



# CV22A

## Aftermarket Automotive Computer Vision SoC

### Overview

Ambarella's CV22A SoC combines image processing, 8MP30 video encoding, and CVflow<sup>®</sup> computer vision processing in a single, low-power design, making it an ideal choice to power the next generation of intelligent automotive dash cameras. The CV22A's CVflow architecture provides the deep neural network (DNN) processing required for implementing computer vision algorithms on the camera. Fabricated in advanced 10 nm process technology, it achieves an industry-leading combination of low-power and high-performance in both human vision and computer vision applications.

CV22A implements an highly efficient 8MP30 AVC (H.264) / HEVC(H.265) encoder in hardware along with an industry-leading image signal processor (ISP). The CV22A's 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. The flexible architecture allows encoding of multiple streams that are optimized for storage and video streaming over WiFi / BLE at the same time. The chip also supports ultra-wide angle and fisheye lenses by performing distortion correction of the video in hardware. The CV22A's CVflow architecture provides computer vision processing at full 8MP resolution to enable image recognition over long distances and with high accuracy. The CVflow core allows implementation of algorithms such as forward collision warning, lane departure warning, driver monitoring, and so on. A complete set of tools is provided to help customers easily port their own neural networks onto the CV22A SoC.



The CV22A chip targets dashcam designs

### Key Features

#### Computer Vision Engine **CVflow<sup>®</sup>**

- CNN- / DNN-based processing: detection, classification, tracking, and more
- Computer vision processor
- Tools for high- and low-level algorithm development
- CNN toolkit for easy porting with Caffe, TensorFlow, and ONNX
- Open SDK

#### Advanced Image Processing

- Multi-exposure line-interleaved HDR
- Hardware dewarping engine support
- Electronic image stabilization (EIS)
- Support for multiple cameras
- LED flicker mitigation
- 3D motion compensated temporal filtering (MCTF)
- Superior low-light processing
- Support for RRGB, RCCB, RCCC, RGB-IR, and monochrome sensors

#### High-Efficiency Video Encoding

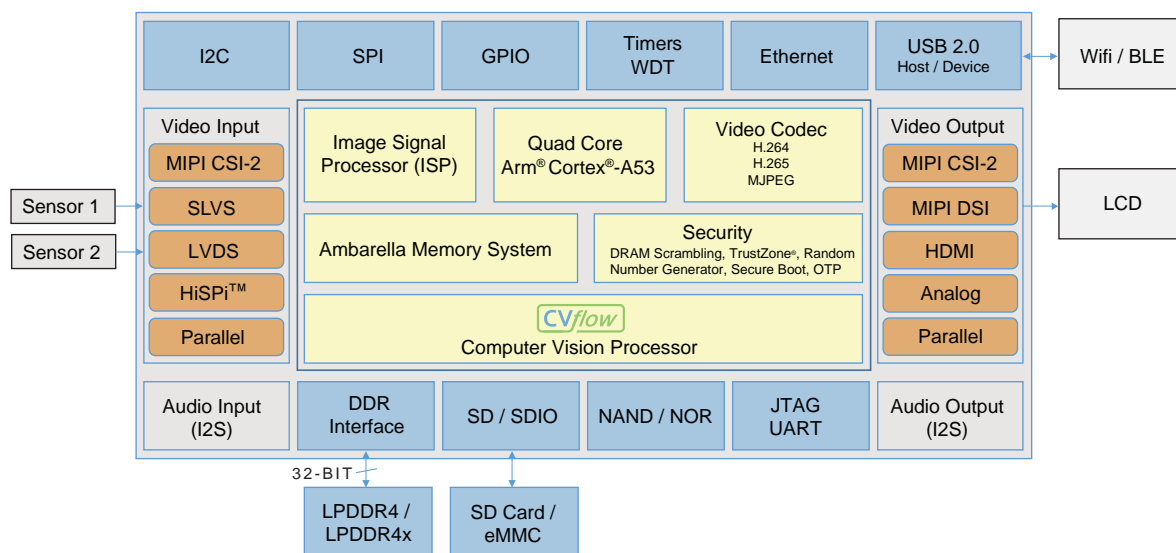
- H.265 and H.264 video compression
- Flexible multi-streaming capability
- 8MP30 video performance
- Multiple CBR and VBR bit rate control modes
- Smart H.264 and H.265 encoder algorithms

#### Target Applications

- Multi-channel drive recorder
- Single- / multi-channel eMirror
- Aftermarket ADAS
- Driver / cabin monitoring system (DMS / CMS)

### Block Diagram

The diagram below illustrates a dashcam based on the Ambarella CV22A device.



