广州市东裕光电科技有限公司

产品规格书
SPECIFICATION

客户名称 CUSTOMER	
产品名称 PRODUCTION	环境光传感器和带 I2C 接口的接近传感器
产品型号 MODEL	DYWH-APM-16D24-U6E-DF8/2T
版本号 VERSION NO	A1.0

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Ambient Light Sensor and Proximity Sensor with I²C Interface

DYWH-APM-16D24-U6E-DF8/2T

Features

Ambient Light Sensor

- 10~16bit ADC resolution
- Specially coated photo diode with an optical response similar to human eyes
- High resolution
- 50Hz/60Hz flicker noise and IR rejection
- Amplifier with adjustable gain (x1, x4, x8, x32, x96)
- Individual programmable low and high threshold for interrupt function
- Programmable integration time

Proximity Sensor

- 8~12bit ADC resolution
- Amplifier with adjustable gain (x1, x2, x4, x8)
- IR driver output with adjustable sink current up to 200mA
- Adjustable number of pulse for the IR proximity signal
- Individual programmable low and high threshold for interrupt function
- Programmable update/sleep time
- Current sink driver for IR LED
- Cross-talk cancellation register
- The product itself will remain within RoHS compliant version
- Compliance with EU REACH
- Compliance Halogen Free(Br < 900ppm, Cl < 900ppm, Br+Cl < 1500ppm)

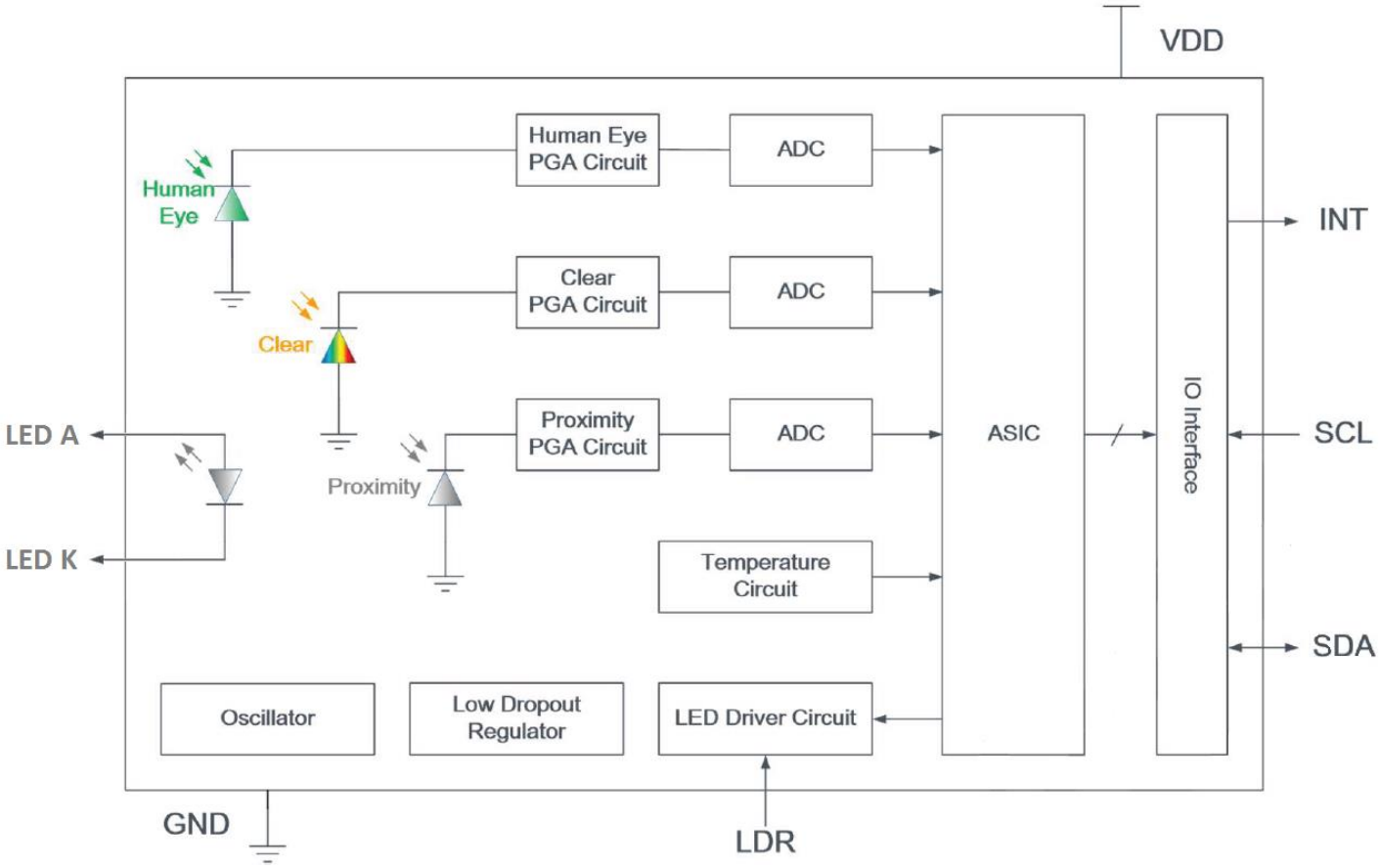
Description

The DYWH-APM-16D24-U6E-DF8/2T is a digital output ambient light and proximity senor with I²C interface and interrupt. Ambient light sensor (ALS) built-in an optical filter for IR rejection, and providing a spectrum which is close to the human eye's response. ALS can work from dark to direct sunlight, the selectable detect range is about 40dB. Dual-channel output (human eye and clear), so ALS has excellent light ratio under different light conditions. Proximity sensor (PS) built-in an 940nm optical filter for ambient light immunity. The PS function has adjustable number of IR pulses from 1 to 256 and flexible IR LED driving current from 50mA to 200mA, to meet different application requirements. Furthermore it is equipped with a filter to reduce unwanted IR signals and noise comes from the environment.

Applications

- Detection of ambient for controlling the backlight of TFT LCD display.
- Automatic residential and commercial lighting management.
- Automatic contrast enhancement for electronic signboard.
- Mobile phone, Smart phone, PDA, Tablet PC.

Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Rating	Unit
Supply Voltage	VDD	4.5	V
I²C Bus Pin Voltage	SCL, SDA, INT	-0.2 to 4.5	V
I²C Bus Pin Current	SCL, SDA, INT	10	mA
IRDR Pin Voltage	V_{IRDR}	-0.2V to VDD + 0.5V	V
Operating Temperature	T_{ope}	-40 to +85	℃
Storage Temperature	T_{stg}	-45 ~ 100	℃
ESD Rating	Human Body Model	2	KV

Note:

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

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Supply Voltage Note1	V_{DD}	2.4	-	3.6	V	
I²C Bus Pin Voltage	V_{Bus}	1.62	1.8	V_{DD}	V	$V_{Bus} \leq V_{DD}$
Operating Temperature	T_{ope}	-40	-	+85	℃	
I²C Bus Input High Voltage Note2	V_{IH_SCL}, V_{IH_SDA}	1.4	-	-	V	
I²C Bus Input Low Voltage Note2	V_{IL_SCL}, V_{IL_SDA}	-	-	0.5	V	
SDA Output Low Voltage	V_{OL_SDA}	0	-	0.4	V	3mA sinking current
INT Output Low Voltage	V_{OL_INT}	0	-	0.4	V	3mA sinking current

Notes:

1.The power supply need to make sure the VDD slew rate at least 1.0V/ms. APM-16D24-U6E have power on reset function. When VDD drops below 2.0V under room temp, the IC will be reset automatically. Then power back up at the requirement slew rate, and write registers to the desired values.

