RPLIDAR A1
Low Cost 360 Degree Laser Range Scanner
Development Kit User Manual
Model: A1M8
# CONTENTS

**OVERVIEW** ................................................................................................................. 3

- **Items in the Development Kit** .................................................................................. 3
- **RPLIDAR A1** ............................................................................................................... 4
- **USB Adapter** ............................................................................................................ 4

**CONNECTION AND USAGE** ......................................................................................... 5

- **Connection** ................................................................................................................ 5
- **Install Driver for the USB Adapter** ........................................................................... 6
- **Run Demo Application** .............................................................................................. 7
- **Troubleshooting** ........................................................................................................ 10

**SDK INTRODUCTION AND USAGE** ........................................................................... 11

- **RPLIDAR A1 Pin Definition and Specification** .......................................................... 11
- **Pin Definition for the USB Adapter** ......................................................................... 12
- **Configure RPLIDAR A1 Scan Frequency** ................................................................. 13
- **SDK Usage** ............................................................................................................... 13

**OPERATION RECOMMENDATION** ............................................................................. 13

- **Pre-Heating for Best Performance** .......................................................................... 14
- **Ambient Temperature** ............................................................................................. 14
- **Ambient Light** ......................................................................................................... 14

**REVISION HISTORY** .................................................................................................. 15

**APPENDIX** .................................................................................................................. 16

- **Image and Table Index** ............................................................................................ 16
RPLIDAR A1 development kit includes the matched tools used for evaluating RPLIDAR A1’s performance and initial development. After connecting the RPLIDAR A1 with PC via USB cable and adapter, Users can observe the cloud map of the environment scanning point collected by the RPLIDAR A1 and start development based on the SDK.

**Items in the Development Kit**

RPLIDAR A1 Development Kit contains:

- RPLIDAR A1 (PWM motor driver embedded)
- USB Adapter
- RPLIDAR A1 communication cable

Note: The Micro-USB cable needs to be prepared by users.

*Figure 1-1 Items in the RPLIDAR A1 Development Kit*
RPLIDAR A1

The RPLIDAR A1 development kit contains standard RPLIDAR A1 unit (A1M8-R1). The RPLIDAR A1 is embedded with logic IO drivable (3.3v) motor controller which can be used to configure the scan frequency by tuning motor speed. Developers can also choose to turn off the motor for power saving purpose.

RPLIDAR A1 usage and interface definition will be introduced in the coming sections.

USB Adapter

RPLIDAR A1 development kit contains a USB adapter to provide power supply for RPLIDAR A1 and convert RPLIDAR A1 internal UART serial interface to USB interface.
Connection

RPLIDAR A1 can be easily connected to PC according to the following steps.

1) Connect RPLIDAR A1 with the USB adapter using provided communication cable. The socket is in the bottom of RPLIDAR A1.

![Connect RPLIDAR A1 and USB Adapter](image1)

Figure 2-1 Connect RPLIDAR A1 and USB Adapter

2) Connect the USB adapter to your PC using the Micro-USB cable. After connecting RPLIDAR A1 to your PC through the USB cable, the LED in the bottom of the RPLIDAR A1 will light up and RPLIDAR A1 start scanning.

![Connect the USB Adapter to PC via Micro-USB Cable](image2)

Figure 2-2 Connect the USB Adapter to PC via Micro-USB Cable
Install Driver for the USB Adapter

The USB adapter converts UART to USB by using CP2102 chip. You need to install the device driver for the chip. The driver can be found in the provided SDK package or downloaded from Silicon Labs’ official website:


Here’s the installation steps in Windows:

After connecting the RPLIDAR A1 with PC, please find the driver file “CP210x VCP Windows” and choose correct operating system version accordingly: x86 for 32-bit OS and x64 for 64-bit OS.

Figure 2-3 Choose USB Adapter Driver for Installation

Figure 2-4 Start Page of USB Adapter Driver Installation
After installing the driver according to the above installation steps, you will see corresponding serial port name in the [Control Panel] -> [Device and Printers]. Please refer to the below figure.

![Recognized Serial Port Name Matched with the USB Adapter](image)

Figure 2-5 Recognized Serial Port Name Matched with the USB Adapter

**Run Demo Application**

SLAMTEC provides a Lidars plugin in RoboStudio for users in test and evaluation. You can view the scan result directly in the UI and save the scan result to files for further processing.

This GUI demo can only run under Windows. For Linux and MacOS users, please refer to the other simple demo provided in the SDK.

