

# 32-bit AVR Microcontrollers - Audio Player over USB

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# Chapter 1

## Audio Player over USB for 32-bit AVR Microcontrollers

### 1.1 License

Use of this program is subject to Atmel's End User License Agreement.

Please read the [License](#) at the bottom of this page.

### 1.2 Introduction

This is the documentation for the data structures, functions, variables, defines, enums, and typedefs for the UC3 Audio Player Software. Audio solutions: [www.atmel.com/audio](http://www.atmel.com/audio) Please refer to the corresponding application note for more information.

### 1.3 Covered in this document

- [Features](#)
- [Getting Started](#)
- [Compilation](#)
- [Main Files](#)
- [Release Notes](#)
- [Supported Device List](#)

### 1.4 Contact Information

For further information, visit [Atmel 32-bit AVR Microcontrollers](#).

Support and FAQ: <http://support.atmel.no/>

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# Chapter 2

## Module Index

### 2.1 Modules

Here is a list of all modules:

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# Chapter 3

## Module Documentation

### 3.1 Features

- Play, Pause, Stop, Volume +/-, Next, Previous, FFW, FRW, Shuffle, Repeat features.
- Current and total time, Metadata, Cover arts.
- Navigation, playback and configuration views.
- Supports the **EVK1104** (high speed USB)
- Supports the **EVK1105** and the **EVK1105REV3**
- Supports **MP3**

## 3.2 Compilation

This section describes how to compile and load the code using one of the compiler supported.

This software was written for the GNU GCC and IAR Systems compiler for 32-bit AVR Microcontrollers. Other compilers may or may not work.

- See also AVR32709: AVR32 UC3 Audio Decoder Over USB application note
- Plug the USB power cable on evaluation kit.
- Make sure the Power LED is on.

### 3.2.1 Stand-alone GCC + JTAG

- The GNU Toolchain for 32-bit AVR Microcontrollers must be preliminary installed.
  - If not, please download it and install it from the following link:  
[http://www.atmel.com/dyn/products/tools\\_card.asp?tool\\_id=4118](http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4118)
- Plug the JTAGICE mkII between the PC and the EVK using the JTAG connector.
- Open a shell.
- Go to the /APPLICATIONS/AUDIO-PLAYER/[...]/GCC/ directory and type:

```
`make rebuild program run`
```

### 3.2.2 Stand-alone GCC + USB BOOTLOADER

- The GNU Toolchain for 32-bit AVR Microcontrollers must be preliminary installed.
  - If not, please download it and install it from the following link:  
[http://www.atmel.com/dyn/products/tools\\_card.asp?tool\\_id=4118](http://www.atmel.com/dyn/products/tools_card.asp?tool_id=4118)
- Make sure the USB power cable is plugged on the left USB port of the board (USB USER).
- Open a shell.
- Go to the /APPLICATIONS/AUDIO-PLAYER/[...]/GCC/ directory and type:

```
`make rebuild isp program run`
```

### 3.2.3 AVR32Studio

- See "AVR32769: How to Compile the standalone AVR32 Software Framework in AVR32 Studio V2".

### 3.2.4 IAR + JTAG

- Make sure you have the latest 'IAR for 32-bit AVR Microcontrollers' installed on your PC.
  - If not, an evaluation edition can be downloaded at the following address:  
<http://www.iar.com/>

- Plug the JTAGICE mkII between the PC and the EVK using the JTAG connector.
- Open ‘IAR for 32-bit AVR Microcontrollers’ and load the associated IAR project of this application (located in the director /APPLICATIONS/AUDIO-PLAYER/[...]/IAR/).
- Press the ‘Debug’ button at the top right of the IAR interface.
  - The project should compile. Then the generated binary file is downloaded to the target to finally switch to the debug mode.
- Click on the ‘Go’ button in the ‘Debug’ menu or press F5.

## 3.3 Main Files

### 3.3.1 Audio Player Core

- `main.c` : Contains the `main()` function.
- `com_task.c` : File in charge of the HMI.
- `audio_interface.c` : The abstract layer providing a generic API for audio players.
- `audio_mixer.c` : Common API for output codec drivers.
- `buff_player.c` : Audio samples bufferization.

