LITEON® OPTOELECTRONICS

Data Sheet

# OPTICAL SENSOR
# LTR-2679PS-01

## Description

The LTR-2679PS-01is an integrated low voltage I2C proximity sensor (PS), with built-in emitter in a single miniature chipled lead-free surface mount package.

With built-in proximity sensor (VCSEL emitter and detector), LTR-2679PS-01offers the feature to detect object at a user configurable distance

The sensor supports an interrupt feature that removes the need to poll the sensor for a reading which improves system efficiency. The sensor also supports several features that help to minimize the occurrence of false triggering. This CMOS design and factory-set one time trimming capability ensure minimal sensor-to-sensor variations for ease of manufacturability to the end customers.

## Features

- I²C interface (Standard mode @100kHz or Fast mode @400kHz)
- Proximity Sensing in one ultra-small chipled package
- Very low power consumption with sleep mode capability
- Operating voltage ranges: 1.7V to 3.6V
- Operating temperature ranges: -30 to +85 ºC
- Programmable interrupt function for PS with upper and lower thresholds
- RoHS and Halogen free compliant

## Application

- Control brightness of display panel
- Object detection in mobile, computing, and consumer devices.

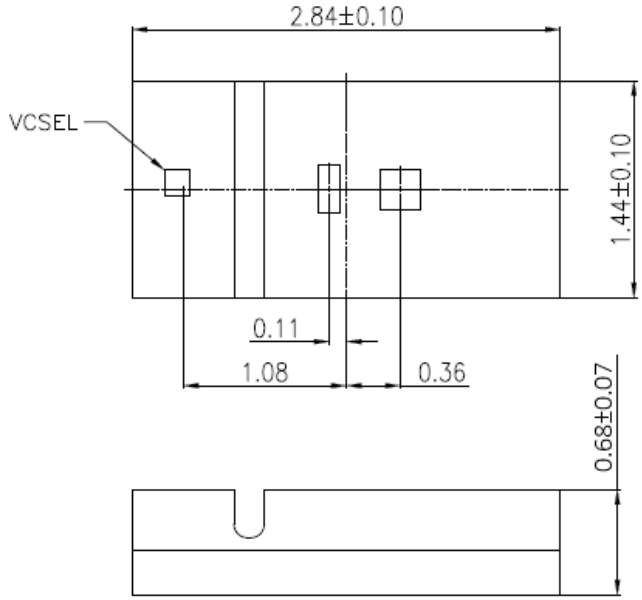
**PS Features**

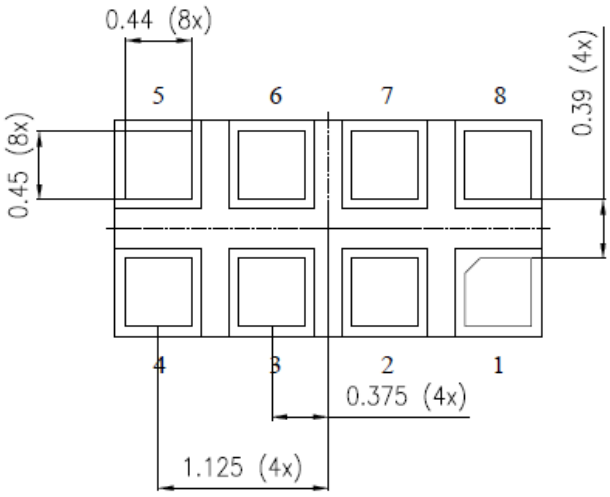
- Built-in VCSEL LED driver
- High ambient light suppression
- 16-bit effective resolution
- 11-bit or 16-bit display
- Cancellation of crosstalk
- Programmable VCSEL LED drive setting
- Ambient IR saturation indicator

## Ordering Information

| Part Number | Packaging Type | Package | Quantity |
|---|---|---|---|
| LTR-2679PS-01 | Tape and Reel | 8-pin chipled package | 4000pcs |

## 1. Outline Dimensions and Pins Configuration



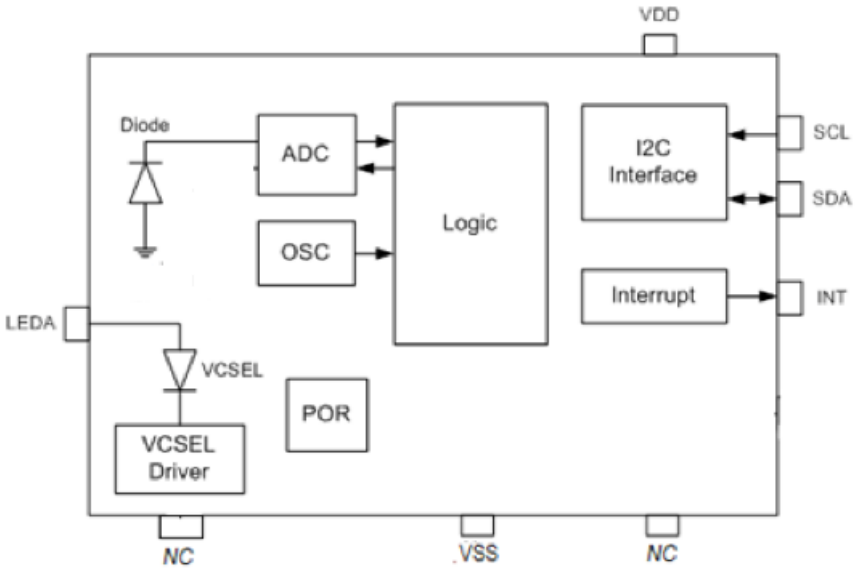

*Pin-Out Assignment:*

| | |
|---|---|
| *1. SCL* | *5. NC* |
| *2. SDA* | *6. NC* |
| *3. VDD* | *7. INT* |
| *4. LEDA* | *8. GND* |

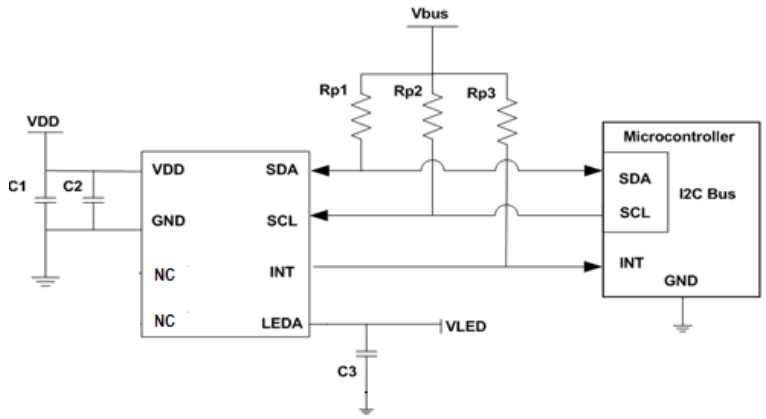
Note: All dimensions in millimeter

## 2. Functional Block Diagram

The LTR-2679PS-01contains an integrated proximity photodiode for photocurrent measurement. The photodiode current is converted to digital values by an ADC. The sensor also included a VSCEL driver, as well as some peripheral circuits such as an internal oscillator, a current course, voltage reference, and internal fuses to store trimming information.



## 3. Application Circuit




**Note: It is a requirement to separate the VDD and VLED**

### I/O Pins Configuration Table

| Pin | I/O Type | Symbol | Description |
|---|---|---|---|
| 1 | OUT | SCL | $I^2C$ serial clock |
| 2 | IN/OUT | SDA | I2C serial data |
| 3 | Supply | VDD | Supply Voltage |
| 4 | Supply | LEDA | LED Anode. Connect to VBAT on PCB |
| 5 | NC | NC | No Connection to this pin |
| 6 | NC | NC | No Connection to this pin |
| 7 | OUT | INT | Interrupt pin |
| 8 | GND | GND | Ground |

### Recommended Application Circuit Components

| Component | Recommended Value |
|---|---|
| Rp1, Rp2, Rp3 [1] | 1 kΩ to10 kΩ |
| C1, C3 | 1uF ±20%, X7R / X5R Ceramic |
| C2 | 0.1uF |

[1] Selection of pull-up resistors value is dependent on bus capacitance values. For more details, please refer to $I^2C$ Specifications: http://www.nxp.com/documents/user_manual/UM10204.pdf

# 4. Ratings and Specifications

### Absolute Maximum Ratings at Ta = 25°C

| Parameter | Symbol | Min. | Max | Unit |
|---|---|---|---|---|
| Supply Voltage | VDD | | 4.5 | V |
| Digital Voltage Range | SCL, SDA, INT | -0.5 | 4.5 | V |
| Max Voltage Range | LDR | -0.5 | 4.5 | V |
| Storage Temperature | $T_{stg}$ | -40 | 85 | °C |
| Electrostatic Discharge Protection (Human Body Model JESD22-A114) | $V_{HBM}$ | | 2000 | V |

Note: Exceeding these ratings could cause damage to the sensor. All voltages are with respect to ground. Currents are positive into, negative out of the specified terminal.

