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**MP3 Player Reference Design
Based on AT89C51SND1
Microcontroller**

User Guide





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Section 1

Introduction

The AT89RFD-01 is an MP3 reader reference design based on the AT89C51SND1 microcontroller. The AT89RFD-01 has the following features:

- **Upload and Download of Files Through a USB Interface**
- **Plays or Records Songs**
- **Adjustable Volume, Treble, Medium and Bass**
- **Record Voice Through a Microphone in .WAV Format**



1.1

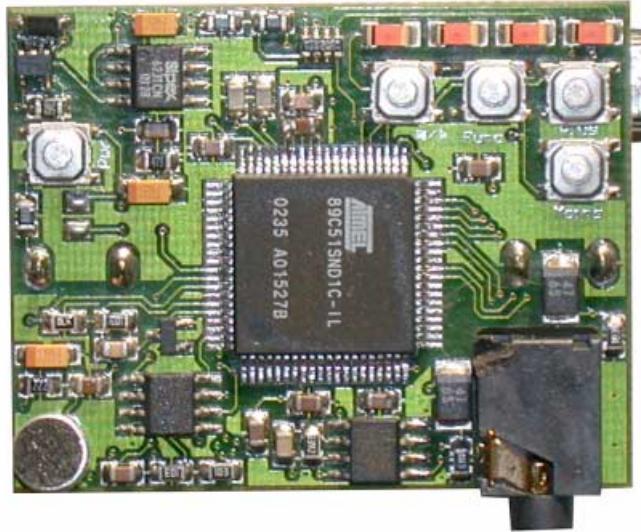
Abbreviations

- AT89C51SND1: the MP3 microcontroller
- ISP: In-System Programming
- MP3: MPEG layer 3, a standard music format
- PC: Personal Computer
- USB: Universal Serial Bus

Section 2

Overview

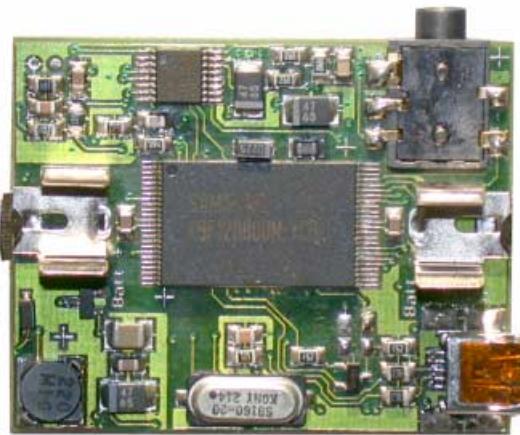
Figure 2-1. Reference Design (Top view)



There are two connectors:

- Earphone stereo jack
- Mini-B USB connector

Figure 2-2. Reference Design (bottom view)



The battery is a standard 1.5V-battery type AAA.

The mass storage system on the board is a 64 MB NAND Flash memory.



