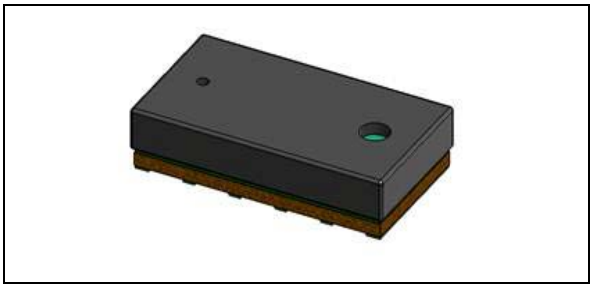
VL53L0X

World’s smallest Time-of-Flight ranging and gesture detection sensor

Datasheet - production data



Features

- Fully integrated miniature module
  - 940 nm laser VCSEL
  - VCSEL driver
  - Ranging sensor with advanced embedded micro controller
  - 4.4 x 2.4 x 1.0 mm
- Fast, accurate distance ranging
  - Measures absolute range up to 2 m
  - Reported range is independent of the target reflectance
  - Advanced embedded optical cross-talk compensation to simplify cover glass selection
- Eye safe
  - Class 1 laser device compliant with latest standard IEC 60825-1:2014 - 3rd edition
- Easy integration
  - Single reflowable component
  - No additional optics
  - Single power supply
  - I2C interface for device control and data transfer
  - Xshutdown (reset) and interrupt GPIO
  - Programmable I2C address

Applications

- User detection for personal computers/ laptops/tablets and IoT (energy saving)
- Robotics (obstacle detection)
- White goods (hand detection in automatic faucets, soap dispensers etc.)
- 1D gesture recognition.
- Laser assisted autofocus. Enhances and speeds up camera autofocus system performance, especially in difficult scenes (low light levels, low contrast) or fast moving video mode.

Description

The VL53L0X is a new generation Time-of-Flight (ToF) laser-ranging module housed in the smallest package on the market today, providing accurate distance measurement whatever the target reflectances unlike conventional technologies. It can measure absolute distances up to 2m, setting a new benchmark in ranging performance levels, opening the door to various new applications.

The VL53L0X integrates a leading-edge SPAD array (Single Photon Avalanche Diodes) and embeds ST’s second generation FlightSense™ patented technology.

The VL53L0X’s 940 nm VCSEL emitter (Vertical Cavity Surface-Emitting Laser), is totally invisible to the human eye, coupled with internal physical infrared filters, it enables longer ranging distances, higher immunity to ambient light, and better robustness to cover glass optical crosstalk.

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1 Overview

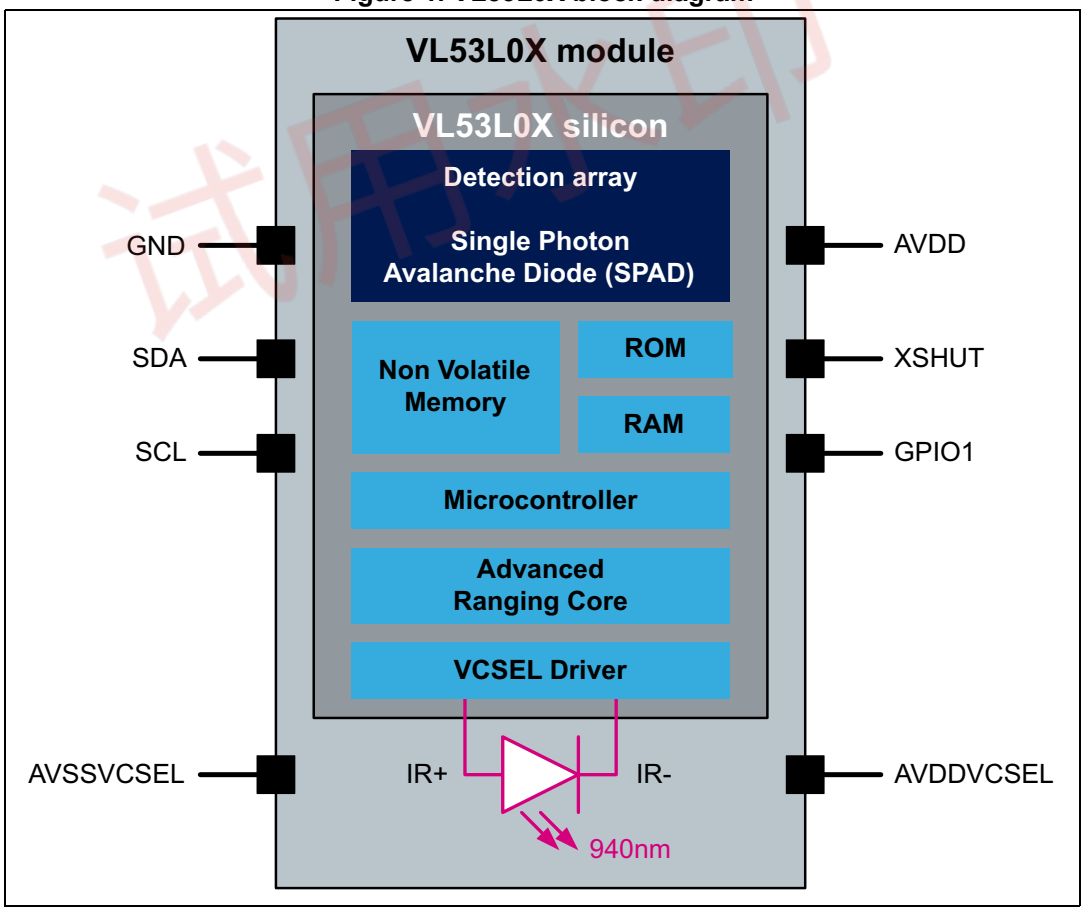
1.1 Technical specification

Table 1. Technical specification

Feature	Detail
Package	Optical LGA12
Size	4.40 x 2.40 x 1.00 mm
Operating voltage	2.6 to 3.5 V
Operating temperature:	-20 to 70°C
Infrared emitter	940 nm
I^2C	Up to 400 kHz (FAST mode) serial bus Address: 0x52

1.2 系统框图

Figure 1. VL53L0X block diagram



1.3 设备引出线

图2显示了VL53L0X (*参见图22*).

Figure 2. VL53L0X pinout (底部视图)

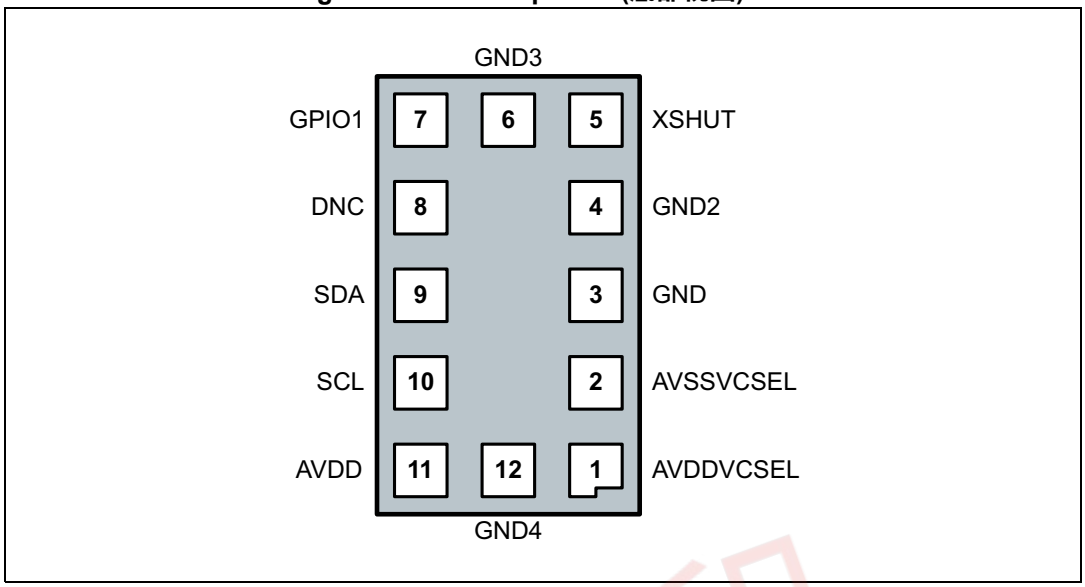


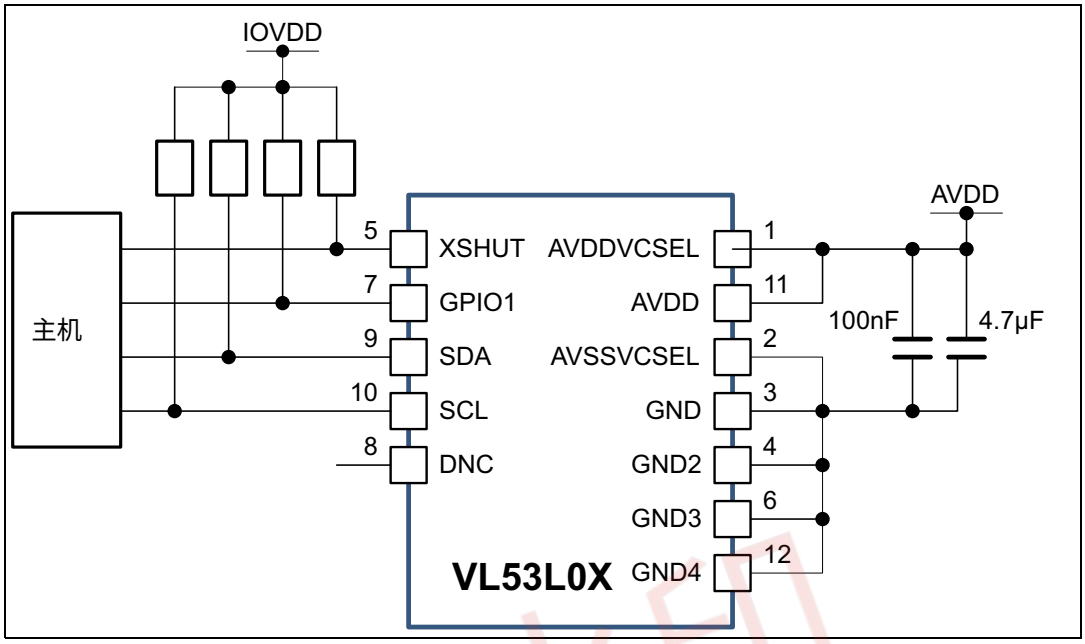
Table 2. VL53L0X pin description

引脚编号	信号名称	信号类型	信号描述
1	AVDDVCSEL	Supply	VCSEL 电源，连接到主电源
2	AVSSVCSEL	Ground	VCSEL 地，要连接到主地
3	GND	Ground	连接到主地
4	GND2	Ground	连接到主地
5	XSHUT	数字输入	X停机脚, 低电平有效
6	GND3	Ground	连接到主地
7	GPIO1	Digital output	中断输出，开漏切断
8	DNC	Digital input	不接，必须留浮
9	SDA	Digital input/output	IIC串行数据
10	SCL	Digital input	I^2C 串行时钟输入
11	AVDD	Supply	电源，连接到主电源
12	GND4	Ground	连接到主地

