

For a thorough introduction and “how-to” for Tsunami, please consider following the excellent [Hook-up Guide on the SparkFun website](#).

This document details the specifications and features of the latest version of Tsunami and its firmware as of 1/14/23. Some features described herein may not be supported in earlier firmware versions, so you are encouraged to update your board to the latest version.

Introduction

Tsunami is an advanced polyphonic embedded audio player, capable of playing 44.1kHz, 16-bit mono or stereo WAV files (tracks) from an on-board microSD card. Depending on whether it is running in mono or stereo mode, it can play up to 18 stereo or 32 mono tracks independently and simultaneously, mixing them to any of either 4 stereo or 8 mono line-level audio outputs. Up to 4096 tracks can be indexed and started with low latency (typically 7ms) using 16 programmable trigger inputs, a serial control port or a dedicated MIDI port.

There are many ways to use Tsunami:

Standalone: Using the programmable trigger inputs it’s possible to create a complete multi-channel audio delivery system with nothing more than Tsunami and some buttons. Triggers can be programmed to start, pause, resume, stop or loop individual tracks, sequential or random ranges of tracks, even control volume. You can even play 5.1 or 7.1 surround content with a single trigger input.

With another microcontroller such as an Arduino: Both an asynch serial control port and a Qwiic (I2C) interface along with a rich serial control protocol, provide a way to access all 4096 tracks and take advantage of Tsunami’s internal faders to do real-time mixing, cross-fading and pitch bending. An Arduino Serial Control Library makes it easy to access all of Tsunami’s features from within your Arduino Sketch.

MIDI: Tsunami’s dedicated MIDI port makes it easy to connect your MIDI keyboard or controller. Tsunami supports MIDI Note-On, Note-Off, Pitch Bend and Program Changes messages, as well as Controller messages for real-time control of sustain, attack and release times and volume. A voice-stealing algorithm means that new notes always play even if you run out of voices.

Tsunami’s programmable features are controlled by an optional “.ini” file stored on the microSD card and read during a reset. While this file is human-readable text, a Robertsonics Configurator

utility (Windows, Mac and Linux versions available), makes it easy to set options and generate this file. See sections below on how to use the Configurator.

Electrical

Tsunami can be powered either with 5 – 15VDC applied to the VIN/GND header or through the onboard USB Micro-B connector.

IMPORTANT: Tsunami is 3.3V device and the Atmel SAM S70 processor's inputs are not 5V tolerant! Please keep this in mind when you connect signals from other powered devices, such as Arduinos and gate signals from modular synths.

WAV Files and Tracks

Tsunami plays “.wav” files stored on a FAT16 or FAT32 formatted microSD card. (Most microSD cards are already formatted so reformatting is typically not necessary.) You might think that the latest, fastest SD cards would be best, but that's not always the case. Please review [this page](#) to fully understand the issues, but as a general rule, speed class 4 or 10, non-UHS cards work best.

Tsunami firmware currently comes in 2 versions: Mono and Stereo. The mono version *requires* 16-bit, 44.1kHz mono .wav files, while the stereo version *requires* 16-bit, 44.1kHz stereo WAV files. Both versions also *require* that there be no meta-data (tags) prior to the start of the audio in the file. If these rules are not met, the file will simply not be played.

The easiest way to ensure proper formatting is by using the free audio editor Audacity to save your Tsunami WAV files.

Tsunami indexes the WAV files into track numbers based on the filename. In order to be recognized by Tsunami, .wav file names must begin with a number between 1 and 4096. This number can be from 1 to 4 digits and leading 0's are not required. Additionally, and only for use with MIDI, if the track number is immediately followed with “_FN”, where F = “L” or “S” and N = 1 – 8, this will specify whether the track is to be looped and what output it should be routed to. If the “_FN” is omitted, then the track will not loop (single-shot) and will be routed to output 1. Again, this “_FN” field is only used when the track is started with a MIDI Note-On command.

