

MACHINE VISION WITH SPARTAN ULTRASCALE+ FPGAs



OVERVIEW

Factory automation cameras and other machine vision systems interface to a wide range of high bandwidth image and non-image sensors across a wide range of industrial and medical applications that demand low latency and deterministic processing. These cameras often rely on a variety of machine vision-specific and industrial communication protocols to connect to frame grabbers for additional vision processing and image management on industrial PCs.

FPGAs have been the optimal solution in machine vision for decades, providing low latency deterministic sensor interfacing, vision processing, and camera output for these high bandwidth systems on both the camera and frame grabbers. In response to rising sensor bandwidth trends and compute density requirements, Spartan™ UltraScale+™ FPGAs support the fastest interfaces in the AMD FPGA Cost-Optimized Portfolio while also considering the power and thermal constraints of these systems.

HIGHLIGHTS

VARIETY OF PACKAGE SIZES:

- Package sizes as small as 10x10 mm, with many devices offered at 12x12 mm
- BGA pitch of 0.5 mm to 0.8 mm for compact camera development
- BGA up to 1.0 mm for less size constrained frame grabbers
- Each package type is optimized for camera or frame grabber use cases through the number of I/O and I/O types supported

LATEST COMMUNICATION STANDARDS:

- MIPI D-PHY support at up to 3.2 Gb/s, complementary to Artix™ UltraScale+™ extensive SLVS-EC support Sub-LVDS at up to 2.5 Gb/s
- PCIe® up to Gen4x 8
- Multiple generations of SLVS-EC, CoaXpress, and GigE Vision support by including up to 8 GTH @ 16.3 Gb/s

POWERING THE FUTURE WITH LOWER POWER:

- Estimated up to 30% reduction in power¹ compared to predecessors due to 16 nm FinFET technology
- Hardened LPDDR4x/5 and MIPI D-PHY contributes to lower power

INDUSTRIAL LONGEVITY AS A STANDARD::

- Spartan UltraScale+ FPGAs designed for 15-year product lifecycle
- Proven track record of 40 years for prior generation devices

KEY APPLICATIONS

FACTORY AUTOMATION CAMERAS

- Variety of sensor interfaces such as MIPI, Sub-LVDS, & SLVS-EC supported for USB, GigE, or CoaXpress cameras
- Flexible and high-performance I/Os ingest and process sensor data using FPGA fabric, DSP slices, and block RAM to transmit to a PC with low latency
- Compact package options as small as 10x10 mm
- Low power and built-in LPDDR4x/5 memory interfaces for thermal constraints in even the smallest cameras

FRAME GRABBER

- Spartan UltraScale+ FPGAs support Frame Grabber applications by increasing I/O and logic count in select members
- Incorporates soft IP blocks like Time-Sensitive Networking (TSN), GigE Vision, and CoaXpress 2.0 (available through AMD or partners)
- Up to PCIe Gen4x 8
- Offers a versatile set of tools, including optimal amount of DSP resources, on-chip memory, and flexible I/O

ADVANCED VISUALIZATION IN SURGICAL AND DIAGNOSTICS

- The Spartan UltraScale+ FPGAs ensure real-time and deterministic response, facilitating precise surgical tool control in surgical visualization systems
- Designed with the right thermal and power characteristics for the efficiency of advanced visualization systems for optimal performance during surgical and diagnostic procedures
- Flexible I/O allowing for integration with a variety of sensors
- This family provides the necessary safety and security features crucial for vision-guided surgical and diagnostic applications, including overlay of images and augmented reality (AR) visualization

FEATURES

FEATURE	HIGHLIGHTS
Small Form Factor Packaging	<ul style="list-style-type: none"> • Package sizes as small as 10x10 mm, with many devices offered at 12x12 mm • BGA pitch of 0.5 mm to 1.0 mm for either compact camera development or frame grabbers • Chip-scale packaging for cost-optimized applications
Sensor Compatibility	<ul style="list-style-type: none"> • Compatible with the latest communication standards such as MIPI, Sub-LVDS, SLVS-EC
Optimal Combination of On-chip Memory and DSP Resources	<ul style="list-style-type: none"> • Hard memory controller LPDDR4x/5 at up to 4266 Mb/s • Optimal DSP resources for compact cameras and frame grabbers
Reduced Power Consumption	<ul style="list-style-type: none"> • Up to 30% power reduction¹ with 16nm FinFET • Power efficiency through hardened DDR and PCIe[®]
Transceiver & PCIe[®]	<ul style="list-style-type: none"> • Up to 8 GTH at 16.3 Gb/s • Up to PCIe[®] Gen4x 8
Flexible I/O	<ul style="list-style-type: none"> • High 3.3V I/O count • A mix of 3 different I/Os: HDIO, HPIO, and the latest, XP5IO
The Most AMD Security Features Available	<ul style="list-style-type: none"> • Offers the most security features² of any AMD cost-optimized FPGA product • PQC with NIST-approved algorithms and AES-GCM for secure configuration • Each device is unique and identifiable through Physical Unclonable Function • True Random Number Generator, essential for robust and reliable encryption

NEXT STEPS

To learn more about automation with AMD FPGAs, visit our solutions websites: www.xilinx.com/applications/industrial/machine-vision-systems.html and www.xilinx.com/applications/medical.html

For more information on the AMD Cost-Optimized Portfolio, visit www.amd.com/cost-optimized

To contact your local AMD sales representative, visit www.amd.com/en/forms/product-inquiry/adaptive-socs-and-fpgas.html

ENDNOTES

1. Projection is based on AMD Labs internal analysis in January 2024, using Total Power calculation (Static plus Dynamic power) based on the difference in logic cell count of an AMD Artix UltraScale+ AU7P FPGA, to estimate the power of a 16nm AMD Spartan™ UltraScale+™ SU35P FPGA versus a 28nm AMD Artix 7 7A35T FPGA, using Xilinx Power Estimator (XPE) tool version 2023.1.2. Actual Total power will vary when final products are released in market, based on configuration, usage, and other factors. (SUS-003)

2. Based on AMD internal analysis in December 2023, using the product datasheets to compare the number of security features a in Spartan™ UltraScale+™ FPGAs to previous generation AMD cost-optimized FPGAs. (SUS-002)

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