

User Manual

STM32F407 VBOT-BASE

2nd edition

Features

- Controlling ROBOT, using STM32F407 KIT
- 24V power supply
- Protection of STM32F407 KIT from peripheral power modules
- Power voltage measuring
- Flexible voltage reference: 3V3 and 5V
- Main control feature, includes:
 - 4 motor driver ports
 - 2 end-stop logic ports
 - 1 relay control port
 - 1 custom PWM port
- Protocol features, include: 2 UART ports, 2 CAN ports, and USB type C on board
- Programing testing feature, includes: 2 switches, 4 buttons, 5 single LEDs, and 2 seven-segment LEDs

ROBOT KIT for STM32F4



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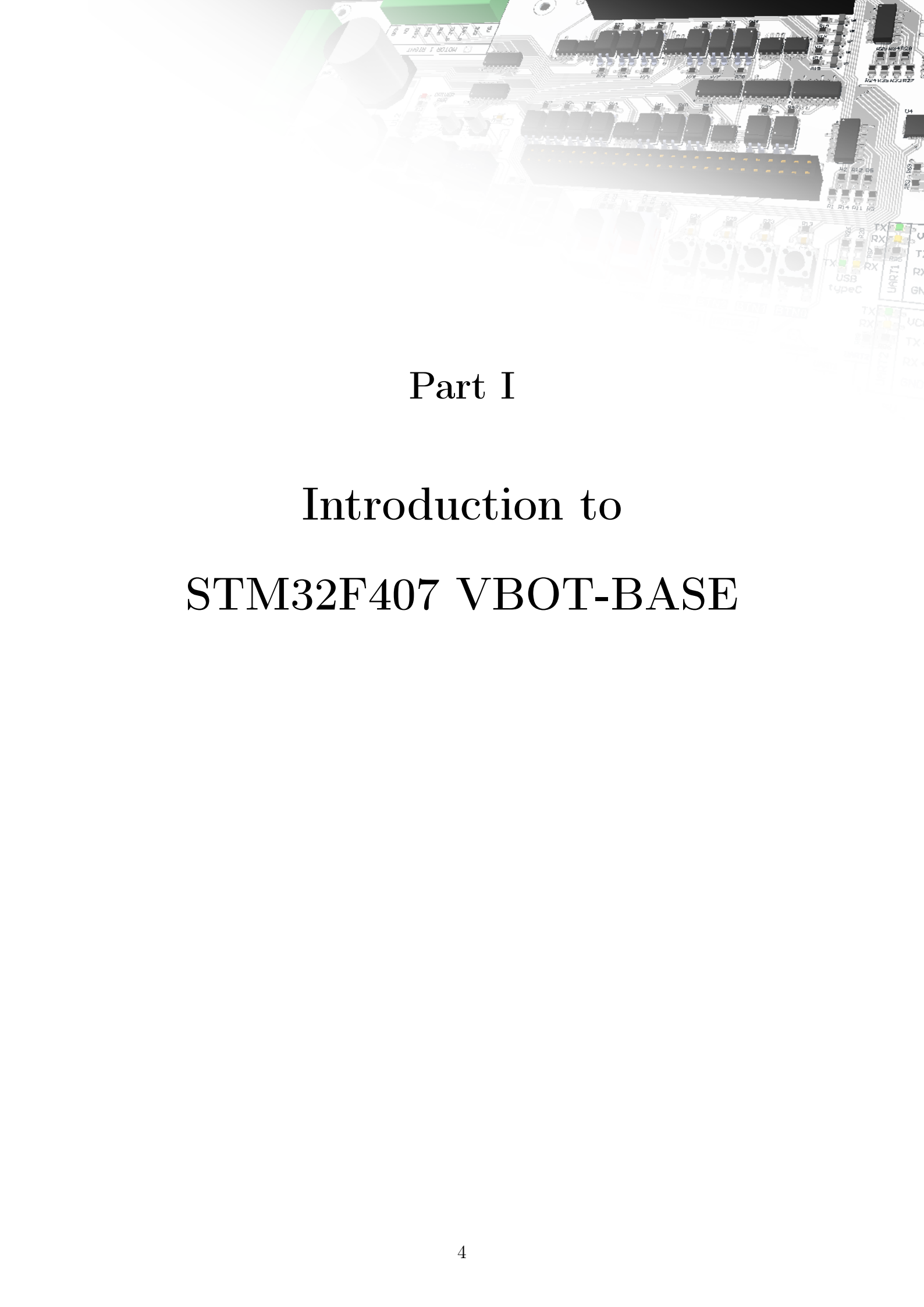
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A faded, high-resolution image of a printed circuit board (PCB) serves as the background. The board is populated with various electronic components, including integrated circuits, resistors, capacitors, and connectors. Labels such as 'STM32F407', 'VBOT-BASE', 'USB typeC', and 'UART1' are visible on the board's surface.

