

## LTR-329ALS-01

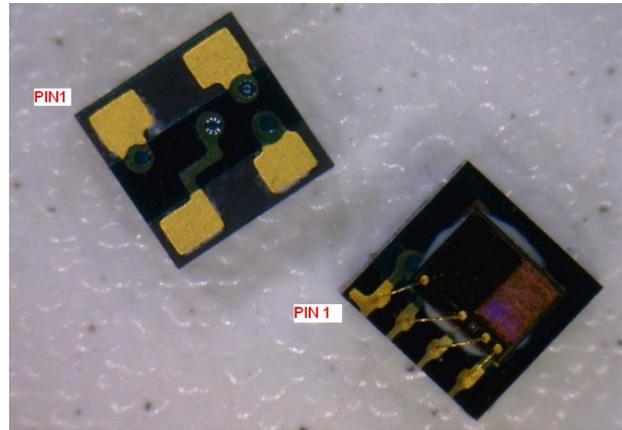
### Digital Ambient Light Sensor

#### Features

- I<sup>2</sup>C interface (Fast Mode @ 400kbit/s)
- Ultra-small 4-pin ChipLED package  
2.0mm(L), 2.0mm(B), 0.7mm(H)
- Built-in temperature compensation circuit
- Low active power consumption with standby mode
- Supply voltage range from 2.4V to 3.6V capable of 1.7V logic voltage
- Operating temperature range from -30°C to +70°C
- RoHS and Halogen free compliant
- Close to human eye spectral response
- Immunity to IR / UV Light Source
- Automatically rejects 50 / 60 Hz lightings flicker
- Full dynamic range from 0.01 lux to 64k lux
- 16-bit effective resolution

#### Applications

- Back-lighting Control in mobile/portable devices
- Touch Panel Control in mobile/portable devices



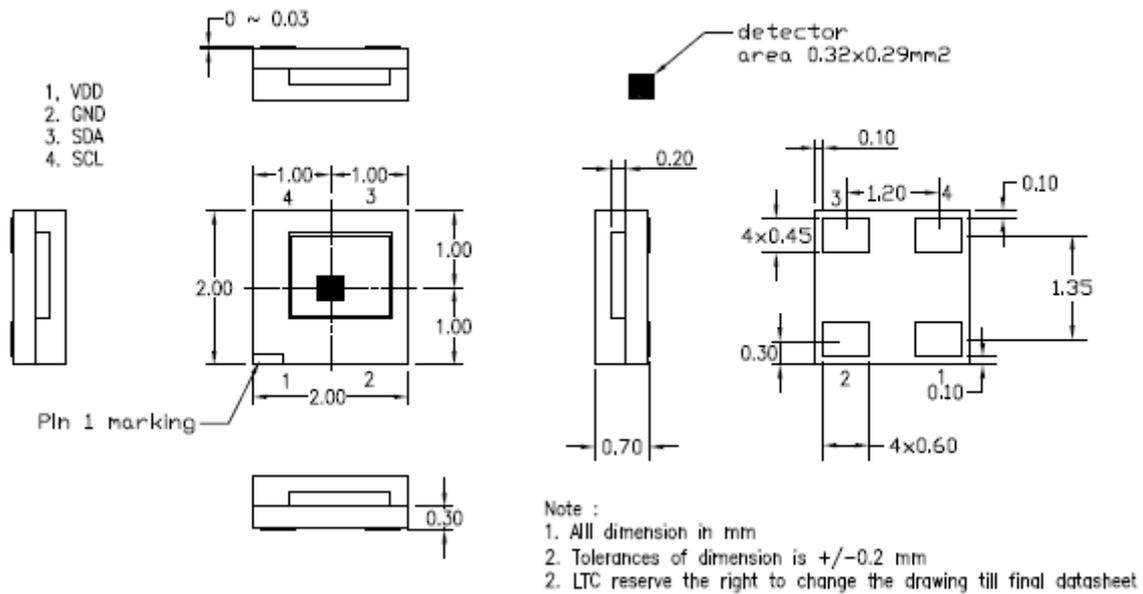
#### Description

The LTR-329ALS-01 is a low voltage I<sup>2</sup>C digital light sensor [ALS] in a low cost miniature chipled lead-free surface mount package. This sensor converts light intensity to a digital output signal capable of direct I<sup>2</sup>C interface. It provides a linear response over a wide dynamic range from 0.01 lux to 64k lux and is well suited to applications under high ambient brightness. There are altogether six gain settings (1X, 2X, 4X, 8X, 48X and 96X) available for user to configure.

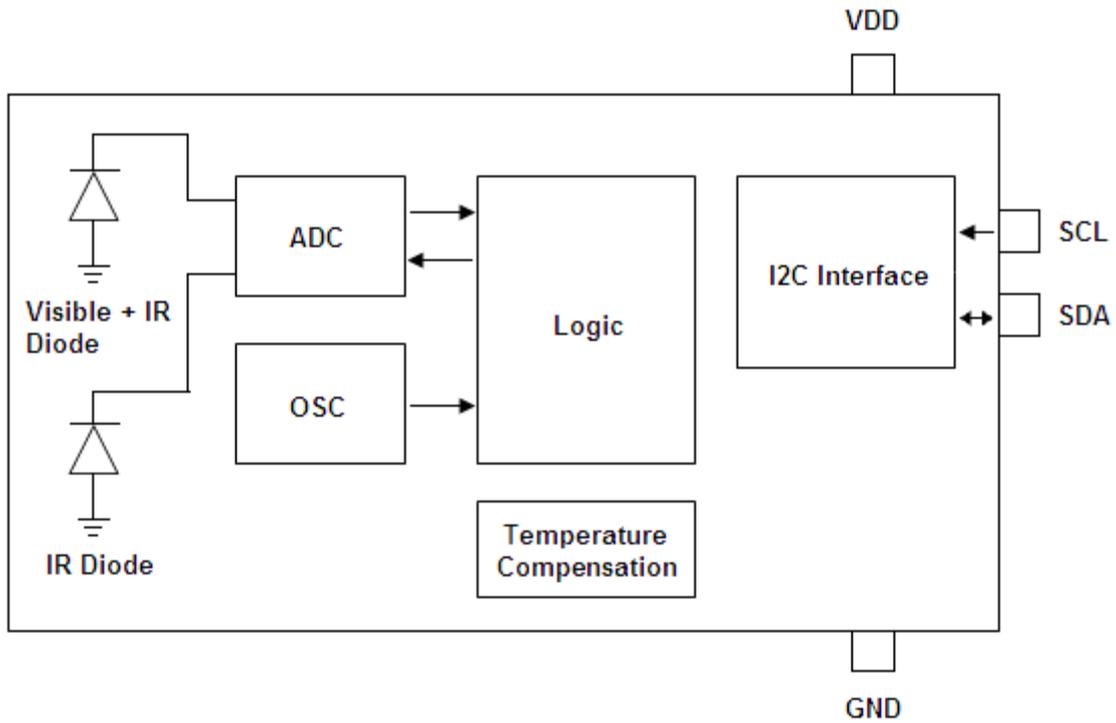
This CMOS design and factory-set one time trimming capability ensure minimal sensor-to-sensor variations for ease of manufacturability to the end customers.

