Supports 1 to 4 3G-SDI inputs, combining and driving 3G-SDI, DVI, or HDMI 2.0 (up to 4K)

HDMI 2.0 input for optional keying or as background to SDI PIP.

Applications include:
- PIP with up to 3 SDI windows within a 4th SDI input (1080P or less)
- Quad viewing of 4 3G-SDI inputs (Input 1080P or less, Output up to 4K)
- Rectangular SDI windows with background imagery from HDMI 2.0 input
- Optional keying, with HDMI 2.0 input or one or more SDI inputs as keyed foreground, and HDMI 2.0 input or one or more SDI inputs as background.

SP4 3G-SDI Converter

The SP4 provides conversion and combining functions for up to 4 SDI video inputs (up to 3G-SDI) plus (1) HDMI 2.0 input (from 1080P to 4K). Various video combining functions are achieved via flexible area-of-interest and windowing control. The SP4 is configured with the SP4 Configuration utility that sends commands to the unit through the RS-232, USB, or optional Ethernet. Appropriate parameters are stored in non-volatile memory to retain desired settings.

Low Latency Plane Input

The SP4 has an HDMI 2.0 input for low latency video combining. If the low latency input is utilized, it forms the Low Latency Plane, and is the basis for the output timing. No re-sizing or re-timing is supported on the low latency input.

Scaler Planes

Scaler Plane #1 is populated from 1 to 4 SDI inputs. Robust windowing and area-of-interest controls allow video content to be placed in programmable locations with variable sizes. The “Windowing Applications” section shows some of the possibilities.

Scaler Plane #2 is rarely used. It is available for applications requiring keying on an SDI input to combine with another SDI input (keyed video combining), such as RGB keying.

Scaler Plane Segments

A scaler plane is divided into segments for processing. The number of segments is 1 to 4, depending on output resolution and timing. For applications requiring 2 scalar planes, there is either 1 or 2 segments per plane.

The configuration application shows the segment boundaries within the output resolution. The segment sizes are based on output resolution and timing. Segments are vertical slices of the overall output resolution.

Examples:
- a 3840x2160 output resolution at 60 Hz requires 4 segments per plane, each 960x2160
- a 3840x2160 output resolution at 30 Hz requires 2 segments per plane, each 1920x2160
- a 2560x1440 output resolution at 60 Hz requires 2 segments per plane, each 1280x1440
- a 1080P output resolution (60 Hz) requires 1 segment per plane
Input Mode Detection and Scaler Plane Windows
Each 3G-SDI video input port (1-4) can be pre-configured with multiple input modes defining timing, resolution, etc. The built-in Mode Handler Control function is programmed to monitor the port for the pre-configured timing modes.

Up to 4 windows can be defined within the output active area. See additional window sections for limitations. Each window is assigned to an input port. Input modes defined for that input port are mapped to the window according to the window’s mode-dependent and mode-independent parameters, such as window size, location, input area-of-interest, flip (vertical or horizontal), and rotate (90/180/270).

If a pre-defined timing mode is not detected for an input port, then windows assigned to that input are programmed to either display a specific RGB color or disappear.

Scaler Plane Methodology and Limitations
Windowing within the scalar plane is accomplished by one of two modes:

1. Independent Windowing (IW)
2. Regional Windowing (RW)

The mode determines how internal scaler assets are allocated, resulting in unique capabilities and limitations. The user will decide the windowing mode via the configuration application.

Independent Windowing (IW): With this mode, up to 4 windows can be placed in a scaler plane. The following constraint (IWC#1) is enforced by the configuration application:

\[ \sum_{n=1}^{\text{# of windows}} \text{(segments utilized by window n)} \leq 4 \]

IW allows each window to have independent horizontal and vertical scaling. Windows can be placed anywhere in the output resolution, tempered by IWC#1. IW supports rotation in 90 degree increments. IW also supports robust background fill colors. In most use models, Westar recommends Independent windowing.

Regional Windowing (RW): With this mode, up to 4 regions can be defined in a scaler plane. Regions are not windows, but areas in the scaler plane. One or more windows can be placed in a region.