Part I

Introduction to

STM32F407 VBOT-BASE

Chapter 1

STM32F407 VBOT-BASE

1.1 Overview

STM32F407 VBOT-BASE is used to control types of vehicular robot programmed by STM32F407 KIT. The KIT is integrated protocol including UART and CAN. The USB type C on board helps to communicate with computer or smartphone.

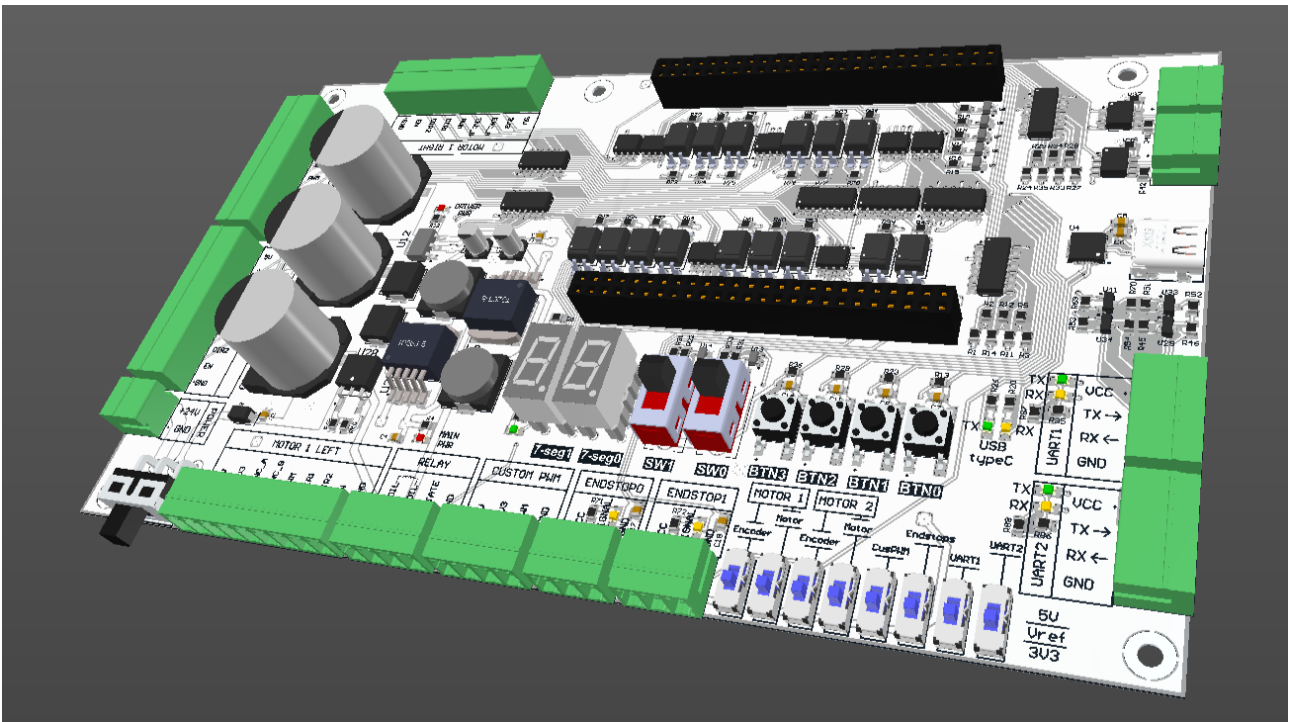


Figure 1.1: STM32F407 VBOT-BASE

1.2 Package contents

STM32F407 VBOT-BASE package includes:

- STM32F407 VBOT-BASE board.
- Female terminal ports for each male terminal port on board.

