



## INS5101A—Low Power Consumption I<sup>2</sup>C RTC

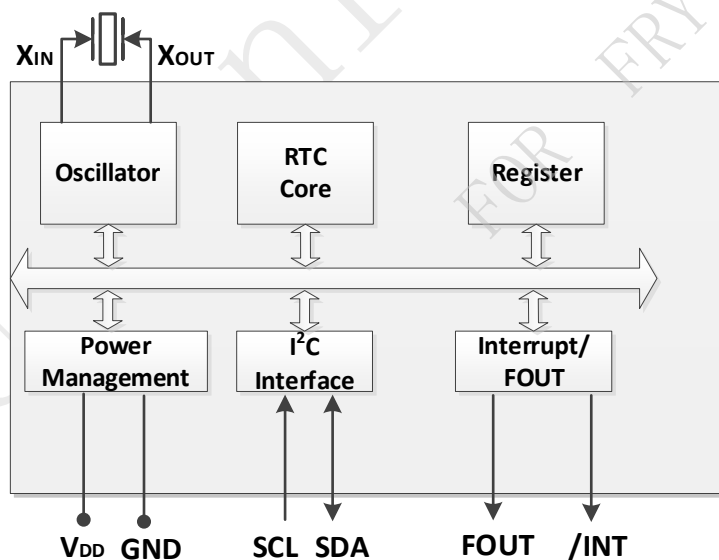
### Key Features

- Low Current Consumption: 0.8uA (Typ.)
- Timer, Alarm and Interrupt
- Frequency Output
- Communication Interface: I<sup>2</sup>C bus
- Build-in 128bit RAM
- Integrated Oscillator Capacitors: 12.5pF/6pF
- Power Supply Voltage: 1.2V~5.5V
- Operation Temperature Range: -40°C ~ +85°C
- Leap Years Autocorrection
- Package: 4.9mm × 6.0mm × 1.6mm (SOP8)

### Ordering Information

| Part Name | Manufacture Part Number (MPN) | Integrated Oscillator Capacitors | Package | Marking |
|-----------|-------------------------------|----------------------------------|---------|---------|
| INS5101A  | INS5101A                      | 12.5pF                           | SOP8    | 5101A   |
| INS5101A  | INS5101AA                     | 6pF                              | SOP8    | 5101A   |

### Block Diagram



### Overview

INS5101A is an I<sup>2</sup>C bus interface real-time clock with low power consumption. It supports calendar (year, month, day, hour, minute, second), timer and alarm function. The SOP8 package makes it suitable to be used in portable electronic devices.

**Revision History**

| Version | Change Contents   | Prepared by | Revised Date |
|---------|---|-------------|--------------|
| V1.0    | Released Version  |             | 2021.11.30   |
| V1.1    | Parameter update  |             | 2022.07.07   |
| V1.2    | Add INS5101AA (6pf)<br>Change Crystal's Rs from 100Kohm to 80Kohm |             | 2022.08.01   |



# Index

|           |   |           |
|-----------|---|-----------|
| <b>1</b>  | <b>OVERVIEW</b> .....                           | <b>4</b>  |
| <b>2</b>  | <b>BLOCK DIAGRAM</b> .....                      | <b>4</b>  |
| <b>3</b>  | <b>FEATURES</b> .....                           | <b>4</b>  |
| <b>4</b>  | <b>PIN DEFINITION</b> .....                     | <b>5</b>  |
| <b>5</b>  | <b>ELECTRICAL CHARACTERISTICS</b> .....         | <b>6</b>  |
| 5.1       | ABSOLUTE MAXIMUM RATINGS .....                  | 6         |
| 5.2       | RECOMMENDED OPERATING CONDITIONS.....           | 6         |
| 5.3       | OSCILLATOR CHARACTERISTICS .....                | 6         |
| 5.4       | DC CHARACTERISTICS .....                        | 7         |
| 5.5       | AC CHARACTERISTICS.....                         | 8         |
| <b>6</b>  | <b>REGISTERS</b> .....                          | <b>9</b>  |
| 6.1       | REGISTER LISTS .....                            | 9         |
| 6.2       | DETAILS OF REGISTERS.....                       | 10        |
| 6.2.1     | <i>Clock counter registers</i> .....            | 10        |
| 6.2.2     | <i>Alarm registers</i> .....                    | 11        |
| 6.2.3     | <i>Timer registers</i> .....                    | 12        |
| 6.2.4     | <i>Extension registers</i> .....                | 12        |
| 6.2.5     | <i>Flag Register</i> .....                      | 13        |
| 6.2.6     | <i>Control Register</i> .....                   | 13        |
| <b>7</b>  | <b>I<sup>2</sup>C BUS INTERFACE</b> .....       | <b>14</b> |
| 7.1       | CAUTIONS.....                                   | 14        |
| 7.2       | SLAVE ADDRESS .....                             | 14        |
| 7.3       | I <sup>2</sup> C BUS PROTOCOL .....             | 14        |
| 7.3.1     | <i>Write process</i> .....                      | 14        |
| 7.3.2     | <i>Read process</i> .....                       | 15        |
| <b>8</b>  | <b>REFLOW SOLDERING CURVE</b> .....             | <b>16</b> |
| <b>9</b>  | <b>DIMENSIONS AND MARKING INFORMATION</b> ..... | <b>17</b> |
| <b>10</b> | <b>PACKAGE INFORMATION</b> .....                | <b>18</b> |



# 1 Overview

INS5101A is an I<sup>2</sup>C bus interface real-time clock with low power consumption. It supports calendar (year, month, day, hour, minute, second), timer and alarm function. The SOP8 package makes it suitable to be used in portable electronic devices.

