Display Technologies
WESTAR
QinetiQ North America

DCP Distortion Correction Processor

Back View (connectors)

Front View

DVI I/O resolutions up to 1920 x 1080 (HD 1080P)

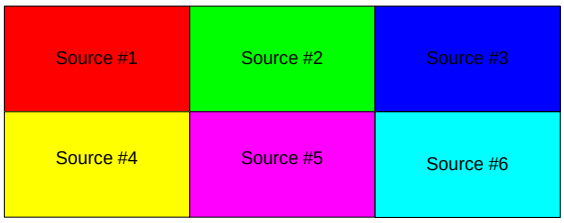
Up to (6) PC video input channels and (6) projector output channels

DCP Configuration utility and API support:

- √ **Definition of input/output resolutions and timing**
- √ **Access to Projector EDID and programmable EDID for each video source**
- √ **Source Image Plane definition and Projector area-of-interest within the Source Image Plane**
- √ **Downloading distortion and non-uniformity correction files**
- √ **Downloadable test patterns and built-in filled rectangle test patterns for third-party projector calibration procedures**

2U rack-mount unit

Unit auto-configures at Power Up with latest settings and correction files

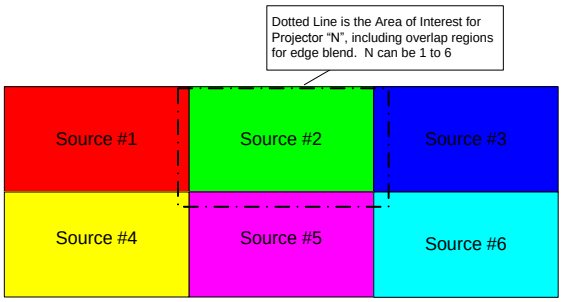


Source Image Plane

The function of the DCP is to translate a PC's source image plane to a high resolution display composed of multiple, loosely aligned projectors. The source image plane typically originates in graphics memory distributed across multiple video cards. The video cards output the imagery via multiple 1080P DVI video streams. In the case shown on the left, the customer has a source image plane composed of a 3x2 array of 1080P sub-images that are piped to (6) 1080P DVI outputs.

This video is captured by the DCP on (6) 1080P inputs. Each of (6) DCP projector outputs is programmed to a specific area-of-interest within the source image plane. The area-of-interest includes appropriate overlap regions, allowing the projectors overlapping beams to be corrected and smoothed into a continuous image plane.

At 1080P HD resolutions, the overlap region may typically be 160 lines on top or bottom, and 160 pixels on the left and/or right. The picture to the right shows a typical area-of-interest definition for projector output "N".



Projector Area-of-Interest Definition

The figure on the next page shows a typical configuration with (3) projectors mounted with their 1080P output images overlapped on the screen. The video source, typically a PC, requires no internal corrections or data overlap. From the PC's perspective, the display is a single, high resolution, uniform, rectangular display. A typical calibration process uses a camera and test images to determine appropriate distortion, color, and uniformity corrections. These corrections are downloaded to the DCP and stored in non-volatile memory. Upon power-up, the DCP auto-configures based on its latest calibration data. The corrections translate the source image plane of the PC to the screen, while correcting distortions due to projector warping, overlap and color and brightness differences.

The DCP supports up to six (6) 1080P video streams for up to (6) projectors.