1.3 Getting helps

Here are the address where you can get help if you encounter any problems:

- Facebook: <https://www.facebook.com/hardware.nhan>
- Email: thiennhan.hardware@gmail.com

Chapter 2

KIT's Layout

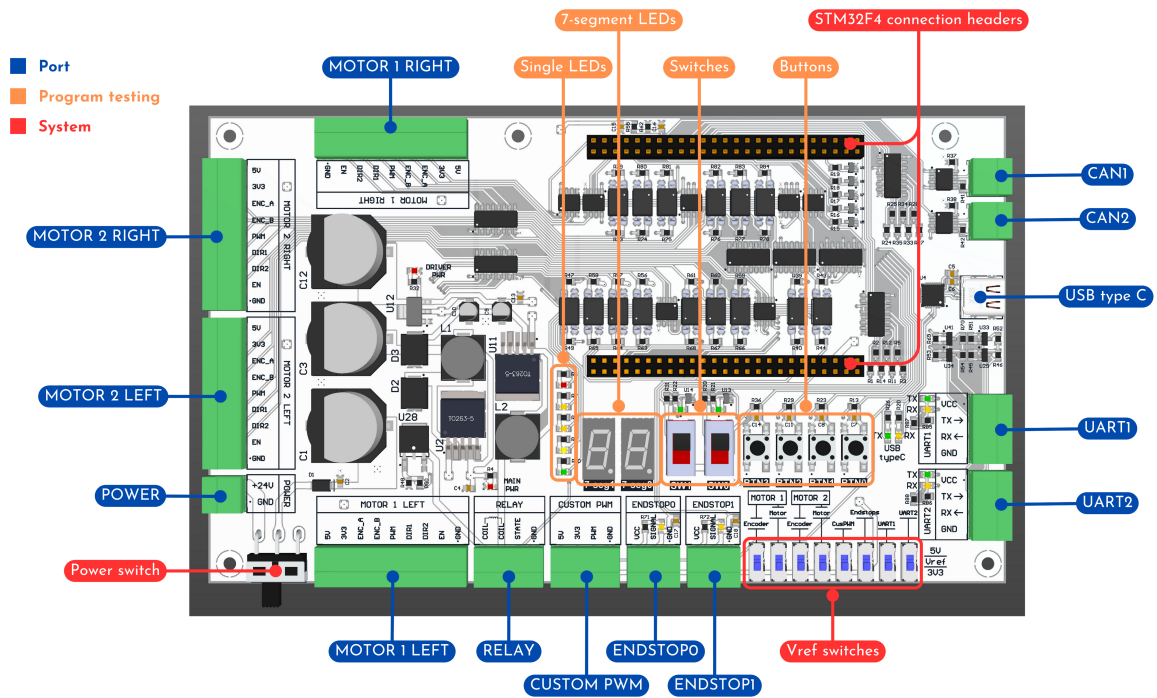


Figure 2.1: KIT's layout

Chapter 3

Features

3.1 Protection

STM32F407 KIT is protected from power source and power module connecting with MOTOR ports, ENDSTOP ports, CUSTOM PWM port, and RELAY port. Each pin is isolated by optocoupler.

3.2 Power source measuring

The voltage of power source is measured and this value is converted to analog signal into STM32F407 KIT.

3.3 Flexible voltage reference

The KIT can be configured with a voltage reference of 3V3 or 5V for the logic voltage level. The types of signal that can be configured, include: motor driver signal (PWM, direction, and enable), encoder signal, end-stop signal, and UART signal.

3.4 Control and protocol ports

The **MOTOR ports** are used to control motor.

The **ENDSTOP ports** are used to get the input value from end-stop switches.

The **RELAY port** is used to control relay.

The **CUSTOM PWM port** is used to generate PWM that is programmed by STM32F407 KIT.

The KIT supports 2 protocol, include: **2 UART ports** and **2 CAN ports**. The KIT also has **USB type C port** is used to communicate with computer or smartphone.

3.5 Program testing

The KIT has **2 buttons**, **4 switches**, **2 seven-segment LEDs**, and **5 single LEDs** with 5 different colors for each one, all those are used for program testing and debugging.

Chapter 4

Pin Functions

Symbol	Type	Function
+24V	Power Supply Pin	The device internal power supply.
GND	Power Supply Pin	The device internal ground.
5V	Power Output Pin	The 5V output power supply.
3V3	Power Output Pin	The 3.3V output power supply.
VCC	Power Output Pin	The output power supply, change voltage reference to configure the voltage
PWM	Output Pin	Pulse Width Modulation output, programable by STM32F407 KIT
ENC_A ENC_B	Input Pin	The logic pin to read the speed of motor. The logic is non-converted
DIR1 DIR2	Output Pin	The logic pin to control direction of motor, programable by STM32F407 KIT. The logic is non-converted
EN	Output Pin	The logic pin to control the motor enable or disable. The logic is non-converted
COIL	Trigger Pin	The pin to trigger the relay, is controlled by digital output pin. The logic to control is ACTIVE-HIGH
STATE	Input Pin	The logic pin to read the state of power source. The logic is converted

SIGNAL	Input Pin	The logic pin to read the state of end-stop switch. The logic is converted
TX	Transmitter Pin	The UART protocol transmitter pin
RX	Receiver Pin	The UART protocol receiver pin
CAN_H	CAN-High Pin	The CAN protocol high pin
CAN_L	CAN-Low Pin	The CAN protocol low pin

Chapter 5

Getting Started

Attention

Before the KIT is powered, the supplied power source, the voltage reference, and the connection into each ports must be checked carefully. Remember that, the KIT is only supplied by 24V power source or lower, and only used for STM32F407 KIT or board with equivalent design, otherwise, the micro-controller can be damaged.