### Recommended Operating Conditions

| Description | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| Supply Voltage | VDD | 1.7 | | 3.6 | V |
| LED Supply Voltage | $V_{LED}$ | 2.8 | | 4.35 | V |
| Interface signal input high | $V_{I2Chigh}$ | 1.5 | | VDD | V |
| Interface signal input low | $V_{I2Clow}$ | 0 | | 0.4 | V |
| Operating Temperature | $T_{ope}$ | -30 | | 85 | °C |

### Electrical & Optical Specifications

All specifications are at VDD = 3.0 V, $T_{ope}$ = 25°C, unless otherwise noted.

| Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|
| PS Active Supply Current | | 120 | 200 | uA | 100ms MRR with 32 pulse 100% duty cycle |
| Standby Current | | | 5 | uA | Shutdown Mode |
| Wakeup Time from Standby | | 5 | 10 | ms | From Standby to Active mode where measurement can start |

## Characteristics Proximity Sensor

| Parameter | Min. | Typ. | Max. | Unit | Condition |
|---|---|---|---|---|---|
| PS Resolution | | | 16 | Bit | Configurable to 11 bit display (capped at 2047) or 16 bit |
| Sensitivity Range | | 940 | | nm | |
| Detection Distance | | 3 | | cm | 5 pulse, 32us, 7mA |
| LED Pulse Current | | | 9 | mA | Configurable |
| LED Pulse width | | | 32 | us | Configurable for 4,8,16,32 us |
| LED Duty Cycle | | 100 | | % | |
| Number of LED Pulses | 1 | | 32 | Pulses | Programmable from 1 to 32 pulses |
| Ambient light suppression ** | | | 100 | klux | Direct sunlight |

## Typical Device Parameter

(VDD = 2.8V, Ta=25°C, Default power-up settings, unless otherwise noted)

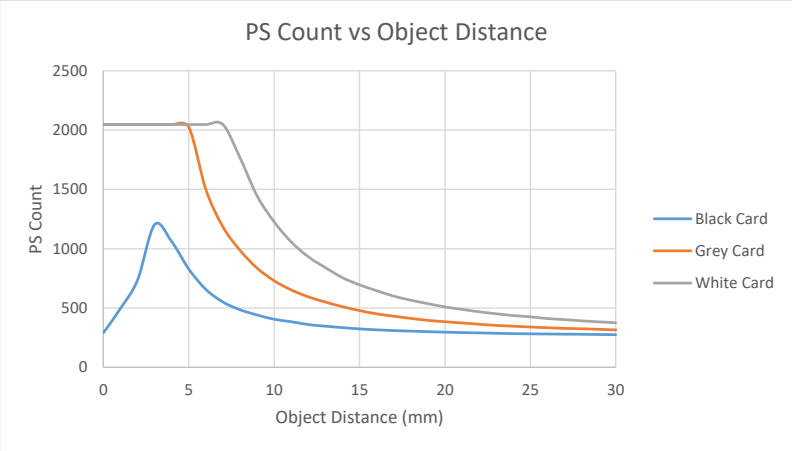



Figure 4.1: PS performance across distance VDD 3V, 7mA, 5pulses, with others in default settings

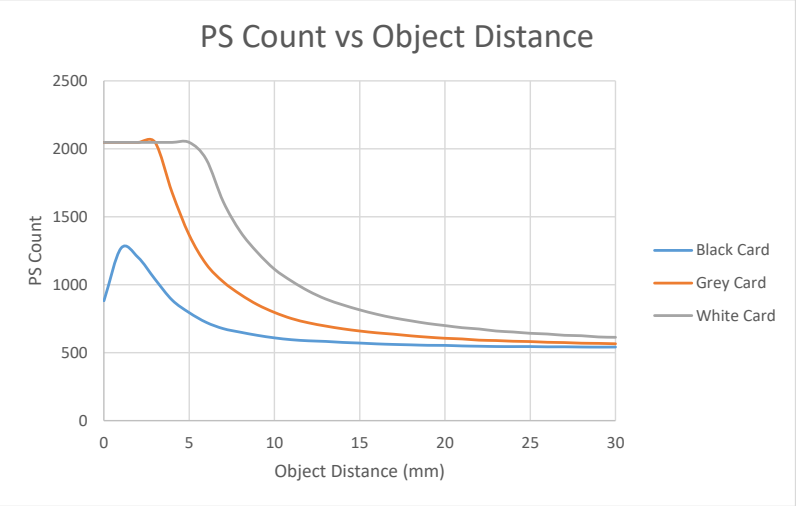
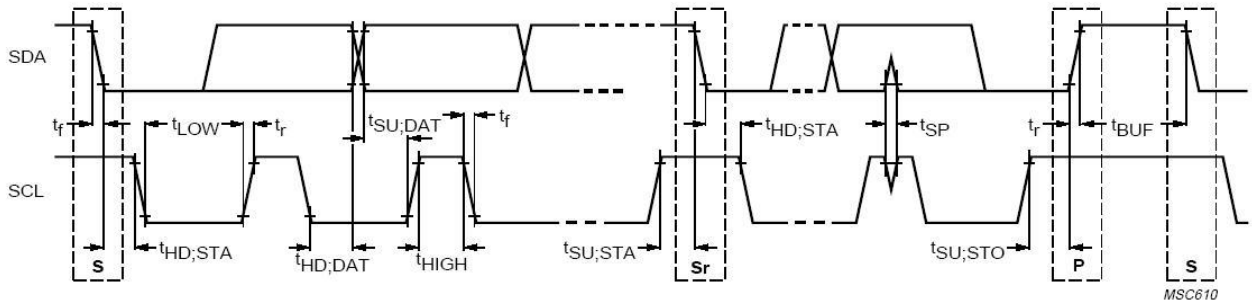



Figure 4.2 PS performance over Gray Card (18% reflectivity) with window glass of 0.6mm thickness, VDD 3V, 7mA, 5pulses with others in default settings

## AC Electrical Characteristics

All specifications are at VBus = 1.7V, $T_{ope}$ = 25°C, unless otherwise noted.

| Parameter | Symbol | Standard mode | | Fast mode | | |
|---|---|---|---|---|---|---|
| | | Min. | Max. | Min. | Max. | Unit |
| SCL clock frequency | $f_{SCL}$ | 100 | | 400 | | kHz |
| Bus free time between a STOP and START condition | $t_{BUF}$ | 4.7 | - | 1.3 | - | us |
| Hold time (repeated) START condition. After this period, the first clock pulse is generated | $t_{HD;STA}$ | 4.0 | - | 0.6 | - | us |
| LOW period of the SCL clock | $t_{LOW}$ | 4.7 | - | 1.3 | - | us |
| HIGH period of the SCL clock | $t_{HIGH}$ | 4.0 | - | 0.6 | - | us |
| Set-up time for a repeated START condition | $t_{SU;STA}$ | 4.7 | - | 0.6 | - | us |
| Set-up time for STOP condition | $t_{SU;STO}$ | 4.0 | - | 0.6 | - | us |
| Rise time of both SDA and SCL signals | $t_r$ | - | 1000 | - | 300 | ns |
| Fall time of both SDA and SCL signals | $t_f$ | - | 300 | - | 300 | ns |
| Data hold time | $t_{HD;DAT}$ | 0 | - | 0 | - | us |
| Data setup time | $t_{SU;DAT}$ | 250 | - | 100 | - | ns |

