

 **SymNet** | Network Audio Solutions

A Technical Overview for Audio System Integrators

Symetrix, Inc.

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Notes:

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1. Introduction

1.0 Document Overview

This document provides information needed to specify SymNet products into installations. We provide a condensed overview of our experience with SymNet in the installed sound industry. Our intent is to shorten the SymNet technical learning curve. In a nutshell, this document covers hardware options, interconnectivity, and basic functionality with an overview of integration. We also address system limits and capacity. The information provided is current as of the publish date of this document. Please see the HELP file within SymNet Designer™ software for more information and details of the latest releases. SymNet Designer™ can be downloaded at no cost from www.SymNetAudio.com.

1.1 SymNet System Overview

The SymNet line is a modular DSP architecture for the installed sound market. SymNet hardware units are combined to provide audio I/O (Inputs and Outputs) and DSP resources necessary for a given task. All connected hardware can act as one system or can be broken up into smaller sub-systems. The system is configured with a standard Windows® PC running the SymNet Designer™ software. Once the system is designed in software, the file is downloaded to the hardware. The hardware will then function as intended.

The system can be controlled via Ethernet if desired. User interface screens can be created and secured. SymNet systems integrate with RS-232 touch screen technologies. There is a full line of wall panels (ARCs) which can be programmed to control the system.

2. Hardware

2.0 Original SymNet versus Express Hardware

SymNet hardware divides into two classes: the “Original SymNet” line of products and the SymNet Express line. The SymNet line uses SymLink, a local audio and control bus that connects Original SymNet hardware. SymNet Express does not have SymLink. Express is either a stand alone box or it can transport audio between units using CobraNet™ (audio over Ethernet).

2.1 Original SymNet

The 8x8 DSP is the main processing unit in the Original SymNet line of products. The two Break I/O units bring in 12 channels of audio into a SymNet system or send 12 channels out to speakers, recorders, etc. These are called the BreakIn12 and the BreakOut12 and they do not contain any DSP resources; they are simply I/O expansion. You can link SymLink audio to CobraNet audio using the CobraLink device. The CobraLink unit does not have DSP, it only routes between the two busing structures. The DigI/O allows 12 inputs and 12 outputs of digital audio via a combination of AES/EBU and TOSLINK formats. All units connect using SymLink.



Original SymNet™ - 8x8 DSP

Original SymNet Hardware

1. **8x8 DSP:** 8 Inputs and 8 Outputs with DSP processing
2. **BreakIn12:** 12 Inputs and no DSP processing
3. **BreakOut12:** 12 Outputs and no DSP processing
4. **CobraLink:** Connects Original SymNet to a CobraNet system
5. **DigI/O:** 12 digital inputs and 12 outputs with DSP processing. The base DSP unit contains 4 channels of I/O (2 AES/EBU and 2 TOSLINK), and I/O breakout boxes are required for the remaining 8 channels. These breakout boxes are:
 - a. **HomerLink™ / AES 8x8 Breakout:** 8 AES Inputs and Outputs
 - b. **HomerLink™ / TOSLINK 8x8 Breakout:** 8 TOSLINK Inputs and Outputs
 - c. **HomerLink™ / TOSLINK / AES Breakout:** 4 AES Inputs and Outputs plus 4 TOSLINK Inputs and Outputs
 - d. **HomerLink™ / TOSLINK 4x4 Breakout:** 4 AES Inputs and Outputs
 - e. **HomerLink™ / AES 4x4 Breakout:** 4 TOSLINK Inputs and outputs

2.2 SymNet Express

The Express line is a very flexible DSP line of products. There are two types of Express hardware with multiple models of each type. The stand-alone units, simply called Express, are intended for single-box installs such as small churches, clubs, etc. The Express Cobra units include an additional RJ-45 connector on the rear panel for connecting to a CobraNet network. SymNet Express Cobra can currently send 16 channels and receive 16 channels of CobraNet audio in addition to the analog I/O on the hardware. Express units come in 4 basic analog I/O versions: 4x4, 8x8, 12x4, and 4x12. These 4 units can also be purchased with CobraNet, making 8 total Express models:



SymNet Express 8x8 Cobra

Express: Stand Alone Units

1. **Express 4x4:** 4 inputs and 4 outputs with DSP
2. **Express 8x8:** 8 inputs and 8 outputs with DSP
3. **Express 12x4:** 12 inputs and 4 outputs with DSP
4. **Express 4x12:** 4 inputs and 12 outputs with DSP

Express Cobra: CobraNet Units

1. **Express 4x4 Cobra:** 4 inputs and 4 outputs with DSP plus 16 inputs and 16 outputs via CobraNet
2. **Express 8x8 Cobra:** 8 inputs and 8 outputs with DSP plus 16 inputs and 16 outputs via CobraNet
3. **Express 12x4 Cobra:** 12 inputs and 4 outputs with DSP plus 16 inputs and 16 outputs via CobraNet
4. **Express 4x12 Cobra:** 4 inputs and 12 outputs with DSP plus 16 inputs and 16 outputs via CobraNet

2.3 ARC Hardware: Adaptive Remote Control = ARC

ARCs are remote wall panels which provide end-user control of the SymNet system. There are many models to choose from. There is the Menu ARC (ARC-2), and there are the Modular ARCs. The Modular ARCs use industry-standard form factors of knobs and switches that fit into standard Decora faceplates.