1.4 应用程序示意图

图3显示了 VL53L0X.的应用原理图

图3. VL53L0X 原理图



Note: 外部电源AVDD上的电容器应尽可能靠近AVDDVCSEL和AVSSVCSEL模块引脚

Note: 外部上拉电阻值可在IIC总线规范中找到。上拉通常是每条总线仅安装一次，靠近主机。2.8V和400KHz IIC时钟的上拉电阻推荐值会是1.5k到2K欧姆

Note: 如果主机状态未知 必须始终驱动XSHUT引脚，以避免漏电流。使用硬件待机模式需要XSHUT（无IIC通信）

Note: XSHUT and GPIO1 上拉推荐值为10KΩ

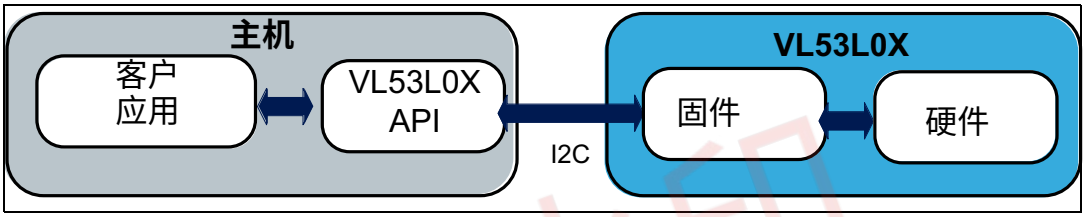
Note: 如果不使用，GPIO1保持不连接

2 功能描述

2.1 系统功能描述

图4 图4显示了系统级功能描述。主机客户应用程序是使用API(应用程序编程接口)控制VL53L0X设备。
API向客户应用程序展示一组高级功能，这些功能允许 VL53L0X固件(FW)的控制，如初始化/校准、测距开始/停止，精度选择，测距模式选择。
API是一个交钥匙解决方案，它由一组C函数组成最终用户应用程序的开发，没有直接多寄存器的复杂性访问。
API的结构可以在任何平台上编译通过隔离良好的平台层。
API包允许用户充分利用VL53L0X的功能。
VL53L0X API用户手册(单独)中提供了API的详细说明文档，DocID029105)。 VL53L0X FW完全管理硬件(HW)寄存器访问。
第2.2节:固件状态机 描述详细说明了固件状态机。