Note: The M3 holes are connected with GND on board, please check carefully when setting up the KIT onto the robot.

Connecting STM32F407 KIT onto KIT

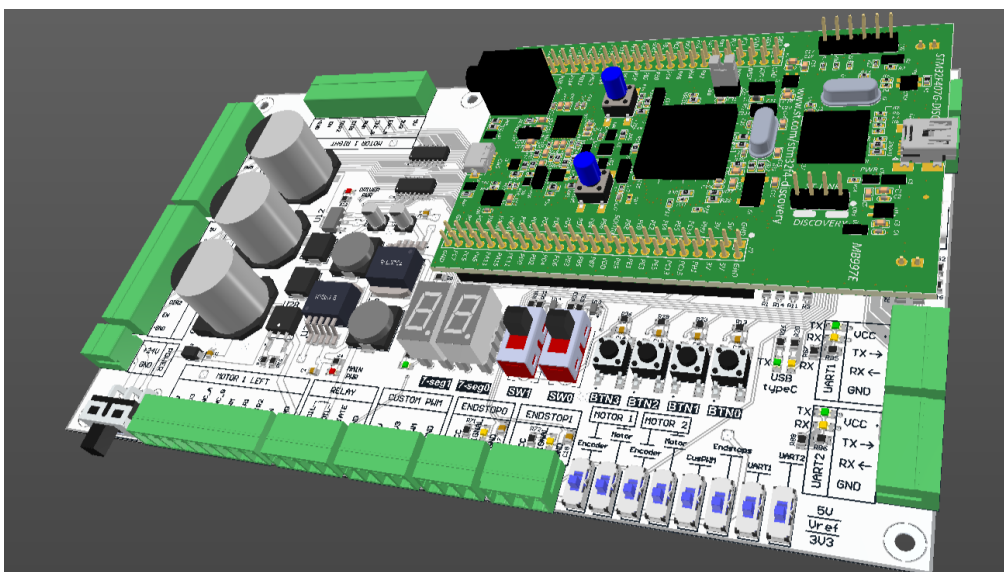
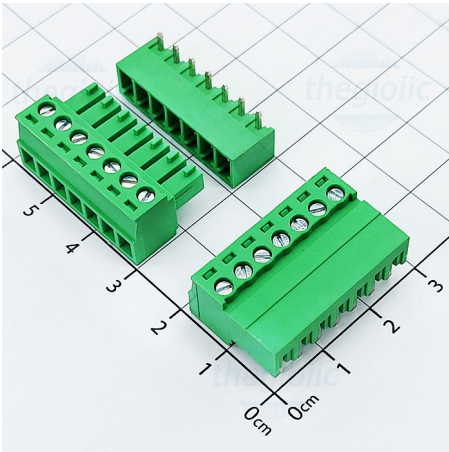


Figure 5.1: The KIT with connected STM32F407 KIT

Selecting ports for connection



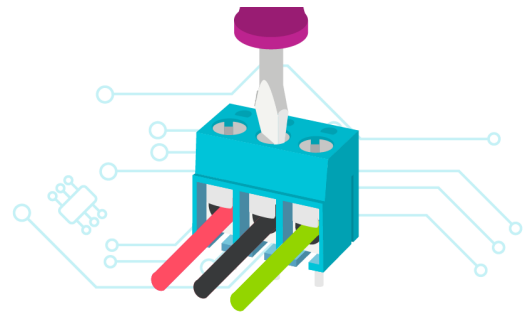
To connect with ports on KIT, please use female terminal port¹ with pin distance is 3.81mm and the same quantity of pin.

These female terminal ports are included in the package.

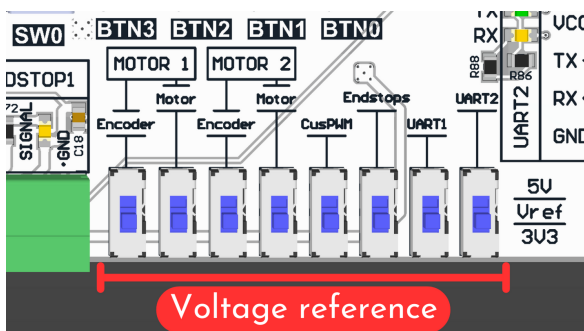
Note: Terminal port has only one direction plug.