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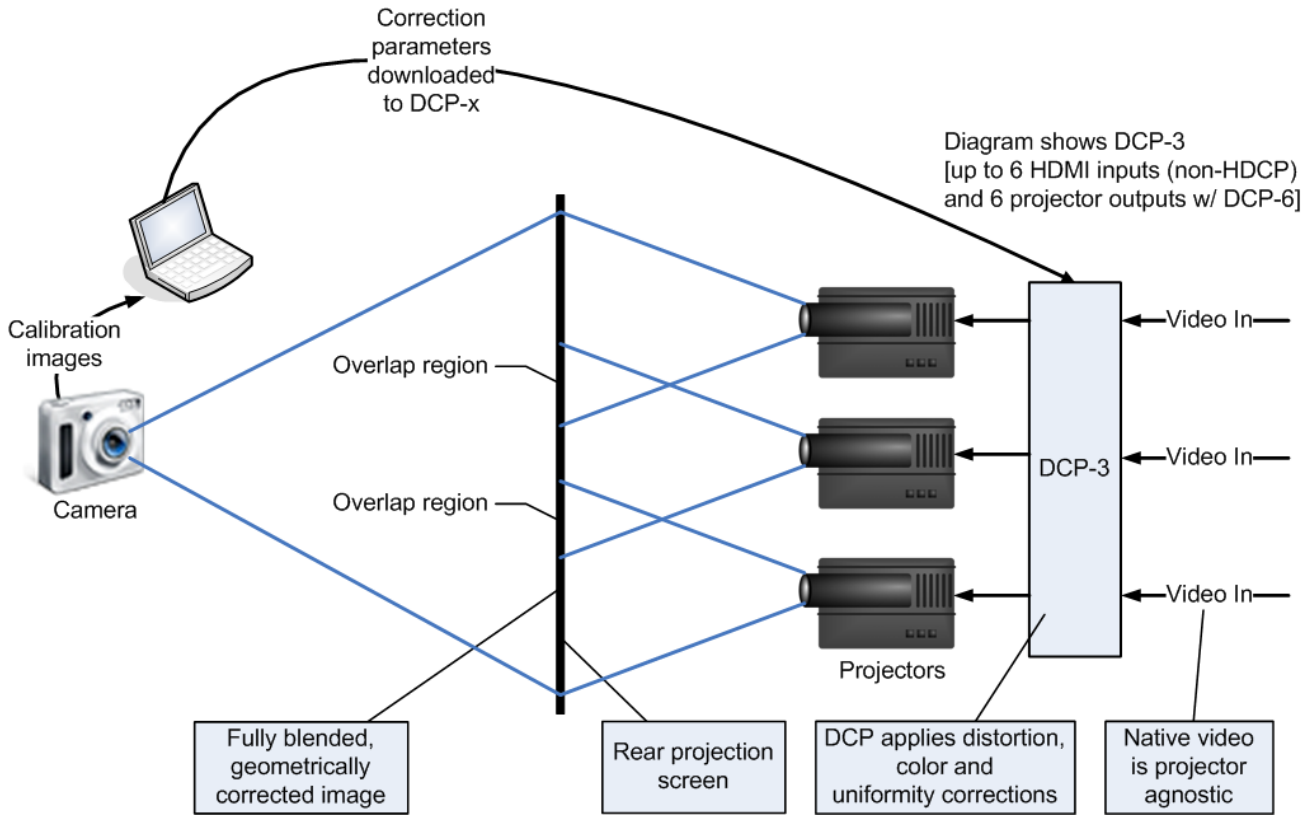
