



# STi5189

## Low-cost QPSK demodulator and MPEG2 decoder for set-top box applications

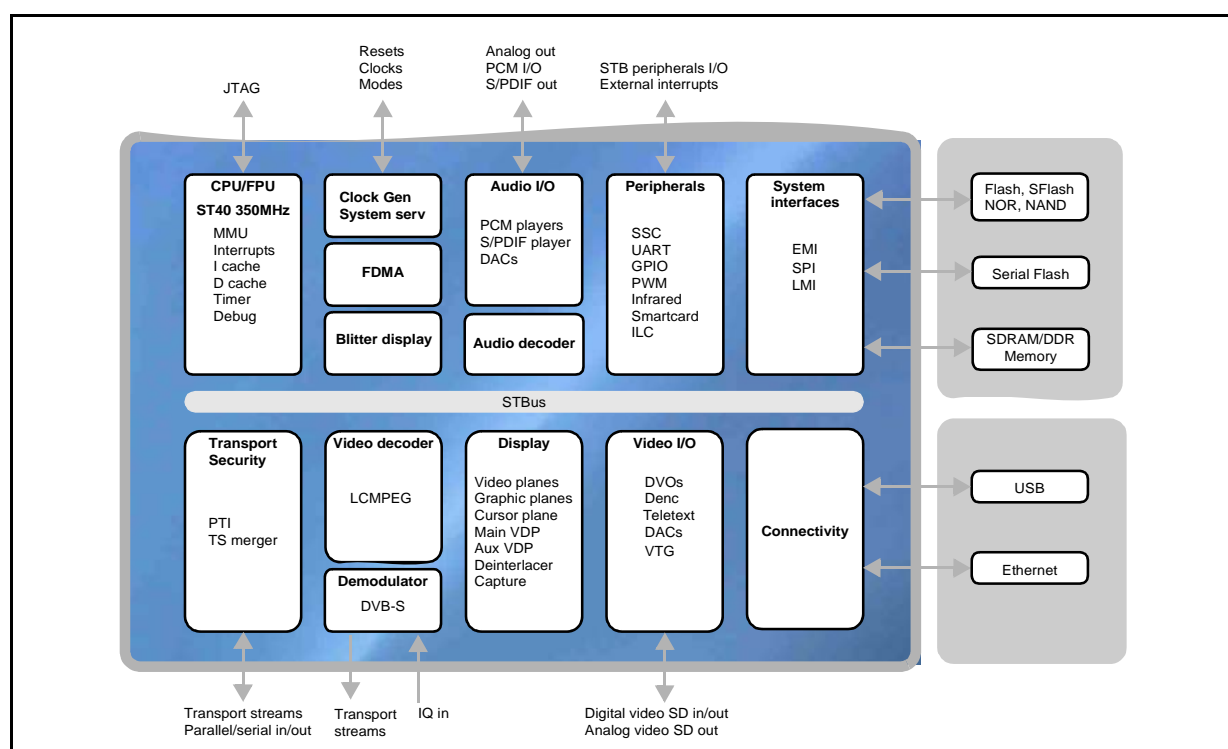
Data brief

### Features

- DVB-S compliant
- QPSK demodulation and DiSEqC™ controller
- MPEG2 MP@ML video decoding
- Audio decoding (MPEG1, 2, MP3, Dolby Digital 5.1)
- Linux and OS21 compatible ST40 applications CPU (350 MHz)
- 16-bit SDR/DDR1 compatible local memory interface
- Multi-stream, DVR capable, transport stream processing
- Extensive connectivity (USB 2.0 host/ULPI, Ethernet MAC MII/RMII, DVB-CI)
- External memory interface supporting NOR, NAND and serial Flash
- Advanced security features, compatible with the latest CA requirements
- Satellite STBs can be produced with very small BOM and two-layer PCBs
- Active and passive low power modes
- Integrated voltage regulator
- Two package options: PBGA 23x23 and LFBGA 15x15

### Description

The STi5189 integrates in a single IC, QPSK demodulation, FEC, Multi-stream transport demultiplexing, an applications CPU, audio/video decode, video processing, graphics and display, advanced security, STB peripherals, audio/video DACs, digital audio/video outputs, USB 2.0 host controller/ULPI and an Ethernet MAC MII/RMII interface.