Connect wires to port

Connect wires to port and tight the screws. Make sure that the positions of all wires are correct, the sizes of them are suitable, and all screws are tightened.

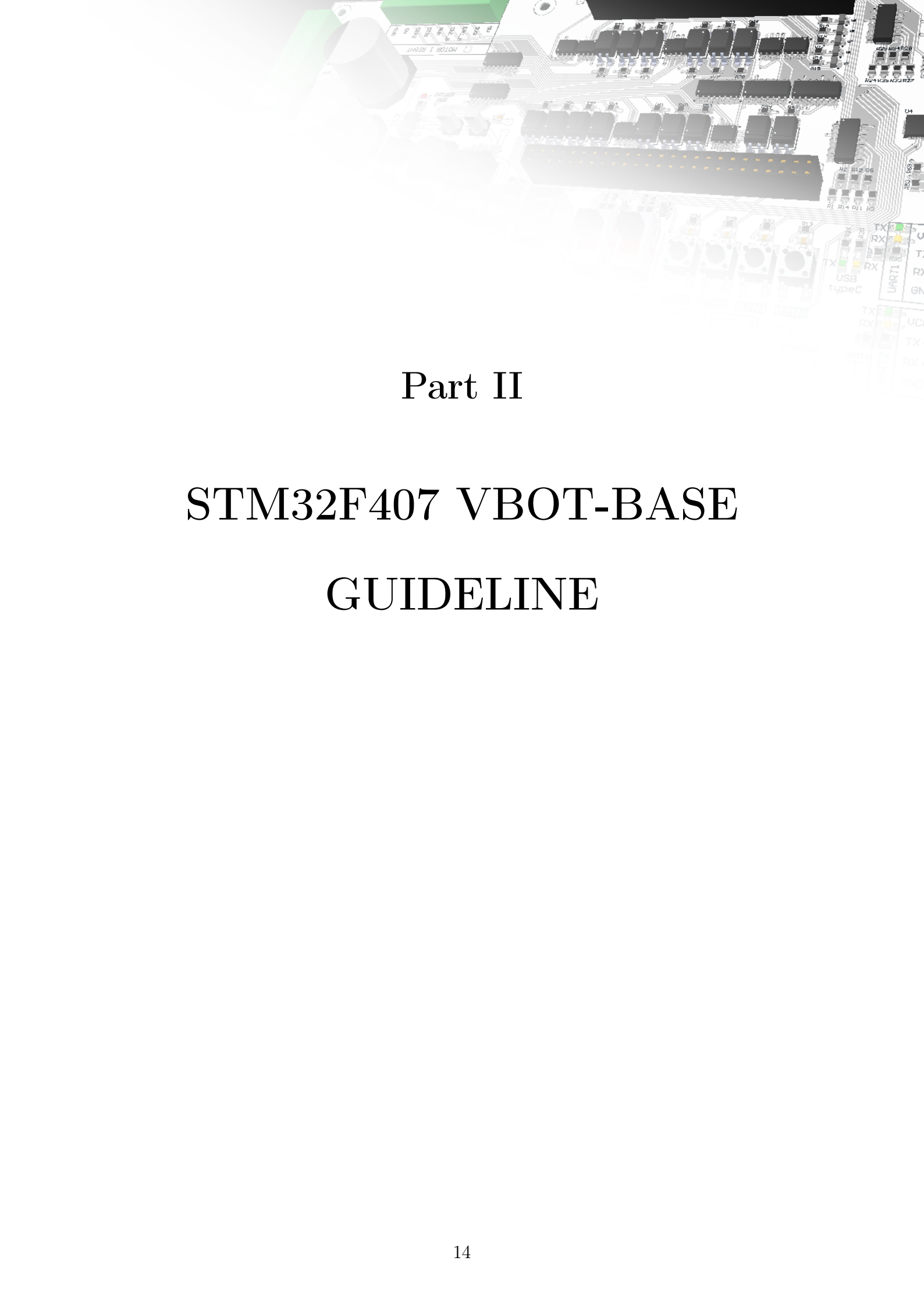


Selecting voltage reference



The voltage reference for each port must be configured before the KIT is powered. See the guideline to configure in Section 7.1.

¹You can see the information of these ports as [link](#).

