

Overview

Feature

- Integrated Photopic ALS, ALS_IR Photodiodes
- Ambient light sensing
 - Ambient light cancellation scheme with offset design
 - Automatic rejection for 50Hz/60Hz lighting flicker
 - Light sensor close to human eye response
 - With Low power design scheme
 - Build in Temperature compensation
 - Support 16bits effective resolution
 - Programmable gain setting
 - ◆ 1/2/4/8/16/32/64/128/256/512/1024 gain
- I²C Interface application
 - Up to 400kHz speed
- Operation Conditions:
 - 1.8~3.6V for sensor and Bus voltage; typical: 3.3 V
 - Temperature Range: -30C ~ 85C
- Lead Free Package (RoHS compliant)

Application

- Environment light Sensing

- Control brightness in panel display management
- Wearable ambient light measurement

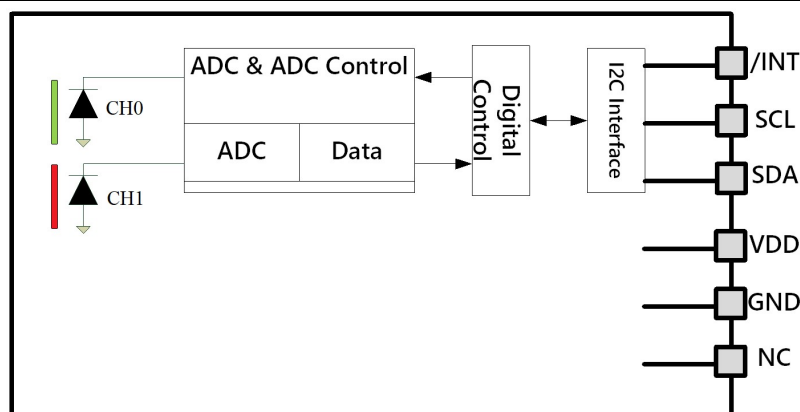
Description

The ELA2502 features ambient light measurement (ALS) with the extremely tiny 2.0mm x 2.0mm x 0.6mm module. This Device provides ambient light sensing for display management and backlight control.

The ELA2502 incorporates Photodiode, timing control and ADC into one chip and digital convert with I²C interface. The ELA2502 provide the excellent spectral response that is close to human eye.

The ELA2502 has provided temperature calibration features and also has lower power design, including standby mode and wait mode support. The ALS and IR photodiodes have dedicated data converters producing 16-bit data. This architecture allows applications to accurately measure ambient light which enables devices to calculate luminance to control display backlight.

Block Diagram



Pin Description

Description

Name	Pin No.	IO	Description
VDD	1	P	Power Supply for sensor module
NC	2	--	Not Connection
GND	3	G	Ground
SCL	4	I	IIC clock (open drain)
INT	5	O	Interrupt(open drain)
SDA	6	IO	IIC data (open drain)

Electrical Specification

■ Absolute Maximum Ratings

Symbol	Parameter	Min	Max	Units	Comments
Electrical Parameters					
VDD	Supply Voltage to GND	-0.3	3.6	V	
V _{IO}	Digital I/O Terminal Voltage	-0.3	3.6	V	
I _{IO}	Digital Output TerminalCurrent	-1	20	mA	
Electrostatic Discharge					
I _{SCR}	Input Current (latch-up immunity)	± 100		mA	Class II JEDEC JESD78E
ESD _{HBM}	HBM ElectrostaticDischarge	± 2000		V	JEDEC/ESDA JS-001-2017
ESD _{CDM}	CDM ElectrostaticDischarge	± 500		V	JEDEC JS-002-2014
Temperature Ranges and Storage Conditions					
T _{STRG}	Storage TemperatureRange	-40	85	°C	
T _{BODY}	Package Body Temperature		260	°C	IPC/JEDEC J-STD-020 The reflow peak soldering temperature (body temperature) isspecified according to IPC/JEDEC J-STD-020 “Moisture/Reflow Sensitivity Classification for Non-hermetic Solid State SurfaceMount Devices.”
RH _{NC}	Relative Humidity(non-condensing)		85	%	
P _{DISS}	Power Dissipation		50	mW	Average power dissipation over a 1 second period

