

**Store** – commits the current settings to memory. Snapshot names and settings become part of the design file when saved to disk.

**Delete** – removes the currently selected snapshot from the drop down list but retains the PEQ settings until a new snapshot is selected.

**PEQ Graph** – displays a graphical representation of adjustable parametric filter settings in both frequency and level. The dark horizontal line on the graph represents the EQ curve and the blue boxes represent the center frequency of each filter band.

By default, all center frequencies are positioned at 1000 Hz, so the blue boxes are all at the same point. You may adjust the center frequency and gain for each filter band by dragging the blue box with your mouse in the PEQ Graph.



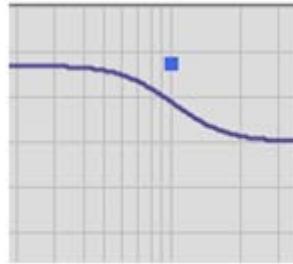
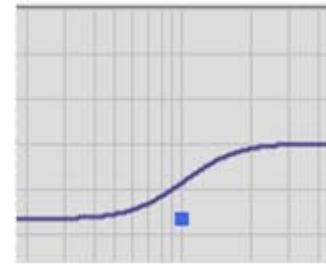
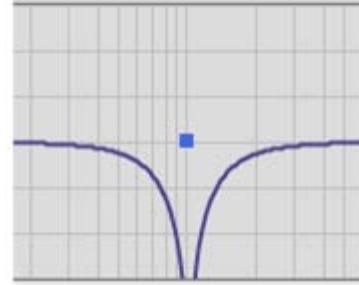
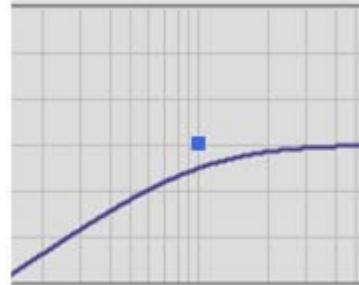
**Load / Save Settings** – supports the loading and saving of all current PEQ values to an external .peq file on the hard drive.

**Sort** – reorders the list of filters by frequency from low to high.

**Q/BW** – provides a toggle switch between the two unit systems representing filter bandwidth. Q is the ratio of the center frequency divided by the bandwidth. BW represents bandwidth and is a value in octaves.

**Type** – is a drop down list of unique filter methods available for use on each EQ band. Filter type descriptions and illustrations are shown below:

<b>PEQ</b> Boosts and cuts the signal in the vicinity of the specified frequency.		
<b>High Shelf</b> Boosts and cuts the signal above the specified frequency.		

<b>Low Shelf</b> Boosts and cuts the signal below the specified frequency.		
<b>Notch</b> Attenuates the signal at the specified frequency.		
<b>Low Pass</b> Attenuates the signal above the specified frequency.		
<b>High Pass</b> Attenuates the signal below the specified frequency.		

*Parametric filter types*

**Frequency** – specifies the center frequency of the filter band in Hertz (Hz). The range of permitted values entered directly into the text box or by using the scroll buttons is 20 Hz to 20 kHz.

**Q or BW** – is a value representing filter width. This column displays either **Q** or **BW** depending on the state of the **Q/BW** toggle button directly above this column. When using filter types other than PEQ or Notch, this field is de emphasized.

**Gain** – is the amount of cut or boost to the signal in dB, from -20 to 20. When using Low Pass and High Pass filters, this field is used to adjust the slope of the attenuation curve (-6 dB/Oct, or -12 dB/Oct).

**Bypass All** – engages all individual bypass buttons simultaneously. When active, the button turns “Green.” When inactive, the button is “Gray.”

**Bypass** – Use the Bypass buttons to remove an individual filter from the signal chain. When active, the button turns “Green.” When inactive, the button is “Gray.”

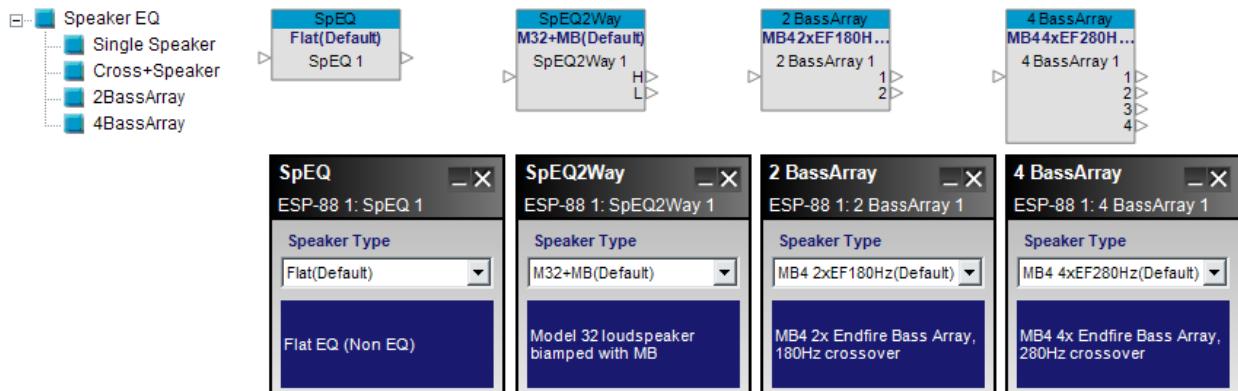
## Speaker EQ

Speaker EQ provides pre-configured equalization blocks for Bose loudspeakers and bass arrays.

Four Speaker EQ processing blocks are provided:

- Single speaker output
- Crossover with high and low frequency speaker outputs
- Two-element bass array configurations
- Four-element bass array configurations

Double-click on the Speaker EQ block in ESP View to open its control panel.



*Speaker EQ processing blocks and control panels*

Each **Speaker EQ control panel** provides the following options:

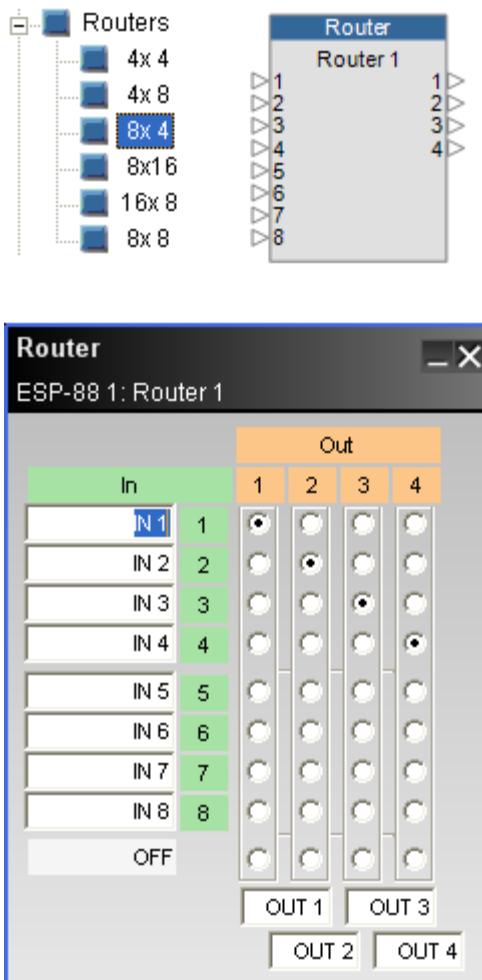
**Speaker Type** – drop down list with a selection of loudspeakers appropriate for the chosen EQ type.

**EQ Description** – provides a detailed list of product and configuration options unique to each speaker type.

## Routers

Routers direct individual inputs to one or more outputs within a programmable signal processing block. Output channels can accept only one input signal and output channels may also be turned off.

Routers are named according to the number of input and output channels they provide. Types currently provided are 4X4, 4X8, 8X4, 8X16, and 16X8 routers. Double-click on the router block in ESP View to open its control panel.



*8x4 Router, processing block and control panel*

The **Router control panel** provides the following options:

**Input Label** – allows direct text entry of user defined labels for inputs.

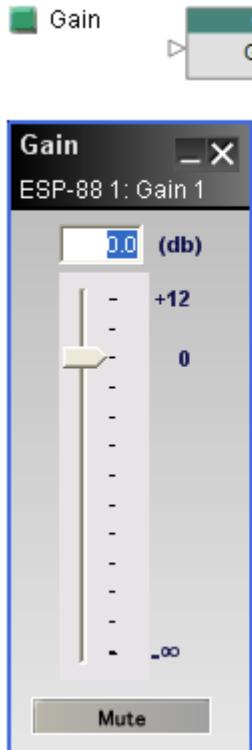
**Output Assignment** – is a router cross point connecting one or more inputs to an individual output. Select the cross point to the right of OFF beneath all inputs to disable the output for a specific channel.

**Output Label** – allows direct text entry of user defined labels for outputs.

## Gain

Gain blocks provide a convenient method to add individual gain control points within a system design. These blocks use the fewest CPU resources of any other signal processing

element and are helpful in many applications. Double-click on a gain block in ESP View to open its control panel.



*Gain processing block and control panel*

The **Gain control panel** provides the following options:

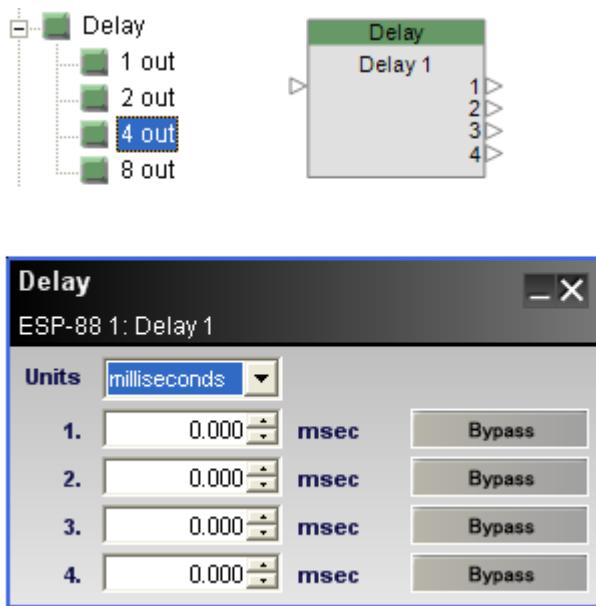
**Gain Value** – permits direct text entry of desired input signal level in dB. Range of adjustment matches and tracks the input gain slider.

**Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dB.

**Mute** – silences the signal and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## Delay

Delay blocks introduce adjustable signal delays configurable for one, two, four, and eight outputs. Delay values are independently adjustable per output. Double click on a Delay block in ESP View to open its control panel.



*Four channel delay processing block and control panel*

The **Delay control panel** provides the following options:

**Units** – define the numbering system and scale for a desired delay value. Supported units are:

**Milliseconds** (0-3000 ms)

**Sample** (0-144,000 samples)

**Meter** (0-1031.1 m)

**Millimeter** (0-1,031,100 mm)

**Feet** (0-3382.874 ft)

**Inch** (0-40594.488 in)

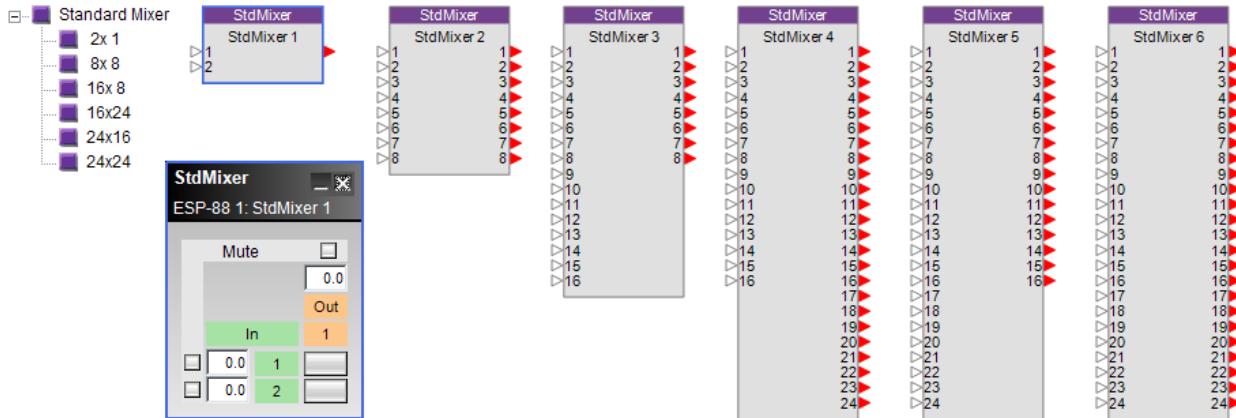
**Output Delay** – adjusts the signal delay delivered to the next gain stage. The range of adjustment varies according to the units chosen. This adjustment point is in the digital domain.

**Bypass** – buttons remove individual delays from the signal chain. When bypass is active, the button turns "Green." When inactive, the button is "Gray."

## Standard Mixer

The Standard Mixer is used to route input and output signals, and to adjust the input and output signal levels. Standard mixers are named according to the number of input and output channels they provide. You can use 2X1, 8X8, 16X8, 16X24, 24X16, and 24X24 standard mixers.

Double-click on a Standard Mixer block in ESP View to open its control panel.



*Standard Mixer processing blocks and 2x1 control panel*

The **Standard Mixer control panel** provides the following options:

**Input Level** – is a direct text entry field for adjusting the input signal. The range of adjustment is from  $-\infty$  to +12dB and the input section is shaded in Green.

**Output Level** – is a direct text entry field for adjusting the output signal. The range of adjustment is from  $-\infty$  to +12dB and the output section is shaded in Orange.

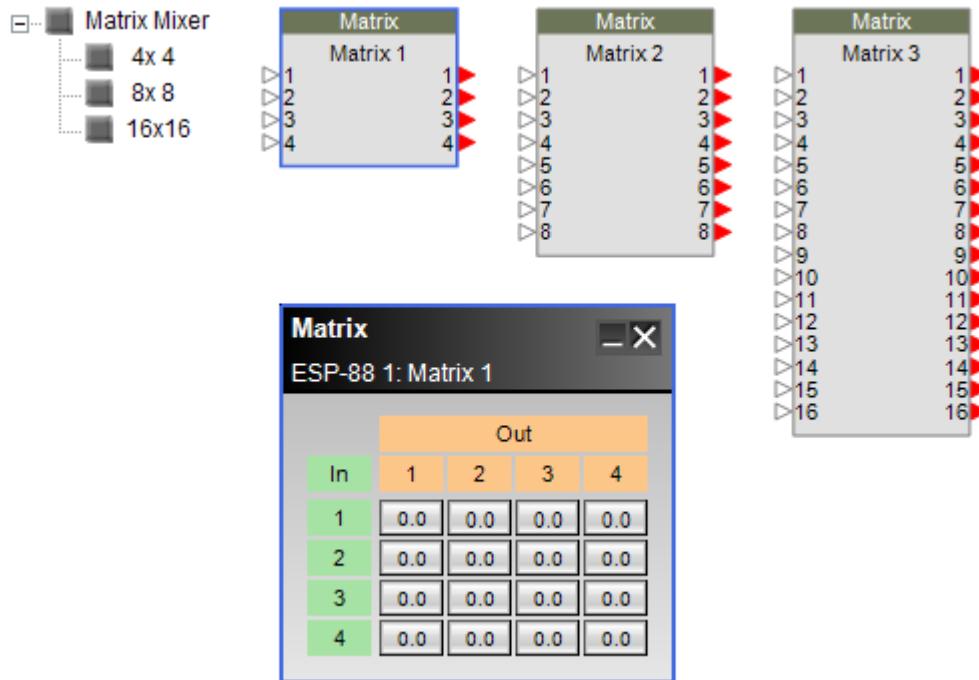
**Note:** To enable  $-\infty$  in a direct text field without a gain slider, enter any value less than -60dB.

**Assign** – creates a routing path between an input and an output. Click the assign button at the intersection of the two channels to permit audio to pass from input to output. When an assignment is made the control panel button is Blue.

**Mute** – silences the signal on a specific input or output panel and disables audio from passing to the next gain stage in the design. When Mute is enabled, the control panel button is Red.

## Matrix Mixer

The Matrix Mixer is used to route input and output signals, and to adjust the input and output signal levels like the Standard mixer. Matrix mixers are named according to the number of input and output channels they provide. You can use 4X4, 8X8, 16X16 matrix mixers. Double-click on a Matrix Mixer block in ESP View to open its control panel.



*Matrix Mixer processing blocks and 4x4 control panel*

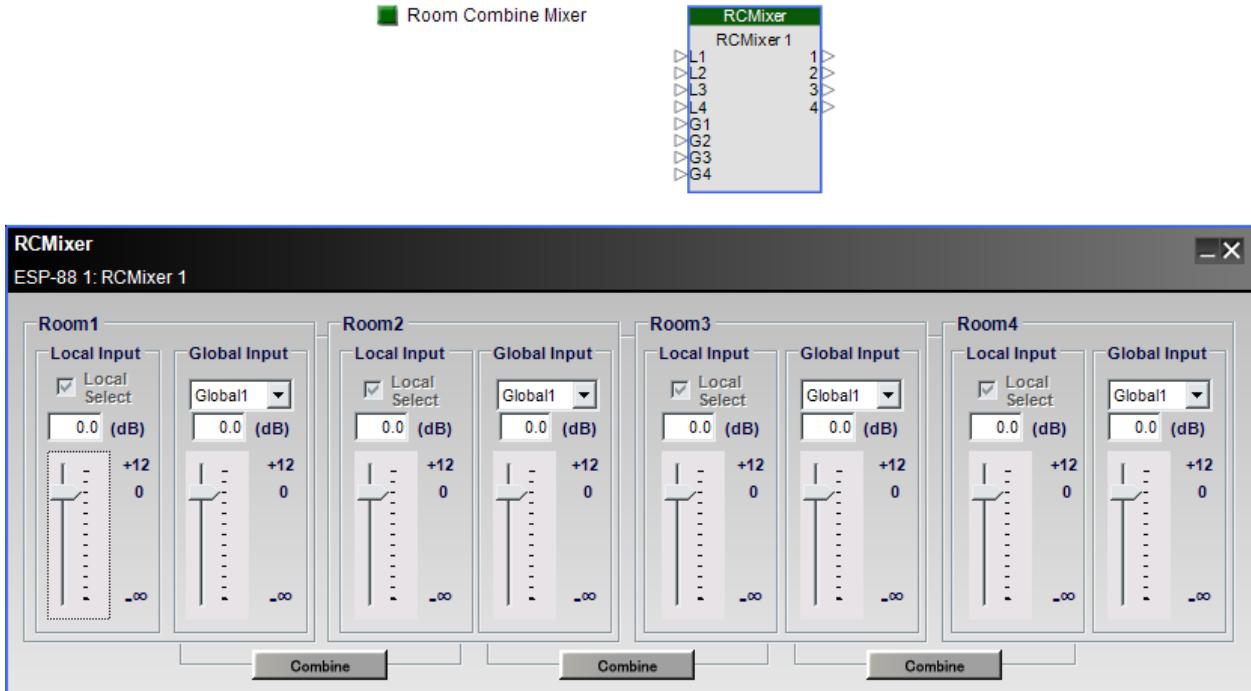
The **Matrix Mixer control panel** provides the following options:

**Assign** – creates a routing path between an input and an output. Click the assign button at the intersection of the two channels to permit audio to pass from input to output. When an assignment is made the control panel button is Blue.

**Assign Level** – provides a signal gain adjustment at the assignment cross point. Right click on an assignment button to access a gain slider. The range of adjustment is from  $-\infty$  to 0.0dB

### Room Combining Mixer

The Room Combining Mixer supports from one to four rooms and performs mixing and routing of local and global inputs to various combinations of rooms. When adjacent rooms are connected together, or “combined”, the same audio is routed to both rooms. Double-click on the Room Combining Mixer block in ESP View to open its control panel.



*Room Combining Mixer, processing block and control panel*

The **Room Combining Mixer control panel** provides the following options:

**Room1** – is one of four identically configured sections within this control panel. It offers the following configuration options:

**Local Input** - represents a source physically located or controlled within this room. One local source is provided for each of the four rooms. This control is de-emphasized until room combining is activated.

**Local Select** - determines which local input is used when a room is operating in the combined mode. This input is mixed with the currently selected global input.

**Gain Value** – permits direct text entry of desired input signal level in dB. Range of adjustment matches and tracks the input gain slider.

**Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dB.

**Global Input** – represents a source located outside an individual room, such as a system-wide background music channel. Four global sources are supported.

**Global Select** - determines which global input is used when a room is operating individually. This input is mixed with the local input of the same room.

**Gain Value** – permits direct text entry of desired input signal level in dB. Range of adjustment matches and tracks the input gain slider.

**Gain Slider** – adjusts the input signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dB.

**Room2, 3, and 4** – are identical in function to **Room1**

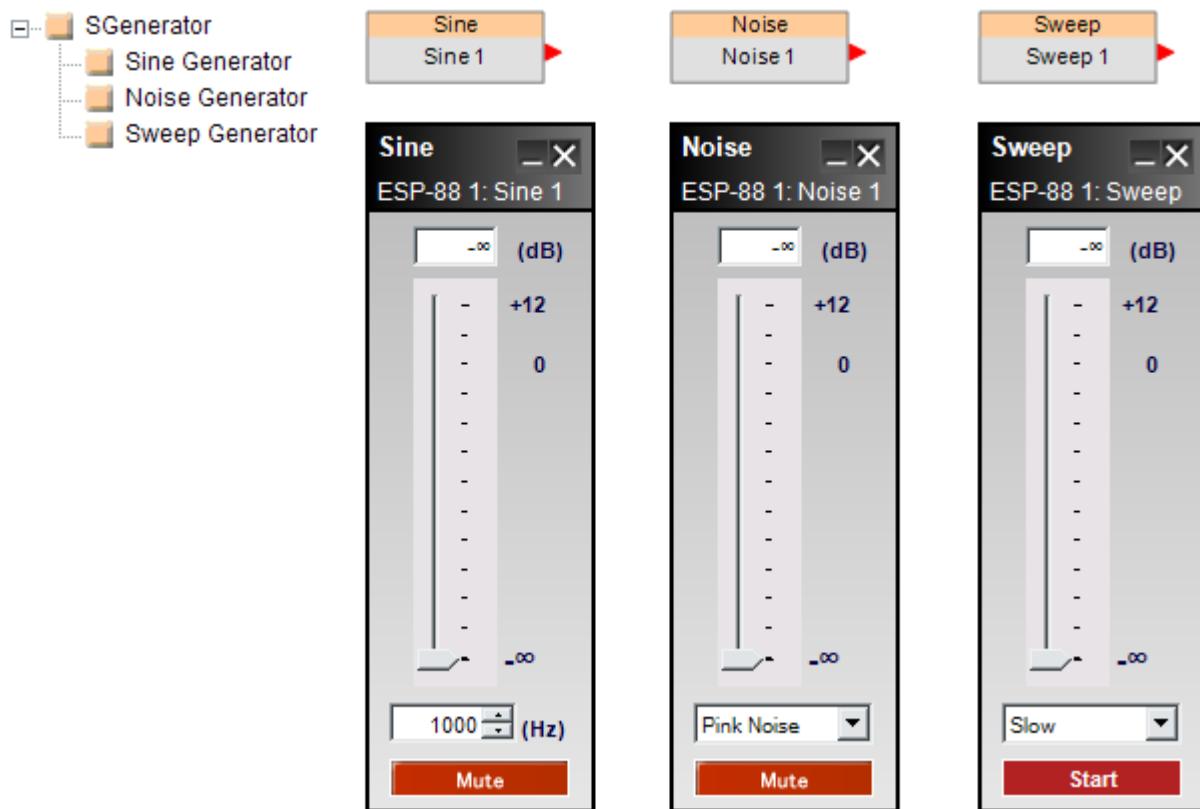
**Combine** – connects two rooms together electronically and mixes the local input and the selected global input. Three combine buttons are available and two rooms are combined the button is Green.

## SGenerator

The SGenerator is a processing group providing three types of dedicated signal generators:

- Sine
- Noise
- Sweep

Double-click on an SGenerator block in ESP View to open its control panel.



*Signal Generators, processing blocks and control panels*

The **SGenerator control panels** provide the following options:

**Sine Generator** – outputs a sine wave with variable level and frequency.

**Generator Value** – permits direct text entry of desired output signal level in dB. Range of adjustment matches and tracks the generator gain slider.

**Generator Gain Slider** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dB.

**Frequency** – permits direct text entry of desired output frequency in hertz. The range of adjustment is from 20 Hz to 20 kHz.

**Mute** – silences the signal generator. When Mute is enabled, the control panel button is Red (Default).

**Noise Generator** – outputs two types of broadband noise with variable level.

**Generator Value** – permits direct text entry of desired output signal level in dB. Range of adjustment matches and tracks the generator gain slider.

**Generator Gain Slider** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dB.

**Noise Type** – provides a selector to choose between the two available types of noise, Pink noise and White noise.

**Mute** – silences the signal generator. When Mute is enabled, the control panel button is Red (Default).

**Sweep Generator** – outputs a swept sine wave from 20 Hz to 20 kHz with variable level and speed.

**Generator Value** – permits direct text entry of desired output signal level in dB. Range of adjustment matches and tracks the generator gain slider.

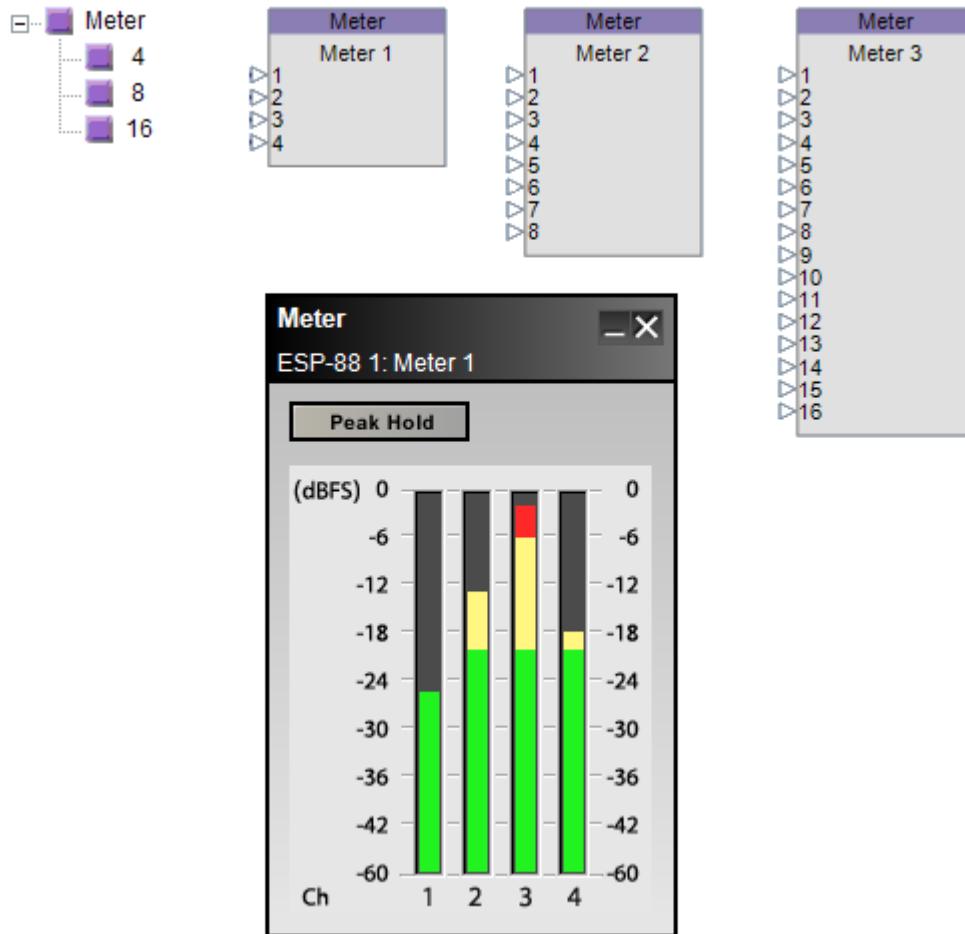
**Generator Gain Slider** – adjusts the output signal level delivered to the next gain stage. The range of adjustment is from  $-\infty$  to +12dB.

**Sweep Speed** – provides a selector to choose between the two available rates of sweep, Fast or Slow.

**Start / Stop** – enables or disables the signal generator.

## Meters

Meters provide vertical bar level indicators for monitoring signals. Meter processing blocks are available in four, eight, and sixteen channel versions. Double-click on a Meter block in ESP View to open its control panel.



*Meter, processing blocks and 4 channel control panel*

The **Meter control panel** provides the following options:

**Peak Hold** – enables a continuous line segment indicating the highest recorded signal. When this feature is enabled the button is Green.

**Bar Level Indicators** – provide a three color graph to represent signal level. Values range from -60 to 0 dBFS (Full Scale). Color ranges are as follows:

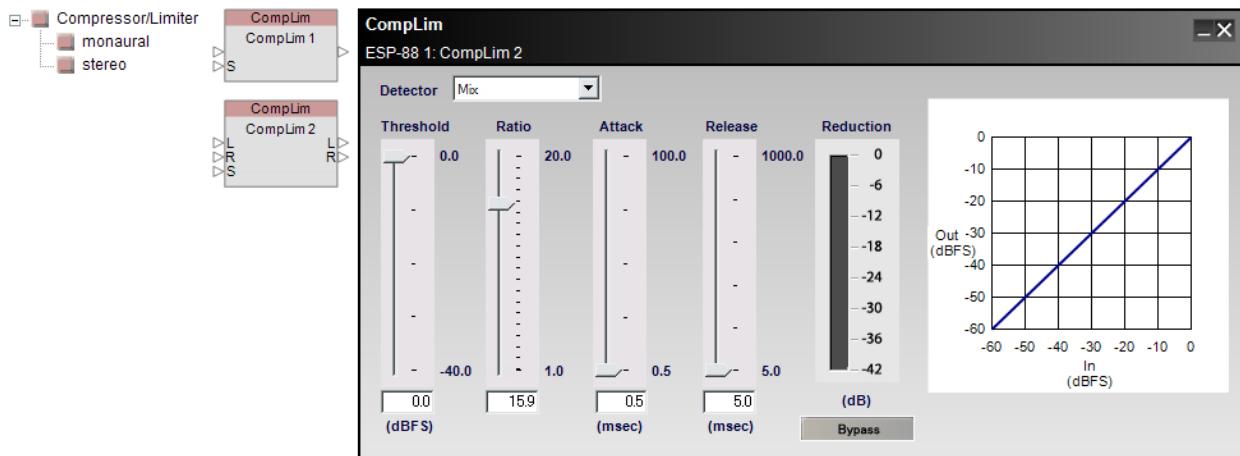
Green	> -20 dBFS
Yellow	-20 to -6 dBFS
Red	>-6 dBFS

## Compressor/Limiter

Compressor/Limiter processing reduces the level of an input signal when it reaches a predetermined threshold. Both a monaural Compressor/Limiter with one input and a side chain input, and a stereo Compressor/Limiter with stereo inputs and a side chain input are supported.

Control panels between mono and stereo versions differ only in the choice of input trigger signals.

Double-click on the Compressor/Limiter block in ESP View to open its control panel.



*Stereo Compressor/Limiter, processing block and control panel*

The **Compressor/Limiter** control panel provides the following options:

**Detector** – determines which of the available signal inputs are monitored to trigger the signal processing.

**Left** - indicates the left signal is the trigger for processing.

**Right** - indicates the right signal is the trigger for processing.

**Mix** - indicates a left/right signal mix is the trigger for processing.

**Side chain** - indicates the side chain input is the trigger for processing.

**Threshold slider** – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

**Threshold gain value** – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

**Ratio slider** – establishes an input/output ratio for signals above the threshold. Signals exceeding the input threshold are reduced by an amount according to the ratio, e.g., a signal ten times greater than the threshold signal value (10:1) results in a processing stage output at 1 dB above the threshold value.

**Ratio value** – is entered directly into the text box. The range of adjustment is 1.0 (default) to  $\infty$  and tracks the threshold slider setting.

**Attack slider** – establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

**Attack value** – is entered directly into the text box. The range of adjustment is from 0.5 milliseconds (default) to 100 milliseconds.

**Release slider** – determines the rate in milliseconds when signal processing is discontinued after threshold is exceeded.

**Release value** – is entered directly into the text box. The range of adjustment is from 5 milliseconds (default) to 1000 milliseconds.

**Reduction graph** – displays a vertical bar level indicator to illustrate the amount of signal reduction applied based upon the currently defined processing values.

**Bypass** – forces the channel to remain open at all times by circumventing the detection circuitry.

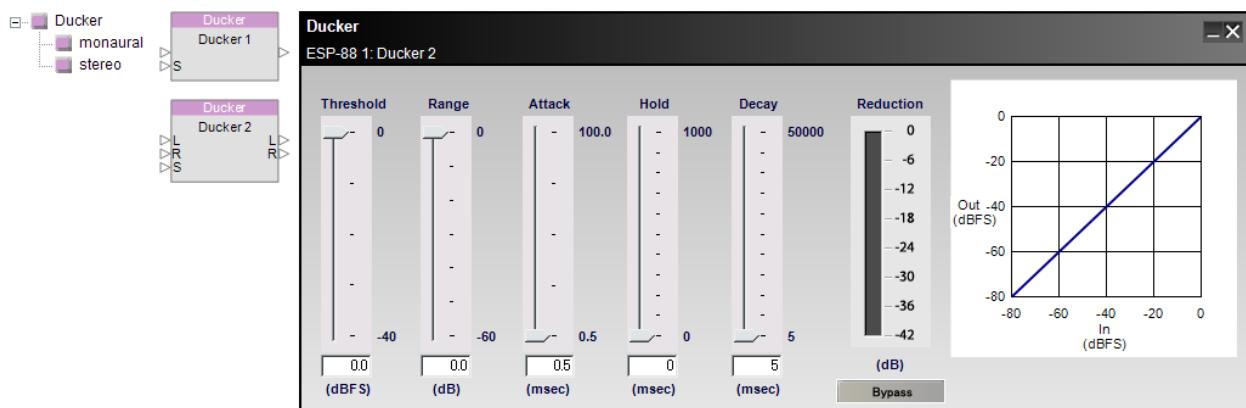
**Compressor/Limiter graph** - illustrates the input level versus the output level of the signal in a graphical manner. The slope of the line indicates the compression ratio.

## Ducker

The Ducker reduces the level of an input signal when a signal is present on the side chain input. Both a monaural Ducker with one input and a side chain input, and a stereo Ducker with stereo inputs and a side chain input are supported.

Control panels between mono and stereo versions are identical.

Double-click on the Ducker block in ESP View to open its control panel.



*Ducker processing blocks and control panel*

The **Ducker** control panel provides the following options:

**Threshold slider** – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

**Threshold gain value** – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

**Range slider** – dictates the amount of reduction in volume when the ducker is active.

**Range value** – is entered directly into the text box. The range of adjustment is -60 to 0 dB (default) and tracks the range slider setting.

**Attack slider** – establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

**Attack value** – is entered directly into the text box. The range of adjustment is from 0.5 milliseconds (default) to 100 milliseconds.

**Hold slider** – determines the length in time (milliseconds) when the input signal is held in a ducked state.

**Hold value** – is entered directly into the text box. The range of adjustment is from 0 milliseconds (default) to 1000 milliseconds.

**Decay slider** – establishes the rate in milliseconds at which input signals are returned to their normal level from a ducked state.

**Decay value** – is entered directly into the text box. The range of adjustment is from 5 milliseconds (default) to 50000 milliseconds.

**Reduction graph** – displays a vertical bar level indicator to illustrate the amount of signal reduction applied based upon the currently defined processing values.

**Bypass** – forces the channel to remain open at all times by circumventing the detection circuitry.

**Ducker graph** - illustrates the input level versus the output level of the signal in a graphical manner.

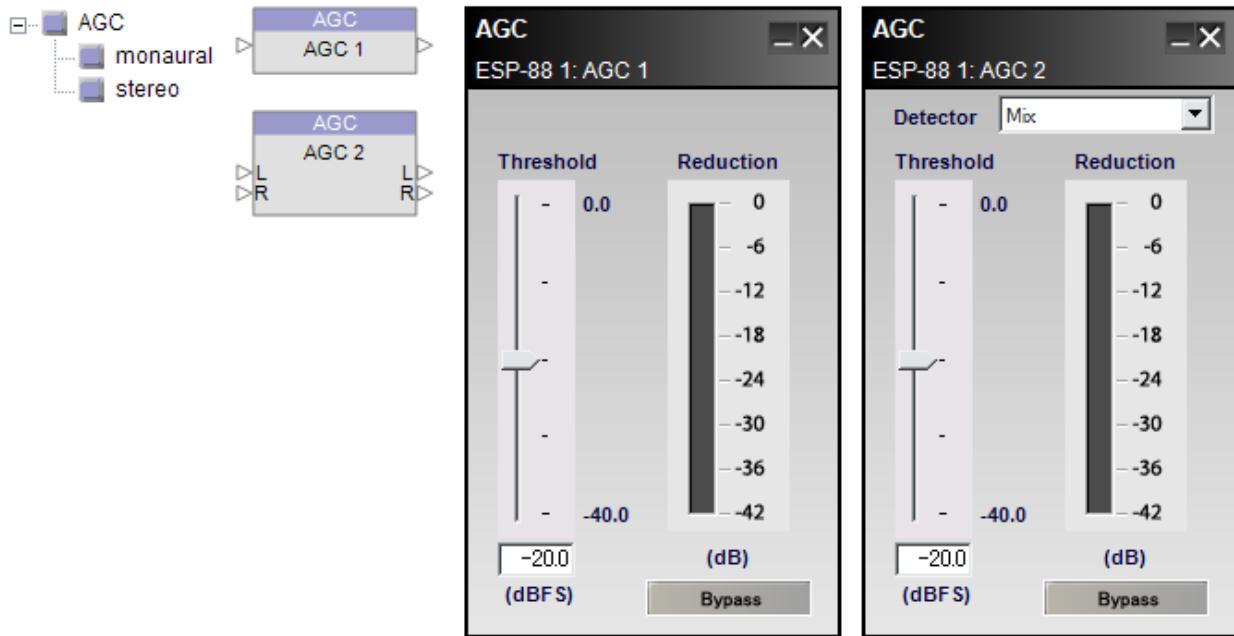
**Note:** The side chain input signal is only used as a trigger signal, it is not passed to the ducker output. To hear this signal, you must mix it back in to the signal chain along with the Ducker output.

## AGC

Automatic Gain Control (AGC) combines a compressor and a gate to maintain a constant output signal level with varying input signal levels. Both a monaural AGC with one input and a stereo AGC with two inputs are supported.

Control panels between mono and stereo versions are similar. The stereo AGC adds a detector drop down list.

Double-click on the AGC block in ESP View to open its control panel.



*AGC processing blocks and control panels*

The **AGC** control panel provides the following options:

**Detector** – determines which of the available signal inputs are monitored to trigger the signal processing.

**Left** - indicates the left signal is the trigger for processing.

**Right** - indicates the right signal is the trigger for processing.

**Mix** - indicates a left/right signal mix signal is the trigger for processing.

**Threshold slider** – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

**Threshold gain value** – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

**Reduction graph** – displays a vertical bar level indicator to illustrate the amount of signal reduction applied based upon the currently defined processing values.

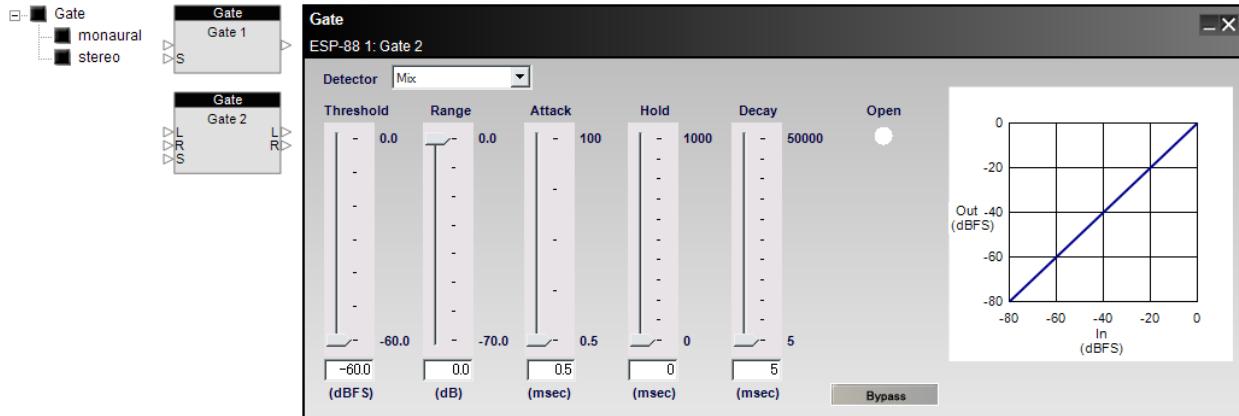
**Bypass** – forces the channel to remain open at all times by circumventing the detection circuitry.

## Gate

Gate attenuates input signals below the designated threshold. Both a monaural Gate with one input and a side chain input, and a stereo Gate with stereo inputs and a side chain input are supported.

Control panels differ only in the choice of input signal used as the trigger signal.

Double-click on the Gate block in ESP View to open its control panel.



Gate processing blocks and control panel

The **Gate** control panel provides the following options:

**Detector** – determines which of the available signal inputs are monitored to trigger the signal processing.

**Left** - indicates the left signal is the trigger for processing.

**Right** - indicates the right signal is the trigger for processing.

**Mix** - indicates a left/right signal mix is the trigger for processing.

**Side chain** - indicates the side chain input is the trigger for processing.

**Threshold slider** – determines when the processing block will begin adjusting the input signal according to its level. When the signal drops below this threshold, the input is prevented from passing through the processing block.

**Threshold gain value** – is entered directly into the text box. The range of adjustment is -40 to 0 dBFS (default) and tracks the threshold slider setting.

**Range slider** – dictates the amount of reduction in volume when the Gate is active.

**Range value** – is entered directly into the text box. The range of adjustment is -70 to 0 dB (default) and tracks the range slider setting.

**Attack slider** – establishes the rate in milliseconds at which input signals are processed once they exceed threshold.

**Attack value** – is entered directly into the text box. The range of adjustment is from 0.5 milliseconds (default) to 100 milliseconds.

**Hold slider** – determines the length in time (milliseconds) when the input signal is held in a gated on state.

**Hold value** – is entered directly into the text box. The range of adjustment is from 0 milliseconds (default) to 1000 milliseconds.

**Decay slider** – establishes the rate in milliseconds at which input signals are returned to their normal level from a gated on state.

**Decay value** – is entered directly into the text box. The range of adjustment is from 5 milliseconds (default) to 50000 milliseconds.

**Open** – is an indicator to illustrate signal is passing through the gate to its output. When the gate is closed and no signal is passing, the indicator is White. When the gate is open and signal is passing, the indicator is Blue.

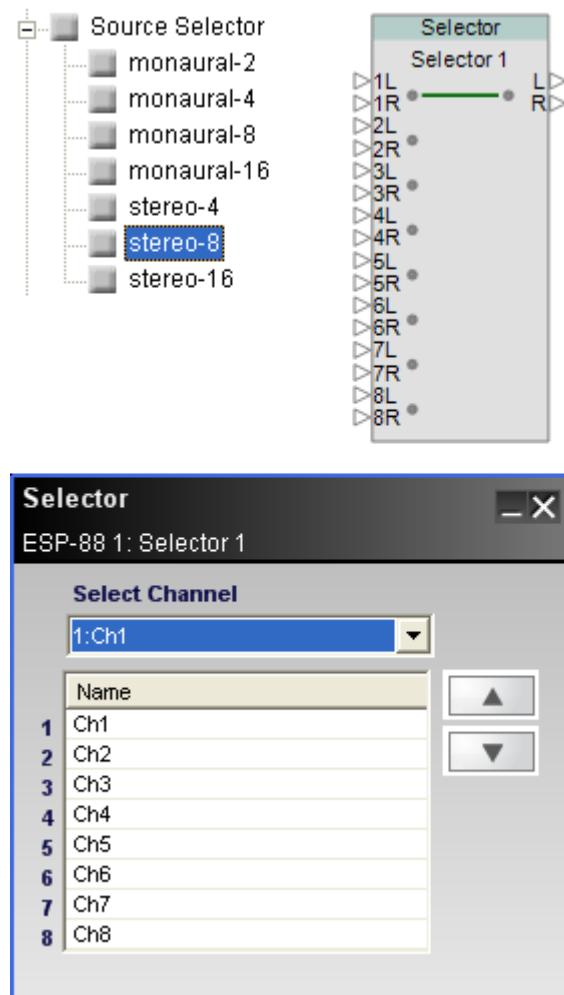
**Bypass** – forces the channel to remain open at all times by circumventing the detection circuitry.

**Gate graph** - illustrates the input level versus the output level of the signal in a graphical manner. The line represents the effect of the gate processing values.

### Source Selector

The Source Selector passes one of its input signals to an output channel. Both monaural and stereo source selectors are available. Four monaural source selectors, and 4-, 8- and 16-channel stereo source selectors are available.

Double-click on the Source Selector block in ESP View to open its control panel.



Source Selector, processing block and control panel

The **Source Selector** control panel provides the following options:

**Select Channel** – a drop-down menu to select the active input channel.

**Channel Name** – displays current channel name.

**NOTE:** Open the *Properties Window* to rename source selector channels.

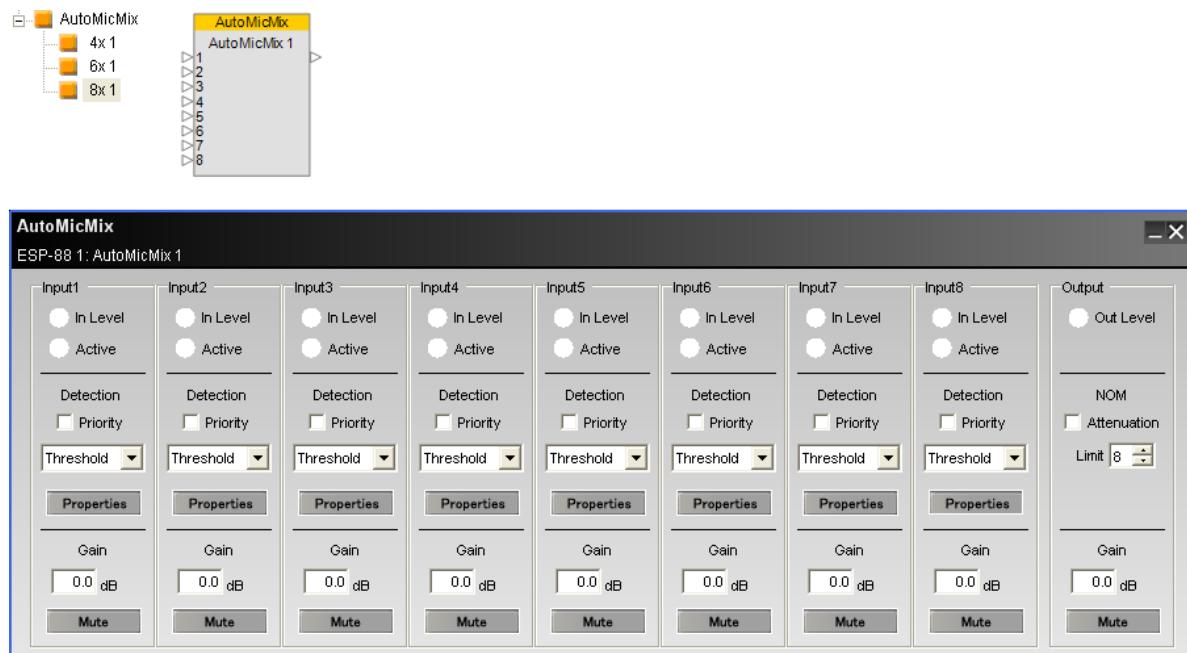
### Automatic Microphone Mixer

The Automatic Microphone Mixer manages the signal level from multiple microphones to achieve a constant output level without user intervention.

The automatic microphone mixer (AMM) is available in three configurations:

- 4x1
- 6x1
- 8x1

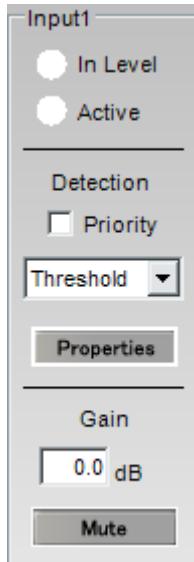
Double click on the AMM block in ESP View to open its control panel.



Automatic Microphone Mixer processing block and control panel

The **Automatic Microphone Mixer control panel** provides the following options:

**Input** – channels are identical in functionality for the 4x1, 6x1, and 8x1 configurations. Each version provides these controls:



*AMM input control panel*

**In Level** – is a three-color status indicator to illustrate the range of the current input signal level. Colors indicate the following input ranges:

Green	> -36 dBFS
Yellow	-20 to -6 dBFS
Red	>-6 dBFS

**Active** – is a three-color status indicator to illustrate the current input activity of the signal processing block:

White	Off (inactive)
Light Blue	Active
Dark Blue	Active input, but at a reduced level due to a higher priority channel

**Detection** – settings determine when the input channel turns on automatically.

**Priority** – check box forces other non-priority input channels to duck or reduce in level when this channel gates on. Multiple input channels can have Priority checked. Any channel with Priority selected will duck “non-priority” channels but will not duck another “Priority” channel.

**Threshold** – enables a channel gate to open when a predetermined signal level is reached. When the signal drops below this threshold, the channel gate closes once more.

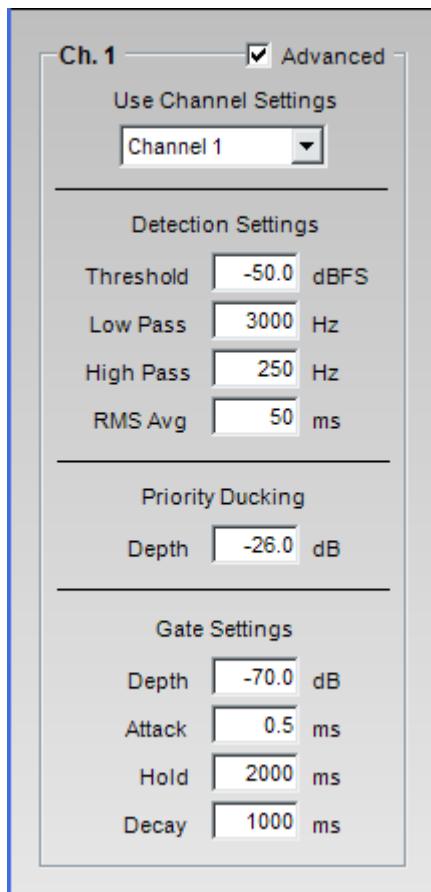
**LastOn** – allows a channel to remain open even after it falls below the threshold. The channel continues to remain open until another channel becomes active.

**PushToTalk** – requires a trigger to open the channel. This trigger can be from a control panel push button or from a programmed GPI event.

**Bypass** – forces the channel to remain open at all times by circumventing the detection circuitry.

**Properties** – opens an additional control panel to adjust settings for each of the detection methods. Available options within this control panel are:

**Advanced** – expands the properties available with an additional option for **Detection Settings** and a new section entitled **Gate Settings**.



AMM advanced section of input control panel

**Use Channel Settings** - applies the settings from a specified channel to the current channel, thereby overriding the current channel settings.

**Detection Settings** - determine the gating method used for the input channel.

**Threshold** - default value is -50 dBFS, and the range is from 80 to -50 dBFS.

**Low Pass** - cut-off frequency default is 20 kHz, and the range is from 300 to 20 kHz.

**High Pass** - cut-off frequency default is 250 Hz, and the range is 20 to 1 kHz.

**RMS Avg** – is an advanced setting available only when the **Advanced** check box is active. Value is the length in milliseconds, of the RMS averaging performed on the detection signal chain. The default is 50 ms, and the range is 0 to 500 ms.

**Priority Ducking** – determines the amount of ducking applied to the channel when the priority channel is open. The default is 26.0 dB, and the range is -60.0 to 0.0 dB

**Gate Settings** - are advanced configuration options available only when the **Advanced** check box is active. Options provided when this window section is visible are:

**Depth** – is the amount of attenuation applied when the input gate is not open. The default is 70.0 dB, and the range is 70.0 to 0.0 dB

**Attack** – is the amount of time, in milliseconds, from when the gate is turned on until it is fully open. The default is 0.5 ms, and the range is 0.5 to 100.0 ms.

**Hold** – is the amount of time the gate will remain open once the signal is no longer present. The default is 2000 ms, and the range is 1 to 50,000 ms.

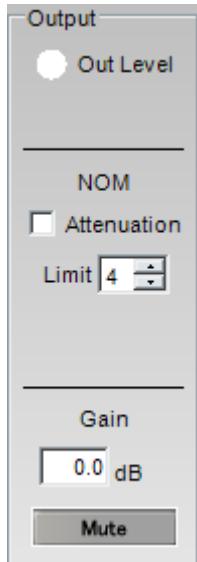
**Decay** – is the amount of time required for the gate to transition from its open to fully attenuated state. The default is 1,000 ms, and the range is 5 to 50,000 ms.

**Gain** - adjusts the post-gate output level of the input channel.

**Gain value** – is entered directly into the text box or by right clicking text box to activate a gain slider. The range of adjustment is  $-\infty$  to 0 dBFS (default).

**Mute** - attenuates the input channel. When Mute is enabled, the control panel button is Red.

**Output** – channel options are common to all versions of AMM. This section of the control panel includes an Output Level indicator, Number of Open Mics (NOM) settings, and Output Gain controls.



*AMM output control panel*

**Out Level** – is a three-color indicator to display the output channel level:

Green	> -36 dBFS
Yellow	-20 to -6 dBFS
Red	>-6 dBFS

**NOM** – provides options related to the Number of Open Microphones.

**Attenuation** - activates the NOM attenuation function. This will apply  $-10 \times \text{Log}(\text{NOM})$  output attenuation to the channel.

**Limit** – determines the maximum number of microphones that may be active at any time. The range of values is from 1 to the total number of channels in the selected Automatic Microphone Mixer processing block, 4, 6, or 8.

**Note:** If the Limit value is less than the number of microphones which are active, the following logic is used to determine which microphones are selected:

**Priority** – channels meeting all other conditions take precedence over non-priority channels.

**First-come, first-served** – activates channels in the order that required conditions are met and held.

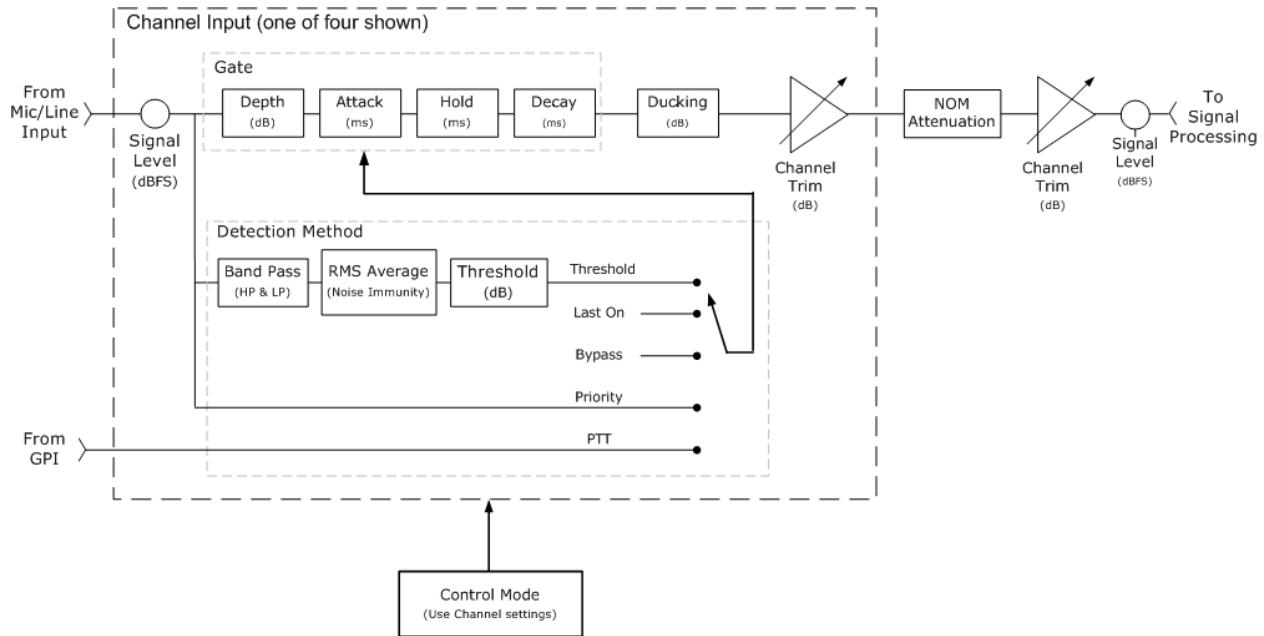
**Lowest-numbered channel** – activates sequentially starting with the smallest numerically valued channel and in ascension thereafter until the NOM limit is reached.

**Gain** - adjusts the overall output level of the Automatic Microphone Mixer block.

**Gain value** – is entered directly into the text box or by right clicking text box to activate a gain slider. The range of adjustment is  $-\infty$  to 0 dBFS (default).

**Mute** - attenuates the output channel. When Mute is enabled, the control panel button is Red.

The following **Automatic Microphone Mixer** functional diagram helps to illustrate the signal flow and logic operations of this signal processing block:

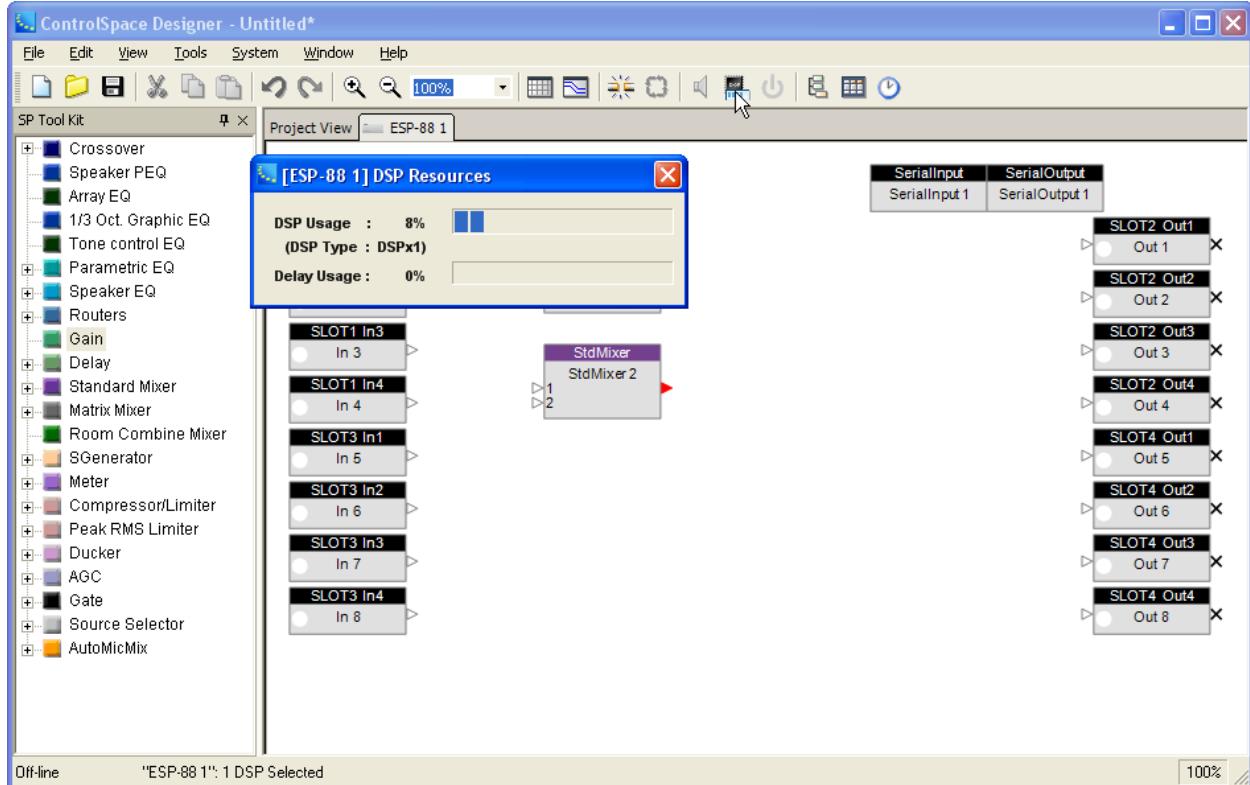


*Automatic Microphone Mixer Functional Diagram*

## Estimating DSP Usage

Estimating DSP usage in a system design is accomplished by accessing the DSP Resources Window.

Click the DSP Resources tool in the Main Toolbar after selecting an ESP processor within Project View or by opening ESP View.



DSP Resources Window

The **DSP Resources Window** displays the following information:

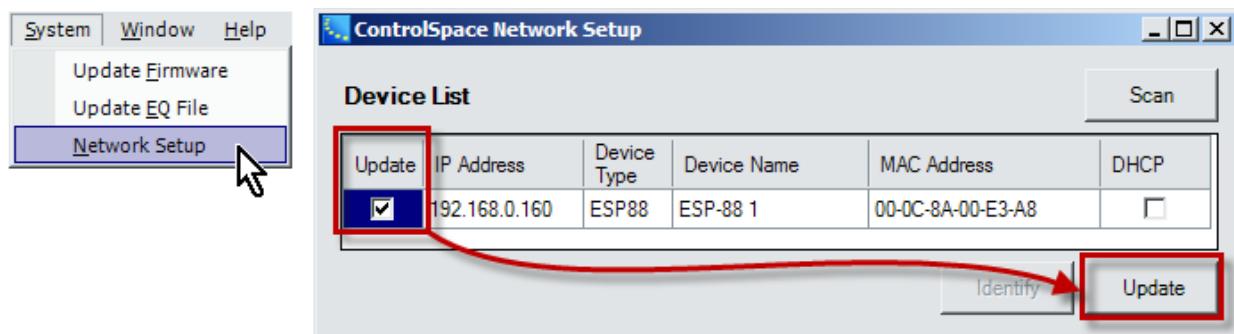
**DSP Usage** – Indicates the current numeric percentage of capacity used for signal processing along with a horizontal bar graph.

**DSPType** – Indicates standard DSP card (DSPx1) or optional DSP expansion card (DSPx4).

**Delay Usage** – Indicates the current numeric percentage of capacity used for signal delay along with a horizontal bar graph.

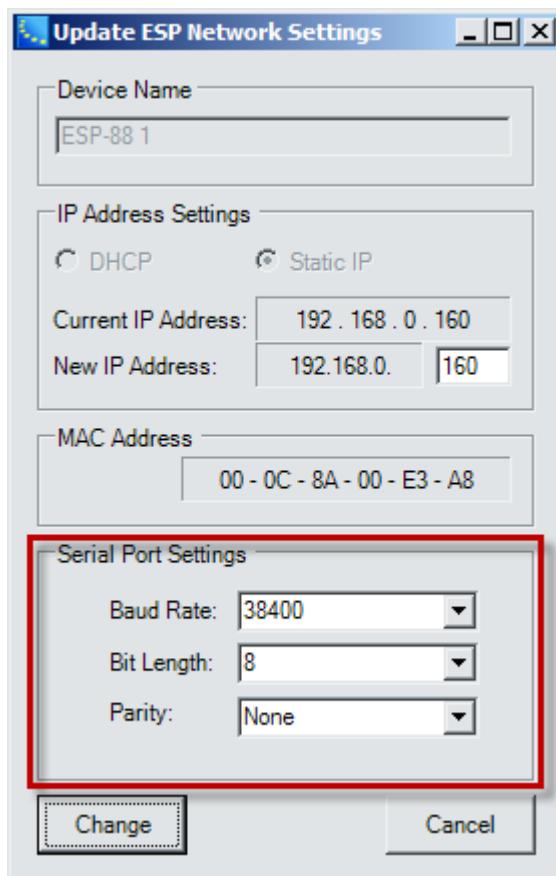
## Changing Serial Port Baud Rate

Changing the serial port baud rate is accomplished by updating the ESP network settings from within the Network Setup control panel. Choose *Network Setup* from the System Menu to open this control panel.



*Network setup control panel*

Selecting the *Update* check box next to an ESP on the network and pressing the *Update* button presents the following **Update ESP Network Settings control panel**.



