# Quick start guide

## EVAL_AUDIO_MA2304xNS

Valid for: MA2304DNS and MA2304PNS

Class D audio team

August 2022

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The community forum features members of the audio applications team that are ready to provide timely support, helping you get your designs done quickly, reliably and right the first time.


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# Product overview and features

## Overview

The demonstration board EVAL_AUDIO_MA2304xNS is a preliminary evaluation and demonstration board for the MERUS™ MA2304xNS family of devices. It contains digital input/output and a variety of output and setup/selection features. It also contains an onboard buck power supply generator (1.8 V and 3.3 V selectable) so only one external power supply ($P_{VDD}$) is necessary. The board can be used for evaluating or demonstrating key features/advantages of the MERUS™ technology:

- Energy efficiency: power losses at typical audio listening levels/idle power loss
- THD performance and audio quality
- Compact application: minimum output filter components, no external heatsink

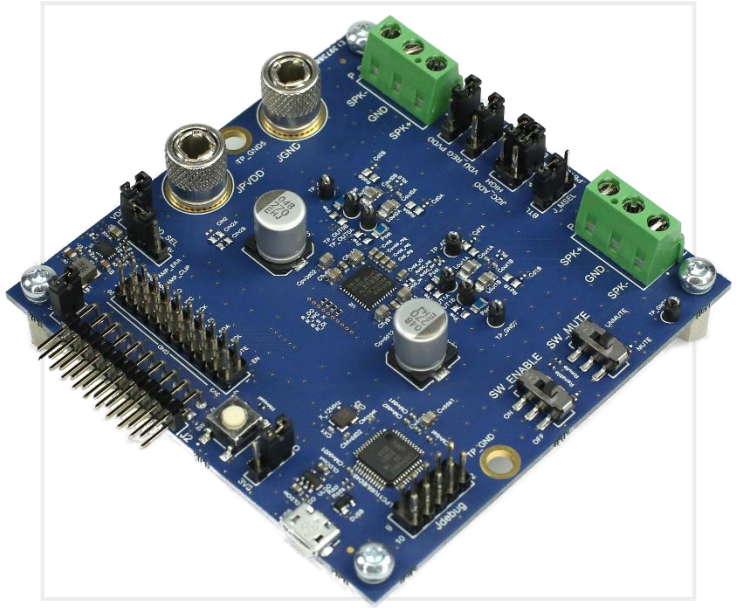



**Figure 1. MA2304xNS evaluation board**

## General features and audio performance

| | |
|---|---|
| Number of audio channels | 2 (BTL) or 1 (PBTL) |
| Audio input format | Digital ($I^2S$, LJF, RJF or TDM) |
| Supply voltage, $P_{VDD}$ | 18 V |
| Output noise level | 52 $\mu V_{rms}$ (high audio performance mode) |
| Dynamic range | 106 dB (high audio performance mode) |
| Idle consumption at $P_{VDD}$ = 18 V | 61 mW (low power consumption mode) |
| Efficiency, 1 W, 8 Ω | More than 79 percent |
| Efficiency, full scale, 8 Ω | More than 90 percent |


