Ambarella’s ASIL B(D)-compliant CV3 domain controller system on chip (SoC) provides industry-leading AI performance per watt for neural network (NN) computation, with a performance increase of over 40x compared to Ambarella’s prior automotive family of SoCs. In addition, CV3 includes a general vector processor (GVP), an advanced image processor, a dense stereo and optical flow engine, up to 16 Arm® Cortex®-A78AE CPUs, and an automotive GPU, in a single SoC. Ambarella’s highly-efficient CVflow®, artificial intelligence (AI) engine enables high performance, low latency, and low-power neural network processing for ADAS and L2+ to L4 autonomous vehicles. CVflow’s neural vector processor (NVP) is enhanced to support the latest advancements in NN inference. The NVP is complemented by the new floating-point GVP, designed to offload classical computer vision and radar processing off the NVP engines and floating-point intensive algorithms from the Arm CPUs.

The ISP provides outstanding imaging in low-light conditions, while its high dynamic range (HDR) processing extracts maximum image detail in high-contrast scenes, enhancing the AI and computer vision capabilities of the chip while delivering crisp video for viewing. CV3 delivers high-resolution video recording and streaming at very low bit rates with efficient encoding in H.265 and H.264 video formats. It includes a hardware security module (HSM), which provides isolation of different domains, secure software provisioning, a suite of advanced cybersecurity features such as asymmetric / symmetric crypto acceleration, secure storage and key provisioning, encrypted CVflow tasks, true random number generator (TRNG), one-time programmable memory (OTP), DRAM scrambling and DRAM virtualization.

Fabricated in an advanced 5 nm process technology, the CV3 is an ideal platform for implementing autonomous driving for vehicles from L2+ to L4, single- and multi-camera ADAS, DMS and in-cabin solutions, single- and multi-channel electronic mirrors with BSD, and intelligent parking assistance systems.
The CV3 domain controller development platform contains the necessary tools, software, hardware, and documentation to develop ADAS and L2+ to L4 autonomous vehicles utilizing the powerful CVflow processor, while supporting development of customized features.

**Evaluation Kit (EVK)**
- CV3 main board with connectors for sensor / lens board and peripherals
- Sensor boards
- Datasheet, BOM, schematics, and layout
- SDK and reference application with C source code available with additional licensing

**Software Development Kit (SDK)**
- SDK, OS, and middleware
- Royalty-free libraries for ISP, dewarp, and video recording
- Image tuning and manufacturing calibration tools
- Detailed documentation with programmer’s guide and application notes
- Tools to optimize, port, and profile NN / DNN

**General Specifications**
- **Computer Vision AI Processor**
  - CVflow processor optimized for high-performance and power-efficient, neural network compute
  - Neural vector processor (NVP) with industry-leading AI performance per watt
  - General vector processor (GVP) for offloading classical computer vision and radar processing, and floating-point intensive algorithms
  - Stereo engine for disparity map generation
  - Dense optical flow engine

- **Processor Cores**
  - Up to 16 core Arm® Cortex®-A78AE for processing island
  - Arm Cortex lockstep cores for safety island
  - NEON™ SIMD and FPU acceleration

- **Graphics Processing Unit**
  - Automotive GPU for 3D surround view rendering

- **Camera and Radar Input**
  - 12x MIPI CSI-2® (4x-lane, MIPI D-PHY)
  - Up to 20 cameras using MIPI virtual channels

- **Video Output**
  - HDMI® 2.0 including PHY with CEC support
  - Two MIPI CSI-2 / MIPI DSI® ports

- **CMOS Sensor / Image Processing**
  - Lens shading, fixed-pattern noise correction
  - Multi-exposure HDR (line-interleaved sensors)
  - 3D motion-compensated temporal filtering (MCTF)
  - RGGB / RCCB / RCCC / RGB-IR / monochrome sensor support
  - Multi-ROI HW scaler
  - Adjustable AE / AWB
  - Dynamic range (WDR and HDR) engine
  - Chromatic aberration correction
  - Geometric distortion correction
  - Gamma compensation and color enhancement
  - Vignetting compensation
  - 3-axis electronic image stabilization (EIS)
  - Crop, mirror, flip, 90° / 270° rotation

- **Video Encoding**
  - H.264 / H.265 MP / HP L5.0 and MJPEG
  - Flexible GOP configuration with I and P frames
  - Multiple CBR and VBR rate control modules

- **Hardware Security Module (HSM)**
  - Asymmetric / symmetric crypto acceleration, domain isolation, secure storage and key provisioning, encrypted CVflow tasks, TRNG, OTP, DRAM scrambling, and DRAM virtualization

- **Tools for Development**
  - Neural Network toolkit to ease the porting of NNs trained using frameworks such as Caffe, TVM, PyTorch, TensorFlow, TensorFlowLite, Keras, and ONNX
  - Compiler, debugger, and profiler for both Arm and microcode development

- **Memory Interfaces**
  - LPDDR5 / LPDDR5x, up to 256-bit data bus for data, up to 128 GB capacity
  - Multiple SD controllers
  - Boot from PCIe / SPI NAND / SPI NOR / USB / eMMC

- **Peripheral Interfaces**
  - Multiple 10 / 100 / 1000 Ethernet with RMII / RGMII
  - Multiple 4-lane PCIe interfaces
  - USB 3.2 host / device and USB 2.0 device only with PHY
  - i²S input and output interfaces, DMIC
  - Multiple CAN FD interfaces
  - Multiplexed UART and I/F of SSI / IDC
  - Multiple GPIO ports, PWM, and IR interfaces
  - Watchdog timer, general purpose timers, and JTAG

- **Physical**
  - 5 nm low-power CMOS
  - HFC BGA package
  - Operating temperature -40°C to +125°C (Tj)
  - Automotive qualified (AEC-Q100 Grade-2, ASIL B/D)

**CV3 Domain Controller Development Platform**

The CV3 domain controller development platform contains the necessary tools, software, hardware, and documentation to develop ADAS and L2+ to L4 autonomous vehicles utilizing the powerful CVflow processor, while supporting development of customized features.

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