Application Report

TAS2563 Speaker Characterization Guide

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Abstract

This document provies a step by step guide on speaker characterization process in Purepath Console 3 (PPC3) specifically for TAS2563 (6.1-W Boosted Class-D Audio Amplifier With Integrated DSP And IV Sense)

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1 Speaker Charcterization

Advanced speaker modeling is essential to maximizing the performance of the selected speaker while still protecting it from damage. The speaker model can be obtained using the characterization process in PPC3 (request access). TI's Smart Amp algorithm then uses this model to protect the speaker during operation while maintaining the loudest and highest quality audio. This section will walk through how to characterize a speaker in PPC3.

The linear parameters of the speaker can be obtained through the Characterization tab in the PPC3 software. Characterization of the speaker is done using the Learning Board 2, TAS2563EVM, PPC3-EVM-MB and PPC3 Software. Please refer to SmartPA Speaker Protection Algorithm for details on the algorithm used during the characterization process.

Note

Please verify the device is set as default PC playback device and configure the jumpers for mono playback/characterization as described in TAS2563EVM User Guide before begin speaker characterization

In order to characterize the speaker, please setup the EVMs and the learning board according to the TAS2563 Quick Start Guide and reference to the following figure. The characterization results demostrated in this document is based on demo speaker *ASE03008MR-LW150-R* (8Ω, 1W).

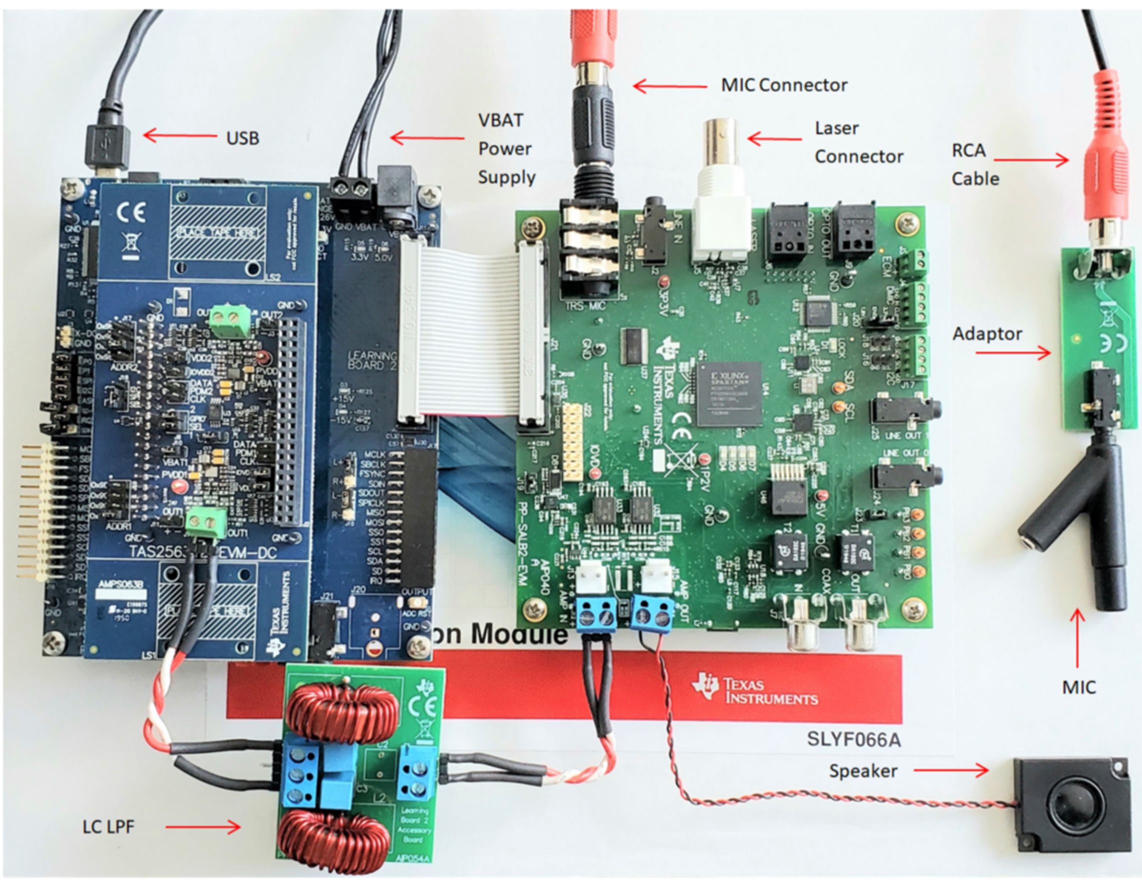

Figure 1-1. Setup for Speaker Characterization

1.1 Step 1: PPC3 Device Plug-in

Sign in to TI account in PPC3 to download the device plug-in and select the device for characterization.

- Only plug-ins requested under the user's account will show up as "Available EVM Apps"

