STMicroelectronics VL53L7CX Time-Of-Flight Ranging Sensor Instruction Manual

AN5853
Application note

PCB thermal guidelines for the VL53L7CX Time-of-Flight 8×8 multizone ranging sensor with 90° FoV

Contents

Introduction

When used in continuous mode, the VL53L7CX module requires careful thermal management to ensure optimum device performance and to avoid overheating.

Table 1. Main thermal parameters

Parameter	Symbol	Min	Typ	Max	Unit
Power consumption	P	–	216 (1)	430 (2)	mW
Module thermal resistance	emod	—	40	—	°C/W
Junction temperature (3)	Tj	–	–	100	°C
Operating temperature range	T	-30	25	70	°C

1. AVDD = 2.8 V; IOVDD = 1.8 V typical current consumption.
2. AVDD = 3.3 V; IOVDD = 3.3 V maximum current consumption.
3. To prevent thermal shutdown, the junction temperature must be kept below 110°C.

Figure 1. VL53L7CX ranging sensor module

Thermal design basics

The symbol θ is generally used to denote thermal resistance which is a measure of a temperature difference by which an object or material resists a heat flow. For example, when transferring from a hot object (such as silicon junction) to a cool one (such as module backside temperature or ambient air). The formula for thermal resistance is shown below and is measured in °C/W:

$$\theta = \frac{\Delta T}{P}$$

Where ΔT is the rise in junction temperature and P is the power dissipation.
So, for example, a device with a thermal resistance of 100 °C/W exhibits a temperature differential of 100°C for a power dissipation of 1 W as measured between two reference points.
If a module is soldered to a PCB or flex then the total system thermal resistance is the sum of the module thermal

resistance and the thermal resistance of the PCB or flex to the ambient/air. The formula is as follows:

$$\Delta T = \left(T_J - T_A\right) = P \times \left(\theta_{\text{mod}} + \theta_{pcb}\right)$$

Where:

- TJ is the junction temperature
- TA is the ambient temperature
- θmod is the module thermal resistance
- θpcb is the thermal resistance of the PCB or flex

Thermal resistance of PCB or flex

The maximum permitted junction temperature of the VL53L7CX is 100°C. So, for a power dissipation of 0.43 W operating at the maximum specified ambient temperature of 70°C (worst case scenario), the maximum permitted PCB or flex thermal resistance is calculated as follows:

- TJ – TA = P × (θmod + θpcb)
- 100 – 70 = 0.43 × (40 + θpcb)
- $\theta_{pcb} = \frac{100 - 70}{0.43} - 40$
- θpcb ≈ 30°C/W

This gives a combined system thermal resistance of 70°C/W (θmod + θpcb).

Note:
To ensure the maximum junction temperature is not exceeded and to ensure optimum module performance, it is recommended not to exceed the above target thermal resistance. For a typical system dissipating 216 mW, the maximum temperature rise is < 20°C which is recommended for optimum performance of the VL53L7CX.

Layout and thermal guidelines

Use the following guidelines when designing the module PCB or flex:

- Maximize the copper cover on the PCB to increase the thermal conductivity of the board.
- Use the module thermal pad B4 shown in Figure 2. VL53L7CX pin out and thermal pad (see the VL53L7CX datasheet DS18365 for more details) adding as many thermal vias as possible to maximize thermal conductivity into adjacent power planes (refer to Figure 3. Thermal pad and via on the PCB recommendation).
- Use wide tracking for all signals particularly power and ground signals; track and connect into adjacent power planes where possible.
- Add heat sinking to the chassis or frames to distribute heat away from the device.
- Do not place adjacent to other hot components.
- Place the device in a low power state when not in use.

