

# Proximity Sensor With Interrupt, IRED, and I<sup>2</sup>C Interface



## ADDITIONAL RESOURCES



## DESCRIPTION

VCNL36821S integrates a proximity sensor (PS), and a IRED into one small package. It incorporates photodiodes, amplifiers, and analog to digital converting circuits into a single chip by CMOS process. PS programmable interrupt features of individual high and low thresholds offer the best utilization of resource and power saving on the microcontroller.

## APPLICATIONS

- Handheld device
- Consumer device
- Industrial application
- Earphone

## FEATURES

- Package type: surface-mount
- Dimensions (L x W x H in mm): 2.55 x 2.05 x 1.0
- Integrated modules: infrared emitter (IRED), proximity sensor (PS), and signal conditioning IC
- Interrupt function
- Smallest light hole opening design
- Immunity to red glow issue (940 nm)
- Supply voltage range  $V_{DD}$ : 1.7 V to 3.6 V
- Low power consumption I<sup>2</sup>C (SMBus compatible interface)
- Floor life: 168 h, MSL 3, according to J-STD-020
- Output type: I<sup>2</sup>C bus (PS)
- Temperature compensation: -40 °C to +85 °C
- Material categorization: for definitions of compliance please see [www.vishay.com/doc?999912](http://www.vishay.com/doc?999912)



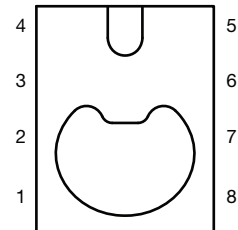
## PROXIMITY FUNCTION

- Immunity to red glow (940 nm IR LED)
- Programmable IR LED sink current
- Intelligent cancellation to reduce cross talk phenomenon
- Smart persistence scheme to reduce PS response time
- Low power consumption mode

## INTERRUPT

- Programmable interrupt function for PS with upper and lower thresholds
- Adjustable persistence to prevent false triggers for PS

## PIN DEFINITION



|   |       |   |          |
|---|-------|---|----------|
| 1 | GND   | 5 | LED_A    |
| 2 | INT   | 6 | $V_{DD}$ |
| 3 | NC    | 7 | SDA      |
| 4 | LED_C | 8 | SCL      |

## PRODUCT SUMMARY

| PART NUMBER | OPERATING RANGE (mm) | OPERATING VOLTAGE RANGE (V) | I <sup>2</sup> C BUS VOLTAGE RANGE (V) | IRED DRIVING CURRENT (mA) | OUTPUT CODE              | ADC RESOLUTION PROXIMITY / AMBIENT LIGHT |
|-------------|----------------------|-----------------------------|--|---------------------------|--------------------------|--|
| VCNL36821S  | 300                  | 1.7 to 3.6                  | 1.7 to 3.6                             | 156                       | 12 bit, I <sup>2</sup> C | 12 bit / -                               |

**ORDERING INFORMATION**

| ORDERING CODE | PACKAGING     | VOLUME <sup>(1)</sup>        | REMARKS                    |
|---------------|---------------|------------------------------|----------------------------|
| VCNL36821S    | Tape and reel | MOQ: 3000 pcs, 3000 pcs/reel | 2.55 mm x 2.05 mm x 1.0 mm |

**Note**

(1) MOQ: minimum order quantity

**ABSOLUTE MAXIMUM RATINGS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

| PARAMETER                   | TEST CONDITION | SYMBOL    | MIN. | MAX. | UNIT               |
|-----------------------------|----------------|-----------|------|------|--------------------|
| Supply voltage              |                | $V_{DD}$  | 1.7  | 3.6  | V                  |
| Operation temperature range |                | $T_{amb}$ | -40  | +85  | $^{\circ}\text{C}$ |
| Storage temperature range   |                | $T_{stg}$ | -40  | +100 | $^{\circ}\text{C}$ |

**BASIC CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

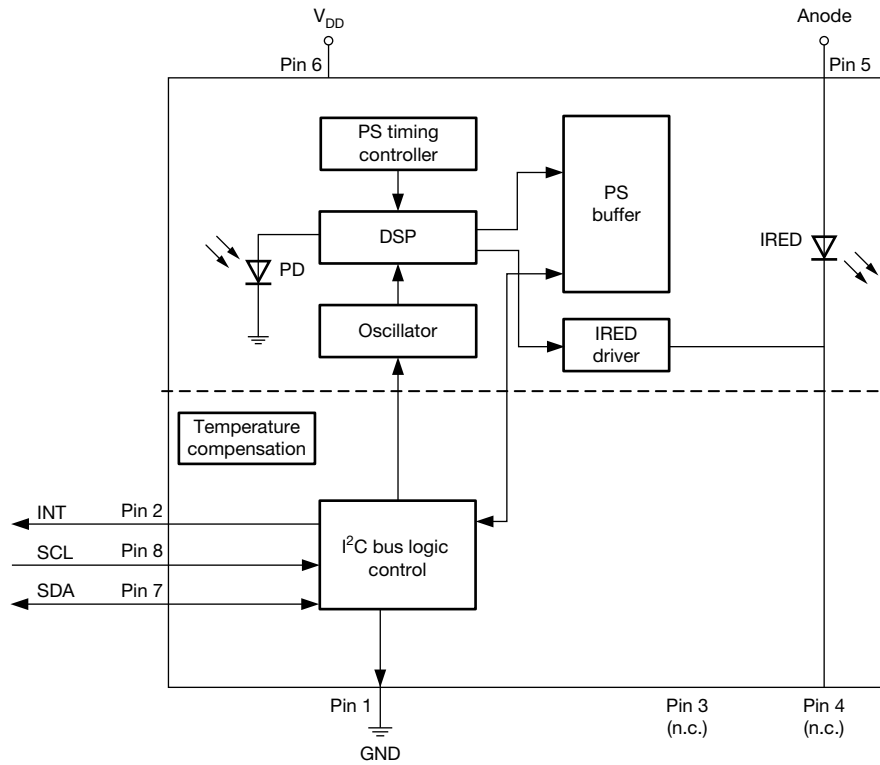
| PARAMETER                                 | TEST CONDITION  | SYMBOL              | MIN. | TYP. | MAX. | UNIT          |
|---|---|---------------------|------|------|------|---------------|
| Sensor supply voltage                     |   | $V_{DD}$            | 1.7  | -    | 3.6  | V             |
| IR LED supply voltage                     |   | $V_{DD}$            | 2.5  | -    | 3.6  | V             |
| Supply current                            | Excluding LED driving   | $I_{DD}$            | 100  | 200  | 300  | $\mu\text{A}$ |
| Shutdown current                          | Light condition = dark;<br>$V_{DD} = 1.8\text{ V}$ , $T_{amb} = 25\text{ }^{\circ}\text{C}$ | $I_{DD}(\text{SD})$ | -    | 1    | -    | $\mu\text{A}$ |
| I <sup>2</sup> C supply voltage           |   | $V_{PULLUP}$        | 1.65 | -    | -    | V             |
| I <sup>2</sup> C signal input, logic high | $V_{DD} = 3.3\text{ V}$   | $V_{IH}$            | 1.26 | -    | -    | V             |
| I <sup>2</sup> C signal input, logic low  | $V_{DD} = 3.3\text{ V}$   | $V_{IL}$            | -    | -    | 0.73 | V             |
| Peak wavelength of IRED                   | $I_F = 50\text{ mA}$  | $\lambda_{pLED}$    | -    | 940  | -    | nm            |
| IRED driving current                      |   |                     | -    | -    | 156  | mA            |