The background of the page is a faded, high-resolution image of a printed circuit board (PCB) for the STM32F407 VBOT-BASE. The board is populated with various electronic components, including integrated circuits, capacitors, and connectors. Key features visible include a USB Type-C port, several push buttons, and a dense array of surface-mount components. The text "Part II" is centered over the middle of the board image.

Part II

STM32F407 VBOT-BASE GUIDELINE

Chapter 6

Pin Configurations on STM32F407 KIT

PIN TYPE	PIN ON	FUNCTION
STM32F407 KIT		
MOTOR 1 LEFT port		
ENC_A	PB4	Digital input
ENC_B	PB5	Digital input
PWM	PA6	PWM output
DIR1	PC11	Digital output
DIR2	PC12	Digital output
EN	PD6	Digital output
MOTOR 1 RIGHT port		
ENC_A	PA0	Digital input
ENC_B	PA1	Digital input
PWM	PA7	PWM output
DIR1	PD2	Digital output
DIR2	PD3	Digital output
EN	PD7	Digital output
MOTOR 2 LEFT port		
ENC_A	PD12	Digital input
ENC_B	PD13	Digital input
PWM	PB8	PWM output
DIR1	PA8	Digital output
DIR2	PA9	Digital output
EN	PD10	Digital output
MOTOR 2 RIGHT port		
ENC_A	PC6	Digital input
ENC_B	PC7	Digital input
PWM	PB9	PWM output
DIR1	PA4	Digital output
DIR2	PA5	Digital output
EN	PD11	Digital output

PIN TYPE	PIN ON	FUNCTION
STM32F407 KIT		
RELAY port		
COIL-COIL	PB14	Digital output
STATE	PB10	Digital input
CUSTOM PWM port		
PWM	PB11	PWM output
ENDSTOP0 port		
SIGNAL	PD4	Digital input
ENDSTOP1 port		
SIGNAL	PD5	Digital input
UART1 port		
UART_TX	PB6	UART_TX
UART_RX	PB7	UART_RX
UART2 port		
UART_TX	PD8	UART_TX
UART_RX	PD9	UART_RX
USB type C		
UART_TX	PA2	UART_TX
UART_RX	PA3	UART_RX
CAN1 port		
CAN_TX	PD1	CAN_TX
CAN_RX	PD0	CAN_RX
CAN2 port		
CAN_TX	PB13	CAN_TX
CAN_RX	PB12	CAN_RX
Power source voltage measuring function		
Voltage measuring	PB1	Analog input
Program testing function		
SW0	PE5	Digital input
SW1	PE6	Digital input
BTN0	PB3	Digital input
BTN1	PE2	Digital input
BTN2	PE3	Digital input
BTN3	PE4	Digital input
LED_RED ¹	PC5	Digital output
LED_ORANGE ¹	PC4	Digital output
LED_ORANGE ¹	PC3	Digital output
LED_YELLOW ¹	PC2	Digital output
LED_GREEN ¹	PC1	Digital output

¹The sequence of colors in the table corresponds to the order of LEDs from up to down on the board.

PIN TYPE	PIN ON	FUNCTION
STM32F407 KIT		
7-seg0_A	PE14	Digital output
7-seg0_B	PE11	Digital output
7-seg0_C	PE12	Digital output
7-seg0_D	PE13	Digital output
7-seg1_A	PE10	Digital output
7-seg1_B	PE7	Digital output
7-seg1_C	PE8	Digital output
7-seg1_D	PE9	Digital output

Chapter 7

Functions on KIT

7.1 Flexible voltage reference

The KIT supports flexibly selecting a voltage reference of 3V3 or 5V for each peripheral. When the voltage reference is selected, the voltage level of each referenced signal is configured. The switches are pulled up, the voltage reference is 5V, the switches are pulled down, the voltage reference is 3V3.