Recommended Operation condition

Symbol	Parameter	Min	Typ	Max	Unit
VDD	Supply Voltage to Sensor	1.7	3.0	3.6	V
f _{12C}	Clock frequency of I ² C	-	-	400	KHz
T _A	Operating Ambient Temperature	-30		85	°C

Electrical characteristics

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
I _{DD}	Supply current	Active ALS State (ALS_MODE = 1) ⁽¹⁾		128		μA
		Active ALS State (ALS_MODE = 1) ⁽²⁾		87		
		Sleep State (ALS_MODE = 0) ⁽³⁾		0.5		
V _{OL}	INT, SDA output low voltage	6mA sink current			0.6	V
I _{LEAK}	Leakage current, SDA, SCL, INT		-5		5	μA
V _{IH}	SCL, SDA input high voltage ⁽⁴⁾		0.7 VDD			V
V _{IL}	SCL, SDA input low voltage				0.3VDD	V
T _{Active}	Time from power-on to ready to receive I ² C commands			1.5		ms

Note(s):

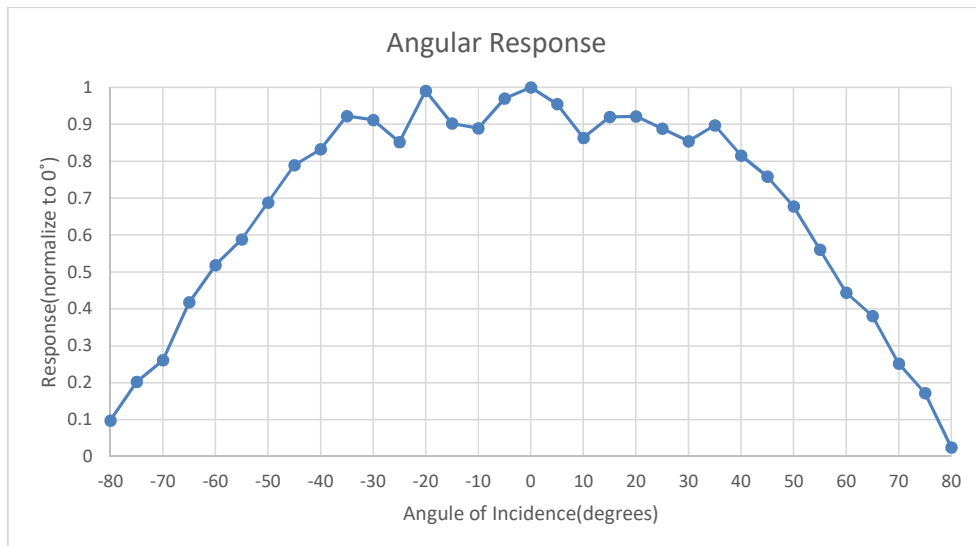
1. Active state occurs when ALS_MODE = 1 and the device is actively integrating ALS. For ALS active, this time is determined by the ALS integration time (ATIME). The conditions is 50ms INT and 50ms measurement rate(MRR) @ VDD=3.3v
2. Active state occurs when ALS_MODE = 1 and the device is actively integrating ALS. For ALS active, this time is determined by the ALS integration time (ATIME). The conditions is 50ms INT and 100ms measurement rate(MRR) @ VDD=3.3v
3. Sleep state occurs when ALS_MODE = 0 and I²C bus is idle. If sleep state has been entered as the result of operational flow, SAI = 1, ALS_MODE will remain high.
4. Digital pins: SDA, SCL, INT are tolerant to a communication voltage up to 3.6V

