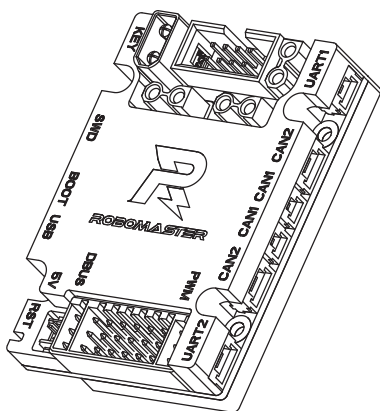# ROBOMASTER

Development Board Type C

User Manual [v1.0]

2020.01

dji

🔍 Searching for Keywords

Search for keywords such as "battery" and "install" to find a topic. If you are using Adobe Acrobat Reader to read this document, press Ctrl+F on Windows or Command+F on Mac to begin a search.

👆 Navigating to a Topic

View a complete list of topics in the table of contents. Click on a topic to navigate to that section.

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Content

Disclaimer

Thank you for purchasing the ROBOMASTER™ Development Board Type C (hereinafter referred to as "Board Type C"). Read this disclaimer carefully before using this product. By using this product, you hereby agree to this disclaimer and signify that you have read it carefully. Install and use this product in strict accordance with all related documents. Users bear the responsibilities in all the consequences caused by using this product. DJI™ will not bear any legal responsibilities for any damages due to improper use, installation, or modification.

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Warning

1. Connect the cables correctly by following the instructions in this document. Otherwise, the cables or the Board Type C may be seriously damaged.
2. Make sure there are no short-circuits and all the cables are in good condition. DO NOT use cables that have been damaged in any way.
3. Make sure to use the product in strict accordance with the specifications listed in this document, including those related to voltage and temperature. Failure to do so may reduce the product service life or even lead to permanent damage.
4. To avoid physical damage, make sure to assemble the Board Type C correctly.
5. If you detect any flames, smoke, strange smells, or other abnormalities, disconnect the Board Type C from the power source immediately.
6. DO NOT open the silicone case. Otherwise, foreign objects may fall inside and the performance of the Development Board Type C may be negatively affected.

RoboMaster Development Board Type C

Introduction

Designed to work with the products of RoboMaster and other accessories, the compact Development Board Type C uses a high-performance STM32 microcontroller chip and supports a wide range of voltage inputs. The highly integrable Board Type C boasts an expansion interface, communication interface, and high precision IMU sensors and features an anti-reverse connection and anti-overvoltage protection. The Board Type C provides rich routines and can be widely used in fields such as robotics competitions, research and education, and automation equipment.

In the Box

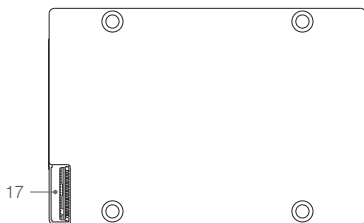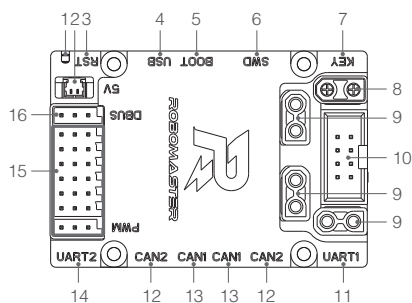Board Type C × 1
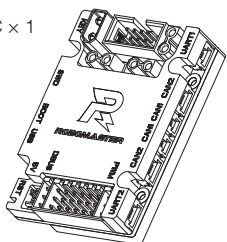
SWD Cable × 1

Power Cable × 1

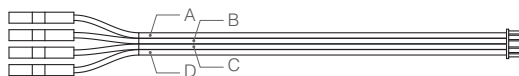2-Pin Cable × 1

4-Pin Cable × 1

Overview

Development Board

No.	Name	Interface Description
1	Customizable LED	Tri-color LED
2	5V Port	5V laser port
3	RST Button	Reset button for STM32
4	Micro USB Port	Port for USB communication or firmware download in DFU mode
5	BOOT Configuration Port	Configuration port of BOOT0 and BOOT1
6	SWD Port	Port for SWD downloader to download programs
7	KEY Button	Customizable button
8	24V Power Input Port	Power input
9	24V Power Output Port	Power output
10	Customizable I/O Port	Port that can be configured as IIC and SPI ports
11	3-Pin UART Port	3-Pin UART port
12	CAN2 Port	4-Pin CAN port
13	CAN1 Port	2-Pin CAN port
14	4-Pin UART Port	4-Pin UART port
15	PWM Port	PWM output port x 7
16	DBUS Port	DBUS remote controller receiver port x 1
17	18-Pin Digital Camera FPC Port	FPC port for DCMI

XT30 Power Cable
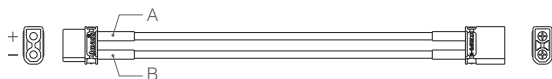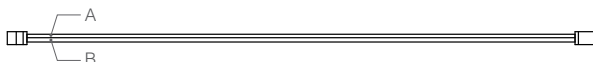
Cable length: 450 mm; A: Positive electrode (Red); B: Negative electrode (Black)

