RPLIDAR A1
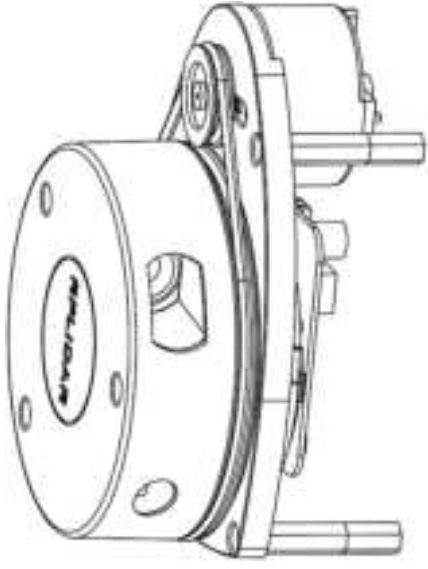
Low Cost 360 Degree Laser Range Scanner

Development Kit User Manual

Model: A1M8

Contents

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:

- o RPLIDAR A1（PWM motor driver embedded）

- o USB Adapter

- o RPLIDAR A1 communication cable

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

USB Adapter

RPLIDAR Module

RPLIDAR communication cable

Figure 1-1 Items in the RPLIDAR A1 Development Kit

RPLIDAR A1

Figure 1-2 The 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

Figure 1-3 RPLIDAR A1 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.
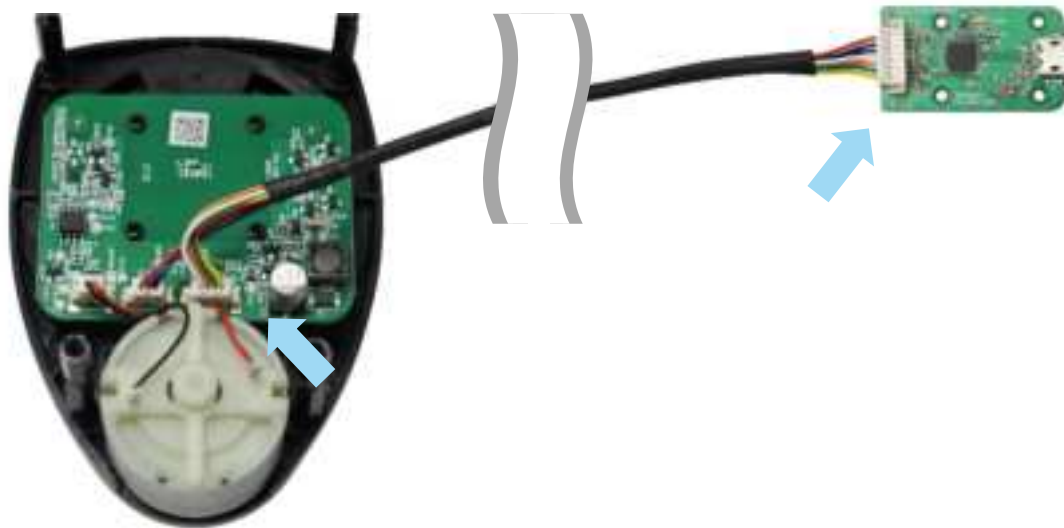

Figure 2-1 Connect RPLIDAR A1 and USB Adapter

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.

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:

http://www.silabs.com/products/interface/usb-bridges/Pages/usb-bridges.aspx

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.
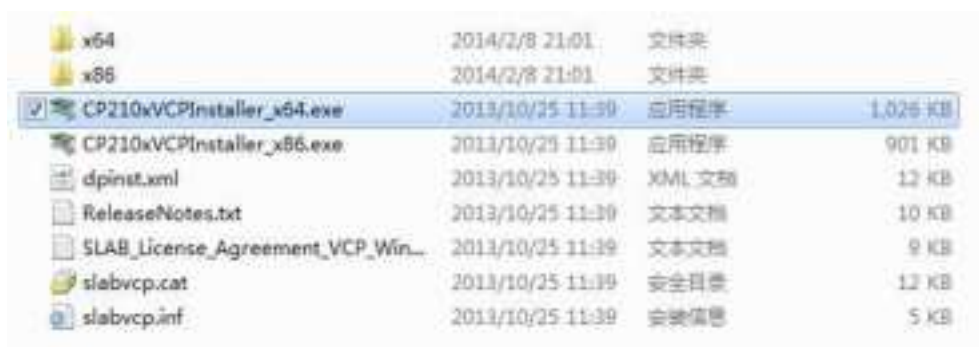

