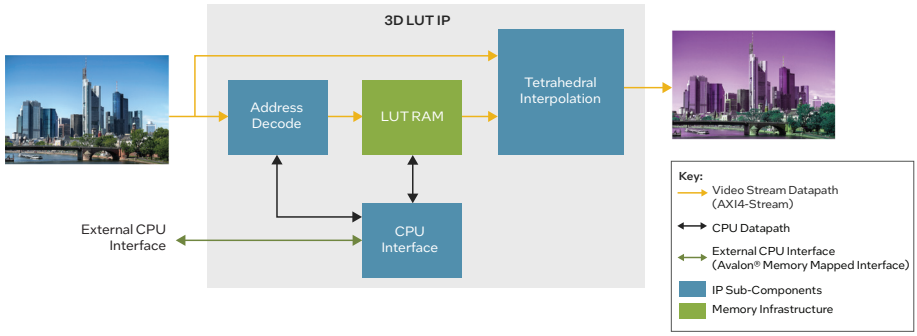
Product Brief

Video Processing

3D LUT Intel® FPGA IP

3D look-up tables (LUTs) Intel® FPGA IP provide an efficient solution for video color-space and dynamic range conversions, chroma-keying, and the creation of artistic effects.

3D LUT Intel FPGA IP provides an efficient solution for video color-space conversions and conversion between nonlinear gamuts. This IP also enables many other artistic and cinematic effects, such as sepia tone, monochrome, color changes, vintage, vivid color, cool/warm film and the ability to create chroma-keys to separate foreground from a colored background. The 3D LUT IP employs Tetrahedral interpolation. The 3D LUT IP uses the most significant bits (MSBs) of the 3-color component inputs to retrieve data values from the contents of the LUT (in FPGA memory), and the least significant bits (LSBs) to interpolate the final output value.



The interpolation processes and memory methods used in Intel's 3D LUT IP use a lower number of gates and memory than competing solutions, enabling practical 3D LUT implementations using an FPGA for a more cost-effective solution. The low resource count and industry standard interfaces such as AXI4-Streaming and AXI4-Lite allow the IP to be easily integrated into your Intel® FPGA design.

Applications

- Color Space Conversions, e.g., HD Rec 709 to UHD Rec 2020
- Color Correction – Film/Video Post Production
- Chroma Keying – Virtual Studios, graphics overlays
- Color replacement – TV commercials, medical imaging
- Dynamic Range Conversions (SDR-HDR)
- Artistic effects, e.g., sepia tone, monochrome, color-space volume adjustments

Key Features

- Support for 17^3, 33^3 and 65^3 LUTs
- Support 3 and 4 output channels from the LUT (Alpha / key channel)
- High quality tetrahedral interpolation
- Independently set input/output pixel depth
- Independently set LUT precision
- Dynamic update of table values with optional double buffering to enable clean synchronous switching to a new LUT
- Includes '.cube' file format conversion utility
- Support for 8, 10, 12 and 16 bit per color component
- Support up to 4 pixels in parallel (PIP) per clock processing
- Low subframe latency (21 clock cycles)
- Support resolutions up to 4K at 60 fps on Intel® C10/A10/S10 FPGAs and up to 8K at 60 fps on Intel Agilex® FPGAs
- 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
- 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 FPGAs
- Intel® Arria® 10 FPGAs
- Intel® Stratix® 10 FPGAs
- Intel Agilex® FPGAs

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 or contact an Intel sales representative.

Design Example

Intel® Arria® 10 GX Development Kit with Bitec HDMI FMC daughter card. Fully compatible with Intel IP cores.

Typical Resource Usage – Single Buffer

PIP	Bits per color	LUT Size	ALMs	M20K	DSPs
1	8	173	810	17	6
2	10	173	1,640	33	12
2	10	333	1,649	120	12
2	10	653	2,575	830	12

Figures for Intel Arria 10 FPGA with video clock FMAX of 300 MHz.

Typical Resource Usage – Double Buffer

PIP	Bits per color	LUT Size	ALMs	M20K	DSPs
1	8	173	937	25	6
2	10	173	1,681	49	12
2	10	333	1,685	224	12
2	10	653	4,035	1,622	12

Useful Links

- Intel FPGA 3D LUT Design Example - Requires Intel Resource & Design Center access
- Intel® Arria® 10 GX FPGA Development Kit
- Intel Agilex® 7 FPGA Development Kit
- Bitec HDMI FMC daughter card

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