

SAA7130

Multi-standard TV video decoder for PCI mono applications

Delivering high-quality decoding for all worldwide TV video standards, the Philips SAA7130 gives designers a low-cost solution for adding analog TV video capture and decoding to a variety of PCI-based products.



Key features

- > Detects and decodes all worldwide analog TV video formats: PAL, NTSC, SECAM
- > Adaptive four-line comb filter enhances picture quality
- > Certified Macrovision® detection circuitry
- > Captures raw VBI data (Teletext, Closed Captioning, etc.)
- > Superior subpixel-accurate horizontal and vertical scaling
- > Two advanced, low-noise video ADCs with 2x oversampling
- > Transport stream capture from digital TV broadcasts
- > Configurable PCI FIFOs with graceful overflow handling
- > Line-level audio capture with pass-through (for loop-back to sound card or headphones)
- > 100% pin compatibility with other SAA713x decoders
- > ACPI compliant
- > Supports PCI and standalone configurations

Semiconductors

On a single chip, the highly integrated Philips SAA7130 detects and decodes all worldwide analog TV video formats. Its flexible design, reusable components, and versatile external interfaces lower BOM and cost and support advanced decoder configurations. It supports capture of transport streams from digital TV broadcasts, certified multi-level detection of Macrovision copy protection, and capture of all types of raw VBI samples. 100% pin compatibility with other SAA713x ICs enables reuse of SAA7130 PCB designs to support more advanced audio features and market price points.

The SAA7130 supports legacy audio by providing line-level analog audio input and pass-through. Audio is routed through a loop-back cable to headphones or a sound card for further processing or output. No external components are required.

The SAA7130 delivers exceptional picture quality through advanced video features such as high-quality ADCs, adaptive comb filters, and subpixel-accurate scaling. In PCI configurations, it takes full advantage of the streaming capabilities of modern PCs to output decoded video, VBI, and transport streams through DMA bus-mastered writes across the PCI bus.

Target applications

The SAA7130 is a low-cost solution for adding analog TV video decoding to a wide variety of PCI-based products such as:

- > PCs, laptops, notebooks
- > hybrid (analog/digital) television sets
- > hybrid cable, terrestrial, and satellite set-top boxes
- > DVD recorders
- > video surveillance and security devices.

PHILIPS

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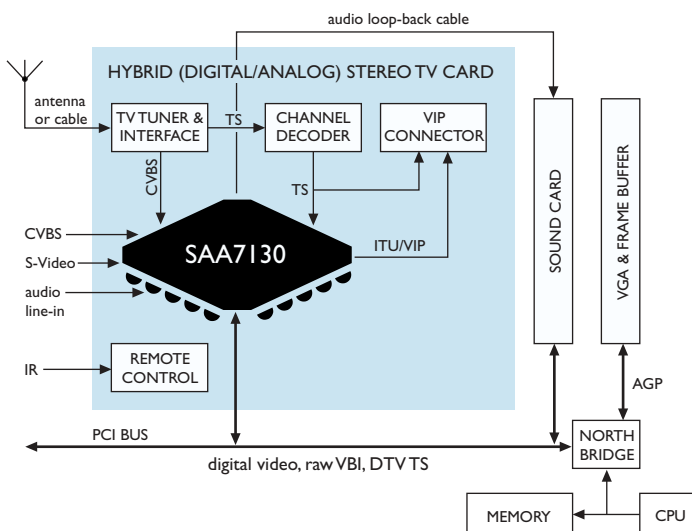


Analog TV video processing

Capture

Analog video is sampled through five video inputs, supporting any combination of CVBS and S-Video signals. The SAA7130 detects all worldwide analog TV video standards: PAL, NTSC, and SECAM. Video is digitized by sophisticated, nine-bit ADCs with automatic clamping and programmable gain control to optimize use of the ADCs' conversion range. Support for 27-MHz oversampling, twice the ITU-601 standard, ensures an exceptional signal-to-noise ratio for maximum picture clarity. Additional capture features include:

- > single crystal support for all video standards
- > fast frame lock for fast input-switching in surveillance applications and VCR fast search, shuttle, and freeze frame
- > forced-field toggle for use with non-interlaced inputs (avoids VCR 'blue screen')



Typical SAA7130 configuration for a hybrid TV PCI add-in card

Decode

The SAA7130 decodes composite video into ITU-601 compatible component color values. Its multi-standard, adaptive four-line comb filter performs best-in-class luma/chroma separation of CVBS signals from all sources, significantly reducing dot crawl and enhancing image resolution and detail. The decoder integrates separate brightness-contrast-saturation circuitry for CVBS, S-Video, and raw VBI samples, and hue control for CVBS and S-Video signals.

