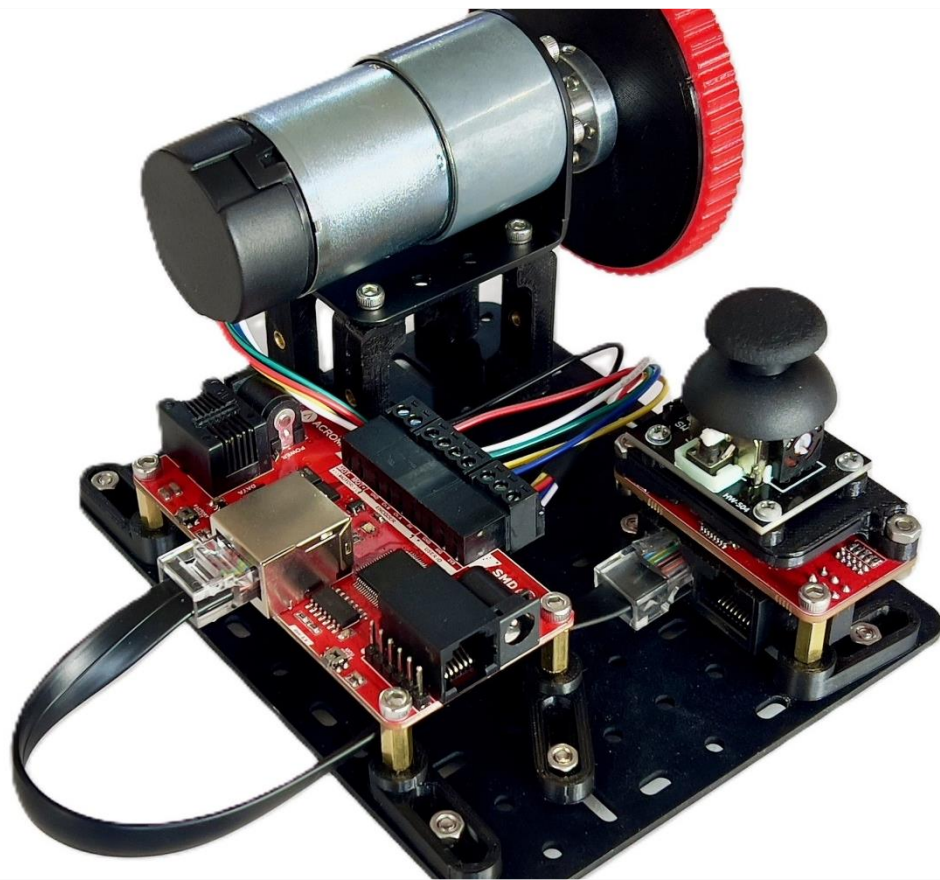




# ACROME

myCONTROL



**SMD STARTER KIT**

**USER MANUAL**

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## Contents

### Contents

<b>Contents</b> .....	3
<b>1 OVERVIEW</b> .....	4
<b>1.1 System Description</b> .....	4
<b>2 COMPONENTS</b> .....	5
<b>2.1 SMD Red</b> .....	5
<b>2.2 USB Gateway Module</b> .....	6
<b>2.3 Brushed DC Motor</b> .....	6
<b>2.4 Ultrasonic Distance Sensor Module</b> .....	6
<b>2.5 Reflectance Sensor Module</b> .....	Hata! Yer işareti tanımlanmamış.
<b>3 TECHNICAL SPECIFICATIONS</b> .....	7
<b>4 WIRING</b> .....	8
<b>4.1 Cable Names</b> .....	8
<b>4.2 Connections</b> .....	9
<b>5 DEVELOPING PROJECTS WITH THE SYSTEM</b> .....	10
<b>5.1 Getting Started</b> .....	10
<b>5.2 Start to Code with SMD</b> .....	10
<b>5.3 Motor PID Auto-tune Application</b> .....	11

# 1 OVERVIEW

## 1.1 System Description

The SMD Starter Kit consists of the SMD Red card, a USB gateway module, a brushed DC motor and various modules that enable countless applications. SMD is more than a just a motor driver, although it is a successful outstanding motor driver card. SMD allows users to develop both robotic and educational applications without having to start projects from scratch, so users can focus on turning their idea to project with ease.