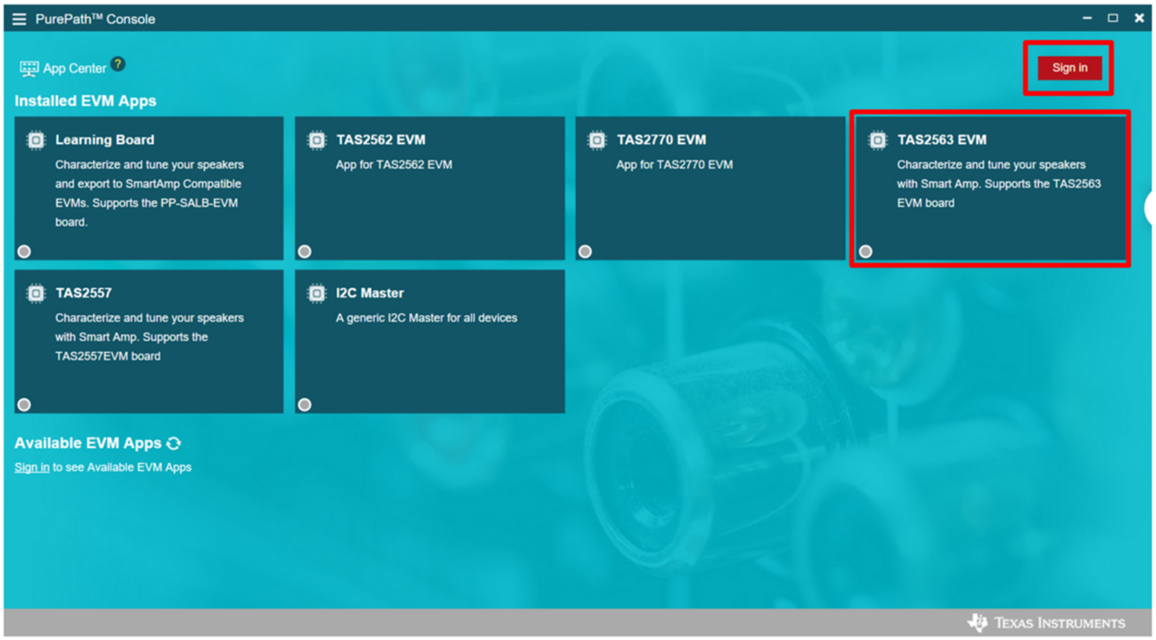

Figure 1-2. PPC3 Home

1.2 Step 2: New Device Profile

Select “New” to create a device profile or open a previously saved profile

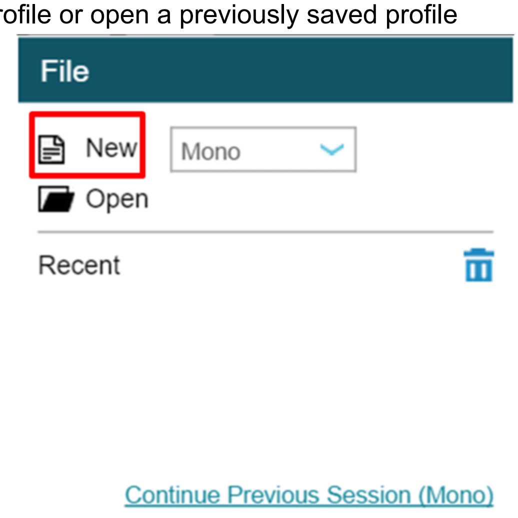

Figure 1-3. New Profile

Note

For Stereo Characterization, make sure to change from “mono” profile to “duo mono” as shown in the Figure 1-3 and characterize each speaker similarly to Mono Mode Speaker Characterization.

1.3 Step 3: PPC3 Device Home

Select “Connect” in the bottom left corner to connect to the device, then select “Characterization” to begin characterization process

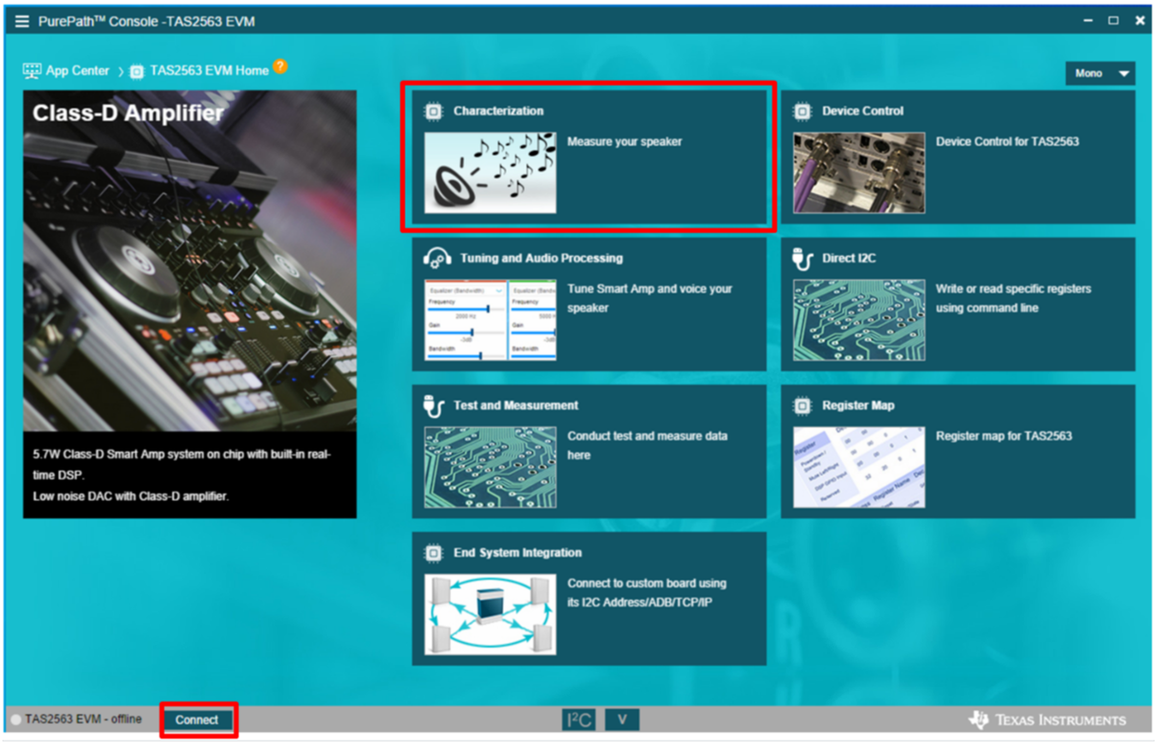

Figure 1-4. PPC3 Device Home

1.4 Step 4: Hardware Setup

Make sure hardware is setup properly and select “Supply is Connected”. Refer to Figure 1-1for TAS2563 specific setup. Then select “Start Checks” to verify the LB2 configuration with the PC

