www.hesaitech.com

Lidar Thermal Requirements Application Note

Classification: Internal

Doc Version: AN001-en-240210

Table of Contents

Introduction

Purpose and scope

This application note describes the thermal design requirements of Hesai's lidar products.

This application note is under constant revision. To obtain the latest version, please contact Hesai technical support.

Relevant documents

This application note is intended for use in conjunction with other technical documents regarding the lidar product. Users should have a general understanding of the lidar product by reading the respective user manual.

To obtain the user manual of your lidar product, please do one of the following:

- Visit the Download page of Hesai's official website: https://www.hesaitech.com/downloads/
- Contact your sales representative of Hesai.
- Contact Hesai technical support: service@hesaitech.com

Legends and format

Warnings: Instructions that must be followed to ensure safe and proper use of the product.

Notes: Additional information that may be helpful.

Applicability

This application note applies to all Hesai's lidar.

1. Necessity of thermal design optimization

The lidar's temperature performance is strongly correlated with three factors:

- Thermal characteristics of the lidar
- Environmental conditions in the vehicle's application scenario
- Mounting scheme

With the first two factors predefined, the mounting scheme needs to be optimized to ensure that the lidar performs as expected under extreme operating conditions.

Yet the evaluation of thermal risks should not be carried out on the lidar alone — all the relevant thermal loads (the surrounding parts on the vehicle) and the mounting environment (such as the material of the mounting bracket) jointly affect the lidar's heat dissipation capability.

Therefore, systematic thermal design optimization is a necessary step in designing the lidar's mounting scheme.

For more details, please contact Hesai's technical support.

2. Heat dissipation optimization measures

The heat dissipation optimization scheme is determined by the design objectives (environmental conditions) and specific design requirements. Below are the general measures.

No.	Measures	Description	Purpose	Influence	Possible negative effects
1	Light color paints	Use light color paint on the external surface of the vehicle body where the lidar is located.	To reduce the absorption of solar radiation	Strong	Adds constraints on exterior design
2	Anti-radiation coating	Use an anti-radiation coating where the lidar is located.		Strong	Adds constraints on the exterior design and increases cost
3	Thermal-protective coating	Add a thermal-protective coating between the lidar and the vehicle exterior.		Medium	Impairs the lidar's heat dissipation capability under driving conditions

No.	Measures	Description	Purpose	Influence	Possible negative effects
4	Metal mounting bracket	Expand the heat dissipation area of the lidar.	To improve the lidar's passive cooling capacity	Medium	Increases cost and weight
5	Thermal interface material (TIM)	Uses TIM between the lidar and its mounting bracket to enhance the heat exchange capacity.		Medium	Increases cost and makes the manufacturing process complex
6	Heat dissipation space	Increase the spacing between the lidar and its decorative cover; avoid enclosing the lidar with low thermal conductivity materials.		Weak	Increases volume of the lidar module
7	Structural opening	Open holes on the lidar's enclosing structure to facilitate airflow.		Weak	Increases noise, vibration, and harshness (NVH); limits sealing design and exterior design
8	Air-cooled heat dissipation	Design air ducts and add cooling fans. Control the starts/stops and load of the fans according to lidar temperature.	To improve the lidar's active heat dissipation capacity	Strong	Increases cost and noise
9	Liquid cooling	Add a liquid-cooling system; control the starts/stops of the system according to lidar temperature.		Extremely strong	Increases cost
10	Control strategy	Under high-temperature conditions, change certain lidar parameters or lower the lidar's performance specifications.	To reduce power consumption	Strong	Degrades lidar performance

3. Solution evaluation

After heat dissipation optimization and establishing the mounting scheme, the lidar's temperature performance should be verified through theoretical analysis and real-world testing.