Please make sure you have connected RPLIDAR to PC by using USB adapter and installed the device driver correctly before running the demo application in RoboStudio. Launch RoboStudio and log in.
If the connection is ok, you will see the user interface is shown as below. Click the "Lidars" option in the "File" menu, and then right click on the Lidars below the box area, the content of dialog box will be "Manual Connect to Lidar... / Auto Discovery to Lidar...".
The serial number, version and model of the RPLIDAR A1 will show next with its icon in the lidar control panel. The supported commands of RPLIDAR are showed in the tool bar. The descriptions are listed in the bellow table.

<table>
<thead>
<tr>
<th>Button</th>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Restart RPLIDAR</td>
<td>Restart scan core to clear internal errors</td>
</tr>
<tr>
<td></td>
<td>Save Scan Data</td>
<td>Save current scan data to the local file</td>
</tr>
<tr>
<td></td>
<td>Stop Scan</td>
<td>Scan core enter power save mode</td>
</tr>
<tr>
<td></td>
<td>Start Scan</td>
<td>Scan data will be displayed after scan core starting work</td>
</tr>
<tr>
<td></td>
<td>Work Mode Switch</td>
<td>Switch among different work modes to fit in specific environments</td>
</tr>
<tr>
<td></td>
<td>Adjust Motor Speed</td>
<td>Adjust the motor speed as required</td>
</tr>
</tbody>
</table>

*Figure 2-8 The Supported Commands of RPLIDAR in RoboStudio*

Press the Start Scan button, the scan data will be displayed as below (by default, the motor rotating speed should be about 8Hz.):

*Figure 2-9 The Scan Outline by RPLIDAR in RoboStudio*

Right click in the major working area to choose a range so as to zoom in or out the view.

The scan frequency is also showed in the above interface.
Troubleshooting

When the scan core or the laser power works abnormally, the scan core will enter protection mode. This state can be retrieved via SDK API. If such scenario happened, please send restart command \( C \) to reset the scan core.
RPLIDAR A1 Pin Definition and Specification

In the development kit, the bottom motor interface and core interface of the RPLIDAR A1 module use PH1.25-3P and PH1.25-4P vertical mounts respectively. Users can use a cable connection with 1.25mm-pitch 3pin and 1.25mm-pitch 4pin terminals. Please find the detail pin definition in the bellow table:

<table>
<thead>
<tr>
<th>Interface</th>
<th>Signal Name</th>
<th>Type</th>
<th>Description</th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Interface</td>
<td>5V_MOTO</td>
<td>Power</td>
<td>Power for RPLIDAR A1 Motor</td>
<td>-</td>
<td>5V</td>
<td>9V</td>
</tr>
<tr>
<td></td>
<td>CTRL_MOTO</td>
<td>Input</td>
<td>Enable signal for RPLIDAR A1 Motor/PWM Control Signal</td>
<td>0V</td>
<td>-</td>
<td>5V_MOTO</td>
</tr>
<tr>
<td></td>
<td>GND_MOTO</td>
<td>Power</td>
<td>GND for RPLIDAR A1 Motor</td>
<td>-</td>
<td>0V</td>
<td>-</td>
</tr>
<tr>
<td>Core Interface</td>
<td>VCC_5</td>
<td>Power</td>
<td>Power for RPLIDAR A1 Range Scanner Core</td>
<td>4.9V</td>
<td>5V</td>
<td>5.5V</td>
</tr>
<tr>
<td></td>
<td>TX</td>
<td>Output</td>
<td>Serial output for Range Scanner Core</td>
<td>0V</td>
<td>-</td>
<td>5V</td>
</tr>
<tr>
<td></td>
<td>RX</td>
<td>Input</td>
<td>Serial input for Range Scanner Core</td>
<td>0V</td>
<td>-</td>
<td>5V</td>
</tr>
<tr>
<td></td>
<td>GND</td>
<td>Power</td>
<td>GND for RPLIDAR A1 Range Scanner Core</td>
<td>-</td>
<td>0V</td>
<td>V5.0</td>
</tr>
</tbody>
</table>

Figure 3-1 RPLIDAR A1 Pin Definition and Specification

External system must provide required VMOTO and V5.0 power to make scan motor and scan core work correctly. In most of scenarios, VMOTO and V5.0 can share the same power supply.
MOTOCTL Pin used to control scan motor speed to adjust RPLIDAR A1’s scan frequency, PWM signal also can be applied. The equivalent circuit showed as bellow:

![Figure 3-2 RPLIDAR A1 MOTOCTL Equivalent Circuit](image1)

- **Reference Design for RPLIDAR A1 development**

![Figure 3-3 RPLIDAR A1 Pins Reference Design](image2)

**Pin Definition for the USB Adapter**

The USB adapter uses a 1.25mm pitch 7pin socket and is connected to the RPLIDAR A1 module through a communication cable:
Configure RPLIDAR A1 Scan Frequency

Since USB adapter’s control signal MOTOCTL is fixed to high level, RPLIDAR A1’s scan motor is always rotating at its highest speed which makes RPLIDAR A1 working on a relative high scan frequency. You can configure RPLIDAR A1’s scan frequency by controlling motor speed.