### 3.3.2 USB Host

- `usb_task.c` : Basic USB features handler (connections, errors...).
- `usb_host_task.c` : State machine of the USB host process.
- `usb_host_enum.c` : In charge of the USB host enumeration.

### 3.3.3 Mass Storage

- `ai_usb_ms.c` : The USB mass storage module to be plugged into the generic audio interface.
- `host_mem.c` : USB host memory manager.
- `scsi_decoder.c` : Set of functions to parse SCSI packets.
- `host_mass_storage_task.c` : Detects the presence of a USB mass storage device.

### 3.3.4 FAT

- **Low level functions**

- `fat.c` : Set of all basic low level functions (`get_cluster_list...`).
- `fat_unusual.c` : Extended set of low level functions (`mount...`).

- **Abstract interface**

- `ctrl_access.c` : Abstract layer for memory management.

- **Navigation**

- `navigation.c` : Functions to navigate in the FAT file system (`cd...`).
- `nav_automatic.c` : Plug-in to automatic navigation (`next, previous...`).
- `nav_filterlist.c` : Plug-in to handle file filtering during navigation.

- **File**

- `file.c` : Basic functions to handle a file (`open, read...`).
- `reader_txt.c` : Set of function to handle text files (`read_line...`).
- `unicode.c` : Plug-in to handle Unicode in text files.
- `play_list.c` : Set of functions to parse and read a playlist file.

### 3.3.5 MP3

- `ai_usb_ms_mp3_support.c` : This file provides the MP3 support on the USB mass storage module.
- `codec_mp3_task.c` : Contains the call to the MP3 codec front-end.
- `libmad-at32ucr2-speed_opt.a` and `libmad-at32ucr2-speed_opt.r82` : MP3 decoding algorithm.
- `mp3_libmad_player.c` : Abstract interface between the audio interface and the MP3 library.
- `reader_id3.c` : Metadata information parser and reader.

## 3.4 Getting Started

### 3.4.1 EVK1104

The following steps have to be achieved one by one in the proper order.

#### 3.4.1.1 Step1 : Load the bitmap pictures into the dataflash

This application needs some bitmap pictures to be stored into the data-flash of the evaluation kit.

Here is the procedure for a PC using Windows XP/Vista (for other platforms, please adapt this steps according to the OS):

1. Plug a JTAGICE or AVRONE! emulator on the EVK1104.
2. Launch the "EVK1104\_program\_mass\_storage.cmd" application. It will program the internal flash with a USB device mass storage application.
3. Connect the board to a PC using a USB cable. Use the "USB User" connector: from the 2 set of USB connectors, this the one which is on the left.
4. This application will start and the EVK will be seen from the PC as a removable disk that will appear on the Windows desk after few seconds.
5. Format this removable disk. Its size should be 8 MBytes. It represents the local dataflash (AT45DB) on the kit.
6. Copy the content of the APPLICATION/AUDIO-PLAYER/PICTURES directory (do not copy the folder, but its content) into the removable disk.
7. Once this is done, "safely remove" the removable disk (green icon on the right of the Windows tool bar).

That's it. The dataflash now contains the pictures for the Audio Player application.

#### 3.4.1.2 Step2 : Load the application

Load the audio decoder over USB application, refer to the AVR32709 application note doc7817.pdf.

The following describes the most simple way to load the application but you need the appropriate setup. For an alternative, please refer to the ['Compilation'](#) section.

1. Plug a JTAGICE or AVRONE! emulator on the evaluation kit. Power the board with a USB miniAB cable to the "USB VCP" connector (from the 2 sets of USB connectors, this the one which is on the right).
2. Drag the appropriate "EVK1104\*\_audio\_player\_\*.elf,bin" file onto the "EVK1104\_program\_audio\_player.cmd" application. It will program the internal flash with the audio decoder application.
3. Wait until the programming is done.

