FLI7540

Freeman Ultra — iDTV SoC worldwide H.264/MPEG decoder + Faroudja video processing

Data brief

Features

- Proven DVB-T/DVB-C demodulator

- ST231 @ 450 MHz for advanced HD video decoding (H.264/VC-1/MPEG2/…) --> Worldwide DTT broadcast video standards

- Dual ST231 @ 450 MHz for advanced multi-channel audio decoding (MPEG-1/2, MP3, WMA, Dolby® Digital/Dolby Digital+, AAC/AAC+/…) --> Worldwide DTT broadcast audio standards

- Dual ST40 CPU @ 450 MHz (delivers 1600 DMIPS) runs Linux and OS21 --> One CPU (800 DMIPS) fully dedicated to application and user interface

- 256 Kbyte level 2 cache --> High performance Internet TV applications

- Faroudja® video processing for Main Video --> Vivid picture quality for the consumer

- 14-bit Advanced Color Management (3D) and Contrast processing --> Ultimate video quality for OEMs and consumers

- Award-winning DCDi, MADi technologies --> Crystal-clear rendering on 1080p displays

- Worldwide analog audio demodulator

- Picture-in-Picture --> Flexible viewing

- High-performance 3D graphics engine --> Innovative GUI and OpenGL ES 2.0/OpenVG 1.1/Flash 10 applications

- Standalone 3DTV support 60L60R (frame-sequential) and 60 Hz (line-interleaved)

- Two physical graphics planes at up to 1080p/ 32 bpp --> Enables rich, easy-to-use user I/Fs

- Extensive analog A/V and digital HDMI (x4) inputs --> End-user convenience for legacy and future content source boxes

- DVR support on Flash/HDD --> Integration into DTV results in convenience and ease-of-use

- Extensive connectivity (dual USB host controller + dual PHY, Ethernet MAC) --> Play back content from anywhere (home or Internet)

- Advanced security with trusted ST40 CPU and DRM support including HDCP, AES/3DES, CI/CI+ and DTCP-IP --> Protects IP & content

- 48-bit (3 x 16 or 1 x 16 + 1 x 32) DDR2/DDR3 1066 Mbps DRAM I/F --> Performance and flexibility with DRAM ICs

- PCIe 1.1 bus --> Expansion available for wireless/HDD applications

- Dual high-speed 10-bit LVDS outputs --> Convenient connectivity to panel TCON

- Board Support Package (BSP) API accelerates time to market

Applications

- Connected, high-performance, and mainstream iDTVs with support for 3DTVs

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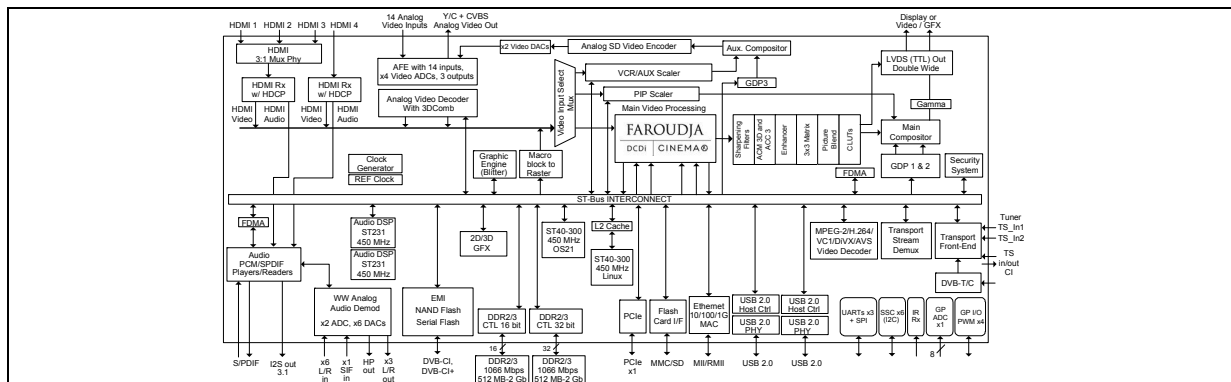
1 Description

The FLI7540 is a revolutionary new iDTV SoC that integrates two highly successful, market-proven subsystems: STi710x digital/front-end processing and multi-format audio/video decoding from the STB market, and Faroudja video/back-end processing from the TV market. The FLI7540 is a high-performance, state-of-the-art SoC that can power DTT/cable/satellite/IPTV iDTV designs for worldwide deployment. From the software compatibility extending from the mature STi710x STAPI layer to the extensive video processing, tuning, and tools from Faroudja Labs, the FLI7540 is the ideal solution for addressing the next generation of iDTV design requirements.