The remainder of the filename does not matter and long filenames are allowed.

The following are examples of valid filenames and their meaning:

1-Music Loop 21.wav: Track 1

438_Barking Dog.wav: Track 438

0101_L3 Violin A3.wav: Track 101, when triggered by MIDI will loop and appear on output 3

4096_S4 Flute B3.wav: Track 4096, when trigger by MIDI will not loop and appear on output 4

All WAV files must be located in the root directory of the microSD card.

Anytime the microSD card is removed and re-inserted, Tsunami must be either reset or power-cycled. This is because it reads the init file (see below) and indexes all the tracks only when reset.

Some things to keep in mind when planning your track numbering: The default behavior of the trigger inputs is to start the corresponding track, e.g. Trigger 1 plays Track 1, Trigger 2 plays Track 2 and so on. A Trigger Bank feature allows you to shift the trigger tracks up by increments of 16, so while the default trigger tracks are 1 – 16, Trigger Bank 1 maps them to Tracks 17 – 32, Trigger Bank 2 maps them to Tracks 33 – 48, and so on.

When using MIDI, Tsunami maps MIDI Note number to track number, so MIDI Notes 1 – 128 map to Tracks 1 – 128. Similarly, a MIDI Bank feature shifts offsets the track number by 128, so MIDI Bank 1 maps MIDI Notes 1 – 128 to Tracks 129 – 256, and so on up to MIDI Bank 32. The MIDI Bank can be incremented and decremented either with trigger inputs or the MIDI Program Change message.

When using serial control, it's easy to control any track directly by its track number so the numbering scheme is more just a matter of personal preference.

Polyphony

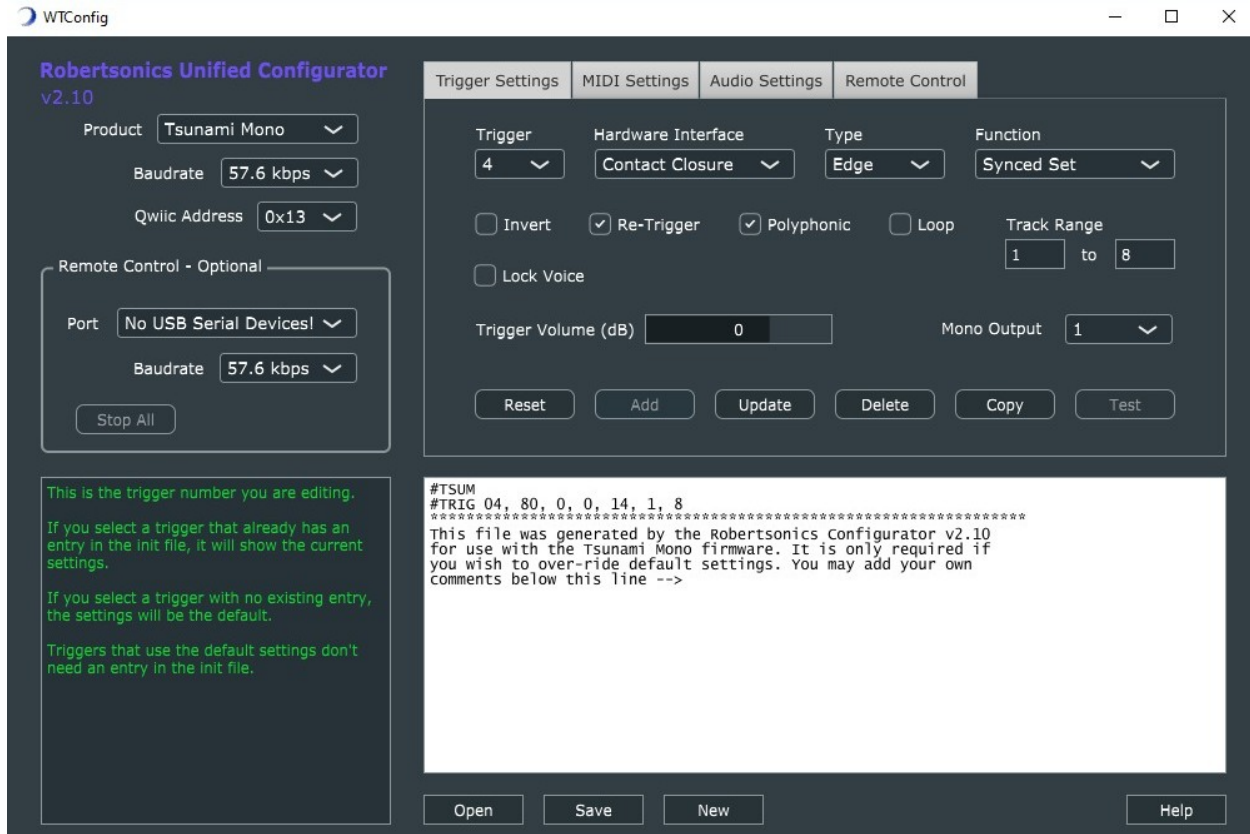
Unlike most other embedded audio players, Tsunami is “polyphonic”. This means that it can play more than one track at a time. It does this by maintaining multiple file pointers and digitally mixing the tracks to Tsunami outputs. When operating in polyphonic mode, tracks can be started at any time, regardless of whatever tracks may be playing, including other copies of the same track (depending on the settings). The only limit is the number of “voices” – the number of separate tracks that can be played at any given moment. Currently, Tsunami provides 18 low-latency stereo voices or 32 low-latency mono voices.