The SAA7130 supports certified hardware Macrovision detection with active-status interrupt. By ensuring the content's original analog copy protection is intact, Macrovision prevents unauthorized recording of copyrighted material transmitted through analog video outputs in applications such as time-shift or archive recording or large screen display.

Scaling, matrix, clipping

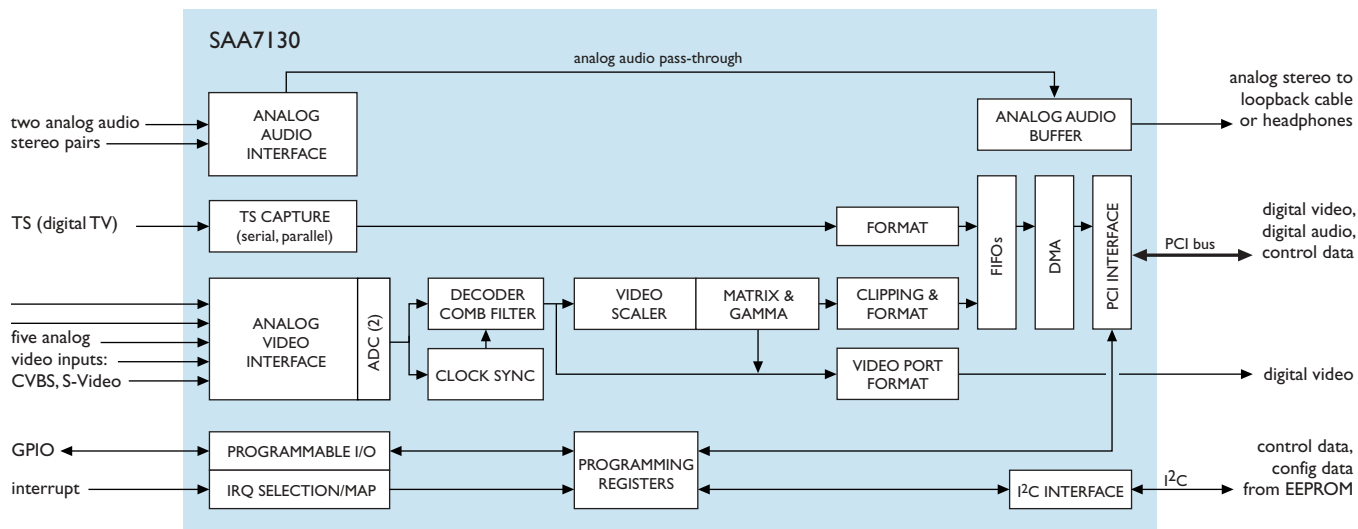
The SAA7130 incorporates an adaptive filter and circuitry to crop, scale, and reduce frame rate. It can horizontally or vertically downscale or zoom video, supporting playback windows of any size. Two alternating settings for active video scaling support independent capture and preview definition. Adaptive anti-alias filters reduce board space, system costs, and external components.

Optional YUV-to-RGB and RGB-to-YUV matrices and a color lookup table can be used to normalize ITU-standard color values to the full RGB range and apply gamma correction as needed to optimize screen contrast and color. A clipping unit allows definition of overlay rectangles (for Video for Windows (VfW) legacy requirements) or assignment of alpha values to video pixels.

Output

Decoded, scaled video can be output in various YUV or RGB formats, including packed and planar, gamma-compensated or black-stretched. The video stream is transmitted through DMA writes across the PCI bus or through a digital video output port.

SAA7130 Conceptual Block Diagram



Audio pass-through

To support legacy analog audio, the SAA7130 provides line-level input and pass-through of analog audio signals. After capture through two pairs of line-level stereo inputs (with source select), mono audio signals are directly forwarded through a loop-back cable to a sound card for further processing or output. No external components are required.

VBI capture

The SAA7130 captures raw VBI samples that can be provided to software components for decoding. The VBI sampling rate can be adjusted as needed by the data slicing software. Supported VBI formats include Closed Captioning, Teletext, WST, NABST, CGMS, and WSS.

Digital TV transport stream capture

In low-cost hybrid TV applications, the SAA7130 supports capture of transport streams from digital TV (ATSC, DVB, or BS-Digital) broadcasts. After capture, the transport stream is written to memory across the PCI bus for demux and program stream decoding, typically by software running on the system CPU.

Versatile external interface

The SAA7130's flexible design, reusable components, and versatile external interfaces lower BOM and cost and support advanced decoder configurations. Such flexibility is made possible, in part, through a set of 28 general purpose I/O (GPIO) pins, initially dedicated to interface with key onboard components to provide:

- > a digital video port
- > transport stream capture from a DTV channel decoder
- > peripheral interrupt input.

