ATSC

COMB FILTER

SAA7130
PAL/NTSC/SECAM/TS PCI 9-Bit Video Decoder

DVB

With Adaptive 4-Line Comb Filter, Digital Video/Transport Stream Port, VBI Capture, and High-Performance Scaler

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SAA7130

THE SAA7130 IS A 9-BIT PCI VIDEO DECODER on a single chip. It supports various video formats, including Composite, S-Video, and external VSB/COFDM/QAM devices. The SAA7130 is ideal for emerging video applications, including PCI Windows-based Analog TV Add-in Boards (AIB), ATSC (Advanced Television Standards Committee) AIBs, and DVB (Digital Video Broadcast: DVB-S, DVB-T, and DVB-C) AIBs. Consider the SAA7130 for time-shift recording, which requires its sophisticated features, such as fully automatic hardware Macrovision detection. The SAA7130 complies with the most rigorous standards to provide high-quality video over the PCI bus. This new generation solution for PCI video decoding from Philips Semiconductors meets the complex demands of analog/digital broadcast video and data capture, as well as playback on the PC.

PRODUCT HIGHLIGHTS

The SAA7130 is Philips Semiconductors' most integrated and feature-packed video capture device to date, offering these major benefits:

- Fully automatic detection and decoding of any worldwide analog TV standard
- Adaptive 4-line comb filter to improve luminance and chrominance sharpness
- Hardware detection of Macrovision's 3-level copy protection scheme
- TV capture over PCI, multistandard video decoding, scaling, and data processing on one IC
- Advanced up/down 3-D scaler with Nyquist correct interpolation filters
- TV capture of raw VBI data, software slicing and decoding of Closed Caption, Teletext, Intercast, and all other VBI standards
- Direct VSB/COFDM/QAM support via dedicated "sidecar" I/O for hybrid analog/digital broadcast designs
- Multiple video output formats, YUV and RGB (including packed and planar, gamma-compensated, or black-stretched)
- Configurable PCI FIFOs with graceful overflow handling
- Legacy analog audio signal routing (analog audio pass-through and loop-back cable to sound card)
- ACPI 1.0 Power Management compliant
- Video synchronization and line-locked clock
- Audio (default stereo) line-level inputs and outputs

APPLICATIONS

For a highly integrated, low cost and solid foundation for Analog TV capture in the PC, as well as for tomorrow's digital video broadcast platforms, check out the SAA7130 for the following PCI-based AIB designs:

- PC-video capture and editing cards
- PC Analog TV receiver cards
- PC Hybrid Analog/Digital TV receiver cards
- PC DVB (Satellite, Terrestrial, Cable) receiver cards
- PC Teleconferencing Cards
- VBI data services capture (Closed Caption, Teletext, WST, NABST, CGMS, WSS, and more)
- PC Hardware Digital VCRs
- WebTV for Windows
- PC Radio
- Mobile applications (ACPI compliant)

PCI Multistandard Video Decoding, Scaling, and Data Processing on One IC

When your PC video application demands high quality decoding, flexible scaling, and transport stream processing, look to the SAA7130 PCI Video Decoder. Highly integrated and accommodating worldwide video standards, the SAA7130 is designed to provide a digital video stream for any video-input application. This includes input to the image port of a VGA controller, or to provide digital baseband video to some picture-improvement processing.

The SAA7130 PCI capture device is a highly integrated, low-cost solution for TV capture in the PC—for analog TV as well as for digital video broadcast. The various multimedia data types are transported over PCI by bus-master-write, to optimally exploit the streaming

SAA7130 PCI 9-Bit Video Decoder

capabilities of a modern host based system. Either software or hardware enhancements handle legacy A/V requirements. The SAA7130 conforms to PC Design Guides 98/99 and 2001, and is PCI 2.2 and ACPI compliant.