Polyphony can make things quite complex, and it's important to understand the various options so that you can achieve the results you want.

Polyphony also affects how you handle volume. If you mix 4 tracks together that are all full-scale volume, the result will be clipped and distorted. In this case, it won't help to lower the output gain setting since this only affects the final output stage – you'll just lower the volume of an already clipped mix. You must reduce the volume of the WAV files themselves so that the resulting addition of the tracks does not clip.

The Init file and the Robertsonics Configurator Utility app

Tsunami has a number of options that can be set through the use of an Init file – a text file placed on the microSD card along with the .wav files. Tsunami Configurator is an application that allows you to set these options using a graphical user interface, and will then create the Init file for you. The Init file is still a text file and can be created and/or edited by hand, but Configurator makes this process much easier and less prone to error.



To be recognized by Tsunami, the Init file must be named “tsunami.ini” and be placed in the root directory of the microSD card.

An Init file is only required if you want to change a default behavior, and the only entries that are required are for options that are not default. The following discussion of both global and trigger options assumes that you will be using the Configurator app to create an Init file.

Global Options

Serial Baudrate: This sets the baudrate for the async serial port. This baudrate will remain in effect until the next power cycle. The default is 57.6kbps.

Mode: This selects either mono or stereo mode and should be set to match the version of firmware you are using in Tsunami. It simply adjusts the number of outputs available, which are arranged as either 8 mono or 4 stereo. The mono version also includes a trigger function to start a pair of tracks in adjacent outputs as a way of playing stereo content.

Output N Volume: These sliders set the initial volume applied to the final mix of tracks mixed to the corresponding output. These values can be overridden by a volume command. The range is -70dB to +10dB, and the default value is 0dB (unity gain). This gain affects the final output mix for that output, not the individual tracks that make up the mix.

Trigger Options

Trigger options are set by first selecting the trigger number in the Trigger combo box. If there's already an entry for that trigger in the Init file, the options will indicate the current values for that entry. If there is no entry for that trigger, the options will reset to default. Using the "Save" or "Update" buttons will create or update an entry in the Init file for that trigger. Once saved, trigger settings may be transferred to Tsunami over the serial port (if it is connected) using the "Test" button. This allows you to easily test the effect of changing options without having to deal with writing the init file, transferring the microSD card and resetting Tsunami.