Menu ARC



ARC-2: Provides switching of 24 parameters

Modular ARCs



ARC-K1: 1 knob-style encoder which controls 2 parameters

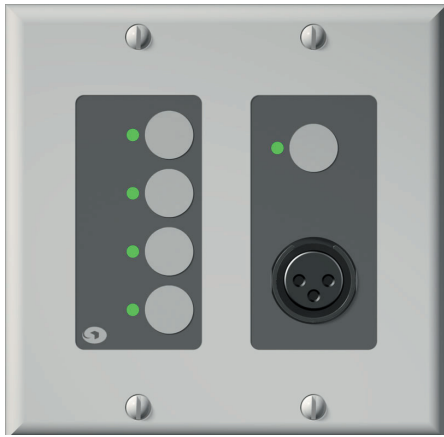


ARC-SW4: 4 configurable switches with 2 color LEDs

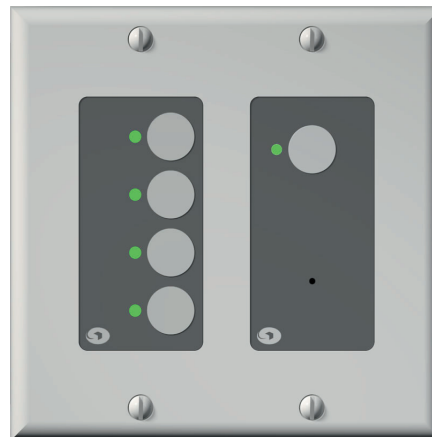


ARC-SWK: 4 configurable switches with 2 color LEDs and 1 knob. There are a variety of configurations for this panel.

Modular ARCs



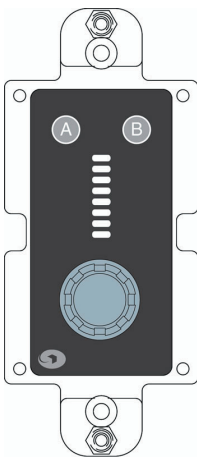
ARC-XLR: 4 configurable switches with a push-to-talk switch and an XLR input for an external microphone.



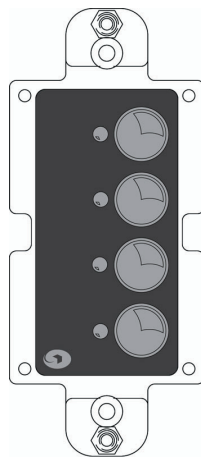
ARC-MIC: 4 configurable switches with push-to-talk switch and an on-board electret condenser microphone.

Modular ARC Extension Panels

ARC extension panels add knobs or switches to the main ARC panels listed above. They connect to the main circuit board and share the same RS-485 address. Thus, paging stations and background music selection panels can be expanded without the expense of a new ARC panel. The table below shows how many extension panels can be added to various main ARC panel:

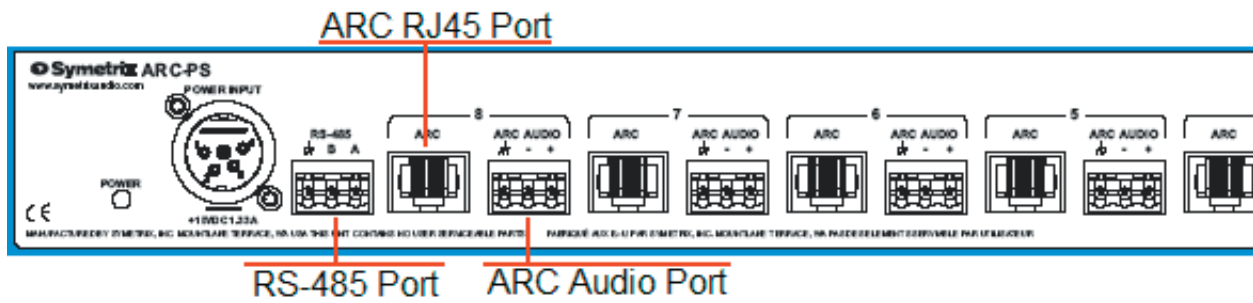


ARC-EXK



ARC-EX4

Modular ARCs	EXK	EX4
ARC-K1	1	4
ARC-SW4	2	3
ARC-SWK	1	3
ARC-XLR	2	3
ARC-MIC	2	3



2.4 ARC-PS (ARC Power Supply)

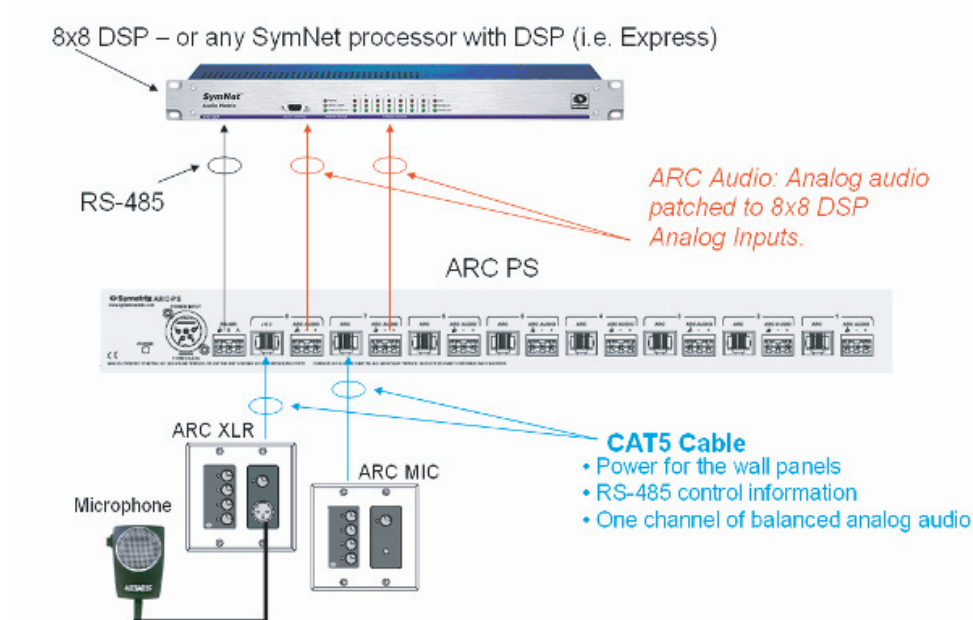
The ARC panels can be locally powered with a wall transformer (ships with the unit) or with the ARC-PS (rack mount Power Supply). The ARC-PS has eight RJ-45 connectors so CAT5 cable can be used as the interconnect between the ARC wall panels and the power supply. ARCs can daisy chain together and communicate via a proprietary RS-485 protocol. It is a parallel wiring scheme for all RS-485 connections.

RS-485 Port: This port connects to the SymNet hardware. Usually it connects to the Master DSP device in a ring of SymNet Hardware. It can also connect up to slave DSP devices in a ring. When CobraLink is used in a SymNet design, it is best to connect ARCs to the Slave DSP devices they are controlling instead of the CobraLink device. However, this will complicate global preset triggering through an ARC.

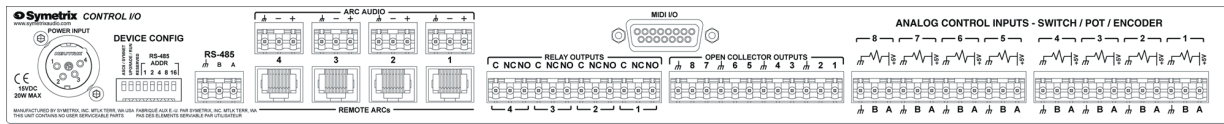
ARC RJ-45 Port: This port connects directly to the ARC wall panels. A standard CAT5 cable can be used. The cable will have power, RS-485 information and 1 channel of audio routed through it. This balanced channel of analog audio is referred to as 'ARC Audio'.

ARC Audio Port: This is a breakout port for ARC Audio. It is meant to route to an audio input or output on a SymNet DSP unit. It breaks the audio away from the CAT5 cable much the same way the RS-485 port breaks away the RS-485 protocol from the same CAT5 cable. There is only one (1) ARC Audio run per CAT5 cable. ARC panels can daisy chain, however, all ARCs on the chain share this one channel of audio. If you are creating a number of paging stations for example, each station would require an independent CAT5 cable run to the ARC-PS. Then the audio would be routed from the ARC-PS to the inputs on SymNet via the Euro-block connectors on each of the units.

Adaptive Remote Controls (ARCs) connected to an ARC-PS and a SymNet 8x8 DSP



2.5 Control I/O



The Control I/O adds more connections for potentiometers, LEDs and ARCs, etc. to a SymNet DSP unit and communicates with the SymNet DSP Hardware via RS-485. Control I/O units can attach to either the Original SymNet line or the Express line of products. Typically, the Control I/O attaches to the DSP unit it is controlling if CobraLinks are in the design.

Rear Panel Connections:

Analog Control Inputs: Eight potentiometers or sixteen contact closures (switches) can be added to a system.

Open Collector (OC) Outputs: Eight OC (binary) outputs can connect to relays or switch a binary source. There is a 5V DC reference voltage which can be used to light LEDs.

Relays: 4 Relay ports.

ARC RJ-45 Ports: Four ARC RJ-45 ports can be used to power ARC wall panels.

MIDI: A 15-pin MIDI I/O connector allows mapping of MIDI continuous controller (CC) messages to SymNet parameters. Preset switching can also be achieved. The 15-pin connector is a standard computer Joystick-to-MIDI adapter found in many computer shops.

