Datasheet

Ambient Light Sensor IC Series

Digital 16bit Serial Output Type Ambient Light Sensor IC for Automotive

BU27100NUC-MZ

General Description

BU27100NUC-MZ is a digital Ambient Light Sensor IC with I²C bus interface. This IC is most suitable for obtaining ambient light data for adjusting luminance of electronic mirror, head-up display and instrument cluster. It is capable of detecting a very wide range of illuminance.

Features

- AEC-Q100 Qualified(Note 1)
- Built-in High Accuracy Optical Filter
- 2 Outputs with Different Spectral Response
- Rejecting 50 Hz/60 Hz Light Noise for Stable Measurement
- I²C bus Interface (f/s mode support)
- LUX Resolution 0.0031 lx/count (Typ)
  (In the highest gain and the longest measurement time setting)

(Note 1) Grade 2

Applications

Electronic Mirror, Head-up Display, Instrument Cluster, Car Navigation etc.

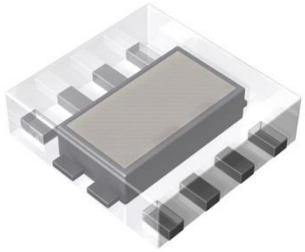
Key Specifications

- VCC Voltage Range: 2.5 V to 3.6 V
- LUX Detection Range(Note 2): 200 klx (Typ)
- Current Consumption(Note 2): 150 µA (Typ)
- Power Down Current: 2.5 µA (Typ)
- Operating Temperature Range: -40 °C to +105 °C

(Note 2) White LED is used.

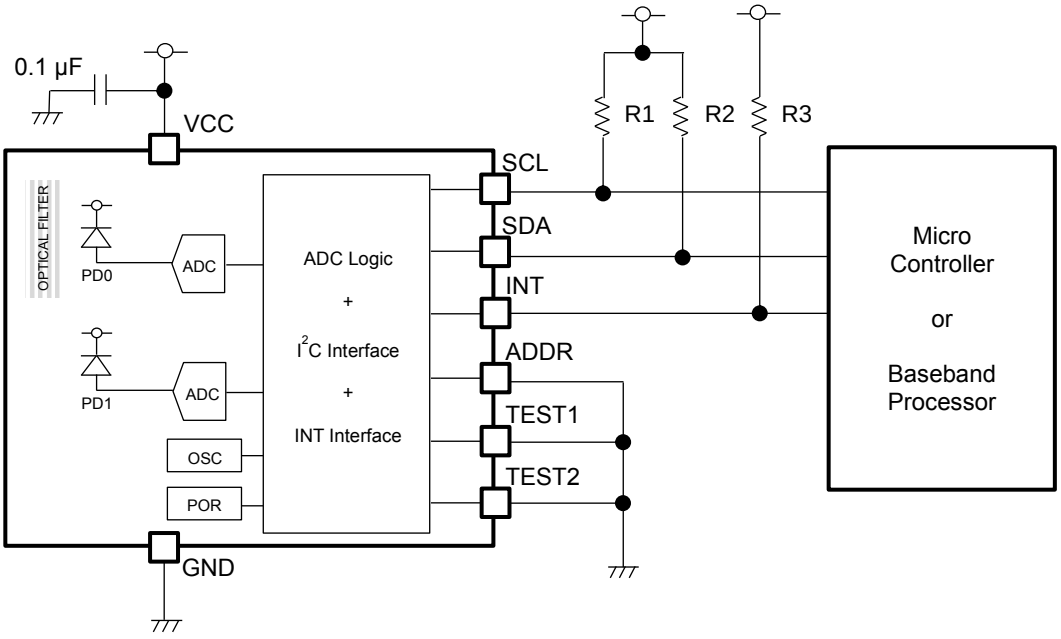
Package

Package	W (Typ) x D (Typ) x H (Typ)
WSON08X2120A	2.1 mm x 2.0 mm x 0.55 mm



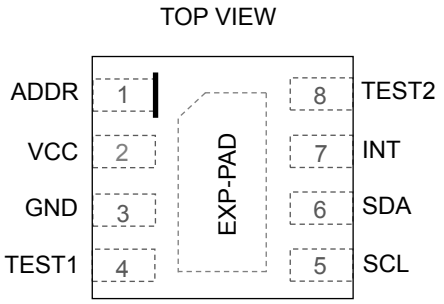
Typical Application Circuits

- External components (proposed value)
  R1 = R2 = 2.2 kΩ to 4.7 kΩ
  R3 = 10 kΩ to 100 kΩ



○Product structure: Silicon integrated circuit
○This product does not include laser transmitter.
○This product includes Photo detector, (Photo Diode) inside of it.
○This product has no designed protection against radioactive rays.
○This product does not include optical load.

