Texas Instruments

Technology for Innovators™

Digital Video Technology

Market Segments

As consumer electronic devices increasingly move to digital interfaces, there remains the requirement to support legacy interfaces such as composite video signals. This includes over-the-air broadcast, cable, and VCR inputs to end-equipment such as digital TVs, DVD-Recorders, and others. The quality of the video from these sources will be increasingly critiqued and become much more visible on larger, digital video displays. With this shift, it is imperative that providers of these end-equipment choose the right analog-to-digital video products.

Texas Instruments (TI), a worldwide leader in High-Performance Analog products, has been developing video products for almost a decade. Video decoders, ADCs and DACs are included in TI's extensive product portfolio. These products provide competitive features that fit numerous end-equipment requirements.

In the pages that follow, you will learn more about TI's Mixed-Signal Video devices and how each of these meet the demanding video quality, power consumption and flexibility requirements of numerous consumer electronic products.

Complete Decoder Solutions

TI's experience in video decoders goes back almost a decade. During this time, TI has become a leader in providing highly integrated and flexible solutions.

- Many decoders provide unparalleled flexibility by being able to be customized to end-provider requirements
- Reduction of overall product development cost is made simple by TI's auto-switch technology that allows system providers the ability to release both NTSC and PAL models without changing the decoder
- TI's cutting-edge silicon process technologies provide fast-to-market, low power, and small package options all at the most competitive price

Complete Decoder Solutions

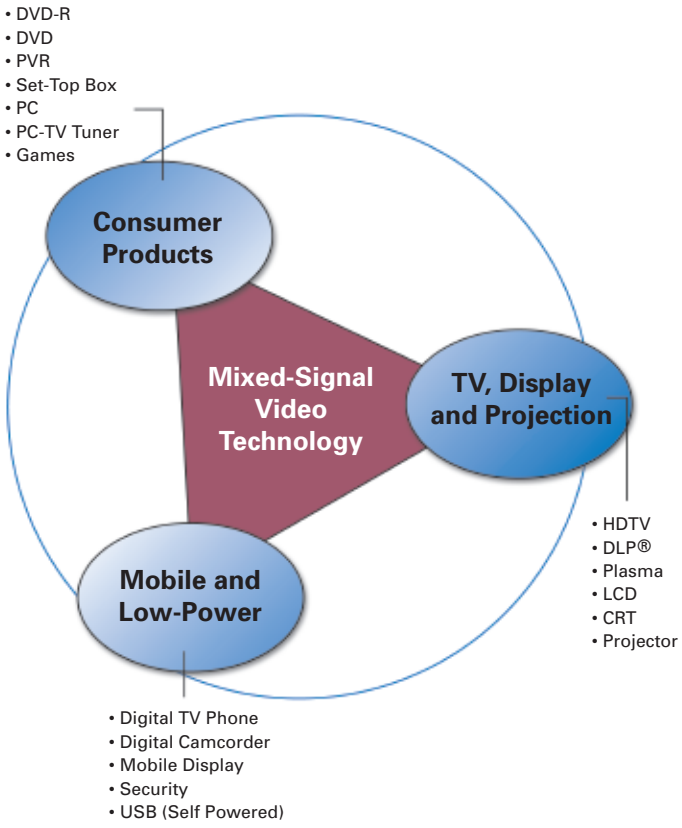
Providing the ability to convert analog video signals to the digital domain and vice versa requires very sophisticated and well designed converter products. Whether it is to support PC graphics on a DLP® business projector or to provide the ability to support analog HD video signals in a television set, designers will have to choose the right converter to provide the performance and price point their product requires.

World-Class Design-In Support

When developing products using TI video products, designers can expect extensive worldwide support throughout the entire process. TI has developed a complete line of evaluation modules, software, and application reports that decrease designer's time to market while reducing their overall design costs by avoiding unnecessary design changes during development periods. A world-wide applications support structure also allows designers to receive support within their own region.

TI Mixed-Signal Video Products

TI Mixed-Signal Video solutions are at the center of today's mixed-signal video designs. For more information about using them as the foundation for your next design, please contact your local TI field sales office (see PIC on last page). Or visit: **www.ti.com/msv**