### 3.4.1.3 Step3 : Set in place the application

- Stop the debugger if it is still running.
  - AVR32 Studio or IAR.
- Make sure the USB power cable is plugged on the right USB port of the EVK1104 board.
- Plug the mini A to B receptacle USB cable extension in the left USB port of the EVK1104 board.
  - This cable is the short black USB cable with a female USB port at one end and a mini A plug at the other end.
- Plug the USB device (see '[Supported Device List](#)') to the other end of this USB cable.

### 3.4.1.4 Step4 : Use the application

The audio player application is divided in 3 different views.

#### KEYS

- CS1  
To switch to the previous view.
- CS4  
To switch to the next view.

#### Disk Navigation view

This view shows the content of the device plugged. It shows basically a list of files and folders in an explorer-like view. This view is the first one shown once the USB device is plugged.

#### KEYS

- WHEEL or UP/DOWN  
To select a file or a directory.
- LEFT  
To go to parent directory.
- RIGHT  
To enter a directory.
- CS3  
To play the selected file or folder.

#### Playback view

Shows information of the track currently played.

#### KEYS

- WHEEL

Fast Forward or Fast Rewind the song.

- LEFT

To select the previous song.

- RIGHT

To select the next song.

- UP/DOWN

To update the volume level.

- CS3

To switch between play and pause modes.

### Configuration view

This view is used to display and edit configurable options of the audio player.

#### KEYS

- WHEEL

To select the next option.

- CS2/CS3

To edit the option.

## 3.4.2 EVK1105

The following steps have to be achieved one by one in the proper order.

### 3.4.2.1 Step1 : Load the bitmap pictures into the dataflash

This application needs some bitmap pictures to be stored into the data-flash of the evaluation kit.

Here is the procedure for a PC using Windows XP/Vista (for other platforms, please adapt this steps according to the OS):

1. Plug a JTAGICE or AVRONE! emulator on the EVK1105.
2. Launch the "EVK1105\_program\_mass\_storage.cmd" application. It will program the internal flash with a USB device mass storage application.
3. Connect the board to a PC using a USB cable. Use the "USB User" connector: from the 2 set of USB connectors, this the one which is on the left.
4. This application will start and the EVK will be seen from the PC as a removable disk that will appear on the Windows desk after few seconds.
5. Format this removable disk. Its size should be 8 MBytes. It represents the local dataflash (AT45DB) on the kit.
6. Copy the content of the APPLICATION/AUDIO-PLAYER/PICTURES directory (do not copy the folder, but its content) into the removable disk.
7. Once this is done, "safely remove" the removable disk (green icon on the right of the Windows tool bar).

That's it. The dataflash now contains the pictures for the Audio Player application.

### 3.4.2.2 Step2 : Load the application

Load the audio decoder over USB application, refer to the AVR32709 application note doc7817.pdf.

The following describes the most simple way to load the application but you need the appropriate setup. For an alternative, please refer to the [‘Compilation’](#) section.

1. Plug a JTAGICE or AVRONE! emulator on the evaluation kit. Power the board with a USB miniAB cable to the "USB VCP" connector (from the 2 sets of USB connectors, this the one which is on the right).
2. Drag the appropriate "EVK1105\*\_audio\_player\_\*.elf,bin" file onto the "EVK1105\_program\_audio\_player.cmd" application. It will program the internal flash with the audio decoder application.
3. Wait until the programing is done.

### 3.4.2.3 Step3 : Set in place the application

- Stop the debugger if it is still running.
  - AVR32 Studio or IAR.
- Make sure the USB power cable is plugged on the right USB port of the EVK1105 board.
- Plug the mini A to B receptacle USB cable extension in the left USB port of the EVK1105 board.
  - This cable is the short black USB cable with a female USB port at one end and a mini A plug at the other end.
- Plug the USB device (see [‘Supported Device List’](#)) to the other end of this USB cable.

### 3.4.2.4 Step4 : Use the application

The audio player application is divided in 3 different views. To switch between views, use the following:

#### KEYS

- Slide from PLAY / PAUSE key to LEFT key  
`Switch to the previous view.`
- Slide from PLAY / PAUSE key to RIGHT key  
`Switch to the next view.`

#### Disk Navigation view

This view shows the content of the device plugged. It shows basically a list of files and folders in an explorer-like view. This view is the first one shown once the USB device is plugged.

