Ambarella®
AI envisioned™

CV22AQ

Automotive Computer Vision SoC

Key Features

Computer Vision Engine CVflow®
- Convolutional neural network (CNN-) / deep neural network (DNN)-based processing to enable detection, classification, tracking, and more
- Computer vision (CV) processor
- Tools for high- and low-level algorithm development
- CNN toolkit for easy porting with Caffe, TensorFlow, and ONNX
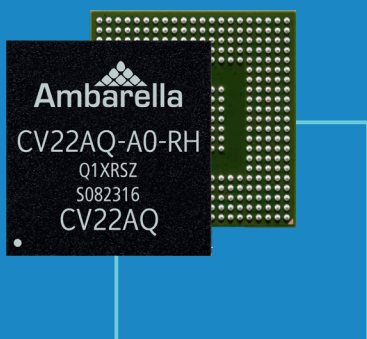
Advanced Image Processing
- Multi-exposure line-interleaved high dynamic range (HDR)
- Hardware dewarping engine support
- Electronic image stabilization (EIS)
- Multiple camera support
- 3D motion-compensated temporal filtering (MCTF)
- Superior low-light processing
- RGGB / RCCB / RCCC / RGB-IR / monochrome sensor support

High Efficiency Video Encoding
- H.265 and H.264 video compression
- Flexible multi-streaming capability
- 12MP30 video performance
- Multiple constant bit rate (CBR) and variable bit rate (VBR) control modes
- Smart H.264 and H.265 encoder algorithms

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

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CV22AQ

Overview

Ambarella's AEC-Q100 qualified CV22AQ system on chip (SoC) combines image processing, 12MP30 video encoding / decoding, and CVflow® 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, CV22AQ achieves an industry-leading combination of low power and high performance in both human and computer vision applications. It is an ideal platform for implementing advanced driver assistance systems (ADAS), electronic mirrors, surround view, and drive recorder solutions.

The CV22AQ's CVflow architecture provides computer vision processing at 12MP resolution, enabling image recognition over long distances and 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.

CV22AQ includes a suite of advanced cyber-security features such as secure boot with TrustZone® 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. To help customers easily port their own neural networks onto the CV22AQ SoC, Ambarella's software development kit (SDK) offers a complete set of tools.
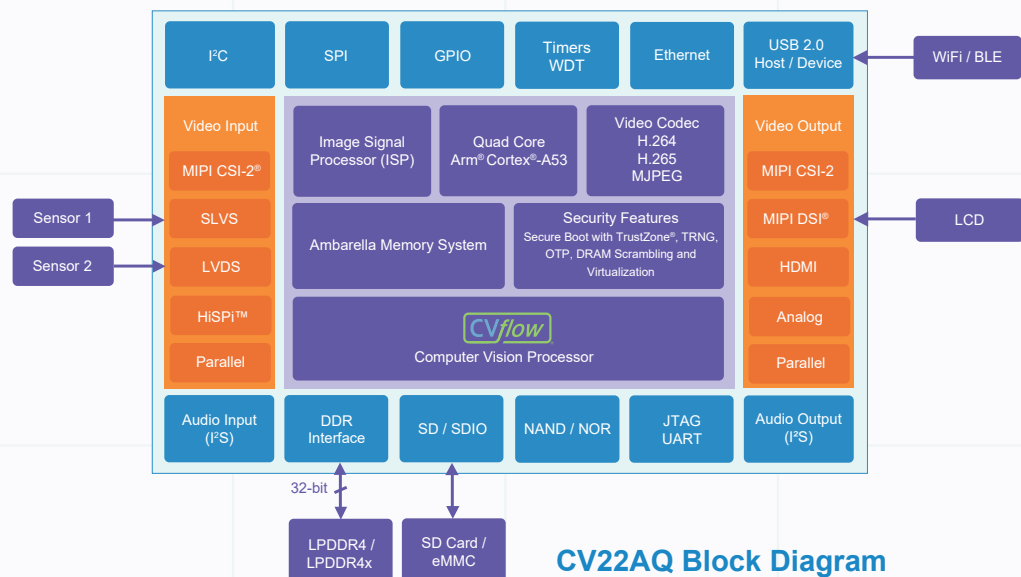
CV22AQ Block Diagram

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
- AES / SHA1 / SHA2-256 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 consumer electronic control (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 auto exposure (AE) / auto white balance (AWB)
- Dynamic range (WDR and HDR) engine
- Chromatic aberration correction
- 180° fisheye lens and geometric distortion correction

- On-screen (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 / Decoding
- H.265 (HEVC) MP L5.1, H.264 MP / HP L5.1, and MJPEG
- 12MP30 maximum encoding / decoding performance
- Up to eight simultaneous stream encodes
- Flexible group of pictures (GOP) configuration with I, P, and B frames
- Multiple CBR and VBR 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

Security Features
- Secure boot with TrustZone® and secure memory, TRNG, OTP, DRAM scrambling and virtualization

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 I²S
- 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 complimentary metal-oxide semiconductor (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, onsemi, Omnivision, and others
- Datasheet, BOM, schematics, and layout
- SDK and reference application with C source code available with additional licensing

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