GH3011 Datasheet

Rev: 1.2

Release Date: 2021-04-29

Shenzhen Goodix Technology Co., Ltd.

Contents

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

1 Product Profile

1.1 Overview

GH3011 is a heart rate sensor that integrates three LED drivers, one photodiode (PD) and one analog front-end. In addition to Heart Rate (HR) sensing, it supports such extended functions as Heart Rate Variability (HRV), Peripheral Capillary Oxygen Saturation (SpO2) and Wearing detections, featuring ultra-low power consumption and extremely high precision. It is applicable to the smart devices such as wristbands and watches.

1.2 Features

- Ultra-Low Power consumption
  - Average current consumption in Heart Rate Detection mode (typical value): 25 µA @25 Hz Heart Rate Sampling Frequency and 52.6µs ADC sampling (excluding LED drive current)
  - Average current consumption in Heart Rate Detection mode (typical value for yellow skin): 60 µA @25 Hz Heart Rate Sampling Frequency and 52.6µs ADC sampling (including 30mA LED drive current)
  - Average current consumption in SpO2 Detection mode (typical value): 110 µA @25 Hz Heart Rate Sampling Frequency and 352µs ADC sampling (excluding LED drive current)
  - Average current consumption in SpO2 Detection mode (typical value for yellow skin): 460 µA @25 Hz Heart Rate Sampling Frequency and 352 µs ADC sampling (including 20mA LED drive current)
  - Average current consumption in In-Ear Detection mode (typical value): 10 µA (including LED drive current)
- Excellent Performance
  - 24-bit highly accurate ADC
  - Dynamic range: 96 dB
- Light Transmitter Block
  - Three independent LED drivers embedded; each supports up to 100mA drive capability
  - Two LED drivers can output drive signals synchronously
  - 8-bit programmable current controller
  - Automatic dimming, self-adaptive to environment changes in optical path for optimal SNR output
- Light Receiver Block
  - Built-in photodiode (PD);
  - Up to 1 kHz heart rate sampling frequency for each channel
- Internal FIFO: 768 Bytes
- LGA Package
  - Size: 3 mm × 4 mm × 0.8 mm
  - Three LED drivers, one PD and one AFE embedded
- Operating Voltage: 2.1 V-3.3 V

- Communication Interface: IIC or SPI
- Functions: HR, HRV, SpO2 and Wearing Detections
- Application: Wearable devices such as wristbands, watches, fitness arm bands, stick-on heart rate monitors, fingerprint oximeter and in-ear headphones

1.3 Technical Specifications

Table 1-1 GH3011 Technical Specifications

Parameter	Description	Value	Unit
Dimensions	LGA Package Dimensions	3.0×4.0	mm
	Thickness	0.80	mm
Power Consumption in Sleep Mode	Sleep Mode Current (Typ.)	3	μA
Heart Rate Detection Mode	Average Power Consumption @25Hz Heart Rate Sampling Frequency (LED power consumption excluded)	25	μA
	PPG data refresh rate	25	Hz
SpO2 Detection Mode	Average power consumption @ 25Hz Heart Rate Sampling Frequency (LED power consumption excluded)	110	μA
	PPG data refresh rate	25 - 200	Hz
	Measurement range of static blood oxygen saturation	70 - 100	%
	SpO2 Accuracy	±3	%
Power Supply	VCC	2.1 - 3.3	V
	VDDIO	1.62 - VCC	V

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

2 Application

2.1 Overview

As shown in Figure 2-1, GH3011 heart rate sensor mainly consists of the following parts:

- HBD analog front end: HBD Sensor, LED Driver, TIA, ADC, etc.;
- Communication interface: IIC or SPI;
- Basic circuit units: PMU, Clock System, Reset, Interrupt, etc.;
- Digital and logic control units: Data Buffer, Logic Control, etc.

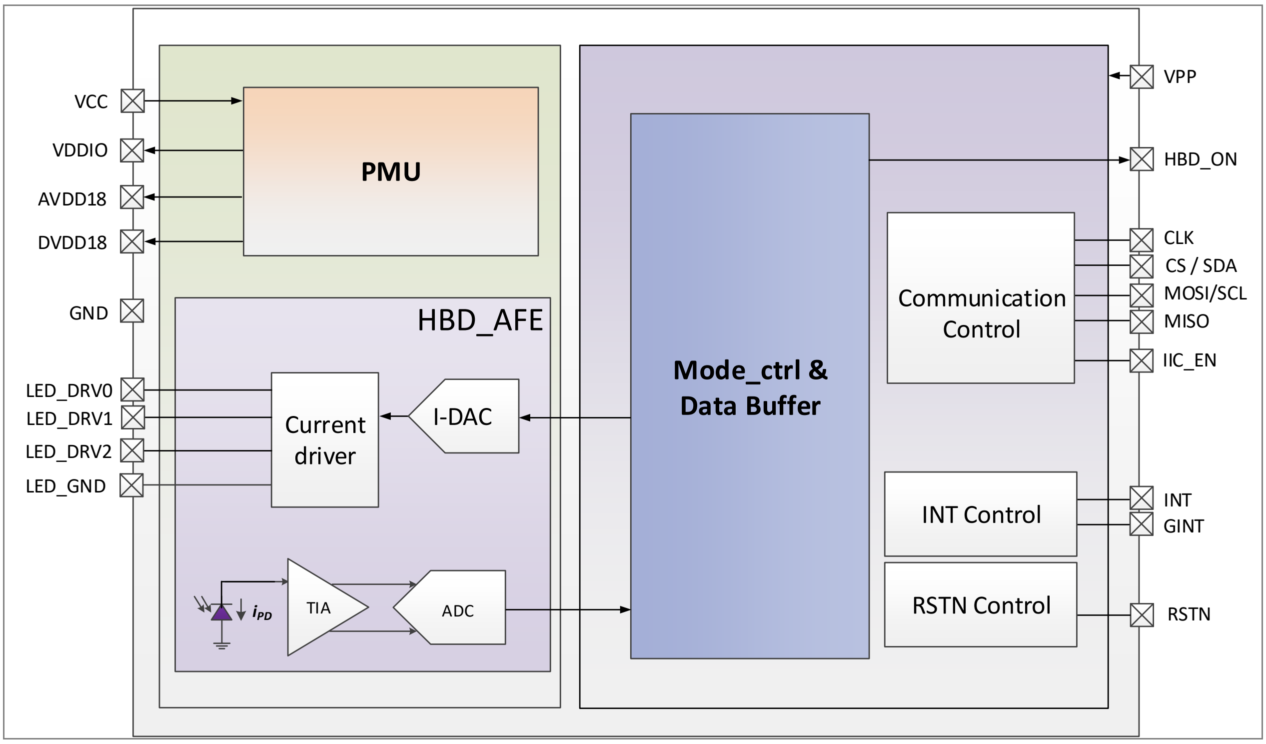

Figure 2-1 GH3011 IC Block Diagram

Note:

TIA (Trans-Impedance Amplifier) is used to convert the photocurrent into voltage which serves as the input of ADC.

2.2 Typical Application System

The block diagram of GH3011 typical application system is shown in Figure 2-2. GH3011 can be regarded as a smart sensor responsible for capturing heart rate data; the MCU on the wearable device is responsible for data pre-processing and calculation in the exercising algorithm module; the cellphone serves as the control and signal processing center.

The dynamic integration of GH3011, G-Sensor and exercising heart rate algorithm enables users to track their heart rate more accurately when exercising.

