**EZwindow4KE Video Processor**

The EZwindow4KE video combiner provides video combining for displays up to 4096x2400 @ 60 Hz.

Up to 4 input cards are used to populate 4 windows placed in either of 2 Scaler Planes. The Low Latency Plane is populated via DisplayPort 1.2 or HDMI 2.0 low latency inputs. A Scaler Plane can be combined with a 2nd Scaler Plane or the Low Latency (LL) Plane, using various keying techniques, to create the Display Plane. The output video channel is DisplayPort 1.2 or HDMI 2.0.

**Order Configuration**

The EZwindow4KE has (4) input board slots that may house various input boards, plus (1) low latency slot to support either DisplayPort 1.2 or HDMI 2.0 I/O. The unit is configured at the factory. Table 1 shows the available I/O boards.

The I/O boards and their location are defined directly in the part number, in the following format: EZwindow4KE-wxyzm, where

- **w** is the input board type in Slot 1
- **x** is the input board type in Slot 2
- **y** is the input board type in Slot 3
- **z** is the input board type in Slot 4
- **m** is the LL interface type

**Table 1: Available I/O boards**

<table>
<thead>
<tr>
<th>I/O Board</th>
<th>Function</th>
<th>Location(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>RGBHV, DVI-D, NTSC/PAL Input Card (1 input processed at a time)</td>
<td>Any of Slots 1-4</td>
</tr>
<tr>
<td>BB</td>
<td>Dual DVI input (Dual Card occupies Slot 1 and Slot 2)</td>
<td>Slot 1-2 or Slot 3-4</td>
</tr>
<tr>
<td>C</td>
<td>DisplayPort, up to 165 MPixels/sec</td>
<td>Any of Slots 1-4</td>
</tr>
<tr>
<td>DD</td>
<td>DisplayPort, up to 330 MPixels/sec</td>
<td>Slot 1-2 or Slot 3-4</td>
</tr>
<tr>
<td>M2</td>
<td>DisplayPort 1.2 I/O</td>
<td>LL slot</td>
</tr>
<tr>
<td>M6</td>
<td>HDMI 2.0 I/O</td>
<td>LL slot</td>
</tr>
</tbody>
</table>

Table 1: Available I/O boards

If a slot is unpopulated, then a # is placed in that location. Examples:

- **EZwindow4KE-A##M2** has the following configuration:
  - Slot 1: Type A input board
  - Slot 2: Not populated
  - Slot 3: Not populated
  - Slot 4: Not populated
  - LL: DP 1.2

- **EZwindow4KE-AABB#M6** has the following configuration:
  - Slot 1: Type A input board
  - Slot 2: Type A input board
  - Slot 3/4: Type BB input board
  - LL: HDMI 2.0
Enhancements over EZwindow4K
The EZwindow4KE has many enhancements over the EZwindow4K, including:
- Greater variety of Input cards, including Type C and Type DD DisplayPort input cards,
- Input Mode detection for I/O boards in Slots 1-4

Low Latency Plane Input
The EZwindow4KE low latency input can be either DisplayPort 1.2 or HDMI 2.0 I/O, as identified in Table 1 as M2 or M6 respectively.

If a 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 low latency inputs.

Low Latency Plane EDID
The EZwindow4KE low latency input has a EDID programmed with a user-selected preferred or custom timing.

Scaler Plane Inputs
The following (4) board types provide inputs for windows that are sized and placed in the Scaler Plane.

Type A: Multi-Format Input Board
- Supports the following inputs: DVI-D, RGBHV, RGBsog, RS170, RS343, composite (NTSC/PAL). Any one of these inputs may be selected.
- Resolutions up to WUXGA with pixel rates up to 162MHz.

Type BB: Dual DVI Input Board
- Supports a dual DVI input, for resolutions such as 2560x1600 and 2560x1440.

Type C: DisplayPort Input Board
- Supports DisplayPort 1.1a Resolutions up to WUXGA with pixel rates up to 165MPixels/sec.

Type DD DisplayPort Input Board
- Supports DisplayPort 1.1a Resolutions up to 2560x1600 / 60 Hz, and pixel rates up to 330MPixels/sec.

