TDK SmartSound One Evaluation Module User Guide

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OVERVIEW

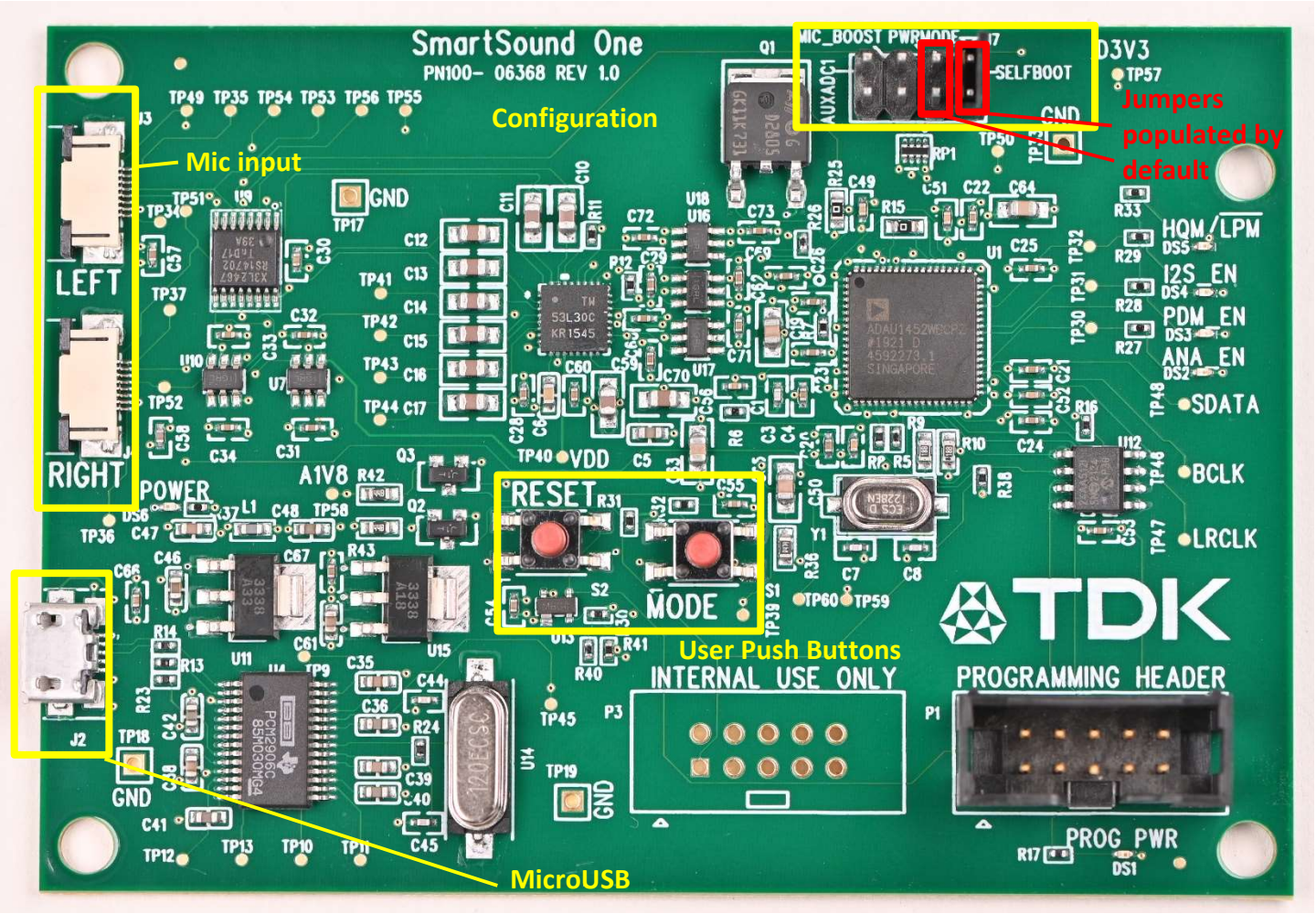

Figure 1. SmartSound One evaluation module with key components identified

The SmartSound One Evaluation Module is an easy to use, plug-and-play audio device that is compatible with any TDK MEMS microphone Flexible PCB (FPCB) featuring edge finger pins (see **Figures 2-4**) and supports the following microphone audio output interfaces:

- **Analog**
  - Single Ended
  - Differential
- **Digital**
  - PDM

SmartSound One was designed to provide a platform that enables customers to easily evaluate the performance of TDK MEMS Microphones. Users can evaluate key performance specifications and characteristics by recording the audio over USB. The board has been designed to maintain the audio signal integrity so that the full performance of the microphone can be realized on the USB recording or real time stream.