■ ALS optical characteristics

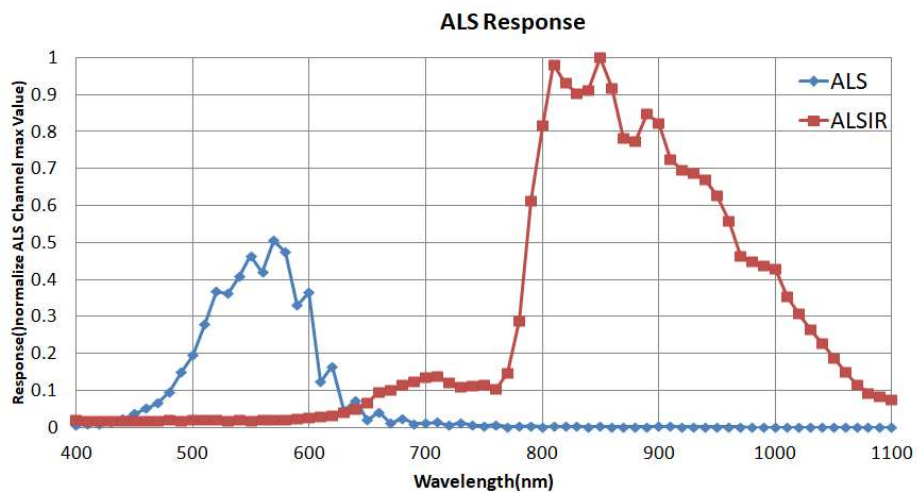
Parameter	Conditions	Min	Typ	Max	Unit
ALS sensitivity 1	5000K LED @ 500Lux AGAIN = 64x ATIME = 50ms	-10%	40284	+10%	Counts
ALS sensitivity 1	5000K LED @ 50Lux AGAIN = 512x ATIME = 50ms	-5%	32506	+5%	Counts
ALS integration step size	ALS_STEP = 1.78ms	1.73	1.78	1.83	ms
ALS dark count	0μW/cm ² AGAIN = 1024x ATIME = 50ms		0	2	Counts
ALS noise	AGAIN = 64x ATIME = 100ms		0.03		%(σ)