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

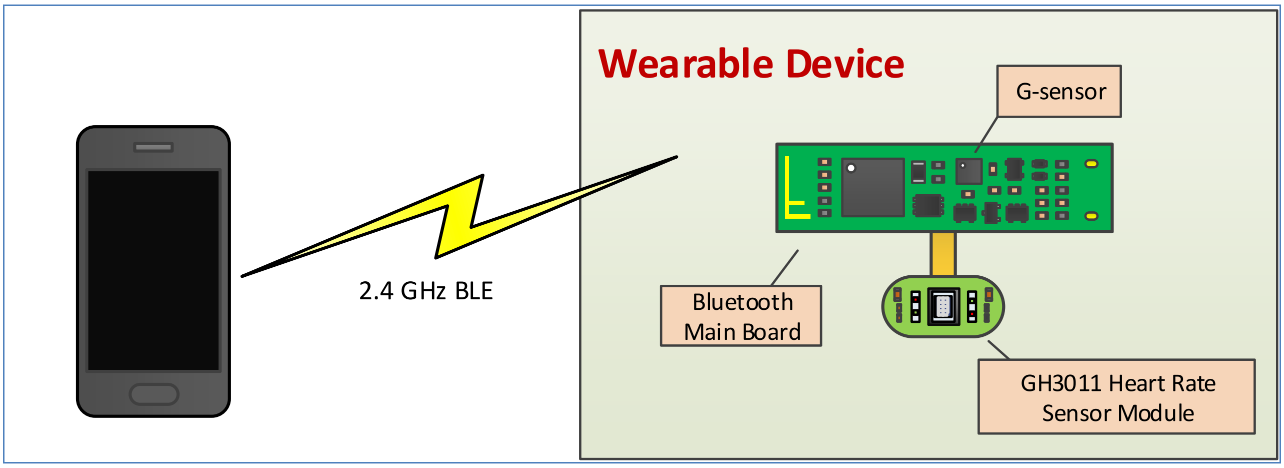

Figure 2-2 GH3011 Typical Application in Wristband

2.3 Pin Definition

2.3.1 Pin Assignment

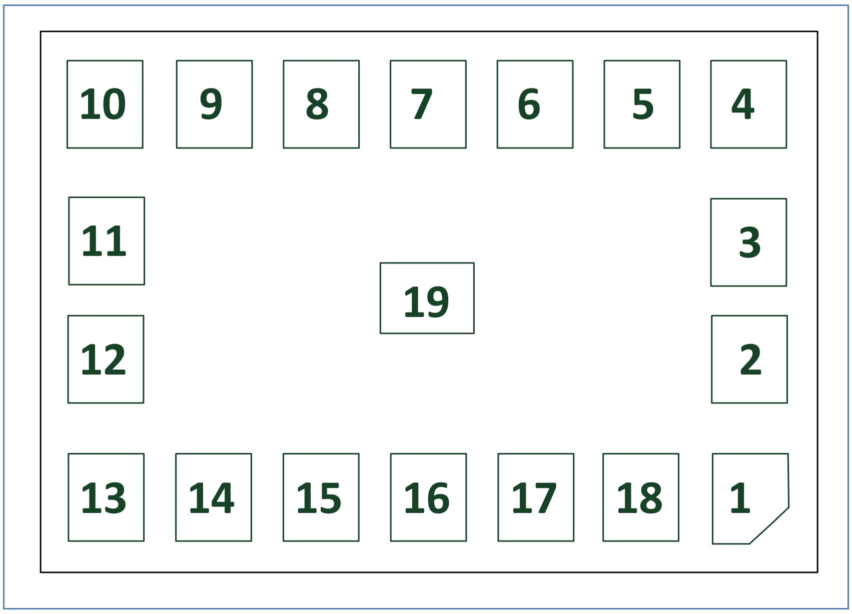

Figure 2-3 GH3011 Pin Assignment (Top View)

2.3.2 Pin Definition

Table 2-1 Pin Definition

Pin No.	Name	Type	Description
1	MISO	I/O	MISO signal for SPI communication; When IIC communication is employed, this pin can be used to define IIC address; the level on this pin during power-on process decides the bit 0 of the 7-bit IIC address.
2	IIC_EN	I/O	Communication protocol selection: connecting to ground indicates SPI is selected; leaving floating indicates IIC is selected.
3	HBD_ON	I/O	HBD working flag, active-high, left floating if unused
4	VPP	PWR	For internal use only; left floating when applied.

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

Pin No.	Name	Type	Description
5	RSTN	I/O	Hardware reset, active-low
6	INT	I/O	Interrupt signal output
7	AVDD18	PWR	Analog power domain for GH3011, internal LDO integrated, must be connected to external 1μF decoupling capacitor
8	GND	PWR	System Ground
9	LED_GND	PWR	Ground for LED driver; connected to GND when applied
10	VCC	PWR	Power supply for GH3011 system
11	LED_DRV0	Analog	LED0 driver pin, connected to the negative lead of the external LED
12	LED_DRV1	Analog	LED1 driver pin, connected to the negative lead of the external LED
13	LED_DRV2	Analog	LED2 driver pin, connected to the negative lead of the external LED
14	VDDIO	PWR	Power domain for digital IO, powered by external power supply
15	DVDD18	PWR	Digital power domain for GH3011, internal LDO integrated, must be connected to external 1 μF decoupling capacitor
16	CS/SDA	I/O	Chip select signal in SPI mode / Data signal in IIC mode
17	MOSI/SCL	I/O	MOSI signal in SPI mode / Clock signal in IIC mode
18	CLK	I/O	Clock signal in SPI mode. When IIC communication is employed, this pin can be used to define IIC address; the level on this pin during power-on process decides the bit 1 of the 7-bit IIC address.
19	GINT	I/O	Wake-up interrupt input for wearing detection; can be connected to the interrupt output pin of the G-sensor

2.4 Sample Schematic

A typical GH3011 module is composed of GH3011 heart rate sensor, LED light source, Bluetooth host, G-sensor, and other components. Wristband and fingertip oximeter are taken as example herein to illustrate the application scheme.

