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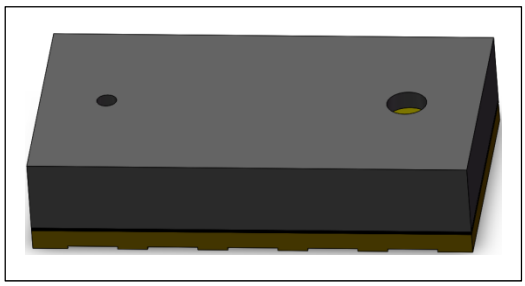
# Datasheet – VI5301

Time-of-Flight Sensor



## Features

- Fully integrated SIP module
  - Size: 4.4 mm × 2.4 mm × 0.975 mm
  - 940 nm VCSEL emitter
- Ranging Methodology
  - Direct time-of-flight measurement
  - Histogram based algorithm
  - Reference SPAD
- Distance measurement
  - Range: up to 3.3m
  - Ranging rate: up to 90 Hz
  - Measurement accuracy: ±4%
  - Distance and confidence level reported
- Optics
  - Class 1 laser device
- On-chip compensation
  - Ambient light rejection
  - Cover glass calibration
  - Dynamic compensation for smudge on glass
- Easy integrating
  - Single power supply
  - SIP package design
  - $I^2C$ interface

## Applications

- Distance measurement for camera autofocus (LDAF)
- Proximity detection
- Collisions avoidance
- 1D gesture recognition
- Object detection supporting low-power system operation
- Work as a trigger in high-power system

## General description

The VI5301 is a direct Time-of-Flight (dToF) sensor module within a single modular package which integrates a single photon avalanche diode (SPAD) sensor array and a VCSEL emitter. This sensor module provides a compact solution for precise ranging of an object irrespective of the color, reflectance factor and texture of the object. With the independent developed SPAD and exclusive ToF collecting and processing technology, the VI5301 achieves an up to 3.3 meters accurate distance measurement and up to 90 Hz high ranging frequency.

A histogram-based algorithm with cover glass calibration and smudges compensation is implanted in the sensor module. So that it's able to operates in high reliability. Benefiting to sub-nanosecond optical pulse and reliable eye safety control system, Class-1 Eye Safety is certified. The sensor module can work for distance measurement in outdoor sunlight since the ambient light noise is minimized by the on-sensor narrow band optical filter and built-in sunlight rejection algorithm. Measurement data and system configuration are transferred via fast-mode $I^2C$ interface. With only a single power source supply and zero external component design, the sensor module is easy for system integrating.

# Table of contents


**1 Overview ..... 5**

1.1 Technical specifications ..... 5

1.2 System block diagram ..... 5

1.3 Pin definition ..... 6

**2 Module dimensions ..... 7**

**3 Electrical characteristics ..... 8**

3.1 Absolute maximum ratings ..... 8

3.2 Recommended operating conditions ..... 8

3.3 ESD performance ..... 8

3.4 Digital input and output ..... 9

**4 Typical ranging characteristics ..... 10**

**4.1 Normal Mode ..... 10**

**4.2 Near Mode ..... 10**

**5 Functional description ..... 12**

5.1 I²C Control interface ..... 12

5.2 Timing ..... 15

5.2.1 Ranging acquisition timing ..... 15

5.2.2 Reset pin and power-up timing ..... 16

5.3 Current consumption ..... 16

5.4 Typical optical characteristics ..... 16

**6 Registers Map ..... 17**

**7 Application information ..... 18**

7.1 Application schematic ..... 18

7.2 PCB layout ..... 19

7.3 PCB pad layout ..... 20

**8 Tape & reel information ..... 21**

**9 Soldering and storage ..... 22**

9.1 Manufacturing and soldering ..... 22

9.2 Storage information ..... 23

**10 Laser eye safety ..... 24**

**11 Ordering information ..... 25**

**12 Acronyms and abbreviations ..... 26**

**13 Copyright & Disclaimer ..... 27**

**14 Revision history ..... 28**

# List of figures


**Figure 1: System block diagram** ..... 5
**Figure 2: Pin out diagram (bottom view)** ..... 6
**Figure 3: VI5301 outline dimension** ..... 7
**Figure 4: I²C Data transfer protocol** ..... 12
**Figure 5: VI5301 I²C device address: 0xd8** ..... 12
**Figure 6: VI5301 data format (write)** ..... 13
**Figure 7: VI5301 data format (read)** ..... 13
**Figure 8: VI5301 data format (sequential write)** ..... 13
**Figure 9: VI5301 data format (sequential read)** ..... 14
**Figure 10: I²C timing characteristics** ..... 15
**Figure 11: Ranging timing diagram** ..... 15
**Figure 12: VI5301 FoI/FoV** ..... 16
**Figure 13: VI5301 schematic** ..... 18
**Figure 14: Recommended PCB layout** ..... 19
**Figure 15: Recommended PCB layout** ..... 19
**Figure 16: PCB footprint (top view)** ..... 20
**Figure 17: Tape and reel drawing** ..... 21
**Figure 18: Recommended reflow soldering thermal profile** ..... 22

# List of tables

**Table 1: Technical specifications** ..... 5
**Table 2: Pin definition** ..... 6
**Table 3: Absolute maximum ratings [1)]** ..... 8
**Table 4: Recommended operating conditions** ..... 8
**Table 5: ESD performance** ..... 8
**Table 6: Digital input and output** ..... 9
**Table 7: Ranging characteristics[1)]** ..... 10
**Table 8: Characteristics of near-mode1)** ..... 10
**Table 9: $I^2C$ interface - timing characteristics** ..... 14
**Table 10: Ranging acquisition timing** ..... 15
**Table 11: Reset pin and power-up timing** ..... 16
**Table 12: Current consumption** ..... 16
**Table 13: Registers** ..... 17
**Table 14: Recommended thermal profile parameters** ..... 22
**Table 15: Ordering information** ..... 25
**Table 16: Acronyms and abbreviations** ..... 26
**Table 17: Datasheet revision history** ..... 28