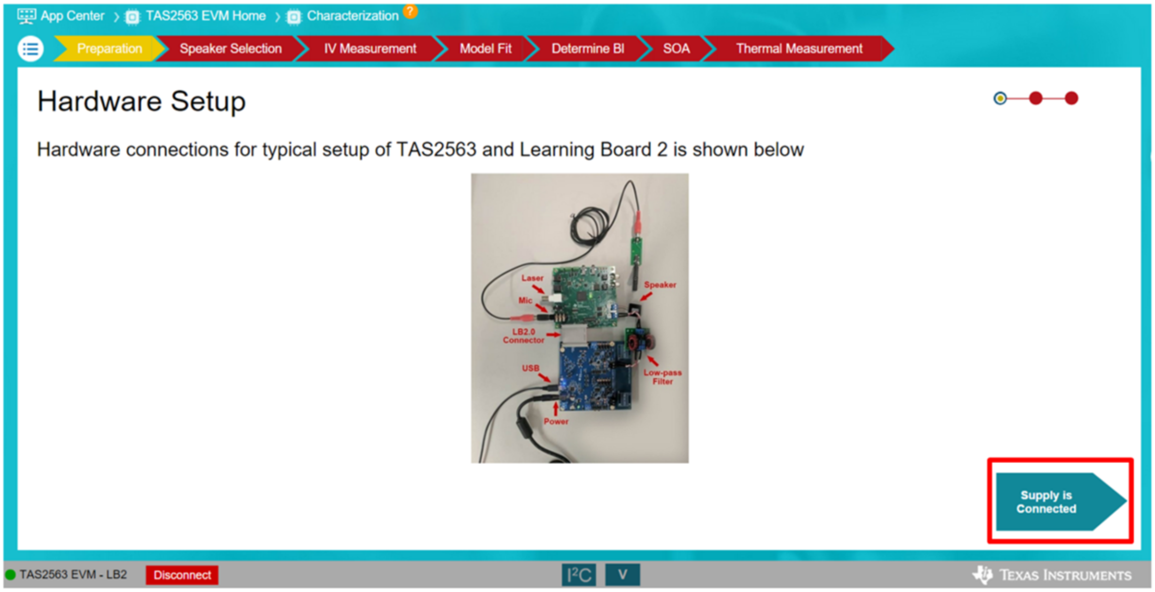

Figure 1-5. Hardware Setup

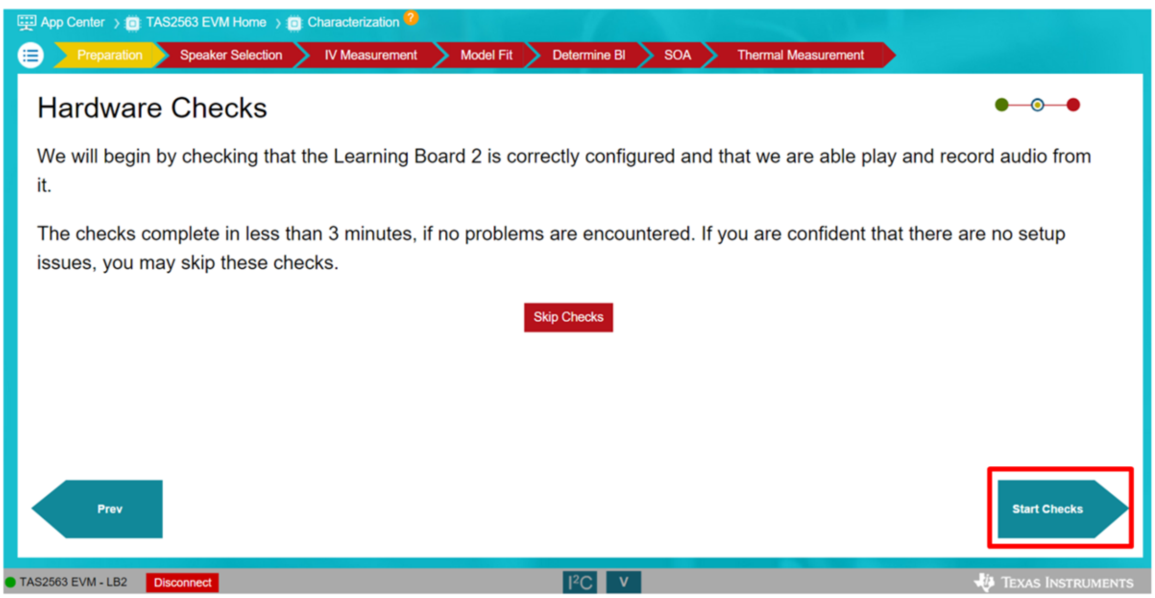

Figure 1-6. Hardware Checks

1.5 Step 5: Hardware Check Results

Verify that hardware passes all hardware checks, then select "Done" to proceed

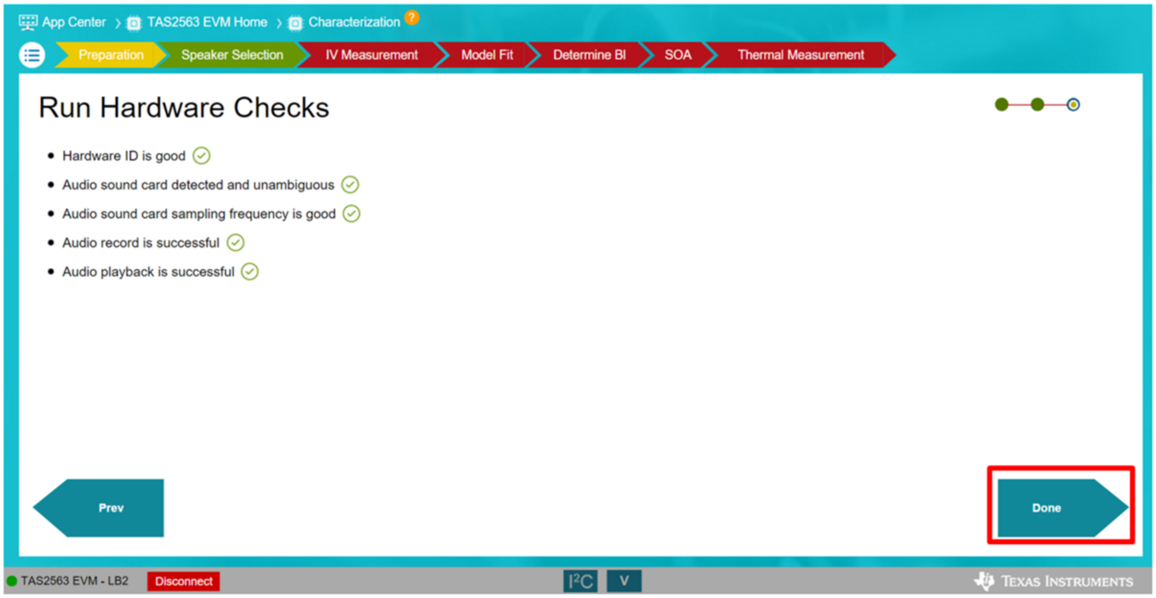

Figure 1-7. Hardware Check Results

Note

If an error occurs, please verify the setup according to the user guides described in the *EVMs and LB2 Setup*section and restart both PPC3 and EVM. If it cannott be resolved, please reach out to the E2E forum.