2.6 CM Labs MotorMix™

The CM Labs MotorMix provides 8 channels of moving faders, pans and switches. This exact product can be connected to the Control I/O MIDI port and may control up to 64 channels on SymNet mixer modules. Also, the mutes and panning controls can also be addressed through the MotorMix surface. Only one MotorMix can be attached on an RS-485 chain. However, SymNet supports multiple RS-485 chains and the Control I/O + MotorMix combo attaches to the DSP unit that it is controlling.



<http://www.cmlabs.net/motormix.html>

2.7 SymNet Busing

2.7.1 SymLink: The Original SymNet line uses a busing architecture called SymLink with which audio is moved around in circular path between hardware units.

- 64 channels may travel from one box to the next adding only 0.08 milliseconds of latency to the signal at every jump. This is a very fast transfer.
- SymLink is a local bus with a distance limitation of 10 meters from box to box.
- Up to 16 hardware devices connect with CAT5 cable to form a “Ring” of hardware.
- Each ring of original SymNet hardware has its own 64 channels of SymLink routing. We anticipate the units will live in the same rack or near each other.
- We refer to this as a centralized processing system. The advantages are a higher channel count capacity and a faster data transfer. We call this bus SymLink. SymNet supports 2 busing structures, the other being CobraNet.

2.7.2 CobraNet™ i.e. CobraLink: The CobraLink hardware marries the two busing structures. It has no DSP so it only bridges SymLink and CobraNet. It operates as the Ring master and needs to be the first unit in a Ring of hardware. The very first device in the design holds all the information for every device when the file is archived. This is referred to as Ring 1, Address 1. All other devices contain their own information or design programming.

CobraNet Overview:

- CobraNet is audio over Ethernet. It has 3 latency modes: 5.33, 2.66, and 1.33 milliseconds. All are supported because a whole CobraNet system has to be set to the same latency throughout all connected hardware.
- Audio channels are grouped into bundles. Bundles can contain up to 8 channels, but SymNet allows you to break these down into 1 to 8 channel bundles. SymNet CobraLink units allow 32 transmit channels and 32 receive channels of audio which are contained in 16 transmit and 16 receive bundles.
- Express uses a different CobraNet implementation which provides 16 inputs and 16 outputs of CobraNet audio. The audio is contained within 8 input bundles and 4 output bundles.

2.8 Network Considerations

CobraNet systems need to exist on their own network. Connecting a CobraNet system to a LAN will swallow its bandwidth and choke the network. SymNet CobraLink devices currently combine the Ethernet control and the CobraNet audio onto the same cable. This cuts cabling in half when larger systems are implemented. However, this complicates system integration because a route has to be created to connect the LAN to the CobraNet subnet, allowing control of the SymNet system while segregating the CobraNet traffic. In IT speak, this isn't that big of a deal, but on a “get an IT person in the same room as the audio person to work out the details”, situation this can be a challenge. In Express, we separated the control and CobraNet data. The Ethernet and the CobraNet ports are separate (unlike the CobraLink). This makes it easy to connect to a LAN, however, it increases network cabling and Ethernet switch hardware.

3. Software

3.0 Software Overview

SymNet Designer™ is a free software package used to configure a SymNet system. It runs under Windows versions 98 through XP. SymNet Designer is an open architecture system. Thus, all routing and DSP modules are virtual so there is no set audio path or structure. SymNet site files (files generated by SymNet Designer) are created based upon the system needs. The SymNet programmer is responsible for creating the signal flow and for placing the processing DSP modules (compressors, EQ, etc.) in the appropriate order. Once the system is designed, the file is loaded into the hardware. Then, the system will function as intended/designed.

Initially, connection to the hardware requires an RS-232 connection. Many brands of USB to RS-232 adapters do work, but our testing indicates the Belkin brands should be avoided. Once an IP address is set in the hardware, the computer can connect and control the system over Ethernet through a CAT5 cable.

The following information concerning software only addresses the major DSP processes and the main sub-system operations that are commonly used in audio installations. These topics include:

1. Matrixing
2. Automixing
3. Room Combining
4. Security

3.1 Matrixing

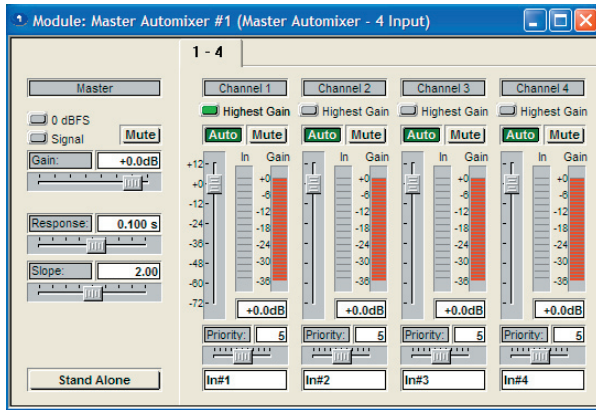
The heart of an audio DSP system is audio matrixing and routing. SymNet has 21 matrix modules ranging from 8 Input by 4 Output up to 64 Input by 8 Outputs. Additionally, there are 23 stereo matrixes. Matrixes can be combined to create larger matrixing blocks. We use true cross point matrix modules, thus every input has a separate volume control for every output.