# 1 Overview

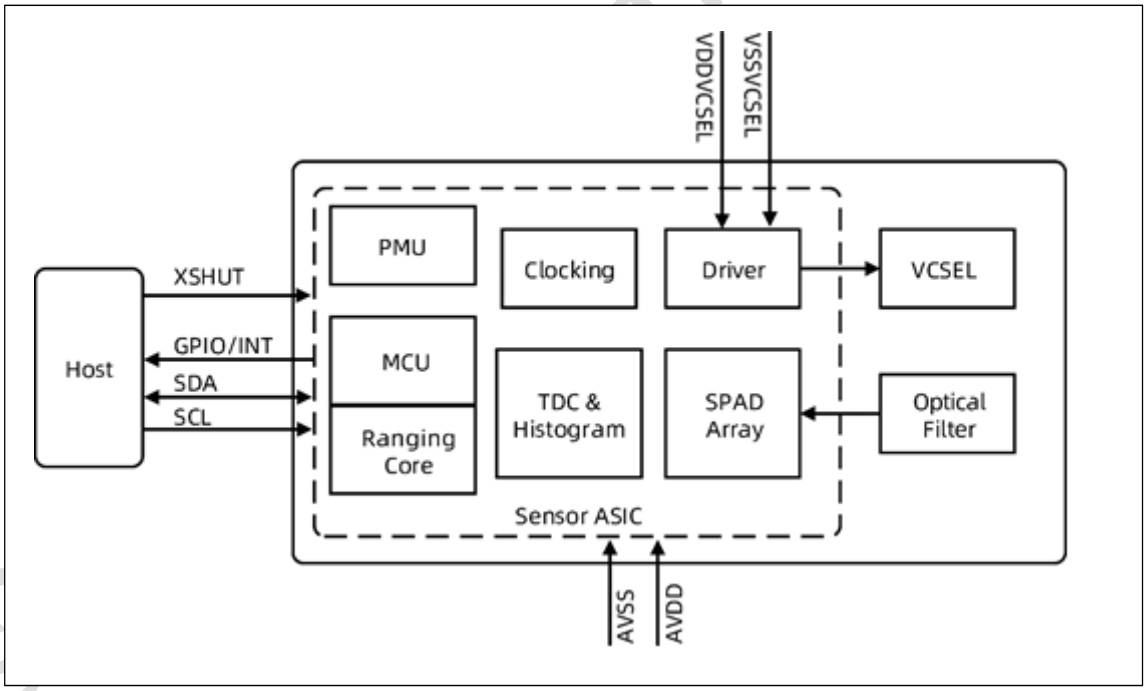
## 1.1 Technical specifications

**Table 1: Technical specifications**

| Parameter | Value |
|---|---|
| Package | OLGA 12 |
| Size | 4.4 mm × 2.4 mm × 0.975 mm |
| Operating voltage | 2.8 V ~ 3.5 V |
| Operating temperature | -30℃ ~ 85℃ |
| Infrared emitter | 940 nm |
| $I^2C$ interface | Up to 1 MHz<br>Address: 0xd8 |

## 1.2 System block diagram

**Figure 1: System block diagram**



## 1.3 Pin definition

**Figure 2: Pin out diagram (bottom view)**

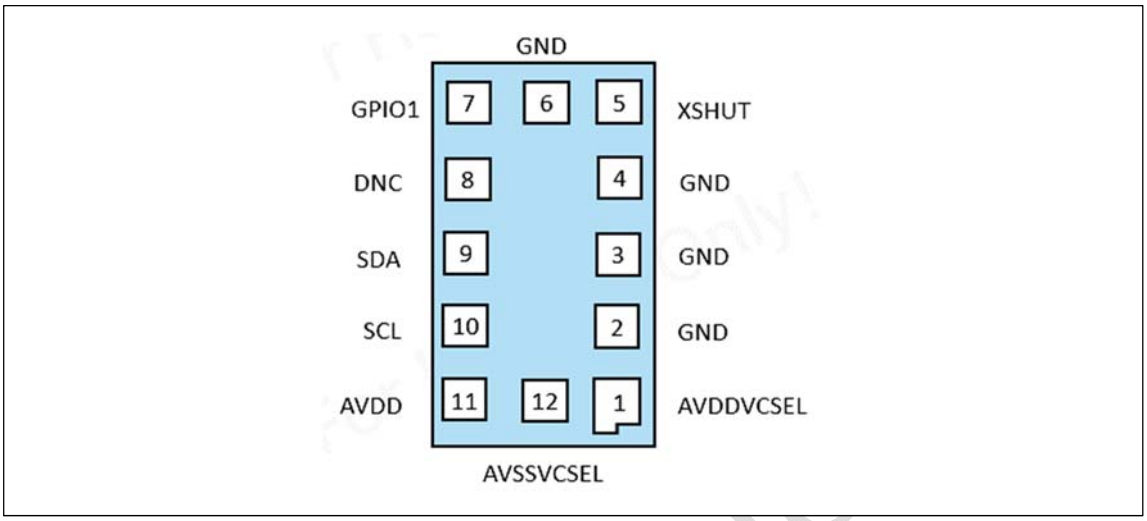
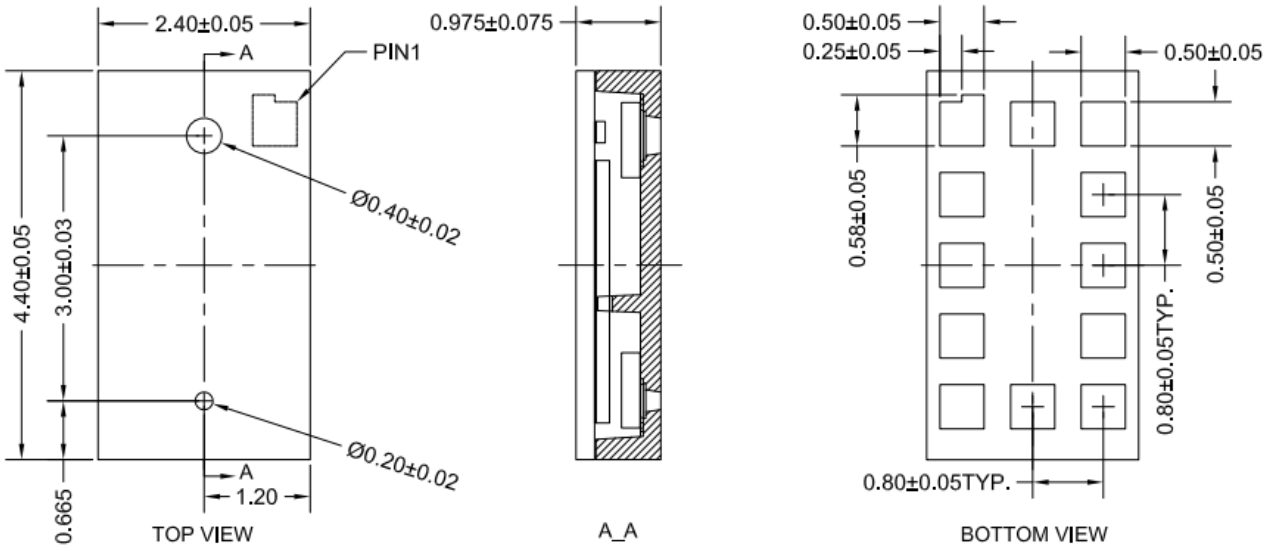



**Table 2: Pin definition**

| Pin No. | Pin name | Signal type | Description |
|---|---|---|---|
| 1 | AVDDVCSEL | Supply | 2.8 V ~ 3.5 V DC |
| 2 | GND | Ground | To be connected to ground |
| 3 | GND | Ground | To be connected to ground |
| 4 | GND | Ground | To be connected to ground |
| 5 | XSHUT | Digital input | Hardware reset pin, active low |
| 6 | GND | Ground | To be connected to ground |
| 7 | GPIO1 | Digital output | Interrupt output, open drain output |
| 8 | DNC | - | Leave this pin floating |
| 9 | SDA | Digital input/output | I2C serial data |
| 10 | SCL | Digital input | $I^2C$ serial clock input |
| 11 | AVDD | Supply | 2.8 V ~ 3.5 V DC |
| 12 | AVSSVCSEL | Ground | To be connected to ground |

# 2 Module dimensions

**Figure 3: VI5301 outline dimension**




Note: all dimensions are mm unless otherwise specified.

# 3 Electrical characteristics

## 3.1 Absolute maximum ratings

**Table 3: Absolute maximum ratings [1)]**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| AVDD | -0.3 | - | 3.6 | V |
| SCL，SDA，XSHUT and GPIO | -0.3 | - | 3.6 | V |
| I_SCR(Latch-up suppression) | | ±200 | | mA |
| Storage temperature | -40 | - | 85 | ℃ |
| Relative humidity (non-condensing) | - | - | 85 | % |
| Moisture sensitivity level | MSL.3 [2)] | | | - |

[1)] Stresses beyond those listed in Table 3 may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in Section 5 Electrical characteristics is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

[2)] Represents a maximum floor life time of 168 h with ambient temperature < 30°C and relative humidity < 60%.