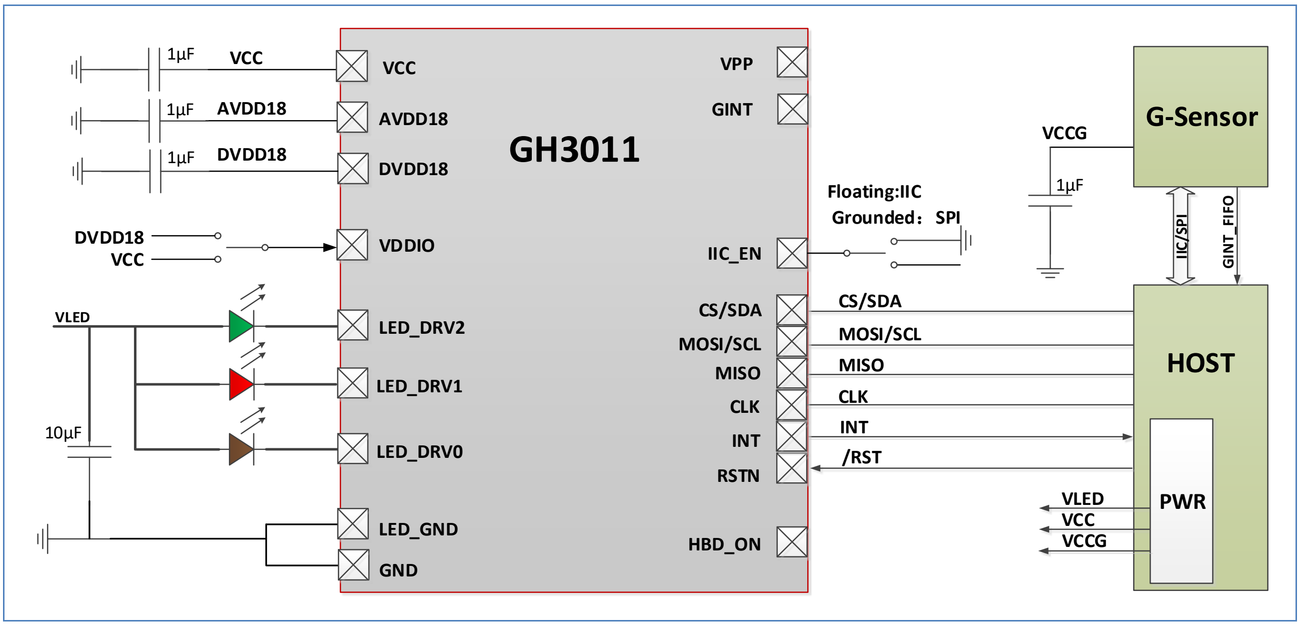

Figure 2-4 Sample Schematic for GH3011 Wristband Application

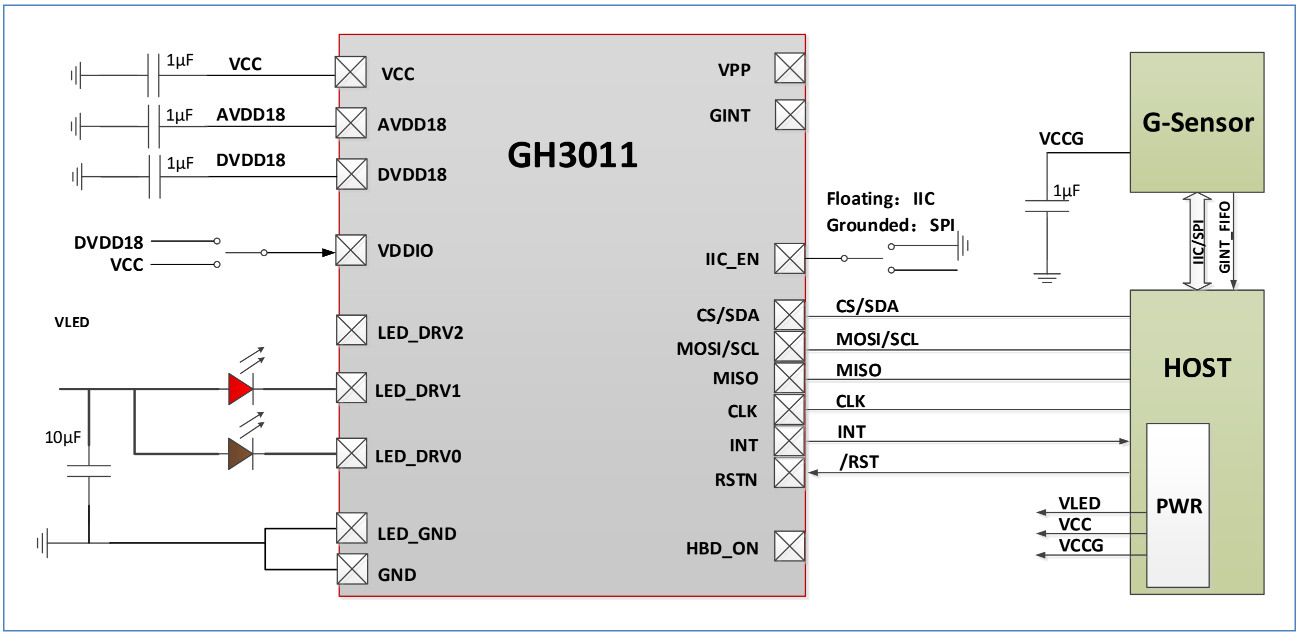

Figure 2-5 Sample Schematic for GH3011 Fingertip Oximeter Application

The LED configuration of the reference application scheme provided by Goodix is shown in the table below. In this reference scheme, the function and LED type of each LED_DRV channel are specified.

Table 2-2 LED_DRV Channel Function and LED Model Selection

Drive Channel	"SpO2+HR" Detection		"HR" Detection		SpO2 Detection	
	LED Light Source	Function	LED Light Source	Function	LED Light Source	Function
LED_DRV0	IR	Wearing and SpO2 detections	IR	Wearing Detection	IR	Wearing and SpO2 detections
LED_DRV1	Red	SpO2	Green	HR and Wearing Detections	Red	SpO2
LED_DRV2	Green	HR and Wearing Detections	Green		Null	Null

In "SpO2+HR" detection, external IR, red and green LEDs are required. The IR and red LEDs are used for SpO2 detection; meanwhile, the red LED is used for wearing detection as well and the green LED is used for heart rate and wearing detections.

In "HR" detection, external IR and green LEDs are required. The IR LED is used for wearing detection while the green LEDs are used for heart rate and wearing detections.

In SpO2 Detection, the external IR LED and red LED are required. Both the IR and red LEDs are used for SpO2 detection. Besides, the IR LED can be used for wearing detection.

2.4.1 System Power Selection

As for the typical application of GH3011, two alternative power supply schemes are provided below.

Table 2-3 System Power Selection

Scheme	Power Supply Mode	Requirements on VCC Power Supply	Requirements on VLED Power Supply	Remark
Scheme 1	VCC and VLED share the same power supply	3.3±0.1V ≥120mA		VCC power supply white noise: <50mVpp @ 0 to 1 MHz

 Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

Scheme	Power Supply Mode	Requirements on VCC Power Supply	Requirements on VLED Power Supply	Remark
Scheme 2	VCC and VLED are powered independently by different power supplies	2.1-3.3V ≥40mA	3.3-4.5V ≥120mA	bandwidth

2.4.2 Communication Voltage Level Selection

The supply voltage of VDDIO ranges from 1.8 V to VCC; VDDIO can be connected to the VCC pin or DVDD18 pin of GH3011. DVDD18 supplies 1.8V voltage. After selecting the communication voltage level for VDDIO, please check whether it matches with the communication voltage level on the host side, to prevent current leakage caused by the mismatch between the communication voltage level on host side and that on the module side.

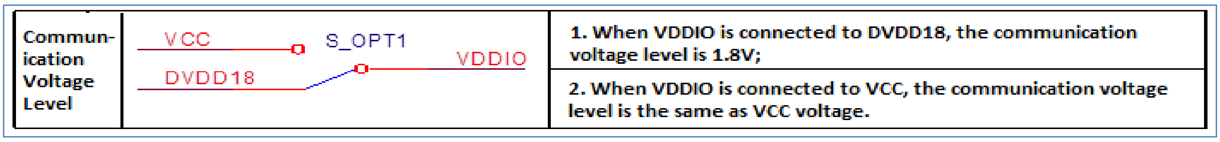

Figure 2-6 Communication Logic Level Selection

Note:

When the communication voltage level on the host side is not VCC or 1.8V, the main board should supply power to the VDDIO pin of GH3011 module to ensure that the communication voltage level on host side is identical with that on the module side.

3 Power Management and Reset

3.1 Power-Up/Down Timing Sequence

As for power-up, VCC should rise to the threshold voltage (Vpor) preset by GH3011 first, and then GH3011 will complete power-on reset (POR). Subsequently, the host will configure GH3011 to start initialization. After initialization, the host will configure GH3011 to enter Sleep/HBD/ADT mode.

As for power-down, please make sure that VDDIO is powered down before VCC, or VDDIO and VCC are powered down simultaneously.

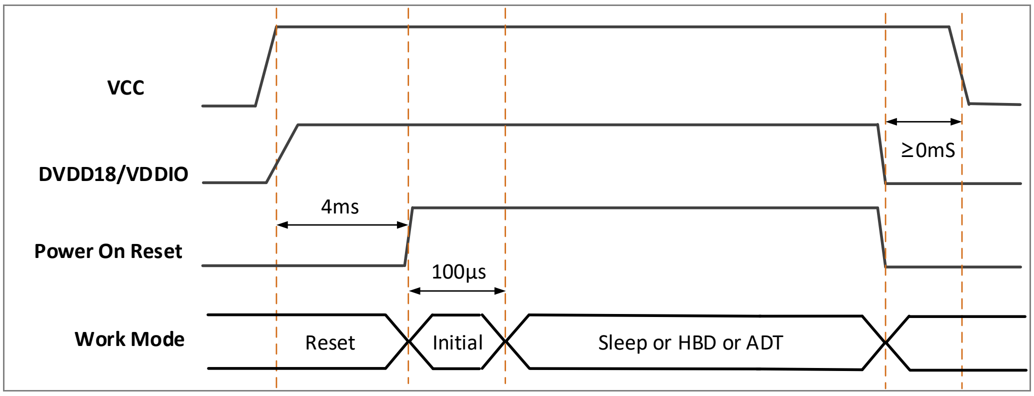

Figure 3-1 Power-Up/Down Timing Diagram

Follow the timing sequence below during system application.

