SLAMTEC
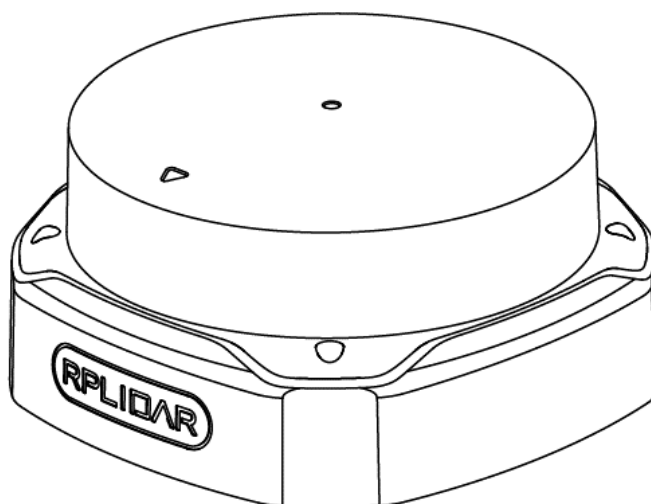
RPLIDAR S2E

Low Cost 360 Degree Laser Range Scanner

Introduction and Datasheet

Model: S2M1-R2E

32K

Contents

The RPLIDAR S2E is the next generation low cost 360 degree 2D laser scanner (LIDAR) solution developed by SLAMTEC. It can take up to 32000 samples of laser ranging per second with high rotation speed. And equipped with SLAMTEC patented OPTMAG technology, it breakouts the life limitation of traditional LIDAR system so as to work stably for a long time.

The system can perform 2D 360-degree scan within a 30-meter range. The generated 2D point cloud data can be used in mapping, localization and object/environment modeling.

Compared with RPLIDARs in other series, RPLIDAR S2E has a more stable performance when detecting objects in long distance, objects in white or black alternatively and objects under direct sunlight, which is ideal for map building in the outdoor environment within a 30-meter ranging radius. Therefore, it can be widely applied in many consumer-oriented business scenarios.

The typical scanning frequency of RPLIDAR S2E is 10Hz(600rpm). With the 10Hz scanning frequency, the sampling rate is 32kHz and the angular resolution is 0.12°.

Due to the improvements in SLAMTEC hardware operating performance and related algorithm, RPLIDAR S2E works well in all kinds of indoor environment and outdoor environment with direct sunlight. Meanwhile, before leaving the factory, every RPLIDAR S2E has passed the strict testing to ensure the laser output power meet the eye-safety standard of IEC-60825 Class 1.

System connection

The RPLIDAR S2E consists of a range scanner core and the mechanical powering part which makes the core rotate at a high speed. When it functions normally, the scanner will rotate and scan clockwise. And users can get the range scan data via the communication interface of the RPLIDAR.

