OPTICAL SENSOR
LTR-690PS-AHX

Description

LTR-690PS-AHX is an integrated low voltage I2C long distance digital proximity sensor [PS] with built-in emitter, in a single ChipLED lead-free surface mount package. This sensor converts light intensity to a digital output signal capable of direct I2C interface. With built-in proximity sensor (LED emitter and detector), LTR-690PS-AHX offers the feature to detect object at a user configurable distance.

Features

- I^2C interface (Standard mode @100kHz or Fast mode @400kHz)
- Small ChipLED surface mount package
- Built-in temperature compensation circuit
- Low active power consumption with standby mode
- Supply voltage range from 2.7V to 3.6V
- Operating temperature range from -30ºC to +70ºC
- RoHS and Halogen free compliant

- **Long Distance Proximity Sensor**
  - Built-in LED driver, LED emitter
  - Programmable LED drive settings
  - Selectable 11/16-bit resolutions

Application

To control display backlight and/or presence detection in

- Touch Panel Control in home appliances
- Presence detection in Smart Home applications

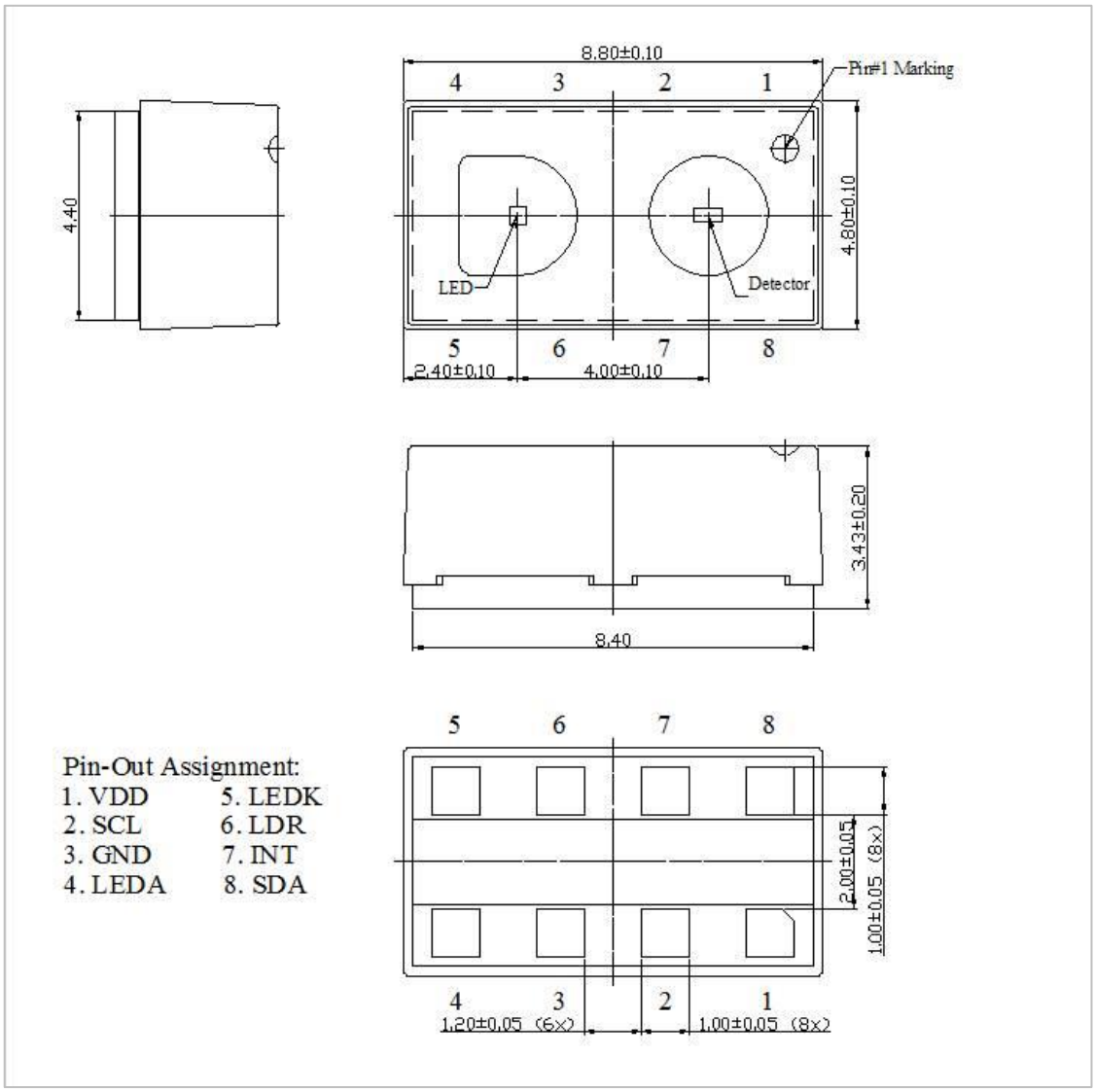
Ordering Information

Part Number	Packaging Type	Package	Quantity
LTR-690PS-AHX	Tape and Reel	8-pins Chip-Led package	2000

IMPORTANT: Lite-On reserves the right to make changes in the specifications, structure, and other contents described herein without prior notice in order to improve design or reliability.

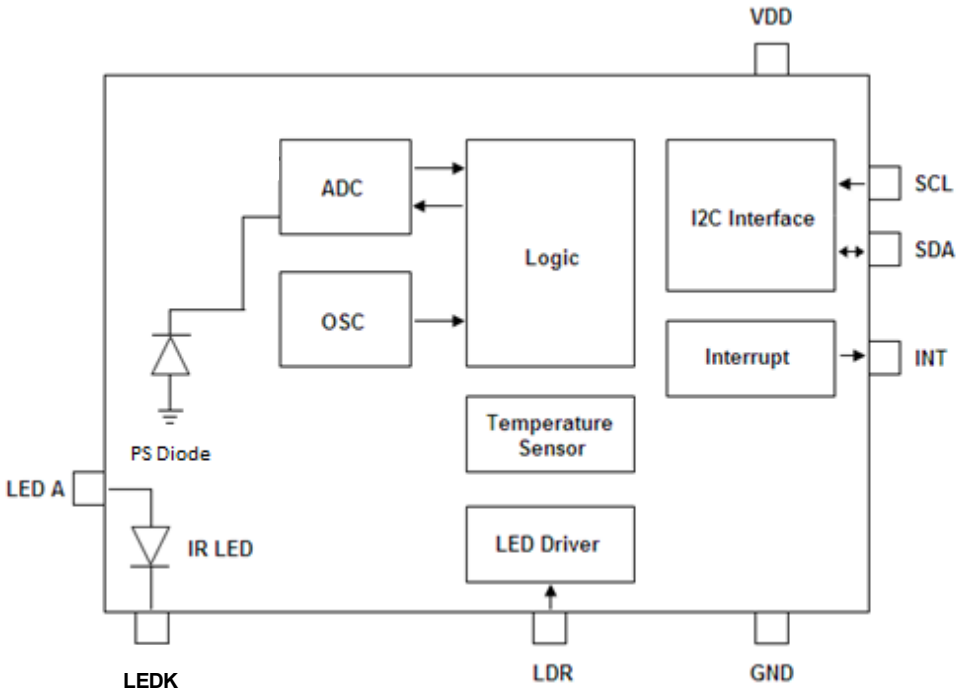
OPTICAL SENSOR
LTR-690PS-AHX

1. Outline Dimensions and Pins Configuration

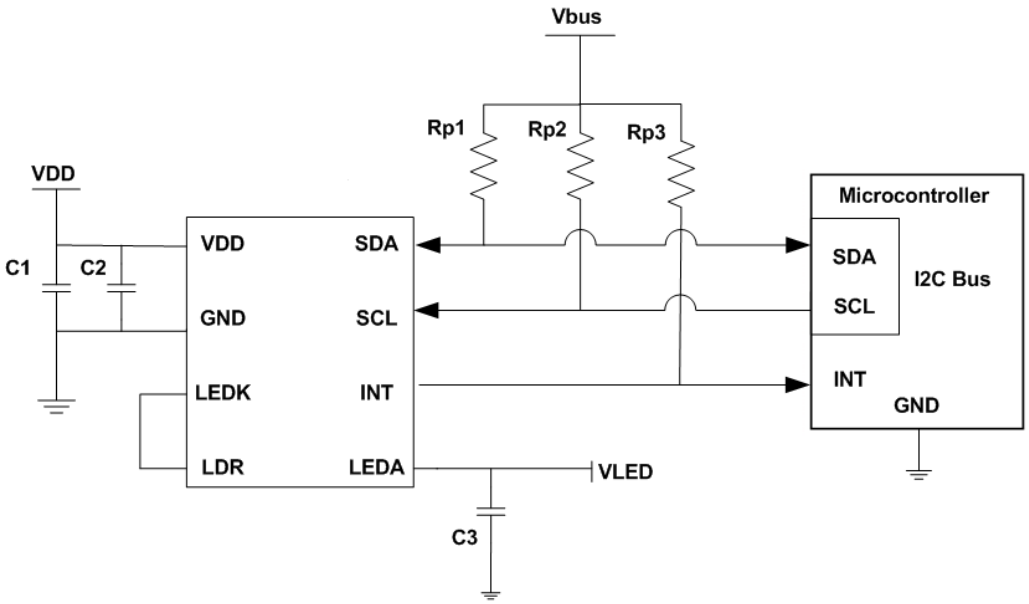


Note: All dimensions are in millimeters

2. Functional Block Diagram



3. Application Circuit



Recommended Application Circuit Components

Component	Recommended Value
Rp1, Rp2, Rp3 [1]	1 kΩ to 10 kΩ
C1, C3	1uF ±20%, X7R / X5R Ceramic
C2	0.1uF