1.6 Step 6: IV Measurement

Select the speaker type, and then continue to IV Measurement tab by selecting "Start IV Measurement"

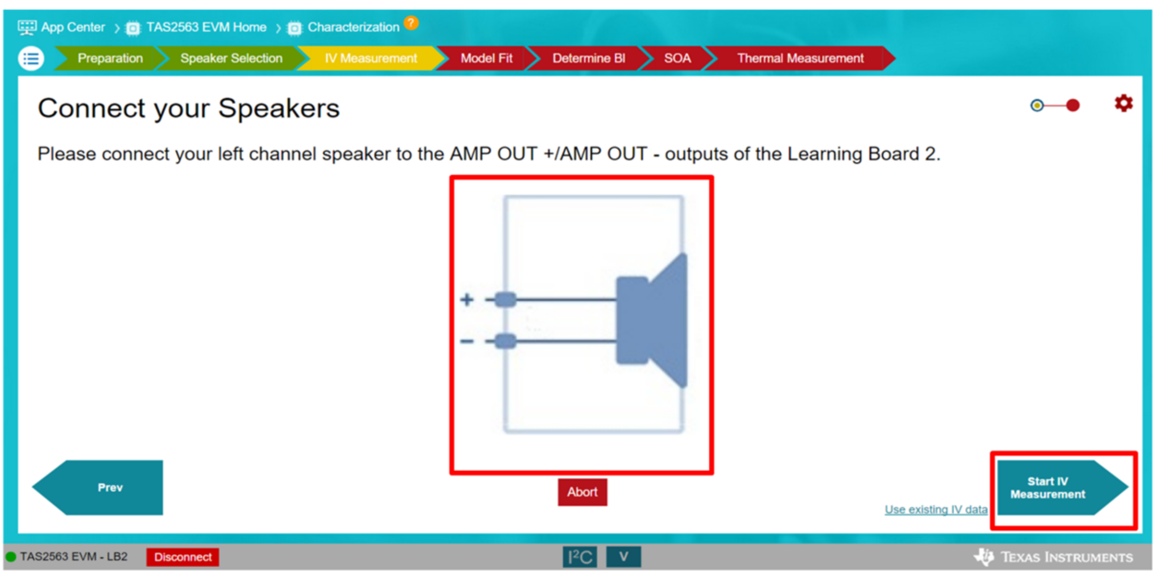

Figure 1-8. Speaker Selection

Note

A chirp sound will play for few seconds after this tab. Make sure the facing measurement microphone is within approximately 10 cm from speaker

1.7 Step 7: Speaker Model

Review speaker model by verifying DC impedance and resonant frequency to the respective values on the speaker datasheet. Select "Accept" to continue

