

Rugged 3U VPX Video & AI Processing Engine

Capture. Process. Infer. Encode. Stream. All inside a single rugged 3U VPX module.

Overview

VPX3-VIDEO-AI is a rugged 3U VPX video and AI processing engine designed to bring complete real-time video intelligence inside a single embedded module.

Based on AMD Versal™ Prime and AI Edge Series Gen 2 adaptive SoC technology, the board combines high-speed video acquisition, deterministic FPGA processing, AI inference, video encoding, synchronization and VPX backplane connectivity in one compact and rugged platform.

Unlike conventional architectures requiring separate video capture, FPGA, GPU, network and carrier boards, VPX3-VIDEO-AI integrates the complete video processing chain directly on the card. This reduces system size, integration effort, latency and hardware complexity while improving deployment readiness for defense, aerospace, UAV, surveillance and mission-computing applications.

VPX3-VIDEO-AI is not only a processing board. It is a complete rugged video intelligence platform.

| <u>Technical Challenge</u> | <u>VPX3-VIDEO-AI Answer</u> |
|-----------------------------------|--|
| Too many separate boards | Single 3U VPX video + AI processing module |
| High integration complexity | Native video I/O, no external FMC+ required |
| Latency-sensitive video pipelines | Dedicated FPGA front-end + Versal processing |
| Need AI close to the sensor | Versal AI Edge Gen2 options |
| Rugged deployment constraints | Air-cooled and conduction-cooled variants |
| Long lifecycle programs | PanaTeQ rugged VPX platform approach |

Key Value Points

Single-card video intelligence

Integrated capture, processing, AI acceleration, encoding and streaming in one 3U VPX module.

Native rugged video I/O

Configurable 12G-SDI and ARINC 818 video interfaces without external FMC+ mezzanine complexity.

Deterministic low-latency architecture

Dedicated Artix UltraScale+ video front-end connected to AMD Versal Gen2 programmable logic.

AI-ready embedded vision

Versal AI Edge Gen2 options with AI Engines, Arm processing, programmable logic, ISP and video codec resources.

VPX system integration ready

PCIe Gen5-capable backplane connectivity, Gigabit Ethernet, optional VITA 66.5 optical links and VITA 67.3 nanoRF.

Rugged lifecycle platform

Air-cooled and conduction-cooled variants targeting demanding defense, aerospace and industrial environments. Video I/O Interfaces

Integrated Video I/O

4x configurable high-speed video inputs

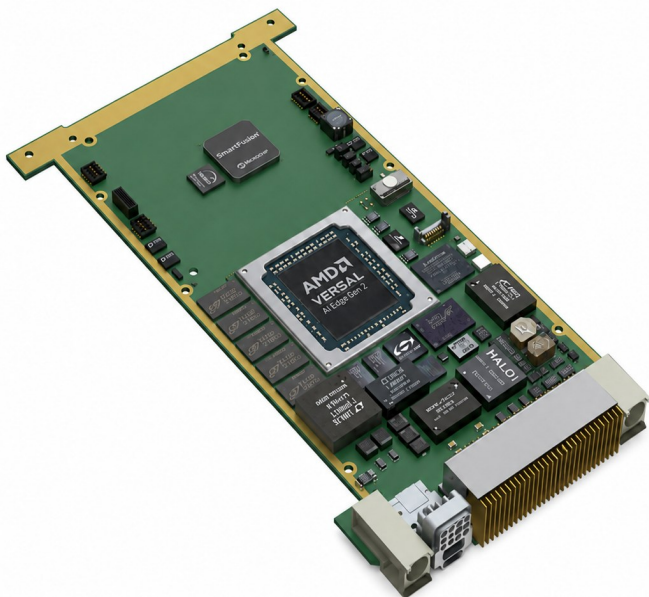
4x configurable high-speed video outputs