**PIN DESCRIPTIONS**

| PIN ASSIGNMENT | SYMBOL      | TYPE               | FUNCTION   |
|----------------|-------------|--------------------|--|
| 1              | GND         | -                  | Ground   |
| 2              | INT         | O (open drain)     | Interrupt pin                                    |
| 3              | NC          | -                  | Connected to GND or floating                     |
| 4              | LED_Cathode | I                  | Cathode (LED) connection                         |
| 5              | LED_Anode   | I                  | Anode of LED                                     |
| 6              | $V_{DD}$    | -                  | Power supply input                               |
| 7              | SDA         | I / O (open drain) | I <sup>2</sup> C digital bus data input / output |
| 8              | SCL         | I (open drain)     | I <sup>2</sup> C digital bus clock input         |



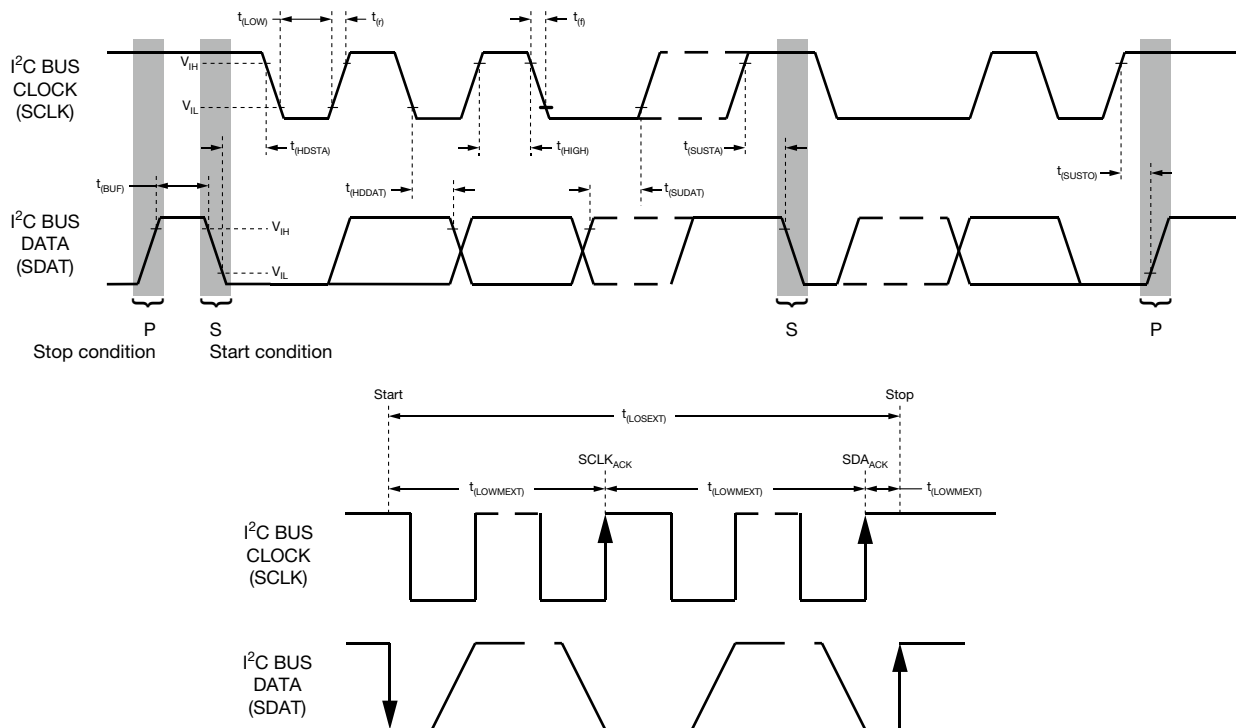
**BLOCK DIAGRAM**



| <b>I<sup>2</sup>C BUS TIMING CHARACTERISTICS</b> ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified) |                |               |      |           |      |               |
|---|----------------|---------------|------|-----------|------|---------------|
| PARAMETER   | SYMBOL         | STANDARD MODE |      | FAST MODE |      | UNIT          |
|   |                | MIN.          | MAX. | MIN.      | MAX. |               |
| Clock frequency   | $f_{(SMBCLK)}$ | 10            | 100  | 10        | 400  | kHz           |
| Bus free time between start and stop condition  | $t_{(BUF)}$    | 4.7           | -    | 1.3       | -    | $\mu\text{s}$ |
| Hold time after (repeated) start condition;<br>after this period, the first clock is generated                          | $t_{(HDSTA)}$  | 4.0           | -    | 0.6       | -    | $\mu\text{s}$ |
| Repeated start condition setup time   | $t_{(SUSTA)}$  | 4.7           | -    | 0.6       | -    | $\mu\text{s}$ |
| Stop condition setup time   | $t_{(SUSTO)}$  | 4.0           | -    | 0.6       | -    | $\mu\text{s}$ |
| Data hold time  | $t_{(HDDAT)}$  | 0             | 3450 | 0         | 900  | ns            |
| Data setup time   | $t_{(SUDAT)}$  | 250           | -    | 100       | -    | ns            |
| I <sup>2</sup> C clock (SCK) low period   | $t_{(LOW)}$    | 4.7           | -    | 1.3       | -    | $\mu\text{s}$ |
| I <sup>2</sup> C clock (SCK) high period  | $t_{(HIGH)}$   | 4.0           | -    | 0.6       | -    | $\mu\text{s}$ |
| Clock / data fall time  | $t_{(f)}$      | -             | 300  | -         | 300  | ns            |
| Clock / data rise time  | $t_{(r)}$      | -             | 1000 | -         | 300  | ns            |

**Note**

- Data based on standard I<sup>2</sup>C protocol requirement, not tested in production