*Update ESP Network Settings control panel*

Options relating to serial ports are located in the lower section of this control panel:

**Serial Port Settings** – provides access to adjustable serial port options.

**Baud Rate** – supports speeds from 2400 baud to 57600 baud. The default value is 38400.

**Bit Length** - supports both 8 (default) and 7 bit lengths.

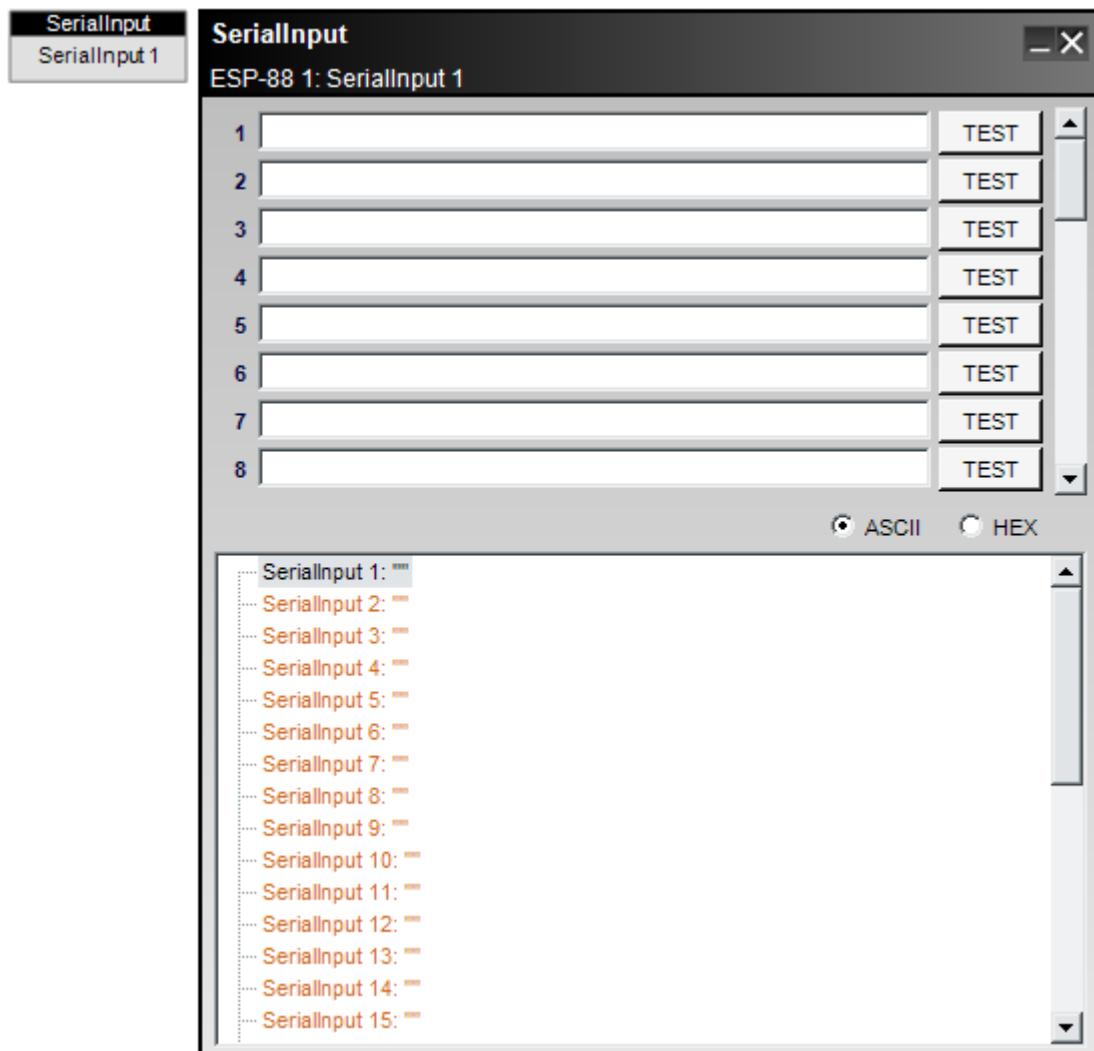
**Parity** - supports None (default), Even, and Odd parity scenarios.

**Flow Control** – is currently unsupported.

**Note:** Pressing the **Change** button will store the serial port settings and require an ESP reboot. You may also reboot the ESP-88 manually by powering off, then on. Rebooting the ESP will activate the new serial port settings.

## Serial Command Support

Serial Command Support is provided via the integral serial port on the rear I/O panel of an ESP and by a built-in serial command protocol (link to current protocol doc?). Up to 32 serial input or output strings are supported. Double-click on the Serial Input or Serial Output blocks in ESP View to open their control panels.



Serial Input processing block and control panel

The **Serial Input control panel** provides the following options:

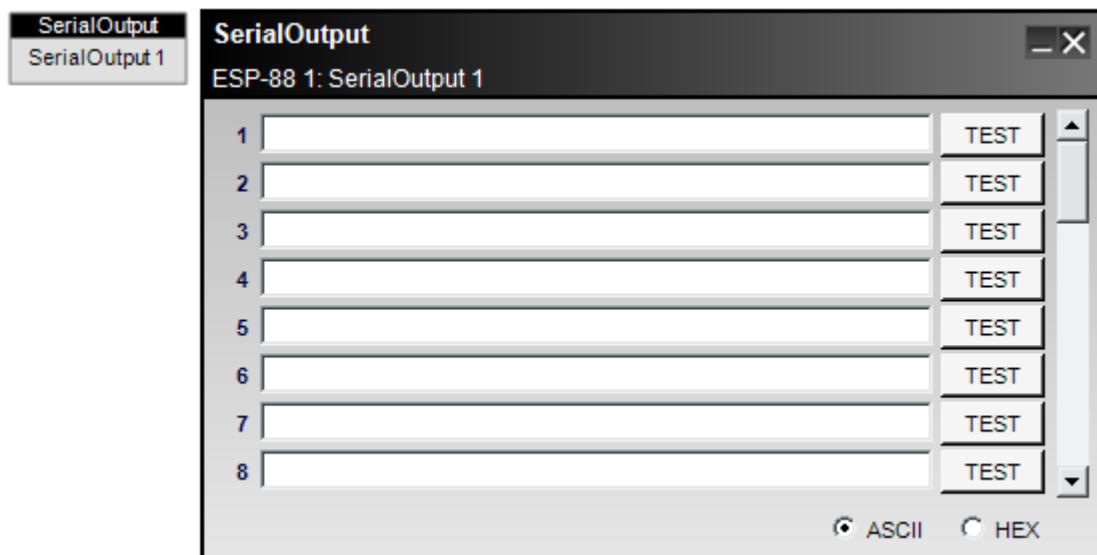
**Serial Inputs 1-32** – are text boxes providing a location to store up to 32 characters (ASCII) or 64 characters (HEX) to match to commands received from external devices via the RS-232 serial port. Matching commands received within the serial data stream perform actions specified in the programming tree.

**Test** - provides the facility to test actions specified in the programming tree for a serial input as if those values just arrived within the serial data stream.

**ASCII / Hex** – is a radio button that determines unit scale for text entry. Select ASCII for traditional alphanumeric character entry or HEX to convert notation to two-bytes per character.

**Serial Input Programming Tree** – provides a drag-n-drop area for assigning ESP functions to perform (block values or parameter sets) when matching serial strings arrive at the serial input.

**Note:** An ESP automatically assumes each input string terminates with one carriage return (CR). You must program the sending equipment to terminate the serial string with one CR at the end of each command. It is unnecessary to include this CR in the Serial Input entry windows.



*Serial output processing block and control panel*

The **Serial Output control panel** provides the following options:

**Serial Outputs 1-32** – are text boxes providing a location to store up to 32 characters (ASCII) or 64 characters (HEX) to transmit via the serial data stream to external devices via the RS-232 serial port.

**Test** - provides the facility to test actions specified in the programming tree for a serial input as if those values just arrived within the serial data stream.

**ASCII / Hex** – is a radio button that determines unit scale for text entry. Select ASCII for traditional alphanumeric character entry or HEX to convert notation to two-bytes per character.

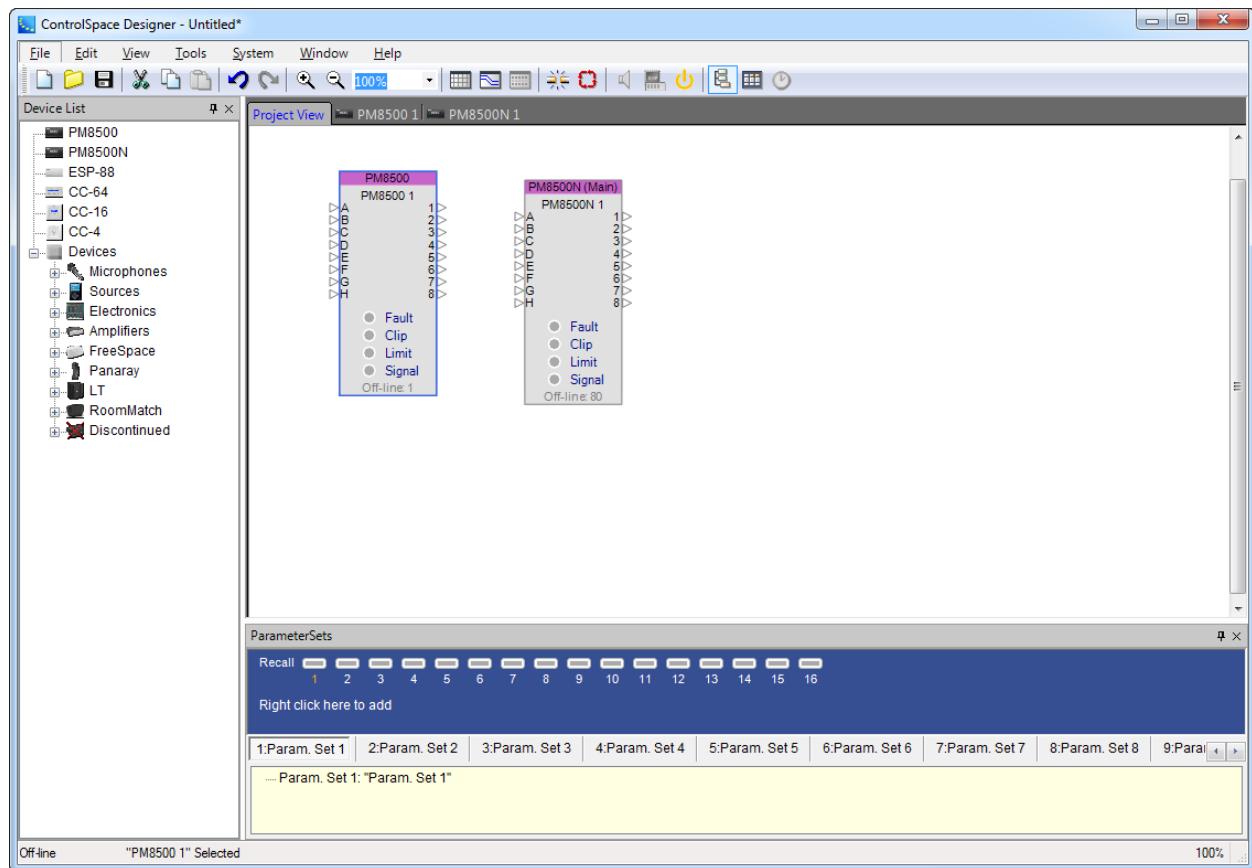
**Note:** Use hex notation when designating a control character like CR or LF. To designate a hex character, use backslash 0, then the hex value of the character (0-F).

# Configuring PowerMatch

## PowerMatch Configurable Professional Amplifier Devices

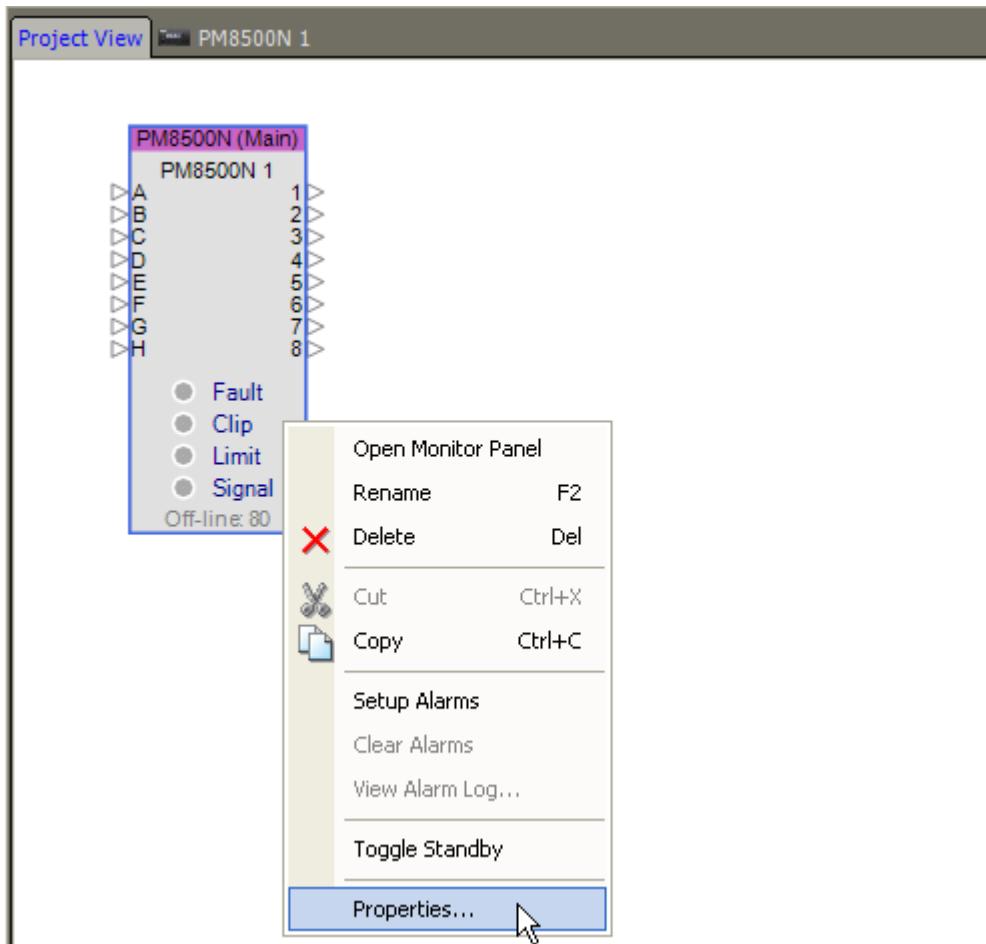
Two PowerMatch amplifiers appear in the Device List as the PM8500 and the PM8500N. While the signal processing and amplification sections of the two devices are identical, the PM8500 does not include an Ethernet network connection, and may only be configured using its [USB connection](#).

The devices are added to the Project View using the same drag and drop mechanism as other devices within the ControlSpace Designer software.

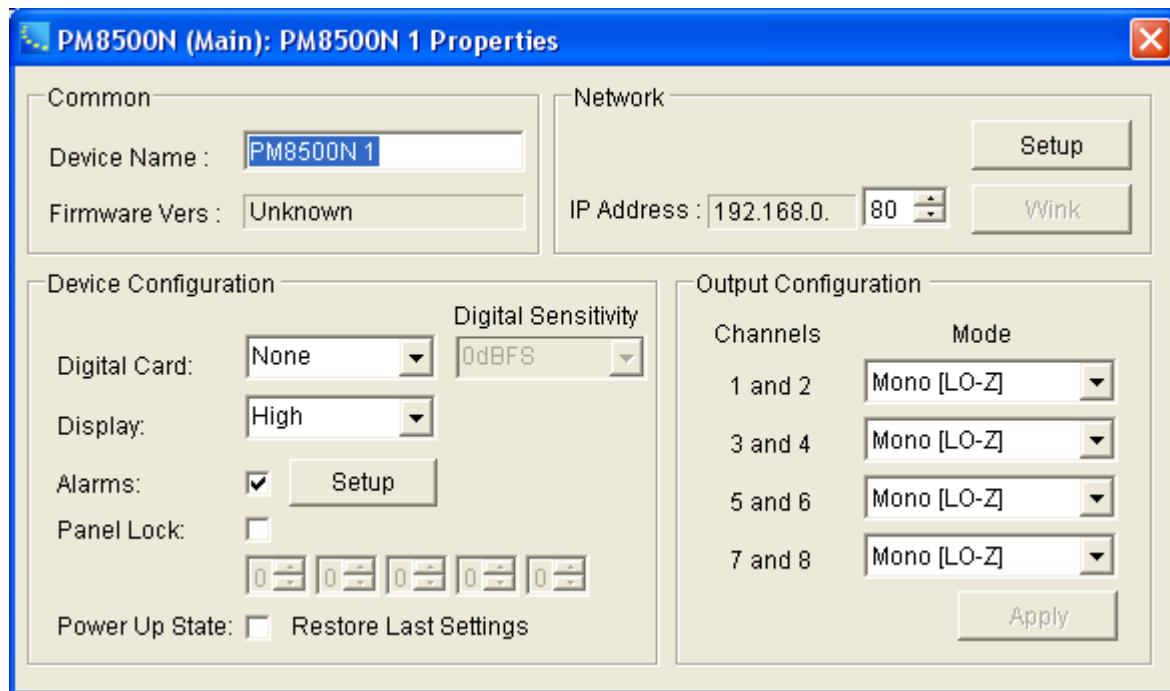


## Amplifier Properties

To view the device properties for a PowerMatch amplifier, right click the amplifier block and choose Properties from the context menu.



From within the PowerMatch amplifier device properties you can specify the amplifier output configuration, the digital input card type and network communication options. When selected, the Properties panel is displayed as shown:



From within the Device Properties, the following options are available:

**Common** – Contains the properties that are common to all devices within ControlSpace Designer.

**Device Name** – This is the label used for the amplifier within ControlSpace Designer. Once a connection is established, this name is displayed on the front panel of the unit.

**Firmware Vers** – Displays the currently loaded firmware version. If the firmware version is not known, "Unknown" is displayed.

**Network** – Displays the current network settings for the PM8500N. Within the properties pane for the PM8500, this section is labeled "Device Identification" since no network options are available.

**Setup** – Displays the Network Setup panel. From the Network Setup panel you may modify the network settings of the amplifier.

**IP Address** – Displays the current IP address of the unit. The device address may be modified when configuring a system.

**Wink** – Causes the front panel display of the unit to flash momentarily. This function is available only when the amplifier is on-line.

**NOTE:** All PM8500N amplifiers are configured for DHCP operation at the time of manufacture. When an installation is performed, the network configuration should be set to fixed IP addressing. See the [Network Configuration](#) section to learn how to modify the network settings of a PowerMatch amplifier.

**Device Configuration** – Settings specific to the configuration and operation of the PowerMatch amplifier.

**Digital Card** – Determines the type of digital card installed in the Expansion slot. Available selections are None, PMESPLink, and CobraNet. When a digital input is selected, the corresponding digital inputs/outputs are displayed on the device view of the PowerMatch amplifier.

**Display** – Determines the display brightness for the front panel display of the hardware. Available settings are High and Low.

**Alarms** – Activates alarm messaging. When selected, the PowerMatch amplifier broadcasts alarm conditions on the network. Select Setup to configure the alarm conditions that will trigger a notification.

**Panel Lock** – Enables the front panel lock. Use the numeric lock to specify the access code. Once the front panel is locked, you will be required to enter the passcode when connecting to the PM8500/N.

**Output Configuration** – Determines the output mode for each pair of amplifier outputs. See the [Output Configuration](#) section for additional details.

## Output Configuration

Each pair of PowerMatch amplifier outputs may be configured for individual, Mono, Voltage Bridged or Current Sharing operation to handle various types of loudspeaker load types. In addition, four amplifier channels, two pairs, may be configured for operation in Quad Bridge (Current and Voltage Bridged) to deliver 4 times the power of a single channel.

### To configure the output section of a PowerMatch amplifier:

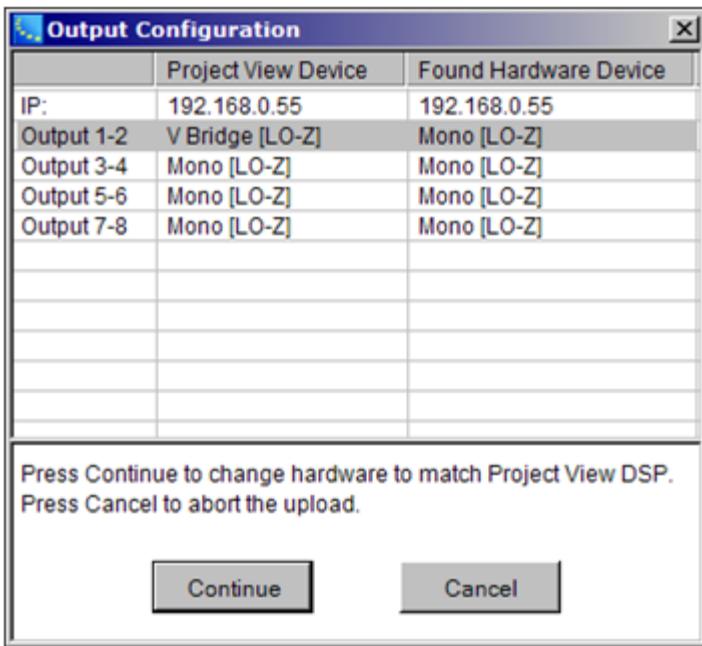
1. **Go Offline.** The output configuration may only be changed when the Gonzo amplifier is off-line.
2. Display the [Amplifier Properties](#). The settings for the PowerMatch output configuration are located within the amplifier properties panel.
3. Select the desired **Output Configuration**. Each pair of outputs may be configured for mono, Voltage Bridged or Current Sharing operation, while a block of four outputs may be configured for Quad Bridge operation. Use the drop-down selection to select the desired output configuration.

Use the following chart to determine the type of output configuration to use based on the loudspeaker load that will be connected:

Configuration Mode	Supported Load				
	2Ω	4Ω	8Ω	70V	100V
Mono	500W	500W	300W	Not avail.	Not avail.
Bridge	500W*	1000W	1000W	800W	1000W
Current Share	1000W	500W*	300W*	Not avail.	Not avail.
QuadBridge	1000W	2000W	1000W*	1600W	2000W

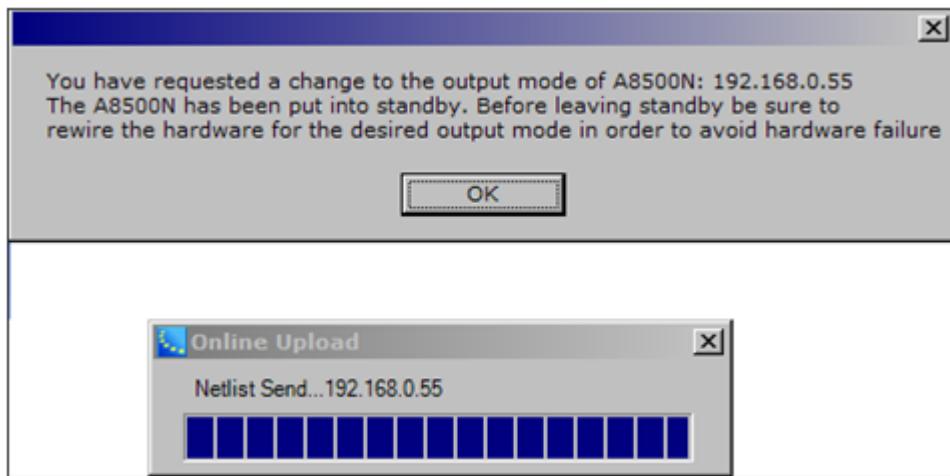
\*Not recommended

4. Close the Properties Panel
  5. **Go Online.** Select the Go on-line button or choose Go on-line from the Tools Menu.
  6. Select **Send to Devices** from the available options.
  7. You will receive the output configuration confirmation dialog if the output configuration in the Project View does not match the output configuration of the hardware.

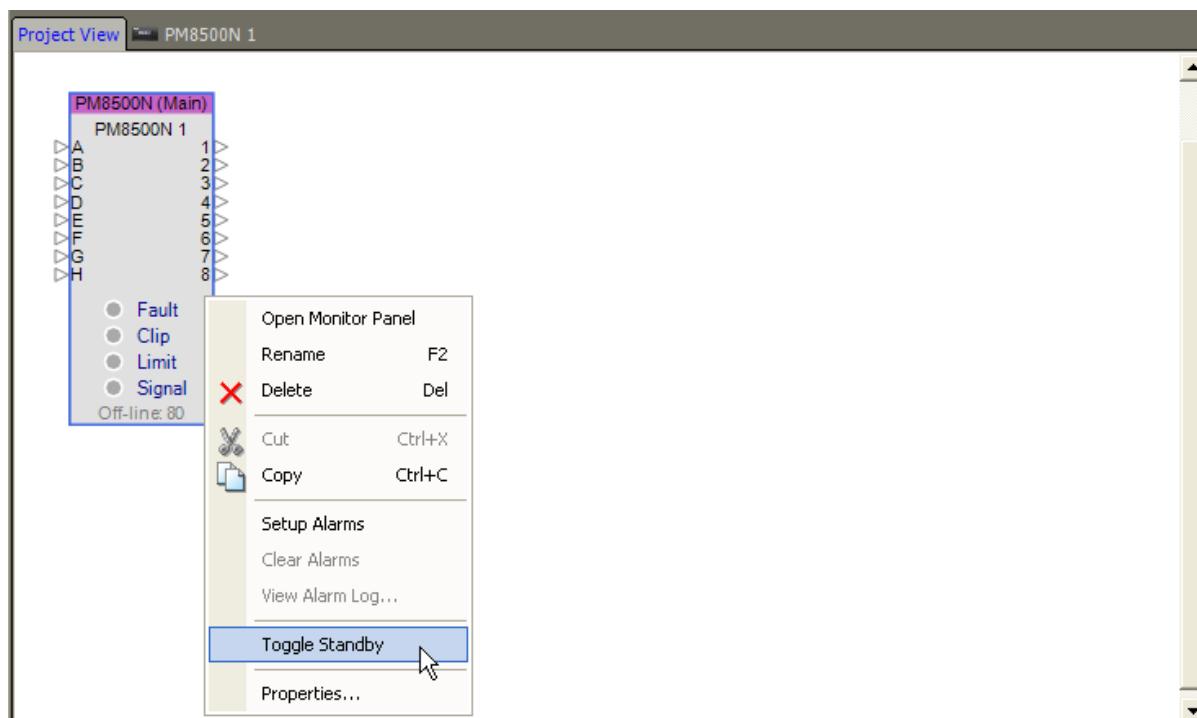


The differences in the output configuration between the Project View and the hardware are highlighted.

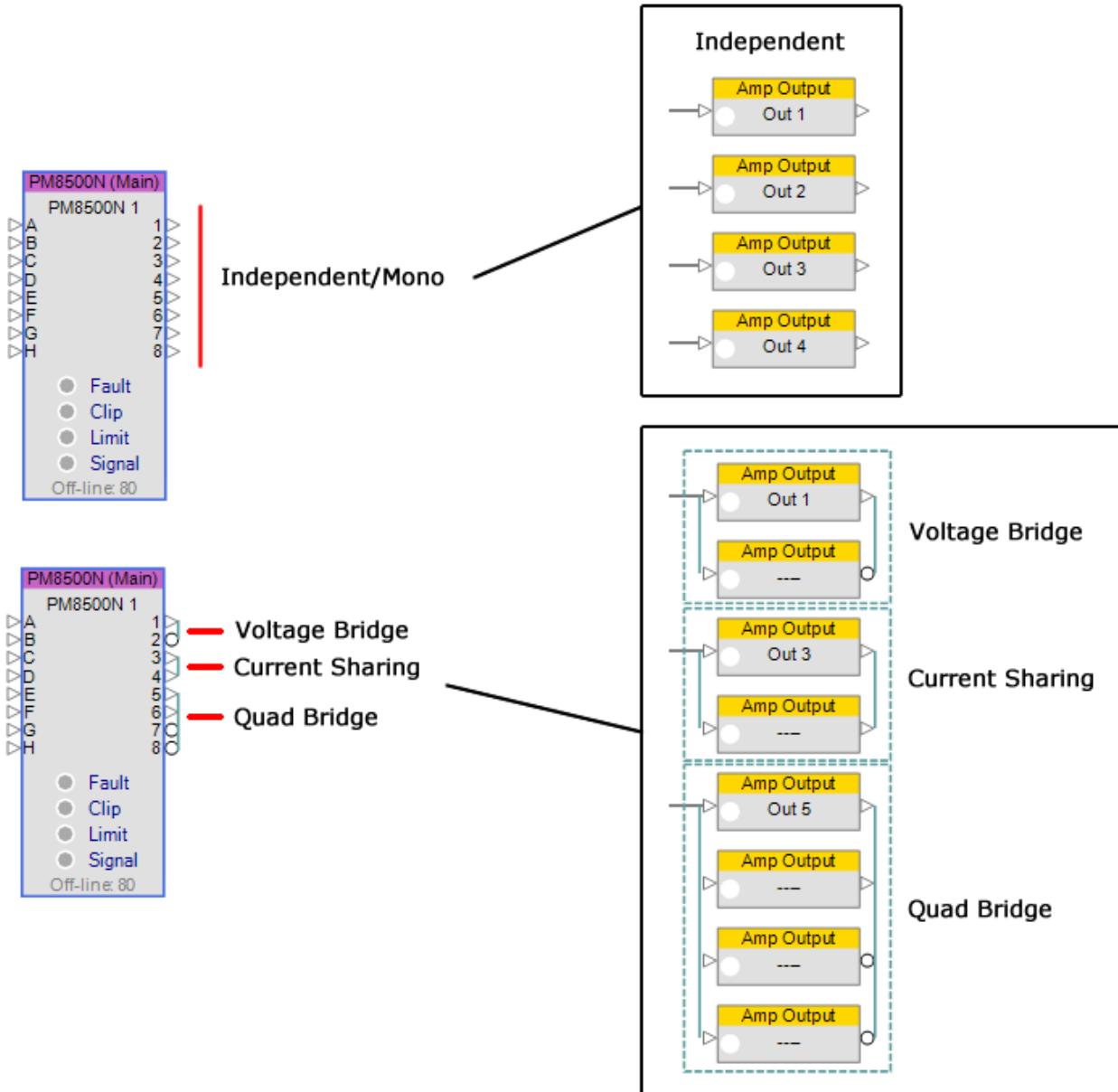
8. To accept the change in output configuration, click **Continue**.  
To ignore the change and leave the hardware untouched, click **Cancel**.
  9. When **Continue** is selected, the new configuration settings are sent to the hardware.  
Configurations which do not require a special jumper, Mono and VBridge, are implemented immediately within the hardware once the connection is established.  
Configurations which require the installation of a output wiring jumper, IShare and QuadBridge, require the unit to be placed into standby.  
At this point you are presented with a secondary dialog asking you to confirm that the output wiring is correct for the selected output configuration:



10. Select **OK** to send the new settings to the hardware, and establish a connection to the amplifier. At this point you will be on-line and connected to the amplifier, although it will be in standby.
11. From within Project View, right-click on the amplifier's icon and select **Toggle Standby** to place the unit into operation.



The Project View and Signal Processing View for the PowerMatch amplifier reflect its current output configuration. You can use these displays to determine the currently active output configuration for the amplifier.



## USB connection

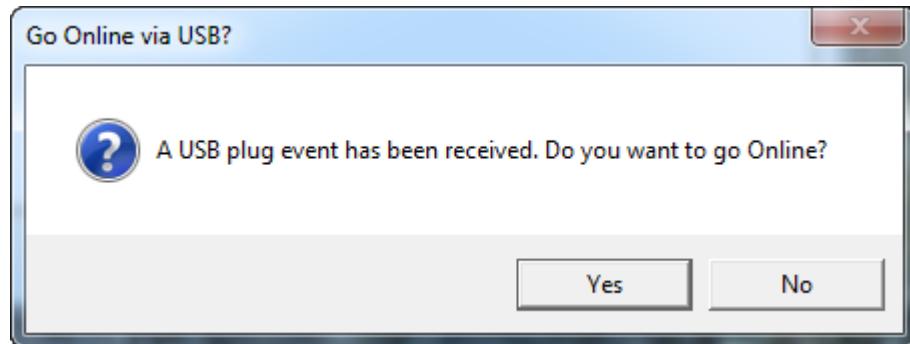
The USB control of a device from within ControlSpace Designer software offers an enhanced level of device control as compared to what is available from the front panel. Some devices, like the PM8500, are only available with a USB connection. In this case the devices do not support Parameter Set and Group control of individual processing blocks.

The USB connection may be used to configure processing parameters within the device, monitor device operation in real time, or to quickly service and replace an existing system.

**NOTE:** ControlSpace Designer software does not support simultaneous USB connections. Only a single device may be controlled via a point to point USB at one time; multiple devices connected to the PC via a USB hub is not supported.

## Initial USB Connection

When launching ControlSpace Designer software (or plugging in a PowerMatch amplifier while ControlSpace Designer is running) you will be prompted to establish a connection with the hardware



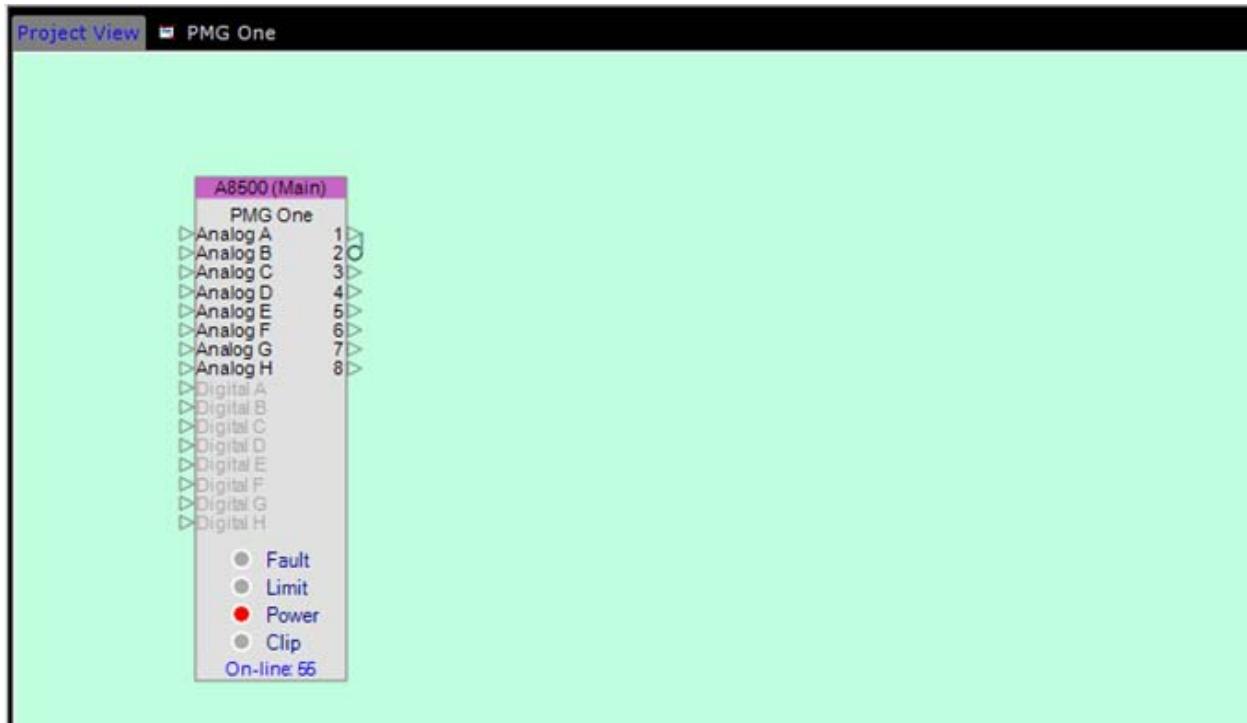
*USB Connection Dialog*

As the connection is established you will need to determine how you wish to connect to the hardware. Available options are to retrieve the hardware settings and display them within ControlSpace Designer, replace the current hardware settings with those in ControlSpace Designer software, or to do nothing.



*Settings Transfer Dialog*

Once the USB connection has been established between the PC and hardware the PM8500 is displayed within the Project View. An active USB device connection is indicated by green background in both the Project and Signal Processing Views.



## USB Device Numbering

Each USB device within a ControlSpace project uses a unique Device ID. The first USB device uses an ID of 1, and as devices are added to the project view the device IDs are automatically incremented.

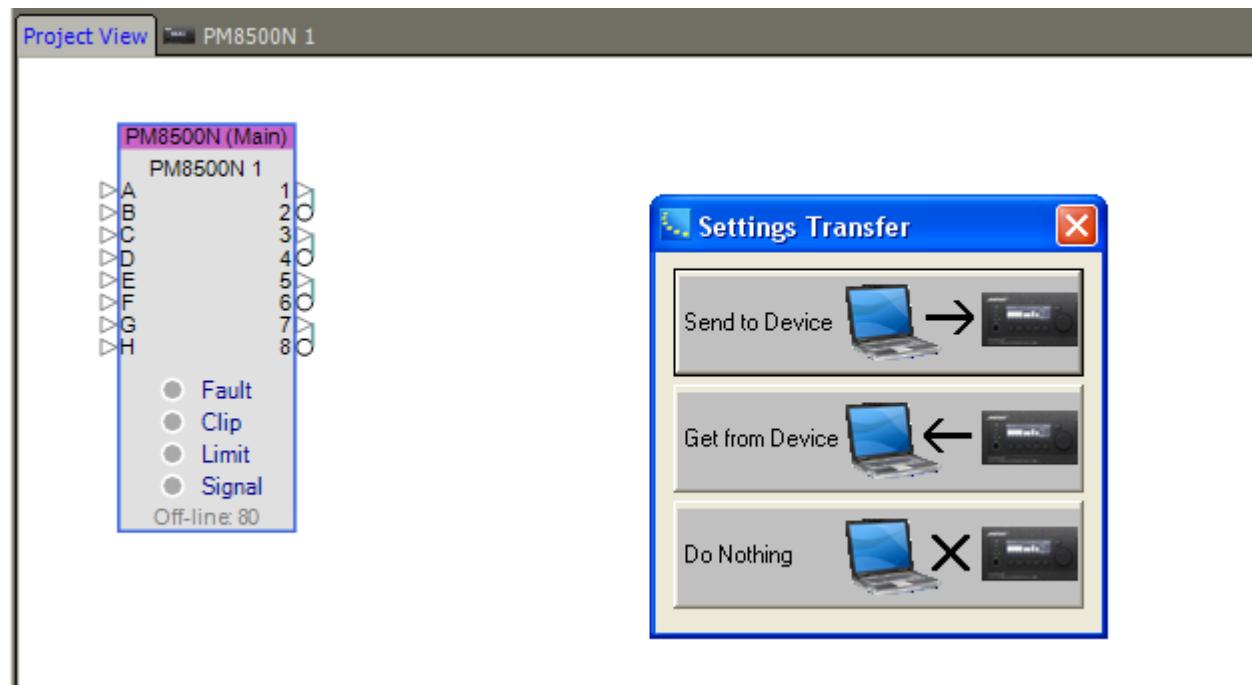
Each USB device ships with a Device ID of 1 from the factory. When multiple USB devices are used within a single project you will need to manage the device addresses carefully to avoid applying the incorrect settings to the hardware.

Once a device connection is established between a device and ControlSpace Designer software the association is stored with the Project File. This relationship is maintained for subsequent connections.

## Adding a Device to the Project via USB

When connecting to a device via USB ControlSpace Designer software determines if the new device exists within the project. If the device does not exist within the Project it will be automatically added to the Project View and a connection will be established.

If, however, a USB device of this type are already present within the Project View, and the Device IDs match you will be asked to determine how you would like to manage the hardware configuration and settings.



**Send To Device** – Applies the current configuration and processing settings of the Project View device to the hardware.

**Get From Device** – Applies the current configuration and processor settings of the hardware to the Project View device.

**Do Nothing** – Stops the connection process and restores control to the ControlSpace Designer software.

In some situations the Device ID of the hardware does not match any of the Device IDs within the Project. In this case you must determine if the hardware to which you are connected is represented by one of the current devices in the Project View, or if it is a new device which must be added to the project.

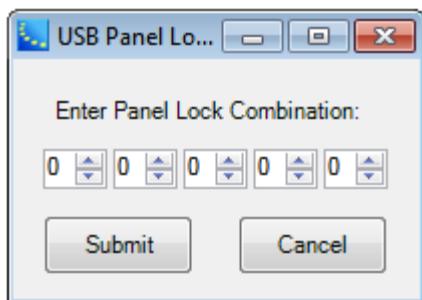


Selecting **Add New Device to Project** will add the device to the Project View, select OK and a connection will be established.

Selecting **Associate with Project Device** activates the Device List drop down menu. From this list select the Project View device to associate with the hardware. Select OK, and a connection will be established, and any hardware reconciliation dialogs will appear as necessary.

## Front Panel Lock Enabled

The PM8500/N may be configured to have the front panel locked to prevent access to the system. When a USB connection is established with a PM8500/N in a locked state you will be prompted to enter the front panel lock combination to enable the connection.



## Closing a USB Connection

USB connections may be closed by either selecting the Go Offline menu item from the System Menu, or by disconnecting the USB cable between the PC and hardware.

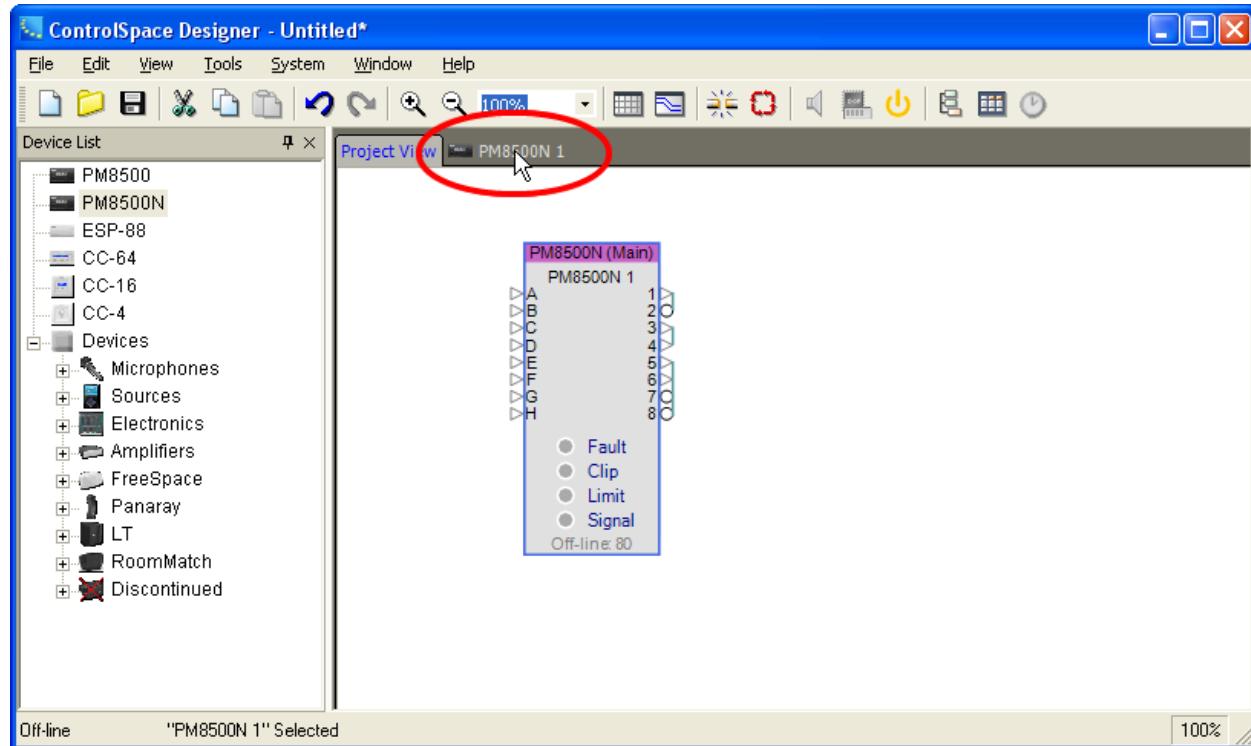
When supports the control of devices which are configured for USB control. The first time a USB enabled hardware device is connected to the PC you will be prompted to locate and load the correct USB driver for the device. Once this step is performed all subsequent connections via USB will occur automatically.

## Signal Processing

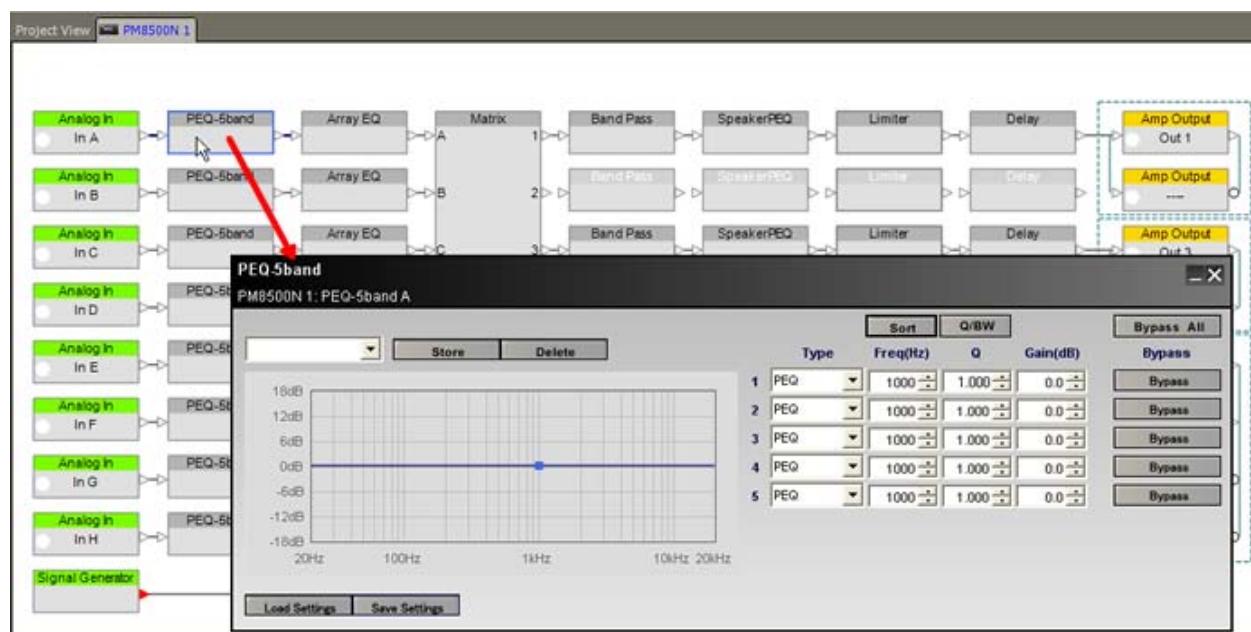
### Signal Processing View

PowerMatch amplifiers include an integrated loudspeaker processor to provide loudspeaker and array processing for Bose loudspeakers. A fixed block diagram architecture provides input signal processing, routing and output signal processing. The signal processing may be pre-configured and sent to the hardware upon connection, or configured while connected and the settings saved within the hardware.

To view the signal processing functions within the PowerMatch amplifier, select the amplifier's signal processing tab.

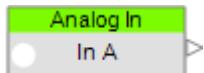


The signal processing view includes the full block diagram. To access any of the signal processing functions, double click on their device icon to expose their control panel.



## Input Control

Control of the input sensitivity for each of the eight inputs, and selection between the input source type, analog or digital, is accomplished using the Input Control Panel. Within the signal processing view each input is represented as a block.



**Input Type** – Displays the input type as either Analog, for analog inputs, or Digital for digital inputs as defined by the current hardware configuration.

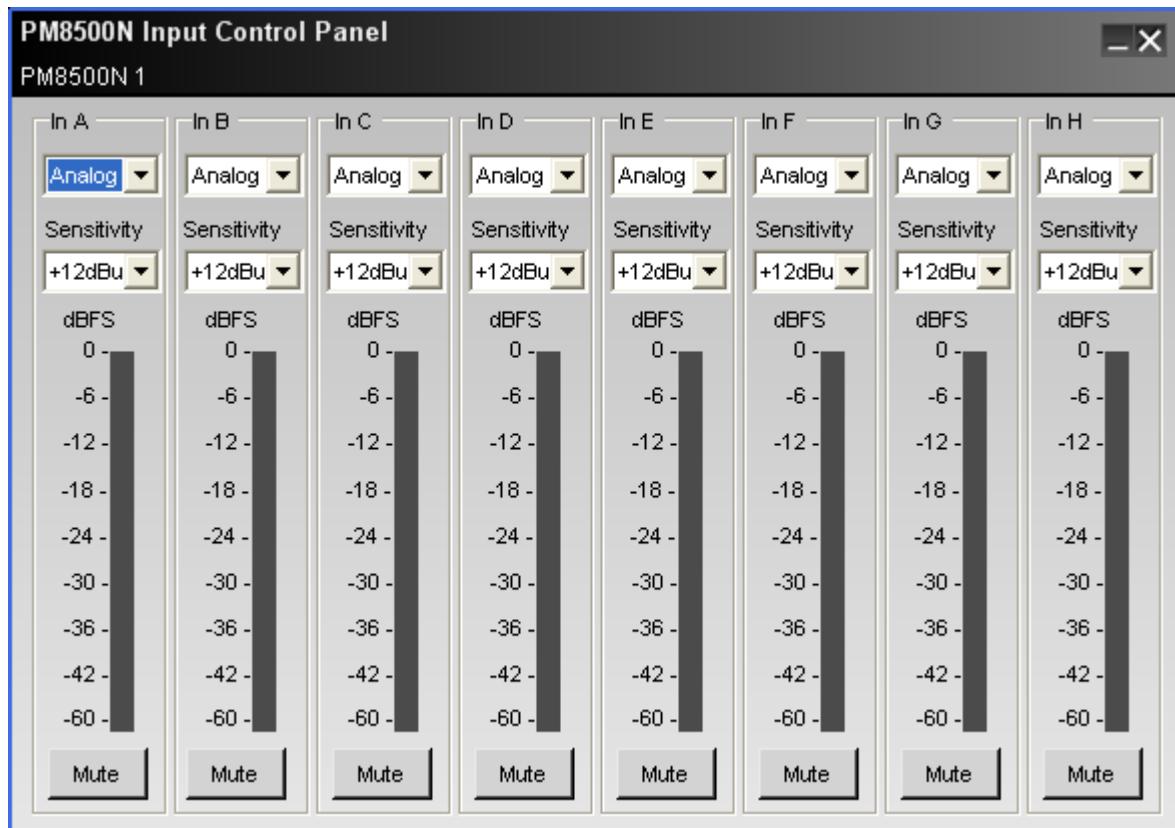
**Input Label** – Default label is “Input n”, and may be modified while off-line.

**Output Connection** – Displays the output connection status (active or mute), and is not user accessible (i.e. the user cannot “wire” this output to another input).

**Input Signal Level Meter** – Displays the current input signal level as green, yellow or red

To access the Input Control Panel, double click on any of the eight input blocks.

The available controls and indicators for the Input Control Panel are described below:



**Input Channel Label** – Default channel label is “In n” and reflects the label applied in the Signal Processing view.

**Input Source Select** – Select the desired input source – analog or digital for each input. The digital selection is only available when an ESPLink input card is installed.

**Input Channel Sensitivity** – Select the desired input signal level to drive the PowerMatch amplifier to its full output. This item is only available for analog inputs. Digital input sensitivity is found in the PM8500 properties panel.

The analog input sensitivity you select will determine the available input headroom and dynamic range of the input channel. When selecting the input sensitivity it is important to determine that appropriate level of noise performance for the application.

	Analog Input Sensitivity Selection			
	0 dB	+4 dB	+12 dB	+24 dB
Input Clip Point (dBu)	+14	+18	+24	+24
Input Headroom (dB)	14	14	12	0

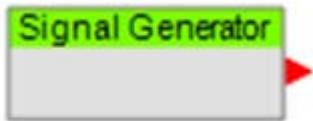
**Input Channel Signal Level Meter** – Displays the current input signal level and is scaled to 0 dBFS and OFF (-inf or MUTE).

The meter is monitoring the signal level post A/D conversion, and is monitoring the RMS signal level.

**Input Channel Mute** – Applies a full mute (no audio) to the selected input channel. When the input is in a mute state the input meter is still active as a reference.

## Signal Generator

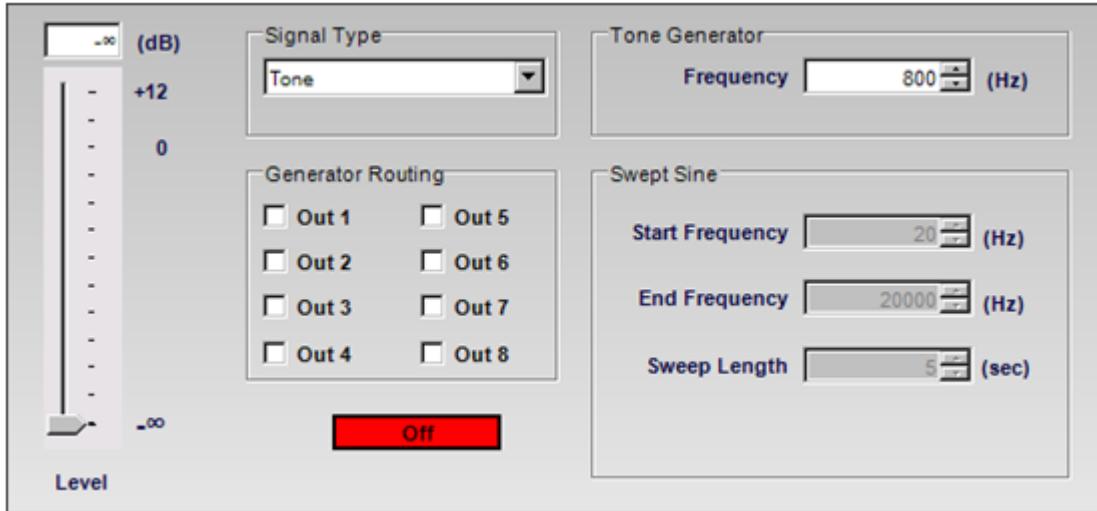
A signal generator is available within the PM8500 signal processing diagram to provide the functions of a tone, sweep and noise generator. Within the signal processing view, each Signal Generator is represented as a block. By default, the signal generator is muted to prevent accidental damage to any loudspeakers connected to the amplifier outputs.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

**Output Connection** – Displays the output connection status (active or muted).

The available controls and indicators contained within the Signal Generator Control Panel are:



**Level** – Adjusts the output level from the signal generator

**Signal Type** – Selects the type of signal type to be generated: Pink Noise, White Noise, Tone, or Sweep.

**Generator Routing** – Selection for the output where the signal generator will be routed.

**Generator On/Off** – Activates or deactivates the noise generator

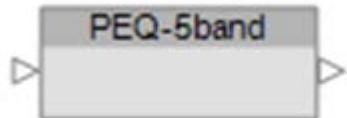
**Tone Generator Frequency** – Selects the desired frequency for the tone generator in Hertz.

**Swept Sine (Start/End/Length)** – Defines the start and stop frequencies, in Hertz, and the sweep length, in Seconds.

**NOTE:** It is possible to create a reverse sweep by setting the Start Frequency higher than the End Frequency.

## Input Parametric EQ

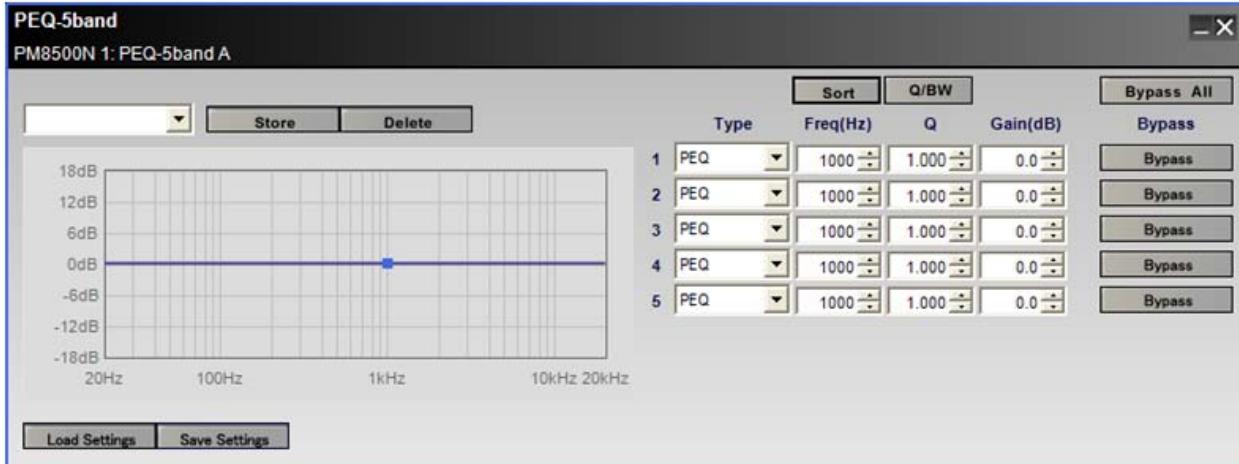
Each input signal processing chain includes an Input Parametric EQ. Within the signal processing view each Parametric EQ is represented as a block.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access a Parametric EQ Control Panel, double click on its signal processing block.

The available controls and indicators for the Parametric EQ Control Panel are described below:



**EQ Preset Select** – Selects a previously stored preset and applies its settings to the PEQ, or saves the current settings as a Preset

**EQ Graph** – Graphs the current EQ settings.

**Load/Save Settings** – Loads the settings from a stored .peq file, or saves the current settings as a .peq file.

**Filter Type** – Defines the filter type for the selected filter stage. Available options are PEQ, High Self, Low Shelf, Notch, High Pass and Low Pass.

**Frequency** – Defines the frequency, in Hertz, where the filter is applied.

**Q** – Defines the Q of the filter for PEQ and Notch filters.

**Gain** – Defines the amount of boost/cut applied to the EQ stage

**Bypass** – Bypasses the selected EQ stage

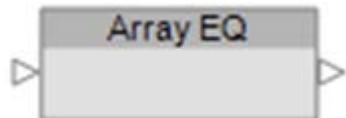
**Sort** – Sorts the filter stages by Frequency

**Q/BW** – Switches between Q and Bandwidth

**Bypass All** – Bypasses all filter stages.

## Array EQ

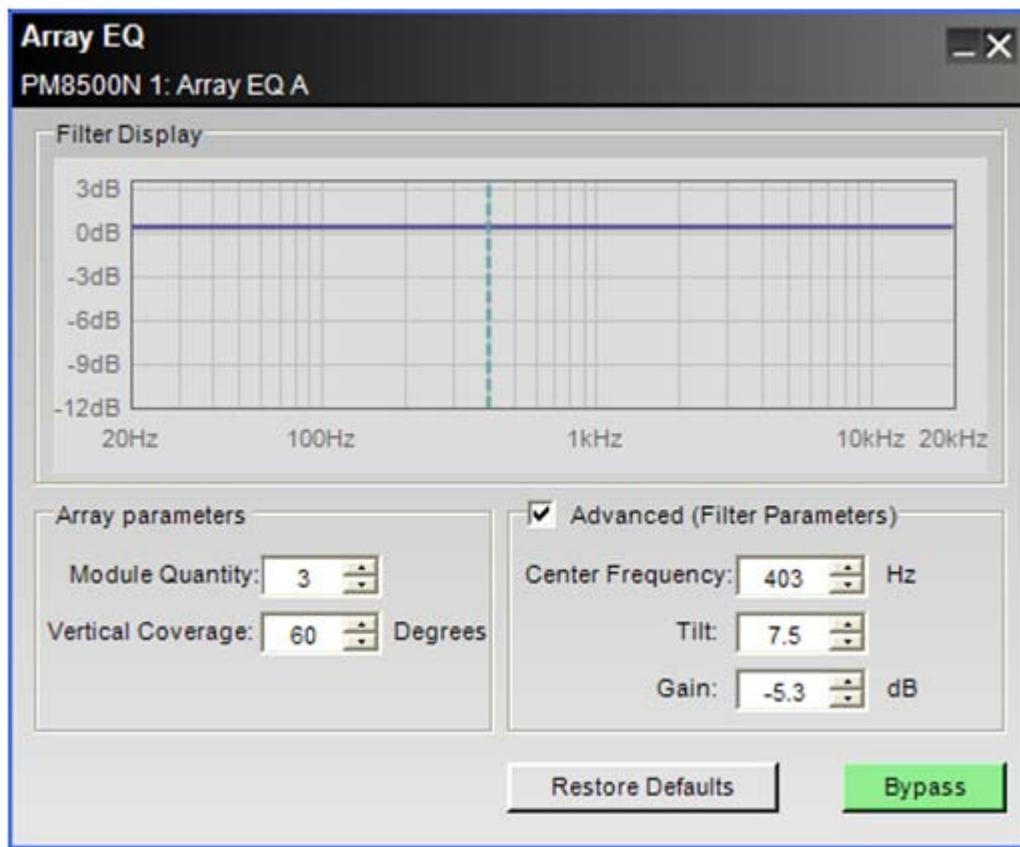
The Array EQ signal processing function provides specialized equalization for RoomMatch arrays. This unique EQ processor may be used as a general purpose room compensation EQ for standard systems.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Array EQ control panel, double click on its signal processing block in the signal processing view. The default state of the Array EQ is Bypass to provide a flat initial response.

The following controls are available within the Array EQ:



**Filter Display** – Displays a graphical representation of array equalization settings in both frequency and level. The line represents the composite frequency response of chosen array and advanced filter parameters.

**Array Parameters** – Specifically for use with RoomMatch Progressive Directivity Arrays.

**Module Quantity** – Selects the quantity of RoomMatch modules within the array.

**Vertical Coverage** – Enters the total vertical angle, in degrees, of the array.

**Advanced (Filter Parameters)** – The RoomMatch Array EQ is represented by three basic filter controls: center frequency, tilt and gain. Using these controls the basic array preset may be modified, or a new array or room EQ may be created.

**Center Frequency** – Center frequency of the filter, represented by the dashed line in the Response Graph.

**Tilt** – Adjusts the start and end points of the filter's slope on either side of the center frequency. Tilt is adjustable between 0 and 10 in steps of 0.3, the greater the tilt the steeper the filter slope.

**Gain** – Amount of boost or cut applied to the filter below the center frequency. Gain is adjustable in 0.3 dB steps between -12 and +2 dB.

## Matrix

The Matrix processor routes any input source to one or multiple outputs, or multiple inputs may be routed to a single output. Within the matrix control panel it is possible to apply a cut-only gain to each of the matrix cross points.

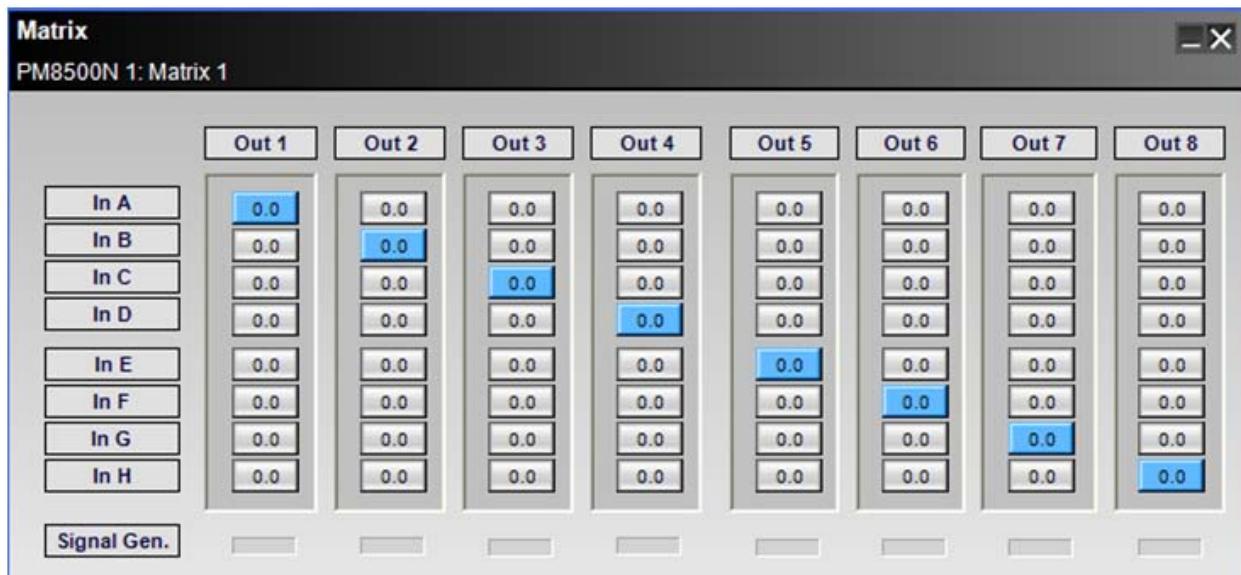


**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

**Output Connection** – Displays the output connection status (active or mute).

To access the matrix mixer control panel, double click on its block in the signal processing view.

The matrix mixer contains the following controls:



**Input Label** – The input label for each input is determined by the input label for the analog/digital input. To modify an input label for the router, modify the input label property for the input block.

**Output Label** – The output label for each output is determined by the output label for the output block. To modify an output label for the router, modify the output label property for the output block.

**Assign** – Each input is routed, by default, to its corresponding output, 1:1 routing. To route an input to an output select the desired input. Multiple inputs can be routed to a single output

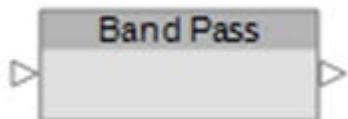
**Cross Point Gain** – available using a right-click selection at any cross point

**Signal Gen.** – Indicates the routing of the signal generator. To change the routing of the signal generator use the Signal Generator control panel.

## Band-Pass Crossover

The Band Pass Crossover function provides a single mono crossover for the output signal processing chain. The Band Pass Crossover supports general purpose operation with user defined settings, or provides the loudspeaker specific band pass when a Bose loudspeaker parametric EQ is active.

