Ambarella
AI envisioned™

CV5

8K AI Vision Processor

Key Features

High-Efficiency Video Encoding
- H.265 and H.264 video compression
- Flexible multi-streaming capability
- 8KP60 video performance
- Multiple CBR and VBR bit rate control modes
- Smart H.264 and H.265 encoder algorithms

Computer Vision Engine CVflow®
- CNN / DNN-based processing: detection, classification, and more
- Accelerators for conventional CV operations
- CNN toolkit for easy porting of neural networks implemented in Caffe, TensorFlow, PyTorch, or ONNX frameworks

Advanced Image Processing
- Multi-exposure line-interleaved HDR
- Hardware dewarping engine
- Electronic image stabilization (EIS)
- Multiple camera support
- LED flicker mitigation
- 3D motion-compensated temporal filtering (MCTF)
- Superior low-light processing
- RGGB / RCCB / RCCC / RGB-IR / monochrome sensor support

Target Applications
- Sports cameras
- Robotic cameras
- Drones
- VR cameras
- Multi-channel drive recorders / data loggers
- Multi-camera aftermarket ADAS systems
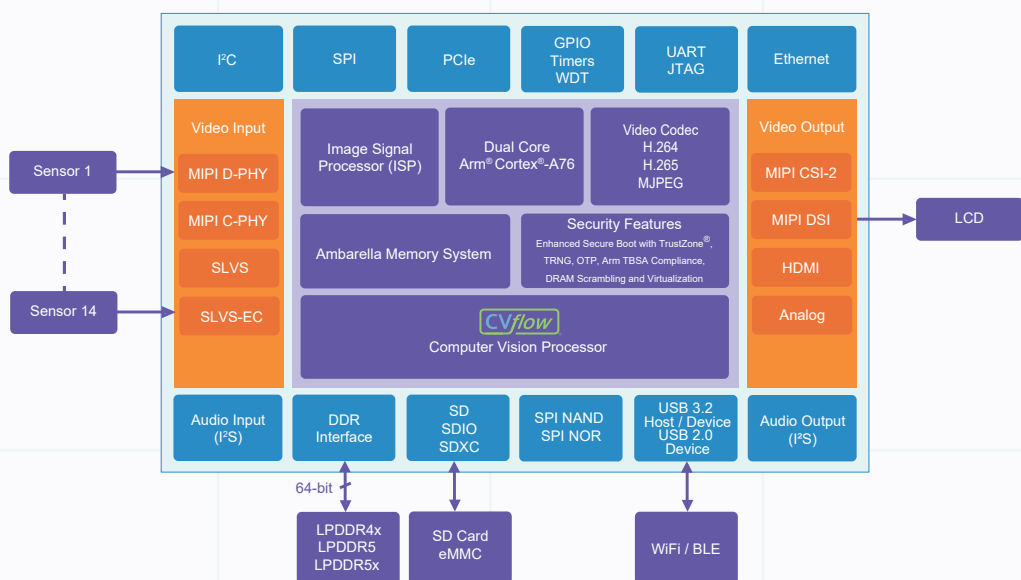
Ambarella
CV5-A0-RH
CAB2BC
S34523
CV5

Overview

Ambarella's CV5 provides 8K image processing, video encoding / decoding, and CVflow® computer vision processing in a single, low-power design. Fabricated in advanced 5 nm process technology, it achieves power consumption below 2W for 8K video recording at 30 fps, and below 5W for 8K video recording at 60 fps. The CV5's CVflow architecture provides the deep neural network (DNN) processing required for the next generation of intelligent cameras.

CV5's advanced image signal processor (ISP) provides outstanding imaging in low-light conditions, while high dynamic range (HDR) processing extracts maximum image detail in high-contrast scenes, further enhancing the computer vision capabilities of the chip. CV5 includes efficient 8K encoding in both AVC and HEVC video formats, delivering high-resolution video recording and streaming with very low bitrates. The CV5's CVflow architecture provides computer vision processing at full 8K, enabling image recognition over long distances, with high accuracy.

The exceptionally low power consumption of the CV5 SoC makes it an ideal solution for the next generation of high-resolution and high frame-rate action / sports cameras, robotic cameras, VR cameras, and consumer / industrial drones. In the video telematics space, CV5 provides image processing and both AVC and HEVC recording for video feeds from multiple cameras, employing CVflow ADAS algorithms to provide lane departure warning, forward collision warning, driver monitoring, and more. To help customers easily port their own neural networks onto the CV5 SoC, Ambarella's software development kit offers a complete set of tools for software and AI implementation.