KEY FEATURES

The SmartSound One Module features the following:

- All-in-one microphone interface evaluation module
- Standard USB connection for power input and data output
- Plug-and-play functionality – no programming or soldering required
- Simple user push button interface to select common microphone output types
- High quality stereo audio capture (48kHz sample rate) to any PC recording software or as a real-time microphone input

GETTING STARTED

SmartSound One uses a micro USB connection to supply power and output audio data. Up to two (of the same audio interface type) TDK FPCB microphones can be connected to the ZIF connectors (shown in **Figure 2**) to measure the audio output in any audio recording software. Before using the board, it is recommended to first follow the instructions in this section to ensure the setup is correct.

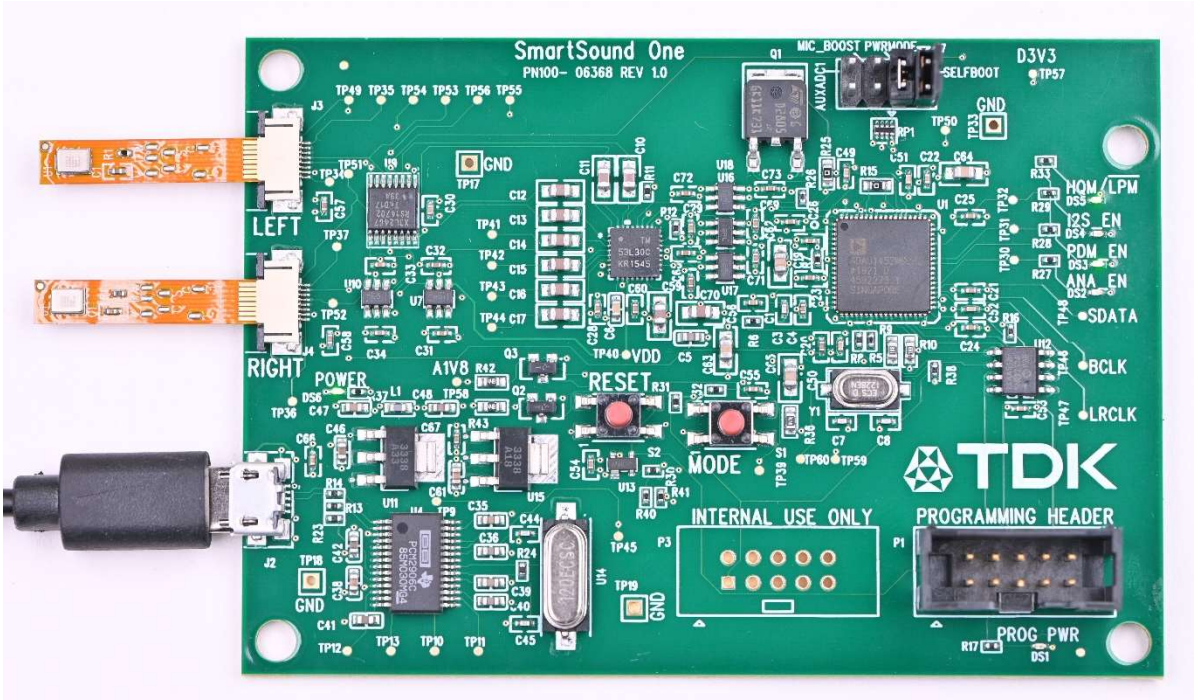

Figure 2. Microphones connected to SmartSound One Module

Figure 3. Edge connector FPCB (Top side)

Figure 4. Edge connector FPCB (Bottom side)

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Host Computer Setup

SmartSound One comes pre-programmed to allow for plug-and-play functionality out of the box. It is first recommended to supply power to the board with a micro USB cable and verify the blinking LED (reference designator DS5) to ensure successful boot. After plugging into a host like a PC, the board will be recognized as an audio card for recording in any audio recording software such as Audacity, which is a free to use and can be downloaded here https://www.audacityteam.org/. In order to enable this capability, the user must perform a one-time configuration of the sound card settings in Windows detailed below.