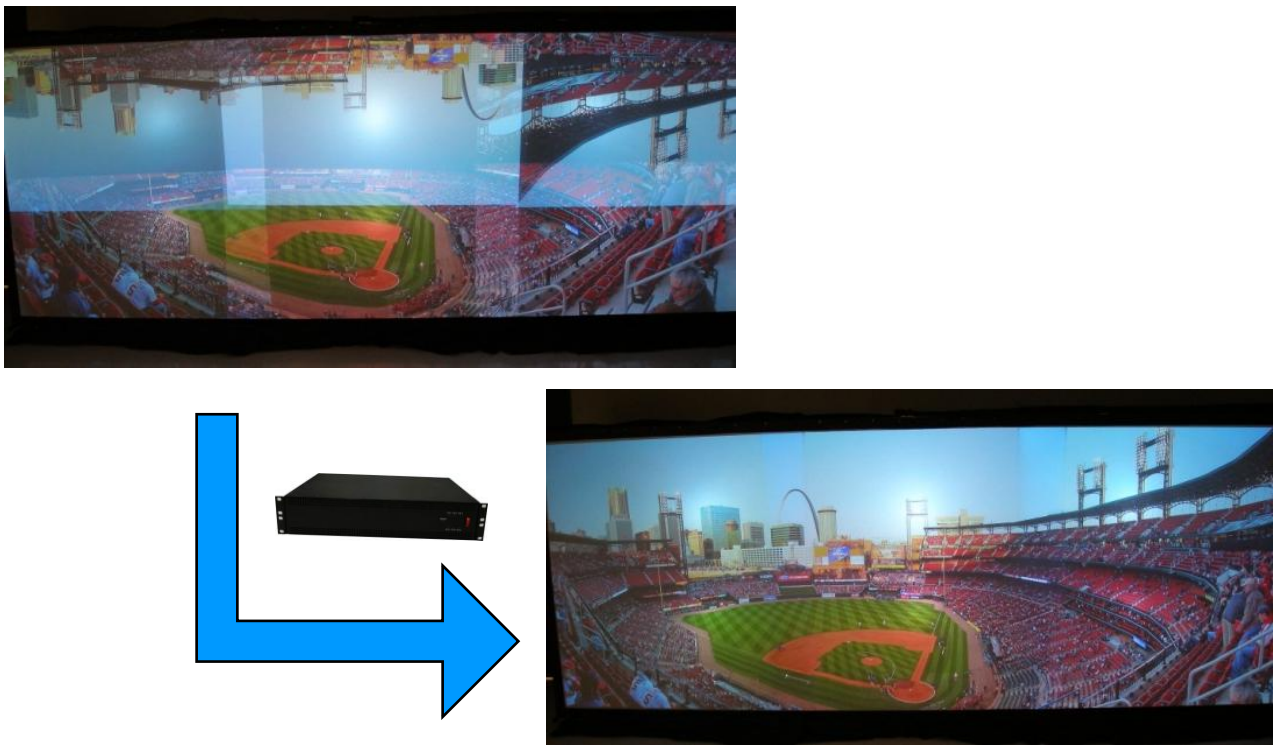
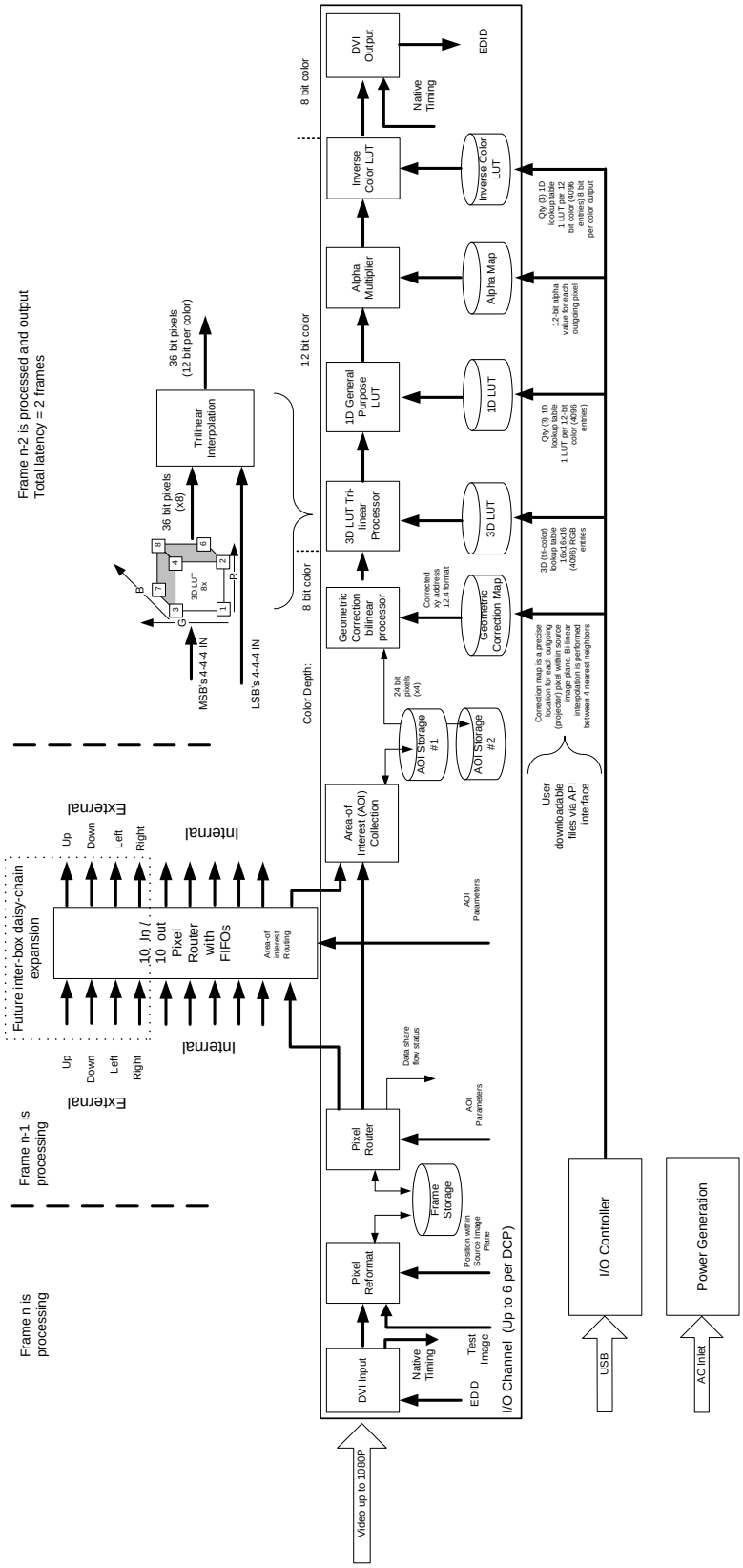