A region is defined with the following parameters:


A segment may include one region in the upper portion and another region in the lower portion. Upper and lower regions may have different zoom rates (or no zoom) but not shrink and zoom. RW has the following constraints (RWC):

<table>
<thead>
<tr>
<th>RWC#</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A window resides in a single region. The window cannot span across multiple regions.</td>
</tr>
<tr>
<td>2</td>
<td>Windows cannot overlap within a region.</td>
</tr>
<tr>
<td>3</td>
<td>Horizontally, regions align with segment boundaries.</td>
</tr>
<tr>
<td>4</td>
<td>All windows within a region must zoom at the same rate. (Note 1)</td>
</tr>
<tr>
<td>5</td>
<td>Rotation is not supported</td>
</tr>
<tr>
<td>6</td>
<td>“Window Fill Color” (border) is drawn with the region fill color, so visible active video window borders are not currently possible.</td>
</tr>
<tr>
<td>7</td>
<td>The “Video Lost Display Color” is drawn with the region fill color, so a window “disappears” when video is lost at the input.</td>
</tr>
<tr>
<td>8</td>
<td>Windows within upper or lower regions of a segment cannot require both shrunk and zoom. Note 1</td>
</tr>
</tbody>
</table>

Notes:
1. Windows within a region may shrink at different rates or stay pixel-for-pixel. There cannot be one window in a segment that is zooming while another window in the segment is shrinking.

Windows for display resolutions up to WUXGA
The SP4 offers robust windowing for display resolutions with pixel clock frequencies <= 165 MPixels/sec (eg 1080P and WUGA @ 60Hz). Up to 4 windows may be sized and placed anywhere in the output active area. Window techniques include PIP, side-by-side, and other window configurations.

Windows for display resolutions beyond WUXGA
The Dual DVI and HDMI outputs both support pixel rates beyond 165 MP/sec (> WUXGA/60Hz). The SP4 supports these displays with some limitations. If the pixel rate exceeds 165 MP/sec, then the output active area is divided into segments. Two (2) segments are required for displays between 165 MP/sec and 330MP/sec; Four (4) segments are required for displays between 330 MP/sec and 660 MP/sec. The # of windows, window sizes, and window locations are limited per the previous Independent Windowing (IW) and Regional Windowing (RW) sections.
Video Combining (Standard)
- PIP is performed by assigning windows in a layer.
- Programmable alphas in a layer support z-order priority and alpha blending per window overlap area.

Keying (Standard)
- Keying requires both the foreground and background layer to form a display plane.
- A foreground layer and background layer of equal resolution are defined (typically 1080P, 2560x1600, or 3840x2160)
- A rectangular key area is defined in the active area.
- With standard “area keying”, programmable foreground and background alpha values are defined for outside the key area and inside the key area.
- An output pixel in the display plane is computed as:
  \[
  \text{Output pixel} = (\text{Foreground alpha} \times \text{foreground pixel}) + \text{(Background alpha} \times \text{background pixel)}
  \]

Keying (Optional)
- Optional keying (:Key) supports calculations on foreground pixels that are “inside” the key area. These calculations may be based on RGB, Luma, or HSV values. Foreground and background alpha values are applied based on the key calculation result (Key = True or Key = False)
- Option also includes a technique that “extracts” an alpha LUT index from the (2) LSB’s of the RGB foreground pixel, supporting a 64 entry table of Foreground/Background alpha values. This technique is “symbology-encoded alpha”.
- Option also includes using the blue content as a LUT pointer for both foreground and background alpha values. This technique is referred to as “blue alpha”.

Programmable
- Remote interface for both initial configuration and, if required, dynamic operational control. (2) RS-232 ports and USB are standard. Ethernet is optional.
- Commands are defined in the Command Line Description.

User Programmable Inputs / Outputs
- Each SDI input supports many standard timings. Typical resolutions are 1920x1080, 1280x720, or 720x480.
- The HDMI input supports many HDMI formats, including 1080P, 2560x1440, and 3840x2160.
- Similar resolutions are supported on the output. The supported output types are SDI (up to 3G-SDI), SL-DVI, Dual Link DVI (DL-DVI), and HDMI 2.0. (1080P and above)
- If the Low Latency (LL) HDMI input is used, then the output timing is identical to the low latency input timing. In cases not using the LL input, output timing is either free-running or gen-locked to a SDI input. Gen-locking for output resolutions/timings up to 1080P/60Hz only.

