

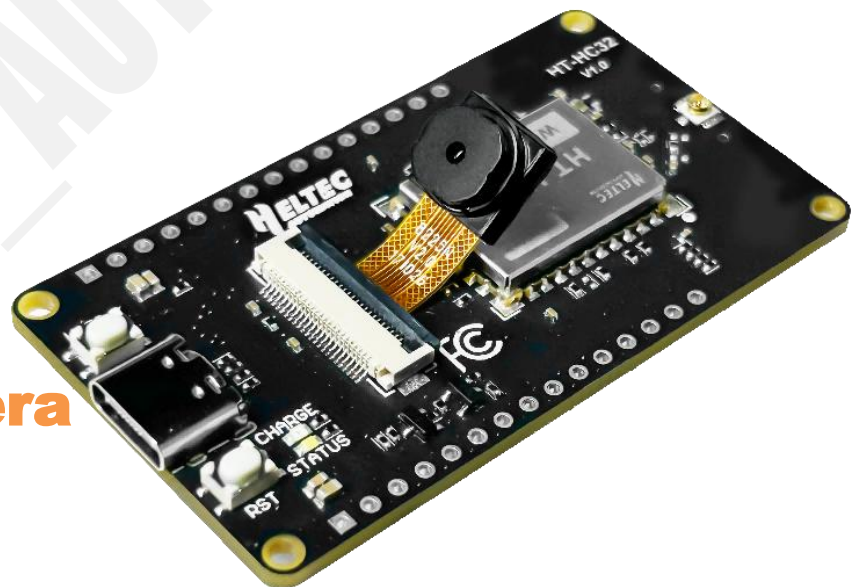


**HT-HC32**

**ESP-HaLowCamera**

*ESP32-S3 Dev-board*

*with Camera and WiFi HaLow*



## Document version

Version	Time	Description	Remark
Rev. 1.0	2024-10-16	P-Development version	Richard

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# 1 Description

## 1.1 Overview

[HT-HC32](#) is a development board with integrated **camera**, based on the **ESP32-S3 MCU** and **Wi-Fi HaLow** module. It is designed for **long-range, high-speed** wireless communication. With support for transmission distances of over 1 km and speeds of up to 32 Mbps, it is ideal for IoT applications that require reliable, high-performance connectivity.

The module features a **low power consumption design** with **excellent signal penetration**, ensuring robust performance even in challenging environments. The integrated camera has a 200-pixel wide-angle, which supports **advanced image processing functions** such as auto exposure control, auto gain control, image scaling, and image compression.

For easy local data storage and deployment, the device includes an integrated **SD card slot**. Additionally, the **Type-C USB** interface provides **built-in protection**, including voltage regulation, ESD protection, short circuit protection, and RF shielding, ensuring durability and safety.

HT-HC32's connectivity options include Wi-Fi, Bluetooth, and Wi-Fi HaLow, with an onboard 2.4 GHz patch antenna for Wi-Fi and Bluetooth, as well as a reserved IPEX (U.FL) interface for the HT-HC01 Wi-Fi HaLow module. The integration of the **CP2102** USB-to-serial chip enables easy program downloading and debugging, while the system is fully compatible with the **Arduino development environment**, offering a flexible platform for rapid prototyping and development.

## 1.2 Product Features

- The MCU is the ESP32-S3, and the Wi-Fi HaLow module is HT-HC01.
- Long transmission range, up to over 1~2km.
- Fast transmission speed, with a maximum of 32 Mbps.
- Low power consumption design with strong penetration.
- Integrated 200-pixel wide-angle camera, supporting auto exposure control, auto gain control, image scaling, image compression, and more.
- Integrated SD card slot for easy local deployment and data storage.
- Type-C USB interface with a complete voltage regulator, ESD protection, short circuit protection, RF shielding, and other protection measures.
- Onboard SH1.25-2 battery interface, integrated lithium battery management system (charging and discharging management, overcharge protection, battery power detection, USB/battery power automatic switching).
- Integrated Wi-Fi, Bluetooth, and Wi-Fi HaLow three network connections, with onboard 2.4 GHz patch antenna for Wi-Fi and Bluetooth, and reserved IPEX (U.FL) interface for Wi-Fi HaLow.
- Integrated CP2102 USB-to-serial chip, convenient for program downloading and debugging information printing.
- Supports the Arduino development environment.



