



CV22FS

Automotive Computer Vision SoC

Overview

Ambarella's ASIL B compliant CV22FS combines high performance and power-efficient computer vision acceleration, superior image processing (ISP), and H.264 video compression in a single SoC. Ambarella's highly efficient CVflow® computer vision processor delivers deep neural network (DNN) processing required by the next generation of intelligent automotive cameras.

The ISP provides outstanding imaging in low-light conditions while its high dynamic range (HDR) processing extracts maximum image detail in high-contrast scenes, enhancing the computer vision capabilities of the chip and delivering crisp video for driver viewing. CV22FS delivers high-resolution video recording and streaming at very low bit rates with efficient encoding in H.264 video formats. A suite of advanced cyber-security features such as secure boot, TrustZone®, and I/O virtualization enable secure operation of the system.

Fabricated in advanced 10 nm process technology, the CV22FS achieves an industry-leading combination of high-performance and low-power for computer vision applications. It is an ideal platform for implementing single- and multi-camera advanced driver assistance systems (ADAS), driver monitoring systems (DMS) and in-cabin solutions, single- and multi-channel eMirrors with blind spot detection (BSD), and intelligent parking assistance systems.



The CV22FS chip targets automotive sensing camera designs

Key Features

Computer Vision Engine

- CNN- / DNN-based processing to enable detection, classification, tracking, and more
- Dense optical flow engine
- 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
- Real time multi-scale / multi-FOV generation
- Hardware dewarping engine support
- Support for multiple cameras
- LED flicker mitigation
- 3D motion-compensated temporal filtering (MCTF)
- Superior low-light processing
- Support for RGGB, RCCB, RCCC, RGB-IR, and monochrome sensors

High-Efficiency Video Encoding

- 4MP30 H.264 video encoding performance
- Flexible multi-streaming capability
- Multiple CBR and VBR bit rate control modes
- Smart H.264 encoder algorithms

Functional Safety

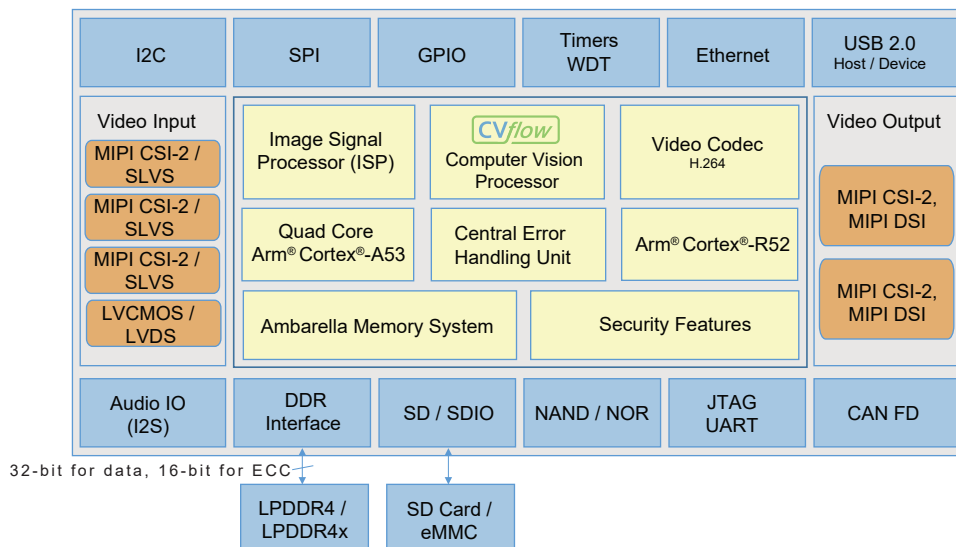
- Error correcting code (ECC) protection of on-chip memory on DRAM
- Central error handling unit (CEHU)
- Processing island targeted to meet ASIL B requirements; safety island targeted to meet ASIL D requirements

Target Applications

- Single- / multi-camera ADAS
- DMS and in-cabin solutions
- Single- / multi-channel eMirrors with BSD
- Parking assistance systems

Block Diagram

The diagram below illustrates the CV22FS 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
- Arm Cortex-R52 504 MHz with DCLS (dual-core lock step)
 - 32 KB / 32 KB I/D L1 cache, 1 MB of embedded SRAMs
- NEON™ SIMD and FPU acceleration
- AES / 3DES / SHA-1 / MD5 crypto acceleration using Arm V8 extensions

Computer Vision Processor

- **CVflow** processor optimized for high performance CNN / DNN execution
- Dense optical flow engine

Video Input

- Multi-sensor input with independent ISP configuration
- Three MIPI CSI-2 (one port with virtual channels) / three SLVS
- LVCMOS / LVDS

Video Output

- Two MIPI CSI-2 / MIPI DSI
- OSD engine and overlays

CMOS Sensor Processing / Image Processing

- Processing up to 480 MPixel/s
- 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
- Geometric distortion correction
- Gamma compensation and color enhancement
- Vignetting compensation
- 3-axis electronic image stabilization (EIS)
- Crop, mirror, flip, 90° / 270° rotation

Video Encoding

- H.264 MP / HP L5.0
- 4MP30 maximum encoding performance
- Flexible GOP configuration with I and P frames
- Multiple CBR and VBR rate control modules

Security Features

- OTP, secure boot, TrustZone®, IO virtualization

Tools for Development

- CNN toolkit to ease the porting of CNN trained popular 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 for data and 16-bit data bus for ECC, up to 4 GB capacity
- Two SD controllers
- Boot from SPI / SPI NAND with BCH / SPI NOR / USB / eMMC
- Single- / dual- / quad- / octal-SPI NOR and single- / dual- / quad-SPI NAND

Peripheral Interfaces

- Six CAN FD controllers
- Two ethernet ports with 10- / 100- / 1000-Mbps data transfer rates
- One USB 2.0 port configurable as device / host w/PHY
- Multiple SSI / SPI, IDC, and UART
- Multiple GPIO ports, PWM, steppers, ADC
- Watchdog timer, general purpose timers, and JTAG
- Audio interface (I²S)

Physical

- 10 nm low power CMOS
- FBGA package (14x14 mm, 0.65 mm pitch)
- Operating temperature -40°C to +125°C (T_j)
- Automotive qualified (AEC-Q100 Grade-2, ASIL B)

CV22FS Camera Development Platform

The CV22FS 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 (EVK)

- CV22FS 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 (SDK)

- ISO 26262 compliant SDK, OS, and middleware
- Royalty-free libraries for ISP, dewarp, and video recording
- Image tuning and manufacturing calibration tools
- Safety documentation for applications required to meet ISO 26262 requirements
- Detailed documentation with programmer's guide and application notes
- CNN / DNN training, profiling, and porting tools

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