1) Go to Sound Device Manager (Control Panel -> Hardware and Sound -> Sound)
2) Right click on the 'USB AUDIO CODEC' device
3) Under the 'Advanced' tab, select 2 channel, 16 bit, 48000 Hz (DVD Quality) and hit 'Apply', shown in **Figure 5**

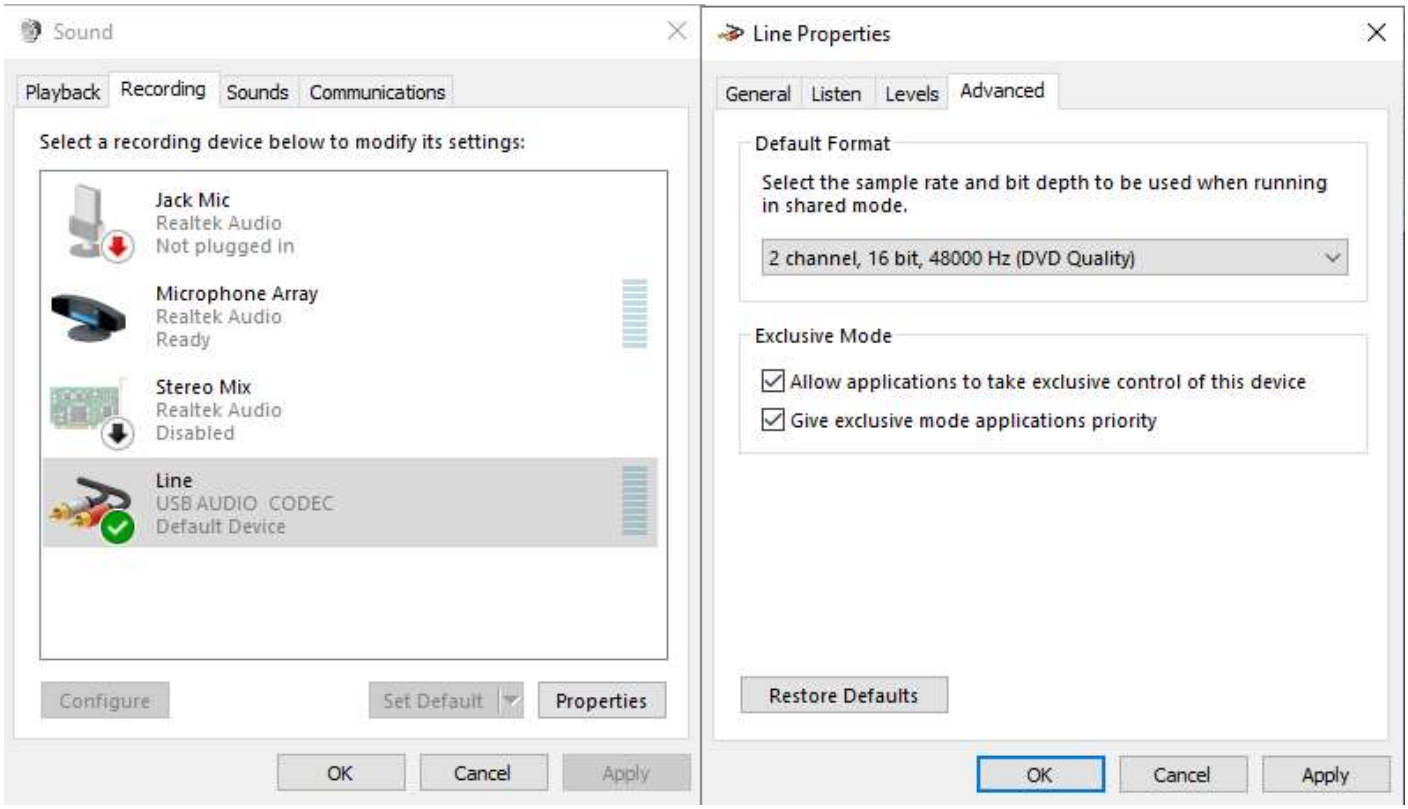

Figure 5. Windows Sound Settings

To verify that this was configured properly:

1) Without any microphone FPCBs attached to the SmartSound Board, open Audacity
2) Configure the input device as the 'LINE IN USB AUDIO CODEC' and the output device to user's preference (i.e speakers or headphones)
3) Hit record with SmartSound One in standby mode (DS5 LED blinking), and user should see
    a. -40dB 400Hz sine tone on the Left channel
    b. -40dB 200Hz sine wave on the Right channel

The user can populate the MIC_BOOST jumper to apply +30dB gain which results in a -10dB test tone level. Reference **Figure 1**, jumper J7 or the "**Configuration Header Settings**" section for the MIC_BOOST jumper location. See **Figure 6** as a reference for these standby mode waveforms.

