1   Introduction

The STi5189 uses state of the art process technology to provide an ultra low cost, full featured, SD set-top box SOC. It is a highly integrated solution combining QPSK (Quadrature Phase Shift Keying) demodulation, audio/video decoding and applications processing into a single chip, suitable for MPEG2 based satellite networks worldwide.

The STi5189 provides a solution for operators to specify a range of low cost SD STBs including low cost Zappers, Interactive STBs and DVR-capable STBs, with content delivery using broadcast or broadband networks, or both (Hybrid STBs).

The STi5189 is optimized for secure Pay-TV applications with integrated DVB, DES, Multi2 and ICAM descramblers and smartcard interfaces. It also has advanced security features normally found in mid-to-high end devices to further safeguard operator and content investment.

The STi5189 offers enhancements in performance, features and integration to current users of ST's MPEG2 SD family of audio/video decoders and QPSK demodulators, whilst reducing cost and time-to-market for the next generation of deployments. Few external components are required to realize a complete STB solution, resulting in very low BOM cost.

Features	Benefits
Combines a configurable DVB-S QPSK demodulator with STB decoding and display functions	This highly integrated SoC helps to reduce board area and manufacturing cost, allowing low-cost, small size STBs to be designed for DVB-S networks
ST40-300 applications CPU @350MHz, 32K I cache, 32K D cache	Up to 580 DMIPs superscalar performance from a single CPU core, using standard tools and operating systems (Linux, OS21)
STMicroelectronics' Delta video decoding system with Blitter display	Allows dual SD decoding of MPEG2 video with PIP capability
Integrated USB 2.0 host, Ethernet MAC with MII/RMII,	Enables connectivity to HDD for PVR systems and to Ethernet networks for IP TV and hybrid/IP STBs
Low power process, design and architecture	Low operating power consumption (<1W). Best in class, low power standby mode (0.1W). Fast resume from standby.
Available in 15x15 package with ballout optimized for 2-layer PCBs	Reduced board manufacturing costs and board size
Support for Serial Flash including secure boot.	Allows low cost BOM, and safeguards boot code integrity

1.1 Features summary

The STi5189 has the following features:

- Embedded QPSK demodulator
    - Fast channel acquisition
    - Compatible with direct conversion tuners
    - Digital carrier and timing recovery loops
    - DVB-S decoding
    - Up to 60 Msps operation
    - Automatic spectral inversion ambiguity resolution
    - Digital cancellation of A/D offset
    - Digital Nyquist root filter
- High performance CPU for applications, middleware, drivers, audio decoding and network protocols
    - ST40-300, dual-issue, applications CPU
    - FPU, MMU, 32K instruction, 32K data, 2-way, set-associative caches
    - Supports OS21 and Linux operating systems
    - Target speed > 350 MHz delivering >580DMIPs
- Single, 16-bit wide, unified local memory interface
    - Supports both SDR SDRAM up to 166 MHz and DDR1 SDRAM up to 200 MHz
- MPEG2 MP@ML video decoder, dual SD decoding/PIP capable
- Audio sub-system
    - MPEG-1 layers I/II decoding
    - MP3 decoding
    - Dolby Digital 5.1 decoding and down mix to Stereo/Pro-logic
    - Concurrent decoding of audio description
    - Optional feature: BTSC stereo encoding
    - PCM mixing with sample rate conversion
    - Simultaneous audio decode and output of Dolby streams on S/PDIF IEC60958/IEC61937 digital audio output interface
    - Integrated stereo audio DAC system
- Programmable external memory interface
    - Four separately configurable banks, 8/16-bit wide
    - SRAM, peripheral, NOR Flash, NAND Flash, Burst Mode Flash support
    - Boot from NOR or NAND Flash
    - Support for DVB-CI module host interface
- Interface to, and boot from, Serial FLASH via high speed SPI interface
    - Dual output read support
- Graphics/Display processing
    - High performance 2-D graphics blitter accelerator and display compositor, Link list control