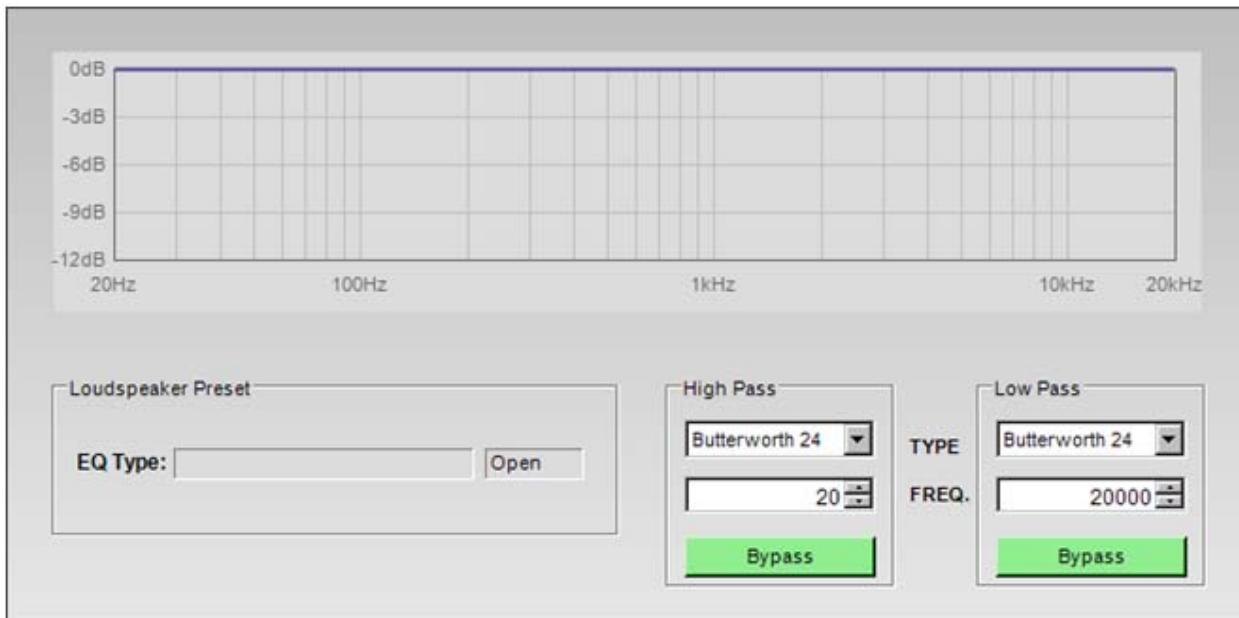
Within the signal processing diagram the Band Pass Crossover is represented by a single block.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Band Pass Crossover control panel, double click on the block in the signal processing view. The default state of the Band Pass Crossover is Bypass to provide a flat initial response.

The following controls are available within the crossover block:



**Response Graph** – Displays the response curve of the High and Low Pass filter settings.

**Loudspeaker Preset** – When a Bose or custom loudspeaker EQ preset is loaded in the loudspeaker parametric EQ name of the active preset is displayed. Bose loudspeaker presets will cause the band pass controls to be locked. When the controls are locked, “lock” is displayed in the status section next to the EQ Type display.

**High Pass Filter Type** – Affects the low frequency cut off of the crossover. Available filter types are Butterworth (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> order), Bessel (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> order), and Bessel (2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> order).

**High Pass Frequency** – Defines the corner frequency of the filter.

**High Pass Bypass** – when active the high pass filter is bypassed.

**Low Pass Filter Type** – Affects the high frequency cut off of the crossover. Available filter types are Butterworth (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> order), Bessel (1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> order), and Bessel (2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and 8<sup>th</sup> order).

**Low Pass Frequency** – Defines the corner frequency of the filter.

**Low Pass Bypass** – when active the low pass filter is bypassed.

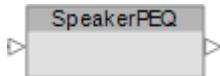
## Loudspeaker Parametric EQ

The Loudspeaker Parametric EQ is a new type of signal processing block which provides either a general purpose 9-band parametric EQ, or a Bose loudspeaker equalization curve. When a Bose loudspeaker equalization curve is active additional settings are applied

to the Band Pass Crossover, Delay and Limiter signal processing blocks, and the settings are locked to prevent modification.

A custom set of loudspeaker settings (Band Pass, Parametric EQ, Delay and Limiting) may be saved as a preset for future use, or a Bose loudspeaker preset may be saved as a starting point for further customization.

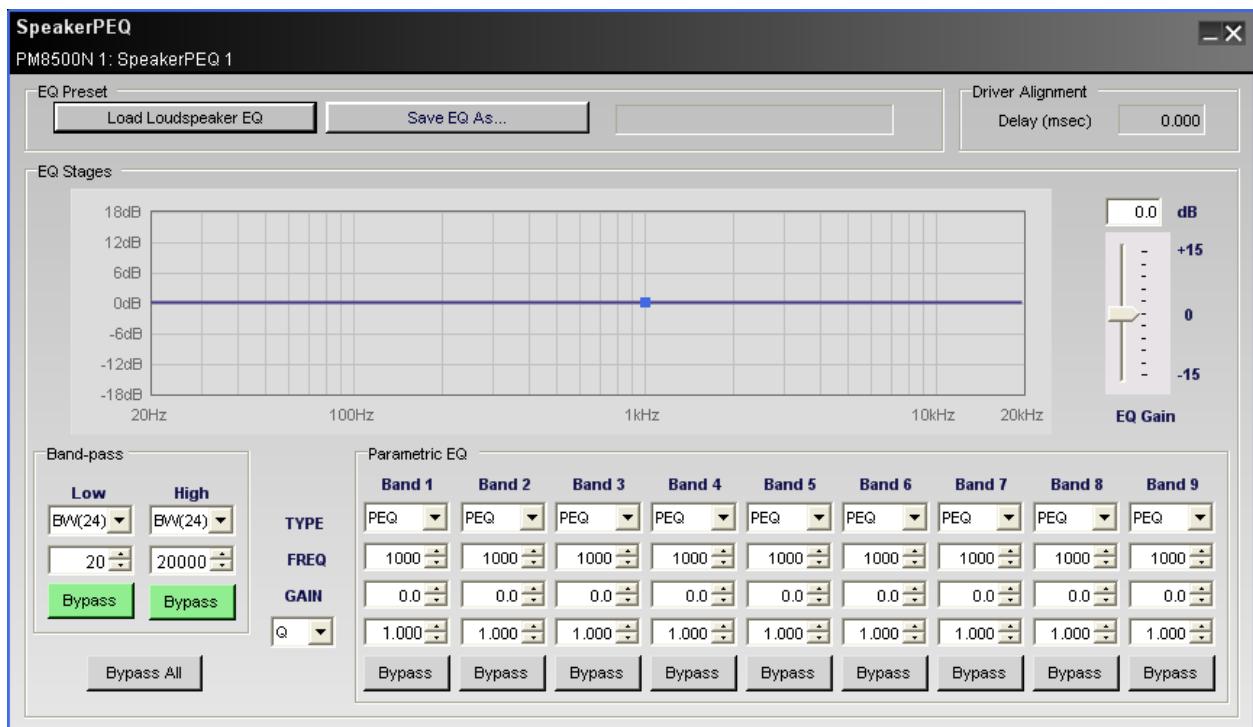
Within the signal processing diagram the Loudspeaker Parametric EQ is represented by a single block.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Loudspeaker Parametric EQ control panel, double click on the block in the signal processing view. The Loudspeaker Parametric EQ provides 9 bands of parametric EQ, and provides access to the Band Pass Crossover settings as a convenience.

The following controls are available within the Loudspeaker PEQ block:



**Load Loudspeaker EQ** – Displays a "file open" dialog with the Bose loudspeaker EQ directory as the default setting. From within this directory, locate and open the desired loudspeaker preset file.

Once a Bose loudspeaker EQ is loaded into the Loudspeaker PEQ, the settings for the Band Pass Crossover, Parametric EQ stages, Delay and Limiter are disabled to prevent modification, and the name of the loudspeaker EQ preset is displayed.

**EQ Type** – Displays the name of the loudspeaker EQ which is loaded.

**Save EQ As...** – Saves the loudspeaker settings (parametric stages, band pass filter settings, limiter settings and alignment delay setting) as a custom file for use in another channel of signal processing or design. The default location for the Save As... function is "My Documents."

**Driver Alignment** – Displays the amount of driver alignment delay used. This is a read-only parameter for Bose loudspeaker EQs.

**EQ Graph Display** – Illustrates the current response curve that is implemented. Nine grab handles, one for each band, are available and the user may directly adjust the frequency and gain for each band. Note that the graph includes the response of the band-pass filter settings.

**EQ Gain** - Makeup gain applied post EQ. Up to +/- 15 dB of gain may be applied.

**Band-Pass Filters** – This section mirrors the controls within the Band Pass Crossover block. Changes made here are reflected in the Band Pass Crossover and vice versa.

**Parametric EQ Bands** – Nine bands of parametric EQ are available. Each band contains the following functions:

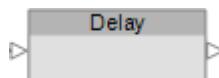
- Filter Type – PEQ, High Shelf, Low Shelf or Notch
- Center Frequency of filter in Hertz.
- Gain of filter in 0.5 dB steps between +20 dB and -20 dB.
- Octave (Bandwidth) / Q of filter between 0.14 and 6.67 Octaves in .01 Octave steps (filter Q between 0.1 and 10). A user selection is available to change the display and data entry between Octave (Bandwidth) and Q.
- Bypass button to bypass the selected EQ band.

**Bypass All** – bypasses all PEQ bands and band pass filters.

## Signal Delay

A signal alignment delay is provided to accommodate cluster or zone signal alignment. A secondary delay is indicated for Bose loudspeaker signal processing which may not be modified.

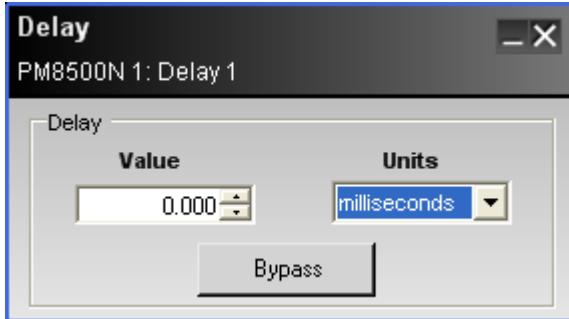
Within the signal processing diagram the Delay is represented by a single block.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Delay control panel, double click on the block in the signal processing view. The Delay provides up to 2 seconds of signal delay per output channel.

The following controls are available within the Loudspeaker PEQ block:



**Value** – Amount of signal delay applied based on the selection within the Units drop down list.

**Units** – The method used to determine the amount of signal delay. Available selections are: milliseconds, sample, meter, millimeter, feet, and inch.

## Limiter

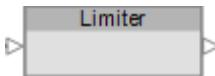
A Limiter provides both peak and RMS voltage limiting for loudspeaker driver protection.

**NOTE:** The limiter block is shown in the processing diagram before the output gain stage, but functionally, the output gain is pre-limiter to provide proper operation.

The limiter may be used as a general purpose peak and RMS limiter. In this application, the peak voltage should be set to prevent over-excitation of the driver, and the RMS limiter should be set to the power handling of the driver; both the peak and RMS values are entered in Volts.

When a Bose loudspeaker preset is active, the limiter settings are specific to the Bose loudspeaker, and the settings are visible but may not be adjusted.

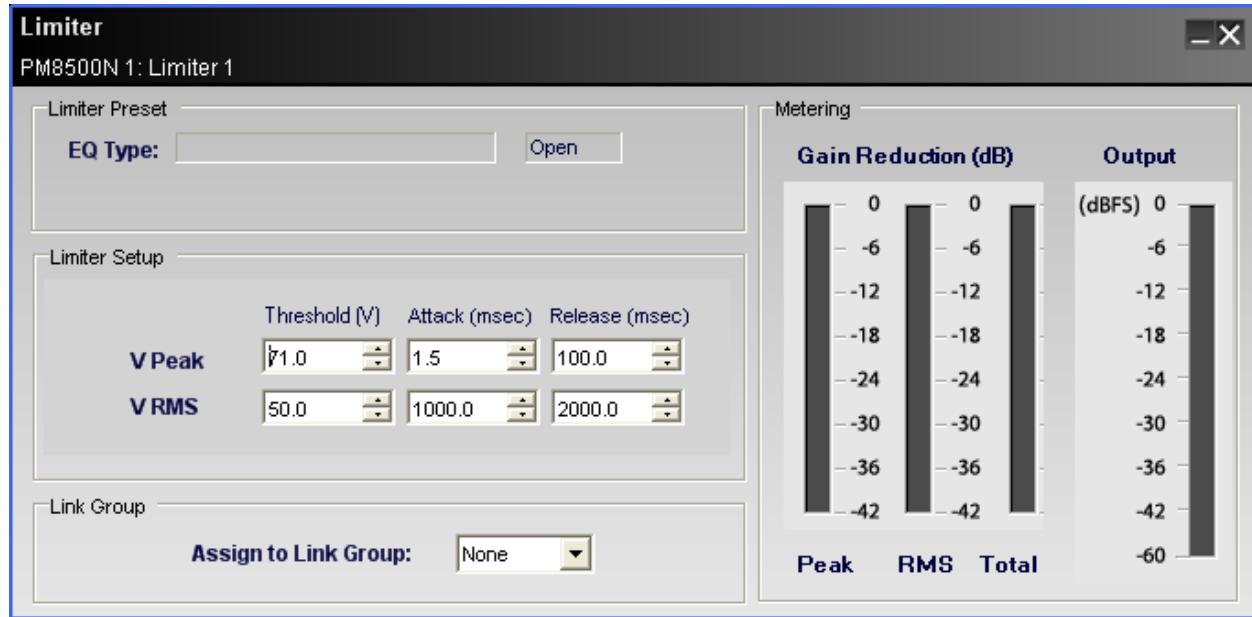
Within the signal processing diagram the Limiter is represented by a single block.



**Block Label** – Default label hidden in the signal processing view, but may be modified while off-line. This information is used in serial communications.

To access the Limiter control panel, double click on the block in the signal processing view. The Limiter provides Peak and RMS limiting, a linking function, and metering of the Peak and RMS limiting, as well as the channel output level.

The following controls are available within the Limiter block:



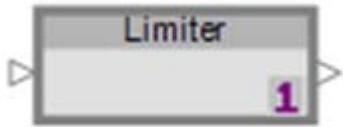
**EQ Type**— Displays the currently selected loudspeaker equalization curve within the Loudspeaker EQ processing block.

**Peak Voltage Limiting** – The Peak Voltage Threshold defines the behavior of the Peak Voltage limiter and corresponds to the maximum voltage which may be applied to the driver without causing over-excitation. The read-only attack and release times are shown.

**RMS Voltage Limiting** – The RMS limiter behavior is defined by the RMS Voltage Threshold, Attack Time (ms) and Release Time (ms). The RMS voltage setting corresponds to the long term power handling capability of the loudspeaker.

**Link Group** – The limiter may be assigned to one of four link groups, or may act independently (no assignment). When channels are linked the presence of limiting on any of the linked channels engages the limiter on all linked channels.

When Limiters are linked their signal processing view graphic displays the Limiter Link Group assignment, and the appearance changes as shown below:

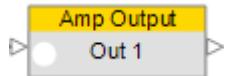


**Metering** – Meters display the amount of gain reduction, in dB, for both the Peak and RMS limiters. A third meter displays the total gain reduction (the greater of either Peak or RMS), in dB, being applied to the signal. An output gain meter is included to assist in the set up and configuration of the limiter.

## Output Attenuation

The Output Attenuation block provides control over the amplifier output for the PowerMatch amplifier. Control of the output attenuation is available for each of the eight outputs, based

upon the current output configuration, and is accomplished using the output Control Panel. Within the signal processing view each output is represented as a block.

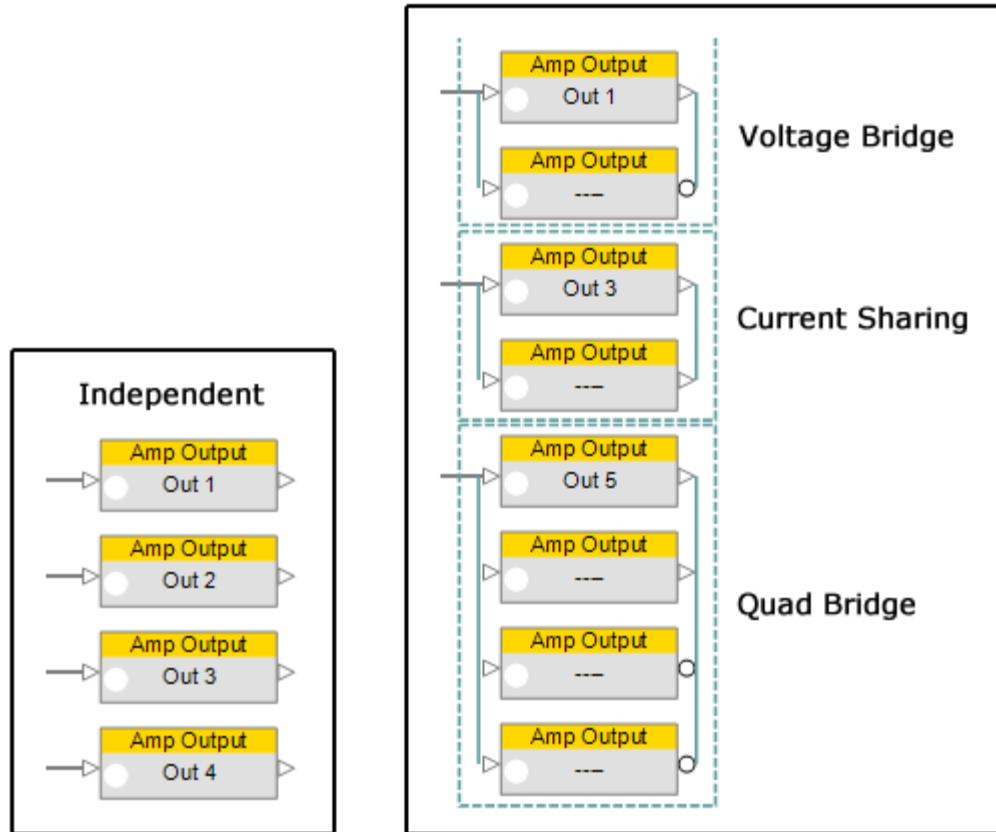


**Output Label** – Default label is “Out n”, and may be modified while off-line.

**Output Connection** – Displays the output connection status (active or mute), and is not user accessible (i.e. the user cannot “wire” this output to another input).

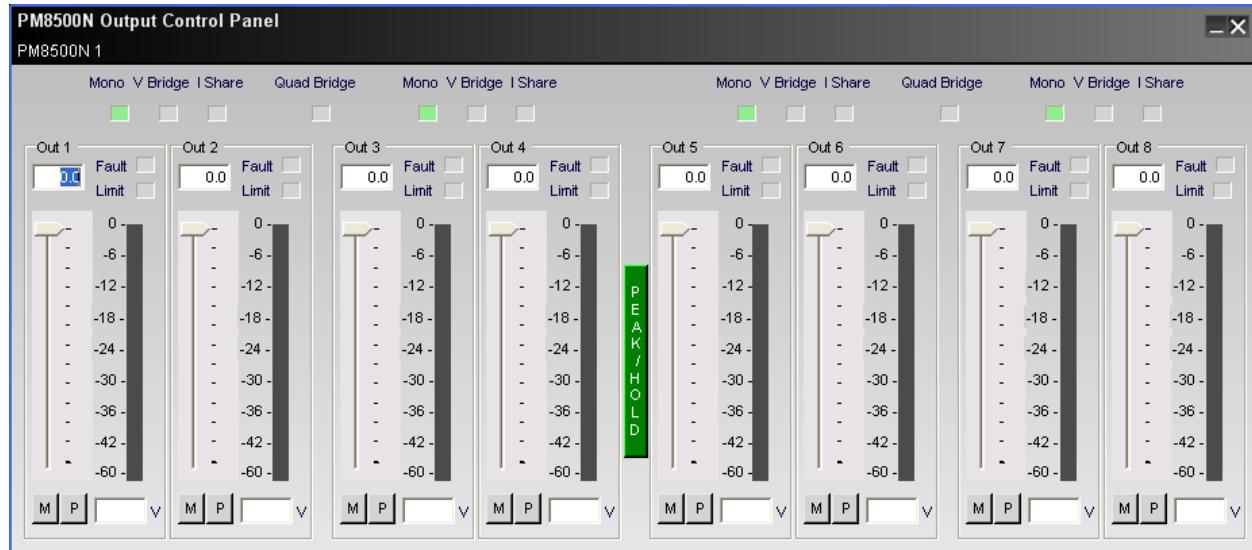
**Output Signal Level Meter** – Displays the current input signal level as green, yellow or red

**Output Configuration** – The current output configuration is displayed as either individual/mono, Voltage Bridge, Current Share or Quad Bridge.



To access the Output Attenuation control panel, double click on any of the Output blocks in the signal processing view. Each of the output channels is available on the Output Attenuation control panel.

The following functions are included for each output control:



**Output Mode Indicators** – Displays the current output configuration for each channel pair. The following are the valid configurations:

**Mono** - Configured for independent channel operation

**V Bridge** – Configured for voltage bridging operation, 2x Voltage output. This configuration may drive a low impedance, 4 or 8 Ohm, or high impedance, 70 or 100V.

**I Share** – Configured for current sharing operation, 2x output current. This configuration may drive a low impedance, 2 or 4 Ohm, only.

**Quad Bridge** – Configured to use four channels simultaneously to provide 4x the output Voltage. This configuration may drive a low impedance, 4 or 8 Ohm, or high impedance, 70 or 100V.

When configured for Quad bridge, the two channel pairs are both configured for current sharing operation, and the Quad Bridge indicator is present as shown:



**Output Channel Label** – Default channel label is “Out n” and can be modified when offline. Channels used for Bridge or QuadBridge operation are shown with a “---”.

**Fault Indicator** – Indicates the present of a fault condition within the amplifier channel. Clicking on the Fault indicator displays the Alarm Panel. From here, details about the fault condition can be viewed, and the fault may be cleared.

**Output Protection Limit Active Indicator** – Illuminates yellow when any of the following amplifier protection mechanisms are engaged: Peak or RMS Voltage limiter active, gain reduction due to amplifier temperature, gain reduction due to power supply temperature.

**Output Channel Attenuation** – Displays the output attenuation between 0 dB (full gain) and -infinity dB. This is a user-accessible display where the user may enter a numeric value using a -00.0 format.

**Output Channel Attenuation Slider** – Attenuates the output gain between 0 dB (full gain) and -infinity dB.

**Output Channel Signal Level Meter** – Displays the current output signal level and is scaled to 0 dB (full gain) and -80.

**Output Channel Mute** – When active, mutes the output of the selected channel.

**Output Channel Signal Polarity** – When active, reverses the signal polarity.

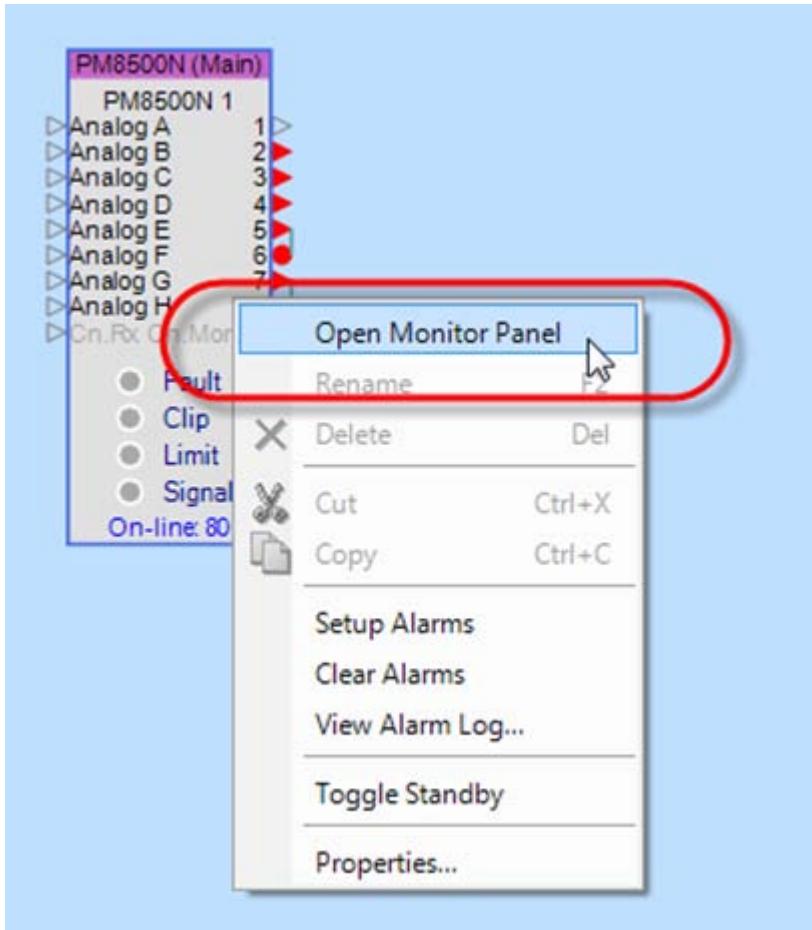
**Output Voltage Display** – Displays the current output voltage of the amplifier channel.

## PowerMatch Monitor Panels

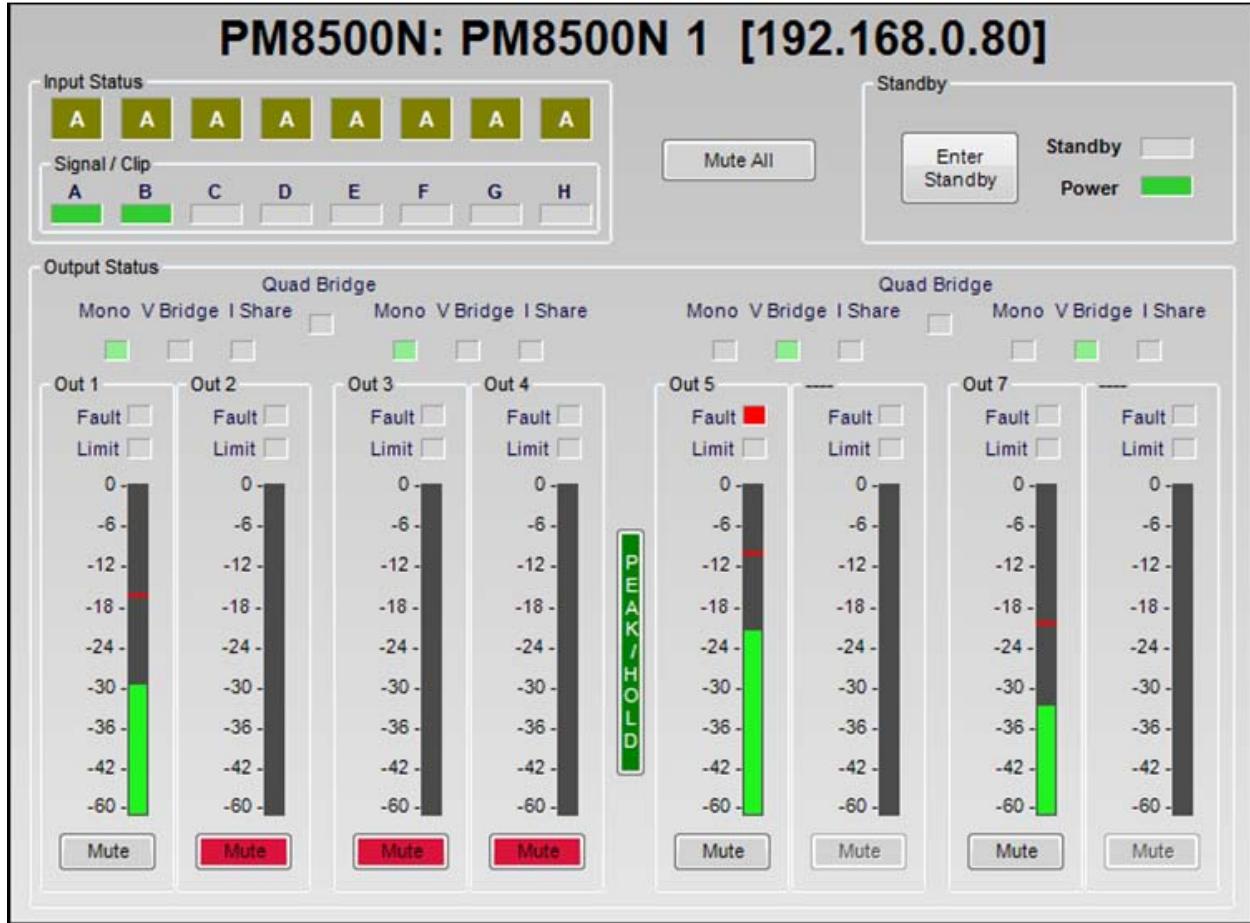
Two types of monitor panels are available for the PowerMatch amplifiers:

- A full size monitor panel which displays the status of inputs, outputs and faults, as well as provides the ability to put the unit into standby
- A small amplifier status panel which is displayed when the system status function is enabled

To access a PowerMatch amplifier's monitor panel, select **Open Monitor Panel** from the right click menu of the PowerMatch amplifier within the Project View.



The full size PowerMatch monitor panel provides an overview of the current operational status of the device, and a control to place the amplifier into/out of standby.



From within the PowerMatch amplifier's monitor view, the following functions are available:

**Input Status** – Displays the currently active input source (Analog/Digital), the Input Card type, and the input signal level for each of the eight inputs (A to H).

**Mute All** – Mutes all output channels.

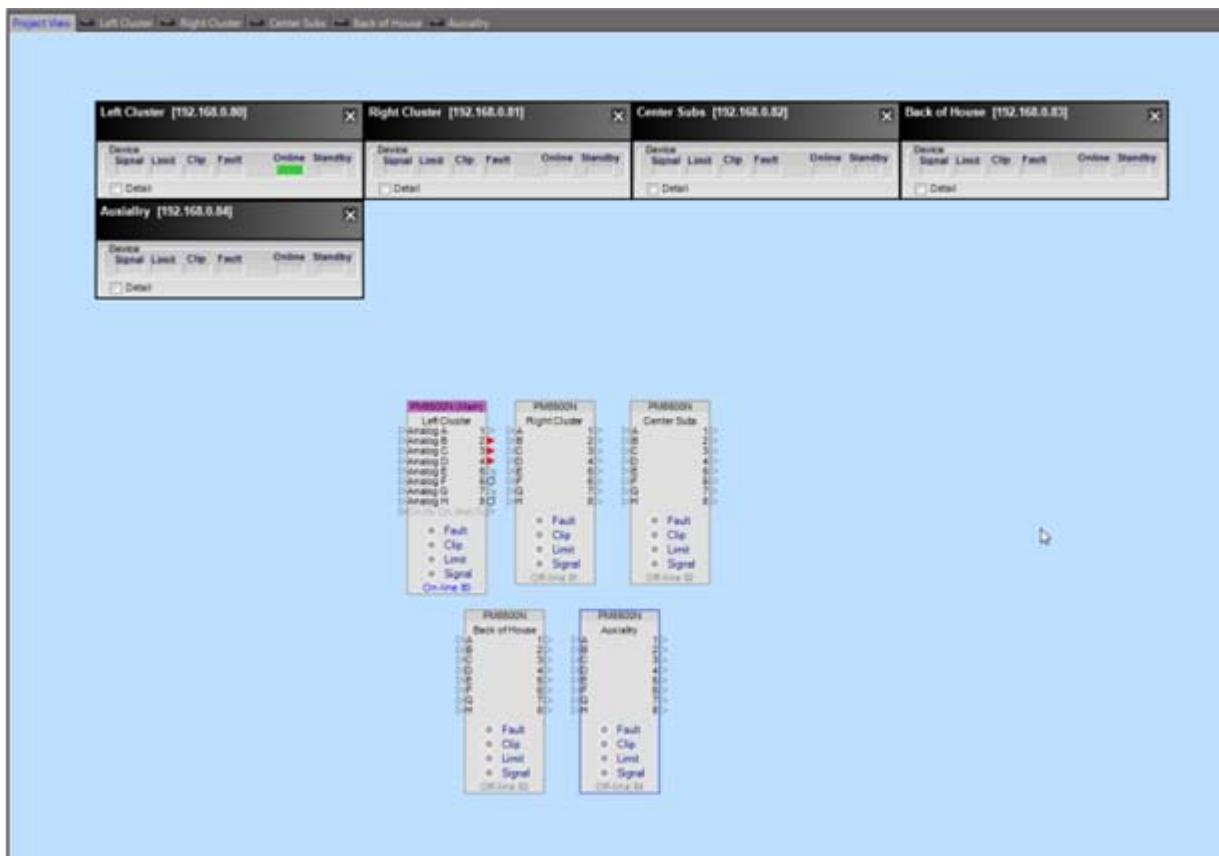
**Enter Standby** – Toggles the standby state of the amplifier

**Output Status** – Displays the output status for each output of the amplifier. Included indicators are the output label, channel configuration, channel alarm status, limiting/protect status, the current output signal level, and an output mute.

When the System Status function is enabled the amplifier status panels for all PowerMatch amplifiers are displayed according to the selected display options, (**AutoTile** and **Collapsed View**).

To access the System Status function, select the system status icon  while on-line and connected to the system.

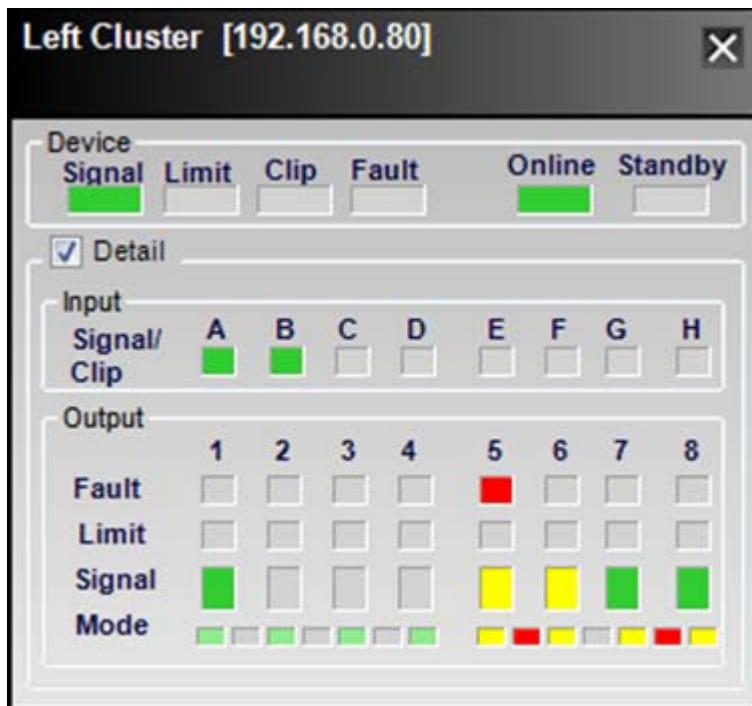
## ControlSpace Designer 3.1 Software Guide



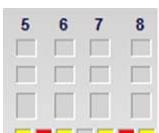
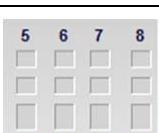
Each amplifier status panel is displayed using either a collapsed or expanded view. In the collapsed view only the primary status indicators are available.



Select Detail to expand the amplifier status panel to see all of the amplifier's status indicators.



Indicator	Status
<b>Signal</b>	Green when input signal level is present on any input channel.
<b>Limit</b>	Yellow, when any output limiter is active.
<b>Clip</b>	Red when input clipping is present.
<b>Fault</b>	Red when an alarm condition is active. See the alarm properties within the device properties to configure which alarms conditions will activate this indicator.
<b>Online</b>	Green when device is online
<b>Standby</b>	Green when device is in standby
<b>Input Signal Level (channel)</b>	Green, Yellow, Red based on input signal level.
<b>Output Fault (channel)</b>	Red when an alarm condition exists. Click on the Fault indicator to view the amplifier alarm panel. Note this displays all alarms, regardless of the settings within the device properties.
<b>Output Limit (channel)</b>	Orange when output limiter is active.

<b>Output Signal (channel)</b>	Green, Yellow, Red based on output signal level.
<b>Output Mode (channel)</b>	Each of the four operation modes is represented using the mode indicators as follows:
	 Mono
	 Voltage Bridge
	 Current Share
	[Add screenshot] Quad Bridge

## Working With Alarms

Each PowerMatch amplifier monitors its operation for proper operating temperature, power supply status, amplifier status, open and short wiring, as well as additional alarm conditions. This information is stored locally in an internal log of all alarm conditions, and information from the alarm log may be viewed using the ControlSpace Designer software.

In systems where the ControlSpace Designer software is connected to the devices, either via USB or Ethernet, the time and date of the alarm condition is appended to the alarm.

### Alarm Summary

The PowerMatch amplifiers monitor the following alarm conditions:

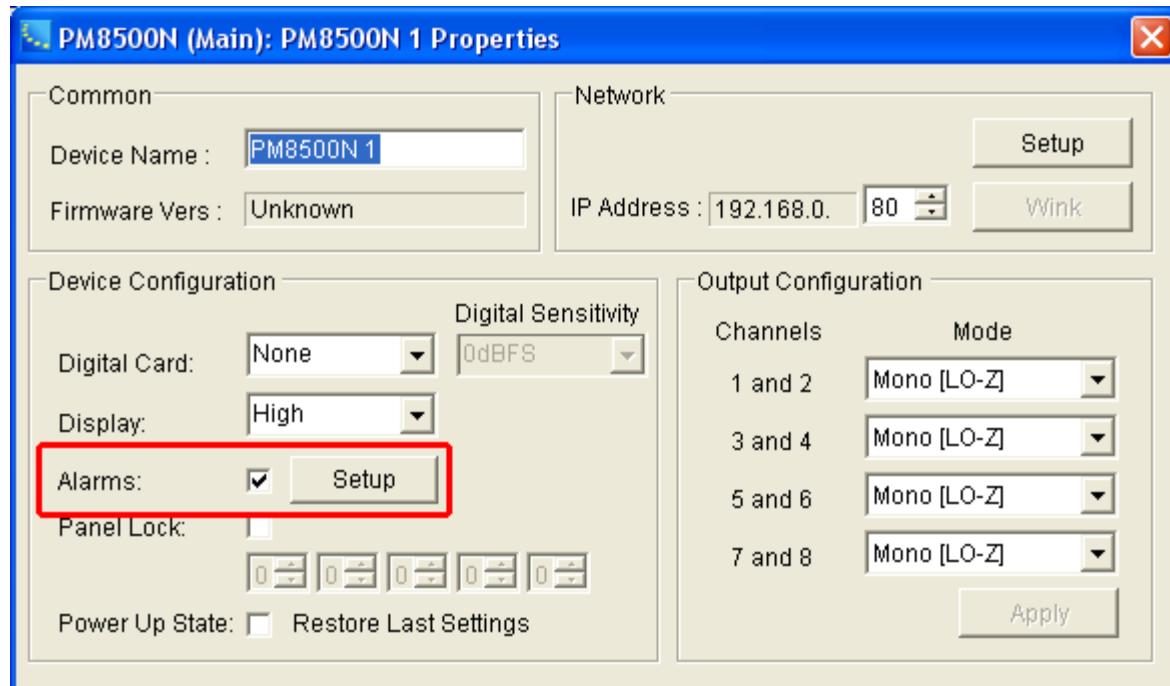
Category	Alarm Condition	Description
Gain Reduction, Signal Limiting	Limiter Active due to high output current	Protection limiter engaged for any output channel.
Output Fault	Open Circuit	An open circuit, output impedance is greater than 20 Ohms.

Output Fault	Short Circuit	A short circuit detected on an output – output impedance is less than 1 Ohm. This alarm condition is always active and may not be disabled.
Input Fault	Input Clipping	Input Signal Clipping
Input Fault	Loss of Digital Audio Source	Digital audio source expected, but digital audio source is not operational.
AC Power Fault	Loss of AC Power	

## Fault Output Configuration

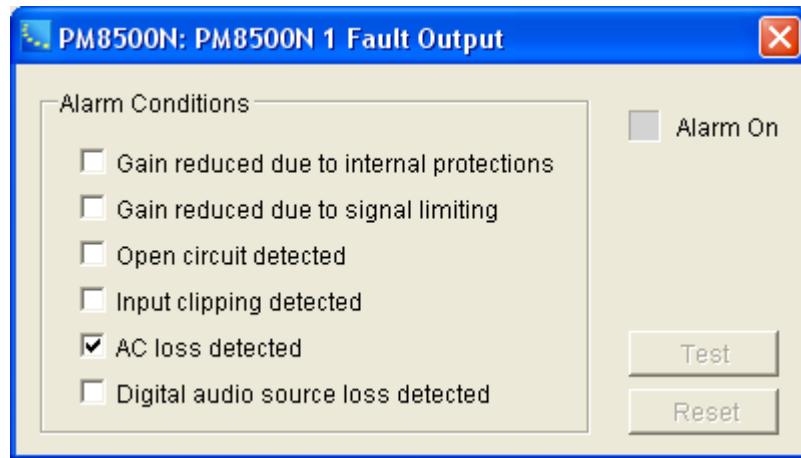
The PowerMatch amplifier includes a hardware fault output capable of driving a normally open, or normally closed contact closure, 1A, 30 VDC maximum. The fault output is intended to provide an external connection to a remote system monitor for fault notification purposes.

The fault output must be enabled for operation, and must have alarm conditions defined which will trigger its operation. This is accomplished from within the Properties Panel of the PM8500 or PM8500N.



**Enable Alarms** – when alarms are enabled the selected alarm conditions will trigger the fault output and front panel fault LED.

**Setup Alarms** – select this item to determine which alarms will trigger the front panel LED and fault output. When selected the Alarm Conditions dialog is displayed.



From within the Alarm conditions dialog you may select which alarm types will trigger the hardware Fault Output and front panel Fault LED. By default the only alarm condition selected is the AC Power Loss alarm.

**Alarm Conditions** – The state of an alarm condition determines how the alarm will be logged, and reported via the Fault Output, front panel Fault LED, and within the ControlSpace Designer software. The following table summarizes the reporting and display for each alarm condition based on its selected state.

[insert table of alarms]

**Alarm ON Indicator** – indicates the presence of an alarm condition.

**Alarm Test** –available when online with the PM8500, selecting Test will trigger the Fault Output and Front Panel LED.

**Alarm Reset** – available when online with the PM8500, selecting Reset will reset the Fault Output and Front Panel LED.

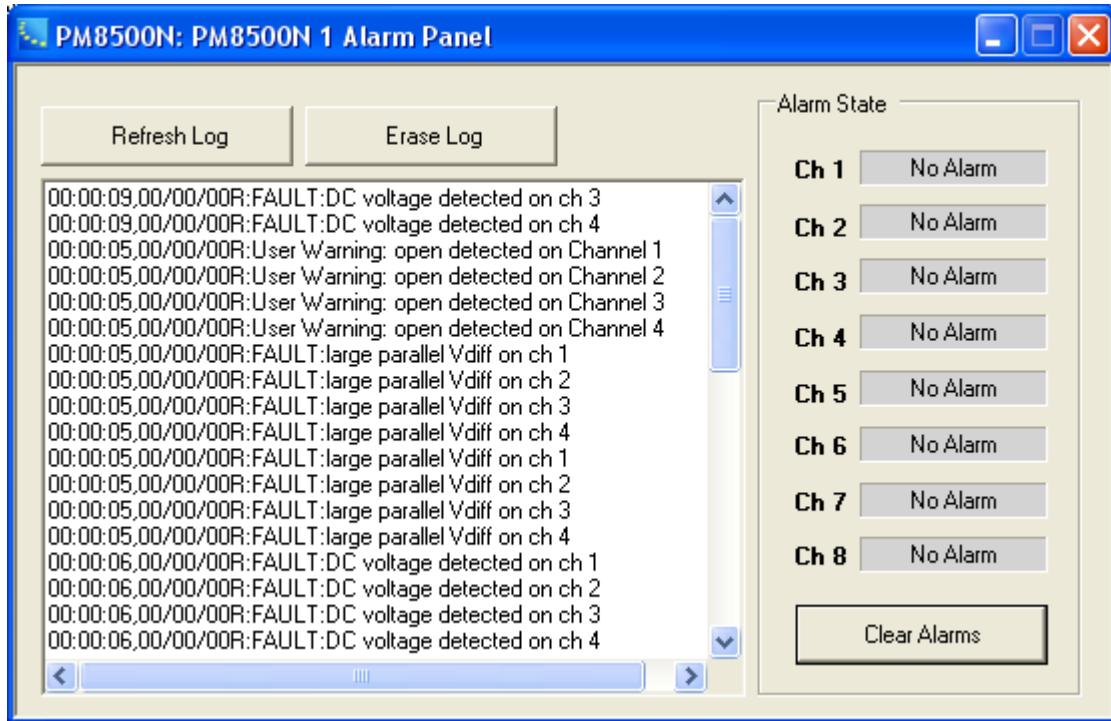
## Viewing the Alarm Log

Upon connection to the PM8500 the ControlSpace Designer software automatically retrieves the alarm log from the hardware. The alarm log may be accessed from a variety of locations from within the PM8500 interface.

To access the PM8500 alarm log use one of the following options:

- Select **View Alarm Log** from within the right-Click context menu for the PM8500 in the Project View
- Click on the **Fault** indicator within the PM8500 Monitor Panel
- Click on the **Fault** indicator within the PM8500 Output Control Panel

Once you have accessed the PM8500 alarm log, the alarm log panel is displayed:



From within the Alarm Log Panel you can view, copy, erase and clear alarms. The following functions are provided:

**Refresh Log** – Updates the alarm list to display the most recent alarms that have occurred.

**Erase Log** – Clears the alarm log from both the software and hardware.

**Alarm List** – Displays the list of alarms which have occurred. Alarms are suffixed with either "R" or "A." "R" indicates a relative time as recorded by the hardware, and "A" indicates the actual time the alarm occurred. Alarms suffixed with "A" occurred when ControlSpace Designer software was connected to the system.

**Alarm State** – Displays the current alarm state of each output channel.

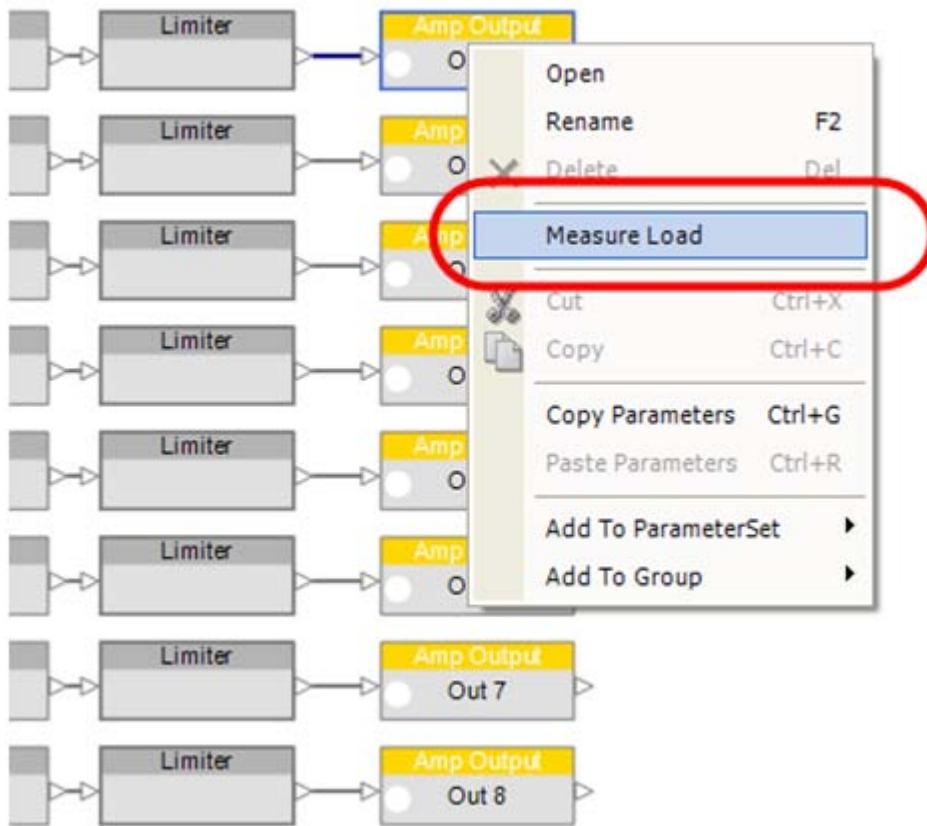
**Clear Alarms** – Clears the alarms within the hardware. Also clears the Fault Output and front panel Fault LED.

## Measuring Loudspeaker Impedance

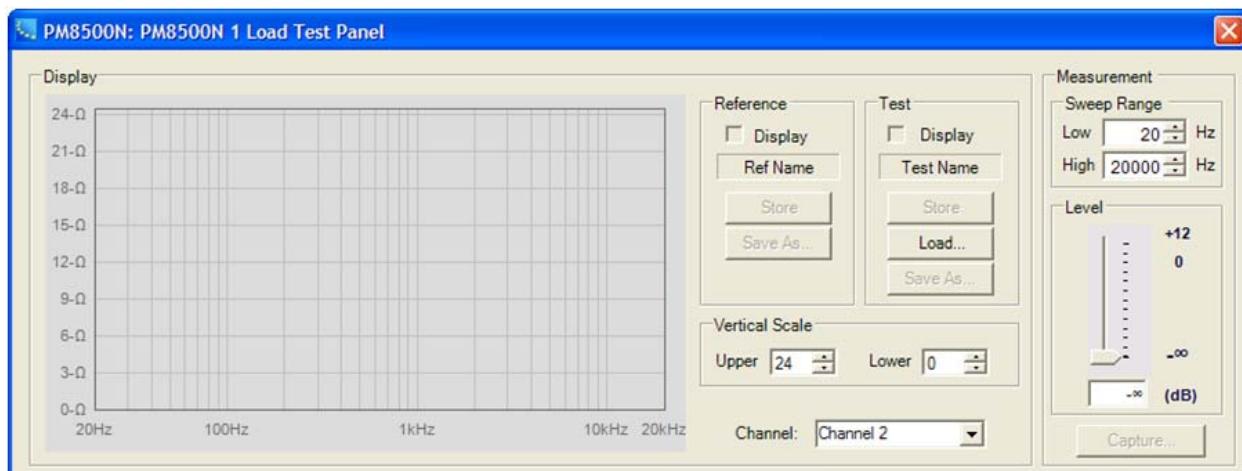
A load measurement function is provided to measure the load impedance of each PM8500 output for system diagnostic and documentation purposes. The load measurement function inserts a test signal into the output signal processing chain and measures the output load impedance and current across a defined frequency range. The result of this measurement is displayed as a frequency vs. impedance graph.

The load measurement can be stored as a reference for the final system installation, and subsequent measurements may be compared to the reference to determine if the system is still operating as expected. Differences between the reference curve and a subsequent measurement can be indicative of wiring or transducer damage. The load measurement function cannot pinpoint the cause of the problem, but can indicate that a problem exists between the output of the amplifier and the transducer.

The load measurement function is accessed from within the PM8500 signal processing view using the right-click context menu for any of the amplifier outputs.



Selecting "Measure Load" from the right-click context menu displays the Load Test Panel:



From within the Load Test Panel the following functions are available:

**Impedance vs. Frequency Graph** – Displays the current measurement, the reference and one additional measurement simultaneously.

**Channel** – Controls the output under test. The default is determined by the output block selected when the Load Measurement was invoked, but all outputs are available for selection.

**Sweep Range** – Determines the frequency range to be measured.

**Output Level** – Controls the output level of the signal generator. Always begin with a low output level to prevent any damage to system components.

**Capture** – Initiates the load measurement. The built-in signal generator is routed to the selected output and the measurement is active. Once the measurement is complete, the previous routing for the output under test is restored, and the impedance vs. frequency data is displayed.

**Reference Display** – Enables the display of the stored reference measurement for the selected channel.

**Reference Name** – Displays the user defined name of the reference measurement.

**Reference Store** – Stores the current measurement as the reference for this channel. When selected you have the option to name the reference curve. The reference is stored with the ControlSpace Designer file (.csp) for future reference.

**Reference Save As...** - Exports the reference curve as a text file for use in other applications.

**Measurement Display** – Enables the display of the stored reference measurement for the selected channel.

**Measurement Name** – Displays the user defined name of the measurement.

**Measurement Store** – Temporarily stores the current measurement for display in the Impedance vs. Frequency graph. To save the measurement for future use select Save As...

**Measurement Load** – Opens a previous saved measurement file for display within the Impedance vs. Frequency graph.

**Measurement Save As...** – Exports the measurement curve as a text file for use in other applications.

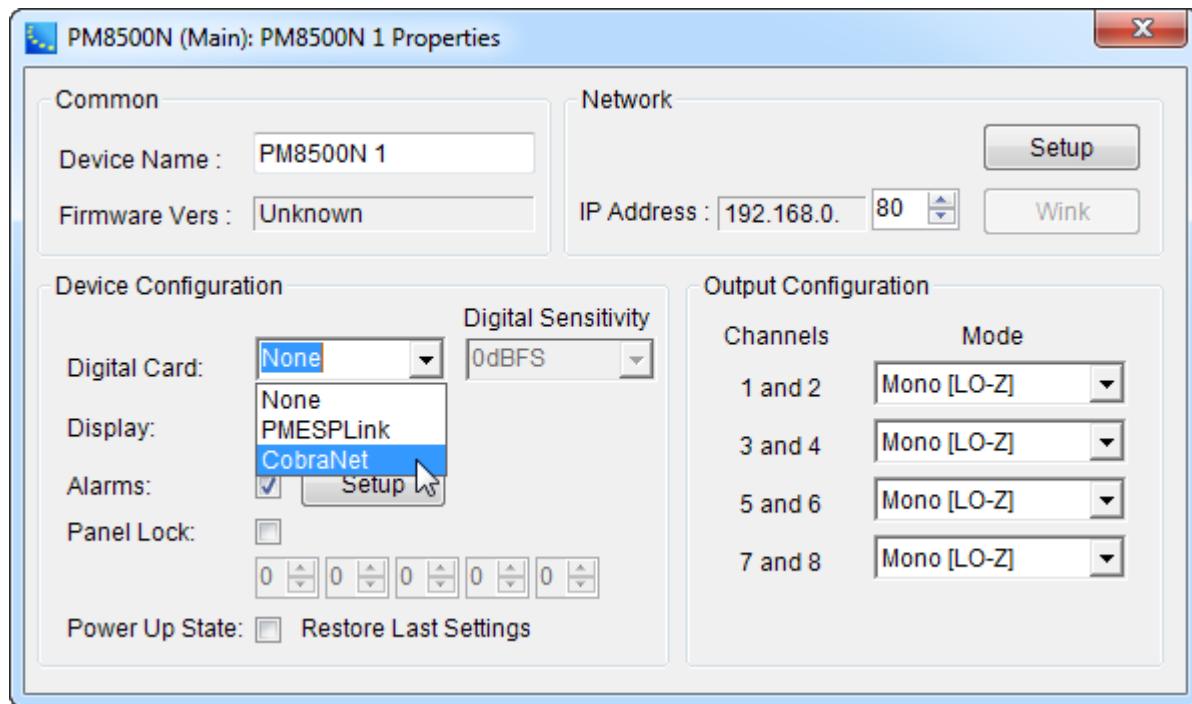
**Vertical Scale, Upper** – Adjusts the upper limit of the Impedance scale.

**Vertical Scale, Lower** – Adjusts the lower limit of the Impedance scale.

## Configuring the PowerMatch CobraNet card

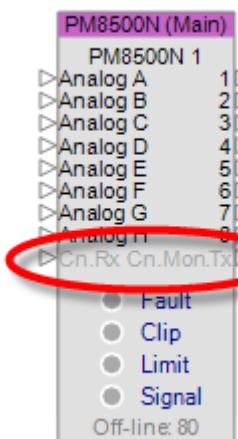
The PowerMatch™ CobraNet® card inserts into the digital input card slot of Bose PowerMatch™ amplifiers and provides up to 16 channels, (8 input and 8 output), of uncompressed 48 kHz digital audio using CobraNet® audio networking. Designed for “plug and play” operation with the ControlSpace ESP-88 CobraNet card, the PowerMatch CobraNet card provides a cost- effective means of distributing audio to multiple remote amplifiers.

To configure a PowerMatch amplifier for operation with a CobraNet input card select the CobraNet option from within the list of available digital card types in the PM8500/N Properties.



*PowerMatch 8500/N Properties – select CobraNet for Digital Card type*

Once the PowerMatch CobraNet card is selected the Project View icon for the amplifier displays a CobraNet input, and CobraNet output connection.

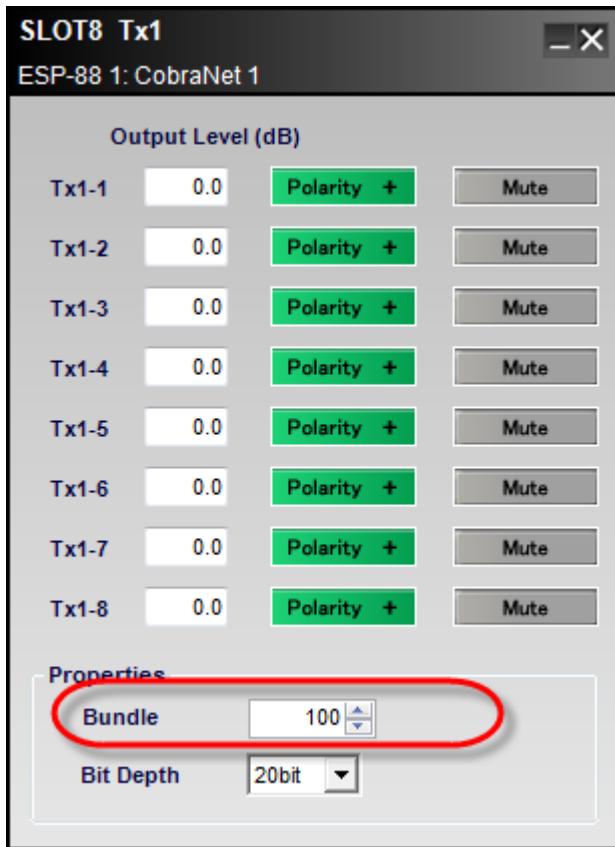


*CobraNet I/O shown on the PM8500 Project View icon*

The PowerMatch CobraNet card ships preconfigured to receive 8 channels of audio on Bundle number 100, while the audio monitor bus is disabled. When configuring the system for operation with a ControlSpace ESP CobraNet card use the following steps:

1. Configure the ESP for use with a CobraNet card. The configuration should include, at a minimum, 8 channels of CobraNet audio output.
2. Configure the PowerMatch 8500/N for operation with a CobraNet input card.

3. From within the ESP-88 signal processing view, select the CobraNet output control panel.
4. Assign the Transmit bundle to bundle address 100.



*CobraNet bundle assignment within the ESP*

5. Route audio to the CobraNet outputs.

At this point you will have successfully routed audio from the ESP to a PM8500 amplifier.

**NOTE:** The ControlSpace Network and CobraNet audio network must be physically separate networks using separate routers/switches. However, if you are using a managed switch you can configure the CobraNet audio network to use a dedicated VLAN for CobraNet network traffic.

For information relating to recommended network set up and design practices for CobraNet audio see [www.CobraNet.info](http://www.CobraNet.info).

## Configuring the PowerMatch™ CobraNet® Card Audio Monitor Bus

The PowerMatch™ CobraNet® is capable of transmitting 8 audio channels for use as an audio monitor. In some situations amplifiers are remotely located, and this function may be used to remotely monitor the audio being sent by the amplifier to the loudspeaker.

Audio from the DSP output for each channel is routed directly to the CobraNet transmit bus, where it is available to be sent to other CobraNet receiving devices.

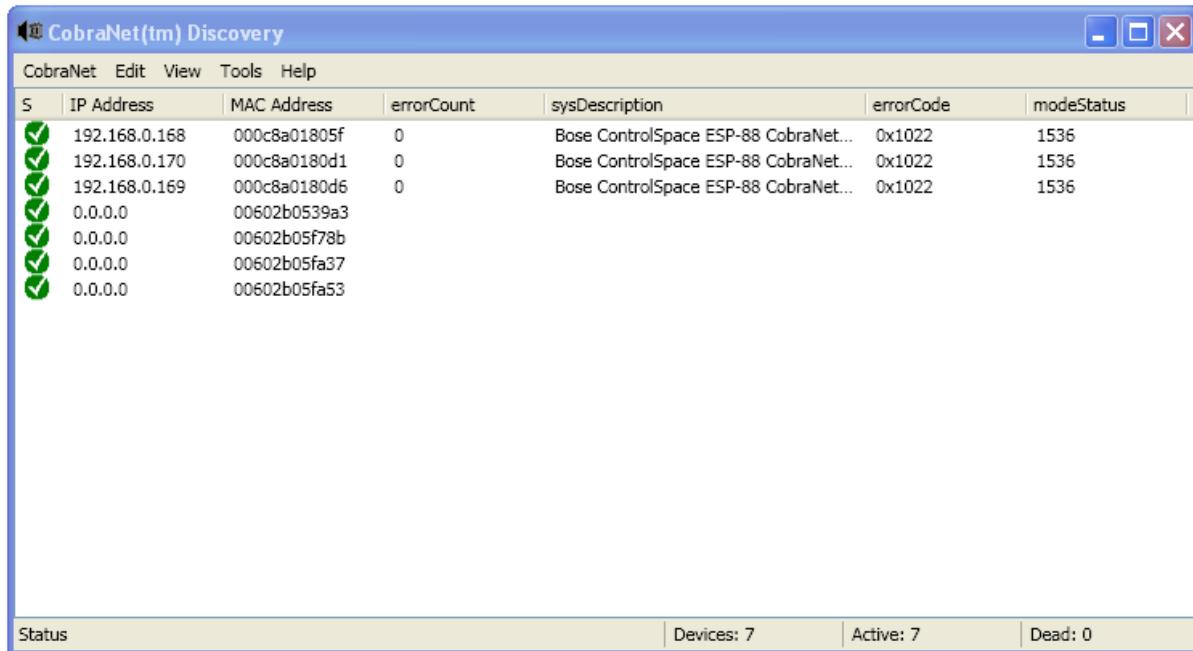
**NOTE:** This is a “post-processing” signal that is after all the DSP processing. If, for example, the output is muted, then the monitor signal will be muted as well.

The default bundle assignment is 0, indicating that the audio is not being placed on the larger network. To enable the audio monitor bus you must use CobraNet Discovery to configure the PowerMatch CobraNet card.

**NOTE:** CobraNet Discovery is available at [www.cobranet.info](http://www.cobranet.info).

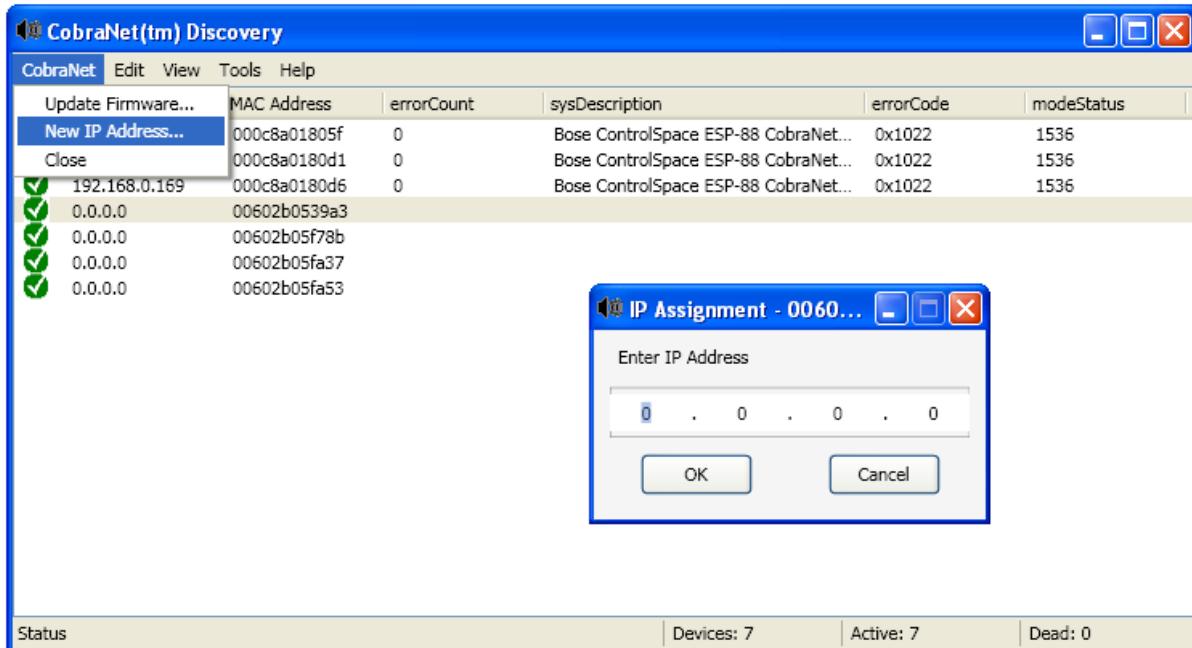
To configure the PowerMatch CobraNet card audio monitor bus, use the following steps:

1. Ensure that your network adaptor is correctly configured and connected to the CobraNet network, rather than the ControlSpace network.
2. Launch CobraNet Discovery – any CobraNet devices will be discovered.