Video Decoders

Feature	TVP5150AM1	TVP5147M1	TVP5146M2	TVP5160	TVP5154
Number of Video Decoders	1	1	1	1	4
Inputs	2	10	10	12	8 (2 per decoder)
Analog-to-Digital ADC	9 Bit (30 MHz)	11 Bit (30 MHz)	11 Bit (30 MHz)	11 Bit (54 MHz)	9 Bit (30 MHz)
Outputs	8 Bit 4:2:2	10/20 Bit 4:2:2	10/20 Bit 4:2:2	10/20 Bit 4:2:2	8 Bit 4:2:2
2D Comb Filter	4-Line	5-Line	5-Line	5-Line	4-Line
3D Comb Filter	—	—	—	√	—
3D Noise Reduction	—	—	—	√	—
Time Based Correction	—	—	—	√	—
IF Compensation	—	—	—	√	—
480p and 576p Support	—	—	—	√	—
Analog Output	—	√	—	√	—
Integrated Scaler	—	—	—	—	√
I^2C Addresses	1	1	1	1	4
Ultra-Low Power Mode	√	√	√	√	√
NTSC, PAL, SECAM Support	√	√	√	√	√
Auto-Detect and Switch Inputs	√	√	√	√	√
Weak/Non-Standard Video Support	√	√	√	√	√
Auto VCR Detect and Trick Mode	√	√	√	√	√
VBI Slicing	√	√	√	√	√
Macrovision Detection and Certificiation	√	√	√	√	—
Packaging	32-pin TQFP 48-ball MicroStar™ BGA	80-pin TQFP	80-pin TQFP	128-pin TQFP	128-pin TQFP
Package Size	7 mm x 7 mm 4 mm x 4 mm	14 mm x 14 mm	14 mm x 14 mm	16 mm x 16 mm	16 mm x 16 mm
Power (Typical all ADC active)	115 mW	490 mW	730 mW	582 mW	700 mW

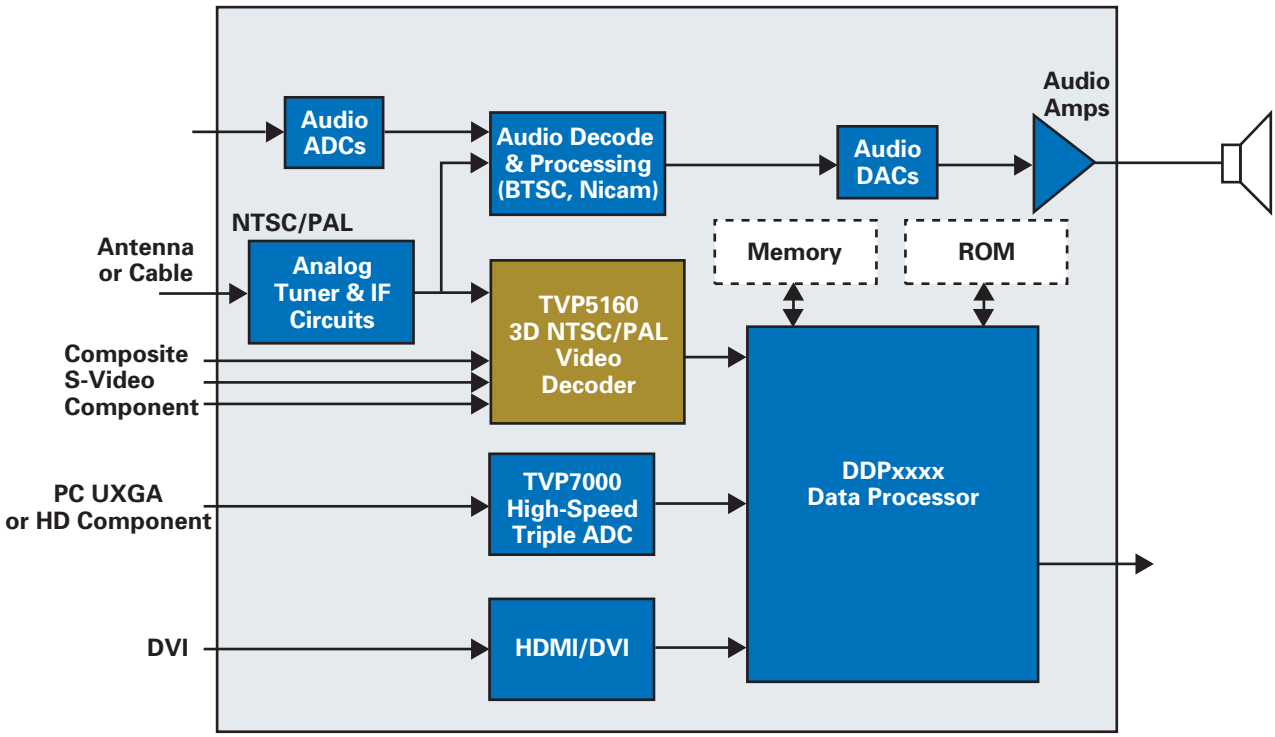
Application Usage

Category	Segment	TVP5150AM1	TVP5147M1	TVP5146M2	TVP5160	TVP5154
DVD-Recorder	Low-End	√	—	—	—	—
	Mid-Range	—	√	√	—	—
	High-End	—	—	—	√	—
Television (CRT, DLP®, LCD, Plasma)	Low-End	√	√	√	—	—
Main Channel	Mid-to High-End	—	√	√	√	—
Set-Top Box	HD and High-End	—	—	√	√	—
Business Projector (DLP, LCD)	Low-End	√	—	—	—	—
	Mid-Range	—	√	√	—	—
	High-End	—	—	—	√	—
Television (CRT, DLP, LCD, Plasma)	Sub-Channel (PIP)	√	√	√	√	—
	Low-Cost VBI Slicer	√	—	—	—	—
Portable Video	DVD-Player	√	—	—	—	—
	Mobile Phone	√	—	—	—	—
	Portable Mutimedia Player	√	—	—	—	—
Security/Surveliance	Single Channel	√	√	—	—	—
	Multi Channel	—	—	—	—	√

With picture quality that has no rival, digital TVs are eclipsing analog models as the television of choice. The digital TV market is surging as the world continues to accelerate the transition from analog-to-digital TV transmission.