2. The specs are defined under VDD=3.3V, T=25°C.

Electro-Optical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Active Supply Current Note1	I_{DD}	-	160	-	μA	E_V=0 lx
	I_{PD}	-	2.5	-	μA	Sleep mode E_V= 0 lx, I^2C inactive
Ambient Light Sensor Note4	Symbol	Min.	Typ.	Max.	Unit	Condition
ALS A/DC resolution	-	10	-	16	bit	
Number of ADC integration time	ATIME	1	-	256	step	
Unit of ADC integration time	A_{Step}	-	2.66	-	ms	
ALS Dark Output Note1	CH0 CH1	0 0	- -	5 5	counts	E_V=0 lx, ALS gain=x96, T_{ALS}=170.888ms
ALS detection output Note2	CH0 CH1	- -	1250 1440	- -	counts	E_V=100 lx, ALS gain=x4, T_{ALS}=170.888ms
ALS detection resolution Note1	-	-	0.0033	-	lx/count	ALS gain=x96, T_{ALS} =170.888ms
ALS detection Lux Note3	-	-	20.7k	-	Lux	ALS gain=x1, T_{ALS} =5.5ms
ALS sensitivity peak wavelength	λ_{PALS}	-	550	-	nm	

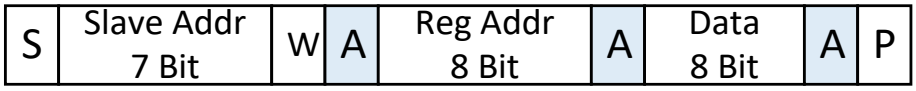
Proximity Sensor	Symbol	Min.	Typ.	Max.	Unit	Condition
PS A/DC resolution	-	8	-	12	bit	
Number of ADC integration time	PTIME	1	-	16	step	
Unit of ADC integration time	P_{Step}	-	0.51	-	ms	
PS sensitivity peak wavelength	λ_{PPS}	-	940	-	nm	

LED Sink Current Driver	Symbol	Min.	Typ.	Max.	Unit	Condition
LED pulse period	T		13.8		μs	
LED Driving Current	I_{LED}	50	-	200	mA	
LED pulse width	T_{LEDW}	1	-	64	T	
LED pulse count	P_{count}	1	-	256	pulse	

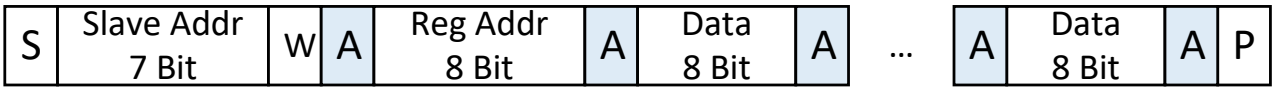
Note :

1. VDD = 3.3 V, TA = 25℃, **EN_ALS**=1, **ALSCONV**=0x3F, **PGA_ALS** =0x4, **WTIME**=0x07
2. VDD = 3.3 V, TA = 25℃, **EN_ALS**=1, **ALSCONV**=0x3F, **PGA_ALS** =0x1, **WTIME**=0x07
3. VDD = 3.3 V, TA = 25℃, **EN_ALS**=1, **ALSCONV**=0x00, **PGA_ALS** =0x0, **WTIME**=0x07
4. The ALS output measurement by white light LED 6500K

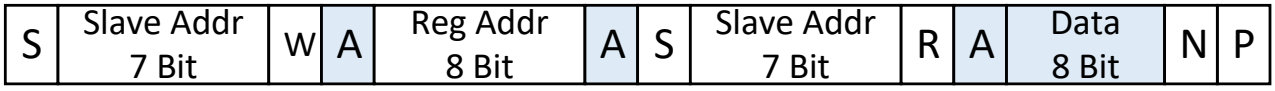
I2C Write Format



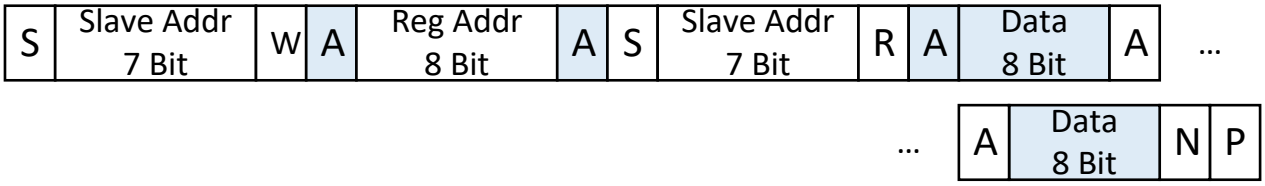
I2C Block Write Format

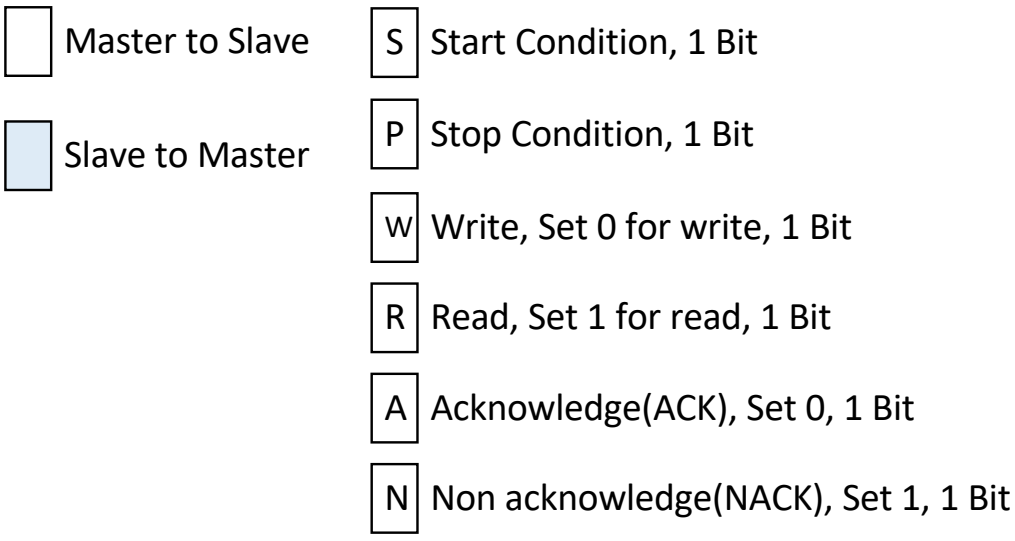


I2C Read Format



I2C Block Read Format





I2C Slave Address and R/W bit

This address is seven bits long followed by an eighth bit which is a data direction bit (R/W). A ‘0’ indicates a transmission (WRITE), a ‘1’ indicates a request for data (READ). The slave address of this device is 0x38.

Register Set

The APM-16D24-U6E-DF8/TR8(DY) is operated over the I²C bus with registers that contain configuration, status, and result information. All registers are 8 bits long.

Address	Name	Type	Default value	Description
0x00	SYSM_CTRL	RW	0x00	ALS/PS operation mode control, waiting mode control, SW reset
0x01	INT_CTRL	RW	0x03	Interrupt pin control, interrupt persist control
0x02	INT_FLAG	RW	0x00	Interrupt flag, error flag, power on reset(POR) flag
0x03	WAIT_TIME	RW	0x00	Waiting time setting
0x04	ALS_GAIN	RW	0x00	ALS analog gain setting
0x05	ALS_TIME	RW	0x00	ALS integrated time setting
0x06	LED_CTRL	RW	0x00	LED setting
0x07	PS_GAIN	RW	0x00	PS analog gain setting
0x08	PS_PULSE	RW	0x00	PS number of LED pulse
0x09	PS_TIME	RW	0x00	PS integrated time setting
0x0B	PERSISTENCE	RW	0x11	ALS/PS persistence setting
0x0C	ALS_THRES_LL	RW	0x00	ALS lower interrupt threshold - LSB
0x0D	ALS_THRES_LH	RW	0x00	ALS lower interrupt threshold - MSB
0x0E	ALS_THRES_HL	RW	0xFF	ALS higher interrupt threshold - LSB
0x0F	ALS_THRES_HH	RW	0xFF	ALS higher interrupt threshold - MSB
0x10	PS_THRES_LL	RW	0x00	PS lower interrupt threshold - LSB
0x11	PS_THRES_LH	RW	0x00	PS lower interrupt threshold - MSB
0x12	PS_THRES_HL	RW	0xFF	PS higher interrupt threshold - LSB
0x13	PS_THRES_HH	RW	0xFF	PS higher interrupt threshold - MSB
0x14	PS_OFFSET_L	RW	0x00	PS offset level - LSB
0x15	PS_OFFSET_H	RW	0x00	PS offset level - MSB
0x16	INT_SOURCE	RW	0x00	ALS interrupt source
0x17	ERROR_FLAG	RW	0x00	Error flag
0x18	PS_DATA_L	R	0x00	PS output data - LSB

0x19	PS_DATA_H	R	0x00	PS output data - MSB
0x1A	IR_DATA_L	R	0x00	IR output data - LSB
0x1B	IR_DATA_H	R	0x00	IR output data - MSB
0x1C	CH0_DATA_L	R	0x00	Channel 0 output data - LSB
0x1D	CH0_DATA_H	R	0x00	Channel 0 output data - MSB
0x1E	CH1_DATA_L	R	0x00	Channel 1 output data - LSB
0x1F	CH1_DATA_H	R	0x00	Channel 1 output data - MSB
0xBC	PNO_LB	R	0x14	Product number, Low Byte
0xBD	PNO_HB	R	0x16	Product number, High Byte

SYSM_CTRL

0x00	SYSM_CTRL, System Control (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	SWRST	EN_WAIT	0	0	0	0	EN_PS	EN_ALS

SWRST：Software reset. Reset all register to default value.