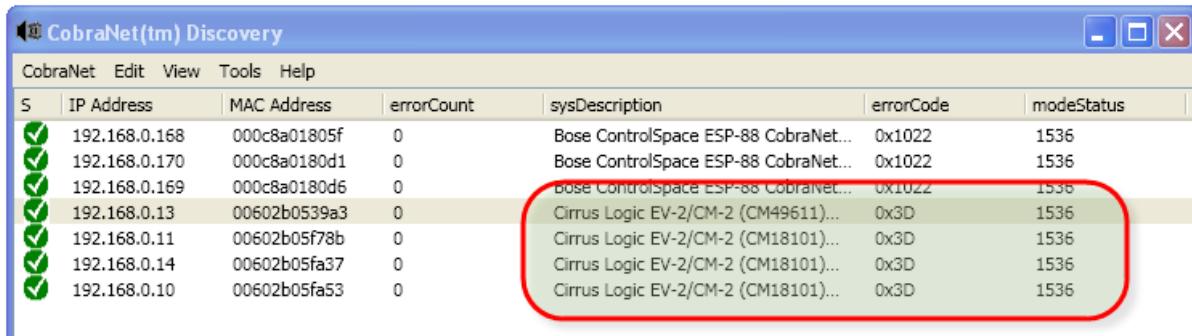
*CobraNet Discovery interface*

3. It will be necessary to configure the PowerMatch devices with an IP address to configure the CobraNet settings. Select one of the devices within the device list, and choose New IP Address from the CobraNet menu. Alternatively you can configure CobraNet Discovery to automatically assign devices an IP address. To do this select the Enable Auto Assignment option within the CobraNet Discovery Options dialog.



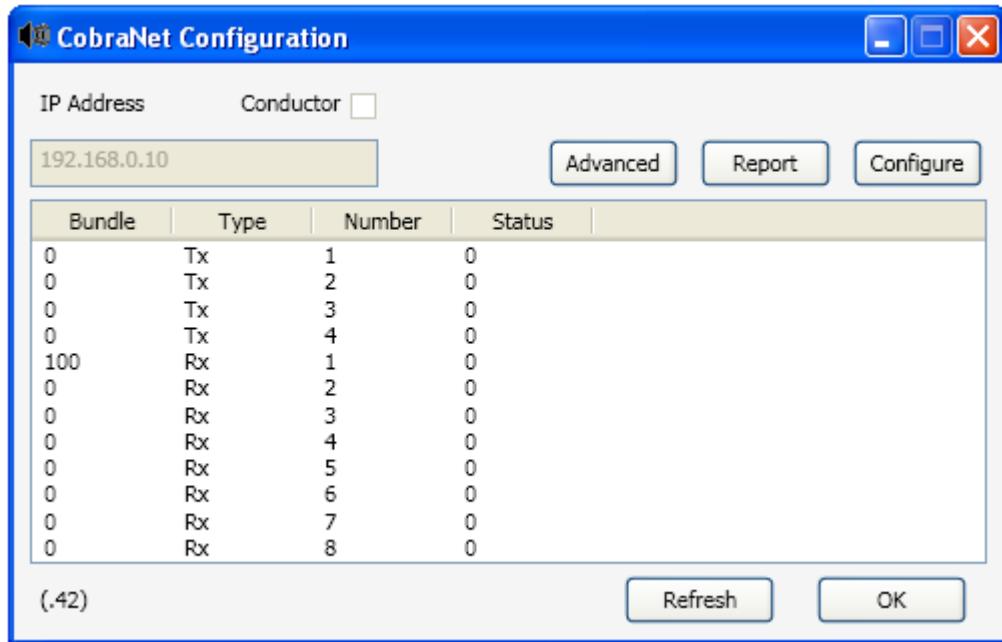
Assign an IP address to CobraNet devices.

Once IP addresses are assigned the device list is refreshed and details about the device's configuration are displayed.



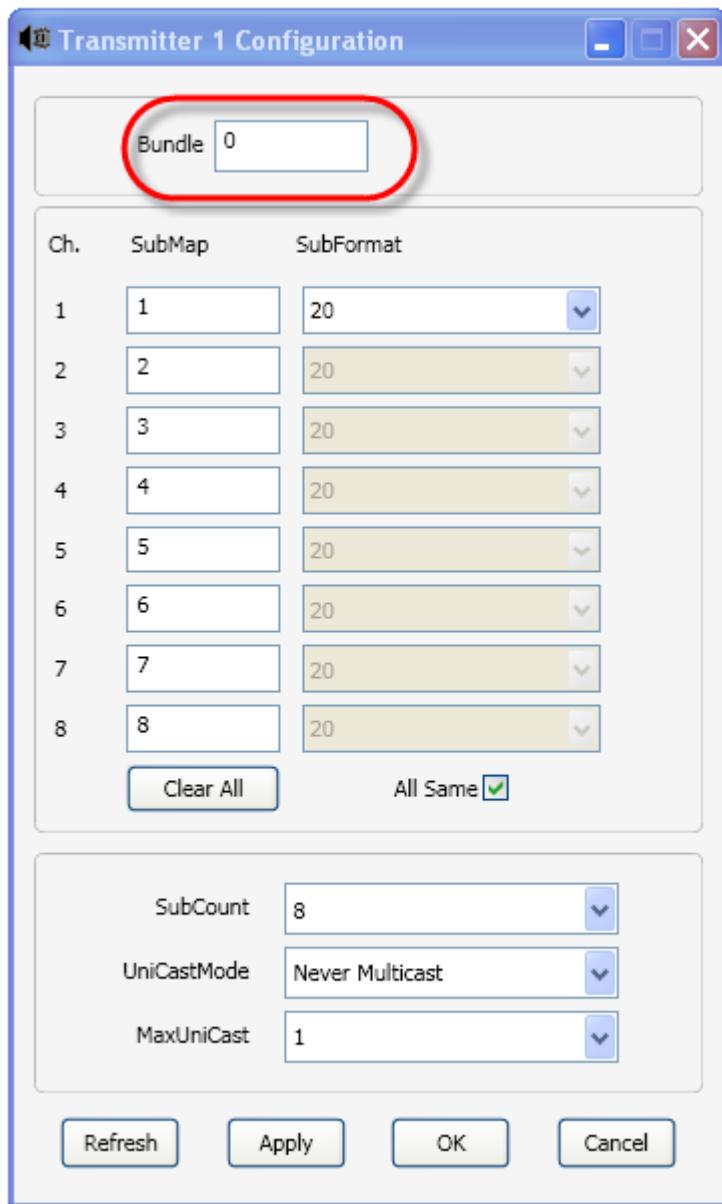
CobraNet device list showing device properties

4. Select one of the PowerMatch 8500 devices and select "Configure" from the Tools menu. This will cause the configuration settings for the device to be displayed:



*CobraNet configuration for a PowerMatch™ amplifier*

5. From within the Configuration settings panel select the first Tx bundle and click "Configure" to display and configure the Transmit bundle settings. Enter a bundle assignment for the Transmit bundle. Bundles 1-255 are Multicast bundles, and bundles greater than 256 are Unicast.



Bundle assignment for PowerMatch amplifiers

**NOTE:** We recommend that you use Unicast bundle assignments to better manage network bandwidth.

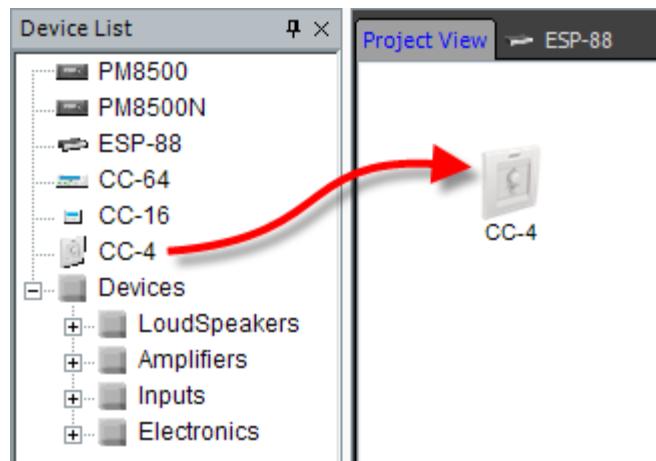
- Set the receive bundle of the receiving CobraNet device to the same as the PM8500 transmit bundle.

For additional information and application examples related to the set-up and configuration of Bose system electronics which employ CobraNet® network audio see <http://pro.Bose.com>. Application notes are available within the ControlSpace® Designer™ software area of the site.

# Configuring Control Centers

## CC-4 Room Controller

The **CC-4 Room Controller** is a wall-mounted control panel. It includes one rotary volume control and a four position selector switch. Both the volume control and selector switch are designed to connect to GPI ports. A *Project View* icon is provided for project documentation purposes.



*CC-4 Project View Icon*



*CC-4 Room Controller*

The CC-4 Room Controller supports the following programming features:

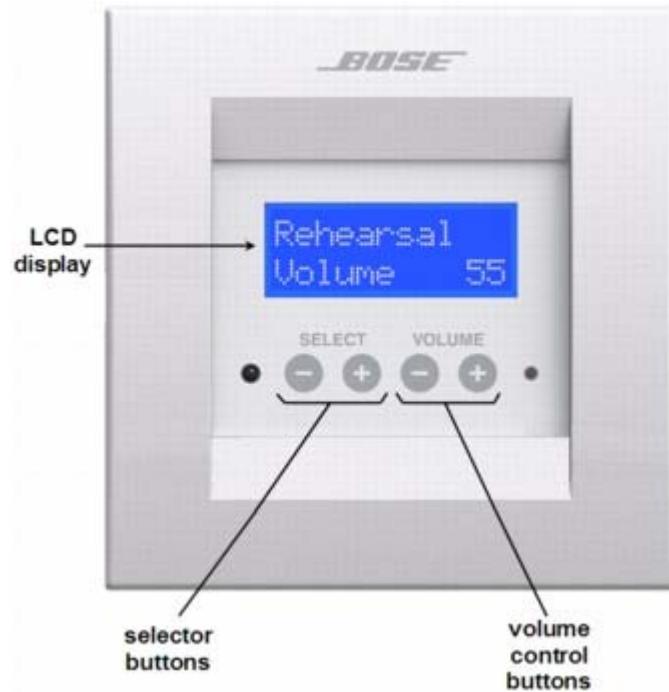
**Volume Control** – Analog Control Input modes of individual GPI ports.

**Selector Switch** – Digital Control Input and Digital Up/Down modes of individual GPI ports.

**Note:** See Programming Control Centers/CC-4 for details on associating signal processing features to a CC-4 via GPI ports.

## CC-16 Room Controller

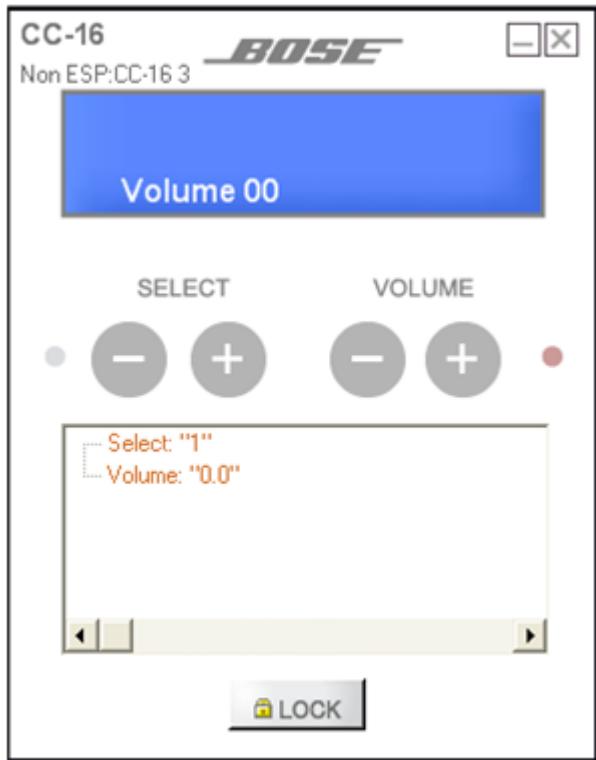
The **CC-16 Zone Controller** is a wall-mounted control panel. The CC-16 includes a membrane touch panel with two selector buttons and two volume control buttons. It also has a two-line, 12 characters per line backlit LCD display. The selector and volume control buttons are fully programmable.



*CC-16 Room Controller*

## CC-16 Smart Simulator

The CC-16 Smart Simulator is a software-based tool within ControlSpace Designer used for programming and simulated operation of the CC-16 Zone Controller. To open the CC-16 Smart Simulator, double-click on the CC-16 block in *Project View* or right click and select **Open**.



*CC-16 Smart Simulator*

The **CC-16 Smart Simulator** provides the following options:

**Virtual LCD** – Represents the two-line backlit display on the CC-16 room controller.

**Select** – Provides minus and plus click zones to simulate selector button presses on the CC-16 room controller.

**Volume** – Provides minus and plus click zones to simulate volume button presses on the CC-16 room controller.

**Programming Tree** – Provides a landing zone for signal processing and other programmable elements. Assign functions to the Select buttons, or to the Volume control buttons by dragging and dropping onto the programming tree. See Programming Control Centers/CC-16 for details on associating signal processing features to a CC-16.

**Lock** – displays the current lock state and provides a programming toggle button for adjusting the control panel lock. Locked panels are identified by the word “--Locked--” beside a green lock button. Locked status must be enabled or disabled from a parameter set.

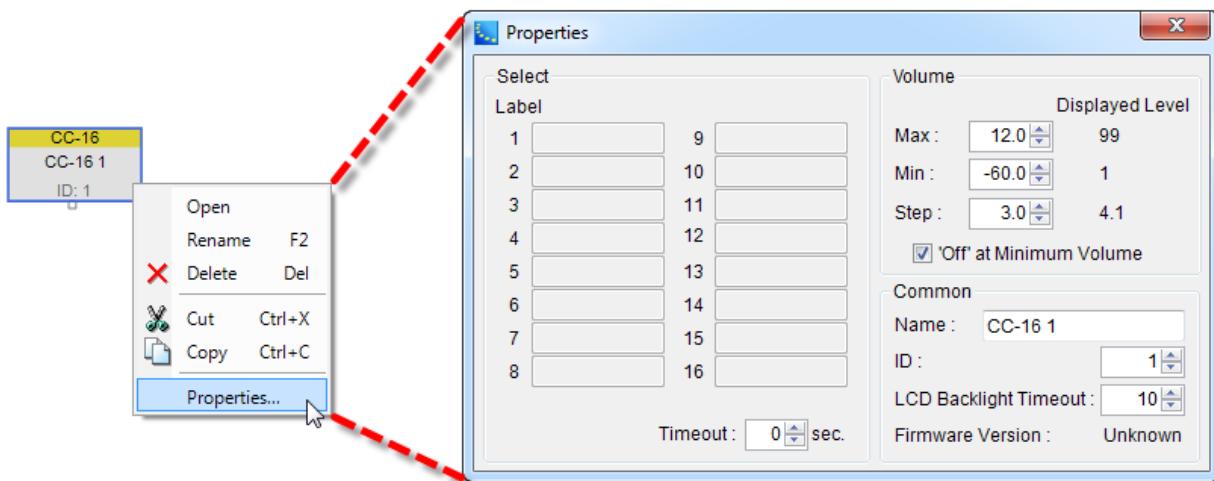


*CC-16 Locked and Unlocked Button States*

**Note:** When an ESP system is online and a control panel lock is enabled, software simulators respond to button clicks but matching hardware in the field no longer accepts input.

## CC-16 Zone Controller Properties

To view or adjust CC-16 properties, right click on the device in Project View, and choose Properties.



*CC-16 Properties*

**Properties** available for the CC-16 are as follows:

**Select** – provides configuration options for the minus and plus touchpad selector buttons.

**Label** – is a series of text fields which reflect the name of a selector position within the CC-16 display. Sixteen label fields are available. These labels are populated automatically by the associated signal processing block selector position name or parameter set name when the panel is programmed. After programming is complete this label may be adjusted to a different value to match project needs.

**Timeout** – is an adjustable time value from 0 to 10 seconds for configuring the **Selection Preview** feature of the CC-16. Selection Preview adds delay to permit viewing the name of the next selector position in either minus or plus directions before performing the programmed action. Returning to the initial selection before this time expires results in no system change.

A value of 0 seconds switches to the next selector position and initiates the programmed action immediately. Values from 1 to 10 seconds add this amount of delay for varying lengths of Selection Preview time.

**Volume** – provides configuration options for the minus and plus volume touchpad volume buttons.

**Max:** – configures the maximum volume level permitted by an associated signal processing block when pressing the plus button on the CC-16. This value ranges from a maximum of 12dB down to the configured **Min** setting plus one **Step** setting value.

This **Max** value equates to a Displayed Level of 99 on the CC-16.

**Min:** – configures the minimum volume level permitted by an associated signal processing block when pressing the minus button on the CC-16. This value ranges from a minimum of -60dB up to the configured **Max** setting less one **Step** setting value.

This **Min** value equates to a Displayed Level of 1 on the CC-16.

**Step:** – configures the amount of change to an associated signal processing block when pressing either the minus or plus buttons on the CC-16. This value ranges from 0.5dB to 36.5dB and defines the **Max** and **Min** levels permitted.

**Displayed Level** – is a calculated value based on current Max, Min, and Step settings to reflect the number shown on the CC-16 display.

**'Off' at Minimum Value** - When enabled, the CC-16 will display "OFF" on the display when it reaches the minimum volume level. When disabled the display will read "--".

**Common** – provides configuration options for the global characteristics of the control panel.

**Name:** – defines the name displayed on the CC-16 block within Project View. This field automatically updates to the current name if the CC-16 is renamed within Project View.

**ID:** – is a unique identification number assigned to each CC-16. Values range from 1 to 15. The default value is 1.

**Note:** Each time a new CC-16 is added to project view; this ID value must be adjusted to a unique number if more than one CC-16 exists within your system design. It must also match the DIP Switch settings of the associated CC-16 in the field for programming to operate correctly.

**LCD Backlight Timeout:** – establishes the amount of time in seconds that a CC-16 display remains illuminated after the most recent button press. Values range from 0 to 30 seconds with a default of 10 seconds. A value of 0 seconds forces the display to remain illuminated continuously.

**Firmware Version:** – displays the current version of firmware available within each system to manage CC-16 operations. Before the first connection to existing hardware, this value is listed as *Unknown*. After the first connection in a ControlSpace Designer program session, this field is automatically updated to reflect current firmware version.

## CC-16 Zone Controller – Monitor Mode

When ControlSpace Designer is started in Monitor Mode, the CC-16 Smart Simulator appearance is altered to show only user adjustable click zones and *Lock* status. In this mode, the programming tree is no longer visible to prevent user tampering with programmed objects. See [Monitor Mode](#) for details.



CC-16 in Monitor Mode

## CC-64 Control Center

The **CC-64 Control Center** is a wall-mounted control panel. The CC-64 includes a master selector knob, four individual gain/selector knobs, four membrane bank select buttons, and a two-line 40 characters per line backlit LCD display. The master selector knob, gain/selector knobs, and display are fully programmable.

The master selector has three LEDs indicating network link status, network data receive, and network data transmit. Each gain/selector knob is surrounded by 15 LEDs which indicate the relative position of the knob. Each bank select button has an LED to indicate when it's active. And the bottom line of the LCD display serves as labels for the gain/selector knobs.

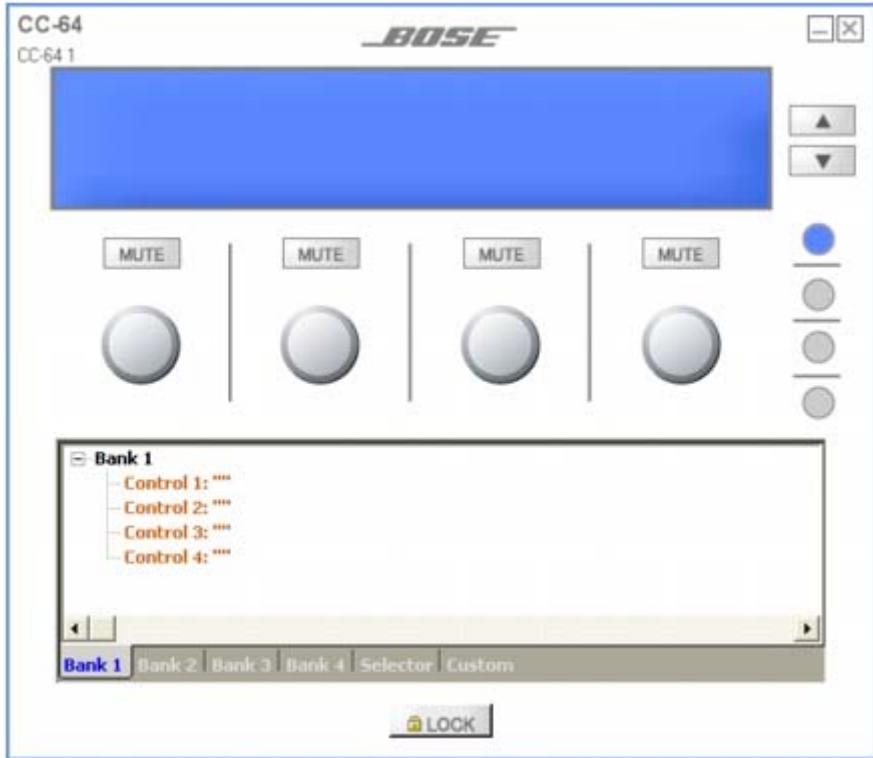
The four gain/selector knobs may control different signal processing functions in each of the four banks, for a total of sixteen settings. Use the bank select buttons to assign control of the gain/selector knobs to one of the four banks at a time.



CC-64 Control Center

## CC-64 Smart Simulator

The CC-64 Smart Simulator is a software-based tool within ControlSpace Designer used for programming and simulated operation of the CC-64 Control Center. To open the CC-64 Smart Simulator, double-click on the CC-64 block in **Project View** or right click and select **Open**.



*CC-64 Smart Simulator*

The **CC-64 Smart Simulator** provides the following options:

**Virtual LCD** – Represents the two-line backlit display on the CC-64 control center.

**Selector Up/Down** – Provides click zones to simulate the master selector knob rotation on the CC-64 control center.

**Mute buttons** – Provide click zones to simulate the push to mute functionality of the gain/selector knobs on the CC-64 control center.

**Virtual gain/selector knobs** – Provide click & rotate zones to simulate gain/selector knob rotation on the CC-64 control center.

**Virtual bank buttons** – Simulate bank selection of the CC-64 control center.

**Programming Tree** – Provides a landing zone for signal processing and other programmable elements. Assign functions to the master selector, gain/selector knobs, or to bank select buttons by dragging and dropping onto the programming tree. See Programming Control Centers/CC-64 for details on associating signal processing features to a CC-64.

**Lock** – displays the current lock state and provides a programming toggle button for adjusting the control panel lock. Locked panels are identified by the word “--Locked--” beside a green lock button. Locked status must be enabled or disabled from a parameter set.

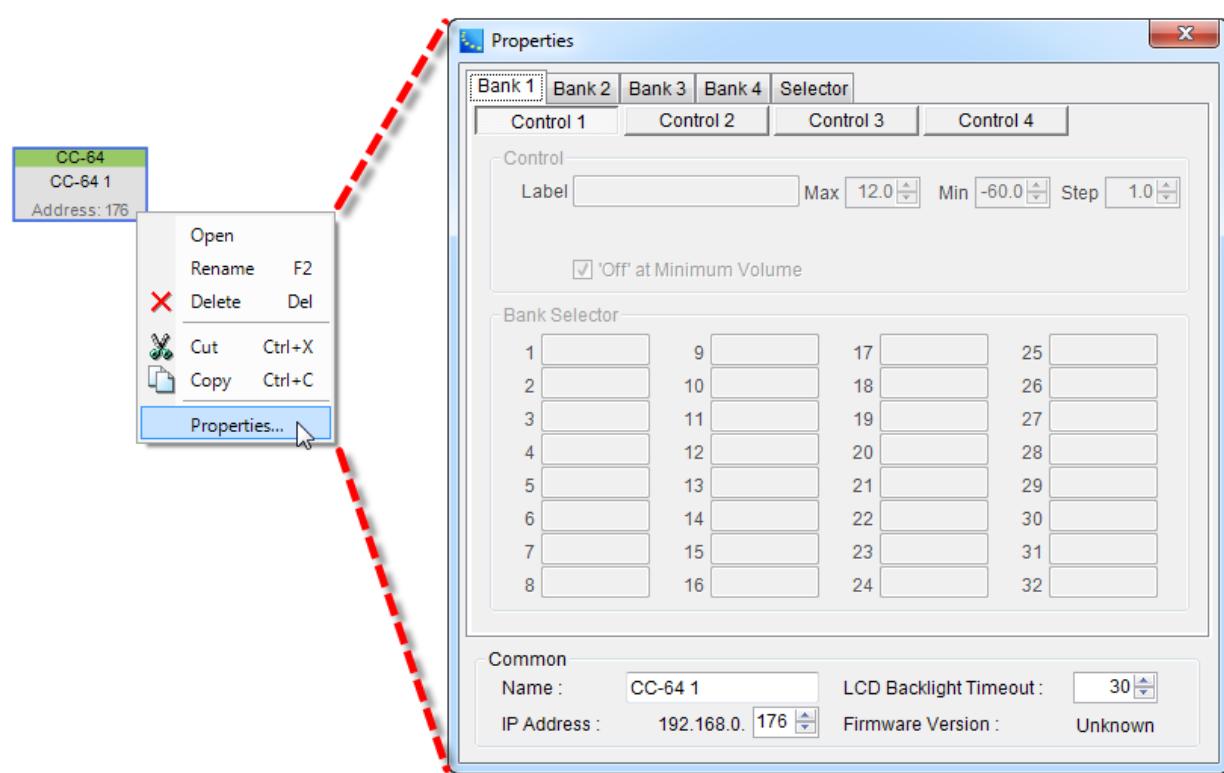


CC-64 Locked and Unlocked Button States

**Note:** When an ESP system is online and a control panel lock is enabled, software simulators respond to button clicks but matching hardware in the field no longer accepts input.

## CC-64 Control Center Properties

To view or adjust CC-64 properties, right click on the device in Project View, and choose Properties.



CC-64 Properties

**Properties** available for the CC-64 are as follows:

**Bank/Selector Tabs** – display options for the bank and master selector configuration pages of the CC-64. Click a tab to view options for each configuration page.

**Control Buttons** – correspond to individual settings available for each gain/selector knob.

**Control** – sections display unique options for each gain/selector knob on the CC-64 from 1 to 4.

**Max:** – configures the maximum volume level permitted by an associated signal processing block when rotating the gain/selector knobs clockwise on the CC-64. This value ranges from a maximum of 12dB down to the configured **Min** setting plus one **Step** setting value.

**Min:** – configures the minimum volume level permitted by an associated signal processing block when rotating the gain/selector knobs counterclockwise on the CC-64. This value ranges from a minimum of -60dB up to the configured **Max** setting less one **Step** setting value.

**Note:** When the gain/selector knobs are fully rotated in either direction, levels shown on the CC-64 LCD display match the value stored in the Max / Min fields.

**Step:** – configures the amount of change to an associated signal processing block when rotating a gain/selector knob on the CC-64. This value ranges from 0.5dB to 36.5dB and defines the **Max** and **Min** levels permitted.

**Label** – is a text field to customize the name of a gain/selector knob within the CC-64 display. This text appears on the second line of the LCD display directly above each knob and is automatically populated by the associated signal processing block selector position name or parameter set name when the panel is programmed. After programming is complete, this label may be adjusted to a different value to match project needs.

The first 9 characters of this label are displayed by default. Each time a bank is selected; labels for its four gain/selector knobs are displayed for one second. Any additional characters in the label are then scrolled horizontally in the display from right to left then left to right to permit viewing the complete label.

**'Off' at Minimum Value** - When enabled, the CC-64 will display "OFF" on the display when it reaches the minimum volume level. When disabled, the display will read "--".

**Common** – provides configuration options for the global characteristics of the control panel.

**Name:** – defines the name displayed on the CC-64 block within Project View. This field automatically updates to the current name if the CC-64 is renamed within Project View.

**IP Address:** – is a unique network identification number assigned to each CC-64. Values may be any address within the same subnet of the system under control that is not already in use. The default value is 192.168.0.160.

**Note:** CC-64 control centers should be physically connected to the network one at a time and programmed with unique IP Addresses to avoid conflicts with other devices on the network configured with the default address.

**LCD Backlight Timeout:** – establishes the amount of time in seconds that a CC-64 display remains illuminated after the most recent button press. Values range from 0 to 30 seconds with a default of 30 seconds. A value of 0 seconds forces the display to remain illuminated continuously.

**Firmware Version:** – displays the current version of firmware available within each system to manage CC-64 operations. Before the first connection to existing hardware, this value is listed as *Unknown*. After the first connection in a ControlSpace Designer program session, this field is automatically updated to reflect current firmware version.

## CC-64 Control Center – Monitor Mode

When ControlSpace Designer is started in Monitor Mode, the CC-64 Smart Simulator appearance is altered to show only user adjustable click zones and *Lock* status. In this mode, the programming tree is no longer visible to prevent user tampering with programmed objects. See [Monitor Mode](#) for details.



CC-64 in Monitor Mode

# Controlling System Devices

## Programming Overview

ControlSpace Designer software allows you to create associations between signal processing and control center operations to meet the unique requirements of any project. These various associations are stored within ControlSpace System Project files (.csp) on the programming computer and within ControlSpace hardware devices for recall on demand both manually and automatically.

The process of defining relationships between processing and control options into a single integrated project file is called programming the system. The primary work area within the ControlSpace Designer user interface where control options of system programming are stored is called the *Control Library*.

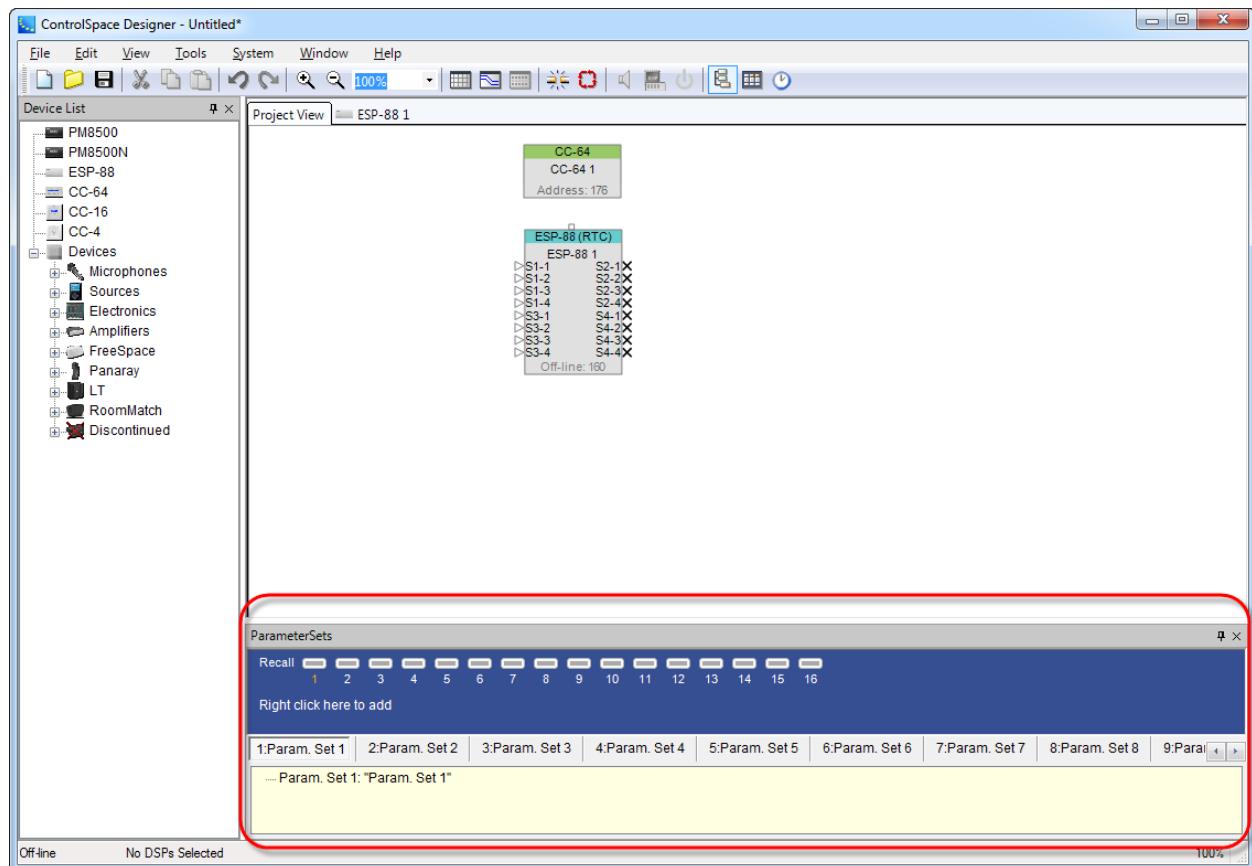
## Control Library

### Work Space

This primary work area is the "drop zone" for drag and drop control programming functions.

Three control library function types are available for use in this work area:

- [Parameter Sets](#)
- [Groups](#)
- [Timers](#)



*Control Library*

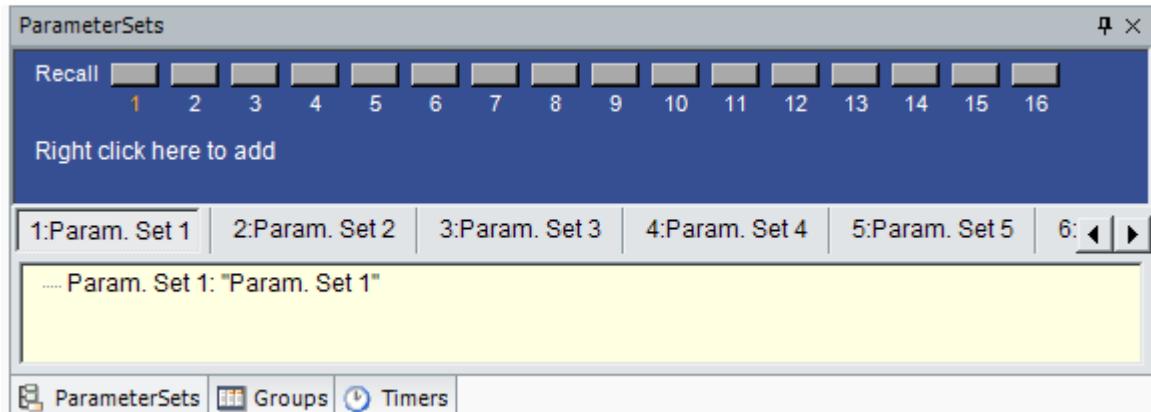
## Parameter Sets

A parameter set stores a snapshot of selected signal processor settings which can later be recalled manually using an external trigger, such as a GPI or control center, or invoked by a timed event. Use parameter sets when you want to change the state of specific processing parameters without affecting the state of the entire design.

Access parameter sets by enabling the parameter sets window from the main menu; Window > Parameter Sets.

### Creating a Parameter Set

Open the Parameter Sets window by accessing the Window Menu and selecting Parameter Sets from the list of available windows.

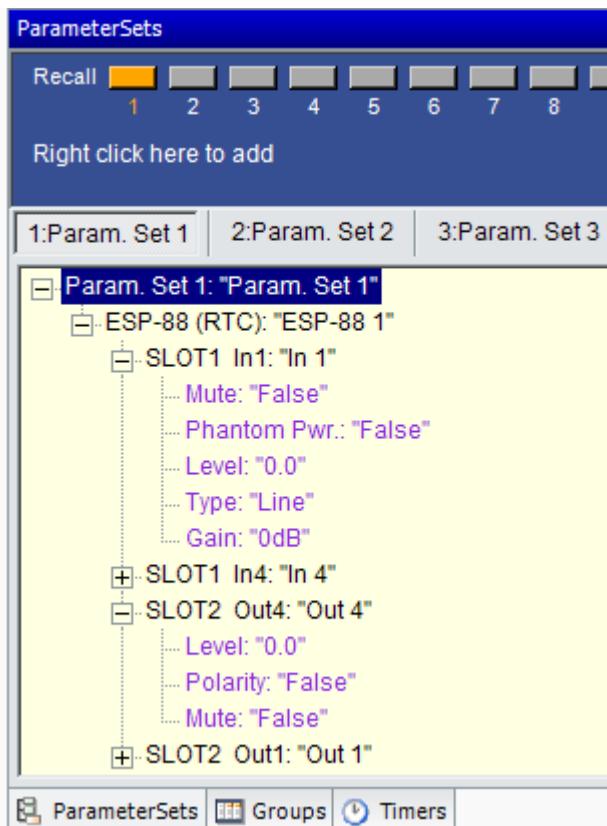


Parameter Sets window

To program a parameter set:

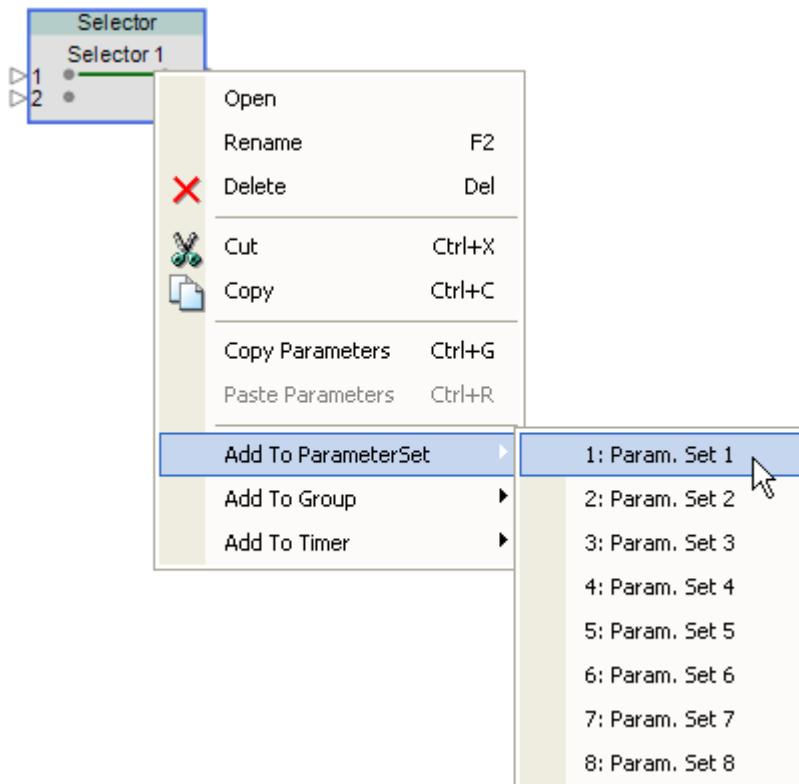
1. Define the state of the signal processing functions to be included.
2. Drag the desired processing blocks into the parameter set tree in the Parameter Set window.
3. Rename the parameter set using the right-click menu or F2 key.
4. Test the parameter set

**Tip:** Double-click on a name in the tree structure to open the control panel for that device or block.



*Parameter set tree structure*

Another way to add blocks to a parameter set is to select one or more blocks, right click, and choose Add To Parameter Set.

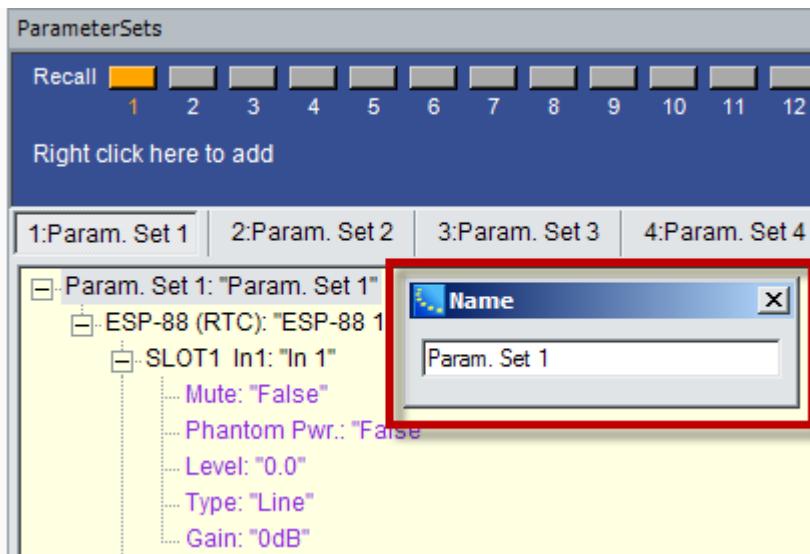


*Right click to add to a parameter set*

**Note:** To change the value of a setting in the parameter set, first change the setting in the block control panel and then drag and drop it into the parameter set once more. You do not need to delete the block from the parameter set to update its settings.

### Renaming a Parameter Set

To rename the parameter set, select the top level of the tree structure and press F2, or right click and choose Rename.



*Rename the parameter set*

## Editing Parameter Sets

The values of parameters are displayed but cannot be changed within the Parameter Sets window. If you need to change the value of a specific setting that is part of a parameter set (for example, a gain of -6 dB), you will need to change the setting of the signal processing block's control panel, and then drag and drop the block once more into the parameter set.

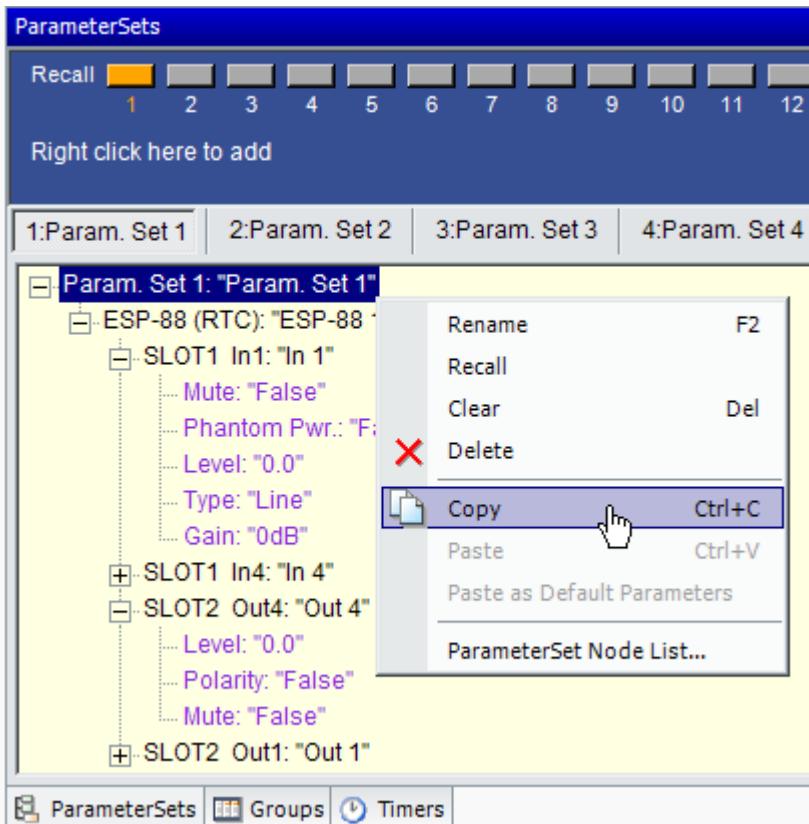
### Copy/Paste Parameter Sets

Parameter sets can be copied and pasted. Right-click on a parameter set within the Parameter Sets window to access the copy/paste functions.

Select a Parameter Set within the Control Library or Project Directory by right-clicking on it, and selecting Copy from the context menu. You can now paste the signal processing blocks in this Parameter Set to a second Parameter Set using one of two options:

**Paste** – Places an exact copy of the Parameter Set and its settings.

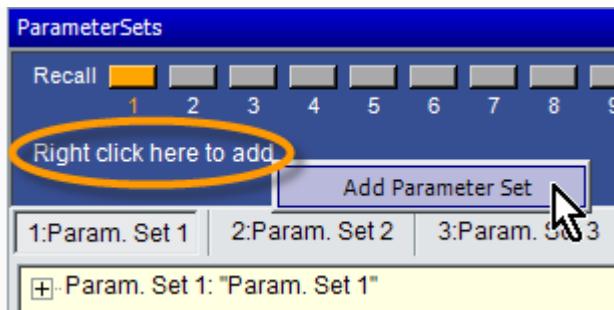
**Paste Default** – Copies the modules associated with the Parameter Set, but restores them to their default values. For example, if a parameter set has a gain module with the level set to -6 dB and Mute is true, the Paste as Default Parameters will paste the gain module but reset the level and mute to their default values, i.e., 0 dB and unmuted.

*Parameter Set Copy*

**Note:** When pasting a Parameter Set, any existing Parameter Set data is overwritten.

### Adding additional Parameter Sets

The default quantity of parameter sets is 16, but additional parameter sets may be added. If you need to add more parameter sets, right click on the words "Right click here to add," and a new parameter set is added at the end of the Parameter Sets list.

*Adding a Parameter Set*

### Recalling parameter sets

Active parameter sets are indicated by the color orange for the Recall button.

To test parameter set programming, parameter sets may be recalled or invoked while off line. First, open included signal processing objects, and then recall the parameter set by selecting its number in the parameter set window.

[image]

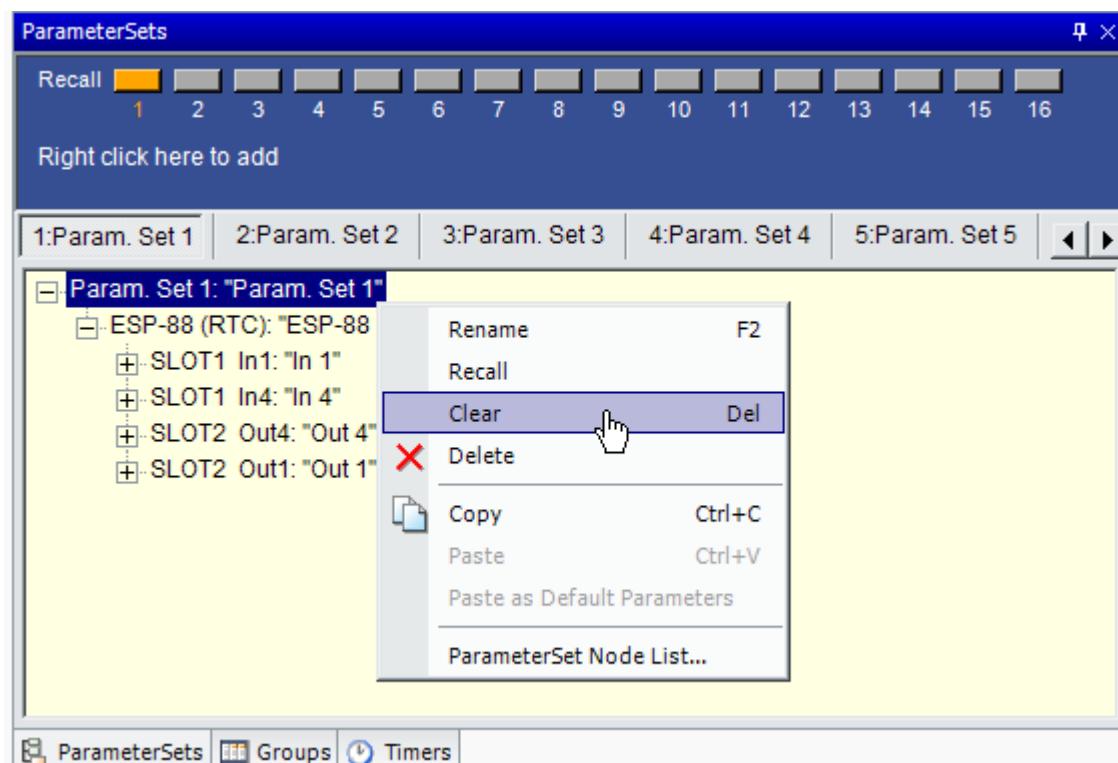
You can view the change in settings from within the control panel.

Pressing the Recall button recalls the state of all signal processing blocks within the parameter set to the stored values.

**NOTE:** Right clicking on a parameter set name provides an alternate method of recalling a parameter set.

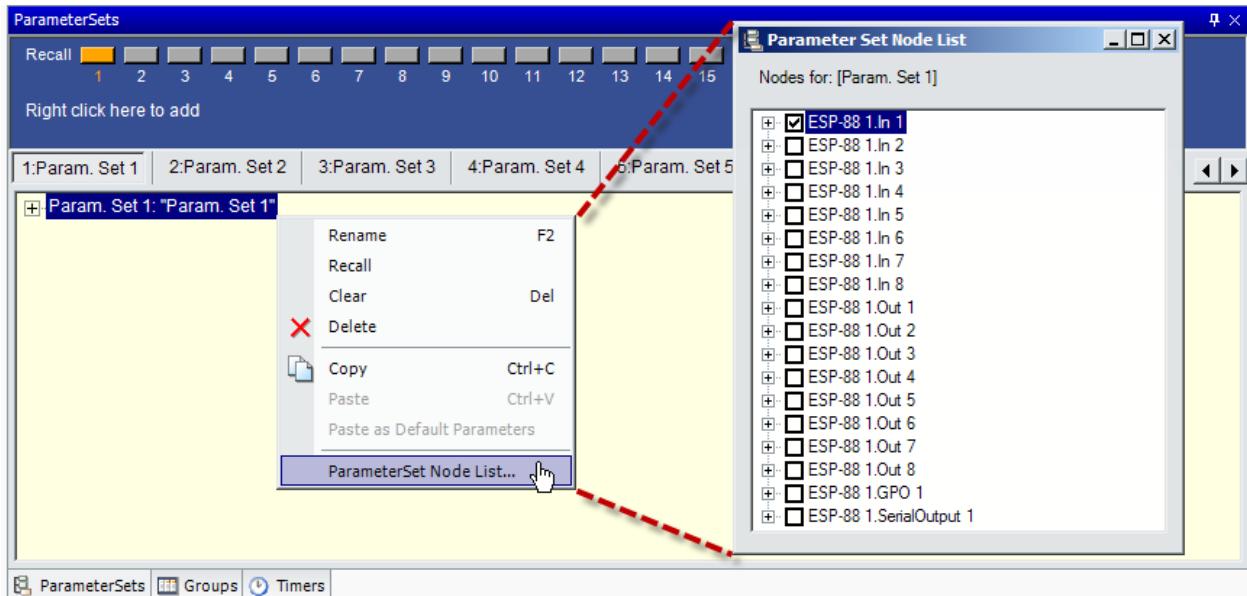
### Clearing parameter sets

To clear the contents of a parameter set, select the parameter set's tree structure and select Delete. Alternatively, you may right click on the top level of the parameter sets tree structure, and select Clear.



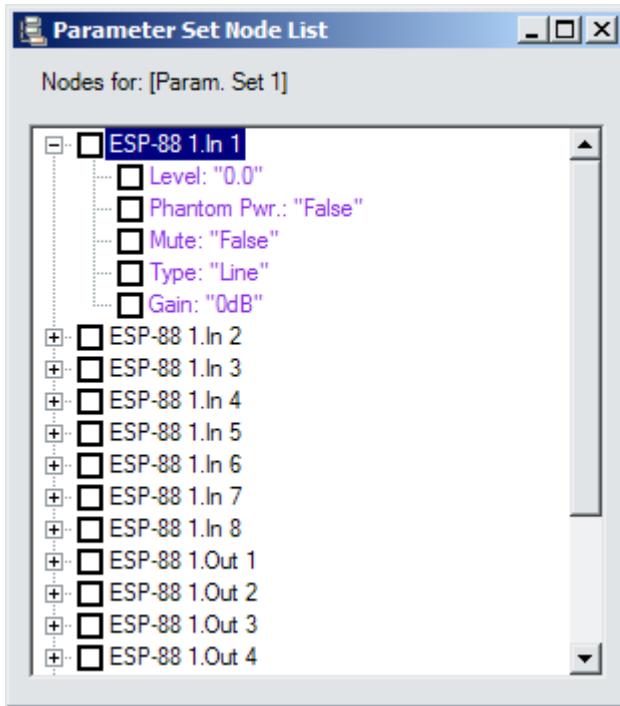
### Parameter Set Nodes List

Parameter Sets may also be created or modified using the Parameter Set Nodes List. To access the Parameter Sets Nodes list, double-click on the parameter set name in the Parameter Sets window. The Parameter Set Nodes List may also be accessed using the right-click option. Once enabled, the Parameter Set Nodes List window shows all signal processing nodes in your system, and indicates those assigned to the parameter set.



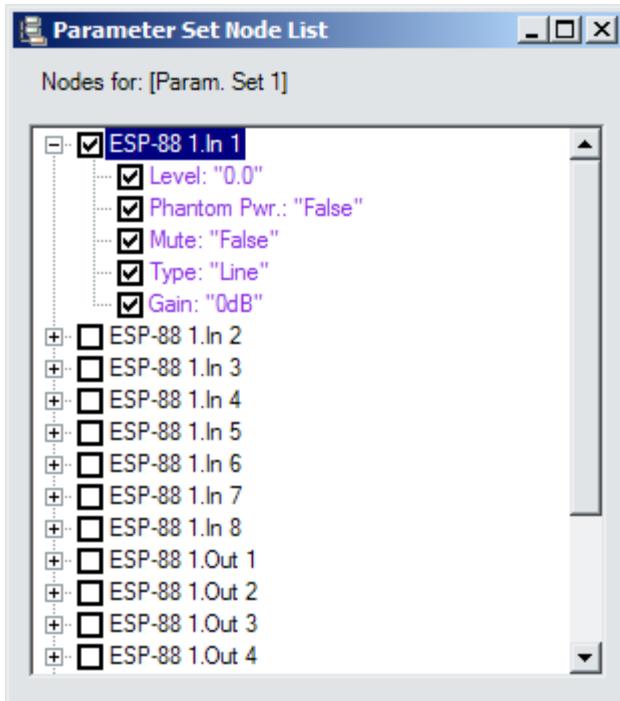
*Opening the Parameter Set Nodes List*

From within the Parameter Sets Nodes List it is possible to determine exactly which processing objects from all system devices are included in the parameter set. The list also displays which specific controls for the signal processing functions are included.



*Expand a device to see properties*

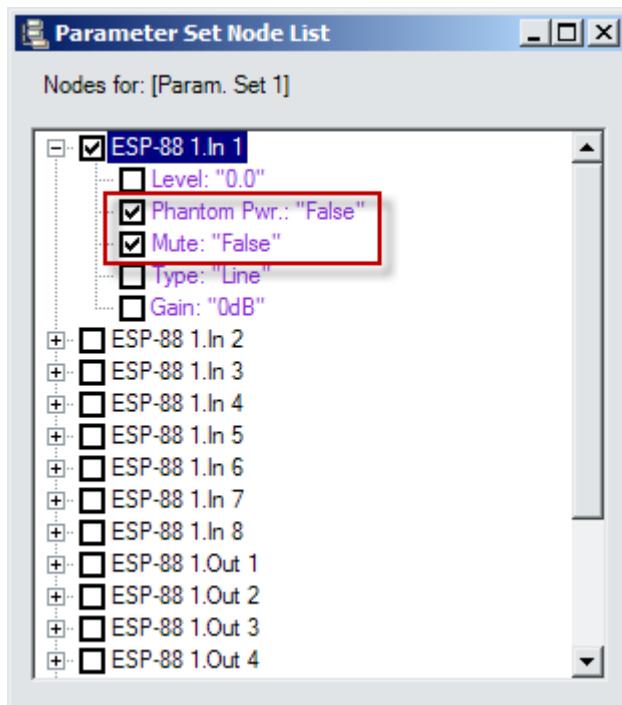
When creating new parameter sets, you may specify exactly which settings you want to store. To store all settings for a given block, place a check mark next to the block name, as shown in the following figure. Note that all the settings within the block are automatically selected.



*Include all settings for the device*

### Storing Discrete Parameters

To include only specific settings in the parameter set, use the Parameter Set Nodes List and place a check mark next to the settings within the block, as shown in the following figure. When the parameter set is invoked, only the selected settings are changed, reducing the possibility of accidentally changing key system settings. The settings that are not checked are not part of the parameter set and remain unchanged when the parameter set is invoked.



*Include selected settings in the parameter set*

You can also use the Parameter Set Nodes List to modify an existing parameter set. Open the Parameter Set Nodes List and check or uncheck the settings that you want to include in the parameter set.

## Groups

Groups link the behavior of two or more similar signal processing blocks. Two types of groups exist: *grouped gains* and *grouped signal processing blocks*.

When gain controls are grouped together, they can be controlled together by a master fader. However, the relative gain offsets of group members are maintained. When you group signal processing blocks together (such as two parametric EQs), the settings are synchronized: changes to one block affect the others in the group. Up to 128 groups may be stored.

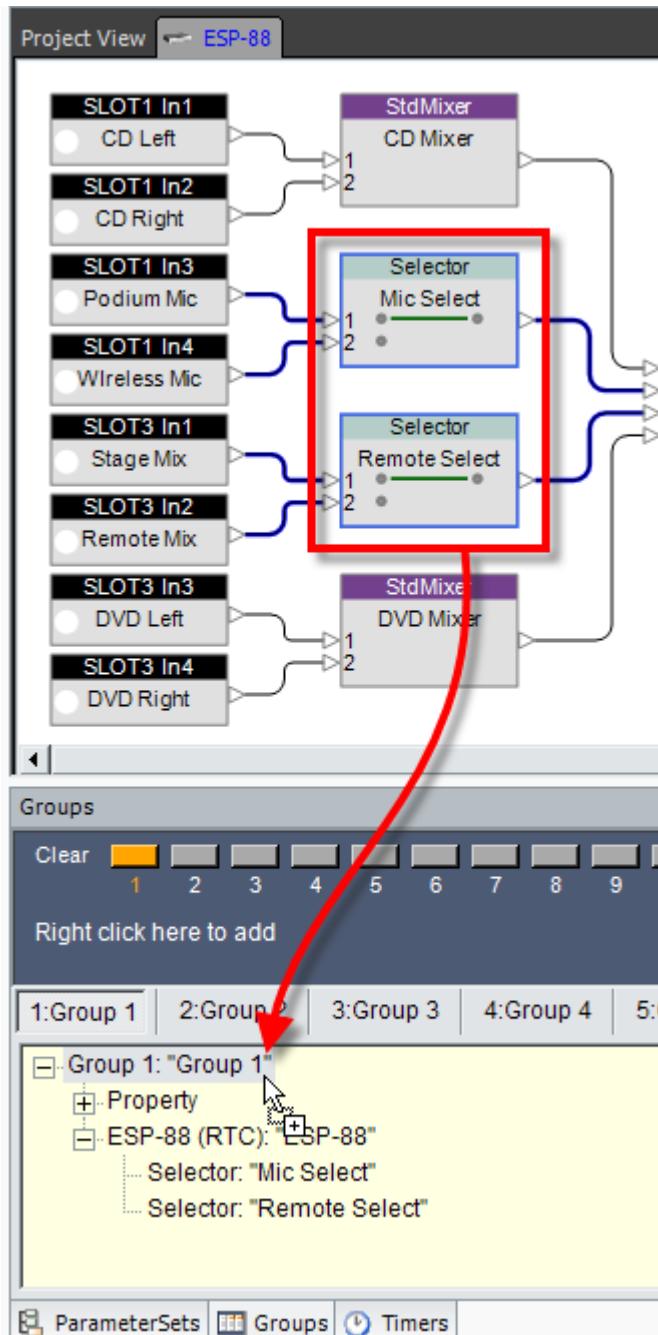
## Creating a Group

Open the Groups window by accessing the Window Menu and selecting Groups from the list of available windows.



*Groups window*

Select the signal processing blocks in the Signal Processing View window of the device whose functions you wish to group. Drag and drop those processing blocks onto a group name in the Groups window. Only processing blocks with identical functionality may be grouped together.



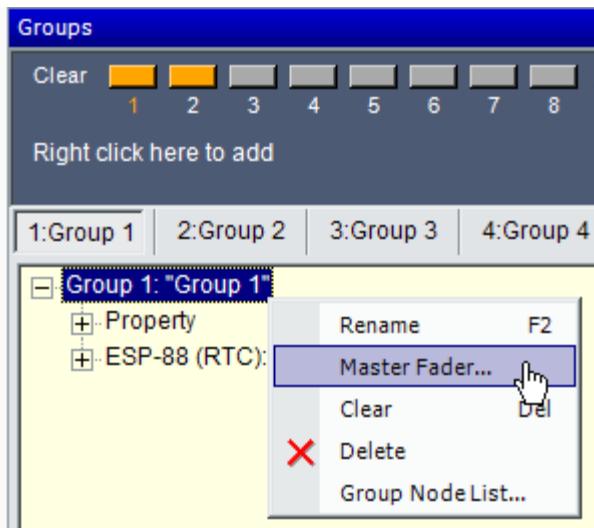
*Dragging and dropping blocks into a Group*

When creating groups from processing blocks that contain gain controls, i.e., inputs, outputs, and gain blocks, you are prompted to choose the properties of the group you wish to create: Level + Mute, Level, or Mute.



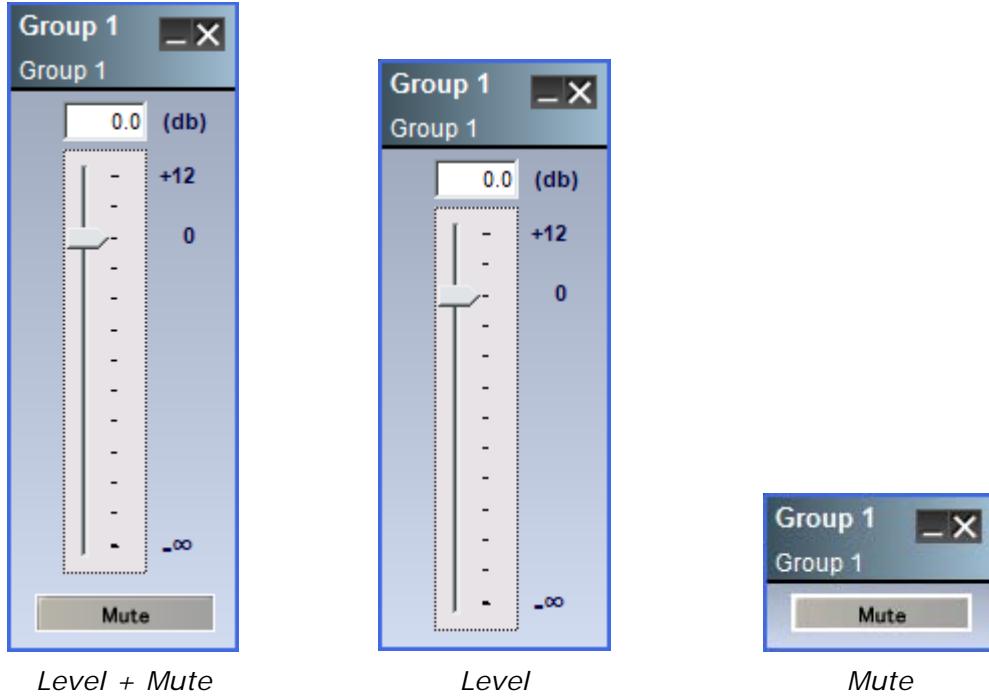
*Set Group Properties*

Grouped Gains are automatically assigned a *Master Fader* control panel to adjust the level and mute functions chosen in the Set Group Properties panel. To access this *Master Fader*, right click on the group name and select *Master Fader*.