Digital tuners are being integrated into the sets, allowing consumers to experience the picture and sound quality of the digital world. Crisp, vivid pictures and the overall experience of digital TV are convincing a growing number of consumers to go digital. Technology also is improving the way the digital picture is delivered. As a result, sales of digital TVs are beginning to soar. Researchers estimate that well over 200 million digital TVs (including high-end CRT, LCD, plasma displays ad DLP®) will be sold worldwide between now and 2008.

The improved picture of digital television can be attributed to the development of the 3DYC comb filter. Using a three-frame filter, it looks at a cube of pixels of the chroma and luma signals for motion instead of a square of pixels that a 2D comb filter would scan. The improvement of 3D filtering is dramatic, especially on highly detailed images or screen displays that use sharp graphics which can confuse conventional 2D filters.



DLP®/LCD Block Diagram

3D Comb-Filter NTSC/PAL/SECAM Video Decoder—TVP5160

TI's newest addition to an already market-proven portfolio of video decoders provides an unparalleled video quality to cost advantage never found in other decoder devices. The TVP5160 device, a high-quality, high-performance digital video decoder (NTSC/PAL/SECAM) digitizes and decodes all popular baseband analog video formats into digital component video.

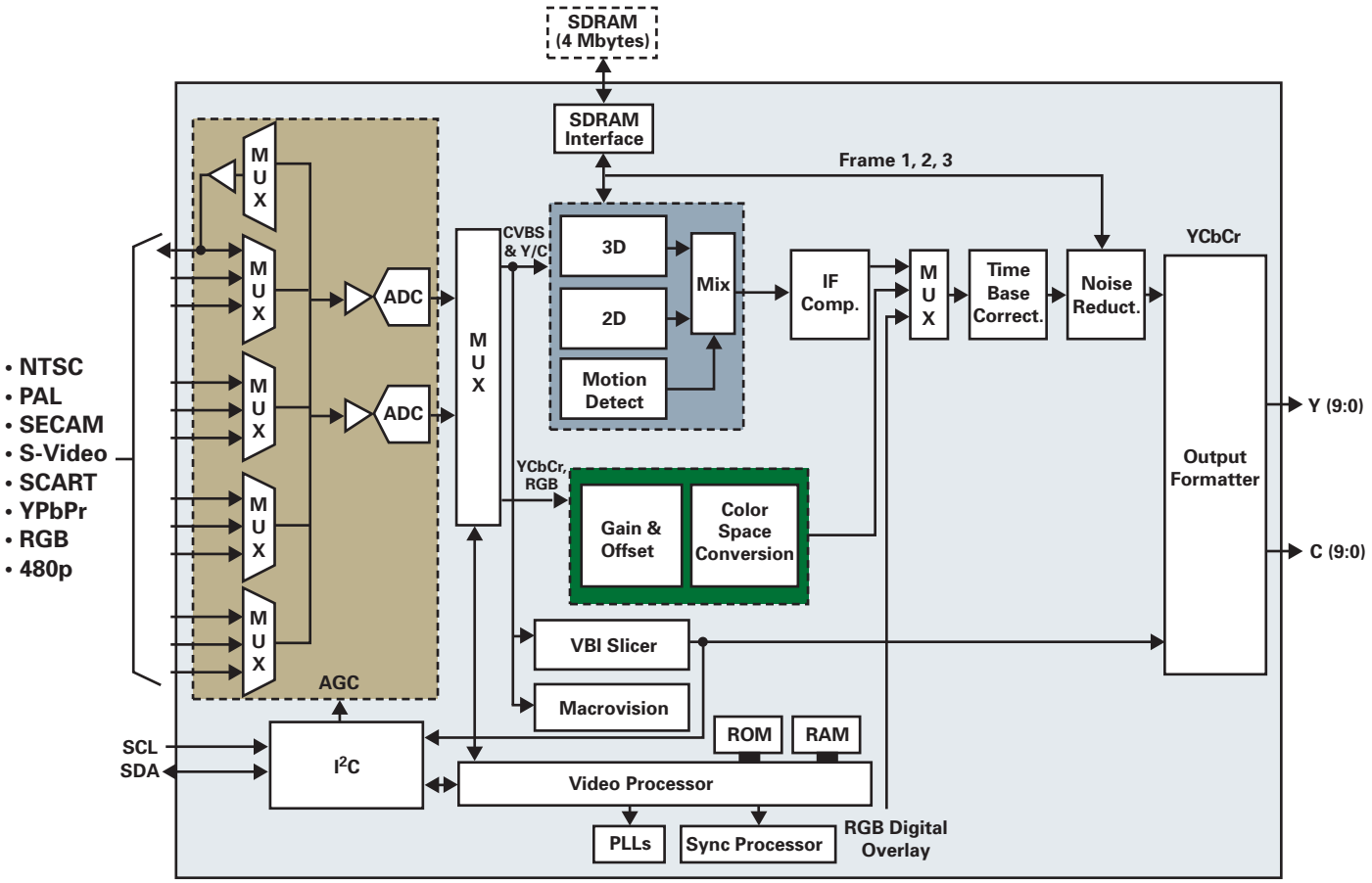
By implementing a 3D comb filter, the TVP5160 provides the highest quality video available today. The 3D comb filter, which separates the composite signal into both Y and C channels to reduce both cross-luma and cross-chroma artifacts, is applied on both NTSC and PAL video inputs. Through a highly sophisticated motion detection algorithm, the TVP5160 successfully applies TI's patented 2D, 5-line comb filter to those portions of the image that are moving but also utilizes TI's 3D comb filter to provide cleaner, crisper images to the static portions of the image. For more information, **www.ti.com/sc/device/TVP5160**