The FLI7540 is the first in a family of scalable in performance and software compatible SoCs that address mainstream and performance segments of the iDTV market.

The FLI7540 implements the latest generation of Faroudja Video Optimized technologies, which allow a high degree of customization for TV OEMs. Key technology improvements in this area include 14-bit color and contrast processing, upgraded sharpness, upgraded temporal noise reduction, and new MPEG noise reduction.

The FLI7540, with high performance CPU, A/V decode, graphics engine, and extensive network interface capability, enables TVs to deliver rich applications for convenient access to multimedia content, both from within the home, as well as from the web.

Along with a high performance, dedicated CPU for customer applications, the FLI7540 is equipped with 256 Kbyte of level 2 cache to deliver the smoothest experience of Internet TV applications. In addition, FLI7540 accelerates 3D graphics with an industry-leading GPU for OpenGL 2.0 and Flash 10 graphics and user interfaces.

ST's strong and extensive relationships with popular web and Internet TV service providers give TV OEMs a fast ramp-up to deliver compelling value-add content to the living room.

2   Main features

The FLI7540 is a new, advanced decoding SoC targeted at next generation iDTVs (DTT, as well as with combinations of cable/satellite/IPTV). It integrates in a single IC, proven DVB-T+C demodulator, multi-stream transport demux, CPU, multi-format audio/video decode, Faroudja video processing, 3D GPU for graphics and display, advanced security, peripherals, audio/video ADCs/DACs, Digital A/V inputs/outputs, 4x HDMI switch, dual USB controllers and PHYs, Ethernet MAC, and glueless SD/MMC card interface.

2.1   Audio/video decoding

● Latest generation "Delta" Video Decoder with ST231 programmable CPU core:
  – MPEG4-Part 2, RealVideo, MPEG2, H.264, VC-1, HD or SD
  – AVS HD decoding
  – DivX, XviD, H.263 decoding
  – Dual SD Decoding, PIP & Mosaic capable
● Advanced de-blocking and de-ringing of decoded H.264/MPEG2/MPEG4-P2/RealVideo HD/SD sources based on ST's Digital Source Enhancer (DSE) technology with 2D analysis window and Texture Adaptive Filter
● Dual ST231 @ 450 MHz for advanced multi-channel audio decoding (MPEG-1/2, MP3, WMA, Dolby Digital/Dolby Digital+, AAC/AAC+). Concurrent audio description decoding. Dolby Digital+ and AAC+ transcoding to Dolby Digital/DTS. In addition, generous headroom remains for OEM post-processing algorithm implementation.

2.2   Graphics and display

● Main and PIP video display pipelines
  – 10-bit arbitrary high-quality H & V scaling (linear and non-linear) with sample rate conversion/filtering and sharpness
  – 14-bit color/contrast processing
  – 10-bit temporal/space noise reduction
  – DCDi diagonal deinterlacing and scaling
● Main video display pipeline
  – 10-bit Motion Adaptive Deinterlacing (MADi)
● Independent Main and PIP display compositions (video/graphics mixing)
● Pass-through display for graphics, Main video or PIP video output concurrently with Main and PIP compositions (VCRO)
● Strong 3D GPU for full HD performance of OpenGL ES 2.0, OpenVG 1.1, and Flash 10 applications
● Two physical graphics planes at up to 1080p/32 bpp resolution for Main display composition, plus a dedicated graphics plane for SD monitor/TV output
● Link list based 2D and high-performance 3D graphics blitter. Up to 200 Mpixels/sec with destination alpha blending. Capable of 3D user interface effects.

● HD display capture and down-conversion for concurrent HD and SD output of the main composition
● LVDS output of separate Main, and PIP with graphics

2.3 3DTV/3D video

3D video is the ultimate entertainment experience to have at home. Bringing 3D to TV is about supporting the proper connectivity to 3D sources and FLI7540 supports all the connectivity options that are required.