 Fig. 1 - I<sup>2</sup>C Bus Timing Diagram

**PARAMETER TIMING INFORMATION**

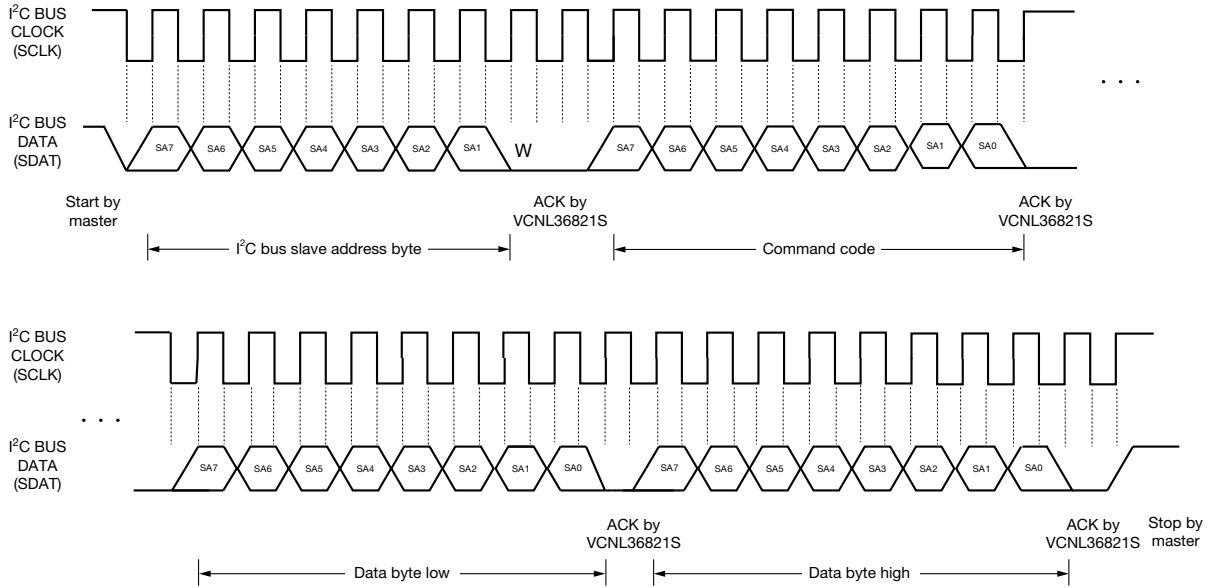


Fig. 2 - I<sup>2</sup>C Bus Timing for Sending Word Command Format

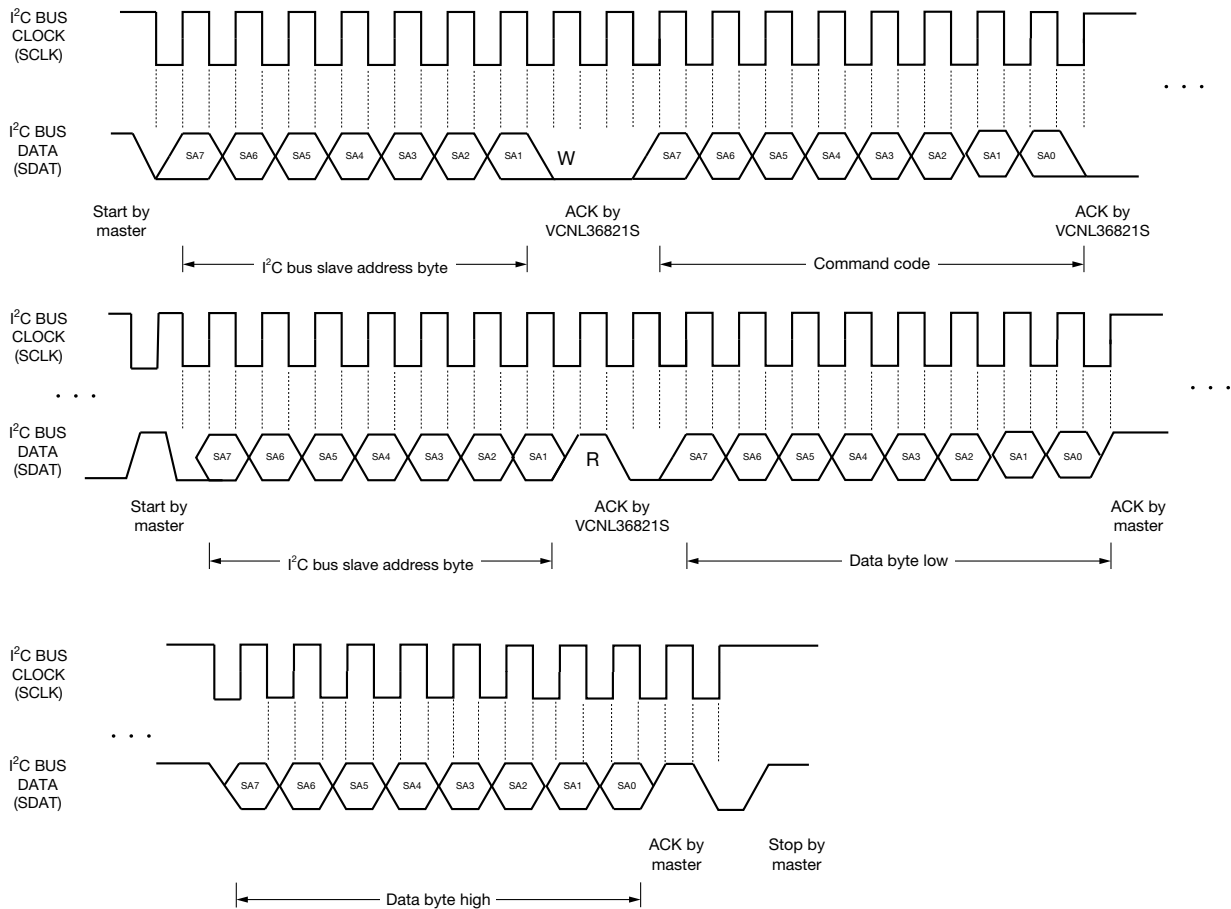


Fig. 3 - I<sup>2</sup>C Bus Timing for Receiving Word Command Format

**TYPICAL PERFORMANCE CHARACTERISTICS** ( $T_{amb} = 25\text{ }^{\circ}\text{C}$ , unless otherwise specified)

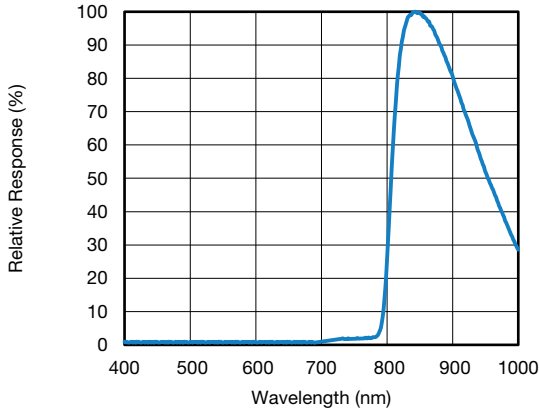


Fig. 4 - PS Sensor Spectral Response

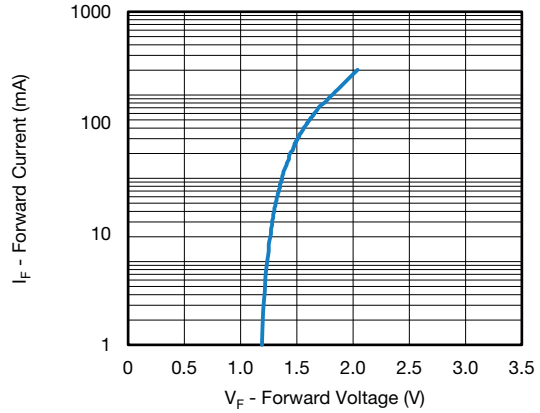


Fig. 6 - Forward Current vs. Forward Voltage

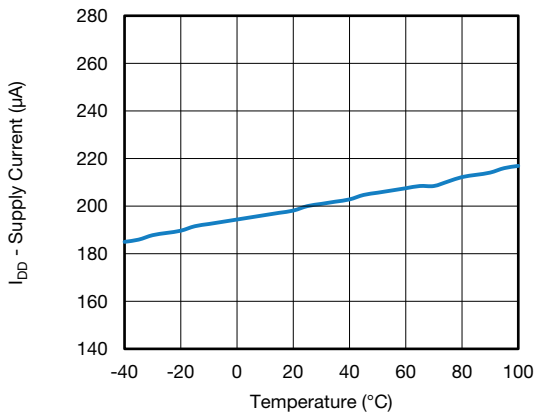


Fig. 5 -  $I_{DD}$  vs. Temperature

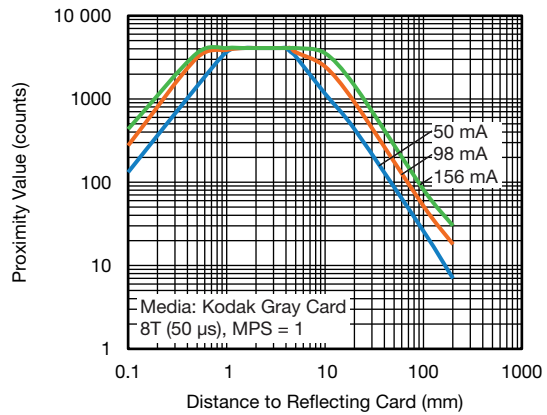


Fig. 7 - Proximity Value vs. Distance;  $PS\_IT = 8T$

**APPLICATION INFORMATION**

**Pin Connection with the Host**

VCNL36821S integrates proximity sensor, and IRED all together with I<sup>2</sup>C interface. It is very easy for the baseband (CPU) to access PS output data via I<sup>2</sup>C interface without extra software algorithms. The hardware schematic is shown in the following diagram.

Two additional capacitors in the circuit can be used for the following purposes: (1) one 1 μF capacitor near the V<sub>DD</sub> pin is used for power supply noise rejection, a second one, close to the anode pin, is used to prevent the IRED voltage from instantly dropping when the IRED is turned on and (2) 2.2 kΩ is suitable for the pull high resistor of I<sup>2</sup>C except 10 kΩ applied on INT pin.

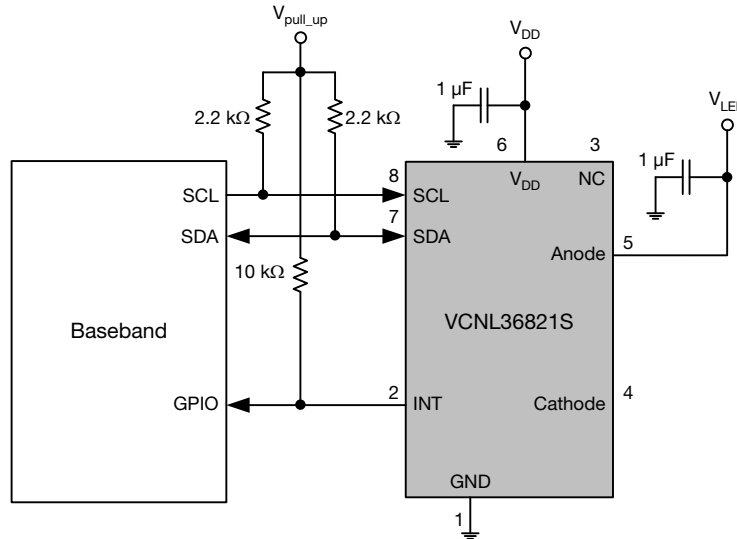


Fig. 8 - Hardware Pin Connection Diagram

**Digital Interface**

VCNL36821S applies single slave address 0x60 (HEX) of 7-bit addressing following I<sup>2</sup>C protocol. All operations can be controlled by the command register. The simple command structure helps users easily program the operation setting and latch the light data from VCNL36821S. As Fig. 9 shows, VCNL36821S's I<sup>2</sup>C command format is simple for read and write operations between VCNL36821S and the host. The white sections indicate host activity and the gray sections indicate VCNL36821S's acknowledgement of the host access activity. Write word and read word protocol is suitable for accessing registers particularly for 12-bit PS data. Interrupt can be cleared by reading data out from register: INT\_Flag. All command codes should follow read word and write word protocols.



Fig. 9 - Write Word and Read Word Protocol

**Function Description**

VCNL36821S supports different kinds of mechanical designs to achieve the best proximity detection performance for any color of object with more flexibility. The basic PS function settings, such as duty ratio, integration time, interrupt, and PS enable / disable and persistence, are handled by the register: PS\_CONF1. Duty ratio controls the PS response time. Integration time represents the duration of the energy being received. The interrupt is asserted when the PS detection levels over the high threshold level setting (register: PS\_THDH) or lower than low threshold (register: PS\_THDL). If the interrupt function is enabled, the host reads the PS output data from VCNL36821S that saves host loading from periodically reading PS data. More than that, INT flag (register: INT\_Flag) indicates the behavior of INT triggered under different conditions. PS persistence (PS\_PERS) sets up the PS INT asserted conditions as long as the PS output value continually exceeds the threshold level. The intelligent cancellation level can be set on register: PS\_CANC to reduce the cross talk phenomenon.