Evaluation type	Theoretical analysis	Real-world testing	
Method	Thermal simulation analysis	Environmental chamber (short-term)	Field testing (long-term)
Basic inputs	• Structural model and physical parameters of the mounting scheme • Lidar thermal characteristics • Ambient temperature • Solar radiation intensity • Airflow conditions outside the vehicle • Operational states of vehicle and lidar	• Ambient temperature • Solar radiation intensity • Airflow settings • Operational states of vehicle and lidar • Test duration • Scope of data acquisition	• Proving ground (with required climatic conditions) • Experimental scenarios • Operational states of vehicle and lidar • Scope of data acquisition • Validity criteria of experimental data • Volume of test data

Appendix A: A typical heat dissipation scheme

This scheme applies to a top-mounted front-facing lidar, installed at the center of a vehicle's windshield header.

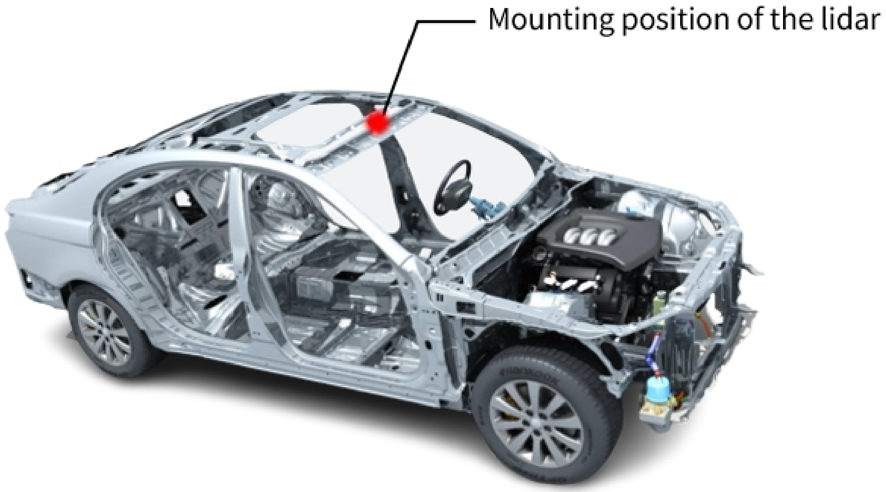

Figure 1. Mounting position

A.1. Environmental adaptability requirements

If the requirements of an application scenario are similar to (or more lenient than) the requirements in this section, then this scheme is likely applicable; otherwise, a detailed evaluation is necessary.

A.1.1. Environmental conditions

- Temperature: 45°C
- Sunlight: 1050 W/m^2 solar radiation (or approx. 130 klux illuminance) with an incidence angle of 75° in the front of the lidar.
- Wind conditions: no significant airflow exists when the vehicle is stationary. Natural convection can be assumed.

A.1.2. Harsh operating conditions

Long-term normal operation cannot be promised under extremely harsh environmental conditions that involve high temperatures and strong sunlight. For example:

- After a long period of parking under strong sunlight, the lidar and its surrounding parts have reached relatively high temperatures. With all those conditions unchanged, turn on the lidar.
- The vehicle travels at a speed < 2.5 km/h with the lidar ON, but the air conditioning in the passenger compartment is OFF.

The minimum vehicle speed to ensure long-term normal operation is determined by multiple factors, such as the lidar's software and hardware, the lidar's operating mode, climatic conditions, and the mounting scheme. Therefore, the parameter(s) in the example above is for reference only.

