# Overview

If you want to DIY the Raspberry Pi into a robot that can detect motion posture and orientation, or if you want the Raspberry Pi to collect data such as temperature, humidity, and atmospheric pressure in the environment, this HAT can just meet the above requirements.

Sense HAT (C)
12C, AD

#### Features

- Standard Raspberry Pi 40PIN GPIO extension header, supports Raspberry Pi series boards
- Onboard QMI8658C+AK09918 (3-axis accelerometer, 3-axis gyroscope, and 3axis magnetometer), detects movement, orientation, and magnetic
- Onboard SHTC3 digital temperature and humidity sensor, allows monitoring of the environment
- Onboard LPS22HB barometric pressure sensor, allows monitoring of the environment
- Onboard TCS34725 color sensor, identifies the color of a nearby object
- Onboard SGM58031, 4-ch 16-bit precision ADC, AD expansion to support more external sensors
- Breakout I2C control pins, for connecting other host boards like STM32 and Arduino
- Comes with development resources and manual (examples for Raspberry Pi/STM32/Arduino)

## Parameters

Product Parameters					
Operating Voltage:	3.3V				
Communication Interface:	12C				
Logic Voltage:	3.3V				
Product Size:	65 x 30.5(mm)				
Accelerometer Features:	Resolution: 16-bit				
	Range (optional): ±2, ±4, ±8, ±16g				
Gyrometer Features:	Resolution: 16-bit				
	Range (optional): ±16, ±32, ±64, ±128, ±2 <mark>56, ±512, ±1024</mark> ,				
	±2048°/sec				
Magnetometer Features:	Resolution: 16-bit				
	Range: ±4912µT				
Barometer Characteristics:	Resolution: 24-bit pressure data, 16-bit temperature data;				
	Measurement Accuracy (at room temperature): ±0.025hPa				
	Measuring Range: 260 ~ 1260 hPa				
	Measurement Rate: 1 Hz - 75 Hz				
Temperature And Humidity Sensor Characteristics:	Measurement Accuracy (humidity): ±2% rH				

	Measuring Range (humidity): 0% ~ 100% rH
	Measurement Accuracy (temperature): ±0.2°C
	Measuring Range (humidity): -30 ~ 100°C
Color Recognition Sensor	Resolution: 4 channel RGBC, 16 bits per channel
AD Conversion Chip	Resolution: 16 bits

# Comparision

PK Item	Sense HAT (C)	Sense HAT (B)	Note
Gyroscope	Measurement range: ±16/32/64/128/256/512/1024/2048 dps Resolution: 16-bit	Measurement range: ±250/500/1000/2000 dps Resolution: 16 bits	C-type angular velocity range is more
Accelerometer	Measurement range: ±2/4/8/16 g Resolution: 16 bits	Measurement range: ±2/4/8/16 g Resolution: 16 bits	
Magnetometer	Measurement range: ±±49.12 gauss Resolution: 16-bit	Measurement range:±49 gauss Resolution: 16-bit	C-type magnetic measurement range is wider
Barometer	Measurement range: 260 ~ 1260 hPa Measurement accuracy (at room temperature): ±0.025hPa Measurement rate: 1 Hz - 75 Hz	Measuring range: 260 ~ 1260 hPa Measurement accuracy (room temperature): ±0.025hPa Measurement rate: 1 Hz - 75 Hz	
Temperature and Humidity Sensor	Measurement accuracy (humidity): ±2% rH Measurement range (humidity): 0% ~ 100% rH Measurement accuracy (temperature): ±0.2°C Measurement range (temperature): -30 ~ 100°C	Measurement accuracy (humidity): ±2% rH Measurement range (humidity): 0% ~ 100% rH Measurement accuracy (temperature): ±0.2°C Measurement range (temperature):-30 ~ 100°C	
Others	Color sensor High-precision 16-bit AD conversion chip	Color sensor High-precision 16-bit AD conversion chip	

# User Guides for Raspberry Pi

#### Hardware Connection

Hardware connection as shown: Connecting with Raspberry Pi Zero





Connect to Raspberry Pi 4 (required to add a 2x20PIN female header)



**Connect to Raspberry Pi Zero** 



# Open I2C Interface

• Open the Raspberry Pi terminal and enter the following command to enter the configuration interface.

```
sudo raspi-config
Choose Interfacing Options -> I2C ->yes start i2C kernel driver
```