# 2 Block Diagram

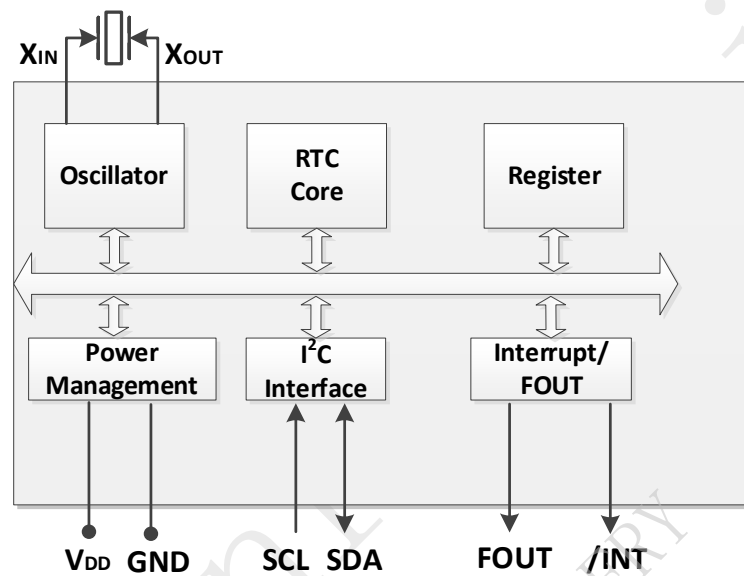


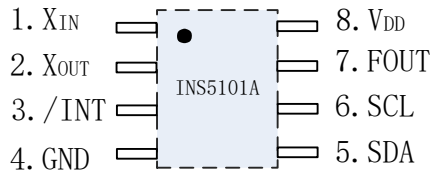
Figure 1. Block Diagram

# 3 Features

- Low Current Consumption:  
0.8 uA (Typ.)
- Communication Interface: I<sup>2</sup>C bus
- Alarm, Timer and Interruption
- Frequency Out
- Build-in 128bit RAM
- Integrated Oscillator Capacitors:  
12.5pF/6pF
- Power Supply Voltage:  
1.2V ~ 5.5V
- Leap Years Autocorrection
- Operation Temperature Range:  
-40°C ~ +85°C
- Package: 4.9 \* 6.0 \* 1.6mm (SOP8)



## 4 Pin Definition



**Table1. Pin Definition**

| Pin Number | Pin Name         | I/O    | Description   |
|------------|------------------|--------|---|
| 1          | X <sub>IN</sub>  |        | Oscillator Input  |
| 2          | X <sub>OUT</sub> |        | Oscillator Output   |
| 3          | /INT             | Out    | This pin can be configured as output of Alarm、Timer、Time-update Interrupt or Frequency, effective when Low Voltage (Open-Drain) |
| 4          | GND              | -      | Ground  |
| 5          | SDA              | In/Out | I <sup>2</sup> C data signal  |
| 6          | SCL              | In     | I <sup>2</sup> C clock signal   |
| 7          | FOUT             | Out    | This pin can be configured as the output of timer or frequency, effective when Low Voltage (CMOS)                               |
| 8          | V <sub>DD</sub>  | -      | Power in  |



## 5 Electrical Characteristics

### 5.1 Absolute Maximum Ratings

**Table2. Absolute Maximum Ratings**

| Parameter             | Symbol            | Value   |      |                      | Unit | Notes            |
|-----------------------|-------------------|---------|------|----------------------|------|------------------|
|                       |                   | Min.    | Typ. | Max.                 |      |                  |
| Power Supply Voltage  | V <sub>DD</sub>   | -0.3    |      | 6.5                  | V    |                  |
| I/O Input Voltage     | V <sub>IN</sub>   | GND-0.3 |      | 6.5                  | V    | SCL, SDA Input   |
| Clock Output Voltage1 | V <sub>OUT1</sub> | GND-0.3 |      | V <sub>DD</sub> +0.3 | V    | FOUT             |
| Clock Output Voltage2 | V <sub>OUT2</sub> | GND-0.3 |      | 6.5                  | V    | SDA, /INT Output |
| Storage Temperature   | T <sub>STG</sub>  | -55     |      | 125                  | °C   |                  |

### 5.2 Recommended Operating Conditions

**Table3. Recommended Operating Conditions**

| Parameter                              | Symbol           | Value |      |      | Unit | Notes |
|--|------------------|-------|------|------|------|-------|
|  |                  | Min.  | Typ. | Max. |      |       |
| Power Supply Voltage<br>(normal mode)  | V <sub>DD</sub>  | 1.6   | 3.0  | 5.5  | V    | *     |
| Power Supply Voltage<br>(Time keeping) | V <sub>DD</sub>  | 1.2   | 3.0  | 5.5  | V    | *     |
| Operation Temperature                  | T <sub>OPR</sub> | -40   | 25   | 85   | °C   |       |

Note 1: V<sub>DD</sub> need to be supplied with more than 1.6V at least for the oscillator to work until stabilization.

Note 2: Ensure that the power on time from 0 to V<sub>DD</sub> is less than 100ms

### 5.3 Oscillator Characteristics

**Table4. Oscillator Characteristics**

| Parameter                          | Symbol            | Value |      |      | Unit | Notes     |
|------------------------------------|-------------------|-------|------|------|------|-----------|
|                                    |                   | Min.  | Typ. | Max. |      |           |
| <b>Oscillator</b>                  |                   |       |      |      |      |           |
| Integrated Capacitance             | C                 |       | 12.5 |      | pF   | INS5101A  |
|                                    |                   |       | 6    |      | pF   | INS5101AA |
| <b>External Crystal(32.768KHz)</b> |                   |       |      |      |      |           |
| Resistance                         | R <sub>S</sub>    |       |      | 80   | kΩ   |           |
| Load Capacitance                   | C <sub>L</sub>    |       | 12.5 |      | pF   | INS5101A  |
|                                    |                   |       | 6    |      | pF   | INS5101AA |
| FOUT Duty cycle                    | t <sub>w</sub> /t | 40    | 50   | 60   | %    | FOUT      |