- – Multi-plane video/graphics composition with alpha blending, typical four-plane use case (background color + still plane + video plane + OSD plane), and integrated Tile RAM bandwidth saver for enhanced performance
- – High quality horizontal and vertical reformatting and resizing, with sample rate conversion/filtering for video and graphics
- – 8 bpp CLUT and 16 bpp true color graphics formats supported
- – Advanced anti-flicker filtering
- – De-interlacing SD to 480p/576p for HDMI output
- Display output
  - – PAL/NTSC/SECAM encoder
  - – Encoding of CGMS, Teletext, WSS, VPS, Closed Caption
  - – Macrovision^{TM} 7.1D copy protection
  - – Four 10-bit video DACs, outputting RGB/CVBS/YC analog video signals
  - – High drive-capability on one of the video DACs for CVBS output without buffering
  - – 8-bit digital video output (DVO), compliant with ITU-R BT 601/656 formats
  - – 54 MHz output data rate on DVO supporting 480p/576p output over 8 bits
- DVR capable transport sub-system
  - – TS reception from internal QPSK demodulator
  - – External TS interface for a second stream input from external tuner/demodulator
  - – Dual internal TS from memory for network/IP stream input and DVR playback
  - – TS output for routing to DVB-CI module
  - – DVB-compliant, triple-stream transport de-multiplexing
- DVB, DES, Multi2 descrambling
- DVR supported with HDD attachment via EIDE (PIO mode) or USB 2.0
- Multi-channel flexible DMA Controller
- Connectivity
  - – 10/100 Ethernet MAC with MII/RMII interface to external PHY
  - – USB 2.0 Host Controller with ULPI interface to external PHY
- On-chip STB Peripherals
  - – Two Smartcard Interfaces with integrated clock generation
  - – Four UARTs with Tx and Rx FIFOs
  - – Three SSCs for I²C/SPI master/slave interfaces, one of which can be dedicated for tuner control with minimum tuner disturbance
  - – Five 8-bit GPIO banks with alternate functions
  - – Infrared transmitter/receiver
  - – PWM
  - – CEC line controller
- System services
  - – All clocks generated from a single external crystal
  - – Integrated DCO for clock recovery
  - – Low power/RTC/watchdog controller
  - – JTAG/TAP interface
  - –

- Advanced security
  - Secure control words
  - Code authentication
  - JTAG interface locking
  - DVR copy protection
- On chip 1V (nominal) voltage regulator
- Two package options
  - 23 mm x 23 mm. Full specification
  - 15 mm x 15 mm. No EMI. Boot from serial Flash only

1.2 Package options

The STi5189 is available in two package options, 15 mm x 15 mm LFBGA, 0.8 mm pitch and 23 mm x 23 mm PBGA, 0.8 mm pitch. Both package types are compatible with the design of two-layer PCBs.

15 mm x 15 mm PBGA, 0.8 mm pitch

This is the main stream, low cost option which does not include the EMI interface. Both Ethernet and USB 2.0 interfaces are still available. For this option the Flash used must be Serial NOR Flash attached to the High Speed SPI interface.

23 mm x 23 mm PBGA, 0.8 mm pitch

This option should be selected if a full specification device is required, which includes the EMI. Any Flash type (Serial NOR, Parallel NOR, NAND) can be used with this package. The following features are available with this package option:

- All the features as in the BGA15 mm x 15 mm package
- DVB-CI support
- NAND Flash storage
- EMI interfaces available, Secure Boot from any Flash (Serial, NAND or NOR)
- HDD attachment via EIDE

With this package, DVB-CI and Ethernet are mutually exclusive options.

Table 1.   Comparison table

| Features	BGA 15 mm x 15 mm (Low-cost option)	BGA 23 mm x 23 mm (Full specification option)
External memory interface	No EMI, secure boot from Serial Flash	EMI supporting Serial Flash, Parallel NOR, NAND, secure boot from any
Connectivity	USB 2.0, Ethernet (MII/RMII)	USB 2.0, Ethernet (MII/RMII), Atapi HDD
DVB-CI support	No	Yes
Transport streams	Parallel/serial TS in, TS out[1]	Parallel/serial TS in, TS out[2]

Table 1. Comparison table (continued)

| Features	BGA 15 mm x 15 mm (Low-cost option)	BGA 23 mm x 23 mm (Full specification option)
Smartcard supported	Two	Two
HDMI support through DVO	Yes	Yes
GPIO banks/UARTs	5/4	5/4
Two layers PCB design optimized	Yes	Yes
Power supplies	Optimize some analog power supplies	Separate analog power supplies
Applications	– Very compact STB, basic zapper, basic DVR with HDD on USB. – Secure application with only one smartcard	Consider this option if any of the following required: DVB-CI, HDD attached through EIDE, NAND Flash storage

1. Muxed with Ethernet pins.

2. Muxed with Ethernet pins.

1.3 Target applications

The following diagrams show typical applications of the STi5189. The first two use the 15 mm x 15 mm package version. The other application use the 23 mm x 23 mm package version.