1 Change Us 2 Network ( 3 Boot Opti 4 Localisat <b>5 Interfaci</b> 6 Overclock 7 Advanced 8 Update 9 About ras	er Password Options Lons tion Options Ing Options Options Spi-config	Change passwor Configure netw Configure opti Set up languag Configure conn Configure over Configure advau Update this to Information ab	d for the curren ork settings ons for start-up e and regional s ections to perip clocking for you need settings ol to the latest out this configu	t user ettings to matc herals r Pi version ration tool	h your locat:
	<select></select>			<finish></finish>	•
P1 Camera P2 SSH P3 VNC P4 SPI P5 Serial P7 1-Wire P8 Remote G	Raspberry I Enable// Enable// Enable// Enable// Enable// Enable// Enable// PIO Enable//	Pi Software Con Disable connect: Disable remote ( Disable graphic) Disable automat) Disable automat) Disable shell an Disable nee-wir Disable remote a	figuration Tool ion to the Raspb command line access ic loading of SP ic loading of I2 nd kernel messag a interface access to GPIO p	(raspi-config) erry Pi Camera ess to your Pi to your Pi usi I kernel module <u>C kernel module</u> es on the seria ins	using SSH ng RealVNC l connection
	<select></select>			<back></back>	24
	Would you l	ike the ARM I2C	interface to be	enabled?	

and then reboot Raspberry Pi

sudo reboot

#### **Install Function**



```
#Open the Raspberry Pi terminal and run the following command
wget http://www.airspayce.com/mikem/bcm2835/bcm2835-1.71.tar.gz
tar zxvf bcm2835-1.71.tar.gz
cd bcm2835-1.71/
sudo ./configure && sudo make && sudo make check && sudo make install
# For more information, please refer to the official website: http://www.airspay
ce.com/mikem/bcm2835/
```

#### wiring Pi

```
#Open Raspberry Pi terminal and execute
sudo apt-get install wiringpi
#For Raspberry Pi systems after May 2019 (earlier than before, it is not necess
ary to execute), an upgrade may be required
wget https://project-downloads.drogon.net/wiringpi-latest.deb
sudo dpkg -i wiringpi-latest.deb
gpio -v
# Run gpio -v and version 2.52 will appear. If it does not appear, the installa
tion is wrong.
```

```
#Bullseye Branch systems use the following commands:
git clone https://github.com/WiringPi/WiringPi
cd WiringPi
./build
gpio -v
# Run gpio -v and version 2.70 will appear. If it does not appear, the installa
tion is wrong.
```

#### Python

sudo apt-get update
#python2
sudo apt-get install python-pip
sudo pip install RPi.GPIO
sudo pip install spidev
sudo apt-get install python-smbus
#python3
sudo apt-get install python-pip3
sudo pip3 install RPi.GPIO
sudo pip3 install spidev
sudo apt-get install python3-smbus

#### Download Demo

```
wget https://files.waveshare.com/upload/0/04/Sense_HAT_C_Pi.zip
unzip Sense_HAT_C_Pi.zip -d Sense_HAT_C_Pi
cd Sense_HAT_C_Pi/RaspberryPi
```

#### I2C device address

ADS1015: AD conversion demos (STM32, BCM2835, WringPi and Python) Device addres s: 0x48

QMI8658C: 6-axis sensor demos (STM32, BCM2835, WringPi and Python) Device addres s: 0x6B

AK09918C: 3-axis sensor demos (STM32, BCM2835, WringPi and Python) Device addres s: 0x0C

LPS22HB: Air pressure sensor demos (STM32, BCM2835, WringPi and Python) Device a ddress: 0x5C

SHTC3: Temperature and humidity sensor demos (STM32, BCM2835, WringPi and Pytho n) Device address: 0x70

TCS34087: Color recognition sensor demos (STM32, BCM2835, WringPi and Python) De vice address: 0x29

Note: The I2C addresses of all the sensors of this module are different, and the user can use all the sensors on the board at the same time.