### 1.3 Application

The HT-HC32 features a powerful MCU and extensive resources, allowing it to be used both as a standard ESP32 or Wi-Fi HaLow development board, and as a specialized platform when paired with a camera for specific applications.

- ✔ Remote camera monitoring
- ✔ Industrial automation control
- ✔ Asset management and tracking
- ✔ Smart home
- ✔ Smart city
- ✔ Smart farming
- ✔ Construction Site Management
- ✔ Wi-Fi/Ethernet/Wi-Fi\_HaLow extension and bridging
- ✔ Proximity sensors
- ✔ Rural internet access
- ✔ Autonomous driving
- ✔ Mobile phone location
- ✔ Environmental monitoring
- ✔ Unmanned supermarket
- ✔ Commodity management
- ✔ Intelligent lighting controls

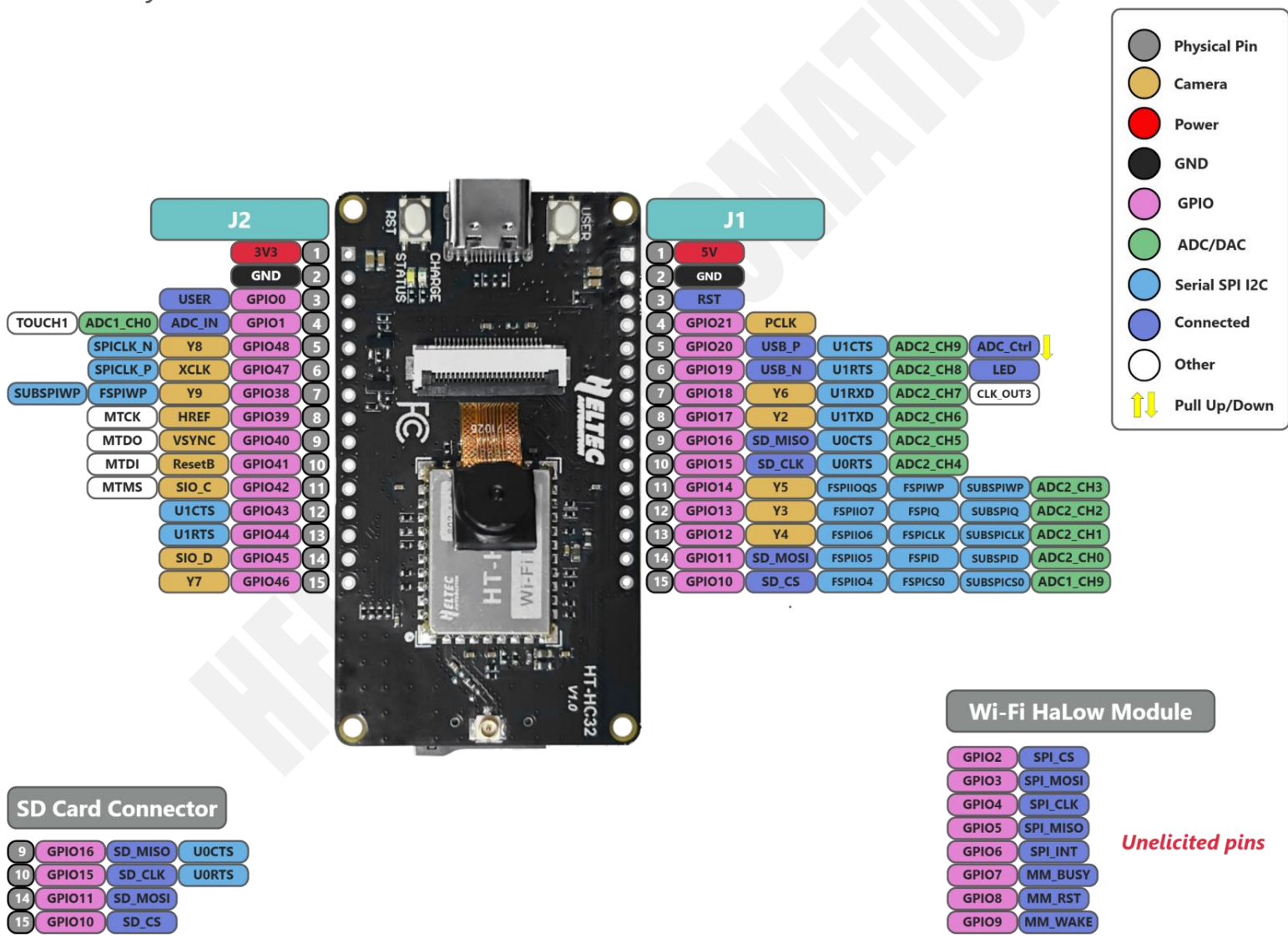
## 2 Pin description

- I<sup>2</sup>C and SPI

Each IO pin is preconfigured with **IO\_MUX** functionality, which means you can use any GPIO as I<sup>2</sup>C or SPI pins. You just need to define these pins in your code. However, it's important to note that once a pin is used, it may affect other functions associated with that pin.

- For information not available in the "Pin Description," please refer to the [HT-HC01 Schematic](#).

HT-HC32 Pin Layout:



<https://heltec.org>

## J1

NO.	Name	Type	Description
1	5V	Power	5V Power
2	GND	Power	Ground
3	RST	I	Reset
4	21	I/O	GPIO21, PCLK
5	20	I/O	GPIO20, ADC_Ctrl, USB_P, U1CTS, ADC2_CH9
6	19	I/O	GPIO19, LED, USB_N, U1RTS, ADC2_CH8
7	18	I/O	GPIO18, Y6, U1RXD, ADC2_CH7
8	17	I/O	GPIO17, Y2, U1TXD, ADC2_CH6
9	16	I/O	GPIO16, SD_MISO, U0CTS, ADC2_CH5
10	15	I/O	GPIO15, SD_CLK, U0RTS, ADC2_CH4
11	14	I/O	GPIO14, Y5, FSPiIOQS, FSPiWP, SUBSPiWP, ADC2_CH3
12	13	I/O	GPIO13, Y3, FSPiIO7, FSPiQ, SUBSPiQ, ADC2_CH2
13	12	I/O	GPIO12, Y4, FSPiIO6, FSPiCLK, SUBSPiCLK, ADC2_CH1
14	11	I/O	GPIO11, SD_MOSI, FSPiIO5, FSPiD, SUBSPiD, ADC2_CH0
15	10	I/O	GPIO10, SD_CS, FSPiIO4, FSPiCS0, SUBSPiCS0, ADC1_CH9

## J2

NO.	Name	TYPE	Description
1	3V3	Power	3V3 Power
2	GND	Power	Ground
3	0	I/O	GPIO0, USER key

<https://heltec.org>



4	1	I/O	GPIO1, ADC_IN
5	48	I/O	GPIO48, SPICLK_N, Y8, SPI CLK_N_DIFF, SUBSPI CLK_N_DIFF
6	47	I/O	GPIO47, SPICLK_P, XCLK, SPI CLK_P_DIFF, SUBSPI CLK_P_DIFF
7	38	I/O	GPIO38, Y9, FSPIWP, SUBSPIWP
8	39	I/O	GPIO39, MTCK, HREF
9	40	I/O	GPIO40, MTDO, VSYNC
10	41	I/O	GPIO41, MTDI, ResetB
11	42	I/O	GPIO42, MTMS, SIO_C
12	TX	I/O	GPIO43, U0TXD
13	RX	I/O	GPIO44, U0RXD
14	45	I/O	GPIO45, SIO_D
15	46	I/O	GPIO46, Y7