Notes:

[1] Selection of pull-up resistors value is dependent on bus capacitance values. For more details, please refer to I2C Specifications: http://www.nxp.com/documents/user_manual/UM10204.pdf

I/O Pins Configuration Table

Pin	I/O Type	Symbol	Description
1	Supply	VDD	Power supply voltage
2	IN	SCL	I²C serial clock.
3	Ground	GND	Power supply ground. All voltages are referenced to GND.
4	IN	LEDA	LED anode. Connect to VLED at system level.
5	IN	LEDK	LED cathode. Connect to LDR pin when using internal LED driver.
6	OUT	LDR	Internal LED driver pin.
7	OUT	INT	Level interrupt pin. This pin is an open drain output.
8	IN/OUT	SDA	I²C serial data.

4. Rating and Specification

4.1. Absolute Maximum Rating at Ta=25°C

Parameter	Symbol	Rating	Unit
Supply Voltage	VDD	3.8	V
Digital Voltage Range	SCL, SDA	-0.5 to 3.8	V
Digital Output Current	SCL, SDA	-1 to 20	mA
Storage Temperature	T_{stg}	-40 to 70	°C
LED Forward DC Current	I_f	100	mA
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.

4.2. Recommended Operating Conditions

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

Parameter	Symbol	Min.	Typ.	Max.	Unit
Supply Voltage	VDD	2.7	3.0	3.6	V
LED Supply Voltage	VLED	2.7	3.0	3.6	V
Interface Bus Power Supply Voltage	VIO	1.7		3.6	V
I2C Bus Input Pin High Voltage	VIH_SCL, VIH _SDA	1.2			V
I2C Bus Input Pin Low Voltage	VIL_SCL, VIL_SDA			0.6	V
Operating Temperature	T_{ope}	-30		70	°C

4.3. Electrical & Optical Specifications

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

Parameter	Min.	Typ.	Max.	Unit	Condition
Supply Current		175		uA	PS in active mode PS 128 pulses, 32us pulse width PS measurement repeat rate = 100ms (Excluding LED current)
Standby Current			2	uA	Standby / Sleep Mode

Initial Startup Time Note 1		50	ms	Min wait time after power up (supply ramp-up to 2.4V) before sending I2C commands
Wakeup Time from Standby Note 1		10	ms	Max wait time after turning device from stand-by to active before measurements starts
Leakage Current	-5	5	uA	SDA, SCL, INT pins

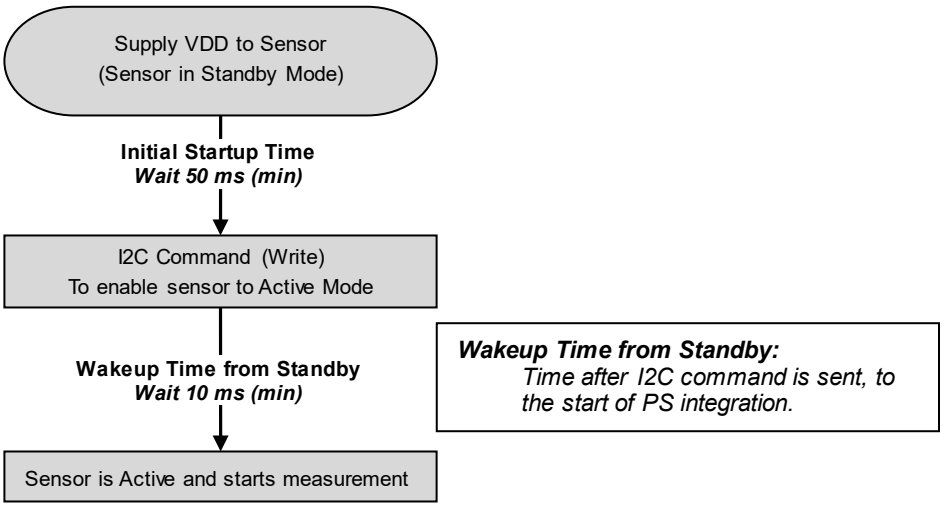
4.4. Characteristics Proximity Sensor

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

Parameter	Min.	Typ.	Max.	Unit	Condition
PS Resolution	11		16	bit	11 or 16 bits.
Full ADC count	2047		65535	count	11 or 16 bits.
Detection Distance	2		150	cm	250mA,32us pulse width, 128 pulses, 18% Grey Card
No of LED Sequence	1		16	set	Total LED pulses = No of LED Sequence x No of LED Pulse
No of LED Pulse	1		16	set	
LED Pulse Width	16		64	us	16us, 32us, 64us options.
LED Pulse Current	20		300	mA	
Peak Wavelength, λP	920	940	955	nm	IF = 100mA

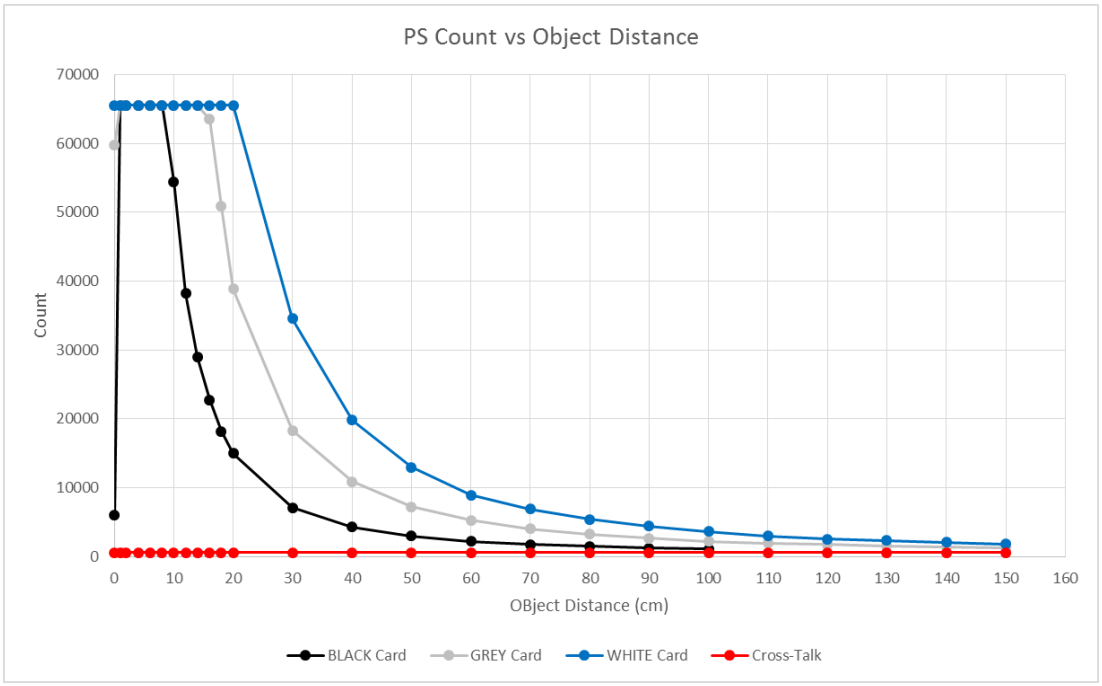
Note:

1 Illustrations of startup sequence:

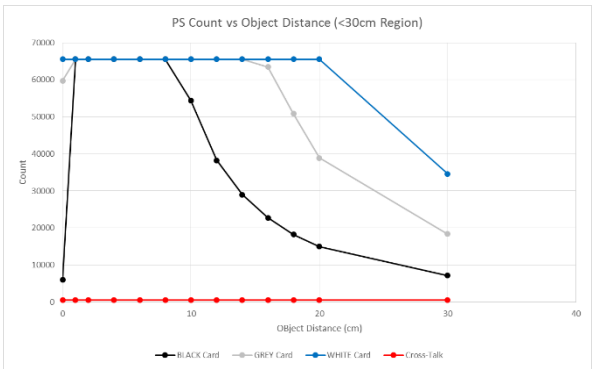


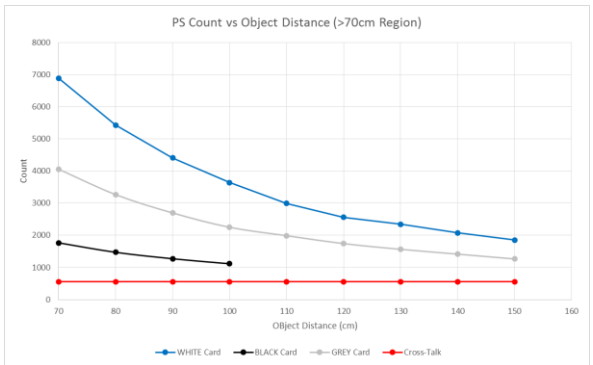
4.5. Typical Device Parameter

Unless otherwise specified, typical device parameters are at VDD = 3.0V, Ta=25°C.

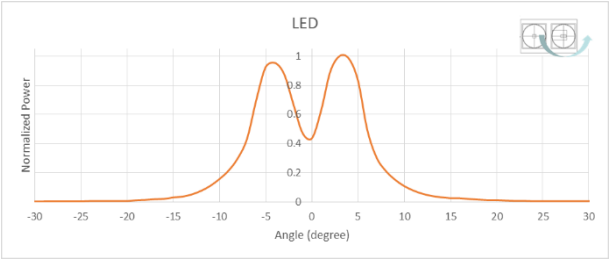


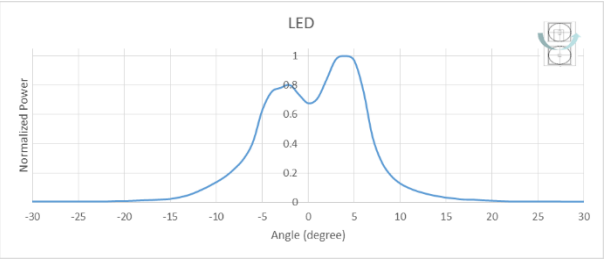
Conditions: VDD 3.0V, VLED 3.0V, LED 250mA/32us pulse width/128 pulses, 16-bit PS resolution, 0.78mm clear window with 1.15mm air gap.



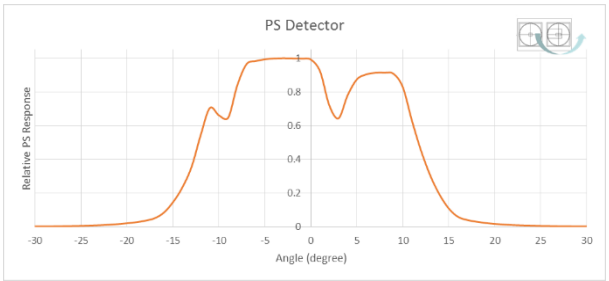


Viewing Angle of LED: +/-6 degrees

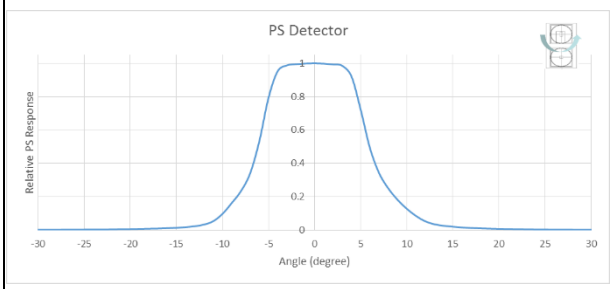




Viewing Angle of Detector: +/-12 degrees



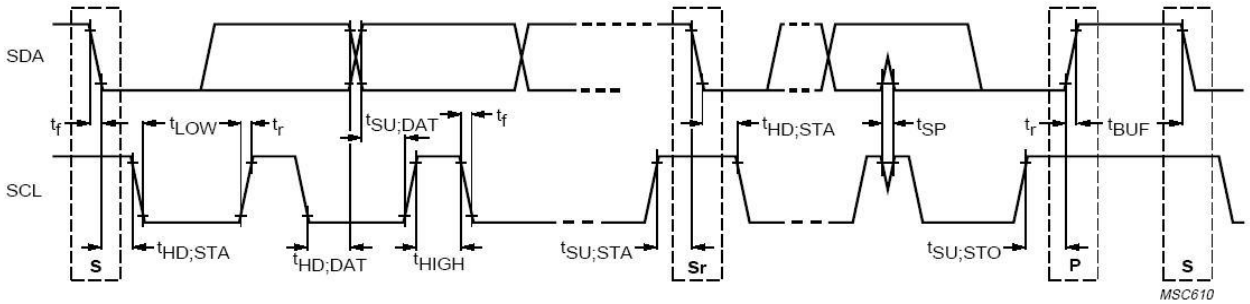
Viewing Angle of Detector: +/-6 degrees



4.6. AC Electrical Characteristics

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

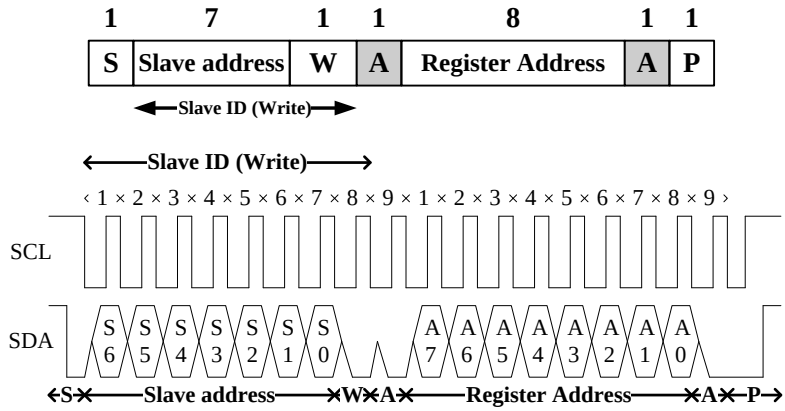
Parameter	Symbol	Standard mode		Fast mode		
		Min.	Max.	Min.	Max.	Unit
SCL clock frequency	f_{SCL}	100		400		kHz
Bus free time between a STOP and START condition	t_{BUF}	4.7	-	1.3	-	us
Hold time (repeated) START condition. After this period, the first clock pulse is generated	$t_{HD;STA}$	4.0	-	0.6	-	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