Key Features

- NTSC/PAL 3D comb filter
- Concurrent 3D noise reduction
- 480 p/576 p
- IF compensation
- Time-based correction (TBC)
- Improved 2D, 5-line comb filter
- Weak and non-standard signal support
- Robust VCR performance

Applications

- Digital TV
- LCD, plasma and DLP® displays
- High-end CRT (>29")
- Set-top box



TVP5160 Block Diagram

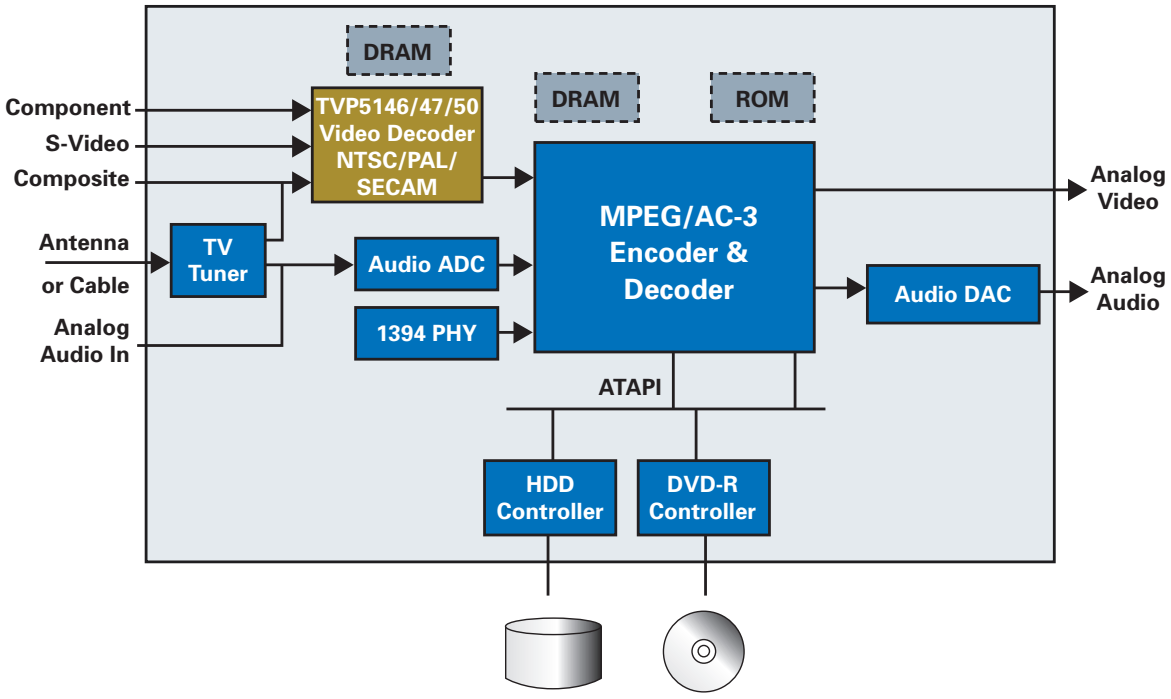
DVD-Recorder (DVD-R)

While video and audio quality, the amount of DVD content available and price declines drove the DVD player to become the most popular consumer electronics product ever, the DVD-recorder (DVD-R) is about to follow the same path.

Introduced to the market in 2002, more DVD-Rs are appearing on the market, and prices are dropping to points that make them affordable for consumers. As more DVD-Rs are shipped, the lineup of features and increasing ease of use will continue to make the products attractive to consumers. In 2007, more than 50 million DVD-Rs are expected to be shipped throughout the world.

Digital TV tuners, 1394 connectivity, electronic program guides, memory card slots, hard drives, high-speed recording capabilities, networking capabilities, DVD Audio, Super Audio CD (SACD) playback and write/rewrite capabilities will help drive consumer demand for DVD-Rs. While DVD players typically sit alongside the VCR in most homes, integrating DVD-Rs into other products, such as home theater-in-a-box, TVs or even VCRs will also help drive adoption rates for the machines.