GPIO pins can be reassigned if dedicated functions are not needed in a specific product configuration. In addition, unassigned pins can be utilized for GPIO under direct software control.

DMA and configurable FIFOs

In PCI configurations, the SAA7130 uses DMA bus-mastered writes to output captured video, VBI, and digital TV transport streams. Six DMA channels share a common FIFO pool of 256 D-words. The ability to define optimal burst length and FIFO capacity per DMA channel allows system designers to tailor and balance the latency behavior for each channel in a given application, adapting to actual conditions.

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Comprehensive software support and reference design

The SAA7130 Software Development Kit (SDK) supports a common code base for Vfw and Windows Driver Model (WDM) architectures, reducing software maintenance and protecting software investments. The SDK is based on a Component Object Model (COM) interface; it includes sample code in Visual Basic and C++ and a description of the interface.

SAA7130 WDM driver support is provided for all DirectShow®-based applications. A WDM device driver kit (DDK) includes a plug-and-play driver, capture-driver installations, and documentation. The SAA7130 WDM driver is WHQL validated and is supported for Windows® 98/ME/2000/XP. The SAA7130 Vfw driver is available for Windows 95/NT4. A BDA-compliant driver is included for digital TV applications. The SAA7130 also provides a custom API enabling development of specialized applications when the published Windows APIs (WDM or Vfw) are insufficient.

A comprehensive SAA7130 Reference Design Kit enables system designers and hardware manufacturers to quickly evaluate SAA7130 features and develop cost-effective single, half-size PCI designs for hybrid TV receivers. The Kit includes:

- > a reference PCI card with SAA7130 decoder, analog TV tuner, 32.111-MHz quartz crystal, I²C EEPROM
- > a board connector plate with TV connector, CVBS and S-Video inputs, audio input (line-in) and output (line-out)
- > an optional voltage regulator for improved video performance
- > the SAA7130 SDK and DDK
- > installation and user guides
- > board design, schematics, and Gerber files
- > video cables.

Technical specifications

PHYSICAL

Package	Rectangular LQFP128; 128 pins
Power	<i>supply</i> 3.3 V <i>consumption</i> 1.35 W (typical application)
Temperature	0 to 70 °C

STANDARD COMPLIANCE/CERTIFICATION

PC	Meets Microsoft/Intel requirements for PC Design Guides 98/99 and 2001
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ANALOG VIDEO SUBSYSTEM

Video input	Five (5) analog input ports supporting any combination of CVBS (NTSC, PAL, SECAM), S-Video
ADCs	Two (2) 9-bit CMOS ADCs, 27-MHz oversampling
Video output	<i>via PCI</i> YCbCr or RGB including packet and planar, gamma-compensated, or black stretched <i>via digital video port</i> ITU-656, YUV-VMI (8 bit), VIP 1.1 or VIP 2.0 (8 or 16 bit), ZV (16 bit), ITU-601 (16 bit)
Sample rate	720 pixels/line (ITU 601)
XTAL reference	32.11 or 24.576 MHz, supports all video standards
Comb filter	NTSC/PAL adaptive 4-line Y-C separation for all sources including broadcast and VCR
Scaling	Downscaling: horizontal, vertical, and by field rate Scalable from 10 taps H (for ratios close to 1:1) to 74 taps (icon-sized video)
VBI	<i>formats</i> Closed Captioning, Teletext, NABST, CGMS, WST, and WSS <i>PCI output</i> DMA writes to memory; dedicated channel Independent sample rate, adjustable by slicing algorithm
Macrovision	3-level with active status interrupt; complies with Macrovision's Copy Protection Detect Specification, Revision 1.00

AUDIO SUPPORT

Analog input	Two pairs (2) analog stereo baseband inputs
Analog output	One (1) analog stereo port (for loop-back to sound card or local headphones)

DIGITAL TV SUPPORT

TS input	(GPIO) serial or parallel TS (from a channel decoder)
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Technical specifications (continued)

I²C INTERFACE

Modes	Bus-master interface, multi-master capable Slave interface
Power	3.3 V and 5 V signal-level compatible Includes peripheral reset and power-down control
Rates	100 kHz and 400 kHz

GENERAL PURPOSE I/O

Total pins	28
Dedicated	Digital video output Serial or parallel TS from a channel decoder Peripheral interrupts

PCI BUS INTERFACE

Compliance	PCI specification, Rev. 2.2 Power Management Interface Specification, Rev. 1 Windows ACPI power down specification (all 4 levels)
Power	3.3-V signaling, 5-V tolerant
DMA	Six (6) master-write DMA channels sharing 1-kB configurable FIFO
Data types	<i>digital</i> video, raw VBI, TS (ATSC/DVB/BS-Digital)

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