A smart persistence (register: PS\_SMART\_PERS) is provided to get faster PS response time and prevent false trigger for PS.

**TABLE 1 - COMMAND CODE AND REGISTER DESCRIPTION**

| COMMAND CODE | DATE BYTE LOW / HIGH | REGISTER NAME | R / W | DEFAULT VALUE | FUNCTION DESCRIPTION   |
|--------------|----------------------|---------------|-------|---------------|--|
| 0x00         | L                    | ST_CONF1      | R / W | 0x01          | Standby and start  |
|              | H                    | ST_CONF2      | R / W | 0x00          | Standby and start  |
| 0x03         | L                    | PS_CONF1      | R / W | 0x01          | PS period, persistence, interrupt, smart persistence and PS enable / disable |
|              | H                    | PS_CONF2      | R / W | 0x00          | PS integration time, multi pulse and interrupt function                      |
| 0x04         | L                    | PS_CONF3      | R / W | 0x00          | PS force mode and sunlight light protect interrupt setting                   |
|              | H                    | PS_CONF4      | R / W | 0x00          | PS LED current   |
| 0x05         | L                    | PS_THDL       | R / W | 0x00          | PS low interrupt threshold setting   |
|              | H                    | PS_THDL       | R / W | 0x00          | PS low interrupt threshold setting   |
| 0x06         | L                    | PS_THDH       | R / W | 0x00          | PS high interrupt threshold setting  |
|              | H                    | PS_THDH       | R / W | 0x00          | PS high interrupt threshold setting  |
| 0x07         | L                    | PS_CANC_L     | R / W | 0x00          | PS cancellation LSB setting  |
|              | H                    | PS_CANC_M     | R / W | 0x00          | PS cancellation MSB setting  |
| 0x08         | L                    | PS_AC_L       | R / W | 0x00          | PS auto-calibration period, number, interrupt setting                        |
|              | H                    | PS_LPPERI     | R / W | 0x00          | PS low power mode setting  |
| 0xF8         | L                    | PS_Data_L     | R     | 0x00          | PS channel LSB output data   |
|              | H                    | PS_Data_M     | R     | 0x00          | PS channel MSB output data   |
| 0xF9         | L                    | Reserved      | R     | 0x00          | Reserved   |
|              | H                    | INT_Flag      | R     | 0x00          | PS interrupt flag  |
| 0xFA         | L                    | ID_L          | R     | 0x26          | Device ID LSB  |
|              | H                    | ID_M          | R     | 0x00          | Device ID MSB  |
| 0xFB         | L                    | PS_AC_Data_L  | R     | 0x00          | PS auto-calibration LSB data   |
|              | H                    | PS_AC_Data_H  | R     | 0x00          | PS auto-calibration MSB data, busy and sunlight protect                      |