# IMU(QMI8658C+AK09918C)

## bcm2835

Enter the terminal of the Linux and execute the following command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/IMU/bcm2835/
#pi for account
sudo make clean
sudo make
sudo ./main
```

Expected result:

```
/-----
Roll: 6.76 Pitch: 3.16 Yaw: 9.92
Acceleration: X: -937 Y: 2038 Z: 16088
Gyroscope: X: -56 Y: 44 Z: -18
Magnetic: X: -160 Y: 6 Z: -205
_QMITemp:31.60 C
```

Press Ctrl+C to end the program.

## WiringPi Program

Enter the terminal of the Linux and execute the following command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/IMU/wiringPi/
#pi for account
sudo make clean
sudo make
sudo ./main
```

Expected result:

```
/-----/
Roll: 6.76 Pitch: 3.16 Yaw: 9.92
Acceleration: X: -937 Y: 2038 Z: 16088
Gyroscope: X: -56 Y: 44 Z: -18
Magnetic: X: -160 Y: 6 Z: -205
_QMITemp:31.60 C
```

Press Ctrl+C to end the program.

## STM32

This demo is based on XNUCLEO-F103RB and exports the data by serial port 2. The wiring as shown below:

Sense HAT (C)	STM32
3V3	+3.3V
GND	GND
SDA	PB9
SCL	PB8

Compile and download the program:

Hile, Edit View Project Hash Debug Peripherals loois SVCS Window Help

71	"F	Comp	lee	TE LOWING	an <sup>5</sup>	19	图			//≣	//= R
٢		🏥 🧼 - 🔜	LOAD	ADS1015	~ *		6	♦	~		

Open the serial port assistant and set the baud rate to 115200. Expected result:

k sscom 3.3		_		×
/	/			^
Roll: 2.08 Pitch: 0.00 Yaw: -46.88				
Acceleration: X: -40 Y: 530 Z: 16399				
Gyroscope: X: -3 Y: 5 Z: 4				
Magnetic: X: -169 Y: -194 Z: -356				
/	/			
Roll: 2.07 Pitch: -0.07 Yaw: -46.79				
Acceleration: X: -29 X: 535 Z: 16312				
Gyroscope: X: -4 Y: 6 Z: 3				
Magnetic: X: -168 Y: -192 Z: -355				
1				~
打开文件	发送文件 停止发送	扩	展一口	RTS
串口号 [COM8] 💌 🛞 _关闭串口 🔄 帮助	保存窗口 清除窗口	∏ нех	《显示 []	DTR

## Parameter Calibration And Calculation

#### **Calculate Acceleration**

The unit of acceleration measured by the program is LSB (least significant bit), and the unit is often converted to gravitational acceleration (g) in actual use. The default range is 16384 LSB/g ( $\pm$ 2g), so the actual acceleration measured is: a=Acceleration/16384 ,Unit:gPlease refer to QMI8658C datasheet P17

#### Gyroscope Angular Velocity

The unit of angular velocity measured by the program is LSB (least significant bit). In practice, the unit is often converted to angular velocity (°/sec). The default range is 64 LSB/(°/s) ( $\pm$ 500°/s), so the actual angular velocity measured is:  $\omega$ =Gyroscope/64 ,Unit:°/s Please refer to QMI8658C datasheet P18

## LPS22HBTR

Note: The temperature detection of the air pressure sensor is only used for compensation. For accurate temperature detection, please observe the value of the SHTC3 temperature and humidity sensor.

## BCM2835

Enter the Linux terminal and run the following command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/LPS22HBTR/bcm2835/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

Expected result:

```
Pressure Sensor Test Program ...

Pressure Sensor OK

Pressure = 997.15 hPa , Temperature = 31.86 °C

Pressure = 997.15 hPa , Temperature = 31.86 °C

Pressure = 997.17 hPa , Temperature = 31.89 °C

Pressure = 997.17 hPa , Temperature = 31.89 °C

Pressure = 997.11 hPa , Temperature = 31.90 °C

Pressure = 997.11 hPa , Temperature = 31.90 °C

Pressure = 997.13 hPa , Temperature = 31.92 °C

Pressure = 997.13 hPa , Temperature = 31.92 °C

Pressure = 997.10 hPa , Temperature = 31.94 °C

Pressure = 997.11 hPa , Temperature = 31.94 °C
```

Press Ctrl+C to end the terminal.

### WiringPi Program

Enter the Linux terminal, and run the following command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/LPS22HBTR/wiringPi/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

Expected result:

```
Pressure Sensor Test Program ...

Pressure Sensor OK

Pressure = 997.15 hPa , Temperature = 31.86 °C

Pressure = 997.15 hPa , Temperature = 31.86 °C

Pressure = 997.17 hPa , Temperature = 31.89 °C

Pressure = 997.17 hPa , Temperature = 31.89 °C

Pressure = 997.11 hPa , Temperature = 31.90 °C

Pressure = 997.11 hPa , Temperature = 31.90 °C

Pressure = 997.13 hPa , Temperature = 31.92 °C

Pressure = 997.13 hPa , Temperature = 31.92 °C

Pressure = 997.10 hPa , Temperature = 31.94 °C

Pressure = 997.11 hPa , Temperature = 31.94 °C
```

Press Ctrl+C to end the terminal.