I²C	SPI	PCIe	GPIO Timers WDT	UART JTAG	Ethernet

Video Input
- MIPI D-PHY
- MIPI C-PHY
- SLVS
- SLVS-EC

Sensor 1
Sensor 14

Image Signal Processor (ISP)
Dual Core Arm® Cortex®-A76
Video Codec H.264 H.265 MJPEG

Ambarella Memory System

Security Features
Enhanced Secure Boot with TrustZone®, TRNG, OTP, Arm TBSA Compliance, DRAM Scrambling and Virtualization

CVflow
Computer Vision Processor

Video Output
- MIPI CSI-2
- MIPI DSI
- HDMI
- Analog

LCD

Audio Input (I²S)
DDR Interface
SD SDIO SDXC
SPI NAND SPI NOR
USB 3.2 Host / Device USB 2.0 Device
Audio Output (I²S)

64-bit

LPDDR4x LPDDR5 LPDDR5x
SD Card eMMC
WiFi / BLE

CV5 Block Diagram

General Specifications

Processor Cores
- Dual-core Arm® Cortex®-A76 up to 1.6 GHz
- 64 KB / 64 KB L1 cache, 256 KB L2 cache, and 1024 KB L3 cache
- NEON™ SIMD and FPU acceleration
- AES / SHA-2 / ED25519 crypto acceleration

Computer Vision Processor
- CVflow processor with parallel architecture to boost performance of the low-level portion of perception algorithms

Video Input
- 12-lane SLVS-EC (1–8 lane single link, 1-6 lane * 2 dual link)
- 2x MIPI DC-PHY
  - Each DC-PHY supports C-PHY mode (1–3 lanes) or D-PHY mode (1–4 lanes)
- 2x MIPI D-PHY (1–4 lanes each)
- 2x SLVS (1–4 lanes each)
- Up to 14 cameras using MIPI virtual channels

Video Output
- HDMI® 2.0 including PHY with CEC support
- PAL / NTSC composite SD video
- 2x MIPI DSI / CSI-2

CMOS Sensor / Image Processing
- Processing up to 8KP60 (1920 MPixel/s)
- Lens shading, fixed-pattern noise correction
- Multi-exposure HDR (line-interleavened sensors)
- 3D motion-compensated temporal filtering (MCTF)
- RGGB / RCCB / RCCC / RGB-IR / monochrome sensor support
- Adjustable AE / AWB
- LED flicker compensation for LED sources
- Advanced dynamic range (WDR and HDR) engine
- Chromatic aberration correction
- 180° and 360° fisheye lens and geometric distortion correction
- OSD engine and overlays
- Gamma compensation and color enhancement
- Vignetting compensation
- 3-axis electronic image stabilization (EIS)
- Crop, mirror, flip, and 90° / 270° rotation

Video Encoding / Decoding
- H.265 (HEVC) MP L6.1, H.264 (AVC) MP / HP L6.1, and MJPEG
- 8KP60 maximum encoding / decoding performance
- Flexible GOP configuration with I, P, and B frames
- Multiple CBR and VBR rate control modules

Security Features
- Enhanced secure boot with TrustZone® and secure memory, true random number generator (TRNG), one-time programmable memory (OTP), Arm trusted base system architecture (TBSA) compliance, DRAM scrambling, and virtualization

Tools for Development
- CNN toolkit to ease the porting of CNNs trained using frameworks such as Caffe, PyTorch, TensorFlow, or ONNX
- Compiler, debugger, and profiler for both Arm and microcode development

Memory Interfaces
- LPDDR4x up to 4.2 Gbits/s / LPDDR5(x) up to 7 Gbits/s, 64-bit data bus, up to 32 GB capacity for LPDDR5(x) and 16 GB for LPDDR4x
- Three SD controllers
- Single- / dual- / quad- / octal-SPI NOR and single- / dual- / quad-SPI NAND
- Boot from SPI NAND / SPI NOR / USB / eMMC

Peripheral Interfaces
- 4-lane PCIe
- 1x USB 3.2 host / device and 1x USB 2.0 device only with PHY
- 2x I²S input and output interfaces, 1x DMIC
- 2x CAN FD interface
- Multiplexed 5x UART and 6 I/F of SSI / IDC
- Multiple GPIO ports, PWM, IR, and ADC
- Watchdog timer, general purpose timers, and JTAG

Physical
- 5 nm low-power CMOS technology
- 16 mm x 16 mm FC TFBGA with 0.5 mm ball pitch
- Operating temperature -20°C to +85°C (additional operational temperature options available)

CV5 Camera Development Platform

The CV5 camera development platform contains the necessary tools, software, hardware, and documentation to develop a camera utilizing the powerful CVflow processor while supporting the development of customized features.

Evaluation Kit

- CV5 main board with connectors for sensor / lens board and peripherals
- Sensor board: Sony, ON Semi, Omnivision, and others
- Datasheet, BOM, schematics, and layout
- SDK and reference application with C source code

Software Development Kit

- Royalty-free libraries for ISP, dewarp, and video recording
- Image tuning and manufacturing calibration tools
- Detailed documentation, including a programmer's guide and more
- CNN / DNN model preparation, porting, and profiling tools

www.ambarella.com/contact-us/