Figure 2-3 Choose USB Adapter Driver for Installation

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.
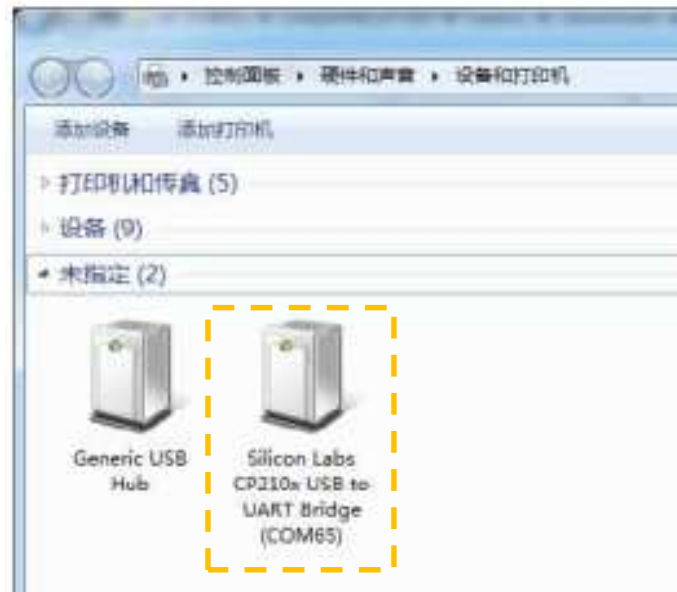

Figure 2-5 Recognized Serial Port Name Matched with the USB Adapter

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.

Figure 2-6 RoboStudio Login Page

If the connection is ok, you shall see the user interface is shown as below.

1. Click **File->Lidars** to open the lidar control panel in the left;

2. Click **Serial Ports** to extend the lidar lists and you'll find the RPLIDAR A1 previously connected to your PC;

3. Click the RPLIDAR A1 icon to extend the tool buttons below the icon: the left one is to adjust the motor speed(RPLIDAR A1 is not adjustable by default.) while the right one is to open the tool bar in the major work area as shown in Figure 2-7.
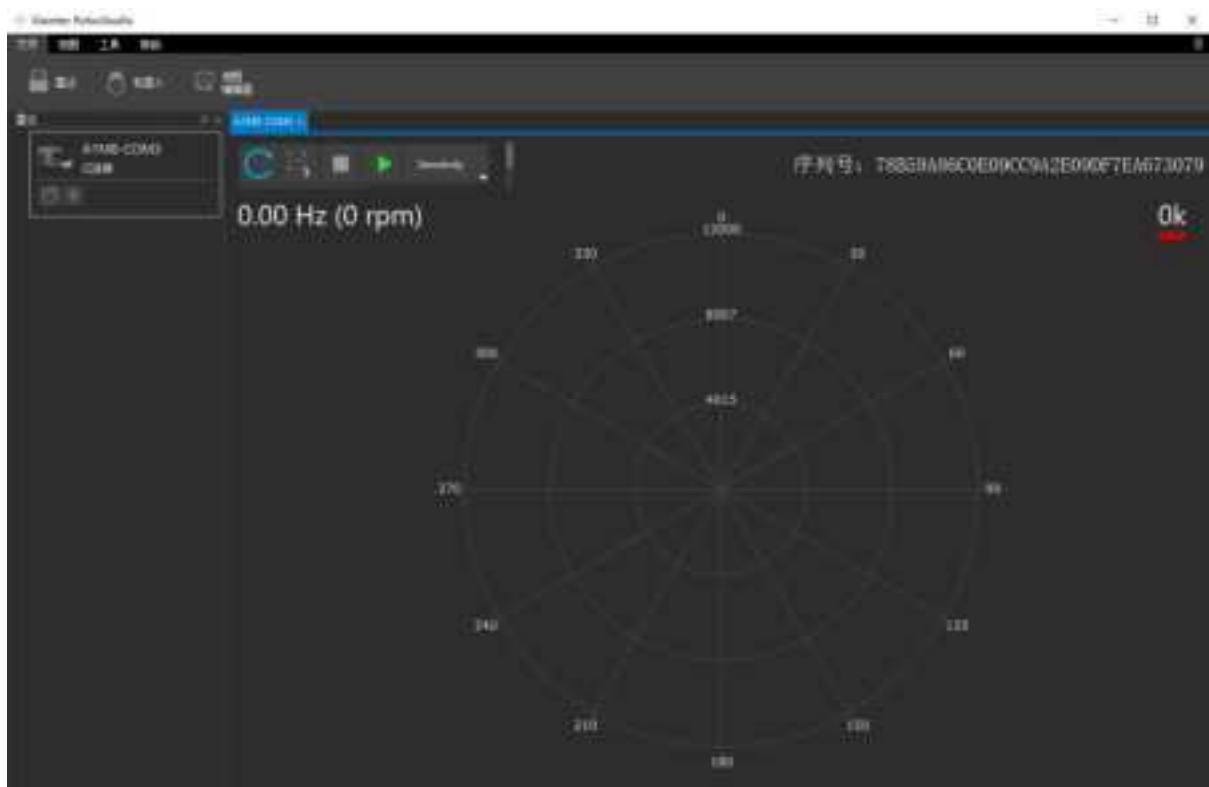
Figure 2-7 The Lidar Plugin in RoboStudio