## 5.4 DC Characteristics

**Table5. DC Characteristics**

| Parameter           | Symbol           | Value               |      |                     | Unit | Notes  |  |
|---------------------|------------------|---------------------|------|---------------------|------|--|--|
|                     |                  | Min.                | Typ. | Max.                |      |  |  |
| Average Current1    | I <sub>DD1</sub> |                     | 1.0  | 3.0                 | uA   | V <sub>DD</sub> =5.0V                              | Input pins are "L"<br>f <sub>SCL</sub> = 0 Hz, /INT = OFF,<br>FOUT = OFF |
| Average Current2    | I <sub>DD2</sub> |                     | 0.8  | 2.8                 |      | V <sub>DD</sub> =3.0V                              |  |
| Average Current3    | I <sub>DD3</sub> |                     | 4.0  | 6.5                 |      | V <sub>DD</sub> =5.0V                              | FOUT = 32.768KHz<br>(CL=15PF), /INT=OFF                                  |
| Average Current4    | I <sub>DD4</sub> |                     | 3.5  | 6.0                 |      | V <sub>DD</sub> =3.0V                              |  |
| Input High Voltage  | V <sub>IH</sub>  | 0.8*V <sub>DD</sub> |      | 5.5                 | V    | SCL, SDA   |  |
| Input Low Voltage   | V <sub>IL</sub>  | GND-0.3             |      | 0.2*V <sub>DD</sub> | V    |  |  |
| Output High Voltage | V <sub>OH1</sub> | 4.5                 |      | 5.0                 | V    | V <sub>DD</sub> =5V, IOH=-1mA                      | FOUT   |
|                     | V <sub>OH2</sub> | 2.7                 |      | 3.0                 |      | V <sub>DD</sub> =3V, IOH=-0.5mA                    |  |
| Output Low Voltage  | V <sub>OL1</sub> | GND                 |      | GND+0.25            | V    | V <sub>DD</sub> =5V, IOL=1mA                       | /INT   |
|                     | V <sub>OL2</sub> | GND                 |      | GND+0.4             |      | V <sub>DD</sub> =3V, IOL=1mA                       |  |
|                     | V <sub>OL3</sub> | GND                 |      | GND+0.5             |      | V <sub>DD</sub> =5V, IOL=1mA                       | FOUT   |
|                     | V <sub>OL4</sub> | GND                 |      | GND+0.3             |      | V <sub>DD</sub> =3V, IOL=0.5mA                     |  |
| Input Leak Current  | I <sub>LK</sub>  | -0.1                |      | 0.1                 | uA   | SDA, SCL, V <sub>IN</sub> = V <sub>DD</sub> or GND |  |
| Output Leak Current | I <sub>OZ</sub>  | -0.1                |      | 0.1                 | uA   | SDA, V <sub>IN</sub> = V <sub>DD</sub> or GND      |  |



### 5.5 AC Characteristics

**Table6. AC Characteristics**

V<sub>DD</sub>=1.6V ~ 5.5V; Ta=-40°C ~ +85°C

| Parameter  | Symbol               | Value |      |      | Unit |
|--|----------------------|-------|------|------|------|
|  |                      | Min.  | Typ. | Max. |      |
| SCL clock frequency                                      | f <sub>SCL</sub>     |       |      | 400  | kHz  |
| SCL Low Voltage Time                                     | t <sub>LOW</sub>     | 1.3   |      |      | us   |
| SCL How Voltage Time                                     | t <sub>HIGH</sub>    | 0.6   |      |      | us   |
| Start condition hold time                                | t <sub>HD, STA</sub> | 0.6   |      |      | us   |
| Start condition setup time                               | t <sub>SU, STA</sub> | 0.6   |      |      | us   |
| Stop condition setup time                                | t <sub>SU, STO</sub> | 0.6   |      |      | us   |
| Bus idle time between start condition and stop condition | t <sub>RCV</sub>     | 1.3   |      |      | us   |
| Data setup time  | t <sub>SU, DAT</sub> | 100   |      |      | ns   |
| Data hold time   | t <sub>HD, DAT</sub> | 0     |      |      | ns   |
| SCL, SDA rising time                                     | t <sub>r</sub>       |       |      | 0.4  | us   |
| SCL, SDA falling time                                    | t <sub>r</sub>       |       |      | 0.4  | us   |

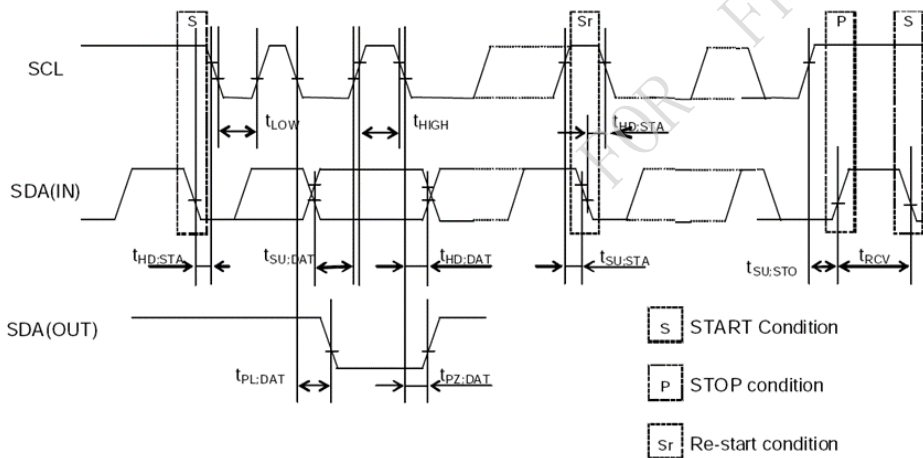


Figure 2. I<sup>2</sup>C bus Timing Chart

Note: When the master device gets access to this slave device through I<sup>2</sup>C, the whole operation duration should be less than 1s, otherwise it will be reset by the I<sup>2</sup>C bus through the internal bus overtime function.