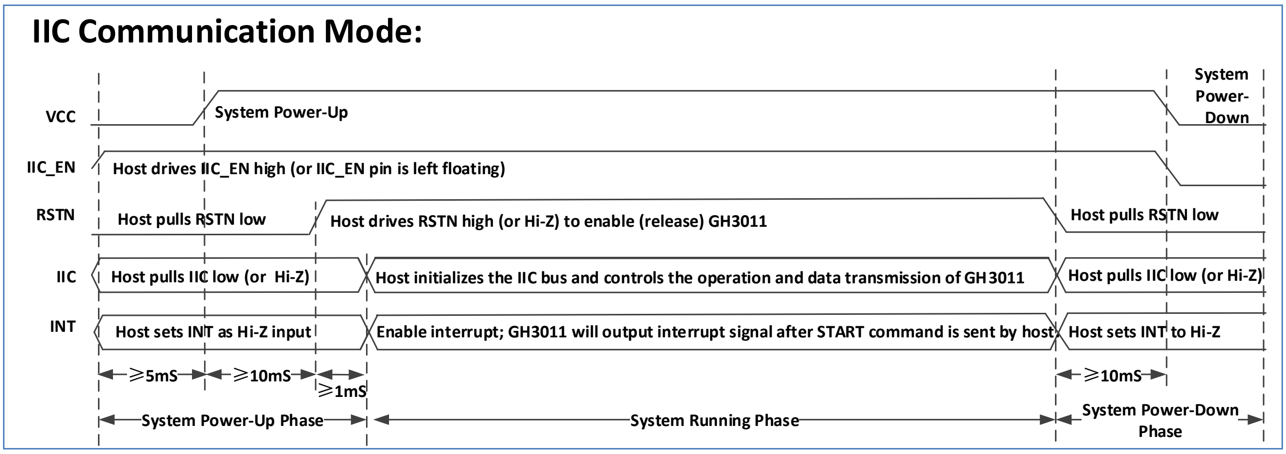

Figure 3-2 IIC System Control Timing Sequence

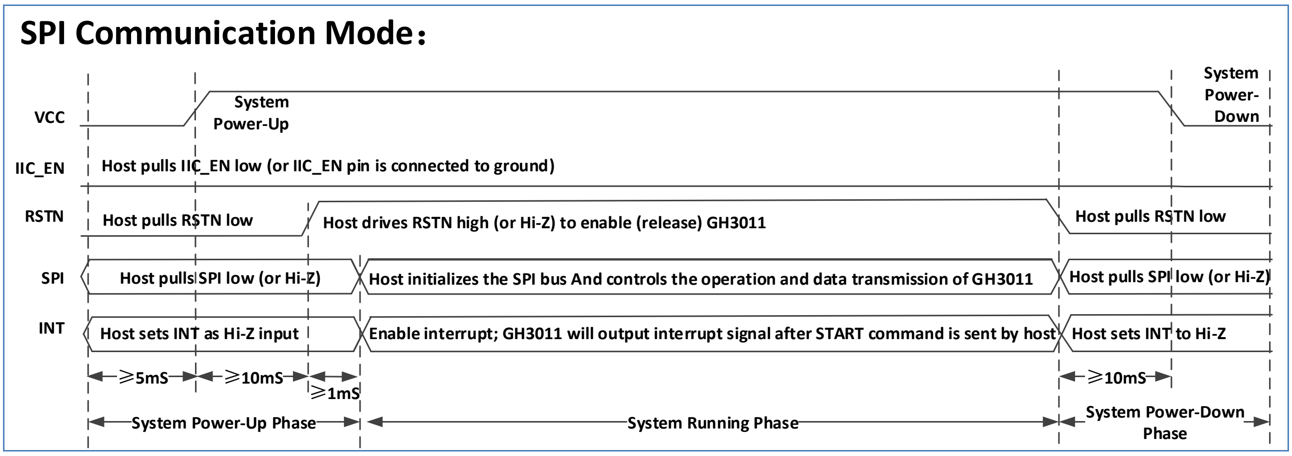

Figure 3-3 SPI System Control Timing Diagram

3.2 Reset

There are 3 reset sources for GH3011, namely, Power-On Reset (POR), Hardware Reset and Software Reset.

Table 3-1 Reset Sources

No.	Reset Source Type	Description
1	POR	GH3011 will start working when VCC voltage reaches the POR threshold (Vpor) preset by GH3011
2	Hardware RSTN	Reset GH3011 by pulling RSTN pin low through hardware
3	Software	Reset GH3011 by sending RSTN command through the communication interface

4 Communication Interface

4.1 IIC

The MCU can access the resources inside GH3011, such as registers and FIFO, through IIC interface. Meanwhile, both single and burst read and write operations are supported. In addition, GH3011 is capable of receiving and parsing the specified commands sent by MCU, so as to control the transition of the internal state machine.

The address, command and data in this protocol will be sent based on the bit order "Most Significant Bit" first; the register address where read/write operation starts and the data are 16-bit wide while the FIFO data is 24-bit wide; they will be transmitted in bytes, most significant bit first.

4.1.1 IIC Address Selection

In this mode, if the communication interface is IIC, the MISO level during GH3011 power-on process decides the value of bit 0 in IIC 7-bit address while the SCK level decides the value of bit 1 in the IIC 7-bit address. Bit 1 and bit 0 are represented by "XX" in the IIC address below.

4.1.2 IIC Write Operation Protocol

The data format of the write operation is as follows:

Start + 8(addr (7'b00101XX + W)) + 8(reg_high) + 8(reg_low) + 8(data_high) + 8(data_low) + …… + stop;

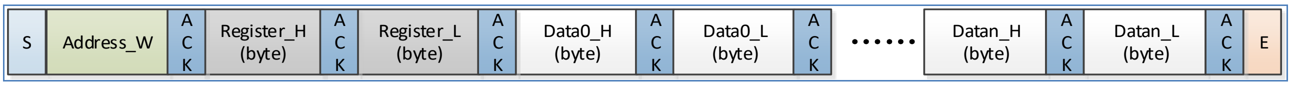

Figure 4-1 IIC Write Operation Data Format

4.1.3 IIC Read Operation Protocol

There are two kinds of data formats when reading from slave:

- Data Format A:

Start + 8(addr (7'b00101XX + W)) + 8(reg_high) + 8(reg_low) + stop;

Start + 8(addr (7'b00101XX + R)) + 8(data_high) + 8(data_low) + …… + stop;

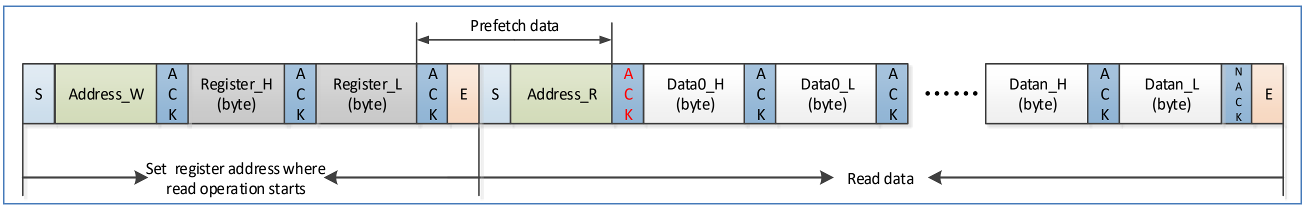

Figure 4-2 Data Format A of IIC Read Operation

- Data Format B:

Start + 8(addr (7'b00101XX + W)) + 8(reg_high) + 8(reg_low) + start + 8(addr (7'b00101XX + R)) + 8(data_high) + 8(data_low) + …… + stop;

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

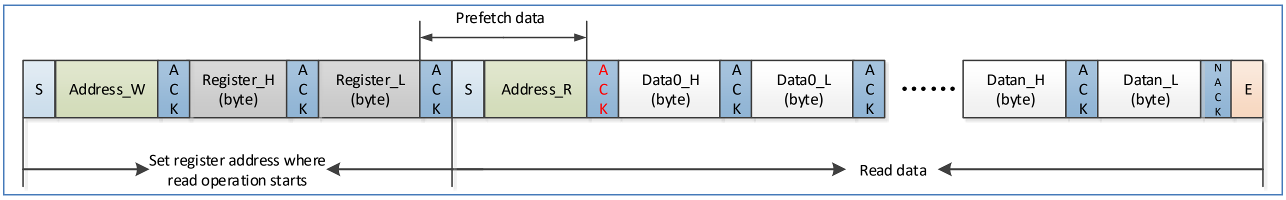

Figure 4-3 Data Format B of IIC Read Operation

Constraint on Read operation: after the reading is completed, if it is necessary to operate IIC bus continuously, the interval between two adjacent read operations should be longer than 10µs.