Figure 1. MPEG2 broadcast satellite STB (basic zapper)
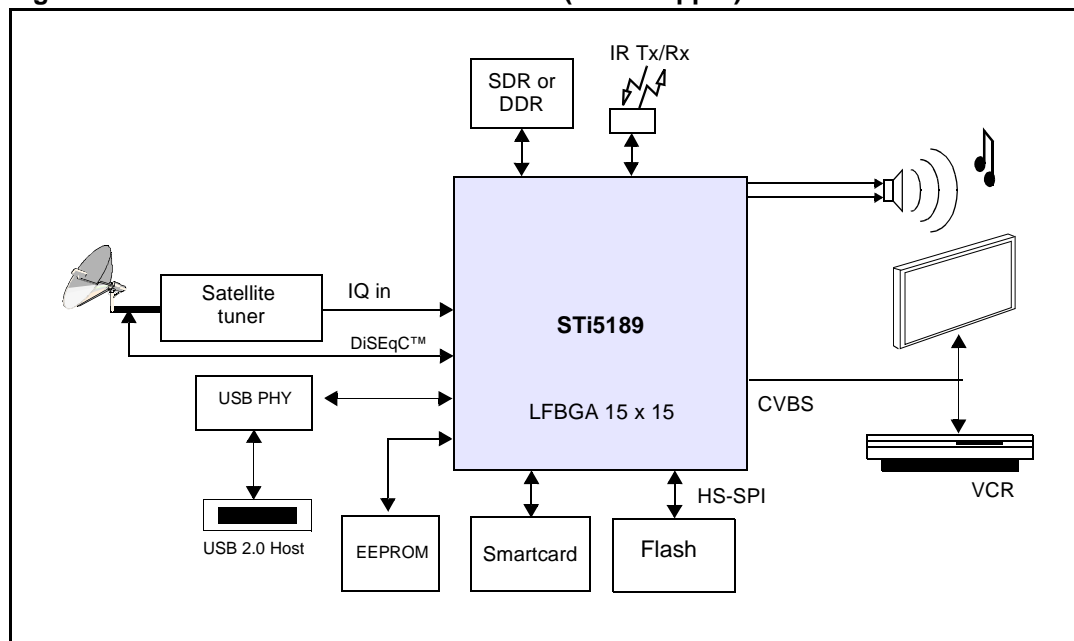
Figure 2.   MPEG2 dual tuner, Hybrid/DVR satellite STB with HDD
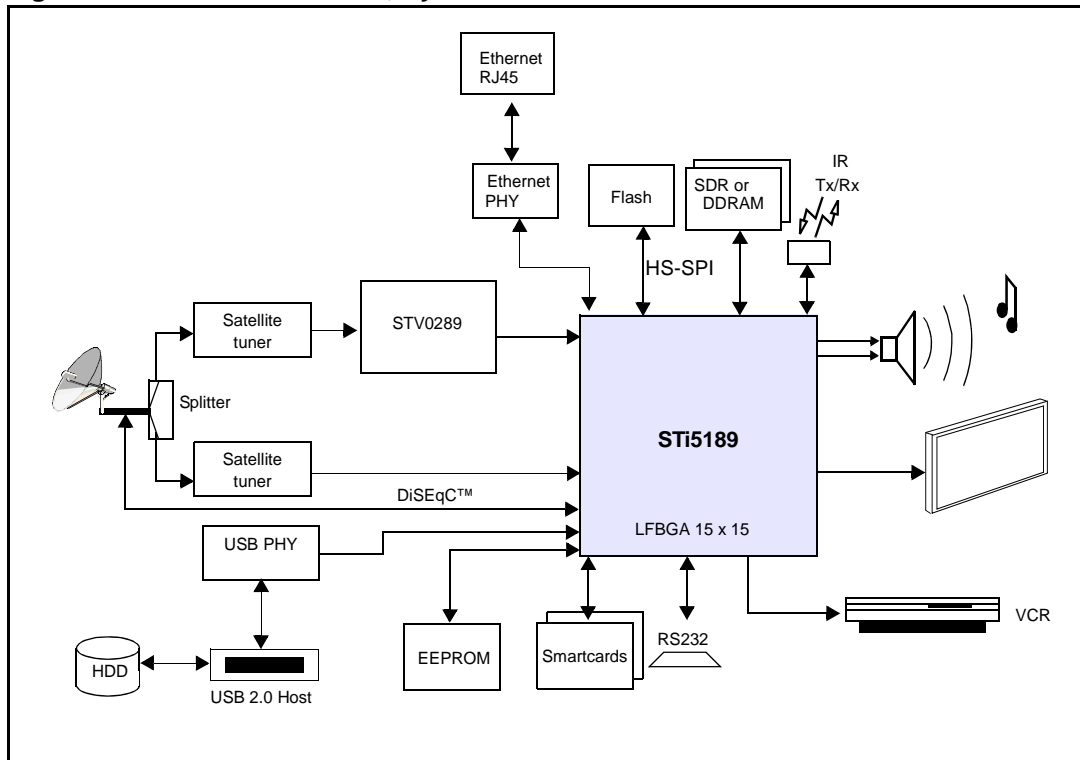
Figure 3.   MPEG2 broadcast satellite STB (common interface zapper)
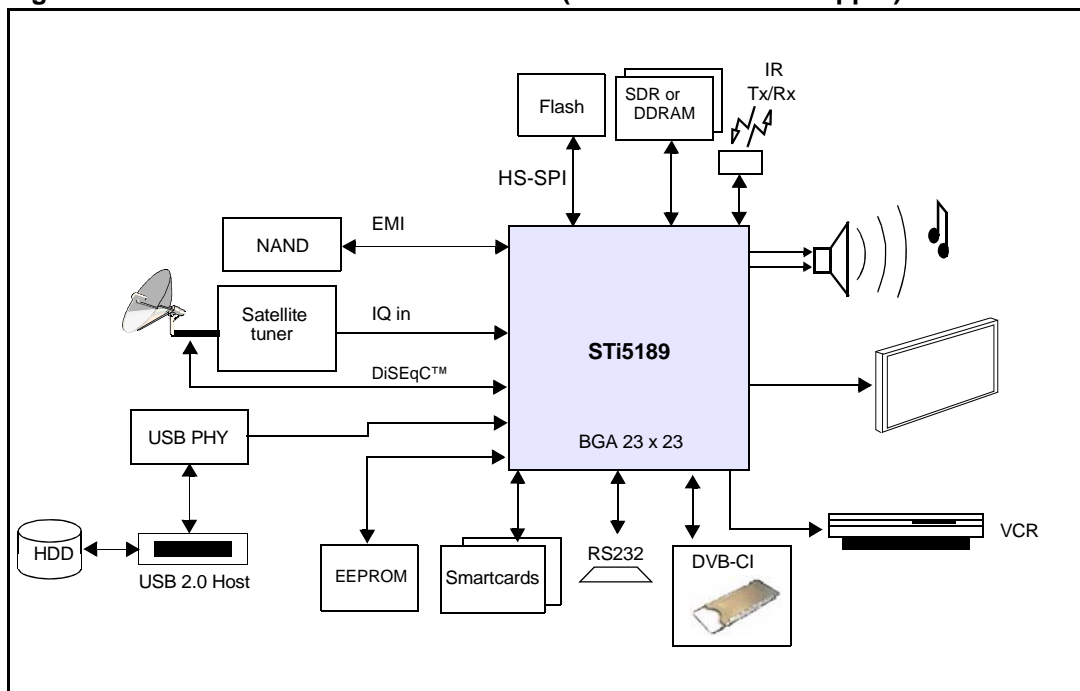
2 Ordering information

Table 2.   Ordering information

Order code	Packaging	Description
STi5189ZBB	LFBGA 15 x 15 mm	Development version.
STi5189ZYB	PBGA 23 x 23 mm	Development version, all options.

3 Revision history

Table 3.   Document revision history

Date	Revision	Changes
05-Mar-2009	1	Initial release
10-Mar-2009	2	Banner removed, no change in document contents.
30-Jul-2009	3	*Section 1.2: Package options* updated. Corporate template 3.1 applied. New cover graphic applied. Table 1 amended. TSMF reference removed. IF input changed to IQ. Features/benefits table added to page 2.

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