

# SSD2386 HIGH-INTEGRATED HMI CONTROLLER

## PRODUCT BRIEF

### CHIP OVERVIEW

The SSD2386 is a feature-rich, highly integrated, low power product, suitable for HMI, mobile, and battery device, as well as high-resolution intelligent application.

The SSD2386 includes a 64-bit quad-core processor, high performance H.265/H.264/MJPEG video encoder, Intelligence Processing Unit (IPU) as well as high speed I/O interfaces like USB, Ethernet, and 12-bit ADC. These features in combination make the SSD2386 an ideal solution that facilitates design and development of high-performance, high-picture-quality, and low-cost products.

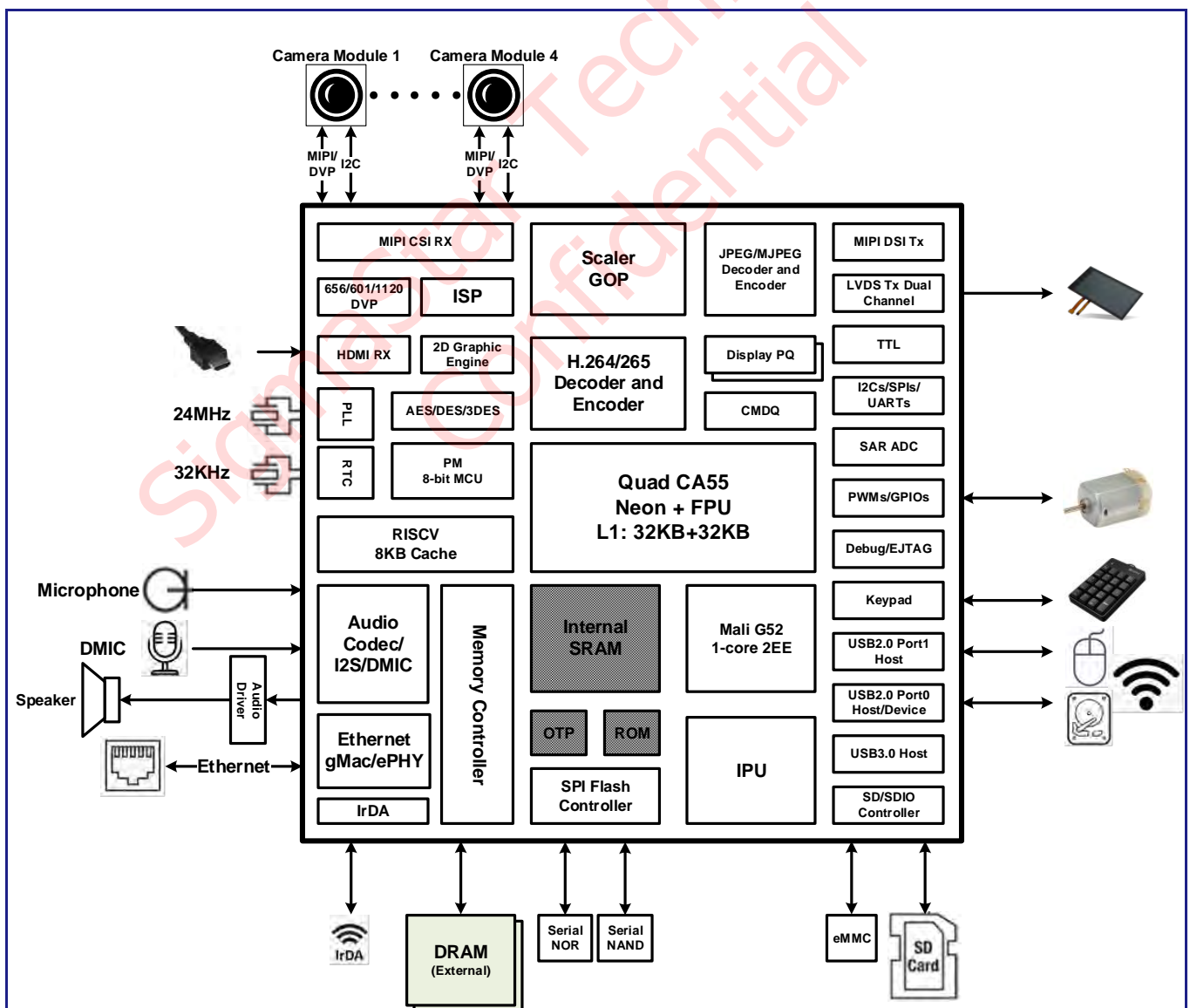
The programmable neural network inference engine featured in the SSD2386 allows customers to achieve a rich variety of intelligent applications with ease.