3.2 Automixing

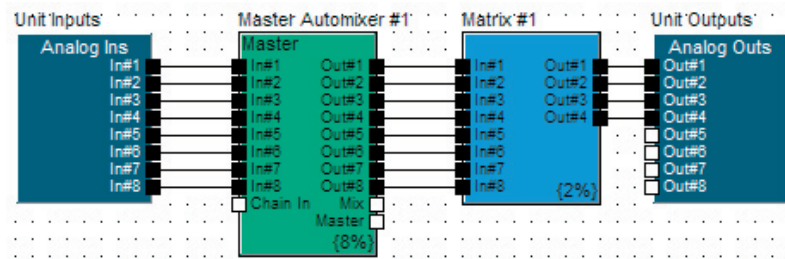
The SymNet automixing technology is an integrated solution. I say this because automixers can work with the room combining technology. Also, Automixers can be chained together to create larger automixing scenarios. In one ring of 16 SymNet hardware devices, 128 channels of audio can be automixed by placing automixer DSP modules in every hardware unit and then connecting the modules together over SymLink.

We use the gain sharing model of automixing. We plan to introduce a gating automixer in the future. We have found the gain sharing model has worked very well in the industry. As channels of audio are added into the automixer, the overall gain is reduced. The audio effect is a smooth ebb and flow of audio out the main mix output as audio is added to, or taken away from, the automixer rather than a abrupt on/off that you get from the gated model.

Priority can be set for each input. Higher priority channels will duck lower priority channels. The amount of ducking depends on the priority number and the master slope setting which affects all channels.



Automixers also have independent outputs that can feed a matrix mixer if mix minus systems are required yet automixing is desired.

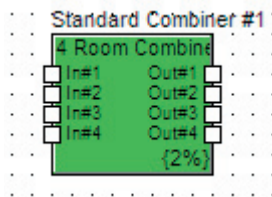


3.3 Room Combining

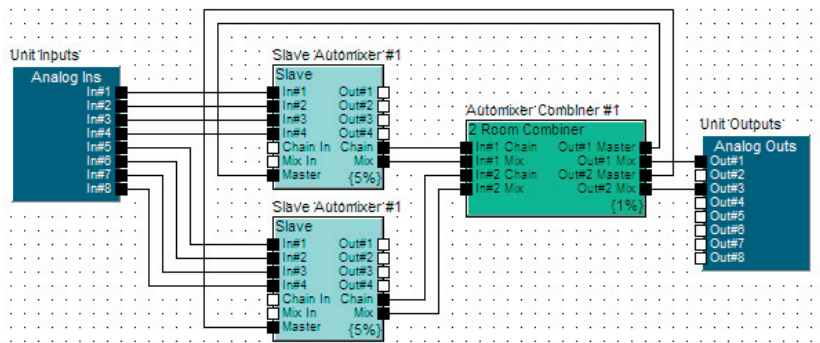
SymNet has one of the most comprehensive room combining solutions on the market. This is because we combined automixing with room combining and now we interface the wall panels into the scenario. Simply stated, the wall panels follow the combined zones, thus, when rooms are combined, so are the wall panels; their settings are mirrored across all panels combined in a zone.

There are 4 types of room combining modules:

1. **Standard Combiners:** allow a set of inputs to combine to a set of outputs.

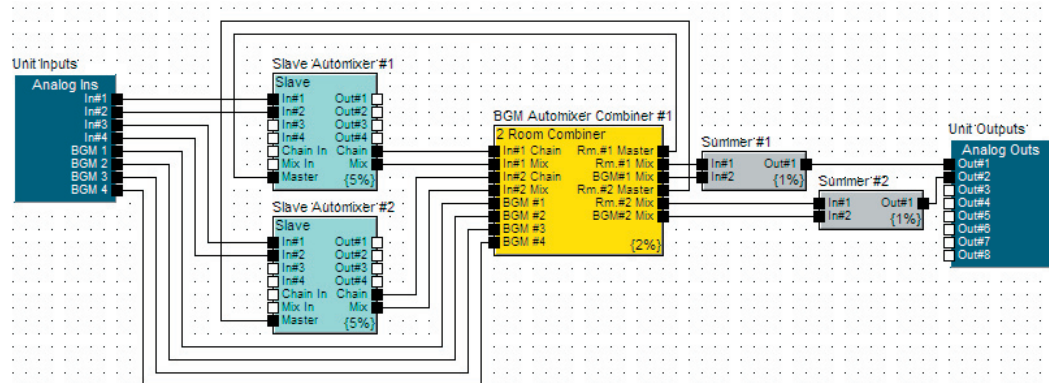


2. **Automixer Combiners:** These allow rooms to have automixers that will combine with other rooms that also have automixers. The attached automixers act like one automixer when inputs are combined. This keeps the priority scheme between automixers intact.



