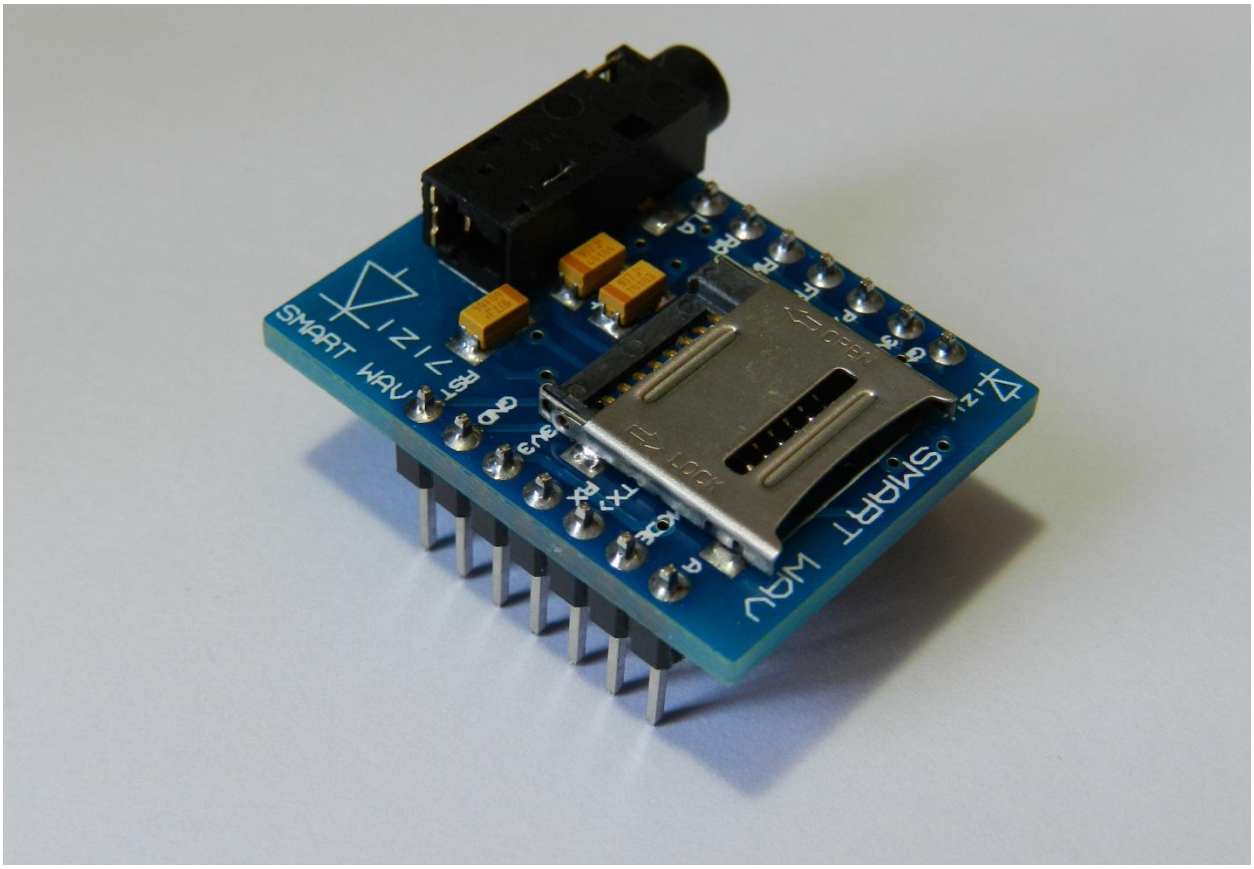
VIZIC TECHNOLOGIES

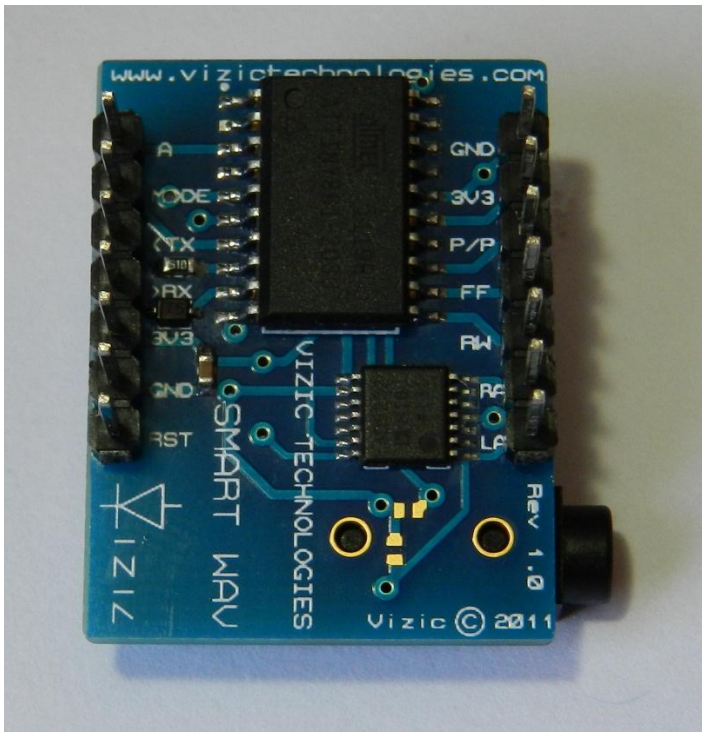
SMART WAV

Datasheet----Rev 1.0

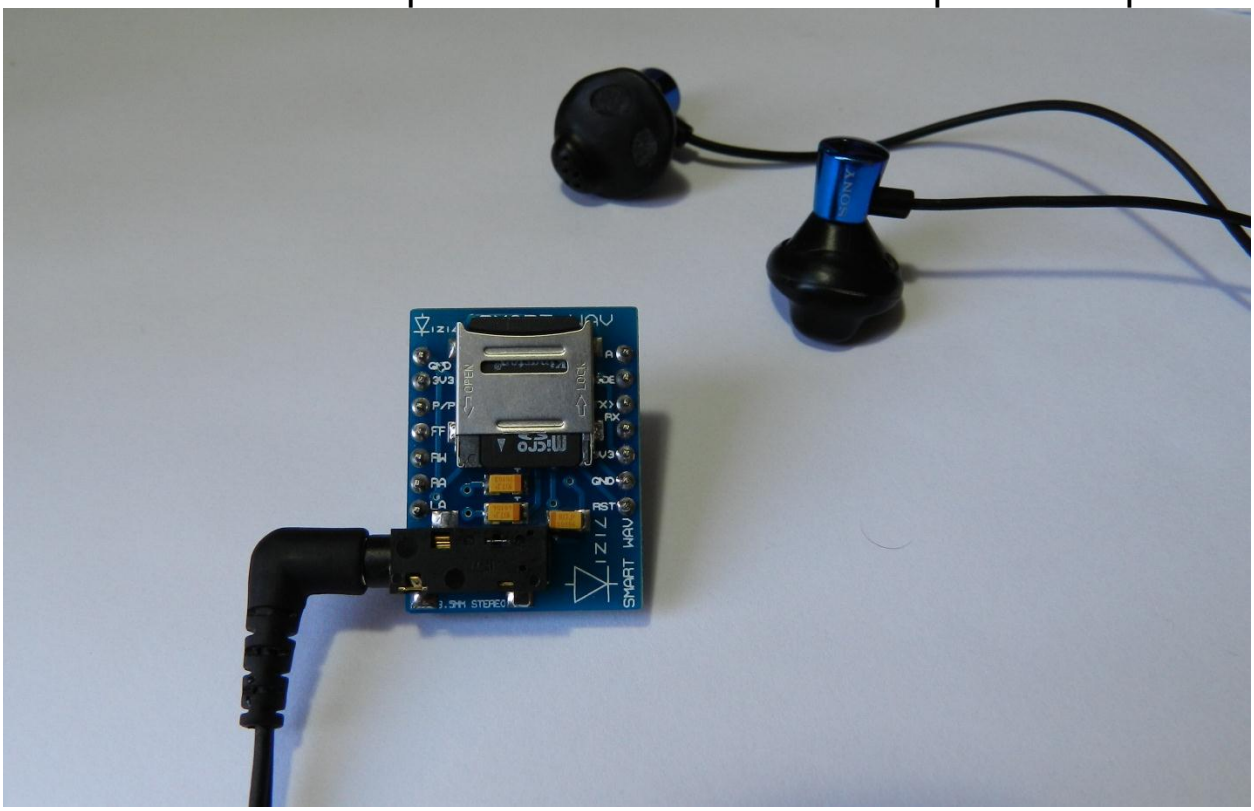
SMART WAV – Intelligent Embedded Audio Processor Unit



Smart WAV Bottom View



Smart WAV Direct phones connection: Pre-Amplified Outputs



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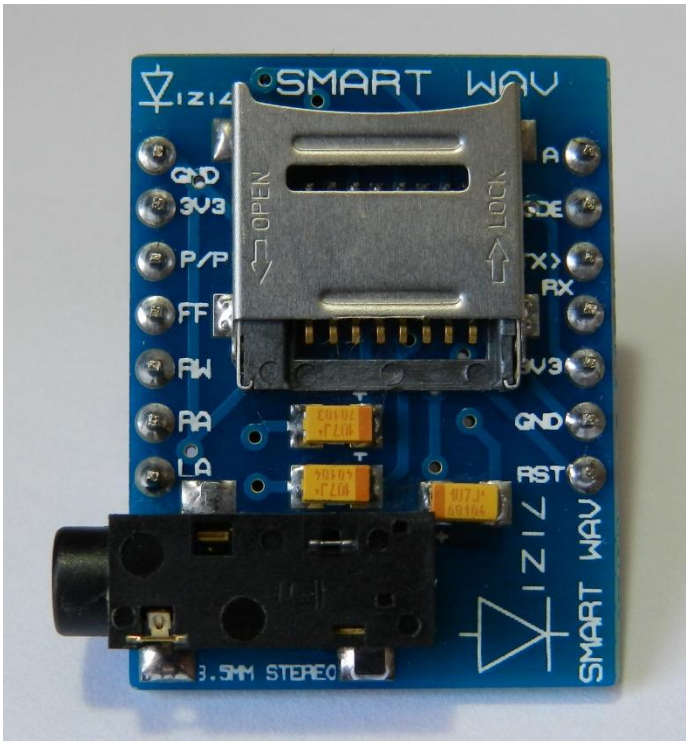


The SMART WAV- Intelligent Audio Processor Unit is a powerful easy to use embedded development / professional board with pre-Amp dual channel stereo out, a 3.5mm stereo plug connector and uSD/uSDHC memory card socket. The Smart WAV is a tiny high quality audio stereo sound module that can play-back pre-stored audio files (voice, songs, etc.) from a micro SD card with **FAT** universal format (PC). The module supports **8/16bit**, **mono/stereo** WAVE (**.WAV**) files with a sample rate up to **48Khz** (CD Quality).

Original music CDs contain .WAV files that can be directly extracted to the micro SD card and directly play them with the Smart WAV. For playing music on other formats than .WAV, any PC audio software like *"iTunes"* can convert .Mp3 or .Wma audio to the .WAV format.

The module offers two modes of operation: **SERIAL MODE**, or **STAND-ALONE MODE**, selection between both modes is by tying the external “MODE” pin to GND(stand-alone mode) or VCC(serial mode).

In **Serial Mode** It offers a simple yet effective serial interface to any host micro-controller that can communicate via a serial port. All Audio related functions (Play, Pause, Stop, Next, Rewind, Call song, Enter Folder/Dir, Volume+, Volume-, Play speed, Get songs list, Get folder/Artist/Album list, and many more…) are called using simple commands via the serial interface. The SMART WAV allows users to develop their application using their favorite micro-controller or FPGA and software development tools.

The SMART WAV processor also doesn't need any configuration or programming on itself, it's a slave device that only receives orders, reducing and facilitating dramatically the code size, complexity and processing load on your favorite main processor (8051, PIC, ATMEL, FREESCALE, STMICRO, ARM, CORTEX, any development platform (ARDUINO or similar, FPGA MBED, etc.) or PC(USB-UART SX)) of your application.