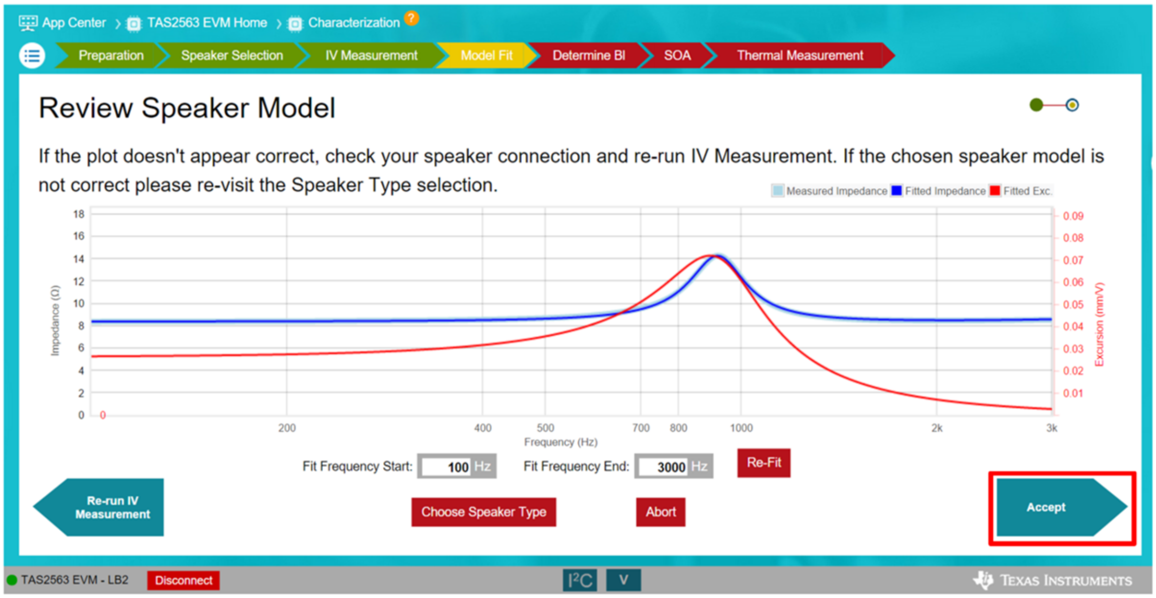

Figure 1-9. Speaker Model

1.8 Step 8: Speaker Details

Enter either the diaphragm area or the diameter of the surround. These values can commonly be obatined from the speaker datasheet, manufacturer, or manual measurment. Select "Next" to continue

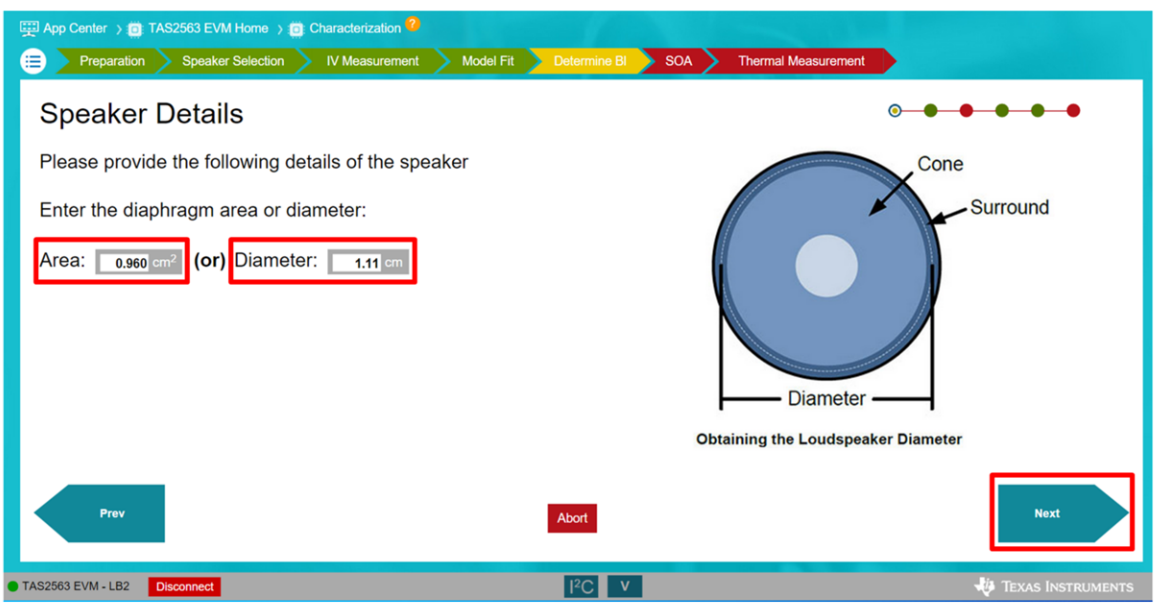

Figure 1-10. Speaker Details

1.9 Step 9: Force Factor (BL)

To determine the force factor (Bl), enter the measurement manually or measure it via the laser method. Once the value is entered/measured, select “Next” to continue.

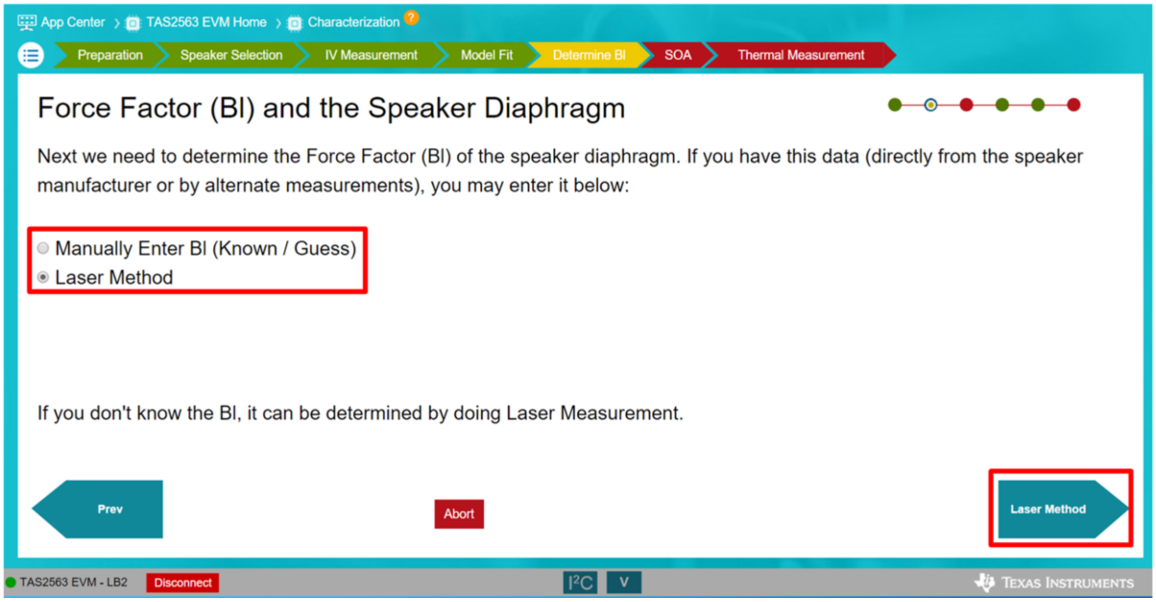

Figure 1-11. Force Factor Value

1.10 Step 10: Excursion Model

Review the speaker model. This model contains the impedance and the excursion plot of the speaker. The protection algorithm will be based on this model, so please verify with the datasheet the DC impedance value and the resonant frequncy peak. Select “Accept” to continue