Scaler Plane Segments
The scaler planes are divided into segments for processing. The number of segments is 1 to 4, depending on output resolution and timing. The configuration application shows the segment boundaries within the output resolution. The segment sizes are based on output resolution, # of scaler planes (1 or 2), and timing. Segments are vertical slices of the overall output resolution.

Examples:
- a 3840x2160 output resolution at 60 Hz requires 4 segments, each 960x2160
- a 3840x2160 output resolution at 30 Hz requires 2 segments, each 1920x2160
- a 2560x1440 output resolution at 60 Hz requires 2 segments, each 1280x1440

Note. In cases where the low latency input is NOT used but keying is still required, a 2nd scaler plane can be defined.

Scaler Plane Windows
Up to 4 windows can be placed in a Scaler plane. Each window is populated with an area-of-interest from any input card in Slots 1-4.

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 the Scaler plane. The following constraint (IWC#1) is enforced by the configuration application:

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

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. Figures 1 and 2 show several windowing possibilities for 4K 60 Hz and 4K 30 Hz operation. Westar recommends Independent Windowing for most applications.
Regional Windowing (RW):

With this mode, up to 4 regions can be defined in a Scaler plane (see Figure 3). 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:

\[ \text{Region}[1-4] = \text{Scaler Offset}, \text{Line Offset}, \text{Scaler Width}, \text{Line Height}, \text{Fill Color}. \]

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 shrink and zoom. Note 2</td>
</tr>
</tbody>
</table>

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

Input Mode Detection:

Each window (Window 1-4) and its assigned input has an associated mode handler to support the automatic detection of multiple video modes. Video modes are defined using our EZwindow4KE Configuration application.

Window parameters (Flip, Rotate, Fill color, border color, Scaled Area of Interest, etc) are defined to be mode independent (applies to all detected modes) or mode dependent (defined specifically for each mode). The following screenshot shows both mode independent window properties and mode dependent window properties.

Based on the detected mode, the EZwindow4KE will apply any mode dependent parameters, such as:
- the size of the window,
- the location of the window,
- the input area-of-interest,
- the scaled area of interest within the window,
- fill color, and
- border color.
Keying and the Display Plane

The Display Plane is formed from the background layer (windowed, but no keying) or a combination of foreground and background (keying). Each of these layers is selectable from 1 of 2 Scaler planes, the Low Latency Plane, or a fixed RGB color. Keying (RGB, Luma, or HSV) is performed on the foreground layer, with programmable foreground and background alpha values for:

- Outside the key area
  - Key = True
  - Key = False

Output pixel = (Foreground alpha * foreground pixel) + (Background alpha * background pixel)

Figure 1: Independent Windowing (IW) Examples (4K 60 Hz)
(Background image input on Low Latency channel)
Figure 2: Independent Windowing (IW) Examples (4K 30 Hz)
(Background image input on Low Latency channel)
Figure 3: Regional Windowing (RW) Example

Regional Windowing mode to support 4 inputs in a quad 2x2 configuration. (This is not possible with IW mode due to IWC#1)

Segments are stripes to support raster output.

Notes:
1. Because Regions 1 and 3 share Segments 1 and 2, each region can zoom at independent rates but one region cannot zoom while the other region shrinks.

Input Board Video Type
- A (see figure on left)
- C DisplayPort (up to 165 MP/sec)
- B6 Dual DVI
- DD DisplayPort (up to 330 MP/sec)
- LL I/O Video Type
- M2 DisplayPort I/O
- M6 HDMI I/O

Ordering Configuration is:
EZwindow4KE-wyzm, where
w is the input board type in Slot 1
x is the input board type in Slot 2
y is the input board type in Slot 3
z is the input board type in Slot 4
m is the LL I/O type

(Place # if location is not populated)
EZwindow Applications

Application #1

In Application #1, an EZwindow4KE-A###M6 fuses a standard resolution HUD image (1920x1200 or less) into a HDMI 2.0 stream. An RGB key with programmable alpha values (separately programmable foreground and background alpha values outside the key area, when Key= TRUE, and when Key = FALSE) results in a realistic HUD overlay. This enables a single projector to be used for both the OTW image and the HUD overlay.

Alternately, a EZwindow4KE-A###M2 would be applicable for DP1.2 I/O.