## 3.2 Recommended operating conditions

**Table 4: Recommended operating conditions**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Voltage (AVDD) | 2.8 | 3.0 | 3.5 | V |
| VIO (IOVDD = 1.2V) [1)] | 1.1 | 1.2 | 1.3 | V |
| VIO (IOVDD = 1.8V) | 1.7 | 1.8 | 1.9 | V |
| VIO (IOVDD = 3.3V) | 2.8 | 3.0 | 3.5 | V |
| Temperature (normal operating) | -30 | - | 85 | ℃ |

[1)] VDDIO MUST be under or equal AVDD.

## 3.3 ESD performance

**Table 5: ESD performance**

| Parameter | Specification | Condition |
|---|---|---|
| HBM (Human Body Model) | JS-001-2017 | ±2000 V |
| CDM (Charged Device Model) | JS-002-2018 | ±500 V |

## 3.4 Digital input and output

**Table 6: Digital input and output**

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| **Interrupt pin (GPIO)** | | | | | |
| $V_{IL}$ | Low level input voltage | - | - | 0.3xIOVDD | V |
| $V_{IH}$ | High level input voltage | 0.7xIOVDD | - | - | V |
| $V_{OL}$ | Low level output voltage ($I_{OUT}$ = 4 mA) | - | - | 0.4 | V |
| $V_{OH}$ | High level output voltage ($I_{OUT}$ = 4 mA) | IOVDD-0.4 | - | - | V |
| $F_{GPIO}$ | Operating frequency ($C_{LOAD}$ = 20 pF) | 68 | 75 | 83 | MHz |
| **I²C interface (SDA/SCL)** | | | | | |
| $V_{IL}$ | Low level input voltage | - | - | 0.3xIOVDD | V |
| $V_{IH}$ | High level input voltage | 0.7xIOVDD | - | - | V |
| $V_{OL}$ | Low level output voltage ($I_{OUT}$ = 4 mA) | - | - | 0.4 | V |
| IIL/IIH | Leakage current [1)] | | | 0.1 | µA |
| | Leakage current [2)] | - | - | 1 | µA |

1) AVDD = 0 V

2) AVDD = 3.0 V; IOVDD = 1.8 V

# 4 Typical ranging characteristics

## 4.1 Normal Mode

To achieve the performance described as follows, a calibration of the algorithm needs to be performed. The calibration test shall be done in a space without any IR light and no target within 60 cm in field of view of the sensor. The VI5301 generates a calibration data set which is permanently stored on the host. Every time the VI5301 is powered on, the calibration data set will be sent via I²C interface to the VI5301 prior to execution of any algorithms (commands=0x0A).
The following operating characteristics are measured with calibrated devices with full FoV covered and no cover glass, and the integration times setting is 131072.

**Table 7: Ranging characteristics**[1)]

| Parameter | Condition | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Maximum distance detection, 1 m x 1 m object | 350 lux fluorescent on object, 88% white card | 3200 | 3300 | - | mm |
| | 350 lux fluorescent on object, 18% grey card | 2400 | 2500 | - | mm |
| | 350 lux fluorescent on object, 10% black card | 1800 | 2000 | - | mm |
| | 700 lux halogen light on object [2)], 88% white card | 600 | 900 | - | mm |
| | 700 lux halogen light on object [2)], 18% grey card | 500 | 700 | - | mm |
| | 14000 lux halogen light on object [3)], 18% grey card | 200 | 300 | - | mm |
| Minimum distance detection, 18% grey card, 1 m x 1 m | | - | 25 | - | mm |
| Accuracy | Object distance ≥ 250 mm | -4 | - | +4 | % |
| | 25 mm ≤ object distance < 250 mm | -10 | - | +10 | mm |

[1)] confidence level ≥30, detection rate: 90%, operating temperature: 25±5℃.
[2)] 700 lux halogen light represents 5k lux sunlight equivalent; light on object only.
[3)] 14000 lux halogen light represents 100 k lux sunlight equivalent; light on object only.

## 4.2 Near Mode

To achieve the near-mode characteristics in below, a dedicated VI5301 firmware and driver is MUST. Customer side calibration and tuning should also be executed. Calibration and tuning are including:1. Calibrate at no target within 60cm of VI5301 FOV without IR energy. 2. Offset calibration at 2cm black-card. The calibration data must be stored in the host machine. Every time when VI5301 power up and initialize, the host must download the calibration data before VI5301 run any algorithm via $I^2C$ interface.
The following operating characteristics are measured with calibrated devices with full FoV covered and no cover glass, and the integration times setting is 196608.

**Table 8: Characteristics of near-mode**[1)]

| Parameter | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Maximum distance detection, 1 m x 1 m object | 350 lux fluorescent on object, 88% white card | 300 | - | - | mm |
| | 350 lux fluorescent on object, 18% grey card | 300 | - | - | mm |
| | 4.3k lux halogen light on object [2)], 88% white card | 300 | - | - | mm |
| | 4.3k lux halogen light on object [2)], 5% black card | 300 | - | - | mm |
| Minimum distance detection, 18% grey card, 1 m x 1 m object | | - | 10 | - | mm |
| Accuracy of 5% black card and 88% white card | 10 mm≤object distance≤30 mm | -6 | - | +6 | mm |
| | 30 mm < object distance≤200 mm | -10 | - | +10 | mm |
| Accuracy of 5% black card in worst case | 10 mm≤object distance≤50 mm | | 4 | | mm |
| | 50 mm≤object distance≤100 mm | | 6 | | mm |

[1)] confidence level ≥30, detection rate: 90%, operating temperature: 25±5℃.

[2)] 4.3K lx halogen light is equaled to 30K lx sunlight.

## 4.3 Micro Mode

To achieve the near-mode characteristics in below, a dedicated VI5301 firmware and driver is MUST. Customer side calibration and tuning should also be executed. Calibration and tuning are including:1. Calibrate at no target within 60cm of VI5301 FOV without IR energy. 2. Offset calibration at 2cm black-card. The calibration data must be stored in the host machine. Every time when VI5301 power up and initialize, the host must download the calibration data before VI5301 run any algorithm via $I^2C$ interface.
The following operating characteristics are measured with calibrated devices with full FoV covered and no cover glass, and the integration times setting is 196608.

**Table 8: Characteristics of near-mode**[1)]

| Parameter | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Maximum distance detection, 1 m x 1 m object | 350 lux fluorescent on object, 88% white card | 100 | - | - | mm |
| | 350 lux fluorescent on object, 18% grey card | 100 | - | - | mm |
| | 4.3k lux halogen light on object [2)], 88% white card | 100 | - | - | mm |
| | 4.3k lux halogen light on object [2)], 5% black card | 100 | - | - | mm |
| Minimum distance detection, 18% grey card, 1 m x 1 m object | | - | 20 | - | mm |
| Accuracy of 5% black card and 88% white card | 10 mm≤object distance≤30 mm | -3 | - | +3 | mm |
| | 30 mm < object distance≤200 mm | -5 | - | +5 | mm |
| Accuracy of 5% black card in worst case | 10 mm≤object distance≤50 mm | | 3 | | mm |
| | 50 mm≤object distance≤100 mm | | 5 | | mm |

[1)] confidence level ≥30, detection rate: 90%, operating temperature: 25±5℃.

[2)] 4.3K lx halogen light is equaled to 30K lx sunlight.