Not all trigger functions support all options. For example, the Next, Previous and Random functions are inherently edge triggered type functions, so the "Type" field defaults to "Edge" and is disabled for these functions.

Hardware Interface: The "Contact Closure" option enables an internal pull-up for the trigger input so that with nothing connected, the trigger input is "high". When combined with the non-inverted (default) option, a contact closure (button or switch) to ground will pull the trigger input low and activate the trigger. The "Active – 3.3V" options disables the internal pull-up for the trigger, requiring either an external 3.3V signal to bring the input "high". This allows the trigger to be driven with the digital output of another micro controller. The invert option will control whether the trigger will be activated on a low or high signal level.

Please note that you should never select "Active – 3.3V" option without having an active signal connected to the trigger. With nothing connected, the trigger input is floating and will produce false and random triggers. Similarly, you should never apply 3.3V to a trigger without first setting it to "Active – 3.3V".

Type: This option affects only certain trigger functions. For the "Normal" trigger function, "Edge Triggered" starts the track when the trigger first goes active, and the track continues to play until stopped by some other event. "Level Triggered" starts the track when the trigger goes active, but the track plays only as long as the trigger remains active. When combined with the "Stop" function, "Level Triggered" will prevent one or more tracks from starting as long as it remains active, creating an "inhibit" function. "Latched" will activate on a transition but remain active as

if it was level type. Another trigger is required to stop any action that is started by a “Latched” type trigger.

Function: This option selects the function that the trigger will perform. Some of the functions require that a range of tracks be specified, and the values in the range can be from 1 to 999. The high value must be equal to or greater than the low value.

“Normal”, the default function, directs Tsunami to play the corresponding track number. The track range is not used. Combining with the “Level Triggered” type option will make the trigger act like a MIDI Note On, causing the track to play only as long as the trigger remains active.

“Next” plays the next track in the specified range, starting with the low track and wrapping back to that track after playing the high track in the range.

“Previous” plays the previous track in the specified range, starting with the highest track and wrapping back to that track after playing the lowest track in the range.

“Random” plays a random track from the specified range. The only rule imposed is that it will not play the same track twice in a row.

“Pause” will pause all the tracks in the specified range. These tracks will remain paused until they are resumed or restarted. Combining with the “Level Triggered” type option creates a momentary Pause feature; the specified tracks will resume when the trigger is released.

“Resume” will resume all the tracks in the specified range, provided that they are still “paused”.

“Stop” will stop all the tracks in the specified range. Combining with the “Level Triggered” type option will create a “Stop and Inhibit” function, preventing all the tracks in the range from restarting as long as the trigger remains active. (Triggers that would have otherwise started an “inhibited” track are ignored, not queued.)

“Volume Up” or Volume Dn” will re-purpose the trigger to be a volume control. Each activation of the trigger will increase or decrease the output stage volume of Tsunami by 1dB.

“MIDI Bank Up” or MIDI Bank Dn” will re-purpose the trigger to increment or decrement the MIDI Bank number. Each MIDI Bank maps MIDI note numbers 1 through 128 to the next bank of 128 track numbers.

“Trigger Bank Up” or Trigger Bank Dn” will re-purpose the trigger to increment or decrement the Trigger Bank number. Each Trigger Bank maps the normal function triggers to the next bank of 16 track numbers.

“Synced Set” is available only when running Tsunami’s mono firmware version, and will start up to 8 tracks, specified in the track range fields, routing the “Low” track to the specified output and subsequent tracks to the next sequential outputs; The tracks will start and stay sample-locked, enabling you to use one trigger to play stereo or even 5.1 or 7.1 surround content.

Invert: This check box will invert the logic of the trigger. The default is active low. Checking this option makes the trigger active high.

Re-Triggers: This option enables certain trigger functions to work again immediately while the track(s) that they may have previously started is (are) still playing. For example, with the “Normal” trigger function, enabling this option allows the trigger restart the corresponding track even if it has not finished playing, while disabling this option prevents the trigger from working until the track has finished playing (or is stopped by some other event.) Similarly, for the “Next”, “Previous” and “Random” functions, disabling this option prevents the trigger from working until whatever track was previously started from this trigger is finished.