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# Board description

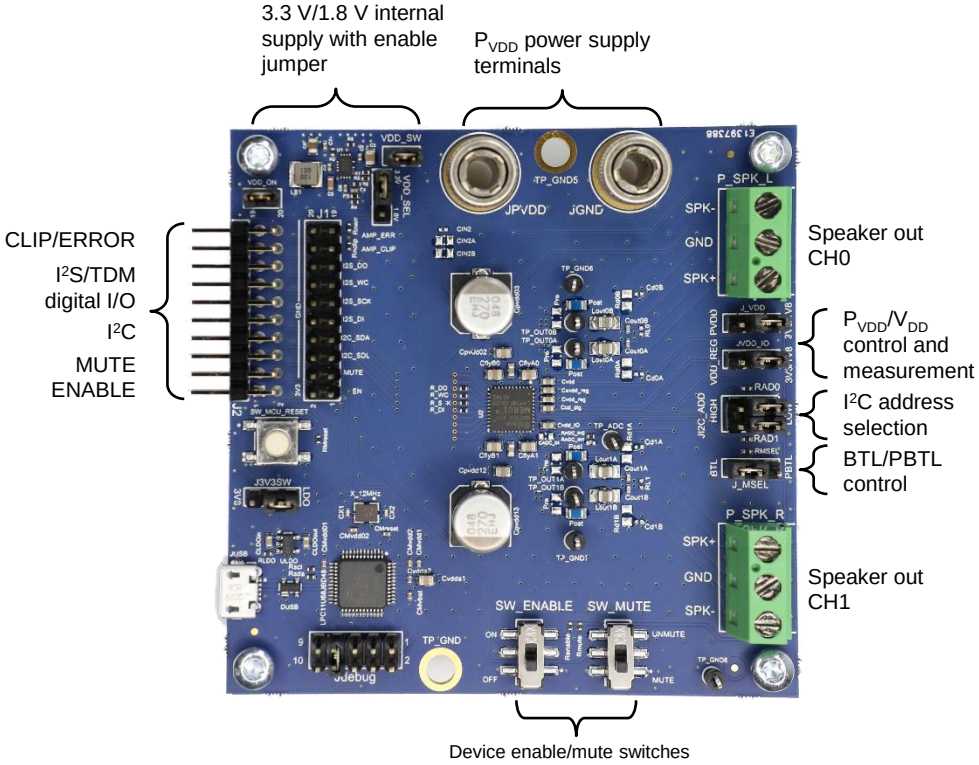



**Figure 2. EVAL_AUDIO_MA2304XX top view**

## › Recommended operating conditions

| Parameter | Part no. | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $P_{VDD}$ | MA2304XX | 10 | 18 | 20 | V |
| $V_{DD}$ | MA2304XX | 1.62 | 1.8 | 5.5 | V |
| Output peak current (BTL) | MA2304XX | | | 6.0 | A |
| Output peak current (PBTL) | MA2304XX | | | 12.0 | A |

## › Typical audio and electrical specifications

(BTL default configuration; power mode profiles = LPC/HAP)

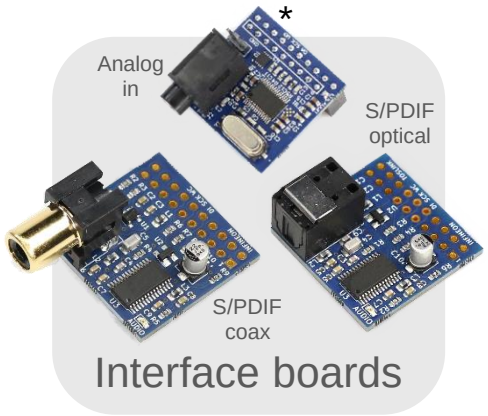
| Parameter | Conditions | Typ. | Unit |
|---|---|---|---|
| Short-term RMS output power (per channel) | THD+N = 10%, RL = 4 Ω, f = 1 kHz | 37 | W |
| Instantaneous peak output power (per channel) | THD+N = 1%, RL = 4 Ω, f = 1 kHz | 60 | W |
| Total harmonic distortion + noise | 1 kHz, $P_{OUT}$ = 1 W, RL = 4 Ω | 0.03 | % |
| Efficiency* | $P_{OUT}$ = 2x1 W, 8 Ω | >79 | % |
| Efficiency* | $P_{OUT}$ = full scale, 8 Ω | >90 | % |

* Efficiency values do not take into account the onboard 3V3 switching regulator consumption.


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# Interface boards

- The evaluation kit includes three interface boards that convert from analog, S/PDIF or TOSLINK signals to $I^2S$. See the hardware user manual for details.
  - Simply plug one of these boards into the digital I/O breakout header (J1).



