AVR32 UC3 Audio Decoder Over USB

- **Software MP3 Decoder**
- **Software WMA Decoder**
- **Play over USB (Host mass storage class) or local SD card (SPI mode)**
- **Low Memory Footprint (Code & RAM)**
- **Audio output over PWM channels or I2S using SSC controller**
- **LCD Display**
- **USART Remote or Local Control**

1. Introduction

This application note is aimed at helping the reader become familiar with the Atmel AVR32® UC3A microcontroller.

The solution presented here in this application is based on Atmel AVR32 UC3: a minimal solution is based on the EVK1100 evaluation kit and the AT32U3CA0512 device.

The MP3 decoder source code is provided under GPL style license.

The WMA decoder is provided under binary form.

An add-on hardware can be mounted on the EVK1100.It mainly contains a TLV320AIC23B stereo audio codec. All CAD files are available in the appendices.

For more information about the AVR32 architecture, please refer to the appropriate documents available from http://www.atmel.com/avr32.

2. Requirements

The software provided with this application notes requires several components:

- The UC3A Evaluation Kit EVK1100
- A computer running Microsoft® Windows® 2000/XP/Vista or Linux
- The AVR32 GNU toolchain (GCC) or IAR Embedded Workbench for AVR32 compiler.
- A JTAGICE mkII debugger

