

# TAS58xx Tuning setup and Linux Driver Integration

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# Agenda

## 1. Tuning setup

- Hardware setup
- Software setup

## 2. Linux Driver integration

- **Linux Driver**
- **DTS**
- **Power on sequence**

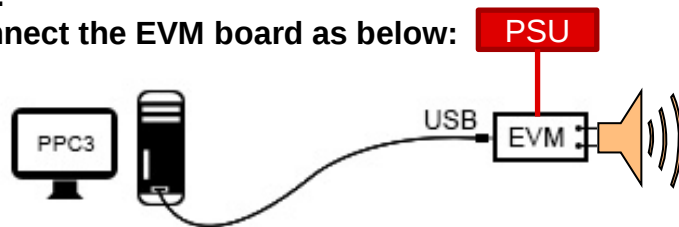
# Hardware setup

## Hardware needed:

- ❑ TAS5805 ([Product folder](#))
  - [EVM board](#)
- ❑ TAS5825: ([Product folder](#))
  - [EVM board](#)
  - PPCMB (<https://www.ti.com/store/ti/en/p/product/?p=PUREPATH-CMBEVM>)

## Setup:

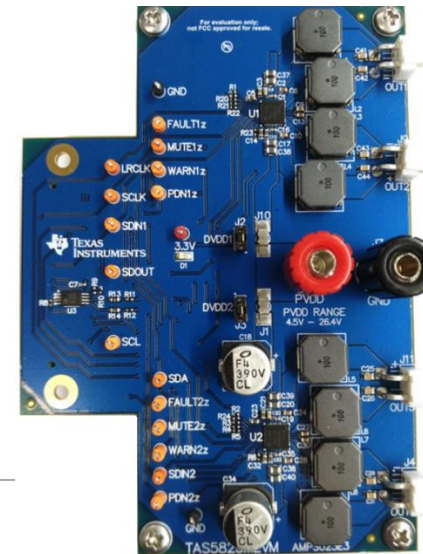
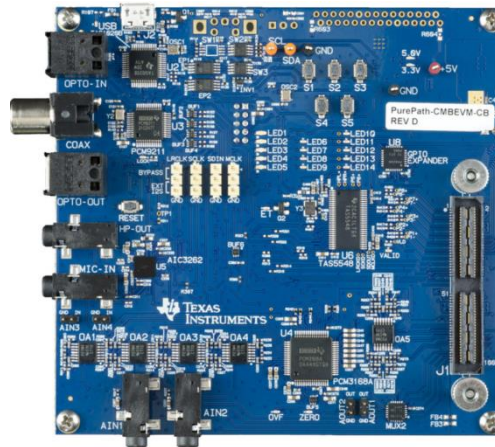
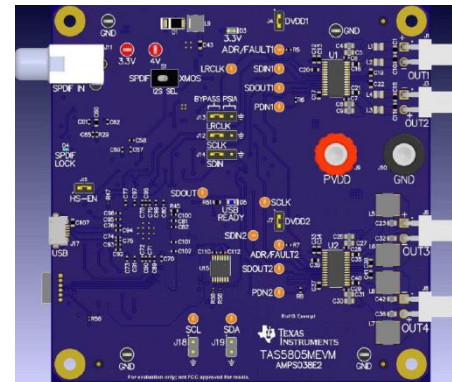
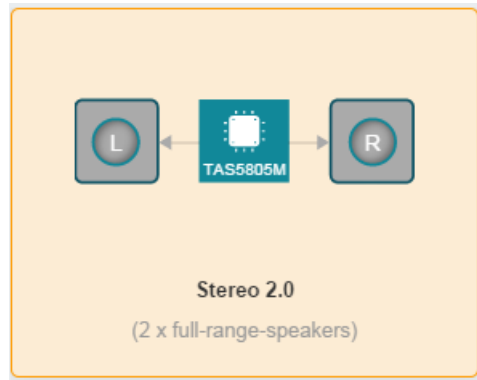
- ❑ Connect the EVM board as below:



## ❑ Check:

- Blue LED indicating USB lock is on
- 3.3V Led is on
- TAS5805 EVM (make sure SWITCH is selected correctly: X MOS (USB input), SPDF)