0: (default)

1: Reset will be triggered.

EN_WAIT：Waiting time will be inserted between two measurements.

0: Disable waiting function.

1: Enable waiting function.

EN_PS：Enables PS function.

0: Disable PS function (default)

1: Enable PS function

EN_ALS：Enables ALS function.

0: Disable ALS function (default)

1: Enable ALS function

INT_CTRL

0x01	Interrupt Pin Control (Default = 0x03)							
BIT	7	6	5	4	3	2	1	0
R/W	PS_INT_MODE	SINT_MODE	PS_SYNC	ALS_SYNC	0	0	EN_PINT	EN_AINT

PS_INT_MODE：This bit selects the interrupt triggered mode of PS function.

0: Hysteresis Mode (default).
1: Zone Mode.

SINT_MODE：Speeding up the interrupt response of PS mode by skipping waiting time in each conversion cycle.

0: Disable speed up (default).
1: Enable speed up.

PS_SYNC：Measurement is pended when PS interrupt is triggered. Until clear the interrupt then start the next measurement.

0: Disable pending PS function (default).
1: Enable pending PS function.

ALS_SYNC： Measurement is pended when ALS interrupt is triggered. Until clear the interrupt then start the next measurement.

0: Disable pending ALS function (default).
1: Enable pending ALS function.

EN_PINT：The PS interrupt (INT_PS) flag can trigger the INT pin to low.

0: Disable **INT_PS** effect INT pin.
1: Enable **INT_PS** effect INT pin (default)

EN_AINT：The ALS interrupt (INT_ALS) flag can trigger the INT pin to low.

0: Disable **INT_ALS** effect INT pin.
1: Enable **INT_ALS** effect INT pin (default)

INT_FLAG

0x02	INT_FLAG, System Control (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	INT_POR	DATA_FLAG	OBJ	0	0	0	INT_PS	INT_ALS

INT_POR：Power-On-Reset Interrupt flag trigger the INT pin when the flag sets to one.

0: Write zero to clear the flag.
1: This bit will be set to one when it satisfy one of the following conditions:

- Power On
- VDD < 2.0V
- SWRST

DATA_FLAG：It shows if any data is invalid after completion of each conversion cycle. This bit is read-only.

0: data valid
1: data invalid

OBJ：Object Detection Bit. It shows the position of the object. It is a read-only bit. Refer to **PMODE** (register 0x02, bit 5) for detailed definition of **OBJ**. This bit is read only.

0: object disappear.
1: object appear.

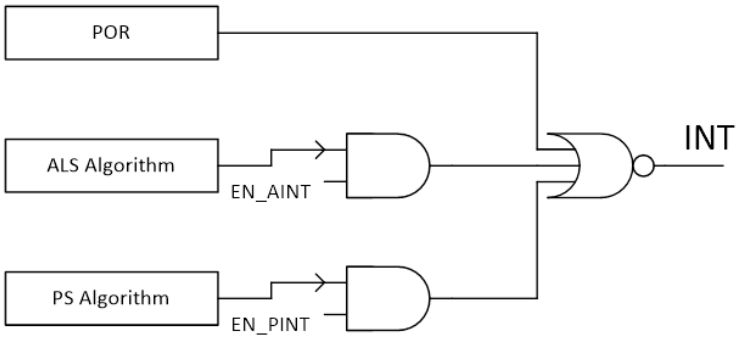
INT_PS：PS Interrupt flag. It correlation with **PS_INT_MODE**, **PS_DATA** and PS high/low threshold. Write zero to clear the flag.

0: PS Interrupt not triggered or be cleared.
1: PS Interrupt triggered.

INT_ALS：ALS Interrupt flag. It correlation with CH0/1 data and ALS high/low threshold. Write zero to clear the flag.

0: ALS Interrupt not trigger or be cleared.
1: ALS Interrupt triggered

Interrupt Behavior :



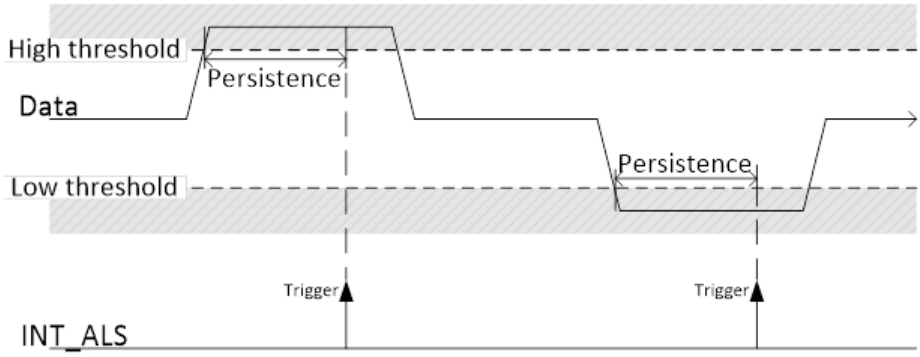
ALS Interrupt Algorithm

Correlative register:

The ALS Interrupt (**INT_ALS, register 0x02, bit0).**
The ALS Persistence (**PRS_ALS**, register 0x0B, bit0 to bit3),
The ALS Data (**CH0_DATA and CH1_DATA**, register 0x1C to 0x1F),
The ALS Low Threshold (**ALS_THRES_L**, register 0x0C to 0x0D),
The ALS High Threshold (**ALS_THRES_H**, register 0x0E to 0x0F).

INT_ALS triggered condition:

1. Rule of active interrupt: **DATA**>**ALS_THRES_H** or **DATA**<**ALS_THRES_L.**
2. If the **DATA** meets the rule, the **interrupt** count increases one.
   If the **DATA** fails in the rule, the interrupt count will be clear.
3. When the **interrupt** count equal to **PRS_ALS setting**, **INT_ALS** will be triggered and reset the interrupt counter.
4. If **PRS_ALS** is set to zero, **threshold** will be ignored and **DATA** will meets the active interrupt rule forcibly.



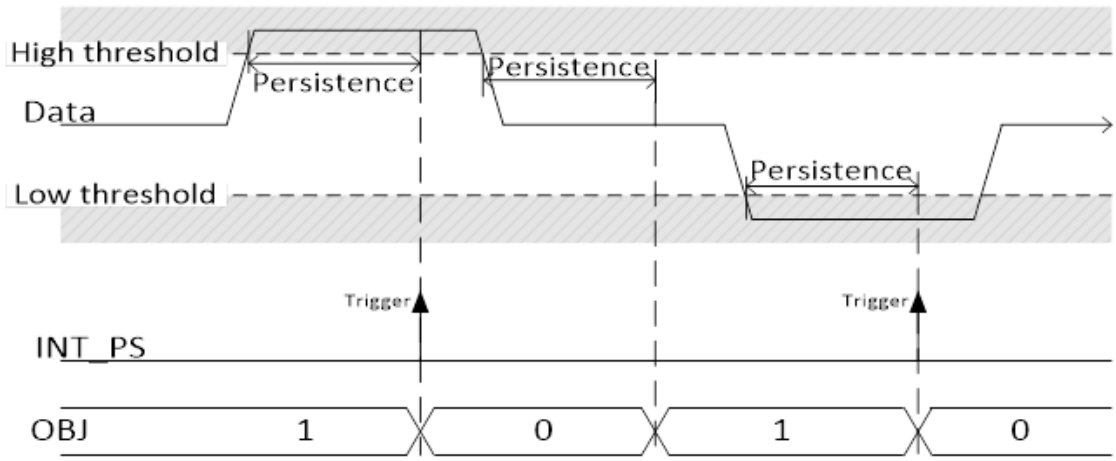
PS Interrupt Algorithm

Correlative register:

The PS Interrupt (**INT_PS**, register 0x02, bit1),
The PS Persistence (**PRS_PS**, register 0x0B, bit4 to bit7),
The PS Data (**PS_DATA**, register 0x18 to 0x19),
The PS Low Threshold (**PS_THRES_L**, register 0x10 to 0x11),
The PS High Threshold (**PS_THRES_H**, register 0x12 to 0x13).
The PS Interrupt Mode (**PS_INT_MODE**, register 0x01, bit7).