Figure 2. VL53L7CX pin out and thermal pad

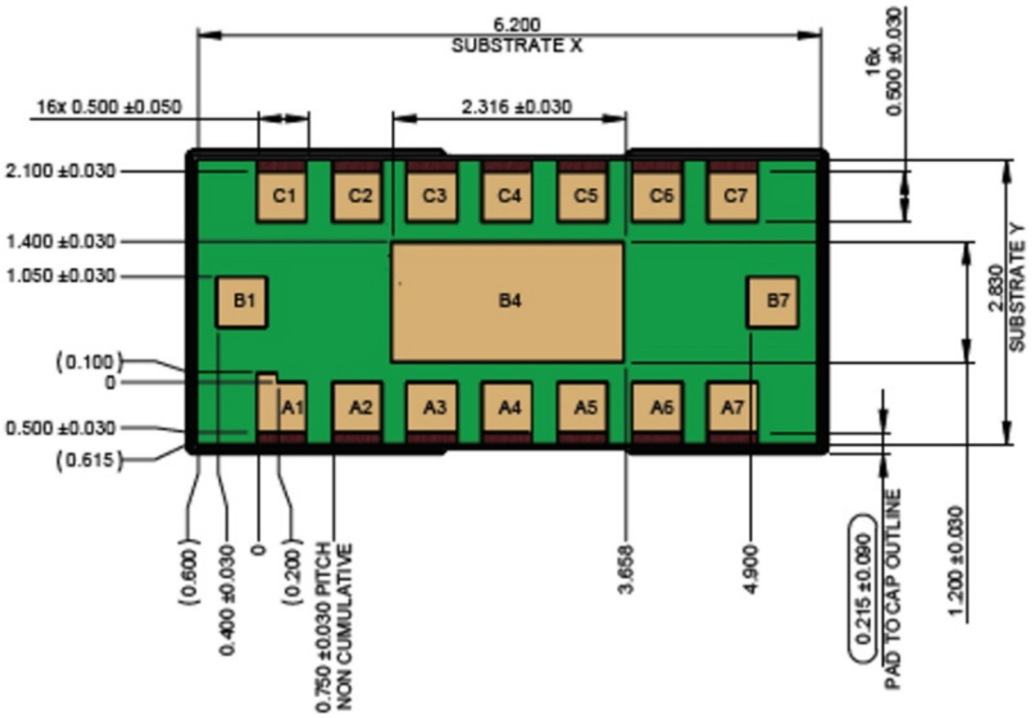
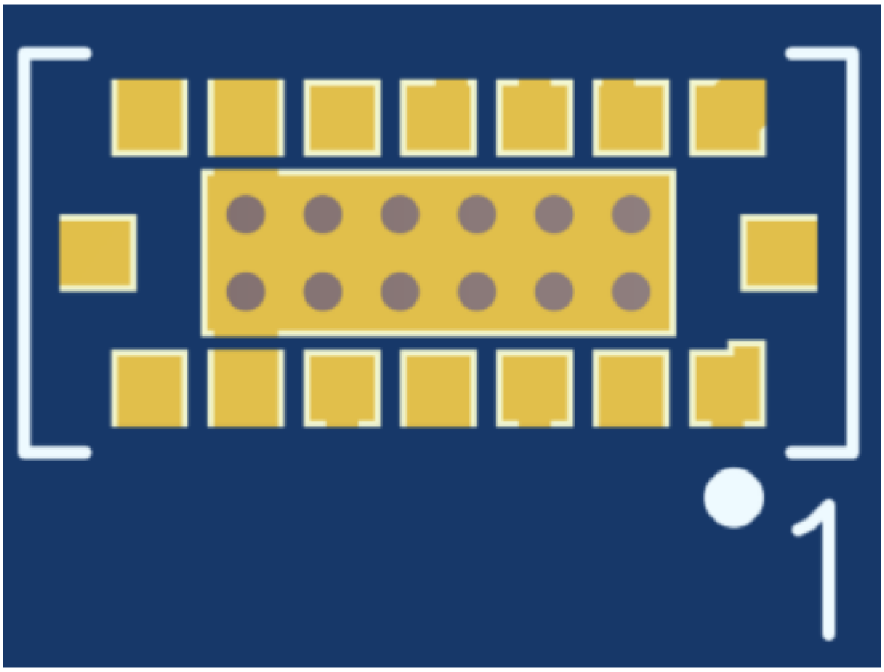


Figure 3. Thermal pad and via on the PCB recommendation



Revision history

Table 2. Document revision history

Date	Version	Changes
20-Sep-22	1	Initial release

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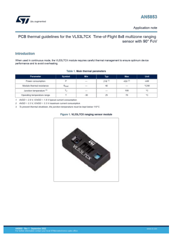	STMicroelectronics VL53L7CX Time-Of-Flight Ranging Sensor [pdf] Instruction Manual VL53L7CX Time-Of-Flight Ranging Sensor, VL53L7CX, Time-Of-Flight Ranging Sensor, Flight Ranging Sensor, Ranging Sensor, Sensor

References

- STMicroelectronics: Our technology starts with you
- STMicroelectronics Trademark List - STMicroelectronics