SWD Cable

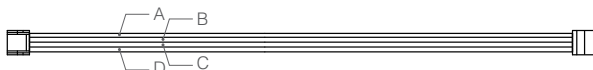Cable length: 100 mm; A: SWDIO (Black); B: SWCLK (Black); C: GND (Black); D: 3.3 V (Black)

2-Pin CAN Cable
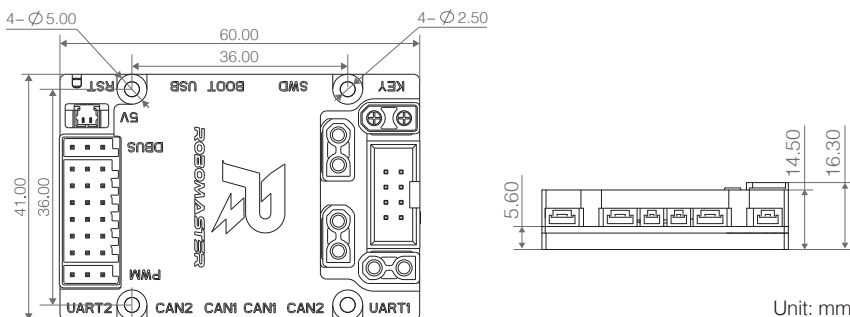
Cable length: 350 mm; A: CANL (Black); B: CANH (Red)

4-Pin CAN Cable

Cable length: 350 mm; A: CANL (Grey); B: CANH (Grey); C: GND (Grey); D: 5 V (Red)

Mounting the Board Type C

Refer to the dimensions in the figure below when mounting the Board Type C.

Unit: mm

On the Board Type C there are four mounting holes, each with an inner diameter of 2.5 mm and an outer diameter of 5 mm. The holes are used to help mount the board onto structural components. As shown below, the ESC Center Board 2 can be used as an extension port for the Board Type C.

M2.5-6 Screw (4 pcs)

M2.5-20 Double Pass Copper Pillar (4 pcs)
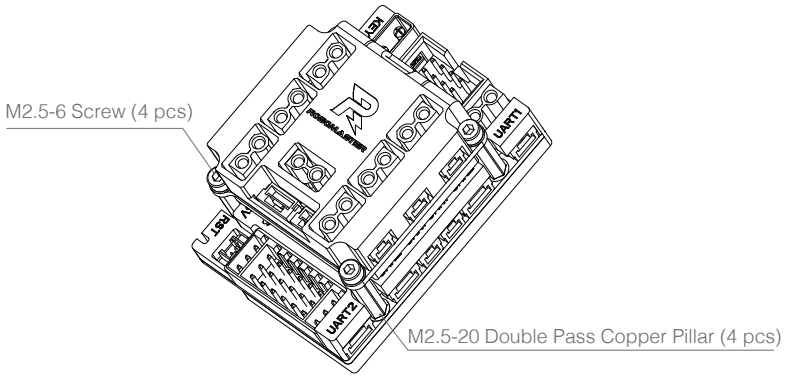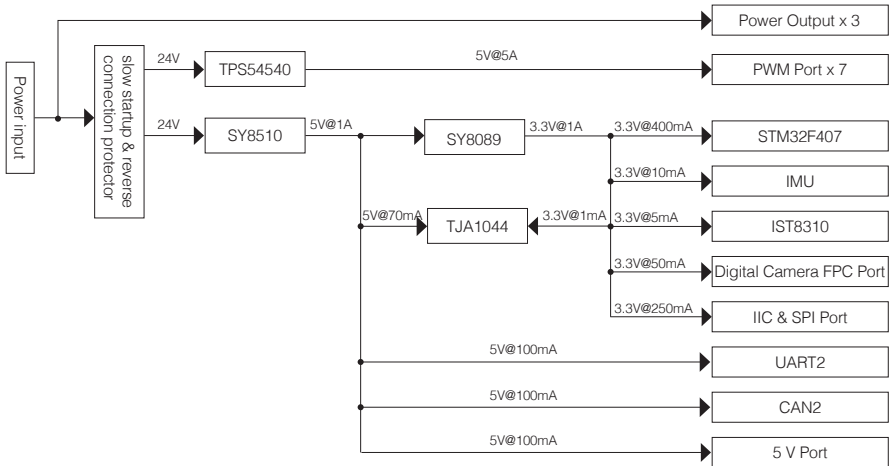
(Note: Screws and copper pillars are not included.)   Unit: mm

Function Description

Power Supply

The Board Type C power supply block diagram is shown below.

The power supply of the Board Type C includes:

One 24 V to 5 V step-down circuit (power network VCC_5V_M), which is used for the seven external PWM servo motor ports. The maximum total output current is 5 A.

One 24 V to 5 V step-down circuit (power network VCC_5V), which is used for the onboard device power supply and as the second input of power supply. The maximum output current is 1 A.