Part Number	Packaging Type	Package	Quantity
LTR-329ALS-01	Tape and Reel	4-pin chipled package	2500

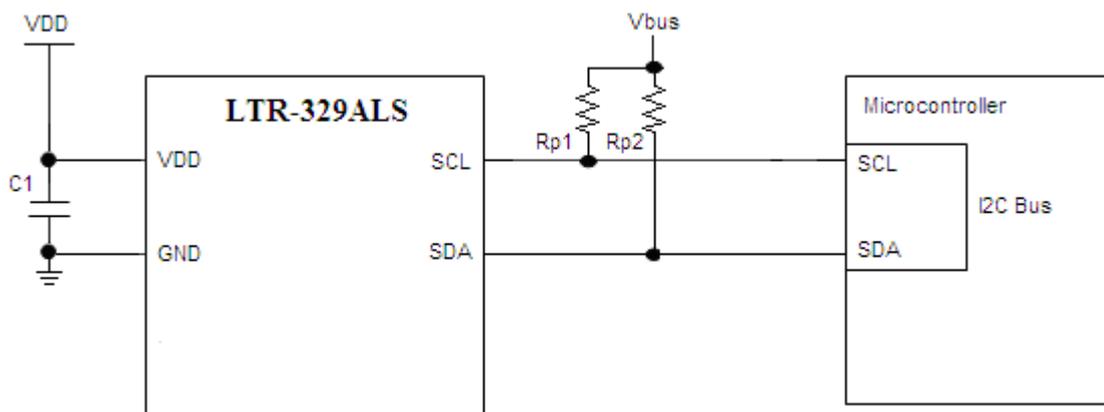
## 1. Outline Dimensions



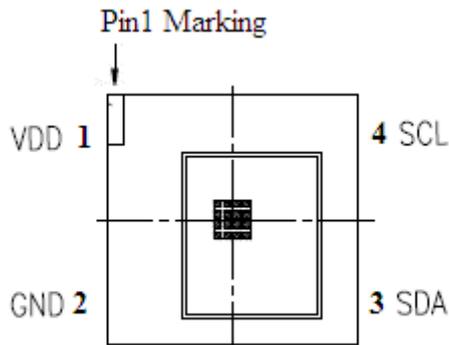
## 2. Functional Block Diagram



## 3. Application Circuit



## I/O Pins Configuration Table



Pin	I/O Type	Symbol	Description
1		VDD	Power Supply Voltage
2		GND	Ground
3	I	SCL*	I <sup>2</sup> C serial clock. This pin is an open drain input.
4	I/O	SDA*	I <sup>2</sup> C serial data. This pin is an open drain input / output.

\* Note: For noisy environment, add 10pF capacitor from signal to GND for additional noise filtering.

## Recommended Application Circuit Components

Component	Recommended Value
Rp1, Rp2	1 kΩ to 10 kΩ
C1	1uF ± 20%, X7R / X5R Ceramic

[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](http://www.nxp.com/documents/user_manual/UM10204.pdf)

## 4. Rating and Specification

### Absolute Maximum Ratings 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 <sub>stg</sub>	-40 to 100	°C

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	2.4		3.6	V
Interface Bus Power Supply Voltage	V <sub>IO</sub>	1.7		3.6	V
I <sup>2</sup> C Bus Input Pin High Voltage	V <sub>IH</sub> SCL, V <sub>IH</sub> SDA	1.2			V
I <sup>2</sup> C Bus Input Pin Low Voltage	V <sub>IL</sub> SCL, V <sub>IL</sub> SDA			0.6	V
Operating Temperature	T <sub>ope</sub>	-30		70	°C

## Electrical & Optical Specifications

All specifications are at VDD = 3.0V, T<sub>ope</sub> = 25°C, unless otherwise noted.

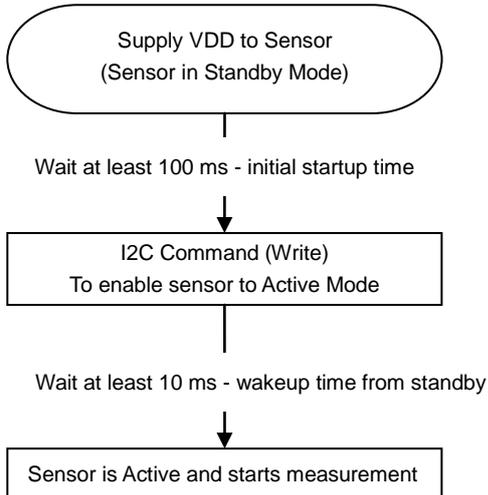
Parameter	Min.	Typ.	Max.	Unit	Condition
Active Supply Current			220	uA	Active Mode T <sub>ope</sub> = 25°C, VDD=3.6V Integration Time : 100ms Measurement rate : 200ms
Standby Current			5	uA	Standby / Sleep Mode
Initial Startup Time	100			ms	(Note 1)
Wakeup Time from Standby			10	ms	(Note 1)

### Light Sensor

Parameter	Min.	Typ.	Max.	Unit	Condition
Full Scale ADC Count			65535	count	
Dark ADC Count	0		6	count	Ch0, Lux = 0
	0		6	count	Ch1, Lux = 0
ADC Count (Gain = 96X) @200Lux	3250		6100	count	Ch0 (see note 2) white LED 200 Lux Integration Time : 50ms Measurement Time : 100ms
	1050		1950	count	Ch1 (see note 2) White LED 200 Lux Integration Time : 50ms Measurement Time : 100ms
	0.15		0.35	Ratio	Ch1/(Ch0 + Ch1)

**Notes:**

**1. Startup Sequence**



**2. LiteOn white LED color temperature 10000K.**

## Typical Performance Curve

All specifications are at VDD = 3.0V, T<sub>ope</sub> = 25°C, unless otherwise noted.