#### KEYS

- UP / DOWN  
`To select a file or a directory.`
- LEFT

To go to parent directory.

- RIGHT

To enter a directory.

- PLAY / PAUSE

To play the selected file or to enter in the selected folder.

### Playback view

Shows information of the track currently played.

#### KEYS

- UP / DOWN

To increase/decrease the volume.

- LEFT / RIGHT

To select the previous/next song.

- LEFT / RIGHT pressed for at least 1s

Fast Forward or Fast Rewind the song.

- PLAY / PAUSE

To switch between play and pause modes.

### Configuration view

This view is used to display and edit configurable options of the audio player.

#### KEYS

- UP / DOWN

To select the previous/next option.

- PLAY / PAUSE

To edit the option.

## 3.5 Release Notes

### 3.5.1 Release notes - Binaries (\*.elf)

The GNU tool chain for 32-bit AVR Microcontrollers has been used to build the binaries published with this package.

#### 3.5.1.1 avr32-gcc

```
avr32-gcc (atmel.1.1.0.0-(mingw32_special)) 4.3.2
Copyright (C) 2008 Free Software Foundation, Inc.
This program is free software; see the source for copying conditions. There is NO
warranty; not even for MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.
```

#### 3.5.1.2 avr32-ld

```
GNU ld (GNU Binutils) 2.19.atmel.1.1.0.1.20081016
Copyright 2007 Free Software Foundation, Inc.
This program is free software; you may redistribute it under the terms of
the GNU General Public License version 3 or (at your option) a later version.
This program has absolutely no warranty.
```

### 3.5.2 Release notes - EVK1104

This package requires a AT32U3A3256 RevE or higher. AT32U3A3256 RevD will not work.

#### 3.5.2.1 Supported tools

- GNU Toolchain for 32-bit AVR Microcontrollers (2.0.10) with GCC version: 4.2.2-atmel.1.1.0.10 (mingw32 special)
- AVR32Studio Version: 2.1.0
- IAR EWAVR32 v3.10A with updated header files:

```
Unzip the UTILS/AVR32_HEADER_FILES/AVR32_Header_Files.zip under <your IAR instal
lation folder>/Embedded Workbench 5.3/avr32/inc/
```

### 3.5.3 Release notes - EVK1105

This package supports AT32UC3A0512 devices revision H and later.

All UC3A revE devices are marked "32UC3Axxxx-xES", later revisions are marked with "32UC3Axxxx-X". Revisions above E fix most of the errata of the 32UC3Axxxx-xES parts. Please refer to the device datasheets for more details on the errata.

#### 3.5.3.1 Supported tools

- GNU Toolchain for 32-bit AVR Microcontrollers (2.0.10) with GCC version: 4.2.2-atmel.1.1.0.10 (mingw32 special)
- AVR32Studio Version: 2.1.0

- IAR EWAVR32 v3.10A with updated header files:

Unzip the UTILS/AVR32\_HEADER\_FILES/AVR32\_Header\_Files.zip under <your IAR installation folder>/Embedded Workbench 5.3/avr32/inc/

### 3.5.4 Release notes - MP3

#### 3.5.4.1 Overview

The MP3 software package is a demonstration firmware designed for the 32-bit AVR Microcontrollers, that behaves like an audio player supporting MP3 files stored on a USB sticks.

#### 3.5.4.2 Release version: 1.0.10

Release date: 2009.11.09

- Remapped the generic clock used with the 14.7456 MHz crystal. Use PB21 instead of PB30 due to a pin conflict on the EVK1105 when used with the Apple Authentication Coprocessor in SPI mode.
- Improved HMI.

#### 3.5.4.3 Release version: 1.0.9

Release date: 2009.10.13

- Obsolete.

#### 3.5.4.4 Release version: 1.0.8

Release date: 2009.10.06

- Obsolete.

#### 3.5.4.5 Release version: 1.0.7

Release date: 2009.06.25

- Added EVK1104 support.

#### 3.5.4.6 Release version: 1.0.6 RC2

Release date: 2009.05.19

- Initial version.
- New user interface.
- Better handling of USB events.
- Increased robustness of the application.
- Added FFW and FRW features.