3. **BGM Combiners:** These are designed to work with the wall panels. There are 4 Background Music (BGM) inputs per combiner module. When zones are linked, the background music selection and the volume controls for the room volume and the BGM volume are linked. These controls can be routed to external wall panels or an RS-232 control system. You can have up to 16 zones with up to 32 zone combine buttons.

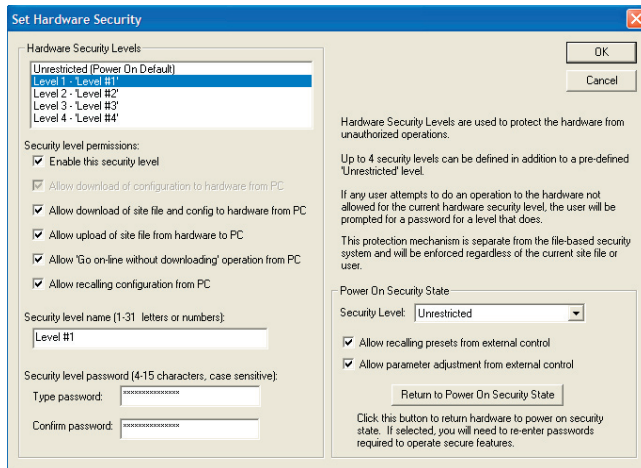
4. **BGM Automixer Combiners:** Are the same as the BGM combiners only they interface automixers into the design in the same fashion as the Automixer Combiners listed above.



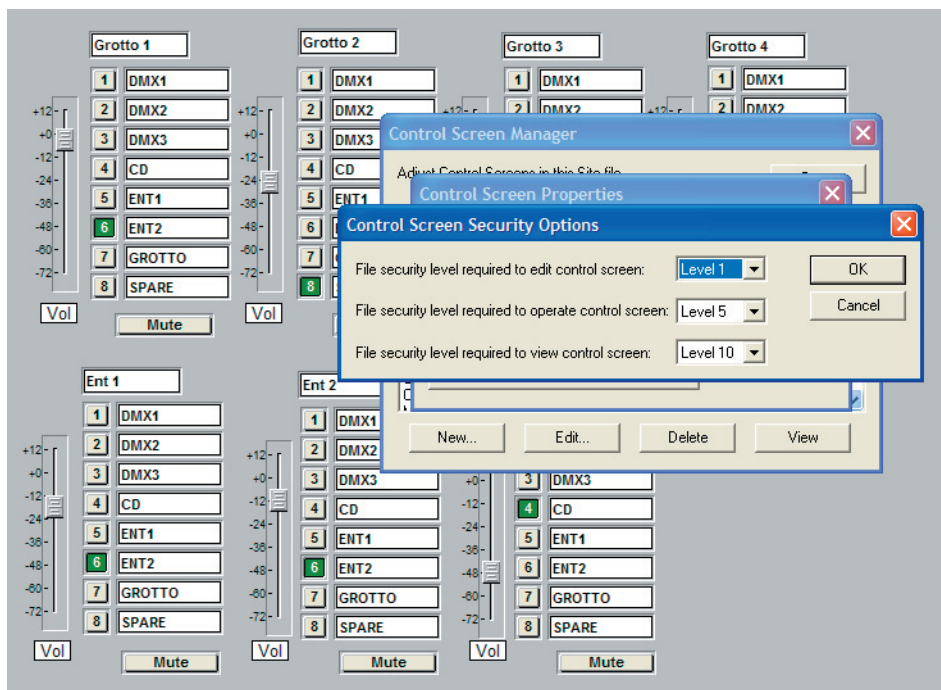
3.4 Security

SymNet has 2 security schemes. One protects the hardware and the other provides a secured system for the user interface screens (control screens). We call this software security.

3.4.1 Hardware security determines what state the unit will boot up when powered on. It also governs what level of access a user has to the hardware. This protects the hardware from having its designed tampered with yet allows end user to connect and control the system.



3.4.2 Software Security is a 10 level security system designed to govern the security of the user interfaces. Control Screens can be created for the system designer, techs or end users and access can be specified for each screen. A specific screen can be specified when a user opens a site file and the screen can automatically connect to the hardware. This eases the client interface; they log in, the system brings up their main screen and then connects automatically to the system.



4. Control

4.0 Control Overview

There are four ways to connect and control a SymNet system:

1. GUI: or Graphical User Interface known as SymNet Designer.
2. RS-485: ARC wall panels and the Control I/O hardware uses a proprietary RS-485 protocol and connect to the RS-485 port.
3. RS-232: Touch screen technologies like Crestron and AMX systems provide custom screens and interfaces.
4. Rear panel control connections: Ports for Potentiometers, Switches, LEDs and Relays.