4.1.4 IIC Command Issuance Protocol

The data format for command issuance is as follows:

start + 8(addr (7'b00101XX + W)) + 8(reg_high 8'hDD) + 8(reg_low 8'hDD) + 8(Cmd) + stop;

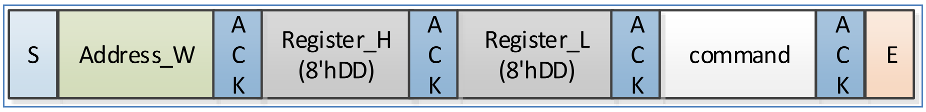

Figure 4-4 Data Format for IIC Command Issuance

4.1.5 IIC Timing

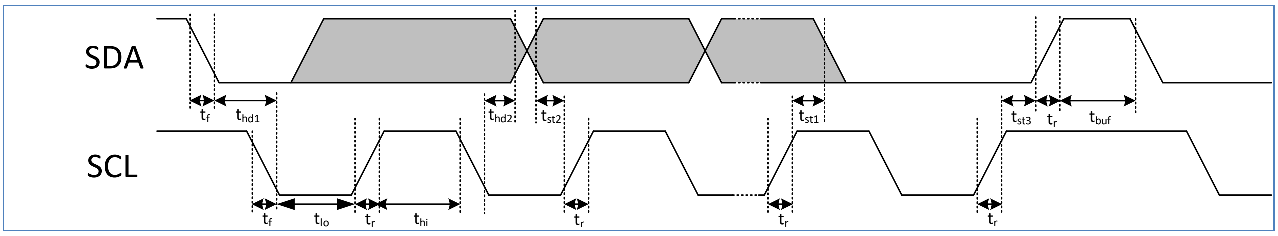

Figure 4-5 IIC Timing Diagram

Table 4-1 IIC Timing Parameters

Parameter	Symbol	Min.	Max.	Unit
Clock Frequency	f_{SCL}	-	400	KHz
SCL low period	t_{lo}	0.4	-	µs
SCL high period	t_{hi}	0.4	-	µs
SCL setup time for START condition	t_{st1}	0.1	-	µs
SCL setup time for STOP condition	t_{st3}	0.1	-	µs
SCL hold time for START condition	t_{hd1}	0.1	-	µs
SDA setup time	t_{st2}	0.1	-	µs
SDA hold time	t_{hd2}	0.1	-	µs
Time before a new transmission can start	t_{buf}	10		µs

4.2 SPI

The MCU can access the resources inside GH3011, such as registers and FIFO, through SPI interface. Meanwhile, both single and burst read and write operations are supported. In addition, GH3011 is capable of receiving and parsing the specified commands sent by MCU, so as to control the transition of the internal state machine.

The address, command and data in this protocol will be sent based on the bit order "Most Significant Bit" first; the

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

register address where read/write operation starts and the data are 16-bit while the

FIFO data is 24-bit wide; they will be transmitted in bytes, most significant bit first.

4.2.1 SPI Write Operation Protocol

The data format of the write operation is as follows: CS_Low + 8(cmd(8'hF0)) + 8(reg_high) + 8(reg_low) + 8(length_high) + 8(length _low)+ 8(data_high) + 8(data_low) + …… + Delay (t1) + CS_High+ Delay (t2);

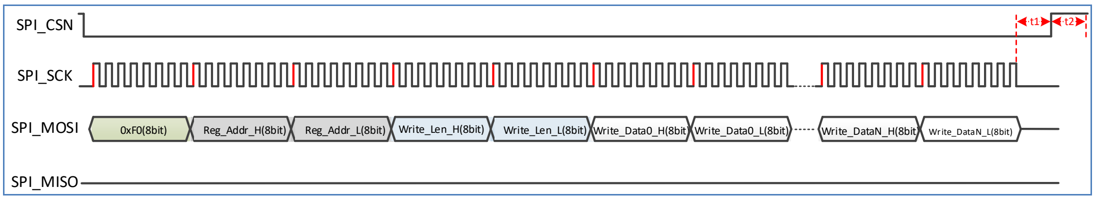

Figure 4-6 Data Format of SPI Write Operation

Constraint on Write operation: A delay (t1≥15 µs) is required after writing the last byte. After CS is pulled high, another delay (t2≥5 µs) is required.

4.2.2 SPI Read Operation Protocol

The data format of the read operation is as follows: CS_Low + 8(cmd(8'hF0)) + 8(reg_high) + 8(reg_low) + Delay (t1) + CS_High+ Delay (t2) + CS_Low + 8(data_high) + 8(data_low) + ……+ CS_High+ Delay (t3);

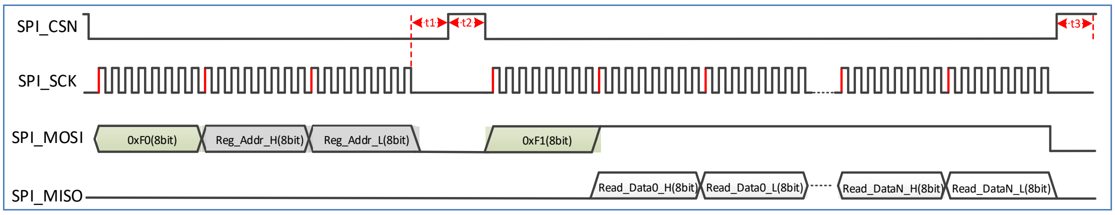

Figure 4-7 Data Format of SPI Read Operation

Constraint on Read operation: a delay (t1≥15 µs) is required after sending the address. After CS is pulled high during the intermediate procedure, there is a delay (t2≥5 µs). After the data reading is completed and CS is pulled high again, a delay (t3≥5 µs) is required.

4.2.3 SPI Command Issuance Protocol

The data format of sending command is as follows: CS_Low + 8(Cmd) + CS_High + Delay (t1);

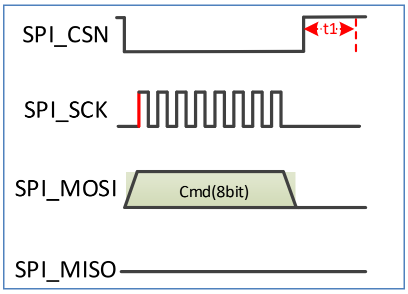

Figure 4-8 Data Format of SPI Command Issuance

Constraint on Write operation: a delay(t1≥5us) is required after sending Cmd is completed and CS is pulled high.

4.2.4 SPI Timing

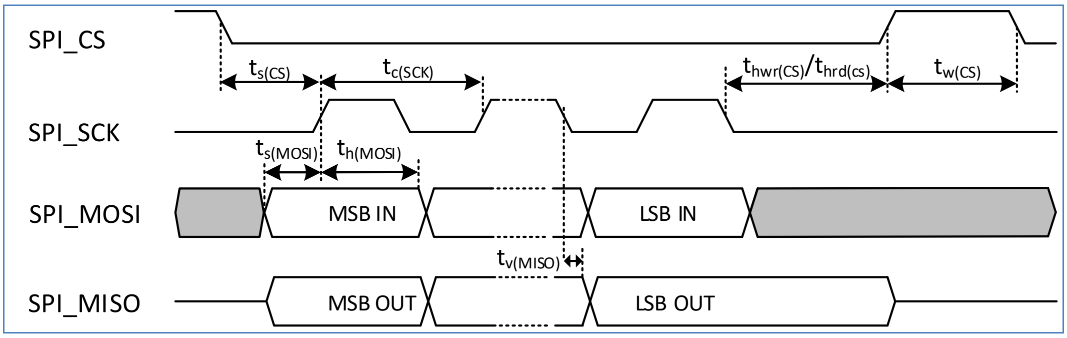

Figure 4-9 SPI Timing Diagram

Table 4-2 SPI Timing Parameters

Symbol	Description	Min.	Typ.	Max.	Unit
$DuCy_{(SPI\_SCK)}$	SPI_SCK Clock Duty Cycle	-	50	-	%
$1/tc_{(SCK)}$	SPI_SCK Clock Speed	-	4	-	MHz
$ts_{(CS)}$	SPI_CS Setup Time	40	-	-	ns
$t_{hwr(CS)}$	SPI_CS Write Operation Hold Time	15	-	-	µs
$t_{hrd(CS)}$	SPI_CS Read Operation Hold Time	10	-	-	ns
$t_{w(CS)}$	SPI_CS Idle Time	6	-	-	µs
$t_{s(MOSI)}$	Data Input Setup Time	40	-	-	ns
$t_{h(MOSI)}$	Data Output Setup Time	40	-	-	ns
$t_{v(MISO)}$	Data Output Valid Time	-	-	30	ns

4.3 Communication Interface Verification Guidelines

Follow the steps below if the user wants to verify whether the communication succeeds.