## Python Program

Enter the Linux terminal and run the following command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/LPS22HBTR/python/
#pi is the account
sudo python3 LPS22HB.py
```

Expected result:

Pressure Sensor Test Program
Pressure = 1023.31 hPa , Temperature = 37.88 °C
Pressure = 1023.31 hPa , Temperature = 37.81 °C
Pressure = 1023.26 hPa , Temperature = 37.82 °C
Pressure = 1023.30 hPa , Temperature = 37.84 °C
Pressure = 1023.30 hPa , Temperature = 37.84 °C
Pressure = 1023.24 hPa , Temperature = 37.86 °C
Pressure = 1023.30 hPa , Temperature = 37.87 °C
Pressure = 1023.32 hPa , Temperature = 37.88 °C
Pressure = 1023.25 hPa , Temperature = 37.88 °C
Pressure = 1023.28 hPa , Temperature = 37.89 °C

Press Ctrl+C to end the program.

#### STM32 Program

This demo is based on XNUCLEO-F103RB and outputs the data by serial port 2. The wiring is shown below:

Sense HAT (C)	STM32
3V3	+3.3V
GND	GND
SDA	PB9
SCL	PB8

Compile and download the program:

<u>F</u> I	e-	Edit	V	lew	F	roje	ct Fla	sh Debug	Peripherals	lool	s j	VCS	Win	dow	Н	elp
f	細	唐	ç	Ø	m	pi	lee	<b>「私」</b> O	wnioą	a	19	限			//≣	// <u>=</u>
~	Ð	₩.		1	•		LOAD	ADS1015	~			6		~		

Open SSCOM and set the baud rate as 115200.

Expected	result:
----------	---------

SSCOM 3.3	-	- 1		$\times$
Pressure = 1000.73 hPa, Temperature = 29.17'C         Pressure = 1000.80 hPa, Temperature = 29.17'C         Pressure = 1000.73 hPa, Temperature = 29.17'C         Pressure = 1000.75 hPa, Temperature = 29.18'C         Pressure = 1000.75 hPa, Temperature = 29.17'C         Pressure = 1000.75 hPa, Temperature = 29.17'C         Pressure = 1000.75 hPa, Temperature = 29.17'C         Pressure = 1000.72 hPa, Temperature = 29.17'C         Pressure = 1000.72 hPa, Temperature = 29.17'C         Pressure = 1000.72 hPa, Temperature = 29.17'C         Pressure = 1000.73 hPa, Temperature = 29.17'C         Pressure = 1000.73 hPa, Temperature = 29.17'C         Pressure = 1000.74 hPa, Temperature = 29.17'C         Pressure = 1000.75 hPa, Temperature = 29.17'C         Pressure = 1000.76 hPa, Temperature = 29.17'C         Pressure = 1000.76 hPa, Temperature = 29.17'C         Pressure = 1000				^
打开文件     文件名     发送文件       串口号 [00M3] ▼ ● 关闭串口 _ 帮助 _ 保存窗口 ]	停止发送 清除窗口	<u>扩</u> 厂 Ю	展 「 R R 示	RTS DTR

# SHTC3 Example

Note: The heating of the Raspberry Pi will affect the actual temperature measurement. The board has an I2C interface. If you need an accurate ambient temperature, you can separate the Raspberry Pi from the module and connect it through a wire to detect it.

### bcm2835

Enter the Linux terminal and run the following command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/SHTC3/bcm2835/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

#### Expected result:

SHTC3 Sensor	Test Program	
Temperature =	31.12°C , Humidity =	70.77%
Temperature =	31.14°C , Humidity =	70.76%
Temperature =	31.12°C , Humidity =	70.74%
Temperature =	31.15°C , Humidity =	70.75%
Temperature =	31.12°C , Humidity =	70.75%
Temperature =	31.16°C , Humidity =	70.76%
Temperature =	31.14°C , Humidity =	70.75%
Temperature =	31.15°C , Humidity =	70.75%
Temperature =	31.12°C , Humidity =	70.75%
Temperature =	31.14°C , Humidity =	70.74%
Temperature =	31.16°C , Humidity =	70.75%
Temperature =	31.17°C , Humidity =	70.76%
Temperature =	31.15°C , Humidity =	70.73%
Temperature =	31.15°C , Humidity =	70.76%
Temperature =	31.13°C , Humidity =	70.74%
Temperature =	31.12°C , Humidity =	70.77%
Temperature =	31.13°C , Humidity =	70.75%
Temperature =	31.13°C . Humidity =	70.75%

Press Ctrl+C to end the program.

## WiringPi

Enter the Linux terminal and execute the following commands:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/SHTC3/wiringPi/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

Expected result:

SHTC3 Sensor	Test Progra	am		
Temperature =	31.12°C ,	Humidity	=	70.77%
Temperature =	31.14°C ,	Humidity		70.76%
Temperature =	31.12°C ,	Humidity	=	70.74%
Temperature =	31.15°C ,	Humidity	=	70.75%
Temperature =	31.12°C ,	Humidity	=	70.75%
Temperature =	31.16°C ,	Humidity	=	70.76%