## 6 Registers

### 6.1 Register Lists

Address 0x10~0x1F: Basic Time and Calendar Registers

Address 0x20~0x2F: RAM Register Group

Address 0x30~32: Extended Register Group

**Table1. Basic Time and Calendar Registers**

| Address        | Function           | bit7                           | bit6                             | bit5                           | bit4                            | bit3                             | bit2     | bit1     | bit0     | R/W |
|----------------|--------------------|--------------------------------|----------------------------------|--------------------------------|---------------------------------|----------------------------------|----------|----------|----------|-----|
| 0x10           | SEC                | ○                              | BCD code, Second tens place, 0-5 |                                |                                 | BCD code, Second ones place, 0-9 |          |          |          | R/W |
| 0x11           | MIN                | ○                              | BCD code, Minute tens place, 0-5 |                                |                                 | BCD code, Minute ones place, 0-9 |          |          |          | R/W |
| 0x12           | HOUR               | ○                              | ○                                | BCD code, Hour tens place, 0-2 |                                 | BCD code, Hour ones place, 0-9   |          |          |          | R/W |
| 0x13           | WEEK               | ○                              | 6                                | 5                              | 4                               | 3                                | 2        | 1        | 0        | R/W |
| 0x14           | DAY                | ○                              | ○                                | BCD code, Day tens place, 0-3  |                                 | BCD code, Day ones place, 0-9    |          |          |          | R/W |
| 0x15           | MONTH              | ○                              | ○                                | ○                              | BCD code, Month tens place, 0-1 | BCD code, Month ones place, 0-9  |          |          |          | R/W |
| 0x16           | YEAR               | BCD code, Year tens place, 0-9 |                                  |                                |                                 | BCD code, Year ones place, 0-9   |          |          |          | R/W |
| 0x17           | RSV                | Reserved                       |                                  |                                |                                 |                                  |          |          |          | R/W |
| 0x18           | MIN Alarm          | AE                             | BCD code, Minute tens place, 0-5 |                                |                                 | BCD code, Minute ones place, 0-9 |          |          |          | R/W |
| 0x19           | HOUR Alarm         | AE                             | ●                                | BCD code, Hour tens place, 0-2 |                                 | BCD code, Hour ones place, 0-9   |          |          |          | R/W |
| 0x1A           | WEEK Alarm         | AE                             | 6                                | 5                              | 4                               | 3                                | 2        | 1        | 0        | R/W |
|                | DAY Alarm          |                                | ●                                | BCD code, Day tens place, 0-3  |                                 | BCD code, Day ones place, 0-9    |          |          |          | R/W |
| 0x1B           | Timer Counter 0    | 128                            | 64                               | 32                             | 16                              | 8                                | 4        | 2        | 1        | R/W |
| 0x1C           | Timer Counter 1    | 32768                          | 16384                            | 8192                           | 4096                            | 2048                             | 1024     | 512      | 256      | R/W |
| 0x1D           | Extension Register | FSEL [1]                       | FSEL [0]                         | USEL                           | TE                              | WAD A                            | TSEL [2] | TSEL [1] | TSEL [0] | R/W |
| 0x1E           | Flag Register      | ○                              | ○                                | UF                             | TF                              | AF                               | Reserved | VLF      | ○        | R/W |
| 0x1F           | Control Register   | TEST                           | STOP                             | UIE                            | TIE                             | AIE                              | TSTP     | Reserved | Reserved | R/W |
| 0x20~ <br>0x2F | RAM                | ●                              | ●                                | ●                              | ●                               | ●                                | ●        | ●        | ●        | R/W |
| 0x30           | RSV                | Reserved                       |                                  |                                |                                 |                                  |          |          |          | R/W |
| 0x31           | RSV                | Reserved                       |                                  |                                |                                 |                                  |          |          |          | R/W |

Note:

1, After power-up reset or in case VLF bit returns "1", make sure to initialize all registers before using the RTC.



2. The default value of register after power on:

Initial 0: TEST、WADA、USEL、TE、FSEL[1:0]、TSEL[1:0]、UF、TF、AF、UIE、TIE、TSTP

Initial 1: VLF、TSEL[2].

3.The bits marked with “○” can be read out “0” after initializing.

4.The bits marked with “●” are RAM bits which can be used to write or read any data.

5.Only 0 can be written to UF、TF、AF and VLF bits.

6.Make sure “0” to be written for TEST bits which are used for manufacturing testing only.

## 6.2 Details of Registers

### 6.2.1 Clock counter registers

**Table2. Second、Minute and Hour Registers**

| Address | Function | bit7 | bit6                             | bit5                           | bit4 | bit3                             | bit2 | bit1 | bit0 | Default |
|---------|----------|------|----------------------------------|--------------------------------|------|----------------------------------|------|------|------|---------|
| 0x10    | SEC      | ○    | BCD code, Second tens place, 0-5 |                                |      | BCD code, Second ones place, 0-9 |      |      |      | 0x00    |
| 0x11    | MIN      | ○    | BCD code, Minute tens place, 0-5 |                                |      | BCD code, Minute ones place, 0-9 |      |      |      | 0x00    |
| 0x12    | HOUR     | ○    | ○                                | BCD code, Hour tens place, 0-2 |      | 0x00                             |      |      |      | 0x00    |

SEC: BCD format, Value: 0~59

MIN: BCD format, Value: 0~59

HOUR: BCD format, Value: 0~23

**Table3. Week Registers**

| Address | Function | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 | Default |
|---------|----------|------|------|------|------|------|------|------|------|---------|
| 0x13    | WEEK     | ○    | 6    | 5    | 4    | 3    | 2    | 1    | 0    | 0x40    |

WEEK: Value 01h, 02h, 04h, 08h, 10h, 20h, 40h. Only one bit can be set to 1 each time, all others must be set to 0.

**Table4. WEEK Register Value table**

| WEEK      | Data | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
|-----------|------|------|------|------|------|------|------|------|------|
| Sunday    | 01h  | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 1    |
| Monday    | 02h  | 0    | 0    | 0    | 0    | 0    | 0    | 1    | 0    |
| Tuesday   | 04h  | 0    | 0    | 0    | 0    | 0    | 1    | 0    | 0    |
| Wednesday | 08h  | 0    | 0    | 0    | 0    | 1    | 0    | 0    | 0    |
| Thursday  | 10h  | 0    | 0    | 0    | 1    | 0    | 0    | 0    | 0    |
| Friday    | 20h  | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    |
| Saturday  | 40h  | 0    | 1    | 0    | 0    | 0    | 0    | 0    | 0    |

**Table5. Day Register**

| Address | Function | bit7 | bit6 | bit5                          | bit4 | bit3                          | bit2 | bit1 | bit0 | Default |
|---------|----------|------|------|-------------------------------|------|-------------------------------|------|------|------|---------|
| 0x14    | DAY      | ○    | ○    | BCD code, Day tens place, 0-3 |      | BCD code, Day ones place, 0-9 |      |      |      | 0x01    |



DAY: BCD format, the value range will be adjusted automatically according to the month setting and if a leap year or not.