Once the test tone has been verified in standby mode, the user may proceed to select the microphone interface mode of interest and plug the included FPCBs to start recording.

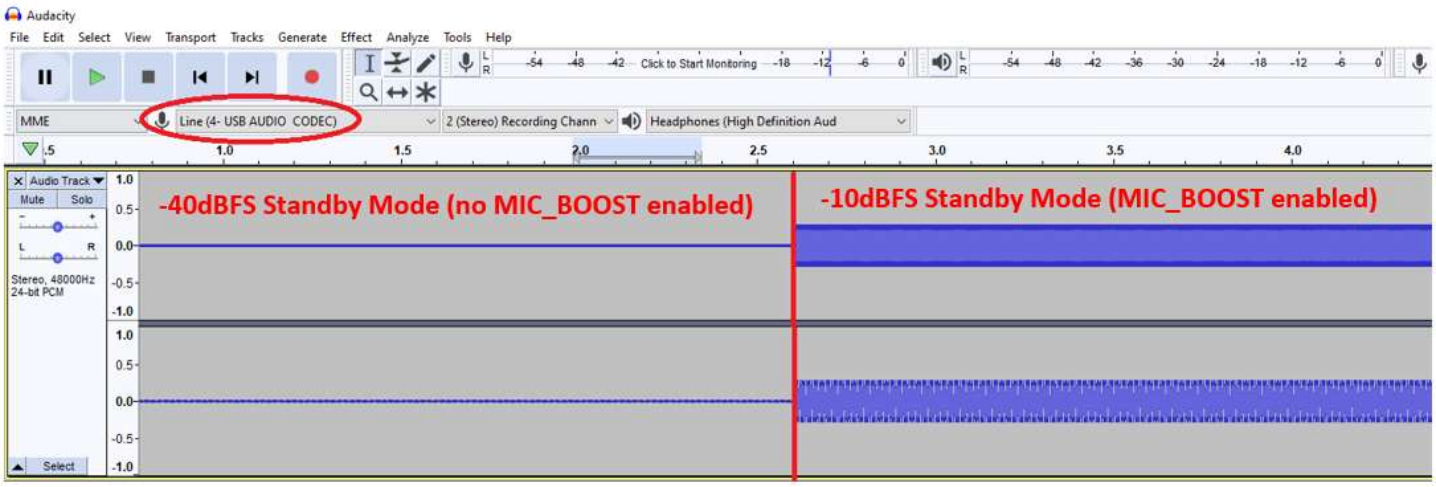

Figure 6. Recording in Audacity – Standby mode test tones

User Hardware Configuration

The board features several settings that are configurable by the user.

- Reset push button
- Mode push button
- Configuration header jumpers which can be used to select between high quality mode and low power mode (where applicable) and add up to +30dB of digital gain

Reset

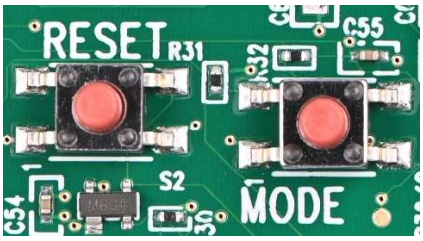

Figure 7. Reset and Mode push buttons

Pressing the reset button is the manual method for resetting the on-board DSP and ADC. If the device were to malfunction for whatever reason, pressing this button would allow the board to load factory default settings.

Mode

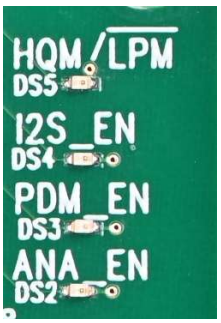

Figure 8. LED indications for mode select

The mode button shown in **Figure 7** selects the type of output interface it expects to see on the FPCB input. SmartSound One starts up in Standby Mode and pressing the 'MODE' button scrolls through the other modes in the order listed below:

- **Standby Mode** – The board starts up in this mode and a blinking LED (DS5) indicates the factory DSP image was successfully loaded. Internally generated test tones will be output on the left and right channels. The mic outputs aren't connected in this mode, so the user will have to toggle MODE to activate the appropriate mic type

- **Analog Mode** – The ANA_EN LED (DS2) will light up to indicate analog mic connection. The signal from the analog flex board will be routed to the ADC for conversion to a digital signal which is subsequently routed to the DSP and USB codec for PC recording/capture
- **PDM Mode** – The PDM_EN LED (DS3) will light up to indicate PDM digital mic connection. The DATA output will be routed to the DSP and USB codec for PC recording/capture
- **I2S Mode** – The I2S_EN LED (DS4) is disabled on this version of the board

Pressing the mode button will continue to cycle through the modes in the order listed above.