One 5 V (power network VCC_5V) to 3.3 V step-down circuit, which is mainly used for the onboard device power supply.

Input Protection Circuit

The XT30 is adopted as the power input port for the Board Type C. The Board Type C prevents reverse connection and slow startup, and with a built-in circuit for input overvoltage protection, it will turn off the second circuit when the input is higher than 28 V.

Customizable LED

The Board Type C has a common anode RGB LED and the corresponding control IO is PH10 (Blue), PH11 (Green), and PH12 (Red). When the output level of the IO port is high, the corresponding status LED will be on. When the output level is low, the LED will be off. The brightness of the LED can be adjusted via the PWM control.
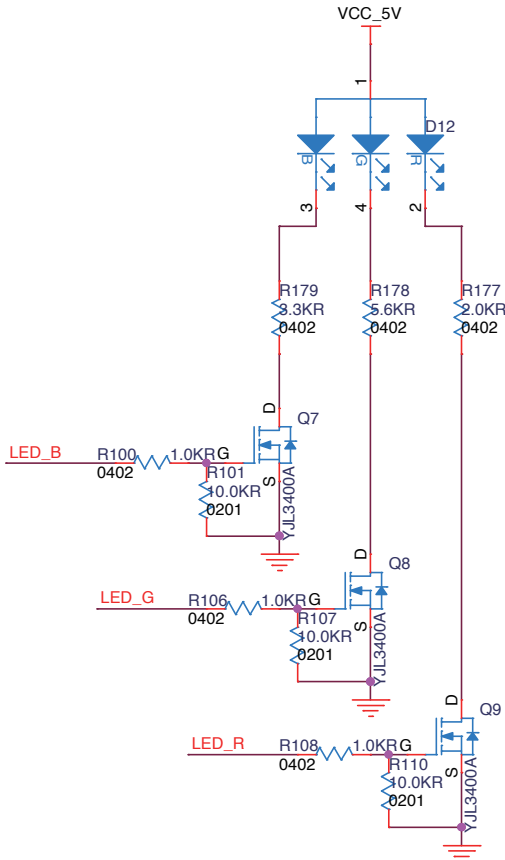
5V Port

The controllable 5V power port can be connected to the RoboMaster Red Laser Sight. The corresponding switch control IO of the port is PC8. The brightness of the RoboMaster Red Laser Sight can be adjusted via the PWM control.
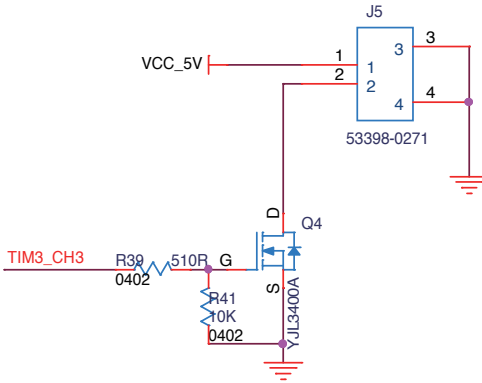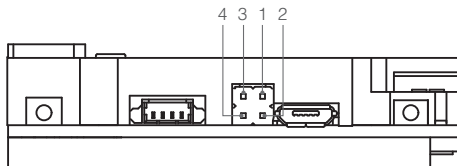

BOOT Configuration Port

The STM32 chip on the Board Type C has two pins: BOOT0 and BOOT1. The STM32 has three boot methods and the level status of the two pins when the chip is reset determines the boot method after the chip is reset. The Board Type C's BOOT configuration schematic diagram is shown below.
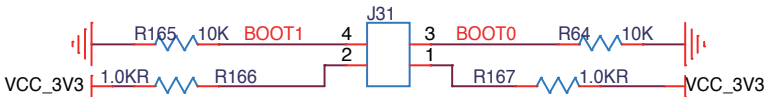
The level of the two BOOT pins is set to low by default. When powered on, STM32 boots from user flash memory. The reset level status of BOOT0 and BOOT1 can also be configured using jumpers. As shown below, the BOOT configuration pin is pinned out by using 2 x 2 rows of pin headers spaced 2.54 mm apart. For example, when BOOT0 = 1 and BOOT1 = 0, STM32 boots from the system memory and enters DFU (Device Firmware Update) mode. Refer to the Micro USB Port section for more information.

The relationship between the STM32 boot method and BOOT configuration is shown below.