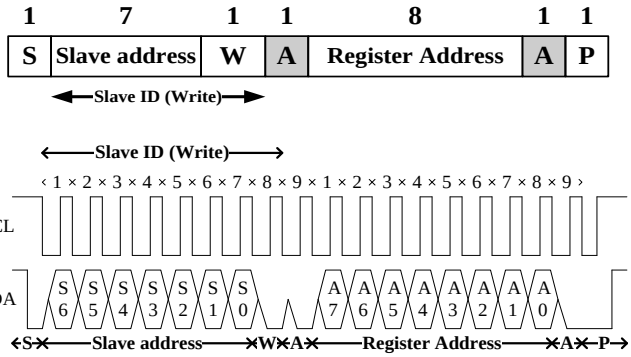


Definition of timing for I²C bus

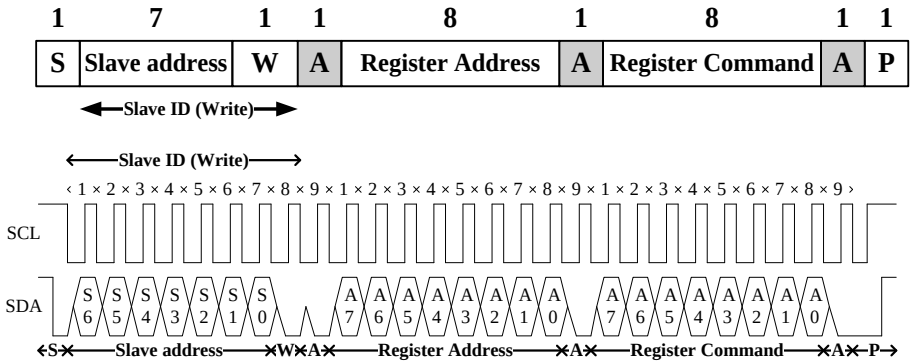
## 5. Principles of Operation

### I²C Protocols

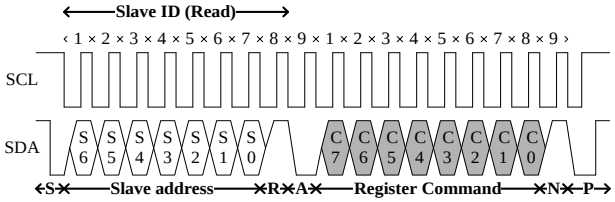
. I²C Write Protocol (type 1):



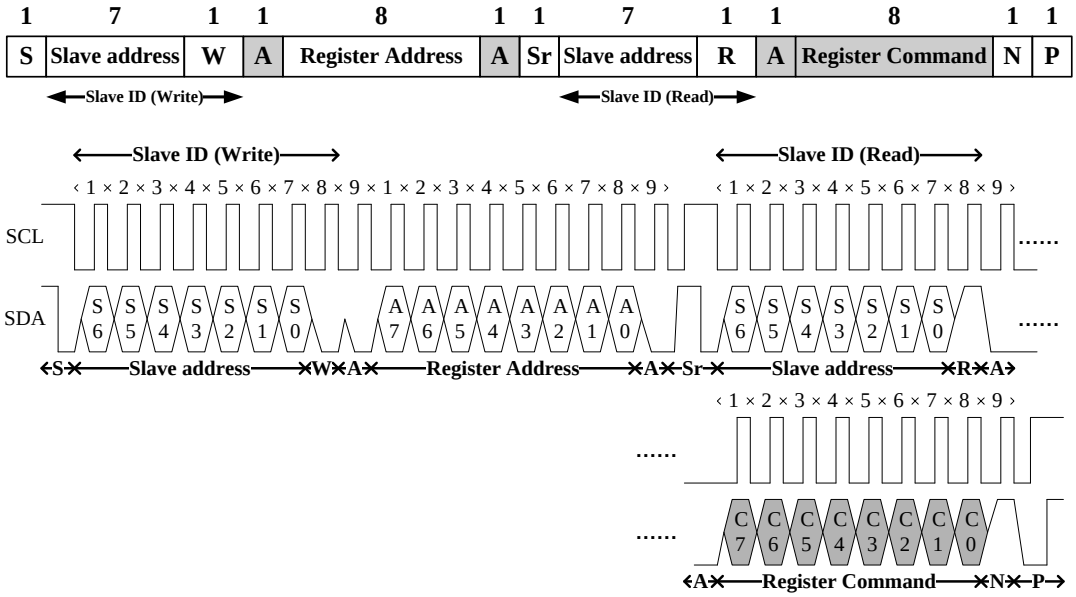

. I²C Write Protocol (type 2):




. I²C Read Protocol:




. I²C Read (Combined format) Protocol:




| | | | |
|---|---|---|---|
| **A** | Acknowledge (0 for an ACK) | **N** | Non-Acknowledge(1 for an NACK) |
| **S** | Start condition | **Sr** | Repeated Start condition |
| **P** | Stop condition | | |
| **W** | Write (0 for writing) | **R** | Read (1 for read) |
| ■ | Slave-to-master | □ | Master-to-Slave |

### I2C Slave Address

The 7 bits slave address for this sensor is 0x23H. A read/write bit should be appended to the slave address by the master device to properly communicate with the sensor.

| I²C Slave Address | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Command Type | (0x23H) | | | | | | | (0x23H) | (0x23H) |
| | Bit7 | Bit6 | Bit5 | Bit4 | Bit3 | Bit2 | Bit1 | Bit0 | |
| Write | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | 0x46H |
| Read | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0x47H |

## 6. Register Set

| Address | R / W | Register Name | Description | Reset Value |
|---|---|---|---|---|
| 0x81 | RW | PS_CONTR | PS operation mode control/SW Reset | 0x10 |
| 0x82 | RW | PS_LED | PS LED setting | 0x7A |
| 0x83 | RW | PS_N_PULSES | PS number of pulses | 0x00 |
| 0x84 | RW | PS_MEAS_RATE | PS measurement rate in active mode | 0x04 |
| 0x86 | R | PART_ID | Part Number ID and revision IDs | 0x1C |
| 0x87 | R | MANUFAC_ID | Manufacturer ID | 0x05 |
| 0x91 | R | PS_STATUS | PS Status | 0x08 |
| 0x92 | R | PS_DATA | PS measurement data, LSB | 0x00 |
| 0x93 | R | PS_DATA | PS measurement data, MSB | 0x00 |
| 0x98 | RW | INTERRUPT | Interrupt settings | 0x08 |
| 0x99 | RW | INTERTUPT_PERSIST | PS interrupt persist setting | 0x00 |
| 0x9A | RW | PS_THRES_HIGH_LSB | PS interrupt upper threshold, LSB | 0xFF |
| 0x9B | RW | PS_THRES_HIGH_MSB | PS interrupt upper threshold, MSB | 0xFF |
| 0x9C | RW | PS_THRES_LOW_LSB | PS interrupt lower threshold, LSB | 0x00 |
| 0x9D | RW | PS_THRES_LOW_MSB | PS interrupt lower threshold, MSB | 0x00 |
| 0x9E | RW | PXTALK_LSB | Xtalk correction on PS CH0 PD, LSB | 0x00 |
| 0x9F | RW | PXTALK_MSB | Xtalk correction on PS CH0 PD, MSB | 0x00 |
| 0xA4 | RW | LED_DRIVE | LED driver Register | 0x00 |

| | | | | |
|---|---|---|---|---|
| 0xB6 | RW | IR AMBIENT SAT VALUE | IR Ambient saturation value | 0x08 |
| 0xB7 | RW | DSS_CONTR | Dynamic Sunlight Suppression control | 0x40 |
| 0xAD | RW | MAIN_CONTR | Main Control Setting | 0x00 |

## PS_CONTR Register (0x81) (Read/Write)

The PS_CONTR register controls the PS operation modes and software reset for sensor. The PS sensor can be set to either standby mode or active mode. At either of these modes, the I2C circuitry is always active. The default mode after power up is standby mode. During standby mode, there is no PS measurement performed but I2C communication is allowed to enable read/write to all the registers. **Register 0xA4 must be set to 0x04, register 0xAD must be set to 0x18 and register 0xB7 must be set to 0x10.**

| 0x81 | PS_CONTR (default = 0x10) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | *Resolution* | *Reserved* | *PS_OS* | *FTN/NTF enable* | *PS Mode* | *SW Reset* |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| Reserved | 7:6 | 00 | **Must write as 00** | |
| Resolution | 5 | 0 | 0 | 11 bit Display (default) |
| | | | 1 | 16 bit Display |
| Reserved | 4 | 1 | **Must write 1** | |
| PS_OS | 3 | 0 | PS Offset/Xtalk Cancellation. When enabled, PS DATA will be subtracted with PS OFFSET register (0x9F + 0x9E) data. | |
| | | | 0 | Disabled **(default)** |
| | | | 1 | Enabled |
| FTN/FTN EN | 2 | 0 | 0 | Disable FTN/NTF Status reporting **(default)** |
| | | | 1 | Enable FTN/NTF Status reporting |
| PSMODE*1 | 1 | 0 | 1 | Active Mode |
| | | | 0 | Stand-by mode **(default)** |

| | | | | |
|---|---|---|---|---|
| SW_RST | 0 | 0 | Reset registers to default values, with sensor into standby mode. | |
| | | | 0 | No action **(default)** |
| | | | 1 | Reset Registers to default values (including calibration values) |

- *[1] Prior to enabling PS Mode, 0xA4 must be set to 0x04, 0xAD must be set to 0x18 and 0x7B must be set to 0x10. Please refer to **Enable PS** pseudocode for complete instructions*