For manufacturers to meet cost, performance, and other region specific needs such as video inputs and formats, it is imperative to choose components that meet these dynamic market requirements.



DVD-R Block Diagram

5-Line Comb Filter NTSC/PAL/SECAM Video Decoder —TVP5146M2

The TVP5146M2, a high-quality, high-performance digital video decoder (NTSC/PAL/SECAM), digitizes and decodes all popular baseband analog video formats into digital component video. The TVP5146M2 includes 10-bit, 30-MSPS analog-to-digital converters. A new robust sync detector provides superior performance in VCR trick modes, nonstandard number of lines and weak signals. The 5-line CF provides the highest 2-D quality in V/C separation. A total of 10 video inputs can be configured to a combination of CVBS, S-video YPbPr, RGB, or SCART video inputs multisource connection. SCART and analog RGB inputs makes the TVP5146M2 a perfect solution for international devices. For more information, **www.ti.com/sc/device/TVP5146M2**

Key Features

- 10-bit, 30-MSPS analog-to-digital converters
- 10 inputs including SCART
- 5-line comb filter
- Robust sync detector
- VBI data processor
- Macrovision copy protection detection

Applications

- Digital TV
- Analog CRT TV
- LCD TV and monitor
- DVD-R
- PVR/DVR

Low-Cost Video Decoder Alternative — TVP5147M1

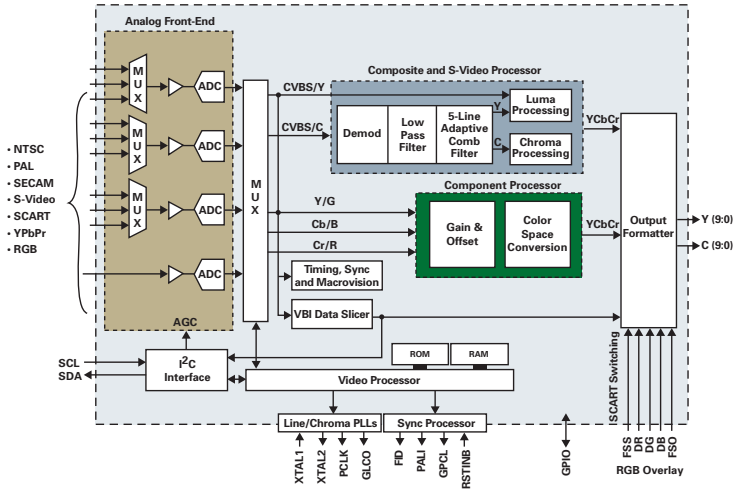
TI's TVP5147M1 device, a high-quality, high-performance digital video decoder (NTSC/PAL/SECAM), a low cost alternative to the TVP5146M2, provides a pin-for-pin and software compatible solution for those devices that do not require SCART or analog RGB inputs. Additionally, the device also provides an analog out function. For more information, **www.ti.com/sc/device/TVP5147M1**

Key Features

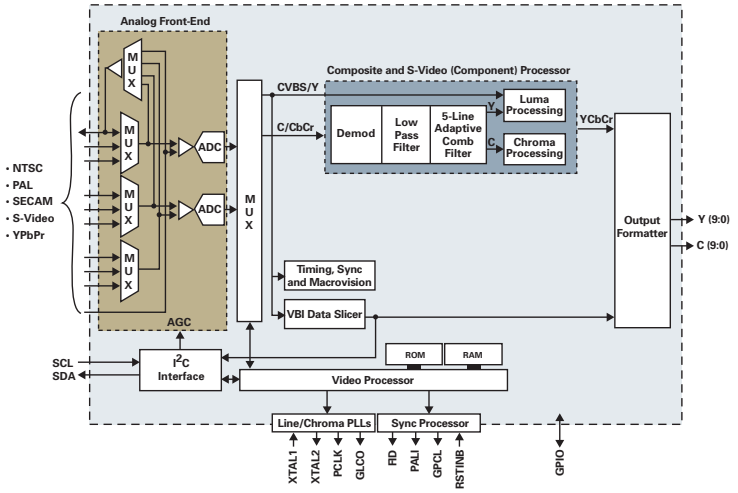
- 10-bit, 30-MSPS analog-to-digital converters
- 10 inputs, one shared analog output
- Robust sync detector
- Improved 2D 5-line adaptive comb filter
- VBI data processor
- Macrovision copy protection detection
- Pin and software compatibility with TVP5146M2

Applications

- Digital TV
- Analog CRT TV
- LCD TV and monitor
- DVD-R
- PVR/DVR



TVP5146M2 Block Diagram



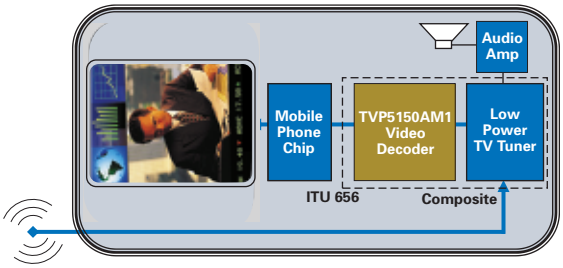
TVP5147M1 Block Diagram

Mobile Products/TVP5150AM1

Mobile telephones, personal multimedia players, and portable DVD players are rapidly becoming popular vehicles to view, share, and record live or previously recorded video content. Historically, power consumption and display sizes have hampered the demand for such products.