In **Stand Alone Mode**, a host controller is not required, with only 5 push buttons (Play/Pause, Next, Rewind, Vol+, Vol-) audio functions can be called allowing to create a full function mp3-player like system without the need of any other main controller/processor. In short it offers one of the most flexible, high quality embedded stereo audio solutions available.

The main goal of the SMART WAV it's to bring a very easy way to add high CD quality stereo audio to any application or project, without the user having experience in handling audio decoding and FAT file managing. Although it's very easy to use, the SMART WAV it's a low power/very high performance Audio processor with pre-Amplified outputs, and a micro SD card slot supporting up to 32 GB of storage, and FAT/FAT12/FAT16 or FAT32 universal file System that is compatible with any PC, no special format is needed.

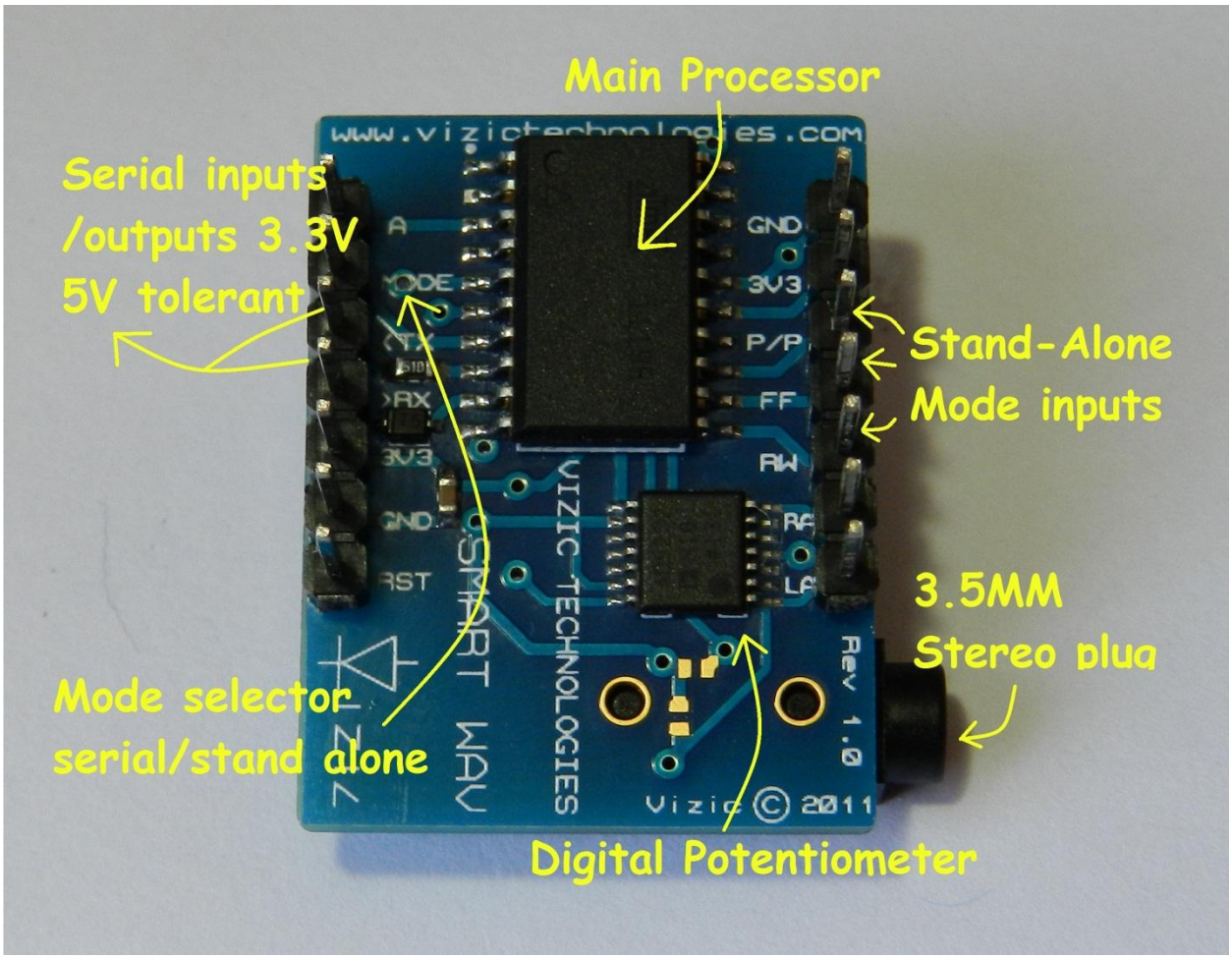
Features:

- Pre-Amplified Dual channel Stereo Out with 8/16bit, stereo/mono, and up to 48khz sampling rate, CD quality.
- Integrated Digital Volume Control with 255 steps.
- Long file names and folder management support.
- **Serial mode** or **Stand-alone mode**.
- On board stereo 3.5mm plug for headphones, or line out.
- Play speed control: 0.5X, 1X, 1.5X and 2X. (Fast Forward).
- Easy 5 pin interface to any host device: **VCC, TX, RX, GND, RESET.**
- On-board uSD/uSDHC memory card socket with FAT (windows PC), Support up to 32GB for storing thousands of songs/audio **WAVE** files. No need of special/rare file format.
- Sleep mode.
- Active out pin for led indicator.
- Input pin for mode selection: VCC-serial, GND-stand-alone.
- 9600 standard Baud Rate speed, 8 bits, no parity, 1 stop bit.
- 5V and 3V3 I/O compatible.
- 3V3 power supply, ultra-low current consumption.

Applications:

- Embedded audio/sound systems.
- All voice annunciator systems.
- Battery powered audio systems.
- Automotive, parking, GPS navigation systems.
- Robotics, industrial control.
- Traffic facilities: Toll gates, parking lots.
- Home automation and domestic appliances.
- Elevator, Security, Access-Control, Warning devices.
- Toys, learning tools, talking books, gaming sound.
- Mp3 like full function simple systems.

SMART WAV-EXPLAINED:



1.-Host Interface – Serial Mode

The SMART WAV could be used as a slave peripheral device, providing a bidirectional serial interface to a host controller via its UART(Universal Asynchronous Receiver - Transmitter) on the serial mode.

Any microcontroller or processor (AVR, PIC, BASICstamp, ARDUINO, 8051, MBED, FPGA, ARM, STmicro, etc) or PC(by serial interface RS232) as host, can communicate to the device over this serial interface at 9600bps.

The SMART WAV doesn't need to be configured in any way; it's a plug-and-play device, could be used by students, up to industrial and professional applications, its compatible with any device and existing development board with a UART.

The serial protocol is universal and very easy to implement.
Serial Data Format: 8 Bits, No Parity, 1 Stop Bit.
BaudRate: 9600 bps.
Serial data is true and not inverted.

1.1 Command Protocol: Flow Control – Serial Mode

The SMART WAV Intelligent Audio Processor Unit is a slave device and all communication and events must be initiated first by the host. Commands consist of a sequence of data bytes beginning with the command/function byte.

When a command is sent from host to the device, this process the command and when the operation is completed, it will always return a response*. The device will send back a single acknowledge byte called the ACK (4Fhex, 'O' ascii), in the case of success, or NAK (46hex, 'F' ascii), in the case of failure or not recognized command.

** Commands having specific responses may send back varying numbers of bytes, depending upon the command and response. It will take the device a certain amount of time to respond, depending on the command type and the operation that has to be performed.*

1.2 Power-up, Reset and Serial Set-up

When the SMART WAV device comes out of a power up or external reset, a 200ms delay before sending any command must be met, do not attempt to communicate with the module before this period. Any command could be sent after this point.

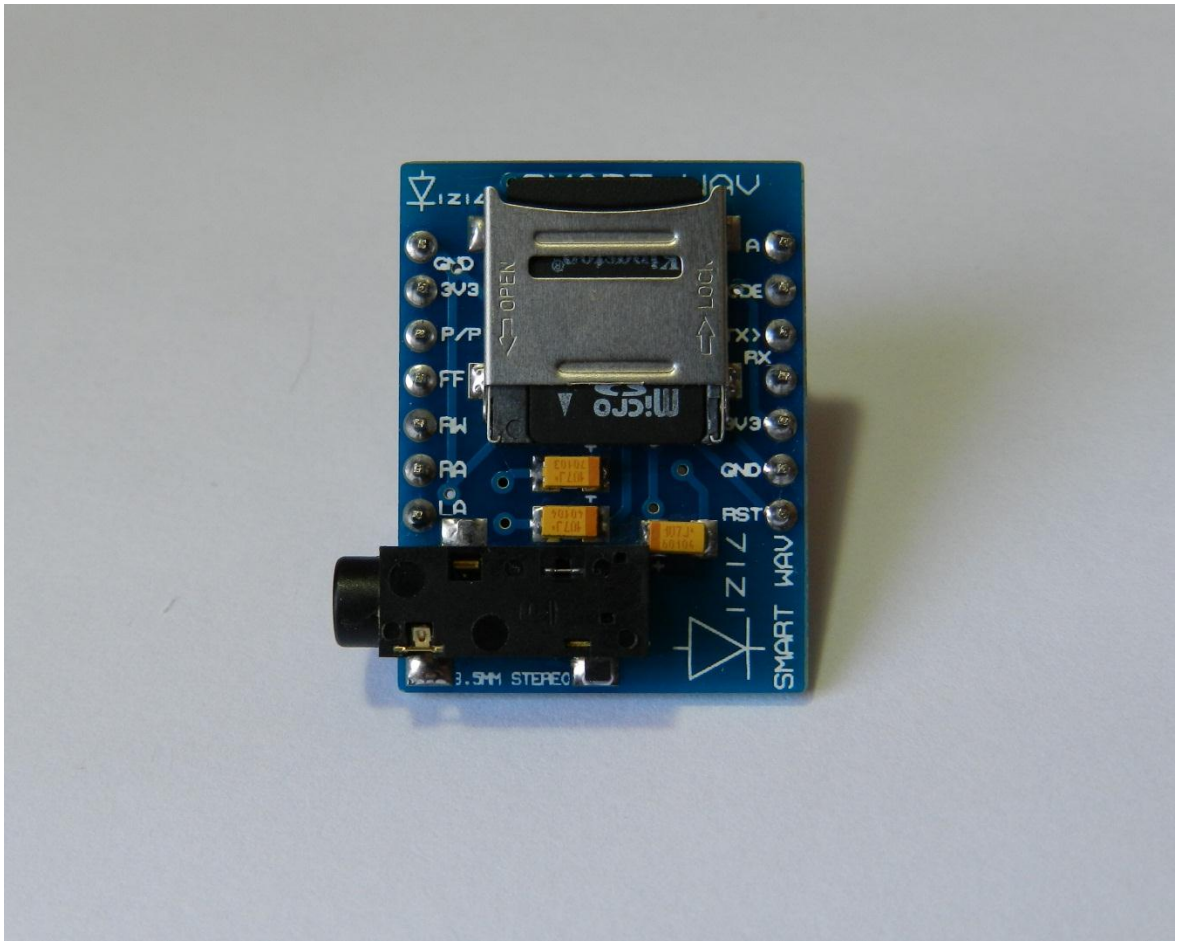
The SMART WAV is configured to work at a standard **baud rate of 9600 bps**. There's no need of any other baudrate speed since almost all commands are very short.