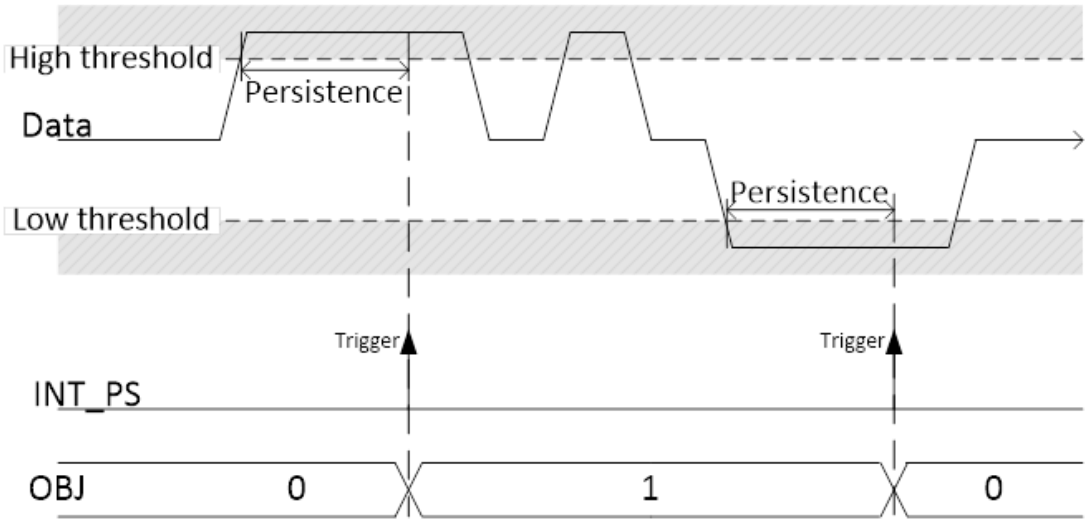
PS_INT_MODE set to one: Zone Mode
INT_PS triggered condition:

1. Rule of active interrupt: **PS_DATA**>**PS_THRES_H** or **PS_DATA**<**PS_THRES_L**
2. If **PS_DATA** meets the rule, the **counter (OUT_CONT)** increases one and another counter (**IN_CONT**) set to zero.
   If **PS_DATA** fails in the rule, the counter (**IN_CONT**) increases one and clear the value of **OUT_CONT**.
3. When the counter value of **OUT_CONT** equal to **PRS_PS**, the **OBJ** flag will set to zero, **INT_PS** will be triggered, and clear **OUT_CONT** counter.
   When the **IN_CONT** counter value reaches **PRS_PS**, the counter will be cleared and **OBJ** flag will set to one.
4. If **PRS_PS** is set to zero, **the threshold** setting will be ignored and **DATA** will meets the active interrupt rule forcibly



PS_INT_MODE set to zero: Hysteresis Interrupt mode:
INT_PS triggered condition:

1. Rule of active interrupt:
   i. When **OBJ** is zero, **PS_DATA**>**PS_THRES_H.**
   ii. **When OBJ** is one, **PS_DATA**<**PS_THRES_L.**
2. If **PS_DATA** meets the rule, the interrupt **counter** increases one.
   If **PS_DATA** fails in the rule, the interrupt counter will be cleared.
3. When the counter value equal to **PRS_PS**, the **OBJ** flag will be inverted, **INT_PS** will be triggered, and clear interrupt counter.
4. If **PRS_PS** is set to zero, **the threshold** setting will be ignored and **DATA** will meets the active interrupt rule forcibly.



WAIT_TIME

0x03	WAIT_TIME, waiting time (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	WTIME							

WTIME：This register controls the time unit of waiting state which is inserted between any two measurements. It is 5ms per time unit.

0x00: 1 time unit.
0x01: 2 time units
……
0xFF: 256 time units

ALS_GAIN

0x04	ALS_GAIN, ALS analog gain (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	PGA_ALS		

PGA_ALS：ALS sensing gain.

0x0: x1 (default)
0x1: x4
0x2: x8
0x3: x32
0x4: x96
0x5, 0x6, 0x7: NA

ALS_TIME

0x05	ALS_TIME, ALS integrated time (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	ALSCONV							

ALSCONV：This register controls the integrated time of AD converter at ALS mode (T_{ALS}), and the resolution of output data (CH0_DATA, CH1_DATA).

0x00: The maximum count of **output data is** 1023, T_{ALS} = 5.513ms (default)
0x01: The maximum count of **output data is** 2047, T_{ALS} = 8.138ms
……
0x3F: The maximum count of **output data is** 65535, T_{ALS} = 170.888ms
……
0xff: The maximum count of **output data is** 65535, T_{ALS} = 674.888ms

The maximum count of **output data is** minimum of [1024 x (**ATIME** + 1) – 1, 65535].

The conversion time of ALS function (T_{ALS}) is decided by **ALSCONV**.
T_{ALS}=2.888 + 2.625 x (**ALSCONV** + 1) (ms)

LED_CTRL

0x06	LED_CTRL, LED control(Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	IRDR_SEL		ITW_PS					

IRDR_SEL：It configures the peak current of the internal LED driver.

0x0：50 mA (default)
0x1：100 mA
0x2：150 mA
0x3：200 mA

ITW_PS：It controls the LED pulse width in PS function mode. Pulse width is 13.675us per unit.

0x00：1T, 13.675 us (default).
0x01：2T, 27.35 us.
……
0x3F：64T, 875.213 us.

PS_GAIN

0x07	**PS_GAIN, PS analog gain (Default = 0x00)**							
BIT	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	PGA_PS	

PGA_PS：PS sensing gain.

0x0: x1 (default)
0x1: x2
0x2: x4
0x3: x8

PS_PULSE

0x08	**PS_PULSE, PS pulse count control(Default = 0x00)**							
BIT	7	6	5	4	3	2	1	0
R/W	ITC_PS							

ITC_PS：It controls the number of LED pulse in PS function mode.

0x00： 1 pulse (default)
0x01：2 pulses
0x02：3 pulses
……
0xFF：256 pulses

PS_TIME

0x09	PS_TIME, PS integrated time (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	0	0	0	0	PSCONV			

PSCONV：This register controls the integrated time of AD converter at PS mode (T_{PS}), and the resolution of output data (PS_DATA, IR_DATA).

0x0: The maximum count of **output data is** 255, 1 time unit (default).
0x1: The maximum count of **output data is** 511, 2 time units.
……
0xf: The maximum count of **output data is** 4095, 16 time units.

The maximum count of **output data is (**256 x time unit) -1.

The conversion time of PS function (T_{PS}) is decided by **ITW_PS**, **ITC_PS**, and **PSCONV**.
T_{PS} ={ 3.051 + [2 x (**ITC_PS** + 1)+1] x [0.01 + 0.01368 x (**ITW_PS**+1)] + 0.51 x (**PSCONV**+1) } x 16 (ms)

The total conversion time (T_{TOTAL}) of device is decided by T_{ALS}, T_{PS}, T_{wait}.
$T_{TOTAL} = T_{ALS} + T_{PS} + T_{wait}$ (ms)

PERSISTENCE

0x0B	PERSISTENCE, ALS, and PS persistence setting (Default = 0x11)							
BIT	7	6	5	4	3	2	1	0
R/W	PRS_PS				PRS_ALS			

PRS_ALS：This register sets the numbers of similar consecutive ALS interrupt events before the interrupt pin is triggered.

0x0: Every ALS conversion is done.
0x1: 1 ALS interrupt event is asserted.
……
0xf: 15 consecutive ALS interrupt events are asserted.

PRS_PS：This register sets the numbers of similar consecutive PS interrupt events before the interrupt pin is triggered.

0x0: Every PS conversion is done.
0x1: 1 PS interrupt event is asserted.
……
0xf: 15 consecutive PS interrupt events are asserted.