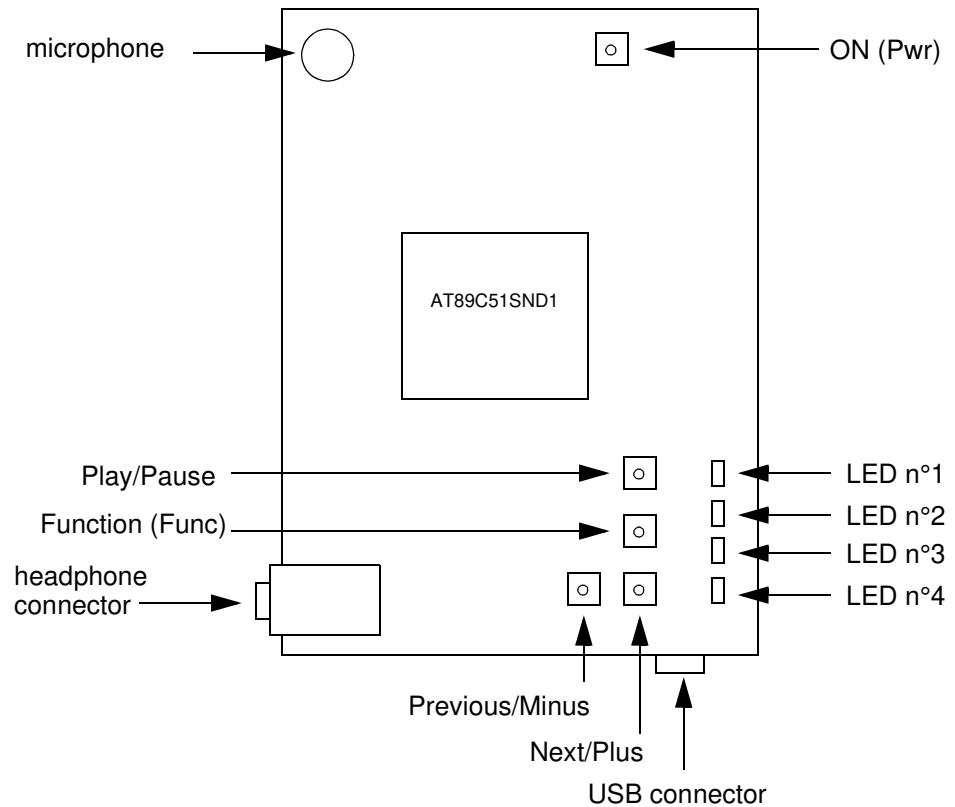
2.1

User Interface

The user interface has 4 LEDs and 5 push-buttons:

- Play/Pause
- Function
- Previous - Minus
- Next - Plus
- ON (Pwr)

Figure 2-3. User Interface Overview



Each LED may be:

- OFF
- Flashing (ON during less than 1 second and only one time)
- Slow blinking (continuously)
- Fast blinking (continuously)
- ON

2.2	Quickstart	<p>This procedure allows you to quickly play an MP3 song stored in the mass storage system. If the mass storage is empty or not formatted, see the following section regarding MP3 upload (“USB Mode”).</p>
		<ol style="list-style-type: none"> 1. If the player is battery powered, push the ON button. If the player is powered by USB, plug the USB cable into your computer. All LEDs flash to confirm the power is ON. After a few seconds, depending of the mass storage type and size, LED n°1 is ON: indicating Song Mode is selected. 2. Push the Play/Pause button to play the first MP3 song of the mass storage medium. LED n°1 blinks during music play. 3. If the player is battery powered, after 1 minute of inactivity (no music), the player will be automatically turned off.
2.2.1	Power ON/OFF	<p>Press the ON button to power the player. Power off is automatic after one minute of inactivity (no music, no button pressed). When the player is connected to a PC using the dedicated USB cable, the player is powered by the USB power line and the battery is useless (and will not be discharged). Disconnecting USB cable will automatically switch supply to the battery without stopping the operation.</p>
2.3	Main Functions	<p>Main functions are the first meaning of the buttons:</p>
		<ul style="list-style-type: none"> ■ Play/Pause: this button means Play/Pause or Select or Record ■ Function: to change the current mode or alternate function ■ Plus/Minus: to change a music track or change a control level ■ ON: to power on the player using the battery
2.4	Mode Functions	<p>After power ON and initialization (step 1 of the previous section), there are 4 basic functions called “modes”, assigned to a dedicated LED:</p>
		<ul style="list-style-type: none"> ■ LED n°1: Song Mode, to play the MP3 files of the embedded mass storage system ■ LED n°2: Voice Mode, to play or record short “wav” messages (phone quality) ■ LED n°3: USB Mode, to upload or download files to the embedded storage system ■ LED n°4: Erase Mode, to format the mass storage system
		<p>By pressing the Function key sequentially, the user will switch between these modes (mode 1, 2, 3, 4, 1...). The LED ON indicates the current mode.</p>
		<p>To validate one of these modes, press the Play/Pause button. For instance, if LED n°1 is ON, the current mode is “Song Mode”. The Play/Pause button will start the MP3 music.</p>



2.5	Alternate Functions	<p>When a mode is validated, the corresponding LED blinks slowly (except for USB mode, LED n°3 blink quickly when mode is activated and more slowly during transfer). Alternate functions regarding this mode are then accessible using the Function button. One LED blinking quickly is dedicated for each alternate function.</p> <p>For Song Mode, alternate functions are:</p> <ul style="list-style-type: none"> ■ LED n°1: Volume Control ■ LED n°2: Bass Control ■ LED n°3: Medium Control ■ LED n°4: Treble Control ■ LED n°2,3,4: Bass Boost Control <p>For Voice Mode, alternate functions are:</p> <ul style="list-style-type: none"> ■ LED n°1: Volume Control ■ LED n°2: Stop and wait for Recording confirmation (to be validated by Play/Pause) <p>For other modes, there exist no alternate functions at the present time.</p> <p>To adjust the controls, press Previous/Minus (to decrease) or Next/Plus (to increase) the control level. A bar graph lights up for the corresponding control when one of these buttons are pressed and during the adjustment, the control ranges from all LED OFF (minimum level) to all LED ON (maximum level).</p> <p>If no buttons are pressed for 3 seconds, the alternate functions setup ends and the LED corresponding to the current mode blinks slowly (Play information).</p>
2.6	Special Information	<p>Normally only one LED is ON or blinking at the same time. Exceptions are:</p> <ul style="list-style-type: none"> ■ Change of Music Track: all LEDs flash one time ■ Start-up/Power ON: all LEDs flash one time ■ Voice Record: LEDs 1, 3 and 4 blink ■ Software ISP mode: LEDs 1 and 4 ON ■ Bar graph for the selected Control: from 0 to 4 LEDs ON ■ Error report: all LEDs are ON <p>Note: A possible error is that the mass storage system is not formatted. If this is the case, press the Function button until Format Mode is selected and validate this mode with the Play/Pause button.</p> <p>All LEDs are off during:</p> <ul style="list-style-type: none"> ■ Format process of mass storage ■ Initialization ■ Power OFF



