Extron®

ADSP™ Advanced Digital Sync Processing Technology

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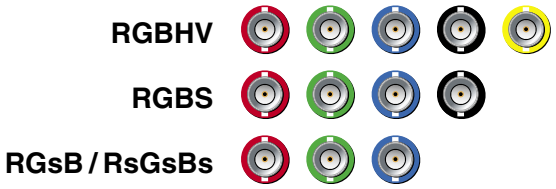
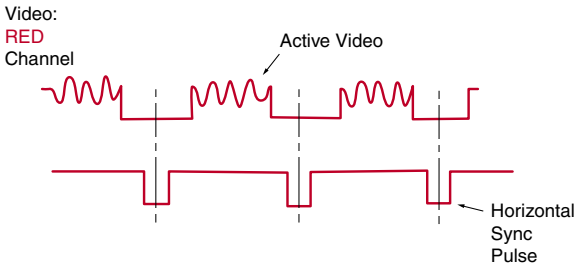
Optimizing Sync in A/V Systems

Advanced Digital Sync Processing (ADSP) is a proprietary Extron technology that addresses potential issues with sync in RGB computer-video signals that could compromise, and even prevent, proper video display. Today's digital flat panel monitors and projectors can be particularly sensitive to imperfections in sync signals. ADSP technology serves to optimize sync so that consistent, reliable video display can always be ensured. This paper provides an overview of Extron ADSP technology, as well as recommendations for ensuring integrity of sync signals in an A/V system.

white paper



RGB signal configurations. Sync is carried as separate horizontal (H) and vertical (V) signals for RGBHV, as a composite sync (S) for RGBS, and as a combination with the green channel (RGsB) or all three colors (RsGsBs).



The red channel of RGB computer-video, and the corresponding horizontal sync signal. Each active video region comprises pixel content for a single line of video.

What is sync?

Computer-video signals comprise the red, green, and blue (RGB) channels for individual pixels within an image, as well as signals used by the display device to synchronize its video processing circuitry with the RGB channels. The latter is known as sync, and enables the display device to map pixels to their proper locations within the image.

A display requires both horizontal and vertical sync. Horizontal (H) sync regulates the rate at which a new line of video is generated within a frame (or field). Vertical (V) sync defines the refresh rate, or frequency at which image generation begins for a new frame of video. H and V are carried as separate sync signals for RGBHV, or as combined sync (S) for RGBS. In other, less common instances, the combined sync is carried within the green component (RGsB), or all three colors (RsGsBs).

Sync signals are waveforms of repeating sync pulses. They are typically standard TTL (Transistor-to-Transistor Logic) digital signals, and the sync pulses are detected by displays for use as the actual timing cues in generating an image.

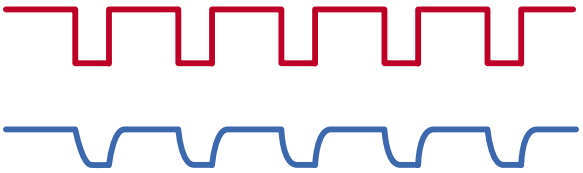
Why is sync important?

Sync is critical in establishing proper timing between the RGB content for the pixels and the display's video processing. Without sync, proper image display is not possible. Sync signals that have artifacts are likely to result in an unstable image or no image at all. The effect of good sync isn't consciously noticed, but the result of poor sync signals certainly cannot be ignored.

Today's digital displays tend to require sync signals that are pristine and uncompromised. They are much less forgiving with imperfections in sync than analog CRT monitors and projectors.

Compromise in either the waveform or the timing of sync signals can result in unacceptable sync to the display. The amplitude of the sync pulses should be at least TTL levels—around 5.0 volts peak-to-peak (p-p), unterminated. Otherwise, they will not properly trigger the display's video processing. The leading and trailing edges for the sync pulses must be well-defined and undistorted. Otherwise, delayed triggering, or no triggering at all may result. Additionally, no time delay should exist between sync and the RGB channels, and between the H and V sync signals.

So what happens when a display device receives a sync signal that has been compromised? At best, the picture is likely to be distorted, with tearing, hooking, or bending in the image. At worst, the display will fail to produce an image at all.



Normal and deficient sync signals. The red signal depicts normal sync pulses that are acceptable to a digital display device. The blue signal exhibits reduced voltage amplitude and distorted sync pulses, and therefore is not likely to be properly detected by the display.

How can sync signals be compromised within an A/V system?

Video cameras, desktop computers, laptops, PC graphics cards, and other video sources generate sync as part of the RGB signals. However, the sync signal amplitudes at the output of some of these sources may be below the TTL levels necessary for proper display on a monitor or projector. Laptops and graphics cards often output sync at around 3.3 volts or lower.