## 3 Specifications

### 3.1 General Parameter

Table 3.1 General parameter

Parameters	Description
MCU	ESP32-S3R8
Wi-Fi HaLow Module	HT-HC01
Serial port chip	CP2102
Wi-Fi HaLow	IEEE 802.11ah
Memory	384KB ROM; 512KB SR; 16KB RTC SRAM; 8M PSRAM, 16MB SiP Flash
Interface	HaLow ANT connector(IPEX1.0); 2*15*1.27 Header Pins, 24P_0.5mm FFC connector(camera), USB TypeC, SH1.25-2 battery interface, Micro-SD card holder
Power Supply	5V@USB, 2.7~4.2V@battery
Power consumption	<a href="#">See Table</a>
Sleep consumption	<a href="#">See Table</a>
Operating temperature	-50 ~ +85°C
Operating humidity	10% ~ 90%, no-condensing
Dimensions	60.00*33.50*7.10mm <sup>3</sup> (excluding Micro-SD and camera)

### 3.2 Wi-Fi HaLow Parameters

Table 3.2 Wi-Fi HaLow Parameters

Parameter	Description
Module	<a href="#">HT-HC01</a>
Wi-Fi Standard	IEEE 802.11ah
Frequency	902-928 MHz
Data Rate	32.5 Mbps @ 8 MHz
Band Width	1/2/4/8MHz
Receiver sensitivities	<a href="#">Table</a>
Transmitter Power	<a href="#">Table</a>