Typical Operating Characteristics

FOV



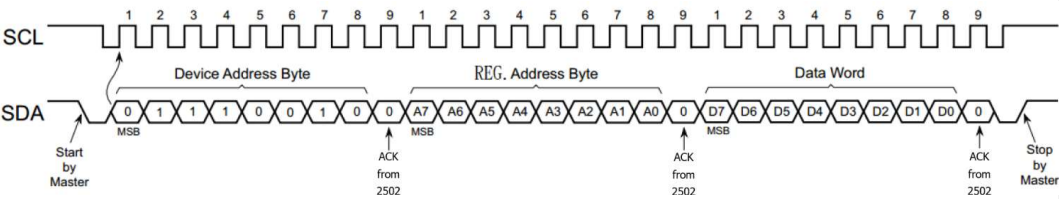
Spectrum



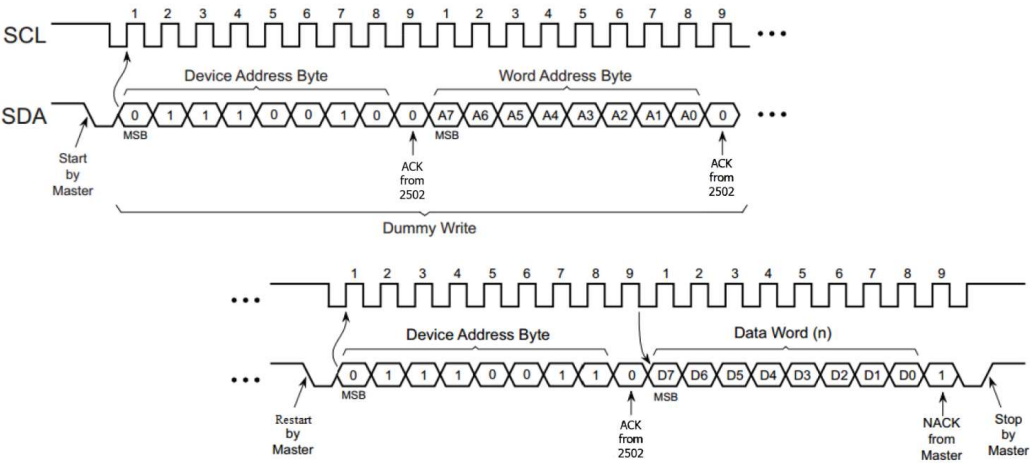
I²C Timing Diagram

IIC Communication

Write:



Read:



■ I2C device address

Master I ² C Bus Signal		7-Bit I ² C Address
Clock	Data	
SCL	SDA	0x39

Register Description

■ Register table

Address	Register Name	R/W	Register Function	Reset Value
0x80	ENABLE	R/W	Enables states and AGAIN setting	0x00
0x81	RESET	R/W	IC Reset control	0x00
0x85	ATIME_STEP	R/W	ALS integrate time scale	0x0A
0x86	ATIME	R/W	ALS integrate time steps	0x3F
0x87	AWAIT	R/W	ALS measurement rate time steps	0xFF
0x88	STATUS0	R	ALS mode status 0	0x00
0x89	STATUS1	R	ALS mode status 1	0x00
0x8B	ALSDTAT0	R	ALS measurement data 0	0x00
0x8C	ALSDATA1	R	ALS measurement data 1	0x00
0x8D	ALSDATA2	R	ALS measurement data 2	0x00
0x8E	ALSDATA3	R	ALS measurement data 3	0x00
0x8F	IRDTAT0	R	ALS IR measurement data 0	0x00
0x90	IRDATA1	R	ALS IR measurement data 1	0x00
0x91	IRDATA2	R	ALS IR measurement data 2	0x00
0x92	IRDATA3	R	ALS IR measurement data 3	0x00
0x95	IREN	R/W	Enable IR channel	0x08
0x98	PDEN	R/W	Enable PD channel	0x40
0xA0	INTEN	R/W	Interrupt setting	0x00
0xA1	PERS	R/W	Interrupt persist setting	0x00
0xAA	AIHTL	R/W	ALS interrupt upper threshold LSB	0xFF
0xAB	AIHTH	R/W	ALS interrupt upper threshold MSB	0xFF
0xAC	AILTL	R/W	ALS interrupt lower threshold LSB	0x00
0xAD	AILTH	R/W	ALS interrupt lower threshold MSB	0x00
0xAE	PARTID	R	Part ID	0xB1
0xAF	MANCID	R	Manufacture ID	0x05
0xB0	AGC_GAIN_HYST	R/W	Auto Gain control hysteresis setting	0x0C

Detail of Register Description

■ Enable register (Address 0x80)

Addr: 0x80		Enable			
Bit	Bit Name	Default	Access	Bit Description	
7:6	Reserved	00	--	Reserved.	
5:2	AGAIN	00	RW	ALS Gain Value This field sets the gain of the ALS sensor.	
				AGAIN	Gain
				0	1x
				1	2x
				2	4x
				...	...
				10	1024x
				otherwise	Reserved.
1	Reserved	0	--	Reserved.	
0	ALS_MODE	0	RW	ALS Enable Flag ALS_MODE = 0, Standby Mode ALS_MODE = 1, Continuous Mode	

■ RESET register (Address 0x81)

Addr: 0x81		RESET		
Bit	Bit Name	Default	Access	Bit Description
7:1	Reserved	0000000	--	Reserved.
0	SOFT_RST	0	RW	Software Reset Enable Flag Writing a 1 to this bit will cause all registers to be reset to their default state. This will immediately terminate all device operation and put the device into the sleep state.