Implemented with the quad-core ARM Cortex-A55 CPU as well as an IPU, the SSD2386 enables fast startup, real-time performance, and connections with various peripheral interfaces.

Efficient computing resources are available to help customers develop industry and consumer applications. Advanced low-power, low-voltage architecture and optimized design flow are implemented to fulfill long time usage applications. Hardwired AES/DES/3DES cipher engines are integrated to support secure boot, authentication, and video/audio stream encryption in security system.

The SSD2386, powered by SigmaStar Technology, comes with a complete hardware platform and software SDK, allowing customers to speed up "Time-to-Market."

### BLOCK DIAGRAM



## FEATURES

- **High Performance Processor Core**
  - ARM Cortex-A55 Quad Core
  - 32KB L1 I-cache and 32KB L1 D-cache for each core
  - 128KB L2 cache for each core and 512KB L3 cache
  - Neon and FPU
  - Separate power domain for each core
  - Stand-alone voltage domain
- **Video Input Interface**
  - Supports 8/10/12-bit parallel interface for raw data input
  - Supports 8-bit CCIR656/601 interface
  - Supports 16-bit BT1120 interface
  - Supports MIPI interface with 6 data lanes and 4 clock lanes
  - Supports sensor interface with both parallel and MIPI
  - Supports max. 6M (2688x2564) pixels video recording and image snapshot
  - Supports HDMI Rx 1.4b with HDCP1.4
  - Static and adaptive bad pixel compensation
  - Crosstalk noise reduction
  - Temporal-domain Noise Reduction (3DNR)
  - Sharpening filters for image enhancement
  - Spatial-domain Noise Reduction (2DNR) for luma and chroma image
  - Filter to remove purple false color in highlight regions
  - Optical black correction
  - Symmetric/Asymmetric lens shading compensation
  - Auto White Balance (AWB) / Auto Exposure (AE) / Auto Focus (AF)
  - CFA color interpolation and demoiré filter
  - Color correction and color adjustment engine
  - Gamma correction
  - High Dynamic Range (HDR) with two exposure frames and de-ghost function
  - Frame buffer data compression and de-compression to save memory bandwidth
  - Wide Dynamic Range (WDR) with local tone mapping
  - Flip, Mirror, and Rotation with 90 or 270 degree
  - Fully programmable multi-function scaling engines
- **H.265/HEVC Encoder**
  - Supports max. 4K30fps
  - Fully compatible with ISO/IEC 23008-2 High Efficiency video coding
  - Main Profile, Level 5.0 encode
  - Supports I-frame and P-frame
  - Supports resolution from 256x128 to 4096x4096
  - 1/4-pixel precision motion vectors
  - Deblocking filter and Sample Adaptive Offset (SAO)
  - Picture/CTU/subCTU level rate control
  - Region of Interest (ROI) encoding with custom QP map
- **H.264/AVC Encoder**
  - Supports max. 4K30fps
  - Compatible with the ITU-T Recommendation H.264 specification
  - Baseline/Constrained Baseline/Main/High Profile, Level 5.1 encode
  - Supports resolution from 256x128 to 4096x4096
  - 1/4-pixel precision motion vectors
  - In-loop deblocking filter
  - CABAC/CAVLC support
  - Error resilience tools
  - Frame level and MB level rate control
  - Region of Interest (ROI) encoding with custom QP map
- **H.265/HEVC Decoder**
  - Supports max. 4K30fps decode
  - Fully compatible with ISO/IEC 23008-2 High Efficiency Video Coding Main Profile