SMD has a special Python library that makes it easy to control any module in the project. Since projects can be coded in Python, one of the most popular and user-friendly programming languages, there are no difficulties for any project.

Daisy-chain connectivity of modules removes the limitations that restricts the user's imagination. Various robotic systems and maker projects can be developed flexibly.

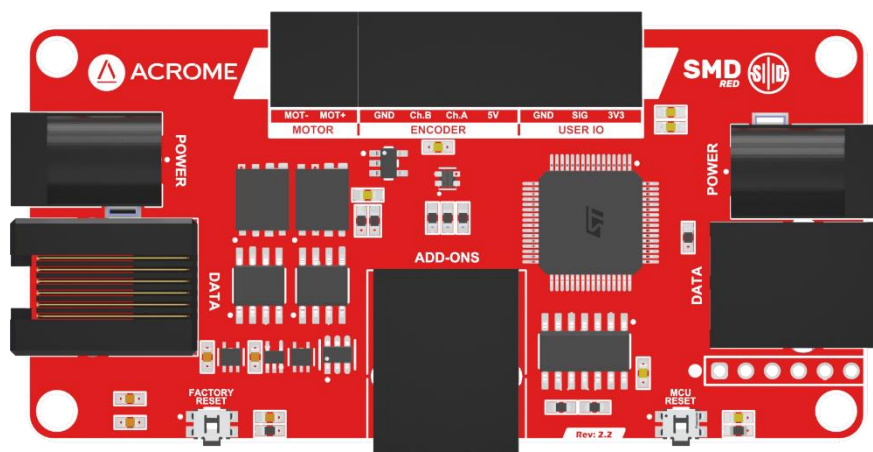


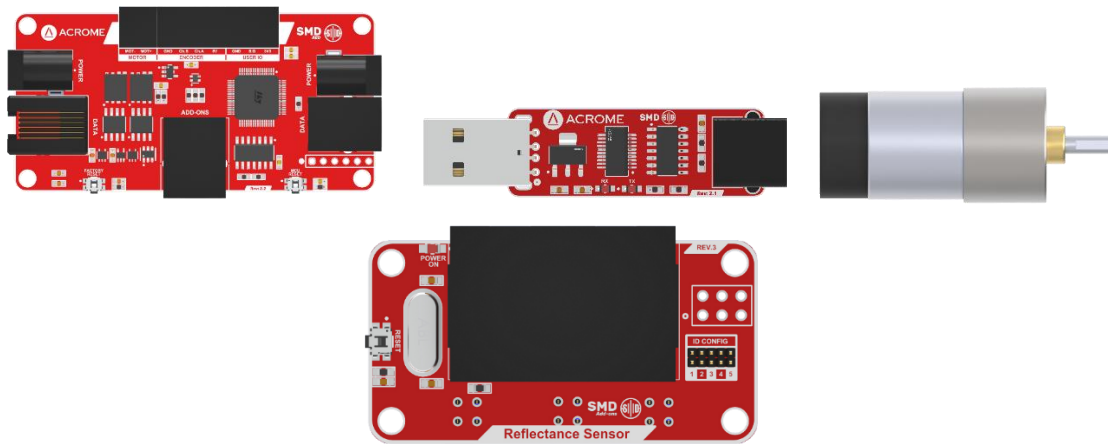
Figure 1.1: SMD Red

## 2 COMPONENTS

All the main components of the “SMD Starter Kit” are numbered and can be seen in the Figure 2.1. The numbers and the names of elements are listed in the Table 2.1 below.

**Table 2.1:** Descriptions and numbers of components

Numbers	Description
1	SMD Red
2	USB Gateway Module
3	Brushed DC Motor
4	Joystick Add-On Module



**Figure 2.1:** Components of SMD Starter Kit

### 2.1 SMD Red

SMD Red card is the powerhouse of the projects. It controls the system by communicating with a PC or a Raspberry Pi™. Users can use the Python library of Acrome SMD to code your projects with ease.

