Overview

The Ambarella S3 Video Encoder SoC integrates Ultra-HD H.264 (AVC) and H.265 (HEVC) encoding, a Dual-Core ARM® Cortex™-A9 CPU, dedicated image processing hardware, network connectivity, and a rich set of peripherals.

The video encoder sub-system is capable of 4K Ultra HD H.264 (AVC) at 60 fps or 4K Ultra HD H.265 (HEVC) at 30 fps. The solution ships with a variety of software-configurable features including on-the-fly GOP, bitrate and resolution change.

Key Features

Encoder SoC
- Dual-Core ARM® Cortex™-A9 up to 1.0 GHz
- Powerful Dedicated Scaling and Encoding DSPs
- Low-Power 28-nm CMOS Fabrication

Powerful Encoding Subsystem
- High-Quality Main Profile Level 5.1 H.265 / HEVC Encoding
- High-Performance BP / MP / HP Level 5.1 4Kp60 H.264 / AVC Encoding
- Advanced Compression Tools
- Real Time Rate Change, Frame Accurate Intra/IDR Insertion and Multi-Resolution Encoding

Best-In-Class Imaging and Peripheral Support
- Best-In-Class 3D Noise Reduction (MCTF)
- Transport Stream (TS) module for video, audio and auxiliary data

Block Diagram

The diagram below illustrates a video encoder design based on the Ambarella S3 device.
## General Specifications

### Processor Cores
- Dual-Core ARM® Cortex™-A9 up to 1.0 GHz
- NEON™ SIMD engine and FPU acceleration
- Ambarella image (ISP) and video DSPs
- Cryptography engine
- Dedicated DMA co-processor for graphics/image operations

### Video Input / Output
- **Video Input**
  - 10-bit BT.656-style interface
  - YUV 4:2:2 differential LVDS interface (up to 4Kp60)
  - YUV 4:2:2 single-ended LVCMOS interface
- **Video Output**
  - BT.656-style YUV output (8-bit and 16-bit mode)
  - HDMI® 2.0 output with on-chip PHY
  - PAL/NTSC (CVBS) composite analog

### Video Encoding
- H.264 / AVC codec BP/MP/HP Level 5.1 up to 4Kp60
- H.265 / HEVC codec MP Level 5.1 up to 4Kp30
- Approximately 2x bitrate reduction from H.264
- Up to eight (8) simultaneous 1080p Adaptive Bitrate (ABR) streams
- On-the-fly change of multiple encoding parameters
- Advanced AVC compression tools
  - I, IP, IBP modes
  - High Profile with B-frames and hierarchical GOP
  - Ultra low delay pipeline options
- Flexible rate control
  - CBR, VBR and Constant QP with maximum bitrate control
- Two-pass encoding of resolutions up to 1920x1080i60

### Image Processing
- 3D motion-compensated noise reduction (MCTF)
- YUV image data processing pipeline
- High-quality polyphase scalers
- OSD and overlay support

### Memory Interfaces
- DDR3 / DDR3L / LPDDR2 / LPDDR3
- 64-bit wide data bus
- Maximum capacity of 32 Gbits (4 Gbytes)
- Triple SMIO with SDXC SD™ Card Support
- NAND flash, SLC with ECC, eMMC support
- Boot from NAND, SPI-NOR, USB, HIF, and eMMC card

### High-Speed Data Interfaces
- Ethernet with GMII / RGMII / MII / RMII interface
- Transport Stream (TS) interface (ISO/IEC 13818-1 / ITU H.220.0)
- Generic Host Interface (HIF)
- Two USB 2.0 High Speed interfaces: host and host/device

### Peripheral Interfaces
- Multiple I2S, SSI / SPI, I2C
- Three SD controllers with support for SDHC, SDXC, MMC, eMMC / UHS-I
- Dual UART with support for DMA and hardware flow control
- Many GPIO ports, multiple PWM, Steppers and ADC channels
- Watchdog Timer, multiple general-purpose timers, JTAG, IR

### Physical
- 28-nm low-power (LP) CMOS technology
- Operating temperature -20ºC to +85ºC
- 15 mm x 15 mm LFBGA package
- 697 pins at 0.5 mm pitch

## S3 Network Video Encoder Development Platform

The S3 Network Video Encoder Development Platform contains the necessary tools, software, hardware and documentation to develop a powerful video encoding system while supporting development of customized features.

### Evaluation Kit (EVK)
- Main board with S3 device populated and YUV input board
- Supplied YUV input board supports HDMI, YPbPr, and analog NTSC / PAL input ports

### Software Development Kit (SDK)
- Royalty-free libraries for image processing and codec functionality
- Demonstration video encoder application with full Linux source code
- Extensive and fully documented API library suite

### Documentation
- Programmer's guide, application notes, API documents
- SoC data sheet, BOM, schematics and layout files

## Contact

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