  - HEVC Main Profile, Level 5.0 decode
  - Supports resolution from 176x128 to 4096x4096
  - I/P/B slices
  - Prediction Unit (PU): 64x64 to 4x4
  - Transform Unit (TU): 32x32 to 4x4
  - 1/4 motion compensation with 8-tap filters
  - High performance CABAC decoding
  - In-loop deblocking filtering
  - Sample adaptive offset (SAO)
  - Error concealment
- **H.264/AVC Decoder**
  - Supports max. 4K30fps decode
  - Compatible with the ITU-T Recommendation H.264 specification
  - Baseline/Constrained Baseline/Main/High Profile, Level 5.1 decode
  - Supports resolution from 176x128 to 4096x4096
  - Variable block size (16x16, 16x8, 8x16, 8x8, 8x4, 4x8 and 4x4)
  - CABAC/CAVLC support
  - In-loop deblocking filter
  - Error detection, concealment and error resilience tools
- **JPEG/MJPEG Encoder/Decoder**
  - JPEG/MJPEG baseline encoding and decoding
  - Supports YUV422 or YUV420 input formats, YUV422 output formats
  - Max. 8192x8192 frame resolution
  - 1080p60 for encoding and decoding max. performance
  - Supports real-time mode and frame encode mode
- **3D Graphic Engine**
  - Mali G52 1-core 2EE with 64KB Cache
  - Supports IFC
  - Supports OpenGL ES 1.1, 2.0, and 3.2
  - Supports Vulkan 1.0 and 1.1
  - Supports OpenCL 2.0 Full Profile
  - Supports 1200Mpix/s fill rate when operating at 600MHz clock frequency
  - Supports 28.8 GFLOPs when operating at 600MHz clock frequency
- **Intelligence Processing Unit (IPU)**
  - Pure hardwired accelerator
  - Programmable 4/8/16-bit process
  - Supports RGB/YUV data format R/W DMA
  - Stand-alone voltage domain
  - Supports various video analysis functions like FD/FR, human detection, MD/OD, object tracking, etc.
  - Supports median filter for TOF
  - Supports 2D TOF filter
- **Co-Processor (RISCV)**
  - Supports RV32 base instruction set, and M/C extension
  - 6 Stage Pipeline, Single Issue, in-order dispatch, out-of-order execution
  - 8KB I-cache and 8KB d-cache
  - Up to 466MHz clock rate
  - Supports dynamic branch prediction
  - Supports memory property configuration
  - Supports JTAG debug
- **Co-Processor (8-bit MCU)**
  - Located in PM power domain
  - Supports 8KB internal PSRAM
  - Supports XDATA SRAM size up to 512Byte
  - Internal FRO clock up to 48MHz
- **Audio Processor**
  - Supports 3-channel ADC with single-end or differential mode
  - Supports 2-channel DAC with single-end mode
  - ADC and DAC SNR over 96dB
  - Digital and analog gain adjustment
  - Supports 8-CH DMIC (1 clock + 4 data)
  - Supports I2S0 TDM mode with input max. 8-ch and output 2-ch
  - Supports I2S1 2-ch input and 2-ch output
  - I2S0/1 support Master or Slave mode and 4/6 wire mode
  - Supports HDMI RX with 2 channels
  - Supports SPDIF 2 channels
- **Video Output Interface**
  - Dual read DMAs and display channels
  - Picture quality enhancement (gamma, AWB, contrast, saturation, sharpness, brightness, 3x3 matrix)
  - Each display channel can output to MIPI/LVDS/Digital port, digital port including one of TTL/CCIR601/656
  - Supports MIPI DSI TX, RGB 16/18/24-bit, 2560x1600@60fps
  - TTL/Parallel-RGB interface, 16/24-bit, 1280x720@60fps
  - Supports LVDS TX dual channel, up to 1080@60fps
  - Simultaneous output display for MIPI/LVDS/Digital port
  - Scale-down and write-back DMA