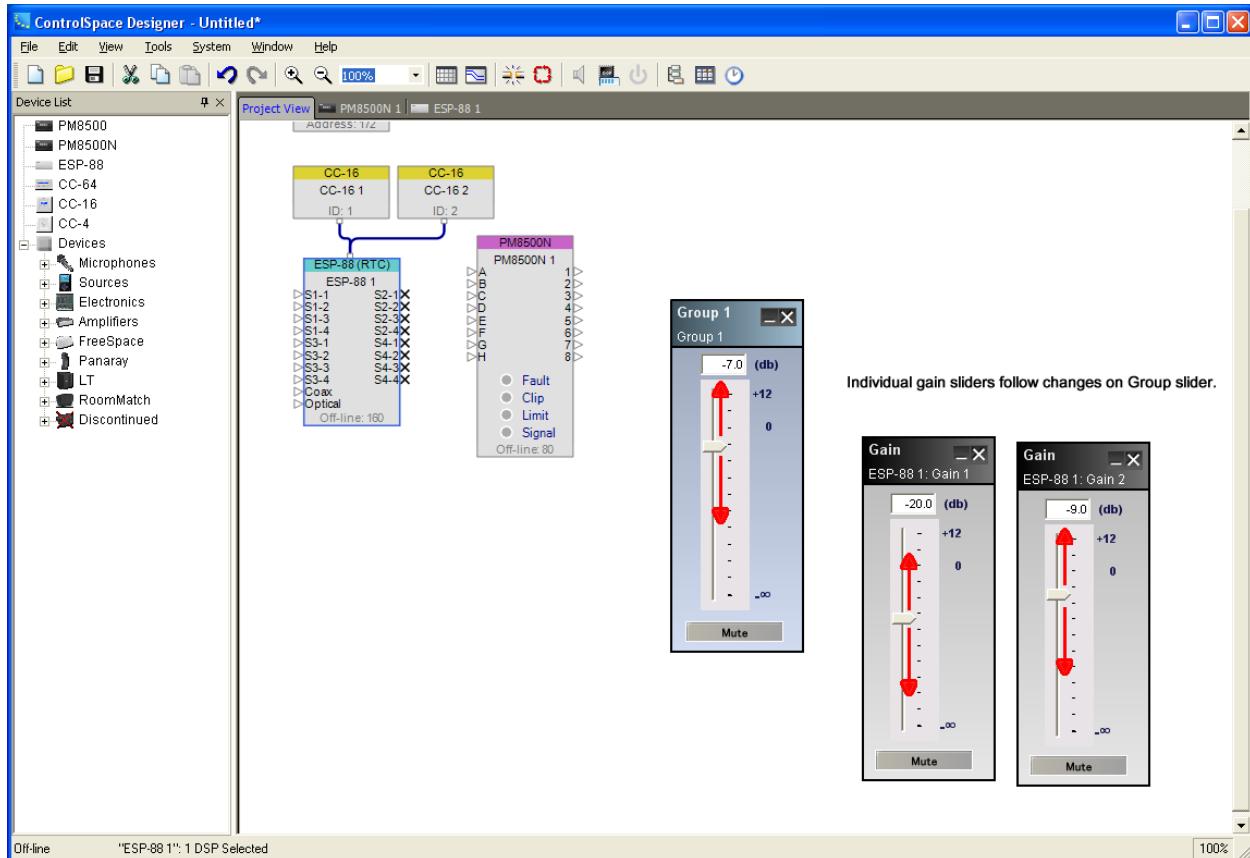


*Access Group Master Fader*

The appearance of each Master Fader type for Grouped Gains is shown below:



Verify correct behavior by opening the *Master Fader*, and each control panel for stored blocks. As you move the slider on the *Master Fader* you will see corresponding movement on the associated block gain sliders.

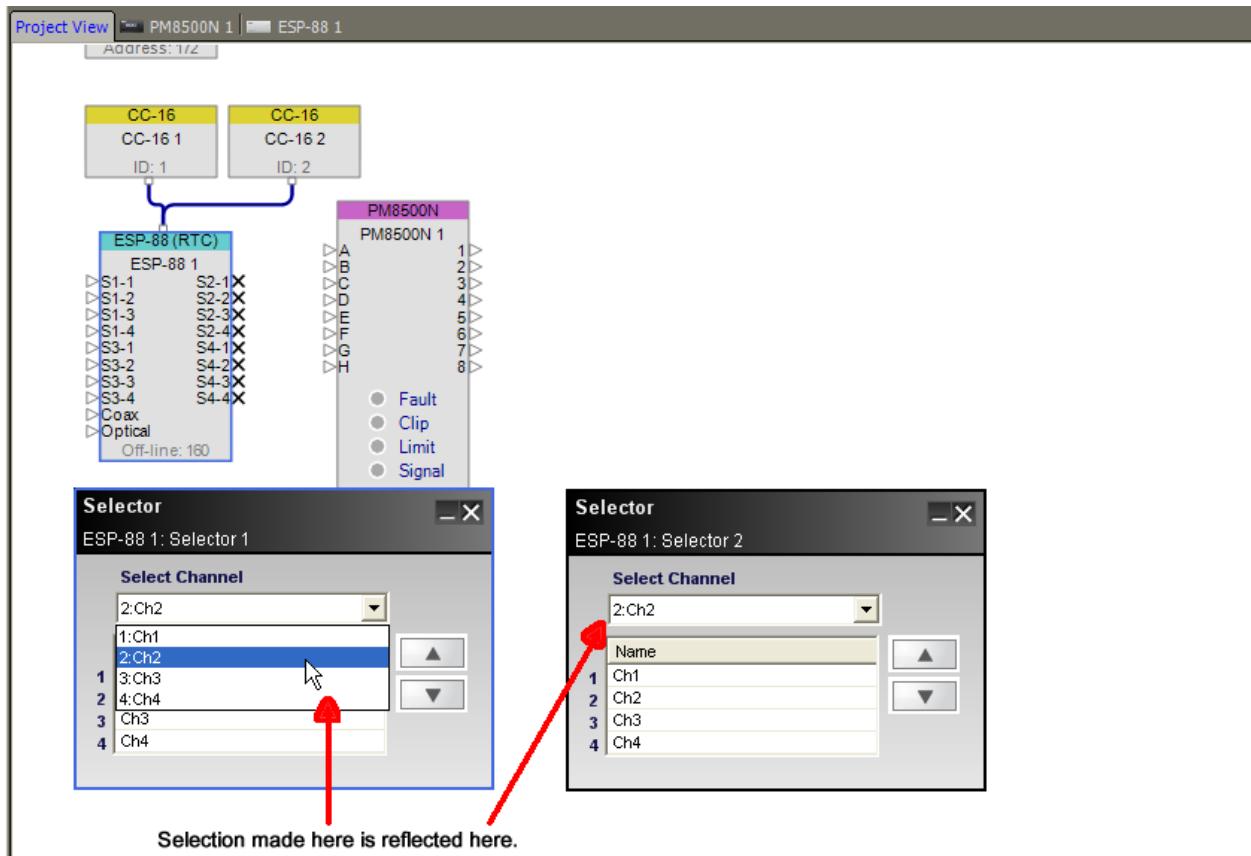


#### Verifying Master Fader changes on associated gains

**NOTE:** Grouped gain control sliders maintain relative positions when adjusting the *Master Fader* and you may adjust the level of an individual group member at any time. As the *Master Fader* is moved, an individual gain stops when it reaches its upper or lower limit, but the other gains in the group will continue to move. When the *Master Fader* is moved back, the relative gains are maintained as the stopped gain comes off its upper or lower limit.

When other signal processing block types (other than gain blocks) are grouped together, their settings are synchronized. Changes to one block automatically affect the others in the group. To create this type of group, select them in the ESP View then drag and drop them onto a group name in the Groups window.

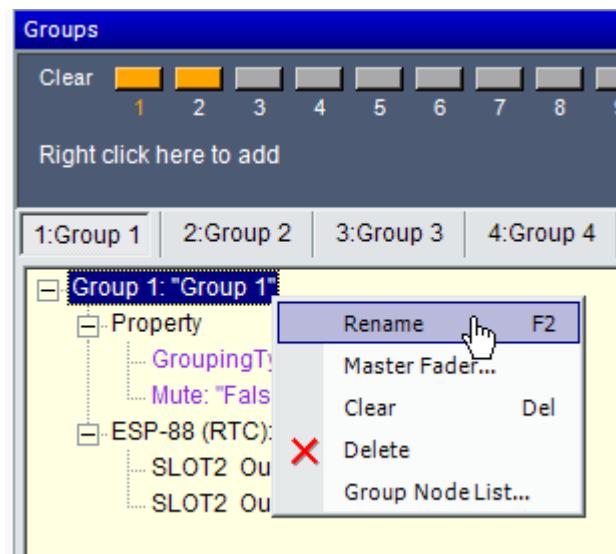
Verify correct behavior by opening each control panel for blocks stored in the group. As you adjust elements within one block, you will see corresponding movement on all other associated blocks.



Changes to selector 1 are mimicked in selector 2

### Renaming a Group

To rename the Group, select the top level of the tree structure and press F2, or right click and choose Rename.



### *Rename the Group*

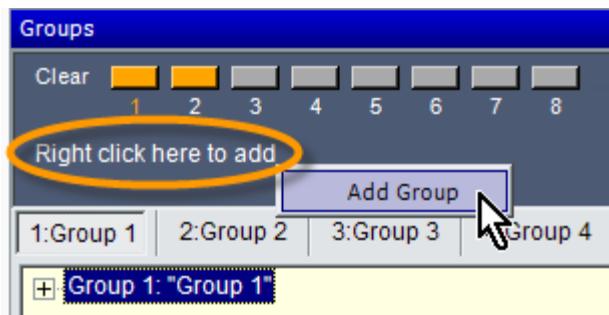
### **Editing Groups**

If you need to change a Group, view the contents by expanding the tree structure within the Groups window. The tree structure displays the blocks that are included in the group. Select a single block and right-click to open the block or to delete it from the group.

[Image]

### **Adding Groups**

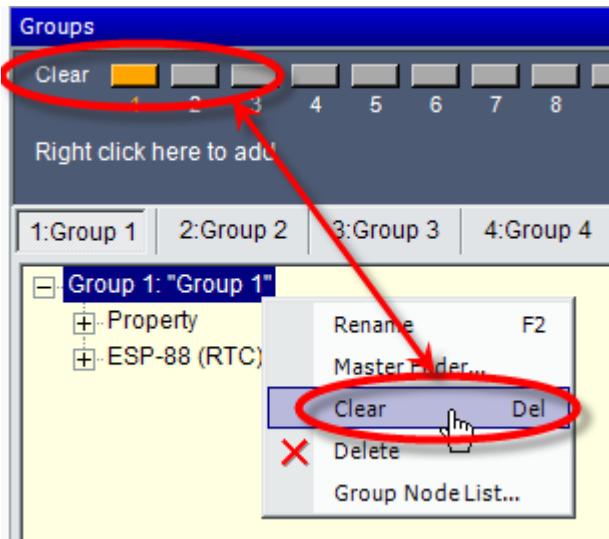
The default quantity of groups is 16, but additional groups may be added. If you need to add more groups, right click on the words "Right click here to add," and a new group is added at the end of the Group list.



*Adding a Group*

### **Clearing Groups**

To clear the contents of a group, select the group's tree structure and select Delete. Alternatively, you may right click on the top level of the group's tree structure, and select Clear.

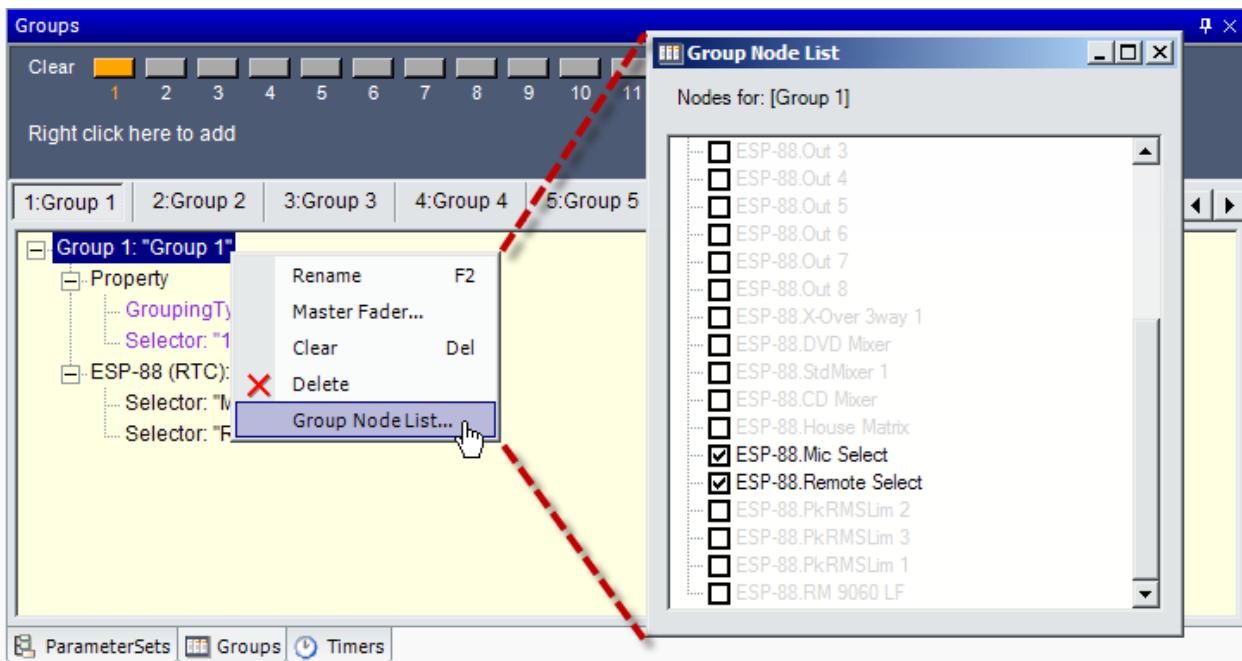


*Clearing a Group*

### Group Node List

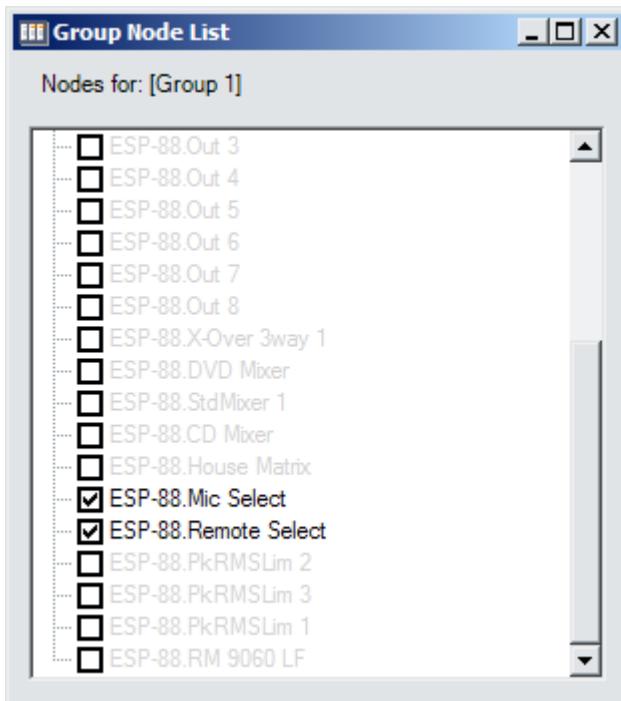
You can also create or modify a Group by using the Group Nodes List. Right click on the Group name in the Groups window and choose Group Nodes List. The Group Nodes List window opens showing all signal processing nodes in your system.

Groups may also be created or modified using the Group Node List. To access the Group Node List, double-click on the group name in the Group window. The Group Node List may also be accessed using the right-click option. Once enabled, the Group Node List window shows all signal processing nodes in your system, and indicates those assigned to the group.



#### *Opening the Group Nodes List*

When creating new Groups, you may add any processing block with identical functionality to that group. To select a given processing block, place a check mark next to the block name as shown in the following figure.



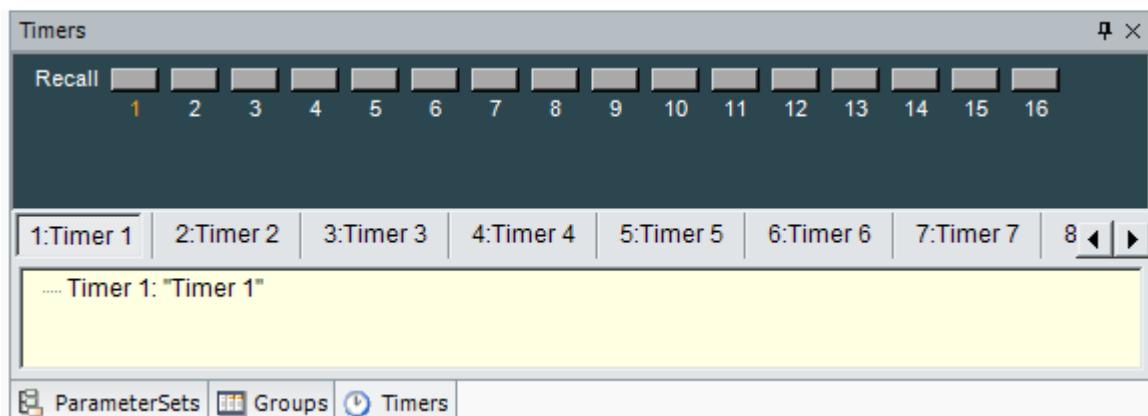
#### *Select processing blocks for group association*

## Timers

Timers can be used to schedule changes that will occur in signal processing or control settings at predetermined times. You can schedule a change to take place on a specific date and time, at the same time every day, or at a time on specific days of the week. For example, you could schedule a change in source selector to take place every day at 5:00 PM.

### Creating a Timer

Open the Timers window by accessing the Window Menu and selecting Timers from the list of available windows. Doing this displays the Timers tab in the Control Library. 16 timers are available for use.

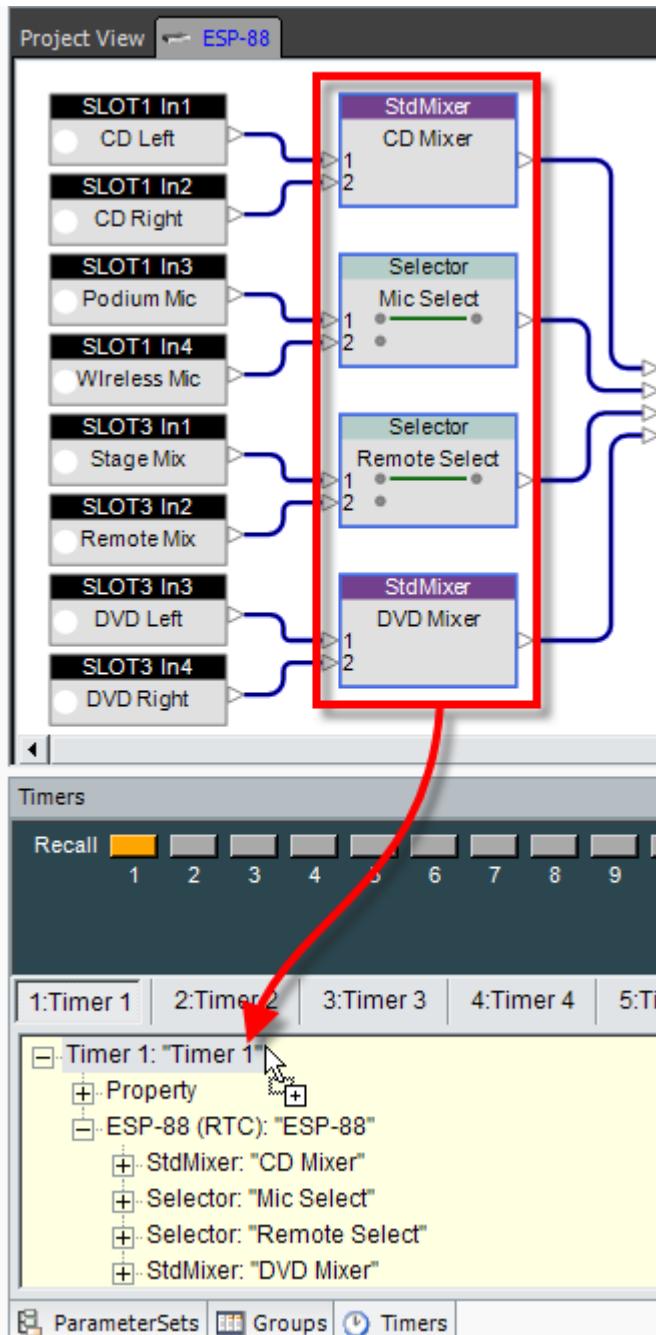


*Timers tab*

Select the signal processing blocks in the ESP View window whose functions you wish to include in a Timer. Drag and drop those processing blocks onto a timer name in the Timers window. Any processing block type may be added to a timer.

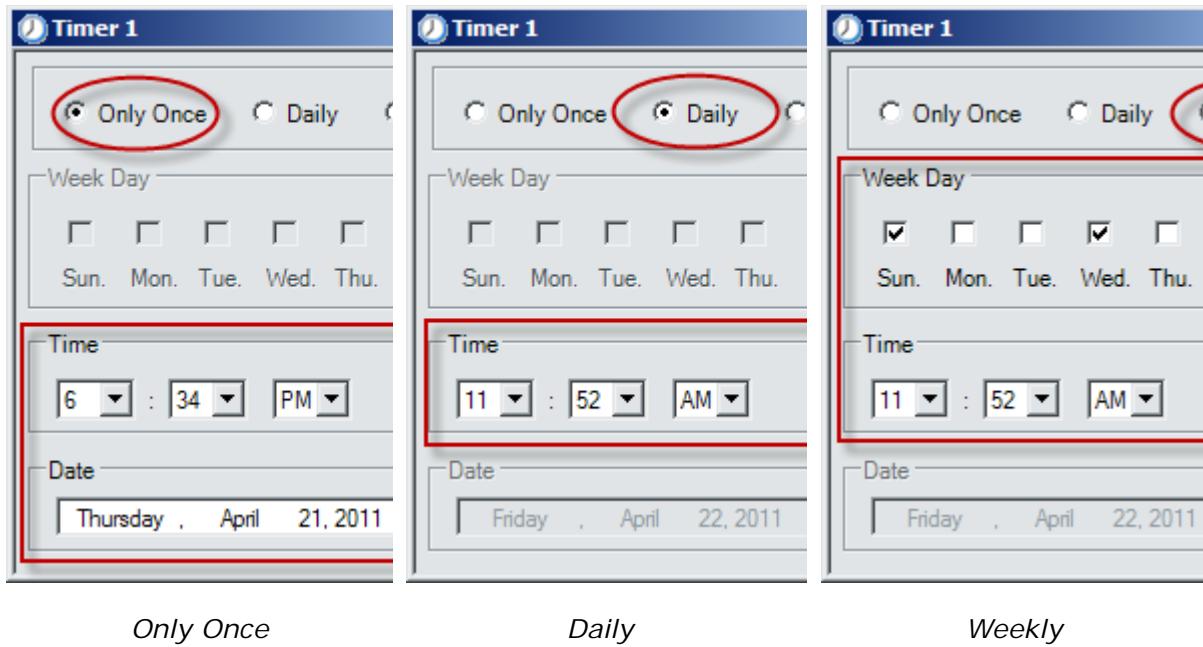
To program a new timer function:

1. Configure signal processing objects you want changed at the timer occurrence.  
**NOTE:** Any processing blocks may be added to a timer.
2. Drag and drop the signal processing objects onto a timer name in the Timers window.



*Dragging and dropping blocks into a Timer*

3. Define the timer's occurrence.

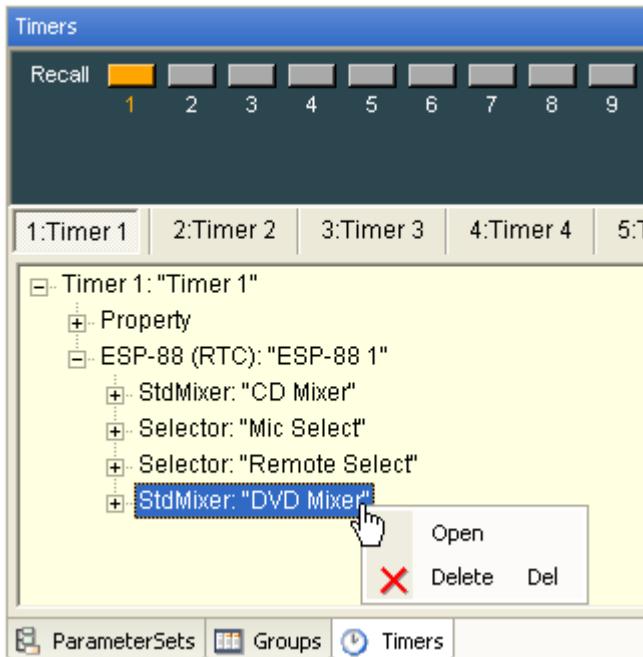
*Timer Control Panel Types*

#### 4. Test the newly programmed timer.

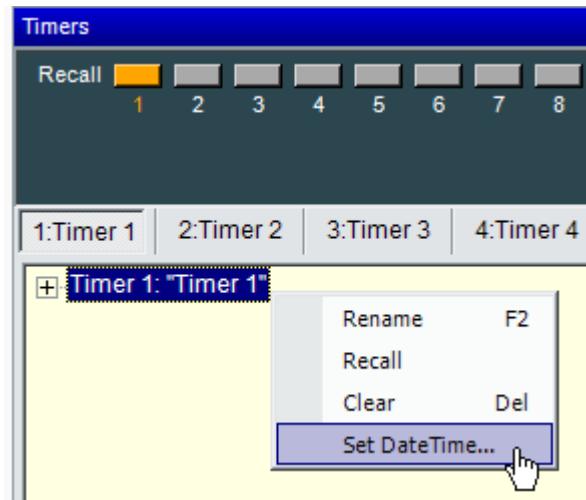
When signal processing objects are added to a timer, the timer setup window is displayed. Select one of three timer types (Only Once, Daily, or Weekly) and then choose the remaining options available for that specific timer type.

#### **Editing a Timer**

To modify an existing timer, view its contents by expanding the tree structure within the Timers window. The tree structure displays the processing blocks included in the timer. Select a single block and right-click to open the block or to delete it from the group.



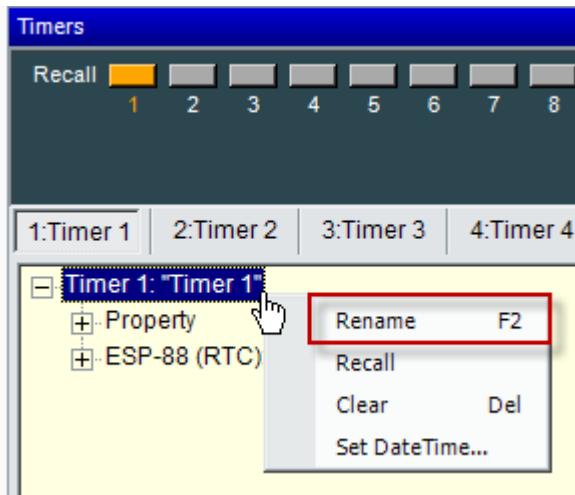
To adjust the occurrence of a Timer, right click on the timer name and select **Set Date Time...**.



*Adjusting Date and Time of a Timer*

### Renaming a Timer

To rename the Timer, select the top level of the tree structure and press F2, or right click and choose Rename.

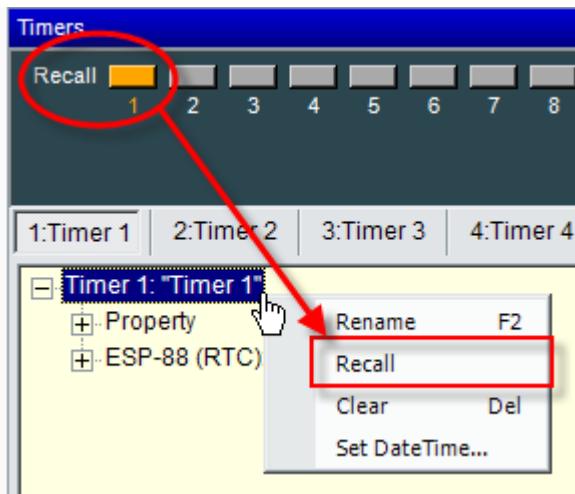


*Rename a Timer*

### Recalling Timers

The recall buttons in the Timers window change to orange when a Timer is stored. Pressing the recall button changes the state of all signal processing blocks to the values stored in the Timer. Right clicking on a Timer name provides an alternate method of recalling a Timer.

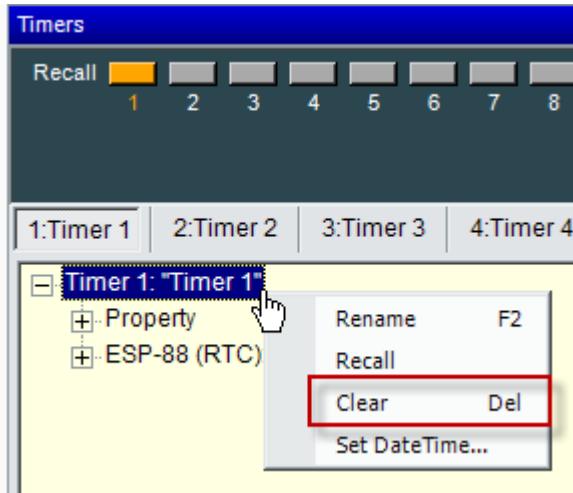
Open the individual signal processing block control panels and then recall Timers to verify that correct settings are stored.



*Recall a Timer*

### Clearing Timers

To clear the contents of a Timer, right click on the top level of the tree structure, and select Clear, or press Delete.



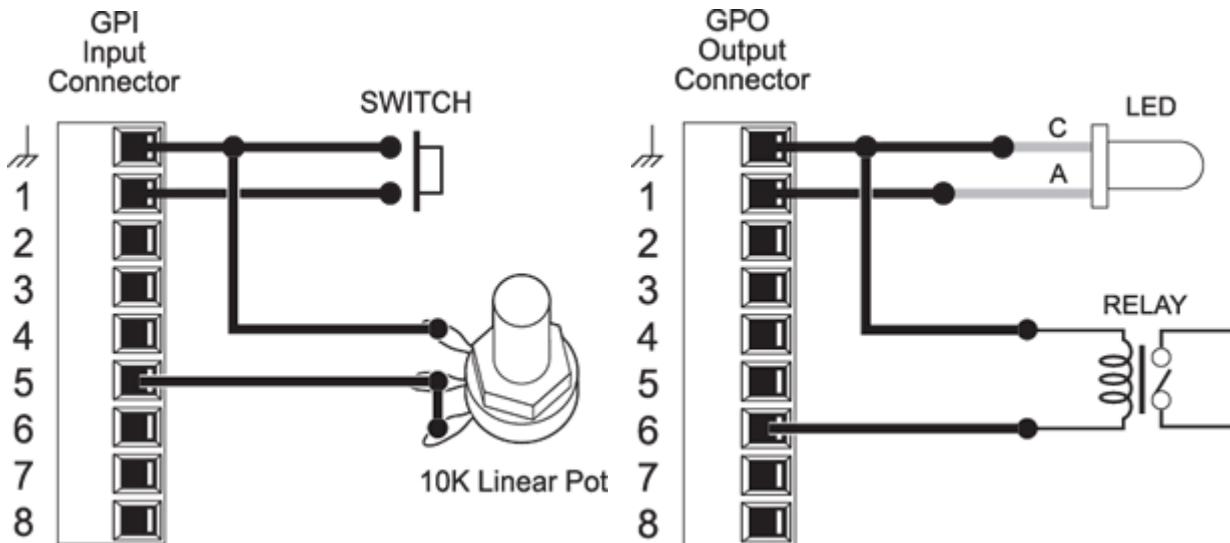
Clearing a Timer

## ESP GPIO Ports

### Programming GPIO

Programming GPIO ports within an ESP system is accomplished using the same drag and drop methods described for all other signal processing and control programming. However, the source and destination of the drag and drop operations, as well as programming logic of the two types of ports, are reversed.

- With General Purpose Inputs, system devices are programmed to respond to voltage changes from external equipment connected to a GPI port.
- With General Purpose Outputs, internal system design changes affect the voltage supplied to GPO ports for driving external equipment.



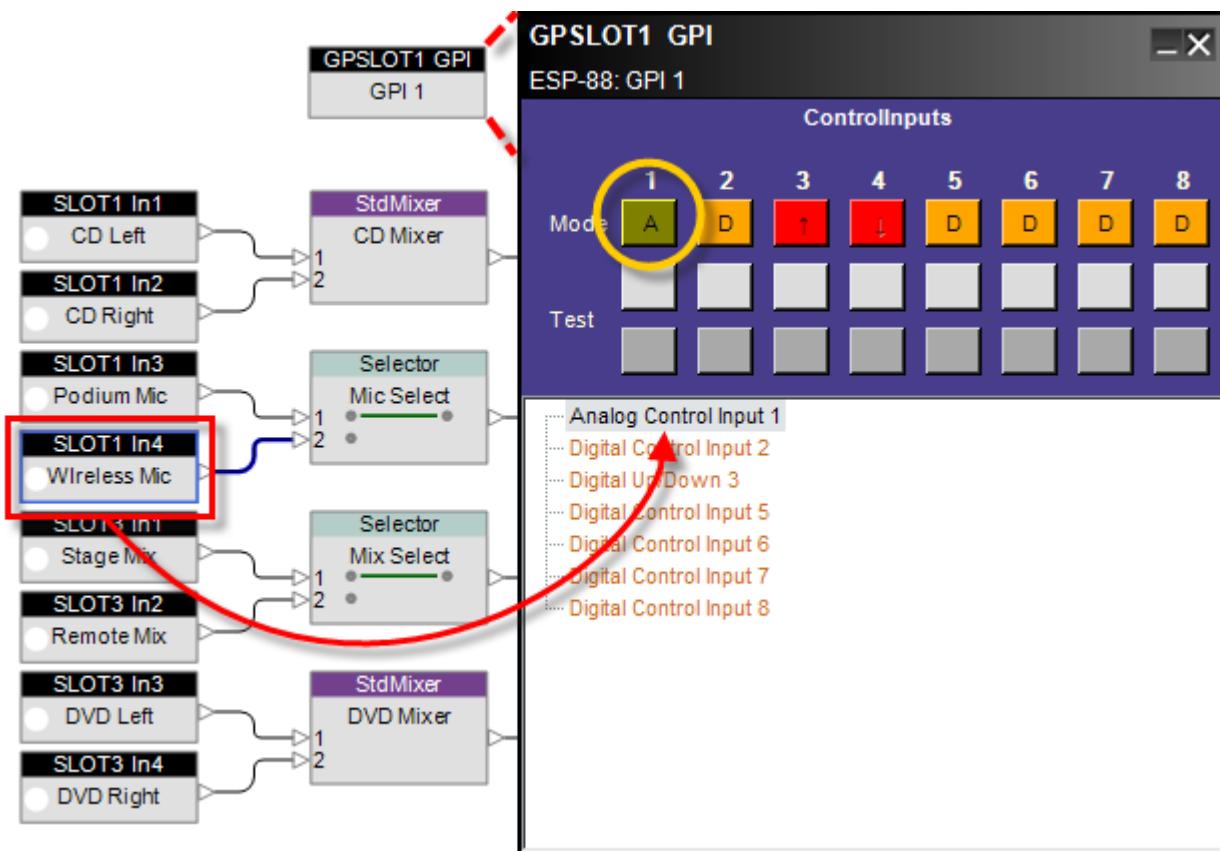
*Typical GPI Device Connections**Typical GPO Device Connections**GPIO External Device Connection Examples*

## Programming GPI

Configure the GPI port control mode then drag and drop processing blocks from the ESP View or Control Library to text lines in the programming tree of the GPI control Panel. Refer to [GPIO](#) for a description of operating modes.

### Analog Mode

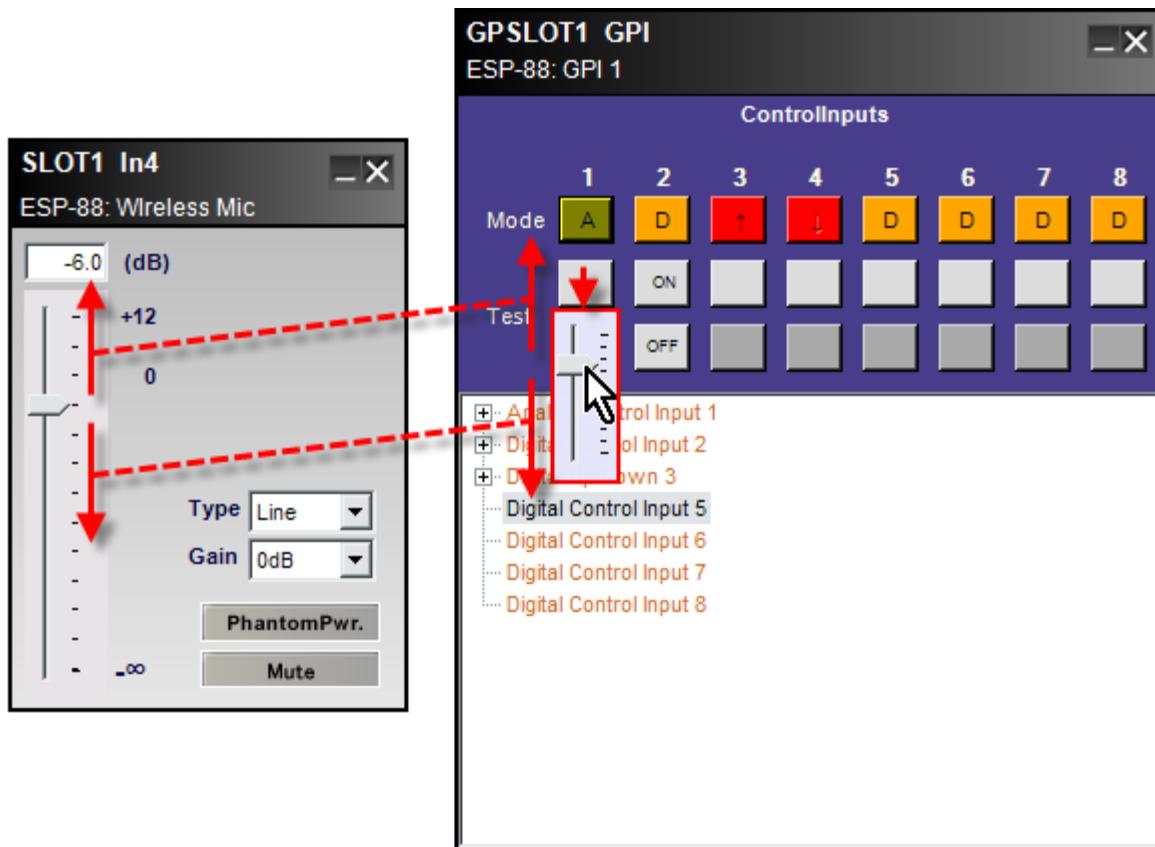
To program an Analog GPI port mode with potentiometer connected to GPI port 1 to control a gain stage, adjust the GPI mode to *Analog* then drag the gain block onto "Analog Control Input 1:"



*Assigning an input gain block to an Analog GPI port*

Testing the operation of this GPI programming within software is accomplished by opening the input gain control panel and right clicking the test button directly beneath the GPI control panel input mode button to gain access to a virtual test slider.

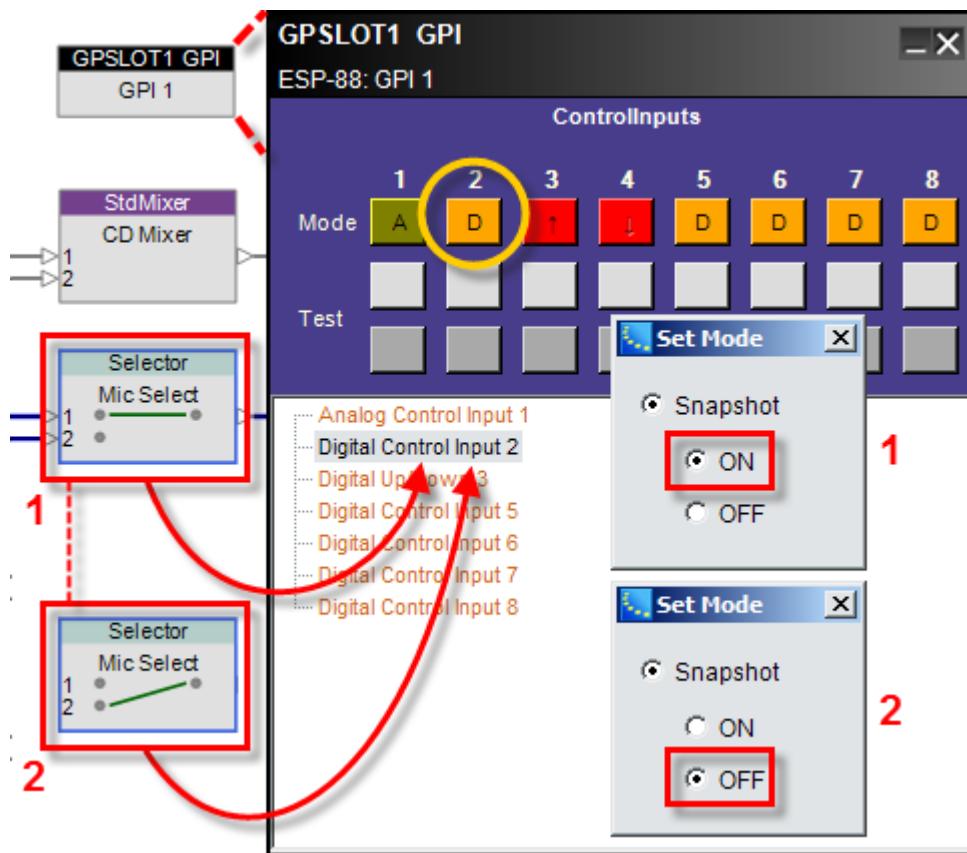
Move the test slider up and down to verify corresponding movement occurs on the gain control. When physical hardware is present and connected, you will see similar movement on the gain control by rotating the potentiometer in the field.



Testing Analog GPI port programming

## Digital Mode

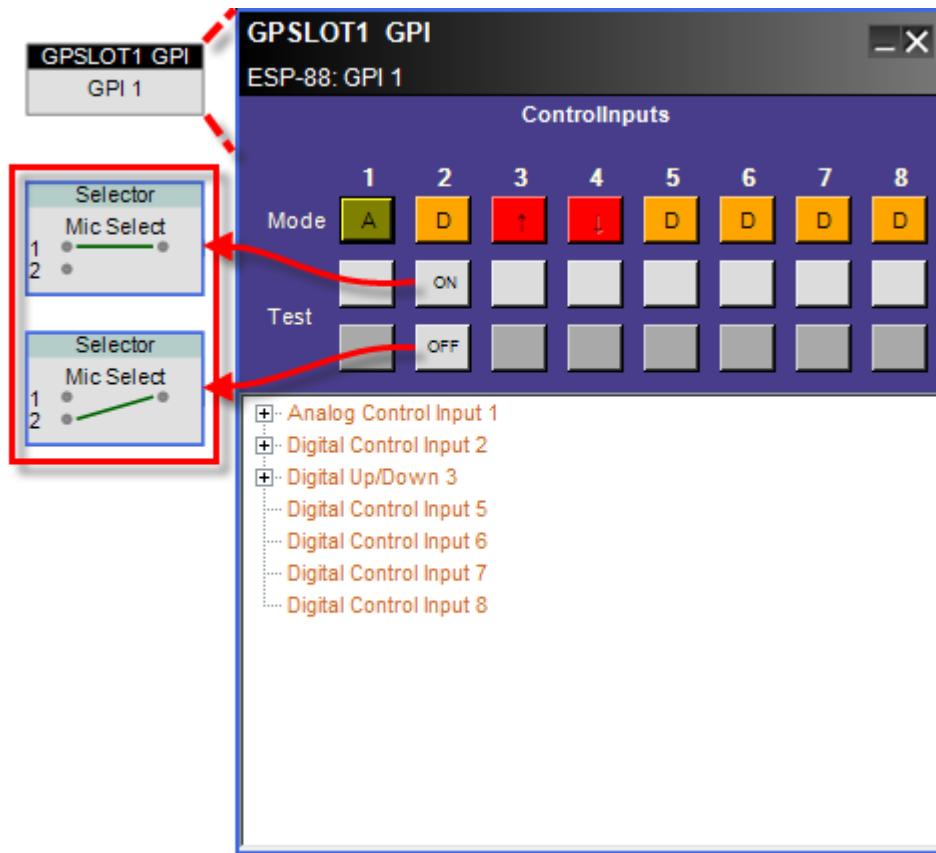
To program a Digital GPI port mode with a latching closure connected to GPI port 2, adjust the GPI mode to *Digital* then drag a selector to "Digital Control Input 2:" This GPI mode stores two Snapshot conditions to match normally open and normally closed switch conditions. Close the Snapshot Set Mode panel after the first drag operation to define the ON condition, adjust the selector to the alternate position, then drag and drop the selector back on to "Digital Control Input 2:" This becomes the Snapshot Set Mode OFF condition.



*Assigning a selector block to a Digital GPI port*

Testing the operation of this GPI programming within software is accomplished by viewing the selector control panel while left clicking the test buttons directly beneath the control input mode button to simulate switch actions.

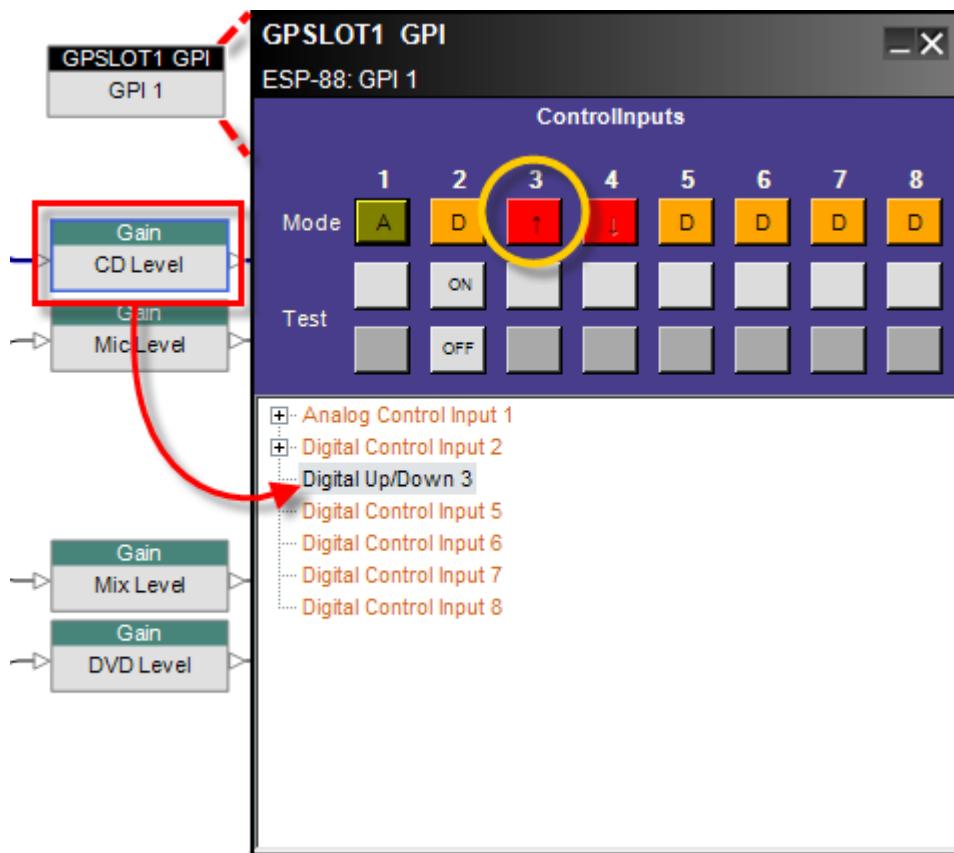
Push the ON test button to verify corresponding movement occurs in the selector. Repeat this to verify selector for the OFF test button. When physical hardware is present and connected, you will see similar movement on the selector by activating the switch in the field.



Testing Digital GPI port programming

### Digital Up/Down Mode

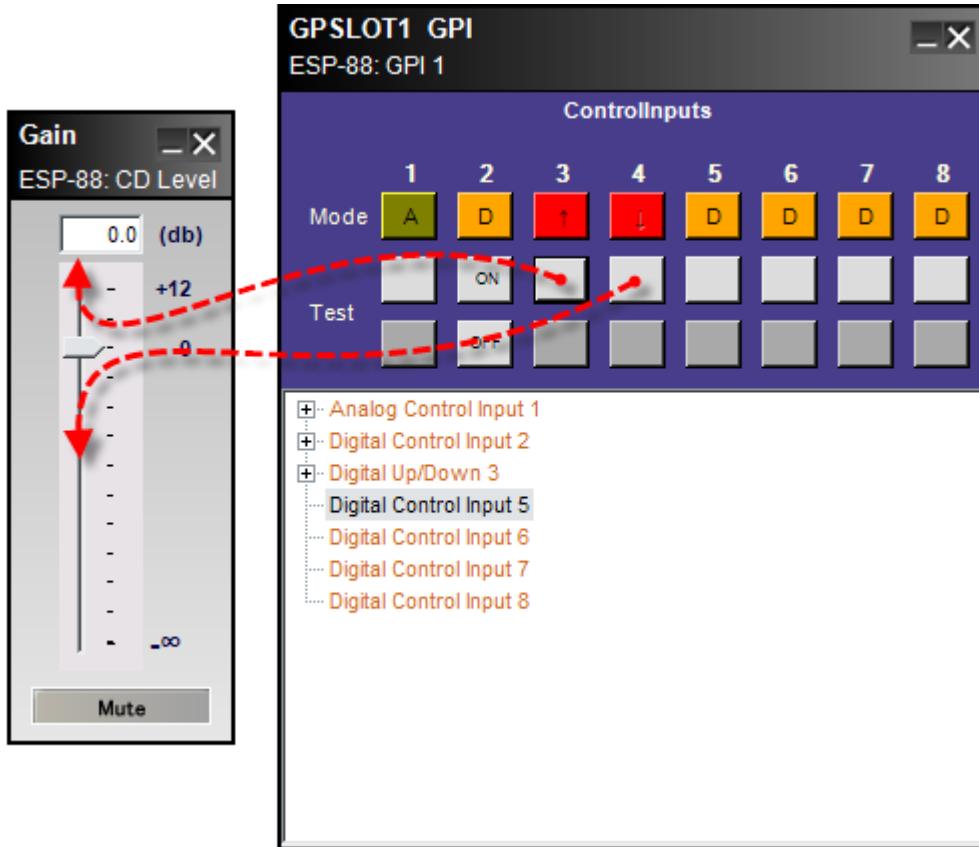
To program a Digital Up/Down GPI port mode with two momentary switches connected to GPI ports 3 & 4, adjust the GPI mode to *Digital Up/Down* then drag a gain block onto "Analog Control Input 3:" Digital Up/Down mode replicates rotary gain control movement with one push button to increase level and another to decrease level. As a result, this mode occupies two positions in the GPI control panel.



*Assigning a gain block to a Digital Up/Down GPI port*

Testing the operation of this GPI programming within software is accomplished by opening the input gain control panel and left clicking the test button directly beneath each GPI control panel input mode button to simulate switch push button actions.

Press the test buttons to verify corresponding movement occurs on the gain control. When physical hardware is present and connected, you will see similar movement on the gain control by pushing the physical buttons in the field.

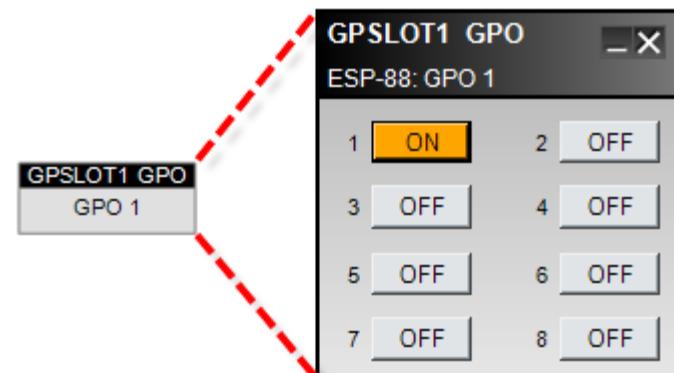


*Testing Digital Up/Down GPI port programming*

## Programming GPO

General Purpose Outputs are activated by parameter set or timer and two methods exist for programming them. The first method is to use the Project Directory and the second method is to use the Parameter Set Nodes List.

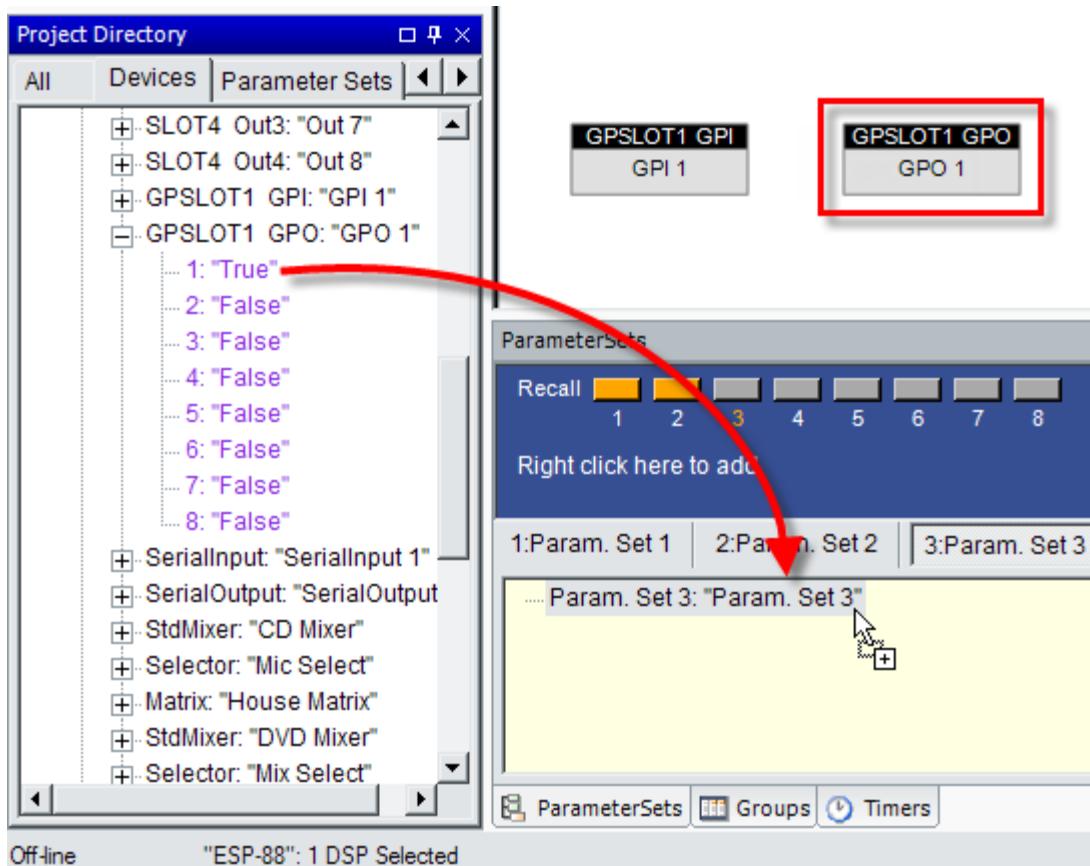
For each of the two methods, the first step is to open the GPO control panel and set the state the desired output to either ON or OFF.



*Open & Enable General Purpose Outputs*

## Using the Project Directory

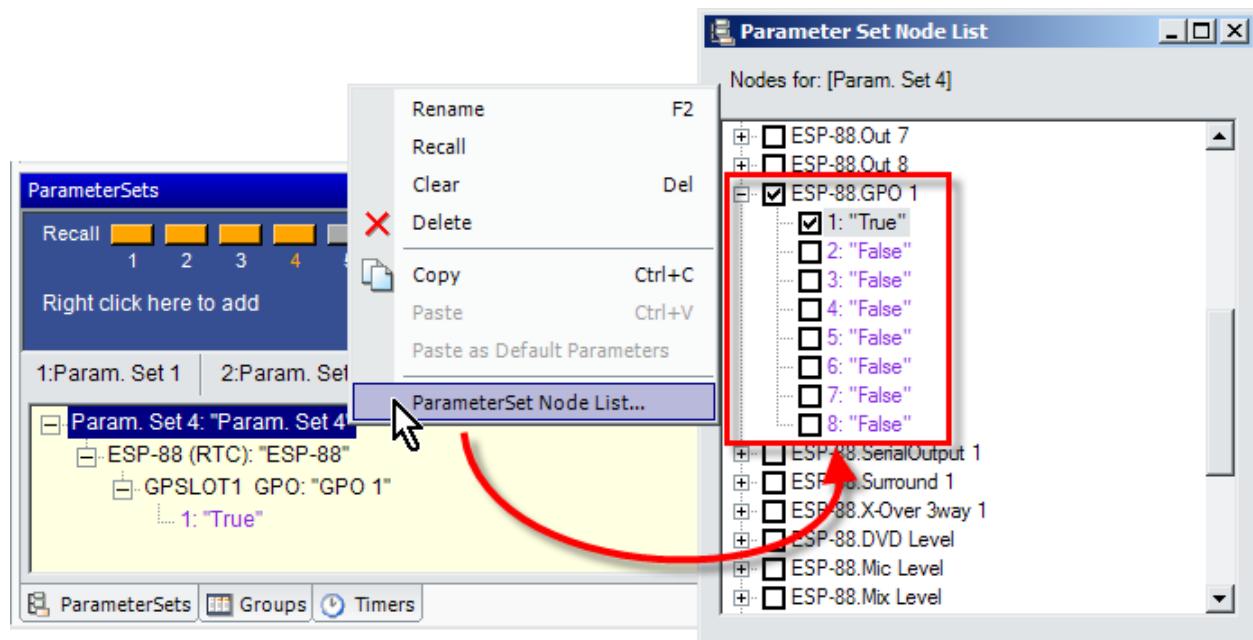
Using the Project Directory, expand the GPO section within the ESP device tree and drag the specific output of interest into a parameter set or timer. When that parameter set is invoked or the timer activates, the GPO will change its state to the programmed value (ON or OFF).



Project Directory GPO Drag & Drop to Parameter Set

## Using the Parameter Set Nodes List

Right click on a parameter set name in the Parameter Set window and select the Parameter Set Nodes List. Place a check mark next to the desired GPO ports in the ESP device tree to store in the parameter set.

*Parameter Set Node List GPO Programming*

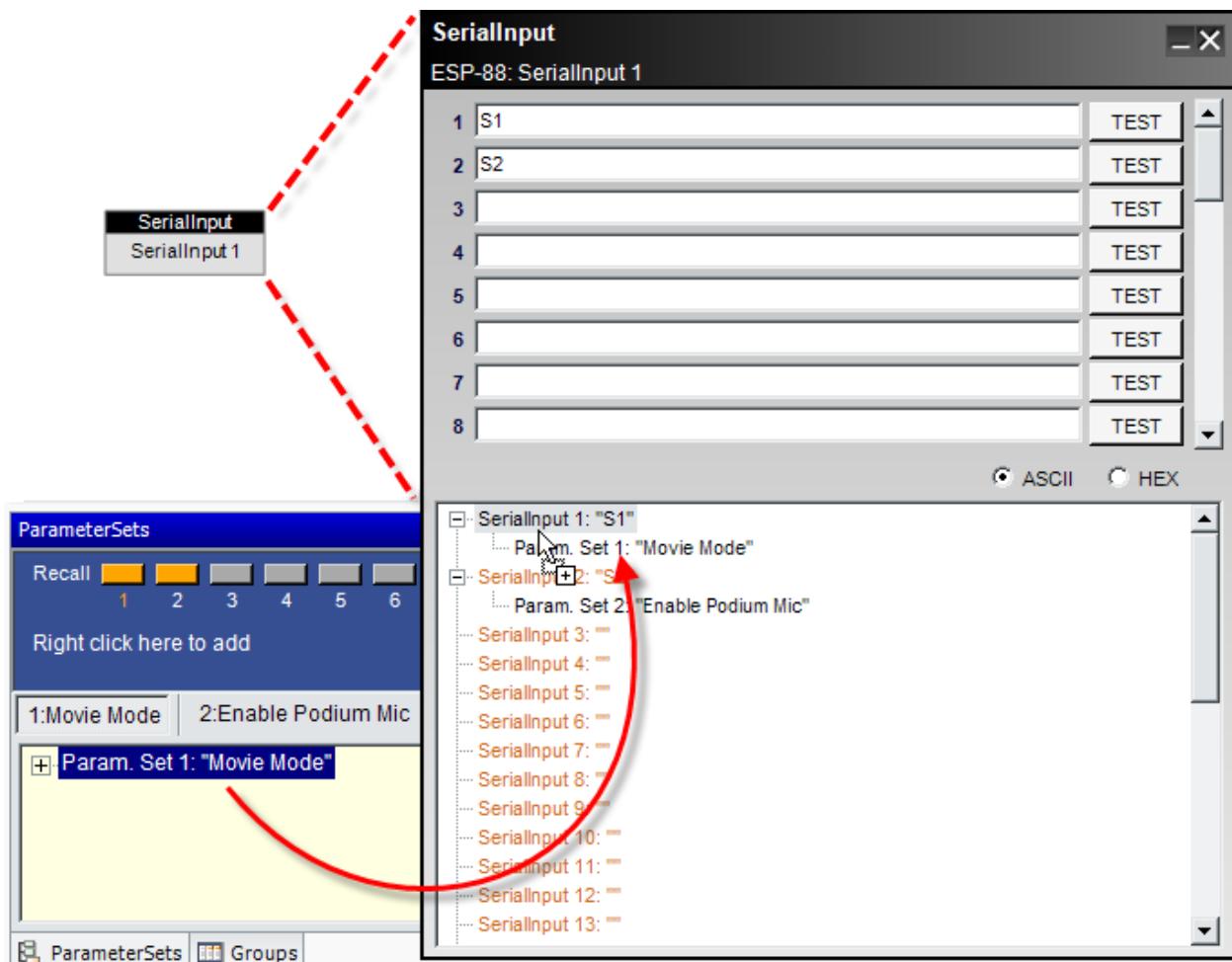
## Serial Port Programming

ControlSpace Engineered Sound Processors will respond to and send serial messages via either the serial port, located on the rear panel of the ESP, or the Ethernet network. The hardware serial port is configured for 38,400 baud, no parity, 8 bits, 1 stop bit, and no flow control.

Serial inputs may be programmed to invoke an action in a device when a serial command is received from an external device. Serial outputs may be programmed to send a serial command to an external device when a parameter set is invoked, or when a timer activates.

### Serial Inputs

ControlSpace ESP systems may recall a snapshot of a block, or invoke a parameter set when a serial string is sent to the serial port. To program a Serial Input, open the Serial Input control panel from ESP View and drag and drop one or more blocks or parameter sets onto a text line in the programming tree.



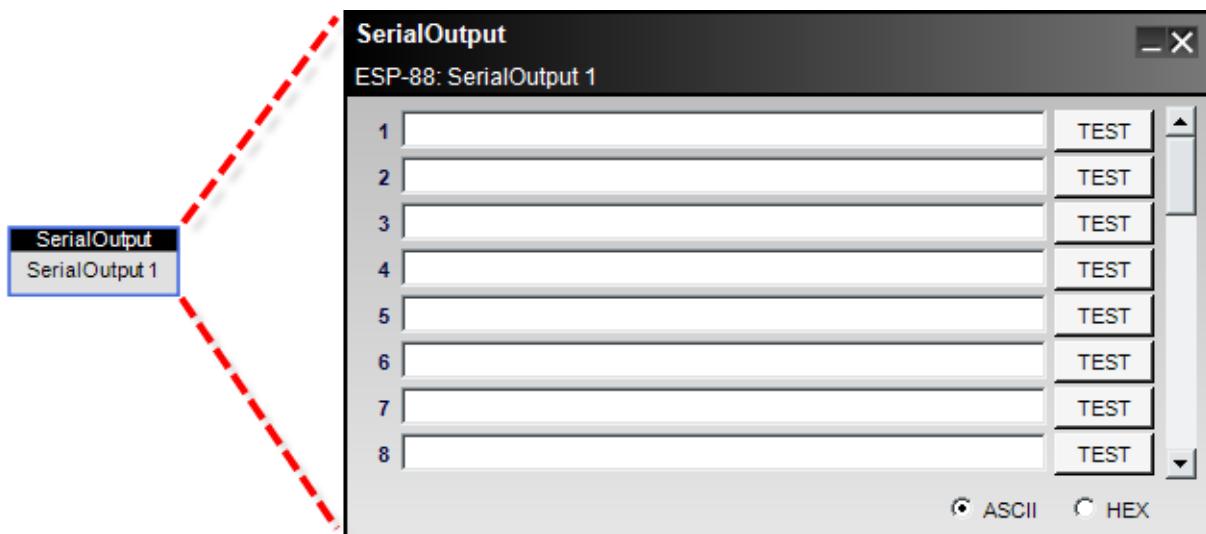
*Input strings "S1" and "S2" invoke parameter sets*

Enter the serial string of characters in the corresponding field in the upper half of the control panel. When the incoming serial string matches any of the eight strings entered, the block or parameter set programmed for that string is invoked. For example, receipt of the ASCII string "S2" from an external system indicates that "scene 2" is selected, and ControlSpace should invoke the programmed signal processing block or parameter set.

Test buttons on the Serial Input control panel are used to simulate the incoming serial string and verify programming is operating as intended.

## Serial Outputs

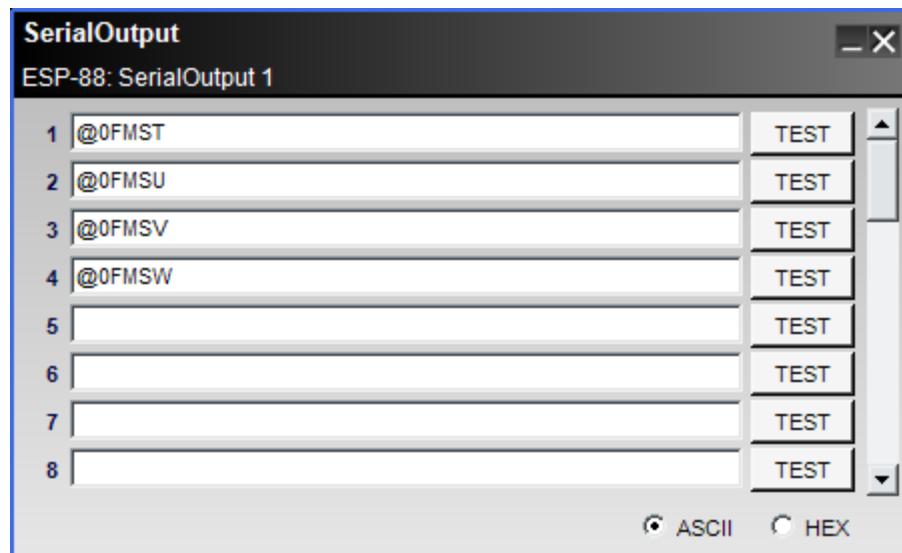
The serial output device is used to transmit a serial string out the port when a parameter set is invoked, or when a timer activates. To open the Serial Output control panel, double-click on the Serial Output block in ESP View.