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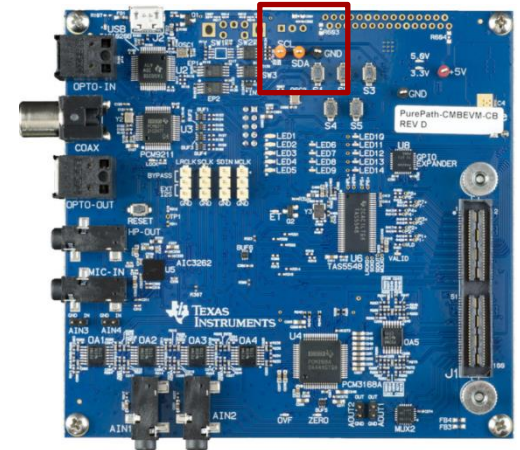
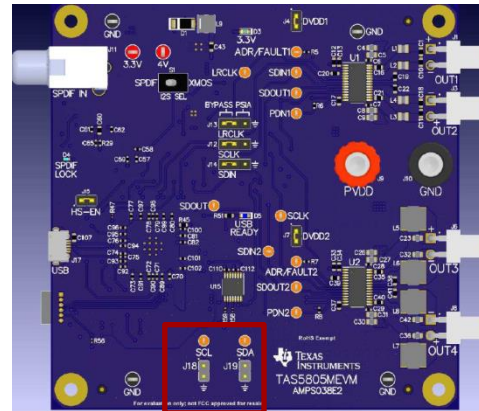
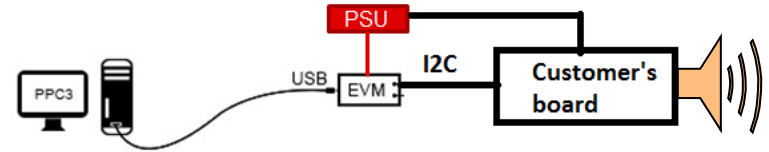
# Hardware setup--- for tuning in customer's PCB

## Setup:

- ❑ Connect the EVM board as below
- ❑ Connect I2C from TAS5805's EVM board or PPCMB to customer board
- ❑ Then use PPC3 software to tune in customer's board
- ❑ I2S can also be generated from EVM/PPCMB (see schematic)

- See UG of TAS5805:

<http://www.ti.com/lit/ug/slou510/slou510.pdf>



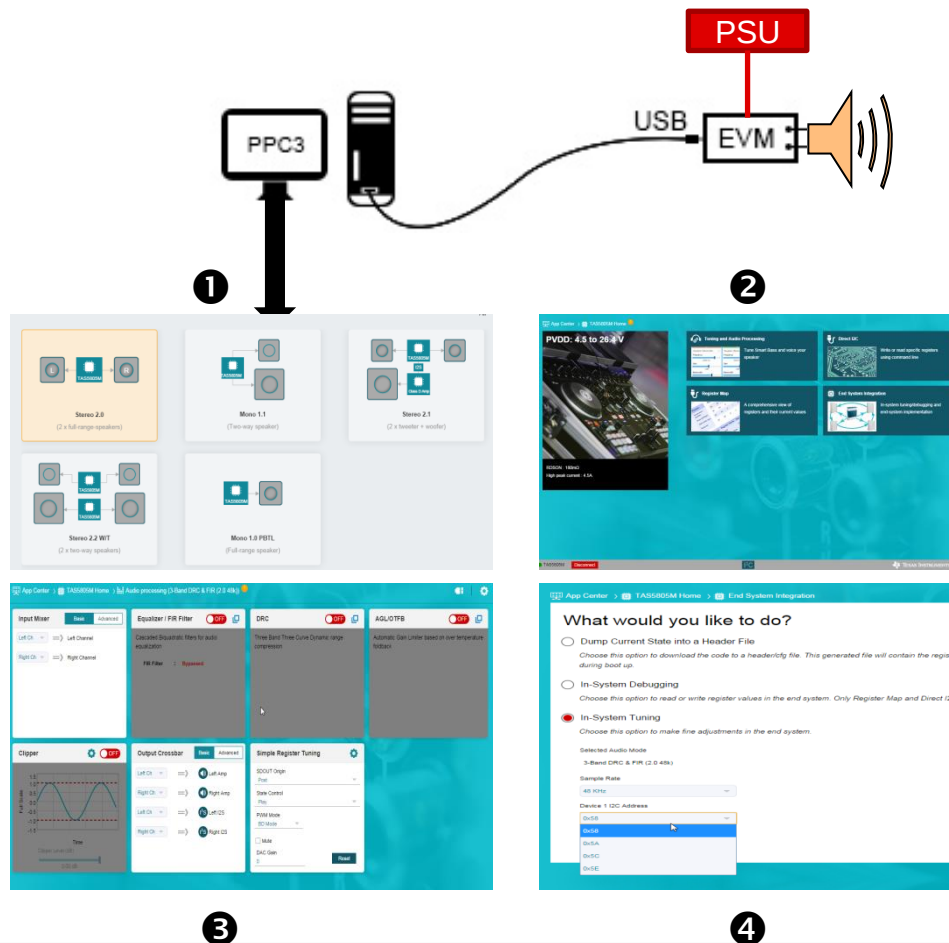
# Software setup

## Access needed:

- ❑ Apply for **PPC3 access** with you **MyTI account**;
- ❑ Apply for **TAS5805 access** with your MyTI account;