**Note**

- All of reserved register are used for internal test. Please keep as default setting

**Command Register Format**

VCNL36821S provides an 8-bit command register for PS controlling independently. The description of each command format is shown in the following tables.

| <b>TABLE 2 - REGISTER: ST_CONF1 DESCRIPTION</b> |       |   |
|---|-------|---|
| <b>REGISTER NAME</b>                            |       | <b>COMMAND CODE: 0x00_L (0x00 DATA BYTE LOW)</b>  |
| Command   | Bit   | Description   |
| Start   | 7     | Must be set to "1" when power on ready  |
| Reserved  | 6 : 2 | Default = (0 : 0 : 0 : 0 : 0)   |
| Standby   | 1     | Set this bit = "1" to enable bias circuit<br><b>Note</b><br>• Initialization process:<br>step 1: set standby bit = "1"; step 2: set start bit = "1"; step 3: set PS_ST = "0" to start self-timed measurements |
| Reserved  | 0     | Default = 1   |

| <b>TABLE 3 - REGISTER: ST_CONF2 DESCRIPTION</b> |       |   |
|---|-------|---|
| <b>REGISTER NAME</b>                            |       | <b>COMMAND CODE: 0x00_H (0x00 DATA BYTE HIGH)</b> |
| Command   | Bit   | Description                                       |
| Reserved  | 7 : 2 | Default = (0 : 0 : 0 : 0 : 0)                     |
| Reserved  | 1     | Must be set to "1" when power on ready            |
| Reserved  | 0     | Default = 0                                       |

| <b>TABLE 4 - REGISTER: PS_CONF1 DESCRIPTION</b> |       |  |
|---|-------|--|
| <b>REGISTER NAME</b>                            |       | <b>COMMAND CODE: 0x03_L (0x03 DATA BYTE LOW)</b>   |
| Command   | Bit   | Description  |
| PS_Period                                       | 7 : 6 | (0 : 0) = 10 ms, (0 : 1) = 20 ms, (1 : 0) = 40 ms, (1 : 1) = 80 ms<br>PS sample period setting               |
| PS_PERS   | 5 : 4 | (0 : 0) = 1, (0 : 1) = 2, (1 : 0) = 3, (1 : 1) = 4<br>PS interrupt persistence setting                       |
| PS_INT  | 3 : 2 | (0 : 0) = interrupt disable, (0 : 1) = logic high / low mode, (1 : 0) = interrupt enable, (1 : 1) = reserved |
| PS_SMART_PERS                                   | 1     | 0 = disable PS smart persistence, 1 = enable PS smart persistence  |
| PS_ST   | 0     | 0 = PS start, 1 = PS stop, default = 1   |

| <b>TABLE 5 - REGISTER: PS_CONF2 DESCRIPTION</b> |       |   |
|---|-------|---|
| <b>REGISTER NAME</b>                            |       | <b>COMMAND CODE: 0x03_H (0x03 DATA BYTE HIGH)</b>                             |
| Command   | Bit   | Description   |
| PS_IT   | 7 : 6 | (0 : 0) = 1T, (0 : 1) = 2T, (1 : 0) = 4T, (1 : 1) = 8T                        |
| PS_MPS  | 5 : 4 | (0 : 0) = 1, (0 : 1) = 2, (1 : 0) = 4, (1 : 1) = 8;<br>PS multi-pulse setting |
| PS_ITB  | 3     | 0: ITB = 25 $\mu$ s, 1: ITB = 50 $\mu$ s                                      |
| PS_HG   | 2     | 0 = disable, 1 = enable, PS high gain mode                                    |
| Reserved  | 1 : 0 | Default = (0 : 0)   |

**TABLE 6 - REGISTER: PS\_CONF3 DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x04_L (0x04 DATA BYTE LOW)   |
|---------------|-------|---|
| Command       | Bit   | Description   |
| Reserved      | 7     | Default = 0   |
| PS_AF         | 6     | 0 = auto mode; 1 = force mode   |
| PS_FOR_Trig   | 5     | 0 = no PS active force mode trigger, 1 = trigger one time cycle<br>VCNL36821S output one cycle data every time host writes in "1" to sensor. The state returns to "0" automatically |
| PS_FORCENUM   | 4     | 0 = one detect cycle after trigger, 1 = two detect cycle after trigger  |
| Reserved      | 3     | When use PS function, must write "1"  |
| PS_SP_INT     | 2     | 0 = disable, 1 = enable, PS sunlight light protect INT setting  |
| Reserved      | 1 : 0 | Reserved  |

**TABLE 7 - REGISTER: PS\_CONF4 DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x04_H (0x04 DATA BYTE HIGH)  |
|---------------|-------|---|
| Command       | Bit   | Description   |
| PS_SC         | 7 : 5 | Default = (0 : 0 : 0), with all 3 bit = "1", (1 : 1 : 1), sunlight cancellation is enabled  |
| Reserved      | 4     | Default = 0   |
| LED_I         | 3 : 0 | (1 : 0 : 0 : 0) = 50 mA; (1 : 0 : 0 : 1) = 66 mA; (1 : 0 : 1 : 0) = 82 mA; (1 : 0 : 1 : 1) = 98 mA;<br>(1 : 1 : 0 : 0) = 114 mA; (1 : 1 : 0 : 1) = 130 mA; (1 : 1 : 1 : 0) = 144 mA; (1 : 1 : 1 : 1) = 156 mA;<br>LED current selection setting |

**TABLE 8 - REGISTER: PS\_THDL DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x05_L (0x05 DATA BYTE LOW) AND 0x05_H (0x05 DATA BYTE HIGH) |
|---------------|-------|--|
| Command       | Bit   | Description  |
| PS_THDL       | 7 : 0 | 0x00 to 0xFF, PS interrupt low threshold setting                           |
| PS_THDL       | 3 : 0 | 0x00 to 0x0F, PS interrupt low threshold setting                           |

**TABLE 9 - REGISTER: PS\_THDH DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x06_L (0x06 DATA BYTE LOW) AND 0x06_H (0x06 DATA BYTE HIGH) |
|---------------|-------|--|
| Command       | Bit   | Description  |
| PS_THDH       | 7 : 0 | 00H to FFH, PS interrupt high threshold setting                            |
| PS_THDH       | 3 : 0 | 00H to 0FH, PS interrupt high threshold setting                            |

**TABLE 10 - REGISTER: PS\_CANC DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x07_L (0x07 DATA BYTE LOW) AND 0x07_H (0x07 DATA BYTE HIGH) |
|---------------|-------|--|
| Command       | Bit   | Description  |
| PS_CANC_L     | 7 : 0 | 0x00 to 0xFF, PS intelligent cancellation level setting                    |
| PS_CANC_H     | 3 : 0 | 0x00 to 0x0F, PS intelligent cancellation level setting                    |