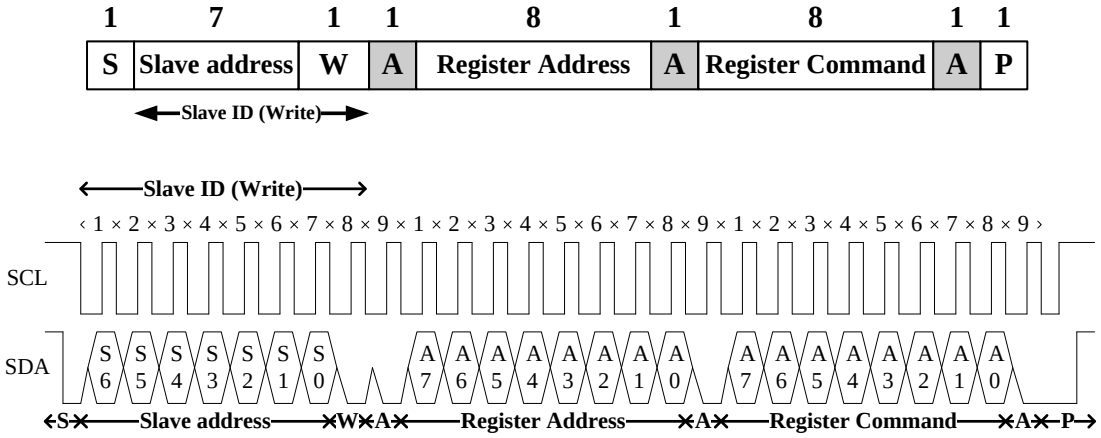
5. Principle of Operation

5.1. I2C Protocol

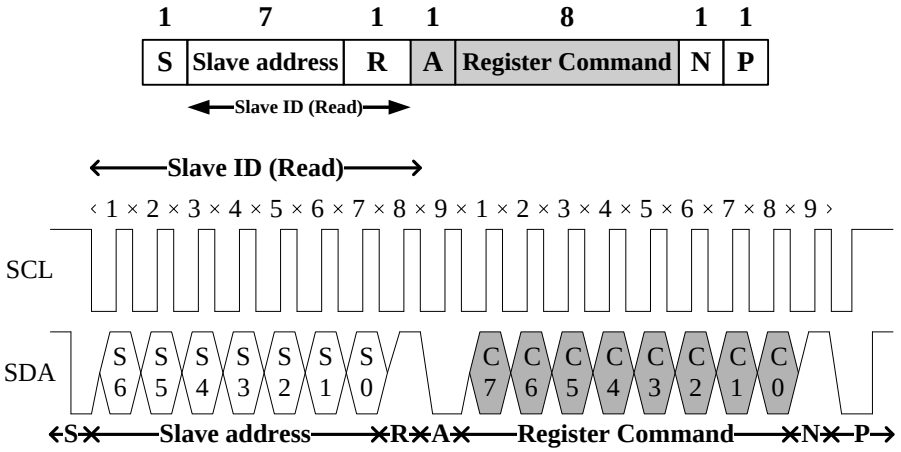
5.1.1. I2C Write Protocol (type 1)



5.1.2. I2C Write Protocol (type 2)



5.1.3. I2C Read Protocol



A	AcknowVcselge (0 for an ACK)	**N**	Non-AcknowVcselge(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

5.2. 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	R / W	PS_CONTR	PS operation mode control & SW reset	0xE0
0x82	R / W	PS_LED	PS LED setting	0xF3
0x83	R / W	PS_N_PULSES	PS number of pulses	0x00
0x84	R / W	PS_MEAS_RATE	PS measurement rate in active mode, PS bit	0x24
0x86	R	PART_ID	Part Number ID and Revision ID	0x1E
0x87	R	MANUFAC_ID	Manufacturer ID	0x05
0x91	R	PS_STATUS	PS new data status	0x30
0x92	R	PS_DATA_LSB	PS measurement data, lower byte	0x00
0x93	R	PS_DATA_MSB	PS measurement data, upper byte	0x00
0xA6	R / W	INTERRUPT	Interrupt settings	0x20
0xA7	R / W	INTERTUPT_PERSIST	PS interrupt persist setting	0x00
0xA8	R / W	PS_THRES_HIGH_LSB	PS interrupt upper threshold, lower byte	0xFF
0xA9	R / W	PS_THRES_HIGH_MSB	PS interrupt upper threshold, upper byte	0x07
0xAA	R / W	PS_THRES_LOW_LSB	PS interrupt lower threshold, lower byte	0x00
0xAB	R / W	PS_THRES_LOW_MSB	PS interrupt lower threshold, upper byte	0x00
0xB0	R / W	PS_CROSSTALK_DATA_LSB	PS crosstalk data, lower byte	0x00
0xB1	R / W	PS_CROSSTALK_DATA_MSB	PS crosstalk data, upper byte	0x00
0xB8	R / W	PS_AVERAGE_CONTR	PS Averaging Function	0x00
0xB9[1]	R / W	PS_CONFIG1	Internal IC configuration	0xE3
0xED[1]	R / W	PS_CONFIG2	Internal IC configuration	0x20
0xEE[1]	R / W	PS_CONFIG3	Internal IC configuration	0x40

Note 1: The 3 PS configuration registers should be written before enabling PS:

PS_CONFIG1 (address 0xB9) = 0xDB

PS_CONFIG2 (address 0xED) = 0x0A

PS_CONFIG3 (address 0xEE) = 0x80

6.1. PS _CONTR Register (0x81)

The PS_CONTR register controls the PS operation modes and software (SW) reset for the 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. FTN/NTF EN controls the FTN/NTF Status Reporting. Note that PS must be set to standby mode first before changing any settings related to PS operation. **It is necessary to write registers PS_CONFIG1 (0xB9), PS_CONFIG2 (0xED) and PS_CONFIG3 (0xEE) before enabling PS. The values to be written can be found under Register Set table (Page 12).**

0x81	PS_CONTR (default = 0xE0)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved				*PS_OS*	*FTN/NTF EN*	*PS Mode*	*SW Reset*

	Bits	Default	Type	Description	
Reserved	7:4	1110	R/W	1110	Must write 0010
PS_OS	3	0	R/W	PS Offset/Xtalk Cancellation. When enabled, PS DATA will be subtracted with PS_CROSSTALK_DATA register data.	
				0	Disabled (default)
				1	Enabled
FTN/NTF EN	2	0	R/W	0	Disable FTN/NTF Status Reporting (default)
				1	Enable FTN/NTF Status Reporting
PS Mode	1	0	R/W	0	Stand-by Mode (default)
				1	PS Mode active
SW Reset	0	0	R/W	0	No action (default)
				1	Reset Registers to default values

6.2. PS_LED Register (0x82)

The PS_LED register sets the LED current, and pulse width.

0x82	PS_LED (default = 0xF3)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved		*PS LED Pulse Width*		*Reserved*	*LED Current*		

Field	Bits	Default	Type	Description	
Reserved	7:6	11	RW	11	Must write 11
PS LED Pulse Width	5:4	11	RW	00	64us
				01	Reserved – Do not use
				10	16us
				11	32us (default)
Reserved	3	0	RW	0	Must write 0
LED Current	2:0	011	RW	000	0 mA
				001	20 mA
				010	50 mA
				011	100 mA (default)
				100	150 mA
				101	200 mA
				110	250 mA
				111	300 mA

6.3. PS_N_Pulses Register (0x83)

This register controls number of PS Sequence set and PS LED pulses. Total LED pulses will be equal to:

Number of LED Pulses **x** Number of Sequence Set

0x83	PS_N_Pulses (default = 0x00)							
	B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
	PS Number of Sequence Set				***PS Number of LED Pulses***			

Field	Bits	Default	Type	Description	
PS number of Sequence Set	7:4	0000	RW	0000	Specifies PS LED number of sequence. Each sequence consists of predefined PS number of LED pulses. If PS number of sequence set = 0, the sequence set will be 1.
PS number of LED pulses	3:0	0000	RW	0000	Specifies PS LED number of pulses. If PS number of pulse set to 0, the pulse count will be 1.

6.4. PS_MEAS_RATE Register (0x84)

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

0x84	PS_MEAS_RATE (default = 0x24)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved					*PS Measurement Time*		

Field	Bits	Default	Type	Description	
Reserved	7:3	00100	RW	00100	Must write 00100
PS Measurement Time	2:0	100	RW	000	Reserved – Do not use
				001	Reserved – Do not use
				010	Reserved – Do not use
				011	50ms
				100	100ms (default)
				101	200ms
				110	400ms
				111	800ms

6.5. PART_ID Register (0x86) (Read Only)

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

0x86	PART_ID (default = 0x1E)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Part Number ID						*Revision ID*	

Field	Bits	Default	Type	Description
Part Number ID	7:2	000111	R	Part ID.
Revision ID	1:0	10	R	Revision of silicon.

6.6. MANUFAC_ID Register (0x87) (Read Only)

The MANUFAC_ID register defines the manufacturer identification of the sensor.

0x87	MANUFAC_ID (default = 0x05)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Manufacturer ID							

Field	Bits	Default	Type	Description
Manufacturer ID	7:0	00000101	R	Manufacturer ID

6.7. PS_STATUS Register (0x91) (Read Only)

0x91	PS_STATUS (default = 0x30)							
	B7	B6	B5	B4	B3	B2	B1	B0
	FTN	*NTF*	*Reserved*		*IR Ambient Saturation Flag*	*Reserved*	*PS Interrupt Status*	*PS Data Status*

Field	Bits	Default	Type	Description	
FTN	7	0	R	0	No far to near object detected (default)
				1	Far to near object detected
NTF	6	0	R	0	No near to far object detected (default)
				1	Near to far object detected
Reserved	5:4	11	R	--	Reserved
IR Ambient Saturation Flag	3	0	R	0	PS is not saturated under strong IR ambient (default)
				1	PS is saturated under strong IR ambient
Reserved	2	0	R	--	Reserved
PS Interrupt Status	1	0	R	0	Interrupt signal INACTIVE (default)
				1	Interrupt signal ACTIVE
PS Data Status	0	0	R	0	Old data (data already read) (default)
				1	New data (first time data is read)

6.8. PS_DATA Register (0x92 / 0x93) (Read Only)

The PS ADC channel data are expressed as a 16-bit data spread over two registers. The PS_DATA_LSB and PS_DATA_MSB registers provide the lower and upper byte respectively. When the I²C read operation starts, both the registers are locked until the I²C read operation is completed. This will ensure that the data in the registers is from the same measurement even if an additional integration cycle ends during the read operation. New measurement data is stored into temporary registers and the PS_DATA registers are updated as soon as there is no on-going I²C read operation.