# 5 Functional description

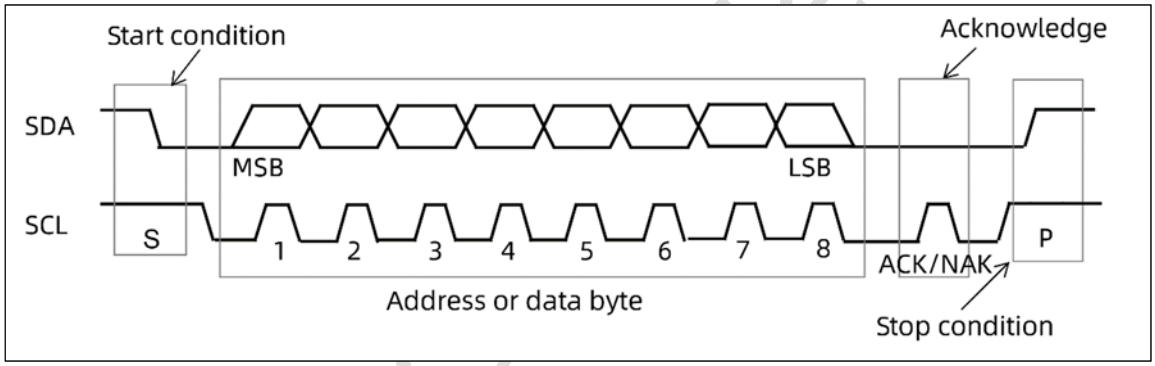
## 5.1 I²C Control interface

The I²C interface uses two signals: the serial data line (SDA) and serial clock line (SCL). Each device connected to the bus uses a unique address and a simple master/slave relationships exists. The VI5301 provides a standard I²C interface which supports slave mode with the device address 0xd8 (0xd8 for Write, and 0xd9 for Read). 8-bit address and 8-bit data are used to configure the registers.

Both SDA and SCL lines are connected to a positive supply voltage using pull up resistors located on the host. Lines are only actively driven low. A high condition occurs when the lines float and the pull up resistors pull them up. When no data are transmitted both lines are high.

Clock signal (SCL) generation is performed by the master device. The master device initiates data transfer. The I²C bus on the VI5301 has a maximum speed of 1 Mbps.

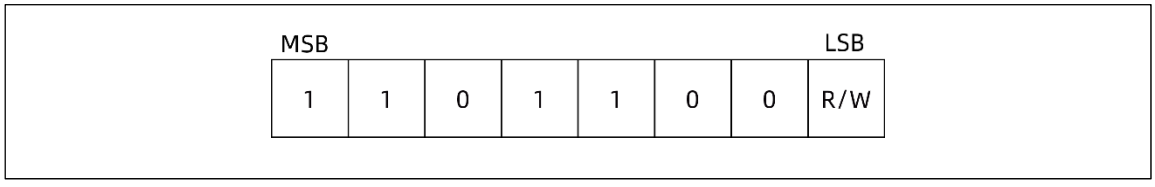
**Figure 4: Data transfer protocol**




Data is packed in 8-bit packets (bytes). During a write sequence, the data bytes are followed by an acknowledge bit ACK for VI5301 acknowledge; during a read sequence, the data bytes are followed by a negative acknowledge bit NAK for master acknowledge. The internal data are produced by sampling SDA at a rising edge of SCL. The external data must be stable during the high period of SCL. The exceptions to this are start (S) or stop (P) conditions when SDA falls or rises respectively, while SCL is high.

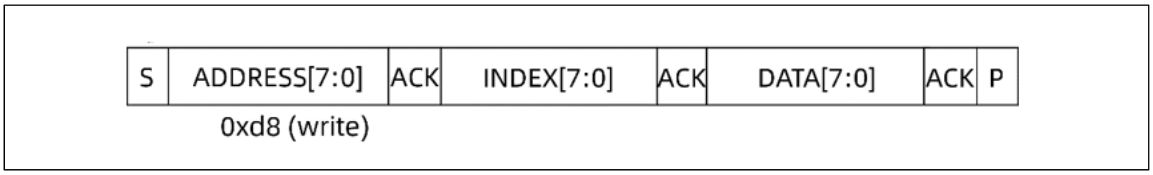
A message contains a series of bytes preceded by a start condition and followed by either a stop or repeated start (another start condition but without a preceding stop condition) followed by another message. The first byte contains the device address (0xd8) and also specifies the data direction. If the least significant bit is low (that is, 0xd8) the message is a master-write-to-the-slave. If the LSB is set (that is, 0xd9) then the message is a master-read-from-the-slave.

**Figure 5: VI5301 I²C device address: 0xd8**




All serial interface communications must begin with a start condition. The VI5301 module acknowledges the receipt of a valid address by driving the SDA wire low. The state of the read/write bit (LSB of the address byte) is stored and the next byte of data, sampled from SDA, can be interpreted. During a write sequence, the second byte received provides an 8-bit index which points to one of the internal 8-bit registers.

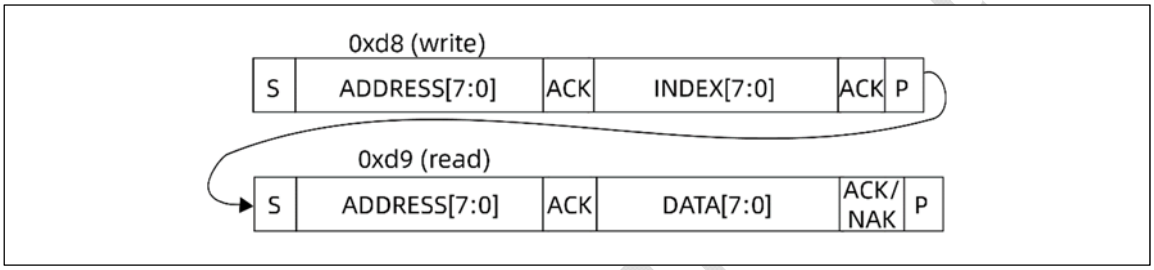
**Figure 6: VI5301 data format (write)**




As data is received by the slave, it is written bit-by-bit to a serial/parallel register. After each data byte has been received by the slave, an acknowledgement is generated, the data is then stored in the internal register addressed by the current index.

During a read message, the contents of the register addressed by the current index is read out in the byte following the device address byte. The contents of this register are parallel loaded into the serial/parallel register and clocked out of the device by the falling edge of SCL.

**Figure 7: VI5301 data format (read)**




During a read sequence, an acknowledgement is issued by VI5301 at the end of each byte.

A message can only be terminated by the bus master, by issuing a negative acknowledge (that is, **not** pulling the SDA line low) after reading a complete byte during a read operation.

The interface also supports auto-increment indexing. After the first data byte has been transferred, the index is automatically incremented by 1. The master can therefore send data bytes continuously to the slave until the slave fails to provide an acknowledgement or the master terminates the write communication with a stop condition. If the auto-increment feature is used the master does not have to send address indexes to accompany the data bytes.