## Start PPC3: (E.g. TAS5805)

1. Choose speaker configuration: 2.0, 1.1, 2.1, 2.2 or 1.0 (When choose PBTL 1.0. please short p/n of output to connect to one speaker)
2. Make sure the dot at left corner turn green: (Connected to EVM board)
3. Enter Audio processing, now the I2C address is 0x58 in default
4. If your I2C address of your TAS5805 is not 0x58, you can choose I2C address in “End System Integration” to set expected I2C address



# Tuning setup

## Control TAS5805

### ❑ State control

- Play mode: music can be played;
- HiZ: output PWM is closed
- Sleep: sleep TAS5805
- Deep sleep: ultra power saving mode

### ❑ PWM mode:

- BD:
- 1SPW

### ❑ Gain setting (see next page)

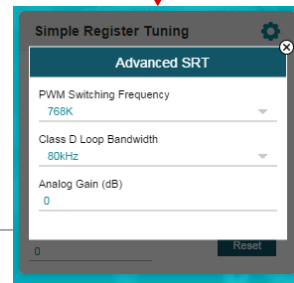
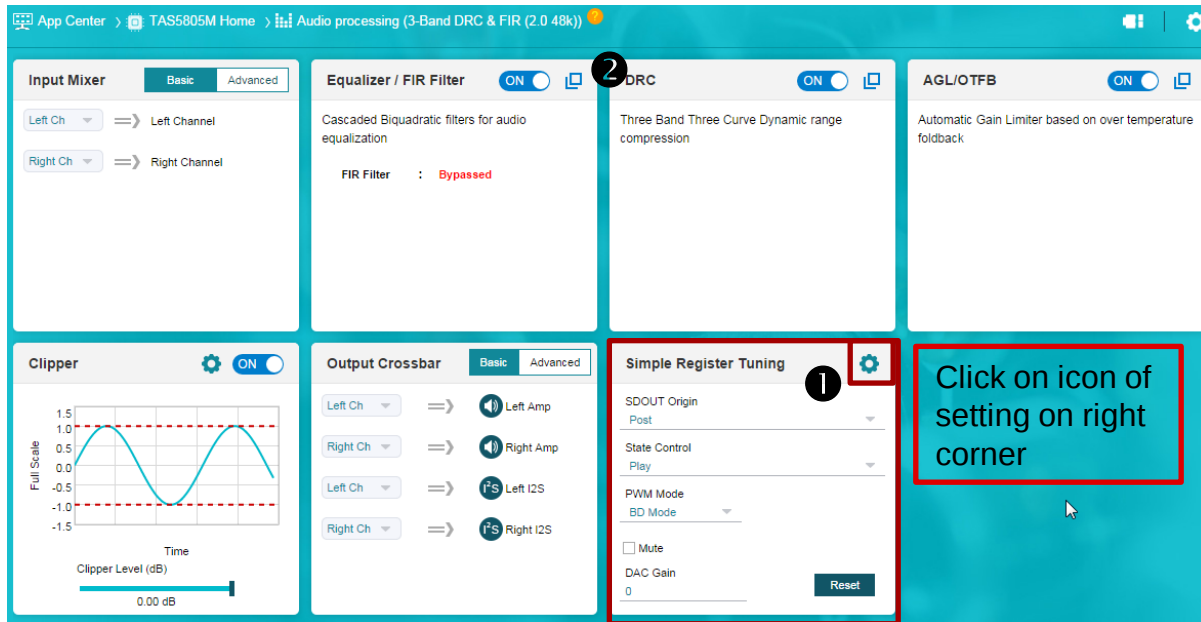
## Tuning

