

DSPtar

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# Chapter 1

## Hierarchical Index

### 1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

AudioStream	
Delay . . . . .	7
Distortion . . . . .	9
EQ . . . . .	10
NoiseGate . . . . .	13
Preamp . . . . .	15
Reverb . . . . .	16
delay_tap_t . . . . .	8
RingBuffer< T > . . . . .	17
RingBuffer< audio_block_t * > . . . . .	17



## Chapter 2

# Class Index

### 2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

<a href="#">Delay</a>	An AudioStream object that applies delay . . . . .	7
<a href="#">delay_tap_t</a>	A struct to hold parameters for one delay tap . . . . .	8
<a href="#">Distortion</a>	An AudioStream object that applies a distortion effect via waveshaping . . . . .	9
<a href="#">EQ</a>	. . . . .	10
<a href="#">NoiseGate</a>	An AudioStream object that applies a noise gate . . . . .	13
<a href="#">Preamp</a>	An AudioStream object that applies preamplification on raw samples . . . . .	15
<a href="#">Reverb</a>	An AudioStream object that applies a reverb effect . . . . .	16
<a href="#">RingBuffer&lt; T &gt;</a>	A templated ring buffer that evicts entries when full . . . . .	17





## Chapter 3

# File Index

### 3.1 File List

Here is a list of all documented files with brief descriptions:

<a href="#">dsptar/delay.h</a>	23
<a href="#">dsptar/distortion.h</a>	23
<a href="#">dsptar/distortion_array.h</a>	24
<a href="#">dsptar/dsptar_config.h</a>	25
<a href="#">dsptar/eq.h</a>	25
<a href="#">dsptar/noisegate.h</a>	26
<a href="#">dsptar/preamp.h</a>	26
<a href="#">dsptar/reverb.h</a>	27
<a href="#">dsptar/reverb_array.h</a>	27
<a href="#">dsptar/ringbuffer.h</a>	114



## Chapter 4

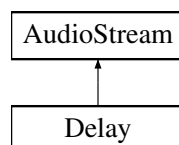
# Class Documentation

### 4.1 Delay Class Reference

An AudioStream object that applies delay.

```
#include <delay.h>
```

Inheritance diagram for Delay:



#### Public Member Functions

- [Delay](#) (void)  
*Construct a new [Delay](#) object.*
- [~Delay](#) ()  
*Destroy the [Delay](#) object.*
- void **setup** (float maxSecs, size\_t numTaps)
- void [setDelay](#) (size\_t index, int delayMs, int16\_t log2Attenuation)  
*Configures a delay tap.*
- virtual void **update** (void)  
*Transmits an output block after applying delay.*

#### 4.1.1 Detailed Description

An AudioStream object that applies delay.

#### 4.1.2 Constructor & Destructor Documentation

#### 4.1.2.1 Delay()

```
Delay::Delay (
    void ) [inline]
```

Construct a new [Delay](#) object.

Initializes the AudioStream super class to take in one input block in inputQueueArray.

### 4.1.3 Member Function Documentation

#### 4.1.3.1 setDelay()

```
void Delay::setDelay (
    size_t index,
    int delayMs,
    int16_t log2Attenuation )
```

Configures a delay tap.

Contribution from this tap will be the signal from delayMs ms ago, scaled by  $2^{(-\log2Attenuation)}$

##### Parameters

<i>index</i>	Index of delay tap (0 to MAX_DELAY_TAPS - 1)
<i>delayMs</i>	<a href="#">Delay</a> in ms
<i>log2Attenuation</i>	log base 2 of attenuation (i.e. 0->gain 1, 1->gain 1/2...)

The documentation for this class was generated from the following files:

- dsptar/delay.h
- dsptar/delay.cpp

## 4.2 delay\_tap\_t Struct Reference

A struct to hold parameters for one delay tap.

```
#include <delay.h>
```

### Public Attributes

- int32\_t **delayBlocks**
- int8\_t **log2Attenuation**

### 4.2.1 Detailed Description

A struct to hold parameters for one delay tap.

The documentation for this struct was generated from the following file:

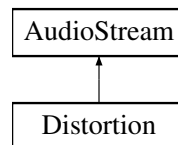
- dsptar/delay.h

## 4.3 Distortion Class Reference

An AudioStream object that applies a distortion effect via waveshaping.

```
#include <distortion.h>
```

Inheritance diagram for Distortion:



### Public Member Functions

- [Distortion](#) (void)  
*Construct a new [Distortion](#) object.*
- [~Distortion](#) ()  
*Destroy the [Distortion](#) object.*
- bool [setup](#) (const int16\_t \*distortionArr, int length)  
*Sets up the [Distortion](#) object with a given array.*
- virtual void **update** (void)  
*Transmits an output block after applying distortion.*

### 4.3.1 Detailed Description

An AudioStream object that applies a distortion effect via waveshaping.

### 4.3.2 Constructor & Destructor Documentation

#### 4.3.2.1 Distortion()

```
Distortion::Distortion (  
    void ) [inline]
```

Construct a new [Distortion](#) object.

Initializes the AudioStream super class to take in one input block in inputQueueArray.

### 4.3.3 Member Function Documentation

#### 4.3.3.1 setup()

```
bool Distortion::setup (
    const int16_t * distortionArr,
    int length )
```

Sets up the [Distortion](#) object with a given array.