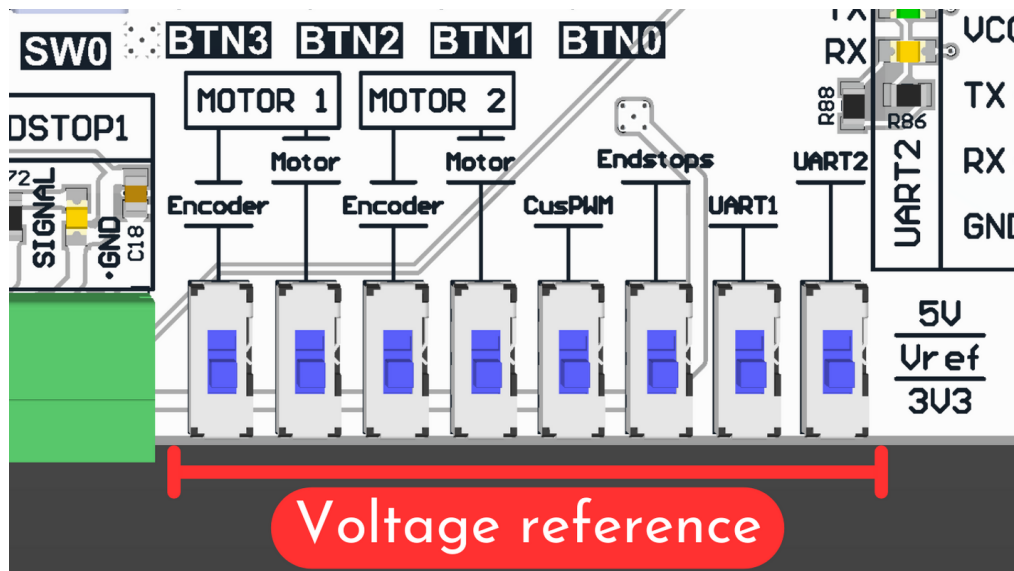


Figure 7.1: Voltage reference switches

REFERENCED PINS¹

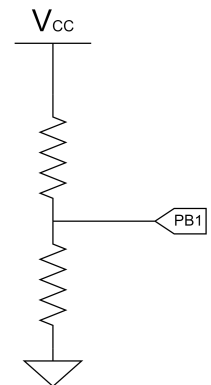
Vref switch	Ports	Pins
Encoder (MOTOR 1)	MOTOR 1 LEFT	ENC_A, ENC_B
	MOTOR 1 RIGHT	ENC_A, ENC_B
Motor (MOTOR 1)	MOTOR 1 LEFT	PWM, DIR1, DIR2, EN
	MOTOR 1 RIGHT	PWM, DIR1, DIR2, EN
Encoder (MOTOR 2)	MOTOR 2 LEFT	ENC_A, ENC_B
	MOTOR 2 RIGHT	ENC_A, ENC_B
Motor (MOTOR 2)	MOTOR 2 LEFT	PWM, DIR1, DIR2, EN
	MOTOR 2 RIGHT	PWM, DIR1, DIR2, EN
CusPWM	CUSTOM PWM	PWM
Endstops	ENDSTOP0	SIGNAL
	ENDSTOP1	SIGNAL
UART1	UART1	TX, RX
UART2	UART2	TX, RX

¹Show the pin referenced to Vref switch.

7.2 Power source measuring

The voltage of power source is divided by resistors that STM32F407 KIT can read the value through analog pin. The value = $\frac{V_{CC}}{8.5}$.

Attention: If the voltage of power source more than 28V, the analog value will be more than 3.3, and it can damage on STM32F407 KIT.



7.3 Control and protocol ports

Control ports

The ports all have 5V and 3V3 power supply for each suitable module. For each pin, its voltage reference is selected by Vref switch, as mentioned in Section 7.1.

The MOTOR ports are used to control H-bridge module and read the encoder input value.

- The ENC_A and ENC_B pins read the encoder input value.
- The PWM pin generates PWM signal programmed by micro-controller.
- The DIR1 and DIR2 pins control direction of motor.
- The EN pin enables or disables motor.

The RELAY port is used to trigger the relay and read the power source state.

- The COIL-COIL pins supply the 24V power source to trigger the relay that is controlled by digital output pin PB14.
- The STATE pin reads the state of power source.

The CUSTOM PWM port is used to generate PWM signal programmed by micro-controller.

The ENDSTOP ports are used to read the state of endstop switch.

Protocol ports

The KIT supports 2 types of protocol, there are UART and CAN:

- For UART, the KIT has 2 ports with TX and RX pins and, and USB type C port that is integrated USB to UART converter. There are 2 corresponded LEDs for each UART port and USB port, the green for TX and the orange for RX.
- For CAN, the KIT has 2 ports with CAN_H and CAN_L pins that is integrated CAN transceiver. This protocol is used 3V3 reference.

The pin functions of all ports are mentioned in Chapter 4.

7.4 Program testing function

The KIT has **2 switches**, **4 buttons**, **5 single LEDs**, and **2 seven-segment LEDs** for program testing.

Switches

The switches are used to create logic level for program testing. When switch is pulled up, the logic level will be HIGH, and the corresponding LED indicator will be on. When it is pulled down, the logic level will be LOW, and the corresponding LED indicator will be off.

Buttons

The buttons are in normally LOW, these are used to create the HIGH logic signal for program testing.