Range Scanner Core

Communication and Power Interface
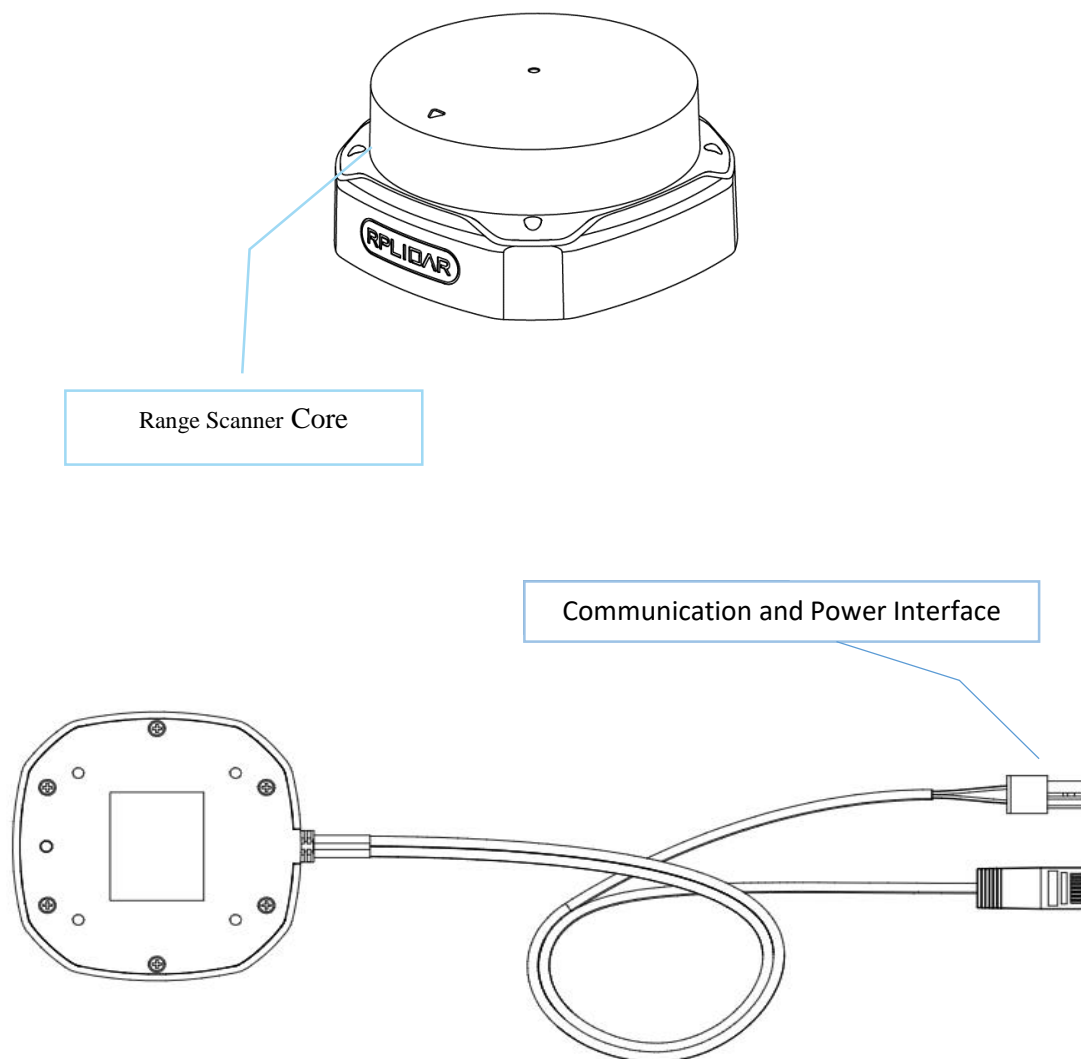
Figure 1-1 RPLIDAR S2E System Composition

The RPLIDAR S2E comes with a rotation speed detection and adaptive system. The system will adjust the angular resolution automatically according to the actual rotating speed. And there is no need to provide complicated power system for RPLIDAR S2E. In this way, the simple power supply schema saves the BOM cost. If

the actual speed of the RPLIDAR is required, the host system can get the related data via communication interface.

The detailed specification about power and communication interface can be found in the following sections.

Mechanism

The RPLIDAR S2E is based on laser flight-of-time (TOF) ranging principle and adopts the high-speed laser acquisition and processing hardware developed by SLAMTEC. The system ranges more than 32000 times per second.