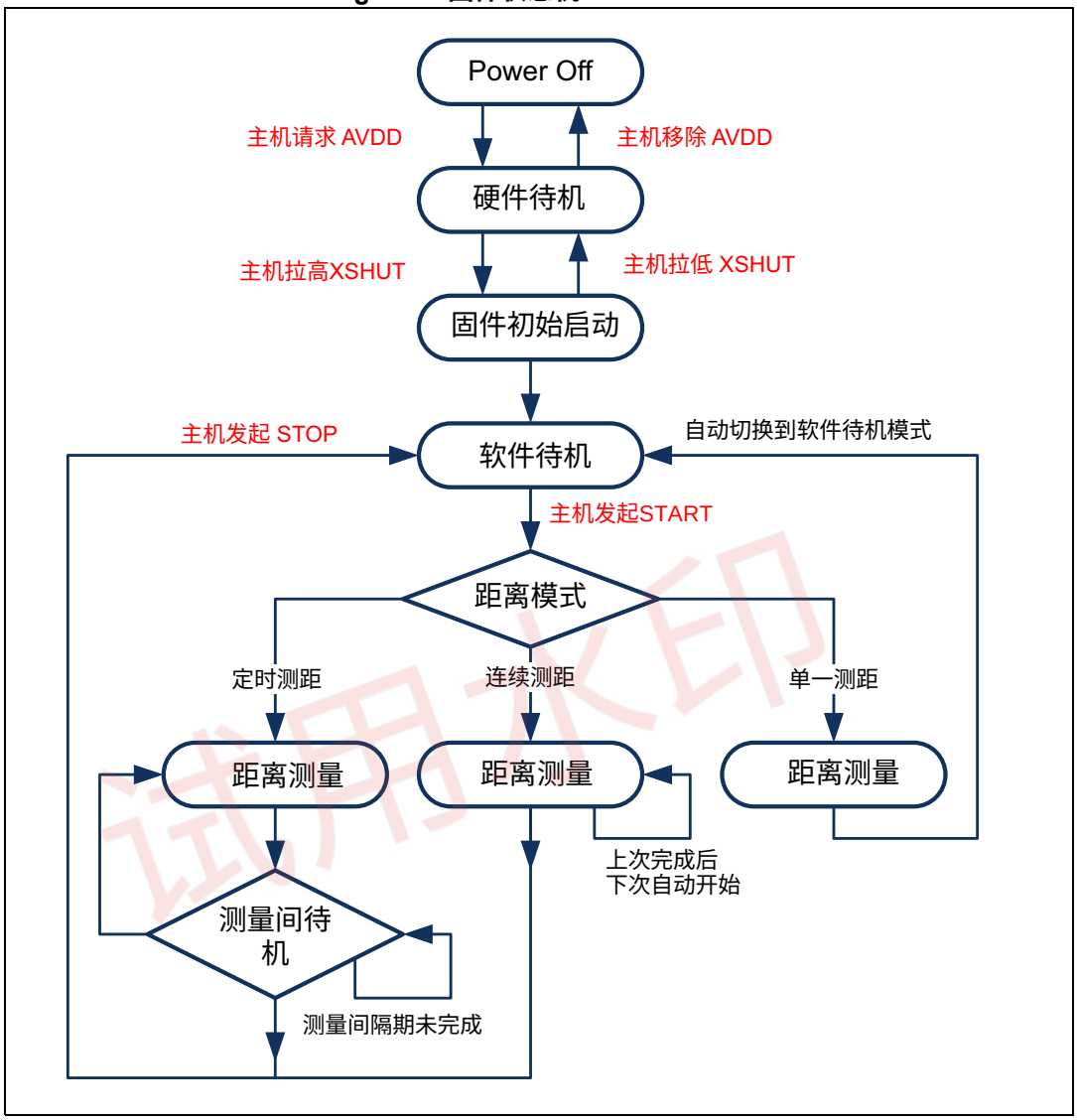
Figure 4. VL53L0X 系统功能描述



2.2 固件状态机描述

Figure 5 显示了固件状态机

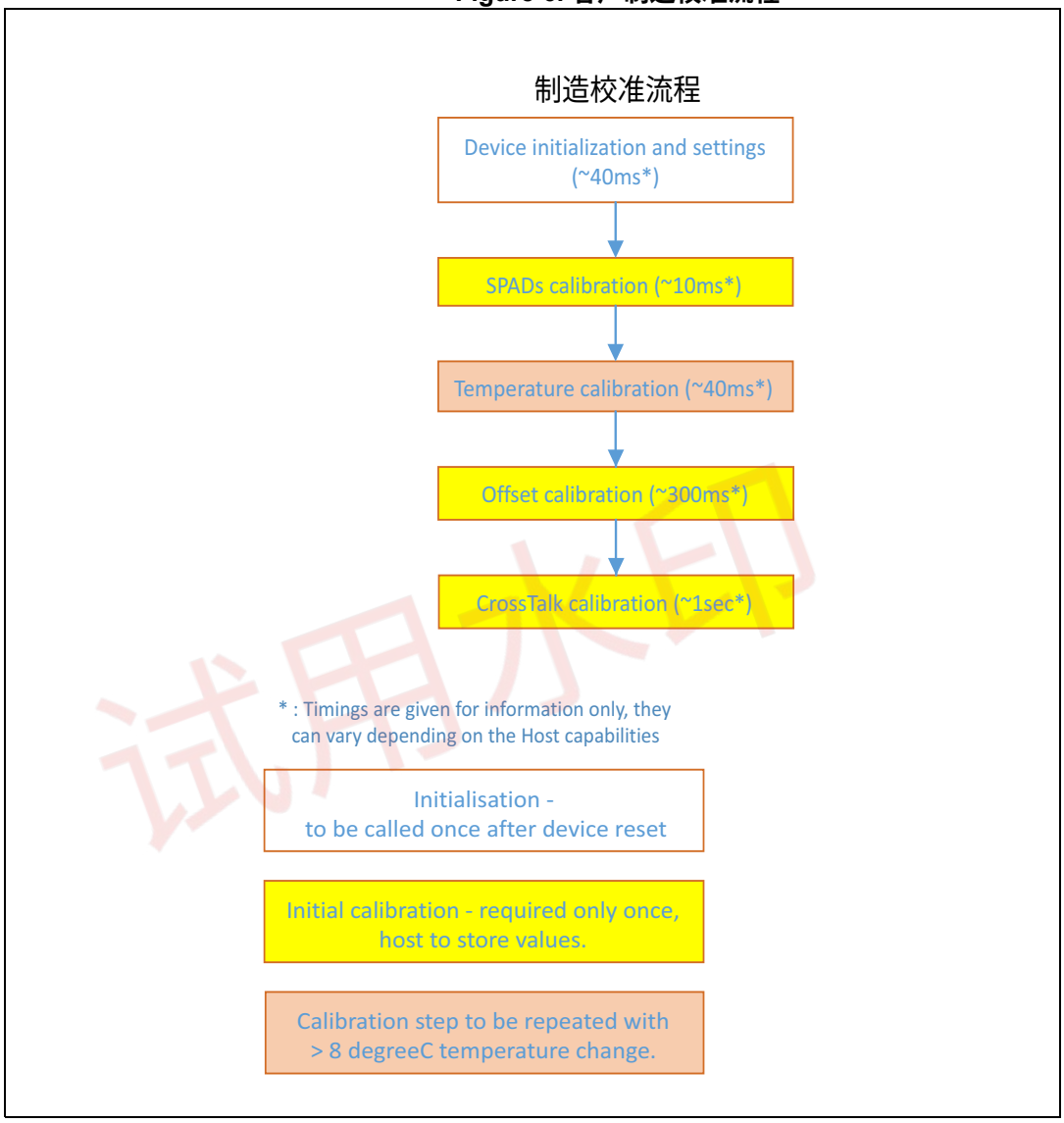
Figure 5. 固件状态机



2.3 客户制造校准流程

Figure 6 显示了应在客户层面应用的推荐校准流程。在工厂，仅一次。该流程考虑了所有参数(盖玻片、温度& 电压)。

Figure 6. 客户制造校准流程



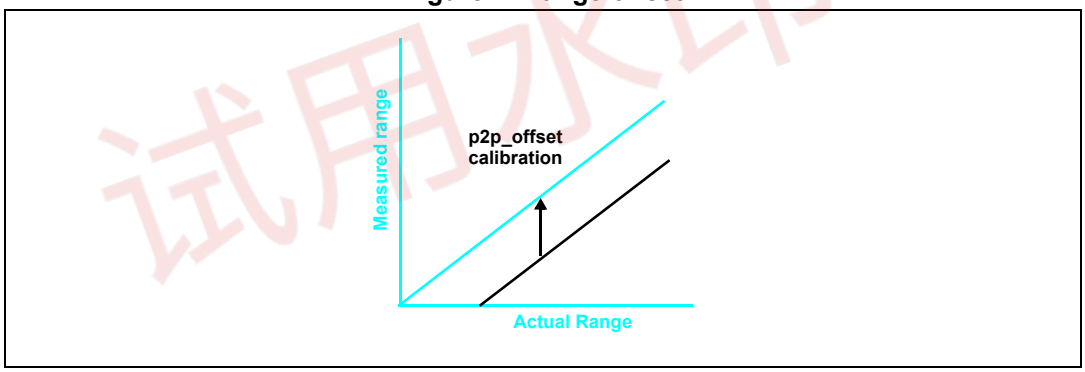
2.3.1 SPAD和温度校准

为了优化系统的动态特性，必须校准参考SPADs。
参考SPAD校准只需在初始制造期间进行一次校准，校准数据应存储在主机上。
温度校准是两个参数(VHV和相位校准)的校准，它们是取决于温度。
这两个参数用于设置器件灵敏度。
校准应在初始制造校准期间进行，必须与初始温度相比，当温度变化超过8摄氏度时，再次执行校准温度。
有关SPAD和温度校准的更多详细信息，请参考VL53L0X API 用户手册。

2.3.2 测距偏移校准

测距偏移可以用平均偏移来表征，它是测量值与实际距离。为获得最佳性能，应在工厂进行失调校准(推荐在10厘米处)。
失调校准应考虑以下因素:
电源电压和温度
VL53L0X模块上方的保护盖玻璃

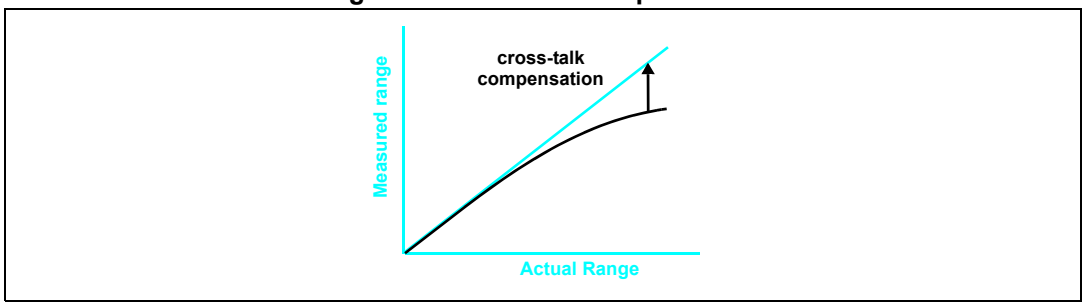
Figure 7. Range offset



2.3.3 串扰校准

串扰被定义为从防护玻璃返回的信号。串扰的大小取决于玻璃和气隙的类型。串扰会导致距离误差与串扰和从目标返回的信号之比成比例。

Figure 8. Cross-talk compensation



VL53L0X API用户中描述了全失调和串扰校准程序手动。

2.4 测距操作模式

API(应用程序编程接口)中有3种可用的测距模式:

1.单一测距

调用API函数后，只执行一次测距。系统自动返回软件待机状态

2. 连续测距
在调用API函数之后，以连续的方式执行测距。
测量完成后，立即开始另一次测量。用户必须停止测距以返回软件待机状态。最后一次测量是停止前完成。.

3. 定时测距
在调用API函数之后，以连续的方式执行测距。当一个测量完成，另一个测量在用户定义的延迟后开始。这个延迟(测量间隔期)可以通过API定义。

用户必须停止测距以返回软件待机状态。

如果停止请求在范围测量期间出现，则测量完成才停下来。如果它发生在测量间隔期间，则距离测量立即停止。

2.5 测距剖面图

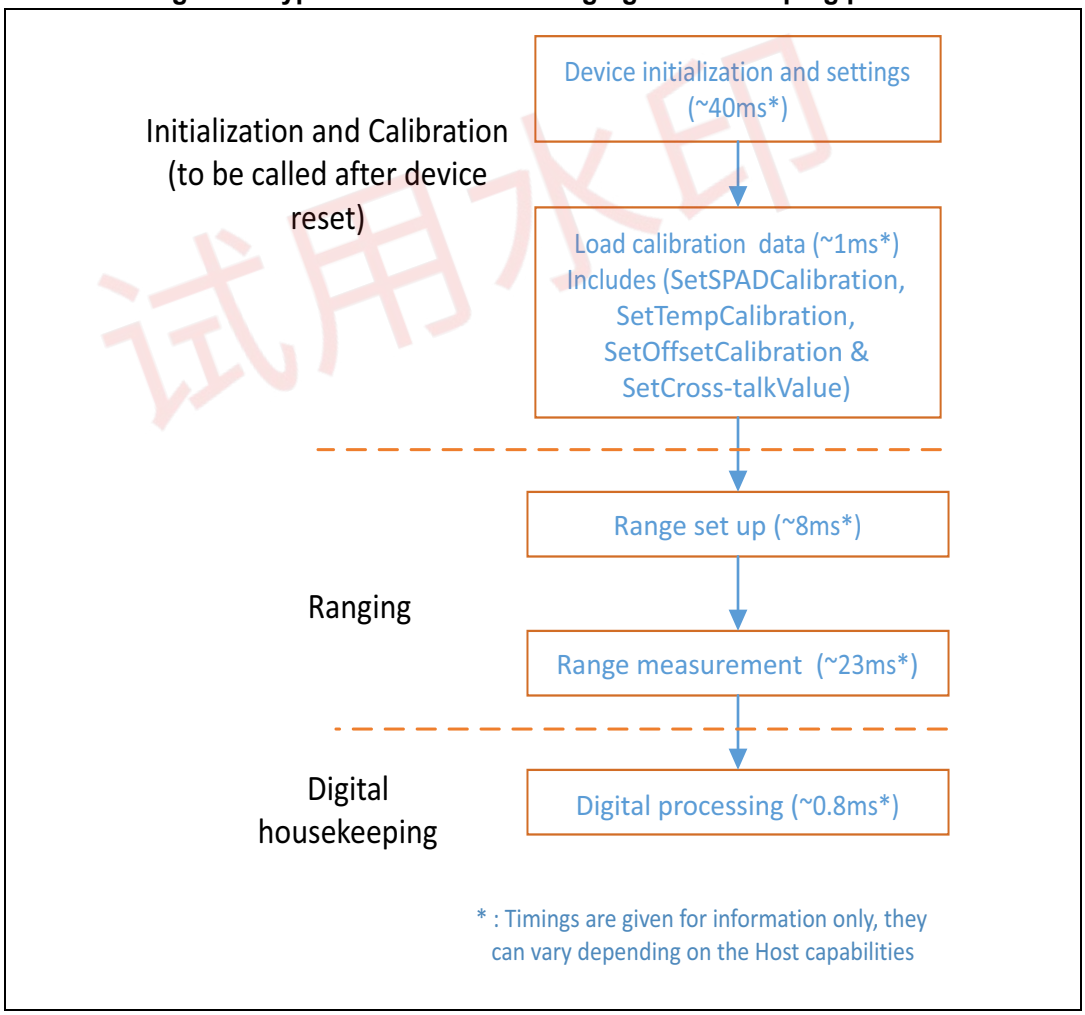
通过API示例代码，有4种不同的测距配置文件可用。客户可以创建他们自己的测距曲线取决于他们的用例性能要求。有关更多详细信息，请参考VL53L0X API用户手册。
1.默认模式
2.高速的
3.高准确度
4.远程

2.6 测距剖面相位

每个距离剖面由3个连续阶段组成:

- 初始化和加载校准数据
- 测距
- 数字家务管理

Figure 9. Typical initialization / ranging / housekeeping phases



2.6.1 初始化和加载校准数据阶段

初始化和校准阶段在第一次测距之前或设备之后执行复位，参见图9。
用户可能必须以周期性的方式重复温度校准阶段，这取决于使用情况。
有关校准功能的更多详细信息，请参考VL53L0X API用户手册。

2.6.2 测距阶段

测距阶段包括测距设置和测距测量。在测距操作期间，发射几个VCSEL红外脉冲，然后反射被目标物体反射回来，并被接收阵列检测到。使用的光电探测器 VL53L0X内部采用了先进的超快速SPAD技术(单光子雪崩二极管)，受多项专利保护。
测距的典型定时预算是33ms(初始化/测距/内务处理)，见图12，实际距离测量需要23ms，见图9。最小范围测量周期为8ms。

2.6.3 数字内务管理

数字处理(内务处理)是测距序列中的最后一个操作计算、验证或拒绝测距测量。执行该处理的一部分而另一部分由API在主机上执行。
在数字处理结束时，由VL53L0X本身计算测距距离。如果无法测量距离(信号弱，无目标…)，相应的错误代码被提供。
以下功能在设备本身上执行:

- 信号值检查(弱信号)
- 失调校正
- 串扰校正(在盖玻片的情况下)
- 最终测距值计算

当API执行以下操作时:

- 返回忽略阈值RIT检查(信号检查与串扰)
- 适马检查(准确度条件)
- 最终测距状态计算

如果用户想要提高测距精度，一些额外的处理(不是 API)可以由主机执行，例如，滚动平均、滞后或任何种类的过滤。

2.7 获取数据:中断或轮询

用户可以通过轮询或中断机制获得最终数据。

轮询模式:用户必须通过轮询API来检查正在进行的测量的状态功能。

中断模式:当一个新的测量可用。

这两种模式的描述可在VL53L0X API用户手册中找到。

2.8 设备编程和控制

设备物理控制接口是I2C，在第3节:控制接口中描述。提供软件层(API)来控制设备。
API在 VL53L0X API用户手册。

2.9 电源顺序

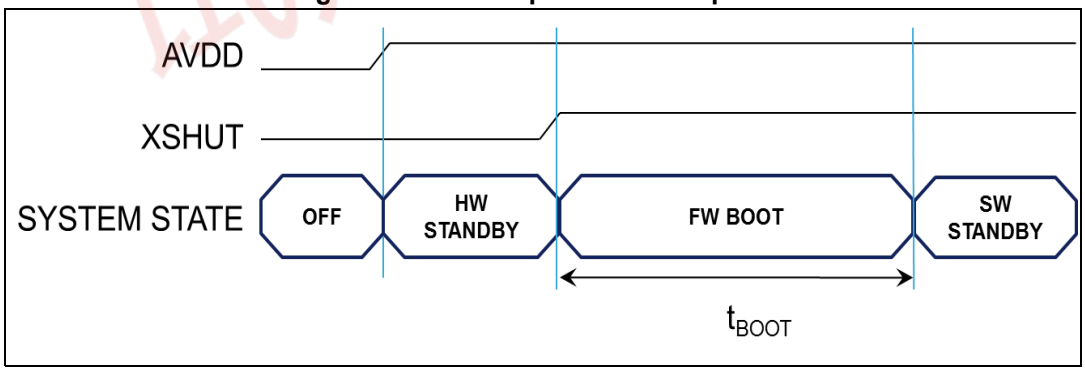
2.9.1 通电和启动顺序

设备加电/启动有两个选项。

选项1:从主机连接并控制XSHUT引脚。
此选项有助于优化功耗，因为VL53L0X可以完全不使用时关断，然后通过主机GPIO唤醒(使用XSHUT引脚)。

硬件待机模式定义为AVDD存在且XSHUT为低电平期间。

Figure 10. Power up and boot sequence



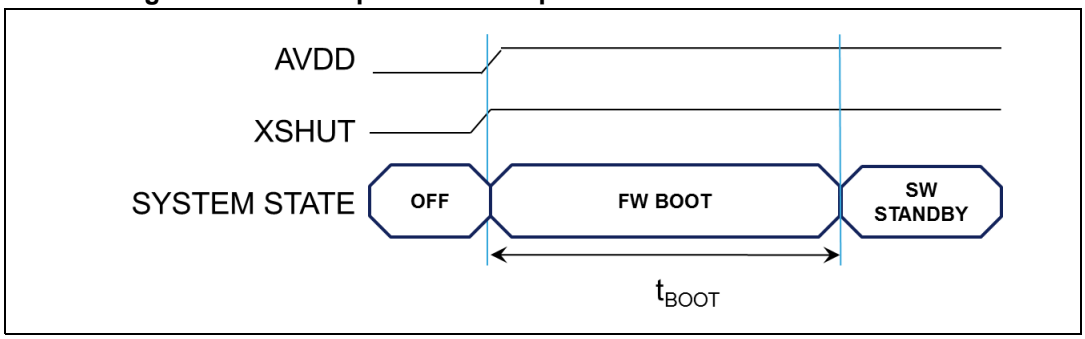
t_{BOOT} is 1.2ms max.

选项2: XSHUT引脚不受主机控制，通过上拉电阻连接到AVDD。

如果XSHUT引脚不受控制，上电序列如图11所示。

在这种情况下，固件启动后，设备会自动进入软件待机模式，而不会进入硬件待机状态。

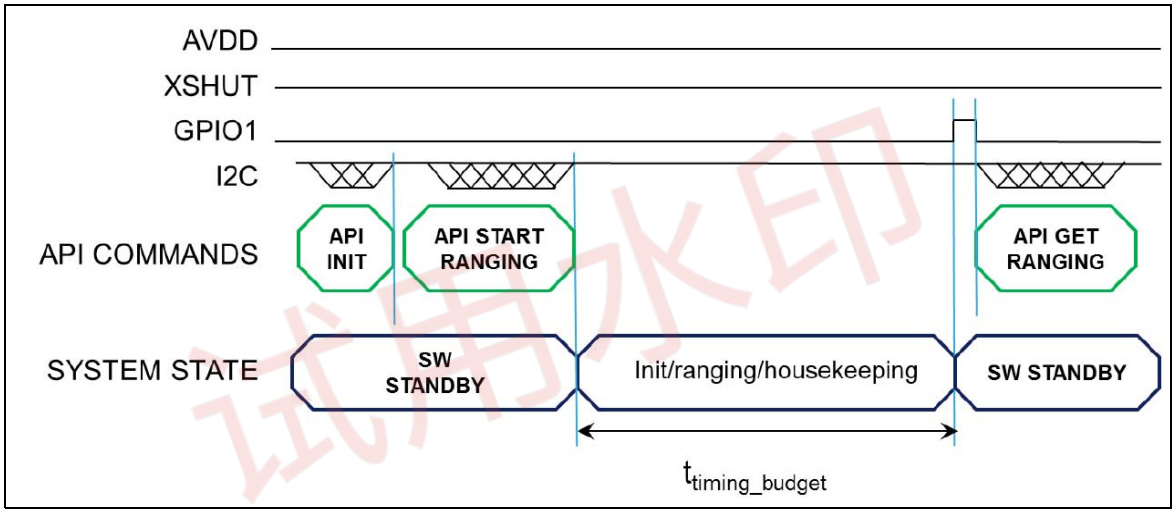
Figure 11. Power up and boot sequence with XSHUT not controlled



t_{BOOT} is 1.2ms max.

2.10 测距序列

Figure 12. Ranging sequence



t_{timing_budget} 是用户使用专用API函数设置的参数。

默认值为33毫秒。

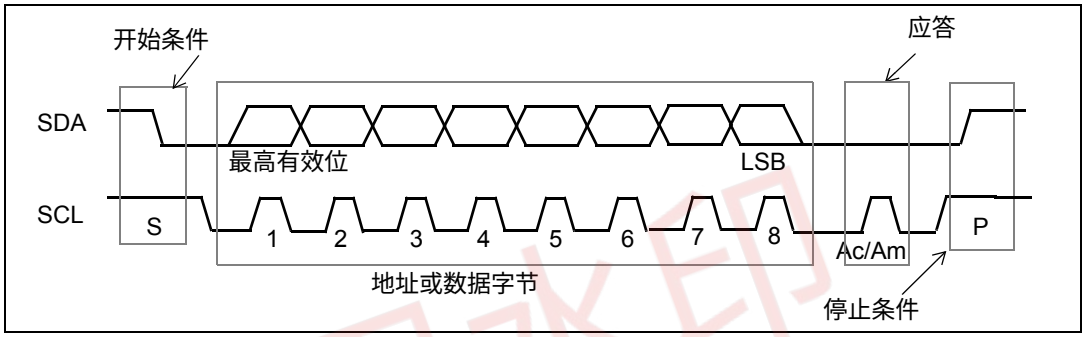
3 控制接口

本节规定了控制界面。IIC接口使用两种信号：串行数据线SDA和串行时钟线SCL。连接到总线的每个设备都使用唯一的地址和简单的主/从关系存在。

SDA和SCL线都使用上拉电阻连接到正电源电压位于主机上。线路仅被有效拉低。当线路出现以下情况时，会出现高电平状态浮动，上拉电阻将线路上拉。当没有数据传输时，两条线都高。时钟信号SCL由主器件产生。

主设备启动数据传输。 VL53L0X上的IIC总线的最大速度为400kbit/s，并使用0x52的设备地址

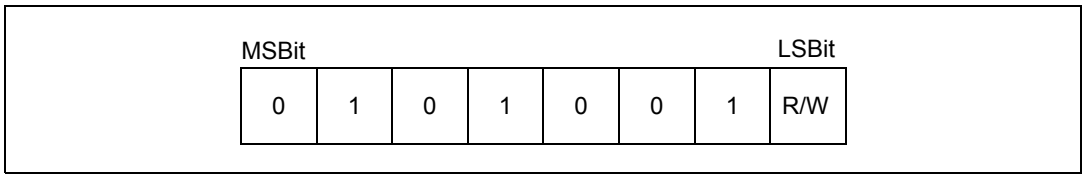
图 13. 数据传输协议



信息打包在8位数据包byte中，后面总是跟着一个应答位，Ac表示VL53L0X**应答和**Am**用于主机应答（主机总线主机）。内部数据通过在**SCL的上升沿对SDA进行采样产生。外部数据必须稳定在SCL为高时。例外情况是启动S或停止P条件，当SDA分别下降或上升时，SCL为高。

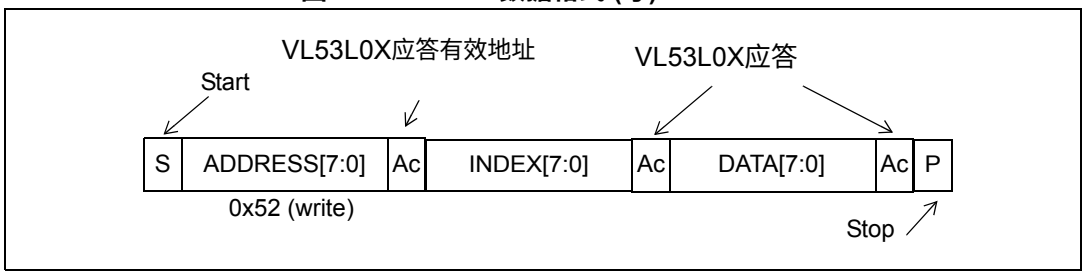
消息包含一系列字节，前面是起始条件，后面是停止或重复启动（另一个启动条件，单前面没有停止条件）接着是另一条消息。第一个字节包含器件地址0x52和指定数据方向。如果最低有效位LSB为低，则消息为主机向从机写入。如果最低有效位LSB置1，则该消息为主机读取从机。

图 14. VL53L0X I2C 设备地址: 0x52



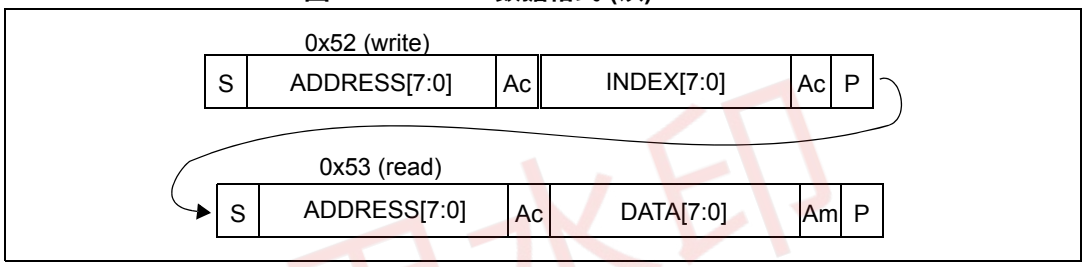
与摄像机模块的所有串行接口通信必须从开始开始条件。VL53L0X模块通过驱动SDA线低电平。存储读/写位（地址字节的LSB）的状态可以解释从SDA采样的数据字节。在写序列期间，第二收到的字节提供一个8位索引，指向内部8位寄存器之一。

图 15. VL53L0X 数据格式 (写)



从机接收数据时，会将数据逐位写入串行/并行寄存器。每次之后从机接收到数据字节，产生应答，然后数据存储在由当前索引寻址的内部寄存器中。
在读消息期间，有当前索引寻址的寄存器的内容被读取，在设备地址字节之后的字节中输出。改寄存器的内容是并行地载入串行/并行寄存器，并在下降沿逐个输出器件SCL。

图16. VL53L0X 数据格式 (读)