- **Advanced Color Engine**
  - Luma gain/offset adjustment
  - Supports 2D peaking with user definition filter
  - Horizontal noise masking
  - Local Contrast Enhancement (LCE)
  - Direct Luma Correction (DLC)
  - Black/White Level Extension (BLE/WLE)
  - IHC/ICC/IBC for hue, saturation, brightness and favorite color adjustment
  - Histogram statistics
- **SPI NOR/NAND Flash Interface**
  - Compliant with standard, dual and quad SPI flash memory components
  - Max. 108MHz clock rate
- **SD/eMMC Interface**
  - SD card 2.0 x1 and SD card 3.0 (SDR104 or SDR50/DDR50) x1, data bus 1/4-bit mode
  - SDIO 2.0 (SDR25) x1, data bus 1/4-bit mode
  - eMMC 5.0 with 4/8 data bit and max. 200MHz clock rate, HS400 DDR mode
- **USB Interface**
  - USB3.0 Host
  - USB2.0 port0 configurable Host or Device
  - USB2.0 port1 Host
    - Host mode supports EHCI specifications
- **DRAM Memory**
  - External 16-bit x2 or 32-bit x1
  - DDR4/DDR3/DDR3L/LPDDR4/LPDDR3
  - Supports memory space up to 32Gb
  - Data rate up to 2133Mbps for DDR3, 3200Mbps for DDR4, and 2666Mbps for LPDDR4
- **Connectivity**
  - Built-in 10/100/1000M Ethernet MAC with RGMII/RMII
  - Built-in 10/100M Ethernet MAC and Ethernet PHY
  - Hash table with 256 entries
  - Broadcast/Multicast storm prevention
  - Supports both full-duplex and half-duplex operation
  - Supports IEEE 802.1Q VLAN tag detection for reception frames
  - Supports checking IPv4 header checksum and TCP, UDP, or ICMP checksum encapsulated in IPv4 or IPv6 datagram
  - Supports TCP Segmentation Offload (TSO) and UDP Fragmentation Offload (UFO)
  - GigaMAC supports IEEE1588v2 PTP
  - GigaMAC supports IEEE802.1 QoS
- **Security Engines**
  - Supports AES128/AES192/AES256/DES/3DES/RSA2048/SHA-1/SHA-256
  - Supports secure booting
  - FIPS 140-1 compliant random number generator
  - Embedded OTP (One Time Programmable) memory to store secure and calibration data
- **Boot Options**
  - SPI NOR
  - SPI NAND with ECC
  - SD Card
  - eMMC
  - USB
- **Peripherals**
  - Dedicated GPIOs for system control
  - Supports 8x PWM inputs<sup>1</sup> and 20x PWM outputs (shared with GPIOs)
  - Up to six generic UARTs and one fast UART with flow control
  - Three generic timers and one watchdog timer
  - Two SPI interfaces, which can be configured as master or slave mode
  - Up to six I2C Masters
  - Built-in 10-bit SAR ADC with 2-channel analog inputs for different kinds of application
  - Built-in 12-bit SAR ADC with 24-channel analog inputs for different kinds of application
  - Supports 7x7 Keypad
  - Supports IrDA
  - Supports POR (Power On Reset)
  - Supports internal temperature sensor
- **Real Time Clock (RTC)**
  - Built-in RTC working with 32.768 KHz crystal
  - Alarm interrupt for wakeup
  - Tick time interrupt (millisecond)
  - Built-in regulator
  - Supports low leakage RTC mode for long battery application
- **Always on power domain (PM)**
  - Built-in LDO to provide both 0.9V and 1.8V power sources
  - Built-in RC FRO to generate clock source
  - Supports 8-bit MCU to control PM GPIO
  - Supports multiple GPIOs for power control and RTC events
- **Package**
  - BGA 19x19
  - Ball pitch and size: 0.65 and 0.3 mm
  - 4 or 6 Layer PCB
  - Moisture Sensitivity Level (MSL): 3

<sup>1</sup> 8-ch for duty measurement and 4-ch for pulse counting