During every ranging process, the RPLIDAR emits modulated infrared laser signal and the laser signal is then reflected by the object to be detected. The returning signal is then sampled by laser acquisition system in RPLIDAR and the processor embedded in RPLIDAR starts processing the sample data and outputs distance value and angle value between object and RPLIDAR S2E via communication interface.
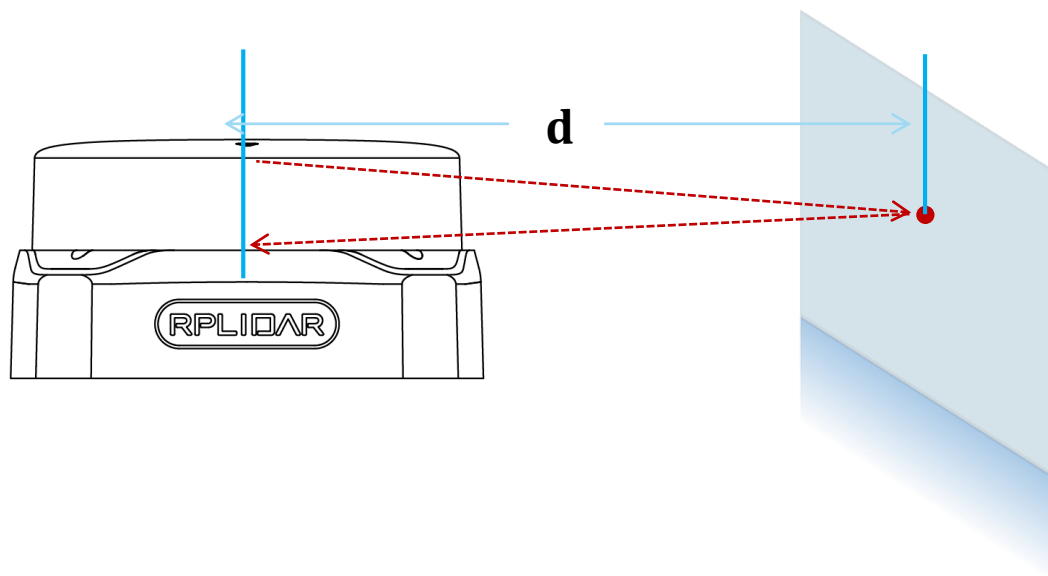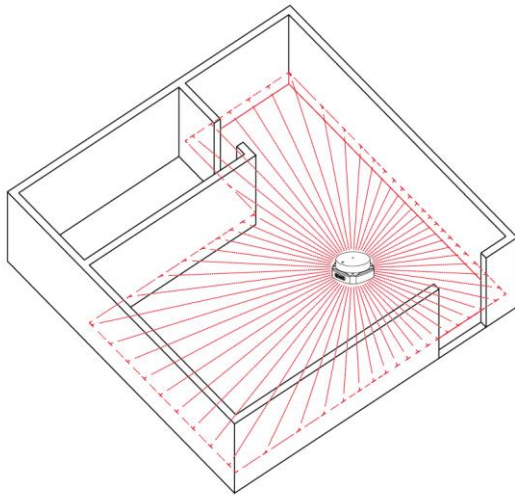
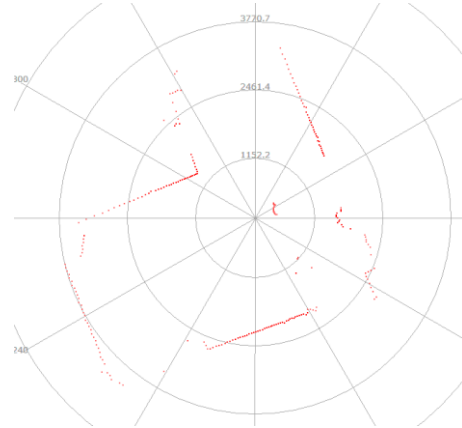

Figure 1-2 The RPLIDAR S2E Working Schematic

When drove by the motor system, the range scanner core will rotate clockwise and perform the 360-degree scan for the current environment.

Class I

*Note： The LIDAR scan image is not directly relative to the environment showed here. Illustrative purpose only.

Figure 1-3 The Obtained Environment Map from RPLIDAR S2E Scanning

Safety and Scope

The RPLIDAR S2E system uses a low power infrared laser as its light source, and drives it by using modulated pulse. The laser emits light in a very short time frame which can ensure its safety to human and pet, and it reaches Class I laser safety standard. Complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

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

The modulated laser can effectively avoid the interference from ambient light and sunlight during ranging scanning process, which makes RPLIDAR S2E work excellent in all kinds of indoor environment and outdoor environment with direct sunlight.