**Figure 8: VI5301 data format (sequential write)**

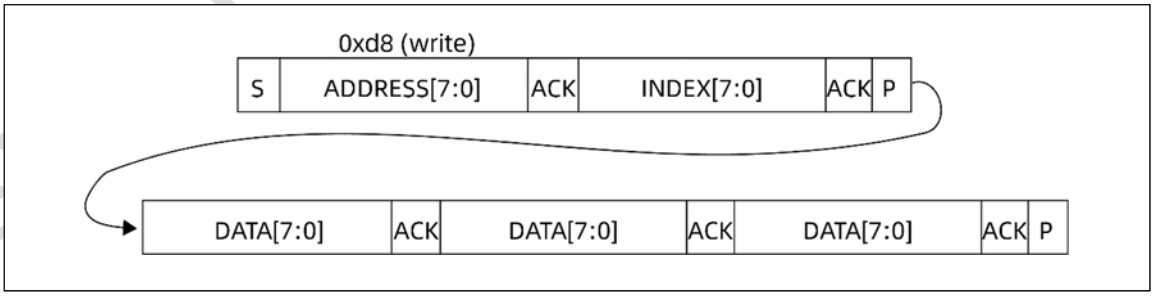


**Figure 9: VI5301 data format (sequential read)**

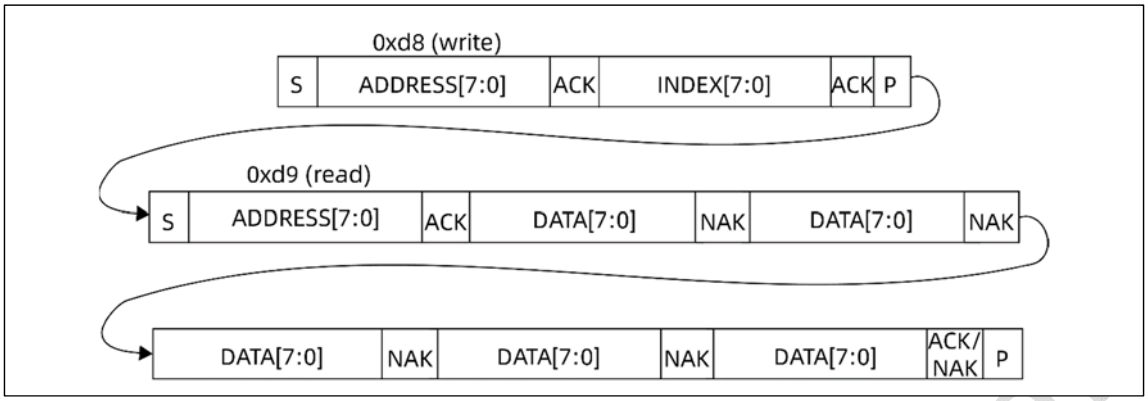
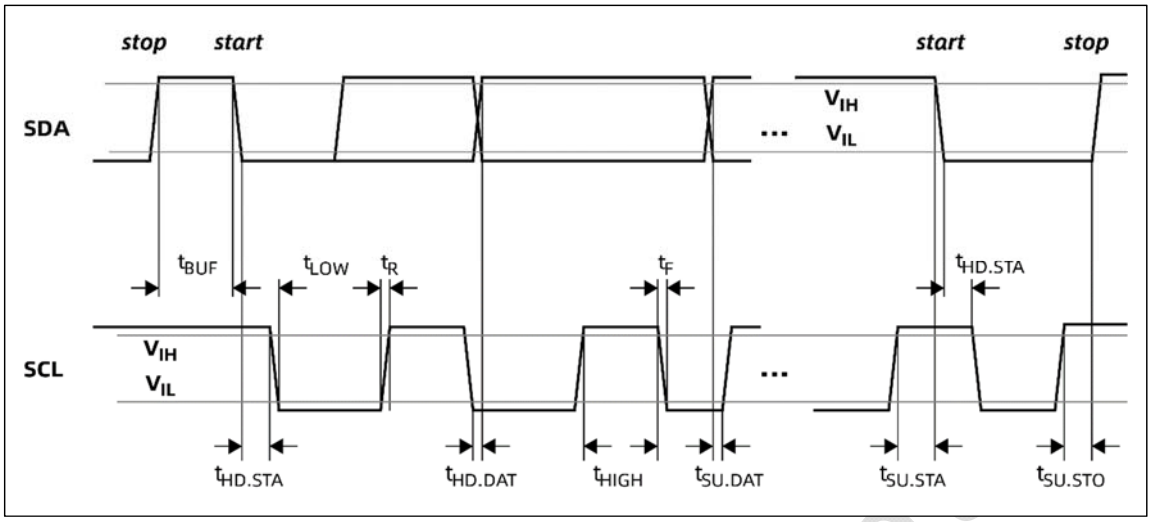



**Table 9: I²C interface - timing characteristics**

Please refer to **Figure 10** for an explanation of the parameters used.

| Symbol | Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| $F_{I2C}$ | Operating frequency | 0 | - | 1 | MHz |
| $t_{LOW}$ | Clock pulse width low | 0.5 | - | - | µs |
| $t_{HIGH}$ | Clock pulse width high | 0.26 | - | - | |
| $t_{SP}$ | Pulse width of spikes which are suppressed by the input filter | - | - | 1 | ns |
| $t_{BUF}$ | Bus free time between transmissions | 0.5 | - | - | µs |
| $t_{HD.STA}$ | Start hold time | 0.26 | - | - | µs |
| $t_{SU.STA}$ | Start set-up time | 0.26 | - | - | |
| $t_{HD.DAT}$ | Data in hold time | 0 | - | | |
| $t_{SU.DAT}$ | Data in set-up time | 50 | - | - | ns |
| $t_R$ | SCL/SDA rise time | - | - | 100 | |
| $t_F$ | SCL/SDA fall time | - | - | 100 | |
| $t_{SU.STO}$ | Stop set-up time | 0.26 | - | - | µs |
| $C_{i/o}$ | Input/output capacitance (SDA) | - | - | 10 | pF |
| $C_{in}$ | Input capacitance (SCL) | - | - | 10 | |
| $C_L$ | Load capacitance | - | | 400 | |

**Figure 10: I²C timing characteristics**




All timings are measured from either $V_{IL}$ or $V_{IH}$.

## 5.2 Timing

### 5.2.1 Ranging acquisition timing

**Figure 11: Ranging timing diagram**

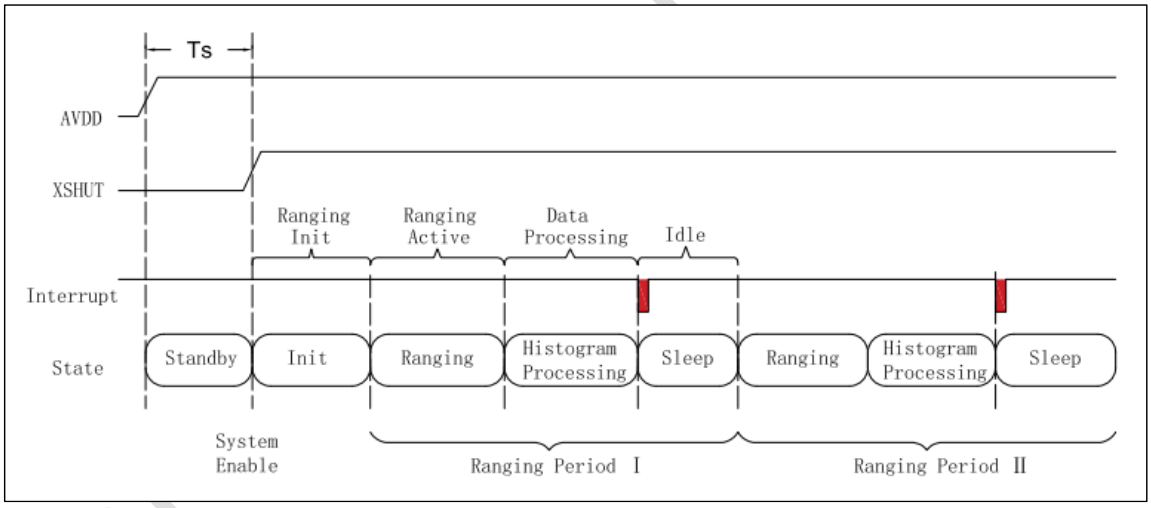



**Table 10: Ranging acquisition timing**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Ranging Time Default Setting [1)] | - | 19.2 | - | ms |
| AVDD power on to XSHUT pull up | 0 | 5 | - | ms |
| Ranging Init (including electrical calibration) [2)] | - | 200 | - | ms |
| Ranging Period [3)] | 11 | 33 | - | ms |

[1)] Varies with operational mode;

[2)] Only done on startup and if temperature changed from last calibration;I2C frequency: 400K bit/s.

[3)] Typical frame rate is 30 fps and is programmable by the interface.