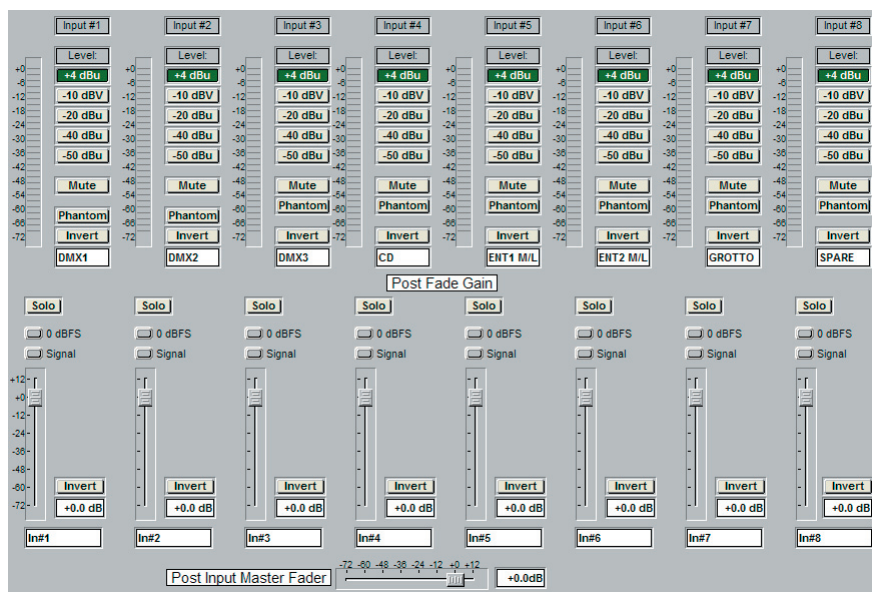
In addition, there is a complete set of “Control Modules” which are logic based software modules that are processed by the onboard DSP chips. These modules can control logic related events, as well as audio. It is like having a mini AMX or Crestron logic set available for end-user interface building.

4.1 GUI Control – SymNet Designer Control Screens

SymNet Designer™ allows system integrators to create a user interface which we call “Control Screens”. These were previously mentioned in the Security (section 3.4). Parameters are copied to Control Screens and then edited.

- Control Screens can be linked together for larger control scenarios.
- Background color and object (parameter) appearance can be edited.
- Bitmaps can be imported and used. However, bringing in numerous and large bitmaps will increase the file size. In order archive a SymNet site file on hardware, the file size cannot should not exceed 6 megabytes.*See FAQ #107

SymNet Control Screen



4.2 RS-485 Control. The RS-485 network is comprised of wall panels called ARCs (Adaptive Remote Controls) and the Control I/O (which deals with contact closure, potentiometers, relays and MIDI). From a development standpoint, RS-485 is a tricky beast. Mainly because of the updating that has to happen across an entire audio system. This includes wall panels, GUI interfaces and RS-232 systems.

By default, the system is designed to have 485 devices connected to a master unit to allow communication with all units in a system. 485 devices can be connected to slave units allowing it to only control the unit that it's connected to, but gaining performance in larger systems. A configuration preference allows these devices to be programmed while connected to a slave unit.

4.3 RS-232 Control or Touch Screen Interfacing. The RS-232 protocol is under constant development. It is a full feature control implementation that can address almost any parameter inside of a SymNet system. "Unsolicited Response", or what we call RS-232 Push allows parameter values to be automatically sent to the external control system when adjusted from the RS-232 network, RS-485 network or the GUI. This prevents the need to constantly "Poll" the box for changed values which clogs the RS-232 line.

The basics of the system break down to SymNet's RS-232/485 control numbering scheme. A parameter (volume for instance) is assigned a number from 1 to 10,000. This number is then addressed via the RS-232 protocol. The protocol uses ASCII strings for all commands. The protocol can be downloaded on the net at:

http://www.symnetaudio.com/repository/symnet_232_protocol_rev55.pdf

4.4 Analog Control i.e. Potentiometers, Switches, LEDs. All SymNet DSP units have a variety of Analog Control Inputs (Logic Inputs), Open Collector (Binary Outputs) and Relays. These can be used to provide easy external control switching from hardwired solutions. Resistor ladders can be used to extend the switching on a single Analog Control Input port. Generally no more than 4 steps should be implemented if a resistor ladder is created. Volume control, source selection and preset triggering are some of the applications for this technology.

The rear panel connections differ for the Original SymNet line versus Express:

Original SymNet

- Eight analog control inputs: 8 potentiometers or 8 binary switches
- Six open collector outputs: for switching binary sources or driving LEDs
- Three Relays

Express

- Two analog control inputs: Supports 2 potentiometers or 4 switches or 2 encoders.
- Two open collector outputs: for switching binary sources or driving LEDs
- One relay

4.5 Control Modules. Logic and switching is one of the most powerful features of a SymNet system. It is similar to having a mini AMX or Crestron system inside of SymNet. Control Modules are used to provide elegance in user interface building. It also provides solutions for unique problems that come up in an installation. We use these constantly to overcome obstacles. Many times when asked if SymNet can perform in a particular way, the answer is "we have a lot of tools, if a function isn't in the toolkit, it can usually be built with control logic."