0x92	PS_DATA_LSB (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Data Low							

0x93	PS_DATA_MSB (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Data High							

Field	Address	Bits	Default	Type	Description	
PS Data Low	0x92	7:0	00000000	R	--	PS ADC lower byte data
PS Data High	0x93	7:0	00000000	R	--	PS ADC upper byte data.

6.9. INTERRUPT Register (0xA6)

The INTERRUPT register controls the operation of the interrupt pin and functions. When the Interrupt Mode is set to 00, the INT output pin is disabled and will not trigger any interrupt. However at this condition, the PS_STATUS register will still be updated.

Note that when this register is to be set with values other than its default values, it should be set before device is in Active mode.

0xA6	INTERRUPT (default = 0x20)							
	B7	**B6**	**B5**	**B4**	**B3**	**B2**	**B1**	**B0**
	Reserved				***PS Extension Bits En***	***Interrupt Polarity***	***Interrupt Mode***	

Field	Bits	Default	Type	Description	
Reserved	7:3	0010	RW	0010	Must write 0010
PS Extension Bits En	3	0	RW	0	Set PS resolution to 11 bits (default)
				1	Set PS resolution to 16 bits
Interrupt Polarity	2	0	RW	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	RW	00	Interrupt pin is INACTIVE/high impedance state (default)
				01	PS measurement can trigger interrupt
				10	Reserved. Don't Use.
				11	Reserved. Don't Use.

6.10. INTERRUPT PERSIST Register (0xA7)

The INTERRUPT PERSIST register controls the N number of times the measurement data is outside the range defined by the upper and lower threshold limits before asserting the interrupt.

0xA7	INTERRUPT PERSIST (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Persist				*Reserved*			

Field	Bits	Default	Type	Description	
PS persist	7:4	0000	RW	0000	Every PS value out of threshold range (default)
				0001	1 consecutive PS values out of threshold range
				.....	.....
				1111	16 consecutive PS values out of threshold range
Reserved	3:0	0000	-	-	

6.11. PS_THRES Register (0xA8 / 0xA9 / 0xAA / 0xAB)

PS_THRES register is used to set the limits of the absolute interrupt threshold value. Interrupt functions compare the value in the PS_THRES registers to measured data value in PS_DATA registers. The data format for PS_THRES must be the same as that of PS_DATA registers.

0xA8	PS_THRES_HIGH_LSB (default = 0xFF)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Upper Threshold LSB							

0xA9	PS_THRES_HIGH_MSB (default = 0x07)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Upper Threshold MSB							

0xAA	PS_THRES_LOW _LSB (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Lower Threshold LSB							

0xAB	PS_THRES_LOW_MSB (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Lower Threshold MSB							

Field	Address	Bits	Default	Type	Description
PS Upper Threshold LSB	0xA8	7:0	11111111	RW	PS upper threshold lower byte.
PS Upper Threshold MSB	0xA9	7:0	0000111	RW	PS upper threshold upper byte.
PS Lower Threshold LSB	0xAA	7:0	00000000	RW	PS lower interrupt threshold lower byte.
PS Lower Threshold MSB	0xAB	7:0	00000000	RW	PS lower interrupt threshold upper byte.

6.12. PS_CROSSTALK_DATA Register (0xB0 / 0xB1)

PS_CROSSTALK_DATA registers let user define PS crosstalk of the device. All PS data will be subtracted by this crosstalk data registers.

0xB0	PS_CROSSTALK_LSB (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Crosstalk Data LSB							

0xB1	PS_CROSSTALK_MSB (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	PS Crosstalk Data MSB							

Field	Address	Bits	Default	Type	Description
PS Crosstalk Data LSB	0xB0	7:0	00000000	RW	PS crosstalk data LSB.
PS Crosstalk Data MSB	0xB1	7:0	00000000	RW	PS crosstalk data MSB

6.13. PS_AVERAGE_CONTR Register (0xB8)

The PS_AVERAGE_CONTR register controls the PS Averaging operation modes of the sensor. The sensor can be set to 4 different averaging modes by changing the PS Average bits. For example, if the PS Average is set to 01, 2 PS data will be captured within the same PS repeating cycle, and average of the 2 PS captures will be calculated and updated to PS_DATA registers. Do note that current consumption will increase proportionally if PS averaging feature is activated. This can be compensated by reducing numbers of LED pulses per capture through PS_N_PULSES. However, the detection threshold will need to be calibrated in accordance to reduced pulses at system level, as the absolute PS count will also reduce accordingly.

0xB8	PS_AVERAGE_CONTR (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved					*PS Average*		*Reserved*

	Bits	Default	Type	Description	
Reserved	7:3	00000	R/W	00000	Must write 00000
PS Average	2:1	00	R/W	00	No average (default)
				01	Average of 2 PS data
				10	Average of 4 PS data
				11	Average of 8 PS data
Reserved	0	0	R/W	0	Must write 0

6.14. PS_CONFIG1 Register (0xB9)

The PS_CONFIG1 register must be written with 0xDB before enabling PS.

0xB9	PS_CONFIG1 (default = 0xE3)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved							

Field	Bits	Default	Type	Description
Reserved	7:0	11100011	RW	Must write 11011011

6.15. PS_CONFIG2 Register (0xED)

The PS_CONFIG2 register must be written with 0x0A before enabling PS.

0xED	PS_CONFIG2 (default = 0x20)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved							

Field	Bits	Default	Type	Description
Reserved	7:0	00100000	RW	Must write 00001010

6.16. PS_CONFIG3 Register (0xEE)

The PS_CONFIG3 register must be written with 0x80 before enabling PS.

0xEE	PS_CONFIG3 (default = 0x40)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved							

Field	Bits	Default	Type	Description
Reserved	7:0	01000000	RW	Must write 10000000

7. Application Information

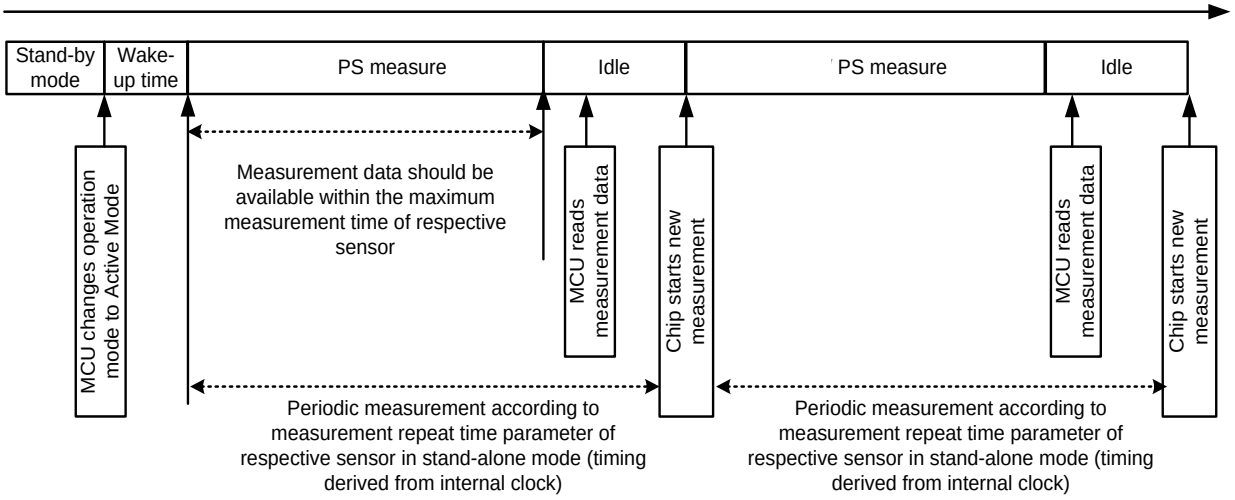
7.1. Operating Modes

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

Figure below shows typical active mode operation. Measurement data is expected to be available within a known fixed time (refer to measurement time parameter).



7.2. Interrupt Features

The interrupt function is active if PS measurement is outside of the upper and lower absolute threshold levels set in the appropriate threshold register. Refer to figure below for the illustration. 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. 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.