A.2. Heat dissipation scheme

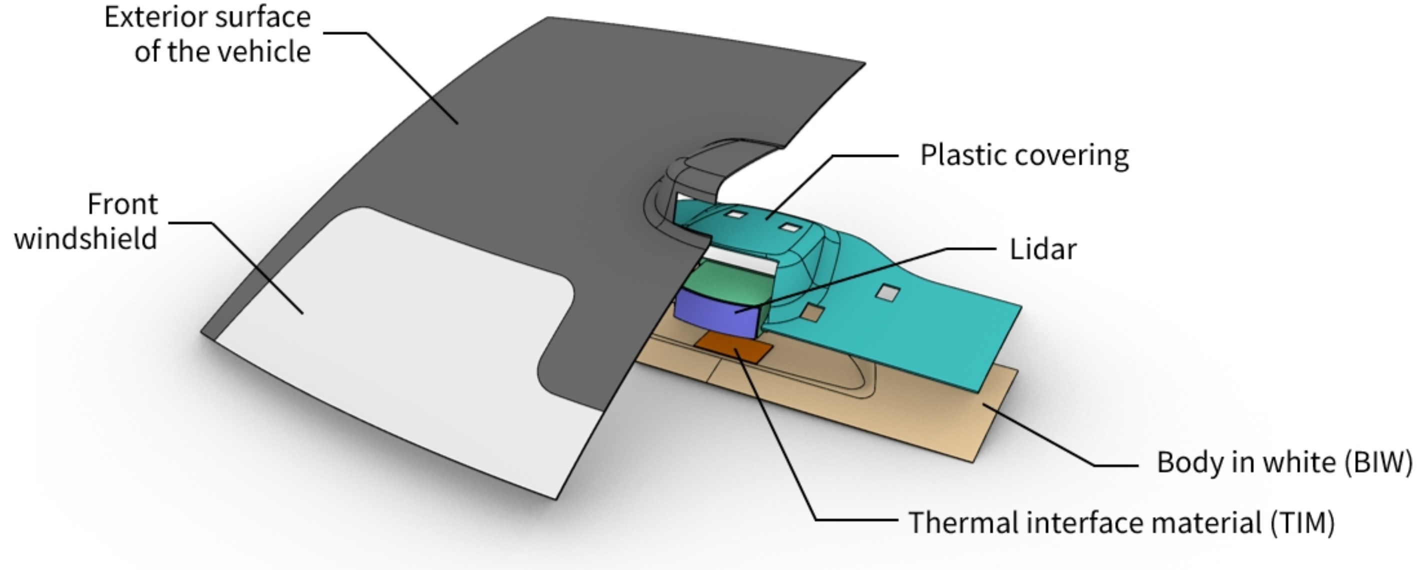

Figure 2. Mounting scheme

- TIM (see Thermal interface material (TIM)) should be used between the lidar and the vehicle's body in white (BIW) to optimize heat dissipation.
- The mounting position should be within 300 mm on either side of the BIW's central axis (600 mm in total), as shown in Figure 3. BIW cross-section.
- For the BIW: its thickness should be ⩾ 1.2 mm and its cross-section should cover an area of ⩾ 300 mm^2.
- For the TIM: its thermal conductivity should be ⩾ 2 W/mK; the average theoretical thickness should be ⩽ 2.5 mm; the effective filling area should be ⩾ 3500 mm^2 within the area shown in Figure 4. Allowed area of the TIM.
- A plastic cover should be added above the lidar and the BIW, with a thermal conductivity ⩽ 2 W/mK.
- The lidar should not be enclosed with low thermal conductivity materials, such as thermal insulation cotton and soundproof cotton. The area within 10 mm from the lidar should be cleared, except for the connection point.
- Using a mounting bracket between the lidar and the BIW is also viable. However, the mounting bracket must be metal and its structural design should facilitate heat dissipation.