**TABLE 11 - REGISTER: PS\_AC DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x08_L (0x08 DATA BYTE LOW)  |
|---------------|-------|--|
| Command       | Bit   | Description  |
| PS_AC_PERIOD  | 7 : 6 | (0 : 0) = 3 ms, (0 : 1) = 6 ms, (1 : 0) = 12 ms, (1 : 1) = 24 ms; PS auto-calibration detect sample period setting |
| PS_AC_NUM     | 5 : 4 | (0 : 0) = 1, (0 : 1) = 2, (1 : 0) = 4, (1 : 1) = 8; PS auto-calibration detect sample number setting               |
| PS_AC         | 3     | 0 = disable, 1 = enable; PS auto-calibration enable; need set PS_AF = 1  |
| PS_AC_TRIG    | 2     | 0 = disable, 1 = enable; trigger one time auto-calibration   |
| Reserved      | 1     | Reserved   |
| PS_AC_INT     | 0     | 0 = disable, 1 = enable; PS auto-calibration INT setting   |

**TABLE 12 - REGISTER: PS\_LP DESCRIPTION**

| REGISTER NAME |       | COMMAND CODE: 0x08_H (0x08 DATA BYTE HIGH)  |
|---------------|-------|---|
| Command       | Bit   | Description   |
| Reserved      | 7 : 3 | Default = (0 : 0 : 0 : 0 : 0)   |
| PS_LPPER      | 2 : 1 | (0 : 0) = 40 ms, (0 : 1) = 80 ms, (1 : 0) = 160 ms, (1 : 1) = 320 ms;<br>PS detection period setting at low power mode (PS_LPEN = 1)  |
| PS_LPEN       | 0     | 0 = disable, 1 = enable = starts proximity low power measurements; now PS_LPPER used as periode, but LED_I, PS_IT, PS_ITB, PS_MPS as defined within register 3 and register 4 |

**TABLE 13 - READ OUT REGISTER DESCRIPTION**

| Register     | Command Code                 | Bit                                 | Description  |
|--------------|------------------------------|-------------------------------------|--|
| PS_Data_L    | 0xF8_L (0xF8 data byte low)  | 7 : 0                               | 0x00 to 0xFF, PS output data   |
| PS_Data_M    | 0xF8_H (0xF8 data byte high) | 3 : 0                               | 0x00 to 0x0F, PS output data   |
| INT_Flag     | 0xF9_H (0xF9 data byte high) | 7 : 6<br>5<br>4<br>3<br>2<br>1<br>0 | Reserved<br>PS_ACFLAG, after PS finishing auto-calibration, INT raise<br>PS_SPFLAG, PS entering protection mode<br>Reserved<br>Reserved<br>PS_IF_CLOSE, PS rises above PS_THDH INT trigger event<br>PS_IF_AWAY, PS drops below PS_THDL INT trigger event |
| ID_L         | FAH_L (FAH data byte low)    | 7 : 0                               | Default = 0010 0110, device ID LSB byte  |
| ID_M         | FAH_H (FAH data byte high)   | 7 : 6<br>5 : 4<br>3 : 0             | (0 : 0)<br>(0 : 0) slave address = 0x60<br>Version code (0 : 0 : 0 : 0) device ID MSB byte   |
| PS_AC_Data_L | 0xFB_L (0xFB data byte low)  | 7 : 0                               | 0x00 to 0xFF, PS auto-calibration data (LSB)   |
| PS_AC_Data_H | 0xFB_H (0xFB data byte high) | 7<br>6<br>5 : 4<br>3 : 0            | AC_BUSY, when AC, the bit will be "1"<br>AC_SUN, PS enters sunlight protect during auto-calibration<br>Reserved<br>0x00 to 0xFF, PS auto-calibration data (MSB)  |

**Initialization**

VCNL36821S includes default values for each register. As long as power is on, it is ready to be controlled by host via I<sup>2</sup>C bus.

**Proximity Interrupt**

There are two different Interrupt methods: "normal" interrupt mode and so-called "logic high / low" mode.

The "normal" interrupt mode is selected with PS\_INT = interrupt enabled (0x03\_L, bit 3:2 = 1:0) within register PS\_CONF1.

Tests with ready-made application will show where to set the value for high threshold (PS\_THDH) and low threshold (PS\_THDL). For more information and explanation please study also the application note [www.vishay.com/doc?80178](http://www.vishay.com/doc?80178).

The "logic high / low" mode is selected with PS\_INT = trigger by logic high/low mode (0x03\_L, bit 3 : 2 = 1 : 1) within register PS\_CONF1. When this mode is selected, the interrupt pin is pulled low when the proximity counts reach the programmed high threshold (PS\_THDH) and will return to high level when counts drop below the count value for low threshold (PS\_THDL).

With help of the function PS persistence one may also improve a reliable detection that not just one short event directly triggers an interrupt, but only when 2 (or up to 4) consecutive proximity measurements are above the programmed threshold value the interrupt will be set; please see also within the application note [www.vishay.com/doc?80178](http://www.vishay.com/doc?80178).

**PROXIMITY LOW POWER CONSUMPTION MODE**

While register PS\_LPEN set to 1, proximity sensor operates in a special low power consumption mold offering significant lower power consumption of just 17.6  $\mu$ A with response time of 320 ms for proximity detection that is a remarkable feature for any fuctions required a lower power consumption operations and did not want to always request one proximity measurement with proximity force mode (PS\_AF and PS\_TRIG).

|                           |      |      |     |     |     |      |
|---------------------------|------|------|-----|-----|-----|------|
| PS period (ms)            | 10   | 20   | 40  | 80  | 160 | 320  |
| Normal mode ( $\mu$ A)    | 2794 | 1492 | 841 | 515 | n/a | n/a  |
| Low power mode ( $\mu$ A) | n/a  | n/a  | 106 | 56  | 30  | 17.6 |

**Notes**

- IR LED = 130 mA, PS\_IT = x 4, PS\_ITB = 50  $\mu$ s
- While register PS\_LPEN = 1, proximity sensor

**PROXIMITY DETECTION HYSTERESIS**

A PS detection hysteresis is important that keeps PS state in a certain range of detection distance. For example, PS INT asserts when PS value over PS\_THDH. Host switches off panel backlight and then clears INT. When PS value is less than PS\_THDL, host switches on panel backlight. Any PS value lower than PS\_THDH or higher than PS\_THDL, PS INT will not be asserted. Host does keep the same state.