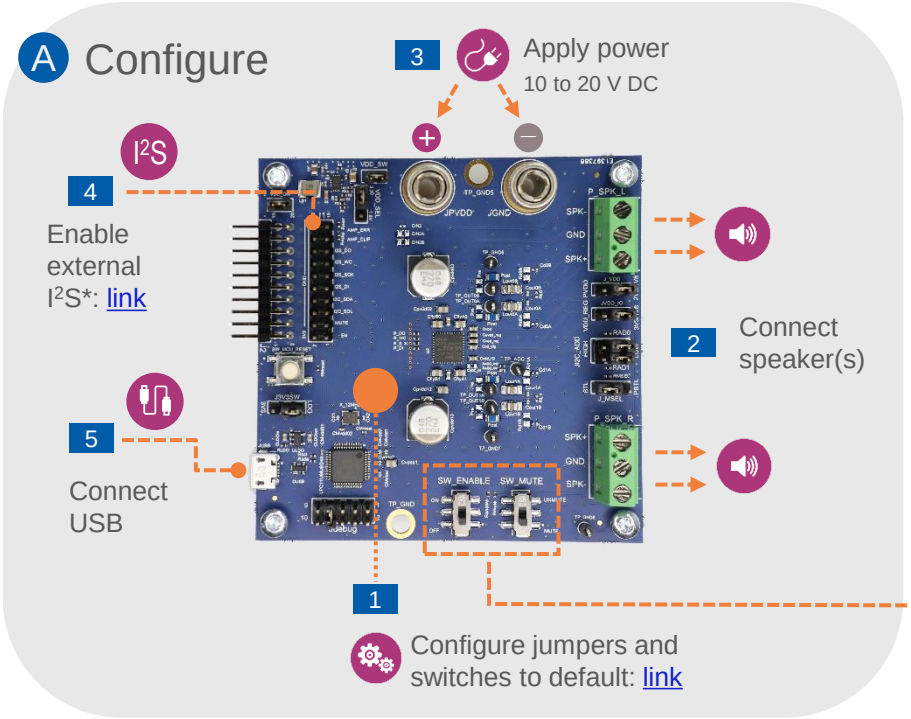

MA2304xNS board



***Note:** Noise measurements and other specs will show degraded performance when using the analog in interface board.


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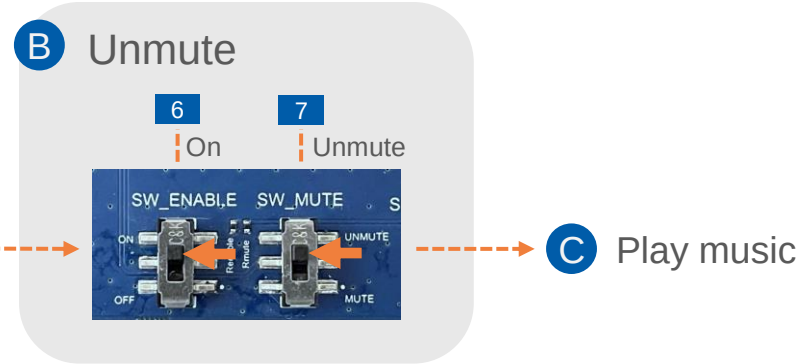
# One-page quick start – audio playback




*GUI configuration required if using other audio formats such as TDM, left-justified and right-justified.

## Required hardware

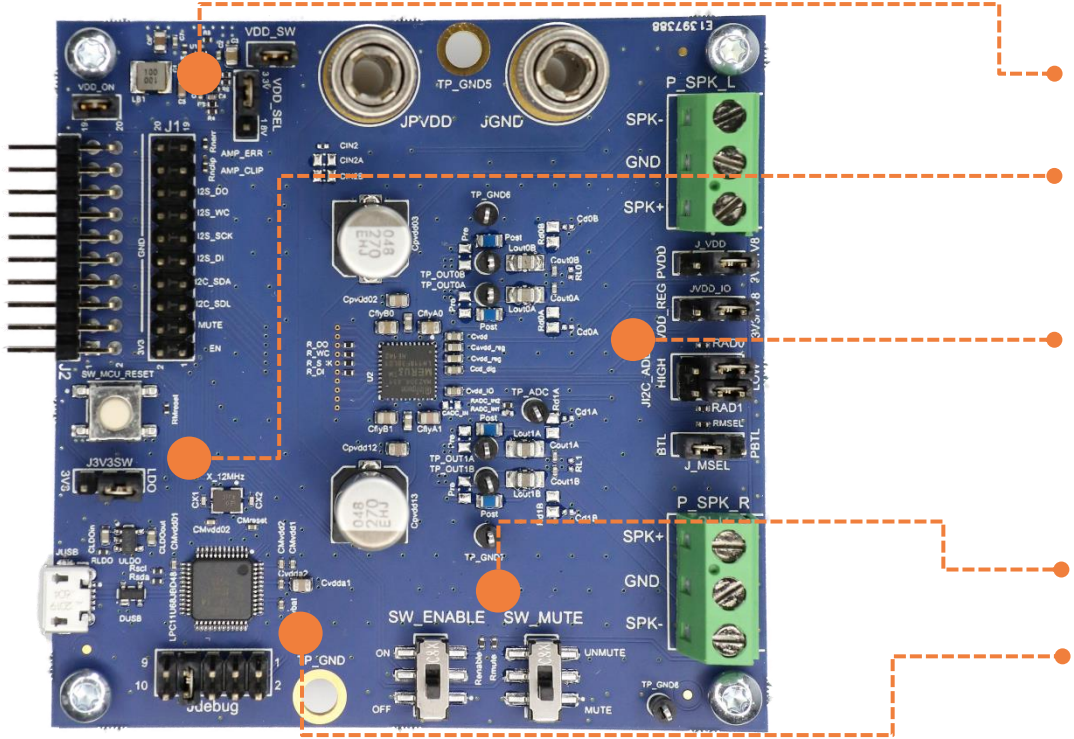
- EVAL_AUDIO_MA2304xNS EVK
- I²S source: interface boards (included) or audio precision, etc.
- 2 to 8 Ω speaker(s)
- 10 to 20 V DC power supply
- Micro USB cable




