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AI envisioned™

A12AQ

AEC-Q100-Qualified SoC for Automotive Cameras

Key Features

Superior Image Quality
- Advanced night vision for low-light conditions using smart exposure and temporal noise filtering
- Dynamic range (WDR and HDR) engine
- Automotive multi-channel smart auto exposure (AE) and auto white balance (AWB)

Advanced Features
- Multiple hardware and software fail-safe mechanisms to prevent "frozen image" errors
- WiFi and 4G / LTE connectivity

Target Applications
- Single-channel electronic mirrors
- Video recorders with basic advanced driver assistance system (ADAS) functions
  - Single- and dual-channel recording
  - OEM dash camera solutions that require automotive-level certification
  - In-vehicle video security systems
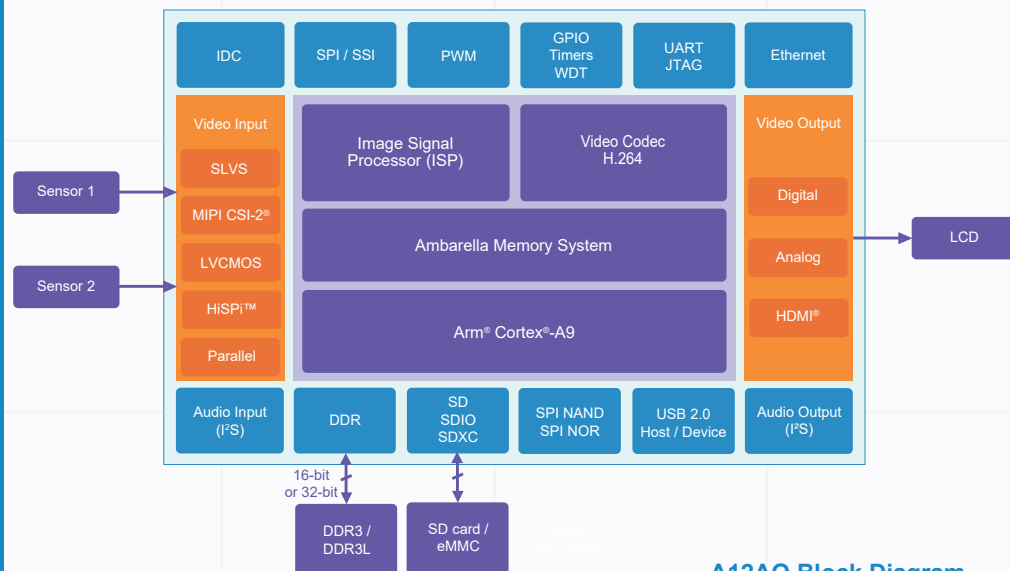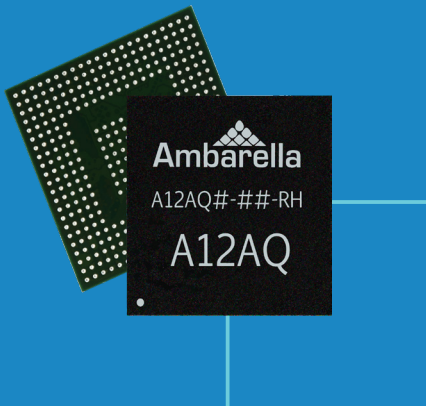
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Overview

The AEC-Q100 Grade 2-qualified A12AQ system on chip (SoC) family provides an integrated single-chip solution for single-channel electronic mirrors and single / dual sensor video recording systems. The A12AQ's combination of advanced image processing, high dynamic range (HDR), 3D noise filtering, smart auto exposure (AE), and high-resolution capability provide superior visibility, even in low light or high-contrast scenes. The chip also supports wide-angle and fisheye lenses by performing distortion correction via dedicated hardware blocks.

The SoC implements a highly-optimized hardware H.264 encoder that enables digital video recording systems with streaming capability over WiFi and 4G / LTE. The flexible video capture enables connection of two image sensors with independent resolutions and independent controls. The dual-channel video processing removes the need for a dedicated ISP chip in each camera module, enabling compact camera modules while improving video quality, reducing power consumption, and lowering system cost.

The SoC includes a high-speed, 672 MHz single-core Arm® Cortex®-A9 CPU with Neon™ digital signal processor (DSP) extensions to enable powerful processing performance for customer applications, including the user interface and wireless networking. The flexibility of the firmware and hardware also enables implementation of proprietary communication protocols along with targeted and non-targeted auto-calibration solutions.