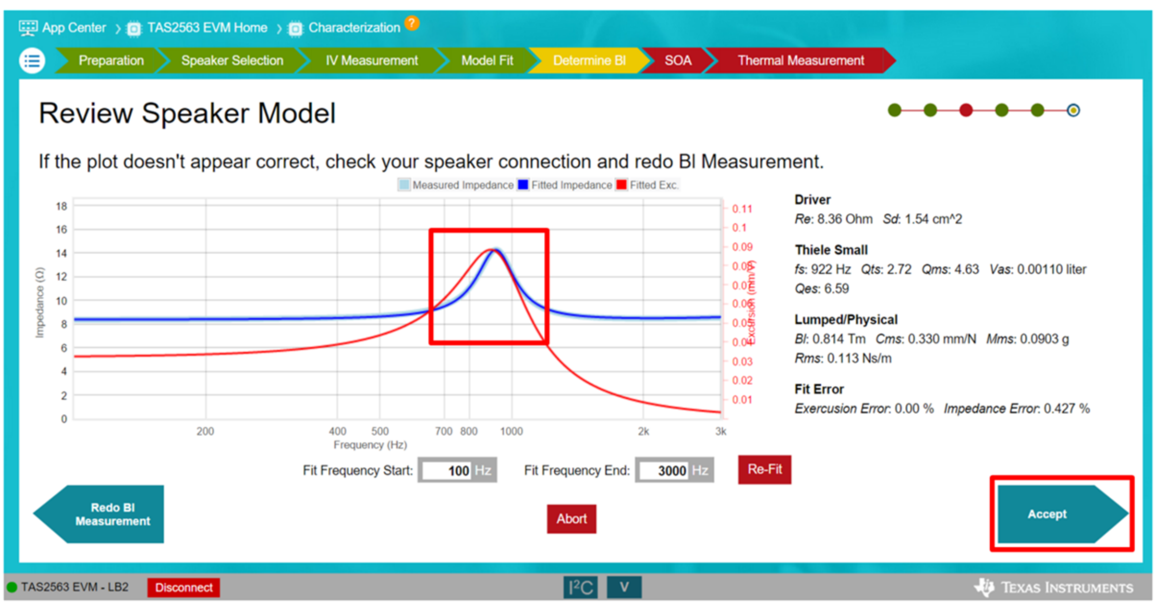

Figure 1-12. Review Excursion and Speaker Models

1.11 Step 11: Defining Safe Operating Limits

Please define the safe operating limit (Excursion and Thermal Limits) for thermal modeling. The Excursion Limit is usually defined as the X_{max} in the speaker datasheet, and Thermal Limit as T_{max}. If these values cannot be found on the datasheet, please request them directly from the speaker manufacturer. Select “Accept” to continue

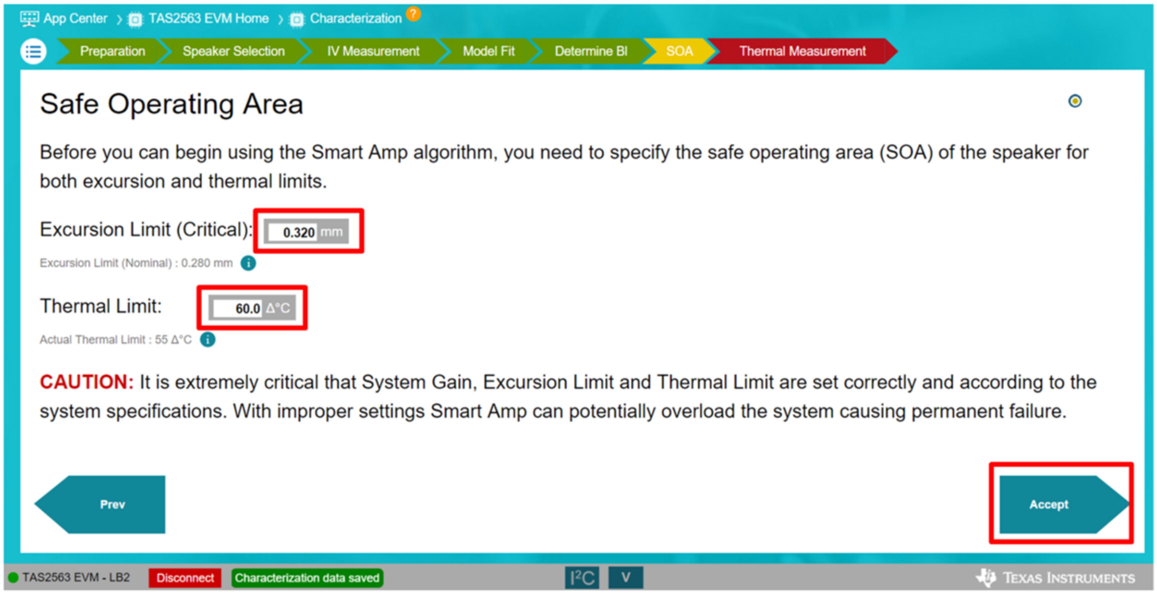

Figure 1-13. Safe Operating Limits

Note

The Thermal Limit is defined as the change or the difference in temperatures (Δ°C) between the maximum temperature (T_{max}) of the speaker and the ambient temperature.