3. Audio Player Overview

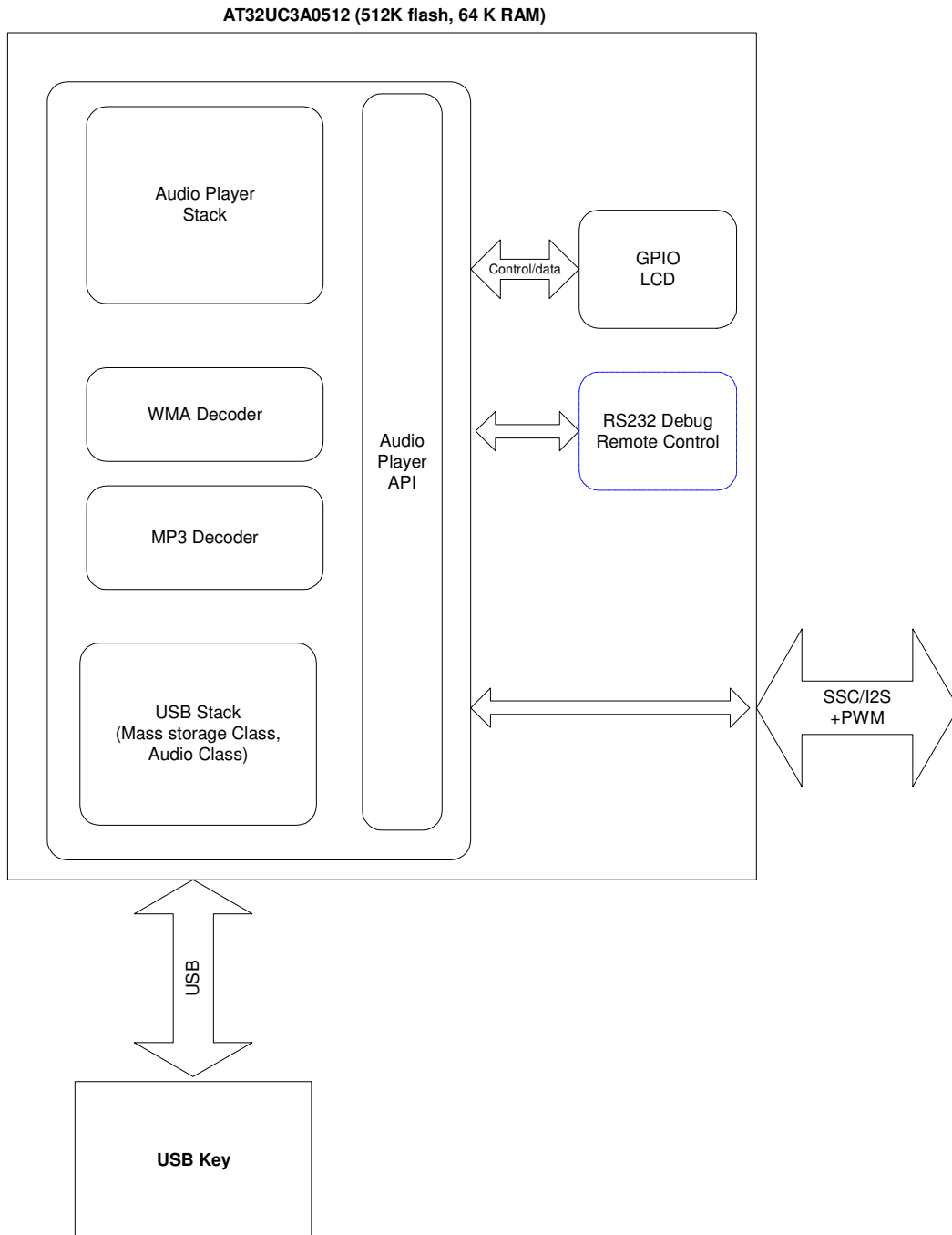**Figure 3-1.** Block Diagram

AT32UC3A0512 (512K flash, 64 K RAM)

4. Implementation Details

  • APPLICATIONS/EVK1100-AUDIO-PLAYER: demo sources:
  • /AT32UC3A: IAR and GCC compilers project files
  • /CONF: configuration header files of demo modules.
  • /LIBMAD: AVR32 port of LibMAD MP3 decoder.
  • /audio_player: main module of the demo. It contains the main() function.
  • /dac_pwm: management of the PWM channels to generate the audio DAC output.
  • /dv_sys_clk: management of MCU clocks.
  • /host_mass_storage_task: management of the USB host mass-storage task.
  • /mp3_player: top layer of the MP3 player using LibMAD.
  • /ushell_task: uShell command line interpreter used with the USART.

5. Audio Player API

5.1 Overview

The commands to interface the audio player is divided into several parts :

- **File System navigation**: explore a disk like the Windows explorer.
- **Audio navigation**: use your playlist.
- **Audio Control**: play song file control (play/pause a song).

5.2 Limitations

5.2.1 Playlist

- Support playlist up to 65535 path files
- Support ASCII or UNICODE Big Endian (UTF16) (compilation choice)
- The navigation in the playlist is only possible only in play file navigation (not in the file system navigation.

5.2.2 Navigation

- The random mode is a random play inside a directory then a random play in the next directory etc.

5.2.3 File system

- There is no limitation in the firmware for the supported number of files and directories. The only limitation is du to the FAT file system:
    - for FAT12/16 root directory only: up to 256 files (short names) ,
    - for FAT12/16/32 up to 65535 files (short names) per directory.

5.2.4 Audio

- Depending the RAM settings, the audio player may not be able to provide a track info (e.g. author) while playing another track.

5.2.5 Speed

Speed navigation may be affected by:

- high-bitrate is played at the same time.
- Directories has many files.
- The playlist includes many files.

5.3 File System Navigation

The exploration is based on a selector displacement. The **file list** is the list of the files in the current directory according to the extension filter (. mp3, . wma, .m3u)

The "file list" :

- is updated when you exit or enter a directory or a disk.
- starts with the directories then the files.
- is not sorted by alphabetic order. The order is the creation order.

Note: In the following tables, KO is 0. OK is 1. True is 1, false is 0.

Table 5-1. Main File System Commands

ID command	In	Out	Description
IA_NAV_DRIVE_NB	-	Number of drive	Return the number of disk available
IA_NAV_DRIVE_SET	Drive number	OK or KO	Selects the disk but do not mount it: (0 for drive 0, 1 for drive 1...).
IA_NAV_DRIVE_GET	-	Drive number	Return the disk number selected.
IA_NAV_DRIVE_MOUNT	-	OK or KO	Mount the selected disk.
IA_NAV_DIR_ROOT	-	OK or KO	init the file list on the root directory.
IA_NAV_DIR_CD	-	OK or KO	enter in the current directory selected in file list
IA_NAV_DIR_GOTOPARENT	-	OK or KO	Exit current directory and go to parent directory.
IA_NAV_DIR_NAME	-	UNICODE name	Return the name of parent directory
IA_NAV_FILE_GOTO	Position in file list	OK or KO	Go to a position in file list (0 for position 0, 1 for position 1...). Return an error when the file position is not available.
IA_NAV_FILE_NB	File or Directory	Number of files	Return the number of files or directories in file list. Note: Depending of the number of files, the command may be slow. It is preferable to use the IA_NAV_FILE_GOTO command to detect the end of the file list.
IA_NAV_FILE_ISDIR	-	True or false	Return the type of selected file
IA_NAV_FILE_NAME	-	UNICODE name	Return the name of selected file
IA_NAV_GOTOPLAYFILE	-	OK or KO	Go to the current played file.

5.4 Audio Navigation

.