ALS_THRES_L

0x0C 0x0D	ALS_THRES_L, ALS low interrupt threshold (Default = 0x0000)							
BIT	7	6	5	4	3	2	1	0
R/W	ALS_THRE_LL							
R/W	ALS_THRE_LH							

This register sets the lower threshold value of ALS interrupt. The interrupt algorithm compares the selected ALS data and ALS threshold value.

ALS_THRE_LL：ALS lower interrupt threshold value, LSB. (Reg. 0x0C)
ALS_THRE_LH：ALS lower interrupt threshold value, MSB. (Reg. 0x0D)

ALS_THRES_H

0x0E 0x0F	ALS_THRES_H, ALS high interrupt threshold (Default = 0xFFFF)							
BIT	7	6	5	4	3	2	1	0
R/W	ALS_THRE_HL							
R/W	ALS_THRE_HH							

This register sets the high threshold value of ALS interrupt. The interrupt algorithm compares the selected ALS data and ALS threshold value.

ALS_THRE_HL：ALS high interrupt threshold value, LSB. (Reg. 0x0E)
ALS_THRE_HH：ALS high interrupt threshold value, MSB. (Reg. 0x0F)

PS_THRES_L

0x10 0x11	PS_THRES_L, PS low interrupt threshold (Default = 0x0000)							
BIT	7	6	5	4	3	2	1	0
R/W	PS_THRE_LL							
R/W	PS_THRE_LH							

This register sets the lower threshold value of PS interrupt. The interrupt algorithm compares the selected PS data and PS threshold value.

PS_THRE_LL：PS lower interrupt threshold value, LSB. (Reg. 0x10)
PS_THRE_LH：PS lower interrupt threshold value, MSB. (Reg. 0x11)

PS_THRES_H

0x12 0x13	PS_THRES_H, PS high interrupt threshold (Default = 0xFFFF)							
BIT	7	6	5	4	3	2	1	0
R/W	PS_THRE_HL							
R/W	PS_THRE_HH							

This register sets the high threshold value of PS interrupt. The interrupt algorithm compares the selected PS data and PS threshold value.

PS_THRE_HL：PS high interrupt threshold value, LSB. (Reg. 0x12)
PS_THRE_HH：PS high interrupt threshold value, MSB. (Reg. 0x13)

PS_OFFSET

0x14 0x15	PS_OFFSET, PS offset level (Default = 0x0000)							
BIT	7	6	5	4	3	2	1	0
R/W	PS_OFFSET_L							
R/W	PS_OFFSET_H							

This register used to calibrate the device's cross talk. The **PS_DATA** should be closed to zero with no object. The PS_OFFSE is subtracted from the measured data before it output to **PS_DATA**.

PS_OFFSET_L：PS high interrupt threshold value, LSB. (Reg. 0x14)
PS_OFFSET_H：PS high interrupt threshold value, MSB. (Reg. 0x15)

INT_SOURCE

0x16	INT_SOURCE, ALS interrupt source (Default = 0x00)							
BIT	7	6	5	4	3	2	1	0
R/W	0	0	0	0	0	0	0	INT_SRC

INT_SRC： **This register sets to select the ALS data for the ALS Interrupt algorithm.**
0x0: Select CH0_DATA.
0x1: Select CH1_DATA.

ERROR_FLAG

0x17	ERROR_FLAG, Error flag status							
BIT	7	6	5	4	3	2	1	0
R/W	0	0	0	0	ERR_IR	0	ERR_CH1	ERR_CH0

This register indicates the ALS / IR data status. If the ALS / IR data is outside of measurable range, the corresponding error flag (ERR_CH0, ERR_CH1, ERR_IR) will set to one. That also means the data is invalid.

PS_DATA

0x18 0x19	PS_DATA, PS output data.							
BIT	7	6	5	4	3	2	1	0
R/W	PS_DATA _L							
R/W	PS_DATA_H							

The PS conversion result is written into PS_DATA.
For insuring the data in the register comes the same measurement, the high byte data will be latched when the low byte data has been accessed until the high byte data has be read.

IR_DATA

0x1A 0x1B	IR_DATA, IR output data.							
BIT	7	6	5	4	3	2	1	0
R/W	IR_DATA_L							
R/W	IR_DATA_H							

The IR sensor result is written into IR_DATA when PS conversion is done.
For insuring the data in the register comes the same measurement, the high byte data will be latched when the low byte data has been accessed until the high byte data has be read.

CH0_DATA

0x1C 0x1D	CH0_DATA, Channel 0 output data.							
BIT	7	6	5	4	3	2	1	0
R/W	CH0_DATA_L							
R/W	CH0_DATA_H							

The channel 0 result of ALS sensor is written into CH0_DATA when ALS conversion is done.
For insuring the data in the register comes the same measurement, the high byte data will be latched when the low byte data has been accessed until the high byte data has be read.

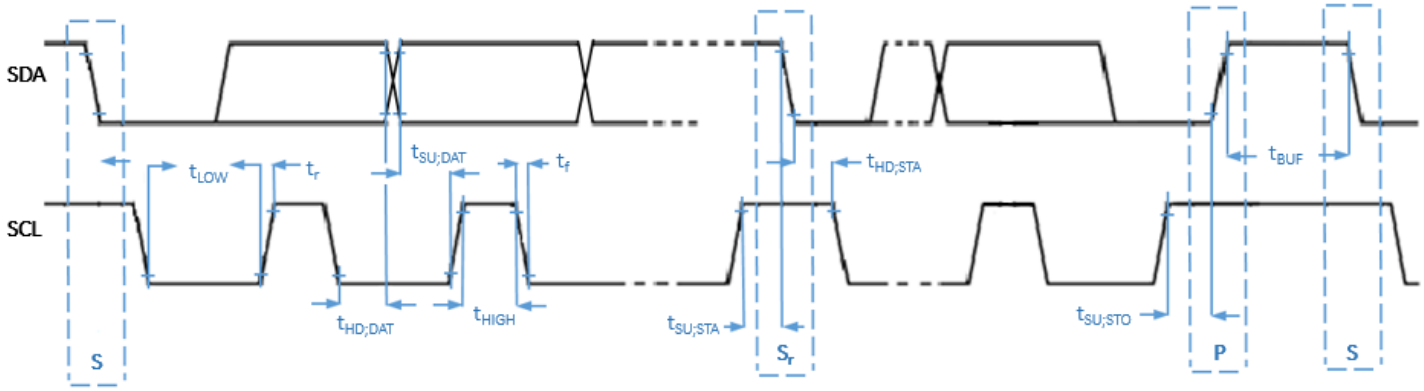
CH1_DATA

0x1E 0x1F	CH1_DATA, Channel 1 output data.							
BIT	7	6	5	4	3	2	1	0
R/W	CH1_DATA_L							
R/W	CH1_DATA_H							

The channel 1 result of ALS sensor is written into CH1_DATA when ALS conversion is done.
For insuring the data in the register comes the same measurement, the high byte data will be latched when the low byte data has been accessed until the high byte data has be read.

I²C Interface Timing Characteristics

This section will describe the protocol of the I²C bus. For more details and timing diagrams please refer to the I²C specification.



Parameter (*)	Symbol	I²C Standard Mode		I²C Fast Mode		Unit
		Min.	Max.	Min.	Max.	
SCL clock frequency	f_{SCL}	0	100	0	400	kHz
Hold time (repeated) START condition	$t_{HD;STA}$	4	--	0.6	--	μs
Set-up time (repeated) START condition	$t_{SU;STA}$	4.7	--	0.6	--	μs
LOW period of the SCL clock	t_{LOW}	4.7	--	1.3	--	μs
HIGH period of the SCL clock	t_{HIGH}	4	--	0.6	--	μs
Data hold time	$t_{HD;DAT}$	0	3.45	0	0.9	μs
Data set-up time	$t_{SU;DAT}$	250	--	100	--	ns
Rise time of both SDA and SCL signals	$t_{(r)}$	--	1000	20	300	ns
Fall time of both SDA and SCL signals	$t_{(f)}$	--	300	--	300	ns
Set-up time for STOP condition	$t_{SU;STO}$	4	--	0.6	--	μs
Bus free time between STOP condition and START condition	t_{BUF}	4.7	--	1.3	--	μs

(*) All specifications are at V_{Bus} = 3.3V, T_{ope}=25˚C, unless otherwise noted. Specified by design and characterization; not production tested.