1.12 Step 12: Thermal Parameters

Enter the Temperature coefficient in grey box acorrding the speaker coil material. Temperature coefficient can be obtained from the speaker manufacturer. It is default to copper's temperature coefficient and can be left unchanged if the coil material is the same. Select “Thermal Characterization” to continue

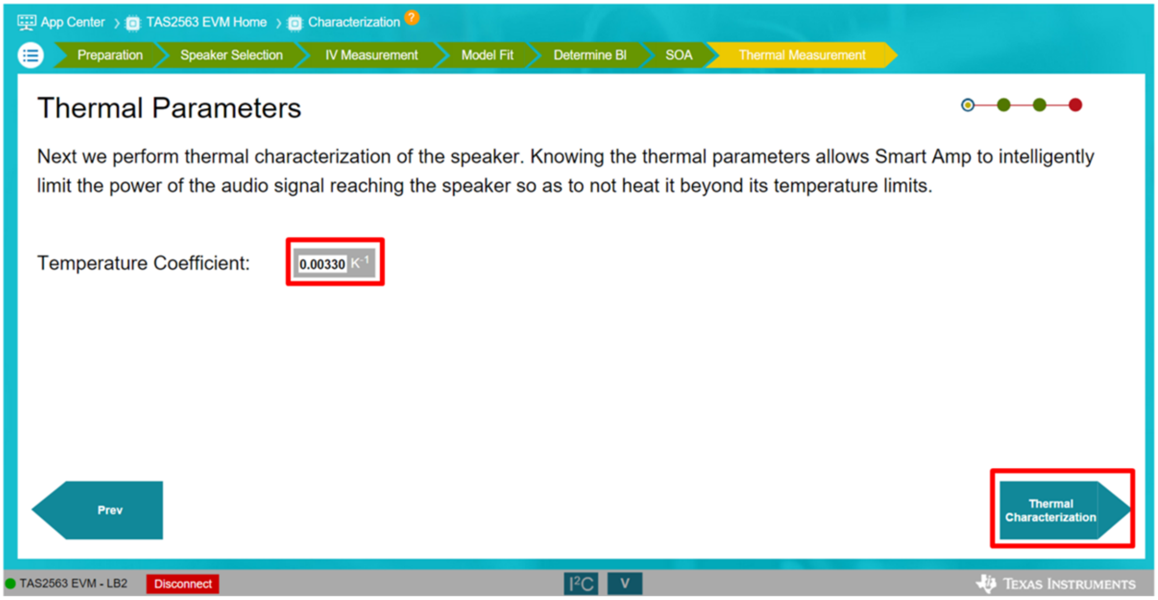

Figure 1-14. Theraml Parameters

1.13 Step 13: Thermal Modeling

Define the excitation frequency to test the speaker. Depending on the impedance characteristic of each speaker, excitation frequency required may change. The default excitation frequency is 16 kHz; however lower frequency (e.g. 3 kHz) may leads to more accurate result. Select “Next” to continue

Select the Option icon in the upper-right corner to access more settings.

- “Ambient temperature” can be changed to the room temperature which the device is under testing.
- “Max. delta temperature” was defined previously in the Safe Operating Area tab as “ΔThermal Limit”
- Min. and Max duration define the runtime of the thermal measurement test and should be left in default values.
- For larger speakers, the “Controller setting correction” and “Controller Gain” may need to be increased. For example, for speakers with power rating of 1 W, use a controller gain of 0.01, and for speakers with power rating between 2 W to 3 W, change the controller gain to 0.03
- Thermal Fit Offset is usually set as default.
- In case of oscillatory behavior during temperature test, it is recommended to run with lower controller gain for a more stable response.
- In order to properly test the thermal characteristic, please wait at least 30 minutes before performing the thermal characterization test again on the same speaker unit. This will ensure the speaker coil has time to cool down and reach ambient temperature.

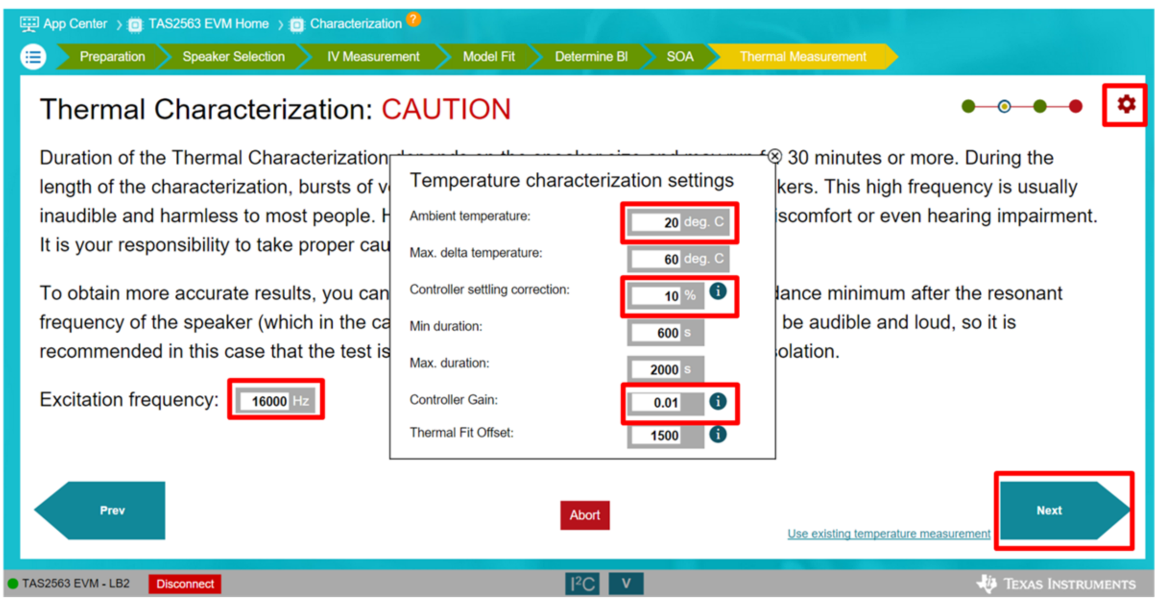

Figure 1-15. Thermal Characterization

Note

After this page, the device will run several cycles of temperature test with loud tone (set by the excitation frequency).

