

Design Guide: TIDA-060026

Scalable 2.1 Channel Audio Amplifier Reference Design



Description

This 2.1 channel audio amplifier reference design incorporates the TAS5825M digital stereo amplifier for left and right channel audio and the TAS5720M digital mono amplifier for the subwoofer channel. This design operates from a single audio host interface and is scalable to 5.1, 7.1, and 9.1 channel configurations, ideal for soundbar applications.

Resources

TIDA-060026	Design Folder
TAS5825M	Product Folder
TAS5720M	Product Folder
PurePath™ Console Motherboard	Tool Folder
PurePath™ Console Software (PPC3)	Tool Folder



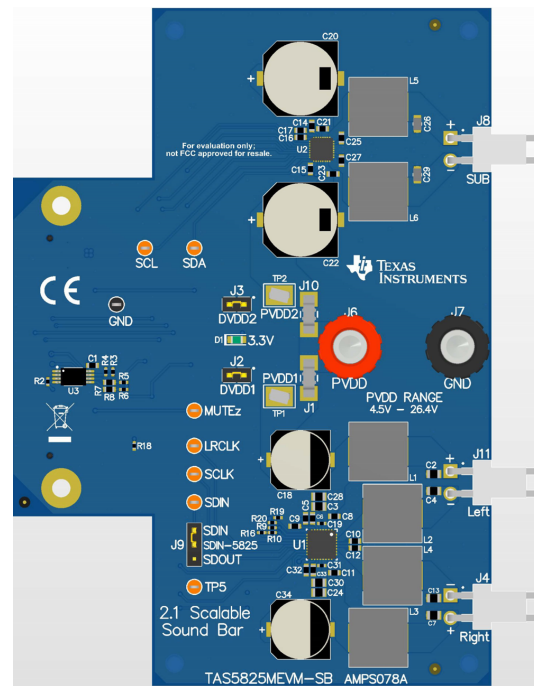
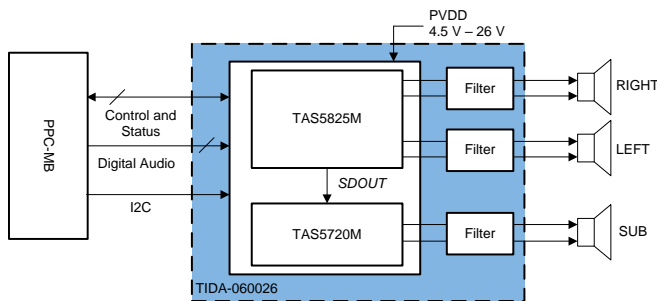
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Features

- PVDD tracking and thermal fold-back protection
- Smart Amp technology
- Modular, scalable multi-channel solution based on digital audio TDM
- Integrated self-protection (OCE, CB3C, OTW, OTE, UVLO, OVLO)
- Integrated audio DSP with enhanced 96 kHz processing supporting several advanced audio process flows
- Operates in TDM mode (as well as I2S) for speaker scalability

Applications

- [Soundbar](#)
- [Smart Speaker](#)
- [TVs](#)
- [Notebook/PC Speaker](#)
- [Wireless Speaker](#)
- [Smart Display](#)



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1 System Description

Soundbars and wireless speakers, such as smart speakers and smart displays, often are released as part of a family of models that range in size and sound levels. Audio designers are often challenged to create new audio solutions for each model, in both hardware and software. This reference design illustrates how to start with a 2.1 channel system that can be easily scaled to more speakers on the same channel (such as in the case of Smart Speakers) or more channels (such as in the case of new emerging multi-channel Dolby Atmos soundbar systems). As the number of channels expands, the need remains to minimize the number of audio data output ports from the host SoC audio source. This design illustrates both the use of TDM mode and the main amplifier's SDOOUT port as means to scale the number of channels from a singular I2S port from the main audio source. The design uses high-quality, low-THD digital amplifiers that integrate mini DSPs for a number of process options including equalization, audio look-ahead, digital output for acoustic echo cancellation and a variety of speaker and amplifier protection functions.