● Supports 3D mandatory formats defined in HDMI 1.4b specification
● Supports Deep Color with mandatory 3D timings up to 12 bpc
● FLI7540 paired with FLI25xx improves 3D playback by increasing the frame rate per eye, leading to the highest quality 3D TV possible through the following key advantages
  – Improved 3D handling with 240 Hz output
  – High-quality 3D video that can be used in conjunction with Faroudja's Motion Corrected Temporal Interpolation (MCTi™)
  – With FLI25xx's superior 240 Hz processing, the 3D video will be much brighter and have significantly less "ghosting" artifacts
  – Backlight scanning supported for motion blur reduction
  – Improved artifact reduction with separate handling of Main video, and PIP plus graphics
  – Automatic detection of OSD from sources like STB
  – Support for 3D OSD
  – iDP Tx – Simpler and cheaper versus LVDS

Table 1.   3D video formats supported

Input format	Output to FLI25xx
720p @ 50/60 Hz (frame packed)	720p @ 100/120 Hz (frame sequential)/60 Hz (line-interleaved)
1080p @ 24 Hz (frame packed)	1080p @ 48 Hz (frame sequential)/60 Hz (line-interleaved)
1080p @ 24 Hz (top-bottom half vertical resolution)	1080p @ 48 Hz (top-bottom half vertical resolution)
720p @ 50/60 Hz (side-by-side half horizontal resolution)	720p @ 50/60 Hz (side-by-side half horizontal resolution)
720p @ 50/60 Hz (top-bottom half vertical resolution)	720p @ 50/60 Hz (top-bottom half vertical resolution)
1080i @ 50/60 Hz (side-by-side half horizontal resolution)	1080p @ 50/60 Hz (side-by-side half horizontal resolution)
1080p @ 50/60 Hz (side-by-side half horizontal resolution)	1080p @ 50/60 Hz (side-by-side half horizontal resolution)
1080p @ 50/60 Hz (top-bottom half vertical resolution)	1080p @ 50/60 Hz (top-bottom half vertical resolution)

2.4   Legacy audio/video interfaces

- 1+3-inputs of HDMI into two receivers, with HDCP supporting HD and SD video formats up to 1080p60 (222.75 MHz). HDMI receivers are compliant to v1.4b specification and support deep color formats, enhanced colorimetry (xvYCC and gamut metadata reception) and Picture-in-Picture. They also support audio reception in HDMI layout 0 and HDMI layout 1 formats.
- PAL/NTSC/SECAM analog video decoder
- PAL/NTSC/SECAM digital video encoder
- Two 10-bit DACs for S-Video/composite analog video output (SD formats up to 480i/576i)
- Six pairs of L/R audio inputs multiplexed into one pair of 16-bit stereo ADC for digitizing
- Three pairs of L/R audio outputs and one pair of L/R headphone outputs generated from three pairs of 24-bit stereo DACs
- Programmable bypass option for any six pairs of L/R audio inputs to any three pairs of L/R audio outputs
- 3.1-channel Audio PCM Output Interface
- SPDIF input and output

2.5   Transport

- Dual transport stream inputs (two parallel)
- Glueless interface to DVB-CI/DVB-CI+ modules
- Multi-stream transport stream de-multiplexing, dual-tuner DVR, watch/record capable

2.6   Processors and memory

- High-performance dual ST40 CPUs for applications and real-time control
    - ST40 @ 450 MHz, dual-issue, applications CPU, 32KI, 32KD caches deliver > 800 DMIPs
- 256 Kbyte level 2 cache for accelerated performance, especially web applications
- 48-bit (3 x 16 or 1 x 16 + 1 x 32) DDR2/DDR3 Local Memory Interface (LMI), up to 1066 Mbps
- Supports NAND Flash and Quad Speed Serial Flash
    - SLC NAND controller supports 1-bit ECC
    - 8 Gb SLC NAND is supported
    - MLC NAND is not supported
- Dual multi-channel, flexible DMA controllers

2.7   Connectivity

- Dual USB 2.0 host controllers, with two PHY
- Integrated 10/100/1G Ethernet MAC/MII/RMII, SD/MMC
- PCIe 1.1 bus available for host bus expansion for wireless/HDD applications

2.8 DVR

● DVR supported, with HDD attachment through USB or Flash drive
● DVB-T+C/3DES/AES/Multi-2/ARC4 descrambling and support for Hash functions

2.9 Security

● Advanced security management with secure boot and trusted processor
● Broadcast stream encryption management (CI/CI+) and DVR data re-encryption
● Fully supports DRMs, including HDCP, WMDRM, DTCP-IP
● Rovi™ copy protection support

2.10 TV SoC peripherals

● Two UARTs
● Six SSCs for I2C/SPI master/slave interfaces (four of them shared with other IO)
● GPIO banks with alternate functions
● Infrared receiver
● Four PWMs
● HDMI CEC
● Low bandwidth ADC for chassis control

2.11 Tools

ST provides an extensive array of video and audio quality tuning tools, called "ST Media Tools." These tools not only provide unprecedented access to low-level operation of the audio/video pipelines, but also deliver this flexibility in an easy-to-use fashion.