## General Specifications

### Processor Cores

- Quad-core Arm® Cortex®-A53 up to 1.0 GHz
- 32 KB / 32 KB I/D and 1 MB L2 Cache
- NEON™ SIMD and FPU acceleration
- OTP, secure boot, TrustZone®, IO virtualization
- AES / 3DES / SHA-1 / MD5 crypto acceleration

### Video Input

- Single or dual sensor input with independent ISP configuration
- Sub-LVDS / MIPI CSI-2 / SLVS / HiSPi™
- 16-bit parallel LVC MOS (BT.601 / 656)

### Video Output

- 16-bit parallel LVC MOS (BT.601)
- HDMI® 2.0 including PHY with CEC support
- PAL / NTSC composite SD video
- MIPI DSI / CSI-2 and FPD (VESA / JEIDA)

### CMOS Sensor Processing / Image Processing

- 8MP30 maximum input resolution
- Lens shading, fixed pattern noise correction
- Multi-exposure HDR (line-interleaved sensors)
- 3D motion compensated temporal filtering (MCTF)
- RRGB / 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° 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, 90° / 270° rotation

### Video Encoding

- H.265 (HEVC) MP L5.1, H.264 MP / HP L5.1, and MJPEG
- 8MP30 maximum encoding performance
- Up to 8 simultaneous stream encodes
- Flexible GOP configuration with I, P, and B frames
- Multiple CBR and VBR rate control modules

### Computer Vision Processor

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

### Tools for Development

- CNN toolkit to ease the porting of CNN trained with Caffe, TensorFlow, or ONNX
- Compiler, debugger, and profiler for both Arm and Microcode development

### Memory Interfaces

- LPDDR4x / LPDDR4 up to 1.8 GHz clock rate, 32-bit data bus, up to 2-Gbyte capacity
- Two SD controllers
- Boot from SPI / parallel SLC NAND with BCH / SPI NOR / USB / eMMC
- Single- / dual- / quad-SPI NOR and SPI NAND

### Peripheral Interfaces

- One USB 2.0 port configurable as device / host w/PHY
- Audio interface including I<sup>2</sup>S
- Multiple SSI / SPI, IDC, and UART
- Multiple GPIO ports, PWM, Steppers, IR, ADC
- Watchdog timer, multiple general purpose timers, JTAG

### Physical

- 10 nm low-power CMOS
- FBGA package (441 balls, 16x16 mm, 0.65 mm pitch)
- Operating temperature -20°C to +85°C (additional temperature option available)

## Computer Vision (CV) Applications

The CV22A vision processor enables different CV applications in different markets with its state-of-the-art technology.

### Perception Applications

- Driver and in-cabin monitoring system (DMS, CMS)
  - Driver drowsiness / distraction
  - Driver intent
  - Cabin monitoring
  - Driver authentication
  - Gesture control
- Object detection / classification (CNN-based)
  - Pedestrians, vehicles
  - Traffic signs, traffic lights
  - Headlight detection
- Free space detection
- Lane marking detection
- Parking lines detection

### Enabled Computer Vision Applications

- Lane departure warning / lane keeping assistance
- Forward collision warning
- Auto emergency braking (AEB)
- Intelligent headlight control / high beam assist
- Speed assist functions
- Auto parking assist (APA)
- Blind spot detection

**Contact** [www.ambarella.com/about/contact/inquiries.html](http://www.ambarella.com/about/contact/inquiries.html)

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