Data Output

During the working process, the RPLIDAR will output the sampling data via the communication interface. And each sample point data contains the information in the following table. If you need detailed data format and communication protocol, please contact SLAMTEC.

Data Type	Unit	Description
Distance	mm	Current measured distance value between the rotating core of the RPLIDAR and the sampling point
Heading	degree	Current heading angle of the measurement
Start Flag	(Bool)	Flag of a new scan
Checksum		The Checksum of RPLIDAR return data

Figure 1-4 The RPLIDAR S2E Sample Point Data Information
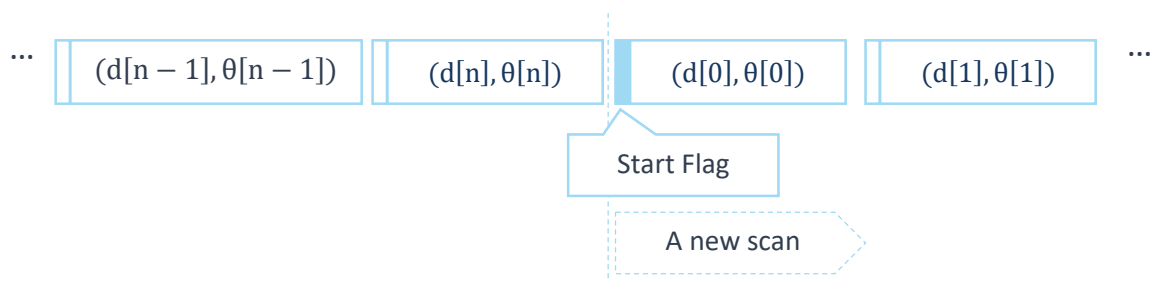
Figure 1-5 The RPLIDAR S2E Sample Point Data Frames

The RPLIDAR S2E outputs sampling data continuously and it contains the sample point data frames in the above figure. Host systems can configure output format and stop RPLIDAR by sending stop command. For detailed operations please contact SLAMTEC.

High Speed Sampling Protocol and Compatibility

The RPLIDAR S2E adopts the newly extended high Speed sampling protocol for outputting the 32000 times per second laser range scan data. Users are required

to update the matched SDK or modify the original driver and use the new protocol for the 32000 times per second mode of RPLIDAR S2E. Please check the related protocol documents for details.

Application Scenarios

The RPLIDAR can be used in the following application scenarios:

- General robot navigation and localization

- Environment scanning and 3D re-modeling

- Service robot or industrial robot working for long hours

- Home service /cleaning robot navigation and localization

- General simultaneous localization and mapping (SLAM)

- Smart toy's localization and obstacle avoidance

Measurement Performance

- For Model S2E Only

Item	Detail
Application Scenarios	Ideal for both outdoor and indoor environments with reliable resistance to daylight.
Distance Range	White object: 0.05~30 meters（under 90% reflection）
	Black object: 0.05~10 meters（under 10% reflection）
Scan Field Flatness	0°~1.5°（other angle requirements can be customized）
Sample Rate	32kHz
Scan Rate	10 Hz
Angular Resolution	0.12 °
Communication Interface	Ethernet
Accuracy	±30mm*
Resolution	13mm*

Figure 2-1 RPLIDAR S2E Performance

Note: Under 90% reflection, * means the typical value. The actual value depends on environmental conditions.

Laser Power Specification

- For Model S2E Only

Item	Unit	Min	Typical	Max	Comments
Laser wavelength	Nanometer(nm)	895	905	915	Infrared Light Band
Laser power	Watt (W)	-	25	-	Peak power
Pulse length	Nanosecond(ns)	-	5	-	-
Laser Safety Class	-	-	IEC-60825 Class 1	-	-

Figure 2-2 RPLIDAR S2E Optical Specification

*Note: The laser power is the continuous luminous power, the actual average power will be much lower than this value.