*Open the Serial Output control panel*

There are two ways to program a Serial Output which are similar to programming a GPO. The first method is to use the Project Directory and the second method is to use the Parameter Set Nodes List.

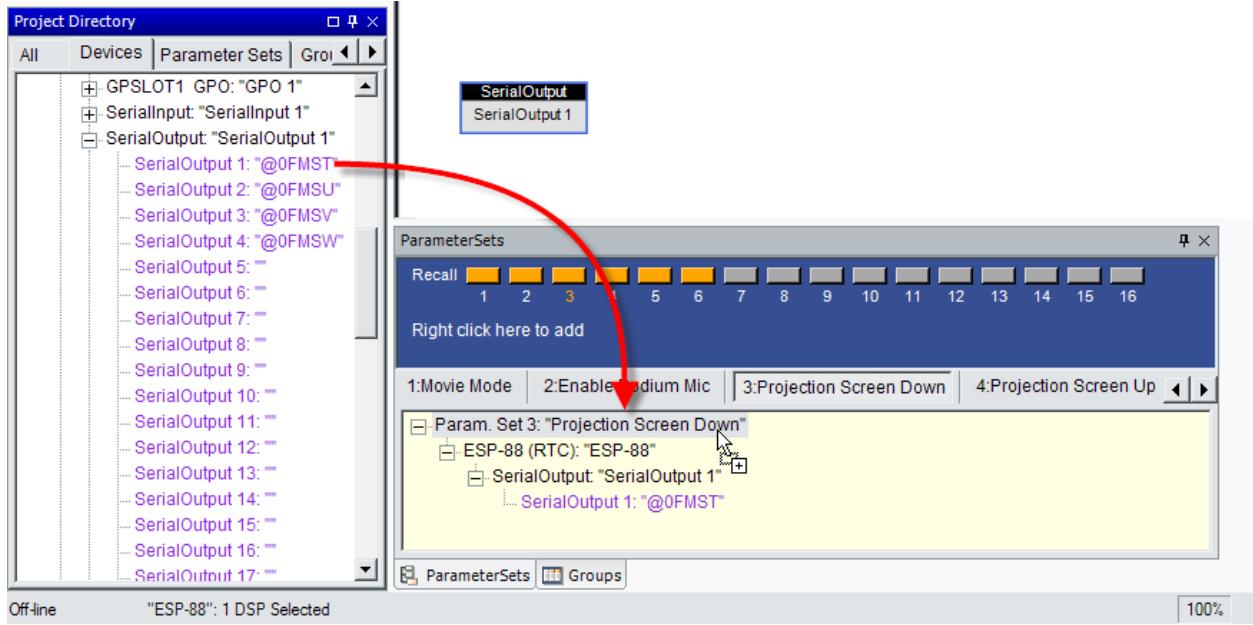
For each of the two methods, the first step is to open the Serial Output control panel and enter the serial command strings to provide the desired device control.



*Serial Output Commands*

## Using the Project Directory

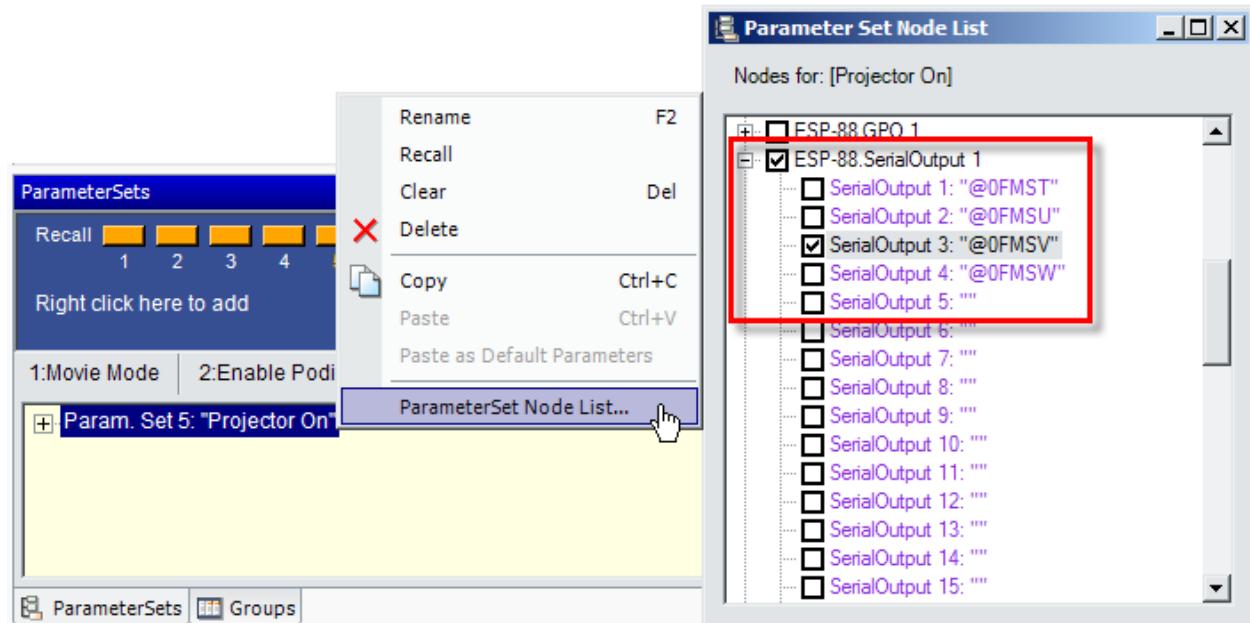
After typing the serial string or command into the Serial Output control panel, find the Serial Output in the Project Directory, and drag it into a parameter set or timer. When the parameter set is invoked, or the timer activates, the Serial string is sent out the Serial port on the ESP. For example, you could send a signal to a video switcher when a parameter set is invoked or a timer expires.



*Using Project Directory to Program Serial Output*

## Using the Parameter Set Nodes List

Right click on a parameter set name in the Parameter Set window and select the Parameter Set Nodes List. Place a check mark next to the desired GPO ports in the ESP device tree to store in the parameter set.



*Parameter Set Node List Serial Output Programming*

**Note:** The ESP automatically assumes that each input string is terminated with one carriage return (CR). You must program the equipment sending the serial string to the ESP to

terminate the serial string with one CR at the end of each command. You do not need to enter this CR in the Serial Input entry windows

**Note:** You must use hex when designating a control character like CR or LF. To designate a hex character, use backslash 0, then the hex value of the character (0-F).

## Control Centers

### Control Center Programming

ControlSpace Designer software allows for a great amount of flexibility in how the user will control the system. The amount of programmed control depends on the system design, and the needs of your customer. Your system might be a static signal processing tool, and require no user controls, or it might be a multi-room, multi-zone solution requiring CC-4, CC-16, and CC-64 controllers, along with general purpose switches and potentiometers.

For information on programming these controllers, see:

[Programming CC-4 Room Controllers](#)

[Programming CC-16 Zone Controllers](#)

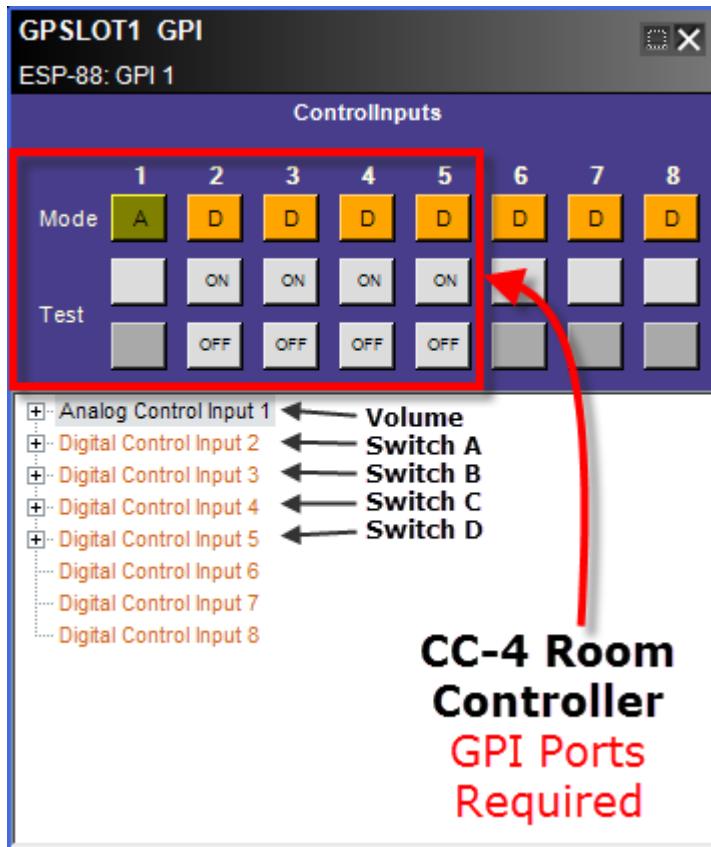
[Programming CC-64 Control Centers](#)

### Programming CC-4 Room Controllers

The CC-4 Room Controller has no dedicated control panel within ESP View. It has a Project View icon only. However, it supports the following programming features via the GPI port:

**Volume Control** – Drag and drop any gain block to an analog mode control for the GPI port to which this volume control is wired.

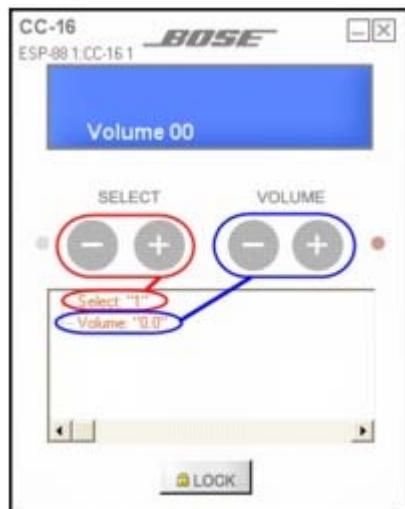
**Selector Switch** – Drag and drop any parameter set to four individual digital mode GPI controls for each switch position, A through D.



*CC-4 Programming via GPI Analog and Digital Modes*

## Programming CC-16 Zone Controllers

Once a signal processing design is complete, programming associated controllers is accomplished using the same drag and drop methods as discussed in previous sections. Open the CC-16 Smart Simulator by double clicking on its Project View icon.



*Programming tree functions of the CC-16 Smart Simulator*

The buttons on the CC-16 can be programmed with the following objects:

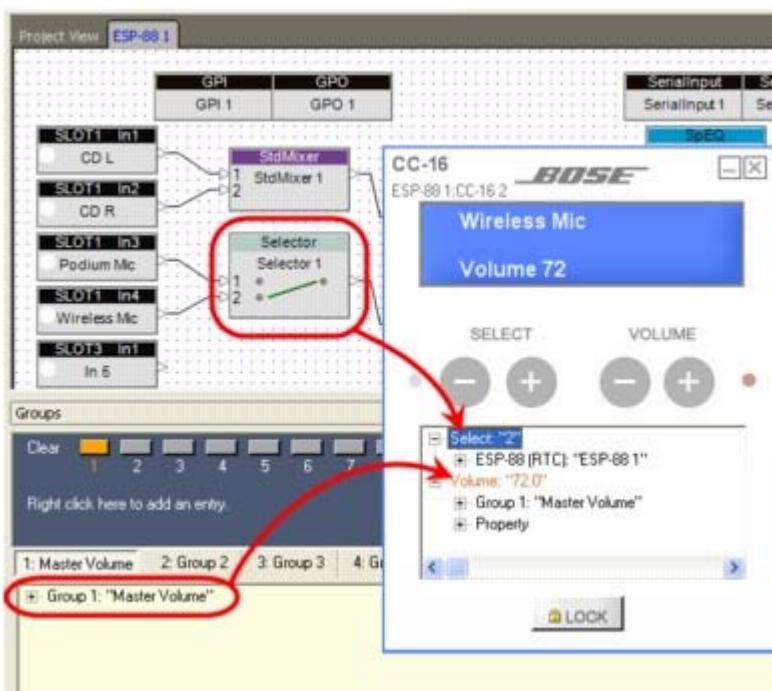
## SELECT buttons:

- Selector blocks
- Parameter sets

## VOLUME buttons:

- Gain blocks (including Input and Output blocks)
- Groups of gain blocks

Select one of the appropriate block types listed above for use within the CC-16 Select buttons within ESP View. Then drag and drop that processing object onto the Select entry in the CC-16 programming tree. Repeat this process for a gain or grouped gain for Volume entry programming.



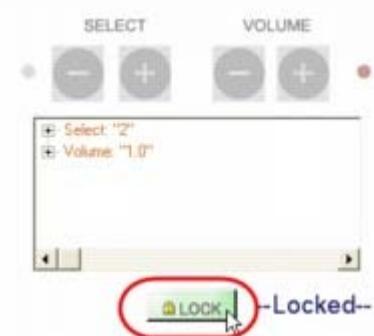
*Assigning functions to CC-16 buttons*

**NOTE:** Labels for the CC-16 display are inherited from the individual blocks, parameter sets, and groups. If the name is modified after adding the item to the CC-16, it must be re-assigned to the CC-16 for the new name to be applied.

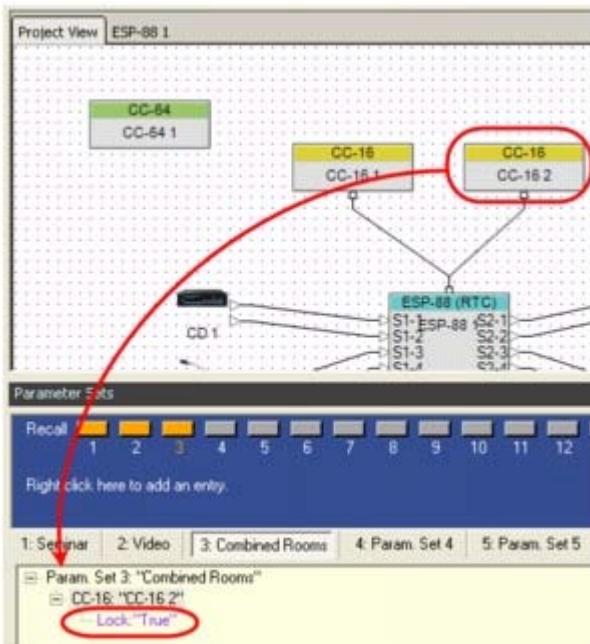
## Locking the CC-16

When locked, the select and volume control buttons of the CC-16 are disabled. The lock/unlock status of a CC-16 must be stored in two unique parameter sets, one for lock and one for unlock. When either parameter set is invoked, the CC-16 is either locked or unlocked accordingly.

To store the lock/unlock status in a parameter set, first set the lock button on the CC-16 Smart Simulator to the locked or unlocked state, then drag the CC-16 from Project View into a parameter set. The lock status is the only CC-16 setting that is stored in the parameter set.



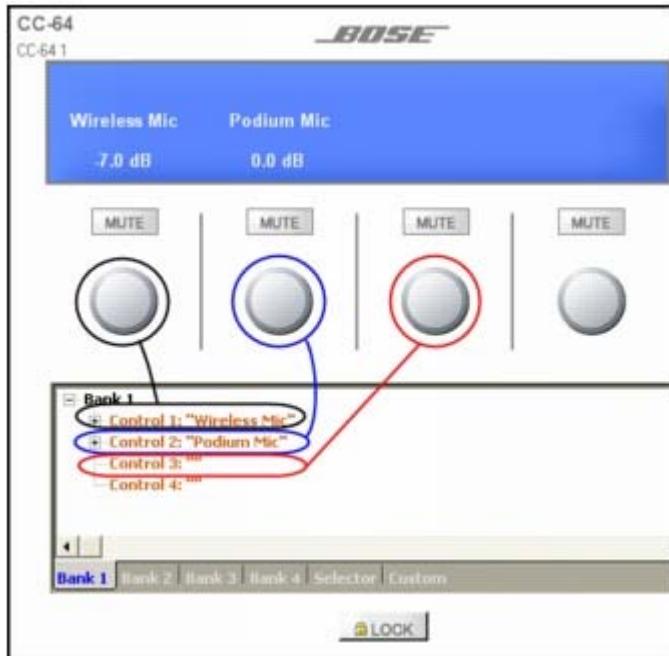
*Setting the lock button on the CC-16 Smart Simulator*



*Dragging the locked CC-16 into a parameter set*

## Programming CC-64 Control Centers

The programming tree in the lower half of the CC-64 Smart Simulator is used for assigning functions to the controls on the CC-64.



*Programmable Controls for Bank 1*

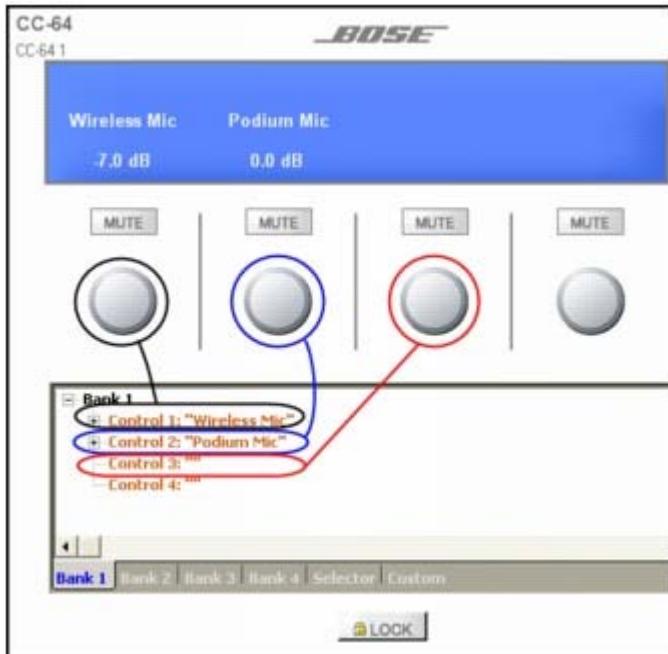
This control center may be programmed to control or invoke the following objects:

- Gain blocks (including Input and Output blocks)
- Grouped Gain blocks
- Selector blocks
- Parameter sets
- Select signal processing blocks using custom settings

Once a signal processing design is complete, programming associated controllers is accomplished by dragging and dropping the desired processing object onto the appropriate user control.

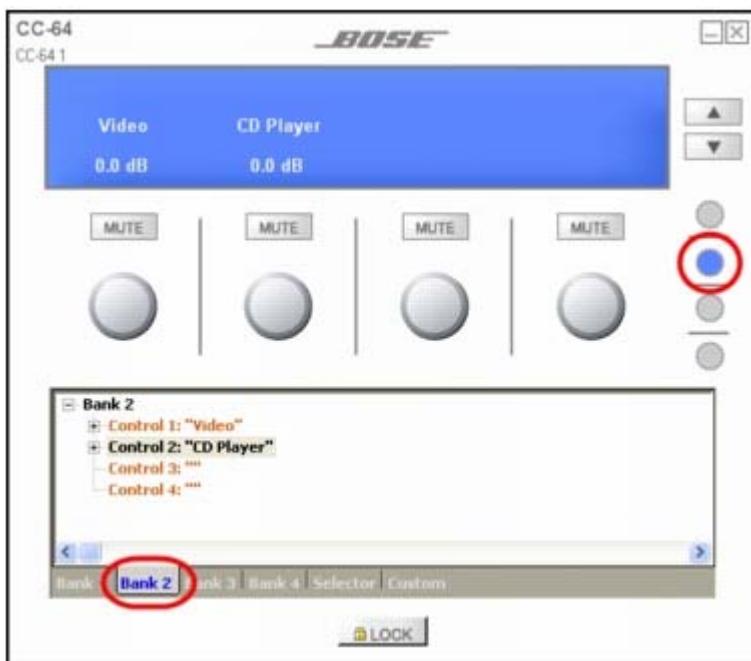
When you open the Smart Simulator, the controls for Bank1 are displayed in the programming tree by default.

You may assign functions to controls 1-4, which correspond to control knobs 1-4 once the Bank1 tab is selected, by dragging and dropping from ESP View onto the controls.



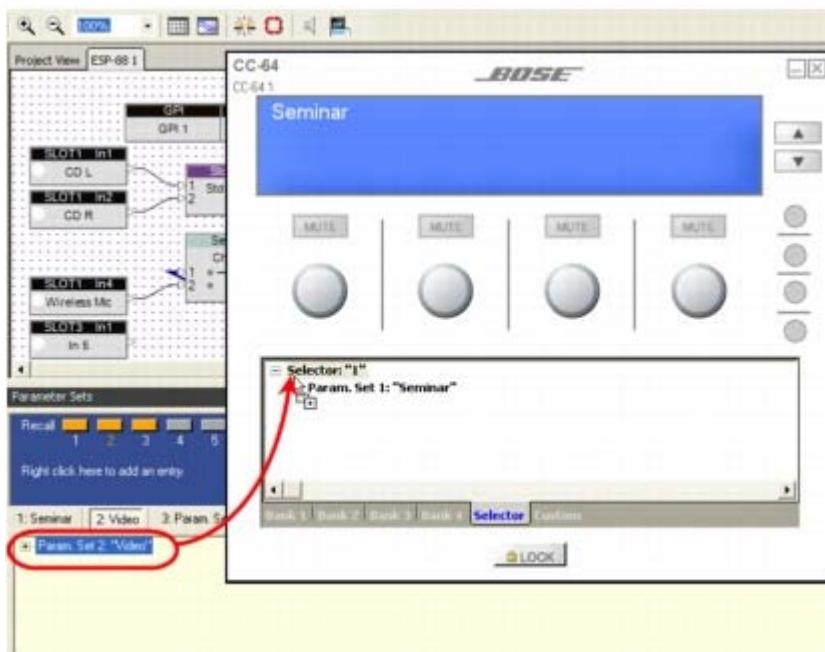
*Dragging a sound processing block onto a Bank 1 control*

To assign functions for the control knobs in Bank 2, select the Bank 2 tab at the bottom of the Smart Simulator window or press the Bank 2 selector button. Drag and drop functions onto the controls. The LCD display in the Smart Simulator shows what is displayed on the actual CC-64.



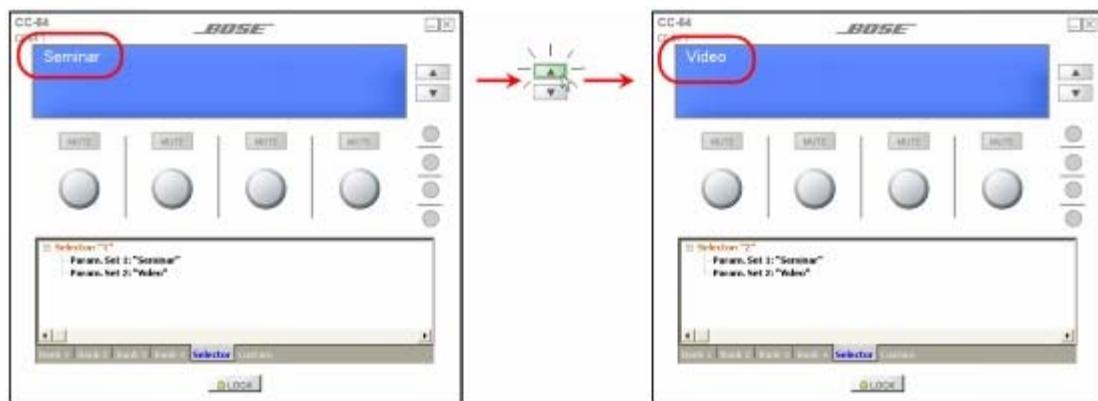
*Assign functions to Bank 2*

To assign functions to the Selector knob, choose the Selector tab at the bottom of the Smart Simulator window. Drag and drop a Selector sound processing block, or parameter set onto the Selector.



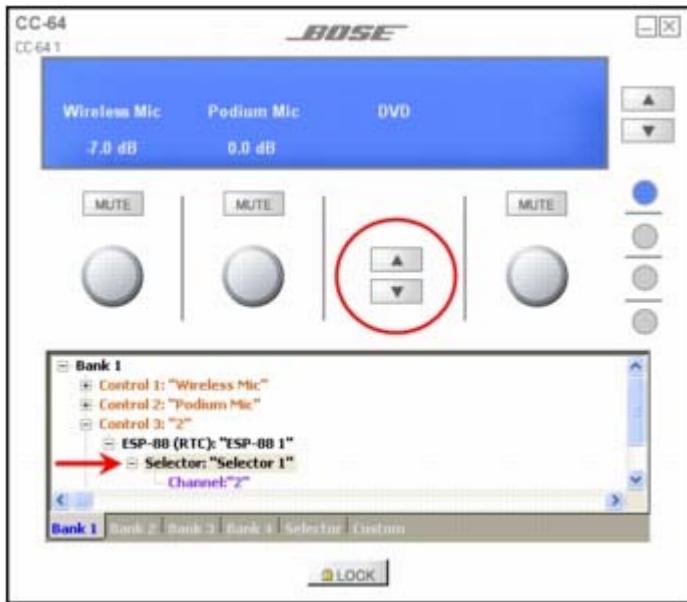
*Dragging and dropping a parameter set into the Selector*

Verify your programming by clicking on the Selector arrows in the Smart Simulator, which correspond to clockwise and counter-clockwise knob rotation. The display will switch between descriptions of any series of parameter sets assigned to the Selector.



*Testing the programming by switching between two parameter sets*

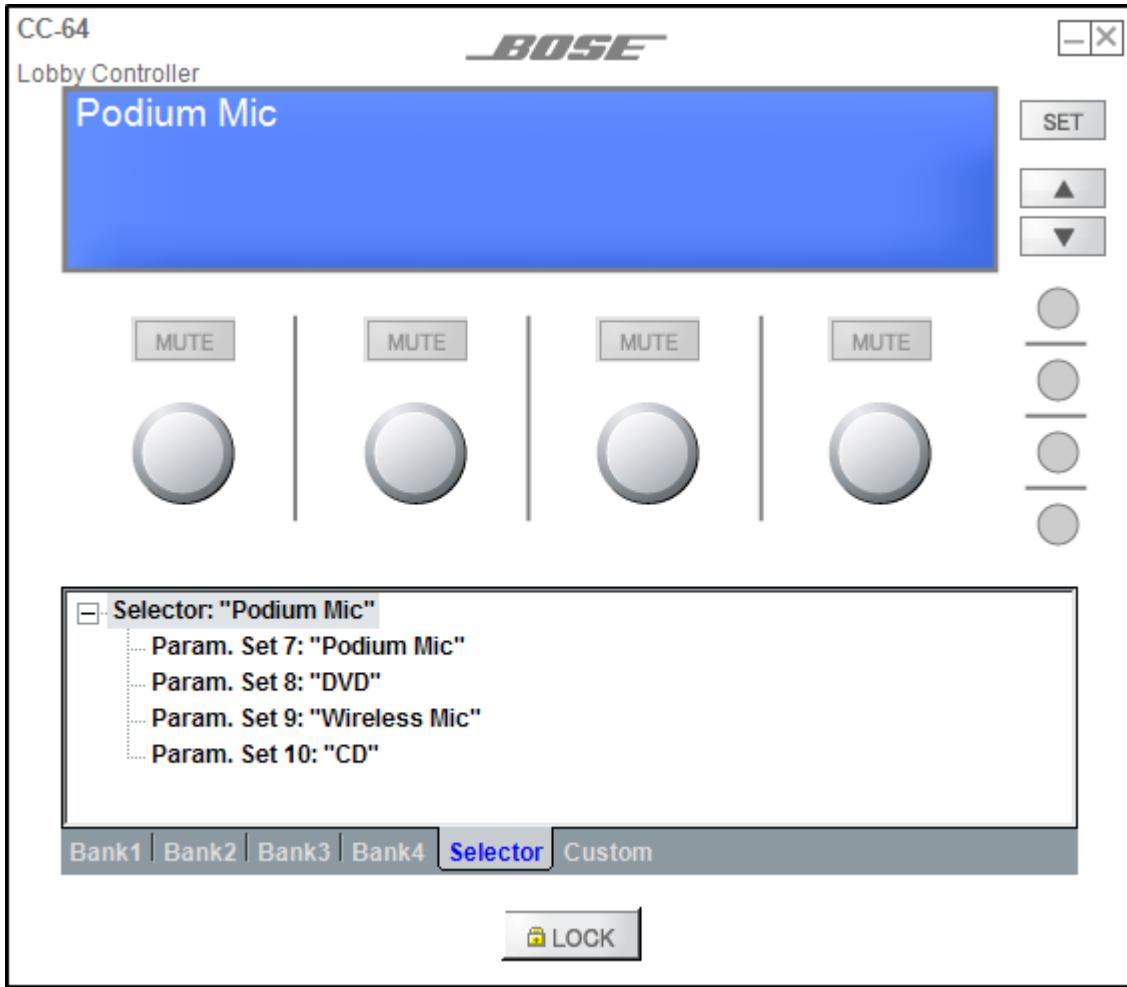
A control knob may also act as a selector. If you program a control knob to invoke parameter sets or control a selector block, the control will change to selector arrows in the Smart Simulator.



A control knob programmed to operate a selector

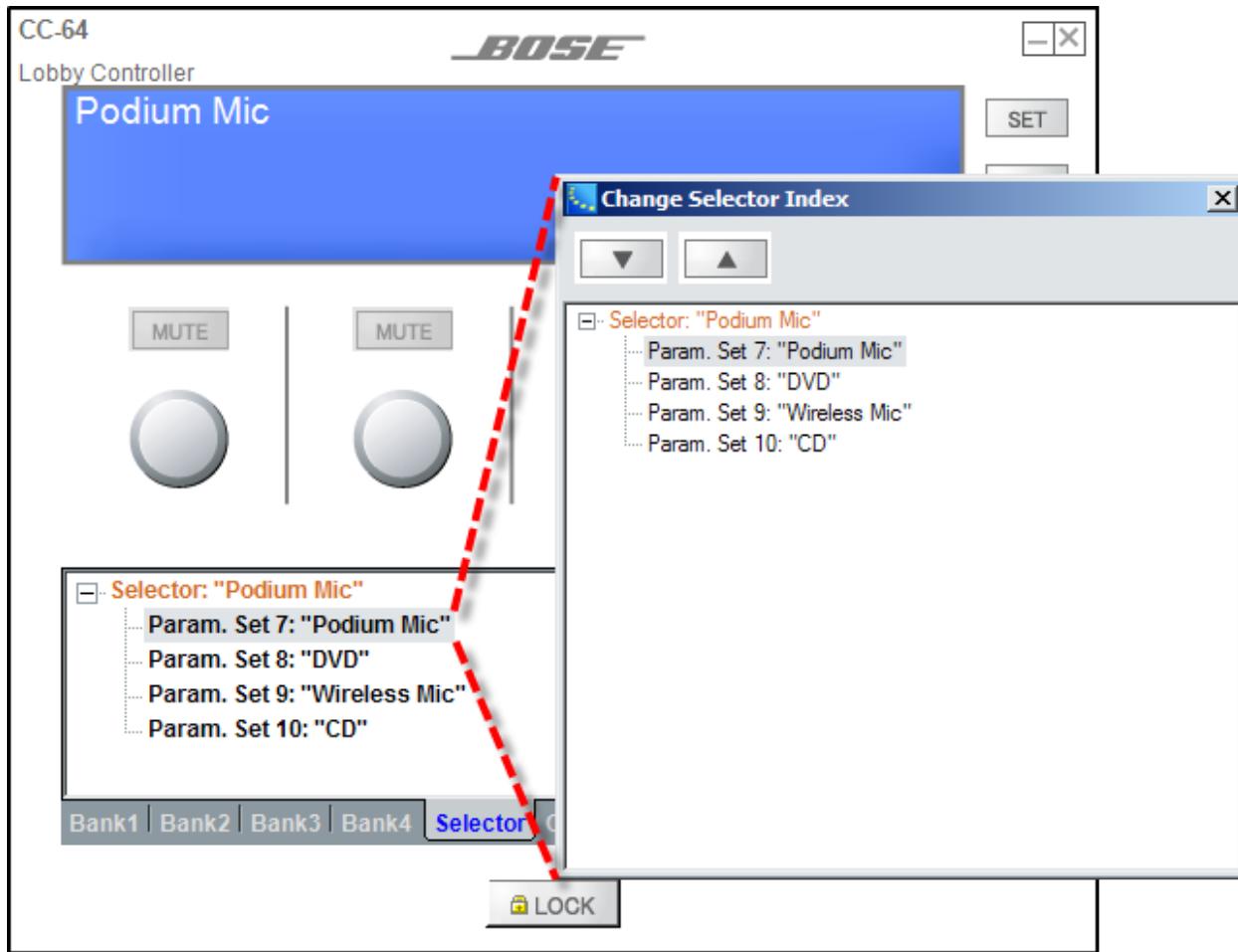
## Changing the Selector Order

When a selector knob on the CC-64 is programmed with parameter sets, you have the option of changing the order in which the parameter sets appear. For example, you can program the CC-64 selector knob with four parameter sets as shown below:



Programming the CC-64 selector knob with parameter sets

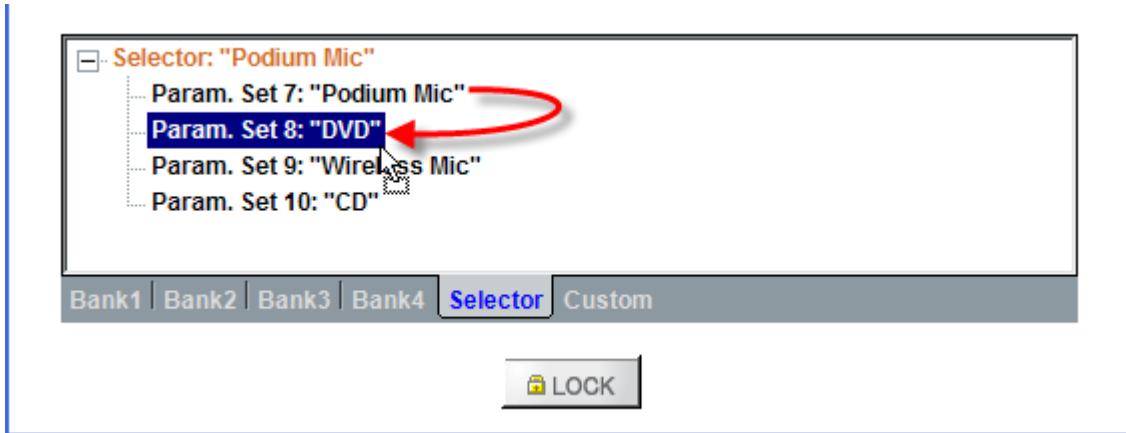
To change the order in which the parameter sets appear, double click on one of the parameter sets to open the Change Selector Index window.



*Double click a parameter set to open the Change Selector Index window*

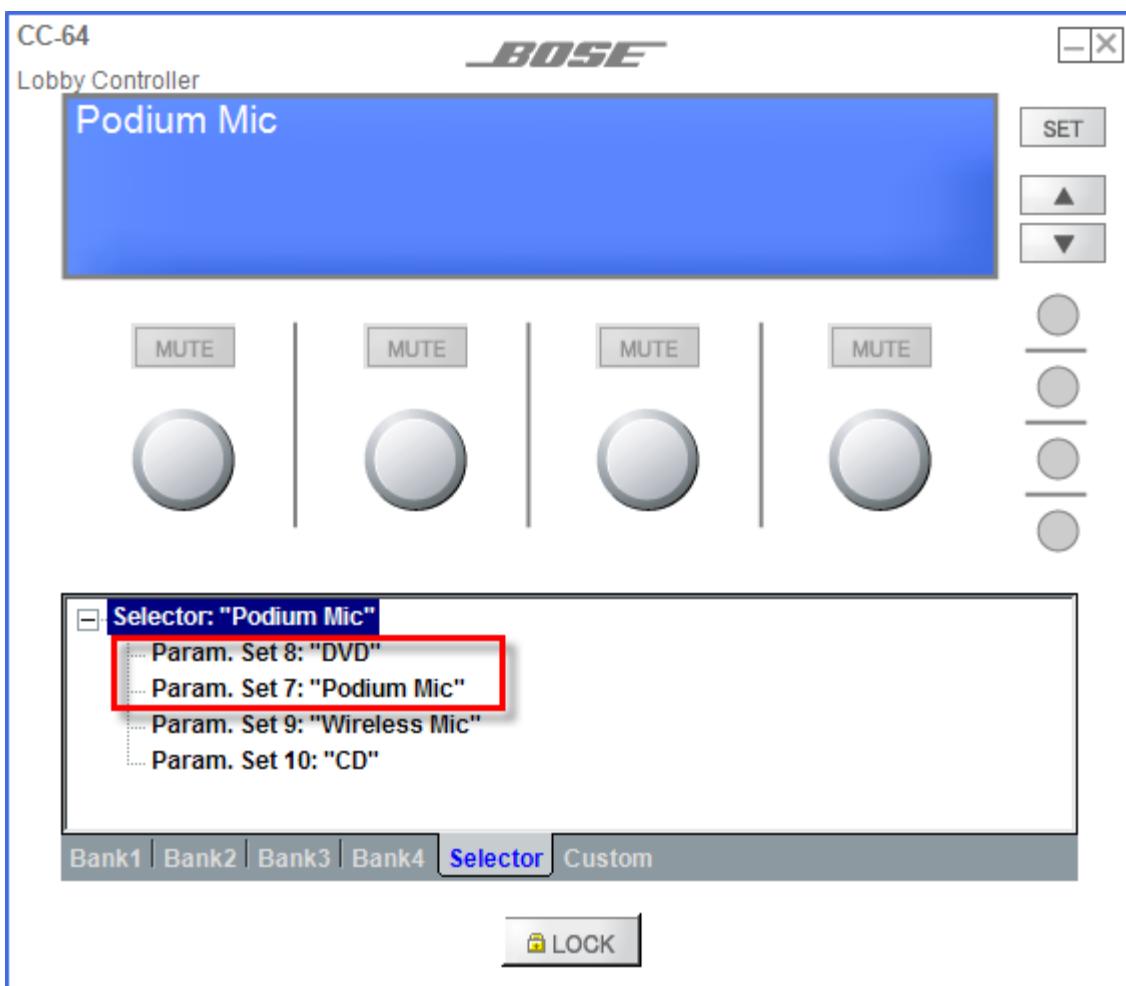
Use the arrow buttons at the top of the window to move the selected parameter set up or down in the list. In this window, you can select any of the parameter sets and use the arrows to change its position.

Another way to reorder the parameter sets is to drag and drop them within the CC-64 Smart Simulator window. For example, to move the "Podium Mic" parameter set to appear after the "DVD" parameter set, simply drag and drop the "Podium Mic" parameter set onto the "DVD" parameter set:



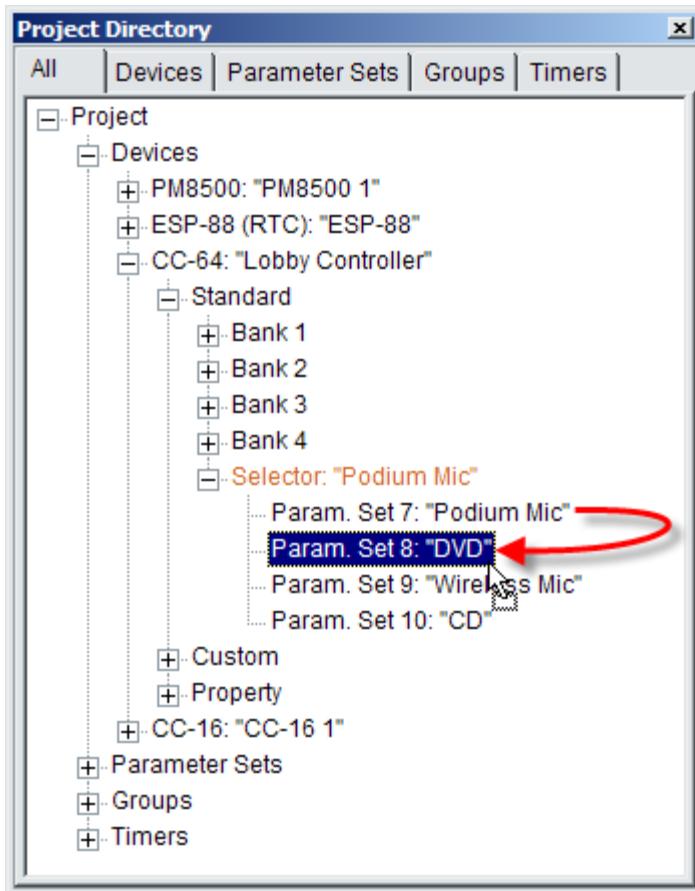
*Dragging and dropping a parameter set to change the order*

The list is reordered after the drag and drop operation.



*Newly Reordered Selector List*

This technique may also be used within the Project Directory window. Locate the CC-64 selector settings in the Project Directory window, then drag and drop to new positions to reorder the parameter sets within that list.



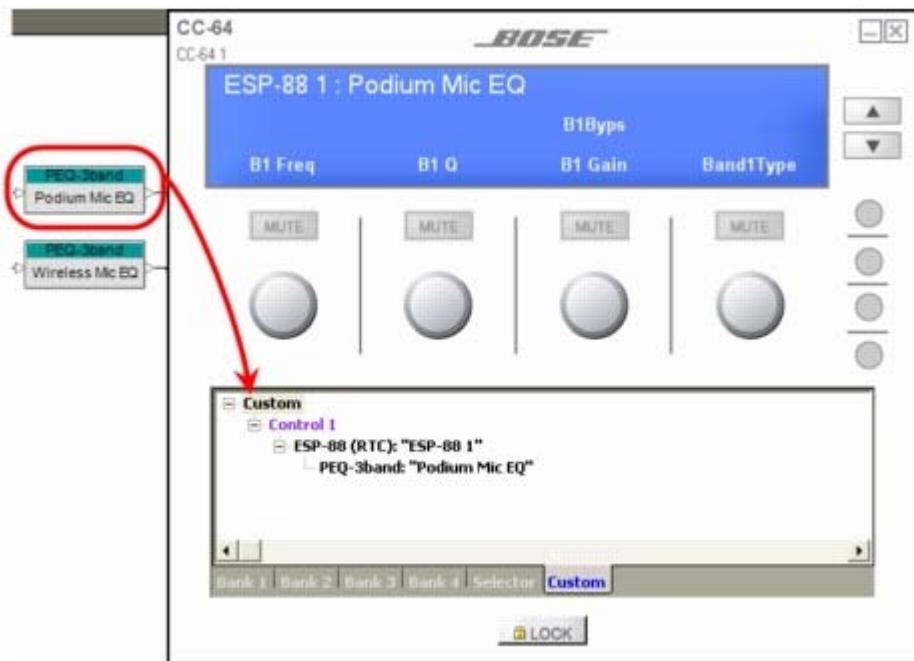
*Reorder List Items in the Project Directory Window*

## Custom Settings

The CC-64 supports a custom mode, whereby you can access settings for certain signal processing blocks such as EQ blocks, and crossover blocks by using a special button activation. You may program the CC-64 to control the following signal processing block types in custom mode:

- Crossover
- Graphic EQ
- Tone control EQ
- Parametric EQ
- Delay
- Signal Generator

To add signal processing blocks to the custom control, drag and drop one or more blocks listed above onto the Custom Tab of the CC-64 Programming Tree. The Smart Simulator displays the list of blocks assigned to custom control mode.



*Dragging a Parametric EQ block onto a Custom control*

**Note:** To access the Custom controls from the CC-64 hardware, press and hold the Selector knob for 5 seconds.

### Locking the CC-64

When the CC-64 is locked, the user controls are disabled. This is a very useful if you have multiple CC-64s in your system and desire only one of the CC-64s to be active at a time.

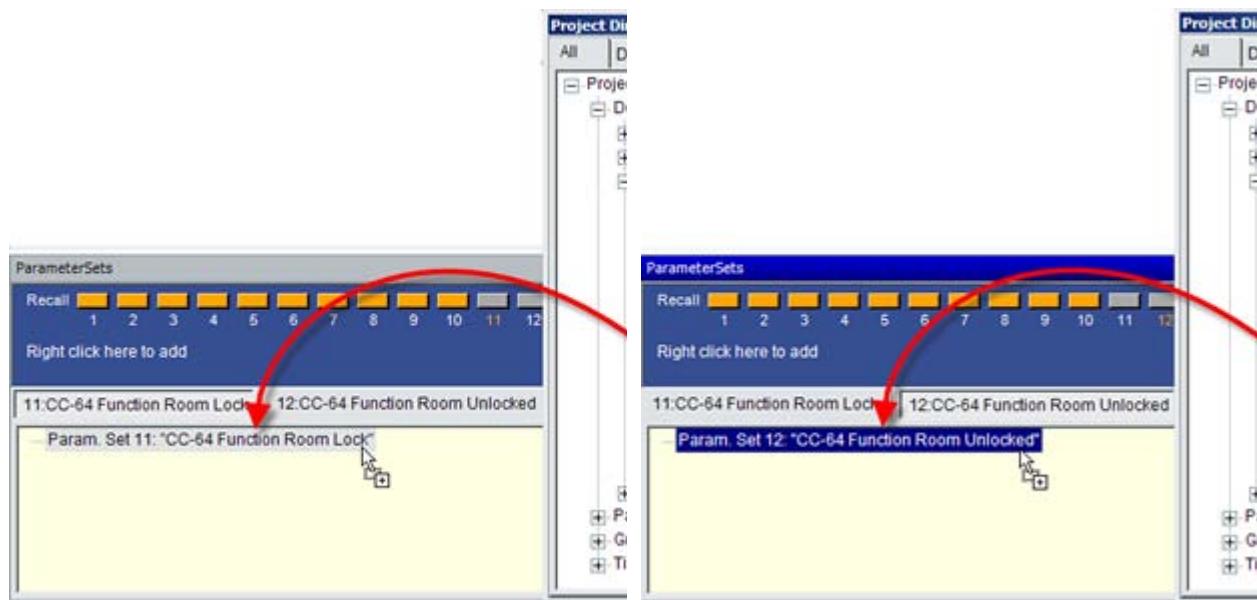
Consider a system configuration with two CC-64s; one in a function room and another in a private office. During a crowded event in the function room, locking that control center prevents accidental change of system settings by unauthorized individuals. The master CC-64 located in the private office remains unlocked for performing system changes.

The lock/unlock status of a CC-64 must be stored in a parameter set. When this parameter set is invoked, the CC-64 is locked or unlocked according to the state stored in the chosen parameter set. To store the lock/unlock status in a parameter set, open the CC-64 Smart Simulator and set the lock state.



*Enabling the CC-64 Lock*

Next, open the Project Directory and locate the CC-64 Smart Simulator in the Device Tree. Expand the tree and drag only the Lock status property into a parameter set.



*Creating a Lock CC-64 Parameter Set*

*Creating an Unlock CC-64 Parameter Set*

To create a parameter set to unlock a locked panel, repeat this process by opening the Smart Simulator and setting the unlock state. Then drag the updated Project Directory lock status property into a new parameter set.

**NOTE:** Be careful not to add a parameter set to a CC-64 that locks itself unless you have another user control that can unlock the CC-64. Otherwise the user can become "locked out" of the system. Always add the unlock parameter set to an alternate user control (control panel, key switch connected to GPI, etc.) to ensure you can restore normal unlocked operation to the system.

## Dynamic Control Programming with Parameter Sets

The CC-64 and CC-16 controllers can be programmed to control or invoke the following objects in ControlSpace Designer software:

- Gain blocks (including Input and Output blocks)
- Grouped Gain blocks
- Selector blocks
- Parameter sets
- Certain signal processing blocks, such as crossover and EQ, using custom settings in a CC-64

Once you have established your processing and control design, programming is accomplished by dragging and dropping the object to control onto the appropriate user control programming tree.

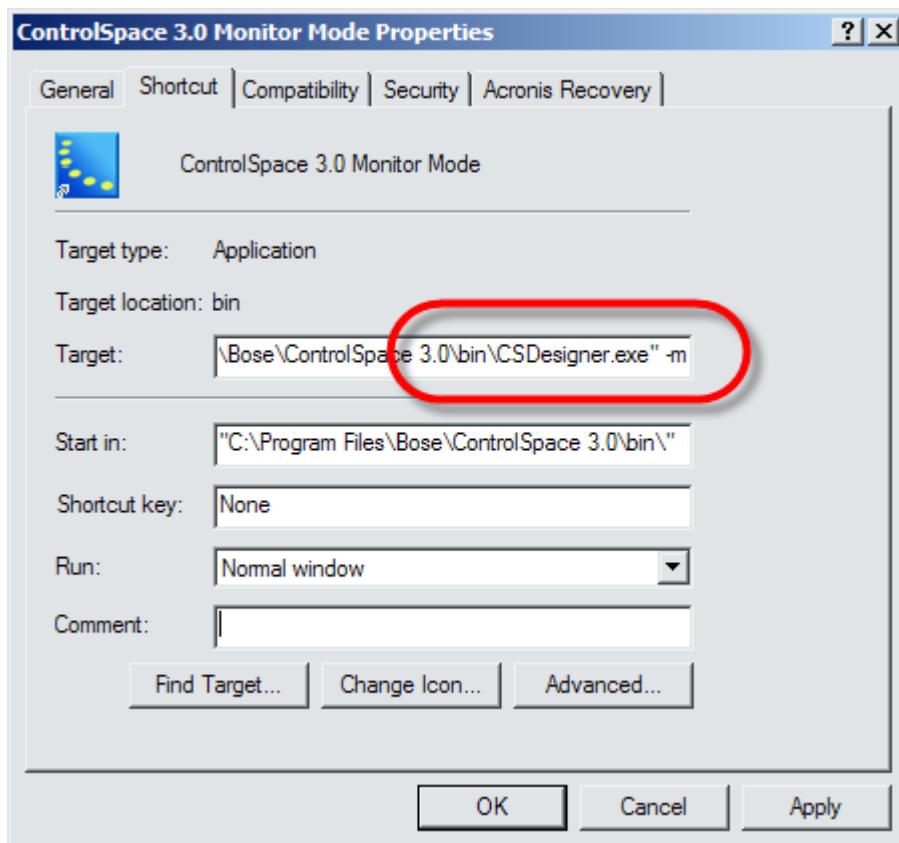
In ControlSpace Designer, you may also store different controller programming in separate parameter sets. When the parameter sets are invoked, the controller programming is changed.

## Monitor Mode

ControlSpace Designer software versions 3.0 and above provide support for running the application as a stand-alone system monitor. When configured for system monitor operation, all design and control programming functions are disabled and a system connection is automatically established at application launch. System monitor mode provides the system owner with a convenient operational overview of all system devices, and virtual operation of system controls such as the CC-16 and CC-64 control centers.

Monitor mode is invoked by appending a command line parameter to the Target field of the application shortcut. To configure the application for monitor mode first create a shortcut for the ControlSpace Designer application or copy the existing shortcut for modification. Select the Properties item from the application shortcut's right-click menu.

At the end of the application target location add the parameter "[space]-m" outside the quotes as shown in the following example.

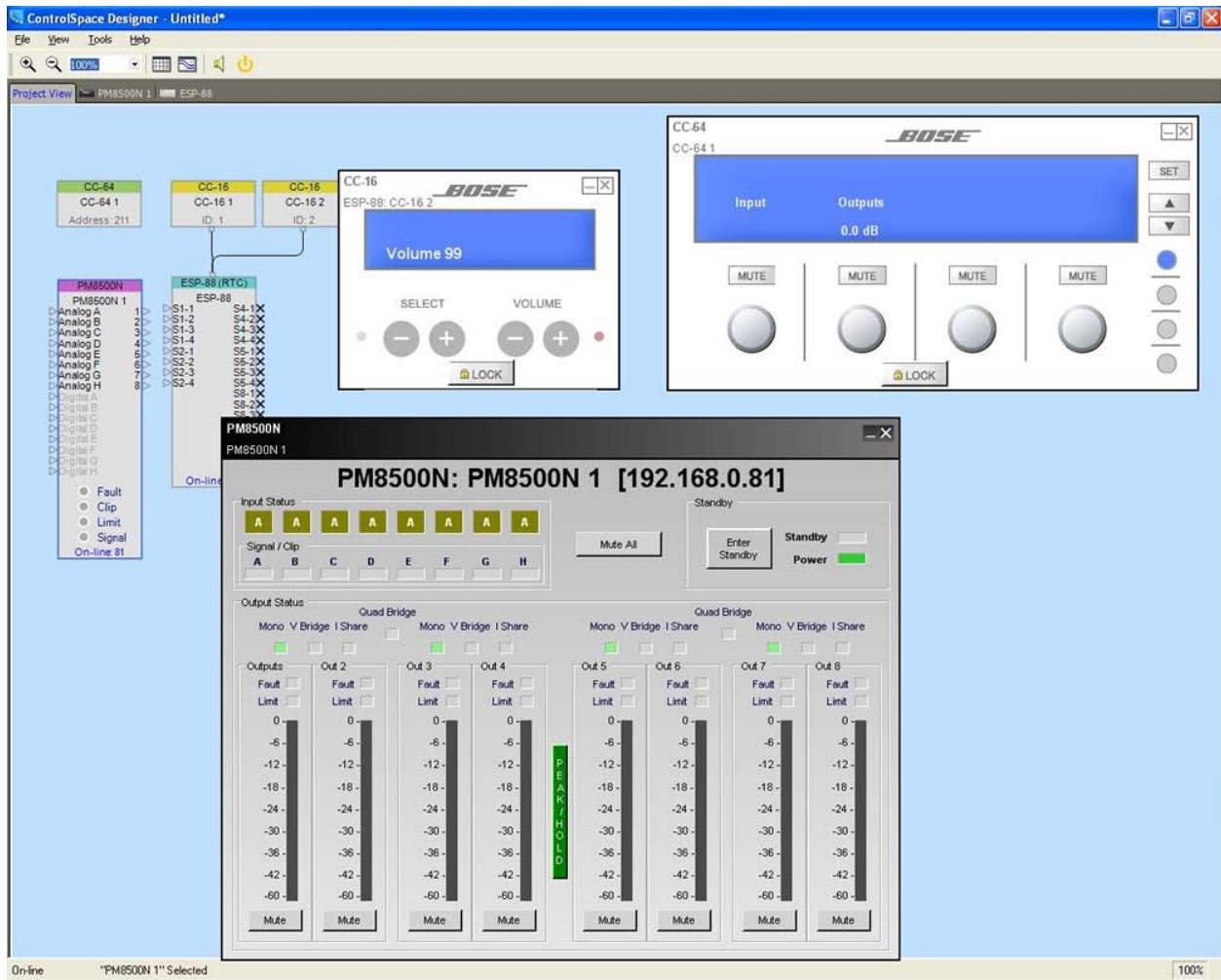


#### *Creating a Monitor Mode Shortcut*

Launch ControlSpace Designer from this modified shortcut to activate Monitor Mode. Once Monitor Mode is active, all design functions are removed and the ControlSpace Designer application remains in Monitor Mode for all subsequent application launches using the modified shortcut.

When in Monitor Mode a system connection is automatically established when a design file is loaded and the running state of all system devices is retrieved and displayed within the ControlSpace Designer Project Tab.

## ControlSpace Designer 3.1 Software Guide



*ControlSpace Designer software operating in Monitor Mode*

To exit monitor mode, close ControlSpace Designer software and restart the application using the standard shortcut.

# Maintaining Your System

## Protecting System Settings

Password Protection secures configuration files from unauthorized access by prompting the user to enter password each time the file is loaded by ControlSpace Designer. When a password protected configuration is uploaded to an ESP, it inherits the password protection stored in the configuration file.

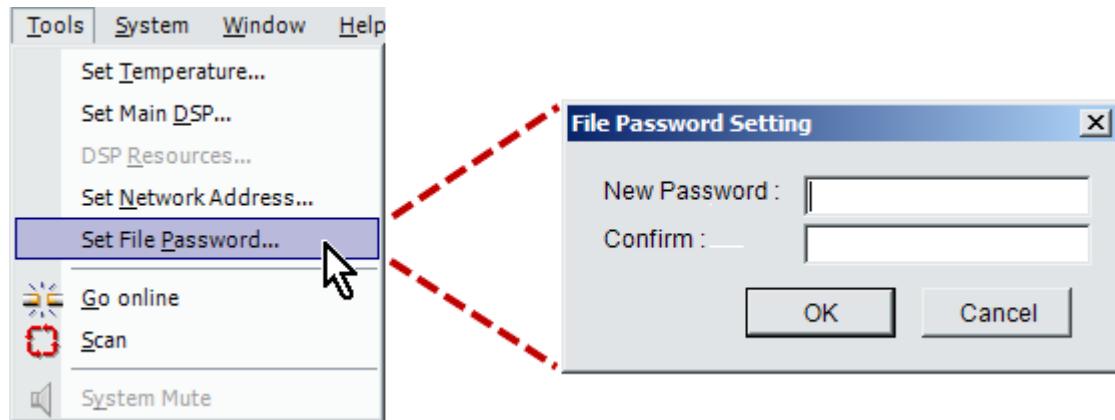
Password protected ESP systems will not accept new configuration uploads or downloads without supplying the password. Opening a password protected design file or attempting to go online with a protected ESP results in the following prompt.



*Password Prompt*

## Protecting a Configuration (.csp) File

Password protection is accessed from the *Tools Menu* in the option entitled ***Set File Password***.



*Tools Menu - Set File Password*

Options for the **File Password Setting** are as follows:

**New Password:** – provides a text entry field to type a preferred password. The password may be any length word, phrase, or number combination.

**Confirm:** - is a text entry field to verify the new password is entered as intended.

**Note:** Saving an unprotected back-up copy of the configuration file to a secure location before using the password protection option is highly recommended. It is possible to lock yourself out of your own configuration file if you lose or forget password.

## Saving Protected Configuration (.csp) Files

Saving new designs to local storage after entering password settings will store a password-protection encryption key in the file. Thereafter, the design file may not be opened or changed without first entering this password.

## Uploading Password-Protected Configuration (.csp) Files

When a password is stored in a design file, uploading that configuration to an ESP will protect the file within the hardware until that password is disabled. All subsequent file transfers to and from an ESP thereafter require the entry of this password.

## Downloading Password-Protected Configuration (.csp) Files

If a password-protected configuration is stored within the ESP, you must enter the correct password when retrieving the configuration. Go online with an ESP, choose the *Download Configuration* option, and select either the *Running* or *Saved* options to access the password prompt.

If an incorrect password is entered, the software responds with an error. A valid password must be entered before proceeding.



Invalid Password Error

## Uploading New Configuration (.csp) Files To Protected Systems

Once a password is enabled for a design file, uploading that configuration to an ESP by going **online** will protect the file within the hardware until the password is disabled. All subsequent file transfers to and from an ESP thereafter require the entry of this password.

## Changing or Disabling Passwords in Protected Configurations

The password of a protected configuration file can be changed in either ***online*** or ***offline*** modes using the **Set File Password** command from the *Tools Menu*. Altering protected systems using the Set File Password sequence, results in a request to enter the old password before proceeding.



*Old Password Prompt*

After successfully entering the old password, new password entry occurs as shown above in Figure xx: Tools Menu - Set File Password. Entering blank information in the resulting Set File Password dialog removes password protection in the ESP and also in the design file if you choose to save it.

## Retrieving System Configurations

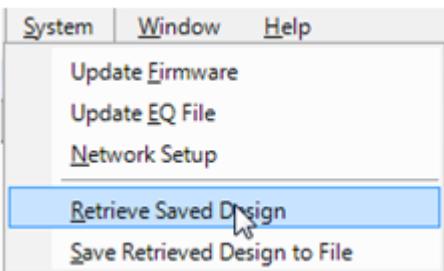
Two functions are available within the ControlSpace Designer software which allow you to retrieve the saved system settings without initiating a connection to the system.

- **Retrieve Saved Design:** Select this item to retrieve the project file without establishing a network connection to the system. Note that you must have an active network connection to enable this function.
- **Save Retrieved Design to File:** Select this item to retrieve the project file without establishing a network connection to the system, and immediately save it as a file. Note that you must have an active network connection to enable this function.

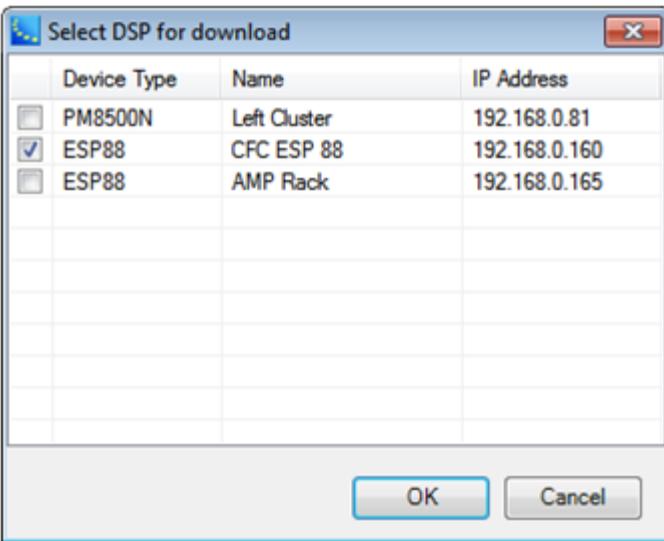
### Retrieving a Saved Design

A copy of the original ControlSpace project file is stored within each signal processing device on the network, (ESP and PowerMatch). The project file contains the original system design and control programming, and represents the “power on” state of the system. To retrieve the saved system configuration use the following steps:

1. Select **Retrieve Saved Design** from the System Menu



2. From the list of available system devices, select the one from which you would like to retrieve the system configuration file and click **OK**.

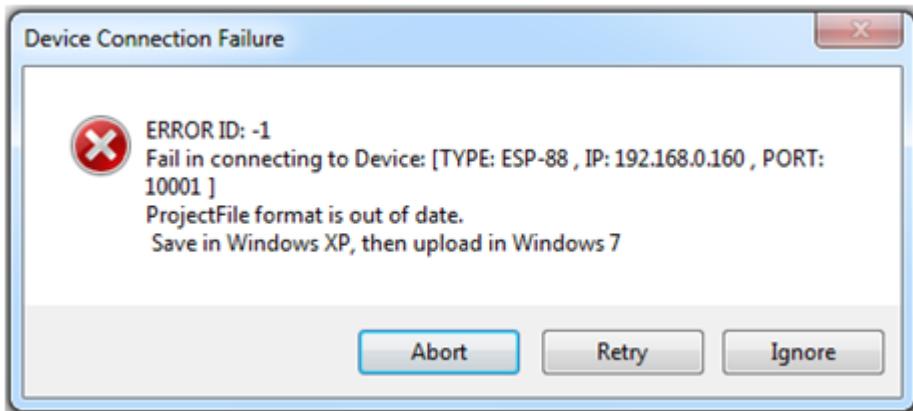


3. The system configuration is retrieved and displayed. At this point it is possible to either save the file directly to the PC, or initiate a connection to the system.

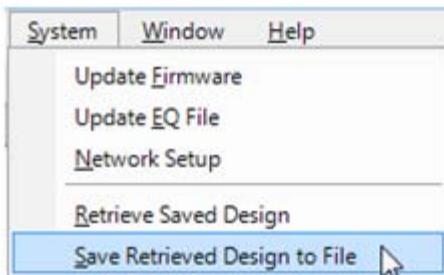
## Saving a Retrieved Configuration to File

When running on the Windows 7 operating system, ControlSpace Designer uses a new compression scheme to compress the ControlSpace project file before transferring it to the hardware. As a result, project files stored in hardware using a version of ControlSpace Designer older than v3.0 cannot be read without first saving them to local PC, and re-opening the file within ControlSpace Designer.

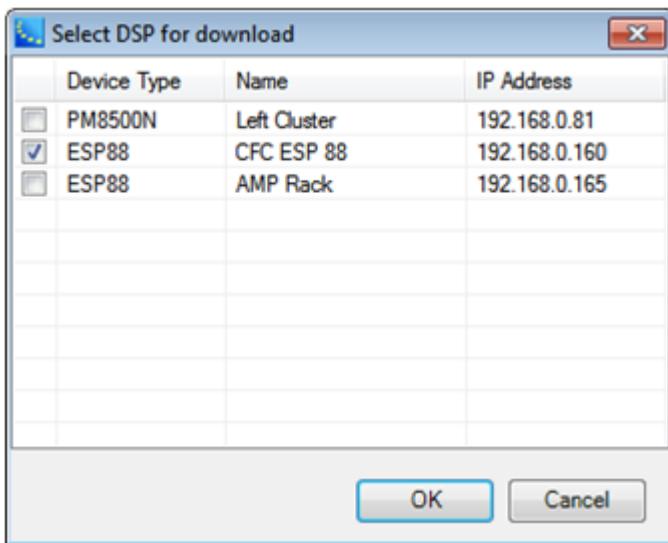
If when connecting to the system you receive the following error message, use the steps outlined below to retrieve the file and connect to the system.



