

SAA7174

Analog TV video and stereo decoder for computing and consumer applications in Europe

Integrating high-quality, multi-standard TV video (PAL, SECAM, and NTSC) and TV stereo (NICAM, A2/Dual-FM) decoding, the Philips SAA7174 gives designers a low-BOM, space-efficient solution for adding analog TV features to a variety of computing and consumer products.



On a single chip, the SAA7174 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 such as high-quality ADCs, an adaptive comb filter, subpixel-accurate scaling, and certified three-level Macrovision detection circuitry. The SAA7174's flexible design, reusable components, and versatile external interfaces lower BOM and cost and support a variety of TV decoder configurations.

Target applications

The SAA7174 is a space-efficient solution for adding high-quality multi-standard analog TV decoding to a wide variety of computing and consumer products. Its 100% pin compatibility with the SAA7173 decoder enables efficient reuse of SAA7173 designs for new markets or price points. The SAA7174 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
- > USB/1394 video dongles
- > DVD recorders and more.

Key features

- > Detects and decodes all worldwide analog TV video formats: PAL, NTSC, SECAM
- > Detects and decodes TV stereo formats used in Europe: 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
- > Outputs digital I²S audio and ITU-656 video
- > 100% pin compatibility with the SAA7173 decoder

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Analog TV video capture and decoding

The SAA7174 samples analog video through five video inputs supporting any combination of CVBS and S-Video signals from a TV tuner or nonstandard sources such as a VCR or camcorder. 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 oversampling, twice the ITU-601 standard, ensures an exceptional signal-to-noise ratio for maximum picture clarity. Additional 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').

The SAA7174 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

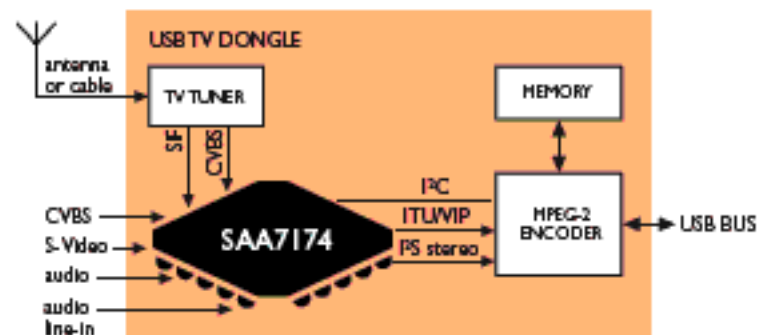
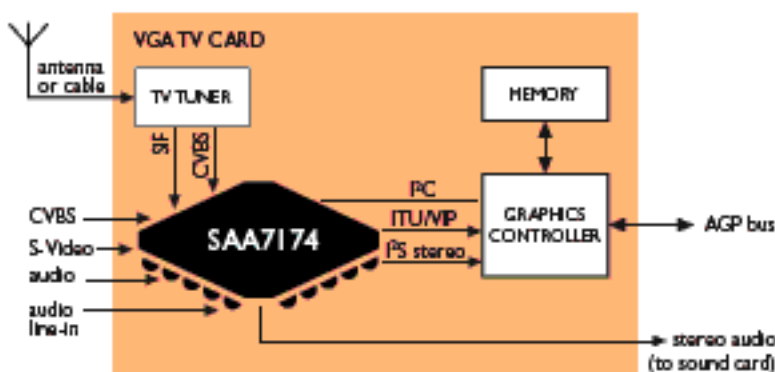
integrates separate brightness-contrast-saturation circuitry for CVBS, S-Video, and raw VBI samples and hue control for CVBS and S-Video signals.

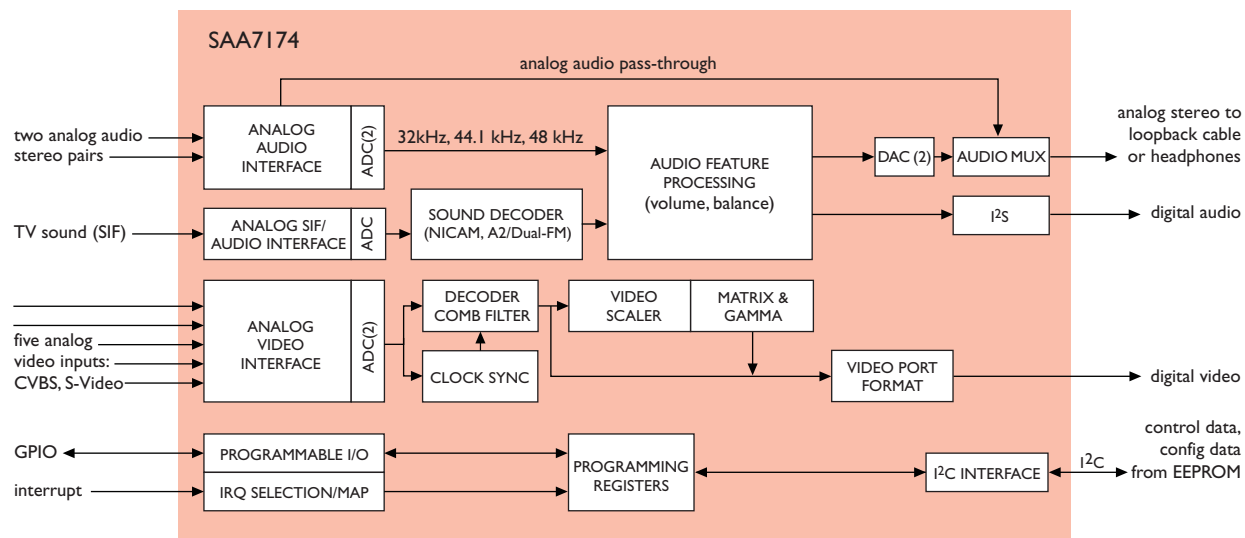
The SAA7174 supports certified hardware Macrovision detection with active-status interrupt. By ensuring the content's original analog copy protection is still intact, Macrovision prevents unauthorized recording of copyrighted material transmitted through analog video outputs in applications such as time-shift or archive recording or large screen display.

Scaling, matrix, clipping

The SAA7174 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.

Typical SAA7174 configurations for analog TV and USB TV dongle





SAA7174 conceptual block diagram

Video output

Decoded, scaled video is output through a digital video output port in various YUV or RGB formats including packed and planar, gamma-compensated, or black-stretched.

Stereo audio capture, decode, and output

The SAA7174 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 of audio and video streams. The SAA7174 also performs on-chip volume and balance processing.

Decoded digital audio is 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 SAA7174 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 routed through a loop-back cable to a sound card for further processing or output. No external components are required.

VBI capture

The SAA7174 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.

Versatile external interface

The SAA7174'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 28 general purpose I/O (GPIO) pins, initially dedicated to provide a digital video port and 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.

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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

ANALOG VIDEO SUBSYSTEM

Video input	Five (5) analog input ports supporting any combination of CVBS (NTSC, PAL, SECAM) or S-Video signals
ADCs	Two (2) 9-bit CMOS ADCs, 27-MHz oversampling
Video output	<i>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 formats	Closed Captioning, Teletext, NABST, CGMS, WST, and WSS
Macrovision	3-level with active status interrupt; compliant with Macrovision 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)
Decode formats	NICAM, A2/Dual-FM

AUDIO DECODE SUBSYSTEM (CONTINUED)

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, 400 kHz

GENERAL PURPOSE I/O

Total pins	28
Dedicated	Digital video output Peripheral interrupts I ² S port (for digital audio output)

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