1. When there is no GH3011 driver library, follow the steps below:

   (1) Implement IIC/SPI interface function;

   (2) Send command “0xC0” according to the IIC/SPI command sending protocol; delay for 1ms and then read 2 bytes from the register whose address is 0x0028 according to the IIC/SPI read operation protocol; if the read-out value is 0x0031, the communication interface passes the verification.

2. When there is GH3011 driver library, follow the steps below:

   (1) Implement IIC/SPI interface function;

   (2) Invoke HBD_SetIICRW/HBD_SetSPIRW function in GH3011 driver library to register the IIC/SPI interface into the library;

   (3) Invoke HBD_CommunicationInterfaceConfirm interface in GH3011 driver library; if the returned value is “HBD_RET_OK”, the communication interface passes the verification.

Note:

As for the details of the interfaces in the driver library, please refer to the file *GH3011 Heart Rate Sensor Application Note*.

5 Operating Modes

GH3011 can operate in three modes: Sleep Mode, HBD Mode and ADT Mode.

5.1 Sleep Mode

GH3011 enters Sleep mode after power-on initialization. In Sleep mode, the blocks which are not required will be turned off and the system consumes the least power.

5.2 HBD Mode

After entering HBD Mode, GH3011 will capture the PPG data periodically and generate the new-data-ready interrupt or FIFO-almost-full interrupt. The host will wake up and read the data through SPI/IIC interface only after receiving the interrupt, so as to save power. The PPG data captured can be used for heart rate, heart rate variability, SpO2 and other relevant detections.

5.3 ADT Mode

After the wearing detection is enabled, the system will enter into ADT mode and GH3011 starts the wearing detection. The wearing status will be returned by triggering interrupt.

5.4 Mode Transition

GH3011 can switch between Sleep Mode and HBD Mode by invoking the HBD_HbStart and HBD_Stop functions, and switch between Sleep mode and ADT mode by invoking the HBD_AdtStart and HBD_Stop functions.

The transition diagram is shown below:

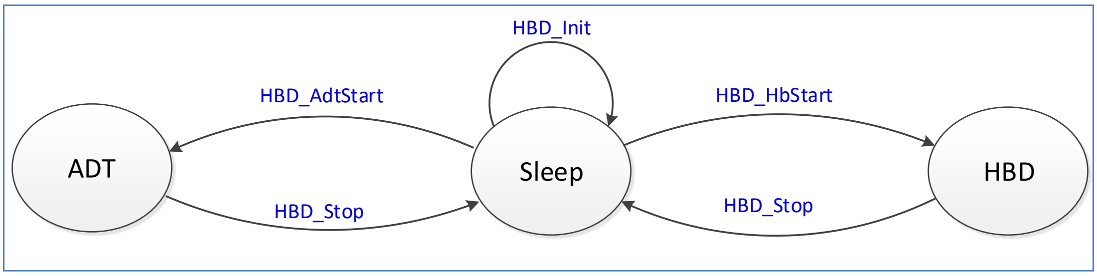

Figure 5-1 System Operating State Transition

Note:

As for details of invoking functions for the operating mode transition, please refer to the file *GH3011 Heart Rate Sensor Application Note*.

6 Electrical Characteristics

6.1 Absolute Maximum Ratings

Table 6-1 GH3011 Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VCC	-0.3	3.6	V
LED_DRV[0:2]	-0.3	4.0	V
VDDIO	-0.3	3.6	V
Voltage on digital I/O	-0.3	VDDIO+0.3	V
Storage temperature	-40	+125	°C
ESD susceptibility (HBM)	±2		kV

Note:

- Stresses above these ratings may cause permanent damage.
- These are stress ratings only, and functional operation of the device at these or any other conditions beyond those specified is not implied.
- Exposure to absolute maximum conditions for extended periods may degrade device reliability.

6.2 Recommended Operating Conditions

Table 6-2 Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit	Remark
VCC	2.1	-	3.3	V	Power Supply Noise < 50mVpp (White Noise 1 MHz)
VDDIO	1.62	1.8	VCC	V	Digital IO power domain; voltage on VDDIO cannot exceed voltage on VCC
Operating temperature	-20	+25	+50	°C	-

6.3 DC Electrical Characteristics

Operating Conditions: VCC = 3.3 V, VLED = 4.2 V, Ambient temperature: 25°C

Table 6-3 DC Electrical Characteristics

Parameter	Min.	Typ.	Max.	Unit	Remark
HBD Mode Average current @25 Hz	-	25	-	µA	1. 52.6µs ADC sampling; 2. The LED drive current is excluded.
SpO2 Detection Mode Average Current @25 Hz	-	110	-	µA	1. 352 µs ADC sampling; 2. The LED drive current is excluded.
ADT Mode Current	-	10	-	µA	LED drive current is included
Sleep Mode Current	-	3	-	µA	-
Digital input low voltage/V_{IL}	-	-	0.25*VDDIO	V	-

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

Parameter	Min.	Typ.	Max.	Unit	Remark
Digital input high voltage/V_{IH}	0.75*VDDIO	-	-	V	-
Digital output low voltage/V_{OL}	-	-	0.15*VDDIO	V	-
Digital output high voltage V_{OH}	0.85*VDDIO	-	-	V	-

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

7 Package

7.1 Package Drawing

GH3011 is in LGA package and the specific dimensions are shown in the figure below.