**3.5.4.7 Release version: 1.0.6 RC1**

Release date: 2009.03.13

- Correct ABDAC audio cracks and wrong play sample rate
- Add faster play/pause function
- Update QT60168 with new slide function
- Correct ABDAC display volume problem
- Limit TPA6130 volume to avoid sound saturation

known issues:

- Playback from SD card (SPI) is not supported.

**3.5.4.8 Release version: 1.0.5**

Release date: 2009.02.24

- Added JPEG cover artworks support.
- Added Random mode and Shuffle mode support (look at the "Shuffle and Repeats mode" chapter).
- Added "Navigation while playing" support (using SDRAM buffering).
  - This mode can be disabled.
- Reworked the GUI interface.
- Support EVK1105 revB board.

Known issues:

- Playback from SD card (SPI) is not supported.

**3.5.4.9 Release version: 1.0.4**

Release date: 2008.11.06

- Add PICTURES and Mass Storage tools for the pictures download in the data flash.
- UC3 Master clock uses (back) OSC1 (11.2896MHz) instead of OSC0 (12MHz). This fixes the audio distortion created by the TLV320AIC23B.
- Enhance MMI task.
- Display MP3 artworks (hardcoded).
- Fixed/enhancement in drivers (ADC, EIC, GPIO, USART)
- Fixed bug in Host task ( host\_send\_data() and host\_get\_data() ).
- Added CMD\_AI\_NAV\_FILE\_NEXT and CMD\_AI\_NAV\_FILE\_PREVIOUS in Audio Interface.
- Fixed bug in Libmad decoder.
- Fixed bug in FAT.
- Support EVK1105 revB board.

#### 3.5.4.10 Release version: 1.0.3

Release date: 2008.09.25

- Port for EVK1105 revB board.
- Fixed/enhancement in drivers (SMC, USART)
- Deep rework of MMI interface.
- Fixed bug in Audio Interface.
- Fixed bug in Libmad decoder.
- Fixed bug in FAT.
- Support EVK1105 revB board.

Known issues:

- UC3 Master clock uses back OSC0 by mistake (12MHz): This lead to audio distortion from the TLV320AIC23B.

#### 3.5.4.11 Release version: 1.0.2

Release date: 2008.08.29

- Slight overall cleanup (BOARDS, SD\_MMC, ...)
- Support EVK1105 revA board.

#### 3.5.4.12 Release version: 1.0.1

Release date: 2008.08.21

- Increase Maximal string length in bytes (STRING\_MAX\_LENGTH) to 64 bytes.
- UC3 Master clock uses OSC1 (11.2896MHz) instead of OSC0 (12MHz).
- TLV320AIC23B Master clock uses 12MHz.
- Added display support through USART (DISPLAY\_METHOD==DISPLAY\_USART).
- Fixed SR/BOSR bug in TLV320AIC23B driver.
- Fixed/enhancement in drivers (TC, SMC, PM)
- Fixed bugs in Audio Interface.
- Fixed bug in Libmad decoder.
- Fixed bug in FAT navigation ( nav\_setcwd() ).
- Enhance playlist management.
- Support EVK1105 revA board.

**3.5.4.13 Release version: 1.0.0 RC3**

Release date: 2008.07.18

- Enhance USB stick compatibility.
- Fixed "mpart" missing info in ".cproject" (AVR32Studio project) file.
- Fixed hazardous PDCA Start-of-transfer and SSC start-of-period synchronization.
- Support EVK1105 revA board.

**3.5.4.14 Release version: 1.0.0 RC2**

Release date: 2008.07.15

- Fixed "Z:" occurrence in ".cproject" (AVR32Studio project) file.
- Support EVK1105 revA board.

**3.5.4.15 Release version: 1.0.0 RC1**

Release date: 2008.07.09

- Initial version.
- Support EVK1105 revA board.

## 3.6 Supported Device List

### 3.6.1 USB Mass Storage Devices

- Any USB mass storage devices, which includes USB memory sticks and external USB hard drives.

Make sure the USB device does not drain to much current.