Set I²S source to a low volume level prior to unmuting


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# Default jumper/switch settings




| Jumper/Switch | State | Image |
|---|---|---|
| VDD_SW<br>VDD_ON<br>VDD_SEL | Jumpered<br>Jumpered<br>3V3 |  |
| J3V3SW | LDO |  |
| J_VDD<br>JVDD_IO<br>JI2C_ADD : RAD0<br>JI2C_ADD : RAD1<br>J_MSEL | 3V3<br>3V3<br>Low<br>Low<br>BTL |  |
| SW_ENABLE<br>SW_MUTE | Off<br>Mute |  |
| Jdebug | Jumper on pins 7 and 8 |  |

**Figure 3. EVAL_AUDIO_MA2304xNS default settings**

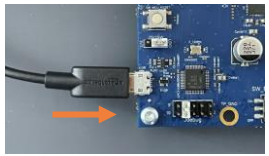

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# GUI quick start – installation and register map setup

The MA2304DNS/PNS can play audio by default without configuration, but to take advantage of the many features the chip offers it is necessary to configure the device. This is done through a software GUI. The following pages describe how to install, set up and connect the GUI to the device as well as an example configuration.

**1.** Download and install the MERUS™ audio amplifier configurator by first visiting https://softwaretools.infineon.com/ and registering your board. Once registered, the software can be installed through the Infineon developer center launcher or downloaded as a separate installer file. This will also install all the necessary device drivers to communicate with the MA2304xNS evaluation board.

**2.** Configure the MA2304xx EVK as described in the Quick start section. Make sure the USB cable is connected and the MUTE switch is kept as MUTE until the device is fully configured (incorrect $I^2S$ settings can produce loud sounds).






**3.** Start the program. The following screen should appear:

MA2304xx detected



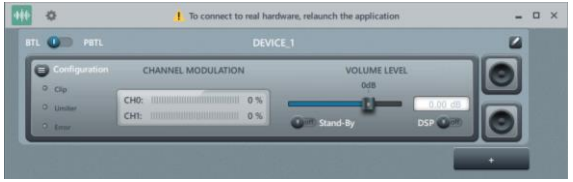

Demo board connected (USB)


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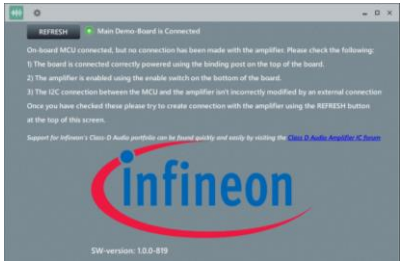
# GUI quick start – connection modes

**4.** Once the GUI is started, the software can run in three different modes:

- **Demo mode:** The PC has not made a connection to the board and the GUI is therefore in demo mode. This can be used to build configurations or test the software without hardware:




- **MCU connection mode:** This screen only contains a refresh button and a green connection light indicating that a connection has been made with the onboard MCU:




**Note:**
If needed, please refer to the hardware manual for step-by-step instructions on how to update the USB MCU firmware.

- To go to normal mode, make sure that the amplifier is powered and its ENABLE switch is set to ON, then click the REFRESH button.