Temperature =	31.14°C ,	Humidity	=	70.75%
Temperature =	31.15°C ,	Humidity	=	70.75%
Temperature =	31.12°C ,	Humidity	=	70.75%
Temperature =	31.14°C ,	Humidity	=	70.74%
Temperature =	31.16°C ,	Humidity	=	70.75%
Temperature =	31.17°C ,	Humidity	=	70.76%
Temperature =	31.15°C ,	Humidity	=	70.73%
Temperature =	31.15°C ,	Humidity	=	70.76%
Temperature =	31.13°C ,	Humidity	=	70.74%
Temperature =	31.12°C ,	Humidity	=	70.77%
Temperature =	31.13°C ,	Humidity	=	70.75%
Temperature =	31.13°C .	Humidity	=	70.75%

Press Ctrl+C to end the program.

## Python Program

Enter the Linux terminal and run the following commands.

cd /home/pi/Sense\_HAT\_C\_Pi/RaspberryPi/SHTC3/python/
#pi is the account
sudo python3 SHTC3.py

Expected	result:

pi@raspberrypi	:~/Sense-HAT-B-Demo/SH	TC3/Raspberry Pi/python \$ sudo python3 SHTC3.py
Temperature =	30.42°C , Humidity =	43.06%
Temperature =	35.30°C , Humidity =	43.45%
Temperature =	35.34°C , Humidity =	43.79%
Temperature =	35.34°C , Humidity =	44.13%
Temperature =	35.35°C , Humidity =	44.49%
Temperature =	35.36°C , Humidity =	44.82%
Temperature =	35.36°C , Humidity =	45.14%
Temperature =	35.34°C , Humidity =	45.46%
Temperature =	35.34°C , Humidity =	45.80%
Temperature =	35.37°C , Humidity =	46.10%
Temperature =	35.36°C , Humidity =	46.42%
Temperature =	35.33°C , Humidity =	46.73%
Temperature =	35.41°C , Humidity =	47.03%

Press Ctrl + C to end the program.

## STM32 Program

This demo is based on XNUCLEO-F103RB and outputs the data by serial port 2.

The wiring is shown below:

Sense HAT (C)	STM32
3V3	+3.3V
GND	GND
SDA	PB9
SCL	PB8

#### Compile and download the program:



#### Expected result:

No error in the sensor, LED 2 is on:



When the humidity is less than 80%, LED 3 will not be on. When the humidity is greater than or equal to 80%, LED 3 will be on.



# TCS34087 Demo

# bcm2835

Enter the Linux terminal and run the following commands in the terminal:

cd /home/pi/Sense\_HAT\_C\_Pi/RaspberryPi/TCS34087/bcm2835/
#pi is the account
sudo make clean
sudo make
sudo ./main

Expected result:

TCS34725	5 initia	alization	success	11					
RGB888	:R=0	G=0 B=0	RGB888	8=0X0	RGB565=0X0	Lux_Interrupt	= 0		
RGB888	:R=0	G=0 B=6	RGB888	8=0X0	RGB565=0X0	Lux_Interrupt	= 0		
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt	H	0
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201	RGB88	8=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt	Η	0
RGB888	:R=241	G=249	B=201	RGB88	8=0XF1F9C9	RGB565=0XF7D9	Lux_Interrupt	-	0
RGB888	:R=241	G=249	B=201	RGB88	8=0XF1F9C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201	RGB88	8=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt		0
RG8888	:R=241	G=248	B=201	RGB88	8=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200	RGB88	8=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201	RGB88	8=0XF1F8C9	RGB565=0XF7D9	Lux Interrupt	=	0

Press Ctrl+C to end the program.

#### wiring Pi

Open the terminal of Linux, compile codes, and run the example by command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/TCS34087/wiringPi/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

Expected result: TCS34725 initialization success!!

RGB888	:R=0	G=0 B=0	RGB888=0X0	RGB565=0X0	Lux_Interrupt	= 0		
RG8888	:R=0	G=0 B=0	RGB888=0X6	RGB565=0X0	Lux_Interrupt	= 0		
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201 RGB8	388=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=249	B=201 RGB8	388=0XF1F9C9	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=249	B=201 RGB8	388=0XF1F9C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201 RGB8	388=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201 RGB8	888=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 RGB8	388=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=248	B=201 RGB8	88=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt	=	0

Press Ctrl+C to end the program.

### Python

Open the terminal of Linux, Compile codes and run the example by command:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/TCS34087/python/
#pi is the account
sudo python main.py
```

```
Expected result:
```