**Table6. DAY Register Value Range**

| Month                   | Day Value Range |
|-------------------------|-----------------|
| 1, 3, 5, 7, 8, 10, 12   | 1~31            |
| 4, 6, 9, 11             | 1~30            |
| February in normal year | 1~28            |
| February in leap year   | 1~29            |

**Table7. Month and Year Register**

| Address | Function | bit7                           | bit6 | bit5 | bit4                            | bit3                            | bit2 | bit1 | bit0 | Default |
|---------|----------|--------------------------------|------|------|---------------------------------|---------------------------------|------|------|------|---------|
| 0x15    | MONTH    | ○                              | ○    | ○    | BCD code, Month tens place, 0-1 | BCD code, Month ones place, 0-9 |      |      |      | 0x01    |
| 0x16    | YEAR     | BCD code, Year tens place, 0-9 |      |      |                                 | BCD code, Year ones place, 0-9  |      |      |      | 0x00    |

MONTH: BCD format, Value1~12

YEAR: BCD format, Value0~99(2000~2099)

Example: 2020/01/01 Wednesday 21:18:36

**Table8. Example of time setting**

| Address | Function | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 |
|---------|----------|------|------|------|------|------|------|------|------|
| 0x10    | SEC      | ○    | 0    | 1    | 1    | 0    | 1    | 1    | 0    |
| 0x11    | MIN      | ○    | 0    | 0    | 1    | 1    | 0    | 0    | 0    |
| 0x12    | HOURL    | ○    | ○    | 1    | 0    | 0    | 0    | 0    | 1    |
| 0x13    | WEEK     | ○    | 0    | 0    | 0    | 1    | 0    | 0    | 0    |
| 0x14    | DAY      | ○    | ○    | 0    | 0    | 0    | 0    | 0    | 1    |
| 0x15    | MONTH    | ○    | ○    | ○    | 0    | 0    | 0    | 0    | 1    |
| 0x16    | YEAR     | 0    | 0    | 1    | 0    | 0    | 0    | 0    | 0    |

### 6.2.2 Alarm registers

**Table9. Alarm Register**

| Address | Function    | bit7 | bit6                             | bit5                           | bit4 | bit3                             | bit2 | bit1 | bit0 | Default |
|---------|-------------|------|----------------------------------|--------------------------------|------|----------------------------------|------|------|------|---------|
| 0x18    | MIN Alarm   | AE   | BCD code, Minute tens place, 0-5 |                                |      | BCD code, Minute ones place, 0-9 |      |      |      | 0x00    |
| 0x19    | HOURL Alarm | AE   | ●                                | BCD code, Hour tens place, 0-2 |      | BCD code, Hour ones place, 0-9   |      |      |      | 0x00    |
| 0x1A    | WEEK Alarm  | AE   | 6                                | 5                              | 4    | 3                                | 2    | 1    | 0    | 0x00    |
|         | DAY Alarm   |      | ●                                | BCD code, Day tens place, 0-3  |      | BCD code, Day ones place, 0-9    |      |      |      |         |

Alarm interruption can be generated with the setting of these registers and the cooperation of AIE、AF and WADA.

WEEK Alarm/Day Alarm: WADA control bit 0x0A can choose week alarm or day alarm, details refer to 0x1D register bit3

AE (Alarm Enable): Alarm Enable bit, 0-Enable; 1-Disable.

AF function refer to 0x1E register bit3.

AIE function refer to 0x1F register bit3.



### 6.2.3 Timer registers

**Table10. Timer Register**

| Address | Function        | bit7  | bit6  | bit5 | bit4 | bit3 | bit2 | bit1 | bit0 | Default |
|---------|-----------------|-------|-------|------|------|------|------|------|------|---------|
| 0x1B    | Timer Counter 0 | 128   | 64    | 32   | 16   | 8    | 4    | 2    | 1    | 0x00    |
| 0x1C    | Timer Counter 1 | 32768 | 16384 | 8192 | 4096 | 2048 | 1024 | 512  | 256  | 0x00    |

Alarm interruption can be generated with the setting of these registers and the cooperation of TE、TF、TIE and TSEL[1:0].

TE function refer to 0x1D register bit4.

TF function refer to 0x1E register bit4.

TIE function refer to 0x1F register bit4.

TSEL[1:0] function refer to 0x1D register bit2, bit1 and bit0.

### 6.2.4 Extension registers

**Table11. Extension Register**

| Address | Function           | bit7     | bit6     | bit5 | bit4 | bit3 | bit2     | bit1     | bit0     | Default |
|---------|--------------------|----------|----------|------|------|------|----------|----------|----------|---------|
| 0x1D    | Extension Register | FSEL [1] | FSEL [0] | USEL | TE   | WADA | TSEL [2] | TSEL [1] | TSEL [0] | 0x04    |

Used for the specified functions, including Alarm、Time Update Interruption、Setting and etc.

WADA (Week Alarm/Day Alarm): 0-WEEK Alarm, 1-DAY Alarm。

USEL (Update Interrupt Select): 0-Interrupt per Second (Default), 1-Interrupt per Minute。

TE (Timer Enable): 0- Disable Timer Interrupt function, 1-Enable Timer Interrupt function。

FSEL[1], FSEL[0] to confirm the output frequency. Shown as below table:

**Table12. FSEL Table**

| FSEL [1] | FSEL [0] | FOUT Frequency |
|----------|----------|----------------|
| 0        | 0        | Disable        |
| 0        | 1        | 1Hz output     |
| 1        | 0        | 1024Hz output  |
| 1        | 1        | 32768Hz Output |

TSEL[2], TSEL[1], TSEL[0]: Timer/Counter Clock configuration bits, just as below table:

**Table13. TSEL Table**

| TSEL [2] | TSEL [1] | TSEL [0] | Timer/Counter Clock | Interruption duration |
|----------|----------|----------|---------------------|-----------------------|
| 0        | 0        | 0        | 4096Hz (244.14us)   | 122uS                 |
| 0        | 0        | 1        | 64Hz (15.625ms)     | 7.813mS               |
| 0        | 1        | 0        | 1Hz (S)             | 7.813mS               |
| 0        | 1        | 1        | 1/60Hz (Min)        | 7.813mS               |
| 1        | 0        | 0        | 1/3600Hz (Hour)     | 7.813mS               |