## PS_LED Register (0x82) (Read/Write)

The PS_LED register controls the LED pulse width and LED peak current. **The minimum LED current should be at least 5.5 mA to turn on the VCSEL.**

| 0x82 | PS_LED (default = 0x7A) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | *PLED Pulse Width* | | *LED current* | | |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| Reserved | 7:5 | 011 | **Must write as 011** | |
| PLED Pulse Width | 4:3 | 11 | 00 | 4us |
| | | | 01 | 8us |
| | | | 10 | 16us |
| | | | 11 | 32us **(default)** |
| LED current | 2:0 | 010 | 010 | 3.5 mA **(default)** |
| | | | 011 | 4.5 mA |
| | | | 100 | 5.5 mA |
| | | | 101 | 6.5 mA |
| | | | 110 | 7 mA |
| | | | 111 | 9 mA |

## PS_N_Pulses Register (0x83) (Read/Write)

The PS_N_Pulses register controls the PS averaging factor and LED pulses to be emitted.

| 0x83 | PS_N_Pulses (default = 0x00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *PS averaging factor* | | *Reserved* | *PS number of LED pulses* | | | | |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| PS averaging factor | 7:6 | 00 | 00 | No average **(default)** |
| | | | 01 | 2n averaging |
| | | | 10 | 4n averaging |
| | | | 11 | 8n averaging |
| Reserved | 5 | 0 | 0 | Reserved |
| PS number of LED pulses | 4:0 | 00000 | | Specifies PS LED number of pulses. If PS number of pulse set to 0, the pulse count will be 1. |

## PS_MEAS_RATE Register (0x84) (Read/Write)

The PS_MEAS_RATE register controls the timing of the periodic measurements of the PS in active mode. Measurement Repeat Rate is the interval between DATA registers update.

| 0x84 | PS_MEAS_RATE (default = 0x04) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | | | *PS Measurement Repeat Rate* | | |

| Field | | Bits | Default | Description | |
|---|---|---|---|---|---|
| Reserved | | 7:3 | 00000 | **Must write as 00000** | |
| PS Measurement Rate | | 2:0 | 100 | 000 | 6.125ms |
| | | | | 001 | 12.5ms |

| | | | | | |
|---|---|---|---|---|---|
| | | | | 010 | 25ms |
| | | | | 011 | 50ms |
| | | | | 100 | 100ms **(default)** |
| | | | | 101 | 200ms |
| | | | | 110 | 400ms |
| | | | | 111 | 800ms |

### PART_ID Register (0x86) (Read Only)

The PART_ID register defines the part number and revision identification of the sensor.

| 0x86 | PART_ID (default = 0x1C) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Part Number ID* | | | | *Revision ID* | | | |

### MANUFAC_ID Register (0x87) (Read Only)

The MANUFAC_ID register defines the manufacturer identification of the sensor.

| 0x87 | MANUFAC_ID (default = 0x05) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Manufacturer ID* | | | | | | | |

### PS_Status Register (0x91) (Read Only)

| 0x91 | PS_Status (default = 0x08) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | *FTN* | *NTF* | *Reserved* | *PS IR Ambient Saturation* | *PS Interrupt Status* | *PS Data Status* |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| Reserved | 7:6 | 00 | | Reserved |
| FTN | 5 | 0 | 0 | No far to near object detected **(default)** |
| | | | 1 | Far to near object detected |
| NTF | 4 | 0 | 0 | No near to far object detected **(default)** |
| | | | 1 | Near to far object detected |
| Reserved | 3 | 1 | | Reserved |
| PS IR Ambient Saturation | 2 | 0 | 0 | No PS IR ambient saturation (PS data is valid) |
| | | | 1 | PS IR Ambient saturation happens (PS data is invalid) |
| PS interrupt status | 1 | 0 | 0 | interrupt signal INACTIVE (default) |
| | | | 1 | interrupt signal ACTIVE |
| PS data status | 0 | 0 | 0 | OLD data (data already read), (default) |
| | | | 1 | NEW data (first time data is read) |

## PS_DATA Register (0x92 ~ 0x93) (Read Only)

PS measurement results are stored in PS_DATA registers. **It is necessary to do a block read on both registers 0x92 and 0x93 to ensure the data integrity.**

| 0x92 | PS_Data LSB (default = 0x00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *PS Data LSB* | | | | | | | |

| Field | Bits | Default | Description |
|---|---|---|---|
| PS_Data LSB | 7:0 | 0000 0000 | PS measurement data LSB |

| 0x93 | PS_Data MSB (default = 0x00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *IR SAR* | *Reserved* | | | | *PS Data MSB* | | |

| Field | Bits | Default | Description |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| PS IR Ambient Saturation | 7 | 0 | 0 | No PS IR ambient saturation (PS data is valid) |
| | | | 1 | PS IR Ambient saturation happens (PS data is invalid) |
| Reserved | 6:3 | 0000 | | Reserved |
| PS_Data MSB | 2:0 | 000 | | PS_Data MSB |

## INTERRUPT Register (0x98) (Read/Write)

INTERRUPT register controls the operation of the interrupt pin and functions. The PS_STATUS register is updated even if interrupt pin is INACTIVE / high-impedance state. **Bit 7 of 0x98 must be set to 1 even though Interrupt function is not used.**

| 0x98 | INTERRUPT (default = 0x08) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | | | *Interrupt Polarity* | *Interrupt Mode* | |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| Reserved | 7:3 | 00001 | | **Must write as 10000** |
| Interrupt Polarity | 2 | 0 | 0 | INT pin is considered active when it is a logic 0 (default) |
| | | | 1 | INT pin is considered active when it is a logic 1 |
| Interrupt mode | 1:0 | 00 | 00 | Interrupt pin is INACTIVE / high impedance state (default) |
| | | | 01 | Only PS measurement can trigger interrupt |
| | | | 1x | Reserved |

### INTERRUPT PERSIST Register (0x99) (Read/Write)

INTERRUPT PERSIST register sets the N number of times the measurement is out of the threshold range settings before asserting the INTERRUPT pin.

| 0x99 | INTERRUPT PERSIST (default = 0x00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *PS_PERSIST* | | | | *Reserved* | | | |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| PS_PERSIST | 7:4 | 0 | 0 | Every PS value out of threshold range (default) |
| | | | 1 | 1 consecutive PS values out of threshold range |
| | | | ..... | ..... |
| | | | 1111 | 15 consecutive PS values out of threshold range |
| Reserved | 3:0 | 0 | | Reserved |

### PS_THRESHOLD Register (0x9A -0x9D) (Read/Write)

PS_THRESHOLD registers are used to set the upper and the lower limits of the absolute interrupt threshold value. Interrupt function compares the value in the PS_THRESHOLD registers to measured data value in PS_DATA registers. The data format for PS_THRESHOLD registers must be the same as that of PS_DATA registers. PS_ Threshold registers must be written in the sequence of LSB first and then followed by MSB.

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| PTH_HIGH LSB | 0x9A | 11111111 | -- | PS upper interrupt threshold value, LSB |
| PTH_HIGH MSB | 0x9B | 11111111 | -- | PS upper interrupt threshold value, MSB |
| PTH_LOW LSB | 0x9C | 00000000 | -- | PS lower interrupt threshold value, LSB |

| | | | | |
|---|---|---|---|---|
| PTH_LOW MSB | 0x9D | 00000000 | -- | PS lower interrupt threshold value, MSB |

### PS_ OFFSET Register (0x9E -0x9F) (Read/Write)

PS OFFSET registers let user define PS crosstalk of the device. PS data will be subtracted by this OFFSET value if PS_OS is enabled at register 0x81.

| Field | Bits | Default | Description |
|---|---|---|---|
| PS OFFSET LSB | 0x9E | 0 | PS OFFSET LSB |
| PS OFFSET MSB | 0x9F | 0 | PS OFFSET MSB |

### LED_DRIVE Register(0xA4) (Read/Write)

LED DRIVE register controls the LED driving current capability. **Bit 2 must be set to 1 for VSCEL as module is integrated with VCSEL LED.**

| 0xA4 | LED_DRIVE (default = 0x00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | | | VCSEL *driver* | *Reserved* | |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| Reserved | 7:3 | 00000 | | **Must write as 00000** |
| VCSEL driver | 2 | 0 | VCSEL | **Must write as 1** |
| Reserved | 1:0 | 00 | | **Must write as 00** |

### PS IR Ambient Saturation Value Register (0xB6) (Read/Write)

The PS data (0x93 + 0x 92) will be forced to 0 when 10Klux of direct sunlight is detected. **It is necessary to write 0xB6<3:0> with a value of 0000.**

A proximity Sunlight Saturation status flag 0x91<2> will return a value of 1 when saturation happens.