- **Normal mode:** This screen will be shown when a connection is made with the onboard MCU and the device:

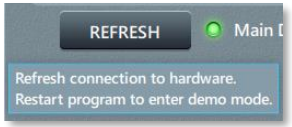




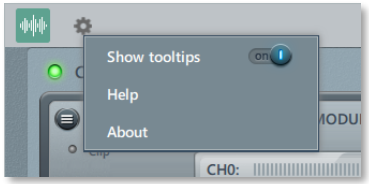
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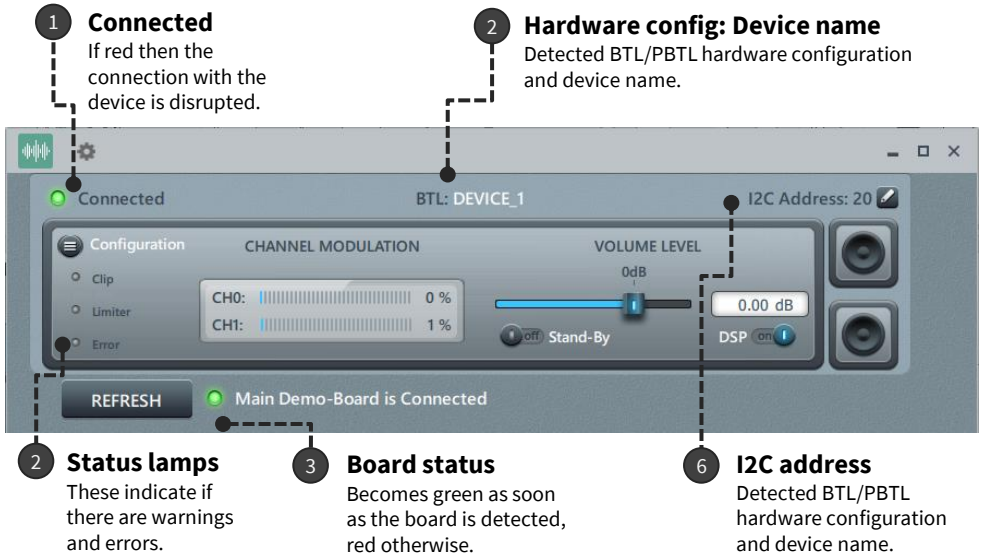
# GUI quick start – initial screen indicators

- The initial screen indicators and descriptions are shown on the right.
- Additional information is available as tooltips by hovering the mouse cursor on top of a control or indicator:




- Tooltips can be enabled or disabled in the settings menu:



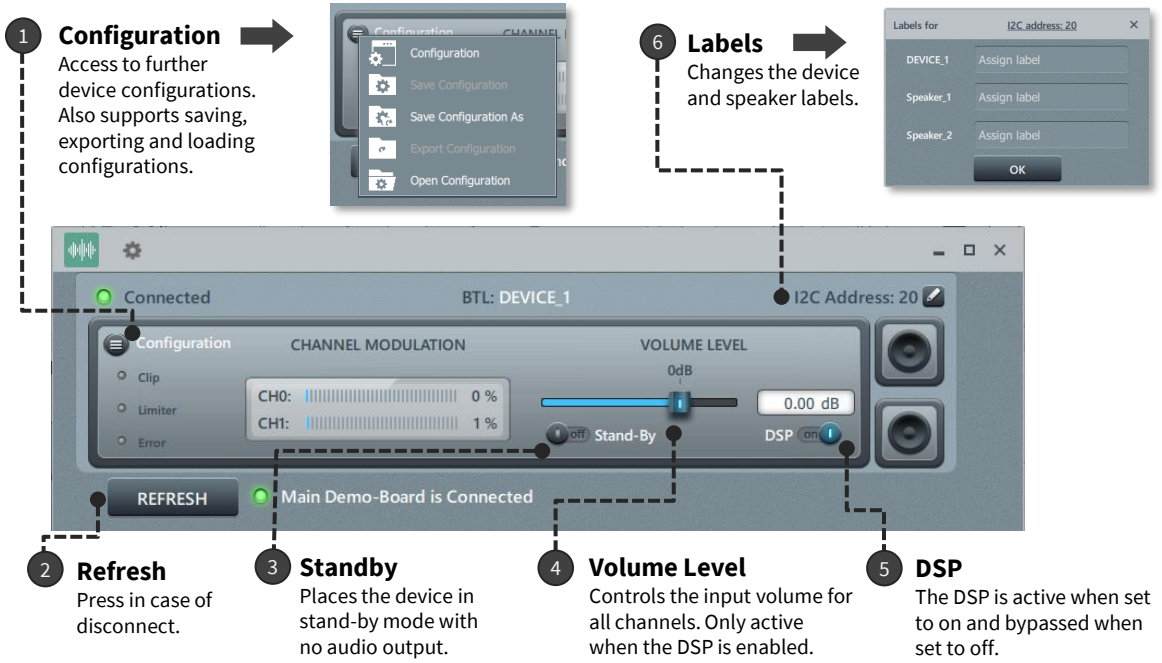





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# GUI quick start – initial screen controls