Table 5-2. Audio Navigation Commands

ID command	In	Out	Description
IA_AUDIO_CONTEXT_GET	-	Structure context	Give complet audio context (player state, play time, repeat, random, file played, explorer mode).
IA_AUDIO_CONTEXT_RESTORE	Structure context	OK or KO	Restore an audio context (eventualy restart play).
IA_AUDIO_NAV_PLAYFILE	-	OK or KO	Play the current selected file or playlist. This commands does not change the current option repeat/random/explorer_mode.
IA_AUDIO_NAV_NEXT	-	OK or KO	Jump to next song file. The next song file is determinated by the current option repeat/random/explorer_mode.
IA_AUDIO_NAV_PREV	-	OK or KO	Jump to previous song file. The previous song file is determinated by the current option repeat/random/explorer_mode.
IA_AUDIO_NAV_NB	-	Number of song file	Return the number of .mp3 and .wma files present in the current directory. If a playlist is played, return the number of file present in the current playlist.
IA_AUDIO_NAV_GETPOS	-	File position	Return the file position in the current file list.
IA_AUDIO_NAV_GETNAME	-	UNICODE name	Return the name of selected file.
IA_AUDIO_NAV_GETINFO	-	File info	Return the song info (ID3).
IA_AUDIO_NAV_EXPMODE_SET	Explorer mode	Status	Change the explorer mode : - all disks, - one disk, - directory only, - directory + sub directories The explorer mode cannot be changed while a playlist is played.
IA_AUDIO_NAV_EXPMODE_GET	-	Explorer mode	Give the explorer mode: all disks, one disk, directory only, directory + sub directories
IA_AUDIO_NAV_REPEAT_SET	Repeat mode	Status	Change the repeat mode : - no repeat, repeat single, repeat all
IA_AUDIO_NAV_REPEAT_GET	-	Repeat mode	Give the repeat mode (no repeat, repeat single, repeat all).
IA_AUDIO_NAV_RAND_SET	Random mode	Status	Enable/disable the random play mode.
IA_AUDIO_NAV_RAND_GET	-	True or false	Return true when the random play mode is enabled.

5.5 Audio Control

Table 5-3. Audio Control Commands

ID command	Param In	Param Out	Description
IA_AUDIO_CTRL_PLAY	Time to start	OK or KO	Play the selected file.
IA_AUDIO_CTRL_PAUSE	-	OK or KO	Pause.
IA_AUDIO_CTRL_STOP	-	OK or KO	Stop play
IA_AUDIO_CTRL_FFW	Time in second	OK or KO	Fast forward
IA_AUDIO_CTRL_FRW	Time in Second	OK or KO	Fast rewind
IA_AUDIO_CTRL_RESUME	-	OK or KO	Resume play after a pause/ffw/frw
IA_AUDIO_CTRL_STATUS	-	OK or KO	Give the audio status : - stop, - play, - pause, - new song file selected, new folder selected
IA_AUDIO_CTRL_GETTIME	-	Time play	Get the current elapsed time.
IA_AUDIO_CTRL_SETVOLUME	-	OK or KO	Set volume
IA_AUDIO_CTRL_GETVOLUME	-	OK or KO	Get volume
IA_AUDIO_CTRL_MUTE	-	OK or KO	Mute volume
IA_AUDIO_CTRL_UNMUTE	-	OK or KO	Unmute volume

5.6 Example

5.6.1 Example 1

Given the following disk with the following contents:

- dir1
- dir2
- file1.mp3
- file2.wma
- file3.wma

Let's take this disk as disk number 0 for the system.

Table 5-4. Example: play file1.mp3

Command Order	Command Name
0	IA_NAV_DRIVE_NB(): return one disk, logical number 0.
1	IA_NAV_DRIVE_SET(0): select the disk 0.
2	IA_NAV_DRIVE_MOUNT(): mount the select disk 0.
3	IA_NAV_FILE_GOTO(0): goto file position 0
4	IA_NAV_FILE_NAME(): return the name dir1
5	IA_NAV_FILE_ISDIR(): return true, the current file is a directory.
6	IA_NAV_FILE_GOTO(1): goto file position 1
7	IA_NAV_FILE_NAME(): return the name dir2
8	IA_NAV_FILE_GOTO(2): goto file position 2
9	IA_NAV_FILE_NAME(): return the name file1.mp3
10	IA_AUDIO_CTRL_PLAY(): play the selected file file1.mp3
11	IA_NAV_FILE_GOTO(3): goto file position 3
12	IA_NAV_FILE_NAME(): return the name file2.mp3