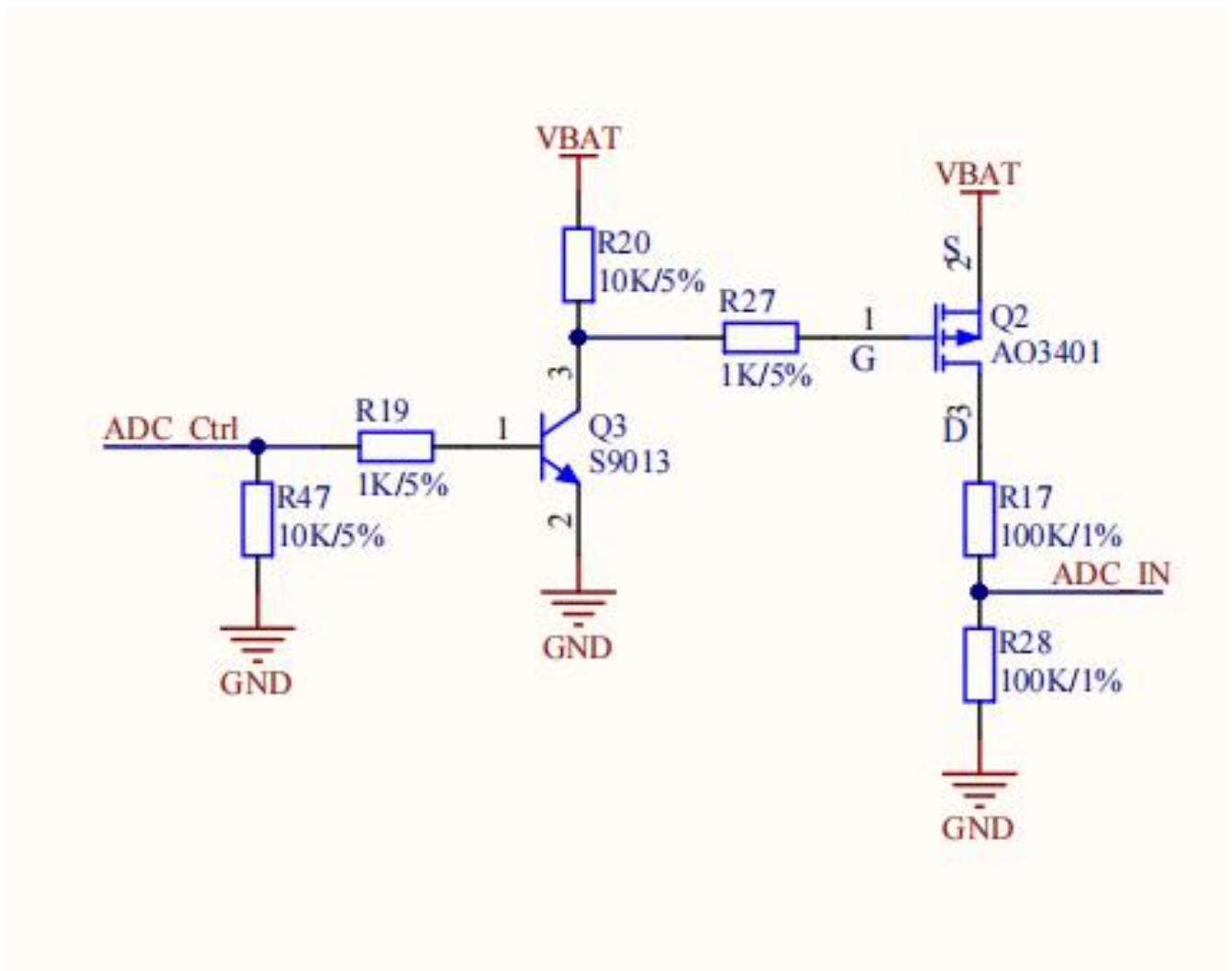
### 3.3 Camera Parameters

Table 3.2 Camera parameters

Parameter	Description
Interface	Data: 8-bit, Control: SCCB (a protocol similar to I <sup>2</sup> C)
Output format	RaWRGB, RGB(RGBS65/RGB555), GRB422, YUV(422/420), YCbCr(422), JPEG
Output Bit	8-bit
Output resolution	UXGA (1600x1200) and any size down to 40x30.
Maximum frame rate	UXGA(1600*1200)@15, SVGA(800*600)@30, CIF(352*288)@60
Sensor Size	1/4inch
Sensitivity	0.6V/Lux-sec
SNR	40dB
Dynamic range	50dB
Aperture	F2.0
FOV	78°
Focal Length	3.6mm
Lens Filter	850nm, IR Cut Filter or Infrared Cut Filter

## 4 Electrical Characteristics

### 4.1 Battery voltage detection circuit





## 4.2 Operating Voltage

Stress beyond absolute maximum ratings may cause permanent damage to the module. Functional operation is guaranteed for recommended operation conditions only. Operation of the device outside the recommended conditions may result in a reduced lifetime and/or reliability problems (even if the absolute maximum ratings are not exceeded).

Table3.3.1 Operating Voltage

Parameter	Min	Typical (recommended)	Max	Units
Voltage @USB		5		V
Voltage @Battery		3.7		V

## 4.3 Power consumption

Table3.3.1 power consumption

Parameter		Min	Typical	Max	Units
Wi-Fi	AP	175	195	220	mA
	SCAN		144		mA
	Client	80	92	160	
Wi-Fi HaLow STA		120	160	192	mA
CameraWebServer <sup>①</sup>			220		mA

<sup>①</sup> LAN monitoring via Wi-Fi HaLow.