### 5.2.2 Reset pin and power-up timing

**Table 11: Reset pin and power-up timing**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| Power On (Boot Time) | - | 5 | - | ms |
| Enable high to ready for measurement [1)] | - | 2 | - | ms |
| Standby to Active Time | - | 1 | - | ms |
| Active to Standby Time | - | 1 | - | ms |
| Enable Low to Power Down Time | - | 1 | - | ms |

[1)] Does not include calibration data download time.

## 5.3 Current consumption

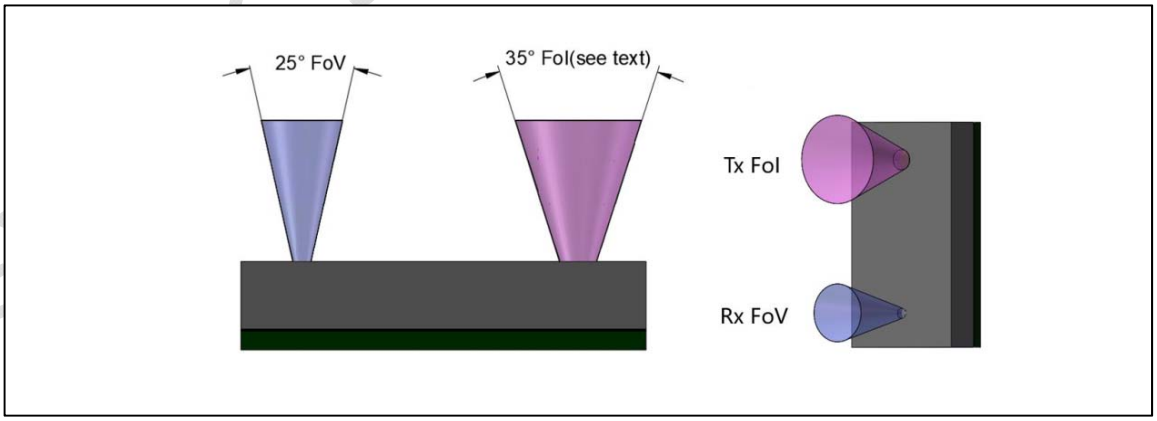
**Table 12: Current consumption**

| Parameter | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|
| HW standby [1)] | 0.3 | 1.2 | 2 | µA |
| SW standby [2)] | 6 | 8.4 | 10 | µA |
| Active ranging average consumption [3)] | 13 | 14.5 | 16 | mA |

[1)] AVDD 3.0 V, XSHUT is low;
[2)] AVDD 3.0 V, XSHUT is high, and $I^2C$ interface is active;
[3)] 65536 x 2 integrations at 30 fps, at room temperature.

## 5.4 Typical optical characteristics

**Figure 12: VI5301 FoI/FoV**




**VCSEL FOI**

- 35° is the aperture needed in mechanical design.
- Emitting FOI is max.25℃@1/e^2

**Filter characteristics**

- FWHM 45 nm
- Pass band center wavelength 940 nm

# 6 Registers Map

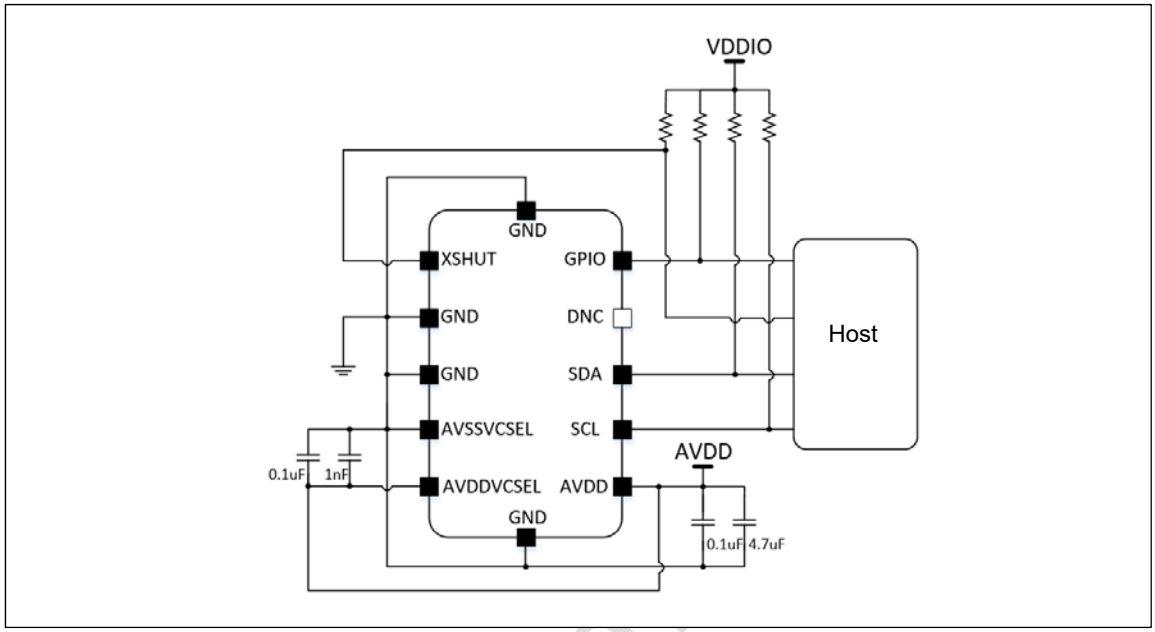
**Table 13: Registers**

| Register Name | Address | Type | Description |
|---|---|---|---|
| Device stat | 0x02 | RO | [0] Device Status：1 = busy；0 = free<br>[7:1] Reserved |
| Intr stat | 0x03 | RC | [0] Interrupt Status：1=Interrupt，auto-clear after read.<br>[7:1] Reserved |
| Intr mask | 0x04 | RW | [0]Interrupt mask：1 = Enable，0 = Forbidden. MUST SET to 1.<br>[7:1] Reserved |
| I2C dev addr | 0x06 | R/W | I2C address. B[7:1]:0xd8, b[0]: R/W bit, fixed to 0 internally. |
| Power ctrl | 0x07 | R/W | [0] Enable super low power mode<br>[1] Enable low power mode<br>[7:2] Reserved. |
| Spcial purpose reg | 0x08 | R/W | Firmware download flag:0x66<br>Xtalk calibration success flag:0xaa |
| REG_DIG<87:80> | 0x0A | R/W | [4:0] Command code. Single range:0x0e, Continuance range:0x0f, Stop continuance range:0x1f<br>[7:5] Reserved. |