1.3 Stand-Alone Mode

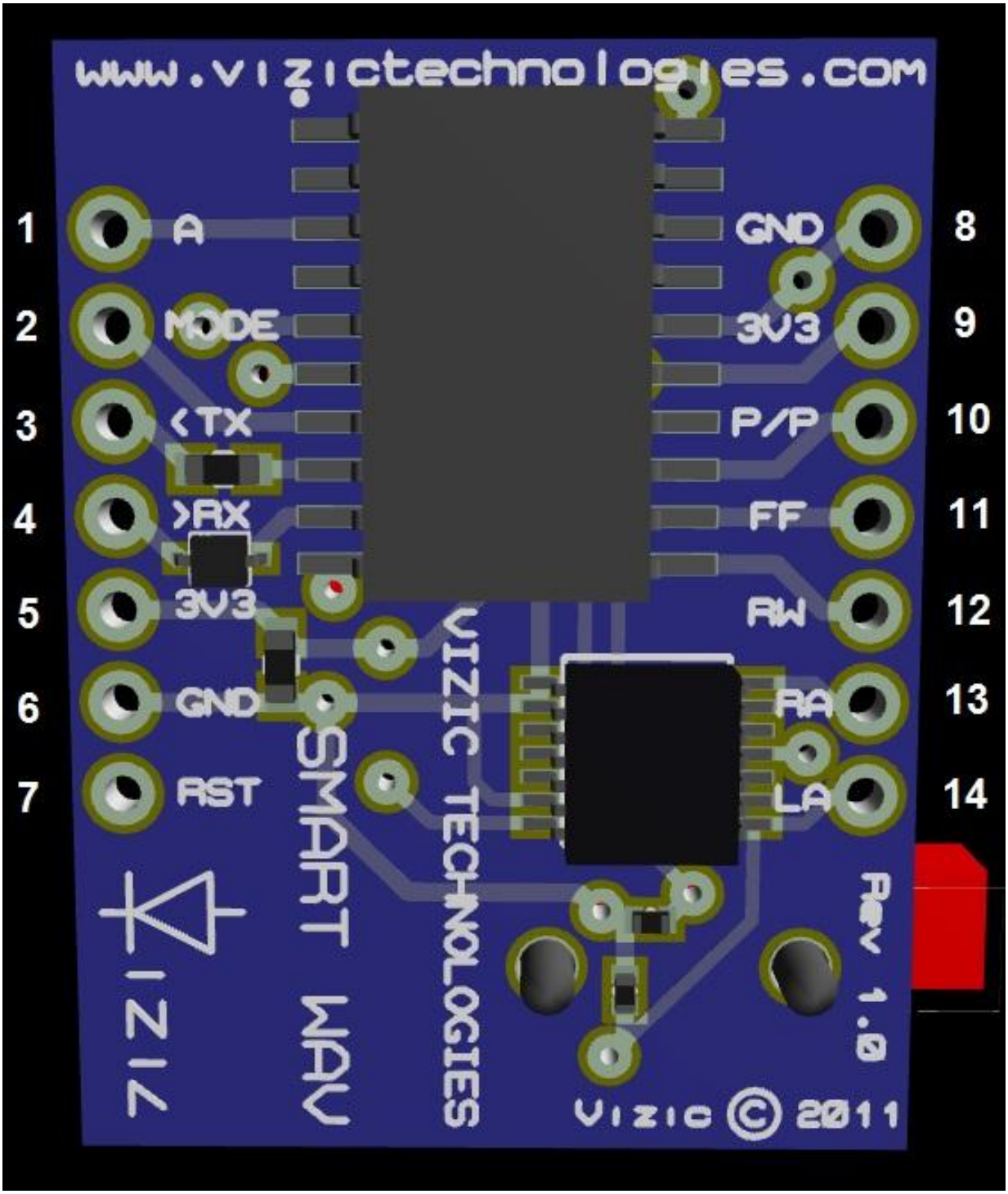
The SMART WAV could be connected as a Stand-Alone module without the need of an external host controller, in this fashion the Smart WAV with only 5 push buttons acts as an mp3 like system with Play/Pause, Next, Rewind, Volume+ and Volume- functions. Can be used as a battery powered system due to the ultra-low power consumption.

In Stand-Alone Mode, the Smart WAV plays all the files stored in the root path of the microSD card in an infinite loop.

The SMART WAV doesn't need to be configured in any way; it's a plug-and-play device, could be used by students, up to industrial and professional applications, its compatible with any device and audio system.



1.4 Pin configuration



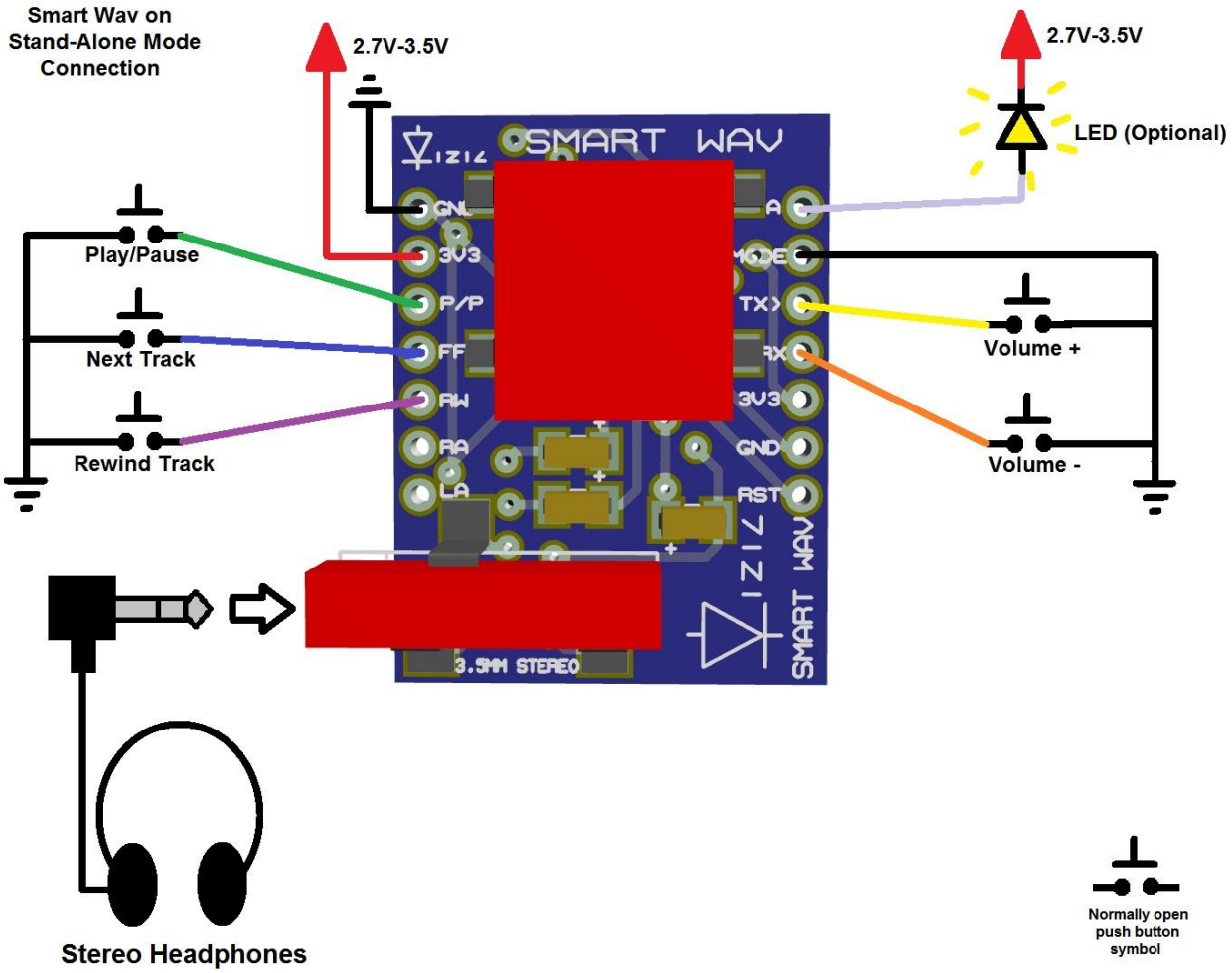
Pin	Symbol	I/O Serial Mode	I/O Stand Alone Mode	Description
1	**A**	**Out**	**Out**	Digital Out pin, driven low when playing an audio file, driven high on any other state. (active indicator).
2	**MODE**	**In**	**In**	Digital In pin, when HIGH: Serial Mode is selected, when GND: Stand-Alone mode is selected. Internally pulled up to 3.3V via a 30K resistor.
3	**Transmitter Out 3.3V / Volume +**	**Out**	**In**	Dynamic Digital In/Out pin, when Mode=0: acts as Vol+ input, when Mode=1: acts as TX (asynchronous serial transmitter output pin). Internally pulled up to 3.3V via a 30K resistor when input.
4	**Receiver In 3.3V-5V / Volume -**	**In**	**In**	Digital In pin, when Mode=0; acts as Vol- input, when Mode=1, acts as RX (asynchronous serial receiver input pin). Internally pulled up to 3.3V via a 30K resistor. 5V tolerant input.
5	**VCC 3.3V**	**In**	**In**	Main voltage supply, 2.7v-3.5v.
6	**Ground**	**In**	**In**	Supply Ground.
7	**Reset**	**In**	**In**	Master reset signal, an active low pulse greater than 100ns will reset the module. Internally pulled up to 3.3V via a 30K resistor. 5V tolerant input.
8	**GND**	**In**	**In**	Supply Ground.

9	**VCC 3.3V**	**In**	**In**	Main voltage supply, 2.7v-3.5v.
10	**P/P**	**NC**	**In**	Digital In pin, a low pulse will switch between Play/Pause states. Internally pulled up to 3.3V via a 30K resistor.
11	**FF**	**NC**	**In**	Digital In pin, a low pulse will switch to next track/audio file. Internally pulled up to 3.3V via a 30K resistor.
12	**RW**	**NC**	**In**	Digital In pin, a low pulse will reload current track/audio file. Internally pulled up to 3.3V via a 30K resistor.
13	**RA**	**Out**	**Out**	Right channel audio output pin. Connect this pin instead of the 3.5mm plug to an 8/16/32 Ohm Speaker.
14	**LA**	**Out**	**Out**	Left channel audio output pin. Connect this pin instead of the 3.5mm plug to an 8/16/32 Ohm Speaker.

*__NC__ means no connect.

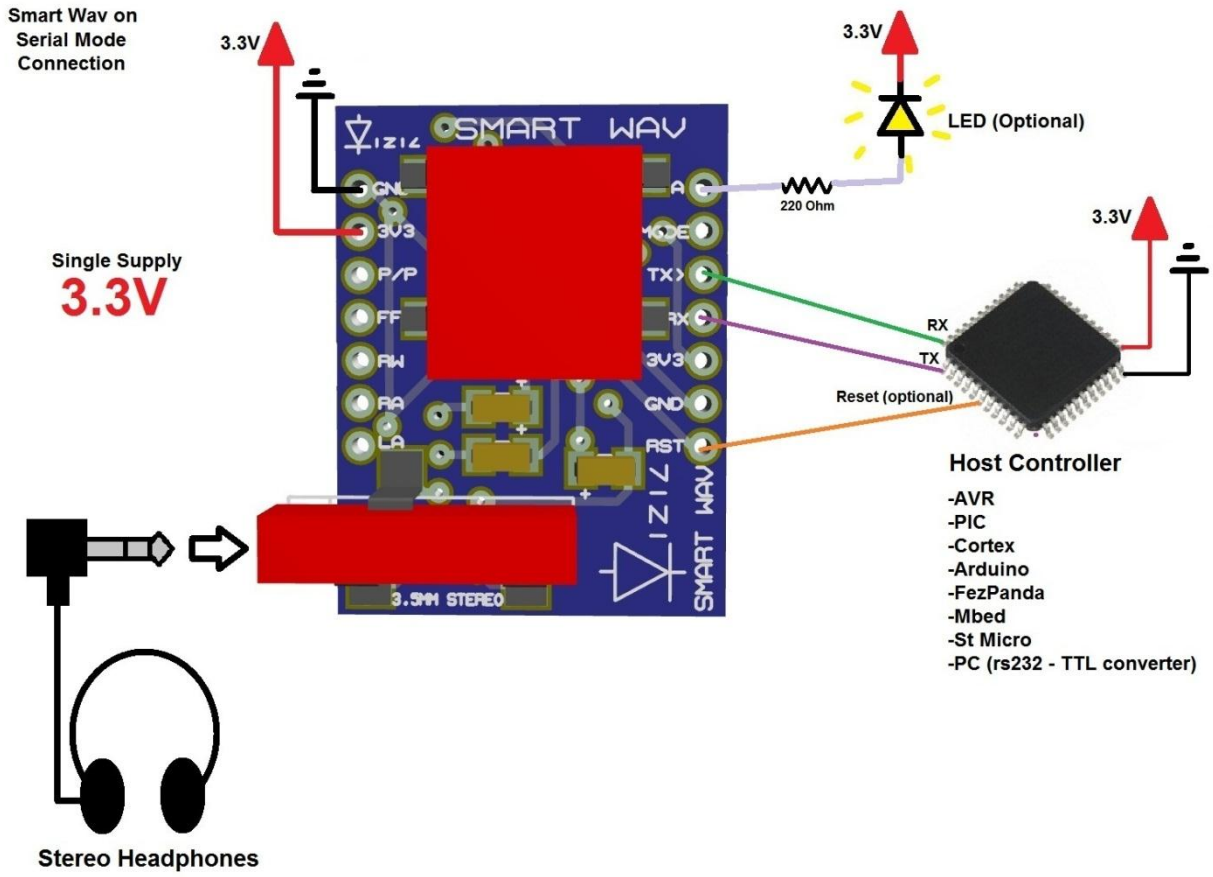
1.5 TYPICAL STAND-ALONE CONNECTION: for Single 3.3V