Lux Calculating

User could calculate lux value by using the following equation (for white LED)

- **If *CH0/CH1* < 0.3, Lux= (*CH0*/ PGA_ALS)*[64/(ALSCONV +1)]*K1**
- **If 0.3 ≤ *CH0/CH1* ≤ 0.8, Lux= (*CH0*/ PGA_ALS)*[64/(ALSCONV +1)]*K2**
- **If *CH0/CH1* > 0.8, Lux= (*CH0*/ PGA_ALS)*[64/(ALSCONV +1)]*K3**

Ex:

Register setting：**ALSCONV** = 0x3F, **PGA_ALS** = 0x03, ***CH0/CH1*** > 0.8

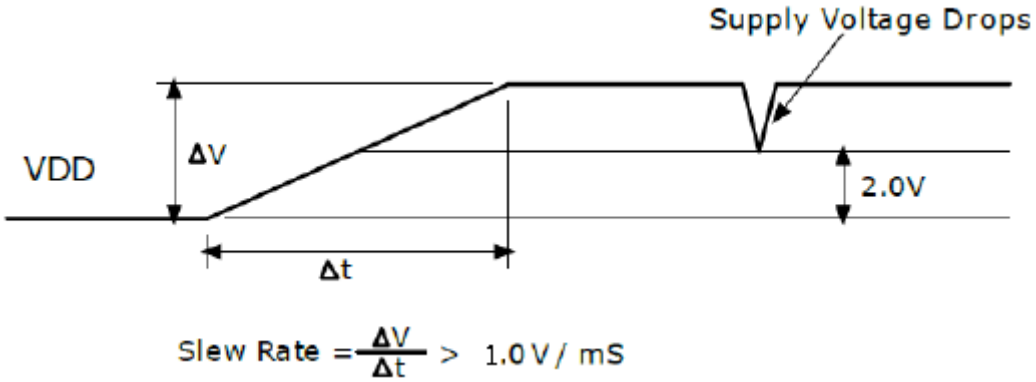
Lux=(*CH0* / 32)*[64 / (63+1)]*K3

Note:

1. Recommend calibrate value：**K1 = 0.193, K2=0.633, K3=0.309**
2. The values for **K1**、**K2** and **K3** shown above are only valid for the sensor component. If the sensor is placed behind an optical system (e.g. lens, cover panel etc.) the values above might not be suitable for a lux calculation. In such case the values for **K1**、**K2** and **K3** must be determined in the application by using a luxmeter and the sensor readings.

Supply Voltage Drops

Upon power-up, please ensure the slew rate of VDD greater than 1.0 V/mS. After power-up , the supply voltage shall NOT drop below 2.0V. Once it happens, please switch off the power, wait more than 1 second, and then power on the device again.



Note:

I²CBus Clear

In the unlikely event where the clock (SCL) is stuck LOW, the preferential procedure is to reset the bus using the HW reset signal if your I²C devices have HW reset inputs. If the I²C devices do not have HW reset inputs, cycle power to the devices to activate the mandatory Internal Power-On Reset (POR) circuit.

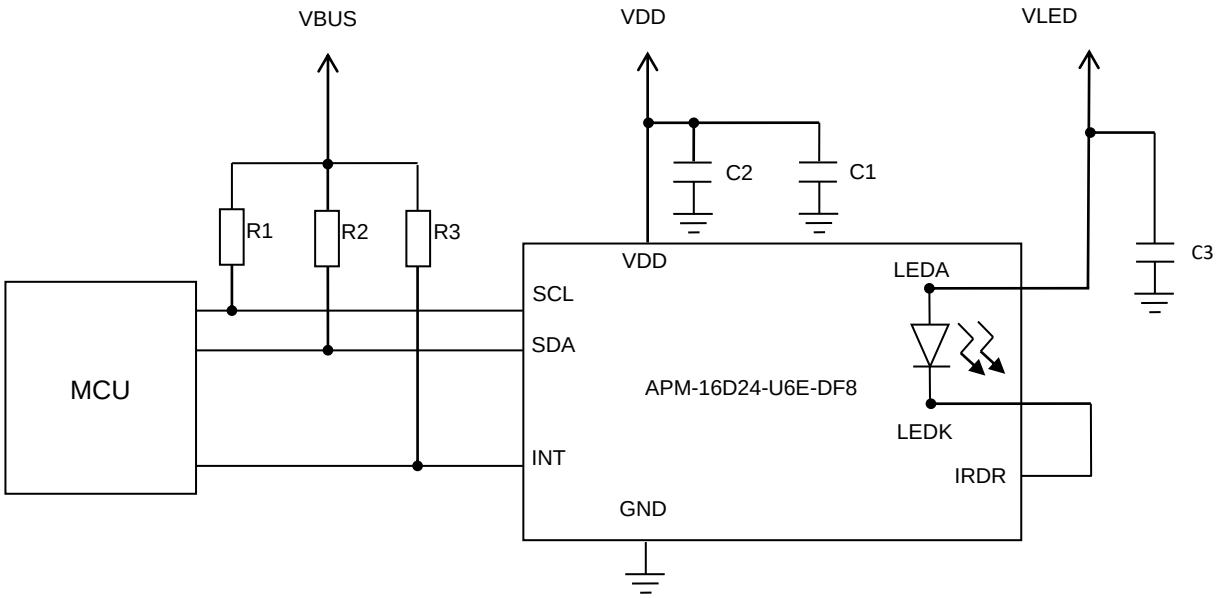
If the data line (SDA) is stuck LOW, the master should send nine clock pulses. The device that held the bus LOW should release it sometime within those nine clocks.

I²C General Call Software Reset

Following a General Call, (0000 0000), sending 0000 0110 (06h) as the second byte causes software reset. This feature is optional and not all devices will respond to this command. On receiving this 2-byte sequence, all devices designed to respond to the general call address will reset and take in the programmable part of their address.

Precautions have to be taken to ensure that a device is not pulling down the SDA or SCL line after applying the supply voltage, since these low levels would block the bus.

Typical Application Circuit

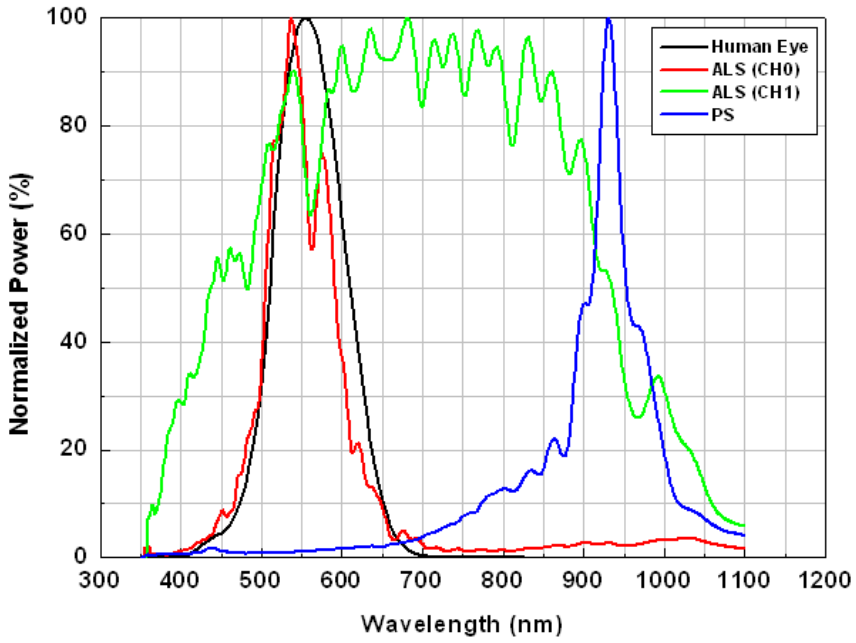


The capacitors (C1, C2) are required for sensor power supply. The capacitors should be placed as close as possible to the device. The high frequency AC noises can be shunted to the ground by the capacitors. The transient current caused by digital circuit switching also can be handled by the capacitors. A typical value 0.1 / 1 μF can be used.