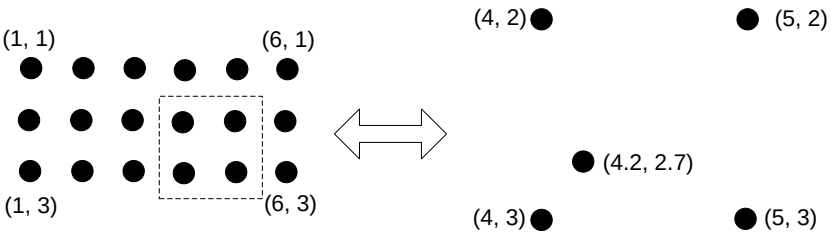
The picture below shows a typical 6 projector display before DCP corrections (top) and after corrections are applied (bottom). (Note that the top projectors are mounted upside down. This is corrected by the DCP.



\DCP Corrections: The DCP block diagram is shown below with an introduction to several of the image processing functions:



Geometric Correction: Each projector output channel captures an area-of-interest (AOI) within the source image plane. Each pixel within the projector's output resolution (typically 1920x1080) is derived from a "mapped" location within the projector's area-of-interest, via a downloaded geometric correction map. Assume a 1080P input/output format. The incoming 1920 pixels per row are numbered 1 to 1920 and the rows are numbered 1 to 1080. Projector output pixel (x, y) is mapped to (4.2, 2.7) in the projector's area of interest. A bilinear interpolation between the four nearest neighbor pixels is used to determine the image value at (4.2, 2.7), as shown in the diagram above.



3D Tri-Linear processor: Each pixel is color corrected from an ideal color space to the projector's color space, via a downloaded 3D lookup table. This table accounts for inter-color dependencies found in many projectors. The 4 most significant bits of each color define the vertex of the tri-color cube. The 4 least significant bits then are used to interpolate between the (8) 36-bit color vertices of the tri-color cube.

Alpha Multiplier: Each pixel of the projector's output resolution (typically 1920x1080) is multiplied by the appropriate 12-bit alpha value within the alpha map. These alpha adjustments account for non-uniformities as well as edge blending.