##### Parameters

<i>distortionArr</i>	The array of waveshaping coefficients (see <code>_distortion_arr</code> ). Must be in static memory
<i>length</i>	The length of <code>distortion_arr</code> (must be $2^n + 1$ for $0 < n \leq 15$ )

##### Returns

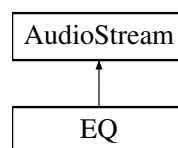
true if the setup succeeded  
false otherwise

The documentation for this class was generated from the following files:

- dsptar/distortion.h
- dsptar/distortion.cpp

## 4.4 EQ Class Reference

Inheritance diagram for EQ:



### Public Member Functions

- [EQ](#) (void)  
*Construct a new [EQ](#) object.*
- void [setCoefficients](#) (uint32\_t stage, const int \*coefficients)  
*Set the coefficients to given Q.30 values.*
- void [setCoefficients](#) (uint32\_t stage, const double \*coefficients)  
*Set the coefficients to given float values.*
- void [setLowpass](#) (uint32\_t stage, float frequency, float q=SQRT2\_OVER\_2)

*Set the coefficients to a lowpass filter.*

- void [setHighpass](#) (uint32\_t stage, float frequency, float q=SQRT2\_OVER\_2)

*Set the coefficients to a highpass filter.*

- void [setBandpass](#) (uint32\_t stage, float frequency, float q=1.0)

*Set the coefficients to a bandpass filter.*

- void [setNotch](#) (uint32\_t stage, float frequency, float q=1.0)

*Set the coefficients to a notch filter.*

- void **setLowShelf** (uint32\_t stage, float frequency, float gain, float slope=1.0f)
- void **setHighShelf** (uint32\_t stage, float frequency, float gain, float slope=1.0f)
- virtual void **update** (void)

*Transmits an output blocks after applying [EQ](#).*

## 4.4.1 Constructor & Destructor Documentation

### 4.4.1.1 EQ()

```
EQ::EQ (
    void ) [inline]
```

Construct a new [EQ](#) object.

Initializes the AudioStream super class to take in an input block in inputQueueArray.

## 4.4.2 Member Function Documentation

### 4.4.2.1 setBandpass()

```
void EQ::setBandpass (
    uint32_t stage,
    float frequency,
    float q = 1.0 )
```

Set the coefficients to a bandpass filter.

#### Parameters

<i>stage</i>	The filter within the cascade to set
<i>frequency</i>	The center frequency of the bandpass
<i>q</i>	The q factor of the bandpass (default 1.0)

#### 4.4.2.2 setCoefficients() [1/2]

```
void EQ::setCoefficients (
    uint32_t stage,
    const double * coefficients )
```

Set the coefficients to given float values.

##### Parameters

<i>stage</i>	The filter within the cascade to set
<i>coefficients</i>	The coefficients [b0, b1, b2, a1, a2]

#### 4.4.2.3 setCoefficients() [2/2]

```
void EQ::setCoefficients (
    uint32_t stage,
    const int * coefficients )
```

Set the coefficients to given Q.30 values.

##### Parameters

<i>stage</i>	The filter within the cascade to set
<i>coefficients</i>	The coefficients [b0, b1, b2, a1, a2]

#### 4.4.2.4 setHighpass()

```
void EQ::setHighpass (
    uint32_t stage,
    float frequency,
    float q = SQRT2_OVER_2 )
```

Set the coefficients to a highpass filter.

##### Parameters

<i>stage</i>	The filter within the cascade to set
<i>frequency</i>	The cutoff frequency of the highpass
<i>q</i>	The q factor of the highpass (default SQRT2_OVER_2)



#### 4.4.2.5 setLowpass()

```
void EQ::setLowpass (
    uint32_t stage,
    float frequency,
    float q = SQRT2_OVER_2 )
```

Set the coefficients to a lowpass filter.

##### Parameters

<i>stage</i>	The filter within the cascade to set
<i>frequency</i>	The cutoff frequency of the lowpass
<i>q</i>	The q factor of the lowpass (default SQRT2_OVER_2)

#### 4.4.2.6 setNotch()

```
void EQ::setNotch (
    uint32_t stage,
    float frequency,
    float q = 1.0 )
```

Set the coefficients to a notch filter.

##### Parameters

<i>stage</i>	The filter within the cascade to set
<i>frequency</i>	The center frequency of the notch
<i>q</i>	The q factor of the notch (default SQRT2_OVER_2)

The documentation for this class was generated from the following files:

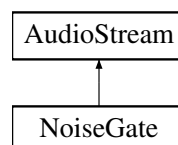
- dsptar/eq.h
- dsptar/eq.cpp

## 4.5 NoiseGate Class Reference

An AudioStream object that applies a noise gate.

```
#include <noisegate.h>
```

Inheritance diagram for NoiseGate:



## Public Member Functions

- [NoiseGate](#) (void)  
*Construct a new [NoiseGate](#) object.*
- [~NoiseGate](#) ()  
*Destroy the [NoiseGate](#) object.*
- void [setThresh](#) (uint16\_t thresh)  
*Sets the threshold of the noise gate.*
- virtual void **update** (void)  
*Transmits an output block after applying noise gate.*

### 4.5.1 Detailed Description

An AudioStream object that applies a noise gate.

### 4.5.2 Constructor & Destructor Documentation

#### 4.5.2.1 NoiseGate()

```
NoiseGate::NoiseGate (
    void ) [inline]
```

Construct a new [NoiseGate](#) object.

Initializes the AudioStream super class to take in one input block in inputQueueArray.

### 4.5.3 Member Function Documentation

#### 4.5.3.1 setThresh()

```
void NoiseGate::setThresh (
    uint16_t thresh )
```

Sets the threshold of the noise gate.