Target support for 12G-SDI and ARINC 818

Dedicated Artix UltraScale+ Video Grabber FPGA

Optional VITA 66.5 optical and VITA 67.3 nanoRF interfaces

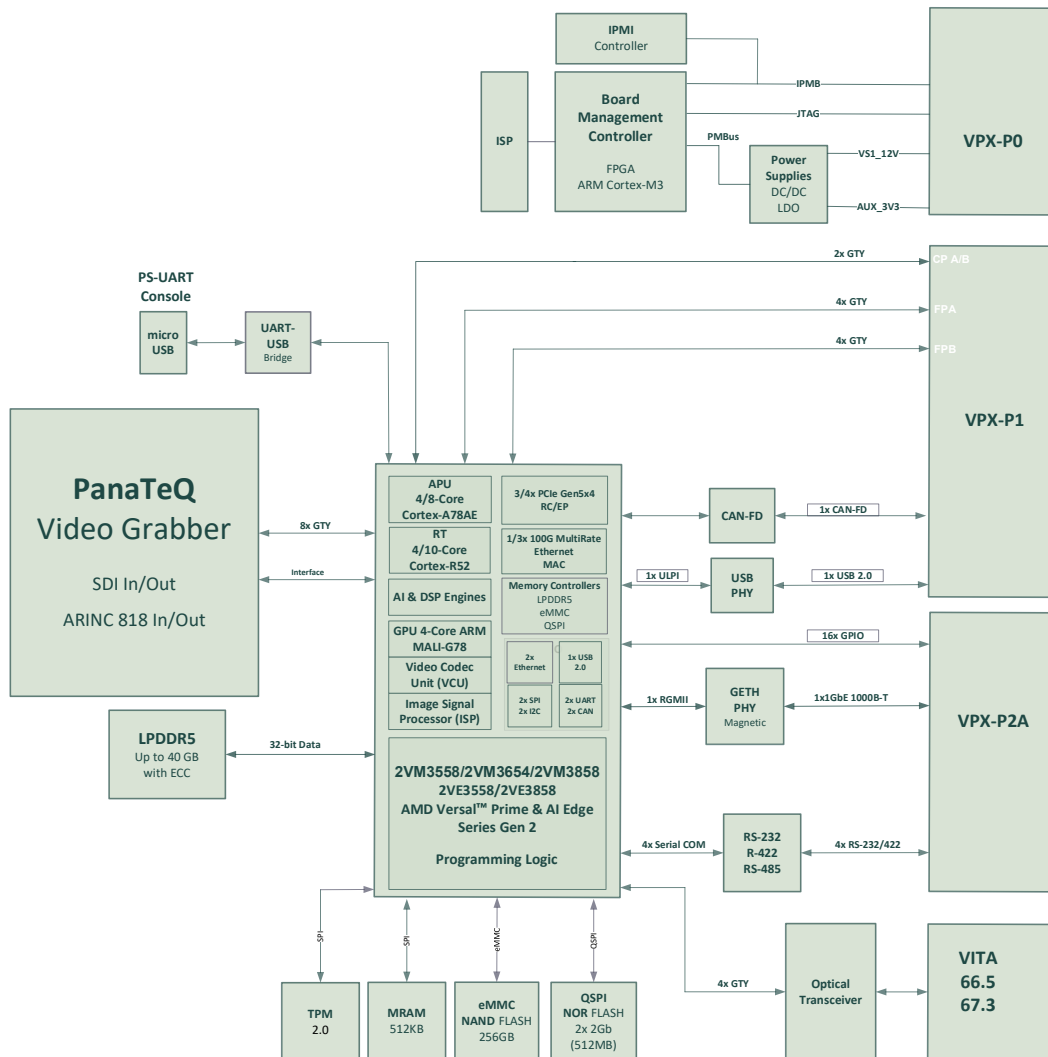
Trigger, frame sync, PPS and GPIO synchronization support



Target Applications

- Rugged airborne video processing
- UAV and autonomous platform vision
- ISR payloads and surveillance systems
- AI-based object detection and tracking
- Mission computer video acceleration
- Multi-camera sensor fusion
- ARINC 818 and 12G-SDI video routing
- Low-latency compression and streaming
- Optical video transport over VPX
- Industrial, medical and scientific imaging

Block Diagram



AMD Versal™ Prime & AI Edge Series Gen2 Overview

VERSAL Prime & AI Edge Series Gen2 Block Diagram



Processing System

Up to 8x Arm® Cortex®-A78AE application processors and up to 10x Cortex-R52 real-time processors designed to offer over 200k DMIPs of total compute with support for USB 3.2, DisplayPort™ 1.4, 10 GbE, PCIe® Gen5, and additional peripherals.

Programmable Logic & I/O

World-class Versal programmable logic and new high-performance X5IO with MIPI C-PHY support provide flexibility, real-time processing, and future adaptability.

AI Engines

New AIE-ML v2 tiles designed to deliver 2X compute/tile compared to previous generation, 3 robust energy efficiency, and new native data types—including MX6 & MX9 designed to boost throughput & performance/watt.

Safety and Security Features

Upgraded safety and security features include ASIL D / SIL 3 operation of the processing system, NoC, memory controllers, a new application security unit, and other security enhancements over the previous generation. The processing system offers up to 100k DMIPs of compute for ASIL D / SIL 3 applications.⁴

Hard Image/Video Processing

New hard image signal processor (ISP) IP accelerates image processing and enhanced video codec unit (VCU) tiles support HEVC & AVC 4K60 4:4:4, 12-bit encode & decode.

