

# AS3525

## Advanced Audio Processor System

### 1 General Description

This highly flexible and fully integrated audio processor system (AS3525) combines strong calculating power, high performance audio features with system power management options for battery powered devices.

Using advanced 0.13µm process technology and large on chip RAM leads to outstanding low power consumption of as low as 58mW for a complete flash-player during MP3 playback.

Based on a powerful ARM9TDMI capable of performing up to 200MIPS it is suited to run MP3, AAC, WMA, OGG... decoders and encoders and, in addition, it can perform extensive user interfaces, motion graphics support, video playback and much more.

The AS3525 SOC (system-on-a-Chip) features dedicated high speed interfaces for ATA IDE, USB2.0 HS-OTG and SDRAM ensuring maximum performance for download, upload, and playback.

Furthermore interfaces for NAND flashes, MMC/SD cards and Memory Stick ensure most flexible system design possibilities. Hardware support for parallel interfaces lower the CPU load serving complex and/or colour user interfaces.

Additional serial high-speed data and control interfaces guarantee the connection to other peripherals and or processors in the system.

Two independently programmable PLLs generate the required frequencies for audio playback/recording, for the processor core and for the USB interface at the same time. An additional external clock input eliminates the use of external crystals when used in multi-processor systems like mobile phones.

It has a variety of audio inputs and outputs to directly connect electret microphones, and auxiliary signal sources via a 10-channel mixer to a 16Ω/32Ω headset, 4Ω speaker or auxiliary audio peripherals.

Further the device offers advanced power management functions. All necessary ICs and peripherals in a Digital Audio Player with flash or hard-disk memory are supplied by the AS3525. The different regulated supply voltages are fully programmable. The power management block generates 10 different supply voltages out of a single battery supply. CPU, NAND flash, SRAM, memory cards, LCD, LCD backlight and USB-OTG can be powered. When operating from a single cell (AA or AAA) battery the AS3525 can use a DCDC booster to generate the needed system supply.

The AS3525 has an independent 32kHz real time clock (RTC) on chip, which allows a complete power down of the system CPU and peripherals.

AS3525 also contains a charger for Li-Io battery supply

The single supply voltage may vary from 1.0V to 5.5V.

### 2 Key Features

#### 2.1 Digital Core

Embedded 32-Bit RISC Controller



- ARM922TDMI RISC CPU
- 2.5Mbit on-chip RAM
- 1Mbit on chip ROM
- Clock speed max. 250MHz (200MIPS)
- Standard JTAG interface

USB 2.0 HS & OTG Interface

- Up to 480Mbit/s transfer speed
- USB 2.0 HS/FS physical including OTG support
- USB 2.0 HS/FS digital core including OTG host
- Dedicated dual port buffer RAM
- DMA bus master functionality

IDE Host Controller

- Supporting Ultra ATA 33/66/100/133 modes
- Programmable IO and Multi-word DMA capability
- Dedicated dual port buffer RAM
- DMA bus master functionality

External Memory Controller

- Dynamic memory interface
- Asynchronous static memory
- DMA bus master functionality

DMA Controller

- Single Master DMA controller
- 2 DMA channels possible at the same time
- 16 DMA requests supported

Interrupt Controller

- Support for 32 standard interrupts
- Support for 16 vectored IRQ interrupts

Audio Subsystem Interface

- Dedicated 2 wire serial control master
- I2S input and output with dual port buffer RAM

Nand Flash Interface

- 8 and 16bit flash support
- 3, 4 & 5 byte address support
- hardware ECC

MMC/SD Interface

- MMC/SD Card host for multiple card support
- 4 data line support for SD cards

MS / MS Pro Interface

- Dedicated dual port buffer RAM

## Product Brief

Display Interface

- Serial and parallel controller supported
- On chip hardware acceleration

Synchronous Serial Interface

- Master and slave operation
- 8 and 16 bit support
- Several protocol standards supported