### ❑ Tuning EQ

### ❑ DRC/AGL/Clipper etc

### ❑ TAS5805 processing flow:

<http://www.ti.com/lit/an/sloa263/sloa263.pdf>



# Gain structure

## Overview

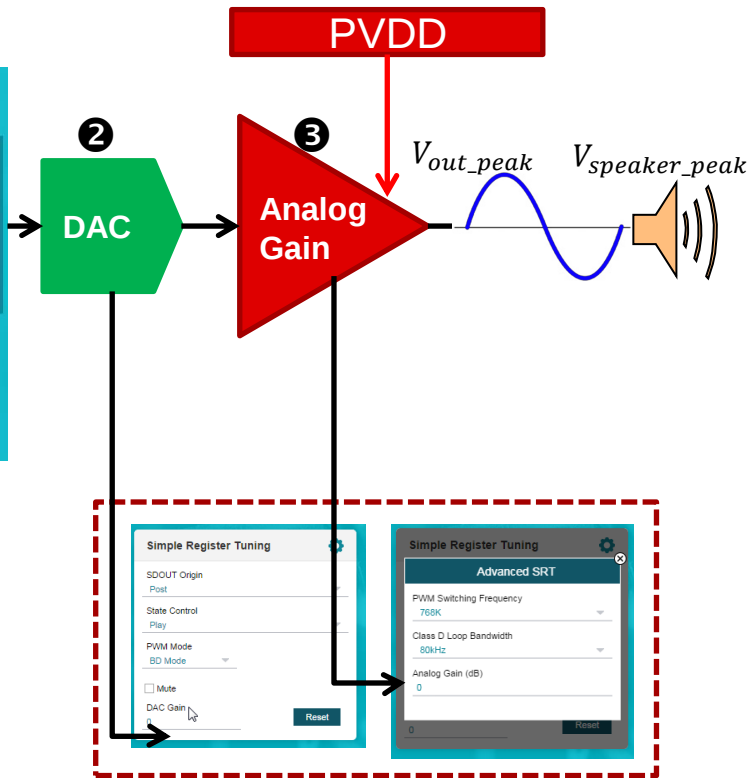
### 1 DSP



### Gain structure:

- DSP: input mixer/EQ/Volume/DRC/Crossbar
  - Gain 24dB headroom (before output corssbar )
  - Output of DSP cannot exceeds 24dB
- DAC: -110dB to 24dB
  - Suggested to be 0dB
  - Can be used as post-gain
- Analog gain [**non-linear**: -15.5dB(5V<sub>peak</sub>) to 0dB (29.5V<sub>peak</sub>) ]
  - Fixed gain (won't vary with value of PVDD)
  - If calculated V<sub>out</sub> > PVDD, it will cause clip

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$$V_{speaker\_peak} \sim V_{out\_peak} * \frac{R_{speaker}}{R_{speaker} + 2 * R_{ds(on)}}$$

# Gain calculation

Design spec  $V_{out\_peak} = 29.5 * 10^{\frac{(Gain_{digital} + Gain_{DAC} + Gain_{Analog})}{20}}$

| Spec                        | Parameter |
|-----------------------------|-----------|
| Power Supply / PVDD         | 12 V      |
| Impedence / $R_{load}$      | 6 ohm     |
| Output power / $P_{OutMax}$ | 2*10W     |

## Gain setting

| Volume | Analog gain | Maximum Vout(peak) | Clip?            |
|--------|-------------|--------------------|------------------|
| 0dB    | 0dB         | 29.5V              | Y (29.5V>PVDD)   |
| 0dB    | -6dB        | 14.75V             | Y (14.75V>PVDD)  |
| -6dB   | -6dB        | 7.38V              | N (7.38V < PVDD) |
| 0dB    | -12dB       | 7.38V              | N (7.38V < PVDD) |

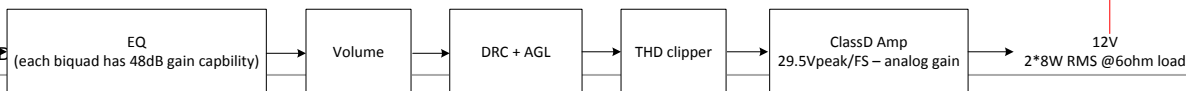
## Signal path analysis

- In order to avoid PVDD clipping, following method is provide to do the calculation

TAS5805 signal path

24dB signal path headroom

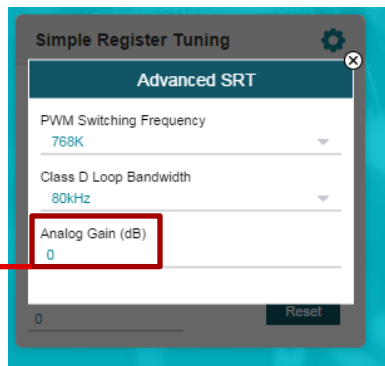
TICor Audio input = NE



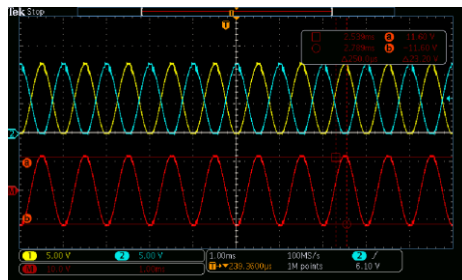
Change input signal level to decide DRC / AGL threshold

$20\log(11/29.5) = -8.5\text{dB}$   
Set analog gain as -9dB: 0x54 write 0x12

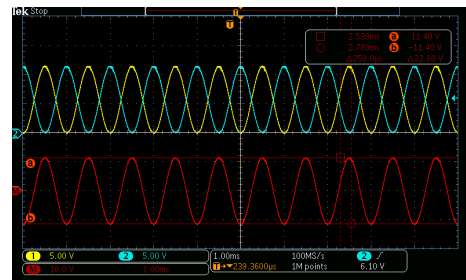
No clipping output ~11V



-8dB (clip)