1.1 Key System Specifications

Table 1. Key System Specifications

PARAMETER	SPECIFICATIONS
Power Supply	4.5 V to 26.5 V DC
Digital Interface	I ² S and I ² C
THD+N vs Frequency	Section 3.2.2
THD+N vs Power	Section 3.2.2

2 System Overview

2.1 Block Diagram

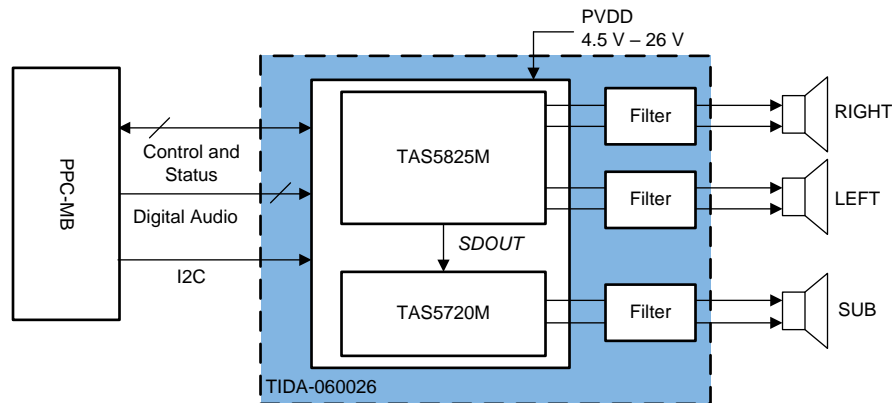
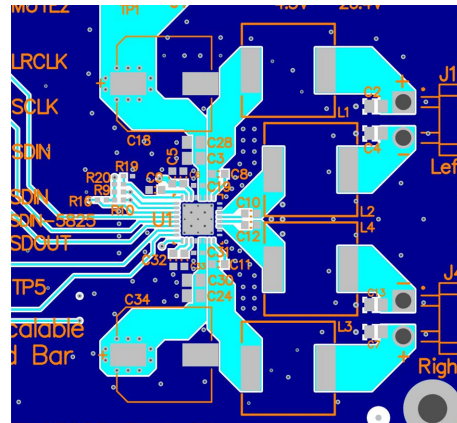


Figure 1. TIDA-060026 Block Diagram

2.2 Design Considerations

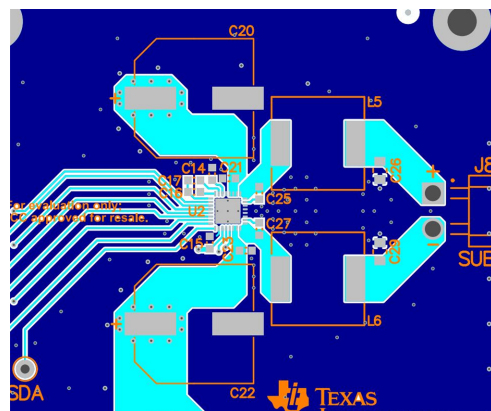
2.2.1 TAS5825M Layout

- Avoid placing other heat producing components or structures near the amplifier.
- If possible, use a higher layer count PCB to provide more heat sinking capability for the TAS5825M device and to prevent traces and copper signal and power planes from breaking up the contiguous copper on the top and bottom layer.
- Place the TAS5825M device away from the edge of the PCB when possible to ensure that the heat can travel away from the device on all four sides.
- Avoid cutting off the flow of heat from the TAS5825M device to the surrounding areas with traces or via strings. Instead, route traces perpendicular to the device and line up vias in columns which are perpendicular to the device.
- Unless the area between two pads of a passive component is large enough to allow copper to flow in between the two pads, orient it so that the narrow end of the passive component is facing the TAS5782M device.
- Because the ground pins are the best conductors of heat in the package, maintain a contiguous ground plane from the ground pins to the PCB area surrounding the device for as many of the ground pins as possible.
- Keep the thermal pad, which connects electrically and thermally to the PowerPAD™ of the TAS5825M device, be made no smaller than what is specified in the package addendum.