#### Parameters

<i>thresh</i>	the threshold to use (must be between 0 and INT16_MAX, inclusive)
---------------	-------------------------------------------------------------------

The documentation for this class was generated from the following files:

- dsptar/noisegate.h

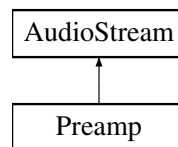
- dsptar/noisegate.cpp

## 4.6 Preamp Class Reference

An AudioStream object that applies preamplification on raw samples.

```
#include <preamp.h>
```

Inheritance diagram for Preamp:



### Public Member Functions

- [Preamp](#) (void)  
*Construct a new [Preamp](#) object.*
- [~Preamp](#) ()  
*Destroy the [Preamp](#) object.*
- void [setGain](#) (float gain)  
*Sets the gain of the preamp.*
- virtual void **update** (void)  
*Transmits an output block after applying gain.*

### 4.6.1 Detailed Description

An AudioStream object that applies preamplification on raw samples.

### 4.6.2 Constructor & Destructor Documentation

#### 4.6.2.1 Preamp()

```
Preamp::Preamp (
    void ) [inline]
```

Construct a new [Preamp](#) object.

Initializes the AudioStream super class to take in one input block in inputQueueArray.

### 4.6.3 Member Function Documentation

#### 4.6.3.1 setGain()

```
void Preamp::setGain (
    float gain )
```

Sets the gain of the preamp.

**Parameters**

<i>gain</i>	the gain to use
-------------	-----------------

The documentation for this class was generated from the following files:

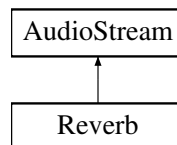
- dsptar/preamp.h
- dsptar/preamp.cpp

## 4.7 Reverb Class Reference

An AudioStream object that applies a reverb effect.

```
#include <reverb.h>
```

Inheritance diagram for Reverb:



### Public Member Functions

- [Reverb](#) (void)  
*Construct a new [Reverb](#) object.*
- bool [setup](#) (float32\_t gain, float32\_t \*fftCoeffs, const float32\_t \*irArr, float32\_t irArrLen, float32\_t \*fftTemp)  
*Sets up the [Reverb](#) object with a given array.*
- virtual void [update](#) (void)  
*Transmits two output blocks after applying reverb.*

#### 4.7.1 Detailed Description

An AudioStream object that applies a reverb effect.

#### 4.7.2 Constructor & Destructor Documentation

##### 4.7.2.1 Reverb()

```
Reverb::Reverb (
    void ) [inline]
```

Construct a new [Reverb](#) object.

Initializes the AudioStream super class to take in two input blocks in inputQueueArray.

### 4.7.3 Member Function Documentation

#### 4.7.3.1 setup()

```
bool Reverb::setup (
    float32_t gain,
    float32_t * fftCoeffs,
    const float32_t * irArr,
    float32_t irArrLen,
    float32_t * fftTemp )
```

Sets up the [Reverb](#) object with a given array.

##### Parameters

<i>gain</i>	Gain to apply to the reverb
<i>fftCoeffs</i>	Statically declared array float32 array of size nBlocks * REVERB_FFT_LENGTH * 2, updated to store fft of irArr
<i>nBlocks</i>	Length of irArr in terms of audio blocks
<i>irArr</i>	Impulse response to convolve with signal
<i>irArrLen</i>	Length of impulse response array in samples
<i>fftTemp</i>	

##### Returns

true  
false

The documentation for this class was generated from the following files:

- dsptar/reverb.h
- dsptar/reverb.cpp

## 4.8 RingBuffer< T > Class Template Reference

A templated ring buffer that evicts entries when full.

```
#include <ringbuffer.h>
```

### Public Member Functions

- [RingBuffer](#) (size\_t size, T initializer)  
*Construct a new [RingBuffer](#) object with copy-constructed elements.*
- [RingBuffer](#) (size\_t size)  
*Construct a new [RingBuffer](#) object with default-constructed elements.*

- `~RingBuffer ()`  
*Destroy the Ring Buffer object.*
- `bool push (T item, T *evicted)`  
*Pushes an item onto the ringbuffer, evicting the oldest item if full.*
- `T peek ()`  
*Peeks the item at the tail of the ringbuffer.*
- `T peekFront (int n)`  
*Peeks the item that is n items away from the front (important for delay)*
- `T pop ()`  
*Pops an item from the ringbuffer.*
- `int count ()`  
*Gets the number of items in the ringbuffer.*
- `int size ()`  
*Gets the number of items the ringbuffer can hold.*
- `bool isEmpty ()`  
*Checks whether the ringbuffer is empty.*
- `bool isFull ()`  
*Checks whether the ringbuffer is full.*

### 4.8.1 Detailed Description

```
template<class T>
class RingBuffer< T >
```

A templated ring buffer that evicts entries when full.

### 4.8.2 Constructor & Destructor Documentation

#### 4.8.2.1 RingBuffer() [1/2]

```
template<class T >
RingBuffer< T >::RingBuffer (
    size_t size,
    T initializer ) [inline]
```

Construct a new `RingBuffer` object with copy-constructed elements.

#### Parameters

<i>size</i>	the size of the buffer
<i>initializer</i>	a default version of T to copy-construct the internal array from

#### 4.8.2.2 RingBuffer() [2/2]

```
template<class T >
RingBuffer< T >::RingBuffer (
    size_t size ) [inline]
```

Construct a new [RingBuffer](#) object with default-constructed elements.

##### Parameters

<i>size</i>	the size of the buffer
-------------	------------------------

### 4.8.3 Member Function Documentation

#### 4.8.3.1 count()

```
template<class T >
int RingBuffer< T >::count ( ) [inline]
```

Gets the number of items in the ringbuffer.

##### Returns

The number of items in the ringbuffer

#### 4.8.3.2 isEmpty()

```
template<class T >
bool RingBuffer< T >::isEmpty ( ) [inline]
```

Checks whether the ringbuffer is empty.