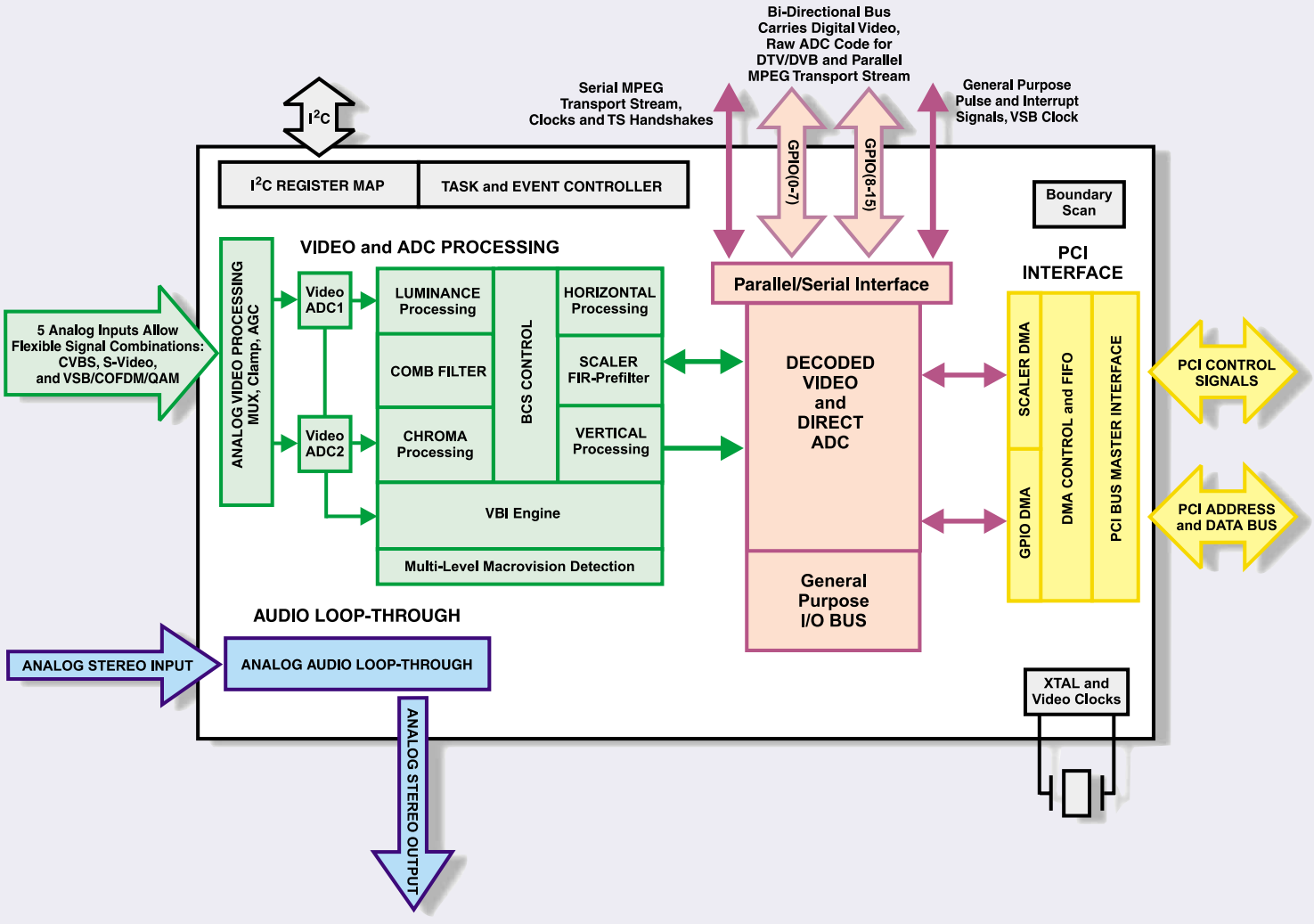
The SAA7130 provides a versatile peripheral interface to support system extensions, e.g. MPEG encoding for time-shift viewing, or DSP applications for audio enhancements. The channel decoder for digital video broadcast reception (ATSC, DVB) can re-use the integrated video ADCs.