Test Pattern / Messaging (Future Feature)
- Test Patterns include: flood fields, color wedges, checkerboards, and color wedges; each highly programmable.
- Test pattern overlays include outline, lines, and pixel.

Future Feature Enhancement. Please contact factory for availability: Up to 8 on-screen messages using built-in 8x10 pixel character generator based on ASCII character set. Each message has:
- up to 64 characters
- 1x, 2x, 4x, 8x character size multiplier
- programmable location in x and y

Ordering Configurations
The standard SP4 can be ordered with optional Keying as: SP4 :Key

SP4 Operation: Typically, the SP4 operates as follows:
1. Upon power up, the SP4 configures itself based on its internal BIOS. The BIOS includes various input definitions and an output definition (timing, electrical format, video combining definition, etc.)
2. If valid video is detected, the SP4 populates windows with that video per the mode definition. If valid video is not detected, the SP4 populates window(s) with a pre-defined color (blue-screen), or some other function as defined in the BIOS created with the configuration utility. In all cases, the SP4 output timing and formats are per the output definition.

- Dimensions: 1U 19” Rackmount , 19” x 1.75” x 8” Deep
- Temperature Range: Operating: 0°C to +70°C (additional data available)
- Video Input: SDIx4 (each with loop-thru), HDMI 2.0 (1080P to 4K)
- Video Output: SDI, HDMI 2.0 (1080P to 4K), SL-DVI, DL-DVI
- Synchronization: When Low Latency (LL) input is used, the output timing is identical to the LL input timing. In cases not using the LL input, output timing is either free-running or gen-locked to a SDI input. Gen-locking only functions for output resolutions/timings up to 1080P/60Hz.
- Input Power: IEC Connector, 100-240 VAC, 47-63 Hz, less than 60 Watts
- Weight: Less than 4 lbs
- Control Interface: RS-232, USB, Ethernet

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SP4 Multi-Input 3G-SDI Converter

For applications requiring a single board to be embedded in the customer’s own enclosure, we offer the SP4 as shown below:

Ordering configurations include:
- SP4 /NE  ; board only
- SP4 /NE /Key  board only, with Keying

Optional Ethernet is available via a cable assembly with built-in Ethernet port.

Contact Us
Call us for additional product info and pricing.

+1 (636) 300-5164
www.westardisplaytechnologies.com

### SP4 /NE Specifications

<table>
<thead>
<tr>
<th>Physical Dimensions</th>
<th>200mm x 125mm x 12mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature Range</td>
<td>Operating: 0°C to +70°C (additional data available)</td>
</tr>
<tr>
<td></td>
<td>Storage: -40°C to +100°C</td>
</tr>
<tr>
<td>Video Input</td>
<td>SDIx4, HDMI 2.0 (1080P or greater)</td>
</tr>
<tr>
<td>Video Output</td>
<td>SDI, HDMI 2.0 (1080P or greater), SL-DVI, DL-DVI</td>
</tr>
<tr>
<td>Input Power</td>
<td>+12 VDC, 10 Watts</td>
</tr>
<tr>
<td>Control Interface</td>
<td>RS-232, USB, Ethernet (optional)</td>
</tr>
</tbody>
</table>

