

## Product Brief

## MPEG-2 VIDEO Encoder/Decoder

### Description

The SM2210 is a real time MPEG-2 video encoder and decoder (CODEC) that fully complies with the ISO/IEC-13818 Main Profile@Main Level (MP@ML) format, Simple Profile@Main Level (SP@ML), and Main Profile @ Low Level (MP@LL).

In encode mode, the SM2210 accepts digital video in ITU-R BT.601 (CCIR-601) or ITU-R BT.656 (CCIR-656) format. The input is filtered and then encoded to produce compressed bitstreams in MPEG-2 MP@ML syntax. In decode mode, SM2210 accepts an MPEG bitstream, decodes it, and then filters the video output to produce either ITU-R BT.601 or ITU-R BT.656 format digital video. Designed for flexibility, the SM2210's video interface supports multiple video formats, resolutions, and frame rates including NTSC, PAL, and FILM.

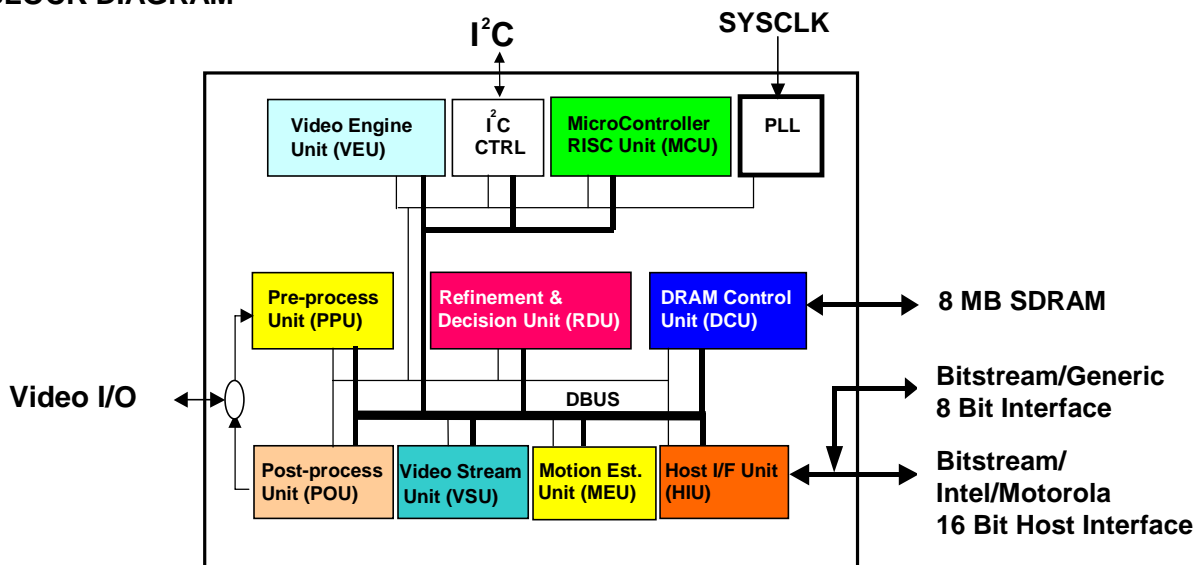
The SM2210's versatile time-stamp feature enables flexible muxing of audio and video elementary bit streams. In addition, the SM2210 can encode and decode bitstreams in both the VCD and SVCD formats.

The algorithmic and architectural innovations of the SM2210 enable a high degree of integration while still providing exceptional video quality over the widest range of bit rates. In addition, the SM2210 provides ease of system design by interfacing to a wide variety of commodity components such as Philips video decoders and encoders, Flash and SDRAM memories. Combining a high degree of integration, exceptional encoding quality, and ease of system design, the combined benefits of the SM2210 make it an ideal platform for MPEG based applications.

### System Features

- Single Chip MPEG-2 Video CODEC
- Supports Real Time MPEG-1 encoding and decoding
- Supports Real Time MPEG-2 MP@ML, SP@ML, and MP@LL encoding and decoding
- Support for constant and one-pass variable bit rate
  - IPB-pictures, CBR or VBR to 15Mbps
  - I-pictures only to 30Mbps
- Proprietary high performance motion estimation
- Low external memory
  - 8 Mbytes for full D1 (720) NTSC/PAL pictures
- Provides complete video encoding and decoding (half-duplex) when combined with system function and supporting commodity devices
- Direct interface to video modulator & demodulator
- Supports Multiple Resolutions & Scan Rates
- NTSC: (720-D1, 704-D1, 640-VGA, 544, 480-2/3D1, 352-1/2D1) x 480, or 352 x 240 (CIF), 320 x 240 (MPEG-1) or 176 x 112 (QCIF) at 30 or 29.97 Hz
- PAL: (720-D1, 704-D1, 640-VGA, 544, 480-2/3D1, 352-1/2D1) x 576, or 352 x 288 (CIS/SIF), or 176 x 144 (QCIF) at 25 Hz
- Film: (720-D1, 704-D1, 640-SVGA, 544, 480-2/3D1, 352-1/2D1) x 480, or 352 x 240 (CIF), or 176 x 144 (QCIF) at 24 Hz
- Intel/Motorola 16-bit host interface
- Generic 8-bit interface for glue-less to multiple devices such as the Philips 7146 PCI Bridge, Philips TriMedia, and USB controllers
- Integrated programmable video pre & post processors
- Integrated I<sup>2</sup>C support
- 0.18u CMOS technology
- 256-pin PQFP package
- 87.75 MHz clock derived from external 27 MHz clock
- 3.3V and 1.8V power supplies, 5V I/O tolerance
- 0.65 Watts @ 87.75 MHz average power consumption