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.

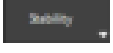| Button	Function	Description
	Restart RPLIDAR	Restart scan core to clear internal errors
	Save Scan Data	Save current scan data to the local file
	Stop Scan	Scan core enter power save mode
	Start Scan	Scan data will be displayed after scan core starting work
	Work Mode Switch	Switch among different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

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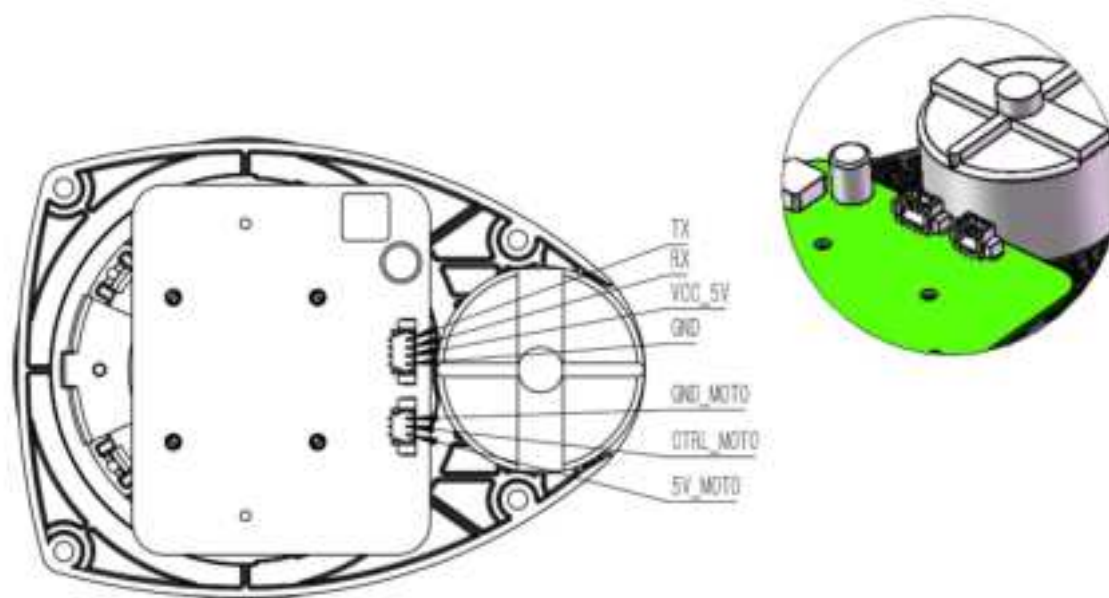
Interface	Signal Name	Type	Description	Min	Typical	Max
Motor Interface	5V_MOTO	Power	Power for RPLIDAR A1 Motor	-	5V	9V
	CTRL_MOTO	Input	Enable signal for RPLIDAR A1 Motor/PWM Control Signal	0V	-	5V_MOTO
	GND_MOTO	Power	GND for RPLIDAR A1 Motor	-	0V	-
Core Interface	VCC_5	Power	Power for RPLIDAR A1 Range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

