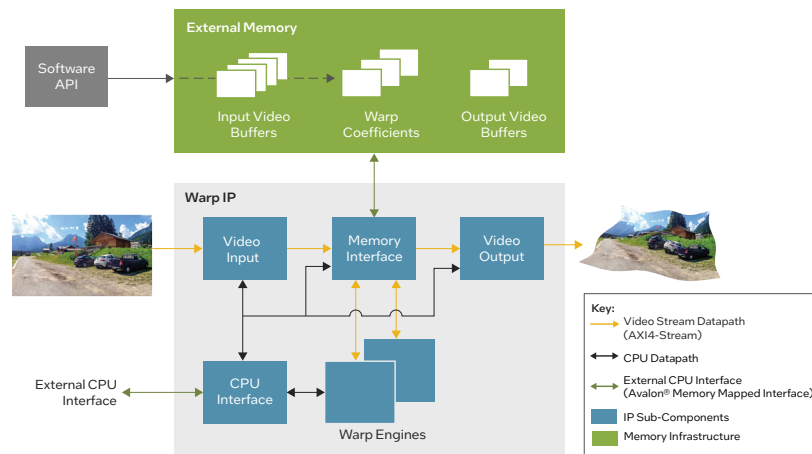


# Warp Intel® FPGA IP

The Warp Intel® FPGA IP is a highly optimized IP core for applying geometric corrections and arbitrary non-linear distortions to a real-time video stream.



The Warp Intel FPGA IP is a highly optimized core for applying geometric corrections and arbitrary non-linear distortions to a real-time video stream of up to 3,840 x 2,160 pixels and up to 60 frames per second. Maximum image quality is achieved through per-pixel filtering with bi-cubic interpolation on full color resolution 4:4:4 video data at up to 10-bits per color plane.



The Warp Intel FPGA IP is delivered with a set of software components including a software driver that configures and controls all the necessary parameters of the IP, a warp data generator, and an example warp mesh generator. The software can be deployed on a Nios® II processor-based system or SoC (recommended).

## Applications

Warp distortion and correction IP can be used in a range of applications including:

- Video projectors - from cinematic and simulators to consumer/short-throw – for lens and curved screen compensation
- 2D and stereo 3D Image capture, alignment, registration and projection
- Camera lens distortion and chromatic aberration correction
- Virtual reality headsets
- Multi-camera image stitching
- Manipulation and registration of overlays, HUDs - interactive graphical and web content

## Standard and Arbitrary Transforms

The Warp Intel FPGA IP allows the input image to be transformed using a number of controls to perform:

- Fish-eye, barrel and general lens/screen correction
- Keystone and pin-cushion correction
- Resizing and rotation
- Perspective mapping
- Arbitrary warps up to local expansion/compression limit

The Warp Scaler block manipulates the image either using high-level instructions such as rotate, keystone, barrel or a mesh mapping from the warp load direct memory access (DMA) block. The input image is stored and manipulated in external SDRAM via the Avalon® Memory-Mapped interconnect.

## Key Features

- Arbitrary warp transforms and rotations
- Highly optimised external memory interface
- 0.5x to 2x local scaling
- High quality per-pixel bi-cubic interpolation
- Coefficient sets available for highest filter quality
- Full data buffering to allow input and output to operate on independent clock domains
- Support for 10 bit per color component
- Support up to 2 pixels in parallel per clock processing
- Low latency
- Support resolutions up to 3840 × 2160 at 60 fps and future support for up to 8K at 60 fps
- Low FPGA resource utilisation
- AXI4-Stream video I/O interface
- AXI4-Stream ↔ Avalon-Stream Protocol Converters
- Avalon® Memory-Mapped CPU control and memory interfaces

## Customer Benefits

- Low resource yielding lower power 'Edge' implementations
- Continuous 360-degree rotations
- Continuous scaling factors
- Free Intel® FPGA IP Evaluation Mode
- Design example available in Intel Resource and Design Center
- Avalon® or AXI interfaces
- Fully maintained and supported by Intel

## Supported Devices

- Intel® Cyclone® 10 GX FPGA
- Intel® Arria® 10 FPGA
- Intel® Stratix® 10 FPGA
- Intel Agilex® FPGA

## Design Your Product Today with Intel FPGAs

Intel provides a large range of complementary and modular IP cores for video processing and connectivity. These IP cores can be used to create complete solutions for applications in Studio Broadcast, ProAV, Aerospace/Defense, Medical, Consumer, Automotive, Machine Vision, and more.

More information is available about Intel video IP at [www.intel.com/content/www/us/en/broadcast/products/programmable/overview.html](http://www.intel.com/content/www/us/en/broadcast/products/programmable/overview.html) or contact an Intel sales representative.

## Design Example

Intel® Arria® 10 GX FPGA Development Kit. Fully compatible with Intel IP cores.

## Typical Resource Use

Device	ALMs	M20K	DSPs
Intel Agilex FPGA	6,871	73	54
Intel Arria 10 FPGA	9,468	97	99

## Useful Links

- [Intel FPGA Warp IP Design Example - Requires Intel Resource & Design Center access](#)
- [Intel® Arria® 10 GX FPGA Development Kit](#)
- [Intel® Cyclone® 10 GX FPGA Development Kit](#)
- [Intel® Stratix® 10 GX FPGA Development Kit](#)
- [Intel Agilex® 7 FPGA Development Kit](#)



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