■ ATIME_STEP register (Address 0x85)

Addr: 0x85		ATIME_STEP		
Bit	Bit Name	Default	Access	Bit Description

7:4	Reserved	0000	--	Reserved.
3:2	ALS_STEP	10	RW	ALS Integration Time in one step
				ALS_STEP Integration Time for each step
				0 3.57 ms
				1 1.78 ms
				2 0.89 ms
				3 Reserved
1:0	ALS_WSTEP	10	RW	The ALS_WSTEP value specifies the ALS wait time.
				ALS_WSTEP Wait Time for each step
				0 0.2 ms
				1 0.39 ms
				2 0.78 ms
				3 1.56 ms

■ *ATIME register (Address 0x86)*

Addr: 0x86		ATIME		
Bit	Bit Name	Default	Access	Bit Description
7:0	ATIME	0x3F	RW	ALS Integration Time Step The ATIME value specifies the ALS integration time step. The ALS integration time depends on the ALS_STEP and ATIME.

■ *AWTIME register (Address 0x87)*

Addr: 0x87		AWTIME		
Bit	Bit Name	Default	Access	Bit Description
7:0	AWTIME	0xFF	RW	ALS Wait Time Step The AWTIME value specifies the ALS wait time step. THE ALS wait time depends on the ALS_WSTEP and AWTIME.

Note(s):

1. Measurement Rate(MRR) is depends on ALS integration time and ALS wait time. $MRR = \max(\text{ALS Integration time, ALS Wait time})$.

■ *STATUS0 register (Address 0x88)*

Addr: 0x88		STATUS0		
Bit	Bit Name	Default	Access	Bit Description
7	IRDATA_SAT	0	R	ALS IR Saturation Flag The ALS IR results may be unreliable due to saturation of AFE.
6	ALSDATA_SAT	0	R	ALS Saturation flag The ALS results may be unreliable due to saturation of the AFE.
5:2	ALS_AGC_GAIN	0000	R	ALS Data Gain Range
				ALS_AGC_GAIN Gain
				0000 1x Gain
				0001 2x Gain
				0010 4x Gain
				
				1001 512x Gain
				1010 1024x Gain
				Otherwise Reserved.
1	INTF	0	R	Interrupt Flag
0	ADATA_VALID	0	R	ALS Data validate ADATA_VALID = 0 ADATA_VALID = 1

■ *STATUS1 register (Address 0x89)*

Addr: 0x89		STATUS1		
Bit	Bit Name	Default	Access	Bit Description
7:2	Reserved	000000	--	Reserved.
1	TEMP_CHG_INTF	0	R	Temperature Change Interrupt Flag
0	AGAIN_CHG_INTF	0	R	AGAIN Change Interrupt Flag

■ *ALSDATA0 register (Address 0x8B)*

Addr: 0x8B		ALSDATA0		
Bit	Bit Name	Default	Access	Bit Description
7:0	ALSDATA0	0x00	RW	ALS Channel 0 Data0 This register contains the least significant byte(LSB) of the 28-bit ALSchannel (CH0) data.

■ **ALSDATA1 register (Address 0x8C)**

Addr: 0x8C		ALSDATA1		
Bit	Bit Name	Default	Access	Bit Description
7:0	ALSDATA1	0x00	RW	ALS Channel 0 Data1 This register contains the second byte of the 28-bit ALSchannel (CH0) data.

■ **ALSDATA2 register (Address 0x8D)**

Addr: 0x8D		ALSDATA2		
Bit	Bit Name	Default	Access	Bit Description
7:0	ALSDATA2	0x00	RW	ALS Channel 0 Data2 This register contains the third byte of the 28-bit ALS channel (CH0) data.