Alternatively, the proximity Sunlight Saturation status flag is also mirrored in 0x93<7>. This register is part of the proximity data registers (0x93 + 0x92).

This method is used to ensure the proximity operation does not become unstable and cause a false detection due to interference caused by very high IR ambient (i.e. under strong sunlight).

| 0xB6 | PS IR Ambient Saturation Register (default = 0x08) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | | *IR Ambient Saturation Value* | | | |

| Field | Bits | Default | Description | |
|---|---|---|---|---|
| Reserved | 7:4 | 0000 | | **Must write as 0000** |
| Saturation Value | 3:0 | 1000 | | **Must write as 0000** |

### DSS CONTR Register (0xB7) (Read/Write) –PS SAR related

The DSS_CONTR register control the DSS features, it must be written with 0x10 before enabling PS.

| 0xB7 | DSS CONTR Register (default = 0x10) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | | | | | |

| Field | Bits | Default | Description |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Reserved | 7:0 | 0000 0000 | **Must write as 0001 0000** |

### MAIN_CONFIG Register (0xAD) (Read/Write)

**The MAIN_CONFIG register must be written with 0x18 before enabling PS**

| 0xAD | MAIN_CONFIG Register (default = 0x00) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Bit 7 | Bit 6 | Bit 5 | Bit 4 | Bit 3 | Bit 2 | Bit 1 | Bit 0 |
| | *Reserved* | | | | | | | |

| Field | Bits | Default | Description |
|---|---|---|---|
| Reserved | 7:0 | 0000 0000 | **Must write as 0001 1000** |

# 7. Application Information

## 7.1 Operating Mode

**Stand-by Mode**

The device is by default in stand-by mode after power-up. No measurement activity done in PS. I2C communication is allowed to be able to read/write to the registers. The device can be reset from MCU by setting appropriate register control (SW reset). Start-up sequence is exactly the same as that when power-on reset is triggered.

**Active Mode**

During active mode, measurement data is expected to be available within a known fixed time (refer to measurement time parameter from PS specification).

## 7.2 Interrupt Features

The interrupt function is active if PS measurements are outside of the upper and lower absolute threshold levels set in the appropriate threshold register. Only newly measured data is compared to the threshold levels set such that old data will not cause triggering of the INT pin if in case the threshold levels are changed in between measurements.

The status of interrupt can be monitored directly through the interrupt (INT) pin or by checking contents of the interrupt register. Interrupt pin can either be enable or disabled. It is possible to invert interrupt output of LOW or HIGH state.

Interrupt pin IO requirements are exactly the same as those of the I2C bus pins SDA and SCL.

There are two user selectable types of interrupt, namely window interrupt type & logic interrupt type. Refer to Figure7.2.1 and 7.2.2 for illustration.