Similar to any other signal within an A/V system, sync signals may be subject to degradation or modification as they are transmitted over significant distances, or pass through equipment. When sent over long cable runs, losses in the signal due to cable resistance and capacitance can occur. Resistance results in signal attenuation which, if significant, reduces the amplitude of the sync pulses below the necessary TTL level. Capacitance compromises the bandwidth of the signal, thereby distorting the leading and trailing edges of the sync pulses. Display problems are more likely to occur due to low sync signal amplitudes.

Distortion in the sync pulses can also be caused by impedance mismatching, which results in signal reflections or standing waves that are combined with the sync signals. Termination for video cables and devices is usually 75 ohms. However, the impedance at the sync output of certain computers may not match that of the display. Impedance mismatching may also be the result of poor cable termination.

The sync circuitry within certain interfaces may affect the timing relationship between sync and RGB channels. In order to shift images horizontally and vertically, these devices may need to delay or time-shift the H and V signals with respect to the video signals. The timing between H and V may also be affected by the circuitry that combines them into a composite sync signal(s).

What is ADSP™?

Advanced Digital Sync Processing (ADSP) is a proprietary Extron technology that addresses potential issues with sync in RGB computer-video signals that could compromise, and even prevent, proper video display. Such problems may be caused by a variety of factors in an A/V system, including deficient signal levels produced by certain laptops and PC graphics cards, losses caused by lengthy cables, and impedance mismatching between source and display.

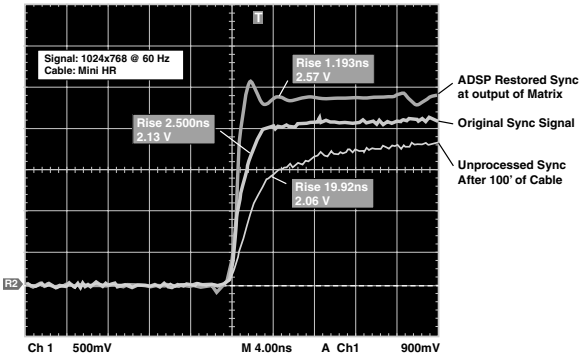
Today's digital flat panel monitors and projectors are particularly sensitive to imperfections in sync signals. ADSP technology serves to optimize sync so that consistent, reliable video display can always be ensured.

What does ADSP technology do for sync signals?

Extron Advanced Digital Sync Processing technology processes sync signals to address any potential or existing problems that could compromise stable, reliable video display. With ADSP, sync signals which may have been degraded are fully regenerated before they reach the display device. ADSP circuitry applies several techniques in processing sync signals. There are essentially three aspects of sync optimization for ADSP: sync shaping, voltage restoration, and sync timing restoration.

Sync Shaping and Voltage Restoration

These processes regenerate the proper waveforms of the sync signals. In voltage restoration, the amplitude of the sync pulses are adjusted, or restored, to proper TTL levels (5.0 volts p-p, unterminated). Then, in order to correct for cable losses and other factors which may have distorted the leading and trailing edges of the pulses, ADSP reshapes the signal, reproducing sync pulses with the sharp rising and falling edges that are essential for proper sync detection by digital displays.



Leading Edge of Sync Pulse

ADSP restores sync to TTL levels (5.0 V p-p, unterminated), and corrects the waveform so that the projector or monitor accurately locks to sync and displays a stable image.

The oscilloscope trace shown illustrates the leading edge of a sync pulse, and how it is affected after passing through 100 feet of cable. The amplitude has been decreased and the leading edge distorted (voltage rise time increased nearly tenfold). A digital display device likely would not properly detect this sync pulse. However, upon application of ADSP technology, the signal has now been fully restored to proper TTL levels with sharp transitions that can be easily detected, so that the projector or monitor can now lock onto sync and display a stable image.

Sync Timing Restoration

In sync timing restoration, ADSP reclocks the H and V signals to ensure that they are properly synchronized with each other, and with the RGB channels. The sync timing circuitry for ADSP also allows for horizontal and/or vertical image adjustments, without impacting the proper timing between the sync and RGB signals. ADSP also maintains proper H and V timing when they are combined into composite sync.

Which Extron Products Feature ADSP Technology?

First introduced with the Extron RGB 202xi computer-video interface (since replaced by the RGB 202Rxi), ADSP technology is featured with most Extron interfaces, as well as the Extron SS 200 Sync Stabilizer. ADSP is also included in all Extron RGBHV matrix switchers. All Extron products with ADSP include sync shaping and voltage restoration. ADSP-equipped interfaces also include sync timing restoration, and select models feature continuously variable horizontal and vertical image shifting adjustments (Enhanced ADSP). The table shows a complete listing of Extron products featuring ADSP technology.