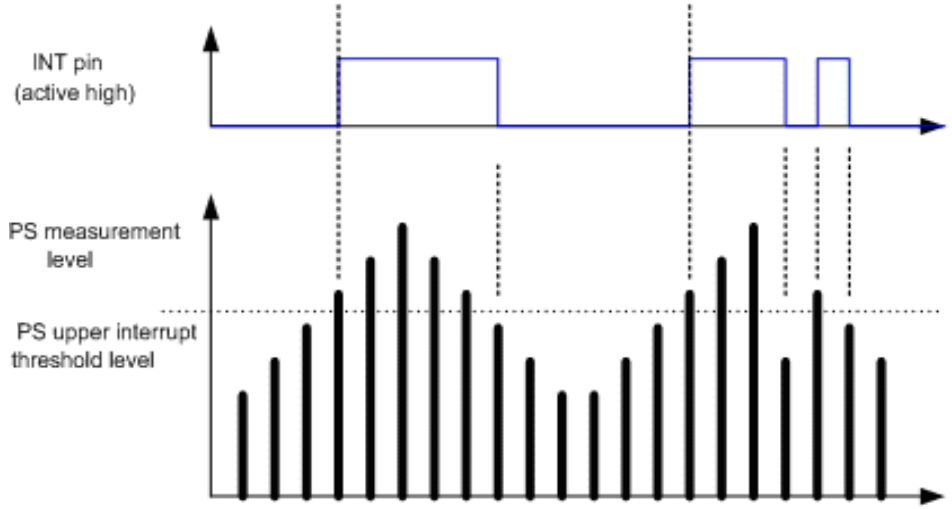


Figure: Interrupt Pin Illustration of Absolute Threshold

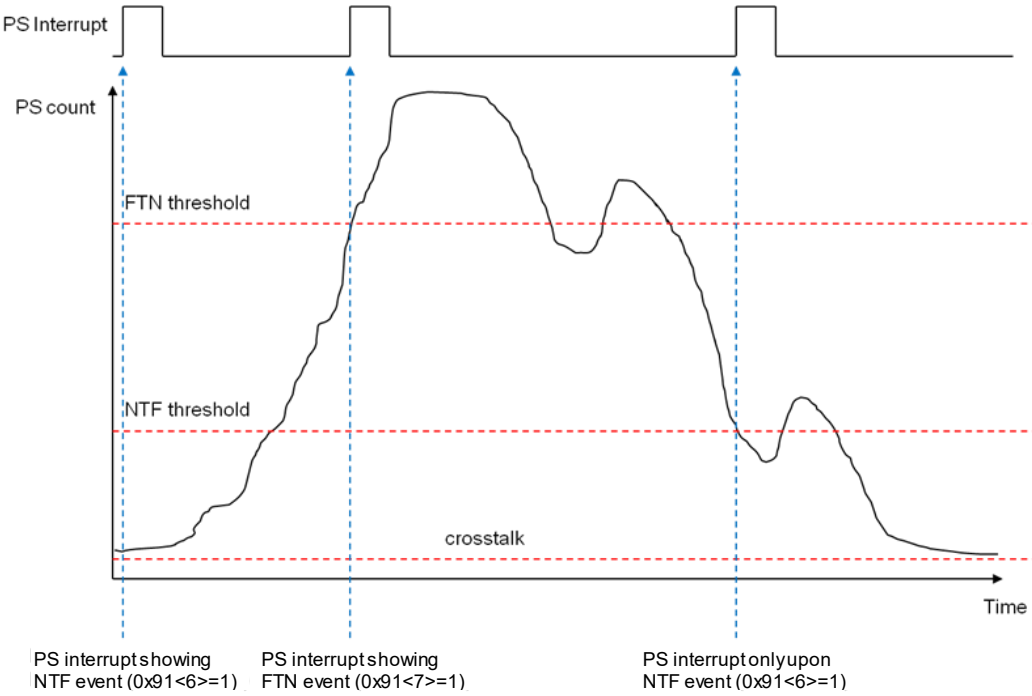
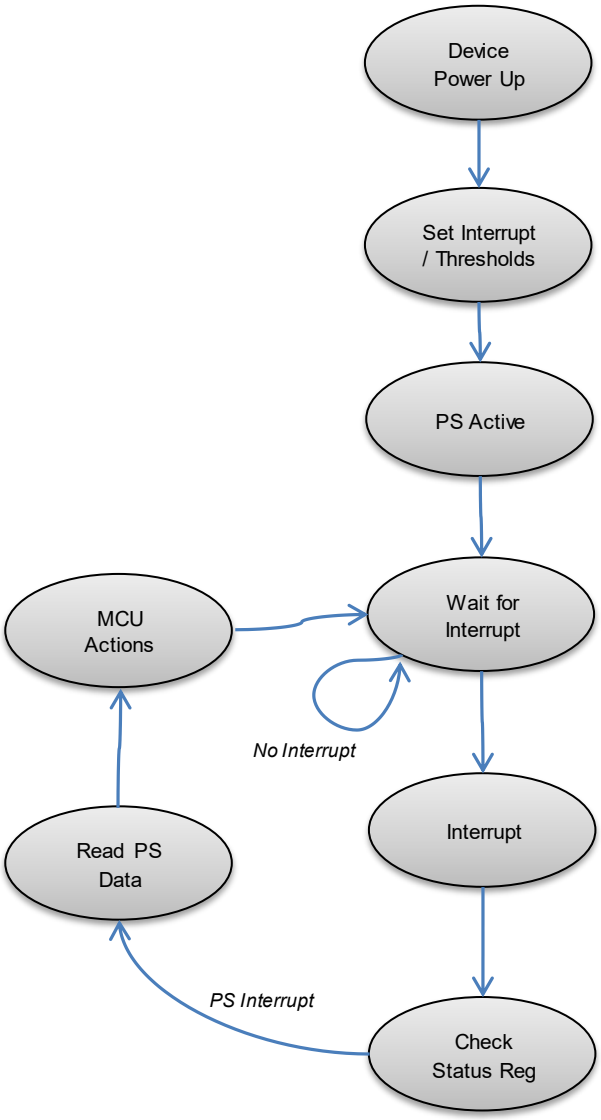


Figure: Interrupt Pin Illustration of FTN/NTF Status Reporting

The flow diagram illustrates the operation involving the use of thresholds and interrupt.


Device
Power Up
Set Interrupt
/ Thresholds
PS Active
Wait for
Interrupt
MCU
Actions
No Interrupt
Interrupt
Read PS
Data
PS Interrupt
Check
Status Reg

7.3. Example Pseudo Code

Control Register

```
// The Control Register defines the operating mode
// Default setting is 0xE0 for PS control register (0x81)

Slave_Addr  = 0x23                          // Slave address of the device

// Enable PS
Register_Addr  = 0x81                       // PS_CONTR register
Command  = 0x22
WriteByte(Slave_Addr,  Register_Addr,  Command)
```

PS LED Registers

```
// The PS LED Registers define the LED pulse modulation pulse width, and peak current.
// Default setting is 0xF3 (15.625kHz, 100% Duty Cycle, 100mA).

Slave_Addr  = 0x23                          // Slave address of the device

Register_Addr  = 0x82                       // PS_LED register
Command  = 0xF6                             // Pulse 32us pulse width, peak current 250mA

WriteByte(Slave_Addr,  Register_Addr,  Command)
```

PS LED Number of pulses

```
// Default setting is 0x00 (Sequence 1, Pulse Count 1, LED pulses = 1x1 = 1).

Slave_Addr  = 0x23                          // Slave address of the device

Register_Addr  = 0x83                       // PS_LED Register for Number of pulses
Command  = 0x7F                             // Number of pulses = 128

WriteByte(Slave_Addr,  Register_Addr,  Command)
```

PS Measurement Rate

```
// The PS_MEAS_RATE register controls the PS measurement rate.
// Default setting of the register is 0x24 (Repeat rate 100ms)

Slave_Addr  = 0x23                          // Slave address of the device

// Set PS Repeat Rate
Register_Addr  = 0x84                       // PS_MEAS_RATE register
Command  = 0xA4                             // Meas rate = 100ms

WriteByte(Slave_Addr,  Register_Addr,  Command)
```

PS Status Register (Read Only)

```
// The PS_STATUS Register contains the information on Interrupt, and PS data availability status.
// This register is read only.

Slave_Addr  = 0x23                          // Slave address of the device

// Read back Register
Register_Addr  = 0x91                       // PS_STATUS register address
ReadByte(Slave_Addr,  Register_Addr,  Data)
```

```
IR_Ambient_Sat_Status = Data & 0x08      // IR_Ambient_Saturation_Status = 8(decimal) ➔ IR Ambient saturated
Interrupt_Status = Data & 0x02           // Interrupt_Status = 2(decimal) ➔ PS Interrupt
NewData_Status = Data & 0x01             // NewData_Status = 1(decimal) ➔ PS New Data
```