So for example, if the user wants to evaluate a TDK PDM microphone on flex, such as the EV_T5837-FX, then the following steps should be executed:

1) Power the board up with micro USB cable and verify standby mode (blinking DS5)
2) Press the mode button twice
3) Verify the PDM_EN LED (DS3) is lit
4) Connect EV_T5837-FX flex board to either channel (or into both channels for a stereo input)
5) Record/measure on the host computer

Configuration Header Settings

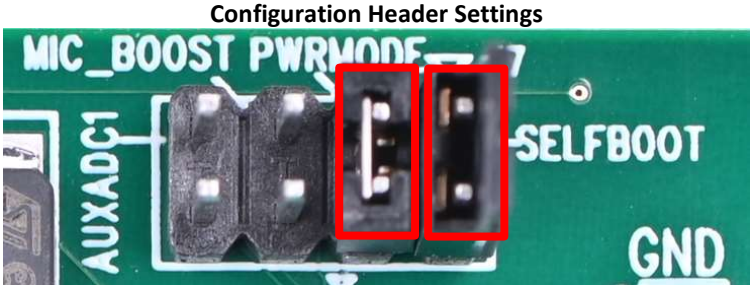

Figure 9. Configuration header

SmartSound One has four vertical user configurable header pins (reference designator J7) which are shown in **Figure 9** and have a 10k pull down resistor by default. Populating the jumper will pull those pins up to 3.3V. The two settings that come pulled up to 3.3V by default are PWRMODE and SELFBOOT, which are highlighted in red in **Figure 9**. The following provides a description of the remaining configuration settings (from left to right):

- **AUXADC1** – *Depopulated by default*; reserved for future use

- **MIC_BOOST** – *Depopulated by default;* populating this jumper applies +30dB of digital gain in the DSP for all microphone signal paths. Users should populate this jumper if they are interested in quick real time monitoring of the output signal as this will apply the appropriate gain to use and listen as a USB microphone. An external resistor **R** can also be populated between these two pins according to the following formula to adjust the digital gain between 0 and +30dB:

GAIN (dB) = 30*[1-(R/(10K+R))]

Resistor value	Gain
0 (populate jumper)	+30dB
5k	+20dB
10k	+15dB
15k	+12dB
20k	+10dB
40k	+6dB
90k	+3dB
Open (depopulate jumper)	0dB

Table 1. MIC_BOOST gain settings (typical)

- **PWRMODE/PWR_MODE_SEL** – *Populated by default*; populated jumper configures any supported microphone for high quality mode. Depopulating this jumper will configure the microphone in low power mode where applicable.
    - For analog microphones, HQM mode biases the microphone VDD with 2.75V while in LPM the microphone VDD is biased to 1.8V.
    - For PDM microphones, HQM mode sets the clock supplied to the microphone to 3.072MHz while in LPM it sets the clock to 768kHz.

- **SELFBOOT** – *Populated by default;* populated jumper allows for self booting of the factory DSP profile. Depopulating this will result in failure to boot up the pre-programmed profile