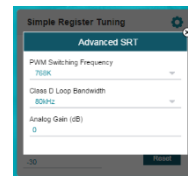
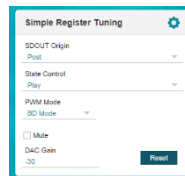
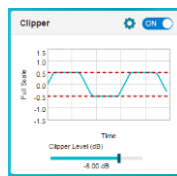
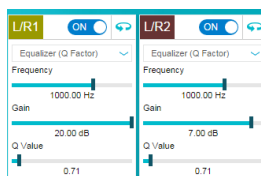
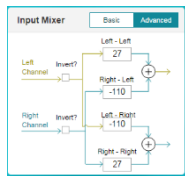


-8.5dB (no clip)



# DSP Headroom

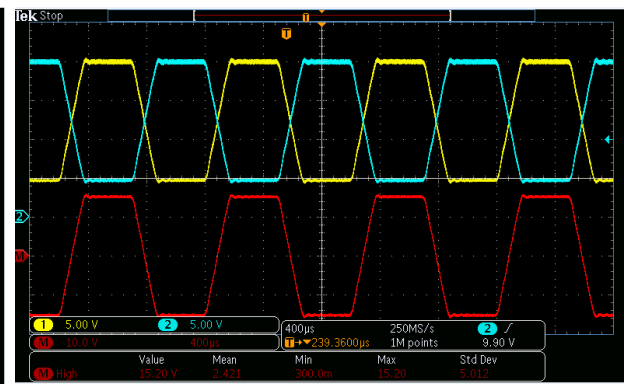
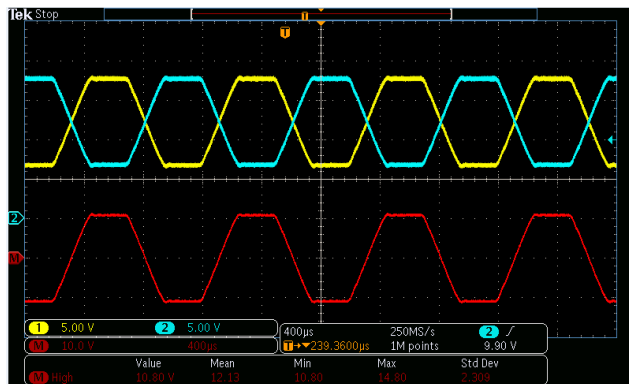
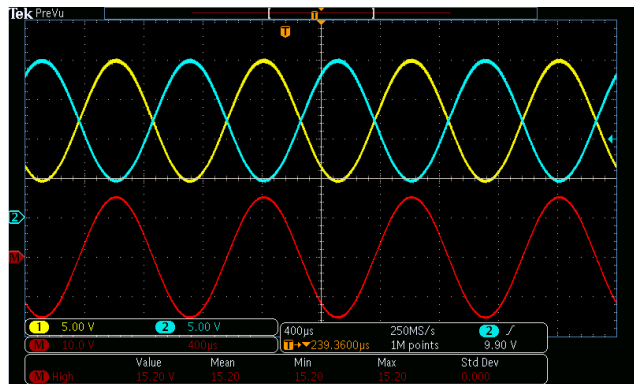
Setup:



Testing results:

| No. | Input | Input mixer | EQ        | Volume | Clipper | DAC gain | Analog gain/Maximum Vout(peak) | Vout(peak)/PVDD | Clip?            |
|-----|-------|-------------|-----------|--------|---------|----------|--------------------------------|-----------------|------------------|
| 1   | 0dB   | 0dB         | 0dB       | 24dB   | 0dB     | -30dB    | 0dB/29.5V                      | 15.2V/24V       | Y (29.5V>PVDD)   |
| 2   | 0dB   | 0dB         | 0dB       | 27dB   | 0dB     | -33dB    | 0dB/29.5V                      | 10.8V/24V       | Y (29.5V>PVDD)   |
| 3   | 0dB   | 27dB        | 0dB       | 0dB    | 0dB     | -33dB    | 0dB/29.5V                      | 10.8V/24V       | Y (14.75V>PVDD)  |
| 4   | 0dB   | 0dB         | 27dB@1KHz | 3dB    | 0dB     | -33dB    | 0dB/29.5V                      | 10.8V/24V       | N (7.38V < PVDD) |
| 5   | 0dB   | 0dB         | 0dB       | 0dB    | -6dB    | 0dB      | 0dB/29.5V                      | 15.2V/24V       | N (7.38V < PVDD) |