CS34725	5 initia	alization	success!!					
RGB888	:R=0	G=0 B=0	RGB888=	0X0 RGB565=0X0	Lux_Interrupt	= 0		
RGB888	:R=0	G=0 B=0	RGB888=	0X0 RGB565=0X0	Lux_Interrupt	= 0		
RGB888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt	=	0
RG8888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=248	B=201 R	GB888=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=249	B=201 R	GB888=0XF1F9C9	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=249	B=201 R	GB888=0XF1F9C9	RGB565=0XF7D9	Lux_Interrupt		0
<b>RGB888</b>	:R=241	G=248	B=201 R	GB888=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=201 R	GB888=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt		0
RGB888	:R=241	G=248	B=200 R	GB888=0XF1F8C8	RGB565=0XF7D9	Lux_Interrupt	=	0
RGB888	:R=241	G=248	B=201 R	GB888=0XF1F8C9	RGB565=0XF7D9	Lux_Interrupt	=	0

Press Ctrl+C to end the program.

## STM32

This demo is based on the XNUCLEO-F103RB development board and outputs data through serial port 2.

The connection is as follows:

Sense HAT (B)	STM32
3V3	+3.3V
GND	GND
SDA	PB9
SCL	PB8

Compile and download the program:

	File	Edit	<u>v</u>	lew	Pro	lect I	lash Debug	Peripherals	0019	51	CS	Win	dow	H	elp
111111	细	F	ç	Ø	np	ile	TANDO	wnioac	12	13	<u>R</u>			//≣	// <del>"</del>
	٢			<b>*</b>		LOAD	ADS1015	~	*		뤔		1		

Open the serial port assistant and set the baud rate to 115200.

Expected	outcome:
Expected	ourconne.

SSCOM 3.3

RGB888 :R=187 G=253 B=185 RGB888=0XBBFDB9 RGB565=0XDFB9	î
RGB888 :R=187 G=252 B=185 RGB888=0XBBFCB9 RGB565=0XDFB9	
RGB888 :R=185 G=251 B=184 RGB888=0XB9FBB8 RGB565=0XDFF8	
RGB888 :R=185 G=250 B=183 RGB888=OXB9FAB7 RGB565=OXDFF7	
RGB888 :R=184 G=249 B=182 RGB888=0XB8F9B6 RGB565=0XDFB6	
RGB888 : R=183 G=247 B=181 RGB888=0XB7F7B5 RGB565=0XBEF5	
	~
打开文件 文件名 发送文件 停止发送 扩展 厂	RTS
串口号 CONG 💌 🛞 _ 关闭串口 _ 帮助 _ 保存窗口 _ 清除窗口   匚 HEX显示 🗌	DTR

How to convert this data to color? The following introduces a tool, copy it to the browser and open it

https://www.sioe.cn/yingyong/yanse-rgb-16/

Or download:

```
https://files.waveshare.com/upload/0/05/Hexacolor3.7z 🗗
```

RGB颜色值 252 70 转换	转换 G	成十7 ] 90	B B B	颜色	码:
🕌 Hexacolor					×
Conversion   16 colors	216 colo Xac Managen	rs   Options Olor nent for the	e Internet		
	Red	Gre	en Bl	Je .	
Decimal	241	<u>-</u> 63	÷ 70		
Hexadecimal	F1	÷ 3F	÷ [46		
-	Co	ibr #F13F	46 <b>•</b> 6	ta	