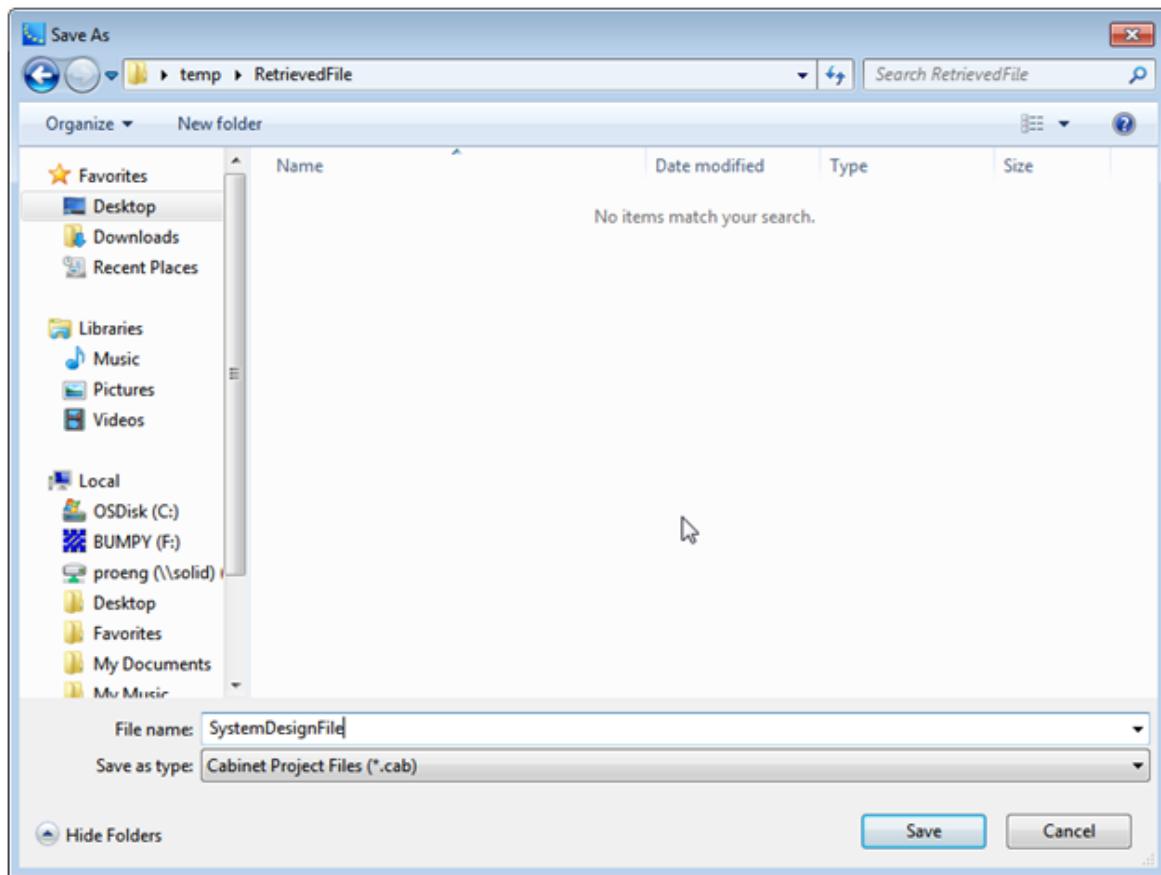
1. Select **Save Retrieved Design to File** from the System Menu



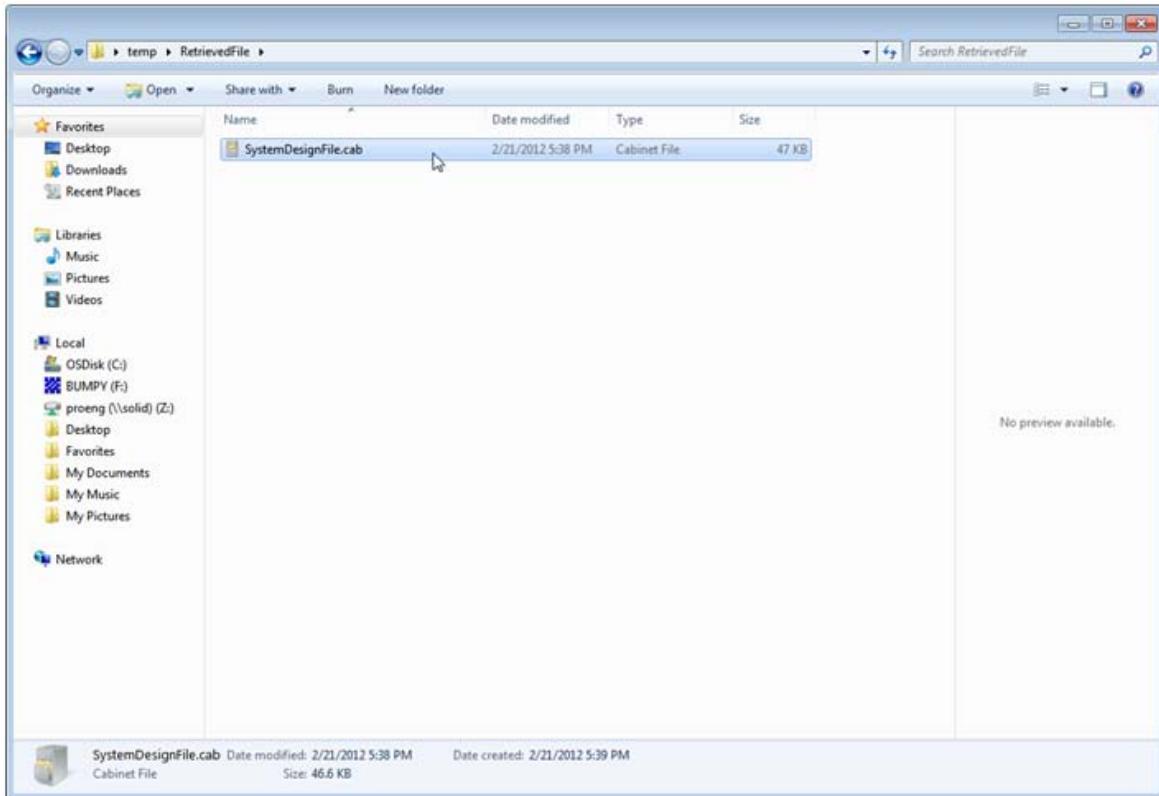
2. From the list of available system devices, select the one from which you would like to retrieve the system configuration file, and click **OK**.



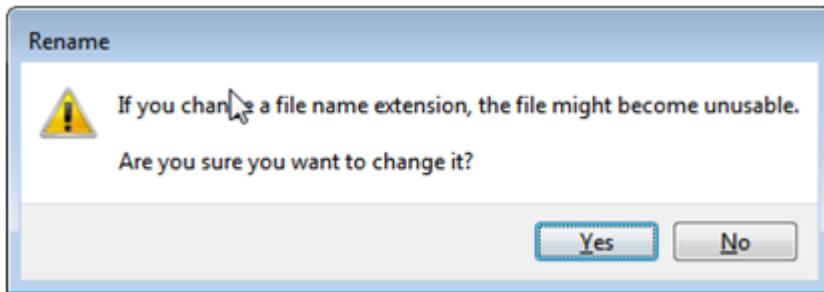
3. Select a location and name for the system design file and click **Save**.



4. Navigate to the file that was retrieved from the system and open it. The file is stored in a compressed file format (.cab) and can be opened directly from the Windows desktop.



5. Copy the file to the desktop, and rename it "SystemTransfer.csp." You will receive a warning asking if you wish to change the file extension. Click **OK**.



6. Once the file and its extension are changed, the file will become associated with the ControlSpace Designer software. You can now open the file from within ControlSpace Designer using the **File --> Open** command.

**NOTE:** For additional information on this topic see the ControlSpace User's Forum knowledgebase posting:

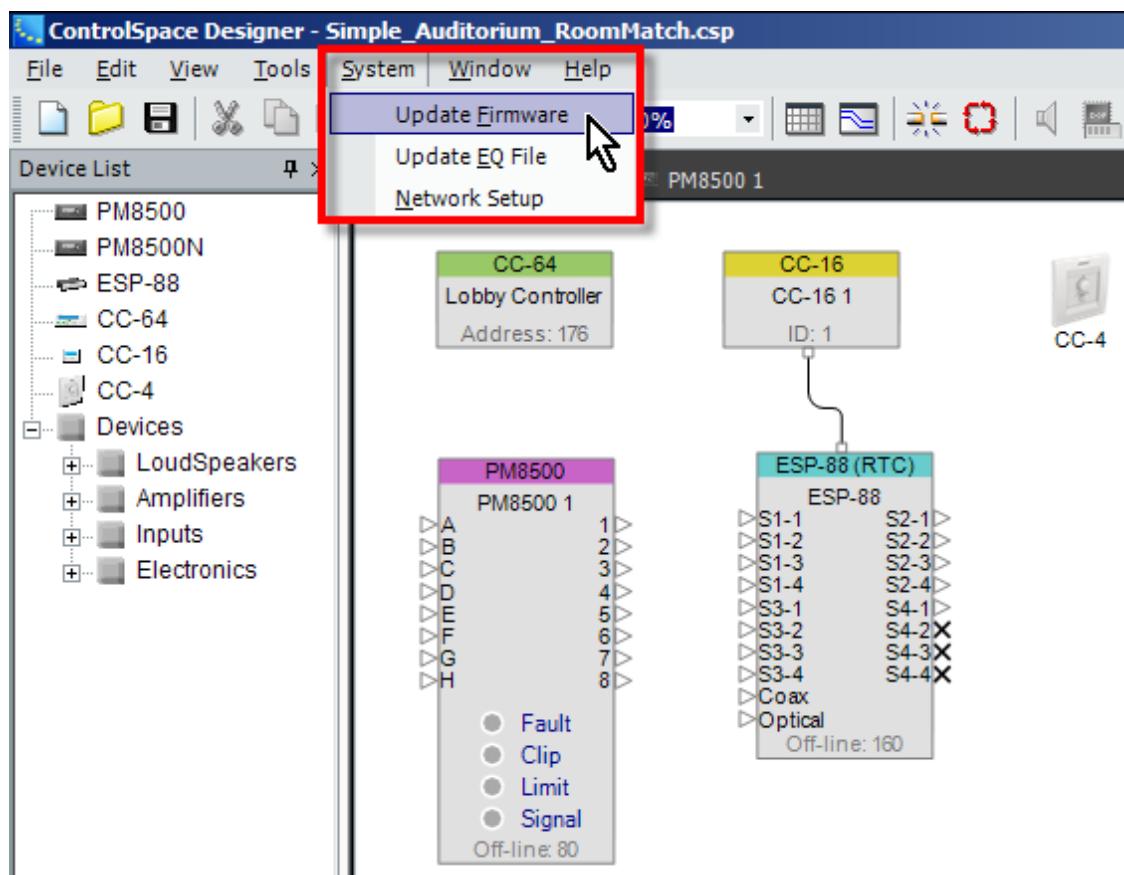
['Project File format is out of date' error when attempting download using Windows 7 PC](#)

## Firmware Updates

The ControlSpace Engineered Sound Processor, PowerMatch™ configurable professional amplifiers, CC-64 Control Center, and CC-16 Zone Controller require firmware to control their operation. Firmware is programming that is stored in Flash memory and is not erased when the power is turned off. On occasion, it is necessary to update this firmware to fix problems or improve features.

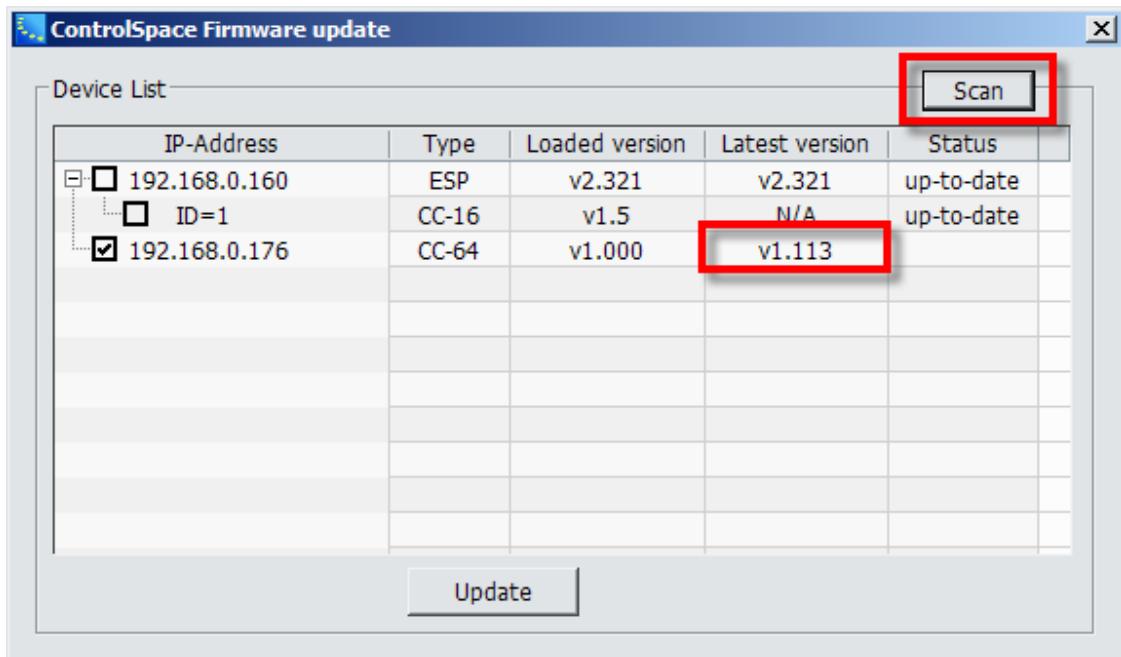
To update firmware, you will first need to get the new firmware file. The best method to do this is to simply download the latest version of ControlSpace Designer software from the Bose Professional Systems Division web site. Follow these steps to retrieve this software:

1. Visit [pro.Bose.com](http://pro.Bose.com) on the web and browse to the software downloads area of the ControlSpace Systems product area.
2. Locate the latest version of software and download the installation package to your local machine.
3. Install and run ControlSpace Designer software.
4. Connect to your ControlSpace system and access the *Update Firmware* option from the System Menu.

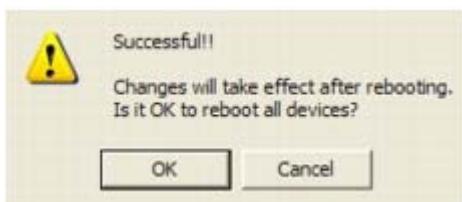


*Update Firmware* option of System Menu

5. The *Firmware update* window opens:

*ControlSpace Firmware update window*

6. All connected hardware is shown in this list. Press the Scan button to refresh the list. The new firmware version number (from the file in the bin folder) will show up in the Latest version column, and the current firmware version number is displayed in the Loaded version column. If your firmware is up-to-date, the loaded and latest versions will be the same, and the status will be "up-to-date."
7. Select the devices to update by placing a check mark in the box next to the IP address. Press the Update button to load the new firmware.
8. After updating is complete, click OK when you are prompted to reboot all devices.

*Reboot devices after firmware update*

After rebooting, the Firmware Update window indicates that the update was successful per device in the status column.

**NOTE:** If any connected device does not appear in the Firmware Update window after the firmware update, try power cycling the ESP, PowerMatch, and control panels then press the Scan button in the Firmware Update window once more.

**NOTE:** If your system needs special firmware versions, an authorized Bose representative may send you firmware to load manually within the ControlSpace Designer environment. If this occurs, please place firmware files in the "C:\Program Files\Bose\ControlSpace

3.0\bin\" directory and repeat the process steps listed above starting at Step 4 to implement the new firmware.

## Loudspeaker EQ updates

With the current release of ControlSpace Designer you may also update the loudspeaker database independent of the ControlSpace Designer application. The necessary steps to update the loudspeaker equalization database are listed below:

### Determining current loudspeaker EQ database version

From within the ControlSpace Designer application, access the Help menu and select *About*. The current loudspeaker database version is shown beneath the application version at the bottom of the *About* window.



ControlSpace Designer Help *About*

If a newer version of Speaker Data is available, follow the steps below to update ControlSpace Designer.

### Updating the Loudspeaker EQ Database

1. Download the latest version of the Bose loudspeaker equalization database for ControlSpace Designer software. The most recent database version is always available for download at [pro.Bose.com](http://pro.Bose.com).
2. Transfer the new *Speakers.xml* and *DeviceList.xml* files contained within the update archive to the ControlSpace designer application folder on your PC.
3. Locate the current ControlSpace Designer application directory. This is typically "C:\Program Files\Bose\ControlSpace Designer".
4. Open the \bin directory within the ControlSpace Designer application folder.
5. Rename the existing *Speakers.xml* file OldSpeakers.xml and *DeviceList.xml* to OldDeviceList.xml.
6. Transfer the new *Speakers.xml* and the *DeviceList.xml* files to the bin directory.  
Loudspeaker EQ Update v2 Page 2 of 2 July 19, 2010
7. Once the files have been copied the new Bose loudspeaker EQs will be available within the ControlSpace Designer software when the application restarts.

#### **NOTES:**

- This method of updating the loudspeaker equalization database is used primarily to support the introduction of new loudspeaker products. However, in some cases a new loudspeaker equalization curve may be provided for an existing loudspeaker product.
- In cases where a new EQ is provided for an existing product it may be necessary to upgrade an existing installation or design to ensure compatibility with the latest equalization version.
- Any custom devices that have been added to ControlSpace Designer will be lost on transferring the new DeviceList.xml file. You will need to manually copy any custom devices from the OldDeviceList.xml into the new DeviceList.xml file.

## **File Types**

ControlSpace Designer uses the following files types with specific extensions to define their function:

<b>Extension</b>	<b>File Type</b>
.csp	ControlSpace Designer project files (raw xml)
.exe	Executable program files (binary)
.frm	ESP & PowerMatch firmware files (binary)
.hex	CC-16 firmware files (binary)
.mot	CC-64 firmware files (binary)
.peq	Parametric Equalization files (raw)

	xml)
.seq	Speaker Equalization files (formatted xml)
.xml	Device List and Loudspeaker Database files (formatted xml)

# Application Examples

## City Council Chamber

As part of a Bose ControlSpace® system design, the Automatic Microphone Mixer provides the perfect solution for multi-microphone public space installations. This application note describes its use in a typical city council chamber.

Figure 1 below, created using the Bose® ControlSpace Designer software, provides an overview of project elements. In this figure, microphones and other input devices are shown on the left, while loudspeakers and other output devices are shown on the right. User interfaces appear at the top and at the heart of the system is the ControlSpace ESP-88 Engineered Sound Processor.

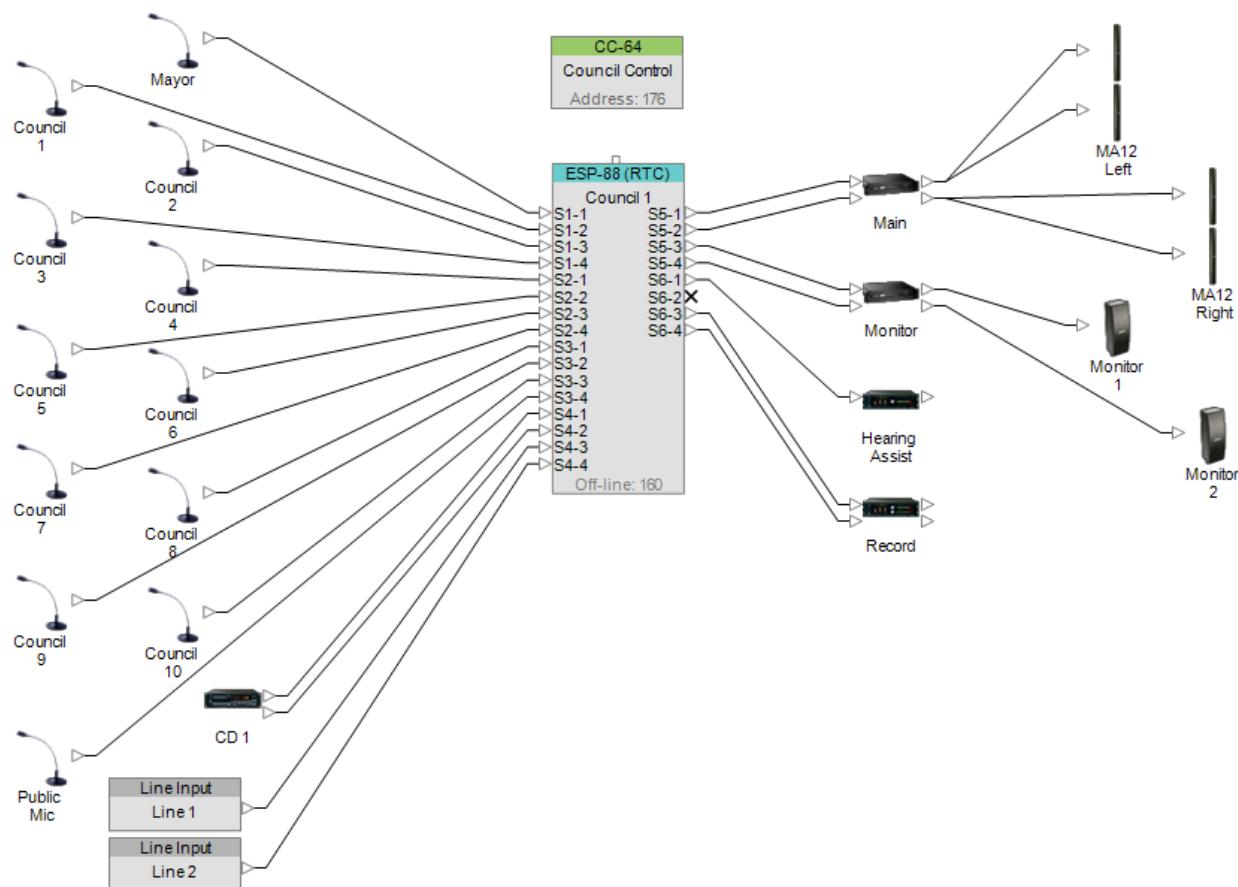


Figure 1: City Council Chamber project elements

In this design, input signals managed by the automatic microphone mixer include those from the Mayor's microphone, ten council member microphones, and a public podium microphone (channels 1-12). While all microphones remain "active" during normal operation, unwanted speech or noise will not be reproduced by the system because the

automatic microphone mixer will only allow the signal to pass once it exceeds a predefined volume.

This is accomplished by using the following DSP processing configuration:

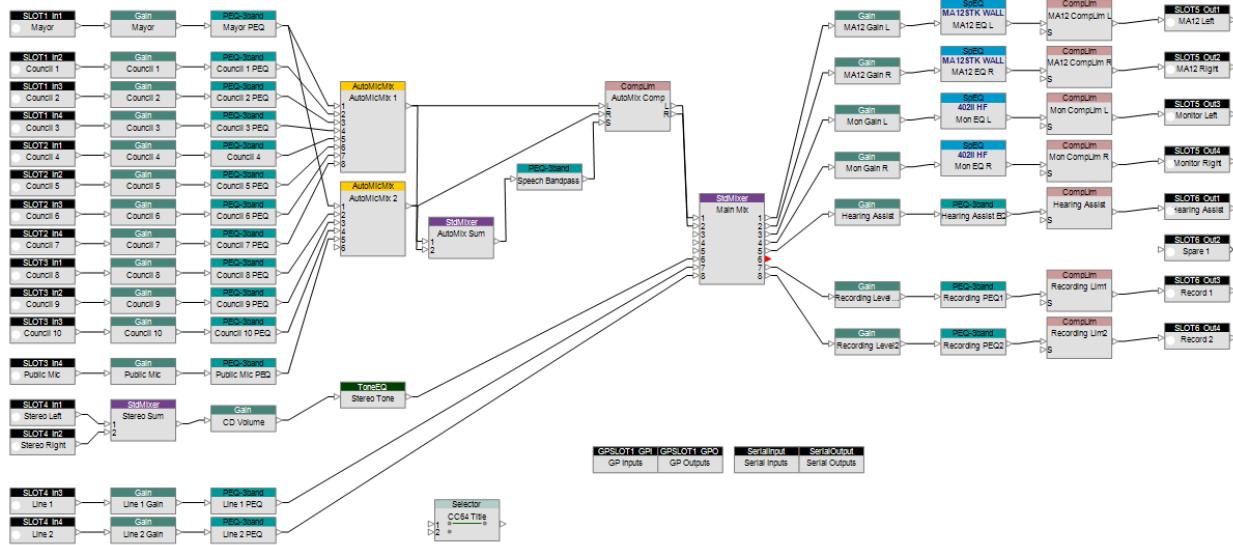


Figure 2: Digital Signal Processing configuration

## Input Processing

The system's input processing comprises:

- Signal conditioning
- Automatic microphone mixing
- Main mixing and routing.

**Signal conditioning** includes independent gain and equalization for each input channel. This streamlines system programming, allowing separate configurations for the user-assigned gain and system gain in order to optimize signal to noise throughout the system. Each channel also incorporates a 3 band parametric EQ.

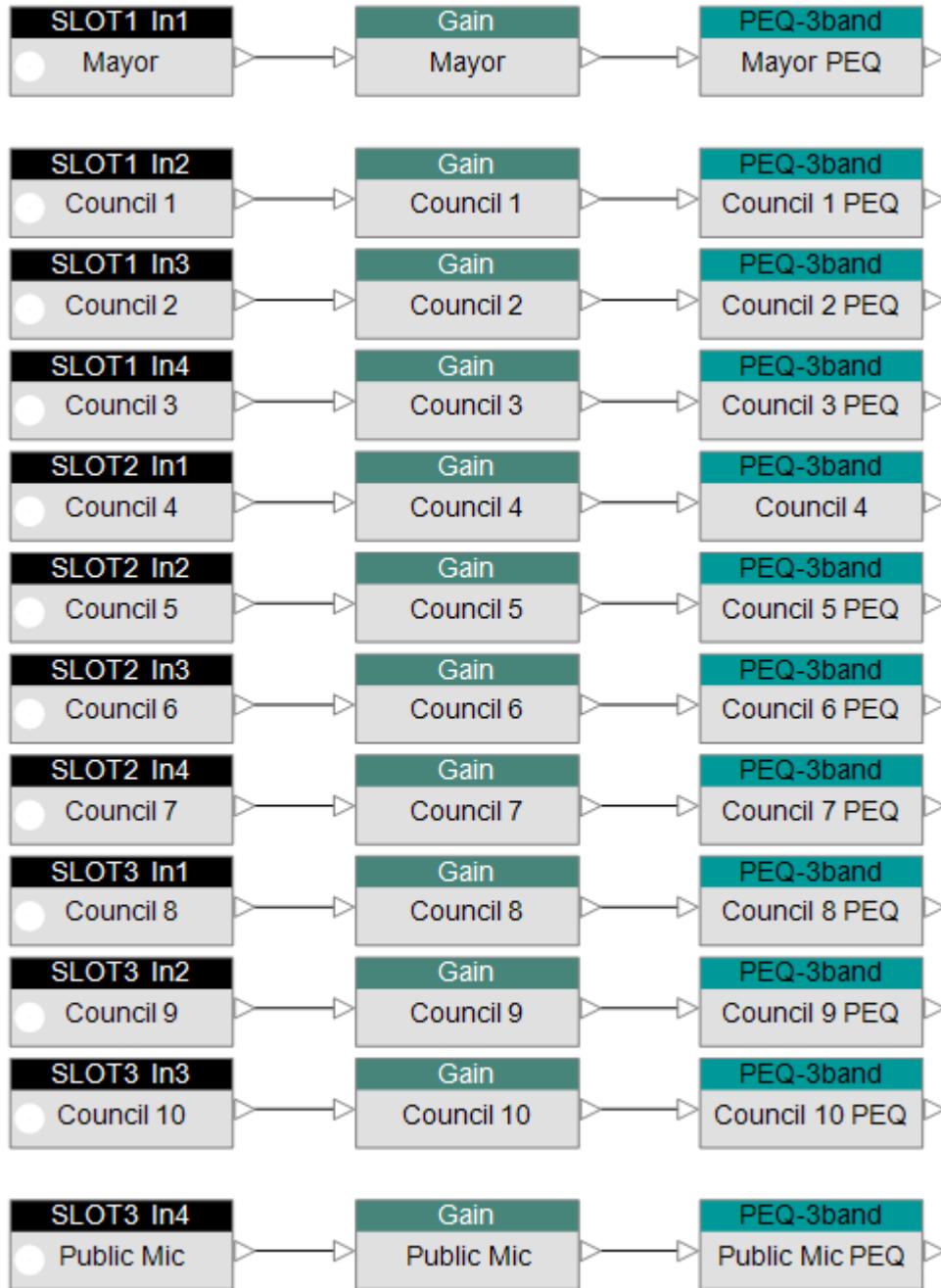


Figure 3: The system manages independent input gain (volume) and equalization for each microphone

The **automatic microphone mixer** manages twelve system microphones. Processing in this section includes automatic mixing combined with compressor/limiter functions to deliver a consistent volume level. This design incorporates a parametric EQ configured as a band-pass filter (250Hz-4kHz), driving the compressor's side-chain input and keeping the compressor responsive to the speech signal only, rather than bass frequencies or noise from handling the active microphone. The automatic microphone mixing function spans two signal processing blocks with the Mayor's microphone connected to input number one on both, thus ensuring the highest system priority for that microphone.

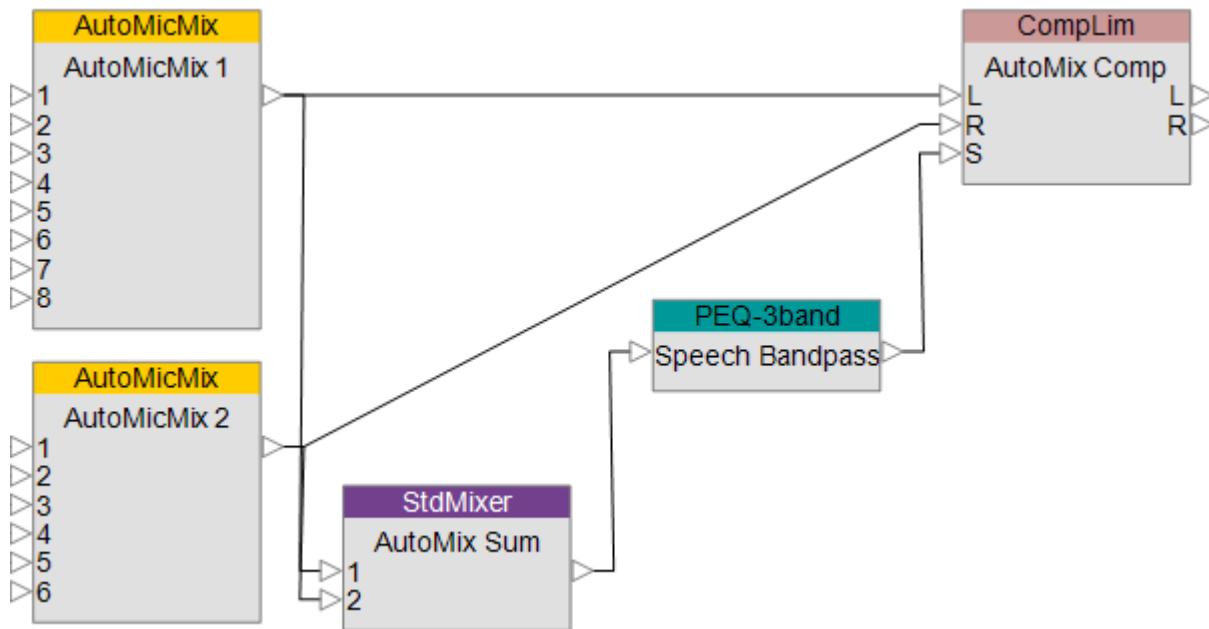


Figure 4: Automatic microphone mixer processing section incorporates a compressor/limiter to maintain a consistent operating level

The **main mixing and routing** section handles the mixing and routing of all system inputs to the various zones:

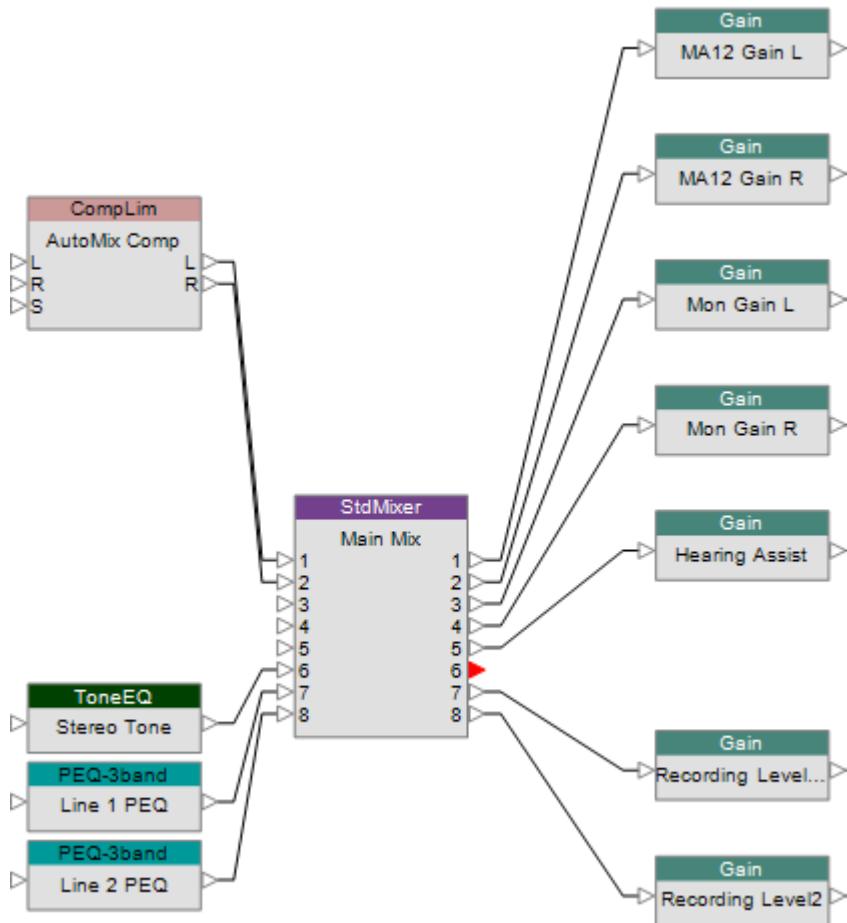


Figure 5: The main mixing and routing section

## Output Processing

The ControlSpace® Automatic Microphone Mixer output processing is comprised of zone gain, zone EQ, loudspeaker EQ, and protection limiters for each zone.

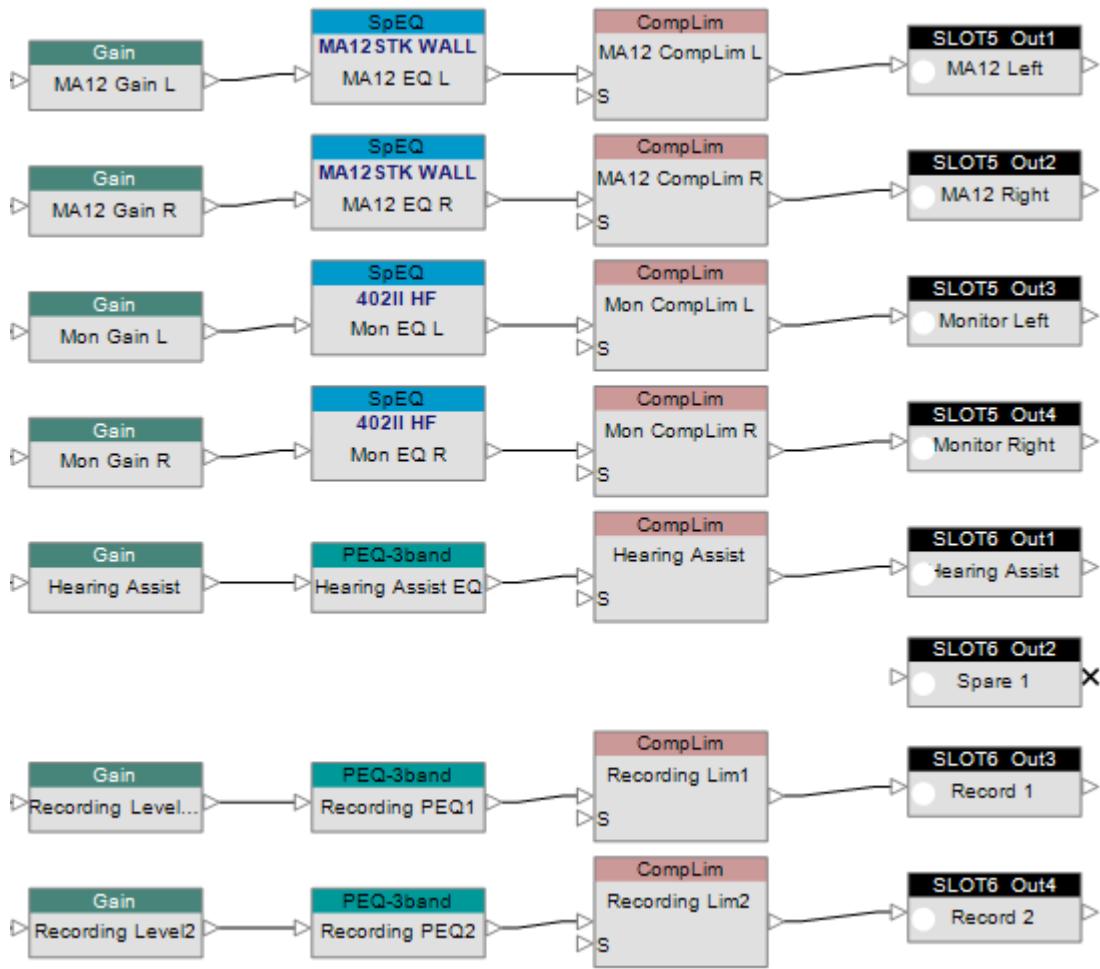


Figure 6: Output processing

## Microphone Mixers

A threshold detection method is used with all microphones except the public podium. This allows microphone signals above a certain level to pass to the output stage of the mixer. During system commissioning, we will configure all input gain settings.

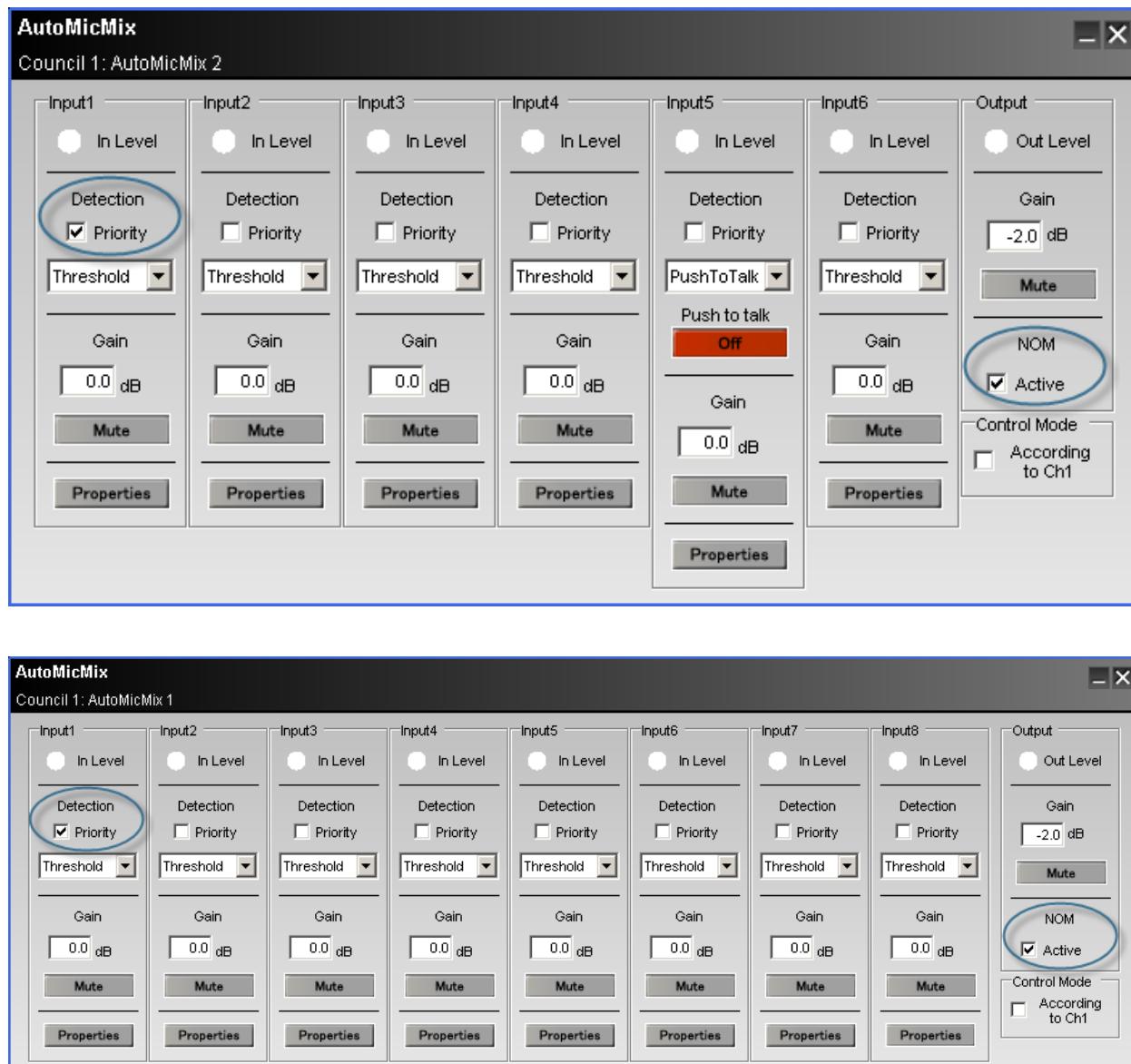


Figure 7: Automatic microphone mixing settings

"Push-to-Talk" detection is used with the public podium microphone. Bose Professional System installers place a sensor pad underneath the carpet behind the podium. Once someone steps on this pad, a contact closure is provided to the ControlSpace ESP General Purpose Input 1, thus activating the microphone.

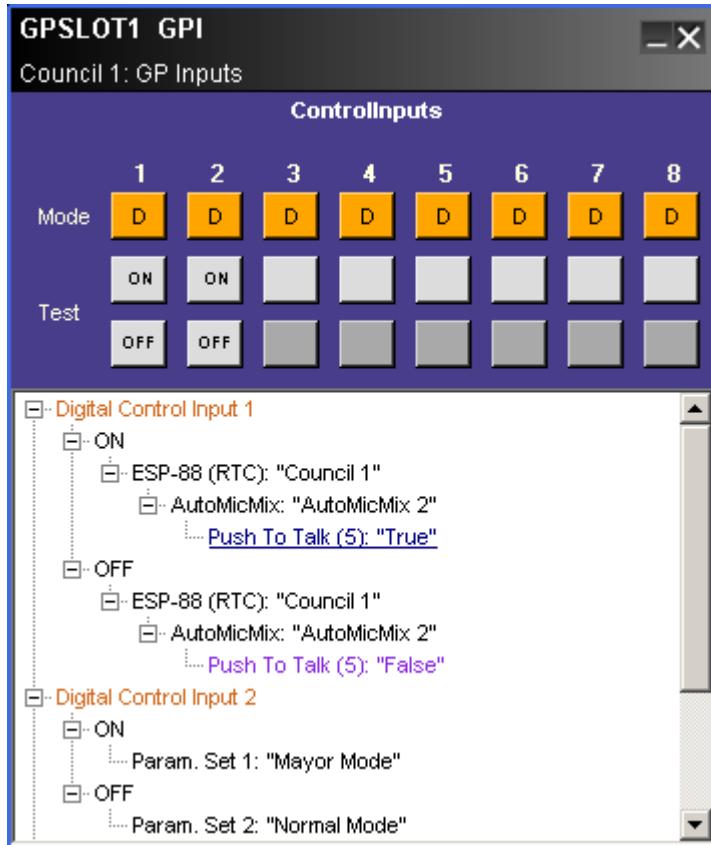
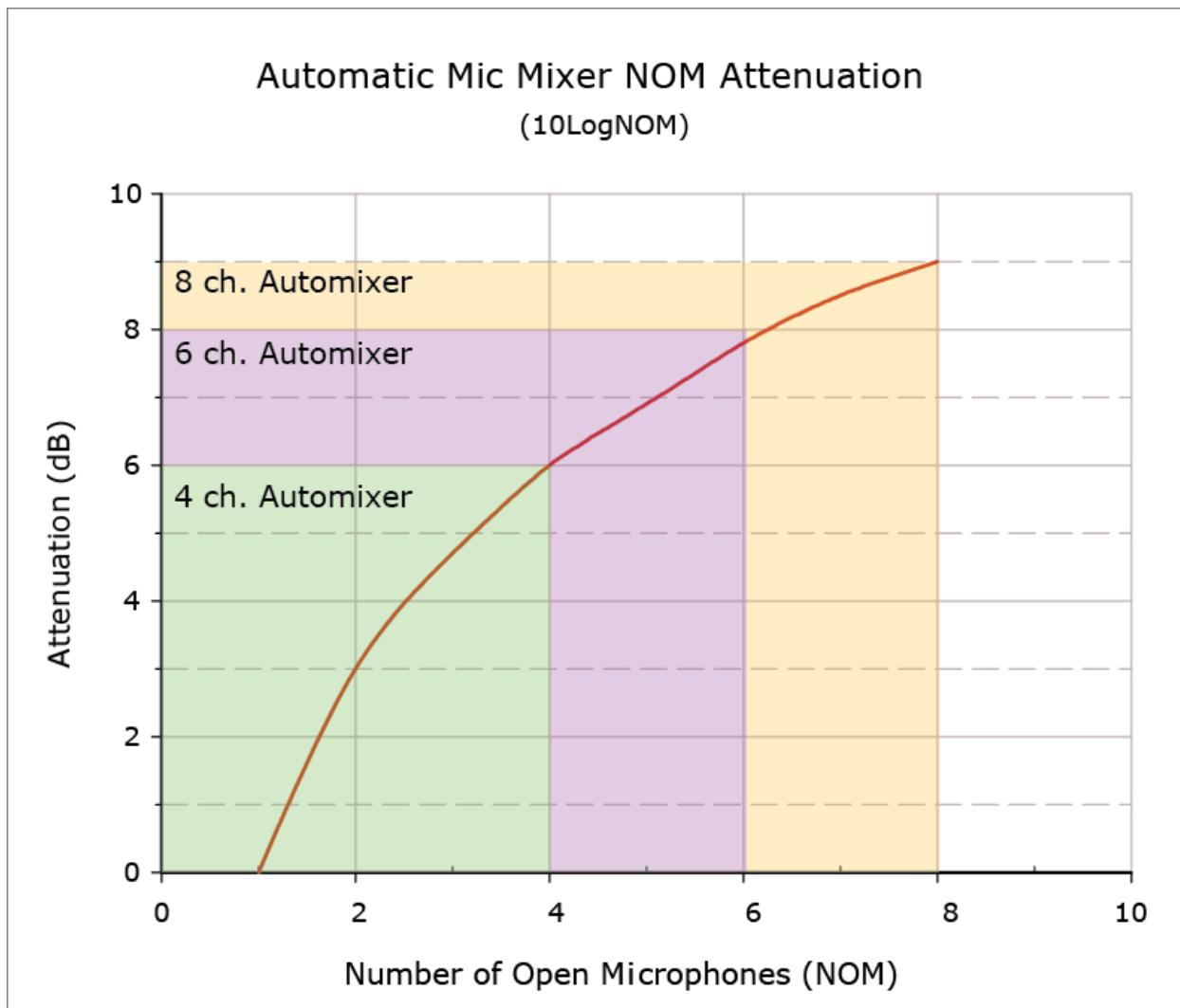


Figure 8: "Push-to-Talk" detection on the public podium microphone

## Override Provisions

The system includes a master override provision called "Mayor Mode." Pressing a push button switch at the Mayor's position will mute all other microphone and input sources. The inverse of "Mayor Mode" is "Normal Mode" which is restored when the button is released. This switch connects to General Purpose Input 2.

Finally, we use an output gain attenuation function called "number of open microphones" (NOM) for this system. When multiple microphones are active, the output gain will be reduced by  $10 \times \text{LOG}(\text{NOM})$ . The following graph shows the amount of attenuation applied for a given number of open microphones:



*Figure 9: Number of Open Microphones (NOM) attenuation*

## House of Worship

As part of a Bose ControlSpace® system design, the Automatic Microphone Mixer provides an elegant solution for multi-microphone installations. This application note describes its use in a typical house of worship.

Figure 1 below, created using the Bose® ControlSpace Designer software, provides an overview of project elements. In this figure, microphones and other input devices are shown on the left, while loudspeakers and other output devices are shown on the right. User interfaces appear at the top and at the heart of the system is the ControlSpace ESP-88 Engineered Sound Processor.

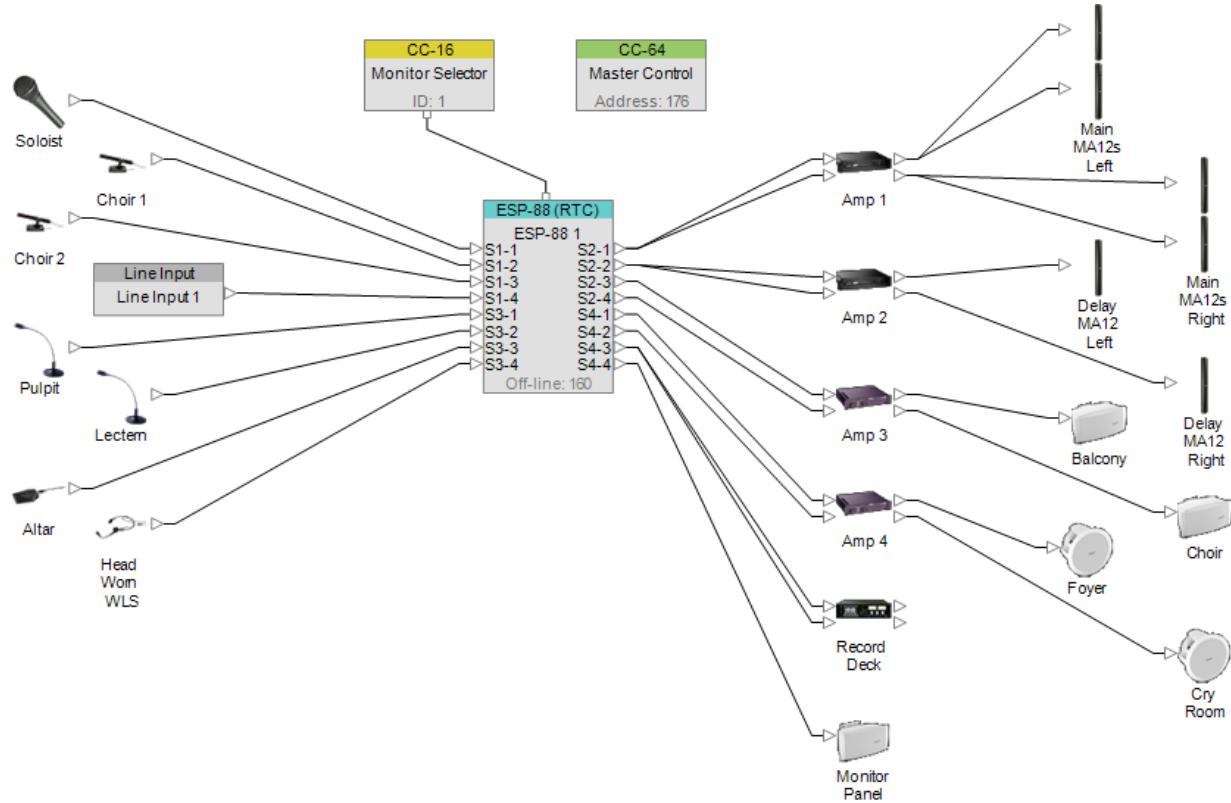


Figure 1: House of worship project elements

In this design, input signals managed by the automatic microphone mixer include those from the pulpit, lectern, altar, and wireless microphones (channels 4-8). While all microphones remain “active” during normal operation, unwanted speech or noise will not be reproduced by the system because the automatic microphone mixer will only allow the signal to pass once it exceeds a predefined volume.

This is accomplished by using the following DSP processing configuration:

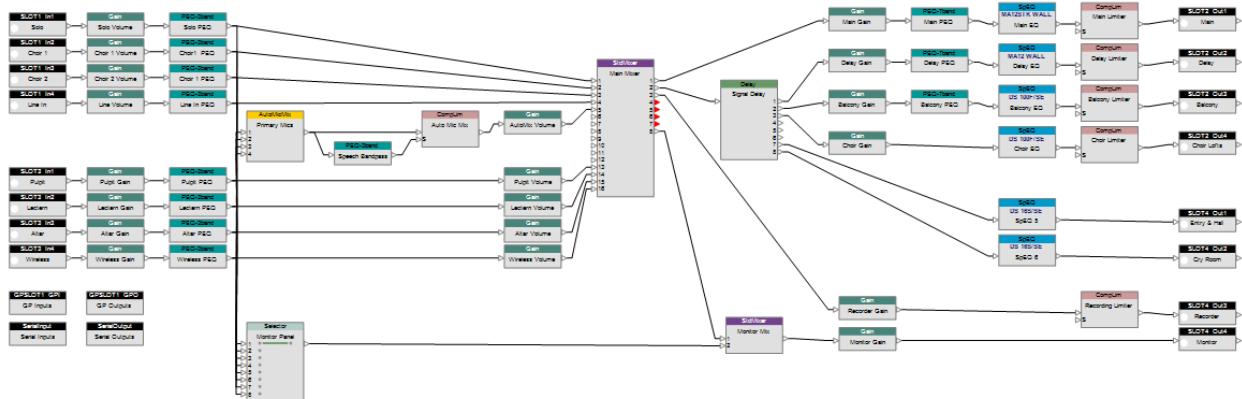


Figure 2: Digital Signal Processing configuration

## Input Processing

The system's input processing comprises:

- Signal conditioning
- Automatic microphone mixing
- Main mixing and routing.

**Signal conditioning** includes independent gain and equalization for each input channel. This streamlines system programming, allowing separate configurations for the user-assigned gain and system gain in order to optimize signal to noise throughout the system. Each channel also incorporates a 3 band parametric EQ.

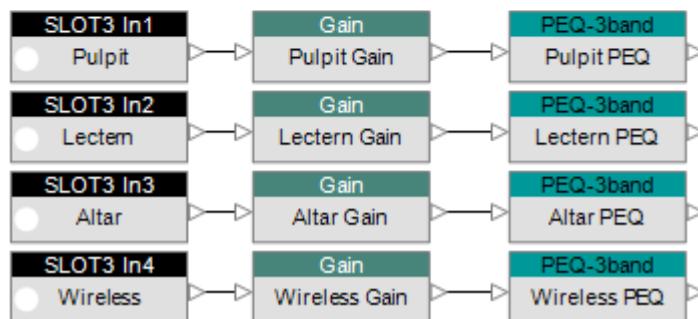
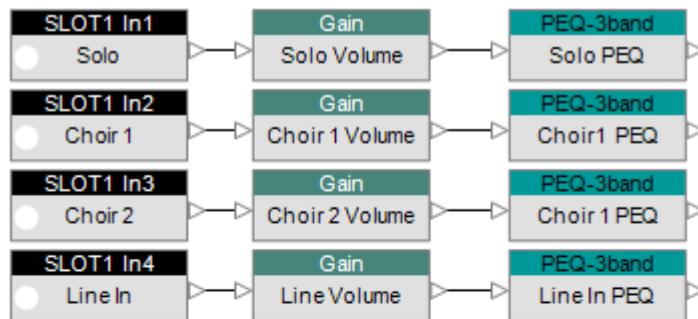
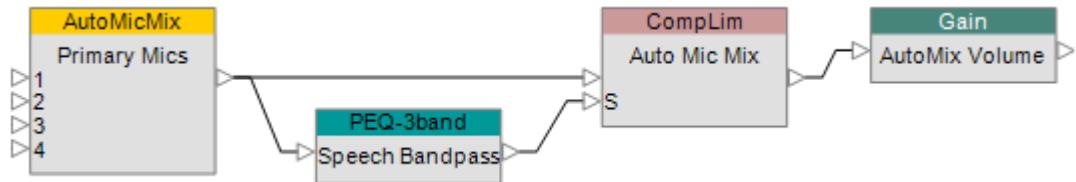


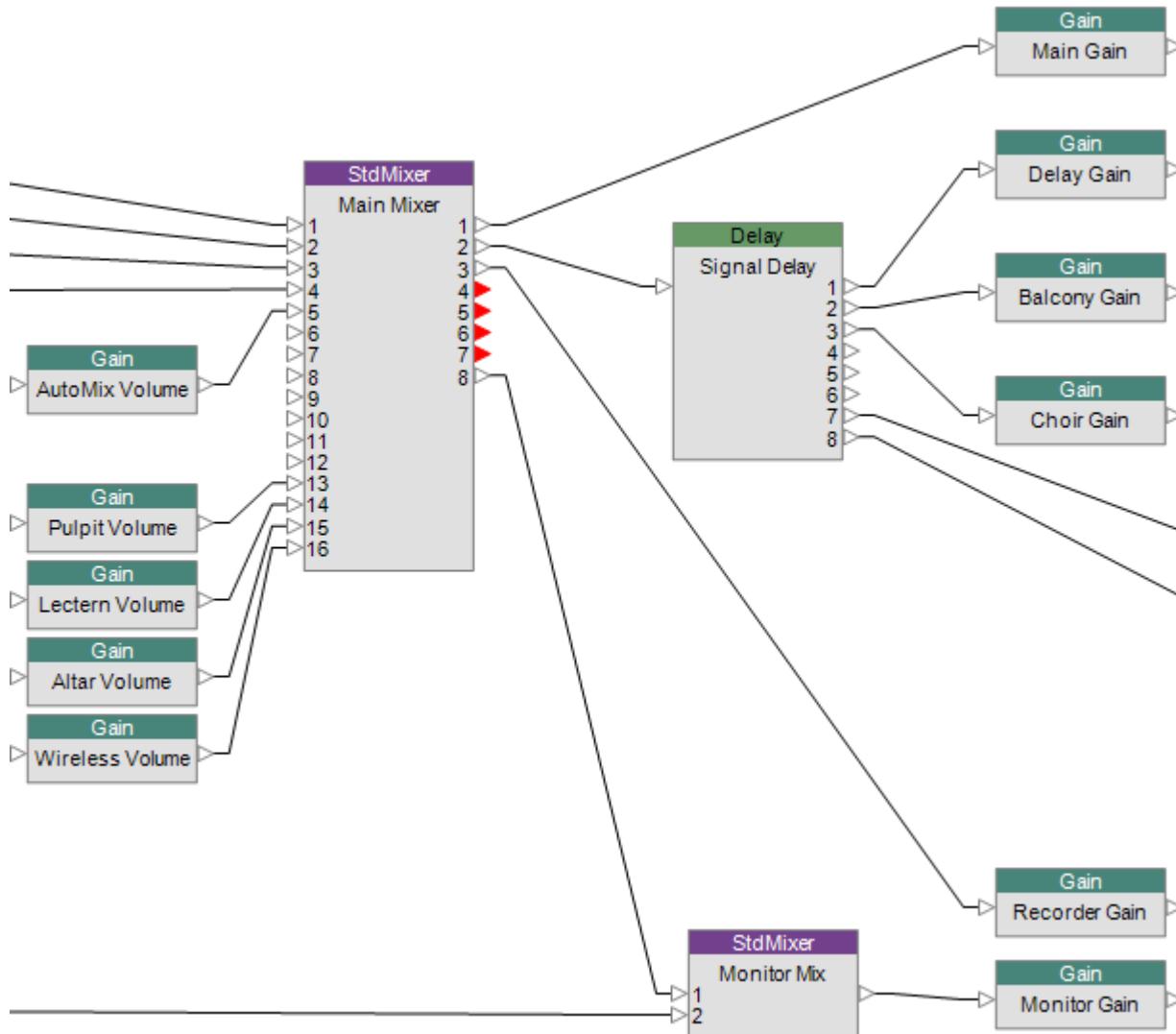
Figure 3: The system manages independent input gain (volume) and equalization for each microphone

The **automatic microphone mixer** manages four system microphones. Processing in this section includes automatic mixing combined with compressor/limiter functions to deliver a consistent volume level. This design incorporates a parametric EQ configured as a band-pass filter (250Hz-2kHz), driving the compressor's side-chain input and keeping it responsive to the speech signal only, rather than bass frequencies or noise from handling the active microphone.



*Figure 4: Automatic microphone mixer processing section incorporates a compressor/limiter to maintain a consistent operating level*

The **main mixing and routing** section handles the mixing and routing of all system inputs to the various zones:



*Figure 5: The main mixer routes signals to the various system zones*

# Output Processing

The ControlSpace® Automatic Microphone Mixer output processing is comprised of signal alignment delay, zone gain, zone EQ, loudspeaker EQ, and protection limiters for each zone.

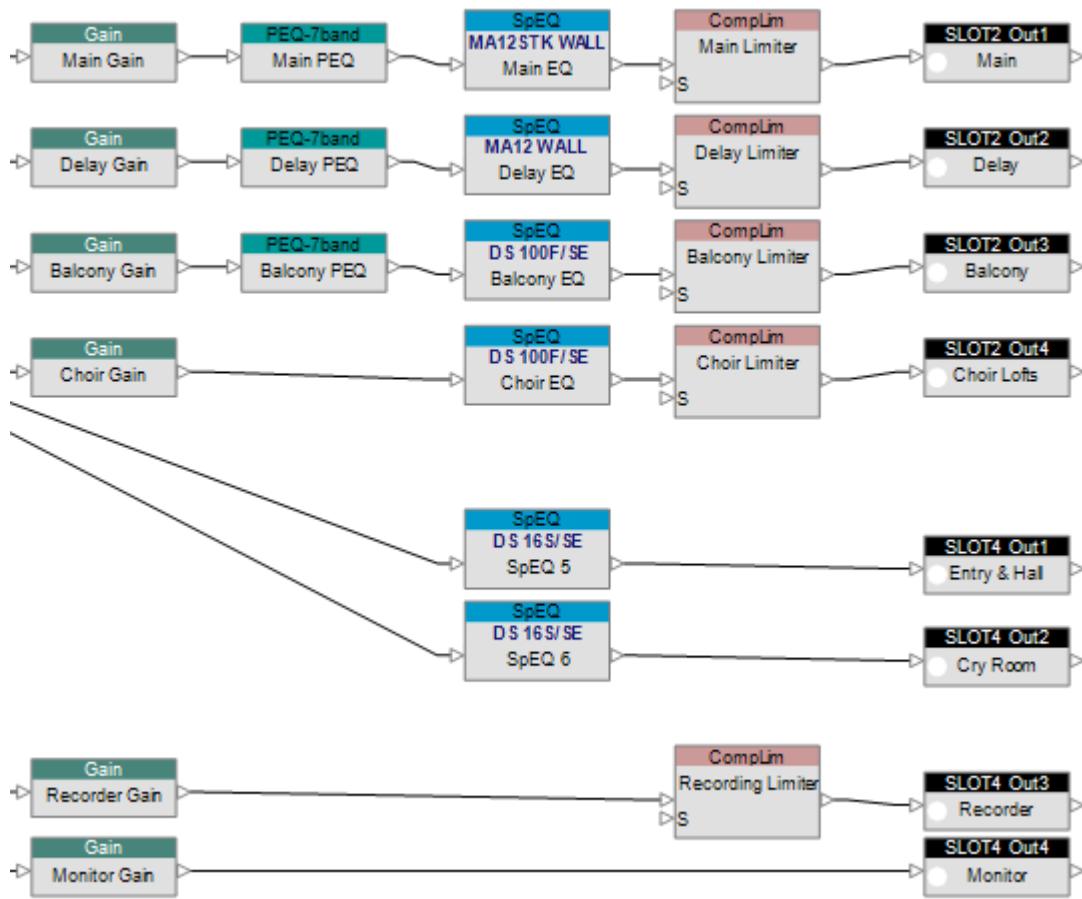


Figure 6: Output processing

## Microphone Mixers

A threshold detection method is used with pulpit, altar and wireless microphones (channels 1, 3 and 4). This allows microphone signals above a certain level to pass to the output stage of the mixer. During system commissioning, we will configure all input gain settings.

