By combining our latest ATSC Digital TV front-end with our well-proven desktop video architecture, Philips has developed a compact PCI card which can receive ATSC DTV broadcast transmissions, as well as NTSC broadcast and cable signals. A complete reference design, it allows hardware manufacturers to develop cost-effective card designs for PC-based DTV reception and other PCI-based receivers, quickly and with minimal risk.

'Coney' reference design

PC-card reference design for PCI-based ATSC DTV and NTSC TV signal reception

Applications

- PCI card for PC DTV reception
- Other PCI-based receivers

Highly featured board

- Multi-format tuner module (Philips TD1536) for VSB and NTSC, with dual input option to allow selection of, for example, analog signals from cable and VSB DTV signals from an antenna
- Single IF stage based around TDA9819T handles both VSB downconversion and NTSC demodulation
- Single-chip TDA8960 ATSC-compliant 8-VSB demodulator
- High performance SAA7113 analog video capture/digitizer IC with 9-bit ADC
- Decoding of analog BTSC stereo sound; digitization of external stereo audio signals
- SAA7146A PCI bridge carries MPEG2 TS, ITU-R 656 and I²S audio streams to host
- Compatible with all 18 ATSC digital broadcast TV formats, and ATVEF and DASE data formats

Complete PCI DTV receiver reference design

Philips Semiconductors has now brought together our market-leading ATSC DTV front-end hardware with ICs from our field-proven desktop video chipset, specifically designed to handle TV and video on the PC and already proven in a number of market-leading video processing systems. The result is the 'Coney' board, a complete reference design which greatly simplifies the design of PCI-based analog and digital TV receivers.

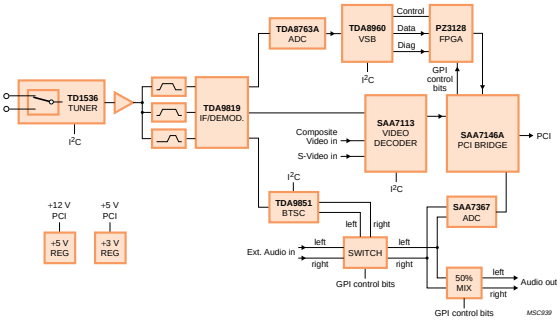
With almost every modern PC using the PCI-bus the market has great potential, but developing such systems is time-consuming and complex, especially as DTV itself is a relatively new area. As a proven kit, this new reference board allows hardware OEMs to gain very early entry in a potentially huge emerging market with minimal development risk. Philips' ICs are all designed to integrate smoothly with each other, so there is no need to design specific interfaces and designers can focus on product differentiation, a key success factor in this market.

A versatile reference board

The board front-end uses a Philips TD1536 multi-format tuner module and a single-chip IF stage (TDA9819T), which can handle both VSB modulated signals for ATSC broadcast reception, as well as analog NTSC terrestrial and cable signals.

Separate video outputs from the IF stage feed digital VSB signals to an ADC converter - which are then handled by the single-chip TDA8960 VSB demodulator/decoder - while analog signals go to the SAA7113, the world's first 9-bit single-chip multistandard video capture device. This IC can also accept video inputs from separate external sources, in CVBS or S-video format, via connectors on the board. A BTSC sound decoder handles stereo sound processing and external audio inputs can also be digitized. The SAA7146A Media Streaming Engine interfaces the other ICs to the PCI-bus, carrying the MPEG2 Transport Stream (TS) from the VSB decoder, the ITU-R 656 representation of the analog NTSC signal, video from the external inputs and the digital audio signals.

ATSC transport stream demultiplexing, MPEG2 HL decoding and decoding of broadcast data services are performed on the host using combinations of hardware and/or software, depending on the application. A licence is available, royalty free, from Philips Semiconductors to use the PCB layout (Gerber) files as well as the original design schematics.



Let's make things better.

PHILIPS

PC-CARD REFERENCE DESIGN FOR PCI-BASED ATSC DTV AND NTSC TV SIGNAL RECEPTION

At the heart of Philips' Coney board are a number of very highly integrated, highly-featured ICs, essentially a single-chip solution for each core function.

TDA8960 VSB DEMODULATOR/DECODER

Key features

- One-chip ATSC-compliant 8-VSB demodulator and concatenated Trellis (Viterbi)/Reed-Solomon decoder with de-interleaver and de-randomizer
- 8-bit MPEG2 transport stream output
- On-chip digital tuner AGC control
- Integrated digital Square-Root Raised-Cosine (half Nyquist) filter with 11.5% roll-off
- AGC control output back to half-Nyquist filter stage
- Digital Nyquist slope generation (rather than via a SAW filter)
- Fully internal carrier recovery loop with programmable loop filter
- Feed forward adaptive equalizer including a Decision Feedback Equalizer (DFE)
- Adaptation based on ATSC field sync (trained) and/or 8-VSB data (blind)
- Capability to read and write taps via I²C-bus
- Rate 2/3 (rate 1/2 Ungerboeck-code-based) Trellis (Viterbi) decoder
- Reed-Solomon decoder with internal convolutional de-interleaving
- De-randomizer based on ATSC standard

The TDA8960 is perhaps the key chip in the DTV Coney board. It accepts 8-VSB modulated signals from the IF block of the tuner front-end and it is also possible to apply the VSB IC AGC control output directly to the tuner. After internal carrier recovery, half Nyquist filtering and symbol timing recovery, adaptive equalization using a decision feedback equalizer (DFE) is performed, using the ATSC field sync (trained equalization) and/or the 8-VSB data itself (blind equalization).