	Reach Web colors	1
-		

# SGM58031

## bcm2835

Enter the Linux terminal and run the following commands:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/SGM58031/bcm2835/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

Expected result:

```
AIN0 = 1186(2372mv) ,AIN1 = 0(0mv) ,AIN2 = 261(522mv) AIN3 = 276(552mv)

AIN0 = 1462(2924mv) ,AIN1 = 0(0mv) ,AIN2 = 263(526mv) AIN3 = 280(560mv)

AIN0 = 1462(2924mv) ,AIN1 = 0(0mv) ,AIN2 = 266(532mv) AIN3 = 262(524mv)

AIN0 = 1655(3310mv) ,AIN1 = 1(2mv) ,AIN2 = 264(528mv) AIN3 = 261(522mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 266(532mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 259(518mv) AIN3 = 278(556mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 276(552mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 276(552mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 260(520mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 264(528mv) AIN3 = 260(520mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 267(534mv) AIN3 = 261(522mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 262(524mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 282(564mv)
```

Press Ctrl+C to end the program.

## WiringPi

Enter the Linux terminal and run the following commands:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/SGM58031/wiringPi/
#pi is the account
sudo make clean
sudo make
sudo ./main
```

Expected result:

```
AIN0 = 1186(2372mv) ,AIN1 = 0(0mv) ,AIN2 = 261(522mv) AIN3 = 276(552mv)
AIN0 = 1462(2924mv) ,AIN1 = 0(0mv) ,AIN2 = 263(526mv) AIN3 = 280(560mv)
AIN0 = 1462(2924mv) ,AIN1 = 0(0mv) ,AIN2 = 266(532mv) AIN3 = 262(524mv)
AIN0 = 1655(3310mv) ,AIN1 = 1(2mv) ,AIN2 = 264(528mv) AIN3 = 261(522mv)
```

AIN0	1654(3308mv)	,AIN1	0(0mv)	,AIN2	260(520mv)	AIN3	266(532mv)
AIN0	1654(3308mv)	,AIN1	0(0mv)	,AIN2	259(518mv)	AIN3	278(556mv)
AINO	1655(3310mv)	,AIN1	0(0mv)	,AIN2	260(520mv)	AIN3	276(552mv)
AINØ	1655(3310mv)	,AIN1	0(0mv)	,AIN2	264(528mv)	AIN3	260(520mv)
AIN0	1655(3310mv)	,AIN1	0(0mv)	,AIN2	267(534mv)	AIN3	261(522mv)
AINØ	1654(3308mv)	,AIN1	0(0mv)	,AIN2	262(524mv)	AIN3	272(544mv)
AINO	1654(3308mv)	,AIN1	0(0mv)	,AIN2	260(520mv)	AIN3	282(564mv)

Press Ctrl+C to end the program.

## python

Enter the Linux terminal and run the following commands:

```
cd /home/pi/Sense_HAT_C_Pi/RaspberryPi/SGM58031/python/
#pi is the account
sudo python AD.py
```

Expected result:

```
AIN0 = 1186(2372mv) ,AIN1 = 0(0mv) ,AIN2 = 261(522mv) AIN3 = 276(552mv)

AIN0 = 1462(2924mv) ,AIN1 = 0(0mv) ,AIN2 = 263(526mv) AIN3 = 280(560mv)

AIN0 = 1462(2924mv) ,AIN1 = 0(0mv) ,AIN2 = 266(532mv) AIN3 = 262(524mv)

AIN0 = 1655(3310mv) ,AIN1 = 1(2mv) ,AIN2 = 264(528mv) AIN3 = 261(522mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 266(532mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 259(518mv) AIN3 = 278(556mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 276(552mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 276(552mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 264(528mv) AIN3 = 260(520mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 267(534mv) AIN3 = 261(522mv)

AIN0 = 1655(3310mv) ,AIN1 = 0(0mv) ,AIN2 = 262(524mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 272(544mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 282(564mv)