Optical Window

To make the RPLIDAR S2E working normally, please ensure proper space to be left for its emitting and receiving laser lights when designing the host system. The obscuring of the host system for the ranging window will impact the performance and resolution of RPLIDAR S2E. If you need cover the RPLIDAR S2E with translucent materials or have other special needs, please contact SLAMTEC about the feasibility.
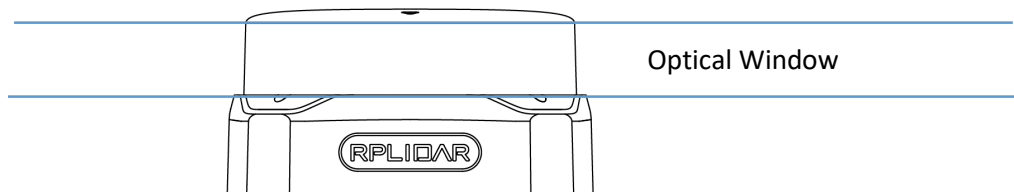
Optical Window

Figure 2-3 RPLIDAR S2E Optical Window

You can check the Mechanical Dimensions chapter for detailed window dimensions.

Coordinate System Definition of Scanning Data

The RPLIDAR S2E adopts coordinate system of the left hand. The dead ahead of the sensors is the x axis of the coordinate system; the origin is the rotating center of the range scanner core. The rotation angle increases as rotating clockwise. The detailed definition is shown in the following figure:
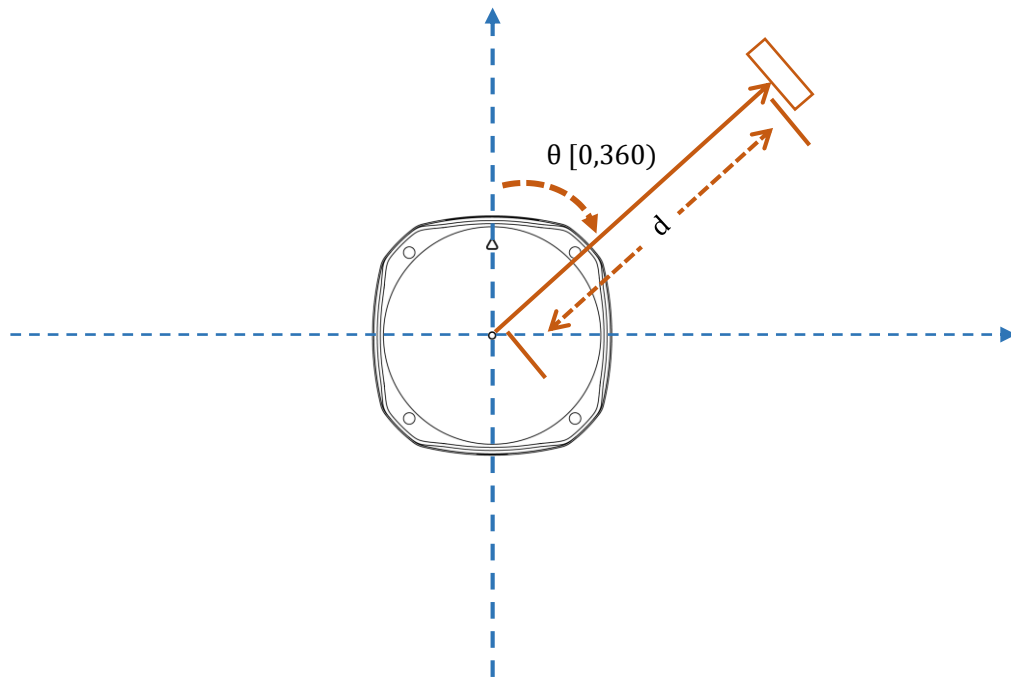
Figure 2-4 RPLIDAR S2E Scanning Data Coordinate System Definition

Communication interface

Data Communication interface

The S2E uses ETHERNET UDP ports and RJ45 ports for communication. The transmission standards and rates are as follows:

PORT	STANDARD	SPEED
Ethernet	802.3/802.3u	10/100M

Figure 2-5 RPLIDAR S2E Network Specifications Interface Information
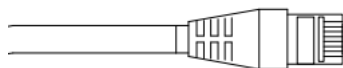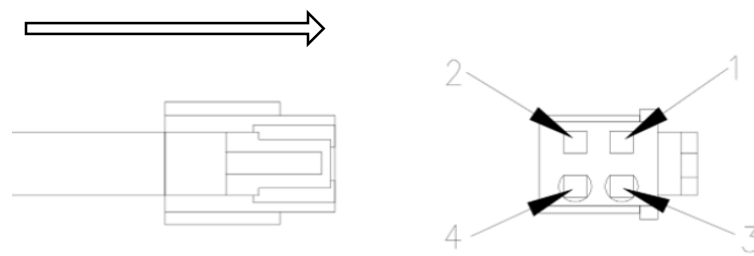
Network Port Interface

Figure 2-6 RPLIDAR S2E Network Port Definition Diagram

Power Supply Interface

Location	Single Name	Type	Description	Min	Typical	Max
1	VCC	Power Supply	System Power Supply	9V	12V	28V
2	GND	Power Supply	Sync Output		0V	
3	NA	Empty	Do not connect the ground and other circuits			
4	NA	Empty	Do not connect the ground and other circuits			

Figure 2-7 RPLIDAR S2E Power Supply Interface Definition Diagram

Power Supply Interface Specifications

The S2E uses a unique external power supply to drive both the range core and a motor system that makes the range core rotate. The external system needs to ensure the current output capacity and ripple characteristics of the power supply to ensure the normal operation of the radar.

S2E	Min	Typical	Max	Comments
Power Voltage	9V	12V	28V	If the voltage is not enough, the measurement will not be accurate.
Start Current		1200mA	1500mA	12V power, lower voltage start-up requires more current.
Working Current		200mA	220mA	12V power

Figure 2-8 RPLIDAR S2E Power Supply Specifications Parameters

Scanner Motor Control

The RPLIDAR S2E is embedded with a closed motor control system which realize accurate rotating speed control. Users can control the start, the stop and the rotating rate by sending protocol commands to RPLIDAR. However, the motor can't start and stop alone, its working state depends on the laser scan operation.

MISC

● For Model S2E Only

| Item	Unit	Min	Typical	Max	Comments
Weight	Gram (g)	TBD	190	TBD	
Working temperature range	Degree Celsius (ºC)	-10	25	50	
Storage temperature range	Degree Celsius (ºC)	-20	25	60	

Figure 2-9 RPLIDAR S2E MISC Specification

To ensure the laser of RPLIDAR always working in the safety range and avoid any other damage caused by device, the RPLIDAR comes with laser power detection and sensor healthy check feature. It will shut down the laser and stop working automatically when any of the following errors has been detected.

o Scan speed of Laser scanner system is unstable

o Scan speed of Laser scanner system is too slow

o Laser signal sensor works abnormally

The host systems can check the status of the RPLIDAR S2E via the communication interface and restart the RPLIDAR S2E to try to recover work from error.