Section 3

Overview of Modes

3.1	Song Mode	<p>This mode will allow users to listen to the MP3 song stored in the embedded mass storage system. If the memory is empty, LED n°1 does not blink and there is no music. If there are valid MP3 files in the memory, the player will play the first song and LED n°1 blinks slowly.</p>
		<p>Main and alternate functions give access to standard player functions.</p>
3.2	Voice Mode	<p>When entering Voice Mode, the first wav file in the directory will be selected and played. When the player reaches the end of a wav file, or if wav file is not present, the player will switch to record mode: LED n°2 blinks quickly. If the button Play/Pause is pressed, the player records voices from the microphone. If the Function button is pressed, the player will go back to its initial state (Voice Mode selected). The microphone will record the voice and store it in the selected file until the maximum size of the wav file is reached. When the maximum size is reached, the player will go back to its initial state.</p>
3.3	USB Mode	<p>This mode will allow users to connect the player to a PC running under Linux[®], Windows[®] 2000/XP/Me and MacOS[®] 9 (without driver) or Windows 98 (with a driver). The Data Storage Flash will then be seen as a removable disk drive and copying from any PC storage media to the player memory will be possible. Current firmware does not support Windows Format function.</p> <p>Prior to entering this mode, a USB cable has to be connected between the PC and the player. The player will then be powered by the USB supply. When entering USB mode, USB lines will be activated and a device will appear in the Hardware window of the PC.</p> <p>Note: First connection may require the driver installation depending of your Operating System.</p> <p>When connected, LED n°3 blinks quickly. When a file is moved to the player, this LED does not blink regularly. Transfer is completed when the LED continues to blink quickly and regularly.</p> <p>Note: The file will appear in the removable media window on the PC before the end of the transfer (almost at the beginning!).</p> <p>Do not disconnect the cable during an on-going transfer.</p> <p>In order to leave this state, the Play/Pause button must be pressed.</p> <p>Do not disconnect the cable before leaving USB Mode.</p>



3.4

Erase Mode

When this mode is validated by pressing Play/Pause button, all LEDs are OFF during the erasing and reformatting of the full on-board mass storage system. LED n°4 will be ON when this operation is performed.

Section 4

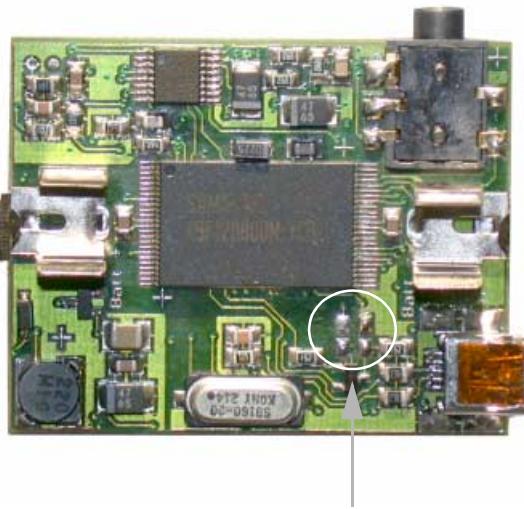
In-System Programming (ISP)

4.1

Using Hardware Conditions

Two solder points or short-cuts have to be physically set up on the board in order to enter this mode. This mode must be used when the initial software has been corrupted and when the ISP cannot be activated by the keyboard.

Figure 4-1. ISP Hardware Condition



Solder two SMD 0Ω resistors here (horizontally).
To activate the USB transfer and
To put hardware ISP conditions on the microcontroller.

4.2

Using Software Condition

When connected to a PC using a USB cable, the player can be accessed by Flexible In-System Programming (FLIP) software. To enter by software in the ISP bootloader of the player, press the Function button while the USB cable is plugged into the PC (the ISP software condition is checked only during power ON Reset).

A driver has to be installed the first time (See FLIP installation note). This driver is delivered with ATMEL FLIP software available on the Atmel Web site.

When connected, a new device will appear in the hardware window of the PC under the "User interface peripheral" section, named USB_DFU_SND1. See FLIP User's guide for information about FLIP execution.





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