DDR5 & LPDDR5X

Hard DDR memory controllers support DDR5-6400 and LPDDR5X 8533 with new inline crypto functionality—offering up to 170 GB/s memory bandwidth.

Integrated GPU

An Arm Mali™-G78AE GPU enables display/HMI applications at up to 4K60 resolutions with up to 268 GFLOPs of compute.⁵ Read the white paper for additional information.

Board Specifications

3U VPX Interfaces

- VITA 46.0/46.4/46.6/65.0 VPX/OpenVPX Specifications compliant
- Optional SOSA Aligned VPX3-VIDEO-AIS. Please contact us for more details
- Up to 8x MGTY connected to/from VERSAL device. PCIe x4 up to Gen5 support
- 2x 1000BASE-X/SGMII links on VPX Control Plane
- 1x 1000BASE-T, 4x RS-232 or 2x Full-Duplex RS-422, 1x USB 2.0, 16x GPIOs, 1x CAN-FD.
- On-board IPMI SOSA compliant, System Controller. JTAG Support

OpenVPX VITA 65.0 Profiles

- MOD3-PAY-1F2F2U-16.2.2-n using slot profile **SLT3-PAY-1F2F2U-14.2.2**
- Optional 4x Full-Duplex Optical Links VITA 66.5 and 10x nanoRF VITA 67.3. Please contact us for more details

SOSA Aligned Profiles

- Please contact us for more details

AMD Versal™ Prime and AI Edge Series Gen 2

- Supported Prime Gen2 Devices: 2VM3558/2VM3654/2VM3858 SSVA2112 Package (Speed Grade -1/2/3)
- Supported AI Edge Gen2 Devices: **2VE3558/2VE3858 SSVA2112** Package (Speed Grade -1/2/3)
- Processing System : Up to 8 Cores Arm® Cortex®-A78AE, 64 KB I w/parity & D w/ECC L1 Cache, 512 KB L2 Cache
- Real-Time Processing Unit : Up to 10 Arm Cortex-R52, 32 KB L1 Cache w/ECC, 128 KB TCM w/ECC
- Programmable Logic: 492,188 Logic Cells (**2VM3558/2VE3558**) / 1,188,040 Logic Cells (**2VM3858/2VE3858**)
225,000 LUTs (**2VM3558/2VE3558**) / 543,104 LUTs (**2VM3858/2VE3858**)
- On-Chip Memories: 23.9Mb (**2VM3558/2VE3558**) / 97.0Mb (**2VM3858/2VE3858**)
- AI Engines: 96 (**2VE3558**) / 144 (**2VE3858**)
- DSP Engines: 700 (**2VM3558/2VE3558**) / 2064 (**2VM3858/2VE3858**)
- Hard IPs: 3x PCIe Gen5x4, 3x 100G Multirate Ethernet MAC
- High Speed Serial Links: 12/20 full duplex, high performance, GTY Multi-Gigabit Transceivers (MGT) @ up to 32.75 Gb/s

External Memories

- Up to 40GB of LPDDR5 Programmable Logic (PL) memory, 32-bit data, with ECC
- 256GB eMMC of managed NAND Flash memory. HS200 support @ up to 100MB/s
- 512KB of SPI MRAM (NVRAM), Flash-memory-based trusted platform module (TPM 2.0)
- 2x 2Gb (512MB) of QSPI NOR Flash memory for booting VERSAL Programmable Logic and Firmware Processing System

Board Management Controller (BMC)

- Based on Microsemi SmartFusion Customizable System-on-Chip (**cSoC**) with on-chip ARM Cortex-M3 at up to 100MHz
- Real-Time Monitoring+Alarms: Voltages, Currents, Temperatures, 6-Axis Accelerometer, Magnetometer and Humidity
- Reset Management, Power-Up and Power-Down Sequencing. Built-In Test (**BIT**)
- Large private 32MB Event Log Flash Memory.
- UART communication with host using RTM-VIDEO-AI Rear-Transition Module
- Smart Power Management using Linear Technology DC/DC modules with Digital Power System Management.
- On-board VPX System and IPMI controllers.