# 7 Application information

## 7.1 Application schematic

**Figure 13: VI5301 schematic**




**Note:**

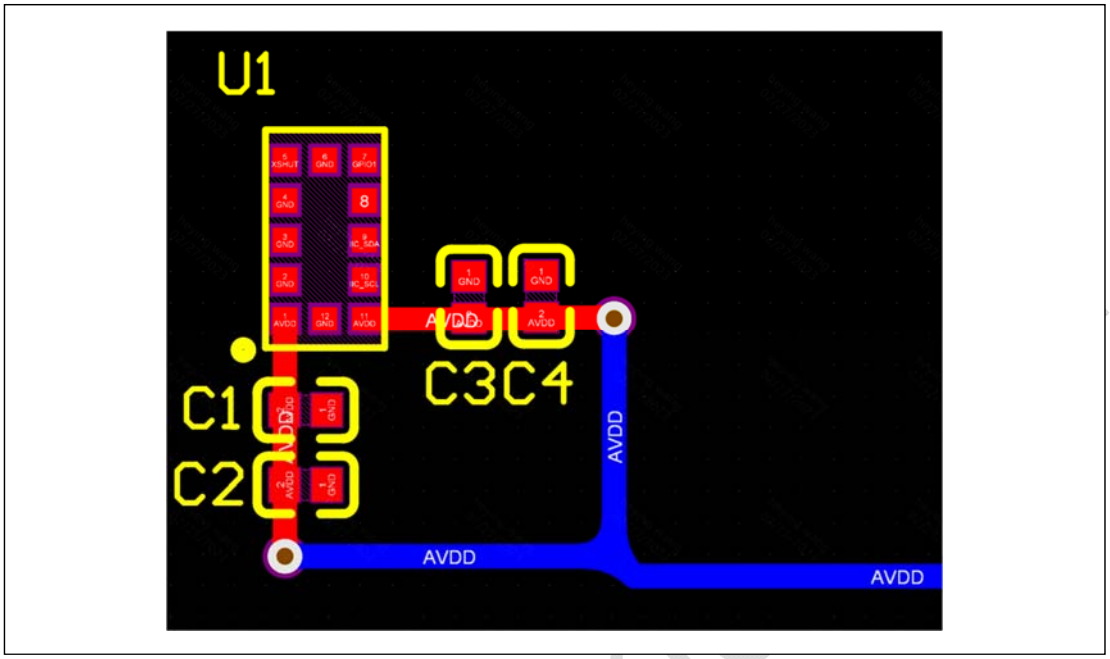
- Capacitors on external power supply AVDD should be placed as close as possible to the AVDDVCSEL and AVSSVCSEL pins of VI5301.
- For external pull-up resistor values, please refer to $I^2C$-bus specification. Pull-ups are typically fitted only once per bus, near the HOST.

  Pull-up resistors of 1 kΩ to 1.5 kΩ are recommended for1MHz $I^2C$ clock with 3.3V AVDD.
- XSHUT pin must always be driven to avoid leakage current. Pull-up is needed if the host state is unknown.

  Recommended value of XSHUT and GPIO pull up resistors is 10 kΩ.

## 7.2 PCB layout

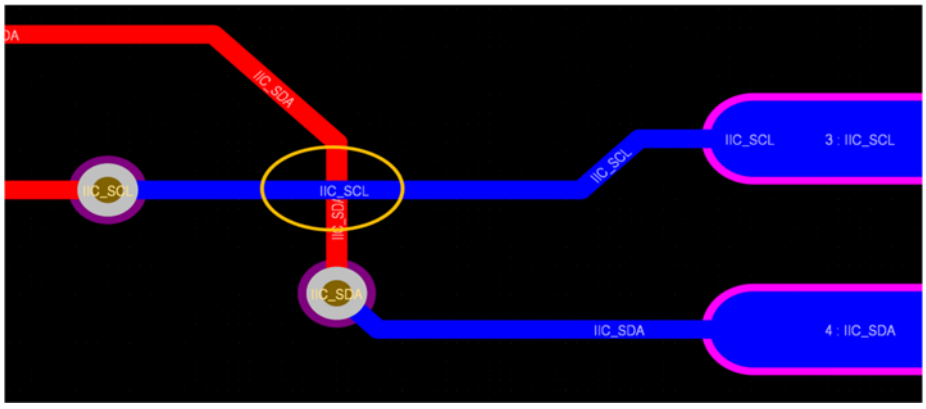
**Figure 14: Recommended PCB layout**




**Note:**

- Recommended capacitance: C1 1nF, C2 100nF, C3 0.1uF, C4 4.7uF.
- C1 and C2 should be placed as closer to the AVDDVCSEL as possible.
- C3 and C4 should be placed the closest to AVDD pin.
- AVSSVCSEL (PIN1) and AVDD（PIN11）pins should be separated wired before passing through the decoupling capacitor.
- Solid GND plane with enough vias is recommended to avoid the interference between AVDDVCSEL and AVDD.
- The power and ground loops should be kept as short as possible.

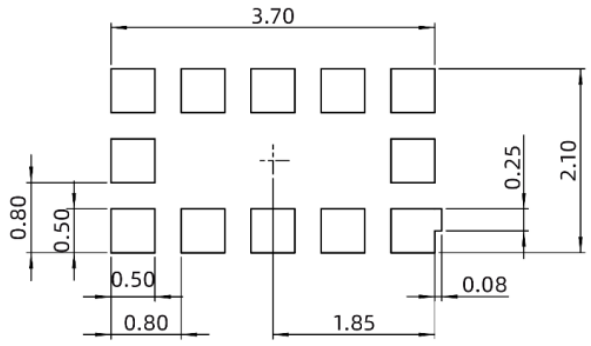
**Figure 15: Recommended PCB layout**




**Note:**

- Avoid I2C traces cross over at acute angle.

## 7.3 PCB pad layout

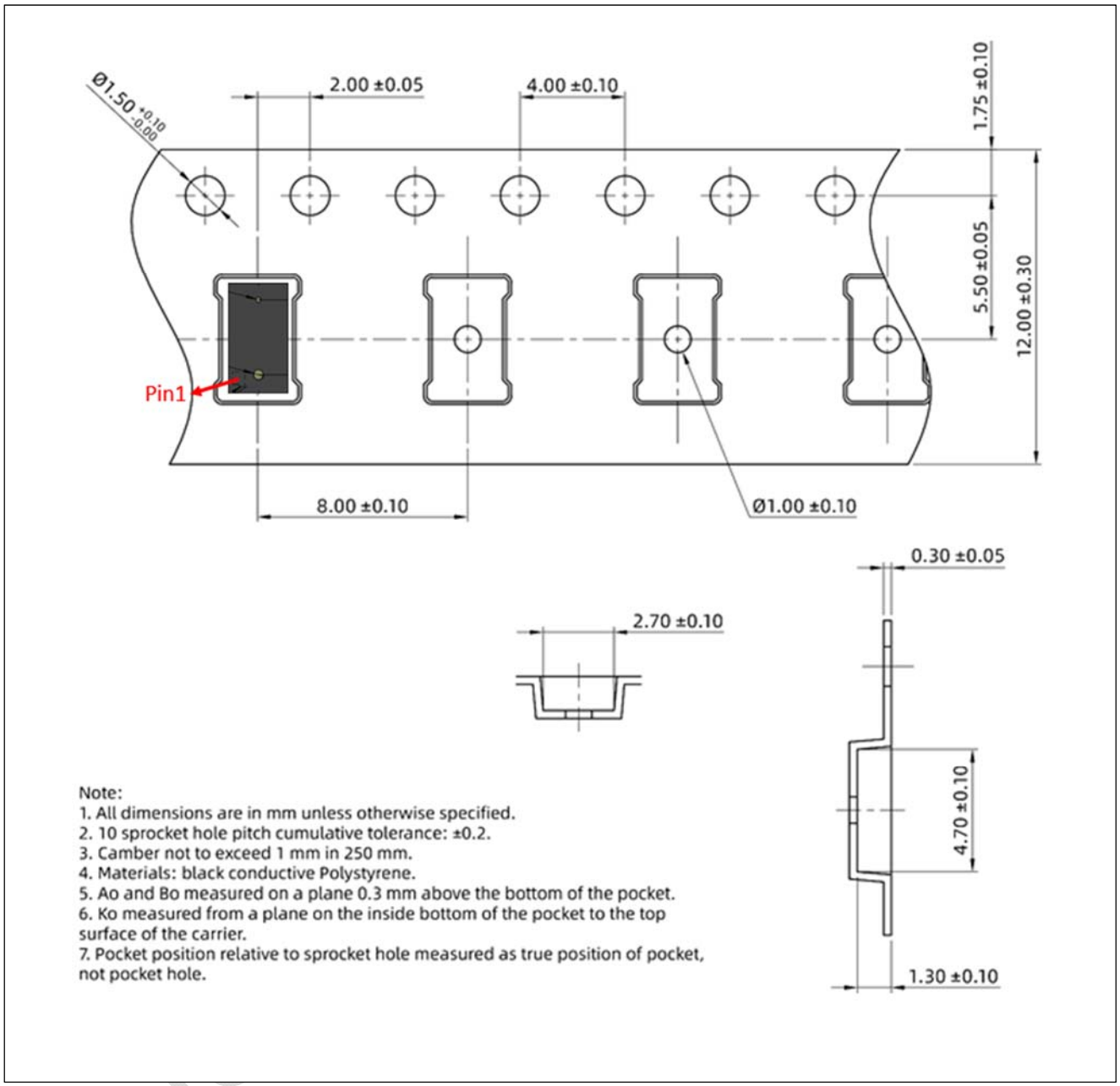



Note:
- All dimensions are in mm unless otherwise specified.