Pin Configuration

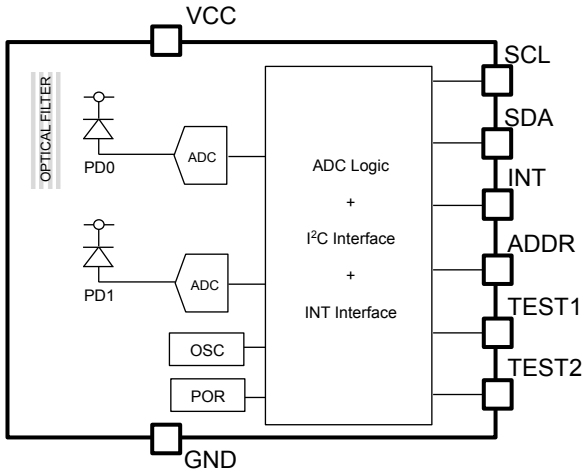


Pin Description

Pin No.	Pin Name	Function
1	ADDR	I²C bus target address select
2	VCC	Power supply *(Note 1)*
3	GND	Ground
4	TEST1	Test pin *(Note 2)*
5	SCL	I²C bus serial clock *(Note 3)*
6	SDA	I²C bus serial data *(Note 3)*
7	INT	Interrupt output
8	TEST2	Test pin *(Note 2)*
-	EXP-PAD	EXP-PAD Connect to GND

(Note 1) Dispose a bypass capacitor as close as possible to the IC.
(Note 2) Connect to Ground.
(Note 3) If there is a device falls sharply among other devices connected to the SDA and SCL pins, it might generate undershoot and the pin voltage might be the ground potential or below. When the undershoot occurs, must take a measure like adding a capacitor near to the pin of the device concerned.

Block Diagram



Description of Blocks

OPTICAL FILTER : Optical filter on PD0
PD0, PD1 : Photodiode
ADC : Analog-to-Digital Converter for obtaining 16 bit digital data depending on PD current
OSC : Clock generator for internal logic
POR : Power ON Reset. All registers are reset after VCC is supplied.
ADC Logic + I²C Interface + INT Interface
: ADC control, I²C bus Interface and Interrupt Interface

Absolute Maximum Ratings (Ta = 25 °C)

Parameter	Symbol	Rating	Unit
Supply Voltage	V_{CC_MR}	4.5	V
Input Voltage [INT, SCL, SDA]	V_{IN1_MR}	-0.3 to +4.5	V
Input Voltage [ADDR]	V_{IN2_MR}	-0.3 to (VCC+0.3) or +4.5 whichever is less	V
Storage Temperature Range	Tstg	-40 to +105	°C
Maximum Junction Temperature	Tjmax	110	°C

Caution 1: *Operating the IC over the absolute maximum ratings may damage the IC. The damage can either be a short circuit between pins or an open circuit between pins and the internal circuitry. Therefore, it is important to consider circuit protection measures, such as adding a fuse, in case the IC is operated over the absolute maximum ratings.*

Caution 2: *Should by any chance the maximum junction temperature rating be exceeded the rise in temperature of the chip may result in deterioration of the properties of the chip. In case of exceeding this absolute maximum rating, design a PCB with thermal resistance taken into consideration by increasing board size and copper area so as not to exceed the maximum junction temperature rating.*

Thermal Resistance*(Note 1)*

Parameter	Symbol	Thermal Resistance (Typ)		Unit
		1s*(Note 3)*	2s2p*(Note 4)*	
WSON08A2120A				
Junction to Ambient	θ_{JA}	324.7	113.8	°C/W
Junction to Top Characterization Parameter*(Note 2)*	Ψ_{JT}	63	37	°C/W

(Note 1) Based on JESD51-2A(Still-Air).
(Note 2) The thermal characterization parameter to report the difference between junction temperature and the temperature at the top center of the outside surface of the component package.
(Note 3) Using a PCB board based on JESD51-3.
(Note 4) Using a PCB board based on JESD51-5, 7.

Layer Number of Measurement Board	Material	Board Size
Single	FR-4	114.3 mm x 76.2 mm x 1.57 mmt

Top	
Copper Pattern	Thickness
Footprints and Traces	70 µm

Layer Number of Measurement Board	Material	Board Size	Thermal Via*(Note 5)*	
			Pitch	Diameter
4 Layers	FR-4	114.3 mm x 76.2 mm x 1.6 mmt	1.20 mm	Φ0.30 mm

Top		2 Internal Layers		Bottom	
Copper Pattern	Thickness	Copper Pattern	Thickness	Copper Pattern	Thickness
Footprints and Traces	70 µm	74.2 mm x 74.2 mm	35 µm	74.2 mm x 74.2 mm	70 µm

(Note 5) This thermal via connect with the copper pattern of layers 1,2, and 4. The placement and dimensions obey a land pattern.