Boot Mode Selection Pins		Boot Mode	Aliasing
BOOT1	BOOT0		
X	0	User Flash memory	User Flash memory is selected as the boot space
0	1	System memory	System memory is selected as the boot space
1	1	Embedded SRAM	Embedded SRAM is selected as the boot space

Micro USB Port

A full-speed USB port is integrated in the Board Type C and can be used for USB communication with other devices while also meeting USB 2.0 protocol specifications. In primary mode, it supports full-speed (FS, 12 Mbps) and low-speed (LS, 1.5 Mbps) transceivers. In secondary mode, only full-speed (FS, 12 Mbps) transceivers are supported.
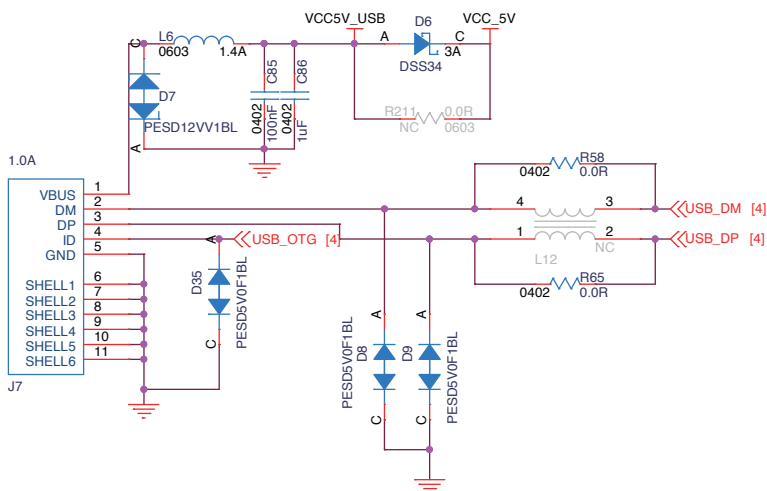

The USB port can be used to supply power for a Board Type C (only STM32 and some onboard external devices can be driven by the USB port*) and download firmware in DFU mode with BOOT configuration. Follow the steps below to download Board Type C firmware in DFU mode.

1. Set the level status of BOOT0 as high and BOOT1 as low using jumpers.
2. Connect the Board Type C to a computer using the USB cable.
3. Press the RST button to reset the Board Type C and enter DFU mode.
4. Convert the BIN file to a DFU file using the DFU File Manager.
5. Download the DFU file to the Board Type C using DfuSe Demo.

* USB power supply is for power network VCC_5V only. Onboard devices like the PWM external port powered by power network VCC_5V_M are not supported.
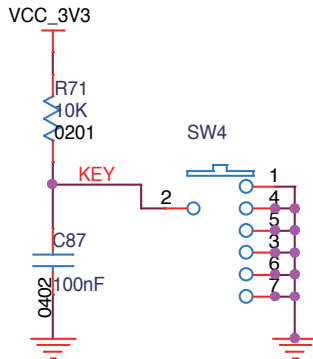
SWD Port

The SWD debugging port can be used for downloading and debugging programs via a dedicated emulator such as J-Link and ST-Link.


Pin1
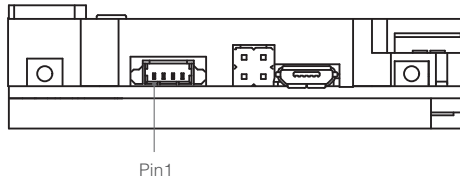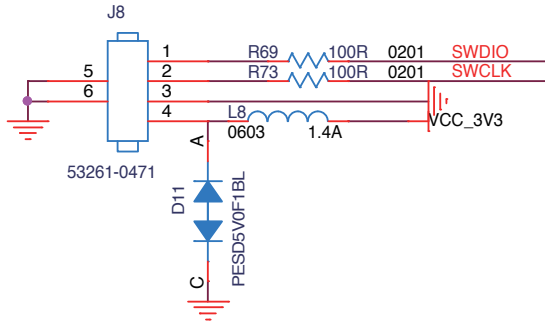
Buttons

The Board Type C has two buttons: the RST button (Reset button) and KEY button (Customizable button). When the KEY button is pressed, the level status of PA0 pin of the STM32 becomes low.
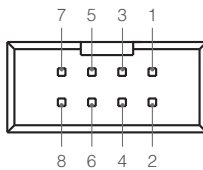
Customizable I/O Port

The customizable I/O port is an 8-pin ejector header connector with each pin spaced 2.54 mm apart, which can be used for connecting an IIC or SPI device. The port supports communication devices with a rated voltage of 3.3 or 5 V*.
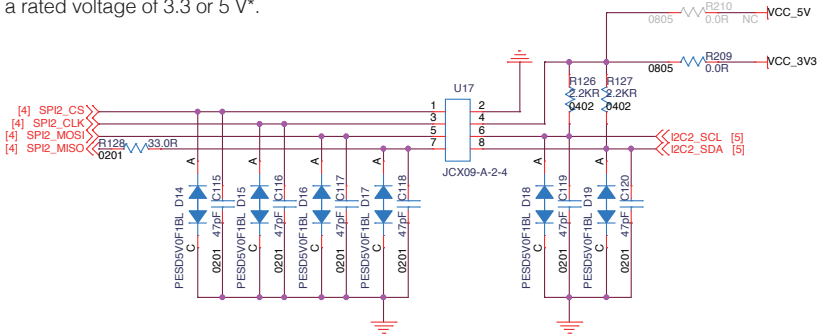

The port pin is shown below.

1	2	3	4	5	6	7	8
SPI2_CS	GND	SPI2_CLK	3.3V	SPI2_MOSI	I2C2_SCL	SPI2_MISO	I2C2_SDA

* When a 5V external device is required, a R210 resistor must be welded manually and the R209 resistor must be removed.

