

SAA7134

Single-chip, multi-standard analog TV video and stereo decoder for PCI applications—Europe

Integrating high-quality, multi-standard TV video (PAL, SECAM, and NTSC) and TV stereo audio (NICAM, A2/ Dual-FM) decoding used in Europe, the Philips SAA7134 gives designers a low-BOM, space-efficient solution for adding analog TV features to a variety of PCI-based computing and consumer products.



Semiconductors

On a single chip, the SAA7134 TV video/stereo decoder detects and decodes all worldwide analog TV video formats and the TV stereo formats used throughout Europe. It delivers exceptional picture quality and advanced video features proven in other SAA713x devices: high-quality ADCs, an adaptive comb filter, subpixel-accurate scaling, and certified three-level Macrovision detection circuitry.

The SAA7134's flexible design, reusable components, and versatile external interfaces lower BOM and cost and support advanced TV decoder configurations. Capture of transport streams from digital TV broadcasts supports hybrid TV designs. In PCI configurations, the SAA7134 takes full advantage of the streaming capabilities of PCs by outputting decoded video, audio, VBI samples, and transport streams through DMA bus-mastered writes across the PCI bus.

Key features

- > Detection and decoding of all worldwide analog TV video formats: PAL, NTSC, SECAM
- > Detection and decoding of TV stereo formats: NICAM and A2/Dual-FM
- > 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 (DVB) broadcasts
- > Configurable PCI FIFOs with graceful overflow handling
- > Outputs digital I²S audio and ITU-656 video
- > 100% pin compatibility with other SAA713x decoders
- > Supports PCI and standalone configurations

Target applications

The SAA7134 is a space-efficient solution for adding high-quality multi-standard analog TV decoding to a wide variety of PCI-based computing and consumer products. Its 100% pin compatibility with existing SAA713x decoders enables efficient reuse of existing SAA713x designs for more advanced audio features, new markets or price points. The SAA7134 is targeted for European markets in products such as:

- > desktop and portable PCs
- > hybrid (analog/digital) TV sets
- > hybrid cable, terrestrial, and satellite set-top boxes
- > DVD recorders
- > and more.

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Analog TV video processing

Capture

The SAA7134 samples analog video through five video inputs supporting any combination of CVBS and S-Video signals. It detects all worldwide analog TV video standards (PAL, SECAM, and NTSC). 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 over-sampling, twice the ITU-601 standard, ensures an exceptional signal-to-noise ratio for maximum picture clarity. Additional capture features include:

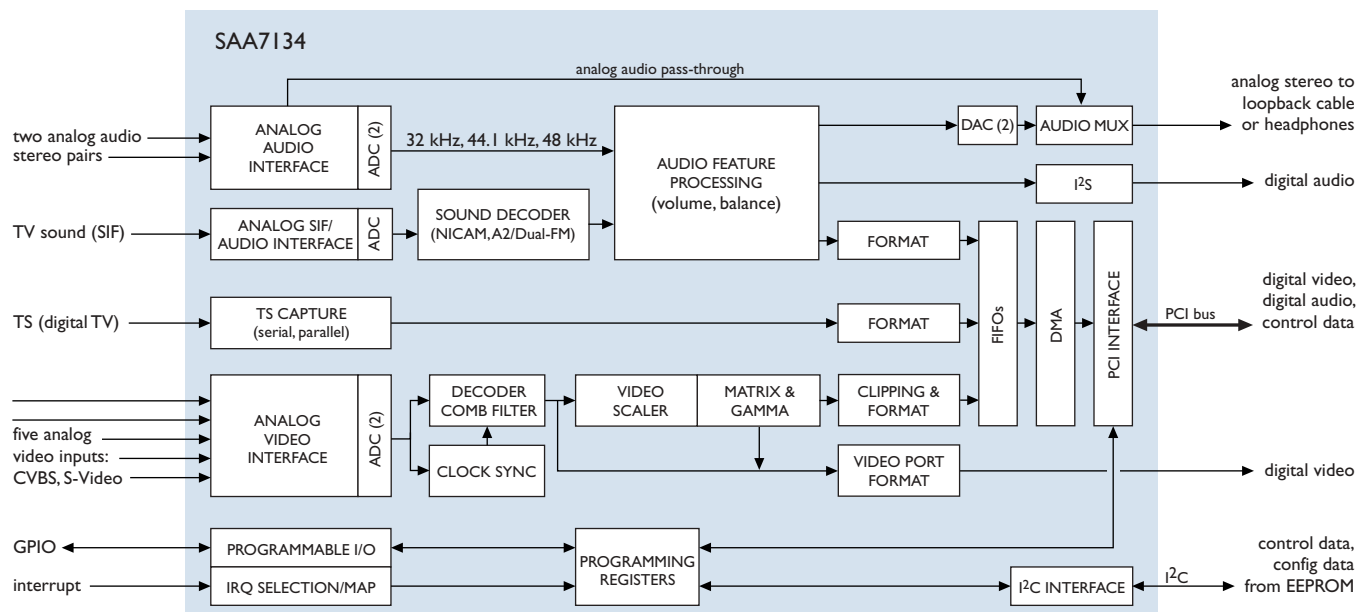
- > single crystal support for all video standards
- > fast frame lock for fast input-switching in surveillance applications and VCR fast search, shuttle, and freeze frame
- > forced-field toggle for use with non-interlaced inputs (avoids VCR 'blue screen')

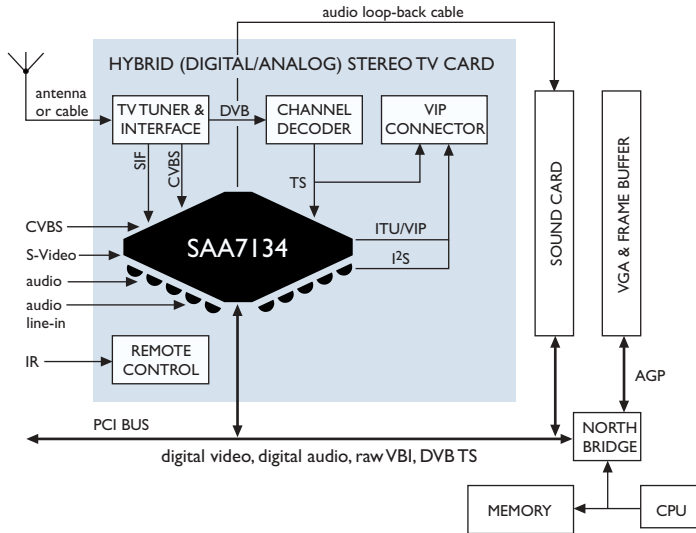
Decode

The SAA7134 decodes composite video into ITU-601 compatible component color values. Its high-quality 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 SAA7134 supports certified hardware Macrovision detection with active-status interrupt. By ensuring the content's original analog copy protection is still 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.

SAA7134 Conceptual Block Diagram





Typical PC application: hybrid TV (DVB) PCI add-in card

Scaling, matrix, clipping

The SAA7134 incorporates an adaptive filter and circuitry to crop, scale, and reduce frame rate. It can perform horizontal or vertical video down scaling or zooming to support 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, cost, 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.

Stereo audio processing

Capture and decoding

The SAA7134 handles capture and on-chip decoding of the TV stereo audio formats used throughout Europe (NICAM and A2/ Dual-FM). After capture from the TV tuner through a SIF (Sound Intermediate Frequency) port, TV stereo audio is digitized and FM or AM demodulated. The audio standard is detected, the pilot tone is investigated (mono, stereo, dual), and the signal is decoded.

Two 16-bit audio ADCs support capture of sound signals from nonstandard sources such as video cameras, VCRs, and AM (mono) or FM (stereo) radio through two stereo line-in inputs. A field-locked audio sampling clock supports a constant number of audio clocks per video field, guaranteeing synchronization between audio and video streams. The SAA7134 also performs on-chip volume and balance processing.