##### Returns

true the ringbuffer is empty  
false the ringbuffer is not empty

#### 4.8.3.3 isFull()

```
template<class T >
bool RingBuffer< T >::isFull ( ) [inline]
```

Checks whether the ringbuffer is full.

##### Returns

true the ringbuffer is full  
false the ringbuffer is not full

#### 4.8.3.4 peek()

```
template<class T >
T RingBuffer< T >::peek ( ) [inline]
```

Peeks the item at the tail of the ringbuffer.

##### Returns

The oldest item in the ringbuffer

#### 4.8.3.5 peekFront()

```
template<class T >
T RingBuffer< T >::peekFront (
    int n ) [inline]
```

Peeks the item that is n items away from the front (important for delay)

##### Parameters

<i>n</i>	the index from which to peek (i.e. 0 for head, 1 for next item, etc.)
----------	-----------------------------------------------------------------------

##### Returns

the (n+1)'th newest item in the ringbuffer

#### 4.8.3.6 pop()

```
template<class T >
T RingBuffer< T >::pop ( ) [inline]
```

Pops an item from the ringbuffer.



**Returns**

The oldest item in the ringbuffer

**4.8.3.7 push()**

```
template<class T >
bool RingBuffer< T >::push (
    T item,
    T * evicted ) [inline]
```

Pushes an item onto the ringbuffer, evicting the oldest item if full.

**Parameters**

<i>item</i>	the item to push
<i>evicted</i>	an item that was evicted to make space, if any

**Returns**

true if an item was evicted  
false if an item was not evicted

**4.8.3.8 size()**

```
template<class T >
int RingBuffer< T >::size ( ) [inline]
```

Gets the number of items the ringbuffer can hold.

**Returns**

The max number of items in the ringbuffer

The documentation for this class was generated from the following file:

- dsptar/ringbuffer.h



## Chapter 5

# File Documentation

### 5.1 delay.h

```
1 #ifndef DELAY_H
2 #define DELAY_H
3
4 #include "Arduino.h"
5 #include "AudioStream.h"
6
7 #include "ringbuffer.h"
8
9 typedef struct {
10     int32_t delayBlocks;
11     int8_t log2Attenuation;
12 } delay_tap_t;
13
14 class Delay : public AudioStream {
15 public:
16     Delay(void) : AudioStream(1, _inputQueueArray), _delayQueue(nullptr), _delays(nullptr), _numTaps(0)
17     {}
18
19     ~Delay() {}
20
21     void setup(float maxSecs, size_t numTaps);
22
23     void setDelay(size_t index, int delayMs, int16_t log2Attenuation);
24
25     virtual void update(void);
26
27 private:
28     audio_block_t *_inputQueueArray[1];
29
30     RingBuffer<audio_block_t*> _delayQueue;
31
32     delay_tap_t* _delays;
33
34     size_t _numTaps;
35 };
36
37 #endif // DELAY_H
```

### 5.2 distortion.h

```
1 #ifndef DISTORTION_H
2 #define DISTORTION_H
3
4 #include "Arduino.h"
5 #include "AudioStream.h"
6
7 class Distortion : public AudioStream {
8 public:
9     Distortion(void) : AudioStream(1, _inputQueueArray), _distortionArr(nullptr) {}
10
11     ~Distortion();
12
13     bool setup(const int16_t *distortionArr, int length);
14 }
```

```

42     virtual void update(void);
43
44 private:
45     audio_block_t *_inputQueueArray[1];
46
47     int16_t *_distortionArr;
48
49     int _bitShift;
50 };
51
52 #endif // DISTORTION_H