### SP4 /NE Connector Table

<table>
<thead>
<tr>
<th>Connector</th>
<th>Type</th>
<th>Description</th>
<th>Connector</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>10 pin header</td>
<td>Factory Use Only</td>
<td>J15</td>
<td>BNC</td>
<td>CH2 – 3G-SDI Video Input</td>
</tr>
<tr>
<td>J2</td>
<td>DF11-10DP</td>
<td>Factory Use Only</td>
<td>J16</td>
<td>DF11-6DP</td>
<td>CH1 – 3G-SDI Loop-Through Out</td>
</tr>
<tr>
<td>J3</td>
<td>2 position jumper</td>
<td>Board Reset</td>
<td>J17</td>
<td>DF11-6DP</td>
<td>CH2 – 3G-SDI Loop-Through Out</td>
</tr>
<tr>
<td>J4</td>
<td>DF11-6DP</td>
<td>USB Interface</td>
<td>J18</td>
<td>BNC</td>
<td>CH4 - 3G-SDI Video Input</td>
</tr>
<tr>
<td>J5</td>
<td>DF11-18DP</td>
<td>Discrete I/O</td>
<td>J19</td>
<td>BNC</td>
<td>CH3 – 3G-SDI Video Input</td>
</tr>
<tr>
<td>J6</td>
<td>DF11-6DP</td>
<td>Future Ethernet</td>
<td>J20</td>
<td>DF11-6DP</td>
<td>CH3 – 3G-SDI Loop-Through Out</td>
</tr>
<tr>
<td>J7</td>
<td>2 position jumper</td>
<td>Boot Jumper</td>
<td>J21</td>
<td>DF11-6DP</td>
<td>CH4 – 3G-SDI Loop-Through Out</td>
</tr>
<tr>
<td>J8</td>
<td>DF11-10DP</td>
<td>Factory Use Only</td>
<td>J22</td>
<td>DF11-20DP</td>
<td>TMDS Video Output</td>
</tr>
<tr>
<td>J9</td>
<td>DF11-10DP</td>
<td>RS-232 Interface</td>
<td>J23</td>
<td>BNC</td>
<td>3G-SDI Video Output</td>
</tr>
<tr>
<td>J10</td>
<td>DF11-8DP</td>
<td>LED Interface</td>
<td>J24</td>
<td>DF11-4DP</td>
<td>EDID TX Interface</td>
</tr>
<tr>
<td>J11</td>
<td>10 pin header</td>
<td>Factory Use Only</td>
<td>J25</td>
<td>HDMI</td>
<td>HDMI Video Output</td>
</tr>
<tr>
<td>J12</td>
<td>DF11-6DP</td>
<td>Aux Fan Power</td>
<td>J26</td>
<td>HDMI</td>
<td>HDMI Video Input</td>
</tr>
<tr>
<td>J13</td>
<td>DF11-6DP</td>
<td>Power Input</td>
<td>J27</td>
<td>2 position jumper</td>
<td>Factory Use Only</td>
</tr>
<tr>
<td>J14</td>
<td>BNC</td>
<td>CH1 – 3G-SDI Video Input</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**SP4 Configuration Application**

The SP4 is configured using the **SP4 Configuration** application. This PC-based application is used to set up all the input modes, windows, and output timing. Commands can also be dynamically sent to the SP4 for real-time operation. The **SP4 Configuration** application also supports in-the-field firmware and FPGA updates.

In the figure below, 2 1080P inputs are captured and placed in the upper left and lower left portion of a 3840x2160 output window. The black area would be filled by the low latency HDMI input.
SP4 Windowing Applications

Please see Application #1 (Page 7) for typical windowing in 1080P (or less) output resolutions.

Using regional windowing, the QuadView shown below is possible for 3840x2160/60 Hz applications.

Using independent windowing, the following windows are possible for 3840x2160 / 60Hz.

Notes:
- Background image is assumed to be HDMI 2.0 input.
- Dotted lines represent segment boundaries.
Using Independent windowing, the following windows are possible for 3840x2160 / 30 Hz

Notes:
- Background image is assumed to be HDMI 2.0 input.
- Dotted lines represent segment boundaries.
Applications

Application #1 Landscape Video Combining

In Application #1 above, a SP4 is used to combine 4 different video feeds (inputs 1-4) into a single HDMI, SDI, or DVI 1080P image. Each layout is easily configured by a hotkey command, making SP4 ideal for viewing multiple SDI video sources, in both a rack-mount or embedded scenario.

Application #2 using standard display for Portrait Video Combining

In Application #2 above, a SP4 is used to capture 3 different SDI video feeds, then rotate and combine to allow a normal landscape 1080P HDMI display to be used as a portrait display.

Application #3 Converting 4xSDI to 4K HDMI Display

In Application #3 above, a SP4 is used to capture 4 different SDI video sources and combine to drive a 3840x2160 HDMI TV.
Applications (Cont.)

Application #4 Keying on a SDI video input to combine with a HDMI background

In Application #4 above, a SP4 :Key is used to key a live video feed (in the foreground) over the map graphic (in the background). Using HSV keying, the greenish area (as well as the black, non-active area) becomes transparent, thereby passing the background.

Application #5 Keying on a (2) SDI camera inputs to combine with a HDMI background

In Application #5 above, a SP4 :Key is used to key (2) live video feeds (3G-SDI) in the foreground over the 3840x2160 Out-The-Window scenery in the background. Using HSV keying, the greenish areas become transparent, thereby passing the background.