*The SMART WAV must always be powered with 2.7V-3.5V



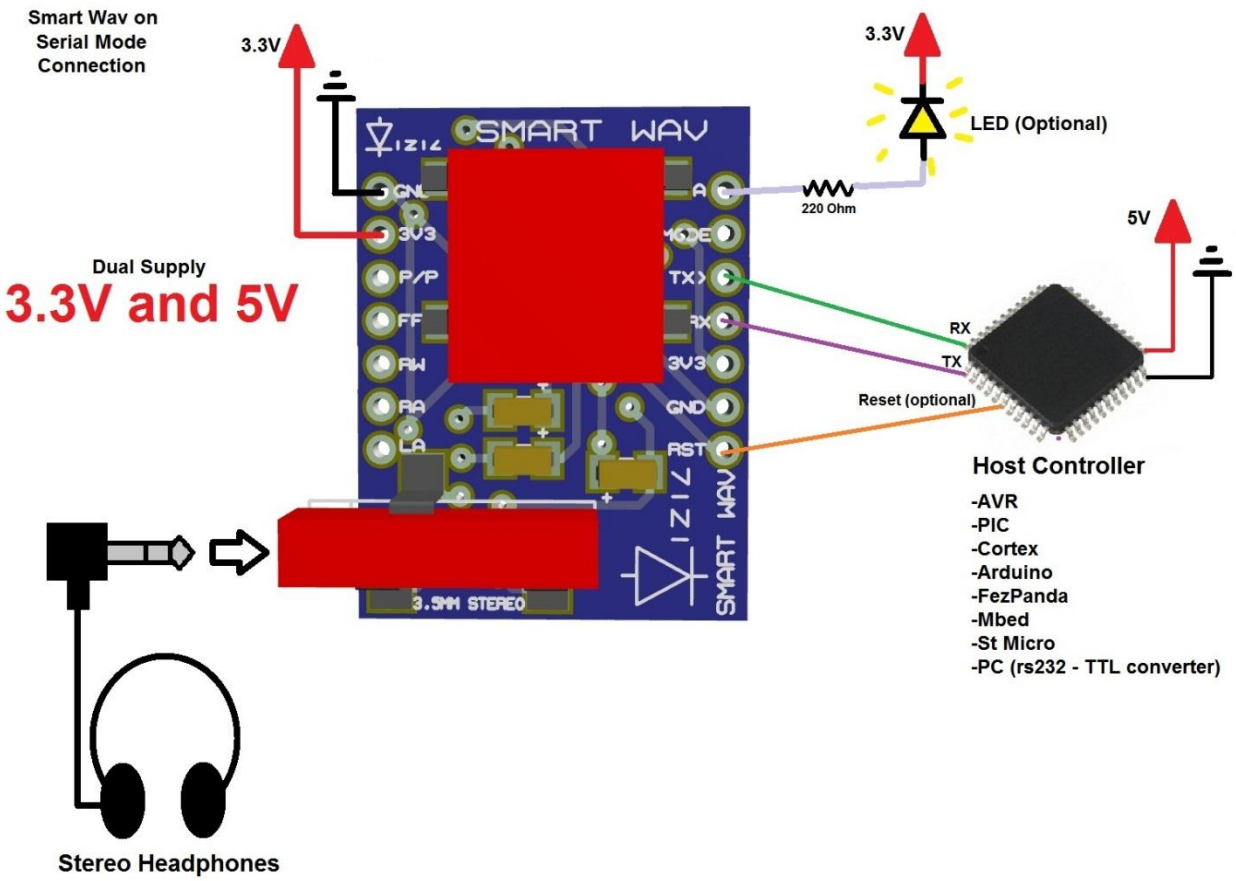
1.6 TYPICAL HOST SERIAL CONNECTION: for Single 3.3V

*The SMART WAV must always be powered with 2.7V-3.5V (Reset and RX pin are 5V tolerant).



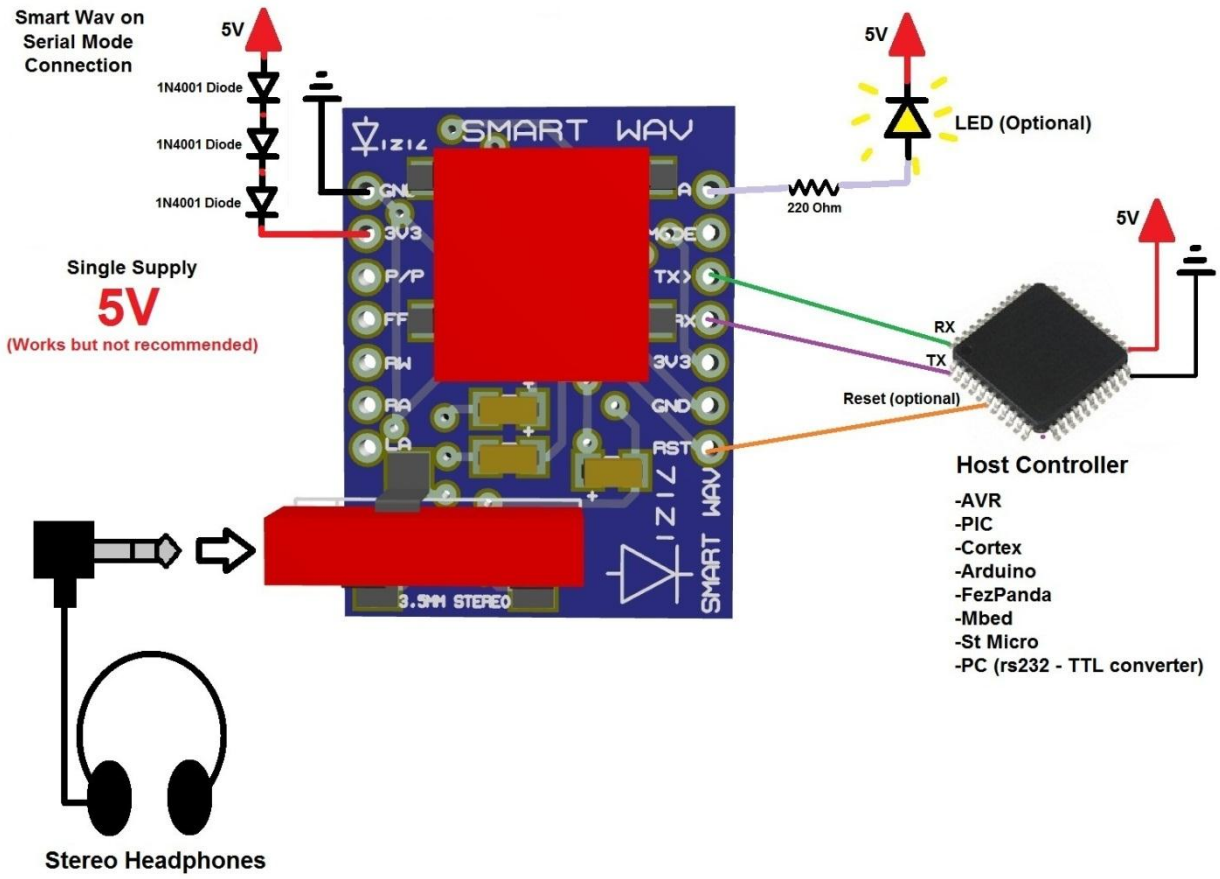
1.7 TYPICAL HOST SERIAL CONNECTION: for 5V and 3.3V

*The SMART WAV must always be powered with 2.7V-3.5V (Reset and RX pin are 5V tolerant).



1.8 TYPICAL HOST SERIAL CONNECTION: for Single 5V

*The SMART WAV must always be powered with 2.7V-3.5V (Reset and RX pin are 5V tolerant).

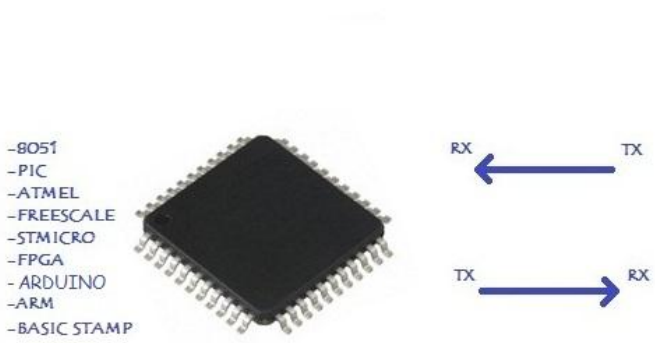


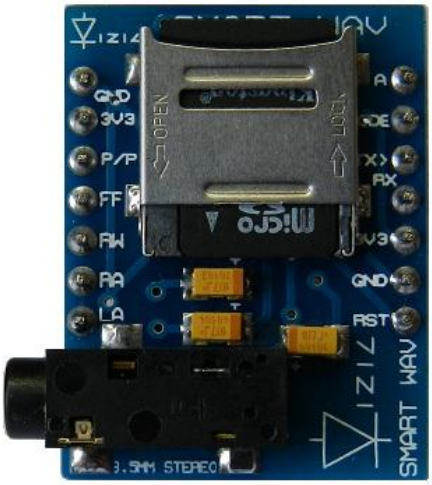
2. SMART WAV Command Set - Software Interface Specification

As mentioned before the command interface between the SMART WAV and the host is via the serial interface UART in **Serial Mode**.

A list of very easy to learn commands provide complete access to all the available functions. Commands and responses can be a single byte or a byte package. All commands always return a response, either a single ACK, or data followed by an ACK.

Remember all commands start with a uppercase letter (ascii).





Main Processor:
-main application processing.
-math processing
-I/O processing

VS

SMART WAV Processor:
-Audio processing
-Sound Output
-SD memory card processing
-Song names processing
-FAT system management
-Play Speed
-Digital Volume control
-And more...

2.1 Command summary – Serial Mode

For detailed information on those commands, be sure to check the Smart WAV **COMMAND SET sheet**. Available to download on the web site.