**Figure 16: PCB footprint (top view)**

# 8 Tape & reel information

**Figure 17: Tape and reel drawing**



# 9 Soldering and storage

## 9.1 Manufacturing and soldering

It is suggested that the peak reflow temperature is 240ºC ~ 260ºC and the absolute maximum reflow temperature is 260ºC. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below:

**Figure 18: Recommended reflow soldering thermal profile**

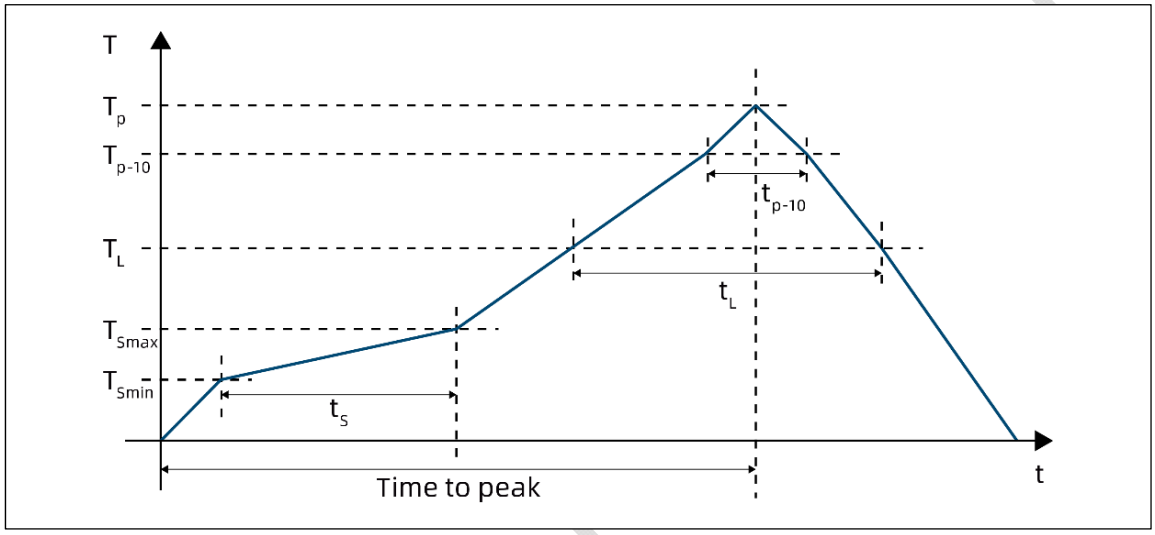



**Table 14: Recommended thermal profile parameters**

| Parameter | Recomm. value | Max. value | Unit |
|---|---|---|---|
| Minimum temperature ($T_{Smin}$) | 130 | 150 | °C |
| Maximum temperature ($T_{Smax}$) | 200 | 200 | °C |
| Time $t_S$ ($T_{Smin}$ to $T_{Smax}$) | 90-110 | 60 - 120 | s |
| Temperature ($T_L$) | 217 | 217 | °C |
| Time ($t_L$) | 55-65 | 55 - 65 | s |
| Ramp up | +2 | +3 | °C/s |
| Temperature ($T_{p-10}$) | - | 250 | °C |
| Time ($t_{p-10}$) | - | 10 | s |
| Ramp up | - | +3 | °C/s |
| Peak temperature ($T_p$) | 240 | 260 max. | °C |
| Time to peak | 300 | 300 | s |
| Ramp down (peak to $T_L$) | -4 | -6 | °C/s |

**Note:**

- Temperature mentioned in the table above is measured at the top of the device package.
- The component should be limited to a maximum of 3 passes through this solder profile.

## 9.2 Storage information

The VI5301 is delivered in sealed moisture-barrier bags. It has been assigned a moisture sensitivity level of MSL 3. The following storage conditions must be noted:

**Moisture Sensitivity**

Optical characteristics of the device can be adversely affected during the soldering process by the release and vaporization of moisture that has been previously absorbed into the package. To ensure the package contains the smallest amount of absorbed moisture possible, each device is baked prior to being dry packed for shipping. Devices are dry packed in a sealed aluminized envelope called a moisture-barrier bag with silica gel to protect them from ambient moisture during shipping, handling, and storage before use.

**Shelf Life**

The calculated shelf life of the device in an unopened moisture barrier bag is 12 months from the date code on the bag when stored under the following conditions:

- Shelf Life: 12 months
- Ambient temperature: ≤ 40℃
- Relative humidity: ≤ 90%

Re-baking of the devices will be required if the devices exceed the 12 months shelf life or the Humidity Indicator Card shows that the devices were exposed to conditions beyond the allowable moisture region.

**Floor Life**

The VI5301 is rated at MSL 3. As a result, the floor life of devices removed from the moisture barrier bag is 168 hours from the time the bag was opened, provided that the devices are stored under the following conditions:

- Floor Life: 168 hours
- Ambient temperature: ≤ 30℃
- Relative humidity: ≤ 60%

If the floor life or the temperature/humidity conditions have been exceeded, the devices must be re-baked prior to solder reflow or dry packing.

**Re-baking Instructions**

Re-bake at 40℃, ≤ 5% RH, for 9 days when the shelf life or floor life exceeds the limit.

# 10 Laser eye safety

The VI5301 is designed to meet the Class 1 laser safety limits including single faults in compliance with IEC / EN 60825-1:2014. This applies to the stand-alone device and the included software supplied by visionICs. In an end application system environment, the system may need to be tested to ensure it remains compliant. The system must not include any additional lens to concentrate the laser light or parameters set outside of the recommended operating conditions. Use outside of the recommended condition or any physical modification to the module during development could result in hazardous levels of radiation exposure.

# 11 Ordering information

**Table 15: Ordering information**

| Order code | Package | Packing | Minimum order quantity |
|---|---|---|---|
| VI5301LDR-CAAC | OLGA_12, with 940 nm filter | 13”Tape & reel | 4500 pcs |

# 12 Acronyms and abbreviations

**Table 16: Acronyms and abbreviations**

| Abbr. | Definition |
|---|---|
| ESD | Electrostatic discharge |
| $I^2C$ | Inter-integrated circuit (serial bus) |
| SPAD | Single photon avalanche diode |
| SPI | Serial Peripheral Interface |
| VCSEL | Vertical cavity surface emitting laser |
| ToF | Time of Flight |
| dToF | Direct Time of Flight |
| FoV | Field of view |

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# 14 Revision history

**Table 17: Datasheet revision history**

| Revision | Date | Description of changes |
|---|---|---|
| 1.0 | 2022-05-02 | Initial release. |
| 1.1 | 2023-10-27 | Added:<br>Section 4.2: Near Mode |
| 1.4 | 2024-7-23 | Sync to Chinese datasheet version 1.4 |