AIN0 = 1654(3308mv) ,AIN1 = 0(0mv) ,AIN2 = 260(520mv) AIN3 = 282(564mv)
```

Press Ctrl+C to end the program.

#### STM32

This demo is based on the XNUCLEO-F103RB development board and outputs data through serial port 2.

The connection is as follows:

Sense HAT (B)	STM32
3V3	+3.3V
GND	GND
SDA	PB9
SCL	PB8

Compile and download the program:

Elle.	Edit	<u>v</u>	lew	Pro	ect	Fla	sh Debug	Peripheral	Is loc	ls	20	CS	Win	dow	Н	elp
細	F	S	er	np	ile	1	<b>取</b>	wnio	ad	1	1.1	P&			//≣	// <u>=</u>
٢		***	1	-	Lof	AD I	ADS1015		~	-	å	뤔		*		

Open the serial port assistant and set the baud rate to 115200.

Expected outcome:

SSCOM 3.3

USIUI5 lest Frogram DS1015 0K INO = 1657(3314mv) .AIN1 = 0(0mv) .AIN2 = 275(550mv) AIN3 = 285(570mv)	^
INO = 1657(3314mv) , AIN1 = O(Omv) , AIN2 = 272(544mv) AIN3 = 288(576mv)	
INO = 1657(3314mv), AIN1 = 0(Omv), AIN2 = 272(544mv) AIN3 = 286(572mv)	
INO = 1657(3314mv), $AIN1 = O(Omv)$ , $AIN2 = 273(546mv)$ $AIN3 = 284(568mv)$	
INU = 1657(3314mv), $AINI = U(Umv)$ , $AINZ = 272(544mv)$ , $AIN3 = 264(566mv)IND = 1657(2214mu)$ , $AIN1 = 0(0mv)$ , $AIN2 = 274(549mv)$ , $AIN3 = 294(569mv)$	
TNO = 1657(3314mv), $AIN1 = O(Omv)$ , $AIN2 = 274(540mv)$ $AIN3 = 264(560mv)TNO = 1657(3314mv)$ , $AIN1 = O(Omv)$ , $AIN2 = 274(548mv)$ , $AIN3 = 284(568mv)$	
INO = 1657(3314mv), $AIN1 = O(Omv)$ , $AIN2 = 274(548mv)$ $AIN3 = 284(568mv)$	
INO = 1657(3314mv), AIN1 = 0(Omv), AIN2 = 274(548mv) AIN3 = 283(566mv)	
INO = 1657(3314mv) , AIN1 = O(Omv) , AIN2 = 272(544mv) AIN3 = 286(572mv)	
INO = 1657(3314mv), AIN1 = 0(0mv), AIN2 = 271(542mv) AIN3 = 282(564mv)	
INU = 1657(3314mv), AIN1 = U(Umv), AIN2 = 274(548mv) AIN3 = 283(566mv)	
	~
打开文件   文件名 / 发送文件   停止发送 / 扩展	RTS
	E DTR

## Resource

## Document

• Sense\_HAT\_(C)\_Schematic ₽

#### Program

• Sense\_HAT\_C\_Demo.7z ₽

### **Related Resources**

- Lps22hb Datasheet IP
- SHTC3 Datasheet.pdf
- TCS3408\_datasheet I
- QMI8658C datasheet @
- AKM-AK09918C.pdf 🖉
- Lsf0204d.pdf ₽
- SGM58031.pdf

# FAQ

#### Question: Incorrect use of Raspberry Pi controls may cause?

#### Answer:

If you run python or bcm2835 and then the screen fails to refresh after running the wiringPi demo. It is because bcm2835 is the library of the RPI CPU chip, which directly operates the register, wiringPi, and python control the device by reading and writing the device files of the Linux system. So it may cause the GPIO header to work abnormally. All you need to do is to reboot the Raspberry Pi.

**Question:**STM32 demo serial port output has no data or data output is garbled?

#### **Answer:**

Confirm whether the baud rate is set to 115200. For the STM32 routine, please confirm that the computer is correctly connected to the development board USART2 (PA2, PA3), PA2 is TXD, and the correct COM port is selected. Control Panel -> Hardware -> Device Manager.



# Support

#### **Technical Support**

If you need technical support or have any feedback/review, please click the **Submit Now** button to submit a ticket, Our support team will check and reply to you within 1 to 2 working days. Please be patient as we make every effort to help you to resolve the issue.

Working Time: 9 AM - 6 AM GMT+8 (Monday to Friday)

#### Submit Now