Environmental Specifications

- Compliant with VITA 47 specification. Please contact PanaTeQ for more information

Video I/O Interfaces

- Integrated video I/O architecture, no FMC+ mezzanine required.
- Dedicated **PanaTeQ Video Grabber FPGA** based on **AMD Artix UltraScale+** technology used as a video front-end interface between the external video interfaces and the AMD Versal Gen2 device.
- The Artix UltraScale+ FPGA manages the low-level video interfaces, including SDI / ARINC 818 physical interface adaptation, video stream capture, protocol handling, synchronization, formatting and data transfer to the Versal device.
- 4x configurable high-speed video input channels supporting SDI or ARINC 818 interfaces, depending on firmware and product configuration.
- 4x configurable high-speed video output channels supporting SDI or ARINC 818 interfaces, depending on firmware and product configuration.
- Target SDI standards: SD-SDI, HD-SDI, 3G-SDI, 6G-SDI and 12G-SDI up to 11.88 Gb/s per channel.
- ARINC 818 support for rugged avionics video transport over high-speed serial links, with line rate depending on selected firmware, interface configuration and device speed grade.
- High-speed internal interface between the Artix UltraScale+ Video Grabber FPGA and the Versal Gen2 device for low-latency video data transfer.
- Optional VITA 66.5 full-duplex optical interface supporting 4x 10 Gb/s or 4x 25 Gb/s links for optical video, ARINC 818, Ethernet, Aurora or customer-specific serial protocols.
- Optional VITA 67.3 nanoRF interface for coaxial video, synchronization, trigger, clock reference or customer-specific signals.
- Video synchronization support through trigger, frame sync, PPS, GPIO or optional external reference clock.
- Versal Gen2 device used for higher-level video processing, AI inference, ISP processing when available, metadata insertion, overlay, H.264/H.265 encoding when VCU-equipped devices are selected, PCIe transfer and Ethernet/optical streaming.

Product Codification

The VPX3-VIDEO-AI can be assembled with different versions of the VERSAL devices and various amounts of memory storage. The cooling technique et ruggedization level are also available options. The following table shows the product coding for all these options.

VPX3-VIDEO-AI- abc-d-rl-e-k

| a | Device | APU Arm A78AE | RT Arm Cortex-R52 | AI AIE-ML v2 Tiles | DSP Engines | Arm Mali-G78AE GPU | Video Codec Unit (VCU) | Image Signal Processor (ISP) | Logic Cells | LUTs | PL Memory |
|---|---------|------------------|-------------------------|--------------------------|----------------|--------------------------|---------------------------|------------------------------------|-------------|---------|-----------|
| A | 2VM3558 | 8-Core | 10-Core | 0 | 700 | 4-Core | 1 | 0 | 492,188 | 225,000 | 23.9 Mb |
| B | 2VM3654 | 4-Core | 6-Core | 0 | 1428 | 1-Core | 2 | 0 | 695,800 | 318,080 | 55.2 Mb |
| C | 2VM3858 | 8-Core | 10-Core | 0 | 2064 | 4-Core | 1 | 0 | 1,188,040 | 543,104 | 97.0 Mb |
| D | 2VE3558 | 8-Core | 10-Core | 96 | 700 | 4-Core | 1 | 3 | 492,188 | 225,000 | 23.9 Mb |
| E | 2VE3858 | 8-Core | 10-Core | 144 | 2064 | 4-Core | 1 | 3 | 1,188,040 | 543,104 | 97.0 Mb |

| b | Device Speed Grade |
|---|--------------------|
| 1 | Slowest |
| 2 | Mid |
| 3 | Highest |

| c | LPDDR5 Memory |
|---|---------------|
| N | 20GB |
| M | 40GB |

| rl | Ruggedization Level | VITA 47 |
|----|---------------------|---------|
| AS | Air Standard | EAC4 |
| AR | Air Rugged | EAC6 |
| CC | Conduction Cooled | ECC3 |

| d | Optical Links VITA 66.5 |
|---|-------------------------|
| O | 4x 10Gbps |
| F | 4x 25Gbps |

| e | Tropicalization |
|---|-------------------|
| E | Conformal Coating |

| k | Backplane Connectors |
|---|----------------------|
| K | KVPX Connectors |

Ordering Information

The following product references are offered by Panateq as standard products. Other combinations of devices, speed grade, memory and cooling can be specially ordered. Please contact us for details

| Reference | Description |
|-----------------------------|---|
| RTM-VIDEO-AI | Rear Transition Module for VPX3-VIDEO-AI |
| VPX3-VIDEO-AI-PSDK-A-A1M-AS | VPX3-VIDEO-AI-A1N-AS System Development Kit |

| Reference | Device | Speed Grade | Memory LPDDR5 | Ruggedization Level |
|----------------------|---------|-------------|---------------|---------------------|
| VPX3-VIDEO-AI-A1N-AS | 2VM3558 | -1 | 20GB | Standard Air Cooled |