But with advances in technologies throughout the signal chain, portable digital TV is becoming a reality. Today, consumers can view their favorite TV program wherever they are.

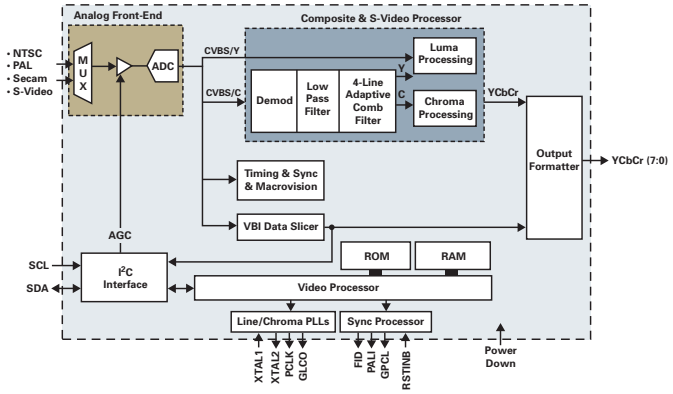
Major improvements in antennas, power requirements, tuner size, picture quality, video decoders, processors and the other underlying components will allow equipment manufacturers to integrate the most up-to-date technologies to their products and improve TV reception to smaller devices.



Mobile Phone TV Block Diagram

Ultra-Low-Power NTSC/PAL/SECAM Video Decoder—TVP5150AM1

The TVP5150AM1 digital video decoder (NTSC/PAL/SECAM) offers the industry's lowest power, smallest size and lowest cost. The device is a highly integrated video decoder with optimized architecture that allows for very low power consumption. Its very low-power standby operation of 100 µA further reduces power consumption, increasing battery life in portable applications. The device outputs standard 8-bit ITU-R.BT601 or ITU-R.BT656 digital video data. Using a 14.31818-MHz clock, the device supports NTSC, PAL and SECAM ITU-R.BT601 sampling output data rates. For more information, **www.ti.com/sc/device/TVP5150AM1**



TVP5150AM1 Block Diagram

Key Features

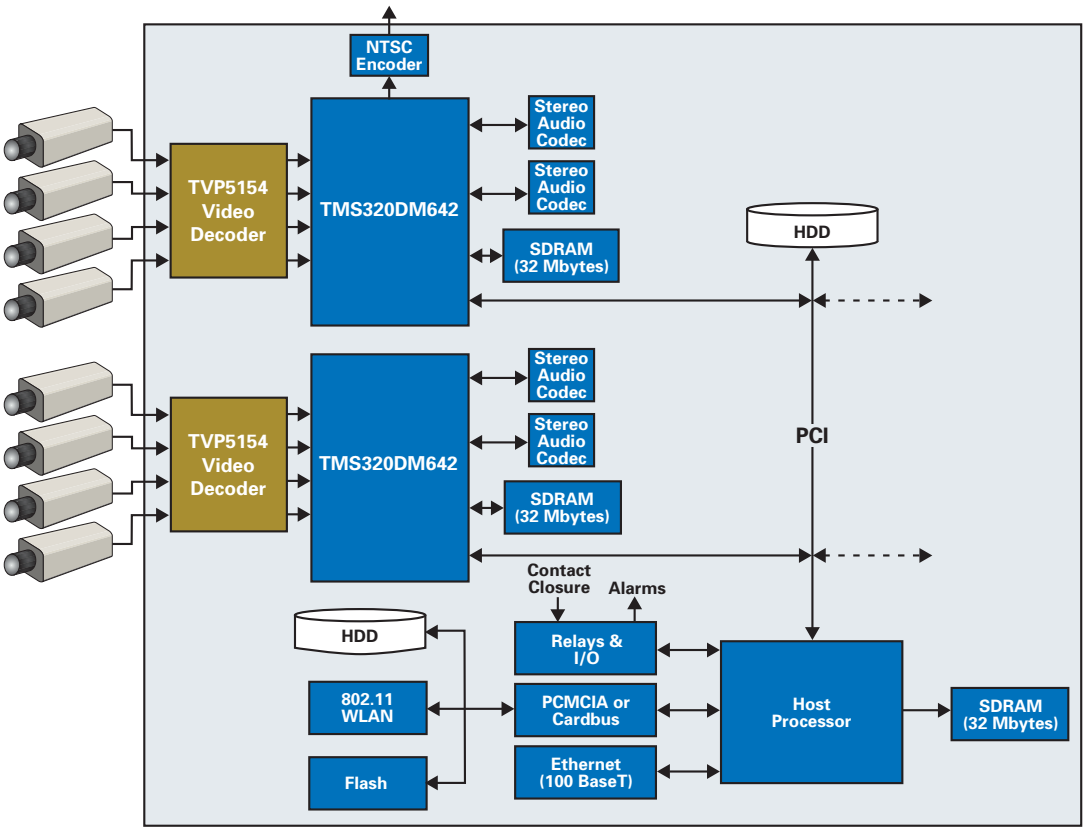
- Accepts two composite or one S-video input
- Ultra-low-power (115 mW)
- Cost-optimized for portable multimedia applications
- Robust sync detector
- VBI data processor
- Macrovision copy protection detection
- Packaging: 32-pin TQFP or 48-ball MicroStar Junior™ BGA (industry's smallest available video decoder)