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:
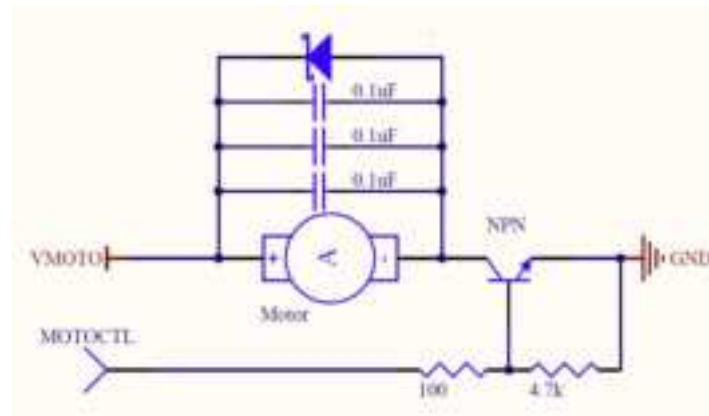

Figure 3-2 RPLIDAR A1 MOTOCTL Equivalent Circuit

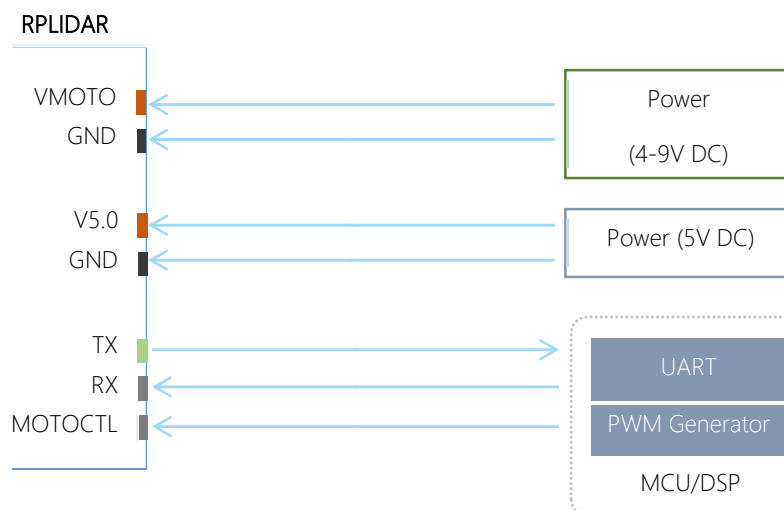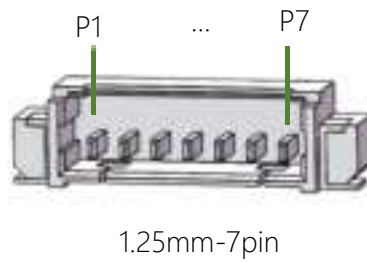o Reference Design for RPLIDAR A1 development

Figure 3-3 RPLIDAR A1 Pins Reference Design

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:

SL/\MTEC

P1   ...   P7

1.25mm-7pin

Pin	Signal Name	Description
P1	V5.0	Power supply for RPLIDAR A1 scan core, USB 5V input
P2	HIGH	constant 5V high level output
P3	GND	GND for RPLIDAR A1 scan motor, USB GND
P4	V5.0	Power supply for RPLIDAR A1 scan core, USB 5V input
P5	RX	Input pin for USB serial adapter
P6	TX	Output pin for USB serial adapter
P7	GND	GND for RPLIDAR A1 scan core, USB GND

Figure 3-4 RPLIDAR A1 USB Adapter Pin Definition

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.

Date	Content
2013-3-5	Initial draft
2014-2-11	Refine for final product
2016-05-19	Replaced obsolete images
2016-08-17	Updated USB adapter image
2017-11-22	Corrected the pin P4 maximum value from 6V to 5.5V in Figure 3-1.
2020-12-22	A1M8 iteration, change the lidar module picture and pin definition; change the evaluation software to Robostudio
2021-05-20	Amend the first paragraph on page 11 about the lidar pin model. Corrected the connector model of the USB adapler on page 12.

Image and Table Index