General Commands:
- Get Active/Play Status – **41hex 'A'**
- Set Folder/Directory – **44hex 'D'**
- Get Info – **49hex 'I'**
- Enter Sleep Mode – **5Ahex 'Z'**

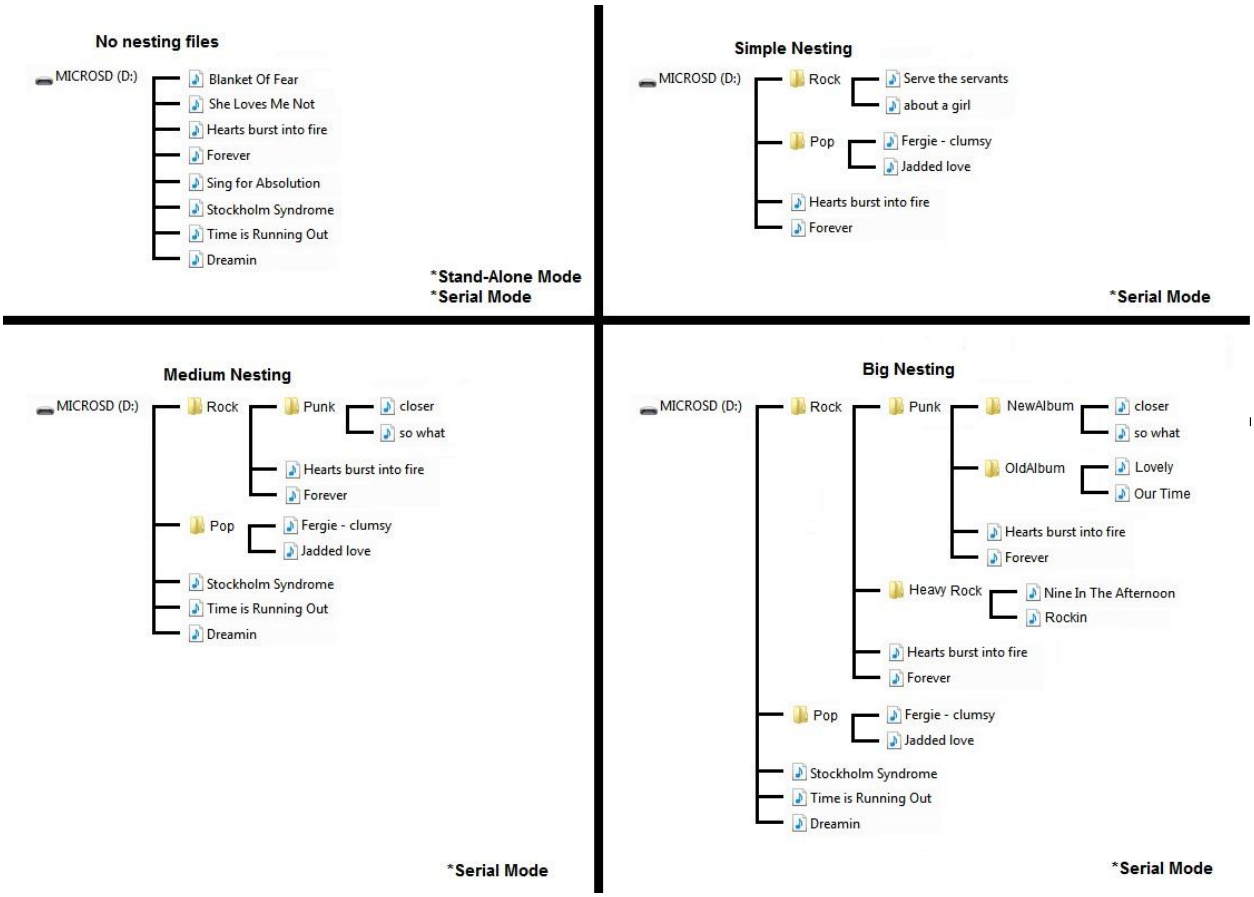
Audio Commands:
- Play File/Track Name – **46hex 'F'**
- Play Tracks/Files – **54hex 'T'**
- Pause/Play Track/File – **50hex 'P'**
- Next Track/File – **4Ehex 'N'**
- Rewind Track/File – **52hex 'R'**
- Stop Track/File – **53hex 'S'**
- Set Volume – **56hex 'V'**
- Set Play Speed – **4Dhex 'M'**
- Enable Continuous Play – **43hex 'C'**

**Remember that all of these commands are only available on the Serial Mode.*

3 Micro SD File/Folder organization – Serial Mode

The Smart WAV is capable of managing and folders in Serial Mode, so a complete library organized by artist/ album/ genre/ year/ etc. could be done inside the micro SD card. Also the Smart WAV could access nested folders for example: “D:/rock/punk/oldies/song.wav”.

The next image gives some examples of files/folders organization/nesting that can be achieved and accessed with the Smart WAV audio processor; up to three folders nesting is allowed:



4 Micro SD card file management

As mentioned before, the SMART WAV is capable of managing files directly in FAT/FAT12/FAT16 or FAT32 file systems without any special program/interface or micro SD rare formats.

A maximum of 32GBs micro SD memory card is supported, allowing storing thousands of songs/audio files.

The files are fully format compatible with any PC. This section explains how to load and create songs/audio files (.wav) to be opened with the SMART WAV.

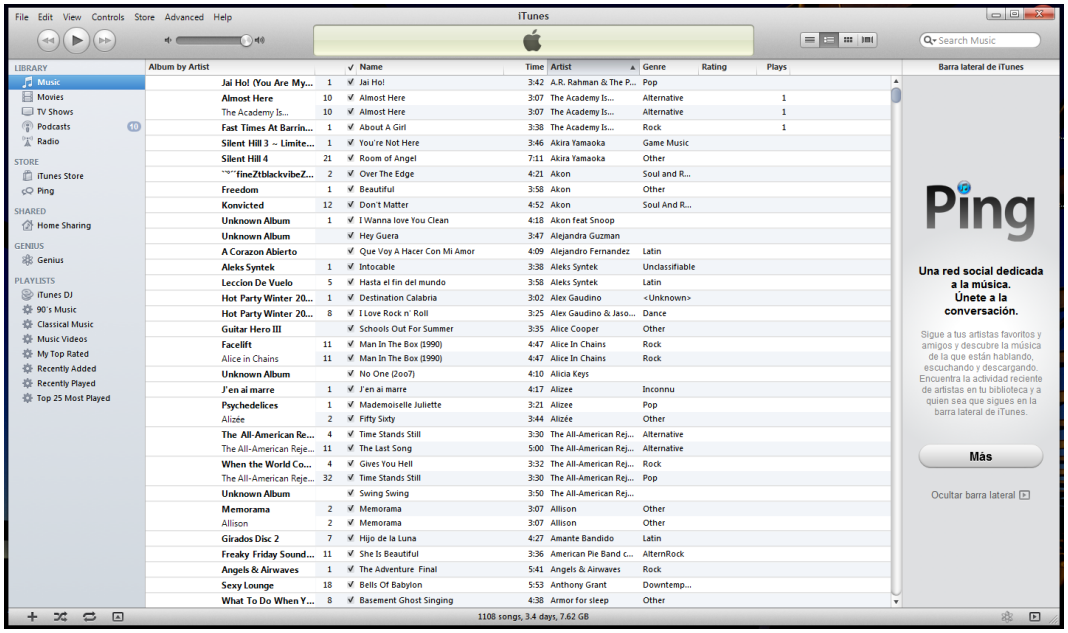
4.1 Storing Songs/Audio files on the micro SD card

Any Song/Audio file could be stored and played by the SMART WAV, the only requirement is the .wav extension and WAVE format.

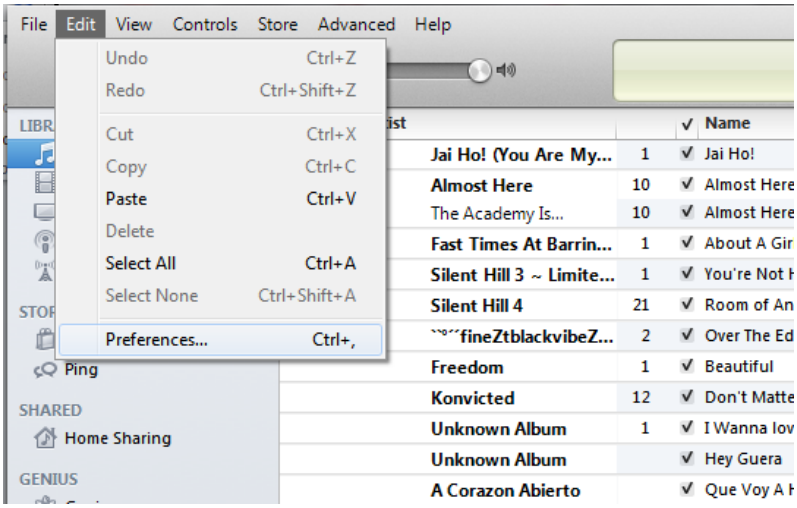
From a music CD, just extract the files/songs in .wav format and place them into the microSD card to be played (see **SmartWAV-Audio Player-CD Tutorial**).

For PC stored files with any other extension than .wav, use any Audio processing software that could convert .mp3, .wma, .atrac, .mp4, etc. to .wav supported format. To keep it simple, we'll explain in this section how to convert any file to .wav using the popular apple's iTunes software.

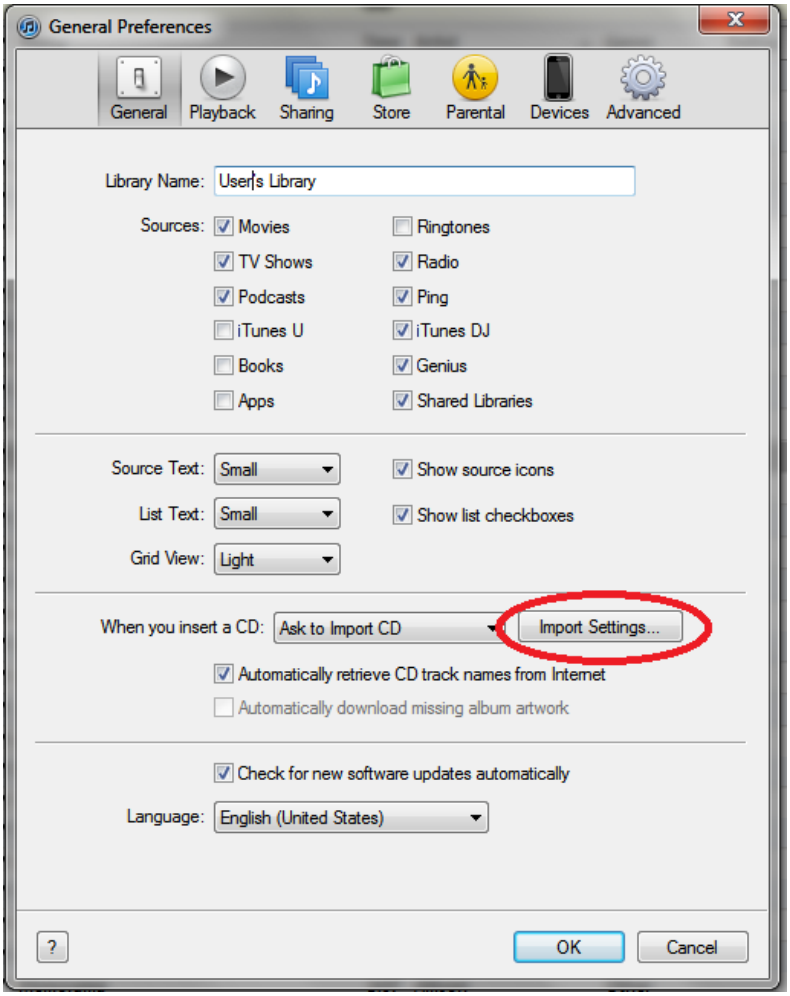
1.- Open the iTunes software.