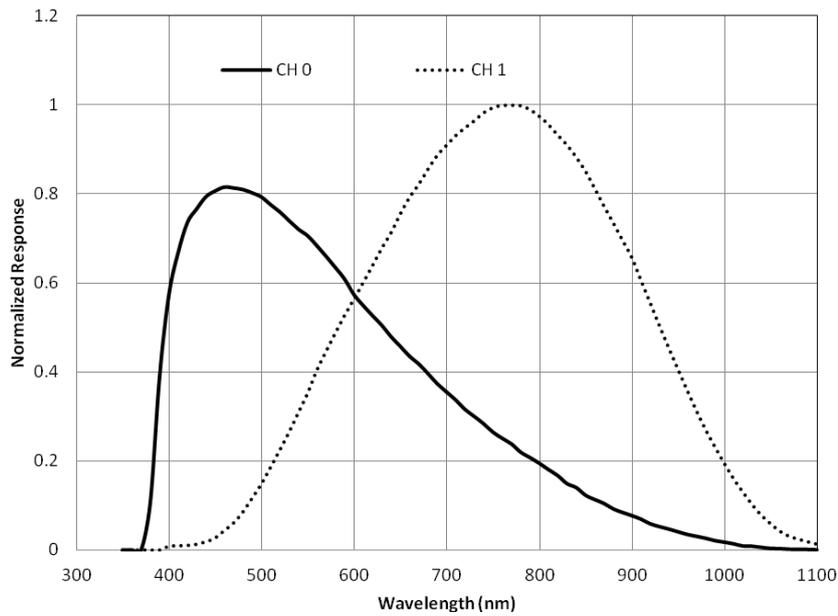


Figure 1: Normalized Spectral Response

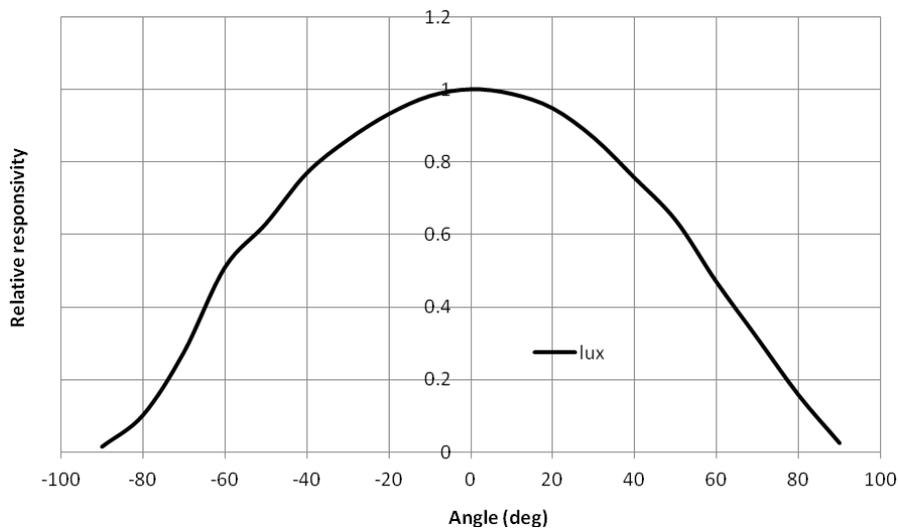


Figure 2 : Viewing angle

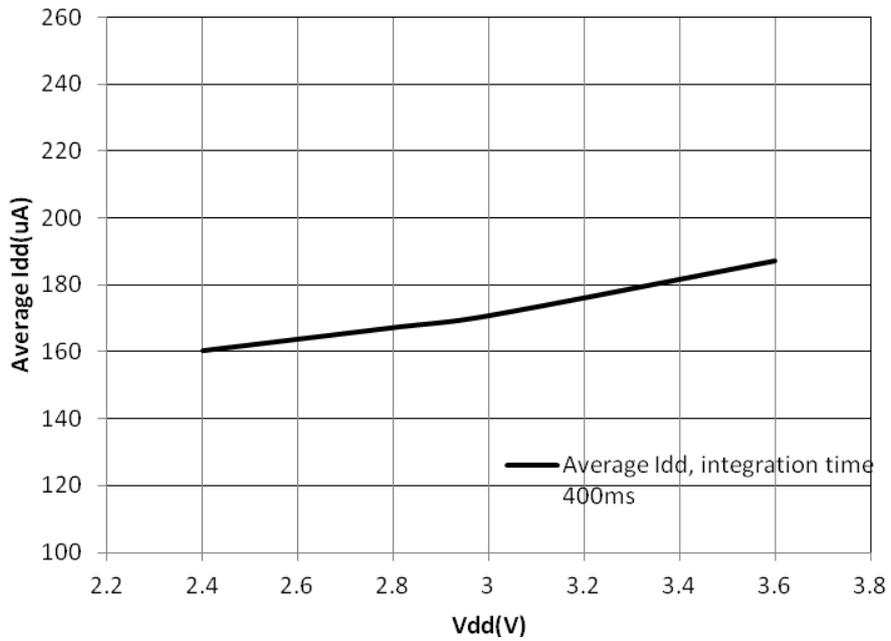


Figure 3 : Vdd versus Average Idd

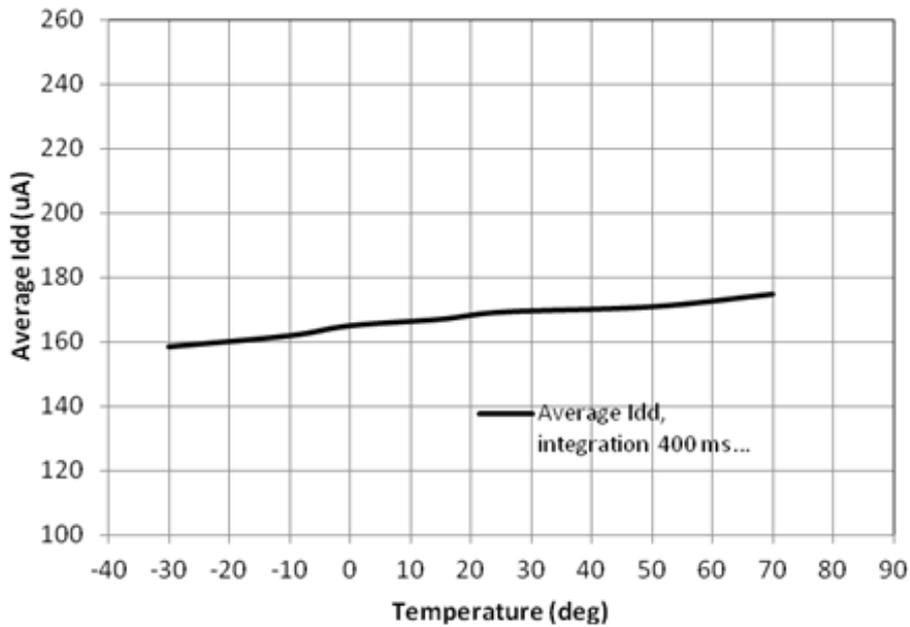


Figure 4 : Average Idd versus temperature

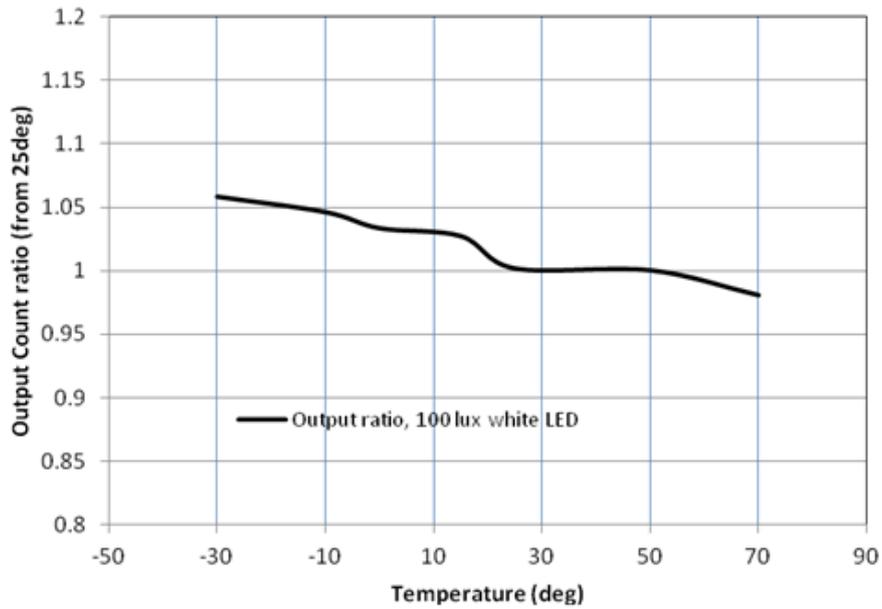


Figure 5 : Output count ratio versus temperature

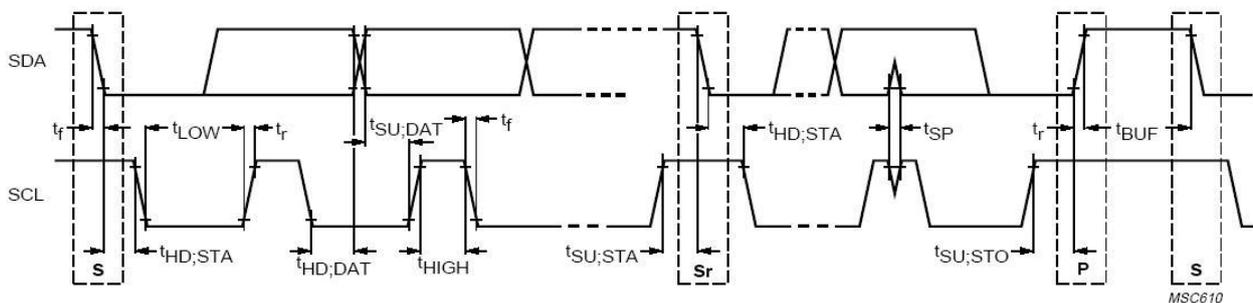
## Lux Formula

Refer to Appendix A for the lux formula

## AC Electrical Characteristics

All specifications are at VBus = 1.8V, T<sub>ope</sub> = 25°C, unless otherwise noted.

Parameter	Symbol	Min.	Max.	Unit
SCL clock frequency	$f_{SCL}$	1	400	kHz
Bus free time between a STOP and START condition	$t_{BUF}$	1.3		us
Hold time (repeated) START condition. After this period, the first clock pulse is generated	$t_{HD;STA}$	0.6		us