Waveform:



1

2 3 4

5

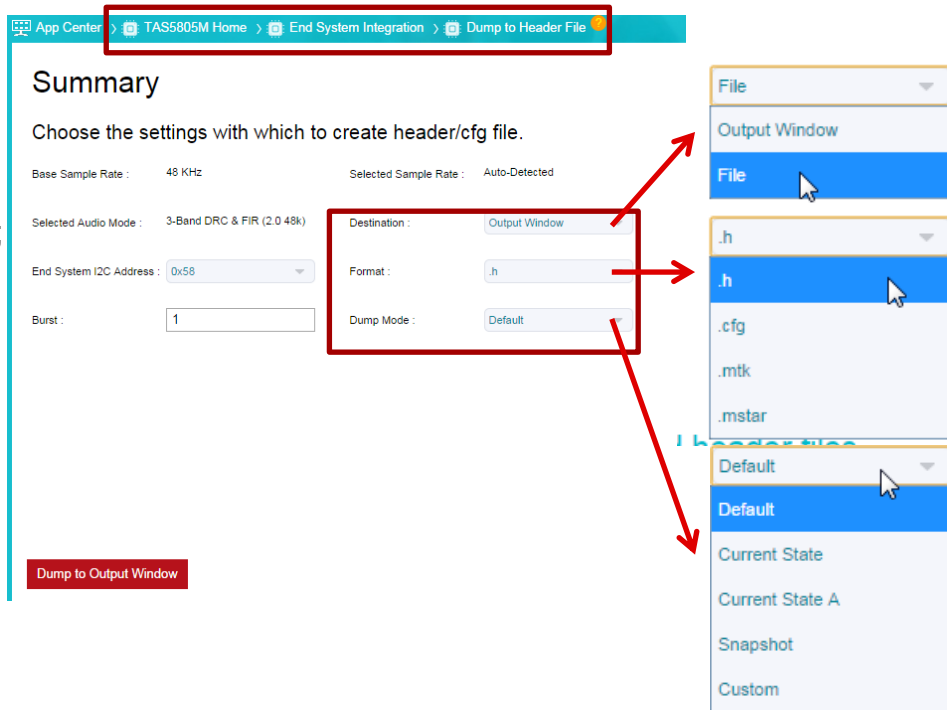
# Dump configuration files

## Dump configuration

- End System Integration
  - Dump current state into a head file

## ❑ Configuration

- Set I2C address basic on your TAS5805;
- Set burst: 1~128
- Destination: file/ window
- Format: based on your software
- Dump mode: **Current Status A!**



# Dump configuration files

Chose the block needed to be dumped

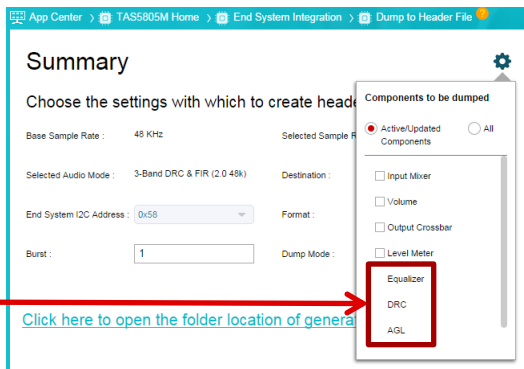
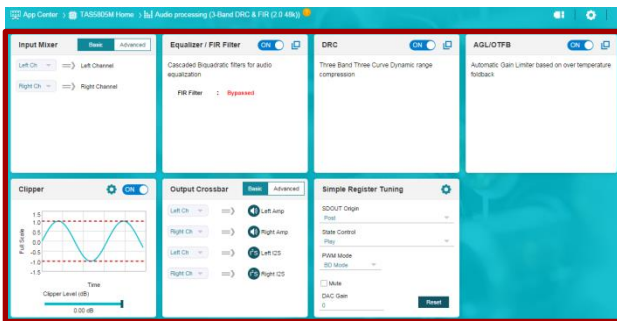
Destination: file

❑ Optional:

- Volume
- Output Crossbar
- Level Meter

❑ Fixed:

- EQ
- DRC
- AGL
- THD



Just EQ or DRC or AGL code is needed:

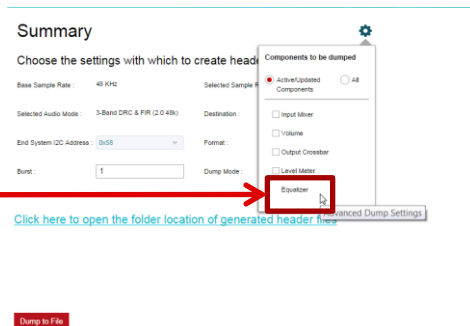
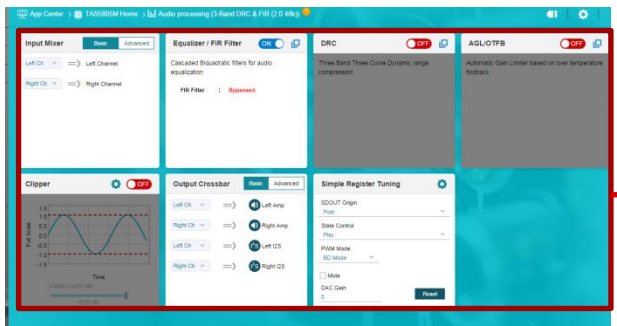
❑ Enable EQ only

❑ Dump just EQ with checkbox

❑ Choose EQ part by referring to

<http://www.ti.com/lit/an/sloa263/sloa263.pdf>

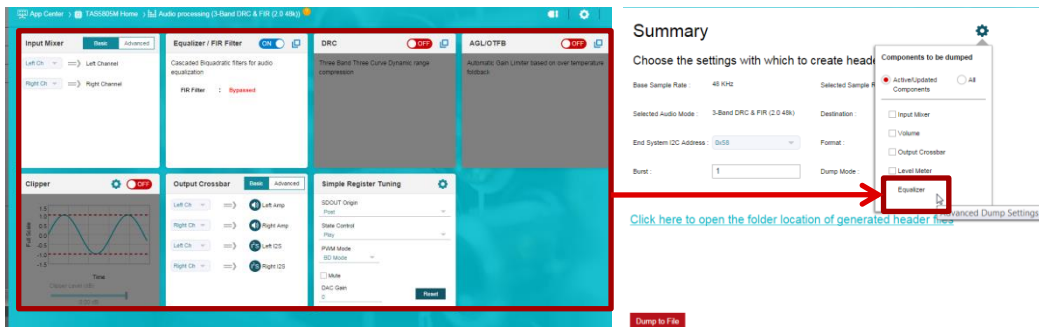
(See next page)



# Dump configuration files

## How to choose EQ from dumped .h file

- Use I2C log to get scripts of enable/disable EQ



- Then find the //register Tuning

- Scripts between them are for EQ

- Use Appendix of [TAS5805 process flow](#) to find EQ part for double check

```

118 // Book 0x00
119 { 0x00, 0x00 },
120 { 0x7f, 0x00 },
121 { 0x66, 0x86 },
122 // Book 0xaa
123 { 0x7f, 0xa },
124 { 0x00, 0x24 },
125 { 0x18, 0x08 },
126 { 0x19, 0x00 },
127 { 0x1a, 0x00 },
...
722 { 0x10, 0x0e },
723 { 0x11, 0x06 },
724 { 0x12, 0x04 },
725 { 0x13, 0x14 },
726 { 0x14, 0xf9 },
727 { 0x15, 0x59 },
728 { 0x16, 0xb6 },
729 { 0x17, 0xb },
...
731 //Register Tuning
732 { 0x00, 0x00 },
733 { 0x7f, 0x00 },
734 { 0x30, 0x00 },
735 { 0x4c, 0x30 },
736 { 0x03, 0x03 },

```

Table 6. 2.0 96 kHz Mode Memory Map — Book 0xaa

| SUB ADDRESS    | PAGE | REGISTER NAME | NUMBER OF BYTES/FORMAT | DEFAULT VALUE | DESCRIPTION         |
|----------------|------|---------------|------------------------|---------------|---------------------|
| EQ LEFT 15 BQS |      |               |                        |               |                     |
| 0x18           | 0x24 | CH-L BQ 1 B0  | 4 / 5.27               | 0x08000000    | left BQ coefficient |
| 0x1C           | 0x24 | CH-L BQ 1 B1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x20           | 0x24 | CH-L BQ 1 B2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x24           | 0x24 | CH-L BQ 1 A1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x28           | 0x24 | CH-L BQ 1 A2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x2C           | 0x24 | CH-L BQ 2 B0  | 4 / 5.27               | 0x08000000    | left BQ coefficient |
| 0x30           | 0x24 | CH-L BQ 2 B1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x34           | 0x24 | CH-L BQ 2 B2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x38           | 0x24 | CH-L BQ 2 A1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x3C           | 0x24 | CH-L BQ 2 A2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x40           | 0x24 | CH-L BQ 3 B0  | 4 / 5.27               | 0x08000000    | left BQ coefficient |
| 0x44           | 0x24 | CH-L BQ 3 B1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x48           | 0x24 | CH-L BQ 3 B2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x4C           | 0x24 | CH-L BQ 3 A1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x50           | 0x24 | CH-L BQ 3 A2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x54           | 0x24 | CH-L BQ 4 B0  | 4 / 5.27               | 0x08000000    | left BQ coefficient |
| 0x58           | 0x24 | CH-L BQ 4 B1  | 4 / 5.27               | 0x00000000    | left BQ coefficient |
| 0x5C           | 0x24 | CH-L BQ 4 B2  | 4 / 5.27               | 0x00000000    | left BQ coefficient |