Applications

- USB video capture
- Mobile phone
- Portable DVD player
- Digital camcorder
- Security and surveillance
- Low-end DVD-recorder
- TV 2nd channel for PIP function
- Low-cost VBI slicer

In today's safety conscious world, video security and surveillance is everywhere. To provide security to patrons and employees, video security systems are being installed at a record rate. According to market research, the Digital Video Recorder (DVR) market is anticipated to grow over 10 million units by 2008.

Video systems generally support 4, 8, 16, or more video capture devices. These requirements demand at least 4 video decoders per system. Due to the number of decoders needed, video quality, component size, and cost are key. Providers must delicately balance these features to provide the optimal solution.
For single input video security applications, the ultra-small package (4 mm x 4 mm) and competitive pricing of the TVP5150AM1 makes it an ideal solution. The TVP5154, TI's newest video decoder, was specifically designed with the security and surveillance market in mind. By featuring four integrated video decoders with independent scalers, the TVP5154 will be the choice of many multi-input security application designers for the foreseeable future.



Multi-Point Digital Video Recorder

The days of using transparencies for business presentations are long gone. As common as cubes and white boards, business projectors have become a standard sight throughout the global business world. A favorite for marketing and sales presentations, projectors are increasingly used in the home entertainment segment as well. Whether you're looking for a lightweight projector for travel or a high-end stationary projector, one fact is for sure, you'll need both analog-video and PC graphic support.

Together with the DLP® team, TI has released numerous reference designs which include both the DLP solution, analog-to-digital video decoder and a video triple ADC for PC graphics support. These designs offer a range of features and allow manufacturers to quickly design and mass produce DLP projectors. Regardless of the market, form factor or price point, TI Digital Video solutions can get you there.

Triple ADC High-Performance Video and Graphics Digitizer—TVP7000, TVP7001

The TVP7000 and TVP7001 triple analog-to-digital converters (ADC) from TI provide a complete video digitizing solution for PC graphics, HDTV and other high definition video. The devices provide a range of benefits to digital video equipment, including higher image quality and increased resolution.

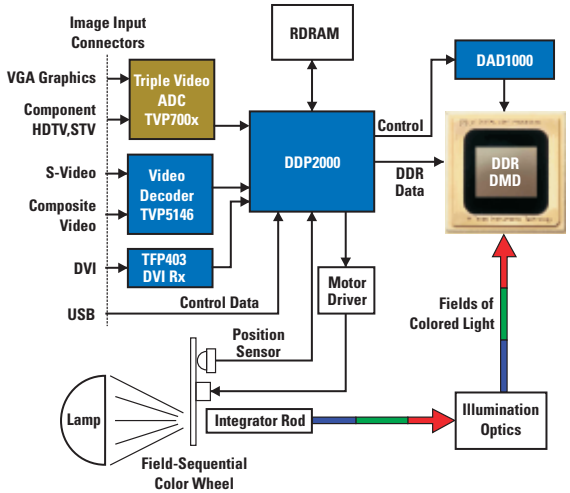
Three independently programmable ADC channels offer 8-bit digital pixel resolution with an output rate of up to 165 MSPS, or 10 bits at 110 MSPS. End products can benefit from this high level of performance by adding features such as dynamic video capabilities and automatic level control. In addition, a high level of functional integration and support for a variety of signal formats saves space and system costs while providing design flexibility.
For more information, **www.ti.com/sc/device/TVP7000**

Key Features

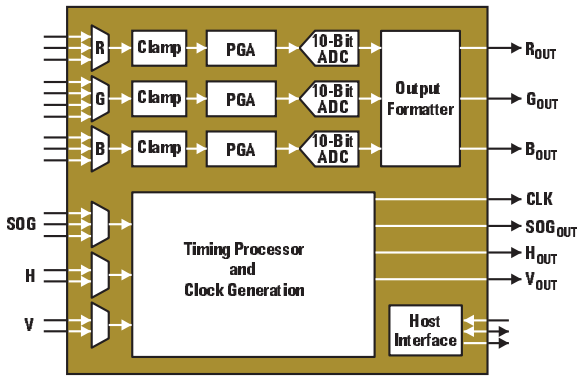
- Three ADC channels with independently controlled clamp and gain
- 8/10-bit resolution, up to 165/110-MSPS sampling rate
- Supports up to 1600 x 1200 UXGA resolution at 60 Hz
- Up to 1080p analog HD performance
- Fully integrated PLL for pixel clock generation