LOW period of the SCL clock	$t_{LOW}$	1.3		us
HIGH period of the SCL clock	$t_{HIGH}$	0.6		us
Set-up time for a repeated START condition	$t_{SU;STA}$	0.6		us
Set-up time for STOP condition	$t_{SU;STO}$	0.6		us
Rise time of both SDA and SCL signals	$t_r$	30	300	ns
Fall time of both SDA and SCL signals	$t_f$	30	300	ns
Data hold time	$t_{HD;DAT}$	0.3	0.9	us
Data setup time	$t_{SU;DAT}$	100		ns
Pulse width of spikes which must be suppressed by the input filter	$t_{SP}$	0	50	ns

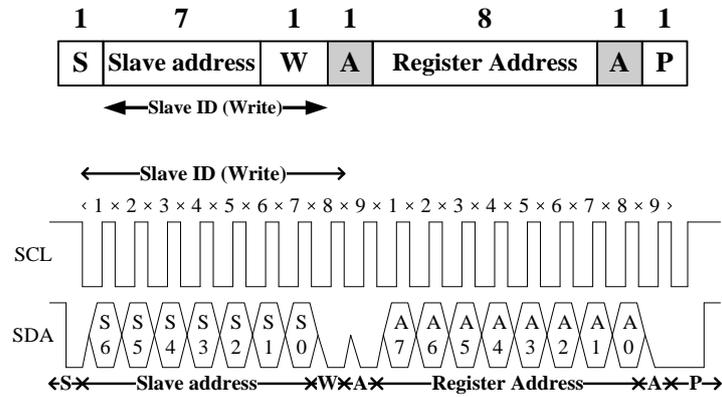


Definition of timing for I<sup>2</sup>C bus

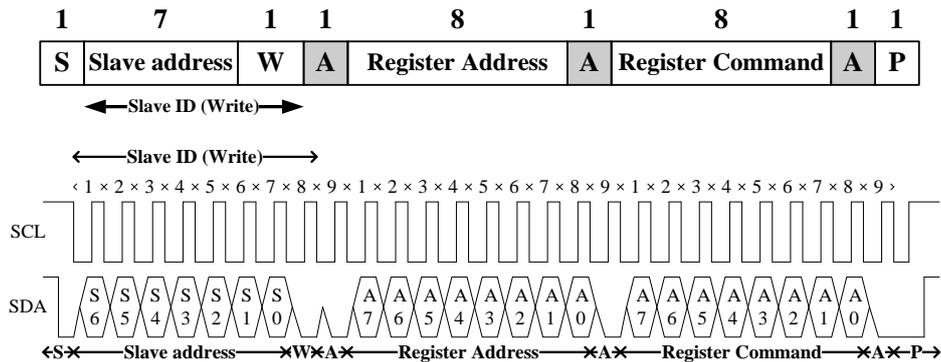
## 5. Principles of Operation

### I2C Protocols

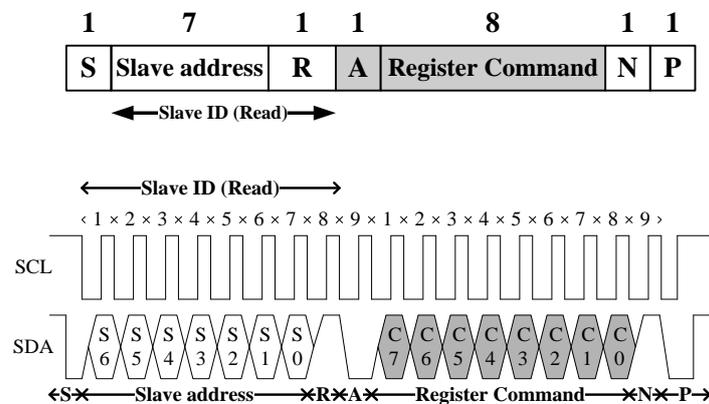
· I2C Write Protocol (type 1):



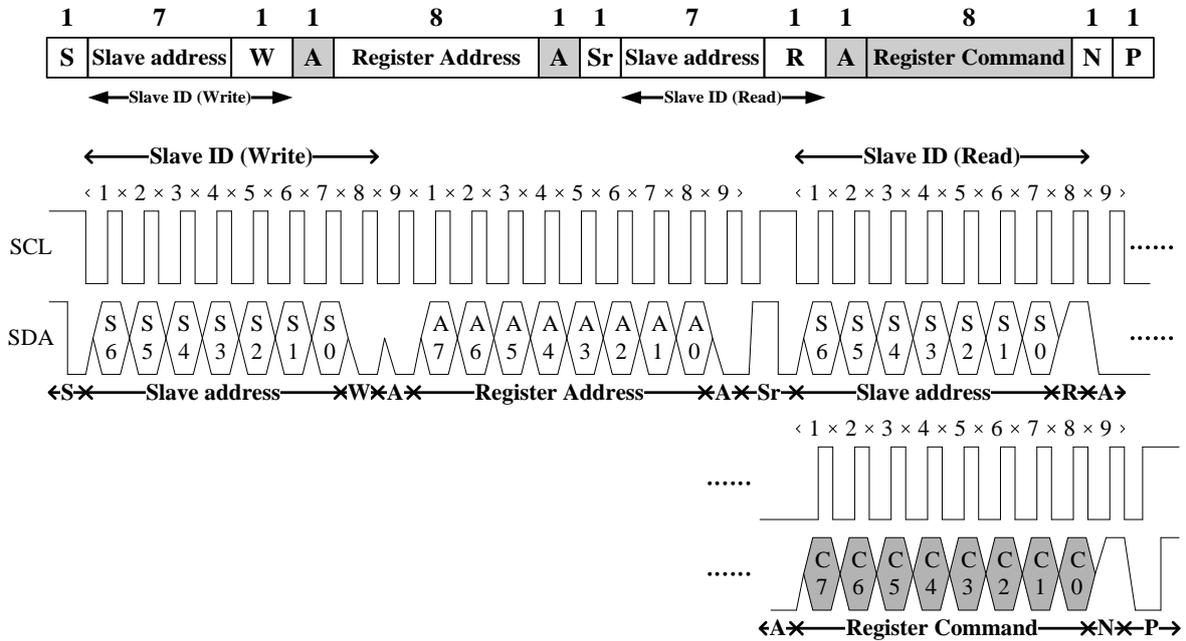
· I2C Write Protocol (type 2):