The SAA7130 incorporates two 9-bit video ADCs and processing units for the entire decoding of any analog TV signal: NTSC, PAL, and SECAM, including non-standard signals, such as play-back from a video tape player. The adaptive multiline comb filter provides superb picture quality, component separation, sharpness, and high bandwidth. The video stream can be cropped and scaled to the need of the application. Scaling down as well as zooming up is supported in the horizontal and vertical directions, and an adaptive filter algorithm prevents aliasing artifacts. With the acquisition unit of the scaler, two different “tasks” can be defined, e.g. to capture video to the CPU for compression and write video to the screen from the same video source but, with different resolution, color format, and frame rate.

For legacy requirements, the SAA7130 incorporates analog audio pass-through for analog audio loop-back cable to line-in connector of the sound card. No external components are required. For example, when the audio signal, which was otherwise connected to the sound card line-in, e.g., analog sound from a CD-ROM drive, can now be connected to one of the inputs of the SAA7130. By default, after system reset and without involvement of any driver, this audio signal will be passed through to the analog audio output pins, which will feed the loop-back cable to the sound card line-in connector.

The decoded video stream is fed to the PCI bus, and it is also provided to a peripheral streaming interface, in ITU/VIP/VMI format. A possible application extension is on-board hardware MPEG compression, or other feature processing. The compressed data is fed back through the peripheral interface in parallel or serial format, for capture to system memory via the PCI bus. In the same way, the Transport Stream (from a DTV/DVB channel decoder) can be captured through the peripheral interface.

The SAA7130 is supported by PCI-based Analog/Digital TV Capture reference designs and a set of drivers for the windows operating system (Video-for-Windows, and Windows-Driver-Model compliant).



SAA7130 PCI 9-Bit Video Decoder

Key Features

Input-Acquisition and Clock-Generation

The analog video preprocessing circuit incorporates source selection, anti-aliasing filters, and two low-noise A/D converters. This subsystem includes input clamps, white-peak control, and user-selectable automatic or fully programmable gain control to match the particular signal properties. The 9-bit CMOS A/D converters provide high performance with oversampling at 27 MHz—twice the ITU-601 standard. On-chip line-locked clock generation is also compliant with ITU-601, and offers free running capability with horizontal and vertical synchronization generation.

- Up to five analog inputs split as desired between CVBS, S-Video, and VSB/COFDM/QAM
- Expansion port offers output of decoded digital YUV, CVBS, S-Video, as well as raw ADC data; direct VSB/COFDM/QAM data output via a dedicated bus (sidecar)
- Independent gain and offset adjustment for raw data path
- Only one crystal (32.11 or 24.576 MHz) required for all standards
- Digital PLL for synchronization and clock generation accommodates all standard and non-standard video sources, even consumer-grade VTR. The vertical PLL has “jam sync” override to allow fast input switching for video surveillance applications
- Forced-field toggle for use with non-interlaced inputs (e.g., avoids VCR “blue screen”)
- Raw VBI streaming, for software data slicing on a selectable VBI region

Video Decoder

The decoder in the SAA7130 is based on the principle of line-locked clock decoding to yield the highest quality video, with maximum discrimination and automation. The decoder features two-dimensional chrominance/luminance separation using an adaptive comb filter.

- Automatic detection and decoding of all television standards worldwide
- Adaptive 2/4 line NTSC/PAL comb filter
  - Offers increased luminance and chrominance bandwidth for all PAL and NTSC standards
  - Reduces cross-color and cross-luminance artifacts
  - Includes user-programmable sharpness control
- Separate brightness-contrast-saturation (BCS) control for Composite, S-Video, and raw VBI samples; hue control on CVBS and S-Video
- Programmable luma/chroma bandwidth
- Comprehensive hardware detection of copy-protected signals according to the Macrovision standard, indicating level of protection (full three-level support)
- Video decoder status/changes including Macrovision detection level, can be selected to issue interrupt on PCI

Video Scaling and VBI

The video scaler incorporates a filter and processing unit to downscale the video picture, to zoom it up in the horizontal and vertical dimension (direction), as well as in the frame rate (the phase accuracy of the re-sampling process is equivalent to a clock jitter of less than 1ns).