Re-Triggers is enabled by default.

Polyphonic: This option specifies that the track played by the trigger function (for those functions that play tracks) should be mixed with any track(s) currently playing. When this option is disabled, activating the trigger will stop any and all tracks that are currently playing on the same output before the new track is started.

Loop: This option, when enabled, will cause the track to loop continuously regardless of the state of any trigger which may have started it. Tsunami loops tracks seamlessly over the length of the loop. The sample frame immediately following the last sample in the file will be the first sample frame in the file.

Lock Voice: This option allows you to specify that the track will not be subject to Tsunami’s voice stealing algorithm. This allows you, for example, to use a trigger to start a backing track, and play MIDI notes on top of it without risk of the backing track being stopped because you played too many notes for the available number of voices.

Output: Any and all tracks started by this trigger will be routed to this output. In mono mode you can select outputs 1 – 8, while in stereo mode you can select stereo pairs 1 – 4.

MIDI Options

Channel: This sets the MIDI Channel number that Tsunami responds to. Omni, the default, means that Tsunami will ignore the MIDI Channel number and respond to all MIDI messages.

Pitch Bend Semitones: This sets the number of semi-tones up, and down, corresponding to full scale Pitch Bend messages.

Default Release: This slider sets the default release time for sounds which are stopped with a MIDI Note-Off command. It can be overridden using MIDI Controller messages as described in the MIDI implementation below.

Ignore Velocity: When checked, this tells Tsunami to ignore the MIDI Note-On velocity value and play all tracks started with MIDI at full volume.

Ignore Note-Offs: When checked, this tells Tsunami to ignore all MIDI Note-Off commands. Useful if you simply want to use a MIDI Controller to start tracks but not stop them.

Serial Control

The bidirectional asynchronous serial port can be used to control and monitor Tsunami's operation. The default baudrate is 57.6kbps, but this can be changed by placing the appropriate entry in the init file using the Configurator.

If you're going to be using Tsunami with an Arduino, there's an easy to use [Tsunami Serial Control Library](#) that will handle all of the serial protocol for you. If you're going to be writing your own serial control code, you still may want to review the library since the source is available and it's written in C.

All messages **to** Tsunami start with the same 2-byte Start-of-Message (SOM) header, followed by a byte indicating the total number of bytes in the message. Next is a 1-byte message code in the range of 0x00 to 0x7f, followed by a number of bytes of data specific to the message. Immediately following the last data byte is an End-of-Message (EOM) byte.

All message **from** Tsunami are formatted the same way. The only difference is that the message codes are in the range of 0x80 to 0xff.

16-bit data values such as track number and volume are sent "little-endian", that is with the LSB first and the MSB second.

Message format: (SOM1, SOM2, length, message code, data * n , EOM), where SOM1=0xf0, SOM2=0xaa, EOM=0x55

Commands TO Tsunami

Command	Code	Length	Data Bytes(0)	Response
GET_VERSION	0x01	5	none	VERSION_STRING

Requests Tsunami to transmit the VERSION_STRING message

Example: 0xf0, 0xaa, 0x05, 0x01, 0x55

Command	Code	Length	Data Bytes(0)	Response
GET_SYS_INFO	0x02	5	none	SYS_INFO

Requests Tsunami to transmit the SYS_INFO message

Example: 0xf0, 0xaa, 0x05, 0x02, 0x55

Command	Code	Length	Data Bytes (0)	Response
GET_STATUS	0x07	5	none	STATUS

Requests Tsunami to transmit the STATUS message

Example: 0xf0, 0xaa, 0x05, 0x07, 0x55

Command	Code	Length	Data Bytes (1)	Response
SET_REPORTING	0x0e	6	Reporting State = 0/1	none

Enable/Disable asynchronous serial reporting of track status. See TRACK_REPORT in the next section

Example: 0xf0, 0xaa, 0x06, 0x0e, 0x01, 0x55 Enables reporting

Command	Code	Length	Data Bytes(0)	Response
STOP_ALL	0x04	5	none	none

Commands Tsunami to stop all tracks immediately

Example: 0xf0, 0xaa, 0x05, 0x04, 0x55

Command	Code	Length	Data Bytes(0)	Response
RESUME_ALL_SYNC	0x0b	5	none	none

Resume all paused tracks.