```

## 5.3 distortion\_array.h

```

1 // autogenerated by Matlab
2 // see matlab/distortion/distortion.m
3 #ifndef DISTORTION_ARRAY_H
4 #define DISTORTION_ARRAY_H
5
6 #define DISTORTION_ARR_LEN 513
7 const int16_t DISTORTION_ARR[DISTORTION_ARR_LEN] = {
8     -32768, -32768, -32768, -32768, -32768, -32768, -32768, -32768,
9     -32768, -32768, -32768, -32768, -32768, -32768, -32768, -32768,
10    -32768, -32768, -32768, -32768, -32768, -32768, -32768, -32768,
11    -32768, -32768, -32768, -32768, -32768, -32768, -32768, -32768,
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15    -32716, -32463, -32212, -31962, -31714, -31468, -31223, -30980,
16    -30739, -30499, -30261, -30025, -29790, -29556, -29324, -29094,
17    -28865, -28637, -28411, -28186, -27963, -27741, -27521, -27302,
18    -27084, -26867, -26652, -26439, -26226, -26015, -25805, -25596,
19    -25389, -25182, -24977, -24774, -24571, -24369, -24169, -23970,
20    -23772, -23575, -23379, -23184, -22990, -22798, -22606, -22415,
21    -22226, -22037, -21850, -21663, -21478, -21293, -21110, -20927,
22    -20745, -20564, -20384, -20205, -20027, -19850, -19673, -19498,
23    -19323, -19149, -18976, -18804, -18632, -18462, -18292, -18123,
24    -17954, -17787, -17620, -17453, -17288, -17123, -16959, -16796,
25    -16633, -16471, -16310, -16149, -15989, -15830, -15671, -15513,
26    -15356, -15199, -15043, -14887, -14732, -14577, -14423, -14270,
27    -14117, -13965, -13813, -13661, -13511, -13360, -13211, -13061,
28    -12913, -12764, -12616, -12469, -12322, -12176, -12030, -11884,
29    -11739, -11594, -11450, -11306, -11163, -11020, -10877, -10735,
30    -10593, -10451, -10310, -10169, -10029, -9889, -9749, -9610,
31    -9471, -9332, -9193, -9055, -8917, -8780, -8643, -8506,
32    -8369, -8233, -8097, -7961, -7825, -7690, -7555, -7420,
33    -7286, -7151, -7017, -6883, -6750, -6616, -6483, -6350,
34    -6218, -6085, -5953, -5820, -5688, -5557, -5425, -5294,
35    -5162, -5031, -4900, -4769, -4639, -4508, -4378, -4248,
36    -4118, -3988, -3858, -3728, -3598, -3469, -3340, -3210,
37    -3081, -2952, -2823, -2694, -2565, -2436, -2308, -2179,
38    -2051, -1922, -1794, -1665, -1537, -1409, -1281, -1152,
39    -1024, -896, -768, -640, -512, -384, -256, -128,
40     0, 128, 256, 384, 512, 640, 768, 896,
41     1024, 1152, 1281, 1409, 1537, 1665, 1794, 1922,
42     2051, 2179, 2308, 2436, 2565, 2694, 2823, 2952,
43     3081, 3210, 3340, 3469, 3598, 3728, 3858, 3988,
44     4118, 4248, 4378, 4508, 4639, 4769, 4900, 5031,
45     5162, 5294, 5425, 5557, 5688, 5820, 5953, 6085,
46     6218, 6350, 6483, 6616, 6750, 6883, 7017, 7151,
47     7286, 7420, 7555, 7690, 7825, 7961, 8097, 8233,
48     8369, 8506, 8643, 8780, 8917, 9055, 9193, 9332,
49     9471, 9610, 9749, 9889, 10029, 10169, 10310, 10451,
50     10593, 10735, 10877, 11020, 11163, 11306, 11450, 11594,
51     11739, 11884, 12030, 12176, 12322, 12469, 12616, 12764,
52     12913, 13061, 13211, 13360, 13511, 13661, 13813, 13965,
53     14117, 14270, 14423, 14577, 14732, 14887, 15043, 15199,
54     15356, 15513, 15671, 15830, 15989, 16149, 16310, 16471,
55     16633, 16796, 16959, 17123, 17288, 17453, 17620, 17787,
56     17954, 18123, 18292, 18462, 18632, 18804, 18976, 19149,
57     19323, 19498, 19673, 19850, 20027, 20205, 20384, 20564,
58     20745, 20927, 21110, 21293, 21478, 21663, 21850, 22037,
59     22226, 22415, 22606, 22798, 22990, 23184, 23379, 23575,
60     23772, 23970, 24169, 24369, 24571, 24774, 24977, 25182,
61     25389, 25596, 25805, 26015, 26226, 26439, 26652, 26867,
62     27084, 27302, 27521, 27741, 27963, 28186, 28411, 28637,
63     28865, 29094, 29324, 29556, 29790, 30025, 30261, 30499,
64     30739, 30980, 31223, 31468, 31714, 31962, 32212, 32463,
65     32716, 32767, 32767, 32767, 32767, 32767, 32767, 32767,
66     32767, 32767, 32767, 32767, 32767, 32767, 32767, 32767,
67     32767, 32767, 32767, 32767, 32767, 32767, 32767, 32767,
68     32767, 32767, 32767, 32767, 32767, 32767, 32767, 32767,
69     32767, 32767, 32767, 32767, 32767, 32767, 32767, 32767,

```

```

70     32767, 32767, 32767, 32767, 32767, 32767, 32767, 32767,
71     32767, 32767, 32767, 32767, 32767, 32767, 32767, 32767,
72     32767,
73 };
74
75 #endif // DISTORTION_ARRAY_H

```

## 5.4 dsptar\_config.h

```

1  #ifndef DSPTAR_CONFIG_H
2  #define DSPTAR_CONFIG_H
3
4  // ADC stuff to avoid magic numbers
5  #define ADC_BITS 10
6  #define ADC_MAX ((1 << ADC_BITS) - 1)
7
8  // Preamplifier gain control
9  #define PREAMP_GAIN_ADC_PIN A3 // analog input pin for preamp gain control
10 #define PREAMP_MIN_GAIN 5 // minimum gain value
11 #define PREAMP_MAX_GAIN 500 // maximum gain value
12
13 // Delay control
14 #define DELAY_MAX_SECS 1.1 // maximum delay time in seconds
15 #define DELAY_NUM_TAPS 4 // number of different delay taps
16 #define DELAY_DELAYS {250, 500, 750, 1000} // ms of delay on each tap (set a tap to 0 to disable)
17 #define DELAY_LOG2ATTENUATION {1, 2, 3, 4} // log 2 of attenuation of each tap (i.e. 0->gain 1,
18 // 1->gain 1/2...)
19 #define DELAY_NOISE_GATE_THRESH 8192 // minimum sample absolute value out of delay (to avoid EQ
20 // loops)
21
22 // Reverb control
23 #define REVERB_GAIN 1.0 // additional gain factor in reverb computation
24
25 // EQ control
26 #define EQ_LOWPASS_FREQ_ADC_PIN A2
27 #define EQ_MIN_LOWPASS_FREQ 10
28 #define EQ_MAX_LOWPASS_FREQ 10000
29
30 // Output noise gate control
31 #define OUTPUT_NOISE_GATE_THRESH 8192 // minimum sample absolute value to be sent to output
32
33 // wav control
34 #define FILENAME "SANDMAN.WAV"
35 #define SDCARD_CS_PIN 10
36 #define SDCARD_MOSI_PIN 7
37 #define SDCARD_SCK_PIN 14
38 #define PLAY_WAV 0
39
40 // Mixer control
41 #define MIXER_GUITAR_GAIN 0.25
42 #define MIXER_WAV_GAIN 1.0
43
44 // Output volume control
45 #define VOLUME_ADC_PIN A1 // analog input pin for volume control
46 #define VOLUME_GAIN 0.5 // constant scale factor to apply to volume
47
48 // amount of audio memory, hopefully should not need to change
49 #define AUDIO_MEMORY_SIZE (DELAY_QUEUE_SIZE + 20)
50
51 #endif // DSPTAR_CONFIG_H