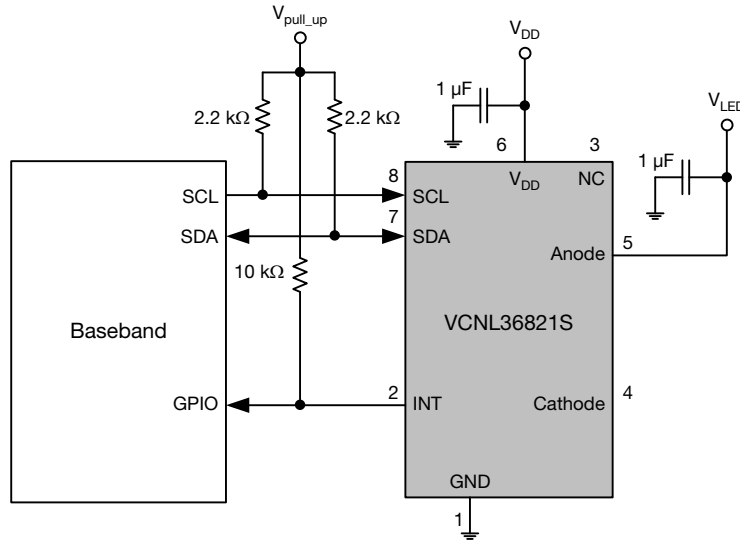


Fig. 10 - VCNL36821S Reference Circuit Connection With Host (proximity detection logic output mode) (VCNL36821S INT pin connecting to BB GPIO instead of INT pin)

**PACKAGE INFORMATION** in millimeters

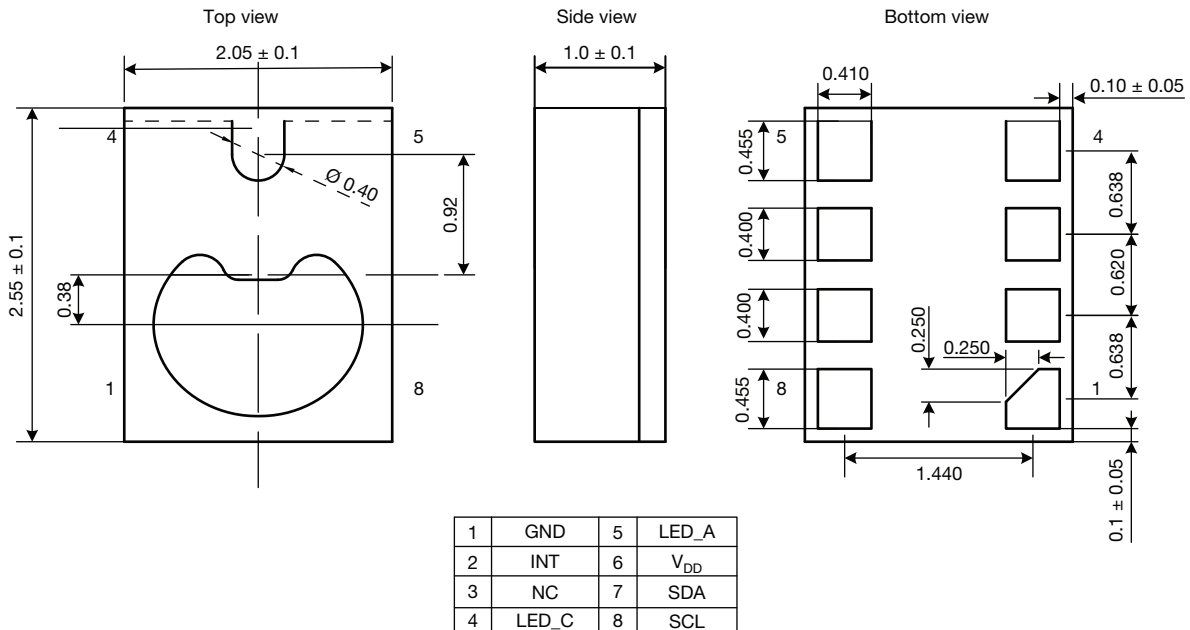


Fig. 11 - VCNL36821S Package Dimensions

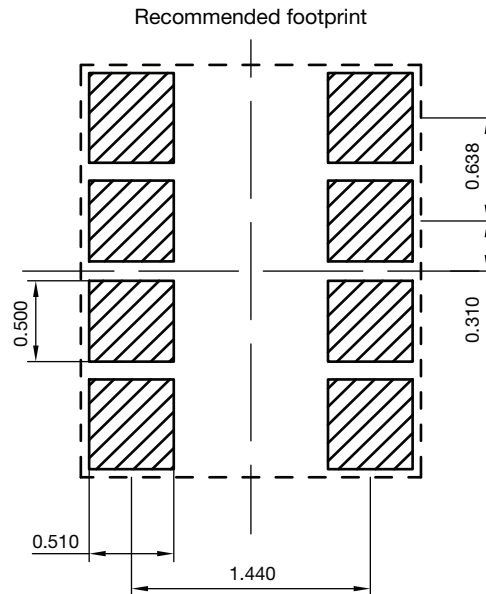
**LAYOUT PAD INFORMATION** in millimeters


Fig. 12 - VCNL36821S PCB Layout Footprint

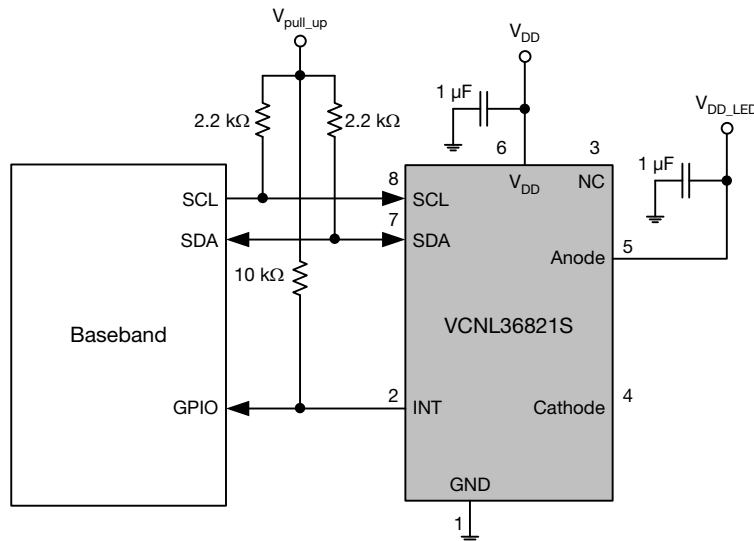
**APPLICATION CIRCUIT BLOCK REFERENCE**


Fig. 13 - VCNL36821S Application Circuit

| RECOMMENDED STORAGE AND REBAKING CONDITIONS |  |      |      |        |
|---|--|------|------|--------|
| PARAMETER                                   | CONDITIONS   | MIN. | MAX. | UNIT   |
| Storage temperature                         |  | 5    | 50   | °C     |
| Relative humidity                           |  | -    | 60   | %      |
| Open time                                   |  | -    | 168  | h      |
| Total time                                  | From the date code on the aluminized envelope (unopened) | -    | 12   | months |
| Rebaking                                    | Tape and reel: 60 °C                                     | -    | 22   | h      |
|   | Tube: 60 °C  | -    | 22   | h      |