Applications

- DLP® Front Projectors
- LCD Front Projectors
- Digital TV



Typical DLP® Technology Projector Application



TVP7000 Functional Block Diagram

Video DACs

Feature	THS8133B	THS8134B	THS8135	THS8200
Resolution Bits	10	8	10	10
Sample Rate (MSPS)	80	80	80 or 240	205
Input Formats *1x10-Bit 4:2:2 YCbCr/RGB* *2x10-Bit 4:2:2 YCbCr/RGB* *3x10-Bit 4:4:4 YCbCr/RGB*	√	—	√	√
1x8-Bit 4:2:2 YCbCr/RGB *2x8-Bit 4:2:2 YCbCr/RGB* *3x8-Bit 4:4:4 YCbCr/RGB*	√	√	√	√
15-Bit RGB, 16-Bit RGB	—	—	—	√
Output Formats *Analog RGB* *Analog YPbPr*	√	√	√	√
Generic DAC	—	—	√	√
10-Bit Digital	—	—	—	√
Color Space Converter	—	—	—	√
Embedded Sync Detection	—	—	—	√
Interpolation Filter	—	—	—	√
Programmable Sync Amplitude and Timing	—	—	—	√
Internal Scaling	—	—	—	√
Maximum PC VESA Resolution	1024x768 @ 75 Hz	1024x768 @ 75 Hz	1920x1440 @ 60 Hz	1600x1200 @ 75 Hz
Packaging	48-pin TQFP	48-pin TQFP	48-pin TQFP	80-pin TQFP
Package Size	9 mm x 9 mm	9 mm x 9 mm	9 mm x 9 mm	14 mm x 14 mm

Video ADCs

Feature	TLV5734	TVP7000	TVP7001
Resolution Bits	8	10	10
Sample Rate (MSPS)	30	110 or 150	110 or 165
Programmable Clamp Timing	—	√	√
Programmable Gain Amplitude	—	√	√
Programmable ADC Sampling Phase	—	√	√
Line-Locked Digital PLL	—	√	√
I^2C Programmable	—	√	√
Output Formats 12-Bit YUV 4:1:1	√	—	—
16-Bit YUV 4:2:2 (BT.601)	√	√	√
24-Bit RGB 4:4:4	√	√	√
30-Bit RGB 4:4:4	—	√	√
Maximum PC VESA Resolution	—	1280x1024 @ 75 Hz	1600x1200 @ 60 Hz
Packaging	64-pin TQFP	128-pin TQFP	128-pin TQFP
Package Size	12 mm x 12 mm	16 mm x 16 mm	16 mm x 16 mm

Design Resources

To assist in your mixed-signal video design efforts, the below resources are available:

- Product Bulletins
- Datasheets
- Application Reports
- User Guides
- Evaluation Modules
- Software Tools

Typical Evaluation Module

TI Worldwide Technical Support

Internet

TI Semiconductor Product Information Center Home Page
support.ti.com

TI Semiconductor KnowledgeBase Home Page
support.ti.com/sc/knowledgebase

Product Information Centers

Americas

Phone	+1(972) 644-5580
Fax	+1(972) 927-6377
Internet/Email	support.ti.com/sc/pic/americas.htm

Europe, Middle East, and Africa

Phone	
Belgium (English)	+32 (0) 27 45 54 32
Finland (English)	+358 (0) 9 25173948
France	+33 (0) 1 30 70 11 64
Germany	+49 (0) 8161 80 33 11
Israel (English)	1800 949 0107
Italy	800 79 11 37
Netherlands (English)	+31 (0) 546 87 95 45
Russia	+7 (0) 95 363 4824
Spain	+34 902 35 40 28
Sweden (English)	+46 (0) 8587 555 22
United Kingdom	+44 (0) 1604 66 33 99
Fax	+(49) (0) 8161 80 2045
Internet	support.ti.com/sc/pic/euro.htm

Japan

Fax	International	+81-3-3344-5317
	Domestic	0120-81-0036
Internet/Email	International	support.ti.com/sc/pic/japan.htm
	Domestic	www.tij.co.jp/pic

Asia

Phone	
International	+886-2-23786800
Domestic	Toll-Free Number
Australia	1-800-999-084
China	800-820-8682
Hong Kong	800-96-5941
India	+91-80-51381665 (Toll)
Indonesia	001-803-8861-1006
Korea	080-551-2804
Malaysia	1-800-80-3973
New Zealand	0800-446-934
Philippines	1-800-765-7404
Singapore	800-886-1028
Taiwan	0800-006800
Thailand	001-800-886-0010
Fax	886-2-2378-6808
Email	tiasia@ti.com or ti-china@ti.com
Internet	support.ti.com/sc/pic/asia.htm

A12095

Printed in U.S.A. by (Printer, City, State)
Printed on recycled paper

TEXAS INSTRUMENTS

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265