# 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

Combines a configurable DVB-S QPSK demodulator with STB decoding and display functions

ST40-300 applications CPU @350MHz, 32K I cache, 32K D cache

STMicroelectronics' Delta video decoding system with Blitter display

Integrated USB 2.0 host, Ethernet MAC with MII/RMII,

Low power process, design and architecture

Available in 15x15 package with ballout optimized for 2-layer PCBs

Support for Serial Flash including secure boot.

## Benefits

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

Up to 580 DMIPs superscalar performance from a single CPU core, using standard tools and operating systems (Linux, OS21)

Allows dual SD decoding of MPEG2 video with PIP capability

Enables connectivity to HDD for PVR systems and to Ethernet networks for IP TV and hybrid/IP STBs

Low operating power consumption (<1W).

Best in class, low power standby mode (0.1W). Fast resume from standby.

Reduced board manufacturing costs and board size

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

Table 1. Comparison table (continued)

| Features                        | BGA 15 mm x 15 mm<br>(Low-cost option)   | BGA 23 mm x 23 mm<br>(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                    | <ul style="list-style-type: none"> <li>– Very compact STB, basic zapper, basic DVR with HDD on USB.</li> <li>– Secure application with only one smartcard</li> </ul> | Consider this option if any of the following required: DVB-CI, HDD attached through EIDE, NAND Flash storage |

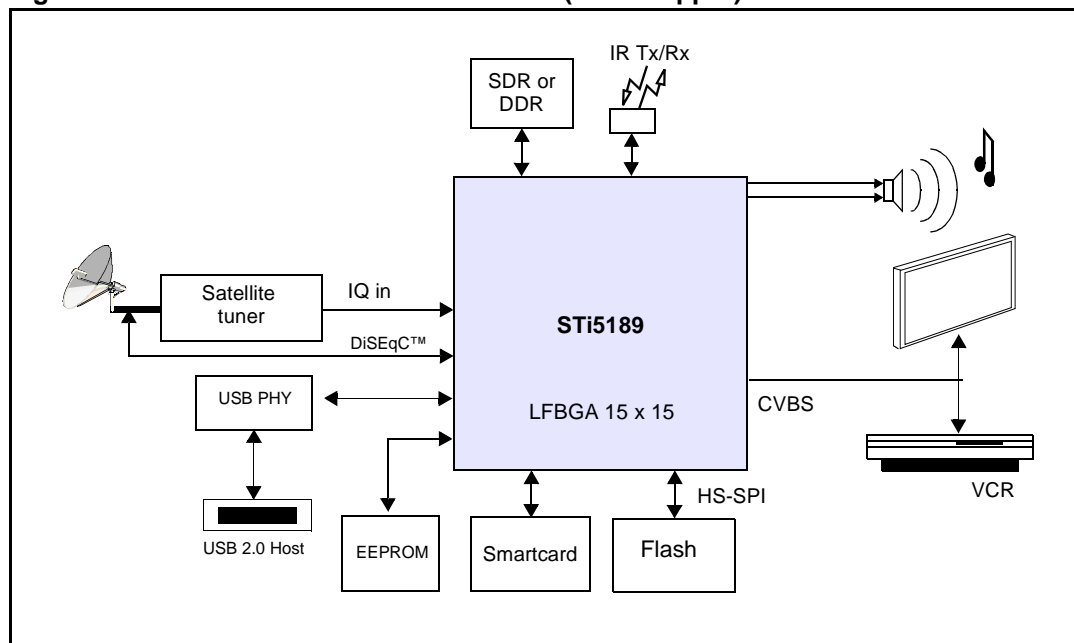
1. Muxed with Ethernet pins.