Recommended windowing mode: Independent Windowing (IW)
In Application #2, an EZwindow4KE-AAAAM2 fuses (4) Multi-function display feeds with a high resolution overlay for a part task trainer. The overlay is generated in a 4kx2k DisplayPort 1.2 format. The output device is a 4kx2k DisplayPort 1.2 monitor.

Recommended windowing mode: Regional Windowing (RW) at 4K 60 Hz (IW possible with 4K 30 Hz I/O).
In Application #3, a single EZwindow4KE-CC##M6 implements a (4) Multi-Function Display (MFD) solution. Each of (4) windows is assigned to a specific MFD. The symbology is created in 4 windows by a COTS image generator. In the background plane, each window’s associated input can be selected independently as sensor 1 or sensor 2. A window can also be independently selected to show symbology only, by reducing the background window’s (1, 2, 3, and/or 4) gain to 0. To show “sensor only” requires the IG to drive the specific MFD overlay to black. Westar LCD controllers are used in many simulated MFD’s. The LCD controller can be individually configured to select the appropriate area of interest from the full 1920x1200 video stream.

Note: Higher display resolutions than 600x600 are possible. Please contact Westar for more details.

Recommended windowing mode: Independent Windowing (IW)
Configuring the EZwindow4KE
The EZwindow4KE is primarily used in applications where video is combined into a 4Kx2K image. The figure below shows the steps in setting up the EZwindow4KE:

1. User sets up the Low Latency Plane (if used) and Output format. 
   # of segments (stripes) required is calculated from format.
   Examples include:
   - HDMI 2.0 Input, HDMI 2.0 Output, 3840x2160 60 Hz (4 Stripes)
   - HDMI 2.0 Input, HDMI 2.0 Output, 3840x2160 30 Hz (2 Stripes)
   - DP1.2 Input, DP1.2 Output, 3840x2160 4 Stripes
   - DP1.2 Input, DP1.2 Output, 2560x1600 2 Stripes
   - No input, HDMI 2.0 Output, 3840x2160 4 Stripes

2. User configures all Scaler Inputs in slots 1-4. Video type, resolution, etc.

3. User defines windows within the Scaler Plane:
   User selects Independent Windowing (IW) or Regional Windowing (RW) approach. For each window, user selects an area-of-interest from an input and then defines the size and location of the corresponding window in the Scaler Plane. For IW mode:
   The summation, from n = 1 to the # of windows, of segments utilized by window n must be less than or equal to 4:
   \[ \sum_{n=1}^{\text{# of windows}} \text{segments utilized by window n} \leq 4 \]

4. The user creates the Display Plane as a blended version of the Scaler Plane and the Low Latency Plane.
Above: HUD window within 4 segments for a 4K projector

Above: HUD window within 2 segments for a 2560x1600 projector
Specifications

<table>
<thead>
<tr>
<th>Low Latency Input /Output</th>
<th>Specification</th>
<th>Input Connector (s)</th>
<th>Output Connector (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M2 (Option)</td>
<td>DisplayPort 1.2 (up to 600 MPixels/sec) / 4K@2K @ 60 Hz, Note 1</td>
<td>DisplayPort (standard connector type)</td>
<td>DisplayPort (standard connector type)</td>
</tr>
<tr>
<td>M6 (Option)</td>
<td>HDMI 2.0 (up to 600 MPixels/sec) / 4K@2K @ 60 Hz, Notes 2, 3</td>
<td>HDMI (standard Type A connector)</td>
<td>HDMI (standard Type A connector)</td>
</tr>
</tbody>
</table>