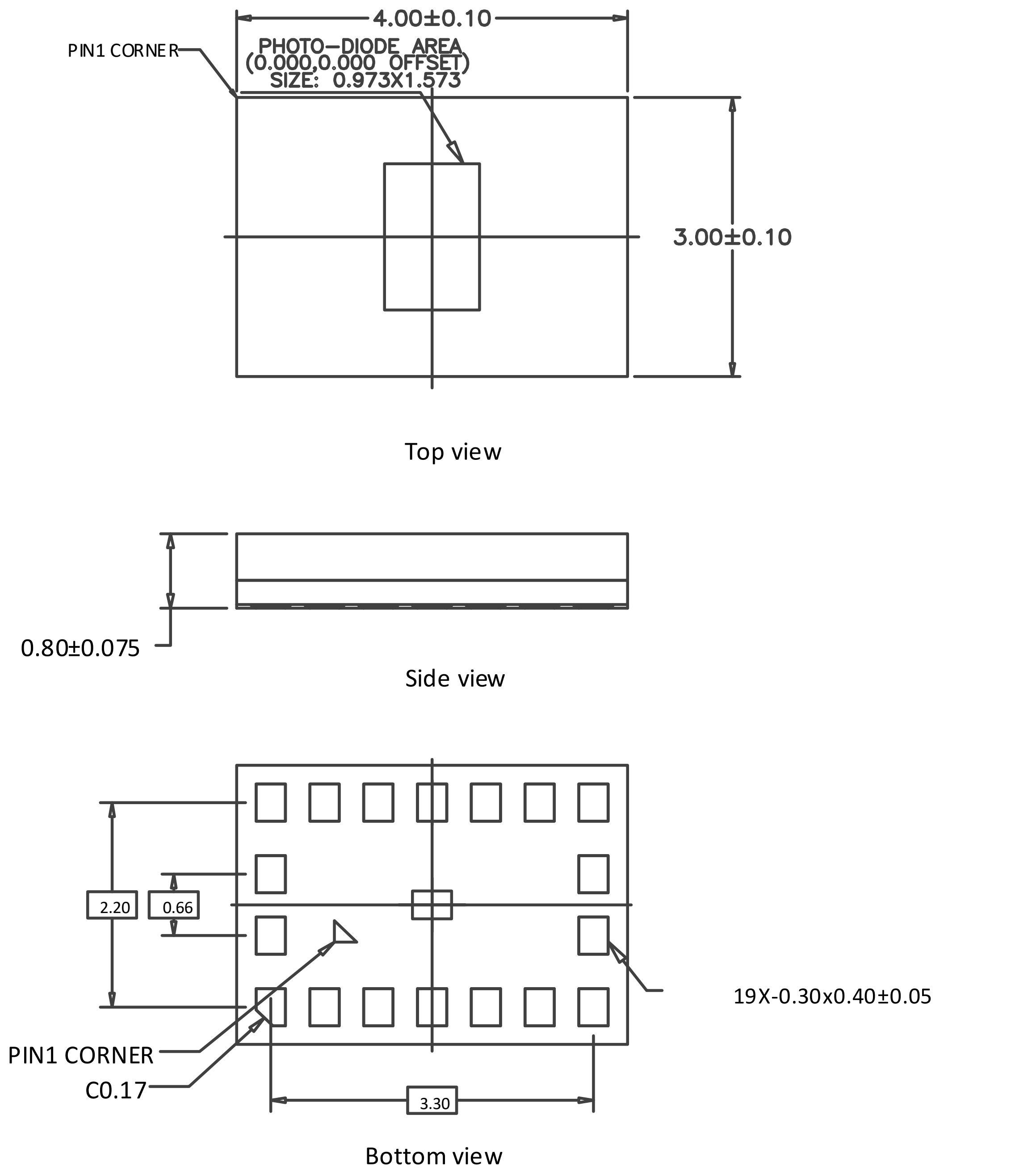

Figure 7-1 Package Drawing (Unit: mm)

7.2 Recommended Package Design on PCB/FPC

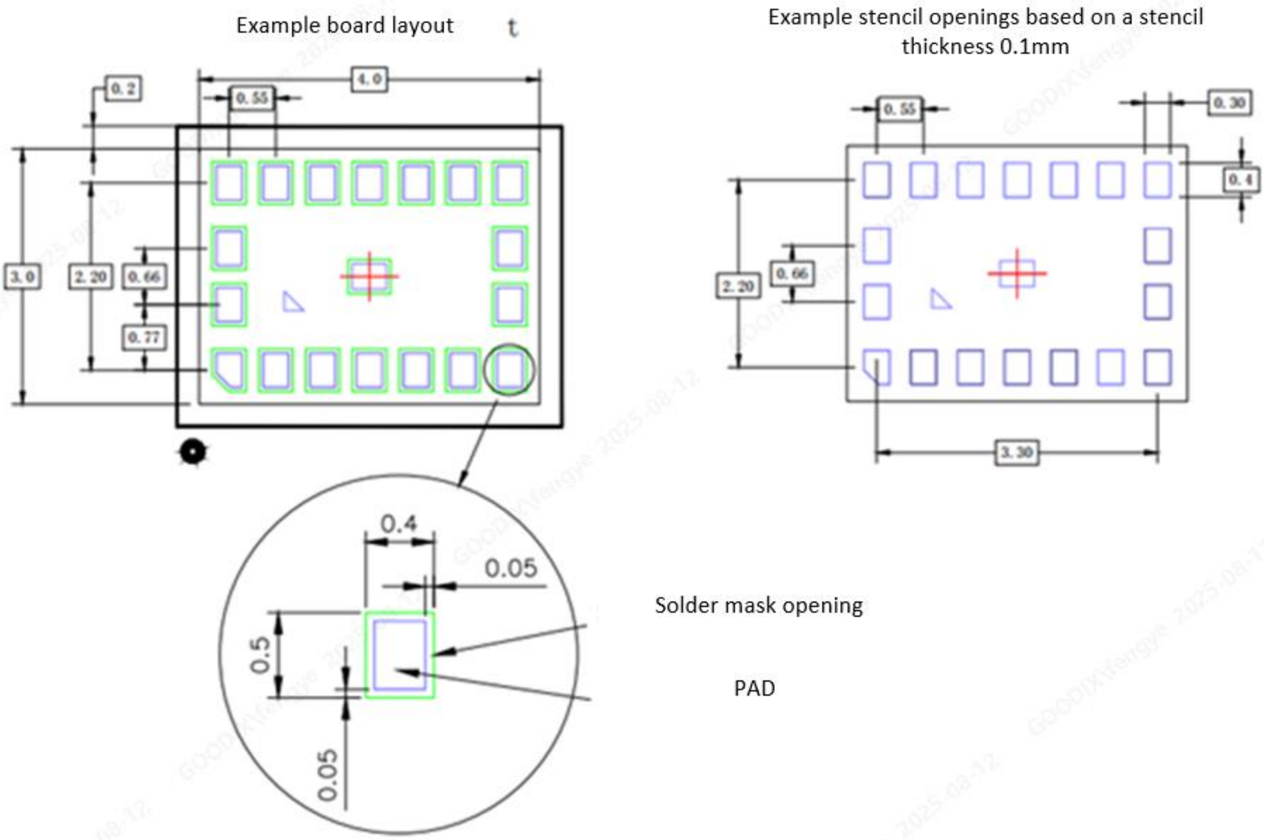

Figure 7-2 Package Design on PCB/FPC

Note:

- All dimensions are in millimeter (mm);
- The size of the pad on PCB/FPC should be identical with that on IC package; the solder mask openings on PCB/FPC should be larger than the pad for 0.05 mm on each side, that is, Cu pad size=0.3 mm×0.4 mm and SR opening size=0.4 mm×0.5 mm;
- The precision of solder mask opening is required to be less than 50 μm (that is, single-side tolerance <50 μm);
- The recommended stencil opening size is 0.3 mm×0.4 mm (tolerance for length/width: ±0.02 mm); stencil thickness can range from 0.08 mm to 0.12 mm and should be adjusted according to SMT yield;
- There should be silk screen printing on PCB to mark the chip outline for the convenience of position alignment and visual inspection; the silk screen printed outline should be 0.2 mm larger than the actual chip size on each side; the PCB area right below the chip should be smooth, without any silk screen printing, in case that it affects SMT.

7.3 Package Marking

The products of the same batch feature the same marking information. The definition of the marking information is shown below.

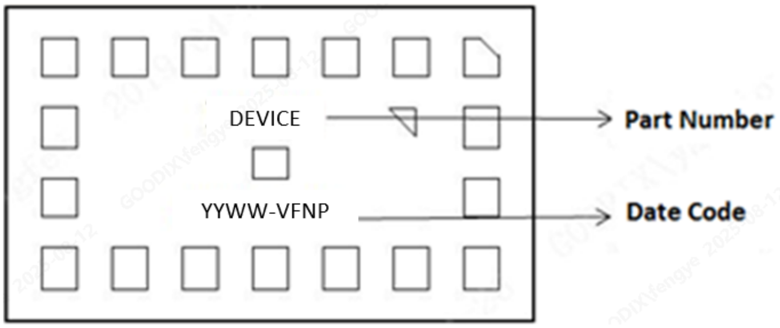

Figure 7-3 GH3011 Package Marking Sample

8 Moisture Sensitivity Level (MSL)

GH3011 is classified as MSL3. The detailed requirements are listed below:

1. Calculated shelf life in sealed Moisture-Barrier Bag: 12 months at <40ºC and < 90% relative humidity (RH).
2. After the bag is opened, devices that will be subjected to IR reflow solder or other high temperature process (<260ºC) must be
   (1) Mounted within: 168 hours of factory conditions ≤30ºC/60% RH, OR
   (2) Stored at ≤10% RH (such as a dry cabinet).
3. Devices require baking before mounting, if:
   (1) Humidity indicator card is >20% when read at 23±5ºC;
   (2) 2(1) or 2(2) not met.
4. If baking is required:
   (1) Devices shipped in low temperature carriers (such as Tape and Reel) can be baked in carriers for 192 hours at 40ºC +5ºC /-0ºC and <5% RH.
   (2) Devices shipped in high temperature carriers (such as Tray) can be baked in carriers for 24 hours at 125ºC +5/-0ºC.
   (3) After baking, device should be put into the Moisture-Barrier Bag right after it cools down. Device shipped in low temperature carriers (such as Tape and Reel) should be packed inside the bag along with at least 5g desiccant and a six-spot humidity indicator card; Device shipped in high temperature carriers (such as Tray) should be packed inside the bag along with at least 10g desiccant and a six-spot humidity indicator card. Each bag should be vacuumized and sealed.