在读和写消息序列中，每个字节的末尾都有一个应答由接收设备发出（即VL53L0X用于写操作，主机用于读操作）。
消息只能有总线主控器通过发出停止条件或通过读取完成后的否定应答（即不拉低SDA线）字节。
该接口还支持自动增量索引。在第一根数据字节被传输后，索引会自动增加1.因此，主设备可以发送数据字节连续发送到从机，直到从机无法提供应答或主机以停止条件终止写通信。
如果自动递增特征，则主设备不必发送地址索引来伴随数据字节。

Figure 17. VL53L0X data format (sequential write)

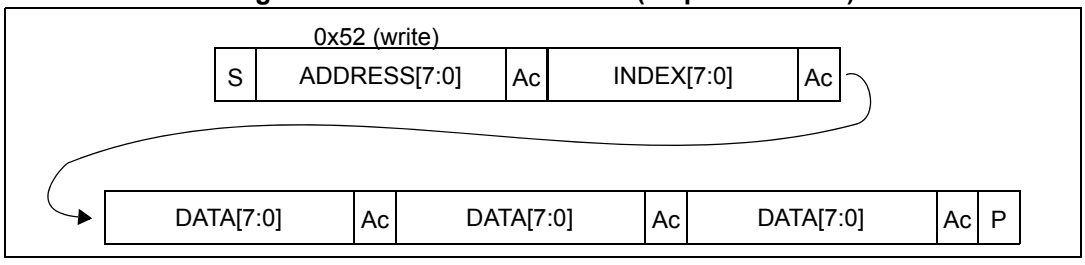
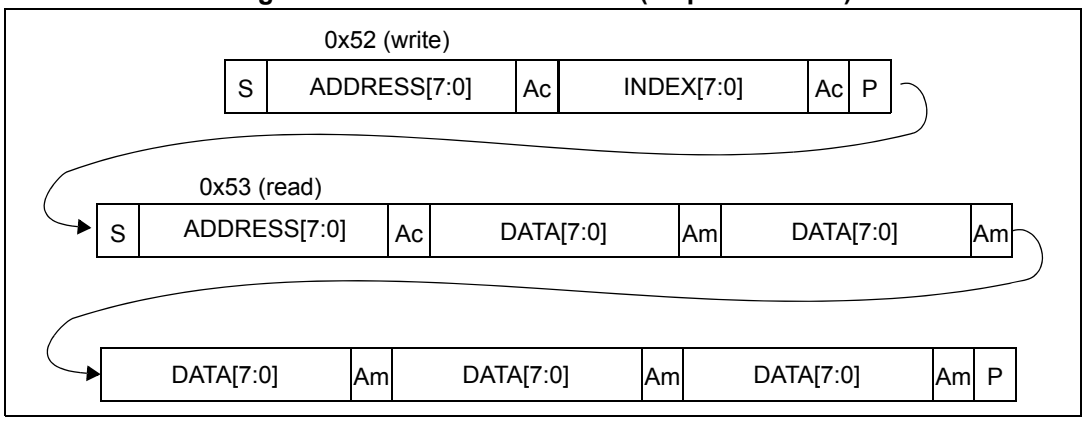


Figure 18. VL53L0X data format (sequential read)



3.1 I²C 接口-定时特性

Timing characteristics are shown in *Table 3*. Please refer to *Figure 19* for an explanation of the parameters used.

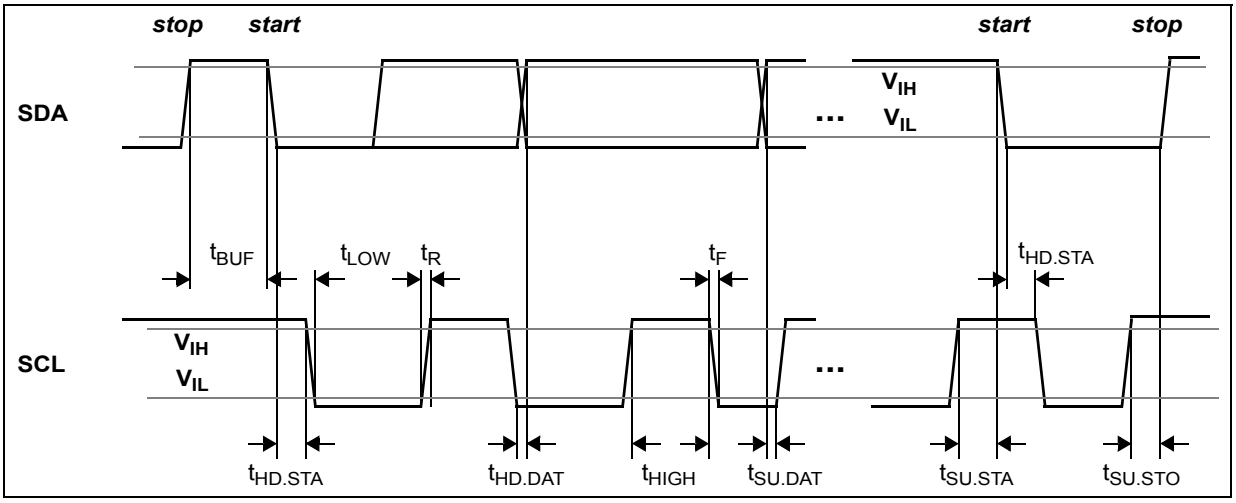
Timings are given for all PVT conditions.

Table 3. I²C interface - timing characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Unit
F_{I2C}	Operating frequency (Standard and Fast mode)	0	-	400(1)	kHz
t_{LOW}	Clock pulse width low	1.3	-	-	µs
t_{HIGH}	Clock pulse width high	0.6	-	-	µs
t_{SP}	Pulse width of spikes which are suppressed by the input filter	-	-	50	ns
t_{BUF}	Bus free time between transmissions	1.3	-	-	ms
$t_{HD.STA}$	Start hold time	0.26	-	-	µs
$t_{SU.STA}$	Start set-up time	0.26	-	-	µs
$t_{HD.DAT}$	Data in hold time	0	-	0.9	µs
$t_{SU.DAT}$	Data in set-up time	50	-	-	ns
t_R	SCL/SDA rise time	-	-	120	ns
t_F	SCL/SDA fall time	-	-	120	ns
$t_{SU.STO}$	Stop set-up time	0.6	-	-	µs
Ci/o	Input/output capacitance (SDA)	-	-	10	pF
Cin	Input capacitance (SCL)	-	-	4	pF
C_L	Load capacitance	-	125	400	pF

1. The maximum bus speed is also limited by the combination of 400pF load capacitance and pull-up resistor. Please refer to the I²C specification for further information.

Figure 19. I²C timing characteristics



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

3.2 I²C 接口-参考寄存器

下表所示寄存器可用于验证用户IIC接口

表 4. 参考寄存器

Address	(全新重置后，不加载API)
0xC0	0xEE
0xC1	0xAA
0xC2	0x10
0x51	0x0099
0x61	0x0000

Note: I2C 读/写可以是8位、16位或32位。多字节读/写总是在升序排列，MSB优先，如表5所示

表 5. 32-bit 注册示例

寄存器地址	Byte
Address	MSB
Address + 1	..
Address + 2	..
Address + 3	LSB

4 电特性

4.1 绝对最大额定值

Table 6. Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
AVDD	-0.5	-	3.6	V
SCL, SDA, XSHUT and GPIO1	-0.5	-	3.6	V

Note: Stresses above those listed in Table 6. may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the operational sections of the specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

4.2 Recommended operating conditions

Table 7. Recommended operating conditions(1)

Parameter		Min.	Typ.	Max.	Unit
Voltage (AVDD)		2.6	2.8	3.5	V
IO (IOVDD)(2)	Standard mode	1.6	1.8	1.9	V
	2V8 mode(3)(4)	2.6	2.8	3.5	V
Temperature (normal operating)		-20		+70	°C

1. There are no power supply sequencing requirements. The I/Os may be high, low or floating when AVDD is applied. The I/Os are internally failsafe with no diode connecting them to AVDD
2. XSHUT should be high level only when AVDD is on.
3. SDA, SCL, XSHUT and GPIO1 high levels have to be equal to AVDD in 2V8 mode.
4. The default API mode is 1V8.
   2V8 mode is programmable using device settings loaded by the API. For more details please refer to the VL53L0X API User Manual.

4.3 ESD

VL53L0X is compliant with ESD values presented in *Table 8*

Table 8. ESD performances

Parameter	Specification	Conditions
Human Body Model	JS-001-2012	+/- 2kV, 1500 Ohms, 100pF
Charged Device Model	JZSD22-C101	+/- 500V

4.4 Current consumption

Table 9. Consumption at ambient temperature(1)

Parameter	Min.	Typ.	Max.	Unit
HW STANDBY	3	5	7	uA
SW STANDBY (2V8 mode)(2)	4	6	9	uA
Timed ranging Inter measurement		16		uA
Active Ranging average consumption (including VCSEL) (3)(4)		19		mA
Average power consumption at 10Hz with 33ms ranging sequence			20	mW

1. All current consumption values include silicon process variations. Temperature and Voltage are at nominal conditions (23degC and 2.8V).

   All values include AVDD and AVDDVCSEL.

2. In standard mode (1V8), pull-ups have to be modified, then SW STANDBY consumption is increased by +0.6uA.
3. Active ranging is an average value, measured using default API settings (33ms timing budget).
4. Peak current (including VCSEL) can reach 40mA.

4.5 Electrical characteristics

Table 10. Digital I/O electrical characteristics

Symbol	Parameter	Minimum	Typical	Maximum	Unit
Interrupt pin (GPIO1)					
V_{IL}	Low level input voltage	-	-	0.3 IOVDD	V
V_{IH}	High level input voltage	0.7 IOVDD	-	-	V
V_{OL}	Low level output voltage (I_{OUT} = 4 mA)	-	-	0.4	V
V_{OH}	High level output voltage at (I_{OUT} = 4 mA)	IOVDD-0.4	-	-	V
F_{GPIO}	Operating frequency (C_{LOAD} = 20 pF)	0	-	108	MHz
I^2C interface (SDA/SCL)					
V_{IL}	Low level input voltage	-0.5	-	0.6	V
V_{IH}	High level input voltage	1.12	-	IOVDD+0.5	V
V_{OL}	Low level output voltage (I_{OUT} = 4 mA in Standard and Fast modes)	-	-	0.4	V
$I_{IL}/_{IH}$	Leakage current(1)	-	-	10	µA
	Leakage current(2)	-	-	0.15	µA

1. AVDD = 0 V
2. AVDD = 2.85 V; I/O voltage = 1.8 V

5 Performance

5.1 Measurement conditions

In all measurement tables in the document, it is considered that the full Field Of View (FOV) is covered.

VL53L0X system FOV is 25degrees.

Reflectance targets are standard ones (Grey 17% N4.74 and White 88% N9.5 Munsell charts).

Unless mentioned, device is controlled through the API using the default settings (refer to VL53L0X API User Manual for API settings description).

