



## Freeman Premier — H.264 iDTV SoC integrated 120 Hz FRC with 3DTV support

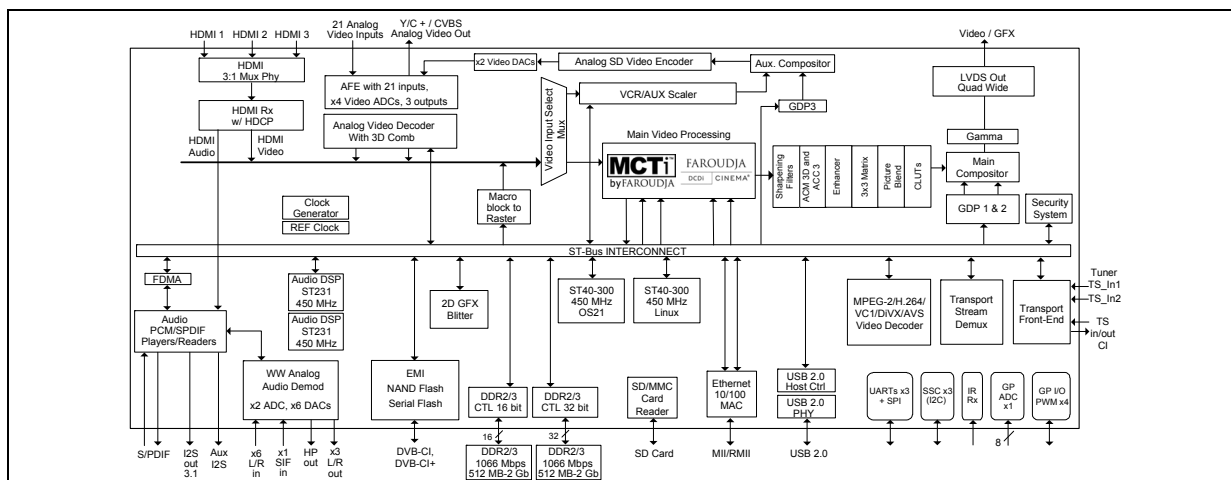
Data brief

### Features

- ST231 @ 450 MHz for advanced high definition video decoding (H.264/VC-1/MPEG2/...) --> Worldwide Digital Terrestrial Television (DTT) broadcast video standards compatibility
- 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 compatibility
- Dual ST40 CPU @ 450 MHz (delivers 1600 DMIPS) runs Linux and OS21 --> One CPU (800 DMIPS) fully dedicated to application and user interface
- Faroudja® video processing for Main Video --> Vivid picture quality for the consumer
- Full support for HDMI 1.4b mandatory 3DTV input formats
- Faroudja® MCTi™ Frame Rate Conversion (FRC) for 2D content (film and video)
- FLI7515 3DTV support through enhancement IC
- FLI7525 standalone 3DTV support 60L60R (frame-sequential) and 120 Hz (line-interleaved)
- FLI7525 includes 3D format converter
- FLI7525 supports MCTi FRC for 3D content
- FLI7525 integrates auto 2D to 3D video/text conversion and depth control
- Worldwide analog audio demodulator
- 14-bit Advanced Color Management (3D) and Contrast processing --> Ultimate video quality for OEMs and consumers
- High-quality graphics for rich, easy-to-use GUI
- Advanced security features supporting embedded CA as well as CI/CI+ and DRM applications--> Copy protection support, including HDCP, AES/DES/TDES, Rovi™
- 48-bit (3x16 or 1x16+1x32) DDR2/DDR3 1066 Mbps DRAM I/F --> Performance and flexibility with DRAM ICs
- Quad 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 120 Hz 3DTVs with MCTi
- Multi-region, single footprint for DVB/ATSC/DTMB/ISDB



# 1 Description

The Freeman Premier series of ICs are revolutionary new iDTV SoCs that integrate 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 Premier series are high-performance, state-of-the-art SoCs 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, Freeman Premier are ideal solutions for addressing the next generation of iDTV design requirements.

The Freeman Premier family of ICs are the latest in a family of scalable performance and software-compatible H.264 SoCs that address mainstream and performance segments of the iDTV market. Notably, they are single-chip, 120 Hz TV solutions incorporating Motion-Corrected Temporal Interpolation (MCTi) Faroudja technology. They utilize industry-leading vector estimation to interpolate in-between frames to correct film motion judder and panel motion blurring. Combining the artistic elements of film with the linear motion of video, Premier provides audiences with a uniquely enjoyable viewing experience.