■ **ALSDATA3 register (Address 0x8E)**

Addr: 0x8E		ALSDATA3		
Bit	Bit Name	Default	Access	Bit Description
7:4	Reserved	0000	--	Reserved.
3:0	ALSDATA3	0000	RW	ALS Channel 0 Data3 This register contains the most significant 4 bit of the 28-bit ALS channel (CH0) data.

■ **IRDATA0 register (Address 0x8F)**

Addr: 0x8F		IRDATA0		
Bit	Bit Name	Default	Access	Bit Description
7:0	IRDATA0	0x00	RW	ALS Channel 1 Data0

				This register contains the least significant byte(LSB) of the 28-bit IR channel (CH1) data.
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■ **IRDATA1 register (Address 0x90)**

Addr: 0x90		IRDATA1		
Bit	Bit Name	Default	Access	Bit Description
7:0	IRDATA1	0x00	RW	ALS Channel 1 Data1 This register contains the second byte of the 28-bit IR channel (CH1) data.

■ **IRDATA2 register (Address 0x91)**

Addr: 0x91		IRDATA2		
Bit	Bit Name	Default	Access	Bit Description
7:0	IRDATA2	0x00	RW	ALS Channel 1 Data1 This register contains the third byte of the 28-bit IR channel (CH1) data.

■ **IRDATA3 register (Address 0x92)**

Addr: 0x92		IRDATA3		
Bit	Bit Name	Default	Access	Bit Description
7:4	Reserved	0000	--	Reserved.
3:0	IRDATA3	0000	RW	ALS Channel 1 Data1 This register contains the most significant 4 bit of the 28-bit IR channel (CH1) data.

■ **IREN register (Address 0x95)**

Addr: 0x95		IREN		
Bit	Bit Name	Default	Access	Bit Description
7	Reserved	0	--	Reserved.
6	IREN	0	RW	IR Enable Flag
5:0	Reserved	001000	--	Reserved.

■ **PDEN register (Address 0x98)**

Addr: 0x98		PDEN		
Bit	Bit Name	Default	Access	Bit Description
7	Reserved	0	--	Reserved.
6	PDEN	1	RW	PD Enable Flag
5:0	Reserved	000000	--	Reserved.

■ *INTEN register (Address 0xA0)*

Addr: 0xA0		INTEN		
Bit	Bit Name	Default	Access	Bit Description
7:4	Reserved	0000	--	Reserved.
3	POL	0	RW	INT rising or falling active flag
2	INTEN	0	RW	Interrupt Enable Flag
1:0	Reserved	00	--	Reserved.

■ *PERS register (Address 0xA1)*

Addr: 0xA1		PERS		
Bit	Bit Name	Default	Access	Bit Description
7:4	Reserved	0000	--	Reserved.
3:0	APERS	0000	RW	This register sets the ALS persistence filter.
				0 (0000) Every ALS cycle
				1 (0001) Any value outside ALS thresholds
				2 (0010) 2 consecutive ALS values out of range
				3 (0011) 3 consecutive ALS values out of range
				
				15 (1111) 15 consecutive ALS values out of range

■ *AIHTL register (Address 0xAA)*

Addr: 0xAA		AIHTL		
Bit	Bit Name	Default	Access	Bit Description
7:0	AIHTL	0xFF	RW	ALS High Threshold Low Byte This register sets the low byte of the high ALS threshold.

■ AIHTH register (Address 0xAB)

Addr: 0xAB		AIHTH		
Bit	Bit Name	Default	Access	Bit Description
7:0	AIHTH	0xFF	RW	ALS High Threshold High Byte This register sets the high byte of the high ALS threshold.

Note(s):

- The ALS High Threshold (AIH) is obtained by combining the AIHTH and AIHTL registers and left-shifting them by 12 bits to form a 28-bit threshold value.

■ AILTL register (Address 0xAC)

Addr: 0xAC		AILTL		
Bit	Bit Name	Default	Access	Bit Description
7:0	AILTH	0x00	RW	ALS Low Threshold Low Byte This register sets the low byte of the low ALS threshold.