### SM2210 BLOCK DIAGRAM



## Video Encoder Features

- Video Preprocessor
  - 4:2:2 to 4:2:0 Conversion
  - Programmable pre-processing filters
  - Horizontal and vertical scaling
  - Horizontal and vertical cropping
  - Synch extraction
- Proprietary High Performance Motion Estimation
  - Half-pel accuracy
  - V Search Range - 31.5, 15.5, 7.5 Pel/Frame
  - H Search Range - 63.5, 31.5, 15.5, 7.5 Pel/Frame
- Encodes MPEG-1 and MPEG-2
- Supports multiple MPEG-2 profiles and levels
- Field and Frame-mode prediction
- Multiple programmable encoding parameters
  - IBBBP, IBBP, IBP, IP, I GOP structures
  - User defined quantization matrices
  - Encoding time
  - Average bit rate
  - Active picture area selection
  - VBR and CBR
- Guaranteed to operate at 30 frames/second

## Video Decoder Features

- Decodes MP@ML and SP@ML MPEG-2 video
- Decodes MPEG-1 video
- Supports full D1, 2/3 D1, and 1/2 D1
- Variable Length Decoder
  - Video stream syntax parsing and decoding
  - Error detection and handling
- Motion Prediction
  - Supports frame, field, 16 x 8, and dual prime motion compensation modes
  - Performs half-pel interpolation and bi-directional interpolation
- Error detection, handling, and mitigation
- Supports multiple picture display parameters
  - Picture Sequence, Frame, Field and Structure
- Video Postprocessor
  - ITU-R BT.601 and BT.656 format filters
  - Telecine (Repetition of the first field for 3:2 pulldown)
  - Horizontal and vertical scaling
  - NTSC to PAL format conversion
  - Letterbox to NTSC format conversion
  - Letterbox to PAL format conversion
- Trick Play Modes
  - Fast and slow play forward
  - Fast play backward

## Technical Overview

The SM2210 is organized as a process pipeline that implements the MPEG-2 encoding and decoding algorithms.

The SM2210 provides application program control over a large number of encoding parameters such as I, P, B-picture cadence, GOP structure and decoder buffer sizes.

For communications applications, the SM2210 can match its output bit rate to the channel rate. This feature allows the host controller to make bit rate changes as needed to demonstrate better bandwidth utilization across multiple channels.

Internal rate control provides a high degree of flexibility in relation to the output bit rate, including the ability to generate variable bitrate compressed video stream in one pass. This makes it suitable for storage sensitive applications such as digital camcorders and personal video recorders (PVRs).

The SM2210 also has features geared toward MPEG-2 publishing and authoring systems. These include the ability to specify the initial decoder buffer fullness.

Pre- and post-processing supports includes pre- and post-filtering and up and down chroma conversions. Other features include:

- DMA in either 8-b or 16-b modes
- Encodes/decodes full D1 to QCIF video resolutions
- Bit rates up to 15 Mb/s in either CBR or VBR modes
- Debugging and DMA monitoring control
- Asynchronous video and system clocks
- Support for commodity video NTSC/PAL encoders and decoders

## VCD, Super-VCD Support

The SM2210 supports MPEG-1 and MPEG-2 video encoding at 1/2 (VCD), 2/3 (SVCD), and full D1 resolutions. In addition, the SM2210's versatile pre-processing features allow the input video to be either shrunk or cropped to the desired encode size.

## Interfaces

The SM2210 includes a 64-bit SDRAM memory interface, a video interface (with I<sup>2</sup>C), 16-bit Motorola/Intel host interface, a generic 8-bit interface, and a serial EPROM /Flash memory interface.

## Applications

The SM2210 can be used in a variety of applications:

- VCD, Super-VCD player and recorder
- DVD-Recordable products
- Advanced Set-top boxes
- Personal video recorder (time shifting)
- PC-based content creation/editing boards
- USB-based products for video capture and display

## Deliverables

For evaluation, Stream Machine provides a 2210-based PCI reference board with a Windows 98 based demonstration application for video capture and playback. Additional 2210-based SVCD player/recorder, personal video recorder, and USB-TV player/recorder reference designs are also available.

All reference designs include schematics (Orcad), Gerber files, Job/Layout files (PADS), and BOMs. Driver and application source code is also available.