IDC	SPI / SSI	PWM	GPIO Timers WDT	UART JTAG	Ethernet

Video Input
- SLVS
- MIPI CSI-2®
- LVCMOS
- HiSPi™
- Parallel

Sensor 1 →
Sensor 2 →

Image Signal Processor (ISP)	Video Codec H.264

Ambarella Memory System

Arm® Cortex®-A9

Video Output
- Digital
- Analog
- HDMI®

→ LCD

Audio Input (I²S)	DDR	SD SDIO SDXC	SPI NAND SPI NOR	USB 2.0 Host / Device	Audio Output (I²S)

16-bit or 32-bit

DDR3 / DDR3L

SD card / eMMC

A12AQ Block Diagram

General Specifications

High-Performance Automotive Video Engine

- Simultaneous encode of multiple high-resolution streams in multi-camera systems
- Advanced night vision with super-resolution oversampling, 3D noise filters, and dynamic tone mapping
- Real-time geometric distortion correction (dewarp) filter
- Advanced automotive dynamic range (HDR / WDR) engine with local exposure, highlight, and tone adjustment
- Multi-channel automotive smart auto exposure (AE) with scene detection, object detection, and dynamic AE
- Picture-in-picture (PIP) support for dual-channel electronic mirrors
- Frame rate conversion to maintain constant output frame rate during low-light conditions

Video Input

- SLVS, MIPI CSI-2®, LVCMOS, 16-bit parallel interface
- CCIR.601 video input with external sync signals and BT.1120 / CCIR.656 style with embedded sync codes

Video Output

- Analog: on-chip video DAC for 480i / 576i composite NTSC / PAL output
- 16-bit parallel output supporting RGB and YUV formats with embedded and external syncs
- HDMI® 1.4b output with CEC and on-chip PHY

Powerful CPU for Advanced Driver Assistance

- Single-core Arm® Cortex®-A9 up to 672 MHz
- 32 KB / 32 KB I/D and 128 KB L2 cache
- AES / 3DES / SHA-1 / MD5 cryptography engine

File Formats

- Audio: AAC (two-channel LC, HEAAC, HEAAC v2), ADPCM / LPCM / PCM
- Video file: MP4, MOV, AVI, TS
- Photo file: JPG

Advanced Video and Display Processing

- MP H.264 level 5.1 and MJPEG encode
- LCD rotation with crop, mirror, flip, and scale functions
- Alpha-blending on-screen display (OSD)

Memory Interfaces

- DDR3 and DDR3L up to 432 MHz, 16-bit / 32-bit data bus, up to 2 GB capacity
- Three SD controllers with SDXC™ SD™ card support; one port supports up to UHS-1 speed
- Parallel NAND flash with ECC
- Boot from SPI NOR / NAND flash / USB / eMMC

Peripheral Interfaces

- Two USB 2.0 ports, one USB 2.0 host, and one USB 2.0 host / device
- Ethernet MAC with IEEE 802.3-compliant RMII / MII gigabit (10 / 100-Mbps) interfaces
- Multiple I²S, SSI / SPI, IDC, and UART
- Multiple GPIO ports, PWMs, steppers, IR, and ADC channels
- Watchdog timer, multiple general purpose timers, and JTAG

Physical

- 28 nm low-power CMOS
- LFBGA package with 404 balls, 15x15 mm, 0.65 mm pitch
- Operating temperature range: -40°C to +105°C
- Automotive qualified (AEC-Q100 Grade 2)

A12AQ Advanced HD Automotive Camera Development Platform

The A12AQ automotive camera development platform contains the necessary tools, software, hardware, and documentation to develop a fully featured automotive camera system.

Evaluation Kit (EVK)

- A12AQ main board with connectors for sensor / lens board and peripherals
- Camera modules or sensor boards: OmniVision, onsemi, Sony, and others
- Datasheet, BOM, schematics, and layout
- Reference application with C source code available with additional licencing

Software Development Kit (SDK)

- ThreadX / Linux with patches, drivers, tools, and application source code
- Royalty-free libraries for ISP, 3A, dewarp, and codecs
- Image tuning and manufacturing calibration tools
- Detailed documentation, including a programmer's guide and more