By connecting MOTOCTL signal to the device has PWM output function such as MCU’s PWM output I/O port, RPLIDAR A1’s scan frequency can be locked in a proper value by adjust duty ratio of PWM using the scan frequency feedback provided by RPLIDAR A1 core.

Please refer to RPLIDAR A1 protocol and application note for more information. SDK also contains the sample code.

SDK Usage

SLAMTEC provides RPLIDAR A1 SDK support on both Windows and Linux platform. And users can embe the SDK source code to other operational system or embedded system quickly. Please refer to the SDK document for more information.
Pre-Heating for Best Performance

The scan core will be heating when start working. We recommend pre-heating RPLIDAR A1 (Start the scan mode and the scan motor is rotating) for more than 2 minutes to get the best measurement accuracy.

Ambient Temperature

RPLIDAR A1’s measurement resolution is sensitive to the ambient temperature. Improper use may even damage the sensor. Please avoid using RPLIDAR A1 in extreme high temperature (>40 degree) and too low temperature (<-10 degree).

Ambient Light

Although RPLIDAR A1 is not sensitive to ambient light, improper use may still lead to errors. In indoor environment, please avoid lighting RPLIDAR A1 with strong light source such as high-power laser.

In outdoor environment, please avoid facing RPLIDAR A1 directly to sun light. This may lead to permanent damage to the image sensor of RPLIDAR A1 and make the measurement invalid

The standard version of RPLIDAR A1 may have less measurement range in the environment with strong sunlight.
<table>
<thead>
<tr>
<th>Date</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-3-5</td>
<td>Initial draft</td>
</tr>
<tr>
<td>2014-2-11</td>
<td>Refine for final product</td>
</tr>
<tr>
<td>2016-05-19</td>
<td>Replaced obsolete images</td>
</tr>
<tr>
<td>2016-08-17</td>
<td>Updated USB adapter image</td>
</tr>
<tr>
<td>2017-11-22</td>
<td>Corrected the pin P4 maximum value from 6V to 5.5V in Figure 3-1.</td>
</tr>
<tr>
<td>2020-12-22</td>
<td>A1M8 iteration, change the lidar module picture and pin definition; change the evaluation software to Robostudio</td>
</tr>
<tr>
<td>2021-05-20</td>
<td>Amend the first paragraph on page 11 about the lidar pin model. Corrected the connector model of the USB adapter on page 12.</td>
</tr>
<tr>
<td>2022-08-05</td>
<td>Updated Figure 2-7</td>
</tr>
</tbody>
</table>
Image and Table Index

FIGURE 1-1 ITEMS IN THE RPLIDAR A1 DEVELOPMENT KIT ................................................................. 3
FIGURE 1-2 THE RPLIDAR A1 .................................................................................................................. 4
FIGURE 1-3 RPLIDAR A1 ADAPTER ...................................................................................................... 4
FIGURE 2-1 CONNECT RPLIDAR A1 AND USB ADAPTER ................................................................. 5
FIGURE 2-2 CONNECT THE USB ADAPTER TO PC VIA MICRO-USB CABLE ......................................... 5
FIGURE 2-3 CHOOSE USB ADAPTER DRIVER FOR INSTALLATION ...................................................... 6
FIGURE 2-4 START PAGE OF USB ADAPTER DRIVER INSTALLATION .................................................. 6
FIGURE 2-5 RECOGNIZED SERIAL PORT NAME MATCHED WITH THE USB ADAPTER ........................ 7
FIGURE 2-6 ROBOSTUDIO LOGIN PAGE ................................................................................................ 8
FIGURE 2-7 THE LIDAR PLUGIN IN ROBOSTUDIO .............................................................................. 8
FIGURE 2-8 THE SUPPORTED COMMANDS OF RPLIDAR IN ROBOSTUDIO ...................................... 9
FIGURE 2-9 THE SCAN OUTLINE BY RPLIDAR IN ROBOSTUDIO ...................................................... 9
FIGURE 3-1 RPLIDAR A1 PIN DEFINITION AND SPECIFICATION ..................................................... 11
FIGURE 3-2 RPLIDAR A1 MOTOCTL EQUIVALENT CIRCUIT .............................................................. 12
FIGURE 3-3 RPLIDAR A1 PINS REFERENCE DESIGN ......................................................................... 12
FIGURE 3-4 RPLIDAR A1 USB ADAPTER PIN DEFINITION .................................................................. 13