Figure 20. Typical ranging (default mode)

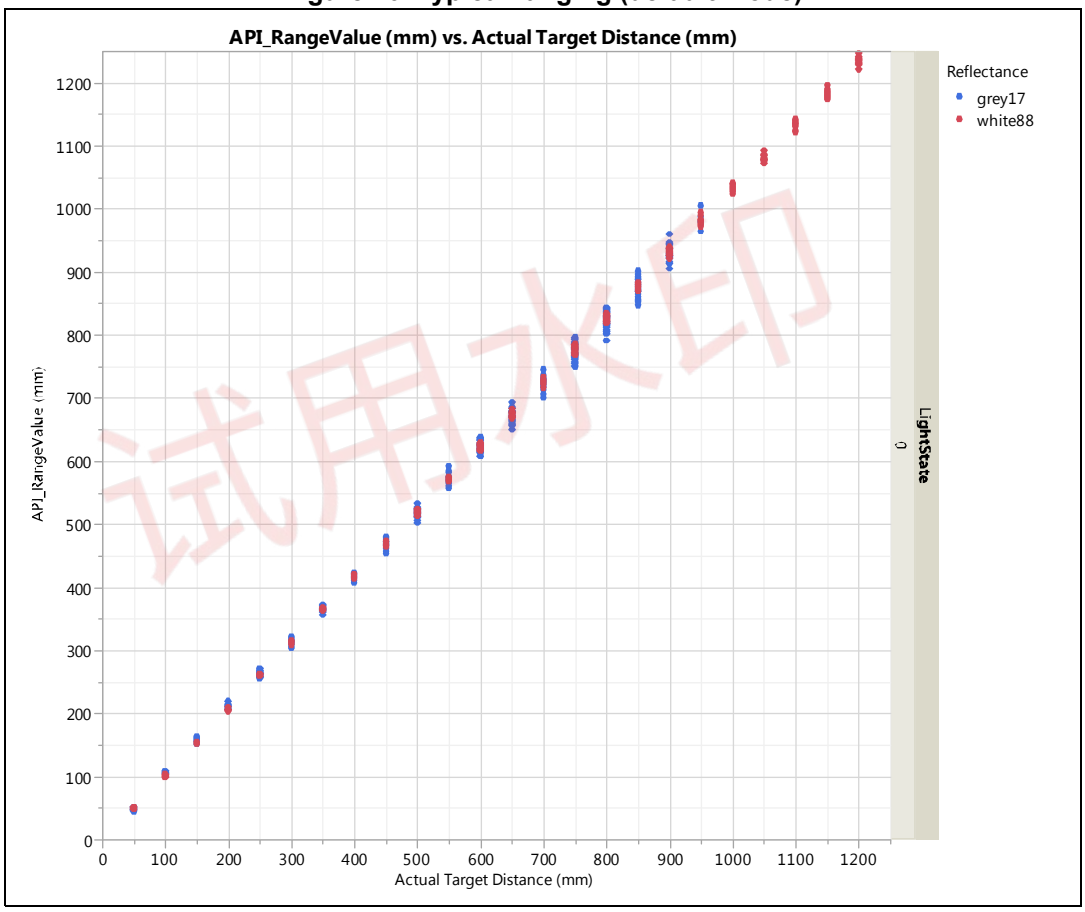
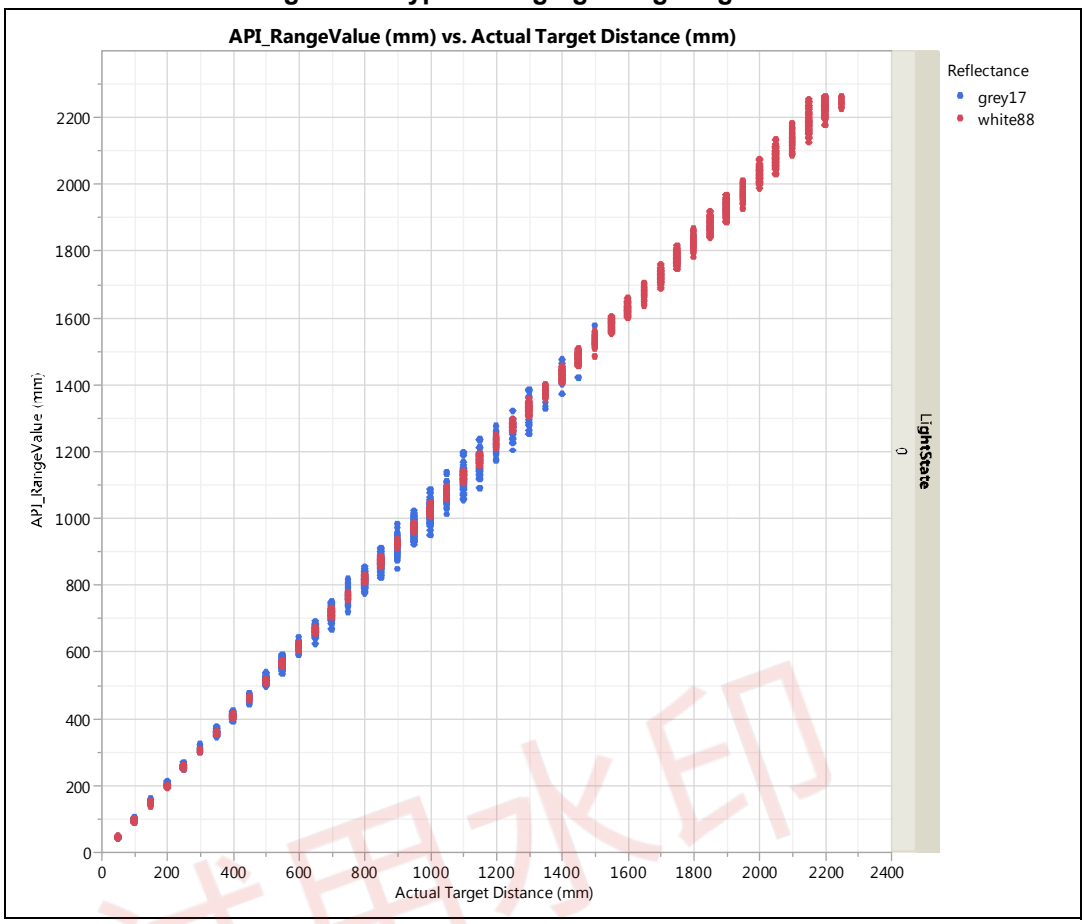


Figure 21. Typical ranging - long range mode



5.2 Max ranging distance

Table 11 presents the ranging specification for VL53L0X bare module, without cover glass, at room temperature (23degreesC) and with nominal voltage (2.8Volts).

Table 11. Max ranging capabilities with 33ms timing budget

Target reflectance level (full FOV)	Conditions	Indoor (2)	Outdoor overcast (2)
White target (88%)	Typical	200cm+ (1)	80cm
	Minimum	120cm	60cm
Grey target (17%)	Typical	80cm	50cm
	Minimum	70cm	40cm

Note (1): using long range API profile

Note (2):

- Indoor: no infrared
- Outdoor overcast corresponds to a parasitic noise of 10kcps/SPAD for VL53L0X module. For reference, this corresponds to a 1.2W/m² at 940nm, and is equivalent to 5kLux daylight, while ranging on a grey 17% chart at 40cm

Measurement conditions:

- Targets reflectance used : Grey (17%), White (88%)
- Nominal Voltage (2.8V) and Temperature (23degreesC)
- All distances are for a complete Field of View covered (FOV = 25degrees)
- 33ms timing budget

All distances mentioned in this table are guaranteed for a minimum detection rate of 94% (up to 100%). Detection rate is the worst case percentage of measurements that will return a valid measurement when target is detected.

5.3 Ranging accuracy

5.3.1 Standard deviation

Ranging accuracy can be characterized by standard deviation. It includes Measure-to-Measure and Part-to-Part (silicon) dispersion.

Table 12. Ranging accuracy

	Indoor (no infrared)			Outdoor		
Target reflectance level (full FOV)	**Distance**	**33 ms**	**66 ms**	**Distance**	**33 ms**	**66 ms**
White Target (88%)	At 120 cm	4 %	3 %	At 60 cm	7 %	6 %
Grey Target (17%)	At 70 cm	7 %	6%	at 40 cm	12 %	9 %

Measurement conditions:

- Targets reflectance used: Grey (17 %), White (88 %)
- Offset correction done at 10 cm from sensor
- Indoor: no infrared / Outdoor: eq. 5 kLux equivalent sunlight (10 kcps/SPAD)
- Nominal voltage (2v8) and Temperature (23 degreesC)
- All distances are for a complete FOV covered (FOV = 25 degrees)
- Detection rate is considered at 94 % minimum

5.3.2 Range profile examples

Table 13 details typical performance for the four example ranging profiles, as per measurement conditions in *Section 5.3: Ranging accuracy*.

Table 13. Range profiles

Range profile	Range timing budget	Typical performance	Typical application
Default mode	30 ms	1.2 m, accuracy as per *Table 12*	Standard
High accuracy	200 ms	1.2 m, accuracy < +/- 3 %	Precise measurement
Long range	33 ms	2 m, accuracy as per *Table 12*	Long ranging, only for dark conditions (no IR)
High speed	20 ms	1.2 m, accuracy +/- 5 %	High speed where accuracy is not priority

5.3.3 Ranging offset error

The table below shows how range offset may drift over distance, voltage and temperature.

Assumes offset calibrated at 10cm. See VL53L0X API User Manual for details on offset calibration.