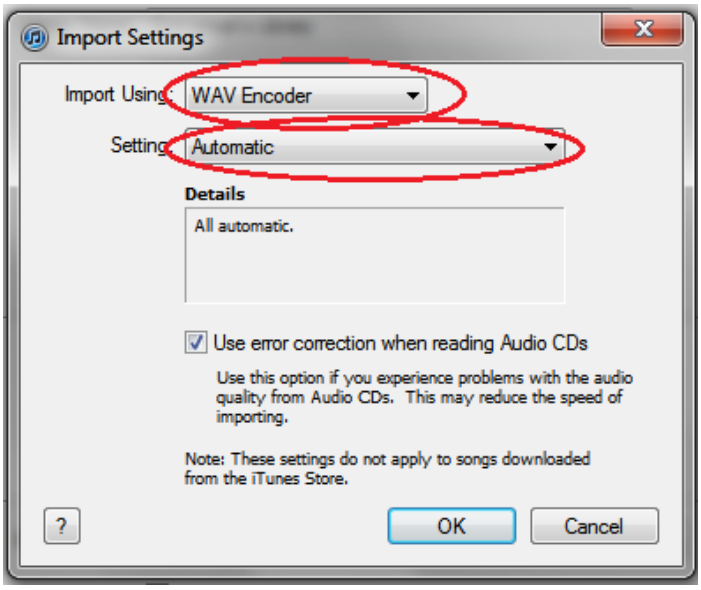
2.- Go to Edit->Preferences, and click.



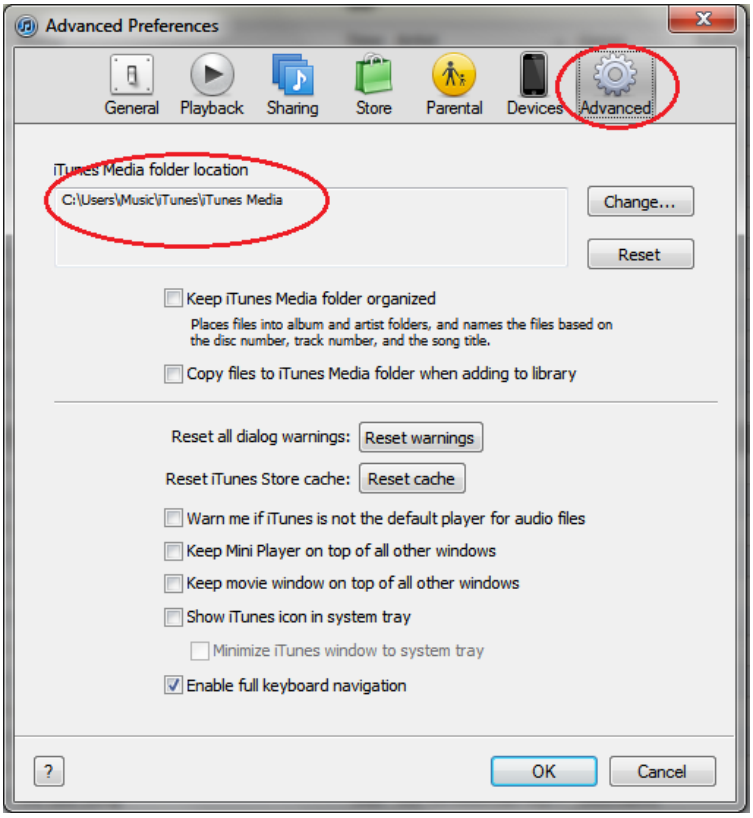
3.-A new Window pops up, then click on the “Import Settings…” box:



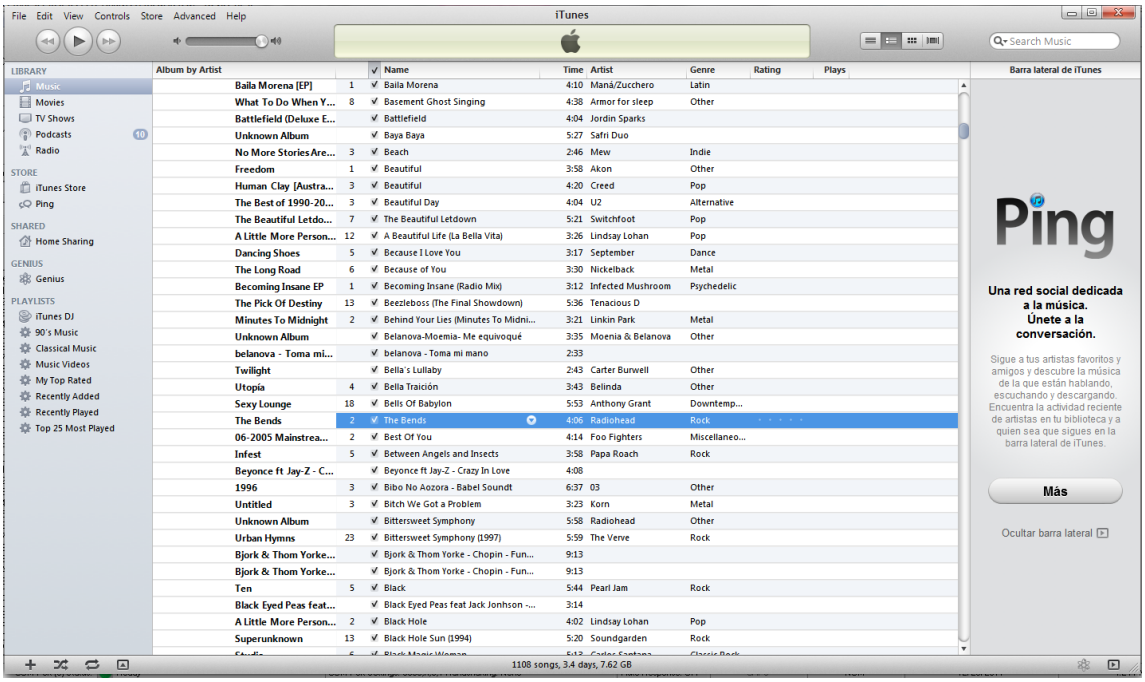
3.1- A new window pops-up, now select "WAV Encoder" and setting "Automatic", then click OK:



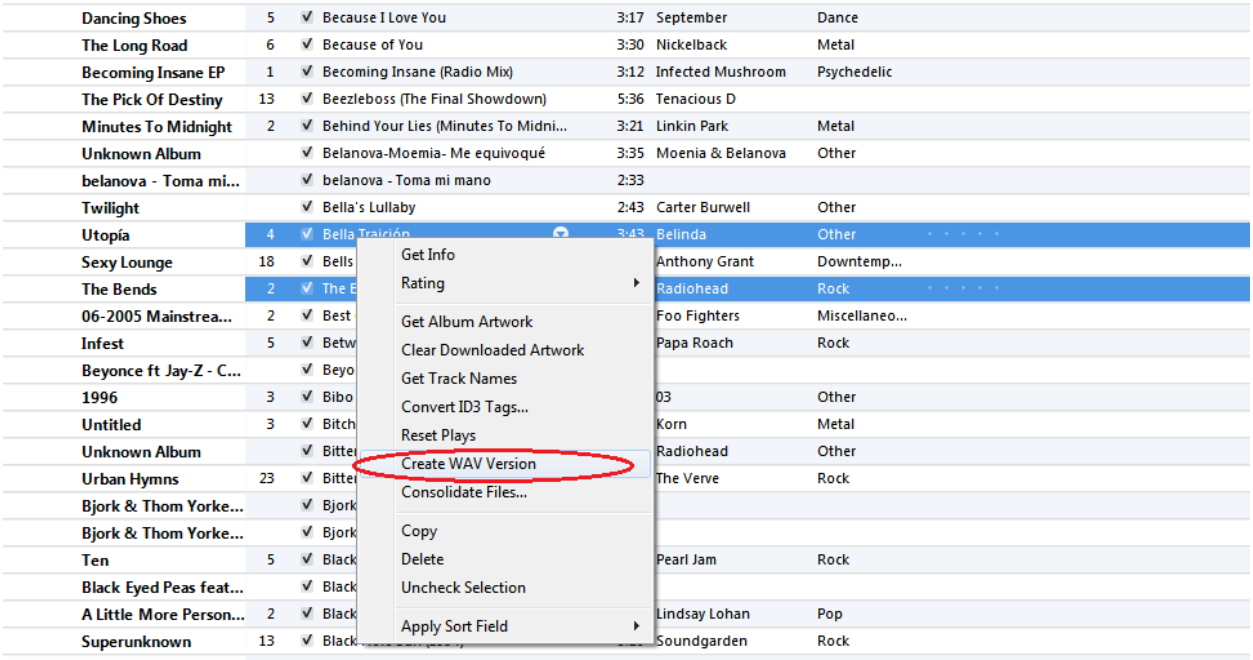
3.2- Now select the Advanced tab to visualize the path where converted files/songs will be stored, finally we click OK to close the window:



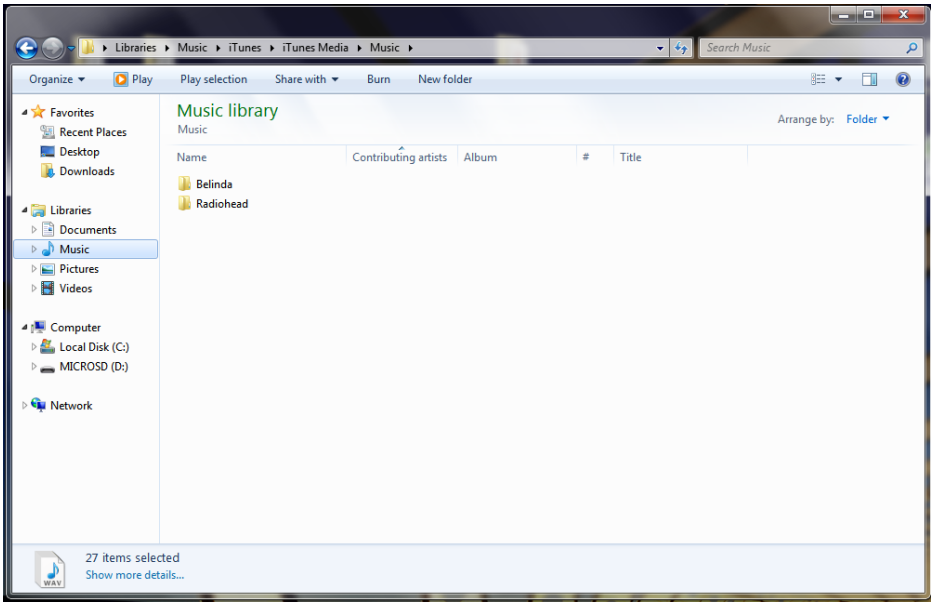
4.- Once back on the main window, select the desired songs to be converted:



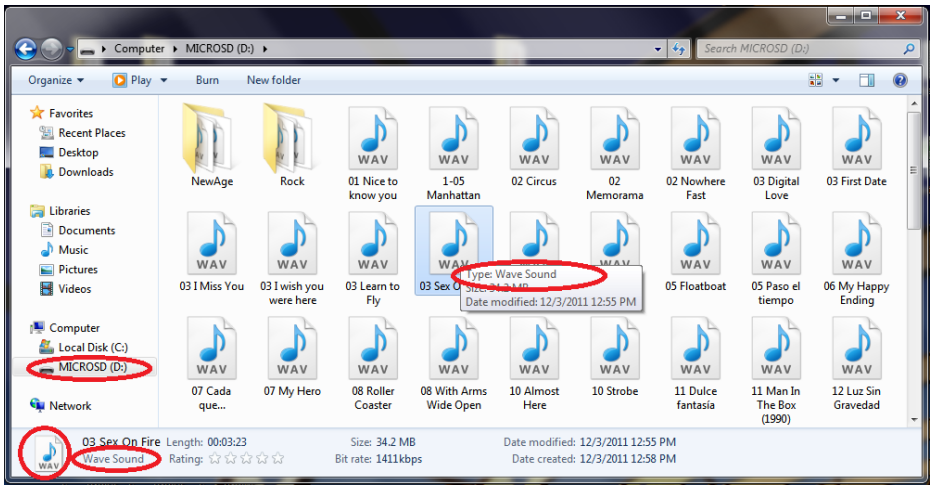
4.1- Once selected, give right click and a new menu pops, click on “create WAV version”:



5.- Wait for the files to be converted and then search for them on the iTunes folder. User could copy all the files with the folders directly to the microSD card to be sorted by artist/album/year, etc., but remember that in stand-alone mode, only Songs/Audio files placed on the microSD root could be played.