Output

Decoded digital audio is streamed across the PCI bus or output through an I²S port. Alternatively, it can be reconverted to analog (by on-chip stereo DACs) and rerouted through a loop-back cable to a sound card.

Audio passthrough

To support legacy analog audio, the SAA7134 also 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 SAA7134 captures raw VBI samples that can be provided to software components for decoding. The VBI sampling rate can be adjusted by the data slicing software. Supported VBI formats include Closed Captioning, Teletext, WST, NABST, CGMS, and WSS.

Digital TV transport stream capture

For low-cost hybrid TV applications, the SAA7134 supports capture of transport streams from digital TV (DVB) 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.

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Versatile external interface

The SAA7134'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 digital TV 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 SAA7134 uses DMA bus-mastered writes to output captured video, audio, 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.

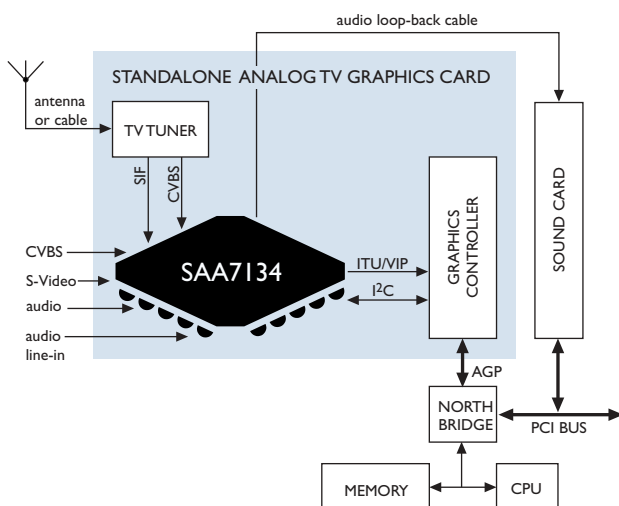
Comprehensive software support and reference design

The SAA7134 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.

SAA7134 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 SAA7134 WDM driver is WHQL validated and is supported for Windows® 98/ME/2000/XP. The SAA7134 Vfw driver is available for Windows 95/NT4. A BDA-compliant driver is included for digital TV applications. The SAA7134 also provides a custom API enabling development of specialized applications when the published Windows APIs (WDM or Vfw) are insufficient.

A comprehensive SAA713x Reference Design Kit enables system designers and hardware manufacturers to quickly evaluate SAA7134 features and develop cost effective single, half-size PCI designs for hybrid TV receivers. The Kit includes:

- > a reference PCI card with SAA7134 decoder, analog TV tuner, 32.11-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 SAA7134 SDK and DDK
- > installation and user guides
- > board design, schematics, and Gerber files
- > video cables



Typical SAA7134 standalone configuration for graphics card

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>supported formats</i> Closed Captioning, Teletext, NABST, CGMS, 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 DECODE SUBSYSTEM

Audio in	One (1) analog SIF port (from tuner) Two pairs (2) analog stereo baseband inputs
Audio out	<i>analog</i> One (1) stereo port (for loop-back to sound card or local headphones) <i>digital</i> One (1) I ² S port (GPIO) for digital audio output
Decode formats	NICAM, A2/Dual-FM
Sample rates	32 kHz, 44.1 kHz, 48 kHz
Clocks	Selectable: 768*fs, 512*fs, 384*fs or 256*fs 24.576 MHz to external audio reference clock Locked to video frame rate
ADCs	Two (2) 16-bit baseband audio One (1) 8-bit SIF, 24.576 MHz
Audio features	Volume, balance

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 I ² S port (for digital audio output)

DIGITAL TV SUPPORT

TS input	(GPIO) serial or parallel TS (from a channel decoder)
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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, audio, raw VBI, and TS (DVB)

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