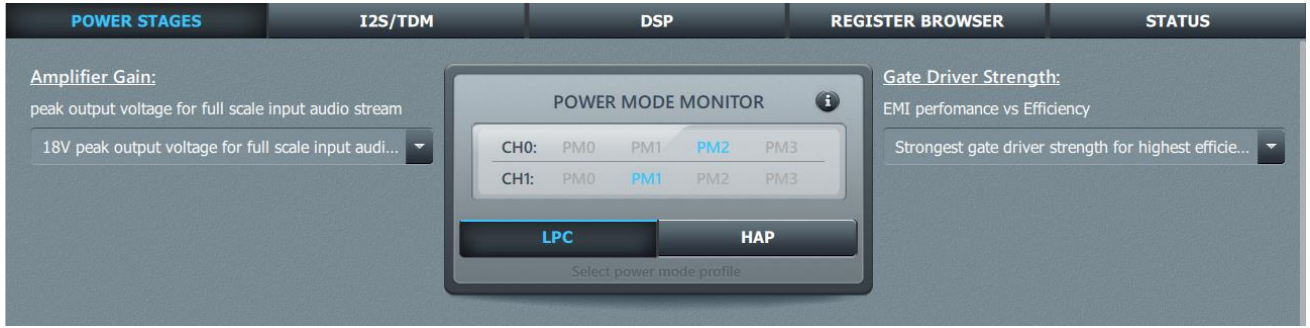
- The initial screen controls and descriptions are shown on the right.
- Use the Configuration menu to open the Configuration window described in the following pages.





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# Configurations – power stages




Through the power stage tab, power mode profiles, gain and drive strength can be configured. There are only two power mode profiles that can be selected:

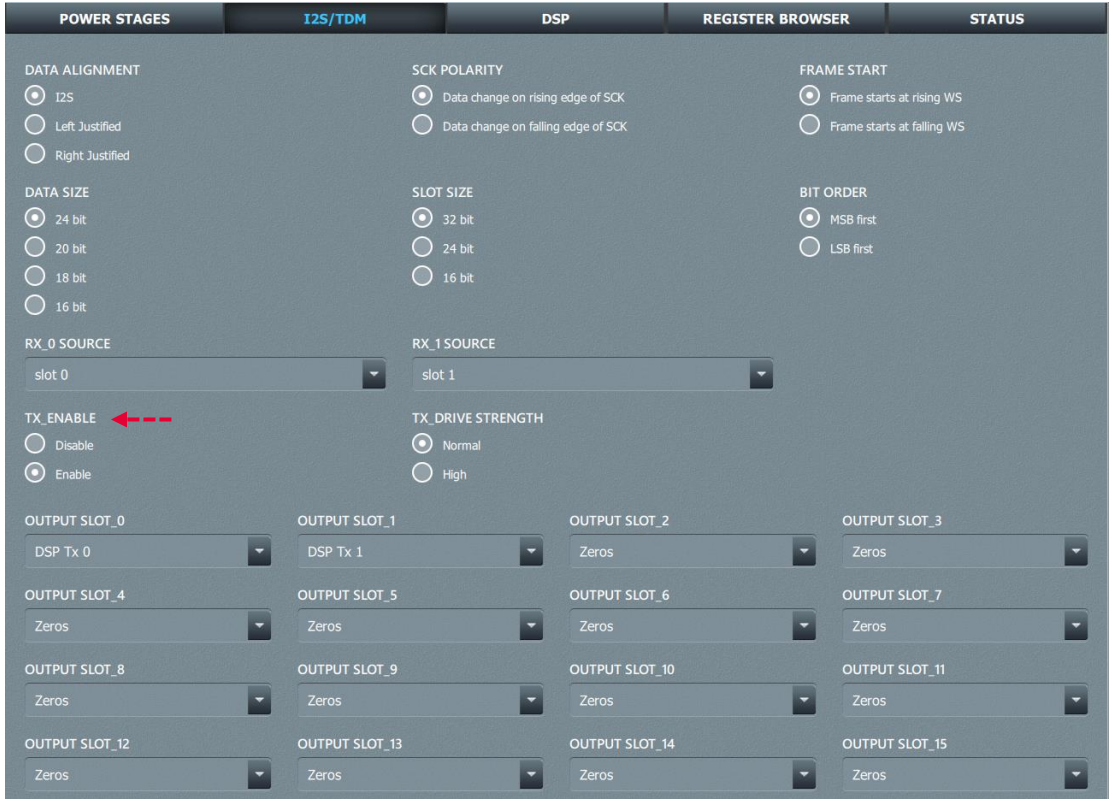
- **LPC: low power consumption (default)**
  - Low power consumption, slightly higher noise
- **HAP: high audio performance**
  - Low noise, slightly higher power consumption

The gain of the amplifier can be adjusted through the gain setting, which chooses the relation between full-scale and output voltage.