UART Ports

The two UART ports map to the UART1 4-pin external port and the UART6 3-pin external port of the STM32. The two ports can be connected to the RoboMaster Power Management Module and the baud rate can be configured. An external level conversion chip is required for the ports to communicate with a RS485 or RS232 port. The ports only support 3.3 and 5 V.
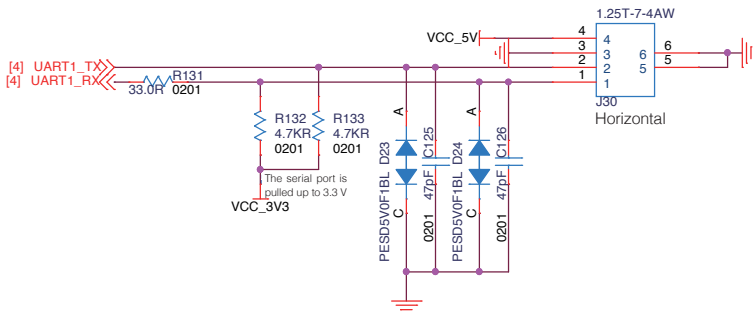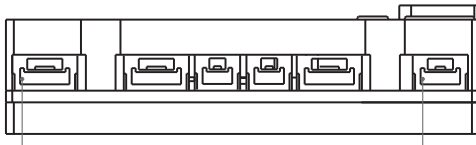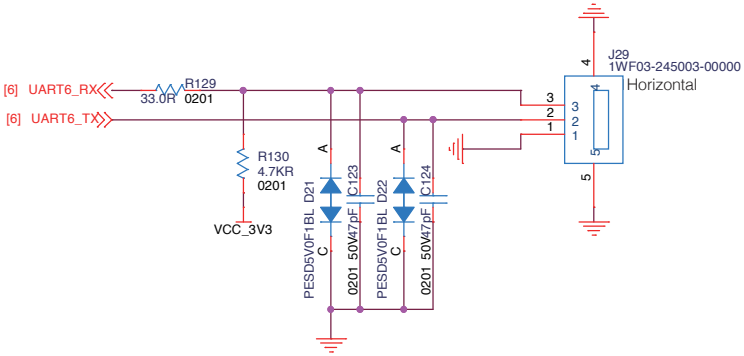
Pin1 (UART1)   Pin1 (UART6)

UART 1 pin:

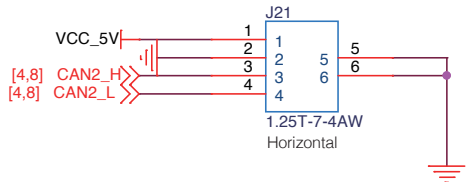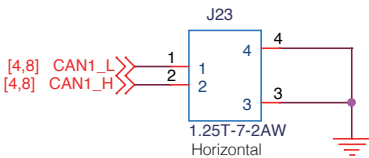| 1	2	3	4
RXD	TXD	GND	5V

UART 6 pin:

1	2	3
GND	TXD	RXD

⚠ • Since the line sequences of the UART6 port and Referee System's Power Management Module are the same, the TX and RX cables must be intersected when the Board Type C communicates with the Power Management Module.
• The silk-screen UART1 and UART2 on the shell of the Board Type C do not correspond with the serial port configuration of the STM32. UART1 corresponds with UART6 of the SMT32 and UART2 corresponds with UART1 of the STM32.

CAN Ports

The Board Type C has two CAN ports. CAN1 port is a 2-pin port and CAN2 is a 4-pin port. The CAN ports support a maximum transmission speed of 1 Mbps and can be used to control the RoboMaster ESC or communicate with other devices.

Pin1 (CAN2)

Pin1 (CAN1)
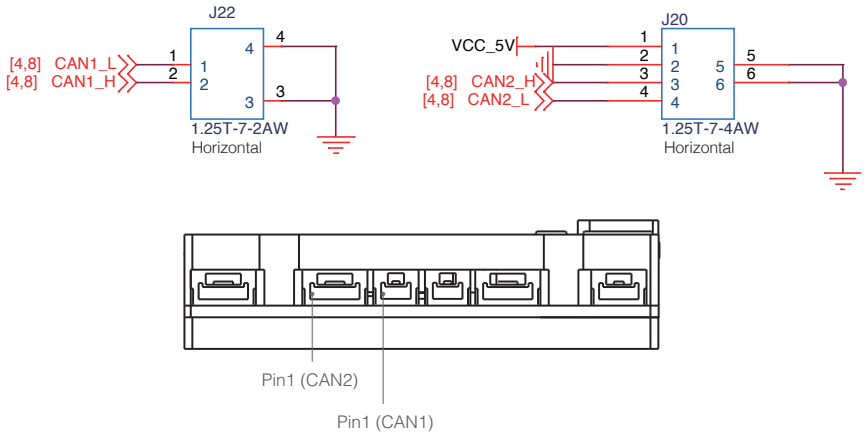
CAN1 pin:

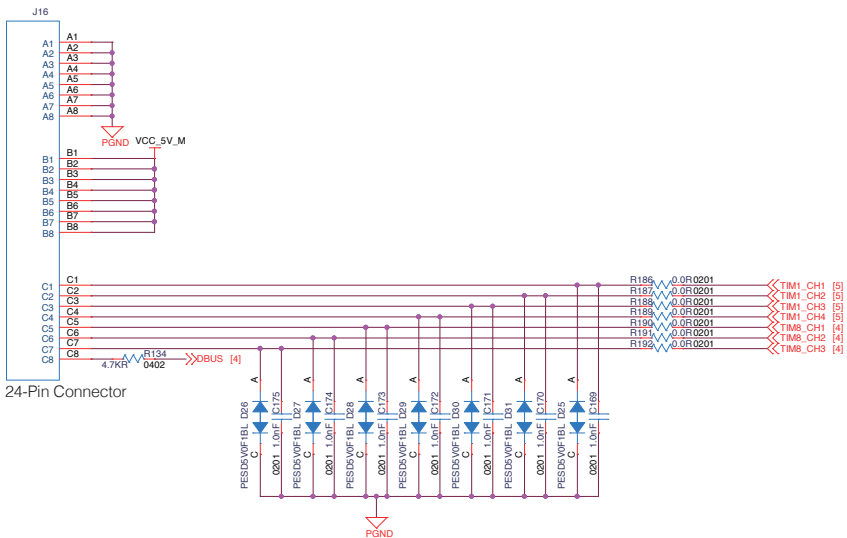| 1	2
CANL	CANH

CAN2 pin:

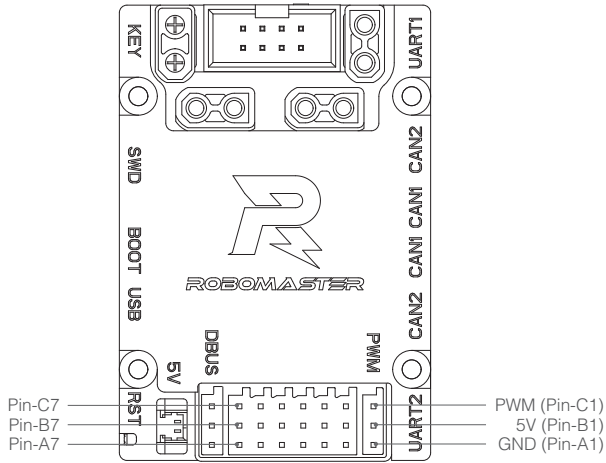| 1	2	3	4
5V	GND	CANH	CANL

PWM Ports

The Board Type C has seven PWM output ports that can be used to connect 5V servo motor modules or other PWM drive modules.

Pin-C7
Pin-B7
Pin-A7

PWM (Pin-C1)
5V (Pin-B1)
GND (Pin-A1)

DBUS Port

The Board Type C has one DBUS* port that shares one connector with the PWM port. When the DBUS signal passes through the inverter circuit to connect to UART3 of STM32, the baud rate is approximately 100 kbps.

VCC_3V3

R109
4.7KR
0402

UART3_RX

Q10
PMBT3904

DBUS 1
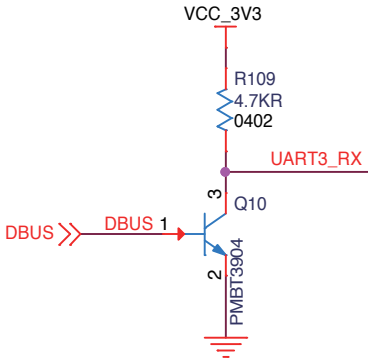
DBUS

* DBUS is the general protocol for DJI remote controllers.

DBUS (Pin-C8)
5V (Pin-B8)
GND (Pin-A8)

Digital Camera FPC Port

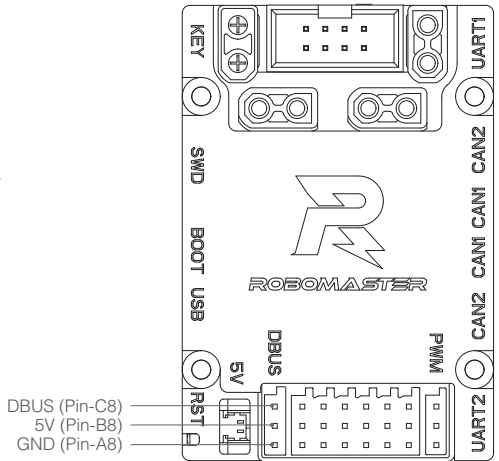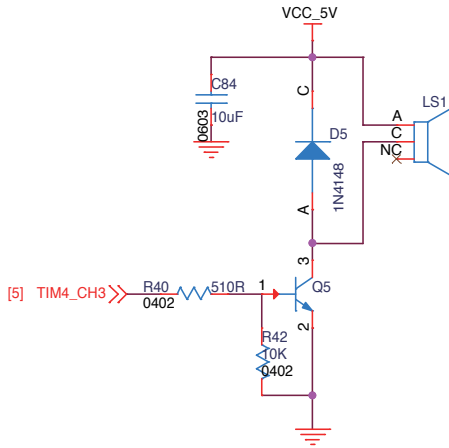The Board Type C has one FPC port (18-Pin) that supports DCMI and can connect 8-bit CMOS camera modules as well as support multiple data formats.