After trellis decoding, the stream is de-interleaved with a convolutional de-interleaver with on-chip memory. The Reed-Solomon decoder is ATSC-compliant, with a length of 207 and it can correct up to 10 bytes. After the decoded stream is derandomized using a pseudo-random bit sequence (PRBS), it outputs an 8-bit MPEG2 transport stream for demultiplexing.

OTHER KEY ICS

TDA9819T IF downconverter

Philips' TDA9819T IF downconverter supports standard 6 MHz VHF/UHF analog and digital terrestrial TV channels in the 38.9 MHz to 45.75 MHz IF frequency range. It uses three AC-coupled, differential amplifier stages, with a feedback stage controlled by emitter-degeneration, to control the IF gain. After gain control, where the AGC regulates the IF and tuner gain to maintain the DTV signal at a constant level, the DTV IF signal is downconverted to the

symbol frequency (3 to 11 MHz) by a linear four-quadrant multiplier. The TDA9819T provides true synchronous and very linear demodulation with active carrier regeneration, good inter-demodulation figures, reduced harmonics and excellent pulse response.

SAA7113 video capture and digitizer IC

The SAA7113 multistandard (PAL/NTSC) video processor is the world's first 9-bit single-chip video capture device. It has an analog processing front-end with two pre-processing channels accepting four inputs. Signal digitization is handled by two 9-bit DACs with a revolutionary low-noise internal differential architecture to reduce dramatically noise in the video digitizing process. A VBI data-slicer handles most worldwide VBI data including teletext and closed captioning.

SAA7146A Media Streaming Engine

The SAA7146A Media Streaming Engine has two input ports for colour-decoded video streams accepting in 8-bit (D1) or 16-bit (D2) format signals. It features high performance 2D scaling to allow electronic zooming, and it produces very few artefacts even when pictures are reduced to icon size, making it ideal for windowing and high-end applications. By performing most of the video processing on-board, the SAA7146A helps reduce load on the CPU, maintaining high overall system performance. In addition to the PCI-bus, it supports a variety of interfaces including an Intel/Motorola 8/16-bit DEBI (Digital Expansion Bus Interface) port to interface to a variety of ICs, a 4-bit general purpose interface, and an I^2C-bus connector usually used to control the decoder.

PHILIPS TD1536D AND TD1536 TUNERS

These tuners can handle ATSC terrestrial signals, as well as cable NTSC and QAM. The TD1536D has a two 'F' connector dual input, so can connect to both antenna and cable, while the TD1536 has a single 'F' connector input.

Both tuners feature:

- Flat frequency response
- Low oscillator phase noise and excellent large signal handling characteristics
- Optimization for handling high adjacent channel levels, through on-board selectivity adjustment (SAW filter) and internal automatic gain control (AGC), minimizing design-in effort
- Low output impedance, capable of driving several SAW filters (for example, second VSB and NTSC SAWs)
- 5 V power supply; tuning voltage (VT) is generated internally

DTV IS HERE AND HAPPENING FAST!

From November 1st, many broadcasters in the USA will be offering a variety of different ATSC DTV services such as HDTV and SDTV 'multicasting' at different times of the day, and roll-out of digital broadcast is happening more quickly than many observers thought. In the first wave, 26 local USA stations in the top 10 television markets volunteered to build digital broadcast capacity by November 1998. In fact, nearly 41 stations - including even some small market stations - will be capable of broadcasting a digital signal by the November 1st deadline, a nearly 50 % increase!

USA broadcasters have promised that there will be at least one digital station in each of the top ten markets by November 1998. They are required to complete the transition to digital in the top ten markets, reaching 30 % of US TV households, by May 1999; and in the top 30 markets, reaching 50 % of US TV households, by November 1999.

These achievements have involved major investments - when the industry digital build out is completed, broadcasters will have invested approximately US$ 16 billion. And consumer demand is likely to grow enormously - DTV offers so much more than analog, not only in terms of stunningly clear and crisp HDTV pictures with multichannel CD quality sound, but the new, interactive datacasting services made possible by digital technology offer fantastic market potential that's only now being realized.

The message is as clear as an HDTV picture - given such figures, there is no doubt about the commitment of the market to DTV. It's not coming in the near future; it's here today!

Source: NAB

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