· I2C Read Protocol:



· I2C Read (Combined format) Protocol:



- |                                     |                            |                          |                                |
|-------------------------------------|----------------------------|--------------------------|--------------------------------|
| <b>A</b>                            | Acknowledge (0 for an ACK) | <b>N</b>                 | Non-Acknowledge(1 for an NACK) |
| <b>S</b>                            | Start condition            | <b>Sr</b>                | Repeated Start condition       |
| <b>P</b>                            | Stop condition             |                          |                                |
| <b>W</b>                            | Write (0 for writing)      | <b>R</b>                 | Read (1 for read)              |
| <input checked="" type="checkbox"/> | Slave-to-master            | <input type="checkbox"/> | Master-to-Slave                |

## I2C Slave Address

The 7 bits slave address for this sensor is 0x29H. 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	(0x29H)							W/R	value
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0	
Write	0	1	0	1	0	0	1	0	0x52H
Read	0	1	0	1	0	0	1	1	0x53H

## Register Set

Addr	R / W	Register Name	Description	Reset Value
0x80	R / W	ALS_CONTR	ALS operation mode control SW reset	0x00
0x85	R / W	ALS_MEAS_RATE	ALS measurement rate in active mode	0x03
0x86	R	PART_ID	Part Number ID and Revision ID	0xA0
0x87	R	MANUFAC_ID	Manufacturer ID	0x05
0x88	R	ALS_DATA_CH1_0	ALS measurement CH1 data, lower byte	0x00
0x89	R	ALS_DATA_CH1_1	ALS measurement CH1 data, upper byte	0x00
0x8A	R	ALS_DATA_CH0_0	ALS measurement CH0 data, lower byte	0x00
0x8B	R	ALS_DATA_CH0_1	ALS measurement CH0 data, upper byte	0x00
0x8C	R	ALS_STATUS	ALS new data status	0x00

**Notes:**

- 1) When reading ALS data registers, read sequence should always be from lower address to higher address (E.g. For ALS data, Ch1 data should be read first followed by Ch0 data. Read sequence should be 0x88, 0x89, 0x8A, 0x8B. When 0x8B is read, all four ALS data registers will be populated with new set of data).

## ALS\_CONTR Register (0x80)

The ALS\_CONTR register controls the ALS operation modes and software (SW) reset for the sensor. The ALS sensor can be set to either standby mode or active mode. At either of these modes, the I<sup>2</sup>C circuitry is always active. The default mode after power up is standby mode. During standby mode, there is no ALS measurement performed but I<sup>2</sup>C communication is allowed to enable read/write to all the registers.

0x80	ALS_CONTR (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved			ALS Gain			SW Reset	ALS Mode

Field	Bits	Default	Type	Description	
Reserved	7:5	000	RW	000	MUST write to 000 (default)
ALS Gain	4:2	000	RW	000	Gain 1X → 1 lux to 64k lux (default)
				001	Gain 2X → 0.5 lux to 32k lux
				010	Gain 4X → 0.25 lux to 16k lux
				011	Gain 8X → 0.125 lux to 8k lux
				100	Reserved
				101	
				110	Gain 48X → 0.02 lux to 1.3k lux
				111	Gain 96X → 0.01 lux to 600 lux
SW reset	1	0	RW	0	Initial start-up procedure is NOT started (default)
				1	Initial start-up procedure is started, bit has default value of 0 after start-up
ALS mode	0	0	RW	0	Stand-by mode (default)
				1	Active mode

## ALS\_MEAS\_RATE Register (0x85)

The ALS\_MEAS\_RATE register controls the integration time and timing of the periodic measurement of the ALS in active mode. ALS Measurement Repeat Rate is the interval between ALS\_DATA registers update. ALS Integration Time is the measurement time for each ALS cycle.

ALS Measurement Repeat Rate must be set to be equal or larger than the ALS Integration Time. If ALS Measurement Repeat Rate is set to be smaller than ALS Integration Time, it will automatically be reset to be equal to ALS Integration Time by the IC internally.

0x85	ALS_MEAS_RATE (default = 0x03)							
	B7	B6	B5	B4	B3	B2	B1	B0
	Reserved		ALS Integration Time			ALS Measurement Repeat Rate		

Field	Bits	Default	Type	Description	
Reserved	7:6	00	-	--	--
ALS integration time	5:3	000	RW	000	100ms (default)
				001	50ms
				010	200ms
				011	400ms
				100	150ms
				101	250ms
				110	300ms
				111	350ms
ALS measurement rate	2:0	011	RW	000	50ms
				001	100ms
				010	200ms
				011	500ms (default)
				100	1000ms
				101	2000ms
				110	
				111	

## PART\_ID Register (0x86) (Read Only)

The PART\_ID register defines the part number and revision identification of the sensor.

<b>0x86</b>	<b>PART_ID (default = 0xA0)</b>							
	<b>B7</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>
	<i>Part Number ID</i>				<i>Revision ID</i>			

Function	Bits	Default	Type	Description	
Part Number ID	7:4	1010	R	1010	Part ID 0x0AH
Revision ID	3:0	0000	R	0000	Revision ID 0x00H

## MANUFAC\_ID Register (0x87) (Read Only)

The MANUFAC\_ID register defines the manufacturer identification of the sensor.

<b>0x87</b>	<b>MANUFAC_ID (default = 0x05)</b>							
	<b>B7</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>
	<i>Manufacturer ID</i>							

Field	Bits	Default	Type	Description	
Manufacturer ID	7:0	00000101	R	NA	Manufacturer ID 0x05

## ALS\_DATA\_CH1 Register (0x88 / 0x89) (Read Only)

The ALS\_DATA registers should be read as a group, with the lower address read back first (i.e. read 0x88 first, then read 0x89). These two registers should also be read before reading channel-0 data (from registers 0x8A, 0x8B).

When the I<sup>2</sup>C read operation starts, all four ALS data registers are locked until the I<sup>2</sup>C read operation of register 0x8B 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 ALS\_DATA registers are updated as soon as there is no on-going I<sup>2</sup>C read operation.

The ALS ADC channel-1 data is expressed as a 16-bit data spread over two registers. The ALS\_DATA\_CH1\_0 and ALS\_DATA\_CH1\_1 registers provide the lower and upper byte respectively.