The gate driver strength can also be adjusted as a trade-off between EMI performance and efficiency.


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# Configurations – I²S/TDM



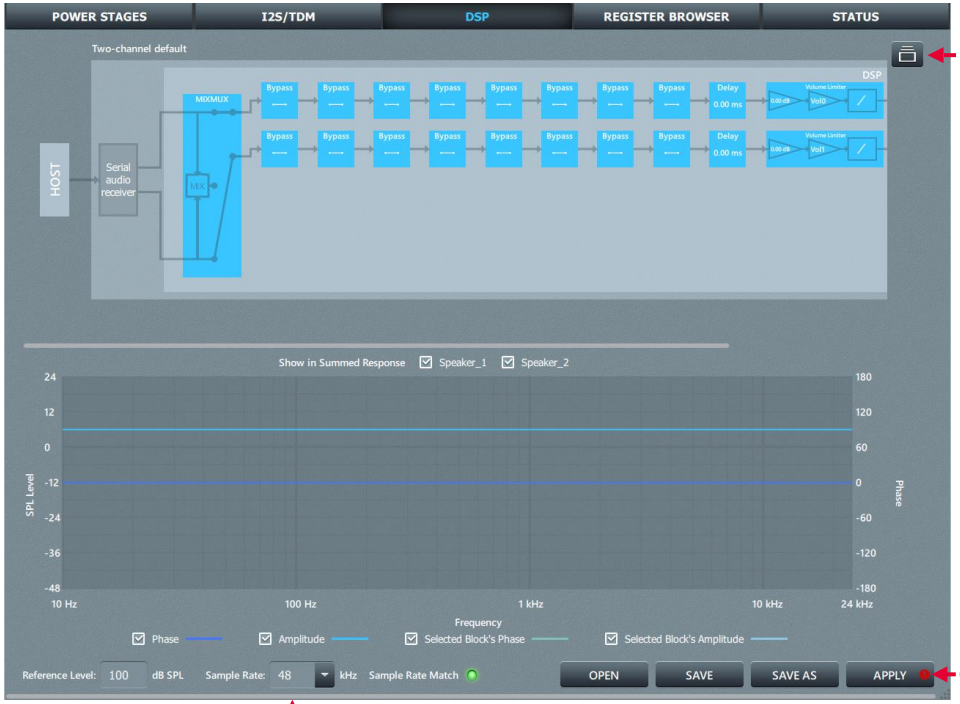

On the **I²S/TDM** page, communication-related configurations can be set up. The I²S configuration is default.

No configuration is required when using any of the interface boards as their audio interface matches the MA2304xNS defaults.

To route the I²S output out of the MA2304DN, it is necessary to enable the “TX_ENABLE” control and load a DSP program that supports this.


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# Configurations – DSP




The DSP page contains the tool to program the internal DSP of the MA2304DNS. It contains a graphical view of the current DSP flow and a plot of the expected amplitude and phase response with options for viewing single channels or combined responses.

To load a default flow, press the library button in the top-right corner of the screen.

For software v700 or lower, mute the device before clicking APPLY.



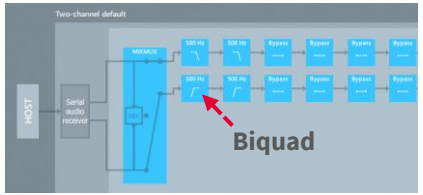

A DSP flow can be saved and loaded through the button in the lower-right corner. To program a DSP flow onto the device press “APPLY” and wait until the warning symbol is gone. In some cases, it will be necessary to press the button twice.

Note that the sample rate selected in the lower-left corner has to match the sample rate of the incoming $I^2S$ signal to the device.