Table 14. Ranging offset

	Nominal conditions	Measure point	Typical offset from nominal	Maximum offset from nominal
Ranging distance	Offset calibration at 10 cm (“zero”)	White 120 cm (indoor) Grey 70 cm (indoor) White 60 cm (outdoor) Grey 40 cm (outdoor)		< 3 %
Voltage drift	2.8 V	2.6 V to 3.5 V	+/- 10 mm	+/- 15 mm
Temperature drift	23 °C	-20°C to +70°C	+/- 10 mm	+/- 30 mm

6 Outline drawing

Figure 22. Outline drawing (page 1/3)

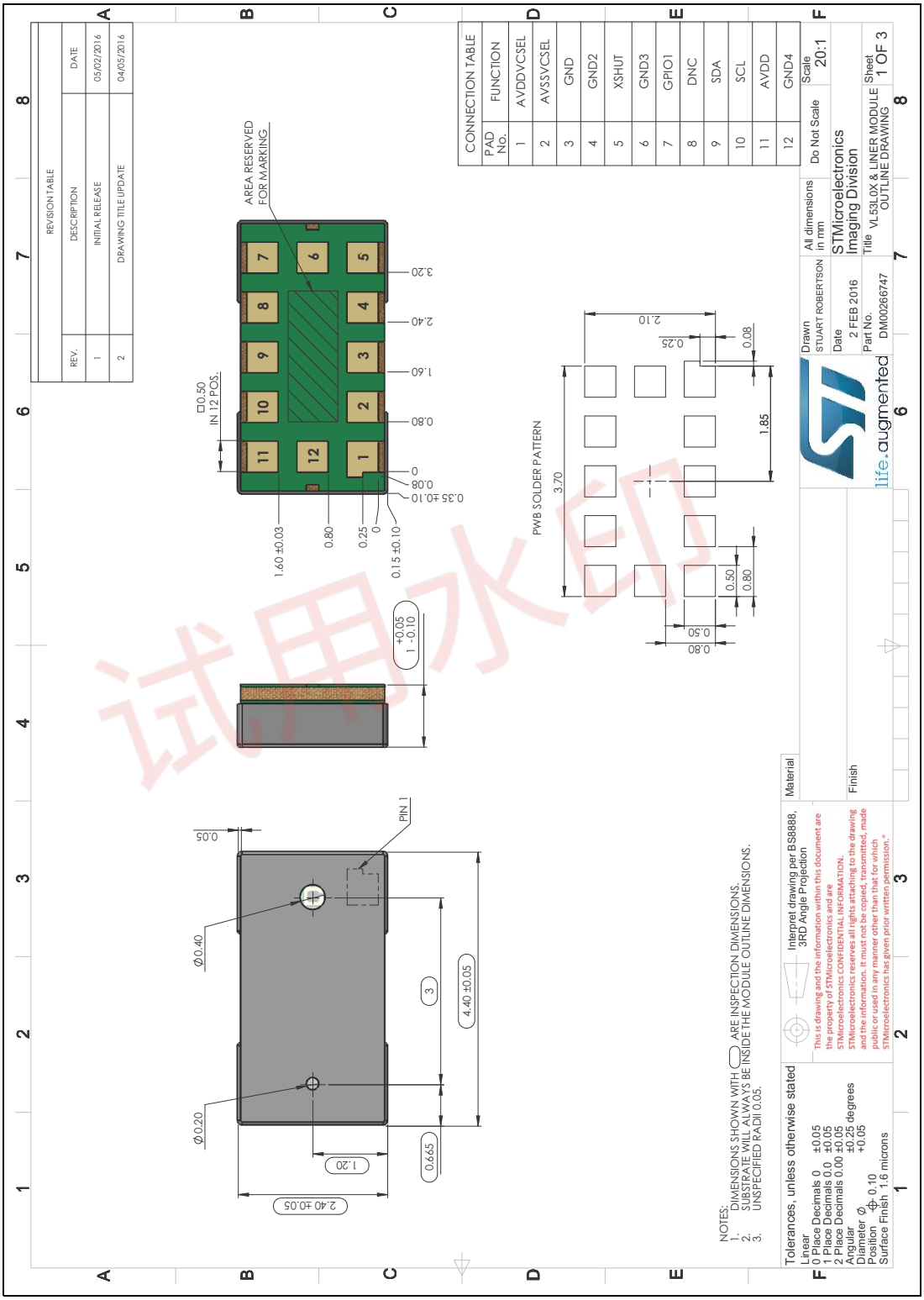


Figure 23. Outline drawing (page 2/3)

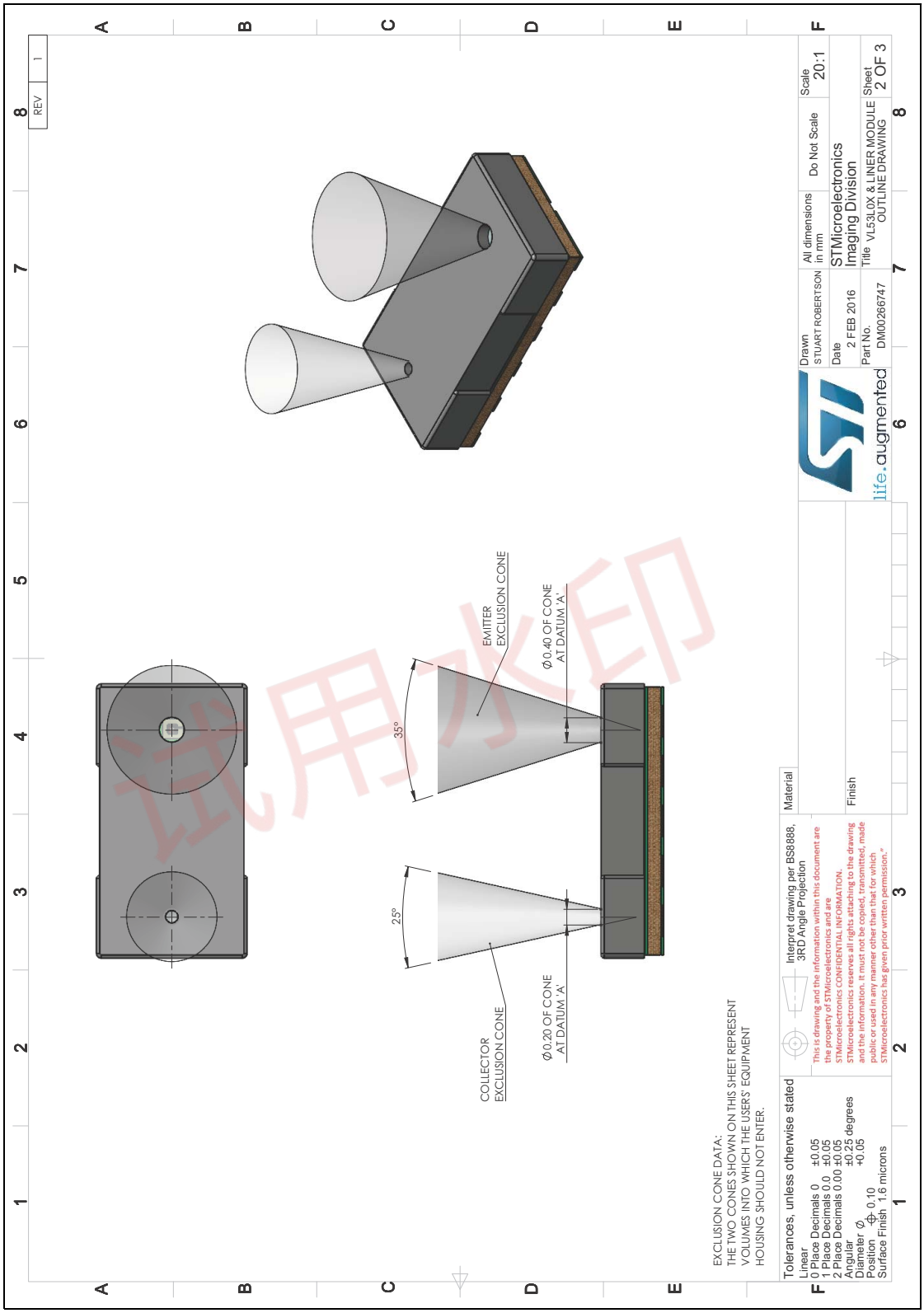
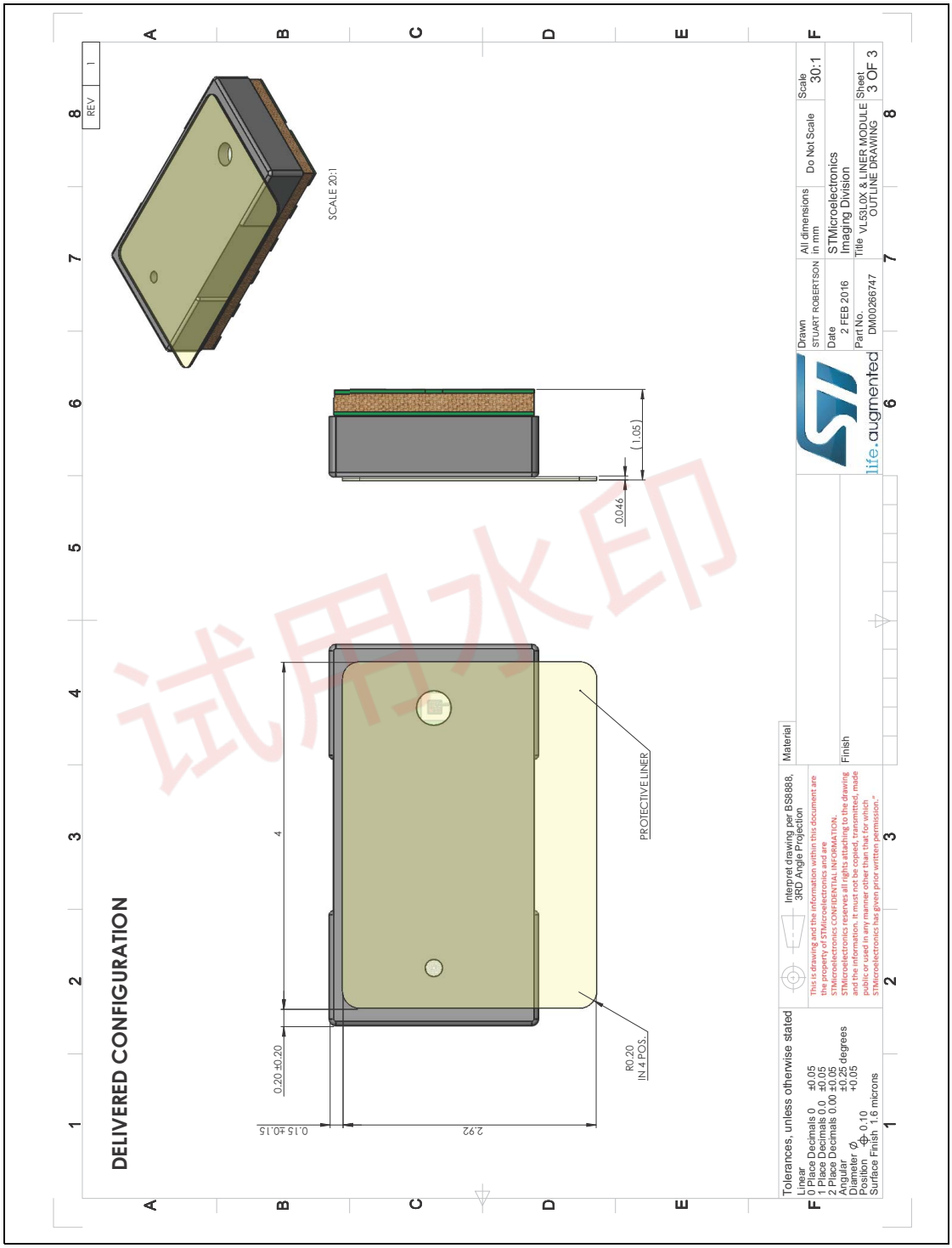


Figure 24. Outline drawing - with liner (page 3/3)

The VL53L0X module is delivered with a protective liner covering the top of the cap to protect the sensor from foreign material during the assembly process. It must be removed by the customer just before mounting the cover glass



7 Laser safety considerations

The VL53L0X contains a laser emitter and corresponding drive circuitry. The laser output is designed to remain within Class 1 laser safety limits under all reasonably foreseeable conditions including single faults in compliance with IEC 60825-1:2014 (third edition).

