

GAIN STRUCTURE MANAGEMENT

The Roland Digital Snake offers many benefits to both live sound events and permanent installations. The S-4000 system provides very high quality mic preamps that are located on stage near the source microphones, providing the highest possible system audio quality. The gain structure of these preamps can be remotely controlled from the FOH or stage positions.

This document outlines suggestions on how to manage the gain structure of the ROLAND digital snake in combination with an analog console at the FOH position and also when the source audio is digitally split to monitor, broadcast or other locations.



SYSTEM OVERVIEW

AT THE STAGE

The function of the S-4000S Stage Unit is to convert the line and mic level signals from stage sources into a digital format.

All digital snakes **MUST** convert mic level (LOW) signals at the stage to a line level (HOT) signal using a Mic Preamp.

This signal is then “sampled” and converted to the digital format used in the S-4000’s Cat5e or fiber optic cable.

If the mic level were not “amplified” in a mic preamp, then the A/D conversion would only have very low level signals to convert, and would therefore use a small number of bits for the conversion. This would result in very poor audio quality.

IN THE CABLE

The S-4000’s digitized signal is sent over inexpensive and light weight Cat5e cable.

Because the signal is digital, there are never any cabling losses. Analog cables all have inherent high frequency losses created by low level audio signals traveling long distances over copper cabling. These losses are caused by the natural resistance, inductance and impedance of the cabling and affect high frequencies the most.

LOSSLESS SPLITS

The signal in the Cat5e cable is digital, and the ROLAND system can be split a virtually unlimited number of times using the S-4000-SP or any standard gigabit Ethernet switch. This allows for lossless and very inexpensive splits of the source signals for a Monitor console, recording or broadcast applications.

AT THE FOH POSITION

Once the digitized signals reach the FOH position, they are converted to +4 line level (HOT) signals using a D/A converter.

Converting to a hot signal at the FOH position is the best way to maximize audio quality as converting back to a low level signal would inherently cause signal quality losses.

Because the signals in the snake are digital, AES digital connections can also be made with digital consoles bypassing any D/A conversion.

ON THE STAGE – CONTROLLING THE MIC PREAMPS

For each input there is one preamp and A/D converter. The gain structure for each preamp can be controlled from either the stage location or the FOH location. An RS-422 cable can also be run from the S-4000 at the stage to a monitor position for control from there as well.

The important point to keep in mind, however, is that there is only one mic preamp per source input, and therefore only one gain setting that affects the outputs at the FOH position and all splits. Typically the basic gain of the mic preamps is remotely controlled and set at the optimal settings from the FOH position. Local control of input signal level is still available at each console location using its analog trims, as outlined below.

ON THE STAGE – THE S-4000'S 24-BIT ADVANTAGE

Most digital snakes are 16-bit systems. The theoretical dynamic range of a 16 bit system is 96dB. For this reason, it is imperative to keep the signal level as close to maximum as possible without overdriving the A/D converter. Otherwise there will be a loss of dynamic range that will damage the signal.

The ROLAND Digital Snake, however, is a 24-bit system, offering a theoretical 144 dB of dynamic range. A 24-bit system does not need to be driven at the highest possible input levels in order to provide excellent signal quality. It also provides the opportunity for much greater headroom and the capacity to easily handle unexpected, loud signals.

The best strategy for system gain, therefore, in an S-4000 system, is to adjust the preamp levels so that the source signals peak at about -18dB. This provides for a lot of headroom and immunity to unexpectedly loud signals but still offers 21-bits for that A/D conversion or about 122 dB of dynamic range.

AT THE FOH POSITION

The output of the S-4000H is line level and should be connected to an analog console via its line inputs or to a multi-function mic/line input using the console's Pad control.

When the gain structure of the stage is managed at -18dB peaks, the analog trims at the FOH analog console can then be used to optimize and control the gain within the console.

Typically there are still 20-30 dB of gain structure that can be controlled using the trims at the analog console. This provides a familiar way to do minor adjustments of level within the console during a live sound event. It also "engages" the electronics and sound quality of the analog console's input circuit.

This strategy gives the best of both possible analog and digital worlds. The benefits of very high quality mic preamps without the high frequency analog cabling losses and potential for hums and buzzes inherent in analog snakes, combined with standard analog console user interface, make for a winning combination.

AT THE SPLIT POSITION

The source inputs for an ROLAND Digital Snake can be split using standard gigabit switches as mentioned above. Unlike the bulky, expensive and potentially sonically compromised splits in the analog world, the splits from an ROLAND Digital snake are lossless and immune to any hums and buzzes.

The gain structure of the digital snake is usually set by controlling the preamps at the stage A/D conversion from the FOH console position. However the gain structure can also be controlled from the stage position or even from a split position if an RS-232 cable is run from the stage unit to the split location.

If the guidelines suggested above are followed and the preamp gain structure is managed with -18dB peaks, then the outputs of an S-4000H at the split position will allow from 20 to 30 dB of analog trim control at the analog console. Once the gain structure is set up, there will be minimal needs, if any, to adjust the gain structure on the stage. Subsequent adjustments to level can be made at the FOH and Monitor consoles using the channel faders and analog trims.

For digital applications, the S-4000 system's optional AES/EBU output cards can be used for a direct digital connection to a digital recording or broadcast system.

Direct control over the S-4000's preamps can also be made from the software of select Yamaha digital mixing consoles.