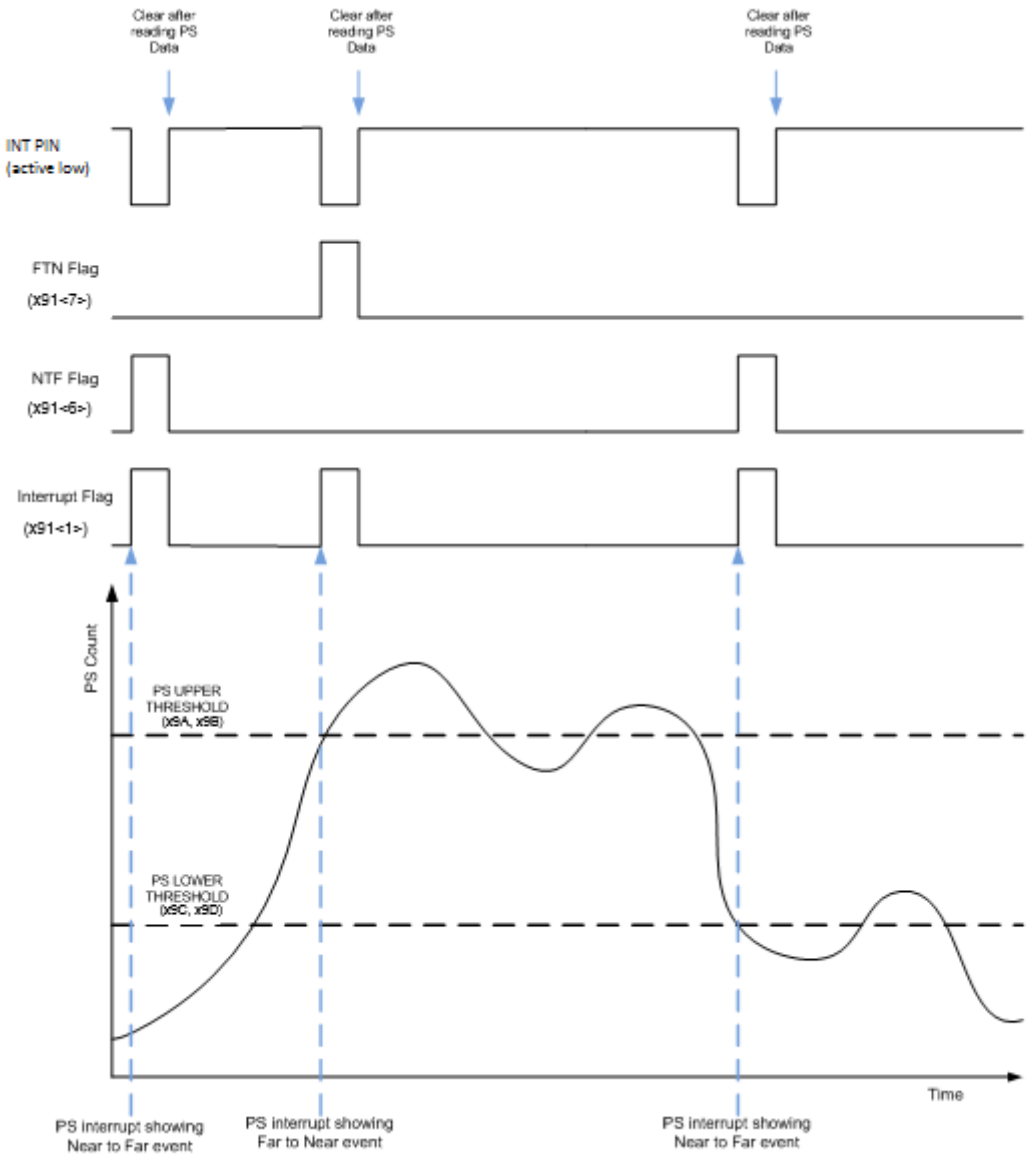



**Figure 7.2.1 : Interrupt illustration on logic type (with NTF/FTN reporting)**

**(Logic Mode: activated by control register PS_CONTR (0x81<2>) and INTERRUPT (0x91<1>))**

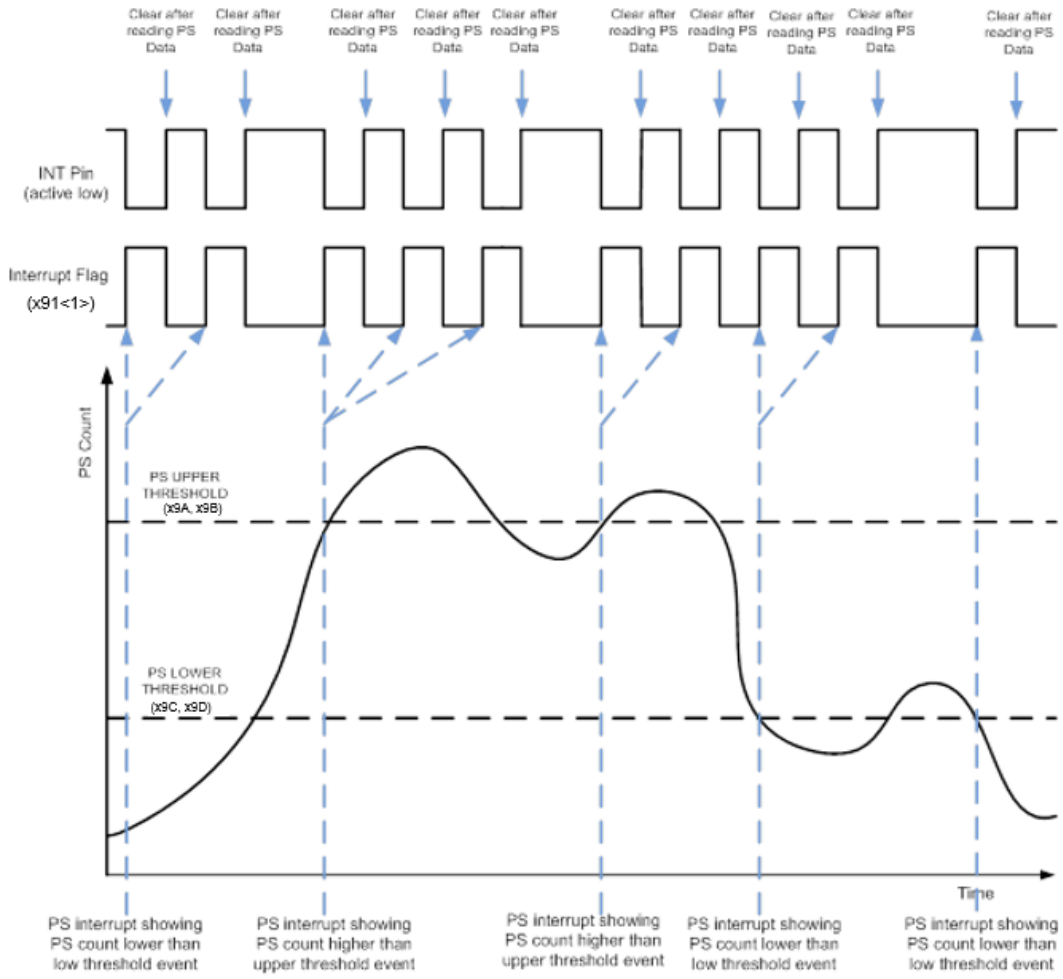
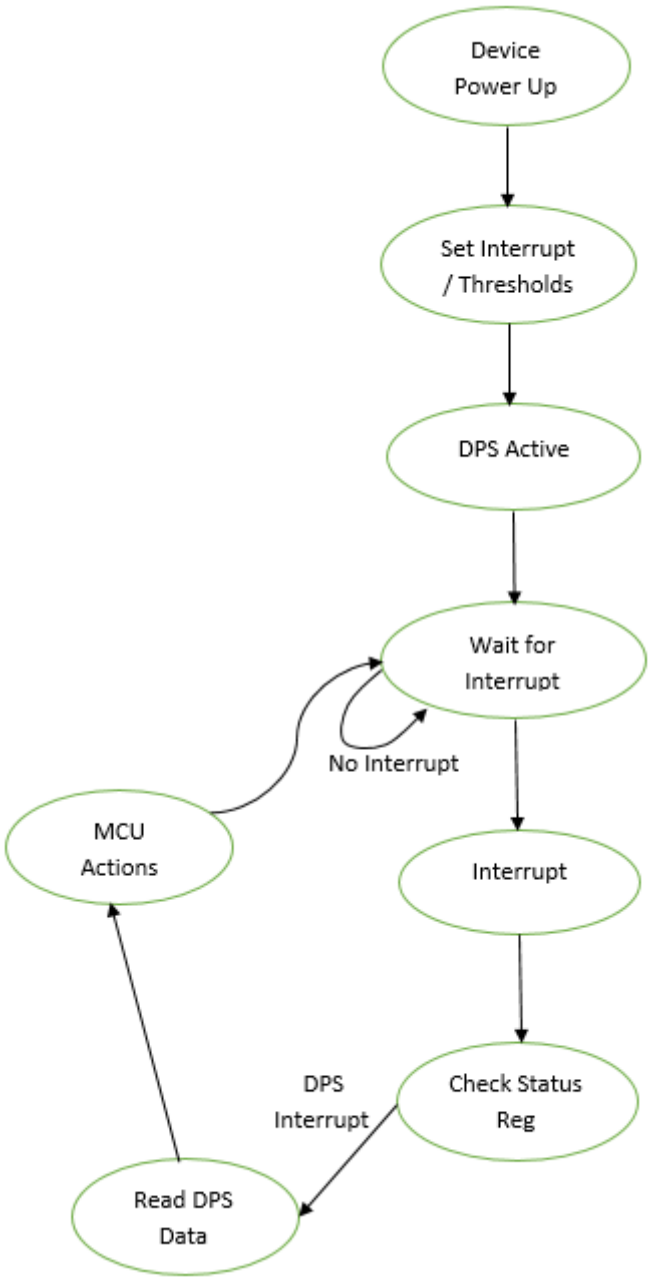



**Figure 7.2.2 : Interrupt illustration on window type (by default, without NTF/FTN reporting)**

Flow diagram below illustrates the operation flow, and involving the use of Thresholds and interrupt.



## 8. Pseudo Codes Examples

**LED Driver Registers**

**//** This LED DRIVE registers define the VCSEL current control

// The register must be set to 0x04 to appropriate VCSEL driving current is used.

```
Slave_Addr  = 0x23                    // Slave address of LTR-2679PS-01device
Register_Addr  = 0xA4
Command = 0x04                        // For selecting VCSEL driving current, Command = 0x04
```

**PS LED Registers**

// The PS LED Registers define the driving peak current.

```
Slave_Addr  = 0x23                    // Slave address of LTR-2679PS-01device
```

**// Set LED Pulse width 4us (with default peak current of 3.5mA)**
// Default setting is 0x7A (Pulse width 32us, 3.5mA).

```
Register_Addr  = 0x82                 // PS_LED register
Command = 0x62                        // For Pulse width=4us,Command = 0x62
                                      // For Pulse width = 8us, Command = 0x6A
                                      // For Pulse width = 16us, Command = 0x72
                                      // For Pulse width = 32us, Command = 0x7A
```

WriteByte(Slave_Addr, Register_Addr, Command)

**// Set LED Peak Current 5.5mA (with default pulse width 32us)**

```
Register_Addr  = 0x82                 // PS_LED register
Command = 0x7C                        // For Peak Current = 5.5mA
                                      // For Peak Current = 6.5mA, Command = 0x7D
                                      // For Peak Current = 7mA, Command = 0x7E
                                      // For Peak Current = 9mA, Command = 0x7F
```

WriteByte(Slave_Addr, Register_Addr, Command)

**PS_N_Pulses Register**

// The PS_N_Pulses register controls the number of LED pulses to be emitted.
// Default setting is 0x00.

```
Slave_Addr  = 0x23                    // Slave address of LTR-2679PS-01device
```

**// Set PS averaging factor 0 (with default number of pulse 1)**

```
Register_Addr = 0x83                // PS_N_Pulses register
Command = 0x00                      // For PS averaging factor 0, Command = 0x00,
                                    // For PS averaging factor 2, Command = 0x40,
                                    // For PS averaging factor 4, Command = 0x80,
                                    // For PS averaging factor 8, Command = 0xC0,
```

**// Set LED Pulses to 2 Pulses (with default PS averaging factor 0)**

```
Register_Addr = 0x83                // PS_N_Pulses register
Command = 0x01                      // For PS pulses = 2,
                                    // For PS pulses = 3, Command = 0x02
                                    // For PS pulses = 4, Command = 0x03
                                    // ……
                                    // For PS pulses = 16, Command = 0x0F
                                    // For PS pulses = 32, Command = 0x1F
```

WriteByte(Slave_Addr, Register_Addr, Command)

**PS Measurement Rate**

// PS_MEAS_RATE register controls the PS measurement rate which define the interval between DATA update.
// Default setting of the register is 0x04

```
Slave_Addr = 0x23                   // Slave address of LTR-2679PS-01device
```

**// Set PS Repeat Rate 6.125ms**

```
Register_Addr = 0x84                // PS_MEAS_RATE register
Command = 0x00                      // Meas rate = 6.125ms
                                    // For Meas rate = 12.5ms, Command = 0x01
                                    // For Meas rate = 25ms, Command = 0x02
                                    // For Meas rate = 50ms, Command = 0x03
                                    // For Meas rate = 100ms, Command = 0x04
                                    // For Meas rate = 200ms, Command = 0x05
                                    // For Meas rate = 400ms, Command = 0x06
                                    // For Meas rate = 800ms, Command = 0x07
```

WriteByte(Slave_Addr, Register_Addr, Command)

**Interrupt Register**

// The Interrupt register controls the operation of the interrupt pins and function.
// The default value for this register is 0x08
// The bit7 must be 1.

```
Slave_Addr = 0x23                   // Slave address of LTR-2679PS-01device
```

**// Set INT pin is considered active when it is a logic 1 ( with Interrupt pin is INACTIVE / high impedance state)**

```
Register_Addr = 0x98                // INT pin is considered active when it is a logic 1
Command = 0x8C                      // INT pin is considered active when it is a logic 1=Command 0x8C
                                    // INT pin is considered active when it is a logic 0=Command 0x88
```

**// Set Only PS measurement can trigger interrupt ( with INT pin is considered active when it is a logic 0)**

```
Register_Addr = 0x98                // Only PS measurement can trigger interrupt
Command = 0x89                      // Only PS measurement can trigger interrupt =Command 0x89
                                    // Interrupt pin is INACTIVE / high impedance state =Command 0x88
```

WriteByte(Slave_Addr, Register_Addr, Command)

**Interrupt Persist Register**

// The Interrupt persist register controls the N number of times the measurement is out of the threshold range settings before asserting the INTERRUPT pin
// The default value for this register is 0x00

Slave_Addr = 0x23 // Slave address of LTR-2679PS-01device

**// Set 1 consecutive PS values out of threshold range**
Register_Addr = 0x99 // 1 consecutive PS values out of threshold range
Command = 0x10 // Every PS value out of threshold range =Command 0x00
// 1 consecutive PS values out of threshold range =Command 0x10
// 2 consecutive PS values out of threshold range =Command 0x20
// ….
// 15 consecutive PS values out of threshold range =Command 0xF0

WriteByte(Slave_Addr, Register_Addr, Command)

**PS Threshold Registers**

// The PS_THRES_UP and PS_THRES_LOW registers determine the upper and lower limit of the interrupt threshold
// value.
// Following example illustrates the setting of the PS threshold window of decimal values of 200 (lower threshold) and
// 1000 (upper threshold).