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# Configurations – DSP example

To give an example of how to use the DSP, the following will set up a crossover filter and enable the built-in limiters of the default two-channel flow:

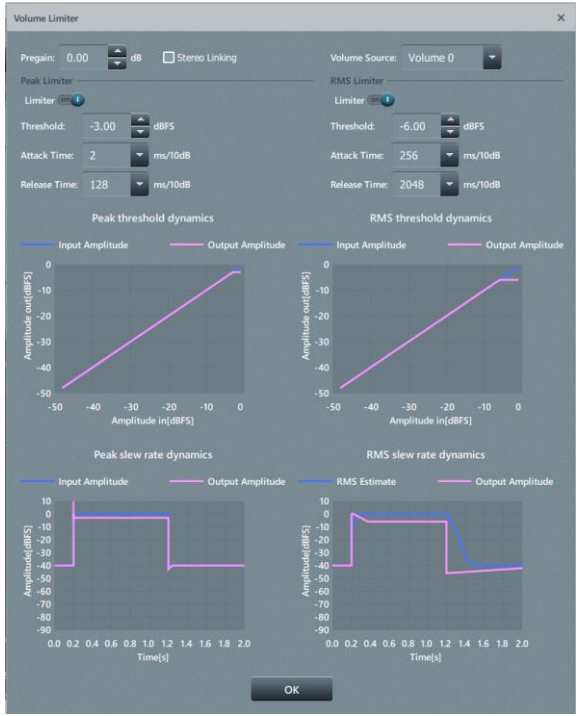



**1.** Double-click a biquad block currently marked as “Bypass”. This will open a biquad configuration window.

**2.** Select “Low Pass” for one channel and “High Pass” for the other channel. Then choose the filter type to fourth-order Linkwitz-Riley (first biquad) for one biquad and then fourth-order Linkwitz-Riley (second biquad) for the biquad following the first. Then select the desired cut-off frequency for the filter. In this example we chose 500 Hz.

This will result in a crossover filter with a flat combined response.

**3.** To enable the limiters double-click that limiter by the end of the flow with two triangles and a square inside the block. This will open the limiter configuration window. Currently, a peak and RMS limiter can be enabled and configured. The limiters can be applied to protect the system and speakers from too-large peaks or from overheating. Once enabled and applied they will limit the output to the level set by the threshold. Note that the attack and release time can be configured to fit with the dynamics of the system.





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# Configurations – register browser




The **register browser** contains detailed information about the many registers of the MA2304xx. However, this should only be applied in rare cases where it is necessary to modify an uncommon setting. In the early engineering sample all registers are available, but it is not advised to modify registers without full knowledge of their function.

If it is necessary to modify some registers in the register browser, it is best to use the search function in the upper-left corner to find the registers.


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# Configurations – status




On the **status page**, warnings and errors can be monitored. Currently, active warnings and errors will be shown with yellow or red lights as individual indicators, while previous warnings or errors will be shown by a circle around the indicator. To clear previous states of error indicators press the “CLEAR” button in the lower-left corner.


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# Audio performance testing

The output test setup depends on the desired evaluation:

- Speaker test
  - Evaluation, listening and tuning
- Datasheet spec test
  - To measure device parameters

Refer to the “Measurement methods” section of the EVK user manual for details.

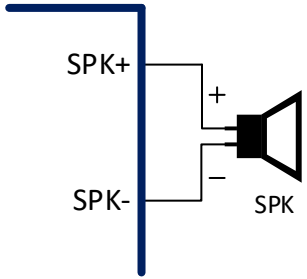
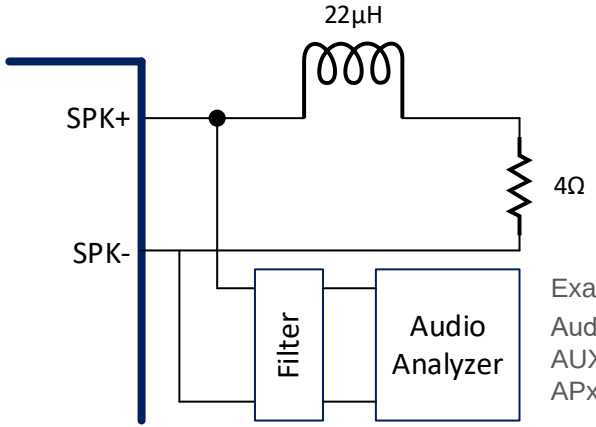



**Figure 4. Speaker test setup**




Example:
Audio Precision’s AUX-0025 filter and APx525 analyzer

**Figure 5. Datasheet spec test setup**


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