
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



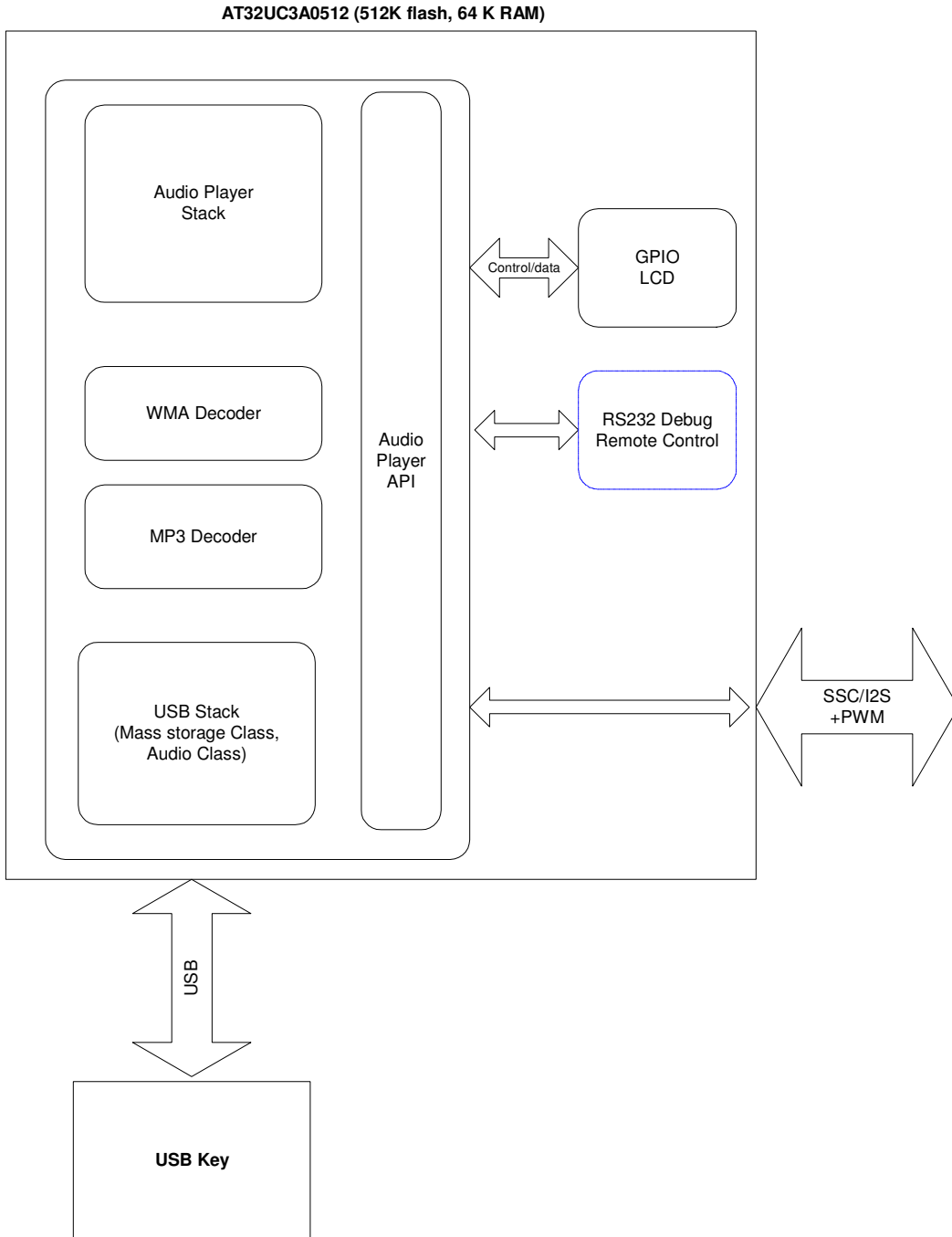
**AVR32 UC3
Microcontrollers**

Application Note



3. Audio Player Overview

Figure 3-1. Block Diagram



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 due 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 (eventually 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_FFWD | 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 |