1 Product Overview

1.1 Introduction

GX3201H is a high performance multi-standard HD decoder SOC chip for DTV set-top box. It integrates a 32-bit CK610M CPU, multi-standard video decoder including MPEG2, MPEG4, AVS, AVS plus, H.264, H265, and multi-standard audio decoder, deinterlacer and video post processor, true-color OSD and 2D graphics accelerator, TV encoder, video DACs, audio DACs, HDMI transmitter, USB2.0 Host, Ethernet MAC and PHY, NAND Flash Controller and so on. It guarantees powerful function, excellent performance and low BOM cost.

The channel demodulator is designed to DVB-C, composed of ADC, QAM demodulator, FEC, etc.

The 32-bit CK610M CPU with high performance offers strong ability of software process, which supports a great many advanced applications. The mature real-time operating system and API library can shorten the developing period remarkably.

The multi-standard video decoder supports MPEG2/4, H.264, H265, AVS, AVS plus and JPEG/MJPEG HD video decoding. Patented video post-processing unit can achieve satisfied deinterlacing and scaling effect.

The processor based audio decoder supports MPEGI/II, MP3, Dolby Digital, Dolby Digital plus, MPEG4 AAC, HE-AAC and DRA decoding.

The PAL/NTSC encoder, one-channel video DAC and integrated HDMI transmitter can be configured as many HD and SD video output mode. Concurrent HD and SD mode output supported.

True-color OSD and 2D graphics accelerator may supply flowery menu effect, which can meet the requirement of browsers. Meanwhile, owing to the flexible capture engine, we can design various multi-picture browser and screen-capture functions.

USB2.0 Host, Ethernet MAC and PHY, NAND Flash Controller may support many advanced applications, such as PVR, VOD.

GX3201H is packaged with LQFP128-EPAD, which helps to reduce the PCB complexity and the BOM cost. Sum up, by the flexible configuration, GX3201H can meet the high performance multi-standard requirement of HD STB market.

1.2 Main Features

Integrates QAM DVB-C demodulator and FEC

Integrates high performance ADC with 10bits, up to 12MHz

High performance 32-bit CK610M CPU integrates 16Kbytes instruction cache and 16Kbytes data cache. The frequency is up to 600MHz. JTAG debug supported

64 PID filtering supported, each of which can mostly use 64 individual data filter channels maximally, and the max filter depth of each channel is 16Byte

The multi-standard video decoder supports JPEG/MJPEG, MPEG2, AVS, AVS plus, MPEG4, H.264, H265 HD or SD advanced video decoding. Error protection and concealment supported

The audio decoder supports MPEGI/II, MP3, Dolby Digital, Dolby Digital plus, MPEG4 AAC, HE-AAC and DRA decoding. The output supports L/R and S/PDIF

5 graphics plane: background color, still image, video, OSD plane, and OSD plane

True-color OSD and 2D graphics accelerator, anti-flicker filter supported

Flexible capture engine, various multi-picture browse and screen-capture functions supported

High performance video deinterlacer and scaler, progressive output supported

All of the PAL and NTSC analog TV standards supported

1 channel video DAC integrated, CVBS output modes are supported

HDMI version 1.4, HDCP revision 1.2 and DVI version 1.0 compliant transmitter embedded

2 channel audio DACs integrated, S/N is more than 80dB

2 USB2.0 Host integrated, High-speed and Full-speed devices supported, PVR is supported

A 10M/100M Ethernet MAC and PHY

NAND Flash supported with 32 bit ECC

DDR2/DDR3 SDRAM supported

1 parallel TS input

Conditional access and data broadcast supported

Integrate OTP, support CAS without smart card

Package: LQFP128-EPAD

Typical application: HD set-top box

1.3 Feature List

DVB-C Demodulator

Compliant with DVB-C

256, 128, 64, 32 and 16 QAM demodulation supported

Direct Intermediate Frequency (DIF) /Low Intermediat Frequency (LIF) sampling supported

Roll-Off Factor: 0.12 ~ 0.2

Carrier Acquisition Range is up to 400KHz

Variable Symbol Rate: 0.45 ~ 8.5 MBauds

Frequency Spectrum Inversion supported

Integrates Frequency Scan, FD and Decision Loop; provides fast capture and high precision

Blind And DDLMS Algorithm Make Equalizer More Robust

Real-Time Monitor Signal Quality

Variable Depth Deinterleaver

CPU

32bit CK610M CPU with MMU , the frequency up to 600MHz

16Kbyte data cache, 16Kbyte instruction cache

Interrupts controller and timers

Linux and other mainstream OS supported

Memory

SDRAM: 16 bit width, up to 533MHz, maximal 2Gbit, DDR2 or DDR3 SDRAM

FLASH: SPI flash, parallel NAND flash

Boot from NAND flash

Transport Stream Processing

TS peak input rate 120Mbps

64 PID filter, each filter corresponding to 64 individual data filter channel maximally, each channel 16Byte depth maximally