PS 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 the device

// Read back PS_DATA registers
Register_Addr = 0x92                     // PS_DATA low byte address
ReadByte(Slave_Addr, Register_Addr, Data0)

Register_Addr = 0x93                     // PS_DATA high byte address
ReadByte(Slave_Addr, Register_Addr, Data1)

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

Interrupt Registers

```
// The Interrupt register controls the operation of the interrupt pins and function. PS Raw bit is also set here.
// The default value for this register is 0x20 (Interrupt inactive)

Slave_Addr = 0x23                        // Slave address of the device

// Set Interrupt Polarity for Active Low
Register_Addr = 0xA6                     // Interrupt Register address
Command = 0x2D                           // PS interrupt enabled, Interrupt is Active Low.

WriteByte(Slave_Addr, Register_Addr, Command)
```

PS Threshold Registers

```
// The PS_UPPER_THRESHOLD and PS_LOWER_THRESHOLD registers determine the upper and
// lower limits of the interrupt threshold values.
// Following example illustrates the setting of the PS dynamic threshold with hysteresis interruption for
// decimal value 1000 (for NEAR detection) and 500 (for FAR detection)

Slave_Addr = 0x23                        // Slave address of the device

// For NEAR detection (decimal 1000)
PS_Upper_Threshold_LSB = 0xA8            // PS Upper Threshold Low Byte Register address
PS_Upper_Threshold_MSB = 0xA9            // 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_Upper_Threshold_LSB, Data0)
WriteByte(Slave_Addr, PS_Upper_Threshold_MSB, Data1)

PS_Lower_Threshold_LSB = 0xAA            // PS Lower Threshold Low Byte Register address
PS_Lower_Threshold_MSB = 0xAB            // PS Lower Threshold High Byte Register address


Data1 = 0 >> 8                           // To convert decimal 0 into two eight bytes register values
Data0 = 0 & 0xFF
WriteByte(Slave_Addr, PS_Lower_Threshold_LSB, Data0)
WriteByte(Slave_Addr, PS_Lower_Threshold_MSB, Data1)

// For FAR detection (decimal 500)
PS_Upper_Threshold_LSB = 0xA8            // PS Upper Threshold Low Byte Register address
PS_Upper_Threshold_MSB = 0xA9            // PS Upper Threshold High Byte Register address
Data1 = 65535 >> 8                       // To convert decimal 65535 into two eight bytes register values
Data0 = 65535 & 0xFF
```

```
WriteByte(Slave_Addr, PS_Upper_Threshold_LSB, Data0)
WriteByte(Slave_Addr, PS_Upper_Threshold_MSB, Data1)

PS_Lower_Threshold_LSB  = 0xAA          // PS Lower Threshold Low Byte Register address
PS_Lower_Threshold_MSB  = 0xAB          // PS Lower Threshold High Byte Register address
Data1 = 500 >> 8                        // To convert decimal 500 into two eight bytes register values
Data0 = 500 & 0xFF
WriteByte(Slave_Addr, PS_Lower_Threshold_LSB, Data0)
WriteByte(Slave_Addr, PS_Lower_Threshold_MSB, Data1)
```

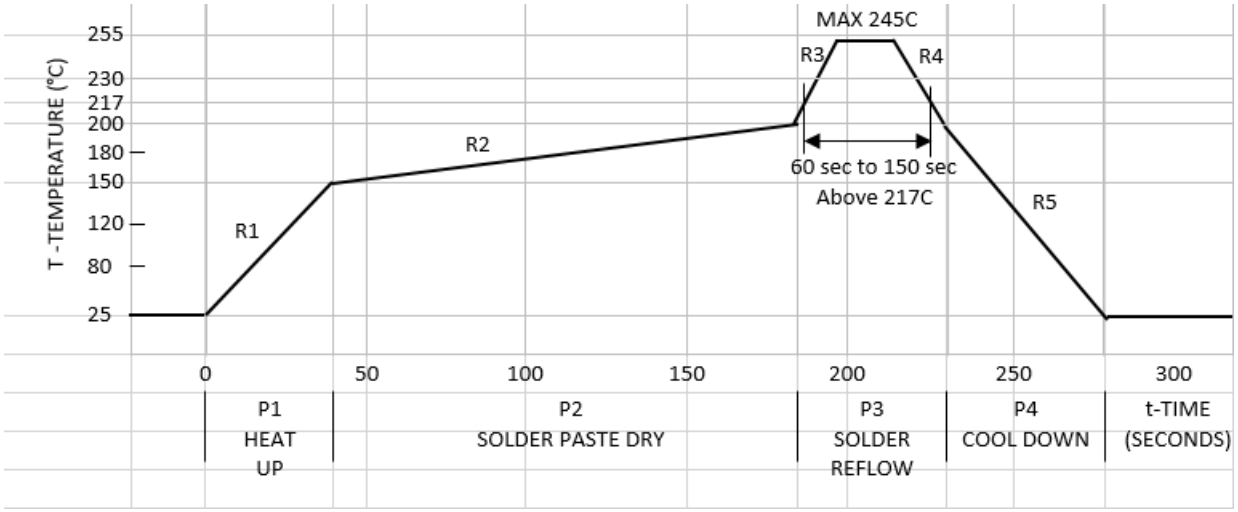
PS CONFIG Registers

```
// The PS_CONFIG registers are required to be set before enabling PS

Slave_Addr  = 0x23                      // Slave address of the device

PS_CONFIG1  = 0xDB                      // PS_CONFIG1 register
PS_CONFIG2  = 0x0A                      // PS_CONFIG2 register
PS_CONFIG3  = 0x80                      // PS_CONFIG3 register
```

8. Recommended Lead-free 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	60s to 120s
Solder Reflow	P3, R3 P3, R4	200°C to 245°C 245°C to 200°C	3°C/s -6°C/s
Cool Down	P4, R5	200°C to 25°C	-6°C/s
Time maintained above liquid's point , 217°C		> 217°C	60s to 150s
Peak Temperature		245°C	-
Time within 5°C of actual Peak Temperature		> 240°C	30s
Time 25°C to Peak Temperature		25°C to 245°C	8mins

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

9. Moisture Proof Packaging

All LTR-690PS-AHX are shipped in moisture proof package. Once opened, moisture absorption begins. This part is compliant to JEDEC J-STD-033A Level 4.

Time from Unsealing to Soldering

After removal from the moisture barrier bag, the parts should be stored at the recommended storage conditions and soldered within three days. When the moisture barrier bag is opened and the parts are exposed to the recommended storage conditions for more than three days, the parts must be baked before reflow to prevent damage to the parts.