■ AILTH register (Address 0xAD)

Addr: 0xAD		AILTH		
Bit	Bit Name	Default	Access	Bit Description
7:0	AILTH	0x00	RW	ALS Low Threshold High Byte This register sets the high byte of the high ALS threshold.

Note(s):

- The ALS Low Threshold (AIL) is obtained by combining the AILTH and AILTL registers and left-shifting them by 12 bits to form a 28-bit threshold value.

■ PARTID register (Address 0xAE)

Addr: 0xAE		PARTID		
Bit	Bit Name	Default	Access	Bit Description
7:0	PARTID	0xB1	R	Device Part ID.

■ MANCID register (Address 0xAF)

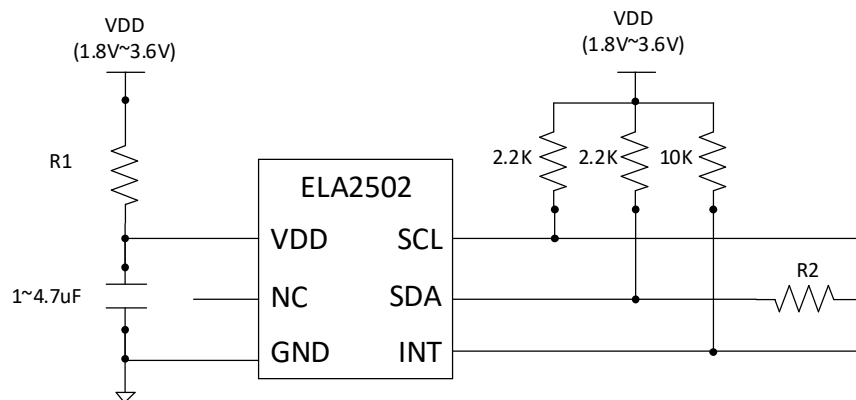
Addr: 0xAF		PARTID		
Bit	Bit Name	Default	Access	Bit Description

7:0	MANCID	0x05	R	Manufacture ID
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■ AGC_GAIN_HYST register (Address 0xB0)

Addr: 0xB0		PARTID		
Bit	Bit Name	Default	Access	Bit Description
7:5	Reserved	000	--	Reserved.
4	AGCEN	0	RW	Auto Gain Control Enable AGCEN = 0, Disable Auto Gain Control. AGCEN = 1, Enable Auto Gain Control.
3:2	AGCHTHR	11	RW	Auto Gain Control High Threshold
				AGCHTHR High Threshold Value
				0 32767
				1 40959
				2 49151
				3 57343
1:0	AGCLTHR	00	RW	Auto Gain Control Low Threshold
				AGCLTHR Low Threshold Value
				0 4095
				1 8191
				2 16383
				3 24575