I2S Interface

- Input multiplexed with audio subsystem
- selectable SPDIF input conversion
- Dedicated dual port buffer RAM

2 Wire Serial Control Interface

- Master and slave operation
- Standard and fast mode support

General Purpose IO Interface

- 4x 8-bit ports

## 2.2 Audio

Multi-bit Sigma Delta Converters

- DAC: 18bit with 94dB SNR ('A' weighted)
- ADC: 14bit with 82dB SNR ('A' weighted)
- Sampling Frequency: 8-48kHz
- 32 gain steps @ 1.5dB and MUTE

2 Line Inputs

- stereo, 2x mono or mono differential inputs
- 32 gain steps @ 1.5dB and MUTE

2 Microphone Inputs

- differential inputs
- 3 gain pre-sets (28/34/40 dB) and OFF with AGC
- 32 gain steps @ 1.5dB and MUTE
- microphone detection with about 50uA
- supply for electret microphone max 1mA
- remote control by switch

Line Output

- max 1Vp @ 10k $\Omega$  in single ended stereo mode
- >32 $\Omega$  in mono differential mode to drive ear-pieces
- 32 gain steps @ 1.5dB and MUTE

Stereo Headphone Audio Amplifier

- 2x 60mW @ 16 $\Omega$  driver capacity
- 32 gain steps @ 1.5dB and MUTE
- Click- and pop-less start-up and power down
- Headphone and over-current detection
- Phantom ground eliminates large capacitors

Stereo Speaker Audio Amplifier

- 2x 500mW @ 4 $\Omega$  driver capacity
- 32 gain steps @ 1.5dB and MUTE
- Click- and pop-less start-up and power down
- Over-current detection

10 Channel Audio Mixer

- mixes Line inputs, Mic inputs and DAC output
- separate selectable source for right and left channel
- possibility to select AGC to prevent clipping

## 2.3 Power Management

Voltage Generation

- step up for system supply (3.0V-3.6V, 150mA)
- charge-pump for CPUcore (1.05V-1.2V, 50mA)
- charge pump for USB OTG (5V, 10mA)
- LDO for digital supply (2.9V, 200mA)
- LDO for analog supply (2.9V, 200mA)
- LDO for IO supply (2.94 or 3.11V, 200mA)
- LDO for peripherals (1.7V-3.3V, 200mA)
- LDO for USB Transceiver (3.26V, 200mA)
- LDO for RTC (1.0V-2.5V, 2mA)

25V Back-light step up converter

- for driving up to 6 white LEDs in series to achieve a uniform illumination
- current programmable up to 40mA (1.25mA steps)

Li-Io Battery Charger

- automatic 50mA trickle charging
- prog. constant current charging (50 – 400mA)
- prog. constant voltage charging (3.9 - 4.25V)

## 2.4 System

RTC

- ultra low power 32kHz oscillator
- 32bit RTC second counter
- selectable alarm (seconds or minutes)
- trim able oscillator

Oscillator

- low power 12-24MHz Oscillator
- generating main system clock

Supervisor

- automatic battery monitoring with interrupt generation and selectable warning level
- automatic temperature supervision with interrupt generation and selectable warning and shutdown levels

General Purpose ADC

- 10bit resolution
- 16 inputs analog multiplexer

UID

- Unique Identification Number in OTP ROM for DRM support

General

- Reset pin, watchdog
- 10sec emergency shut-down
- Wide battery supply range 1V – 5.5V
- MP3 playback with 58mW

Packages:

- AS3525-A: CTBGA224 13x13mm, 0.8mm pitch
- AS3525-B: CTBGA144 10x10mm, 0.8mm pitch
- (in preparation: CTBGA132 9x9, 0.5mm pitch)

## 3 Application

- Portable Digital Audio Player and Recorder
- Portable Digital Media Player
- PDA
- Smartphone

# 4 Block Diagram

Figure 1 AS3525 Block Diagram