Pin1
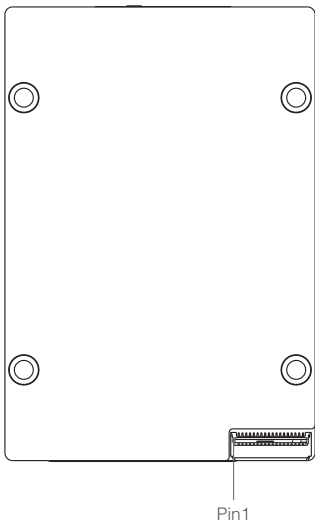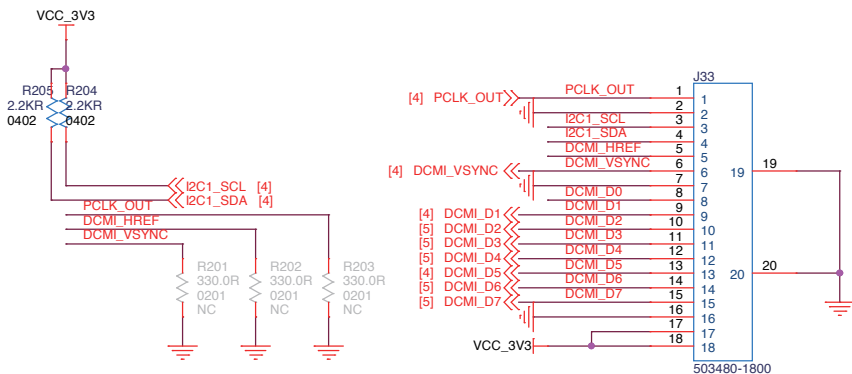
Buzzer

The Board Type C has one SMD passive buzzer that must be driven by PWM. The rated frequency is 4000 Hz and the output pitch of the buzzer can be changed by adjusting different PWM frequencies.

Voltage Detection
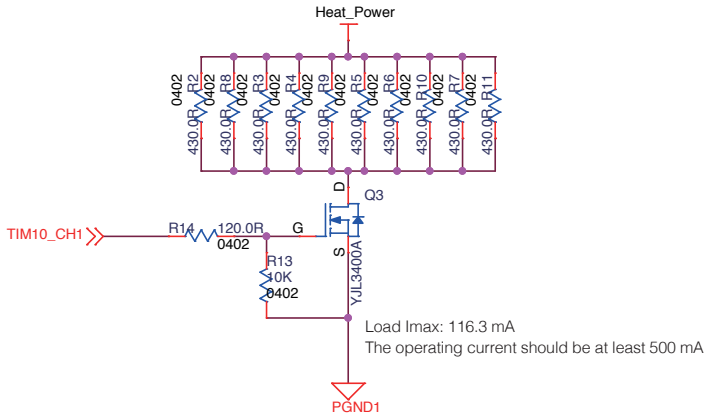
The voltage detection can be used to detect the input voltage VCC_BAT. After being divided, the voltage connects to ADC (PF10) of the SMT32. D10 clamps the voltage and protects the ADC port of the STM32.
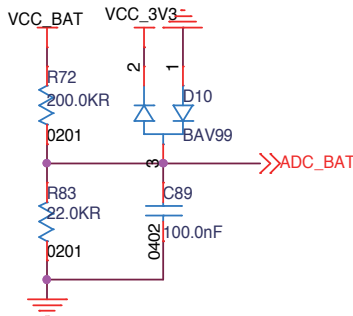
6-Axis Inertial Measurement Unit (IMU)

A high-performance 6-axis IMU is integrated into the Board Type C. The IMU uses a BMI088 that boasts an excellent seismic performance and a unique damping design that greatly improves the reliability of the gyroscope when impacted during operation. To prevent temperature drift, a heating circuit has been added to the Board Type C. The temperature of the gyroscope can be maintained constantly via the TIM10_CH1 (corresponding IO is PF6) of the STM32. The heating circuit is shown below. When the heat power is 5 V and the TIM10_CH1 maintains a high level, the heating power is 0.58 W and the recommended temperature should be 15° to 20° C higher than the normal operating temperature of the circuit board.

The communication method of STM32 and BMI088 is SPI, which supports a maximum communication rate of 10 MHz. The schematic diagram is shown below.