Application Note

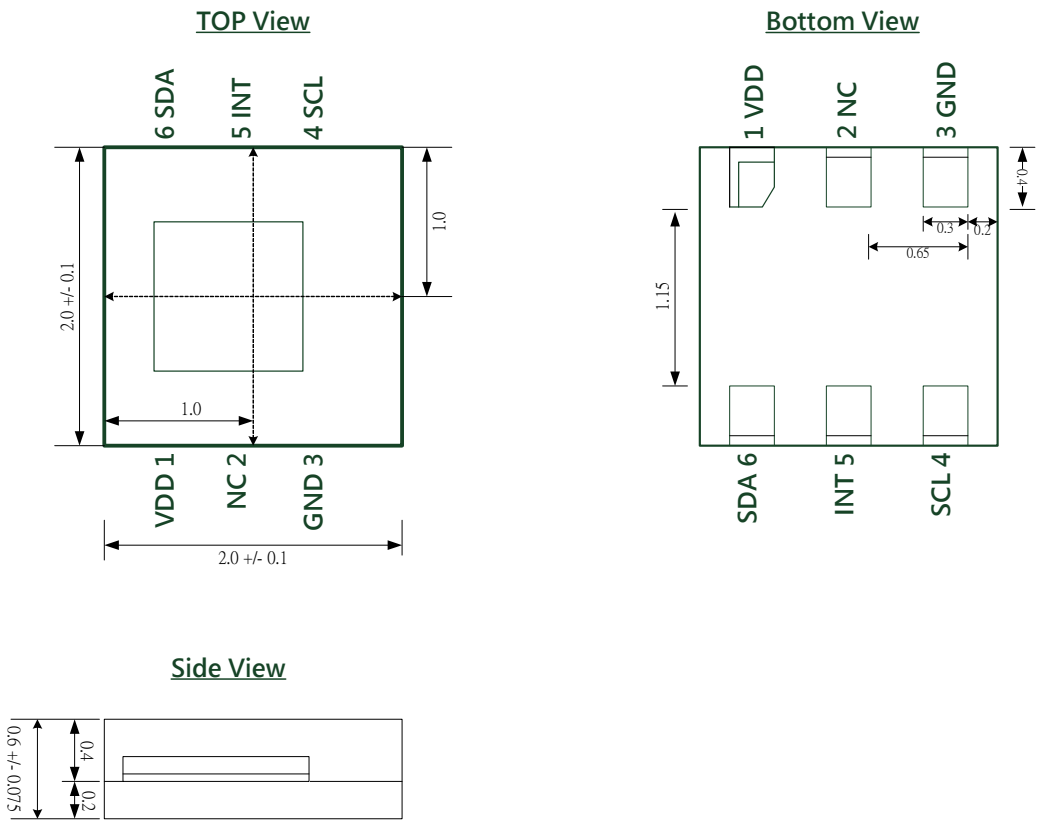


Note:

The recommended R1 value is 22 ohm.

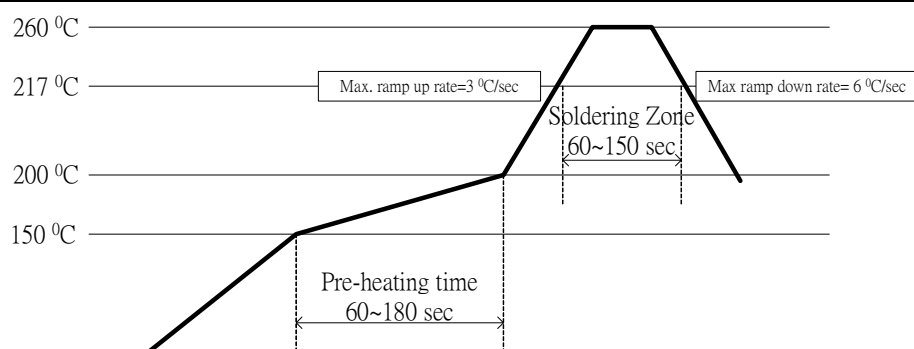
The recommended R2 value is 25 ohm.(Optional)

Package Information



** All dimensions is mm

Soldering Information



Notices:

- (1) Reflow soldering should not be done more than two times
- (2) When soldering active, please do not stress on the device when heating
- (3) After soldering, please do not warp the circuit board

Recommended of storage method and ESD precaution

Dry box storage is recommended as soon as the aluminum bag has been opened. It could prevent moisture absorption.

The following conditions should be followed if dry boxes are not available

- Storage temperature 10C to 30C
- Storage humidity <= 60% RH max

After more than 72 hours Under the conditions moisture content will be too high for reflow soldering. In case of moisture absorption, the devices will recover to former conditions by drying under the following condition

- 192 hours at 40C and 5% RH or
- 96 hours at 60C and < 5% RH for device containers, or
- 24 hours at 125C is not suitable for reel

ESD precaution

- When the Chips are removed from Anti-static bag, please follow the handing procedure to prevent ESD damage

Tape and Reel Specification

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