The adaptive filter depth of the anti-alias filter can be scaled from 10 taps horizontally for scaling ratios close to 1:1 and up to 74 taps for an icon sized video picture. The scaling acquisition circuitry includes cropping, an independent scaling ratio for horizontal and vertical direction, frame rate reduction, and allows the system developer to define the amount of pixels and lines to be captured through DMA over the PCI bus. Two programming pages are available in order to allow re-programming of the scaler in the “shadow” of running processing, i.e. without holding or disturbing the flow of the video stream.

Alternatively, the two programming pages can be applied to support two applications (tasks) with different scaler settings, e.g. to capture video to CPU for compression, and to review the picture on the monitor screen. A separate scaling region is dedicated to the capture of raw VBI samples, with specific sample rate, which can be written into its own VBI DMA channel.

Video Output Port and TS Capture

The decoded and/or scaled video stream can be captured via PCI-DMA to system memory, and/or can be made available through the SAA7130’s peripheral video port (VP), supporting the following applications:

- Feeding the video stream to a local MPEG compression device on the same AIB (e.g., for time shift viewing application)
- 8 bit VMI, ITU-656, VIP 1.1/2.0 format, or 16 bit ZV
- Feeding the raw DTV/DVB sample stream to an on-board channel decoder device (the compressed transport stream is collected as serial or parallel stream, and is captured via a dedicated DMA channel into PCI memory)

Any unused pin of the peripheral interface can be utilized as General Purpose I/O (GPIO) under direct software access.

PCI Interface

The PCI interface of the SAA7130 complies with PCI specification 2.2, and supports power management and ACPI as required by PC Design Guide 2001. The PCI configuration registers hold information essential for plug-and-play, to allow system enumeration and basic device setup without depending on the device driver, and associated software driver. Some of this configuration information is hard-wired in the SAA7130, while the rest of the information is loaded during system start-up. During power-up, initiated by PCI-reset, the SAA7130 will fetch additional system information via I^2C from the on-board EEPROM, to load actual board type specific codes for System Vendor ID, Sub-System ID (board version) and ACPI-related parameters into configuration

registers. Support of ACPI 1.0 and PCI Power Management allows system designers to tailor power consumption of the SAA7130 to the actual needs of their system.

- Support of all four ACPI device power states, less than 25mW for D3-hot
- Propagate_reset pin implemented to notify other subsystem devices to switch to a power-save mode
- Major device and signal status information can be enabled to raise an interrupt on PCI
- Support of power-saving standby modes, controlled by software

DMA and Configurable FIFO

The SAA7130 supports six DMA channels with one shared common FIFO pool of 256 D-words total to master-write captured video, raw VBI, and DTV/DVB transport streams into PCI memory. The FIFO's capacity is configurable for each DMA channel, and minimum burst length can be defined. This allows a system designer to tailor and optimize the latency behavior per DMA channel for a given application. The SAA7130 provides graceful overflow recovery when a FIFO channel of a certain DMA channel is overflowing due to a latency conflict. Because the SAA7130 can monitor (count) this non-transmitted (lost) data, after the latency conflict is resolved, the correct increment of the PCI address pointer is corrected accordingly so that new data is written to the correct memory place.

Comprehensive Software Support

The SAA7130 offers a full-featured and powerful software packet. A common code base for Video for Windows (VfW) and Windows Driver Model (WDM) reduces software maintenance, and thus protects the system designer's software investments. The Device Driver Kit (DDK) for the SAA7130 includes a plug-and-play driver as well as capture-driver installations for all the commonly used 32-bit Windows platforms (Windows 95, Windows NT 4, Windows 98, Windows 2000, and Windows ME).