<b>0x88</b>	<b>ALS_DATA_CH1_0 (default = 0x00)</b>							
	<b>B7</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>
	<i>ALS Data Ch1 Low</i>							

<b>0x89</b>	<b>ALS_DATA_CH1_1 (default = 0x00)</b>							
	<b>B7</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>
	<i>ALS Data Ch1 High</i>							

Field	Addr	Bits	Default	Type	Description
ALS Data Ch1 Low	0x88	7:0	00000000	R	ALS ADC channel 1 lower byte data
ALS Data Ch1 High	0x89	7:0	00000000	R	ALS ADC channel 1 upper byte data

## ALS\_DATA\_CH0 Register (0x8A / 0x8B) (Read Only)

These two registers should be read after reading channel-1 data (from registers 0x88, 0x89). Lower address register should be read first (i.e read 0x8A first, then read 0x8B). See ALS\_DATA\_CH1 register information above.

The ALS ADC channel-0 data is expressed as a 16-bit data spread over two registers. The ALS\_DATA\_CH0\_0 and ALS\_DATA\_CH0\_1 registers provide the lower and upper byte respectively.

<b>0x8A</b>	<b>ALS_DATA_CH0_0 (default = 0x00)</b>							
	<b>B7</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>
	<i>ALS Data Ch0 Low</i>							

<b>0x8B</b>	<b>ALS_DATA_CH0_1 (default = 0x00)</b>							
	<b>B7</b>	<b>B6</b>	<b>B5</b>	<b>B4</b>	<b>B3</b>	<b>B2</b>	<b>B1</b>	<b>B0</b>
	<i>ALS Data Ch0 High</i>							

Field	Addr	Bits	Default	Type	Description
ALS Data Ch0 Low	0x8A	7:0	00000000	R	ALS ADC channel 0 lower byte data
ALS Data Ch0 High	0x8B	7:0	00000000	R	ALS ADC channel 0 upper byte data

## ALS\_STATUS Register (0x8C) (Read Only)

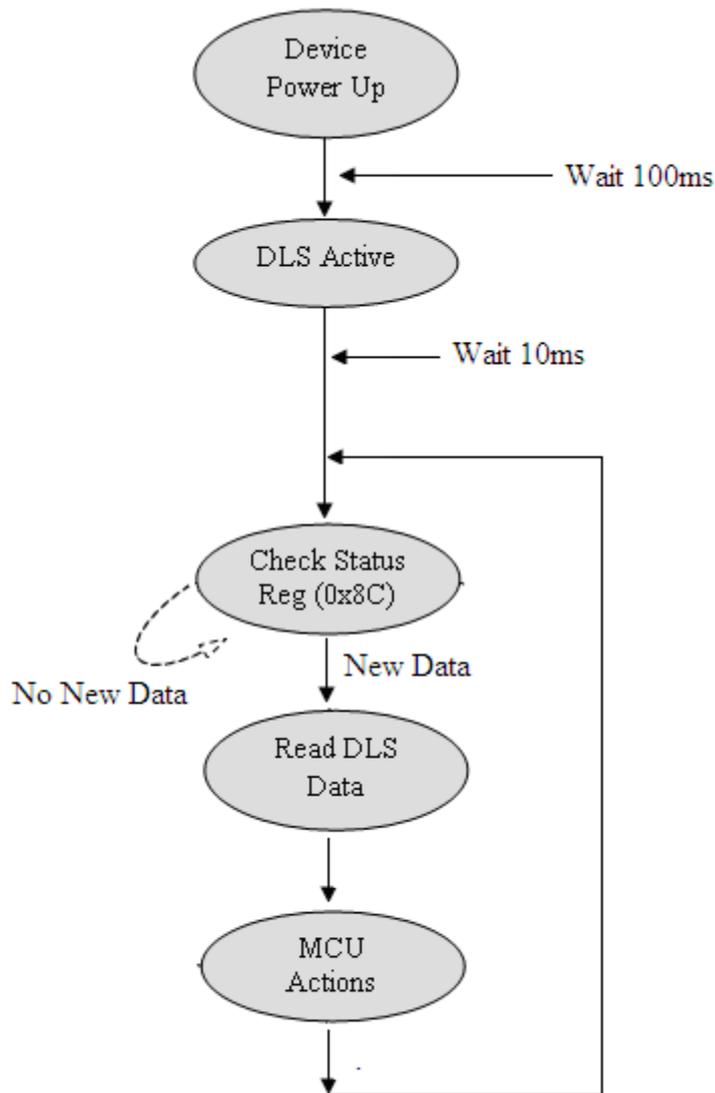
The ALS\_STATUS register stores the information about ALS data status. New data means data has not been read yet. When the measurement is completed and data is written to the data register, the data status bit will be set to logic 1. When the data register is read, the data status bit will be set to logic 0.

0x8C	ALS_STATUS (default = 0x00)							
	B7	B6	B5	B4	B3	B2	B1	B0
	<i>ALS Data Valid</i>	<i>ALS Gain</i>			<i>Reserved</i>	<i>ALS Data Status</i>	<i>Reserved</i>	

Field	Bits	Default	Type	Description	
ALS Data Valid	7	0	R	0	ALS Data is Valid (default)
				1	ALS Data is Invalid
ALS Data Gain Range	6:4	000	R	000	ALS measured data in Gain 1X (default)
				001	ALS measured data in Gain 2X
				010	ALS measured data in Gain 4X
				011	ALS measured data in Gain 8X
				100	Invalid
				101	Invalid
				110	ALS measured data in Gain 48X
				111	ALS measured data in Gain 96X
Reserved	3	0	R	0	Don't care
ALS data status	2	0	R	0	OLD data (data already read), (default)
				1	NEW data (first time data is read)
Reserved	1:0	00	R	--	Don't care

## 6. Device Operation

Below flow diagram illustrates the LTR-329ALS operation.



## 7. Pseudo Codes Examples

### Control Registers

// The Control Register defines the operating modes and gain settings of the ALS of LTR-329.  
 // Default settings is 0x00 (in Standby mode).

Slave\_Addr = 0x29 // Slave address of LTR-329 device

#### // Enable ALS

Register\_Addr = 0x80 // ALS\_CONTR register  
 Command = 0x01 // For Gain X1  
 // For Gain X96, Command = 0x1D

WriteByte(Slave\_Addr, Register\_Addr, Command)

### ALS Measurement Rate

// The ALS\_MEAS\_RATE register controls the ALS integration time and measurement rate.  
 // Default setting of the register is 0x03 (integration time 100ms, repeat rate 500ms)

Slave\_Addr = 0x29 // Slave address of LTR-329 device

#### // Set ALS Integration Time 200ms, Repeat Rate 200ms

Register\_Addr = 0x85 // ALS\_MEAS\_RATE register  
 Command = 0x12 // Int time = 200ms, Meas rate = 200ms  
 // For Int time = 400ms, Meas rate = 500ms, Command = 0x1B

WriteByte(Slave\_Addr, Register\_Addr, Command)

### ALS Data Registers (Read Only)

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

Slave\_Addr = 0x29 // Slave address of LTR-329 device

#### // Read back ALS\_DATA\_CH1

Register\_Addr = 0x88 // ALS\_DATA\_CH1 low byte address  
 ReadByte(Slave\_Addr, Register\_Addr, Data0)  
 Register\_Addr = 0x89 // ALS\_DATA\_CH1 high byte address  
 ReadByte(Slave\_Addr, Register\_Addr, Data1)

#### // Read back ALS\_DATA\_CH0

Register\_Addr = 0x8A // ALS\_DATA\_CH0 low byte address  
 ReadByte(Slave\_Addr, Register\_Addr, Data2)  
 Register\_Addr = 0x8B // ALS\_DATA\_CH0 high byte address  
 ReadByte(Slave\_Addr, Register\_Addr, Data3)

ALS\_CH1\_ADC\_Data = (Data1 << 8) | Data0 // Combining lower and upper bytes to give 16-bit Ch1 data  
 ALS\_CH0\_ADC\_Data = (Data3 << 8) | Data2 // Combining lower and upper bytes to give 16-bit Ch0 data

## ALS Status Register (Read only)

// The ALS\_STATUS Register contains the information on ALS data availability status.  
// This register is read only.