Recommended Storage Conditions

Storage Temperature	10°C to 30°C
Relative Humidity	Below 60% RH

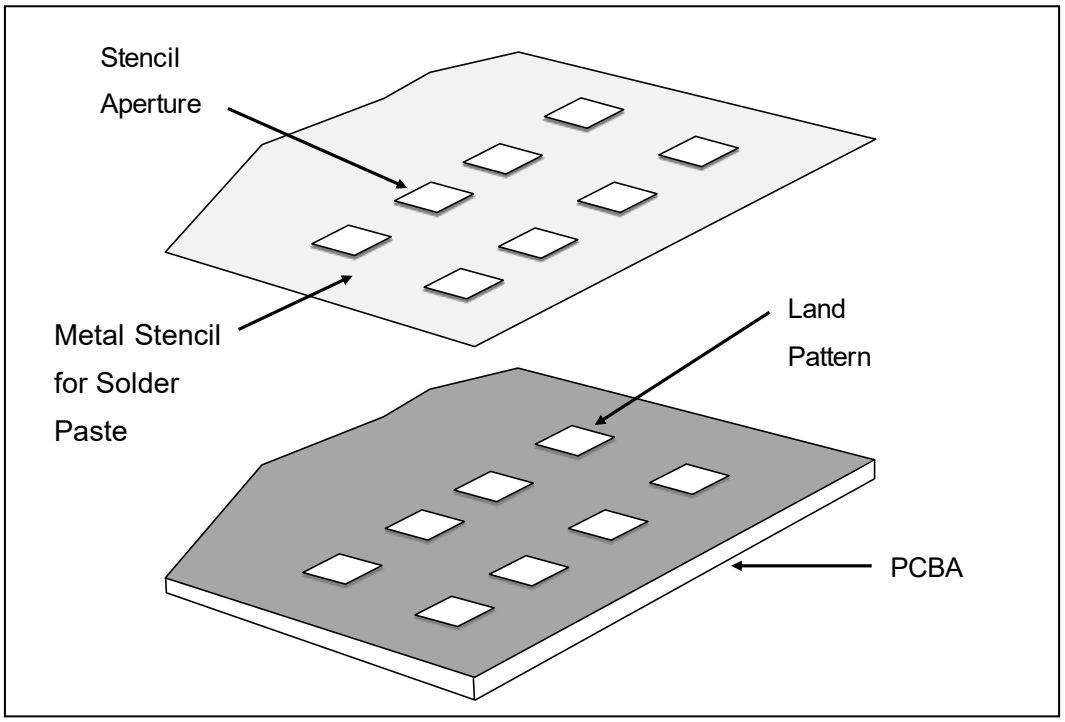
Baking Conditions

Package	Temperature	Time
In Reels	60°C	48 hours

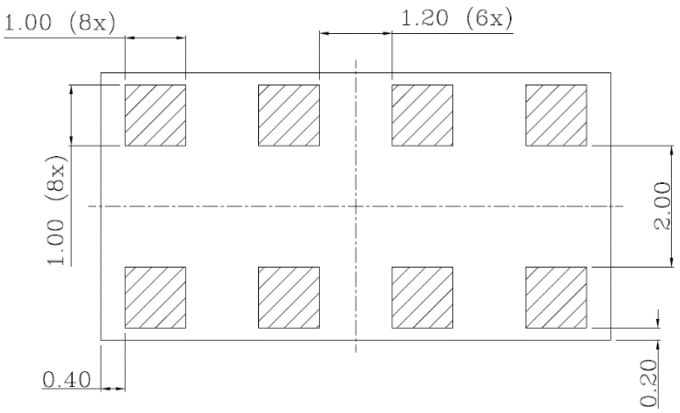
Baking should only be done once.

10. Recommended Land Pattern and Metal Stencil Aperture

10.1. Recommended Land Pattern



Recommended Land Pattern for LTR-690PS-AHX

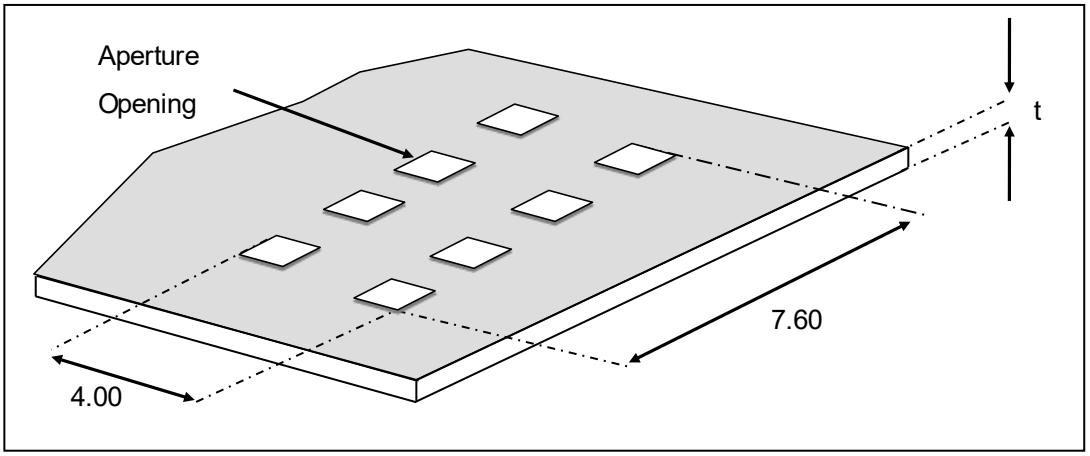


Note: All dimensions are in millimeters

10.2. Recommended Metal Stencil Aperture

It is recommended that the metal stencil used for solder paste printing has a thickness (t) of 0.11mm (0.004 inches / 4 mils) or 0.127mm (0.005 inches / 5 mils).

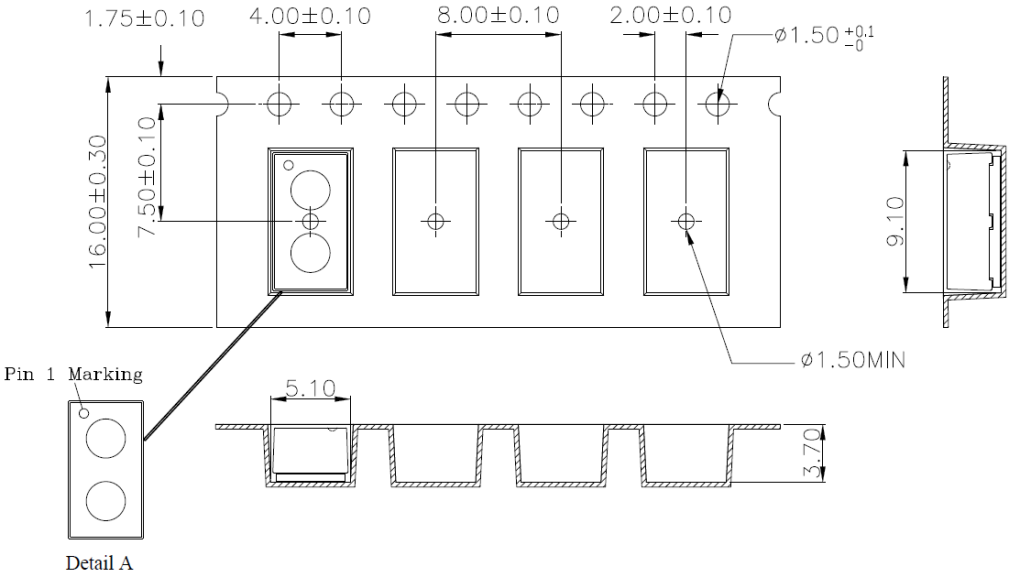
The stencil aperture opening is recommended to be 1.0mm x 1.0mm which has the same dimension as the land pattern. This is to ensure adequate printed solder paste volume and yet no shorting.

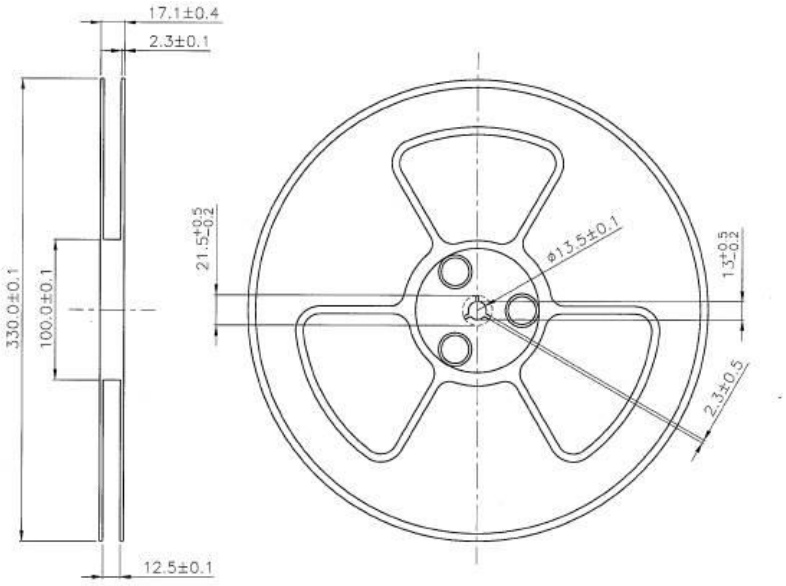


Note:

1. All dimensions are in millimeters

11. Package Dimension for Tape and Reel





Notes:

1. All dimensions are in millimeters
2. Empty component pockets sealed with top cover tape
3. 13 inch reel - 2000 pieces per reel
4. In accordance with ANSI/EIA 481-1-A-1994 specifications

12. Reliability Test

Reliability test conditions for this product is shown in the table below.

No	Test Item	Test Condition
1	High Temperature Life Test	85°C, VDD=VLED=3.6V, 1000 hours.
2	Low Temperature Life Test	-40°C, VDD=VLED=3.6V, 1000 hours.
3	Temperature Humidity Life Test	65°C/90%RH, VDD=VLED=3.6V, 1000 hours.
4	Temperature Cycle	-40°C/85°C, 100 Cycles, 15mins/10mins/15mins.

13. Revision Table

Version	Update	Page	Date
1.0	Final datasheet created.	Total 40	18-July-2018
1.1	Default value of register 0x91 updated. Outline drawing updated.	Total 40	4-Jan-2019