```

## 5.5 eq.h

```

1  #ifndef EQ_H
2  #define EQ_H
3
4  #include "Arduino.h"
5  #include "AudioStream.h"
6
7  #define SQRT2_OVER_2 0.7071f
8  #define TWO_TO_THE_30 1073741824.0f
9  #define PI 3.141592654f
10
11 class EQ : public AudioStream
12 {
13 public:
14     EQ(void) : AudioStream(1, _inputQueueArray) {
15         // by default, the filter will not pass anything
16         for (int i=0; i<32; i++) _coeffs[i] = 0;
17     }
18 };

```

```

24     }
25
26     void setCoefficients(uint32_t stage, const int *coefficients);
27
28     void setCoefficients(uint32_t stage, const double *coefficients);
29
30     void setLowpass(uint32_t stage, float frequency, float q = SQRT2_OVER_2);
31
32     void setHighpass(uint32_t stage, float frequency, float q = SQRT2_OVER_2);
33
34     void setBandpass(uint32_t stage, float frequency, float q = 1.0);
35
36     void setNotch(uint32_t stage, float frequency, float q = 1.0);
37     void setLowShelf(uint32_t stage, float frequency, float gain, float slope = 1.0f);
38     void setHighShelf(uint32_t stage, float frequency, float gain, float slope = 1.0f);
39
40     virtual void update(void);
41
42 private:
43     int32_t _coeffs[32]; // up to 4 cascaded biquads
44     audio_block_t *_inputQueueArray[1];
45
46     bool _setup;
47 };
48
49 #endif // EQ_H

```

## 5.6 noisegate.h

```

1 #ifndef NOISEGATE_H
2 #define NOISEGATE_H
3
4 #include "Arduino.h"
5 #include "AudioStream.h"
6
7 #define DEFAULT_THRESH 0
8
9 class NoiseGate : public AudioStream {
10 public:
11     NoiseGate(void) : AudioStream(1, _inputQueueArray), _thresh(DEFAULT_THRESH) {}
12
13     ~NoiseGate() {}
14
15     void setThresh(uint16_t thresh);
16
17     virtual void update(void);
18
19 private:
20     audio_block_t *_inputQueueArray[1];
21
22     float _thresh;
23 };
24
25 #endif // NOISEGATE_H

```

## 5.7 preamp.h

```

1 #ifndef PREAMP_H
2 #define PREAMP_H
3
4 #include "Arduino.h"
5 #include "AudioStream.h"
6
7 #define DEFAULT_GAIN 1.0
8
9 class Preamp : public AudioStream {
10 public:
11     Preamp(void) : AudioStream(1, _inputQueueArray), _gain(DEFAULT_GAIN) {}
12
13     ~Preamp() {}
14
15     void setGain(float gain);
16
17     virtual void update(void);
18
19 private:
20     audio_block_t *_inputQueueArray[1];
21
22     float _gain;
23 };

```

```

55 };
56
57 #endif // PREAMP_H

```

## 5.8 reverb.h

```

1 #ifndef REVERB_H
2 #define REVERB_H
3
4 #include "Arduino.h"
5 #include "AudioStream.h"
6
7 #include "arm_math.h"
8 #include "arm_const_structs.h"
9
10 #define REVERB_MAX_NBLOCKS 128
11
12 class Reverb : public AudioStream {
13 public:
14     Reverb(void) : AudioStream(2, inputQueueArray) {}
15
16     bool setup(float32_t gain, float32_t *fftCoeffs, const float32_t *irArr, float32_t irArrLen,
17               float32_t *fftTemp);
18
19     virtual void update(void);
20
21 private:
22     audio_block_t *inputQueueArray[2];
23
24     bool _setup = false;
25     size_t _buffIdx;
26     size_t _currIdx;
27
28     float32_t _gain; // additional gain factor
29
30     float32_t _freqResponse[REVERB_MAX_NBLOCKS][AUDIO_BLOCK_SAMPLES * 4];
31     float32_t _ffftin[AUDIO_BLOCK_SAMPLES * 4];
32     float32_t _floatBufL[AUDIO_BLOCK_SAMPLES];
33     float32_t _floatBufR[AUDIO_BLOCK_SAMPLES];
34     float32_t _lastBlockL[AUDIO_BLOCK_SAMPLES];
35     float32_t _lastBlockR[AUDIO_BLOCK_SAMPLES];
36     float32_t _acc[AUDIO_BLOCK_SAMPLES * 4];
37     float32_t _acc2[AUDIO_BLOCK_SAMPLES * 4];
38     float32_t *_ptr_freqResponse;
39     float32_t *_ptr_ffftout;
40     float32_t *_ptr_ffftout_curr;
41     float32_t *_ptr_freqResponse_curr;
42
43     int _nBlocks;
44
45     // counters
46     int _k;
47     int _kMult;
48     int _jMult;
49 };
50
51 #endif

```

## 5.9 reverb\_array.h

```

1 #ifndef REVERB_ARRAY_H
2 #define REVERB_ARRAY_H
3 // (170ms impulse response)
4 // zero-padded to a multiple of partitionsize [128]
5 // so 55 zeros were appended to the original file
6
7 const int16_t REVERB_ARR_LEN = 7552;
8 const float32_t REVERB_ARR [REVERB_ARR_LEN] =
9 { 0.12646,
10 0.43933,
11 0.79095,
12 0.98070,
13 0.91847,
14 0.65977,
15 0.31844,
16 -0.01621,
17 -0.29128,
18 -0.43934,
19 -0.42983,