All platform-related drivers support:

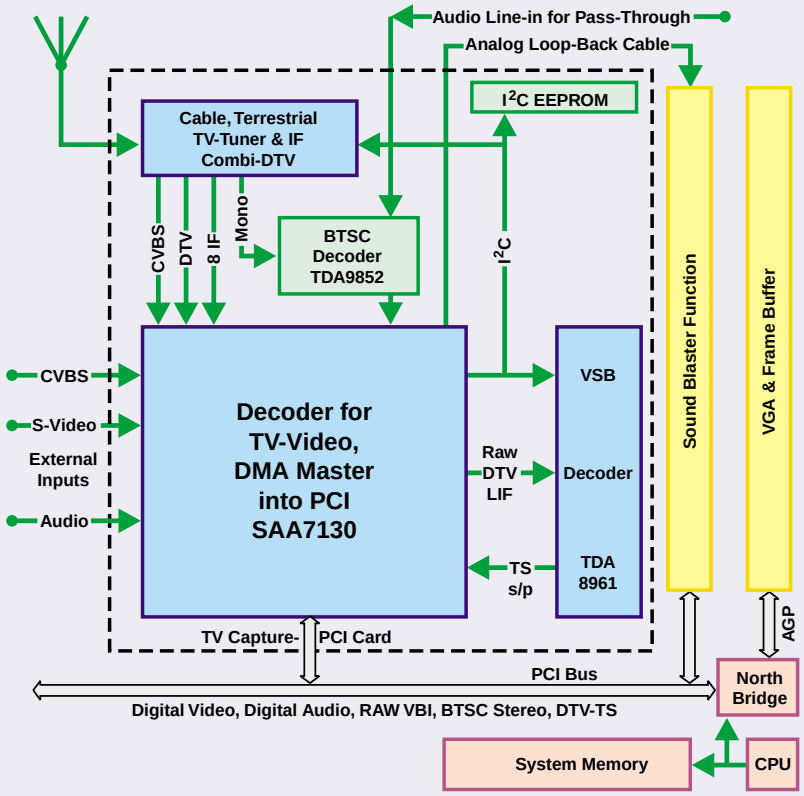
- Video Preview and Capture Interfaces
- A custom application interface that enables the development of specialized applications when the published Windows API (WDM or VfW) is not sufficient

Additional Features

The SAA7130 provides flexibility for easy, cost-effective design for today's video applications.

- Digital inputs and I/O ports are 5-V tolerant
- Boundary-scan test circuit conforming to IEEE-1149.b1-1994
- Available in LQFP128 (SOT425-1) package
- Reference designs available
- SDK for Win-95/98, -NT, -2000, VfW & WDM
- I²C master to program/setup peripheral devices, such as a tuner, enhanced decoder or MPEG compression IC

PC Application: Hybrid ATSC/NTSC TV Capture PCI Card



SAA7130 PCI 9-Bit Video Decoder

Advantages		Benefits
Video Support		
• Two 9-bit Analog-to-Digital Converters (ADCs)	→	Outstanding video performance and signal-to-noise ratio (SNR)
• High-performance adaptive 4-line comb filter with all sources, including VCR and broadcast	→	Best in class luma/chroma separation and bandwidth ease of programming
• Macrovision detection with active status interrupt	→	Enables content protection and low cost time shifting applications
• Integrated anti-alias filters	→	Reduces board space, system costs, and external components
• 27-MHz MPEG compatible clock	→	Glueless MPEG encoder interface without sample rate converter, clock generator or PLL
Digital Broadcast Support		
• Transport stream capture and DMA	→	Enables low-cost PCI-based digital TV and DVB applications
• Direct VSB/COFDM/QAM support via dedicated "sidecar" output, ADC for DTV-DVB channel decode	→	Reduces chip count for hybrid analog/digital broadcast designs
• Video-out/MPEG-in General Purpose Input/Output Pins (GPIO)	→	Enables hardware MPEG encoding for low-cost PC-based video time shifting
Audio Support		
• Two pairs of analog (stereo) inputs and source select for integrated analog audio pass-through to loop-back cable support	→	Captured mono audio (from tuner or stereo/mono line-in) signals can be directly forwarded via loop-back cable to sound card to support legacy analog audio

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