Slave\_Addr = 0x29 // Slave address of LTR-329 device

### // Read back Register

Register\_Addr = 0x8C // ALS\_STATUS register address

ReadByte(Slave\_Addr, Register\_Addr, Data)

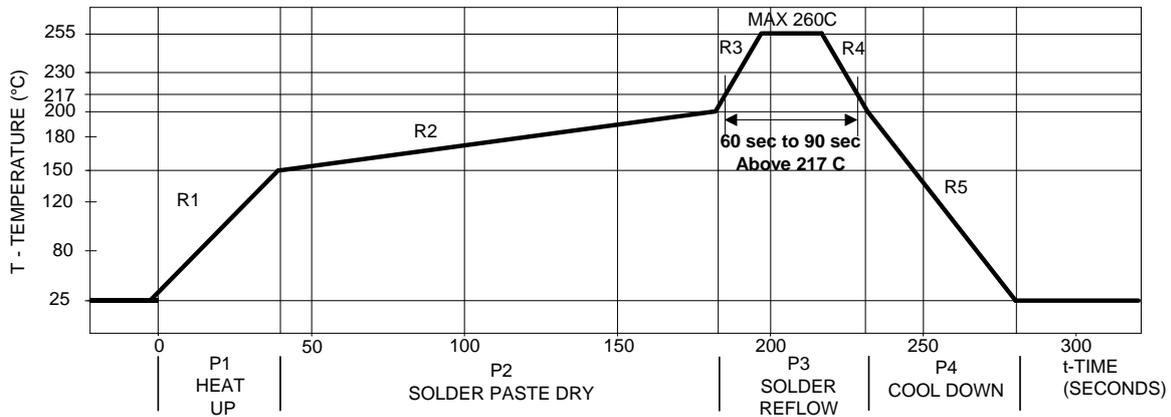
NewData\_Status = Data & 0x04 // NewData\_Status = 4(decimal) → ALS New Data

ALS\_Data\_Valid = Data & 0x80

// ALS\_Data\_Valid = 0x00 → ALS New Data is valid (usable)

// ALS\_Data\_Valid = 0x80 → ALS New Data is invalid, discard and wait for new ALS data

## 8. Recommended Lead-free Reflow Profile



Process Zone	Symbol	$\Delta T$	Maximum $\Delta T/\Delta$ time 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	200°C to 260°C	3°C/s
	P3, R4	260°C to 200°C	-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.

## 9. Moisture Proof Packaging

All LTR-329ALS-01 are shipped in moisture proof package. Once opened, moisture absorption begins. This part is compliant to JEDEC J-STD-033A Level 3.

### 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 seven days. 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.

### Recommended Storage Conditions

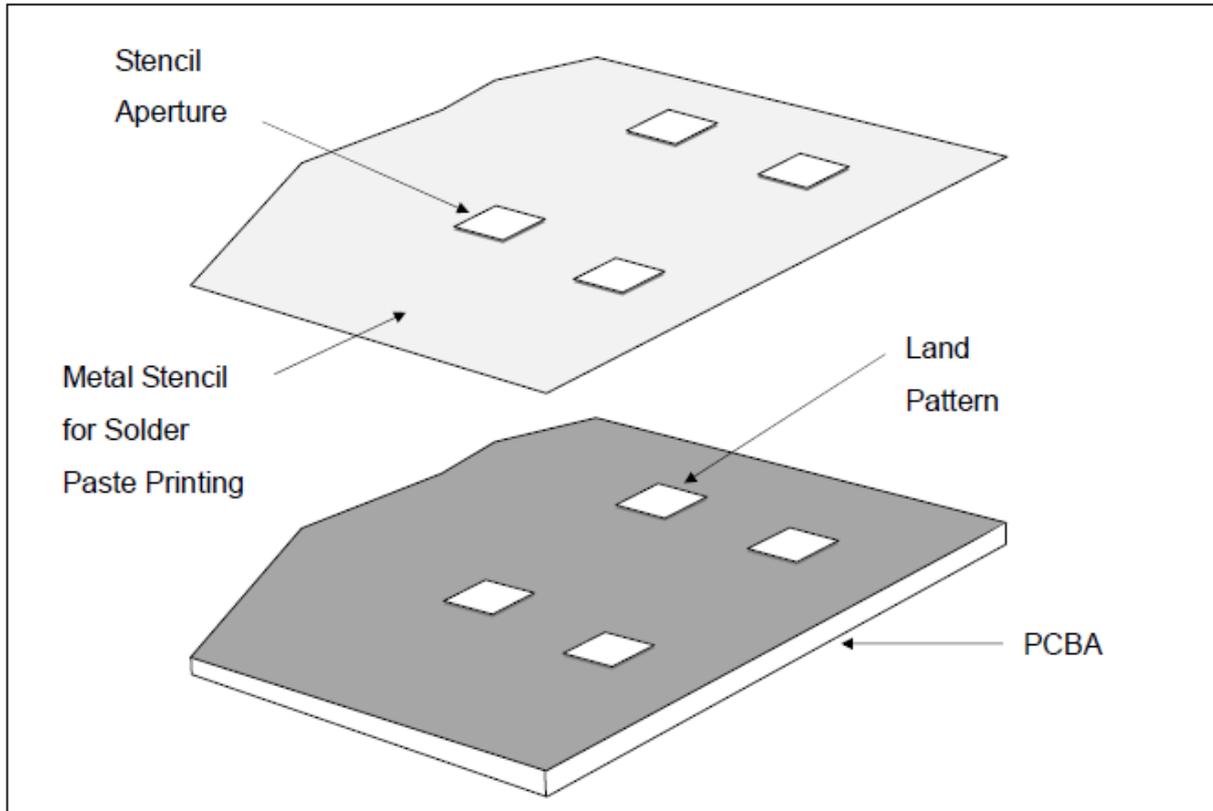
Storage Temperature	10°C to 30°C
Relative Humidity	Below 60% RH

### Baking Conditions

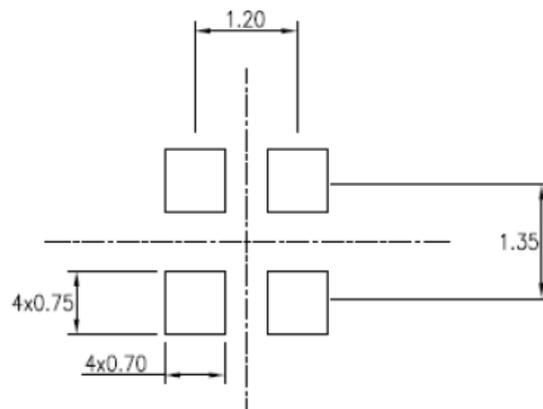
Package	Temperature	Time
In Reels	60°C	48 hours
In Bulk	100°C	4 hours

Baking should only be done once.