To facilitate the usage of RPLIDAR S2E in the product development and speed up the development cycle for users, SLAMTEC has provided the **Framegrabber** plugin in RoboStudio for testing and debugging as well as the SDK available under Windows, x86 Linux and Arm Linux. Please contact SLAMTEC for detail information.
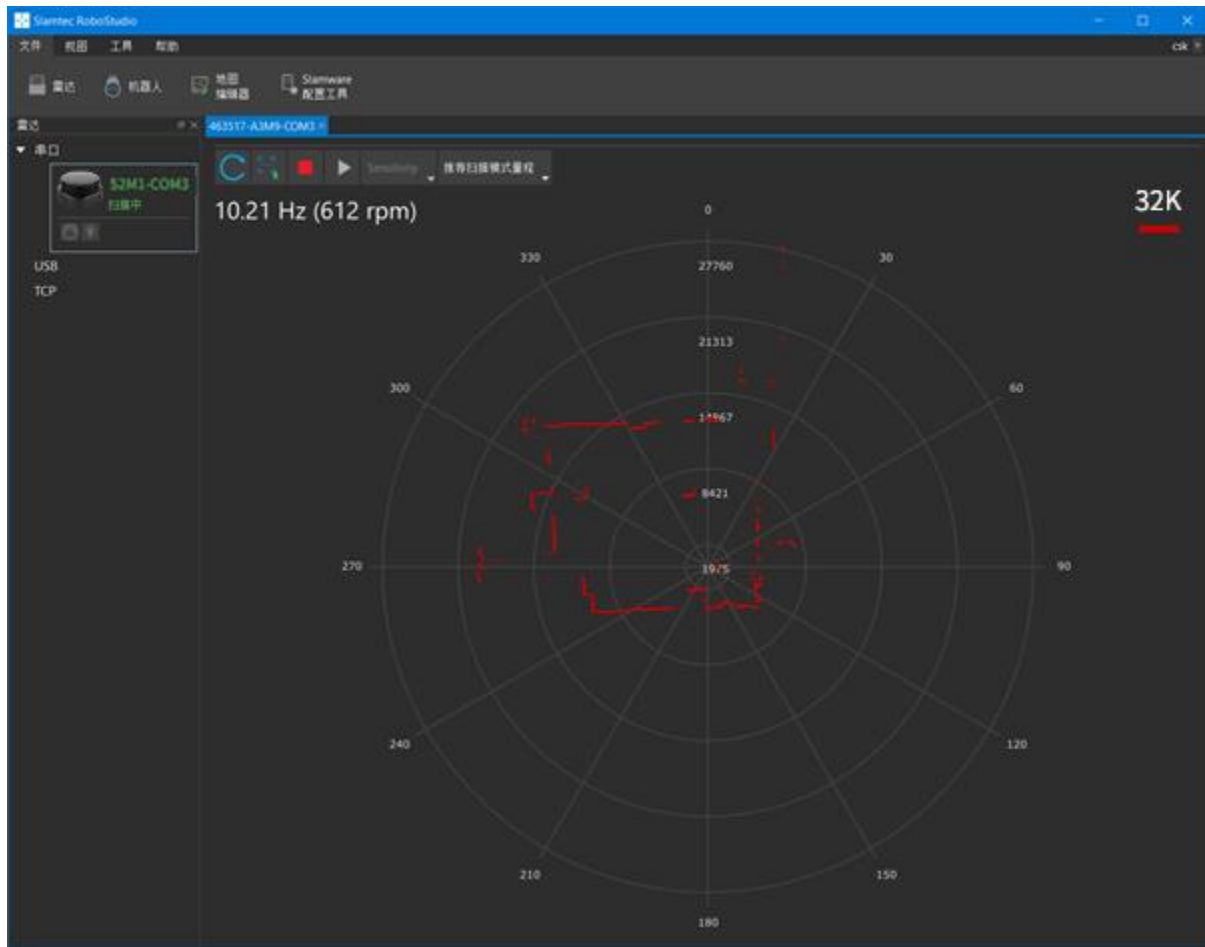
Figure 3-1 the Framegrabber Plugin in RoboStudio

The mechanical dimensions of the RPLIDAR S2E are shown as below:

*Note:

1. The depth of 4*M3 screws in the bottom should be no longer than 4mm. Otherwise, the internal components will be damaged.