Extron
RGB 203xi computer-video interface

Extron
CrossPoint 450 Plus 88 HVA
matrix switcher

Optimizing Sync in A/V Systems

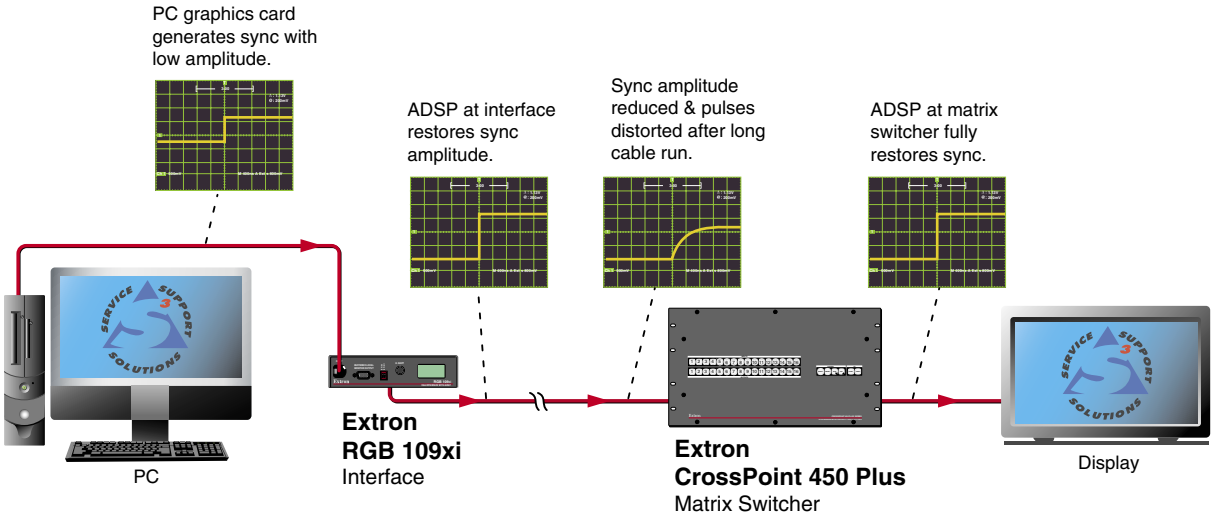
A/V systems should always include sync processing as a safeguard against adverse factors that can compromise the stability and reliability of video presentations. Sync signals are usually processed at the interface. However, in today's budget-minded environment, some A/V systems are being installed without interfaces. Distribution amplifiers and line drivers are often employed in place of interfaces. While less expensive, they may not sufficiently address sync issues.

The Extron CrossPoint 300 and CrossPoint 450 Plus Series of matrix switchers equipped with onboard ADSP technology will help ensure sync integrity, and therefore, reliable video presentations in systems that otherwise may not sufficiently address sync signal issues. While they do not feature sync timing restoration, they do provide the advantage of being able to "repair" sync signals for any accumulated loss or degradation over long cables or through other system components, and optimize them for subsequent transmission over significant distances.

The figure below illustrates Extron's recommendation for comprehensively addressing sync within an A/V system, with ADSP sync processing at the interface and at the matrix

	ADSP Sync Shaping & Voltage Restoration	ADSP Sync Timing Restoration	Horizontal Image Centering	Fine Horizontal & Vertical Image Centering (Enhanced ADSP)
Interfaces				
RGB 109xi	✓	✓	✓	
RGB 160xi Series	✓	✓	✓	
RGB 201 Rxi	✓	✓	✓	✓
RGB 202 Rxi	✓	✓	✓	✓
RGB 203 Rxi	✓	✓	✓	✓
RGB 203 Rxi VTG	✓	✓	✓	✓
RGB 460xi Series	✓	✓	✓	
RGB 470xi Series	✓	✓	✓	
RGB 580xi	✓	✓	✓	
Sync Stabilizer				
SS 200	✓	✓	✓	
Matrix Switchers				
CrossPoint 300 Series	✓			
CrossPoint 450 Plus Series	✓			
Matrix 3200 Series	✓			
Matrix 6400 Series	✓			
Matrix 12800 Series	✓			

switcher. The interface provides voltage restoration to compensate for the insufficient sync voltage level produced by the PC's graphic card, while maintaining proper sync timing and allowing for image shifting. The sync input to the matrix switcher, with reduced voltage amplitude and a distorted waveform, is the result of transmission over long distance cabling. ADSP within the matrix switcher fully restores this signal, so that the display device properly locks onto this signal and displays a stable, reliable image.



A recommended configuration for optimized sync signal transmission, with ADSP at the interface and at the matrix switcher.

Extron Electronics, headquartered in Anaheim, CA, is a leading manufacturer of professional A/V system products including computer-video interfaces, switchers, matrix switchers, distribution amplifiers, video scalers, scan converters, signal processing devices, Ethernet control interfaces, and high resolution cables. Extron products are used to integrate video and audio into presentation systems for today's high tech boardrooms, presentation/training centers, university lecture halls, and other applications.

For additional information, please call an Extron Customer Support Representative at: 800.633.9876 (inside USA and Canada only) or 714.491.1500 for Extron USA; +800.3987.6673 (inside Europe only) or +31.33.453.4040 for Extron Europe; +800.7339.8766 or +65.6383.4400 for Extron Asia; +81.3.3511.7655 for Extron Japan.

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