Single LEDs

The KIT has 5 single LEDs with each color for each LED. The color in sequence from up to down is red, orange, orange, yellow, and green. All LEDs are on when drive these by HIGH level.

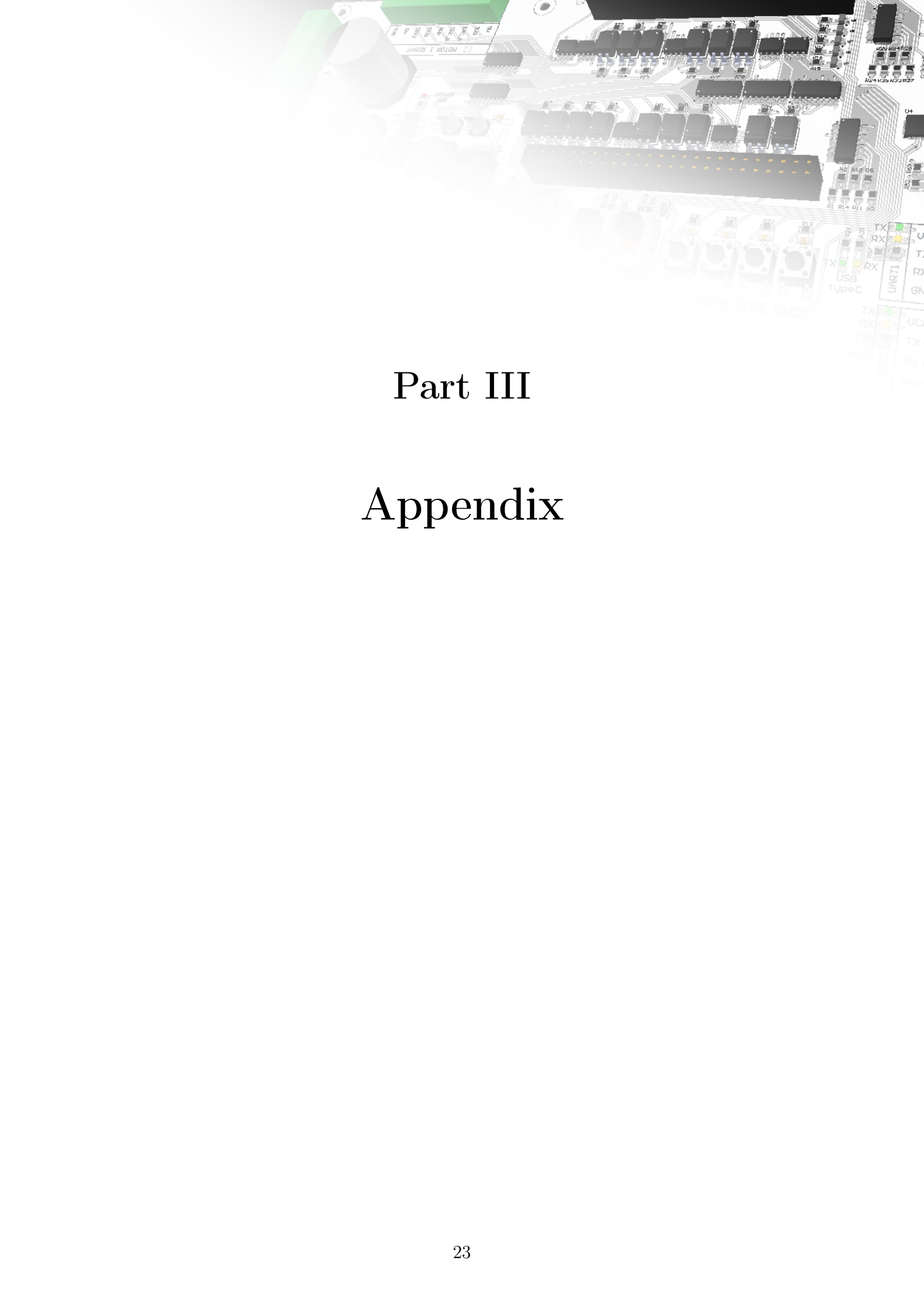
7-segment LEDs¹

7-segment LEDs are used for program testing. Using the BCD code to control these LEDs.

The pin functions of all elements are mentioned in Chapter 4.

Please don't configure pull-up or pull-down mode for button pins, these all are pulled-up on board.

¹The dots are not enable.



Part III

Appendix

Chapter 8

Revision History

Version	Change Log
V1.0	Initial Version
V1.1	The name of board Pin map Update hardware design Electrical Characteristics