# Software integration with dumped header file

## TI provide

1. Linux driver of TAS58xx series: <https://e2e.ti.com/support/audio/f/6/t/722027>
2. Reference of DTS:
  1. DTS file (see picture on the right)
  2. [http://gopinaths.gitlab.io/post/audio\\_codec\\_in\\_linux/](http://gopinaths.gitlab.io/post/audio_codec_in_linux/)
3. **Power on sequence (See next page)**

## Customer need to:

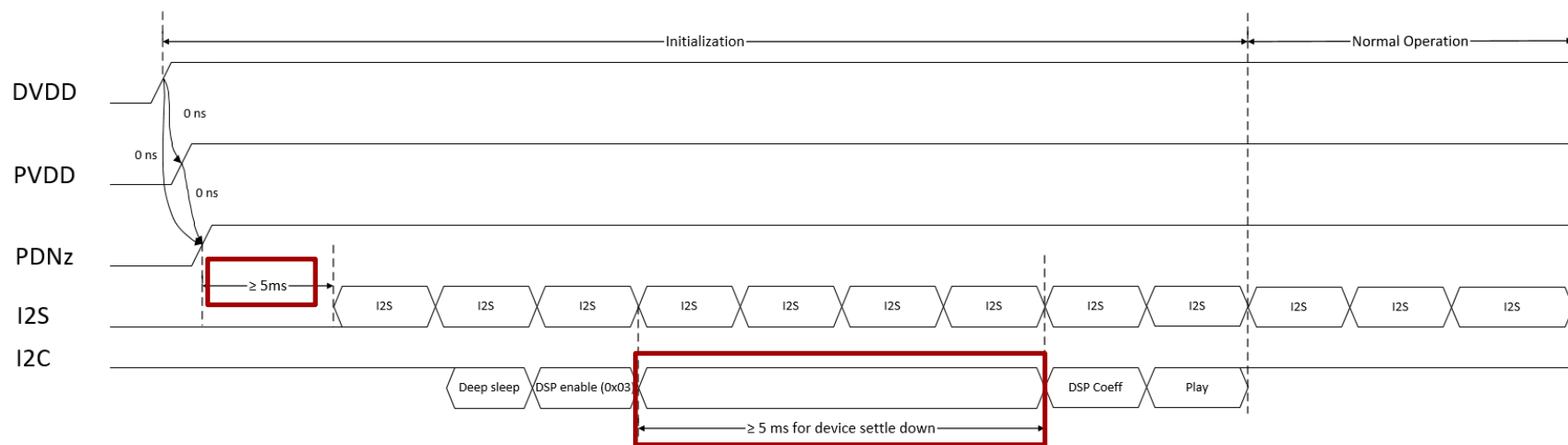
1. Configure DTS (Need SoC or software to finish)
2. Integrate the tas5805m.c into the driver with dumped .h file
3. Implement TI recommended power on sequence

```
/*把TAS5805添加I2C node下*/
dts {
    i2c2 {
        tas5805m: tas5805m@2c {
            compatible = "ti,tas5805m"; // TAS5805m.c 驱动程序提供;
            reg = <0x2c>; // I2C地址客户硬件决定
            #address-cells = <1>; //TI codec copy过来
            #size-cells = <0>; // TI codec 过来
        };
    };

    /*配置平台I2S, mcasp0是TI定义的, NXP可能叫sai,需要根据平台配置*/
    mcasp0 {
        #sound-dai-cells = <0>;
        pinctrl-names = "default"; /*
        pinctrl-0 = <&mcasp0_pins>;
        status = "okay";
        op-mode = <0>; /* MCASP_IIS_MODE */
        tdm-slots = <2>;
        serial-dir = < /* 0: INACTIVE, 1: TX, 2: RX */
            0 0 1 0
        >;
        tx-num-evt = <32>;
        rx-num-evt = <32>;
    };

    {
        sound {
            compatible = "ti,tas5805m-evm-audio"; //machine里添加
            ti,model = "TI TAS5805M"; // TAS5805m.c 驱动程序提供;
            ti,audio-codec = <&tas5805m>;
            ti,mcasp-controller = <&mcasp0>;
            ti,codec-clock-rate = <2457600>;
            mcasp_clock_enable = <&gpio1 27 1>; /* BeagleBone Black Clk enable on GPIO1_27 */
        };
    };
};
```

# Recommended Power on Sequence



It has been integrated in dumped .h file