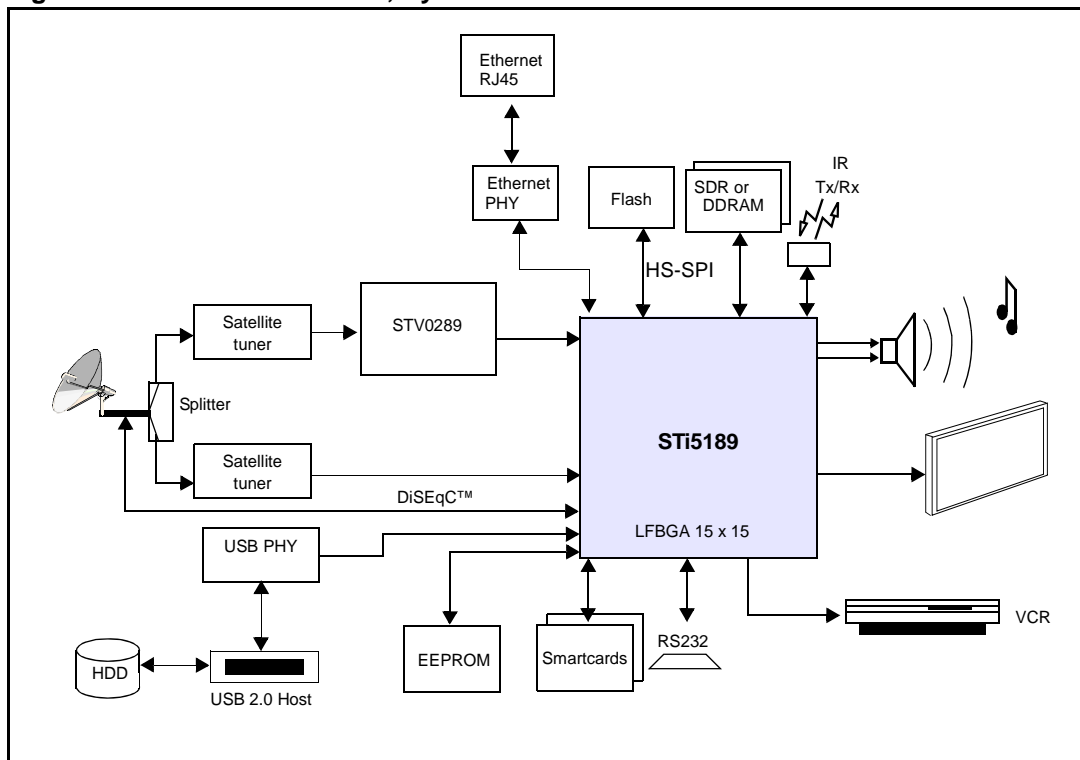
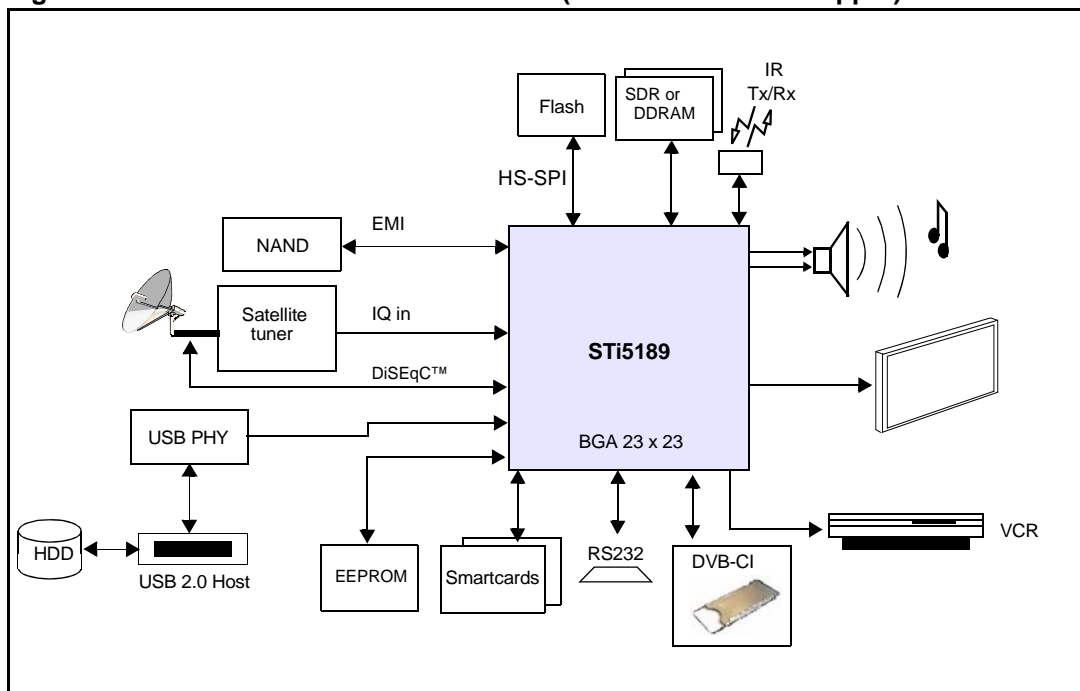
2. Muxed with Ethernet pins.