PS connects GND: SPI mode
PS connects VDD: IIC mode

Load Imax: 116.3 mA
The operating current should be at least 500 mA
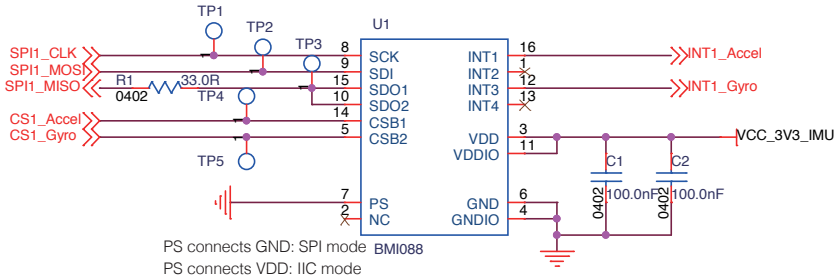
Magnetometer

The 3-axis magnetometer chip IST8310 is integrated into the Board Type C. The communication method of STM32 and IST8310 is IIC, which supports a maximum communication rate of 400 kHz. The default IIC address of IST8310 is 0x0E. The schematic diagram is shown below.

The chip should be far away from the power cable and no device is allowed within 2 mm.

IIC Address: 0x0E
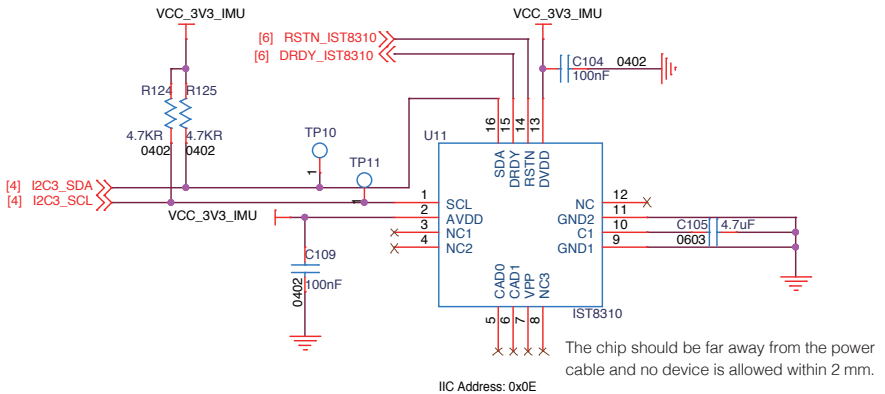
Usage

The Board Type C firmware can be downloaded by SWD or DFU. Users can download and debug programs via J-Link or ST-Link (SWD mode) and also download programs to the Board Type C via USB (DFU mode). To download the factory program to debug the Board Type C, go to https://www. robomaster.com/en-US/products/components/general/development-board-type-c#downloads.

Specifications

Input Voltage	8 - 28 V
Operating Current	0.01 A@DC 24 V
Weight	38 g
Dimensions	60×41×16.3 mm
Operating Temperature Range	0° to 55° C (0° to 131° F)

Appendix

The network name of a single board and IO is shown below.

Function Type	Network Name	IO
LED	LED_R	PH12
	LED_G	PH11
	LED_B	PH10
5V Port	TIM3_CH3	PC8
USB Port	USB_DM	PA11
	USB_DP	PA12
	USB_OTG	PA10
KEY	KEY	PA0
Customizable IO Port	I2C2_SCL	PF1
	I2C2_SDA	PF0
	SPI2_CS	PB12
	SPI2_CLK	PB13
	SPI2_MISO	PB14
	SPI2_MOSI	PB15
3-Pin UART Port	UART6_TX	PG14
	UART6_RX	PG9
4-Pin UART Port	UART1_TX	PA9
	UART1_RX	PB7
CAN1 Port	CAN1_TX	PD1
	CAN1_RX	PD0
CAN2 Port	CAN2_TX	PB6
	CAN2_RX	PB5

PWM Port	TIM1_CH1	PE9
	TIM1_CH2	PE11
	TIM1_CH3	PE13
	TIM1_CH4	PE14
	TIM8_CH1	PC6
	TIM8_CH2	PI6
	TIM8_CH3	PI7
DBUS Port	UART3_RX	PC11
Digital Camera FPC Port	I2C1_SCL	PB8
	I2C1_SDA	PB9
	PCLK_OUT	PA6
	DCMI_HREF	PH8
	DCMI_VSYNC	PI5
	DCMI_D0	PH9
	DCMI_D1	PC7
	DCMI_D2	PE0
	DCMI_D3	PE1
	DCMI_D4	PE4
	DCMI_D5	PI4
	DCMI_D6	PE5
	DCMI_D7	PE6
Buzzer	TIM4_CH3	PD14
Voltage Detection	ADC_BAT	PF10
Six-Axis IMU (BMI088)	TIM10_CH1	PF6
	INT1_Accel	PC4
	INT1_Gyro	PC5
	CS1_Accel	PA4
	CS1_Gyro	PB0
	SPI1_CLK	PB3
	SPI1_MOSI	PA7
	SPI1_MISO	PB4
Magnetometer	RSTN_IST8310	PG6
	DRDY_IST8310	PG3
	I2C3_SCL	PA8
	I2C3_SDA	PC9

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