6.- Finally we check the contents on the microSD. We safely remove the micro SD card, then insert it on the SMART WAV and play the files!

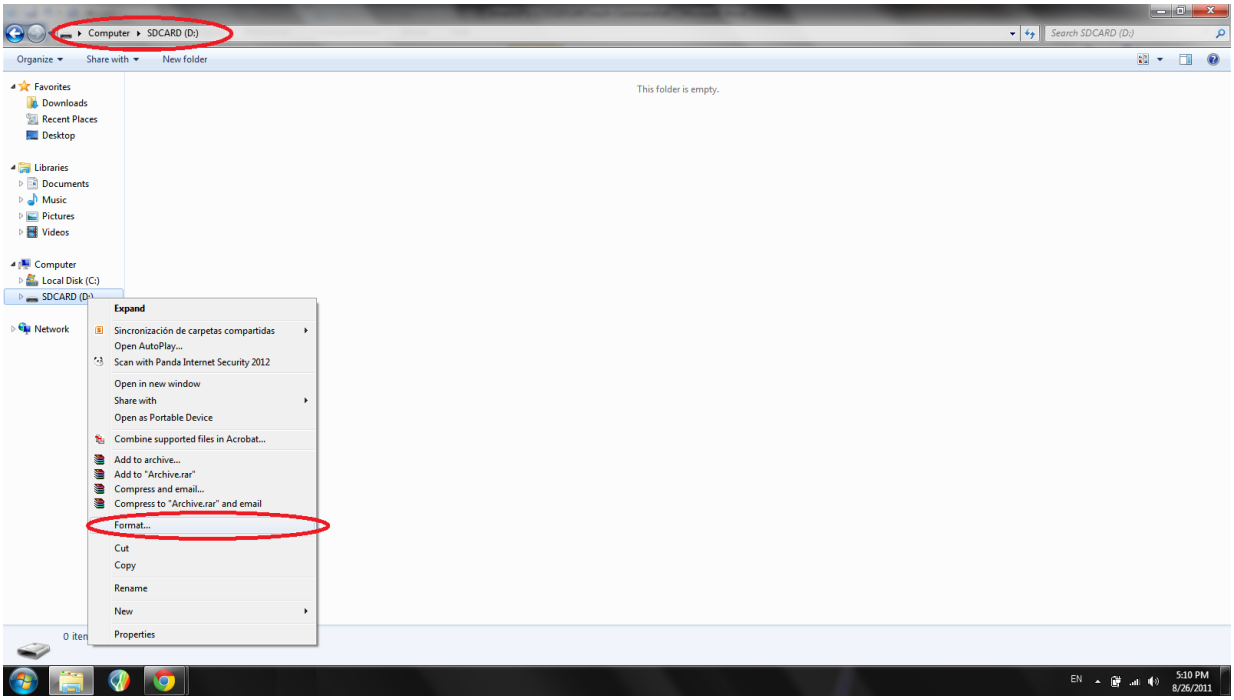


7.- Steps 1-4 must be done only for the first time, once iTunes is configured, user could start from step No 4. Follow always the same procedure to load song/audio files onto the micro SDcard!

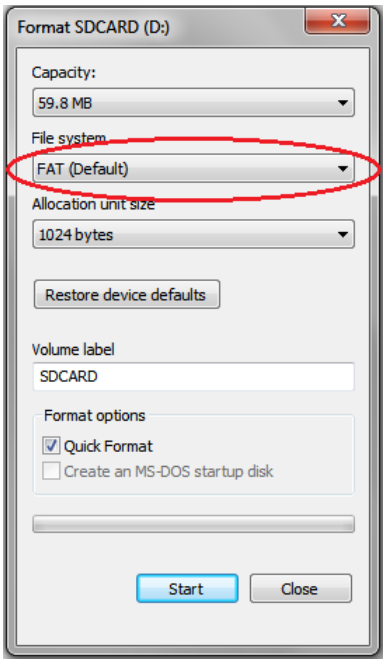
4.2 Formatting the micro SD card for first use

It is recommended but not necessarily to format the micro SD card for first use, in this section a format to new micro SD card to FAT format is explained.

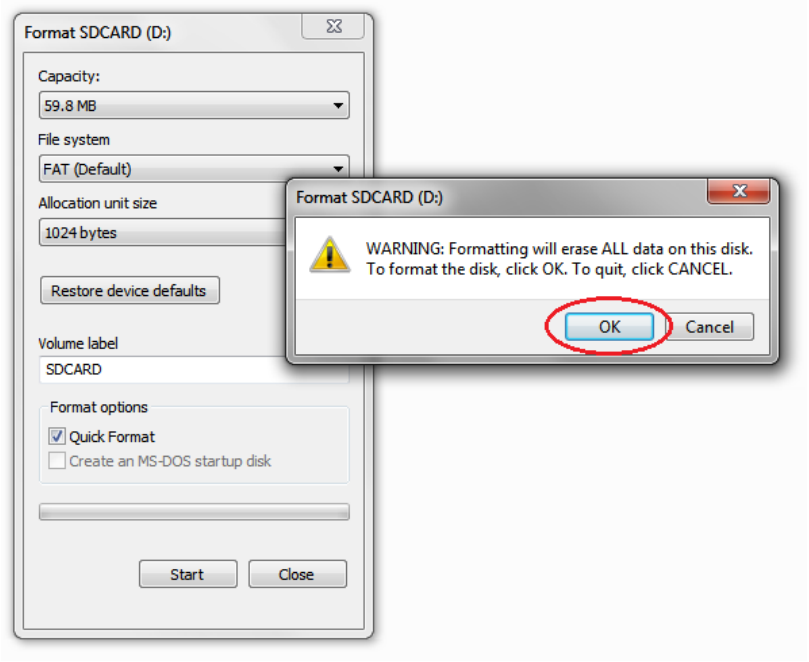
1.- Open a new windows explorer right click on the microSD card and a menu appears, select the "FORMAT…" and click on it. ***(Note that formatting a micro SD card will erase all the contents of it).***



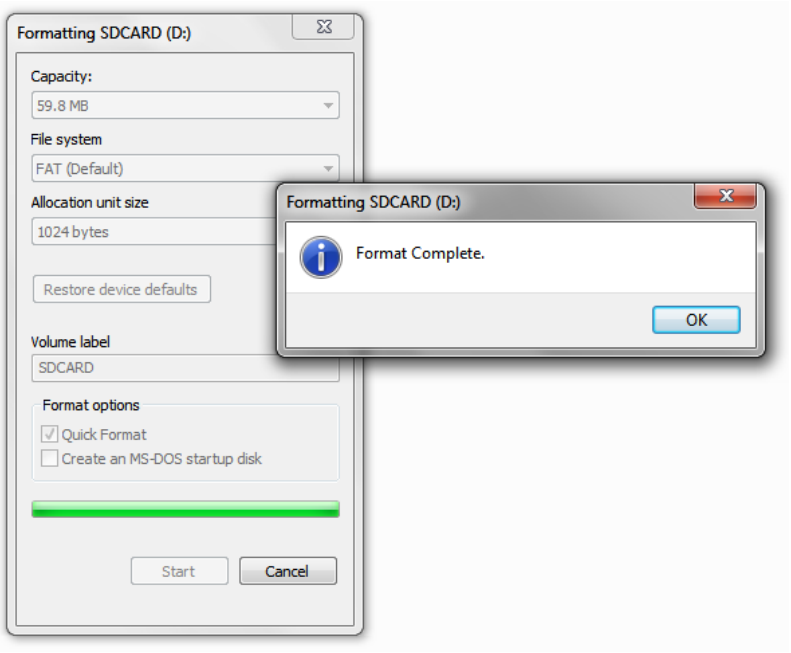
2.- A new window will pop-up, chose FAT(default) on the File System menu, and click start.



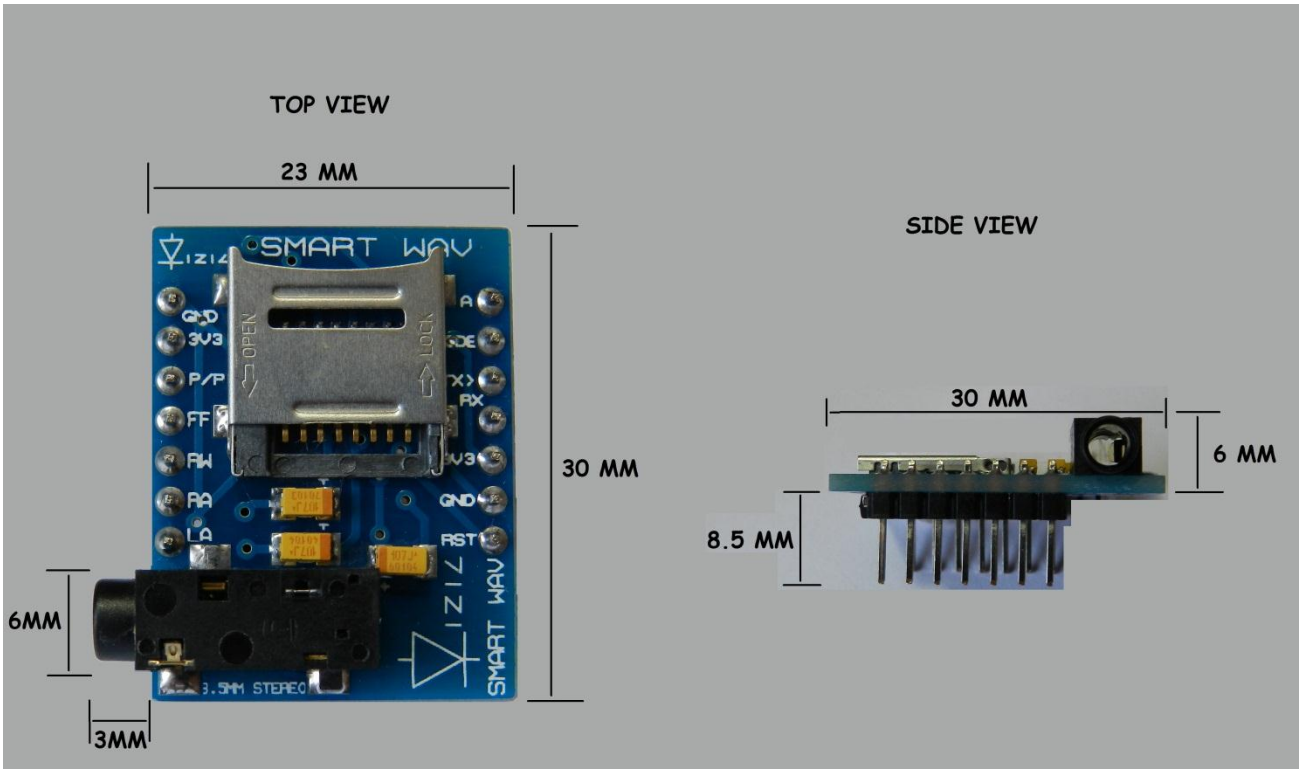
3.- Click OK on the new window and wait to the PC to perform the format.



4.- Now the microSD card is ready to load images and text!



5 Mechanical dimensions



All units are in mm.

6 Specifications and ratings:

Absolute Maximum Ratings*

Operating Temperature	-55°C to +65°C
Storage Temperature	-65°C to +65°C
Voltage on any Pin except $\overline{\text{RESET}}$ and RX with respect to Ground	-0.5V to 3.6V
Voltage on $\overline{\text{RESET}}$ and RX with respect to Ground	-0.5V to +5.5V
Maximum Operating Voltage	3.6V
DC Current per I/O Pin	40.0 mA
DC Current V_{CC} and GND Pins	200.0 mA

*NOTICE: Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

DC Characteristics.