Example: 0xf0, 0xaa, 0x05, 0x0b, 0x55

Command	Code	Length	Data Bytes (4)	Response
CONTROL_TRACK	0x03	10	Control Code (see below)	none
			Track number LSB	
			Track number MSB	
			Output (0 – 7)	
			Flags (see below)	

Sends one of the following Track Control Codes to a specific track number:

PLAY_SOLO = 0x00: Play track without polyphony, stops all other tracks

PLAY_POLY = 0x01: Play track polyphonically

PAUSE = 0x02: Pause track

RESUME = 0x03: Resume track

STOP = 0x04: Stop track

LOOP_ON = 0x05: Set the track loop flag

LOOP_OFF = 0x06: Clear the track loop flag

LOAD = 0x07: Load and pause track

Output: Specifies either stereo output (0 – 3) or mono output (0 – 7)

Flags = Bit 0: If 1, prevents the track’s voice from being stolen

Example: 0xf0, 0xaa, 0x0a, 0x03, 0x01, 0x07, 0x00, 0x03, 0x01, 0x55

Plays track 7 polyphonically to output 4 with voice locked

Command	Code	Length	Data Bytes (3)	Response
OUTPUT_VOLUME	0x05	8	Output (0 – 7)	none
			Gain LSB	
			Gain MSB	

Set the gain of one of the audio output. Gain values are in dB and range from -70 to +10.

This adjust the gain of the post mix of all the tracks playing to this output. It does not reduce the pre-mix volume of the individual tracks. If the result of mixing the tracks causes clipping, then reducing the output volume will not fix the clipping. You would need to use the Track Volume command to reduce the gain of the tracks prior to mixing. Think of the output gain as an output buss level.

Example: 0xf0, 0xaa, 0x08, 0x05, 0x01, 0xf6, 0xff, 0x55

Sets the gain of output 2 to -10dB

Command	Code	Length	Data Bytes (4)	Response
TRACK_VOLUME	0x08	9	Track number LSB	none
			Track number MSB	
			Gain LSB	
			Gain MSB	

Set the gain of the specified track. Gain values are in dB and range from -70 to +10.

This adjusts the gain of an individual track prior to mixing to the output. If you are playing many tracks to one output, you may need to reduce the gain of each track to avoid clipping in the output mix buffer.

The change in gain is applied smoothly over one audio buffer (about 3ms) to avoid distortion, but is otherwise immediate. If you want to smoothly ramp the volume up or down over time, use the TRACK_FADE command instead.

Example: 0xf0, 0xaa, 0x09, 0x08, 0x01, 0x00, 0xf6, 0xff, 0x55

Sets the gain of track 1 to -10dB

Command	Code	Length	Data Bytes (7)	Response
TRACK_FADE	0x0a	12	Track number LSB	none
			Track number MSB	
			Target Gain LSB	
			Target Gain MSB	
			Milliseconds LSB	
			Milliseconds MSB	
			Stop Flag (0/1)	

Fade (up or down) a track to a target gain from the current level in the specified number of milliseconds, with an option to stop the track at the end of the fade.

Target gain is specified in dB and range is from -70 to +10. If Stop Flag = 1, the track will stop at the end of the fade. This is most useful for implementing a fade out, since Tsunami will automatically stop the track and release the voice at the end of the fade out.

Example: 0xf0, 0xaa, 0x0c, 0x0a, 0x02, 0x00, 0xc8, 0xff, 0xe8, 0x03, 0x01, 0x55

Fade track 2 to -50dB in 1000ms and stop.