```

```
20 -0.30531,  
21 -0.13659,  
22 0.02803,  
23 0.14638,  
24 0.19892,  
25 0.17301,  
26 0.09006,  
27 0.00101,  
28 -0.05045,  
29 -0.04988,  
30 -0.00549,  
31 0.05968,  
32 0.10790,  
33 0.11390,  
34 0.07439,  
35 0.00827,  
36 -0.05852,  
37 -0.10538,  
38 -0.12309,  
39 -0.11723,  
40 -0.09913,  
41 -0.08728,  
42 -0.08621,  
43 -0.08915,  
44 -0.08662,  
45 -0.07332,  
46 -0.05192,  
47 -0.02519,  
48 0.00037,  
49 0.01353,  
50 0.01161,  
51 -0.00102,  
52 -0.02037,  
53 -0.04763,  
54 -0.08055,  
55 -0.11057,  
56 -0.12918,  
57 -0.13303,  
58 -0.12598,  
59 -0.10894,  
60 -0.08116,  
61 -0.04968,  
62 -0.02655,  
63 -0.01661,  
64 -0.01498,  
65 -0.01711,  
66 -0.02452,  
67 -0.03769,  
68 -0.05598,  
69 -0.07726,  
70 -0.09824,  
71 -0.11516,  
72 -0.12435,  
73 -0.12324,  
74 -0.11403,  
75 -0.10198,  
76 -0.08952,  
77 -0.07950,  
78 -0.07503,  
79 -0.07683,  
80 -0.08338,  
81 -0.09109,  
82 -0.09664,  
83 -0.09776,  
84 -0.09327,  
85 -0.08168,  
86 -0.06616,  
87 -0.05449,  
88 -0.05269,  
89 -0.05786,  
90 -0.06235,  
91 -0.06032,  
92 -0.05179,  
93 -0.04014,  
94 -0.02927,  
95 -0.02397,  
96 -0.02695,  
97 -0.03660,  
98 -0.04832,  
99 -0.05799,  
100 -0.06242,  
101 -0.06087,  
102 -0.05596,  
103 -0.05132,  
104 -0.04874,  
105 -0.04779,  
106 -0.04629,
```



```
107 -0.04226,  
108 -0.03531,  
109 -0.02589,  
110 -0.01441,  
111 -0.00266,  
112 0.00692,  
113 0.01198,  
114 0.01187,  
115 0.00750,  
116 0.00071,  
117 -0.00563,  
118 -0.00922,  
119 -0.00948,  
120 -0.00777,  
121 -0.00612,  
122 -0.00650,  
123 -0.00995,  
124 -0.01612,  
125 -0.02303,  
126 -0.02842,  
127 -0.03089,  
128 -0.02996,  
129 -0.02667,  
130 -0.02307,  
131 -0.02086,  
132 -0.02047,  
133 -0.02139,  
134 -0.02265,  
135 -0.02357,  
136 -0.02412,  
137 -0.02440,  
138 -0.02423,  
139 -0.02394,  
140 -0.02362,  
141 -0.02350,  
142 -0.02423,  
143 -0.02684,  
144 -0.03156,  
145 -0.03678,  
146 -0.04004,  
147 -0.03929,  
148 -0.03405,  
149 -0.02561,  
150 -0.01610,  
151 -0.00753,  
152 -0.00150,  
153 0.00143,  
154 0.00151,  
155 -0.00084,  
156 -0.00438,  
157 -0.00721,  
158 -0.00792,  
159 -0.00613,  
160 -0.00239,  
161 0.00298,  
162 0.00989,  
163 0.01750,  
164 0.02456,  
165 0.02999,  
166 0.03349,  
167 0.03536,  
168 0.03548,  
169 0.03373,  
170 0.03065,  
171 0.02759,  
172 0.02599,  
173 0.02675,  
174 0.02909,  
175 0.03137,  
176 0.03261,  
177 0.03281,  
178 0.03263,  
179 0.03247,  
180 0.03232,  
181 0.03216,  
182 0.03190,  
183 0.03105,  
184 0.02924,  
185 0.02654,  
186 0.02357,  
187 0.02106,  
188 0.01891,  
189 0.01634,  
190 0.01283,  
191 0.00850,  
192 0.00445,  
193 0.00217,
```