BLOCK DIAGRAM

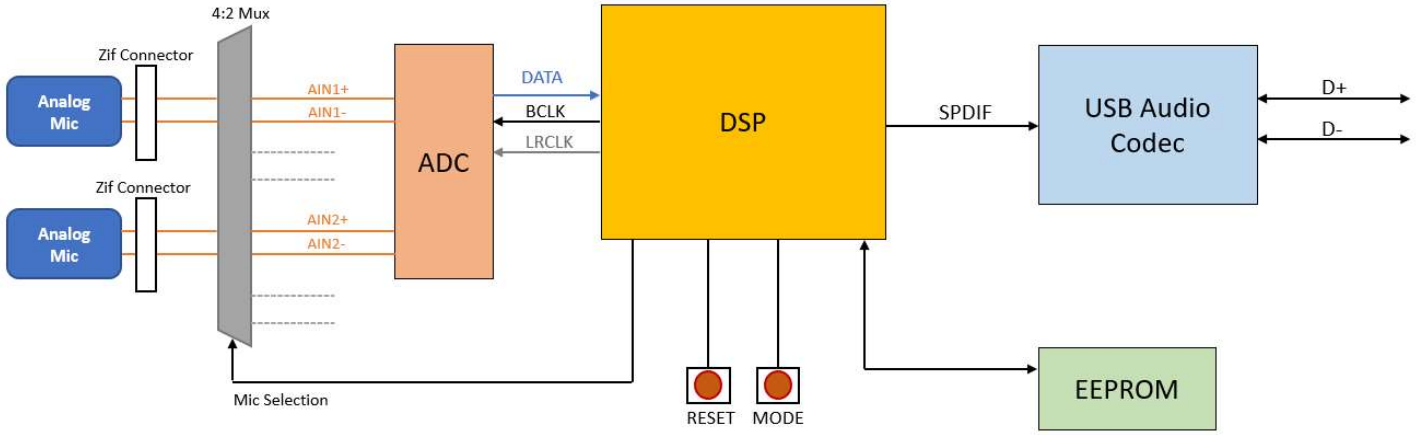

Figure 10. Block diagram of analog signal path

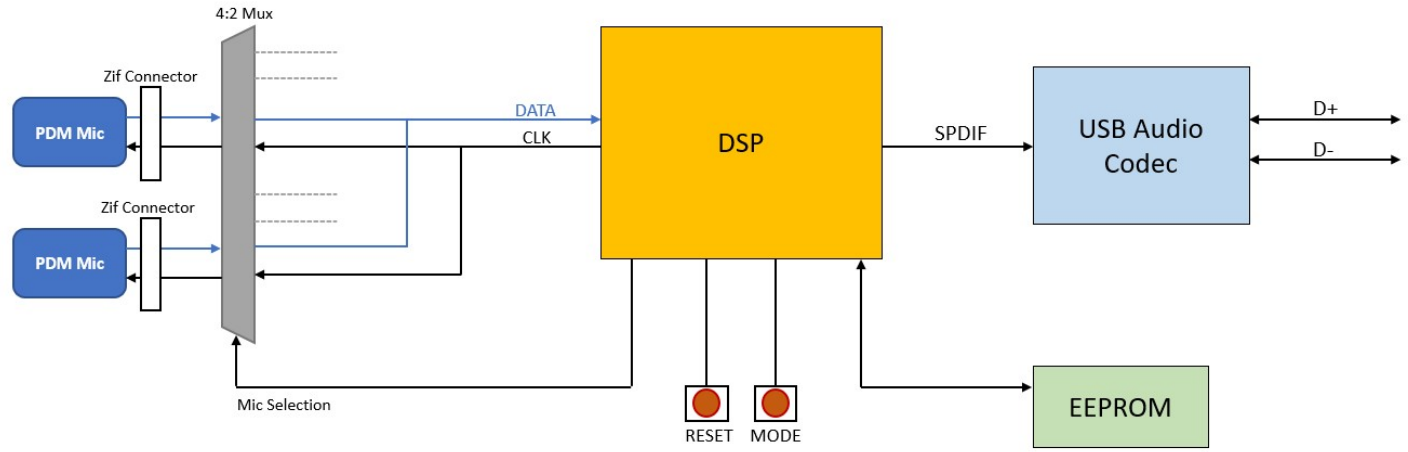

Figure 11. Block diagram of PDM signal path

FREQUENTLY ASKED QUESTIONS

Q: Can I use two microphones of different output types?
A: No. For any given mode, please only connect up to two microphones of the output interface type at a time. Mixing different interface microphones (i.e 1 Analog and 1 PDM) will likely result in malfunctioning or abnormal behavior and can potentially damage the board.

Q: Which TDK MEMS Microphone FPCBs are compatible with this board?
A: Only FPCBs with edge connector pins can be plugged into the two on-board ZIF connectors.

Q: I see an I2S mode LED – does this support I2S microphones?
A: I2S will be supported in a future version of the board

REVISION HISTORY

REVISION DATE	REVISION	DESCRIPTION
1/18/2022	0.1	Initial Release
1/28/2022	1.0	Revised typos and updated pictures

COMPLIANCE DECLARATION DISCLAIMER

TDK believes the environmental and other compliance information given in this document to be correct but cannot guarantee accuracy or completeness. Conformity documents substantiating the specifications and component characteristics are on file. TDK subcontracts manufacturing, and the information contained herein is based on data received from vendors and suppliers, which has not been validated by TDK.

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