Slave_Addr = 0x23 // Slave address of LTR-2679PS-01device

**// Upper Threshold Setting (decimal 1000)**
PS_THRES_UP_0 = 0x9A // PS Upper Threshold Low Byte Register address
PS_THRES_UP_1= 0x9B // PS Upper Threshold High Byte Register address
Data1 = 1000 >> 8 // To convert decimal 1000 into two eight bytes register values
Data0 = 1000 & 0xFF

WriteByte(Slave_Addr, PS_Upp_Threshold_Reg_0, Data0)
WriteByte(Slave_Addr, PS_Upp_Threshold_Reg_1, Data1)

**// Lower Threshold Setting (decimal 200)**
PS_THRES_LOW_0 = 0x9C // PS Lower Threshold Low Byte Register address
PS_THRES_LOW_1 = 0x9D // PS Lower Threshold High Byte Register address
Data1 = 200 >> 8 // To convert decimal 200 into two eight bytes register values
Data0 = 200 & 0xFF
WriteByte(Slave_Addr, PS_Low_Threshold_Reg_0, Data0)
WriteByte(Slave_Addr, PS_Low_Threshold_Reg_1, Data1)

**PS OFFSET Registers**

// PS OFFSET registers let user define PS crosstalk of the device. All PS data will be subtracted by this OFFSET registers.
// Following example illustrates the setting of the PS OFFSET of decimal values of 200

```
Slave_Addr  = 0x23                          // Slave address of LTR-2679PS-01device

// PS OFFSET Setting (decimal 200)
PS_OFFSET_0 = 0x9E                          // PS_OFFSET Low Byte Register address
PS_OFFSET_1 = 0x9F                          // PS_OFFSET High Byte Register address
Data1 = 200 >> 8                            // To convert decimal 200 into two eight bytes register values
Data0 = 200 & 0xFF
WriteByte(Slave_Addr,  PS_OFFSET_0, Data0)
WriteByte(Slave_Addr,  PS_OFFSET_1 , Data1)
```

**Control Registers**

// The Control Registers define the operating modes and gain settings of the PS of LTR-2679PS-01.
// Main Control Register (0xAD) must be set to 0x18 before turning on PS function.
// It is recommended that Control Register for PS (0x81) to be set at the end of the sequence.
// This is to ensure all register settings are the same for all started measurement.
// Default settings is 0x10 for PS register (both in Standby mode after power up).

```
Slave_Addr  = 0x23                          // Slave address of LTR-2679PS-01device


// Enable PS
Register_Addr = 0xAD                        // MAIN_CONTR  register
Command = 0x18                              // Enable
// LED driver register 0xA4 must be set to 0x04 prior any PS LED setting.
Register_Addr = 0xA4                        // LED_DRIVE
Command = 0x04                              // Set to Vsel
// Register 0xB7 must be enabled
Register_Addr = 0xB7                        // DSS_CONTR
Command = 0x10                             // Enable


Register_Addr = 0x81                        // PS_CONTR register
Command = 0x92                             // For PS 11 bits active
Command = 0xB2                             // For PS 16 bits active

// Enable PS OFFSET (with default PS 11 bit)
Register_Addr = 0x81                        // PS_CONTR register
Command = 0x1A                              // For PS active & enable PS OFFSET

// Enable FTN/NTF (with default PS 11 bit)
Register_Addr = 0x81                        // PS_CONTR register
Command = 0x1E                             // For PS active & enable FTN/NTF

WriteByte(Slave_Addr,  Register_Addr,  Command)
```

**Data Registers (Read Only)**

// The PS Data Registers contain the ADC output data.
// These registers should be read as a group, with the lower address being read first.

```
Slave_Addr  = 0x23                          // Slave address of LTR-2679PS-01device
```

**// Read PS_DATA**

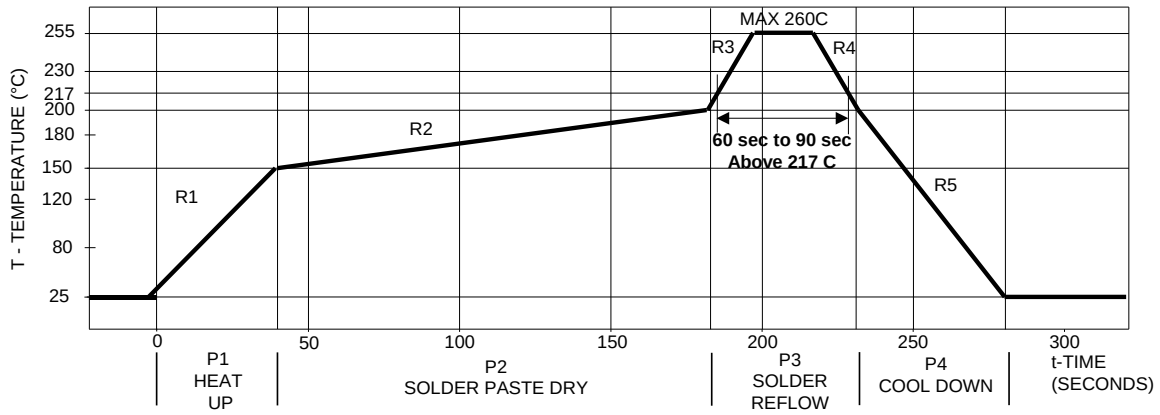
```
Register_Addr = 0x92                    // PS_DATA low byte address (7:0)
ReadByte(Slave_Addr, Register_Addr, Data0)
Register_Addr = 0x93                    // PS_DATA high byte address (2:0)
ReadByte(Slave_Addr, Register_Addr, Data1)

PS_ADC_Data = ((Data1 << 8) | Data0)    // Combining lower and upper bytes to give 16-bit PS data
```

**PS Status Register (Read Only)**

// The PS_STATUS Register contains the information on Interrupt, NTF/FTN information, ambient saturation and PS status.

```
Slave_Addr = 0x23                       // Slave address of LTR-2679PS-01device

Register_Addr = 0x91                    // PS_STATUS register address
ReadByte(Slave_Addr, Register_Addr, Data)

FTN = Data & 0x20                       // FTN = 0x20 ➔ FTN detected
                                        // FTN = 0x00 ➔ No FTN detected
NTF = Data & 0x10                       // NTF = 0x10 ➔ NTF detected
                                        // NTF = 0x00 ➔ No NTF detected

Ambient Saturation= Data & 0x04         // Ambient Saturation = 0x04 ➔ Ambient Saturation happens
                                        // Ambient Saturation = 0x00 ➔ No ambient Saturation

PS_Interrupt_Status = Data & 0x02       // Interrupt_Status = 0x02 ➔ PS interrupt is triggered
                                        // Interrupt_Status = 0x00 ➔ PS interrupt is not triggered

PS Data_Status = Data & 0x01            // NewData_Status = 0x00 ➔ OLD data
                                        // NewData_Status = 0x01 ➔ NEW data
```

## 9. Recommended Leadfree Reflow Profile




| Process Zone | Symbol | ΔT | Maximum ΔT/Δtime or Duration |
|---|---|---|---|
| Heat Up | P1, R1 | 25°C to 150°C | 3°C/s |
| Solder Paste Dry | P2, R2 | 150°C to 200°C | 100s to 180s |
| Solder Reflow | P3, R3<br>P3, R4 | 200°C to 260°C<br>260°C to 200°C | 3°C/s<br>-6°C/s |
| Cool Down | P4, R5 | 200°C to 25°C | -6°C/s |
| Time maintained above liquidus point , 217°C | | > 217°C | 60s to 90s |
| Peak Temperature | | 260°C | - |
| Time within 5°C of actual Peak Temperature | | > 255°C | 20s |
| Time 25°C to Peak Temperature | | 25°C to 260°C | 8mins |

It is recommended to perform reflow soldering no more than twice.