1.14 Step 14: Review Temperature Model

Review the temperature model. Select “Accept” to continue

- The temperature plot from the characterization will look similar to Figure 1-16. Please make sure the speaker heats up to the maximum temperature of the speaker.
- Voice coil temp should stabilize during each test cycle with relativelt flat temperature response near T_{max}.
- Otherwise, repeat Step 14 to remodel

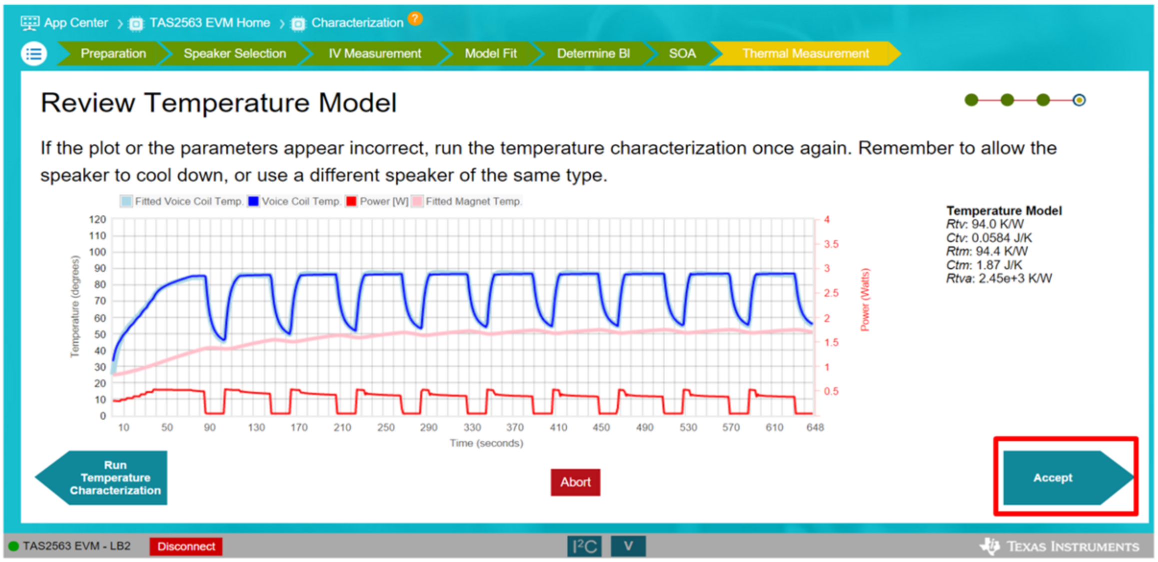

Figure 1-16. Review Temperatue Model

1.15 Step 15: Characterization Result

Characterization is now complete. Please review the characterization data and save it by selecting “Save” in the expanded drop down menu in the top left corner.

- This page contains all of the data collected during the characterization process and all the values should be kept largely unchanged

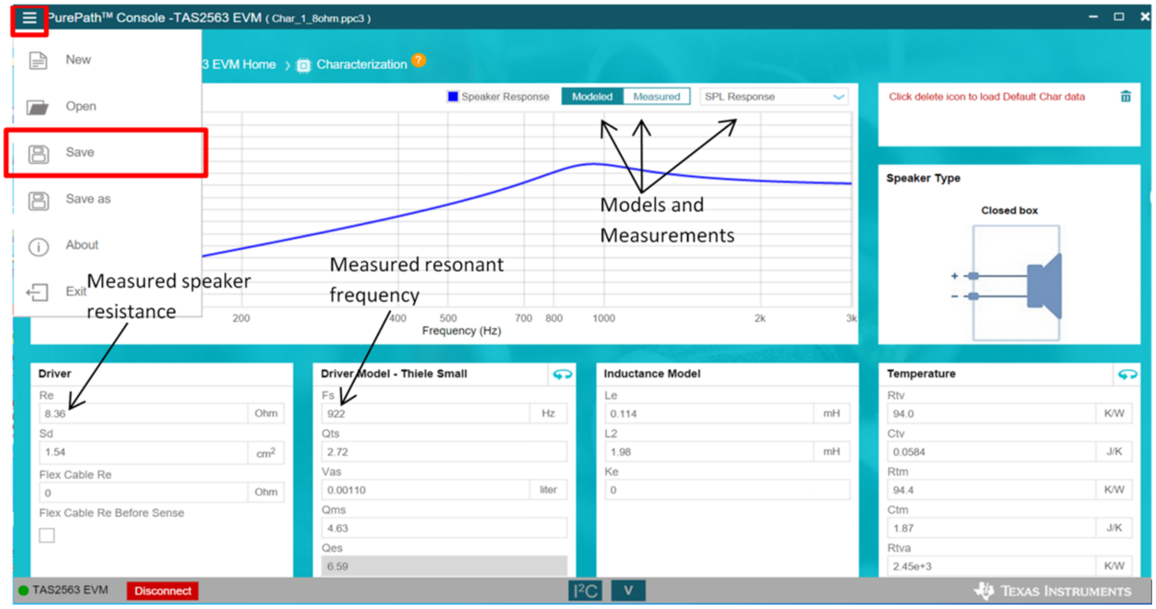

Figure 1-17. Characterization Result

2 Summary

Once the speaker characterzation process is complete, you are now ready to proceed to the next step of the development in PPC3. It is important to follow the above steps carefully to prpoerly characterize the speaker to ensure the reliability of the Smart Amp Protection algorithm.

For more information about speaker characterization, Smart Amp Protection algorithm, and next development step, please visit the following links:

SmartPA Speaker Protection Algorithm

Smart speakers don’t have to sound as small as they are

TAS2563 Quick Start Guide

Smart Amp Quick Start Guide

Don’t limit your audio: how to achieve loud sound from a small speaker

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