Filtering TS, PES, PSI, SI, and so on

Integrated DVB descrambler, TS and PES descrambling supported

Additional TS input interface supports external demodulator

Video Decoder

H265 video (HEVC/H.265), BP/MP/HP up to L4.1

H.264 video (ISO/IEC 14496-10), BP/MP/HP up to L4.1

MPEG-4 video (ISO/IEC 14496-2), SP/ASP up to L5

H.263 P3

AVS

AVS plus

MPEG-2 video (ISO/IEC 13818-2), MP@HL

MPEG-1 video (ISO/IEC 11172-2)

Decoding up to 1920×1080p@30fps

Error detection and concealment

Hardware accelerated JPEG/MJPEG decoding

Audio Decoder

MPEG1 I/II, MP3 decoding

MPEG-4 AAC and AAC plus (HE-AACv1 and v2) decoding

DRA decoding

Optionally supports Dolby Digital (AC-3) decoding

Optionally supports Dolby Digital Plus (DD+) decoding

Single channel, dual channel, stereo, and joint stereo modes supported

Sampling rates of 32kHz, 44.1kHz, 48kHz, and MPEG-2 half sampling rates of 16kHz, 22.05kHz, 24kHz supported

Right justified and left justified output formats supported

Output word length of 16bits, 18bits, 20bits and 24bits supported

Mutes and attenuator supported

Automatic concealment of errors

2 channel audio DAC output, S/N is more than 80dB

One S/PDIF output interface

OSD

Five display planes: background, still image, video, SSD and OSD

True-color for background and still image planes supported

2bpp, 4bpp, 8bpp CLUT graphics and 16bpp, 32bpp true-color graphics, RGB565, RGBA5551, RGBA4444, RGBA8888 formats supported

Alpha blending and anti-flicker filters supported

2D graphics accelerator supported

Video Post Processor

High performance 3D deinterlacer supported

Full-range scaler supported

Letterbox and Pan & Scan modes supported

4:3 and 16:9 supported

Video Interface

PAL-B B1 D D1 G H I K K1, PAL-M, PAL-N, PAL-Nc, NTSC-M, NTSC-4.43 in TV encoder supported

One 10-bit DAC outputs

CVBS output modes supported

HDMI 1.4 transmitter output delivers an HD video (1080p, 1080i, 720p, 576p, 480p, etc)