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating Temperature	Topr	-40	+25	+105	°C
Supply Voltage	V_{CC}	2.5	3.3	3.6	V
Input Voltage [INT, SCL, SDA]	V_{IN1}	0	-	3.6	V
Input Voltage [ADDR]	V_{IN2}	0	-	V_{CC}	V
Input Current [INT, SDA]	I_{IN}	0		5	mA

Electrical Characteristics

Unless otherwise specified, Ta = -40 °C to +105 °C, V_{CC} = 2.5 V to 3.6 V
The typical value is defined at Ta = +25 °C and V_{CC} = 3.3 V

Parameter	Symbol	Min	Typ	Max	Unit	Conditions
Current Consumption	I_{CC1}	-	150	360	µA	Ev = 100 lx*(Note 1)* MEAS_EN = '1'
Power Down Current	I_{CC2}	-	2.5	25	µA	No input light Ta = 25 °C, V_{CC} = 2.5 V to 3.6 V MEAS_EN = '0' SCL = SDA = V_{CC}*(Note 2)*
DATA0 Count Value	D_{CH0}	2125	2500	2875	count	Ev = 1000 lx*(Note 1)* Ta = 25 °C, V_{CC} = 3.3 V MEAS_MODE = 0 DATA_GAIN = 01
		2000	2500	3000	count	Ev = 1000 lx*(Note 1)* Ta = 25 °C, V_{CC} = 2.5 V to 3.6 V MEAS_MODE = 0 DATA_GAIN = 01
DATA1 Count Value	D_{CH1}	1065	1250	1435	count	Ev = 1000 lx*(Note 1)* Ta = 25 °C, V_{CC} = 3.3 V MEAS_MODE = 0 DATA_GAIN = 01
		1000	1250	1500	count	Ev = 1000 lx*(Note 1)* Ta = 25 °C, V_{CC} = 2.5 V to 3.6 V MEAS_MODE = 0 DATA_GAIN = 01
Dark Count Value*(Note 3)*	S_{0_0}	-	-	3	count	No input Light MEAS_MODE = 0 DATA_GAIN = 01
Measurement Time	t_{MEAS}	77	85	95	ms	V_{CC} = 3.3 V MEAS_MODE = 0
		72	85	100	ms	V_{CC} = 2.5 V to 3.6 V MEAS_MODE = 0
SCL SDA Input 'H' Voltage	V_{IH}	1.26	-	-	V	
SCL SDA Input 'L' Voltage	V_{IL}	-	-	0.54	V	
INT SDA Output 'L' Voltage	V_{OL}	0	-	0.4	V	I_{OL} = 3 mA
ADDR Input 'H' Voltage	V_{ADDRH}	0.7 x V_{CC}	-	V_{CC}	V	
ADDR Input 'L' Voltage	V_{ADDRL}	0	-	0.3 x V_{CC}	V	

(Note 1) White LED is used.
(Note 2) Current value depends on the voltage difference between the VCC pin and the SCL or SDA pins.
(Note 3) Average value

Typical Performance Curve

Unless otherwise specified Ta = +25 °C, V_{CC} = 3.3 V

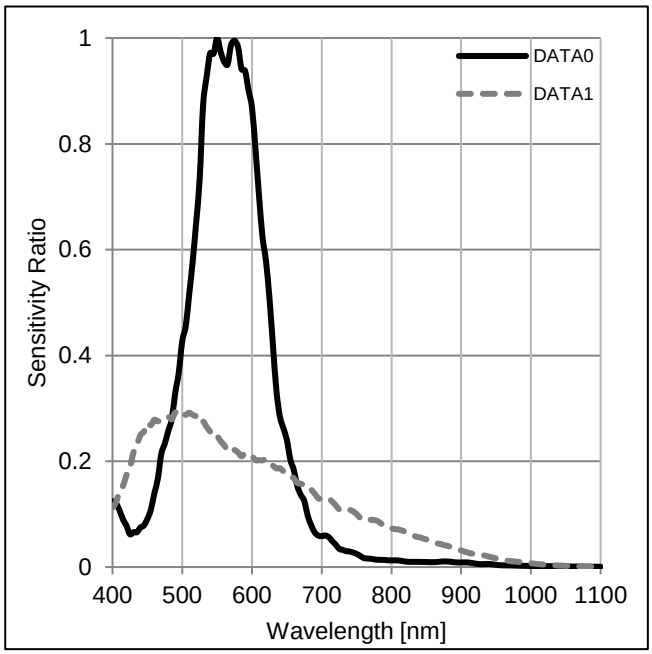


Figure 1. Sensitivity Ratio vs Wavelength (Spectral Response)