2. Dimension unit: mm; tolerance: ±0.2.
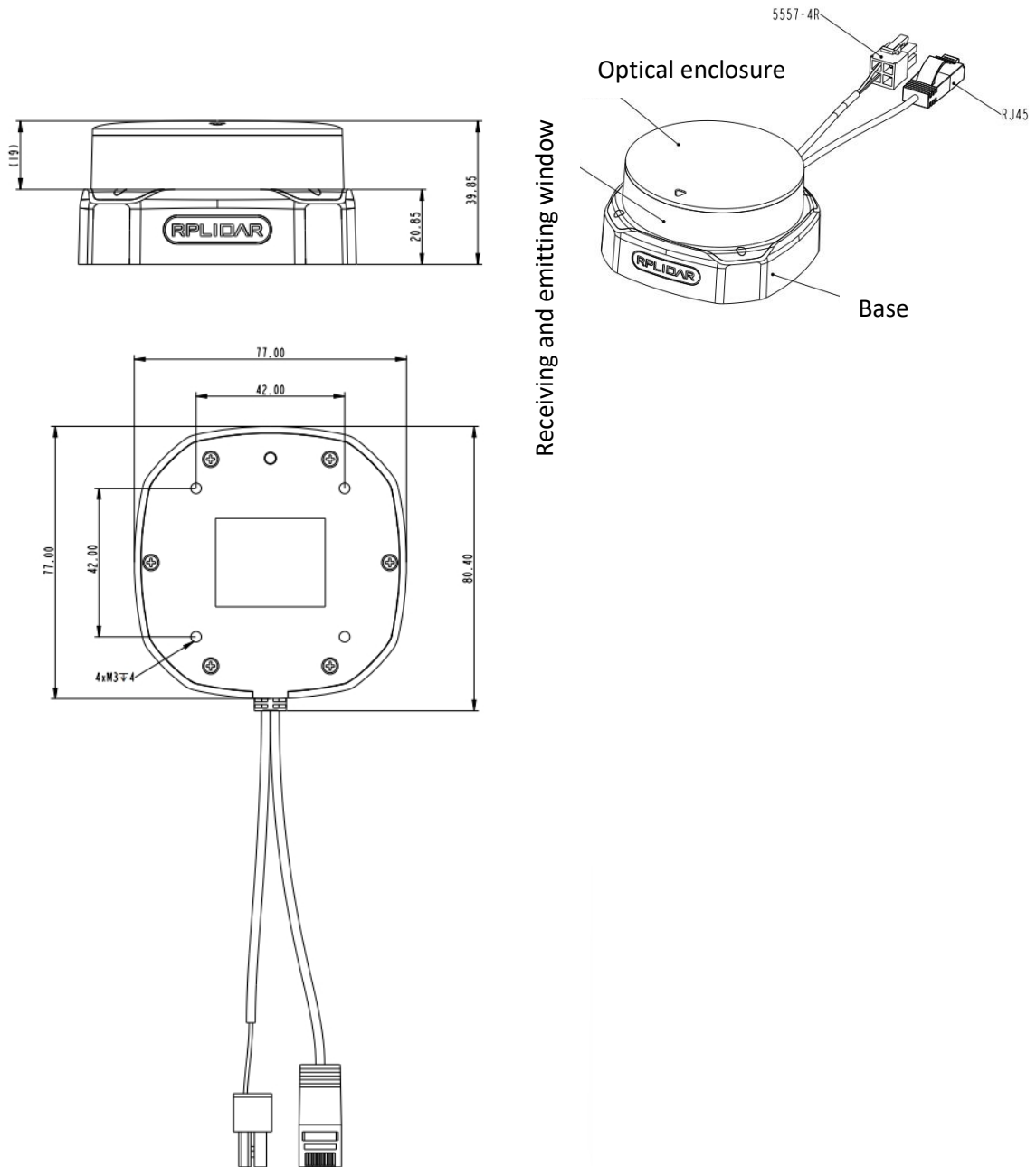
Figure 4-1 RPLIDAR S2E Mechanical Dimensions

Date	Version	Description
2022-05-13	1.0	Initial version for S2E
2022-06-02	1.1	Correct power supply interface
2022-06-22	1.2	Correct Figure 2-1
2022-08-02	1.3	Correct Figure 2-7
2022-11-24	1.4	Add instruction of Figure 2-1
2023-05-04	1.5	Updated Figure 4-1

Image and Table Index

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Made in China