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

9 SMT Requirements

9.1 Pb-Free Reflow Temperature Profile

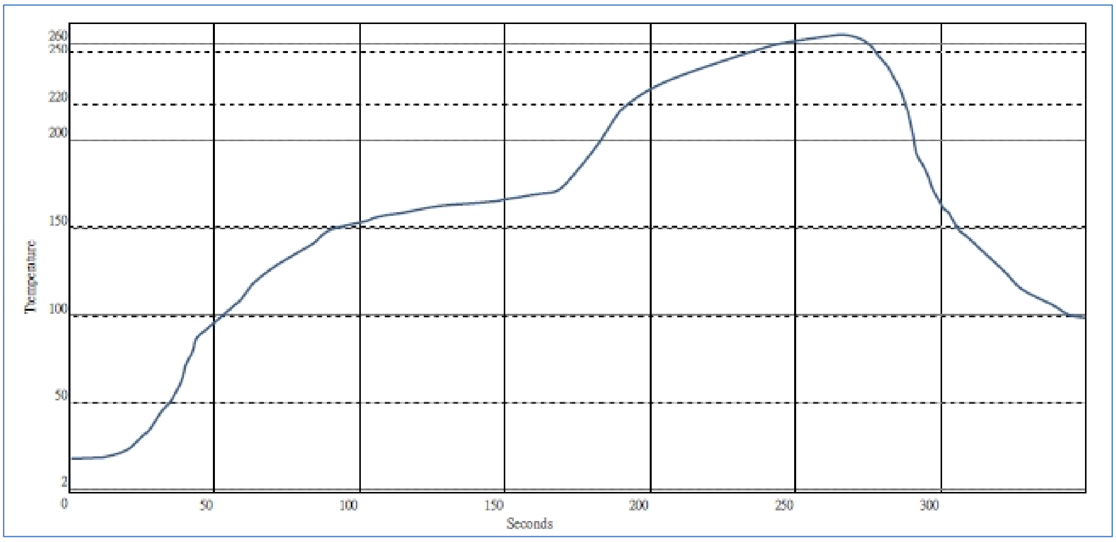

Figure 9-1 Pb-Free Reflow Temperature Profile

GH3011 follows the standard J-STD-020D-01 and more particularly these parameters:

Table 9-1 Pb-Free Reflow Temperature Profile Parameters

<table>
<tr><th colspan="4">Profile Feature</th><th colspan="3">Pb-Free Assembly (For reference)</th></tr>
<tr><td rowspan="7">Room Temperature to Peak Temperature</td><td colspan="2" rowspan="2">A. Pre-heating zone (25°C-150°C)</td><td>Duration</td><td colspan="2">80s-120s</td><td rowspan="7">The time spent on ramping up from room temperature to peak temperature should be less than 8 minutes.</td></tr>
<tr><td>Ramp Up Rate</td><td colspan="2"><3°C/s</td></tr>
<tr><td colspan="2" rowspan="2">B. Constant-Temperature zone (150°C-200°C)</td><td>Duration</td><td colspan="2">60s-120s
(100s is recommended)</td></tr>
<tr><td>Ramp Up Rate</td><td colspan="2"><1°C/s</td></tr>
<tr><td rowspan="5">Time Above 217°C</td><td rowspan="2">C. 217°C-260°C</td><td>Duration</td><td>60s-85s</td><td rowspan="5">Time above 217°C: 60s-150s</td></tr>
<tr><td>Ramp Up Rate</td><td><3°C/s</td></tr>
<tr><td>D. Peak Temp. (255°C-260°C)</td><td>Duration</td><td>20s-30s</td></tr>
<tr><td rowspan="2">--</td><td rowspan="2">E .260°C -217°C</td><td>Duration</td><td>60s-75s</td><td>--</td></tr>
<tr><td>Ramp Down Rate</td><td><6°C /s</td><td>--</td></tr>
<tr><td>--</td><td colspan="2">F. Time Below 217°C (Cooling zone)</td><td>Ramp Down Rate</td><td colspan="2">1°C /s-3°C/s</td><td>--</td></tr>
</table>

Please follow the standard "J-STD-020D-01".

Caution:

- The peak temperature in the oven cannot exceed 260°C (please refer to the reflow temperature profile of the specific solder paste); the temperature tolerance of the IC package material is less than 260°C, therefore , the SMT temperature must be lower than 260°C;
- Rework is not recommended; if rework is inevitable, please do not use heat gun or soldering iron; rework station is recommended and please make sure the temperature is lower than 260°C;
- Number of Thermal shocks: Number of soldering (Reflow solder + Wave Solder +Rework) passes: ≤ 3.

9.2 Requirements on SMT Equipment

1. The chip mounter should be able to identify the pad location and offset tolerance (generally, the offset

Copyright ©2021 Shenzhen Goodix Technology Co., Ltd

tolerance should be less than 50 µm; the chip must be located by identifying the pads on the bottom of the chip instead of identifying the chip outline); microscope/SPI/AOI/X-Ray inspection equipment is used to check the alignment accuracy and whether there is a risk of short circuit, pseudo-soldering or other defects.

2. It is recommended that specialized fixture should be adopted to ensure the flatness of FPC (magnetic fixture is preferred);
3. Manual printer is not recommended (fully-automatic printer is recommended and the automatic printer should be able to identify the mark on PCB/FPC); first piece inspection is required in printing.

9.3 Requirements on Solder Paste

The solder paste is unspecified. Any Pb-free solder paste that has been used in successful mass production is applicable (SAC305 is recommended).

9.4 Requirements on Nozzle

There is no specific requirement on Nozzle.

10 Legal and Contact Information

Copyright © 2021 Shenzhen Goodix Technology Co., Ltd. All rights reserved.

Any excerption, backup, modification, translation, transmission or commercial use of this document or any portion of this document, in any form or by any means, without the prior written consent of Shenzhen Goodix Technology Co., Ltd is prohibited.

Trademarks and Permissions

GOODIX and other Goodix trademarks are trademarks of Shenzhen Goodix Technology Co., Ltd. All other trademarks and trade names mentioned in this document are the property of their respective holders.

Disclaimer

Information contained in this document is intended for your convenience only and is subject to change without prior notice. It is your responsibility to ensure its application complies with technical specifications.

Shenzhen Goodix Technology Co., Ltd. (hereafter referred to as "Goodix") makes no representation or guarantee for this information, express or implied, oral or written, statutory or otherwise, including but not limited to representation or guarantee for its application, quality, performance, merchantability or fitness for a particular purpose. Goodix shall assume no responsibility for this information and relevant consequences arising out of the use of such information.

Without written consent of Goodix, it is prohibited to use Goodix products as critical components in any life support system. Under the protection of Goodix intellectual property rights, no license may be transferred implicitly or by any other means.

Shenzhen Goodix Technology Co., Ltd.

Headquarters: Floor 13, Tower B, Tengfei Industrial Building, Futian Free Trade Zone, Shenzhen, China

TEL: +86-755-33338828 FAX: +86-755-33338099

Website: www.goodix.com

11 Revision History

Table 11-1 Revision History

Revision	Date	Description
0.1	2019-05-10	Preliminary version
0.2	2019-08-13	Updated description on application scheme in section 2.3; Modified the device baking conditions; Updated SMT requirements; Updated power consumption and VCC drive current..
0.3	2019-09-25	Modified description on function and LED model selection of LED_DRV channel in Table 3; Modified description on power supply schemes in section 2.3.1; Updated LED drive current in heart rate detection mode; Added some data in SpO2 detection mode; Modified the test condition of DC electrical characteristics (VLED=4.2 V).
1.0	2019-10-30	Initial release
1.1	2020-09-01	Updated SpO2 detection range and accuracy; Added description on fingertip oximeter in section 2.4; Updated description on HBD mode; Optimized some descriptions; Updated the document style.
1.2	2021-04-29	Updated the power-up/down timing sequence