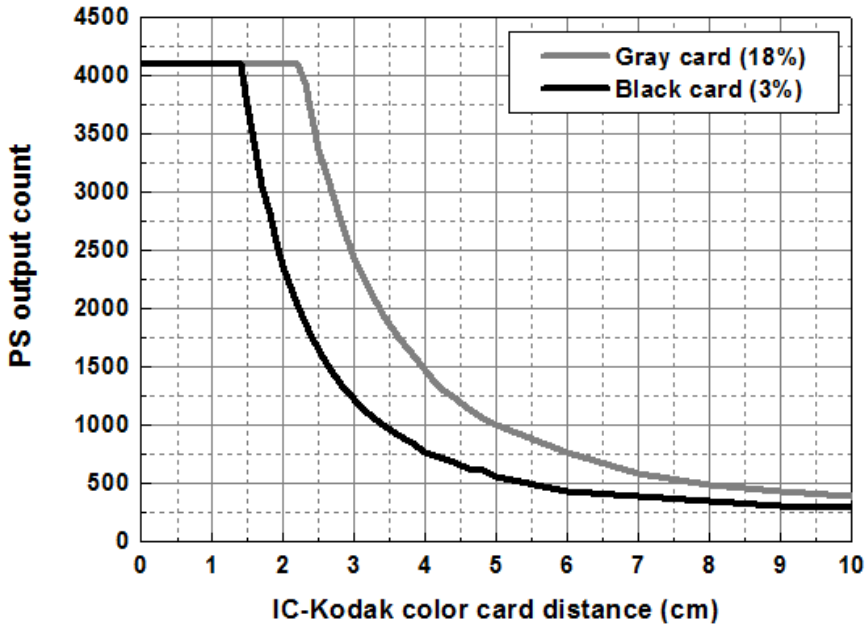
The capacitors (C3) is required for LED power supply. A typical value 2.2μF is used.

The pull-up resistors (R1, R2) are required for I^2C communication. At fast speed mode (400kHz/s) and VBUS = 1.8V, 1.5kΩ resistors can be used. The pull-up resistor (R3) is also required for the interrupt, a typical value between 10 kΩ and 100 kΩ can be used.

Spectral Response



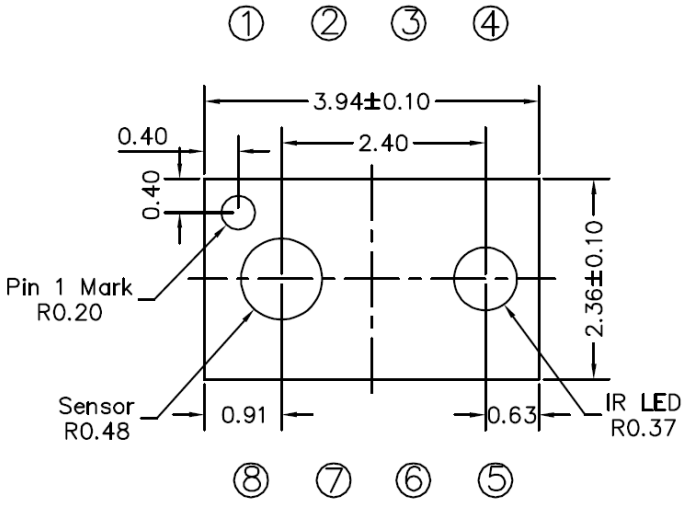
Proximity Distance Profile



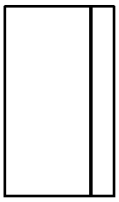
V_{DD}=3V, PS integrated time =12 bit, LED drive current= 100mA, PS Gain= x4, LED pulse width=4, LED pulse count=5

