

# CV22AQ

## Automotive Computer Vision SoC

### Key Features

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

- 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, TensorFlow, and ONNX

#### Advanced Image Processing

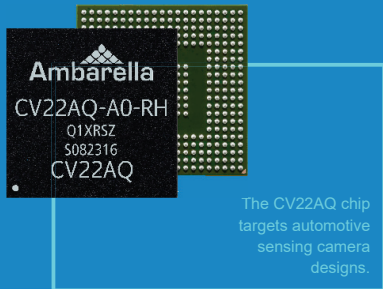
- Multi-exposure line-interleaved HDR
- Hardware dewarping engine support
- Electronic image stabilization (EIS)
- Multiple camera support
- LED flicker mitigation
- 3D motion-compensated temporal filtering (MCTF)
- Superior low-light processing
- RGGG / RCCB / RCCC / RGB-IR / monochrome sensor support

#### High Efficiency Video Encoding

- H.265 and H.264 video compression
- Flexible multi-streaming capability
- 12MP30 video performance
- Multiple CBR and VBR control modes
- Smart H.264 and H.265 encoder algorithms

#### Target Applications

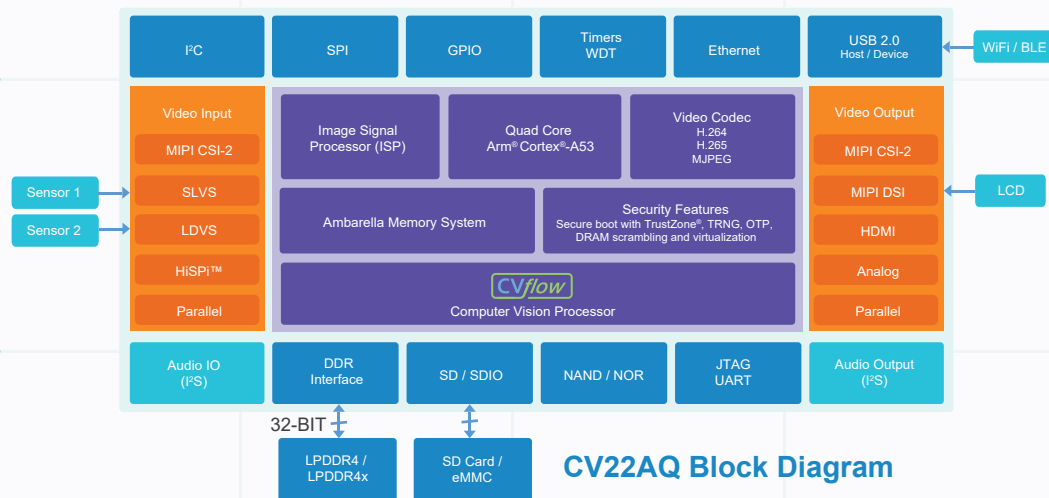
- Multi-channel drive recorder
- AVM / surround view with auto parking assist (APA)
- Single- / multi-channel electronic mirror
- Advanced driver-assistance systems (ADAS)
- Driver / in-cabin monitoring system (DMS / CMS)



## Overview

Ambarella's AEC-Q100 qualified CV22AQ SoC combines image processing, 12MP30 video encoding, and CVflow<sup>®</sup> computer vision processing in a single, low-power design. The CV22AQ's CVflow architecture provides the deep neural network (DNN) processing required by the next generation of intelligent automotive cameras. 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. It is an ideal platform for implementing ADAS, electronic mirror, surround view, and drive recorder solutions.

The CV22AQ's CVflow architecture provides computer vision processing at 12MP resolution, enabling image recognition over long distances with high accuracy. It includes efficient encoding in both AVC and HEVC video formats, delivering high-resolution video streaming with very low bit rates. The CV22AQ's next-generation 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. It includes a suite of advanced cyber-security features such as secure boot with TrustZone<sup>®</sup> and secure memory, true random number generator (TRNG), one-time programmable memory (OTP), DRAM scrambling and virtualization, and a programmable secure level for each peripheral interface. A complete set of tools is provided to help customers easily port their own neural networks onto the CV22AQ SoC.



CV22AQ Block Diagram

# General Specifications

## Processor Cores

- Quad-core Arm® Cortex®-A53 up to 756 MHz
- 32 KB / 32 KB I/D and 1 MB L2 cache
- NEON™ SIMD and FPU acceleration
- Secure boot with TrustZone®, TRNG, OTP, DRAM scrambling and 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 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)
- RGGB / RCCB / RCCC / RGB-IR / monochrome sensor support
- Adjustable AE / AWB
- LED flicker compensation for LED sources
- 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 control modules

## Computer Vision Processor

-  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 1.4 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 I<sup>2</sup>S
- Multiple SSI / SPI, IDC, and UART
- Multiple GPIO ports, PWM, steppers, IR, and ADC
- Watchdog timer, multiple general purpose timers, and JTAG

## Physical

- 10 nm low-power CMOS
- FC TFBGA package (441 balls, 16x16 mm, 0.65 mm pitch)
- Operating temperature -40°C to + 105°C
- Automotive qualified (AEC-Q100 Grade-2)

## CV22AQ Camera Development Platform

The CV22AQ camera development platform contains the necessary tools, software, hardware, and documentation to develop a camera utilizing the powerful CVflow processor while supporting development of customized features.

### Evaluation Kit

- CV22AQ 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 training, profiling, and porting tools

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