- Standard "AND, OR, XOR" logic functions.
- Taper volume curves, create fades, scale input to output controls and many more functions.
- Preset switching and parameter control can be interfaced with logic.
- Logic can also trigger external events through the Open Collector or Relay outputs.

5. System Design Considerations

5.0 Power: SymNet units, like all DSP systems, are computers. It is a task specific computer with an embedded system for reliability. Power fluctuations can wreak havoc on any digital system. It is recommended that you use at least a UPS on the system to provide basic protection. Surge suppression is also recommended especially if the power is not stable. This can be the case with new buildings where various legs of power are being shut off and turned on at random and may create a surge.

5.1 Cooling: SymNet units are a single rack space with a fan mounted on the side. We officially recommend allowing a rack space for each unit that contains an internal power supply. This is the 8x8 DSP, the DigI/O, both Break I/O devices and all the Express units. We have seen installs that stacked multiple units in a rack and the system still functions. You should allow adequate airflow and cooling when installing the system. We recommend climate controlled installations only, and officially spec a 30C max limit, although in practice 35C should have no problems with some airflow. If the system over-heats it will go into a thermal mode and shut-down. The system can be re-powered once the inside temperature of the unit has cooled.

5.2 Staging the System: Contractors should be encouraged to set up the system before they go onsite and install into the venue. Even if it is just connecting the SymLink cables and the CobraNet cables and downloading a basic site file. If the system uses CobraNet, then it is highly recommended you acquire all Ethernet switches and connect to SymNet. Then route some Cobra audio throughout the system and check for audio quality. If media converters are used to convert to fiber optic, then acquire all this hardware and test it first. Especially if you haven't worked with CobraNet before.

It is easier to troubleshoot when everything is located in one room versus spread out over a vast space. Not to mention, a large percentage of the contractors ship to the site and unbox SymNet for the first time and start configuring because they want to save time. Since they are unfamiliar with the system, it ends up costing valuable time and money. If you are unfamiliar with SymNet, please set the system up prior to going onsite.

Symetrix cannot recommend third party hardware (Ethernet hardware, for example) but will let an integrator know what has worked for other customers in the past. It is our experience that manufacturers of external hardware may change the technology under the hood without warning. Thus, things that worked in the past, may not work in the future. Symetrix will not be held liable for compatibility issues between SymNet and other manufacturer's equipment.

6. Frequently Asked Questions (FAQs)

FAQ 101

Q: What is the difference between the Original SymNet products and SymNet Express?

A: The Original SymNet hardware has SymLink, Express does not. The two systems can talk to each other via CobraNet provided the necessary hardware is used.

FAQ 102

Q: What have been the biggest support issues with SymNet?

A: The biggest support issues are the DIP switches on the rear of the units. These switches are used to set various identification and communication parameters for the units. A Quick Start Guide is included with each DSP device. Various illustrations for DIP switch configurations are provided within these Quick Start Guides. Most issues arise from the first time installer, once someone has worked with the system, things go smoothly.

FAQ 103

Q: Is SymNet reliable?

A: Yes, we have delivered nine software releases within three years. During this time, the software architecture has become extremely robust. Once a system is set up correctly, we rarely hear back from the client. Our hardware is conservatively over designed and very reliable. On the whole, the SymNet platform has performed extremely well in the industry and is installed in many high profile venues.

FAQ 104

Q: What won't SymNet do?

A: SymNet does not currently support fault monitoring or event logging. Triggering actions based on an event is possible.

FAQ 105

Q: What can't I control with the GUI?

A: SymNet Designer was built to design and configure a SymNet DSP system. Although you can control every aspect of the system and create custom control screens for various tasks, there is a limit of one GUI connection at a time. Control over ethernet was designed for management of a system on a local network. Offsite connection is possible, but performance is not guaranteed at this time.

FAQ 106

Q: What are the system strengths?

A: Local high-speed bus for low-latency designs and larger I/O counts.

Two DSP architectural models: centralized (local ring via SymLink) and distributed (multi-ring via CobraNet).

Advanced DSP modules: automixing, feedback elimination and room combining.

FAQ 107

Q: What is the file size limit when archiving?

A: Storing a file in SymNet hardware is called archiving. It is there so the integrator can walk up and copy the file from the hardware to his computer. Although each unit in a design has its own configuration, the master SymNet site files lives in Ring 1, Address 1. We have found that files exceeding six megabytes may have a problem archiving. Now, understand, the system can still be configured with these larger files, but this means the integrator will have to maintain a copy of the file on his/her computer in order make changes or regain control of the system. Things that contribute to the size of the file that may slip by new integrators: bit-maps, settings files stored within the site file, super-modules and numerous control screens.

7. In Conclusion

The SymNet modular DSP Architecture provides a reliable and efficient network audio solution, comprised of digital signal processing and control hardware to get the job done right.

For more information please visit: www.SymNetAudio.com