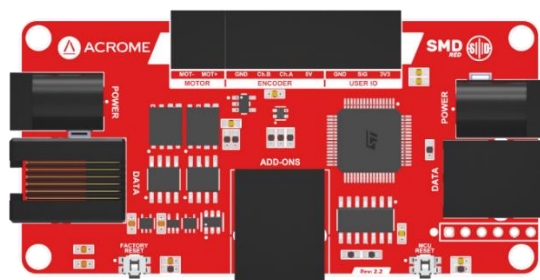


Figure 2.3: SMD Red

## 2.2 USB Gateway Module

USB gateway module is the communication bridge between computer and SMD Red.

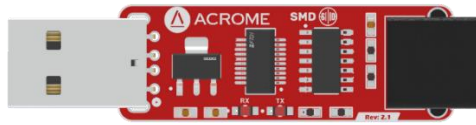


Figure 2.4: USB Gateway Module

## 2.3 Brushed DC Motor

Brushed DC motor can be directly driven over the “Motor” socket of SMD Red. There is also an encoder socket allows to use brushed DC motors with encoders.

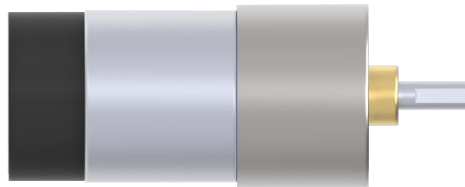


Figure 2.5: Brushed DC Motor

## 2.4 Joystick Add-On Module

The Joystick Module is a device that allows the user to precisely control any system. It gives a control possibility like a game controller. It has 2 potentiometers inside to measure the movement in analog value range of  $[-100, 100]$  in X and Y axis. There is also a button in the middle of the joystick which returns 1 when it is pressed and 0 when not pressed.



### 3 TECHNICAL SPECIFICATIONS




Items	Specifications
<b>Microcontrol Unit</b>	Arm®-Cortex®-M4 32b MCU+FPU, 125 DMIPS, 1MB Flash, 512KB RAM, USB OTG FS, 17 TIMs, 1 ADC, 17 comm. interfaces
<b>Peripherals</b>	• Gyroscope 3Axis, Accelerometer 3Axis, Magnetometer 3Axis (MPU9250) (both internal & external)
	• Ambient Light Sensor (IN-S32GTL5) (External Module)
	• Ultrasonic Sensor (HC-SR04) (External Module)
	• Reflectance Sensor Array (QTR-6A) (External Module)
	• Buzzer (External Module)
	• Button (External Module)
	• Joystick (External Module)
	• Potentiometer (External Module)
	• RGB LED (External Module)
	• Servo (External Module)
<b>Programmer</b>	• ARM Cortex SWD connector
<b>I/O Port Pins</b>	• Voltage Supply <ul style="list-style-type: none"> <li>○ 2 x VM (12 V - 24 V DC Supply Voltage, Reverse Voltage Protection)</li> <li>○ 3 x GND (Reverse Voltage Protection)</li> <li>○ 1 x 5 V Out (Reverse Voltage Protection)</li> <li>○ 2 x 3.3 V Out (Reverse Voltage Protection)</li> </ul>
	• 1 x Analog Input
	• 2 x Encoder Input
	• 1 x Motor Output
	• 2 x RS-485 Port (RJ45)
	• 1 x I2C Port (RJ45) (Buffered)
	• 1 x RGB Status LED
<b>LEDs and Buttons</b>	• 1 x MCU Reset Button
	• 1 x Factory Reset Button
	• For <b>applications without a motor</b> , 12 V 3 A Adapter.
<b>Input Power Sources</b>	• For applications with a motor, <ul style="list-style-type: none"> <li>○ Supply Power must be calculated as,  <b>"Minimum Supply Power = 36W+Motor Power "</b></li> <li>○ Supply Voltage must be calculated as,  <b>"Supply Voltage = Motor Voltage "</b></li> </ul>
	• Supply Voltage Bus Fuse: 20 A
	• 5 V Out Bus Fuse: 600 mA
	• 3.3 V Out Bus Fuse: 600 mA
<b>Power Fuses</b>	• Supply Voltage Bus Fuse: 20 A
<b>Dimensions</b>	• 5 V Out Bus Fuse: 600 mA
	• 3.3 V Out Bus Fuse: 600 mA
<b>Dimensions</b>	81.17 (W) mm X 40 (D) mm X 20 (H) mm

## 4 WIRING

### 4.1 Cable Names

Cables which are used in the SMD Red system are defined and denominated as seen in Table 4.1 below.