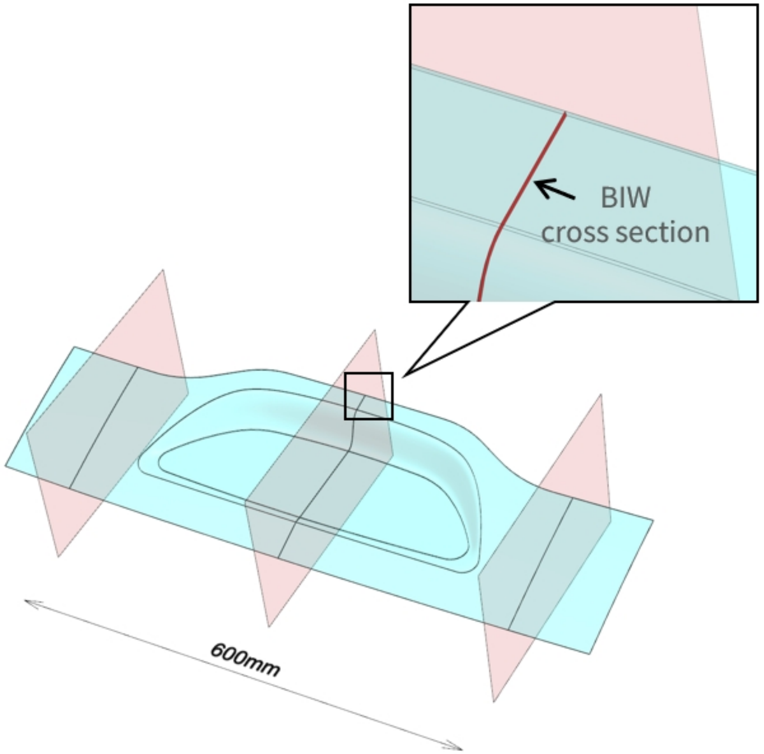

Figure 3. BIW cross-section

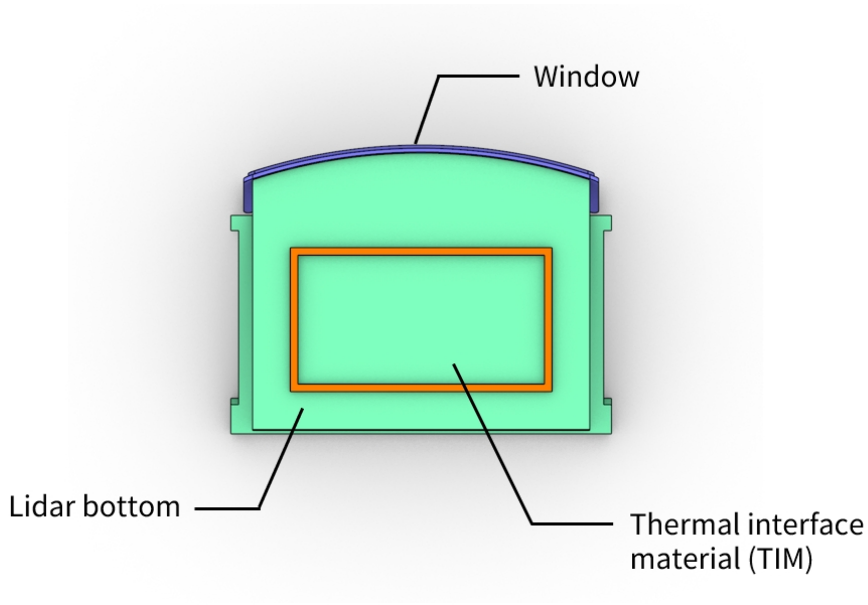

Figure 4. Allowed area of the TIM

Appendix B: Legal notice

Hesai Technology makes no representations or warranties, either expressed or implied, with respect to the contents hereof and specifically disclaims any warranties, merchantability, or fitness for any particular purpose. Further, Hesai Technology reserves the right to revise this publication and to make changes from time to time in the contents hereof without obligation to notify any person of such revisions or changes.

HESAI and HESAI logo are registered trademarks of Hesai Technology. All other trademarks, service marks, and company names in this manual or on Hesai's official website are properties of their respective owners.

The software included in this product contains the copyright that is registered under Hesai Technology. Any third party is not permitted, except as expressly permitted by the licensor or expressly required by applicable law, to decompile, reverse engineer, disassemble, modify, rent, lease, loan, distribute, sublicense, create derivative works based on the whole or any part of the software.

Hesai Product Warranty Service Manual is on the Warranty Policy page of Hesai's official website: https://www.hesaitech.com/warranty-policy/

Hesai Technology Co., Ltd.

Phone: +86 400 805 1233
Website: www.hesaitech.com
Address: Building L2, Hongqiao World Centre, Shanghai, China

Business Email: info@hesaitech.com
Service Email: service@hesaitech.com