2.12 Package

● FPGBA 35 mm x 35 mm, 956 balls, R34x34, Pitch 1.0 mm, Ball 0.6 mm

3 Application overview

Figure 1. EU/US DTT + cable iDTV application
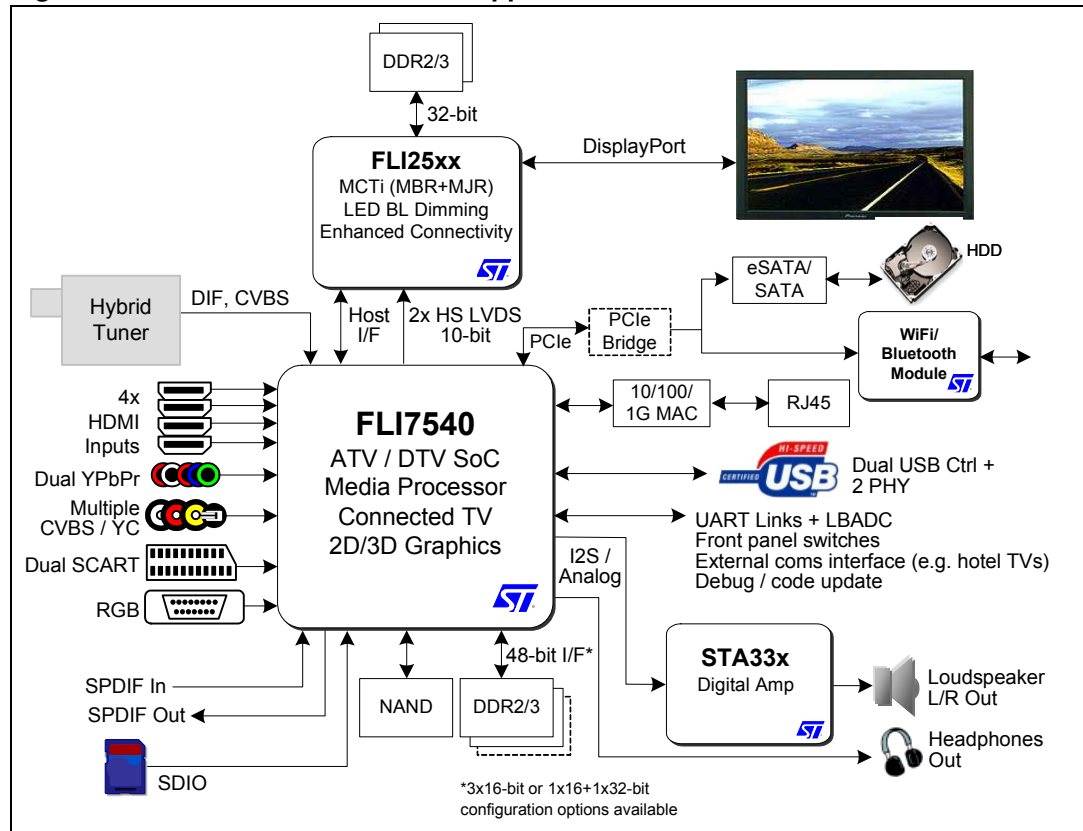
4   Ordering information

Table 2.   Order codes

Part number	Description
FLI7540	FPBGA 35 x 35 mm

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

5 Revision history

Table 3.   Document revision history

Date	Revision	Changes
13-Aug-2010	1	Initial release.
15-Oct-2010	2	Updated Table 1, 3D video formats supported Changed Figure 1, Hybrid tuner output
15-Nov-2010	3	Updated sec 2.9, removed Dwight Cavendish support
03-Mar-2011	4	Updated sec 2.2 Graphics and display; Main and PIP video display pipelines
12-Apr-2011	5	Changed audio/IS2 output to 3.1-channel in block diagram and section 2.4 Legacy audio/video interfaces
08-Jun-2011	6	Changed ST40 CPU bullet on cover page to 1600 DMIPS
08-Sep-2011	7	Added 3D line-interleaved feature to cover and Table 1, 3D video formats supported Updated section 2.6, NAND Flash support Updated section 2.10, changed to two UARTs
23-May-2012	8	Updated the following: Block diagram; sec 2.4, audio inputs/outputs; removed MCARD references; changed to HDMI 1.4b support

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