Package Dimensions and recommended soldering pad layout

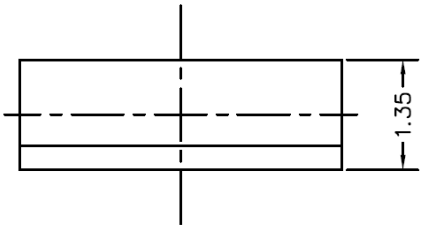
Top View



Right Side View

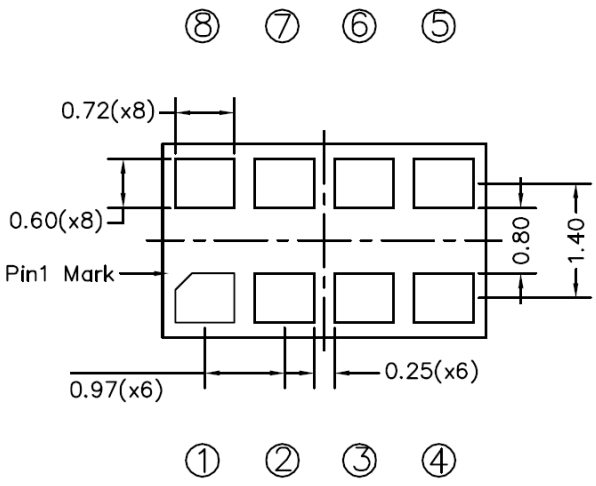


Front View

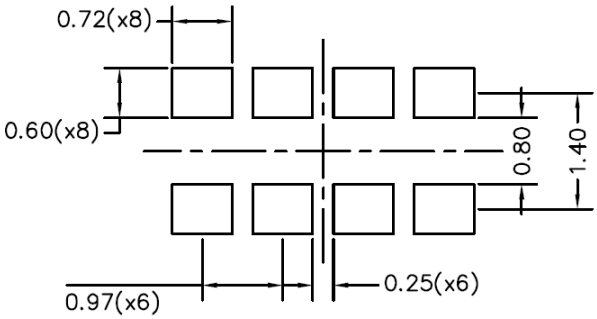


Pad	Name
(1)	SDA
(2)	INT
(3)	IRDR
(4)	LEDK
(5)	LEDA
(6)	GND
(7)	SCL
(8)	VDD

Bottom View

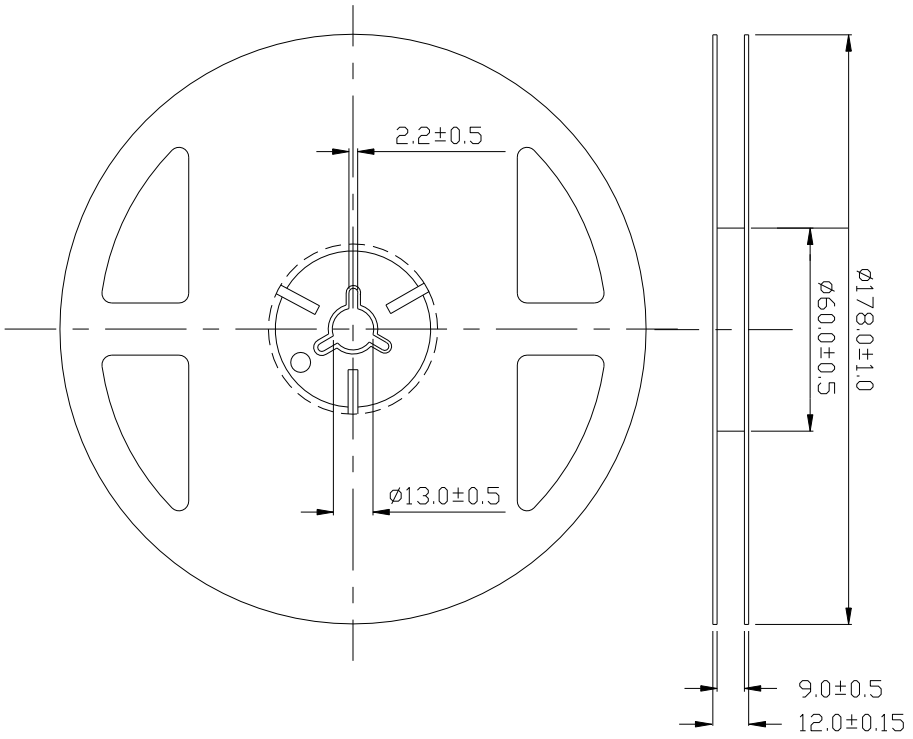


Recommended Soldering Pad



Unit: mm
Tolerances: ± 0.1mm

Reel Dimensions

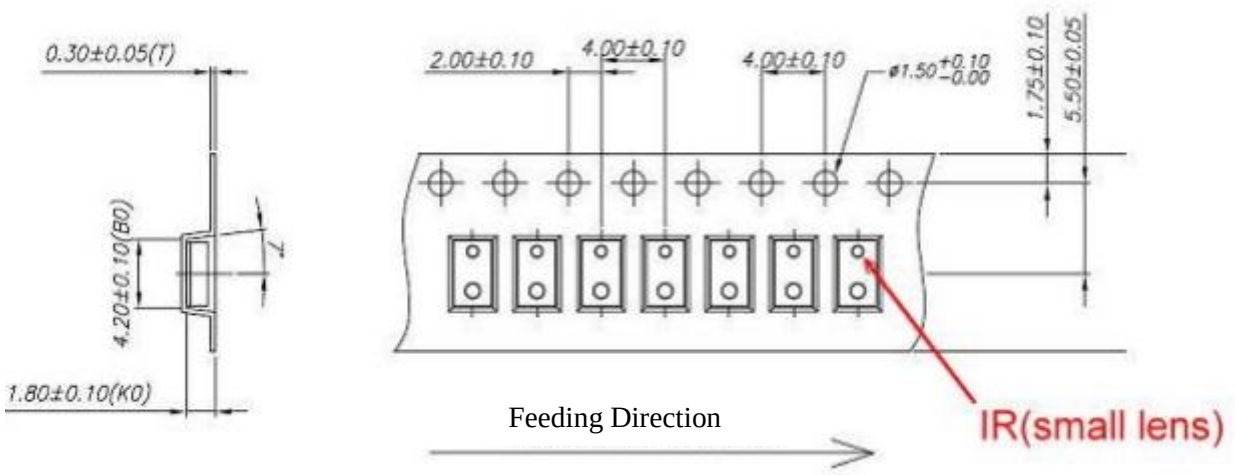


Unit: mm
Tolerances: ± 0.1mm

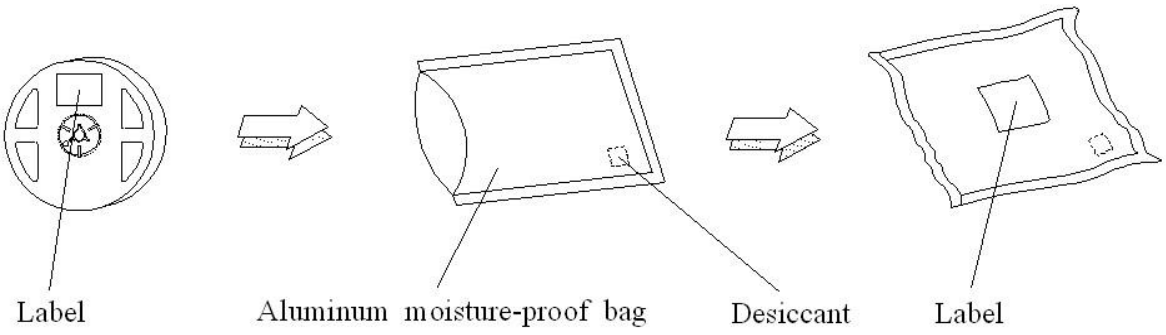
Packing Quantity Specification

2000 PCS/ 1 Reel

Tape Dimensions



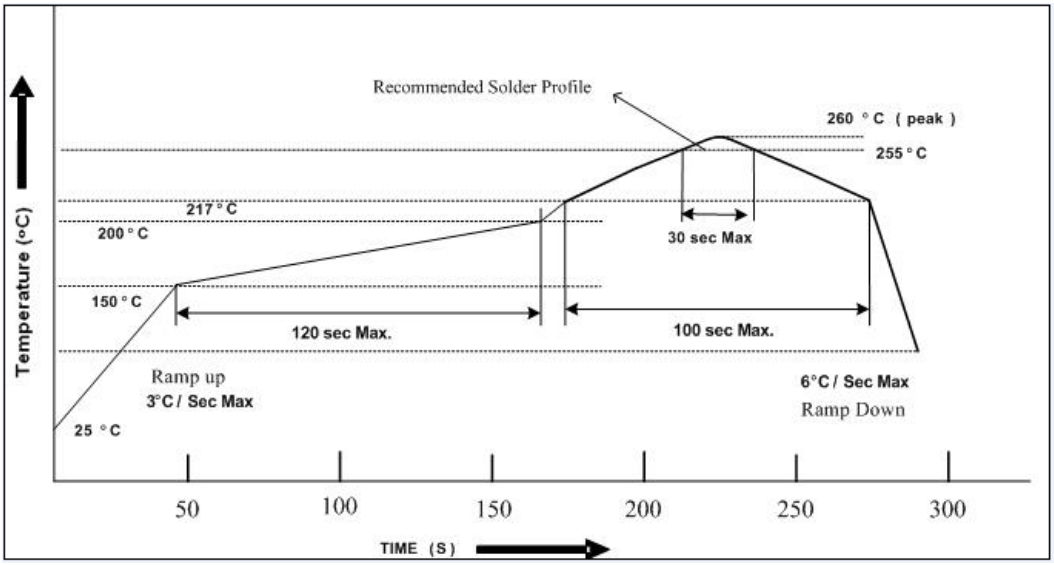
Moisture Resistant Packing Process



Recommended method of storage

1. Do not open moisture proof bag before devices are ready to use.
2. Shelf life in sealed bag from the bag seal date: 18 months at 10°C~30°C and < 90% RH.
3. After opening the package, the devices must be stored at 10°C~30°C and ≤ 60%RH, and used within 168 hours (floor life).
4. If the moisture absorbent material (desiccant material) has faded or unopened bag has exceeded the shelf life or devices (out of bag) have exceeded the floor life, baking treatment is required.
5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure or recommend the following conditions:
   192 hours at 40°C +5/–0°C and < 5 % RH (reeled/tubed/loose units) or
   96 hours at 60°C ± 5°C and < 5 % RH (reeled/tubed/loose units) or
   24 hours at 125°C ± 5°C, not suitable for reel or tubes.

Recommended Solder Profile



Notice:

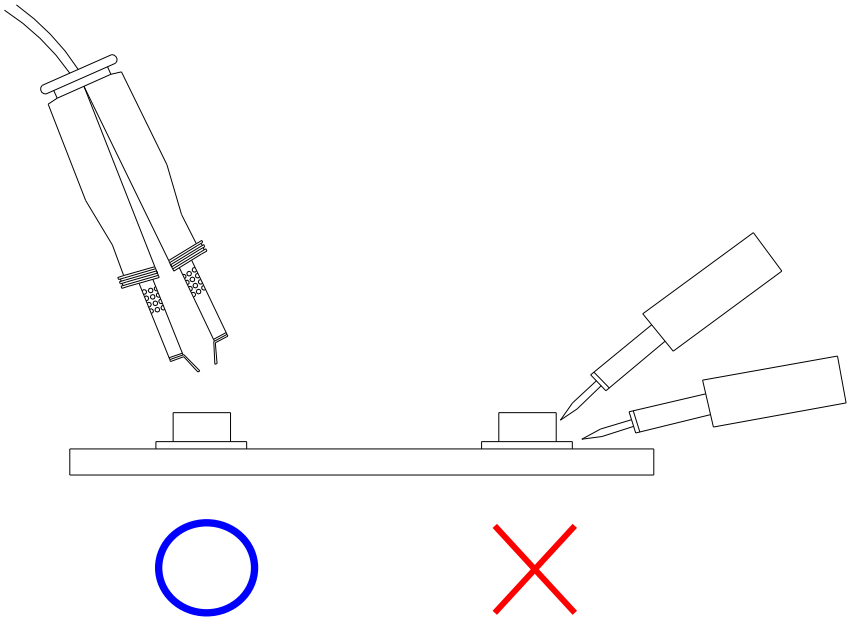
1. Reflow soldering should not be done more than two times.
2. When soldering, do not put stress on the devices during heating.
3. After soldering, do not warp the circuit board.
4. Reference: IPC/JEDEC J-STD-020D

Soldering Iron

Each terminal is to go to the tip of soldering iron temperature less than 350°C for 3 seconds within once in less than the soldering iron capacity 25W. Leave two seconds and more intervals, and do soldering of each terminal. Be careful because the damage of the product is often started at the time of the hand solder.

Repairing

Repair should not be done after the device have been soldered. When repairing is unavoidable, a double-head soldering iron should be used (as below figure). It should be confirmed beforehand whether the characteristics of the device will or will not be damaged by repairing.



DISCLAIMER

1. TONYU reserves the right(s) on the adjustment of product material mix for the specification.
2. The product meets TONYU published specification for a period of twelve (12) months from date of shipment.
3. The graphs shown in this datasheet are representing typical data only and do not show guaranteed values.
4. When using this product, please observe the absolute maximum ratings and the instructions for using outlined in these specification sheets. TONYU assumes no responsibility for any damage resulting from the use of the product which does not comply with the absolute maximum ratings and the instructions included in these specification sheets.
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