### 6.2.5 Flag Register

**Table14. Flag Register**

| Address | Function      | bit7 | bit6 | bit5 | bit4 | bit3 | bit2     | bit1 | bit0 | Default |
|---------|---------------|------|------|------|------|------|----------|------|------|---------|
| 0x1E    | Flag Register | ○    | ○    | UF   | TF   | AF   | Reserved | VLF  | ○    | 0x26    |

UF (Update Flag): Time Update Flag, when time update interruption generates, this bit will change from “0”to “1”,and keep this value until written to “0” by software;

TF (Timer Flag): Timer Flag, when timer interruption generates, this bit will change from “0”to “1”,and keep this value until written to “0” by software;

AF (Alarm Flag): Alarm Flag, when Alarm Interruption generation, this bit will change from “0”to “1”,and keep this value until written to “0” by software;

VLF (Voltage Low Flag): Voltage Low Flag, when voltage is lower than 1.3V ,this bit will be set to”1”, and keep this value until written to “0” by software.

### 6.2.6 Control Register

**Table15. Control Register**

| Address | Function         | bit7 | bit6 | bit5 | bit4 | bit3 | bit2 | bit1     | bit0     | Default |
|---------|------------------|------|------|------|------|------|------|----------|----------|---------|
| 0x1F    | Control Register | TEST | STOP | UIE  | TIE  | AIE  | TSTP | Reserved | Reserved | 0x00    |

TEST: Test bit for manufacture, must always be“0” when used and cannot be changed by user;

UIE (Update Interrupt Enable): When UF changes from“0”to“1”, this bit can control if the interruption generates or not。 0-Did not generate (/INT maintain high resistance), 1-generate the interruption (/INT changes from high resistance to low voltage)。

TIE (Timer Interrupt Enable): When TF changes from“0”to“1”, this bit can control if the interruption generates or not。 0-Did not generate (/INT maintain high resistance), 1-generate the interruption (/INT changes from high resistance to low voltage)。

AIE (Alarm Interrupt Enable): When AF changes from“0”to“1”, this bit can control if the interruption generates or not。 0-Did not generate (/INT maintain high resistance), 1-generate the interruption (/INT changes from high resistance to low voltage)。

TSTP (Timer Stop): This bit is used to stop the count-down timer, always be used with STOP at the same time.

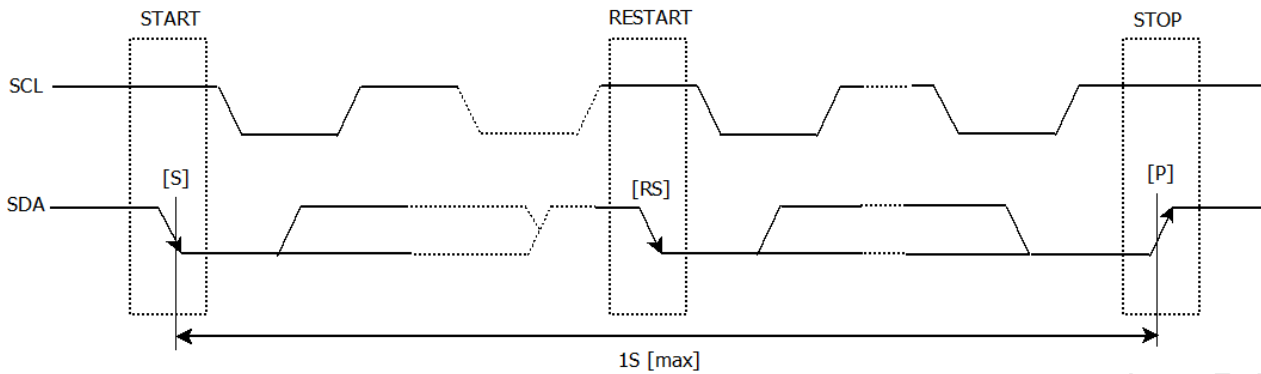
STOP: Used to stop the timer operation. When “STOP=1”, all timer update and calendar stop working. Fixed period timer stops the interruption partly; the output frequency can be 32768Hz, but 1Hz and 1024hz are disable.

**Table16. STOP & TSTP Setting Table**

| STOP | TSTP | Description  |
|------|------|--|
| 0    | 0    | When TSTP is written to“0”, Start timer  |
|      | 1    | When TSTP is written to“1”, Stop timer   |
| 1    | X    | At this moment, when frequency output is set to 64Hz, 1Hz, 1/60Hz or 1/3600Hz, the timer stop working。 |



## 7 I<sup>2</sup>C Bus Interface



I<sup>2</sup>C bus supports bi-directional communications through a serial clock line SCL and a serial data line SDA. I<sup>2</sup>C bus device can be defined as “Master” and “Slave”. INS5101A (A) can only be used as Slave.

### 7.1 Cautions

I<sup>2</sup>C bus includes START, RESTART, STOP conditions, the duration between START and STOP must be less than 1 second just in case the bus to be set to standby mode automatically. If the time is more than 1S, INS5101A will reset I<sup>2</sup>C Interface.

INS5101A I<sup>2</sup>C bus interface supports single byte read/write operations as well as multiple bytes incremental access. After 0xFF address, the next one will be 0x00.

### 7.2 Slave Address

Table17. I<sup>2</sup>C Bus Slave Address

| Transfer data | Slave address |      |      |      |      |      |      | R/W       |
|---------------|---------------|------|------|------|------|------|------|-----------|
|               | bit7          | bit6 | bit5 | bit4 | bit3 | bit2 | bit1 | bit0      |
| 65h (Read)    | 0             | 1    | 1    | 0    | 0    | 1    | 0    | 1 (Read)  |
| 64h (Write)   | 0             | 1    | 1    | 0    | 0    | 1    | 0    | 0 (Write) |

INS5101A I<sup>2</sup>C bus Slave Address is [0110 010\*].