## 10.Moisture Proof Packaging

All LTR-2679PS-01are shipped in moisture proof package. Once opened, moisture absorption begins. This part is compliant to JEDEC J-STD-033A Level 3.

### 10.1 Shelf Life

Device has the shelf life of 12 months if stored in an unopened moisture proof package. It is recommended to store in following condition.

- Shelf Life : 12 months
- Ambient Temperature : <40°C
- Relative Humidity: <90%

### 10.2 Floor Life

After removal from the moisture barrier bag, the parts should be stored at the recommended storage conditions and soldered within seven days.

- Floor Life : 168 hours
- Ambient Temperature : <30°C
- Relative Humidity: <60%

### 10.3 Rebaking information

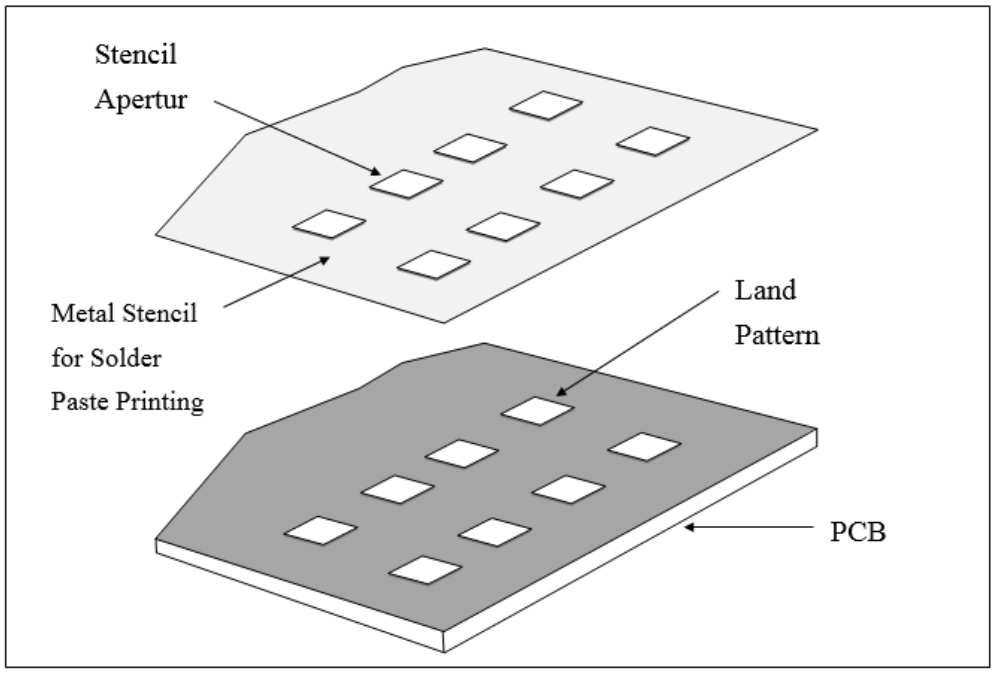
When the moisture barrier bag is opened and the parts are exposed to the recommended storage conditions for more than seven days, the parts must be baked before reflow to prevent damage to the parts.

**Baking Conditions**

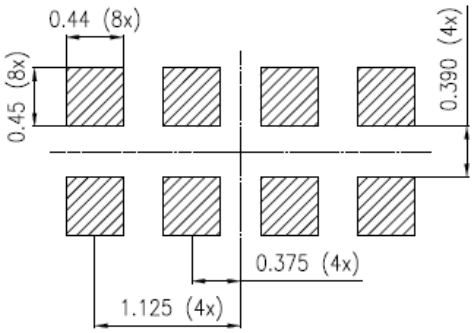
| Package | Temperature | Time |
|---|---|---|
| In Reels | 60°C | 48 hours |
| In Bulk | 100°C | 4 hours |

Baking should only be done once.

## 11.Recommended Land Pattern and Metal Stencil Aperture

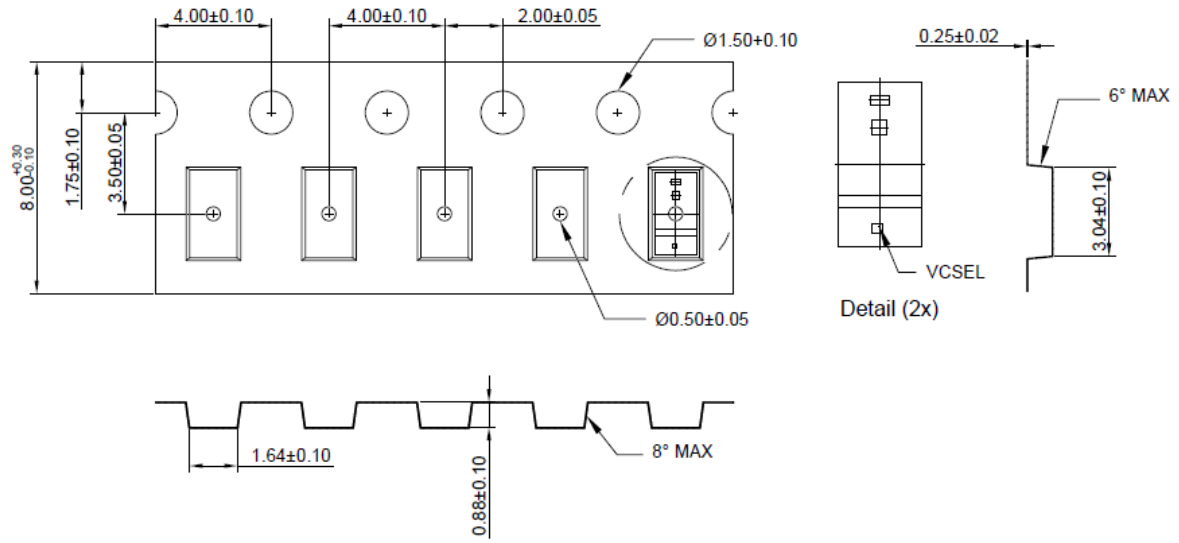


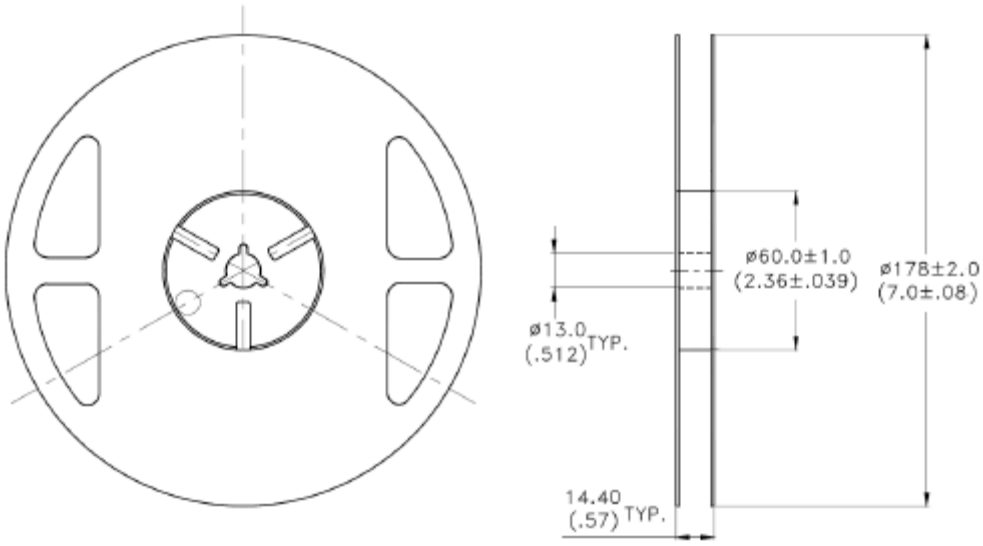

**Recommended Land Pattern**




Note: All dimensions are in millimeters

## 12.Package Dimension for Tape and Reel




Notes:

1. All dimensions are in millimeters
2. Empty component pockets sealed with top cover tape
3. 7 inch reel - 4000 pieces per reel
4. In accordance with ANSI/EIA 481-1-A-1994 specifications

## Revision Table:

| Version | Update | Page | Date |
|---|---|---|---|
| 1.0 | Datasheet created | Total 35 pages | 18/01/19 |
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