**Table 4.1:** Cable Descriptions

Cable Names	View of the Cables	Definitions
RJ11 Cable		This cable provides the connection between the USB gateway module and SMD Red via RJ11 ports.
RJ45 Cable		This cable provides connection between SMD Red and modules. After one module connected to SMD, other modules will be connected to former module.
DC Jack Power Cable (2.1mm)		This cable provides power to SMD(s). Power source can be any technically supported valued battery or adapter unit.



## 4.2 Connections

To use the SMD Red, first connect the USB gateway module to a PC or a Raspberry Pi. Then use a RJ11 cable to connect the SMD Red and USB gateway module. Power up the SMD Red card with a power supply. A brushed motor with encoder can be connected and any module can be connected via RJ45 cable depending on the scope of the project.

Sample Connections:

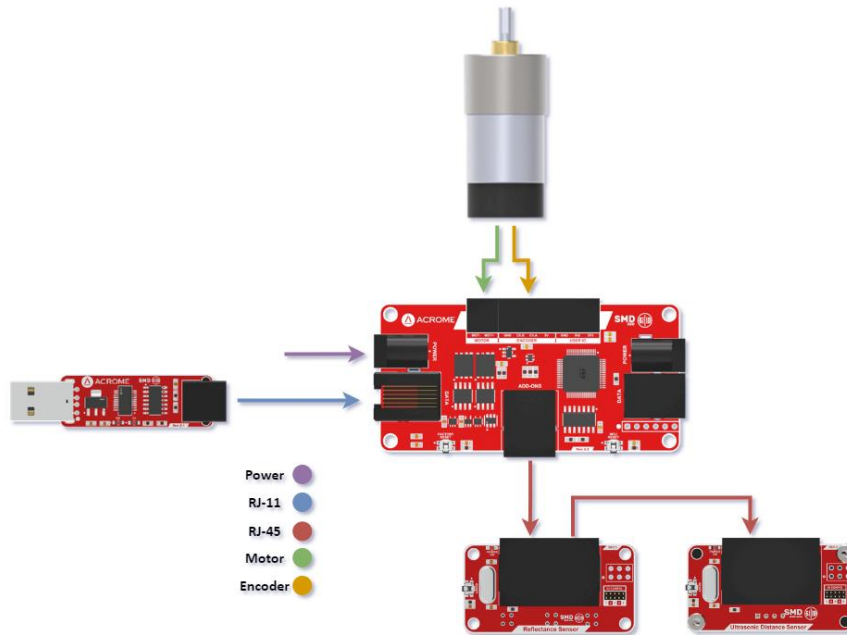


Figure 4.1: Starter Kit Wiring Diagram

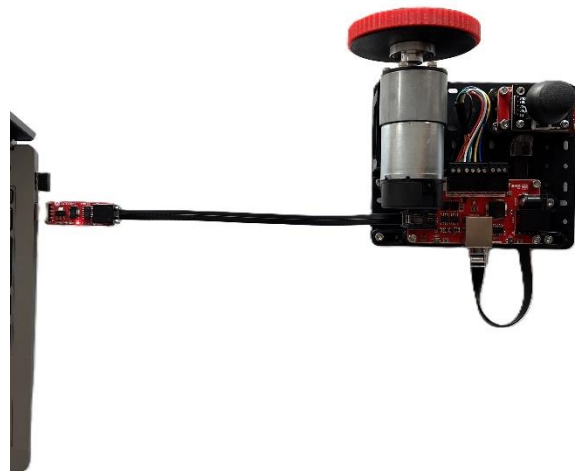


Figure 4.2: Starter Kit Wiring in Practice

## 5 DEVELOPING PROJECTS WITH THE SYSTEM

### 5.1 Getting Started

If all connections have been made, necessary software must be installed to proceed.