### 7.3 I<sup>2</sup>C bus protocol

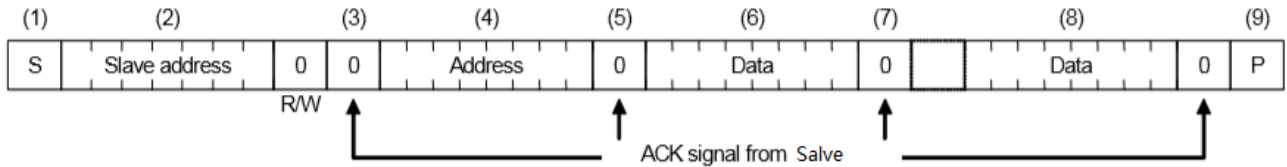
It is assumed CPU is master and INS5101A is slave in this section.

#### 7.3.1 Write process

I<sup>2</sup>C bus includes an address auto-increment function, once the initial address has been specified, the INS5101A increments (+1) the address automatically after each data is sent, then to write next data.



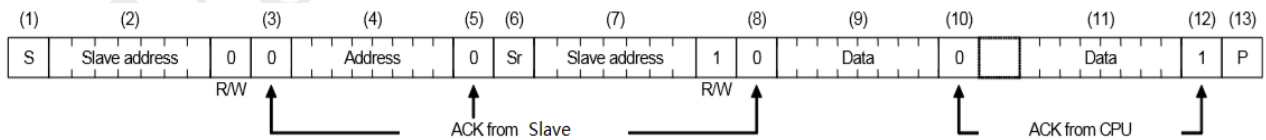
- (1) CPU sends start condition[S]
- (2) CPU sends INS5101A's slave address with R/W bit to set to write mode
- (3) CPU verifies ACK signal from INS5101A
- (4) CPU sends write address to INS5101A
- (5) CPU verifies ACK signal from INS5101A
- (6) CPU sends write data to the address specified at step (4)
- (7) CPU verifies ACK signal from INS5101A
- (8) Repeat (6) (7) if multiple bytes need to be written, address will be incremented automatically
- (9) CPU ends stop condition[P]



### 7.3.2 Read process

Writing the address to be read with write mode firstly, then reading the data with read mode.

- (1) CPU sends start condition[S]
- (2) CPU sends INS5101A's slave address with R/W bit to set to write mode
- (3) CPU verifies ACK signal from INS5101A
- (4) CPU sends address for reading from INS5101A
- (5) CPU verifies ACK signal from INS5101A
- (6) CPU sends RESTART condition [Sr]
- (7) CPU sends INS5101A's slave address with R/W bit to set to read mode
- (8) CPU verifies ACK signal from INS5101A
- (9) CPU reads data from the specified address in step (4)
- (10) CPU sends ACK signal for "0"
- (11) Repeat (9) (10) if multiple bytes need to be read, address will be incremented automatically
- (12) CPU sends ACK signal for "1"
- (13) CPU sends stop condition[P]





# 8 Reflow Soldering Curve

Standard: IPC/JEDEC J-STD-020

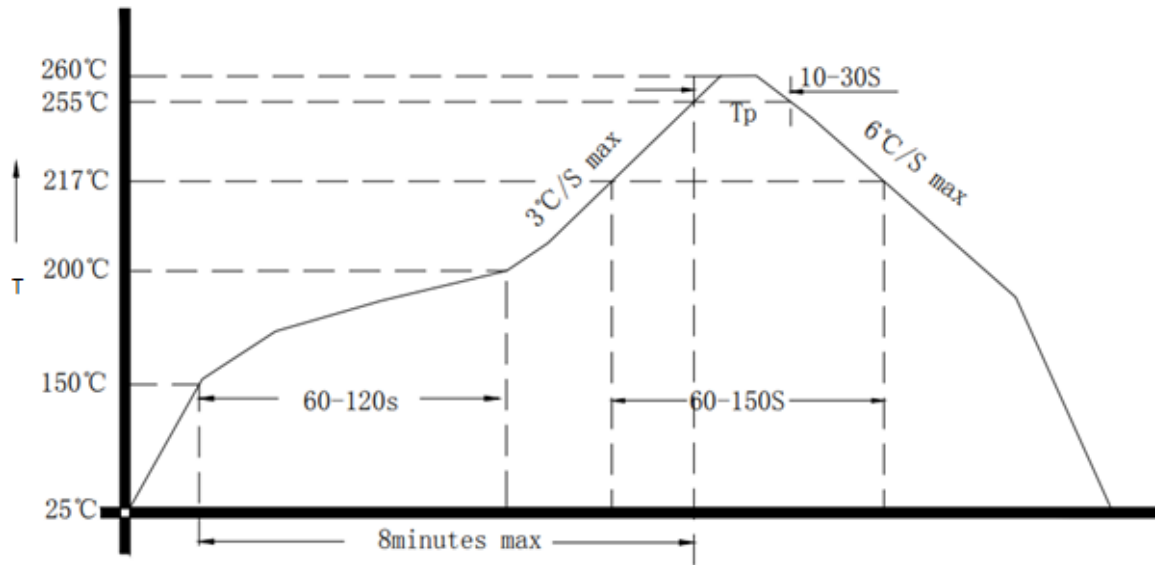


Figure 3. Reflow Soldering Curve

Note: It is suggested to solder IC under the condition shown in the curve above. Must pay attention to the temperature and time when manual soldering,