Symbol	Parameter	Condition	Min	Typ (1)	Max	Units
V_{IL}	Input Low-voltage	ALL pins	-0.5		$0.2V_{CC}$(3)	V
		$\overline{\text{RESET}}$ pin	-0.5		$0.2V_{CC}$(3)	V
V_{IH}	Input High-voltage	ALL pins	$0.7V_{CC}$(2)		V_{CC} +0.5	V
		$\overline{\text{RESET}}$ pin	$0.9V_{CC}$(2)		V_{CC} +0.5	V
V_{OL}	Output Low Voltage (Except Reset pin)	I_{OL} = 5 mA, V_{CC} = 3V			0.5	V V
V_{OH}	Output High-voltage (Except Reset pin)	I_{OH} = -5 mA, V_{CC} = 3V	2.5			V V
I_{IL}	Input Leakage Current I/O Pin	Vcc = 3V, pin low (absolute value)		< 0.05	1	µA
I_{IH}	Input Leakage Current I/O Pin	Vcc = 3V, pin high (absolute value)		< 0.05	1	µA
R_{RST}	Reset Pull-up Resistor		30		60	kΩ
R_{PU}	I/O Pin Pull-up Resistor		20		50	kΩ
I_{CC}	Power Supply Current	V_{CC} = 3V		10	15	mA
	Sleep mode	V_{CC} = 3V		4	10	µA

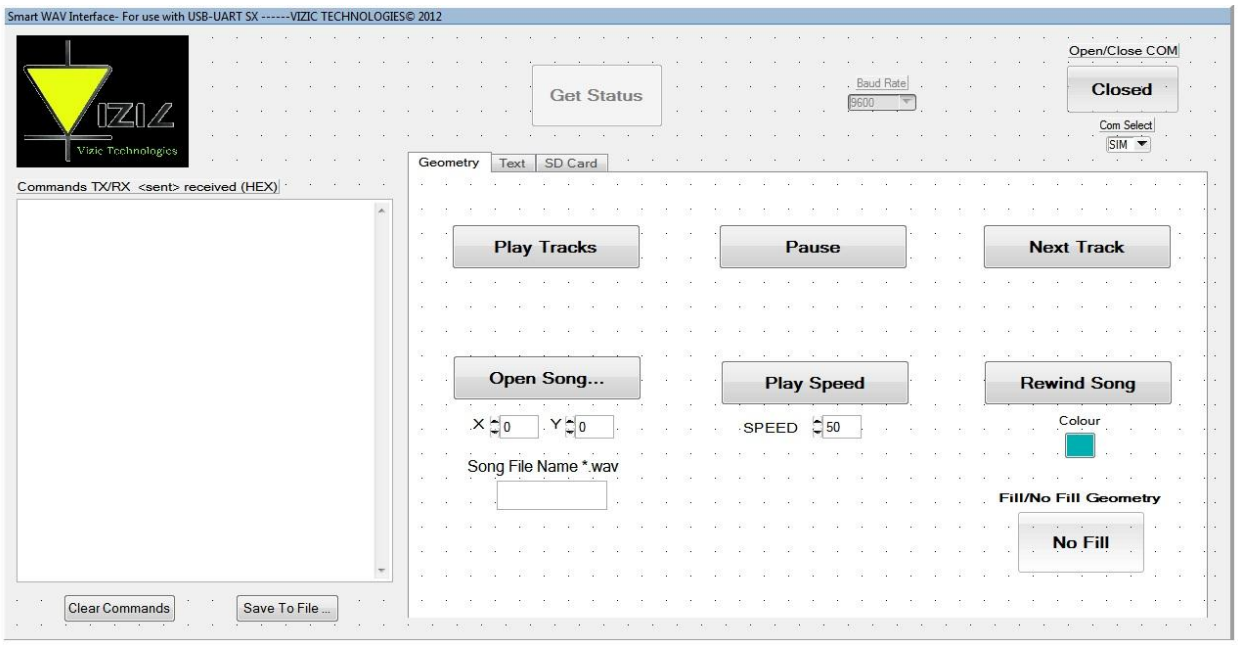
Notes:
1. Typical values at +25°C.
2. "Min" means the lowest value where the pin is guaranteed to be read as high.
3. "Max" means the highest value where the pin is guaranteed to be read as low.

7 Development software tools

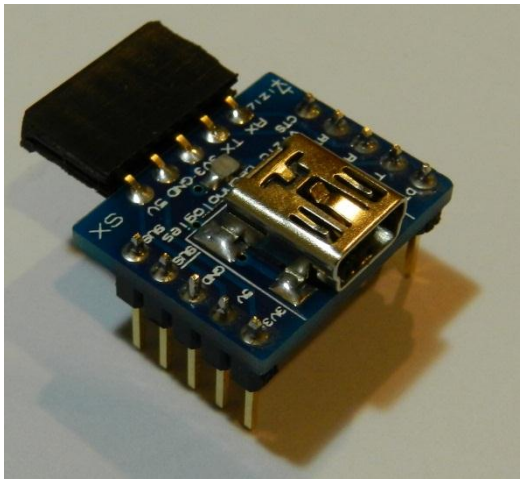
In order to make easier the learning about how to communicate with the SMART WAV, free software could be downloaded and used in any PC. This software simulates all of the functions of the SMART WAV. This is achieved by connecting the USB-UART SX Bridge to the SMART WAV enabling real audio processing.

This software greatly reduces the time of learning the commands, and helps the user to understand how commands are created.

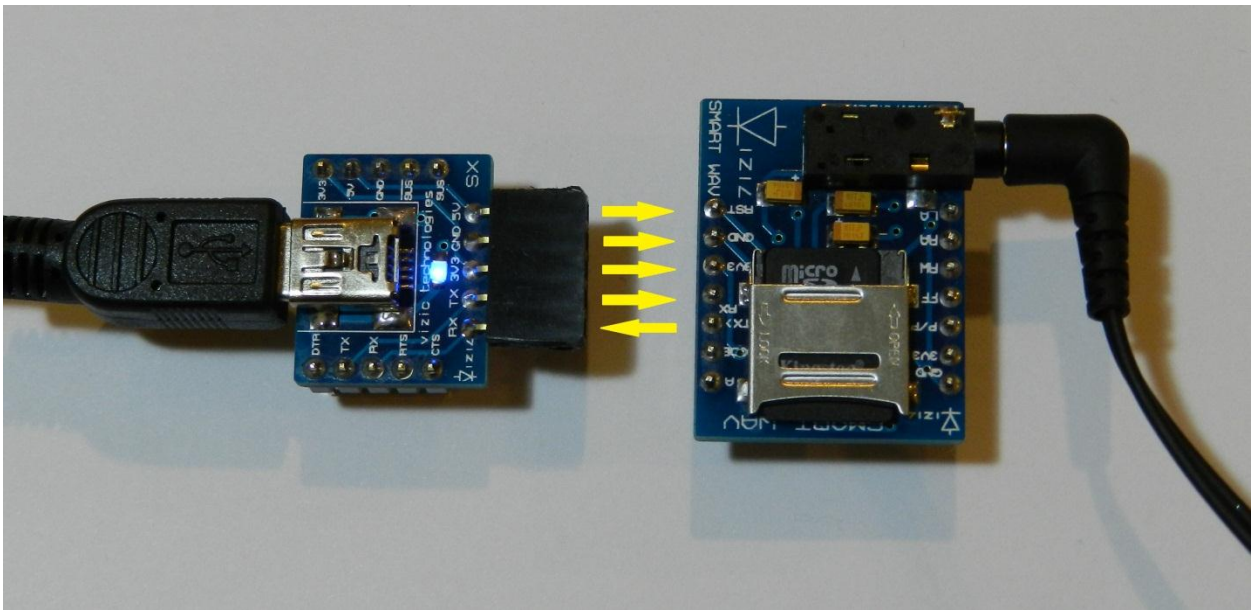
Smart WAV PC Interface:

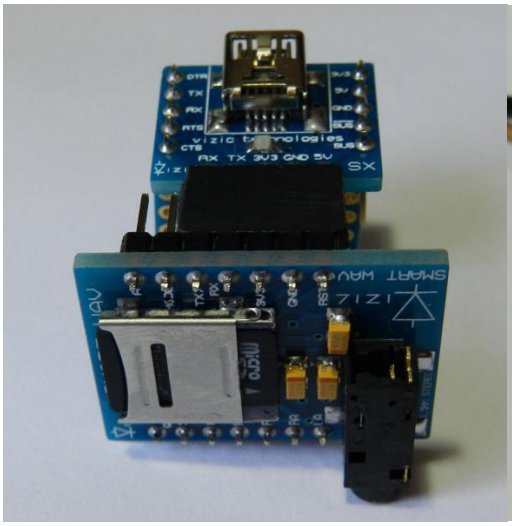


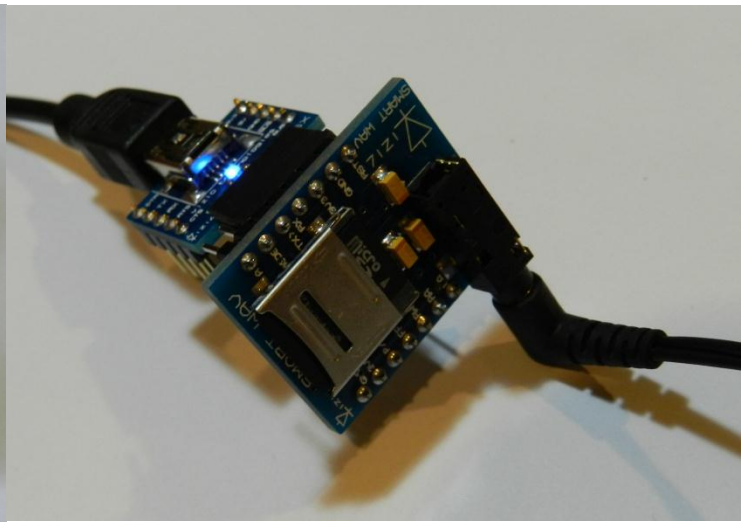
The USB-UART SX:



Smart WAV connected to the USB-UART SX







For detailed information about this software and how to use it, please refer to the "SMARTWAV-PCsimulation.pdf" sheet that could be downloaded in the web site.

For detailed information about the USB-UART SX Bridge, please visit our web site.

Proprietary Information:

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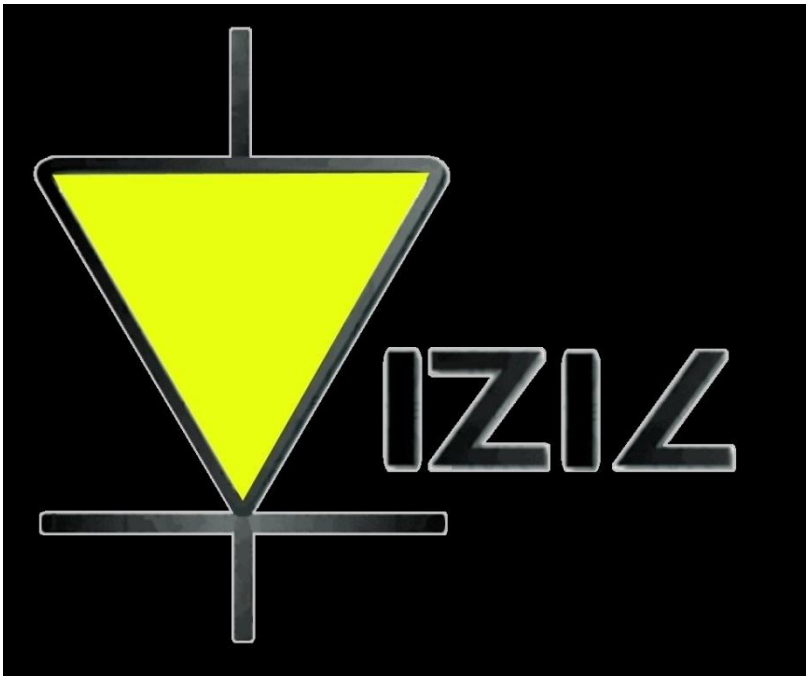

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