Command	Code	Length	Data Bytes (1)	Response
SET_TRIGGER_BANK	0x0e	6	Bank (1 – 32)	none

Sets the trigger bank to the specified value.

Example: 0xf0, 0xaa, 0x06, 0x0e, 0x08, 0x55 Set the trigger bank to 8

Command	Code	Length	Data Bytes (1)	Response
SET_MIDI_BANK	0x10	6	Bank (1 – 32)	none

Sets the MIDI bank to the specified value.

Example: 0xf0, 0xaa, 0x06, 0x0e, 0x0a, 0x55 Set the MIDI bank to 10

Command	Code	Length	Data Bytes (2)	Response
SAMPLERATE	0x0c	8	Output (0 – 7)	none
			Offset LSB	
			Offset MSB	

Set the sample rate offset for the specified output.

Each of Tsunami’s outputs can support its own vari-speed control. The offset value ranges from -32768, corresponding to 1/2X speed (one octave pitch shift down), to +32767, corresponding to 2X speed (one octave pitch shift up.)

Example: 0xf0, 0xaa, 0x08, 0x0c, 0x00, 0x5a, 0x1f, 0x55

Set output 1 to pitch up 2 semitones.

Command	Code	Length	Data Bytes (1)	Response
SET_INPUT_MIX	0x0f	6	Output Mask	none

Set the input routing mix. The lowest 4 bits of the mask correspond to the 4 output pairs. A “1” in the position will enable the audio input to be mixed to the corresponding output pair.

Example: 0xf0, 0xaa, 0x06, 0x0f, 0x05, 0x55

Audio input pair is mixed to output pairs 1 and 3

Commands sent FROM Tsunami:

Command	Code	Length	Data Bytes (22)
VERSION_STRING	0x81	27	ASCII Version String

Sent in response to a GET_VERSION command. Contains the current Tsunami firmware version string.

Example: 0xf0, 0xaa, 0x1b, 0x81, "Tsunami v2.01s (c)2021", 0x55

Command	Code	Length	Data Bytes (3)
SYS_INFO	0x82	8	Number of voices
			Number of Tracks LSB
			Number of Tracks MSB

Sent in response to a GET_SYSINFO command. Contains the maximum number of voices in the current firmware and the total number of tracks found on the installed SD card.

Example: 0xf0, 0xaa, 0x08, 0x82, 0x20, 0xc4, 0x09, 0x55

Tsunami reports 32 Voices and 2500 Tracks found on SD card

Command	Code	Length	Data Bytes (2 * No of Tracks)
STATUS	0x83	Variable	Track n Number LSB
			Track n Number MSB

Sent in response to a GET_STATUS command. The data is a list of 2-byte track numbers that are currently playing. If there are no tracks playing, the number of data bytes will be 0.

Example: 0xf0, 0xaa, 0x09, 0x83, 0x01, 0x00, 0x0e, 0x00, 0x55

Tsunami reports 14 tracks 1 and 15 are currently playing.

Command	Code	Length	Data Bytes (3)
TRACK_REPORT	0x83	9	Track Number LSB
			Track Number MSB
			Voice Number
			State (0/1)

When Track Reporting is enabled using the SET_REPORTING command, Tsunami sends this message every time a track starts or stops.

Example: 0xf0, 0xaa, 0x09, 0x84, 0x10, 0x00, 0x07, 0x01, 0x55

Tsunami reports Track 16 started using Voice 7

MIDI Implementation

Tsunami has a dedicated MIDI port and can act as a low-latency, velocity-sensitive, polyphonic sample player when used with a MIDI controller. It supports both channel assigned and Omni modes of operation, and implements an internal MIDI Bank Number that allows for mapping MIDI's 128 note numbers to alternate groups of track numbers – see below. Also, a filename option routes individual MIDI Notes to any one of the Tsunami's outputs, making it possible to split your keyboard across multiple outputs. See the "Wave Files and Tracks" section above.