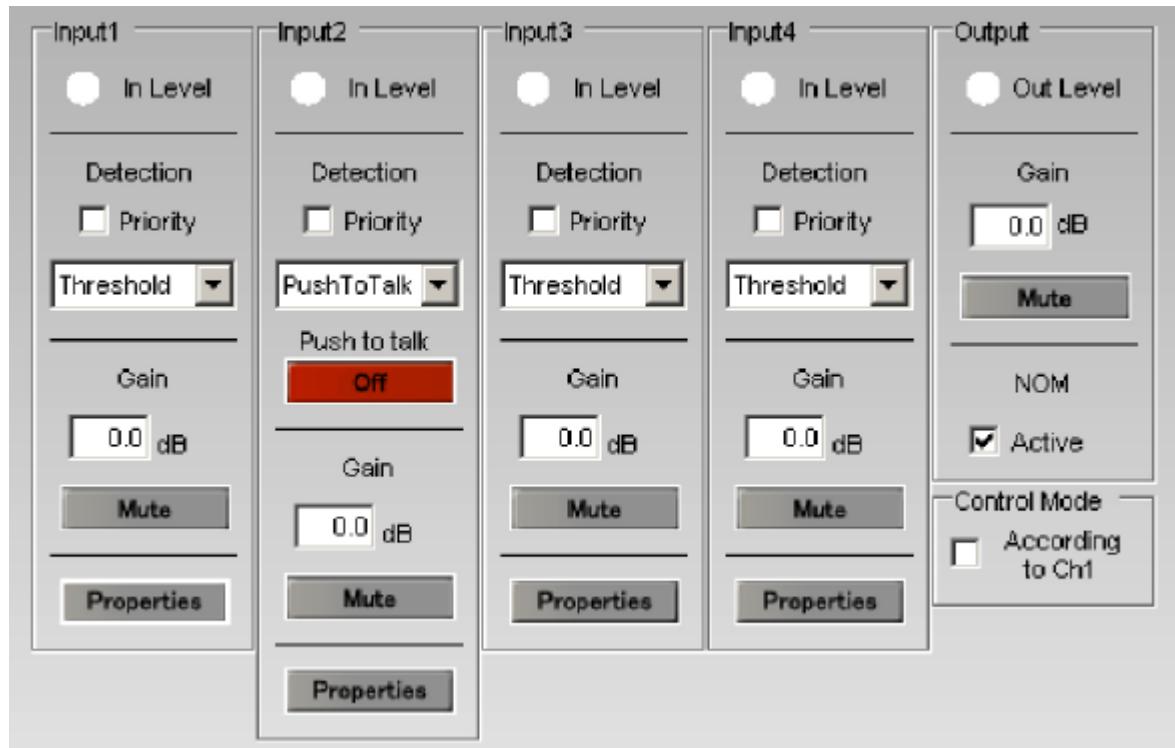


Figure 7: Automatic microphone mixing settings

"Push-to-Talk" detection is used with the lectern microphone. Bose Professional System installers place a sensor pad underneath the carpet behind the podium. Once someone steps on this pad, a contact closure is provided to the ControlSpace ESP General Purpose Input 1, thus activating the microphone.

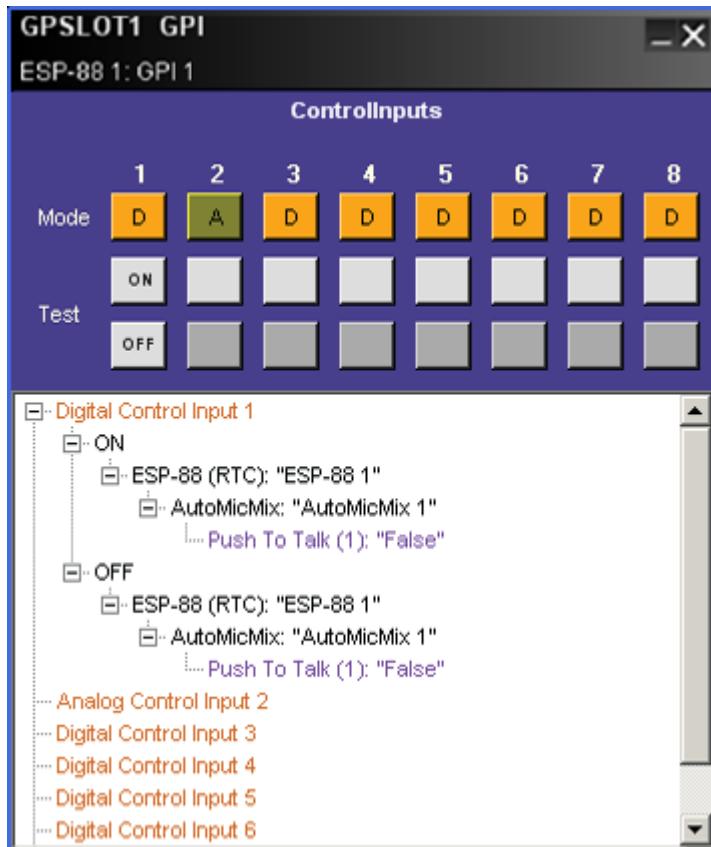


Figure 8: "Push-to-Talk" detection on the public podium microphone

## Surround Sound Decoder

The Bose® ControlSpace® Surround Sound Card offers new opportunities for integration of surround sound systems into commercial spaces. The flexibility of ControlSpace systems and the enhanced listening experience afforded by a surround sound system, makes for an impactful product solution. This application note illustrates basic surround sound system design principles and the implementation of a multi-purpose facility design, within a ControlSpace system.

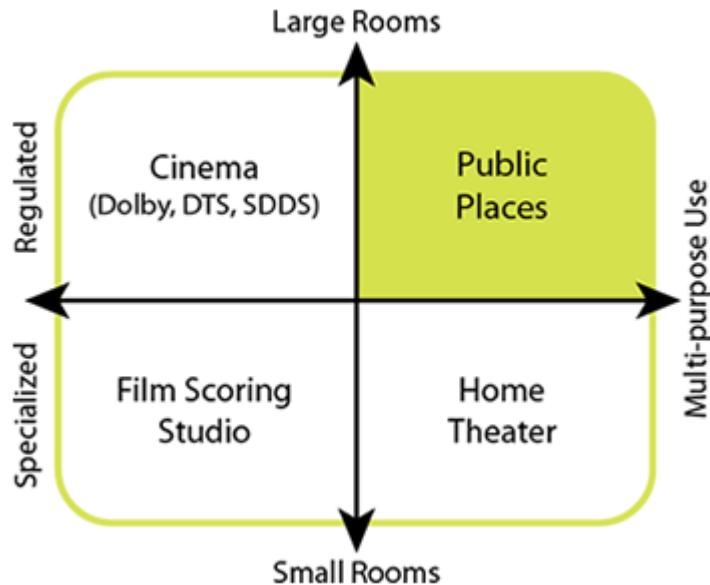
The following concepts are explored:

- Surround sound system types
- Positioning surround sound loudspeakers
- Implementing a surround sound system
- Multi-purpose surround system design example

## Background

We are more accustomed to the immersive listening experience provided by surround sound systems than ever before. They are used in many different types of venues from home

theaters to movie theaters. These venues range in size from small spaces to large rooms, and the use of surround sound systems runs the gamut from multi-purpose implementations to highly specialized facilities. Figure 1 illustrates the four primary quadrants of surround sound venue implementation today.



*Figure 1: Typical surround sound system venues*

## Surround sound system types

The markets targeted by the new ControlSpace Surround Sound Card fit within the upper right-hand quadrant of this graph. Medium to large sized venues with multi-purpose needs are in the sweet spot for surround sound systems managed by ControlSpace. Knowing this, let's take a look at the basic surround sound configurations in today's marketplace.

Surround sound systems are referenced by the number of output channels they produce. The three most common today are named 5.1, 6.1, and 7.1. The first number of this classification indicates the number of full range signals in use. The .1 represents the number of Low Frequency Effect (LFE) channels in operation. The LFE output channel may also receive low frequency information from any of the full range channels when bass management is in effect. The loudspeaker arrangements associated with each of these surround sound system types are shown in Figure 2.

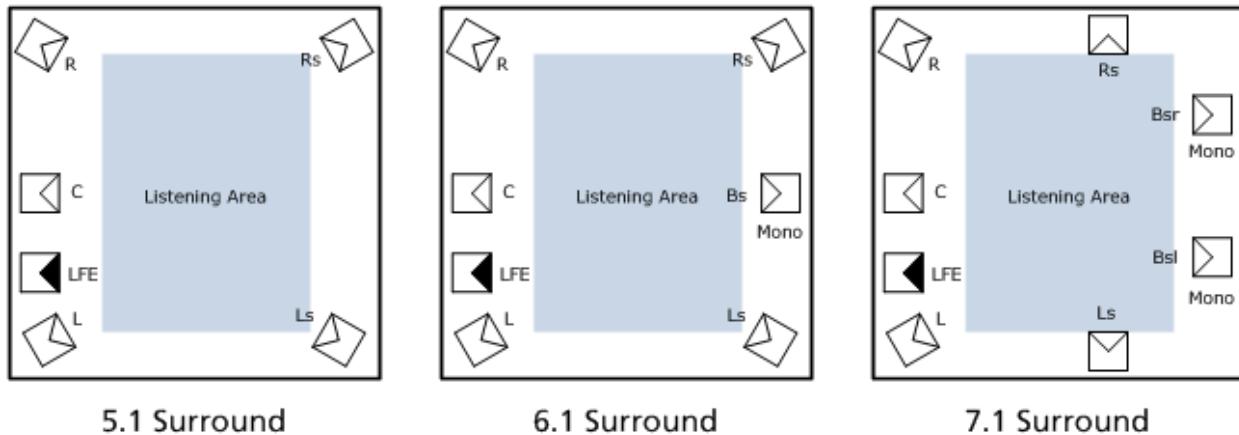


Figure 2: Surround sound system configurations

## Positioning surround sound loudspeakers

When designing loudspeaker systems to reinforce a specific surround sound configuration, the following recommendations will help you position each device appropriately. Front channel loudspeakers (Left, Center, Right) should be positioned behind acoustically transparent projection screens and at a height 65% of the total screen height from its base.

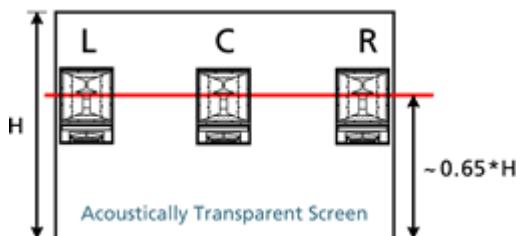


Figure 3: Loudspeakers behind screen

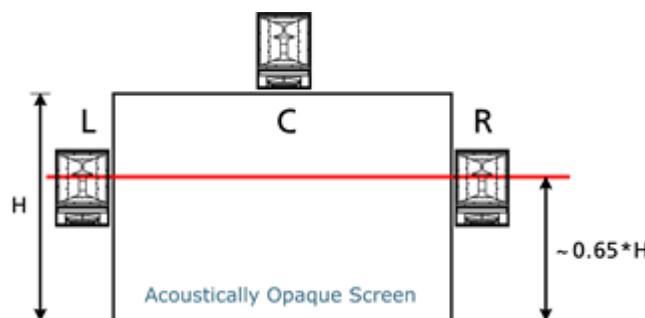


Figure 4: Loudspeakers around screen

When the projection screen is opaque, the same height rule applies to left and right loudspeakers, but they are oriented outside the perimeter of the screen to a location which

will not obscure the on-screen image. The center channel loudspeaker is positioned above the screen in cases like this.

A Low Frequency Effects (LFE) loudspeaker should always be located near the front channel loudspeakers. Moving this loudspeaker away from the other front loudspeakers will reduce its impact and effectiveness during music and movie playback.

### Bass Placement Within Room

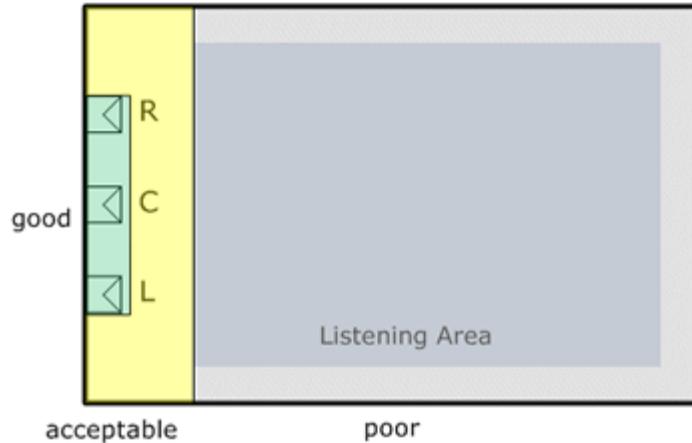


Figure 5: LFE performance area

The optimum LFE position is between the left and right loudspeakers and off axis from the center of the room. This will help to maximize low frequency energy throughout the listening space.

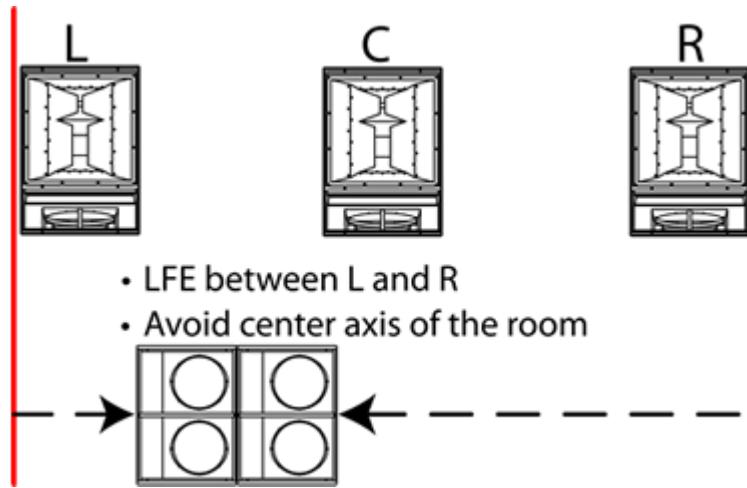


Figure 6: Recommended LFE positioning

Bi-amped loudspeakers are recommended for use with the front channels (L, C, R). The crossover range between the front channels and the LFE loudspeakers should be between 80 and 100 Hz. Each of the surround channel loudspeakers should be full range devices.

Using surround sound loudspeakers that have wider than traditional horizontal coverage, or Articulated Array® technology can enlarge the sweet spot, providing a better surround experience to a larger number of listeners. This becomes a critical factor in system designs for multi-purpose facilities using surround sound.

Bose® Panaray® 402®, Panaray 302™A, and FreeSpace® DS100SE loudspeakers all use Articulated Array technology and make excellent surround sound devices.

In the Multi-purpose surround system design example which we will explore in the following pages, a 7.1 system design option is chosen for maximum flexibility. The positioning of the loudspeakers supporting the surround channels also have rules of thumb to promote a quality experience.

In 7.1 surround systems, the right and left surround loudspeakers (Ls & Rs), which mount on the side walls, should be positioned at 66% of the distance from the projection screen to the back of the room. The back surround loudspeakers (Bsr & Bsl) mount on the back wall of the listening space and are located 25% of the total room width from the back corners.

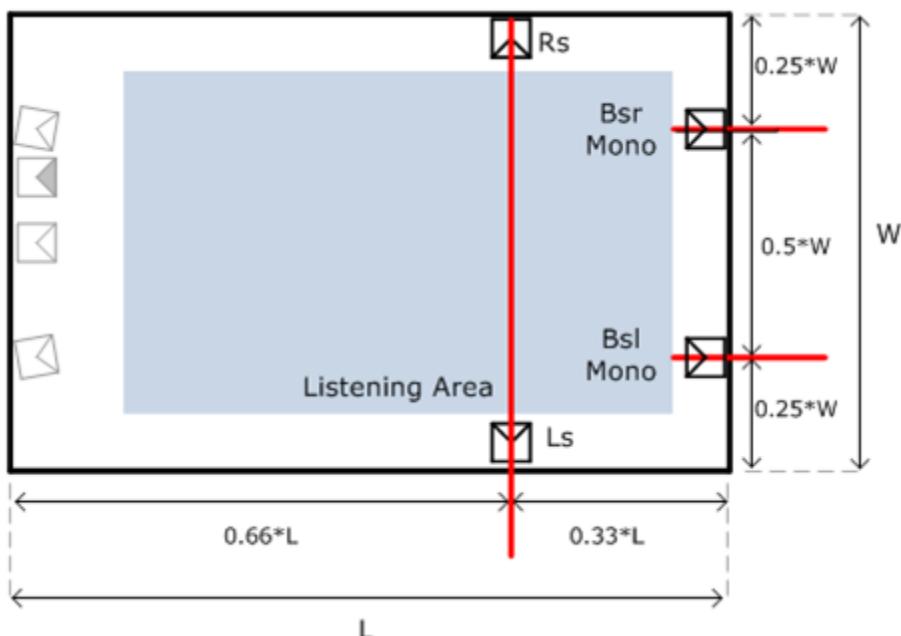
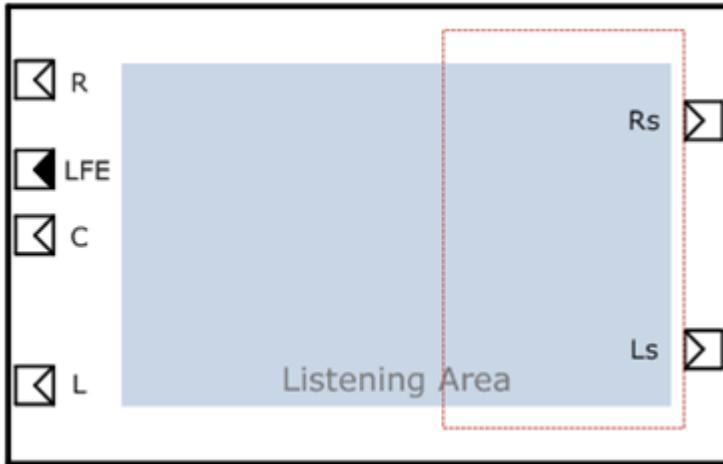


Figure 7: Surround loudspeaker location rules of thumb

Large rooms often require a signal delay applied to rear surround channels to ensure localization to the projected image on screen. Figure 8 illustrates this delay zone with a dashed red box in the rear one-third of the listening space.



*Figure 8: Surround sound audio delay for video zone*

Note: Surround zone delays should only be implemented during playback of video sources (movies). If DVD-Audio program material is active, this signal delay should be disabled. ControlSpace® systems support dynamic configuration of delays and all manner of related system adjustments that are warranted as the input program material changes its content.

## Signal Processing Considerations

The use of Compressor/Limiter processing blocks within ControlSpace systems is strongly recommended to protect loudspeaker drivers. It is normal for action movies to dramatically vary the loudness of passages to achieve a desired effect. Without compression components in the signal chain, extremely loud passages can easily damage loudspeakers in short order.

The DSP power and flexibility of ControlSpace systems will help you dynamically manage signal delay to surround channels as digital program content changes, and when multi-purpose systems vary modes of operation, ControlSpace will adapt its configuration in real time, according to your design.

Please see our multi-purpose surround sound application note for methods to implement these concepts in a system configuration of a Bose® ControlSpace® ESP Engineered Sound Processor.

## Youth Multi-purpose Facility

As part of a Bose® ControlSpace® system design, the Surround Sound Card provides new options for multi-purpose installations. This application note describes its use in a youth multi-purpose facility.

Figure 1 below, created using the Bose® ControlSpace® Designer software, provides an overview of project elements. In this figure, media players, microphones and other input devices are shown on the left, while loudspeakers and other output devices are shown on the right. The master user interface appears at the top of this diagram and at the heart of the system is the ControlSpace® ESP-88 Engineered Sound Processor.

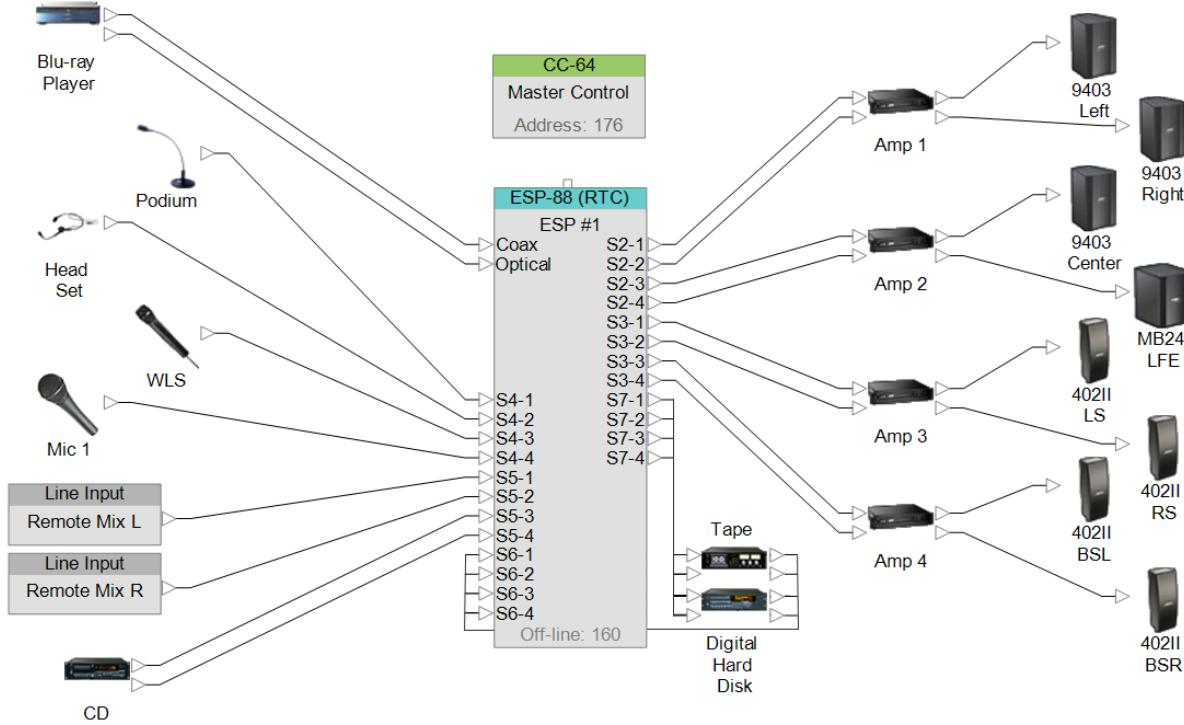
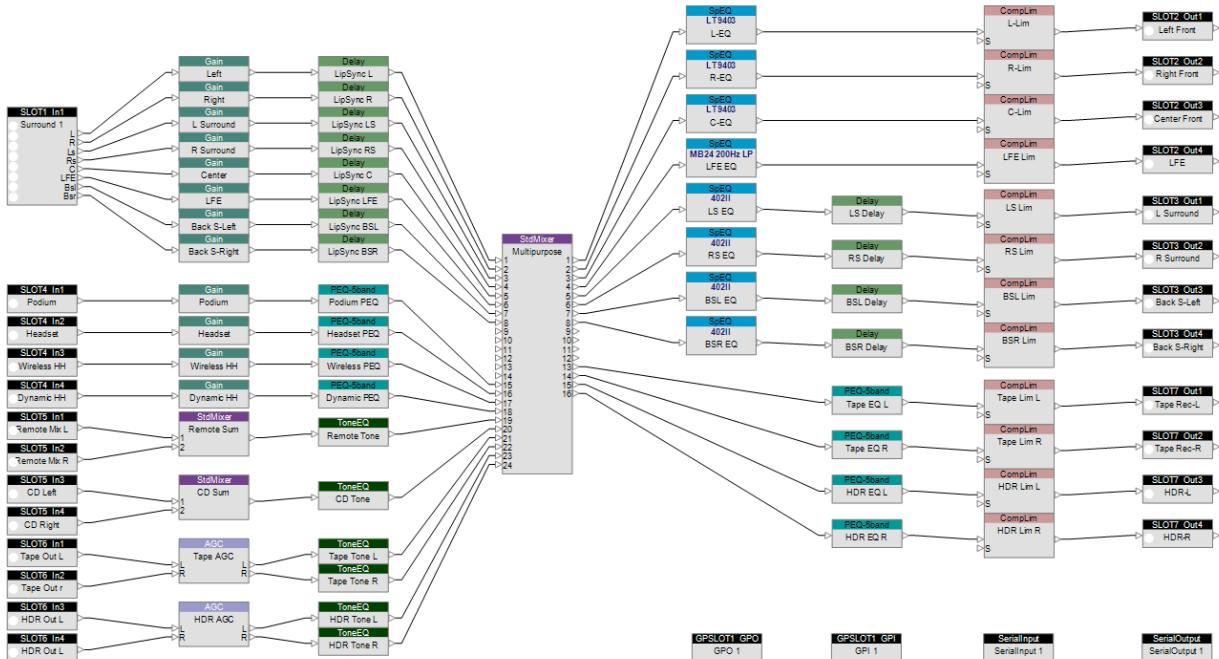


Figure 1: Youth Multipurpose Facility project elements

This system provides traditional sound reinforcement functions such as speech and music playback. It also adapts to deliver an immersive surround sound experience with a loudspeaker design that supports eight total output channels of audio. For this design, we use the following DSP processing configuration:



*Figure 2: Digital Signal Processing configuration*

## Input Processing

The system's input processing comprises:

- Surround signal processing
- Signal conditioning
- Main mixing and routing

**Surround signal processing** monitors the digital audio bit stream for specific surround formats. The current list of supported formats is shown in Figure 3.

Bit Stream	Channels							
	C	R	L	Rs	Ls	LFE	Rb	Lb
Dolby Digital 1.0								
Dolby Digital 2.0								
Dolby Digital 5.1								
DTS 1.0								
DTS 2.0								
DTS 2/1								
DTS 2/2								
DTS 3.0								
DTS 4.0								
DTS 5.0								
DTS 5.1								
DTS ES 6.1 Discrete								
DTS ES 6.1 Matrix								
PCM 16 bit (CD)								
PCM 24/48 bit								
DVD-Audio								
DTS-CDDA								

*Figure 3: Currently supported surround sound formats*

As unique bit streams are detected, the loudspeaker output channels automatically configure to match the unique surround sound format. This configuration adjustment is accomplished by defining unique parameter sets to match each type of surround sound signal anticipated.

Within ControlSpace® systems, we use parameter sets to change the state of specific system adjustments without affecting the state of the entire design. Figure 4 illustrates the assignment of parameter sets in the media type programming area of the surround sound processing block.

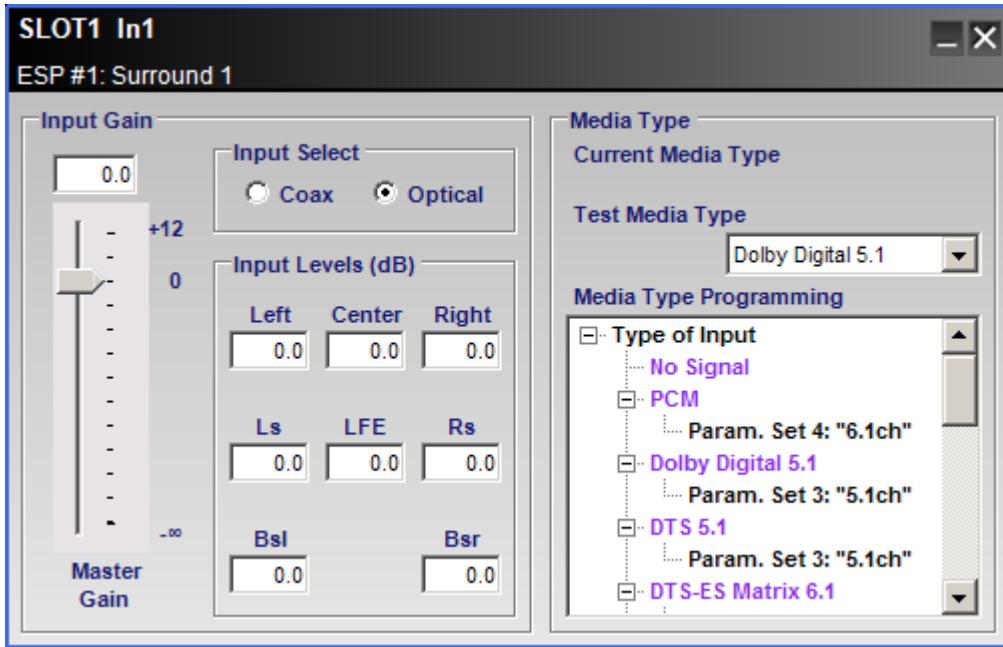


Figure 4: The surround card processing block

**Signal conditioning** provides individual gain stages for each surround sound card channel. Additional delay blocks are included to allow for compensation of audio synchronization issues with video content.

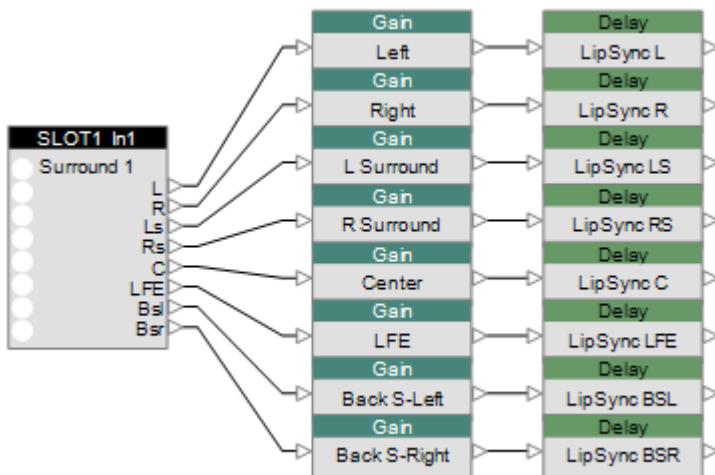


Figure 5: Surround sound channel processing

This system design also incorporates independent gain and equalization for each input channel. This streamlines system programming, allowing separate configurations for user-assigned gain controls on user interfaces. Each mic channel incorporates a 5 band parametric EQ.

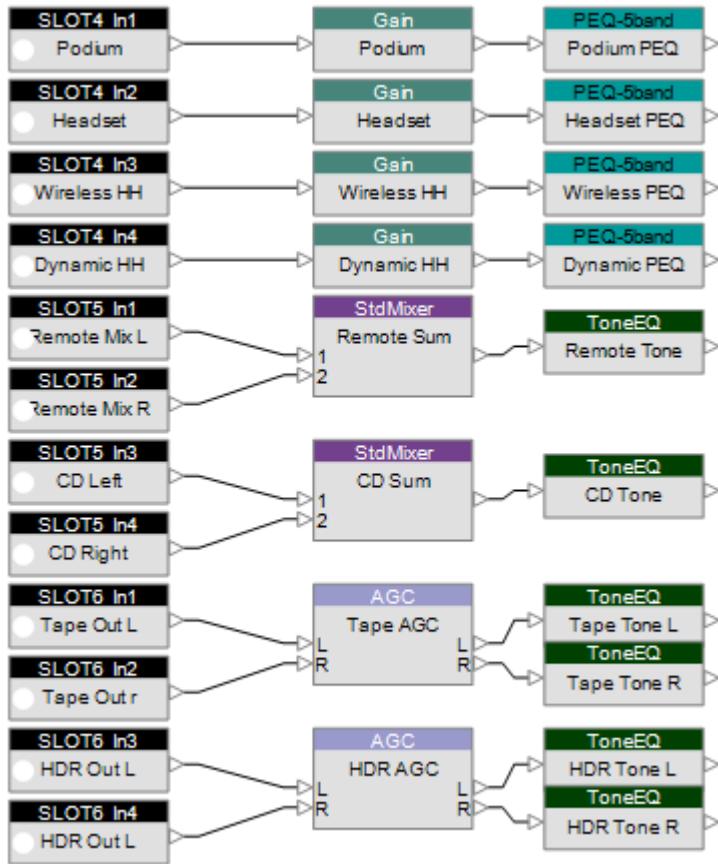


Figure 6: Independent volume and equalization for each microphone

The **main mixing and routing** section consists of a single large mixer and manages all system inputs through to the various output zones.

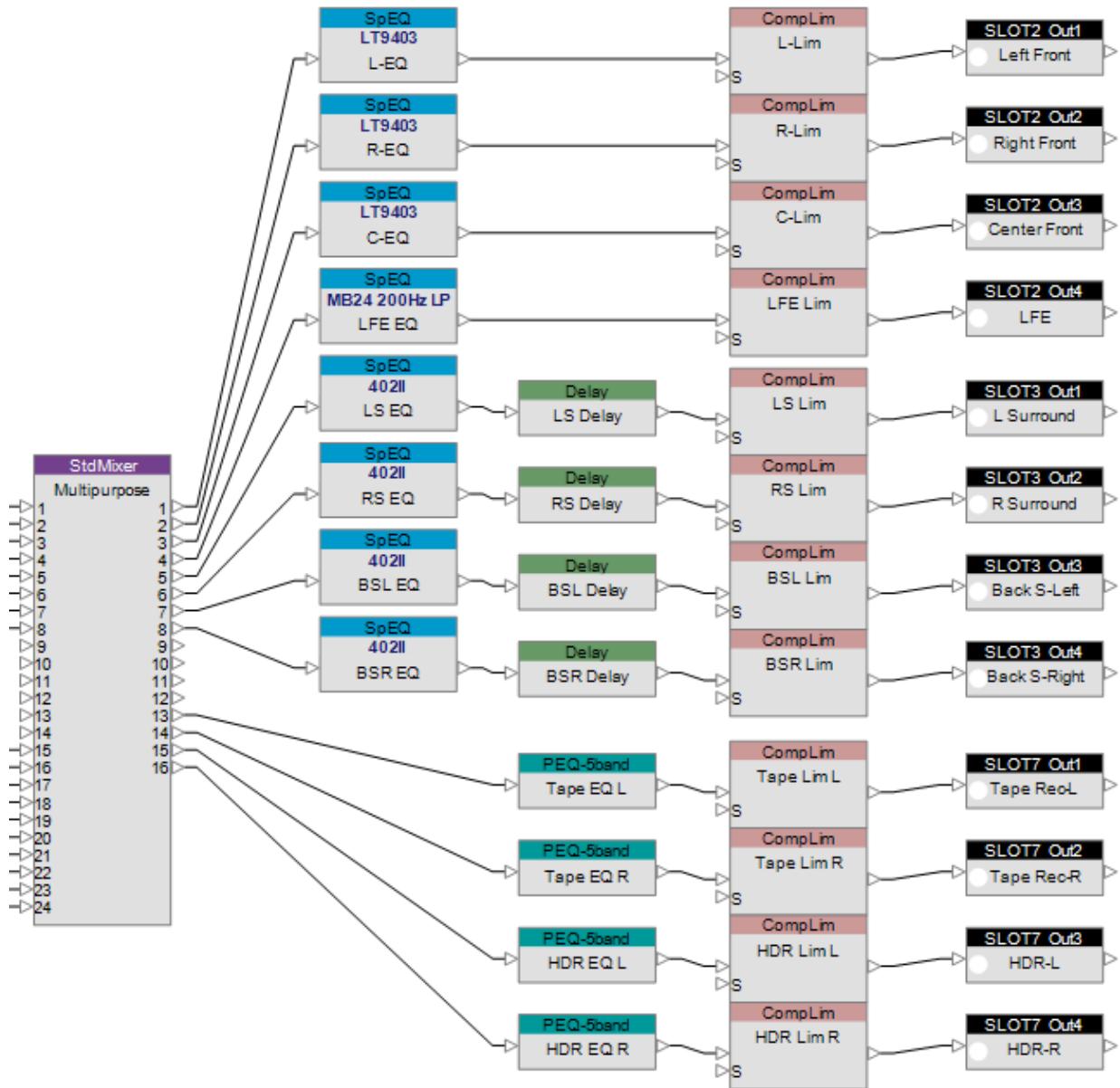


Figure 7: Main mixing, routing, and output processing blocks

## Output Processing

This section of the design contains loudspeaker EQ, signal delay for surround sound zones, parametric equalization for recording devices, and protection limiters for each zone.

## System Control

In this application note, we explored configuration of inputs, outputs, signal processing, mixing, and routing functions within this multi-purpose system. Now it is time to take the final step and discuss control programming for the system. We need to assign all the significant functions to the chosen user interface.

The design goal of this system dictates we use a single ControlSpace® CC-64 Control Center to manage system functions.

The CC-64 is the flagship of our user interface offerings and supports the mapping of internal digital signal processing blocks, parameter sets, or groups, to the five rotary encoders included within the interface.



Figure 8: CC-64 Control Center

Four bank switching buttons on the CC-64, redefine a set of four Gain/Selector control knobs, providing quick access for up to 16 system gain controls or selectors. The 2-line by 40-character backlit LCD display of the CC-64 makes it easy to develop descriptive labels for controlled system elements.

**Modes of operation** within this multi-purpose system are numerous. Rotating the master selector of the CC-64, gives you the ability to scroll through available modes. When the desired mode is reached, simply push the encoder to activate that particular series of functions.

Here is a list of the modes currently defined for this system:

- Speech Mode
- Lecture Mode (Computer and Projector)
- Stereo Music Playback Mode
- Surround Music (DVD Audio and SACD Discs)
- Concert Mode with Performance Mixer
- Movie Mode
- Karaoke Mode

The displays visible by pressing the first three control bank switches are shown in Figure 9. Here you can see and control all significant system functions from a single interface.

<b>Surround Music (DVD Audio and SACD Discs)</b>			
<b>Podium</b>	<b>Dynamic HH</b>	<b>DVD Player</b>	<b>Master Gain</b>
<b>0.0 dB</b>	<b>0.0 dB</b>	<b>0.0 dB</b>	<b>0.0 dB</b>
<b>Lecture Mode (Computer and Projector)</b>			
<b>Headset</b>	<b>Wireless HH</b>	<b>CD Player</b>	<b>Tape Player</b>
<b>0.0 dB</b>	<b>0.0 dB</b>	<b>0.0 dB</b>	<b>0.0 dB</b>
<b>Concert Mode with Performance Mixer</b>			
<b>Remote Mixer</b>	<b>Tape Record Output</b>	<b>HDR Record Output</b>	<b>Sub Woofer</b>
<b>0.0 dB</b>	<b>0.0 dB</b>	<b>0.0 dB</b>	<b>0.0 dB</b>

Figure 9: CC-64 Control Center Functions (Banks 1-3)

With the surround sound decoder input card, loudspeaker configurations occur automatically regardless of whether you listen to 5.1, 6.1, or 7.1 content. This coupled with a CC-64 Control Center, makes for a Bose® ControlSpace® ESP system that is extremely easy to operate.

## Summary

In this application note we examined the flexibility of Bose® ControlSpace® systems and the implementation of a design for a multi-purpose facility using a 7.1 channel surround sound loudspeaker layout.

This type of a system offers maximum flexibility for reinforcement of audio and video functions of greatest interest to young people.

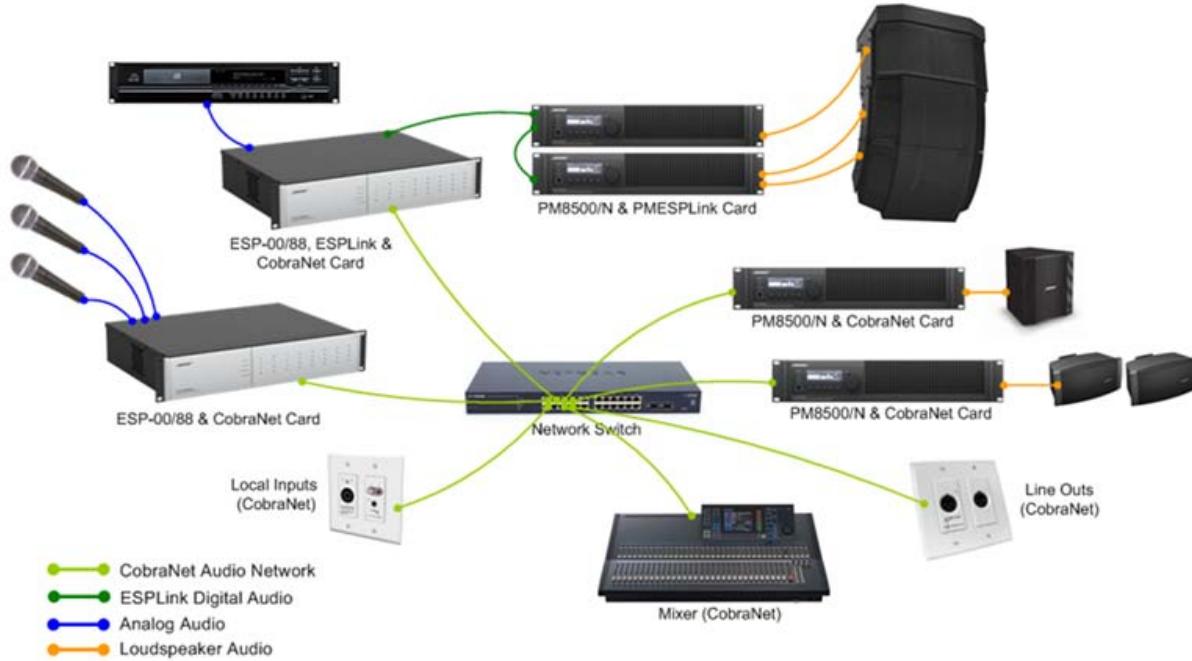
The ControlSpace® surround sound decoder input card is an industry first by integrating a multi-purpose digital signal processor and a surround sound decoder within a single expansion card. This card works with DVD players, and facilitates multi-channel surround playback in our target markets for an enhanced listening experience.

To learn more about the Bose® ControlSpace® ESP engineered sound processor and the new surround sound decoder input card, please visit [pro.Bose.com](http://pro.Bose.com). Look for our related Surround Sound Design Guide for information about designing surround sound systems in large spaces.

## CobraNet

### CobraNet Application Examples

CobraNet network audio expansion cards are available for both the ESP-88/00 engineered sound processors and the PowerMatch™ PM8500/N configurable professional power amplifiers. The cards use industry-standard CobraNet technology to transport multiple channels of high quality, uncompressed digital audio in real time across a standard Ethernet network. CobraNet network audio distribution is typically used in systems which require signal processors and amplifiers that are in different parts of a large building or complex, or to interlink multiple devices within an equipment rack to reduce analog cabling and connections.



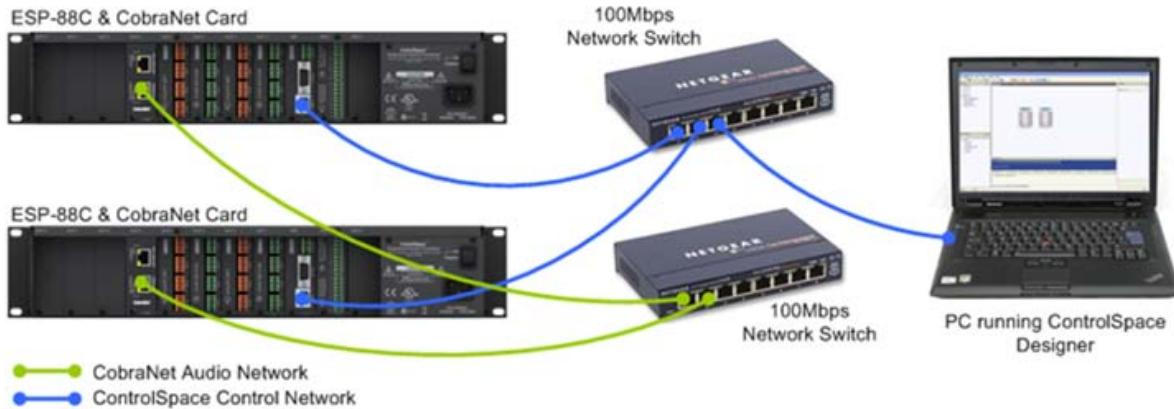
#### *Example system using CobraNet network audio distribution*

The following two examples explore several typical system configurations where a CobraNet audio network is used to distribute audio between signal processors and amplifiers.

- [Example #1: ESP-to-ESP Signal Routing](#)
- [Example #2: Single ESP-to-Multiple PowerMatch Amplifiers](#)

## **Example #1: ESP-to-ESP Signal Routing**

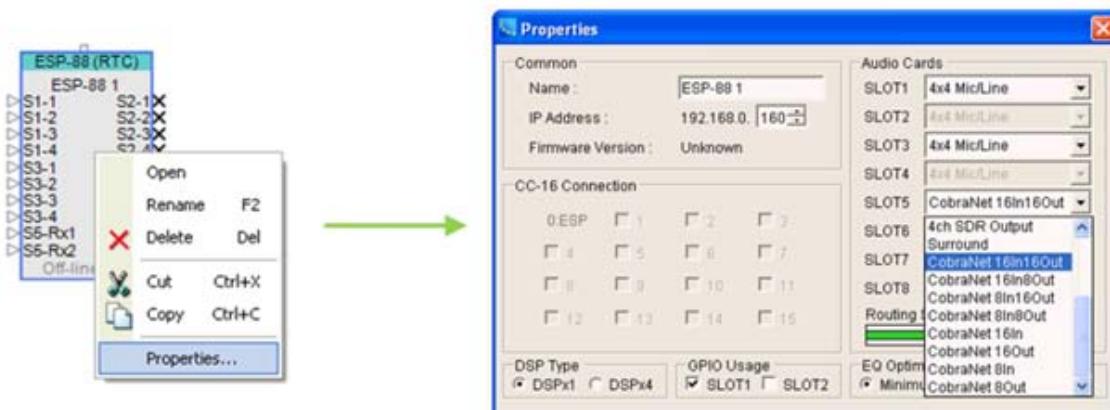
This first example includes two ESP-88s with eight channels of audio passing in each direction between them. This is a common application where the ESPs are physically separated, but act as the primary signal processor for their area. Each ESP provides a number of analog inputs for local sources, while the output section is used for local sound reinforcement. However, there is a need to make all input sources available to both areas, which is accomplished by routing the audio between the units using a CobraNet network.



*System configuration for ESP to ESP signal routing*

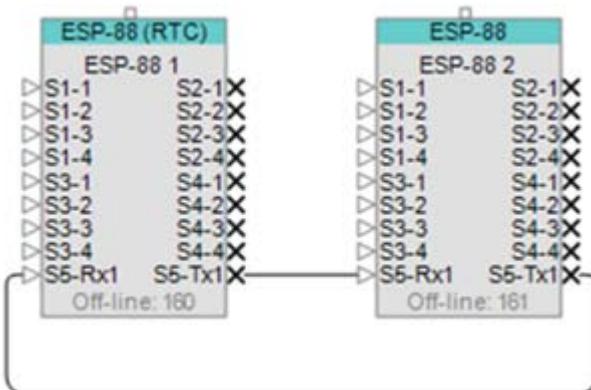
**NOTE:** Before following these steps to configure this example system it is assumed that a CobraNet card has been correctly installed into each ESP and that the independent networks have been created for CobraNet and the ControlSpace control network.

1. Using ControlSpace Designer v2.321 or later create a new design file and perform a hardware 'Scan' either by choosing the option from the 'Tools' menu or by using the toolbar button, .
2. Assuming that all the network connections and settings are correct the two ESP-88s should be detected, populated with their standard 4x4 cards plus the additional CobraNet expansion card. By default the card will be shown as the '16 in, 16 out' variant unless there is an existing design file in the ESP with the card configured differently.
3. Since this system design only requires the CobraNet cards to have 8 inputs and 8 outputs the card can be configured as the '8 in, 8 out' variant, leaving four routing slots (three physical slots) available for other expansion cards. This can be changed in the ESP Properties window which is accessed by right-clicking on each ESP in Project View and selecting 'Properties'.



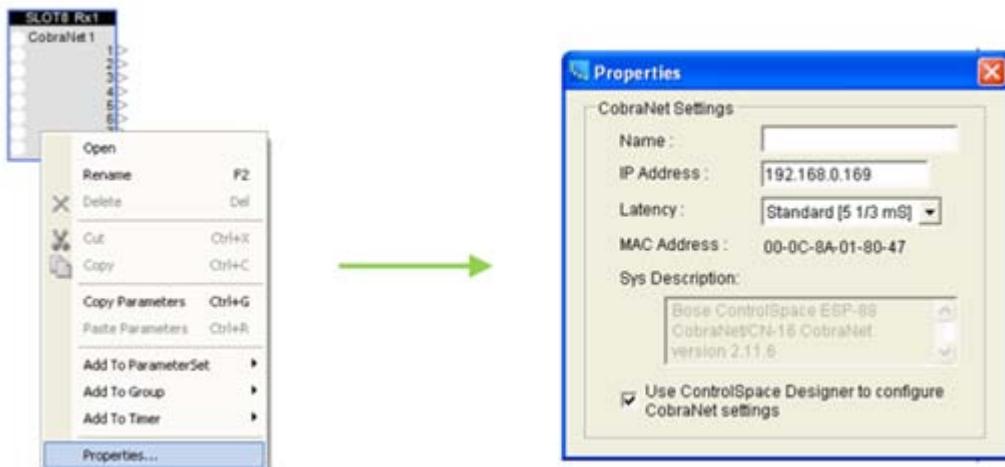
*CobraNet configuration within ESP properties*

4. Once the card variant has been changed it is recommended that the required connections between CobraNet transmitters and receivers are drawn in the Project View. While this has no influence on the actual operation it is a good visual reference of the CobraNet links that will be required.



*CobraNet 'wiring' within the Project View*

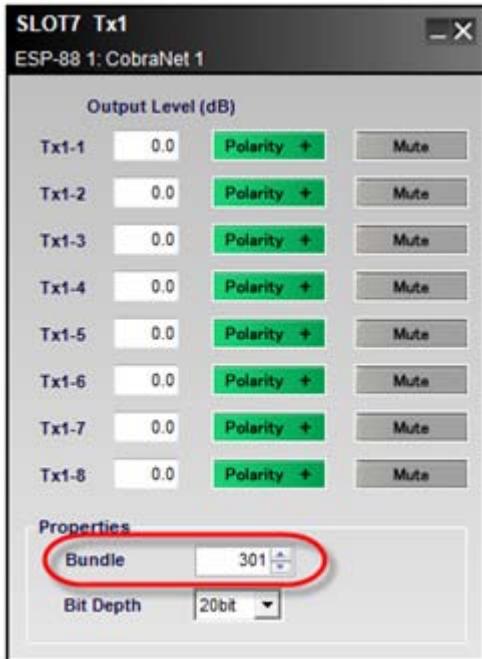
5. Verify the CobraNet configuration within the ESP. These options can be found in the Card Properties which are accessed by right-clicking on any CobraNet input or output module in ESP view and selecting 'Properties'. These are the default settings and should not require any changes.



*CobraNet Input/Output Properties*

6. You will now determine how audio will be routed between ESP-88 #1 and ESP 88#2, by creating a Bundle assignment for the output section of ESP-88#1. This Bundle assignment will determine the method used to broadcast the digital audio on the network. To accomplish this open the CobraNet output control panel within ESP-88#1.

Once open, you can then assign a suitable Bundle number that will reference this group of eight channels. Since the connection is from a single transmitter (ESP-88 #1) to a single receiver (ESP-88 #2) a Unicast Bundle should be used from the range 256-65,279 to minimize network traffic.

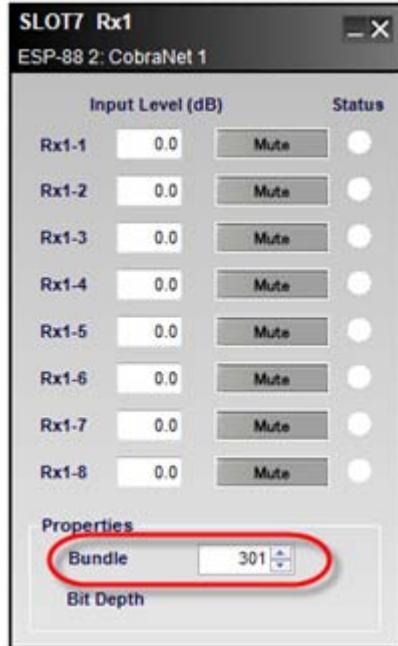


CobraNet Transmitter Bundle Assignment within ESP

**NOTE:** You can use any number within the Unicast range, 256-65,279, but typically it is easier to remember if it ends in '01' for the first link and '02' for the second link, (e.g. 301, 302 or 1001, 1002).

If desired the Bit depth can also be changed but the default of 20bit should be fine for most applications.

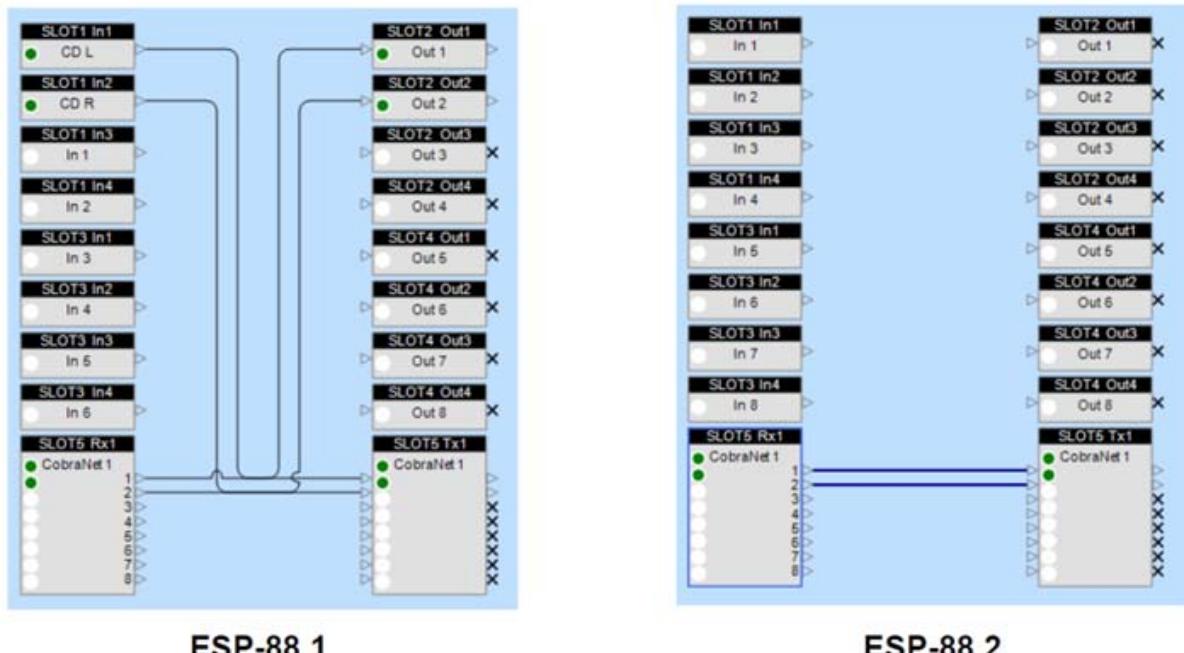
7. Now it is necessary to set up ESP-88 #2 to receive these 8 channels of audio. This is accomplished by configuring the CobraNet input of ESP-88 #2 to receive Bundle 301. Open the CobraNet input control panel in ESP-88 #2, and enter the new Bundle assignment.



*CobraNet Receiver Bundle Assignment within ESP*

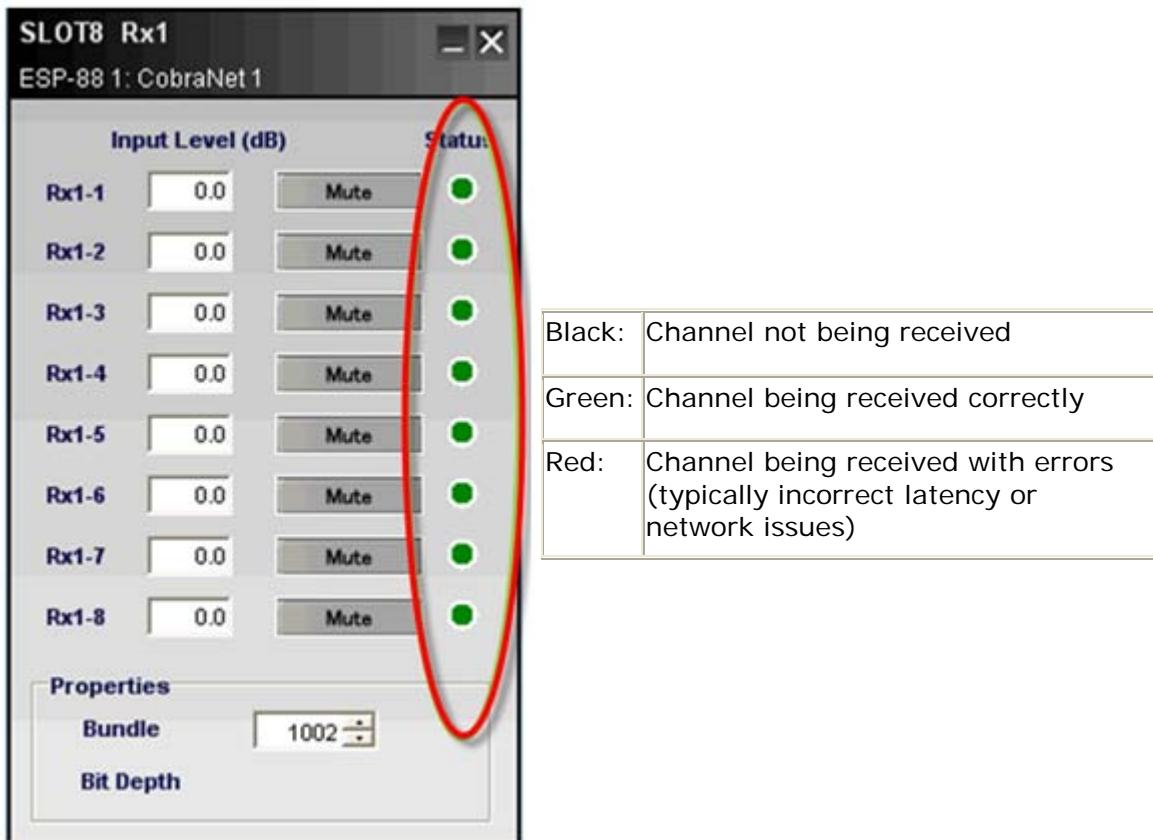
8. The previous two steps now need to be repeated to configure audio routing from ESP-88 #2 to ESP-88 #1. Note that the same Bundle assignment, 301 in this example, cannot be reused, and new Bundle assignment must be created, e.g. 302.

9. At this point the CobraNet configuration is complete and is ready, and once it is uploaded to the ESPs it should be possible to pass audio in both directions between them. To test this one could create a simple design using a source and a powered loudspeaker (or similar), passing the source to the second ESP and back again to prove that both connections are working.



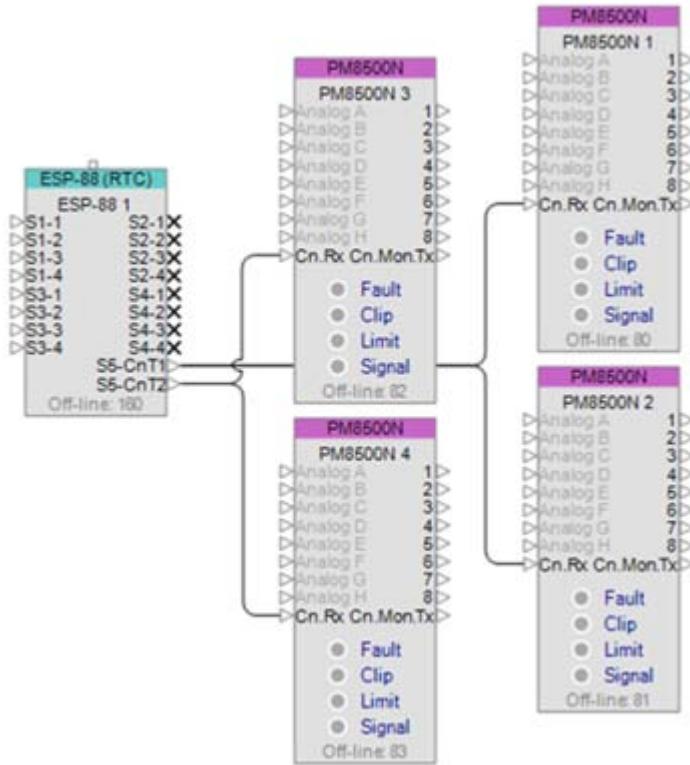
*Simple audio configuration to test CobraNet connectivity.*

10. In addition to monitoring the audio signal level or listening to the audio output, the correct operation of the CobraNet links can also be verified using the CobraNet Status indicators on the input modules. These are not audio signal indicators; instead they indicate the presence of valid CobraNet data for each channel. When ControlSpace Designer is online the indicators will be green if there is a valid CobraNet connection.



## Example #2: ESP-to-Multiple PowerMatch Amplifiers

In this more complex example, 2 Bundles and 16 channels of audio are distributed to two separate racks of PowerMatch 8500 amplifiers. This is a typical application where the ESP is located in a primary control room, while the amplifiers are located remotely throughout the facility.



#### *Example configuration for this example*

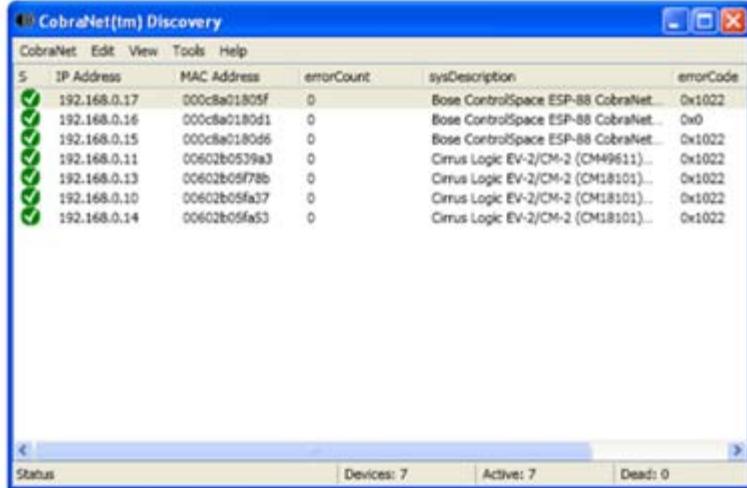
Since this example involves sending multiple Bundles to PowerMatch amplifiers, some configuration of the PM CobraNet cards using the CobraNet Discovery utility will be required.

To configure this system, follow these steps:

1. Install the CobraNet cards and hook up independent networks for the CobraNet audio data and the ControlSpace control data.
2. Open ControlSpace Designer, start a new file and perform a 'Scan' of the hardware or add the ESP, PM amplifiers and CobraNet cards to Project View manually.
3. Select the ESP CobraNet card variant that most closely matches the project requirements in the ESP Properties. In this example it is configured as '16 out' so that two eight channel Bundles can be sent.
4. The first transmitter will automatically be assigned Bundle number 100 (since it is the first CobraNet transmitter in the project), but the second transmitter will need to be assigned Bundle number 101 manually in the CobraNet Tx2 output module control panel.
5. Ensure that the ESP CobraNet card is set to 'Standard [5.33mS]' latency and that ControlSpace Designer has control over the CobraNet settings in the Card Properties (default settings).
6. Open the Input Control Panel for each PM amplifier and select 'Digital' source for each of the inputs.
7. Connect to the ControlSpace control network, send the design to the hardware and then disconnect.

8. Since the PM CobraNet cards come pre-configured all the amplifiers should be receiving audio, but it will the audio intended for amplifiers 1 & 2. To change the Bundle assignment for amplifiers 3 and 4 will require the use of the CobraNet Discovery utility.

9. Swap the PC network connection to the CobraNet network, launch the CobraNet Discovery utility and ensure that all five CobraNet devices are present.

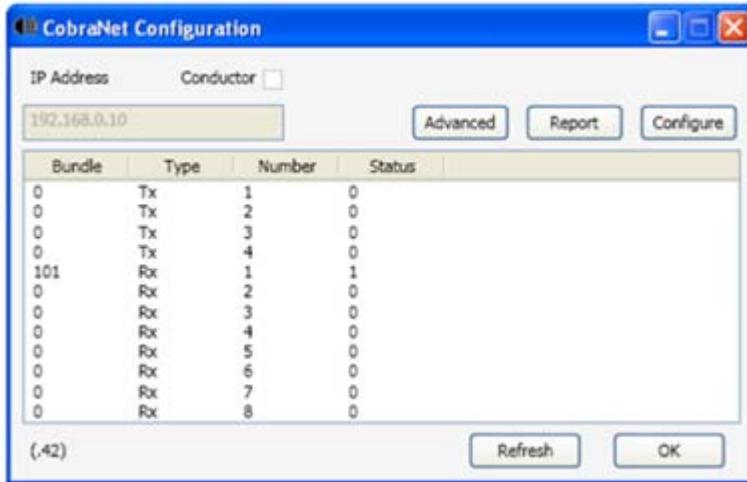


*CobraNet Discover device view*

10. Identify the PM CobraNet cards by temporarily disconnecting each in turn, making a note of the MAC address associated with each amplifier.

11. Assign a valid IP address to each of the PM CobraNet cards (Remember that IP addresses are only temporary).

12. With the cards identified double-click on the card for amplifier #3 to open the 'CobraNet Configuration' dialog.



*Configuration Parameters for PowerMatch amplifier*

13. Then either select the row for Receiver 1 (Rx1) and click 'Configure' or simply double-click the row to open the 'Receiver 1 Configuration' dialog.

14. Since the card is already receiving valid audio data (audio for amplifiers 1 & 2) the status indicators should be green.
15. Change the Bundle assignment from '100' to '101' and then click 'Apply'.
16. To verify that the card is now receiving valid audio data from the second transmitter on the ESP click 'Refresh' and ensure that the status indicators are still green.



*Configuration Panel showing new Bundle assignment and on-line status*

17. Repeat steps 12-15 for amplifier #4 and the system then be configured and working as expected.