Figure 2. TAS5825M Layout

2.2.2 TAS5720M Layout

- Pay special attention to the power stage power supply layout. Each H-bridge has two PVDD input pins so that decoupling capacitors can be placed nearby. Use at least a 0.1- μ F capacitor of X5R quality or better for each set of inputs.
- Keep the current circulating loops containing the supply decoupling capacitors, the H-bridges in the device and the connections to the speakers as tight as possible to reduce emissions.
- Use ground planes to provide the lowest impedance for power and signal current between the device and the decoupling capacitors. The area directly under the device should be treated as a central ground area for the device, and all device grounds must be connected directly to that area.
- Use a via pattern to connect the area directly under the device to the ground planes in copper layers below the surface. This connection helps to dissipate heat from the device.
- Avoid interrupting the ground plane with circular traces around the device. Interruption disconnects the copper and interrupt flow of heat and current. Radial copper traces are better to use if necessary.


Figure 3. TAS5720M Layout

2.3 Highlighted Products

2.3.1 TAS5825M

The TAS5825M is a stereo high-performance closedloop Class-D with integrated audio processor with up to 192-kHz architecture. The powerful audio DSP core supports several advanced audio process flows. With 48-kHz or 96-kHz architecture, an integrated SRC (Sample rate converter) detects the input sample rate change. Then auto converts to the target sample rate which DSP is running to avoid any audio artifacts. These process flows support: 2x15 BQs, 3-Band DRC, Fullband AGL (Automatic Gain Limiter), Smart Amplifier Algorithm (Thermal and Excursion Protection), Bass enhancement, Spatializer, THD manager, PVDD Tracking and Thermal Foldback. The 192-kHz process flow offers Full-band AGL and Thermal Foldback .

2.3.2 TAS5720M

The TAS5720x device is a high-efficiency mono Class-D audio power amplifier optimized for high transient power capability to use the dynamic power headroom of small loudspeakers. The device is capable of delivering more than 15 W continuously into a 4-Ω speaker. The digital time division multiplexed (TDM) interface enables up to eight devices to share the same bus.

2.4 System Design Theory

This 2.1 Soundbar audio system uses the TAS5825M as the left and right channels and the TAS5720M for the subwoofer. The TAS5825M is able to act as the central systems processor for both the stereo left and right speakers and for the mono subwoofer speaker by sending the audio signal through the TAS5825M's SDOUT pin to the TAS5720M's SDIN pin. The TAS5825M DSP can transmit a post-processed audio signal to the TAS5720M allowing for the signal to benefit from bass enhancement, smart amplifier algorithm, etc.

This design also allows for the 2.1 system to be expanded to a 5.1 system with the inclusion of another TIDA-060026 board with the I2C, 3.3-V, PVDD, and GND connected between the boards. This also can be expanded further to be a 7.1 and 9.1 system with the inclusion of the TAS5825MEVM as shown in Figure 4.

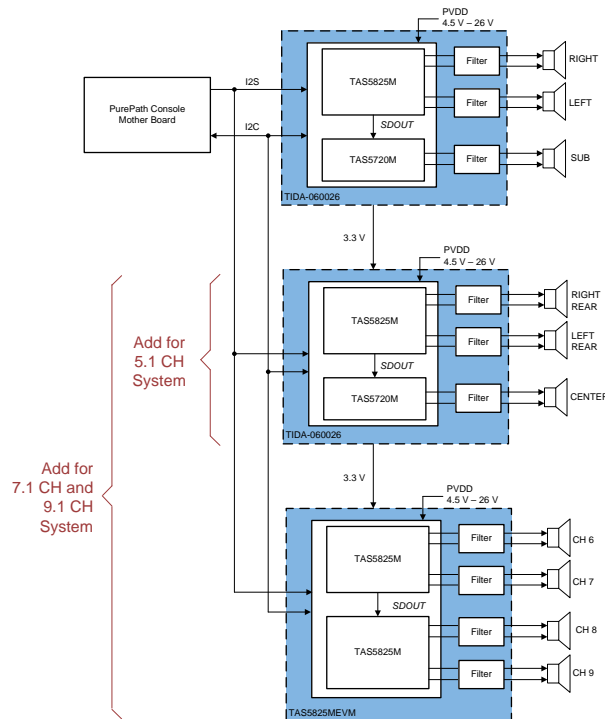


Figure 4. 5.1, 7.1, and 9.1 Channel Expansion Diagram

3 Hardware, Software, Testing Requirements, and Test Results

3.1 Required Hardware and Software

3.1.1 Hardware

- TIDA-060026 Board
- PurePath Console Motherboard
- USB-A to USB-B micro cord
- 4.5-V to 26.4-V 6-A DC power supply
- Speakers rated at or above the expected output power
- Computer
- Audio Precision System (optional)