First, Python must be installed to use the necessary SMD Python library. Be sure to enable “Add Python.exe to path”. After the installation of Python, open command prompt and type “pip”. If Python is installed properly, it will print the commands of the “pip”.

```
C:\Windows\system32\cmd.e: x + v
Microsoft Windows [Version 10.0.22621.3296]
(c) Microsoft Corporation. Tüm hakları saklıdır.

C:\Users\Acrome>pip

Usage:
  pip <command> [options]

Commands:
  install           Install packages.
  download         Download packages.
  uninstall        Uninstall packages.
  freeze           Output installed packages in requirements format.
  inspect          Inspect the python environment.
  list             List installed packages.
  show            Show information about installed packages.
  check           Verify installed packages have compatible dependencies.
  config         Manage local and global configuration.
  search         Search PyPI for packages.
  cache         Inspect and manage pip's wheel cache.
  index         Inspect information available from package indexes.
  wheel         Build wheels from your requirements.
  hash         Compute hashes of package archives.
  completion   A helper command used for command completion.
  debug        Show information useful for debugging.
  help         Show help for commands.

General Options:
  -h, --help           Show help.
  --debug             Let unhandled exceptions propagate outside the main subroutine, instead of logging them
```

Then, type “pip install acrome-smd”. This command will install Acrome SMD Python library and necessary packages to function properly.

Finally, projects can be coded in any preferred Python-supporting editor of user’s choice. (Visual Studio Code is preferred, as it will automatically find the Python base and be able to run Python code.)

### 5.2 Start to Code with SMD

There are basics of starting to code of an application with SMD Python library. First, the user must know the serial port (COM) number of the connected USB gateway module, COM3 as an example. Since SMD Red cards can be used multiple connected, each of them must have a different ID to communicate without interference. SMD Red card has ID of 0 as default. This value can be changed between 0 – 255.

SMD Red card can communicate with different baud rates. User may want to change baud rate depending on the needs of project. SMD Red has a baud rate value of 115200 as default.

With all this information, the crucial part of the starting to use the Python library can be coded.

```

1  from smd.red import *
2
3  SerialPort = 'COM3'
4  baudrate = 115200
5  ID = 0
6  master = Master(SerialPort, baudrate)
7  master.attach(Red(ID))

```

First, the user should import the library as shown in the first line of code. Then, the serial port of USB gateway module and baud rate should be defined. The main object that will be used along the application is defined with “Master” class. After that, ID of SMD Red card should be defined to use in the functions eventually. Finally, *attach()* function must be used to gain access to SMD with specified ID.

### 5.3 Motor PID Auto-tune Application

SMD’s Python library is rich and resourceful in many ways, especially for driving brushed DC motors. One of its most special features is PID auto-tune for the connected brushed DC motor. First, connect the necessary sockets of motor to the SMD Red. Application code is shown below:

```

1  from smd.red import *
2
3  SerialPort = 'COM3'
4  baudrate = 115200
5  ID = 0
6  master = Master(SerialPort, baudrate)
7  master.attach(Red(ID))
8
9  master.set_operation_mode(ID, OperationMode.Velocity)
10 master.set_shaft_rpm(ID, 100)
11 master.set_shaft_cpr(ID, 6533)
12 master.pid_tuner(ID)
13 time.sleep(30)
14 print(master.get_control_parameters_velocity(ID))

```

Import the library and define the necessary variables for SMD as in the “Start to Code with SMD”. Then, select the motor’s operation mode. (Shown in 8<sup>th</sup> line, velocity mode is selected as an example.)

After that, RPM and CPR values of the motor should be defined as in the 9<sup>th</sup> and 10<sup>th</sup> line. (The motor that included in kit has 100 RPM and 6533 CPR value.)

Finally, PID auto-tune function can be called, and the tuning process will start, user can see that motor moves. Auto-tune process approximately take 30 seconds, thus, user should use *sleep()* function to wait 30 seconds for optimal use of motor along the applications. After tuning process has done, PID parameters will be printed with the last line of code, as an example:

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS
[17.368738174438477, 2.2272984981536865, 0.0, 0.0, 0.0, 899.0999755859375]
```

(Terminal outputs may vary due to system's load and physical characteristics.)

The values are as follows: [**P coefficient**, **I coefficient**, **D coefficient**, **Feedforward value**, **Deadband value**, **Output Limit**]. The auto-tuning process affects the P, I, D coefficients. Other values can be intentionally set by the user.



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