194 0.00229,  
195 0.00460,  
196 0.00863,  
197 0.01333,  
198 0.01739,  
199 0.01971,  
200 0.01993,  
201 0.01861,  
202 0.01702,  
203 0.01597,  
204 0.01567,  
205 0.01616,  
206 0.01757,  
207 0.02005,  
208 0.02345,  
209 0.02735,  
210 0.03122,  
211 0.03461,  
212 0.03696,  
213 0.03775,  
214 0.03651,  
215 0.03329,  
216 0.02869,  
217 0.02370,  
218 0.01908,  
219 0.01535,  
220 0.01289,  
221 0.01169,  
222 0.01157,  
223 0.01224,  
224 0.01340,  
225 0.01472,  
226 0.01601,  
227 0.01729,  
228 0.01859,  
229 0.01960,  
230 0.01972,  
231 0.01868,  
232 0.01676,  
233 0.01431,  
234 0.01178,  
235 0.00966,  
236 0.00841,  
237 0.00824,  
238 0.00904,  
239 0.01070,  
240 0.01317,  
241 0.01634,  
242 0.02001,  
243 0.02383,  
244 0.02733,  
245 0.03012,  
246 0.03186,  
247 0.03261,  
248 0.03280,  
249 0.03263,  
250 0.03207,  
251 0.03126,  
252 0.03031,  
253 0.02936,  
254 0.02861,  
255 0.02823,  
256 0.02826,  
257 0.02833,  
258 0.02778,  
259 0.02620,  
260 0.02370,  
261 0.02079,  
262 0.01780,  
263 0.01497,  
264 0.01269,  
265 0.01131,  
266 0.01088,  
267 0.01103,  
268 0.01107,  
269 0.01051,  
270 0.00951,  
271 0.00865,  
272 0.00852,  
273 0.00924,  
274 0.01045,  
275 0.01155,  
276 0.01192,  
277 0.01125,  
278 0.00981,  
279 0.00818,  
280 0.00707,

```
281 0.00675,  
282 0.00730,  
283 0.00836,  
284 0.00946,  
285 0.01058,  
286 0.01177,  
287 0.01304,  
288 0.01438,  
289 0.01562,  
290 0.01655,  
291 0.01707,  
292 0.01711,  
293 0.01668,  
294 0.01588,  
295 0.01492,  
296 0.01395,  
297 0.01309,  
298 0.01229,  
299 0.01153,  
300 0.01072,  
301 0.00977,  
302 0.00874,  
303 0.00780,  
304 0.00710,  
305 0.00673,  
306 0.00657,  
307 0.00646,  
308 0.00645,  
309 0.00673,  
310 0.00719,  
311 0.00750,  
312 0.00738,  
313 0.00681,  
314 0.00601,  
315 0.00519,  
316 0.00450,  
317 0.00406,  
318 0.00388,  
319 0.00400,  
320 0.00440,  
321 0.00492,  
322 0.00546,  
323 0.00604,  
324 0.00675,  
325 0.00762,  
326 0.00842,  
327 0.00873,  
328 0.00826,  
329 0.00709,  
330 0.00568,  
331 0.00439,  
332 0.00349,  
333 0.00314,  
334 0.00324,  
335 0.00347,  
336 0.00344,  
337 0.00284,  
338 0.00163,  
339 0.00009,  
340 -0.00152,  
341 -0.00306,  
342 -0.00443,  
343 -0.00542,  
344 -0.00592,  
345 -0.00584,  
346 -0.00513,  
347 -0.00382,  
348 -0.00216,  
349 -0.00044,  
350 0.00101,  
351 0.00191,  
352 0.00215,  
353 0.00182,  
354 0.00102,  
355 -0.00014,  
356 -0.00163,  
357 -0.00354,  
358 -0.00587,  
359 -0.00850,  
360 -0.01117,  
361 -0.01366,  
362 -0.01571,  
363 -0.01712,  
364 -0.01763,  
365 -0.01707,  
366 -0.01551,  
367 -0.01329,
```

368 -0.01079,  
369 -0.00834,  
370 -0.00612,  
371 -0.00435,  
372 -0.00323,  
373 -0.00281,  
374 -0.00299,  
375 -0.00355,  
376 -0.00434,  
377 -0.00530,  
378 -0.00638,  
379 -0.00732,  
380 -0.00784,  
381 -0.00783,  
382 -0.00744,  
383 -0.00690,  
384 -0.00622,  
385 -0.00544,  
386 -0.00465,  
387 -0.00409,  
388 -0.00407,  
389 -0.00466,  
390 -0.00554,  
391 -0.00637,  
392 -0.00699,  
393 -0.00729,  
394 -0.00714,  
395 -0.00643,  
396 -0.00534,  
397 -0.00427,  
398 -0.00354,  
399 -0.00329,  
400 -0.00349,  
401 -0.00401,  
402 -0.00470,  
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7510 0,0,0,0,0,0,0,0,0,0,
7511 0,0,0,0,0};
7512
7513
7514 #endif // REVERB_ARRAY_H

```

## 5.10 ringbuffer.h

```

1  #ifndef RINGBUFFER_H
2  #define RINGBUFFER_H
3
4  #include "Arduino.h"
5  #include "AudioStream.h"
6
11 template <class T>
12 class RingBuffer {
13 public:
20     RingBuffer(size_t size, T initializer) : _size(size), _head(0),
21         _tail(0), _count(0), _data(new T[size]) {
22         for (size_t i = 0; i < size; i++) {
23             _data[i] = initializer;
24         }
25     }
26
32     RingBuffer(size_t size) {
33         RingBuffer(size, T());
34     }
35
40     ~RingBuffer() {
41         delete[] _data;
42     }
43
52     bool push(T item, T* evicted) {
53         bool ret = isFull();
54         if (ret) {
55             *evicted = pop(); // clear a spot if needed
56         } else {
57             _data[_head] = item;
58             _head = (_head + 1) % _size;
59             _count++;
60             return ret;
61         }
62     }
63
69     T peek() {
70         return _data[_tail];
71     }
72
79     T peekFront(int n) {
80         // not sure if % handles negative numbers correctly... add _size to be sure
81         return _data[( _head - n + _size) % _size];
82     }
83
89     T pop() {
90         T item = peek();
91         _tail = (_tail + 1) % _size;
92         if (_count > 0) {
93             _count--;
94         }
95         return item;
96     }
97
103     int count() {
104         return _count;
105     }
106
112     int size() {
113         return _size;
114     }
115
122     bool isEmpty() {
123         return _count == 0;
124     }
125
132     bool isFull() {

```

```
133         return _count == _size;
134     }
135
136 private:
137     uint32_t _size; // allocated size
138
139     // technically should not need all 3 but it's a little easier
140     uint32_t _head;
141     uint32_t _tail;
142     uint32_t _count;
143
144     T* _data;
145 };
146
147
148 #endif // RINGBUFFER_H
```





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