RECOMMENDED INFRARED REFLOW

Soldering conditions which are based on J-STD-020 C

| IR REFLOW PROFILE CONDITION                |            |                                       |               |
|--|------------|---------------------------------------|---------------|
| PARAMETER                                  | CONDITIONS | TEMPERATURE                           | TIME          |
| Peak temperature                           |            | 260 °C + 5 °C / - 5 °C (max.: 265 °C) | 10 s          |
| Preheat temperature range and timing       |            | 150 °C to 200 °C                      | 60 s to 180 s |
| Timing within 5 °C to peak temperature     |            | -                                     | 10 s to 30 s  |
| Timing maintained above temperature / time |            | 217 °C                                | 60 s to 150 s |
| Timing from 25 °C to peak temperature      |            | -                                     | 8 min (max.)  |
| Ramp-up rate                               |            | 3 °C/s (max.)                         | -             |
| Ramp-down rate                             |            | 6 °C/s (max.)                         | -             |

Recommend Normal Solder Reflow is 235 °C to 265 °C

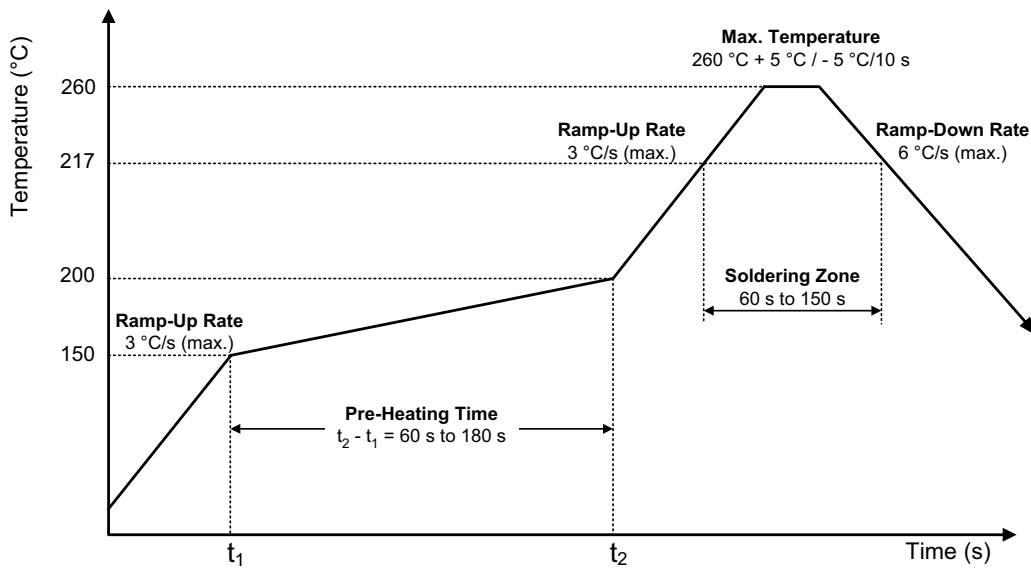


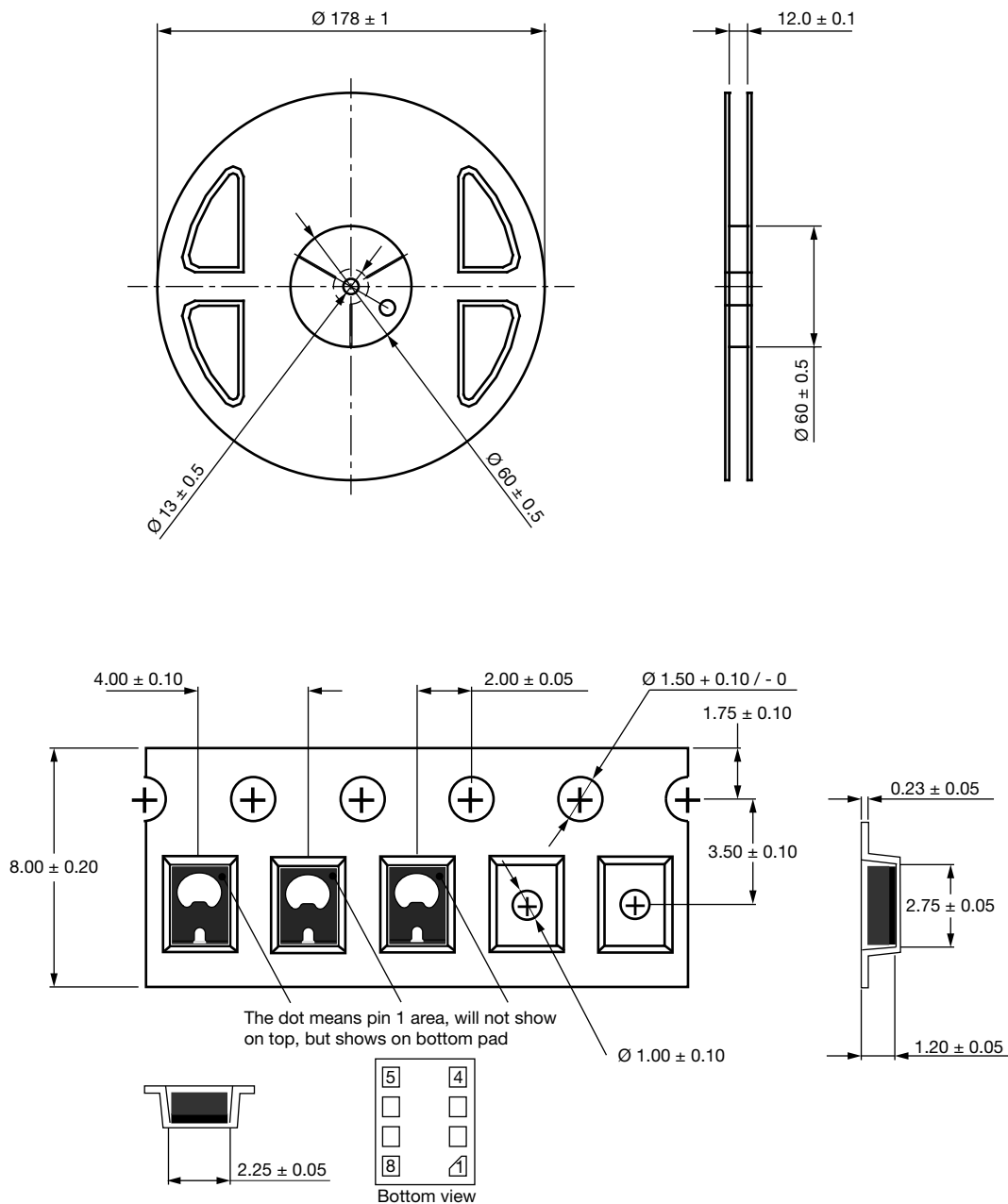
Fig. 14 - VCNL36821S Solder Reflow Profile Chart

RECOMMENDED IRON TIP SOLDERING CONDITION AND WARNING HANDLING

1. Solder the device with the following conditions:
  - 1.1. Soldering temperature: 400 °C (max.)
  - 1.2. Soldering time: 3 s (max.)
2. If the temperature of the method portion rises in addition to the residual stress between the leads, the possibility that an open or short circuit occurs due to the deformation or destruction of the resin increases
3. The following methods: VPS and wave soldering, have not been suggested for the component assembly
4. Cleaning method conditions:
  - 4.1. Solvent: methyl alcohol, ethyl alcohol, isopropyl alcohol
  - 4.2. Solvent temperature < 45 °C (max.)
  - 4.3. Time: 3 min (min.)



TAPE PACKAGING INFORMATION in millimeters





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