## 5 RF Characteristics

### 5.1 Receiver sensitivities

Table5.1 Receiver sensitivities

Minimum Receive sensitivity (dBm) per BW			
1 MHz	2 MHz	4 MHz	8 MHz
-105	-103	-101	-97
-102	-100	-97	-93
-99	-97	-95	-91
-96	-94	-91	-88
-93	-90	-88	-85
-89	-87	-84	-80
-88	-85	-83	-79
-87	-84	-81	-77
-107	N/A		

### 5.2 Transmitter Power

Table5.2 Transmitter power

BW		Min(dBm)	Typical(dBm)	Max(dBm)
1/2MHz	MCS 0	20	21	22
	MCS 7	16	17	18.5
4MHz	MCS 0	20.5	21	22
	MCS 7	16	17	18
8MHz	MCS 0	20.5	21	21.5
	MCS 7	15.5	17	17.5

## 6 Get Started

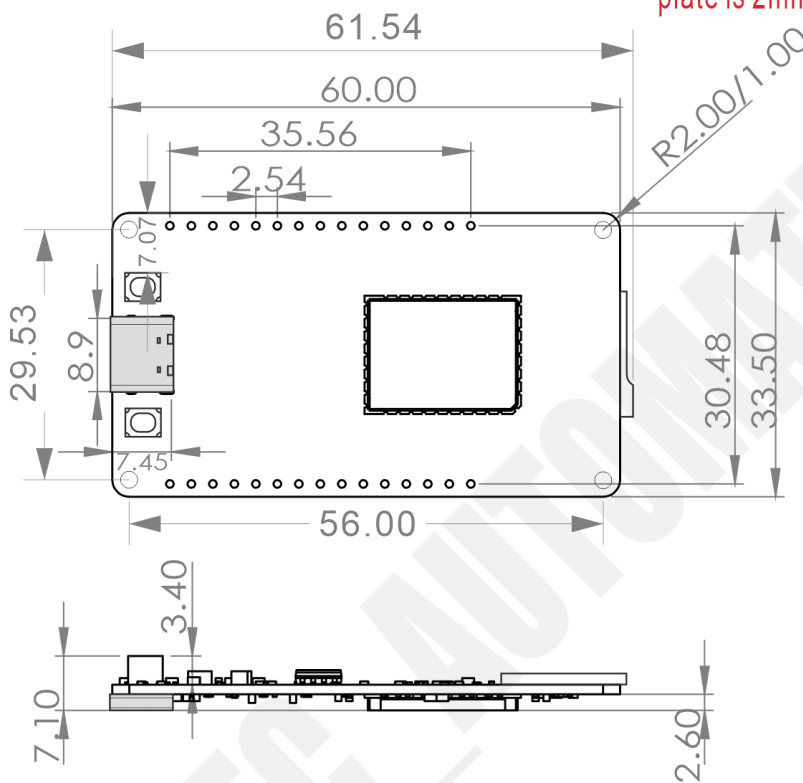
Heltec provides an [Arduino](#)-based development framework:

- GitHub link- [Heltec ESP32 HaLow Development Framework](#)
- [Installation and Getting Started Guide](#).

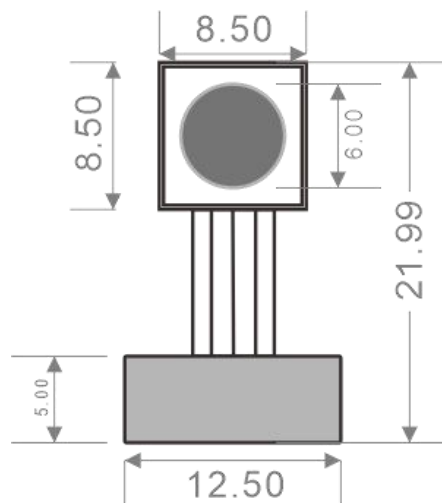
## 7 Hardware Dimensions

### 7.1 Board dimensions (unit: mm)

The radius of the hole is 1mm.  
and the chamfer radius of the  
plate is 2mm



### 7.2 Camera dimensions (unit: mm)



## 8 Resource

### 8.1 Relevant resource

- Documents Page: [Heltec Products Operation Documentation](#)
- Schematic diagram: [listing directory /download/HT-HC32/Schematic diagram](#)
- Resource station: [resource.heltec.cn](#)

### 8.2 Heltec Contact Information

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<https://heltec.org>