### 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        | <a href="#">Section 1.2: Package options</a> 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. |



**Please Read Carefully:**

Information in this document is provided solely in connection with ST products. STMicroelectronics NV and its subsidiaries ("ST") reserve the right to make changes, corrections, modifications or improvements, to this document, and the products and services described herein at any time, without notice.

All ST products are sold pursuant to ST's terms and conditions of sale.

Purchasers are solely responsible for the choice, selection and use of the ST products and services described herein, and ST assumes no liability whatsoever relating to the choice, selection or use of the ST products and services described herein.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted under this document. If any part of this document refers to any third party products or services it shall not be deemed a license grant by ST for the use of such third party products or services, or any intellectual property contained therein or considered as a warranty covering the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

**UNLESS OTHERWISE SET FORTH IN ST'S TERMS AND CONDITIONS OF SALE ST DISCLAIMS ANY EXPRESS OR IMPLIED WARRANTY WITH RESPECT TO THE USE AND/OR SALE OF ST PRODUCTS INCLUDING WITHOUT LIMITATION IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE (AND THEIR EQUIVALENTS UNDER THE LAWS OF ANY JURISDICTION), OR INFRINGEMENT OF ANY PATENT, COPYRIGHT OR OTHER INTELLECTUAL PROPERTY RIGHT.**

**UNLESS EXPRESSLY APPROVED IN WRITING BY AN AUTHORIZED ST REPRESENTATIVE, ST PRODUCTS ARE NOT RECOMMENDED, AUTHORIZED OR WARRANTED FOR USE IN MILITARY, AIR CRAFT, SPACE, LIFE SAVING, OR LIFE SUSTAINING APPLICATIONS, NOR IN PRODUCTS OR SYSTEMS WHERE FAILURE OR MALFUNCTION MAY RESULT IN PERSONAL INJURY, DEATH, OR SEVERE PROPERTY OR ENVIRONMENTAL DAMAGE. ST PRODUCTS WHICH ARE NOT SPECIFIED AS "AUTOMOTIVE GRADE" MAY ONLY BE USED IN AUTOMOTIVE APPLICATIONS AT USER'S OWN RISK.**

Resale of ST products with provisions different from the statements and/or technical features set forth in this document shall immediately void any warranty granted by ST for the ST product or service described herein and shall not create or extend in any manner whatsoever, any liability of ST.

ST and the ST logo are trademarks or registered trademarks of ST in various countries.

Information in this document supersedes and replaces all information previously supplied.

The ST logo is a registered trademark of STMicroelectronics. All other names are the property of their respective owners.

© 2009 STMicroelectronics - All rights reserved

STMicroelectronics group of companies

Australia - Belgium - Brazil - Canada - China - Czech Republic - Finland - France - Germany - Hong Kong - India - Israel - Italy - Japan - Malaysia - Malta - Morocco - Philippines - Singapore - Spain - Sweden - Switzerland - United Kingdom - United States of America

[www.st.com](http://www.st.com)