3.1.2 Software

- PurePath Console 3 (PPC3)—available from [MySecureSoftware](#)
- I²C Master App—downloaded within PPC3
- Audio player
- Audio Precision (optional)

3.2 Testing and Results

3.2.1 Test Setup

- Check that the jumpers are in the following states as shown in [Table 2](#):

Table 2. Jumper States

Jumper	Setting
J2	In
J3	In
J9	2 to 3

- Set the power supplies to 12-V and current to 6-A. Do not power up.
- Connect the power supply to TIDA-060026, with the positive terminal in **J6** and the negative terminal in **J7**.
- Connect the SUB speaker to **J8**.
- Connect the Left speaker to **J11**.
- Connect the Right speaker to **J4**.
- Connect the PurePath Motherboard console to **J5**.
- Turn on the power supplies.
- Connect the USB cable to the PurePath Motherboard console.
- Verify that the computer has set the PurePath Motherboard as the default playback device by opening the sound dialog from the windows control panel (see [Figure 5](#))

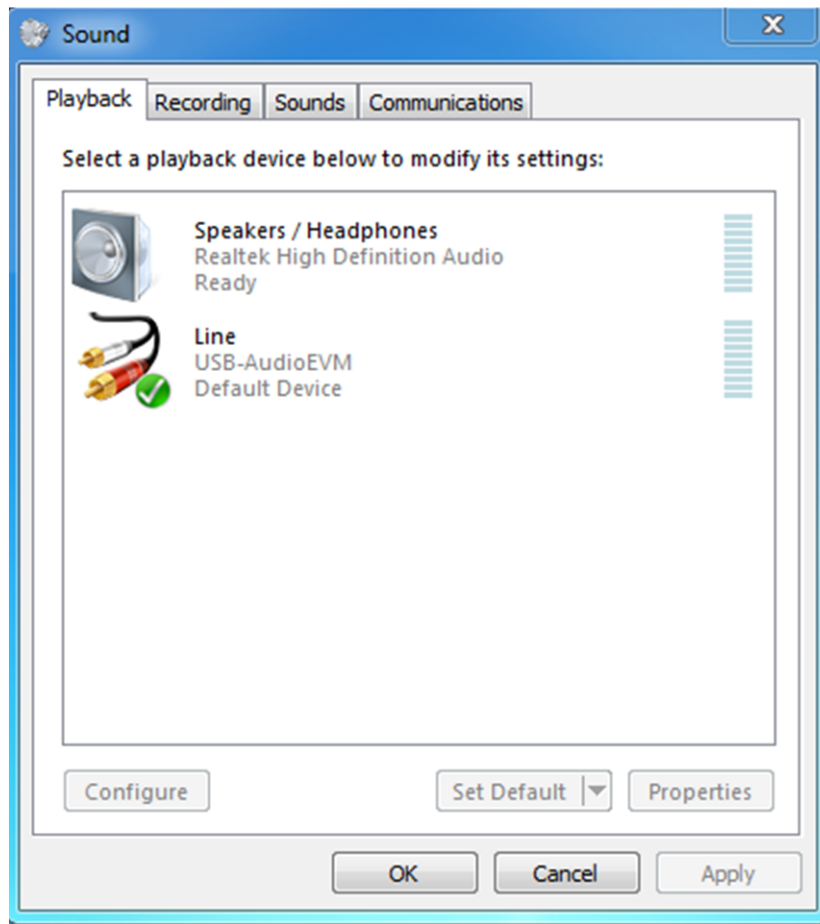


Figure 5. Playback Device Settings

- Start up PPC3 software.
- Log in and download the I2C Master App if it is not downloaded already.
- Launch the I2C Master App. In the bottom lefthand corner there should be a button that says Connect, shown in [Figure 6](#). Press the connect button and now the button should be red and say Disconnect.