Scalerc Inputs

<table>
<thead>
<tr>
<th>Input Types</th>
<th>Type A</th>
<th>Type C</th>
<th>Type BB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Video Type</td>
<td>Analog RGB (0.7 Volt levels, Interlaced or Non-Interlaced), 1xDVI-D, NTSC/PAL more</td>
<td>DisplayPort 1.1a</td>
<td>DisplayPort (standard)</td>
</tr>
<tr>
<td>Pixel Rate</td>
<td>Up to 166 MPixels/sec</td>
<td>Up to 165 MPixels/sec</td>
<td>Up to 330 MPixels/sec</td>
</tr>
<tr>
<td>Active Pixels per Line</td>
<td>Up to 4096 (must meet pixel rate constraint)</td>
<td>Up to 4096 (must meet pixel rate constraint)</td>
<td>Up to 4096 (must meet pixel rate constraint)</td>
</tr>
<tr>
<td>Lines per frame</td>
<td>Up to 4096</td>
<td>Up to 4096</td>
<td>Up to 4096</td>
</tr>
<tr>
<td>Phase Adjustments</td>
<td>Adjustable sample clock to ensure center sampling</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connectors</td>
<td>DVI-I connector for 1xDVI-D and Analog RGB (included) (1) BNC for NTSC/PAL</td>
<td>DisplayPort (standard)</td>
<td>DisplayPort (standard)</td>
</tr>
<tr>
<td>Slots</td>
<td>1 input slot</td>
<td>1 input slot</td>
<td>2 input slots</td>
</tr>
<tr>
<td>Input Types</td>
<td>Type DD</td>
<td>Type DD</td>
<td>Type BB</td>
</tr>
<tr>
<td>Video Type</td>
<td>DisplayPort 1.1a</td>
<td>DisplayPort 1.1a</td>
<td>DisplayPort 1.1a</td>
</tr>
<tr>
<td>Pixel Rate</td>
<td>Up to 330 MPixels/sec</td>
<td>Up to 330 MPixels/sec</td>
<td>Up to 330 MPixels/sec</td>
</tr>
<tr>
<td>Active Pixels per Line</td>
<td>Up to 4096 (must meet pixel rate constraint)</td>
<td>Up to 4096 (must meet pixel rate constraint)</td>
<td>Up to 4096 (must meet pixel rate constraint)</td>
</tr>
<tr>
<td>Lines per frame</td>
<td>Up to 4096</td>
<td>Up to 4096</td>
<td>Up to 4096</td>
</tr>
<tr>
<td>Phase Adjustments</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connectors</td>
<td>DisplayPort (standard)</td>
<td>DisplayPort (standard)</td>
<td>DisplayPort (standard)</td>
</tr>
<tr>
<td>Slots</td>
<td>2 input slots</td>
<td>2 input slots</td>
<td>2 input slots</td>
</tr>
</tbody>
</table>

Functional Specification

<table>
<thead>
<tr>
<th>Features</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Image Flip, scaling, rotate</td>
<td></td>
</tr>
<tr>
<td>Windowing, PIP</td>
<td></td>
</tr>
<tr>
<td>Alpha Blending Programmable</td>
<td></td>
</tr>
<tr>
<td>Border Colors</td>
<td></td>
</tr>
<tr>
<td>Brightness / Contrast Adjustments</td>
<td></td>
</tr>
</tbody>
</table>

Features (cont.)

<table>
<thead>
<tr>
<th>Specification</th>
<th>Functional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keying (RGB, Luma, HSV), with programmable Foreground and background alphas for:</td>
<td></td>
</tr>
<tr>
<td>Outside Key area</td>
<td></td>
</tr>
<tr>
<td>Inside key area, key = True</td>
<td></td>
</tr>
<tr>
<td>Inside key area, key = false</td>
<td></td>
</tr>
</tbody>
</table>

Output Sync Modes

Free run, locked to hi-res input, Sync to input

Dimensions (W x D x H)

19" x 13.75" x 1.75" (1U)

Color Processing Depth

8 bits per color

Weight

Less than 10 lbs.

Re-sizing Limits

Virtually unlimited

Warranty

1 Year Limited

Input Power

IEC Connector, 100-240 VAC, 47-63 Hz, less than 60 Watts

Certifications

RoHS, CE

Certifications

RoHS, CE

Notes:

1. DisplayPort I/O supports RGB 4:4:4 mode only
2. HDMI Input supports RGB 4:4:4 mode only
3. HDMI output supports RGB 4:4:4, YCbCr 4:2:0 modes

EZwindow4KE-AC##M2 shown above, with Type A (DVI) in slot 1, Type C (DisplayPort) in Slot 2, and DisplayPort (M2) enabled in the Low Latency slot. An LED indicates whether LL DP or LL HDMI is enabled and operating.

What's Included:

- EZwindow4KE Video Processor
- RS-232 Serial Cable
- USB Cable
- Power Cable

CD Containing:

- Configuration Utility Software
- User's Guide
- Command Line Description