Freeman Premier 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. Furthermore, the Freeman Premier ICs support all connectivity requirements to 3D sources and all mandatory 3D formats defined in the HDMI 1.4b specification.

With their high performance CPU, A/V decode, graphics engine, motion judder reduction and motion blur removal features, and extensive network interface capability, Freeman Premier enables 3DTVs to deliver rich applications for convenient access to multimedia content, both from within the home, as well as from the web.

**Table 1. Freeman Premier selection table**

Part number	Memory interface	LVDS outputs	IPTV	MCTi for 2D content	MCTi for 3D content	3DTV support	2D to 3D video/text conversion and depth control
FLI7515	48-bit DDR2/DDR3 1066	Quad high-speed 10-bit / FHD@120 Hz	Yes	Yes	No	Passthrough to enhancement device	No
FLI7525	48-bit DDR2/DDR3 1066	Quad high-speed 10-bit / FHD@120 Hz	Yes	Yes	Yes	60L/60R (frame-sequential) and 120 Hz (line-interleaved)	Yes

## 2 Main features

The Freeman Premier series of ICs are new, advanced decoding SoCs targeted at next generation iDTVs (DTT, as well as with combinations of cable/satellite/IPTV). They integrate in a single IC, multi-stream transport demux, CPU, multi-format audio/video decode, Faroudja video processing with MCTi technology, graphics and display, advanced security, peripherals, audio/video ADCs/DACs, Digital A/V inputs/outputs, 3x HDMI switch, USB port, Ethernet MAC, and glueless SD/MMC card interface.

### 2.1 Audio/video decoding

- Latest generation “Delta” Video Decoder with ST231 programmable CPU core:
  - MPEG2, H.264, VC-1, HD or SD
  - AVS HD decoding
  - DivX, XviD, H.263 decoding
- Advanced de-blocking and de-ringing of decoded H.264/MPEG2 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 video display pipelines: high-quality H & V reformatting/resizing with sample rate conversion/filtering. Motion adaptive spatial and temporal de-interlacing for 480p/576p and 1080p120 progressive output
  - 14-bit color/contrast processing
  - 10-bit temporal/space noise reduction
  - DCDi diagonal processing
  - 10-bit Motion Adaptive Deinterlacing (MADi)
  - 10-bit arbitrary scaling, Sharpness (linear and non-linear)
- Independent Main display compositions (Video/Graphics mixing)
- Pass-through display for graphics, Main video output concurrently with Main compositions (VCRO)
- Physical graphics planes for Main display composition. Options include:
  - One graphics plane at up to 1280x720p / 32 bpp @ 120 Hz
  - One graphics plane at up to 1920x1080p / 16 bpp @ 120 Hz
- Dedicated graphics plane for SD monitor/TV output.
- Link list based 2D graphics blitter. Up to 200 Mpixels/sec with destination alpha blending. Capable of 3D-like user interface effects.
- HD display capture and down-conversion for concurrent HD and SD output of the main composition

## 2.3 MCTi by Faroudja

- FLI7515 MCTi FRC processes 2D content
- FLI7525 MCTi FRC processes both 2D and 3D content sources (for 3D content, the left eye and right eye are processed independently for deinterlacing, noise reduction, and motion compensated FRC)
- Reduces film motion judder associated with 2:2 and 3:2 film sources to produce smooth, linear motion for 60/72/100/120 Hz displays
- Removes LCD motion blur for 50/60 Hz video sources for 100/120 Hz displays
- MCTi Film 25 to 100 Hz
- MCTi Film 24 to 120 Hz
- MCTi Video 50 to 100 Hz
- MCTi Video 60 to 120 Hz
- Unique occlusion handling capabilities for error-free motion tracking
- Horizontal and vertical search for optimal motion estimation
- Repetitive pattern artifact optimization
- Programmable FRC “strength”

## 2.4 3DTV

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 Freeman Premier supports all the connectivity options that are required.