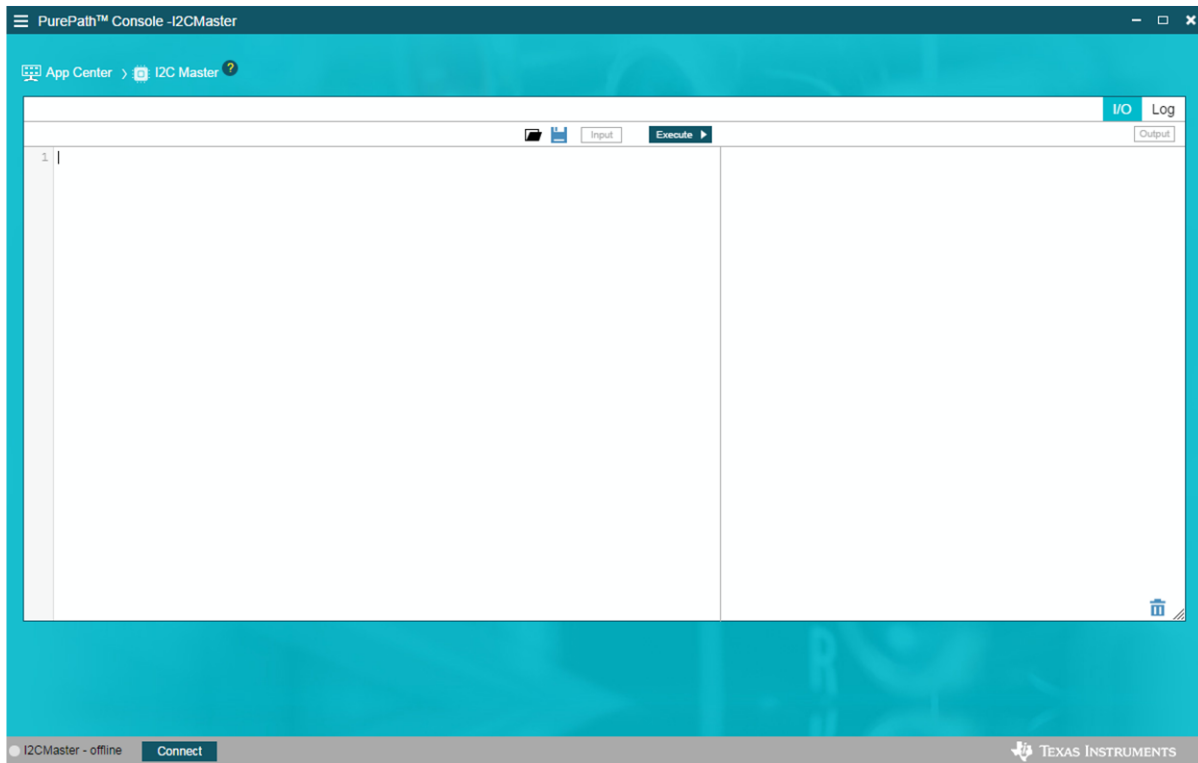
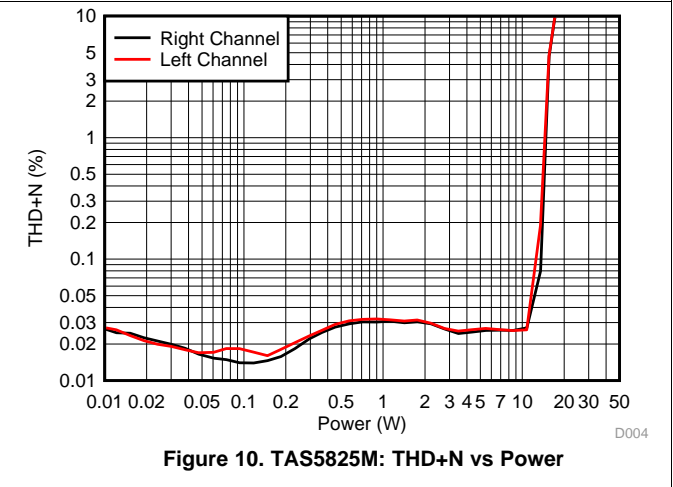
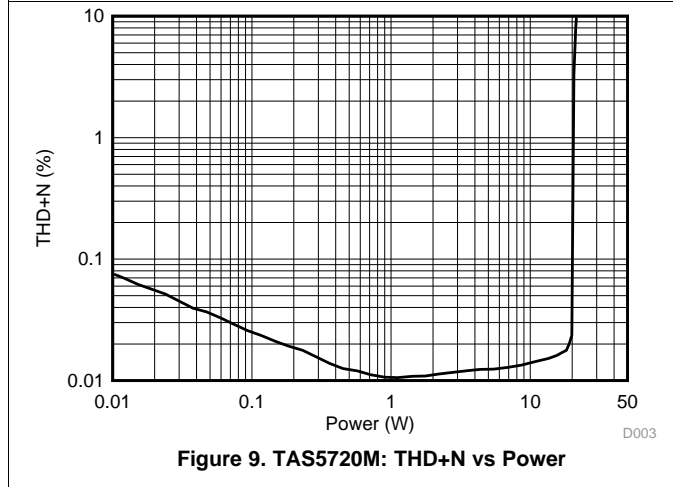
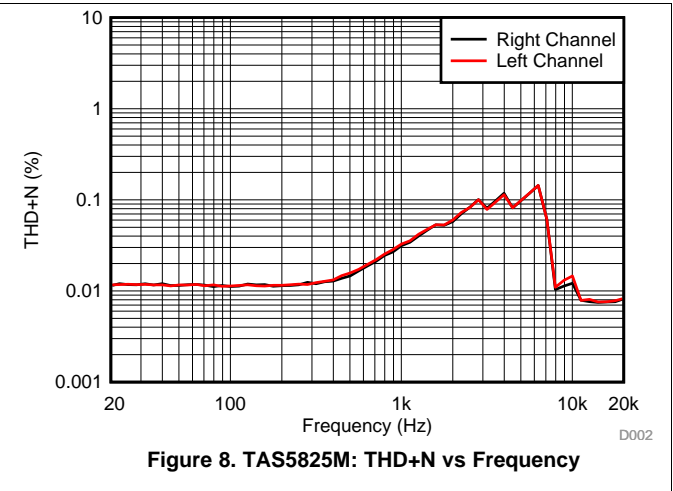
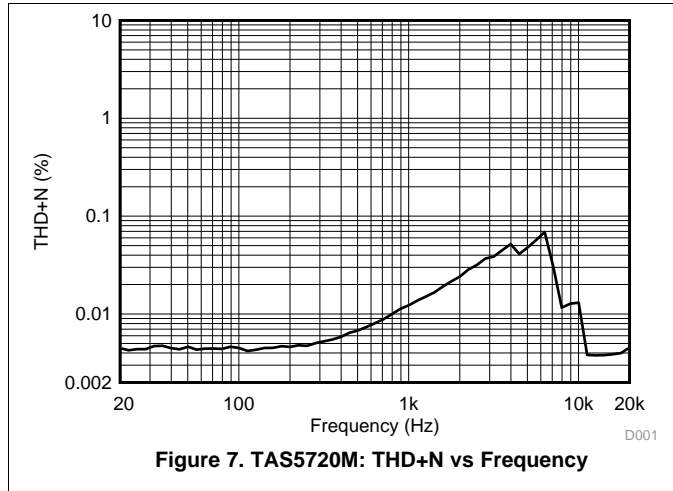


Figure 6. I2C Master Interface

- Open up the code .txt file provided on the website and copy and paste the code into the I2C Master app.
- Shown in [Figure 6](#), click the Excute button. All lines should say successfully written.
- Proceed to play audio through the audio player.

3.2.2 Test Results

Measurements were done at free-air room 25°C, with the Analog Analyzer filter set to 20-kHz brickwall filter. PVDD was set to 12-V with the load being 4-Ω.



4 Design Files

4.1 Schematics

To download the schematics, see the design files at [TIDA-060026](#).

4.2 Bill of Materials

To download the bill of materials (BOM), see the design files at [TIDA-060026](#).

4.3 PCB Layout Recommendations

4.3.1 Layout Prints

To download the layer plots, see the design files at [TIDA-060026](#).

4.4 Altium Project

To download the Altium Designer® project files, see the design files at [TIDA-060026](#).

4.5 Gerber Files

To download the Gerber files, see the design files at [TIDA-060026](#).

4.6 Assembly Drawings

To download the assembly drawings, see the design files at [TIDA-060026](#).

5 Software Files

To download the software files, see the design files at [TIDA-060026](#).

6 Related Documentation

1. [TAS5825M Process Flows](#)

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