The laser output will remain within Class 1 limits as long as the STMicroelectronics recommended device settings (API settings) are used and the operating conditions specified are respected.

The laser output power must not be increased by any means and no optics should be used with the intention of focusing the laser beam.

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

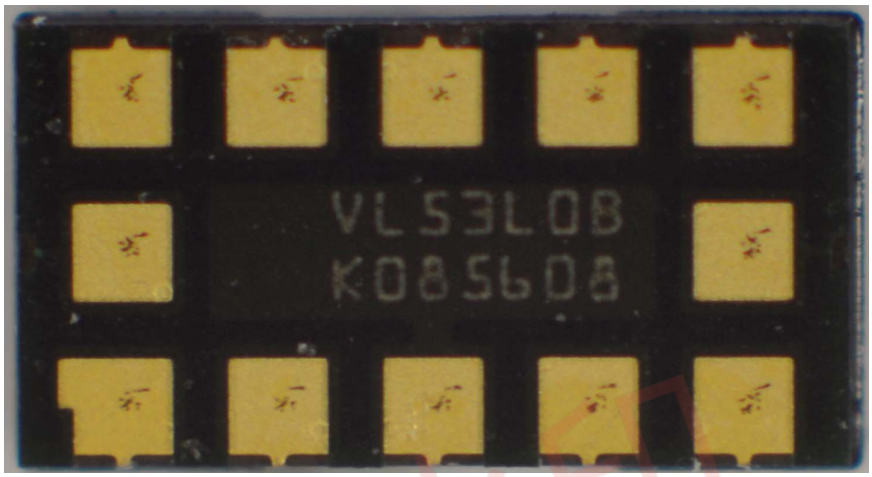
Figure 25. Class 1 laser product label

8 Packaging and labeling

8.1 Product marking

A 2-line product marking is applied on the backside of the module (i.e. on the substrate). The first line is the silicon product code, and the second line, the internal tracking code.

Figure 26. Example of marking



8.2 Inner box labeling

The labeling follows the ST standard packing acceptance specification.

The following information will be on the inner box label:

- assembly site
- sales type
- quantity
- trace code
- marking
- bulk ID number

8.3 Packing

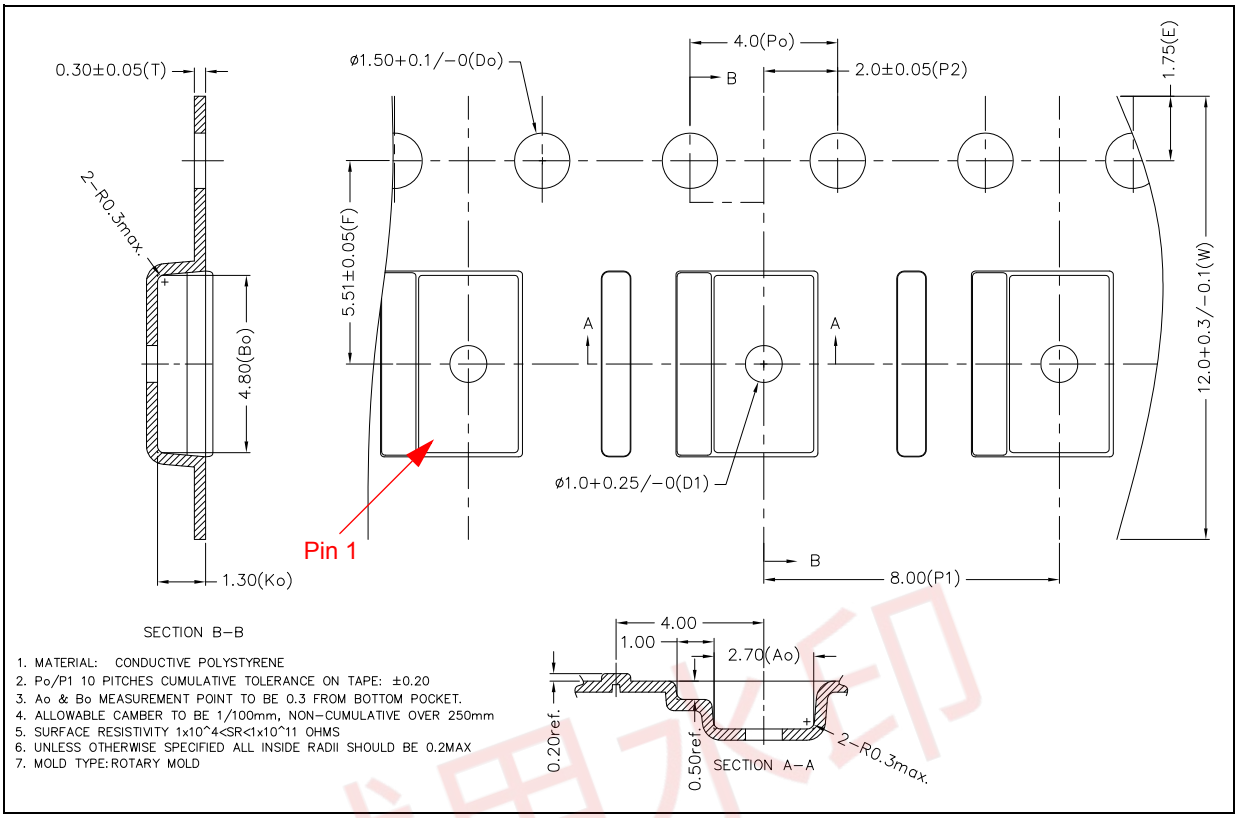
At customer / subcontractor level, it is recommended to mount theVL53L0X in a clean environment to avoid foreign material deposition.

To help avoid any foreign material contamination at phone assembly level the modules will be shipped in a tape and reel format with a protective liner. The packaging will be vacuum-sealed and include a desiccant.

The liner is compliant with reflow at 260°C. It must be removed during assembly of the customer device, just before mounting the cover glass.

8.3.1 Tape outline drawings

Figure 27. Tape outline drawing



8.4 Pb-free solder reflow process

Figure 28 and *Table 15* shows the recommended and maximum values for the solder profile.

Customers will have to tune the reflow profile depending on the PCB, solder paste and material used.

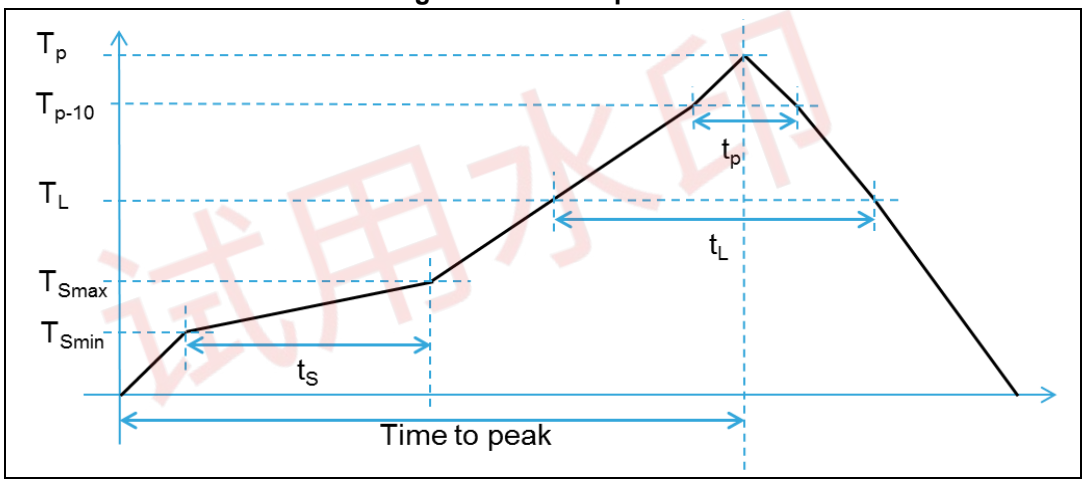
We expect customers to follow the “recommended” reflow profile, which is specifically tuned for VL53L0X package.

For any reason if a customer must perform a reflow profile which is different from “recommended” one (especially peak >240°C), this new profile must be qualified by the customer at its own risk. In any case, the profile have to be within the “maximum” profile limit described in *Table 15*.

Table 15. Recommended solder profile

Parameters	Recommended	Maximum	Units
Minimum temperature (T_S min) Maximum temperature (T_S max) Time t_s (T_S min to T_S max)	130 200 90-110	150 200 60 - 120	°C °C seconds
Temperature (T_L) Time (t_L) Ramp up	217 55-65 +2	217 55 - 65 +3	°C seconds °C/second
Temperature (T_{p-10}) Time (t_{p-10}) Ramp up	- - -	250 10 +3	°C seconds °C/second
Peak temperature (Tp)	240	260 max	°C
Time to peak	300	300	seconds
Ramp down (peak to T_L)	-4	-6	°C/second

Figure 28. Solder profile



Note: Temperature mentioned in Table 15 is measured at the top of VL53L0X package.

Note: The component should be limited to a maximum of 3 passes through this solder profile.

8.5 Handling and storage precautions

8.5.1 Shock precaution

Proximity sensor modules house numerous internal components that are susceptible to shock damage. If a unit is subject to excessive shock, is dropped onto the floor, or a tray/reel of units is dropped onto the floor, it must be rejected, even if no apparent damage is visible.

8.5.2 Part handling

Handling must be done with non-marring ESD safe carbon, plastic, or Teflon tweezers. Ranging module are susceptible to damage or contamination. A clean assembly process is advised at customer after un-taping the parts, and until a protective cover glass is mounted.

8.5.3 Compression force

A maximum compressive load of 25N shall be applied on the module.

8.5.4 Moisture sensitivity level

Moisture sensitivity is level 3 (MSL) as described in IPC/JEDEC JSTD-020-C

8.6 Storage temperature conditions

Table 16. Recommended storage conditions

Parameter	Min.	Typ.	Max.	Unit
Temperature (storage)	-40		+85	°C

9 Ordering information

Table 17. Ordering information

Sales type	Package	Packing
VL53L0CXV0DH/1	Optical LGA12 with liner	Tape and reel

10 Acronyms and abbreviations

Table 18. Acronyms and abbreviations

Acronym/ abbreviation	Definition
ESD	Electrostatic discharge
I^2C	Inter-integrated circuit (serial bus)
NVM	Non volatile memory
RIT	Return Ignore Threshold
SPAD	Single photon avalanche diode
VCSEL	Vertical cavity surface emitting laser

11 ECOPACK®

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*.
ECOPACK® is an ST trademark.

12 Revision history

Table 19. Document revision history

Date	Revision	Changes
30-May-2016	1.0	Initial release.
09-Apr-2018	2	Updated title Updated *Features* Small text changes to *Description* Removed note from *Section 2.6.2: Ranging phase* Added text before *Figure 24*, *Section 6: Outline drawing*

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