Main features include the following:

- Supports 3D mandatory formats defined in HDMI 1.4b specification
- Supports Deep Color with mandatory 3D timings up to 12 bpc
- May be used with an enhancement device to support 1080p 240 Hz output to boost the quality of 3D playback by increasing the frame rate per eye
- Controls sync of active shutter glasses (FLI7525 only)
- Automatically generates stereoscopic 3D OSD using a standard 2D OSD (FLI7525 only)

**Table 2. 3D video formats supported**

Input format	FLI7515 – optional output to enhancement device	FLI7525 – output to TCON (optional output to enhancement device for 240 Hz)
720p @ 50/60 Hz (frame packed)	1080p @ 100/120 Hz	1080p @ 100/120 Hz (frame sequential/line interleaved)
1080p @ 24 Hz (frame packed or top-bottom half vertical resolution)		
720p @ 50/60 Hz (side-by-side half horizontal resolution or 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 or top-bottom half vertical resolution)		

## 2.5 Legacy audio/video interfaces

- 3-inputs of HDMI into a single receiver, with HDCP supporting HD and SD video formats up to 1080p60 (222.75 MHz). The HDMI receiver is compliant to the v1.4b specification and supports deep color formats, enhanced colorimetry (xvYCC and gamut metadata reception), and 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
- SCART input and output

## 2.6 Transport

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

## 2.7 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
- 48-bit (3x16 or 1x16+1x32) DDR2/DDR3 Local Memory Interface (LMI), up to 1066 Mbps
- Support for NAND Flash and Quad Speed Serial Flash
- Dual multi-channel, flexible DMA controllers

## 2.8 Connectivity

- USB 2.0 host interface, with one PHY
- Integrated 10/100 Ethernet MAC/MII/RMII
- SD/MMC card interface

## 2.9 DVR

- DVR support, with HDD attachment through USB or Flash drive
- Encrypted storage support for copy protection using AES/DES/TDES, anti-cloning option

## 2.10 Security

- Advanced security management with secure boot and trusted processor
- Broadcast stream encryption management (CI/CI+) and DVR data re-encryption
- Provide means to protect keys/certificate through HW Root-of-Trust
- Rovi copy protection support

## 2.11 TV SoC peripherals

- Three UARTs
- Three SSC/I2C
- GPIO banks with alternate functions
- Infrared receiver
- Four PWMs
- HDMI CEC
- Low bandwidth ADC for chassis control