## 9 Dimensions and Marking Information

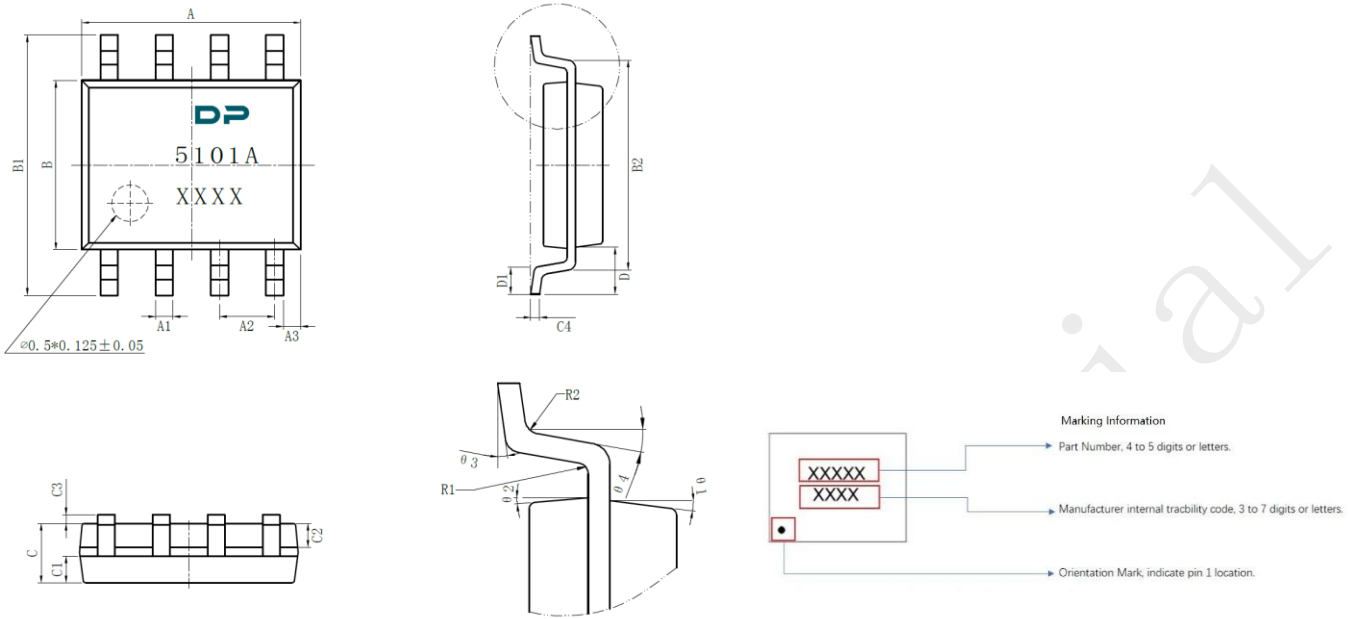


Figure 4. Dimension and Marking information

| Dimension | Min.  | Typ.  | Max.  |
|-----------|-------|-------|-------|
| <b>A</b>  | 4.8   | 4.9   | 5.0   |
| <b>A1</b> | 0.356 | --    | 0.456 |
| <b>A2</b> | --    | 1.27  | --    |
| <b>A3</b> | --    | 0.345 | --    |
| <b>B</b>  | 3.8   | 3.9   | 4.0   |
| <b>B1</b> | 5.8   | 6.0   | 6.2   |
| <b>B2</b> | --    | 5.00  | --    |
| <b>C</b>  | 1.3   | --    | 1.6   |
| <b>C1</b> | 0.55  | --    | 0.65  |
| <b>C2</b> | 0.55  | --    | 0.65  |

(Unit: mm)

| Dimension | Min.   | Typ. | Max.  |
|-----------|--------|------|-------|
| <b>C3</b> | 0.05   | --   | 0.20  |
| <b>C4</b> | 0.203  | --   | 0.233 |
| <b>D</b>  | --     | 1.05 | --    |
| <b>D1</b> | 0.4    | --   | 0.8   |
| <b>R1</b> | --     | 0.2  | --    |
| <b>R2</b> | --     | 0.2  | --    |
| <b>θ1</b> | 17°    |      |       |
| <b>θ2</b> | 13°    |      |       |
| <b>θ3</b> | 0°~8°  |      |       |
| <b>θ4</b> | 4°~12° |      |       |

(Unit: mm)



# 10 Package Information

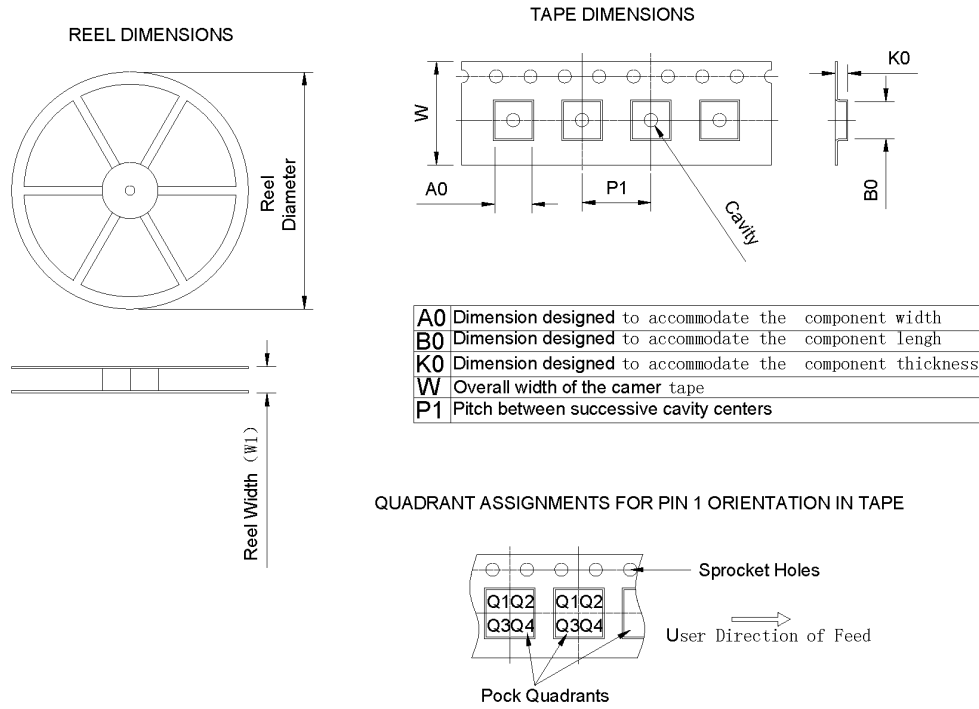


Figure 5. Package information

| Device                 | Package Type | Pins | SPQ  | Reel Diameter (mm) | Reel Width W1(mm) | A0 (mm) | B0 (mm) | K0 (mm) | P1 (mm)      | W (mm)        | PIN1 Quadrant |
|------------------------|--------------|------|------|--------------------|-------------------|---------|---------|---------|--------------|---------------|---------------|
| INS5101A/<br>INS5101AA | SOP          | 8    | 3000 | 330±1              | 12.4±0.2          | 6.40    | 5.30    | 2.10    | 8.00±<br>0.1 | 12.00<br>±0.1 | Q1            |