Inverse Color Lookup: (3) individual LUTs (R, G, B) convert the 12-bit color component in the projector color space back to an 8-bit color component in the ideal color space.

DVI Output Timing: The timing of a DCP projector output channel is identical to the input timing of the channel. Corrected projector video lags the incoming video by precisely 2 frames.

Data Sharing:

The DCP supports a limited amount of data sharing between I/O processors. Data sharing refers to image pixels that come into the DCP on channel "x", but are contained in the area-of-interest in channel "y". Data sharing is crucial in correcting overlapping regions. Because multiple projectors illuminate an overlapped area of the screen, these projectors must share a limited amount of data to create a seamless image. Because the DCP can share data internally, it is not required that the image generators send duplicate data across multiple image generator output channels.

DCP Calibration:

Customers have several options to calibrate the DCP. Some customers have in-house expertise to generate their own calibration data. In addition, Westar has partnered with a third-party company that specialize in camera-based calibration solutions. These solutions measure individual projector performance and warping by capturing images of appropriate test patterns while disabling the other projectors. Image processing software then determines appropriate corrections and creates the DCP correction files for download to the DCP. Please contact Westar for more information.

DCP Integration and Calibration Support:

DCP Driver API: The DCP API provides a programmer's interface to the DCP. The API includes complete descriptions of all programming features and all correction file formats.

DCP Configuration Utility: The DCP Configuration Utility is a Windows-based application that supports file download and other programming features to configure the DCP for a specific application. This utility uses the same DCP API available to customers for customer-specific software. The API and DCP configuration utility use a USB interface to the DCP.

EDID: Many image generators rely on display EDIDs to get critical data on the display's capability. The DCP supports EDID functions in several ways. First, the DCP can be commanded to read the EDID from a display connected to a DCP output, and copy the EDID contents to a dedicated EDID on the corresponding DCP input. Also, an EDID prom may be programmed from the DCP Configuration utility.

Test Patterns: The DCP supports many test pattern features. Test patterns of any rectangular size may be downloaded to the source image plane. The filled rectangle command loads a specific RGB color into a specific region of the source image plane.

I/O channel controls: Multiple channel controls exists, including the ability to "turn off" various correction processors.

DCP Specifications

Input Specifications (Subject to change without notice)		
	Video Type	TMDS; HDMI connector
	Pixel Rate	Up to 150 MHz
	Standard Computer resolutions	Up to 1080P (Programmable EDID included for each input channel)
Output Specifications		
	Video Type	TMDS; HDMI connector
	Pixel Rate	Up to 150 MHz
	Standard Computer resolutions	Up to 1080P (EDID Read function for each output channel)
Electro Mechanical		
	Input Power	IEC Connector, 100-240 VAC, 47-63 Hz, 150 Watts Maximum Input Power
	Control	USB
	Size	Rackmount config: 19"W x 13.75"D x 3.5"H, Benchtop config: 17.4"W x 13.75"D x 3 7/8"H
	Weight	Less than 10 lbs.
Processing		For 1080P formats, each incoming frame is processed with no frame dropping.
Bandwidth		
Latency		2 frame delays from input to output (lower latency available in non-data-sharing configuration)
Warranty		One year
Functional	Specialty Features	Geometric, color, and alpha corrections per pixel Each projector output has access to area-of-interest within the Source Image Plane Includes data sharing to handle video overlap regions outside of the image generator.
	Color processing depth	8 bits per color I/O, 12 bit per color internal processing
Each DCP delivery includes:		DCP unit configured w/ input cards as ordered, rack-mount ears, benchtop feet, IEC power cable with US plug, USB cable, and a CD containing the User's Guide, the DCP Configuration Utility, and the DCP Driver API Guide

Ordering Info / Notes:

1. DCP can be ordered with 1 to 6 I/O processors, and is identified as DCP-x, where x is the # of I/O channels.
2. DCP is delivered with user-installable rack-mount ears and bench-top feet.