Encoding of Teletext, close caption, WSS, CGMS and VPS

PVR

USB device PVR supported

Pause, Slow, Fast and Skip supported

Time shift mode supported

The program can be saved as TS or private type

On-chip Peripherals

Two USB2.0 host support High-speed and Full-speed devices

One smart card interfaces

One 10M/100M Ethernet MAC and PHY

Two UART with maximum 115200bps

One NAND Flash interface

Integrated VCXO, crystal with 27MHz supported

JTAG debug interface

2 Function Description

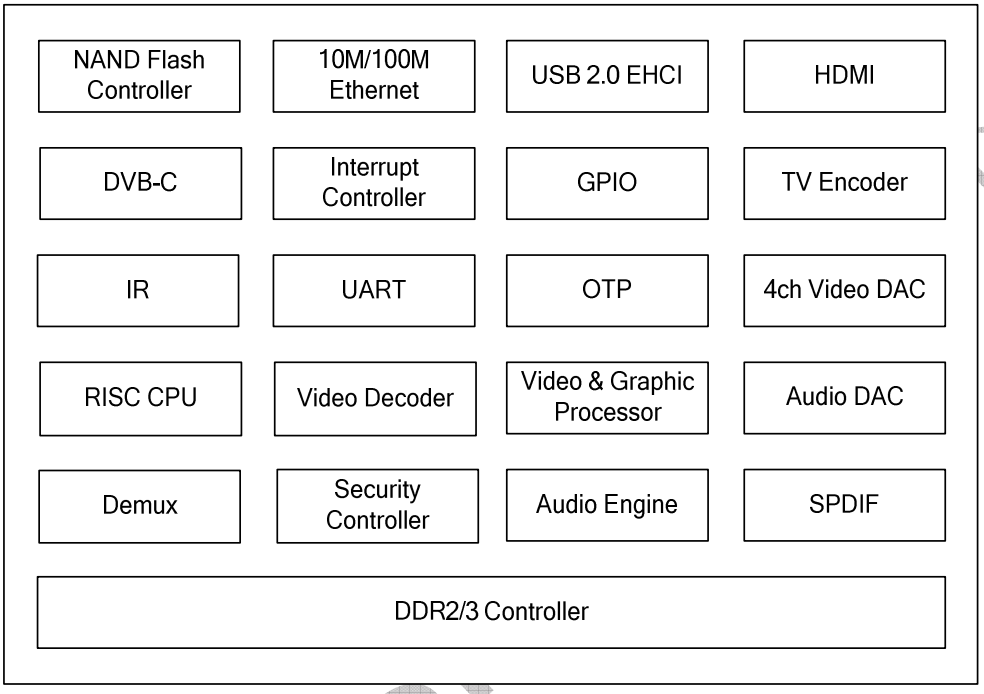

Figure 2-1 GX3201H Architecture diagram

2.1 CPU

The CK610M processor core runs up to 600MHz, which also comprises CPU core, memory (16Kbyte instruction cache, 16Kbyte data cache) and JTAG controller for real-time debugging.

2.2 Memory Subsystem

The GX3201H has a DDR2/DDR3-SDRAM interface and a flash interface.

The GX3201H's DDR2/DDR3-SDRAM interface is used for all data requirements in unified memory applications, including graphics, video and audio buffers, and so on. It provides 16bits wide DDR2/DDR3-SDRAM which can support up to 533MHz.

It supports up to 2Gbit DDR2/DDR3-SDRAM.

2.3 Video Decode and Display

The video decoder gets PES data and reference frames in SDRAM by DMA, and runs decoding,

then transfers the result frame to SDRAM by DMA. The video display module is in charge of the video frame management, deciding which video frame buffer should be displayed.

2.4 Transport Stream Processing

GX3201H supports 1 parallel transport stream input. The demultiplexior performs transport stream descrambling, demultiplexing and data filtering. PES data is transferred by DMA to audio and video buffers in SDRAM. Section data is transferred by DMA to buffers in SDRAM for further processing by CPU. DVB transport streams can be handled by the multiplexior with data rates to 120Mbit/s. PID filtering is to select the audio, video and data packets to be processed. It can also support 64 PID slots.

The demultiplexior can descramble streams using the DVB-CSA cipher. It has a section filter core that filter DVB standard sections using 32*16-byte filters.

2.5 Graphics and Display

VPU (Video Process Unit) is composed of PP (Digital Video Post-Process) unit, OSD (On Screen Display) unit, SOSD (Sub On Screen Display) unit, PIC (Picture)unit, CE (Capture Engine) unit, VDE (VBI Date Engine) and MIXER unit.

The video and graphic data are stored in the SDRAM. VPU will get these data by DMA, process them and finally output to Video out module. The CE unit which captures the graphic data from MIXER unit and stores them to SDRAM is different from other unit in VPU module.

The GA module is composed of buffer_ctrl unit, bitblit unit, mix unit, colorfill unit and cmd_ctrl unit.

GA supports the following operations:

- 2D/1D data block copy;
- 2D/1D data block filling;
- 2D/1D data block mix operation;
- 2D/1D data block color conversion；
- 2D/1D data block scale and rotate.

The deinterlace unit performs video deinterlacing and denoising. The functions of this module are configurable; users can turn on/off functions on different applications. This module supports different resolution, from CIF to HD.

2.6 Video Output

The video output converts a 4:4:4 digital video stream into a standard analog composite baseband PAL/NTSC signals. It supports almost all kinds of composite video baseband standards, including PAL-B/B1/D/D1/G/H/I/K/K1, PAL-M, PAL-N, PAL-Nc, NTSC-M, NTSC-4.43, etc.

2.7 Audio Decode and Display

The audio decoder gets audio PES or PCM data from SDRAM by DMA, and decodes the data, then the PCM audio data will be wrote to the SDRAM again.

The audio player can output PCM data with S/PDIF interface, or the Dolby streams on the S/PDIF interface.

Sampling rates of 32kHz, 44.1kHz, 48kHz, and MPEG-2 half sampling rates of 16kHz, 22.05kHz, 24kHz are supported.

2.8 Internal Peripherals

The GX3201H has many dedicated internal peripherals, including:

- Two USB2.0 hosts which support High-speed and Full-speed devices;
- One smart card interface;
- 10M/100M Ethernet MAC and PHY;
- NAND Flash Interface which supports NAND Flash with ECC;
- Two UART with maximum 115200bps;
- An infrared blaster/decoder interface module;
- An interrupt controller;
- A watchdog controller;
- Integrated VCXO, crystal with 27MHz supported;
- JTAG debug interface;
- HDMI 1.4 supports HDCP 1.2 and DDC.