## 2.12 Package

- FPBGA 35 mm x 35 mm, 956 balls, R34x34, Pitch 1.0 mm, Ball 0.6 mm

### 3 Application overview

Figure 1. FLI7515 – 100/120 Hz FRC for EU/US DTT + cable iDTV application

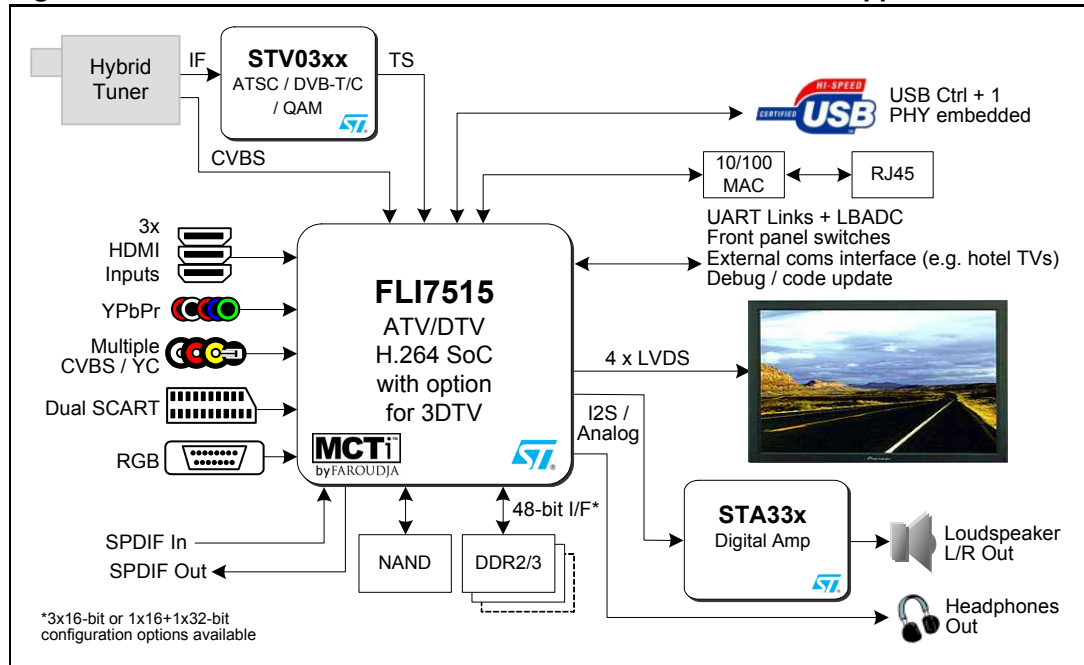
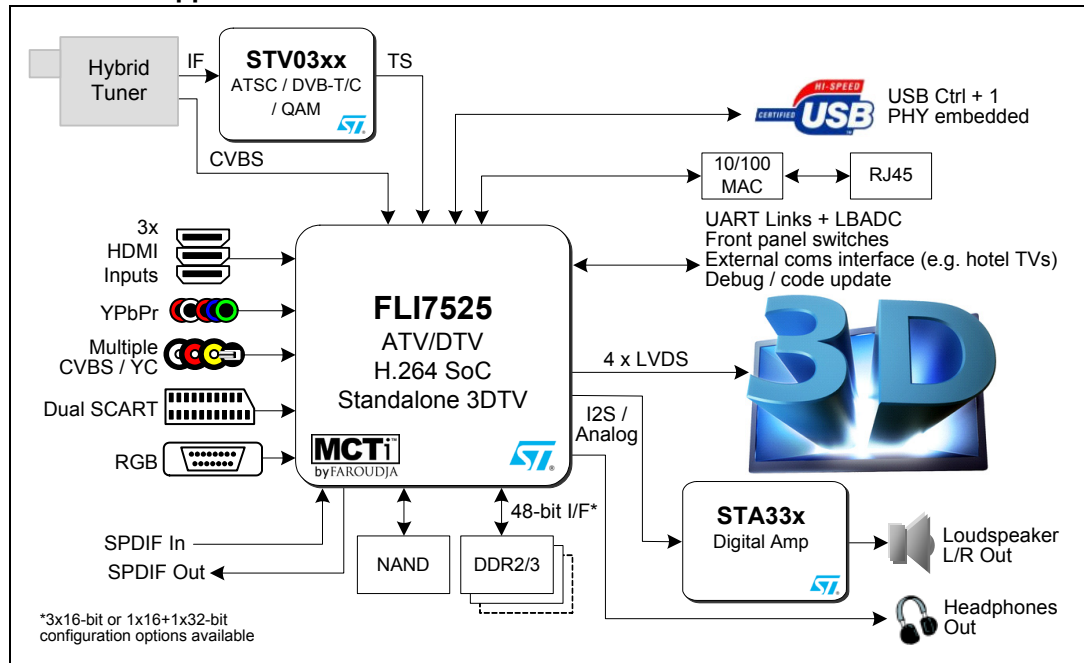


Figure 2. FLI7525 – 100/120 Hz FRC and 3DTV for EU/US DTT + cable iDTV application



## 4 Ordering information

**Table 3. Order codes**

Part number	Description
FLI7515	FPBGA 35 x 35 mm
FLI7525	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](http://www.st.com). ECOPACK® is an ST trademark.



## 5 Revision history

**Table 4. Document revision history**

<b>Date</b>	<b>Revision</b>	<b>Changes</b>
20-Aug-2010	1	Initial release.
13-Oct-2010	2	Updated Table 2, 3D video formats supported
15-Nov-2010	3	Updated sec 2.10, removed Dwight Cavendish support
28-Mar-2011	4	Added line-interleaved feature to 3DTV bullet on cover, Table 1, Freeman Premier selection table, and Table 2, 3D video formats supported
08-Jun-2011	5	Changed ST40 CPU bullet on cover page to 1600 DMIPS
23-May-2012	6	Updated the following: Block diagram; sec 2.1, changed to AVS HD decoding; sec 2.5, audio inputs/outputs; removed MCARD references; changed to HDMI 1.4b support
21-Aug-2012	7	Updated Advanced security bullet on cover page; bullets updated in sections 2.9 DVR and 2.10 Security

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