

# CV22A

Automotive Computer Vision SoC

## Key Features

### Computer Vision Engine ®

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

### Advanced Image Processing

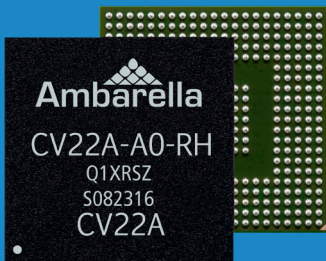
- Multi-exposure line-interleaved HDR
- Hardware dewarping engine support
- Electronic image stabilization (EIS)
- Multiple camera support
- LED flicker mitigation
- 3D motion-compensated temporal filtering (MCTF)
- Superior low-light processing
- RGGB / RCCB / RCCC / RGB-IR / monochrome sensor support

### High-Efficiency Video Encoding

- H.265 and H.264 video compression
- Flexible multi-streaming capability
- 12MP30 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 electronic mirror
- Aftermarket ADAS
- Driver / in-cabin monitoring system (DMS / CMS)

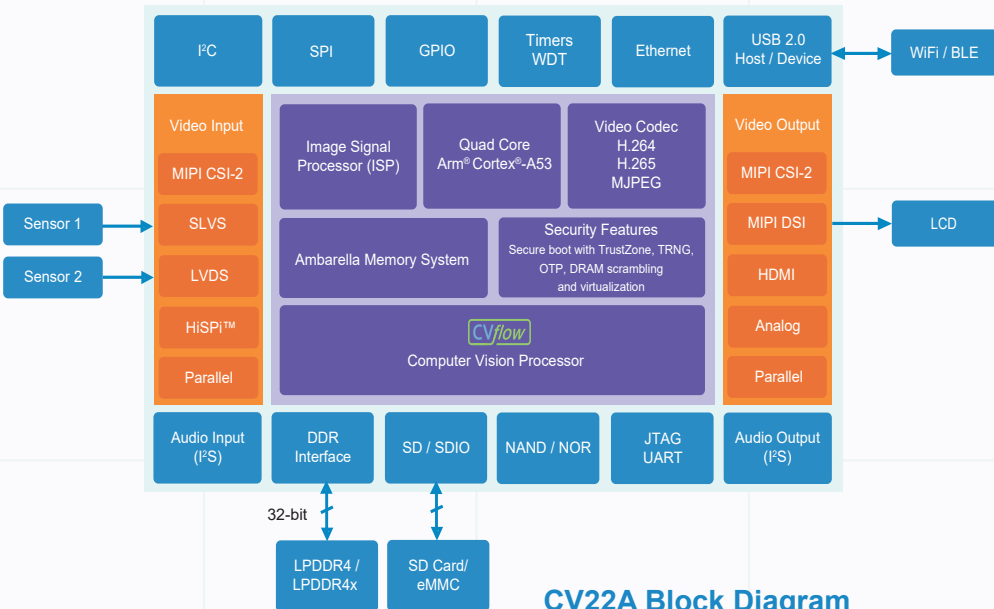


## Overview

Ambarella's CV22A SoC combines image processing, 12MP30 video encoding, and CVflow® computer vision processing in a single, low-power design, making it an ideal choice to enable the next generation of intelligent automotive devices. The CV22A's CVflow architecture provides the deep neural network (DNN) processing required for implementing computer vision algorithms for a wide range of use cases, including dash cameras, aftermarket ADAS devices, and more. 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 a highly efficient 12MP30 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 simultaneously. 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 12MP resolution to enable image recognition over long distances and with high accuracy. The CVflow core allows the implementation of algorithms such as forward collision warning, lane departure warning, driver monitoring, and more. To help customers easily port their own neural networks onto the CV22A SoC, Ambarella's software development kit offers a complete set of tools.



CV22A Block Diagram

# General Specifications

## Processor Cores

- Quad-core Arm® Cortex®-A53 up to 1 GHz
- 32 KB / 32 KB L1 cache, 1 MB L2 cache
- NEON™ SIMD and FPU acceleration
- AES / 3DES / SHA-1 / MD5 crypto acceleration

## Computer Vision Processor

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

## Video Input

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

## Video Output

- 16-bit parallel LVCMOS (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 / Image Processing

- 12MP30 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
- 12MP30 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

## Security Features

- Secure boot with TrustZone®, TRNG, OTP, DRAM scrambling and virtualization

## Tools for Development

- CNN toolkit to ease the porting of CNNs trained using frameworks such as 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 GB 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 with PHY
- Audio interface including I2S
- Multiple SSI / SPI, IDC, and UART
- Multiple GPIO ports, PWM, steppers, IR, and ADC
- Watchdog timer, general purpose timers, and JTAG

## Physical

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

# CV22A Camera Development Platform

The CV22A 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

- CV22A 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

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