## 10. Recommended Land Pattern and Metal Stencil Aperture



### Recommended Land Pattern



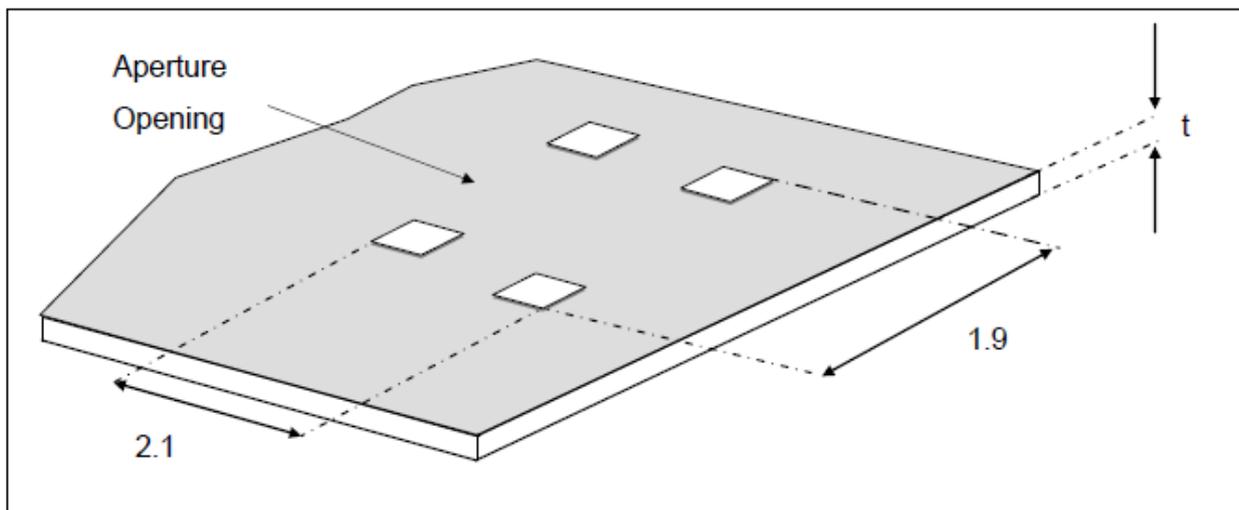
Note:

1. All dimensions are in millimeters

## 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).

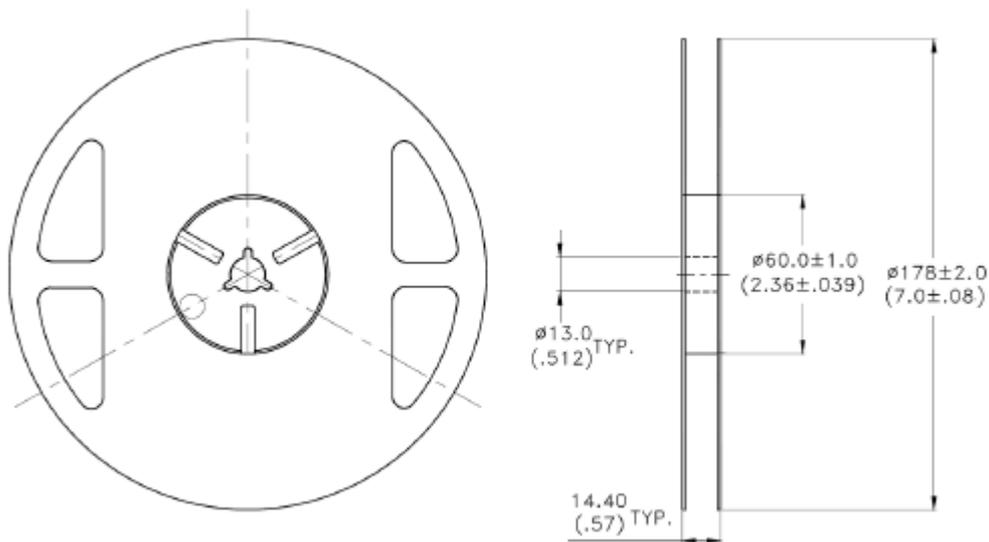
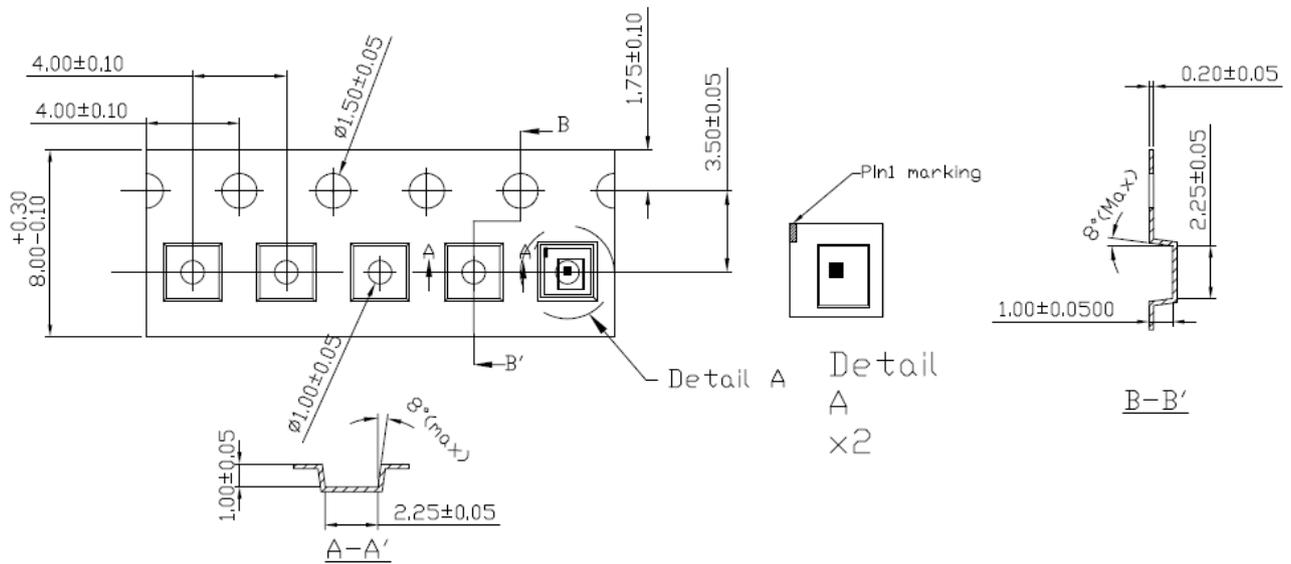
The stencil aperture opening is recommended to be 0.75mm x 0.7mm which has the same dimension as the land pattern. This is to ensure adequate printed solder paste volume and yet no shorting.



**Note:**

1. All dimensions are in millimeters

## 11. Package Dimension for Tape and Reel



### Notes:

1. All dimensions are in millimeters (inches)
2. Empty component pockets sealed with top cover tape
3. 7 inch reel - 2500 pieces per reel
4. In accordance with ANSI/EIA 481-1-A-1994 specifications

# Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

[Lite-On:](#)

[LTR-329ALS-01](#)