Tsunami responds to MIDI Pitch Bend with an adjustable pitch range (in semitones), and provides MIDI Control Change support for adjustable attack and release times, as well as sustain.

MIDI Implementation:

Note-On

Starts track number T, where $T = (\text{MIDI Bank Number} * 128) + \text{MIDI Note Number}$.

The final volume is scaled by the MIDI Velocity, where a velocity value of 127 = 0dB (full volume). If the MIDI Attack time is great than 0, the volume will ramp up to the target value over the specified attack time.

The MIDI Bank Number can be changed by using the MIDI Program Change message (see below) or by using the increment/decrement MIDI Bank trigger functions.

The attack time can be set either with the ini file or changed dynamically using a MIDI Control Change message (see below)

Note-Off

If the “Ignore MIDI Note Off” option is not set, then track T (as calculated above) will be stopped. If the MIDI Release Time is greater than 0, then the volume will ramp down over the specified release time.

The release time can be set either with the ini file or changed dynamically using a MIDI Control Change message (see below)

Pitch Bend

All of the tracks playing to output N will be pitched up or down by an amount determined by the Pitch Bend Semitones set in the ini file (default is 2 semitones), where N = MIDI Channel Number. In other words, Pitch Bend on MIDI Channel 1 will control the pitch of output 1, Pitch Bend on MIDI Channel 2 will control the pitch of output 2, and so on.

Program Change

Program change will set the current MIDI Bank Number to the new program value.

Control Change

CC#1: Release time (0 – 2000ms)
CC#7: Volume Output 1
CC#20: Volume Output 1
CC#21: Volume Output 2
CC#22: Volume Output 3
CC#23: Volume Output 4
CC#24: Volume Output 5
CC#25: Volume Output 6
CC#26: Volume Output 7
CC#27: Volume Output 8
CC#73: Attack Time (0 – 2000ms)
CC#72: Release Time (0 – 2000ms)
CC#64: Sustain
CC#123: All-Notes-Off, reset pitch

Real Time

Stop (0xfc): All-Notes-Off, reset pitch

Updating the Firmware

Tsunami has a resident boot loader that can update the firmware directly from the microSD card. Use the following procedure to update the firmware in your Tsunami:

1. [Download the desired](#) version and unzip to a .hex file.
2. Copy the hex file to a microSD card and then rename the copy on the card to: "tsunamix.hex"
3. Put the card into Tsunami and make sure Tsunami is powered.
4. Press and hold the user button and then tap the reset button. Wait for Tsunami's LED to go on solid.
5. Release the user button and tap the reset button, or power-cycle the Tsunami.
6. You should now be running the new firmware.

If Tsunami's LED does anything other than go solid, here are the error codes:

- 1 long blink every 2 secs: No SD card found
- 1 long blink, followed by 1 short blink: SD format error
- 1 long blink, followed by 2 short blinks: Hex file error
- Continuous short blinks: Flash write error

Troubleshooting

If you have problems, here are a few things to check:

1) Make sure your WAV files are named properly (refer to the above) and are located in the root directory of the microSD card. When you first power on the WAV Trigger, it will locate and index the files and then blink 3 times to indicate that it found at least one WAV file. One long blink means that it either couldn't read the card or it didn't find any WAV files.

4) If you've gotten this far and tracks won't play, then it's most likely that your WAV files are not the correct format. **The WAV Trigger will only play WAV files formatted as 16-bit, stereo, 44.1kHz, and there can be no meta-data (non-audio data) in the file before the audio data.** It seems that many Mac audio applications insert a meta-data chunk prior to the audio, and this will prevent the track from playing. In such cases, simply importing the file and re-exporting with [Audacity](#) will likely fix the problem. See [this video](#) about converting files from MP3 to WAV Trigger compatible files, but the same process works with non-conforming WAV Files. You can always grab some of the (correctly formatted) WAV files from the [download page](#) to see if that's your problem.