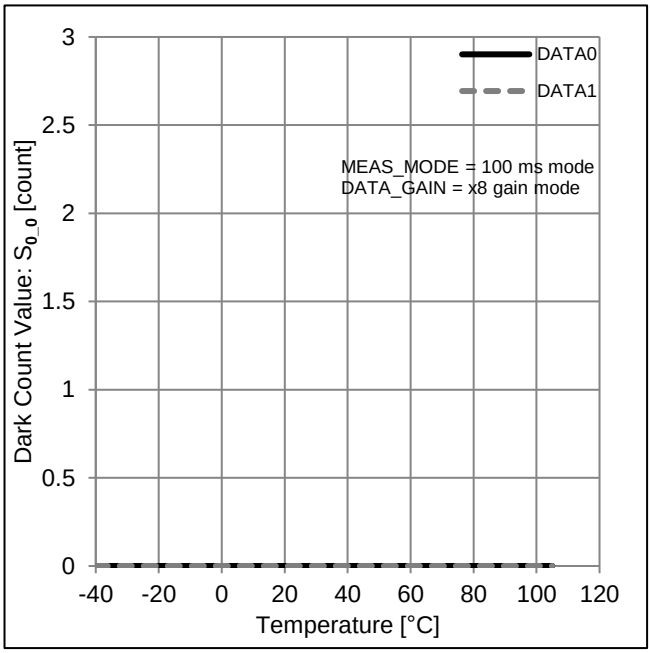


Figure 2. Dark Count Value vs Temperature

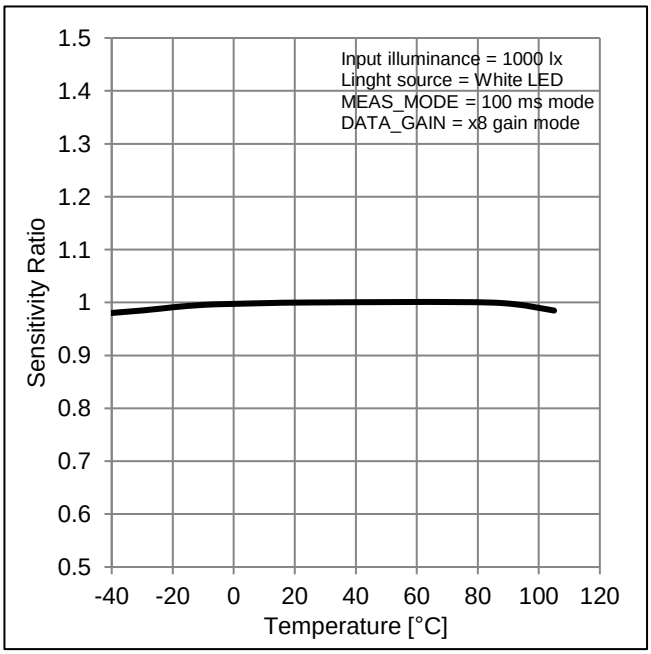


Figure 3. Sensitivity Ratio vs Temperature

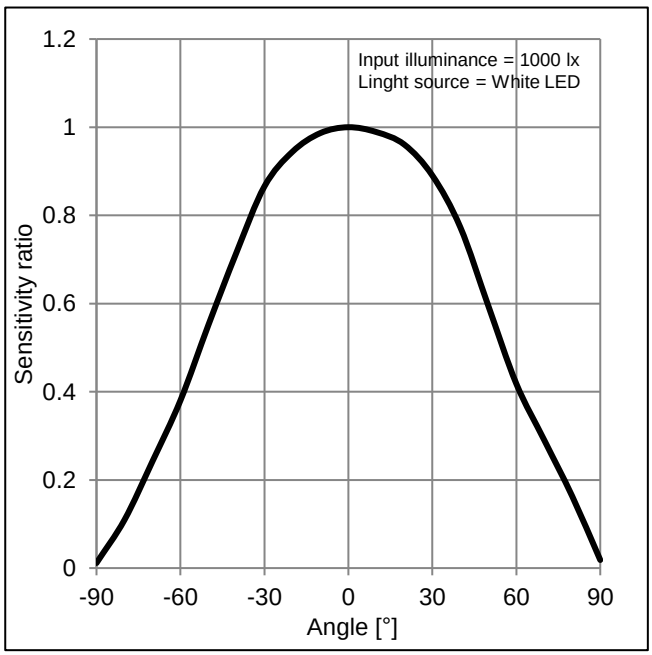


Figure 4. Sensitivity Ratio vs Angle

Typical Performance Curve – continued

Unless otherwise specified Ta = +25 °C, V_{CC} = 3.3 V

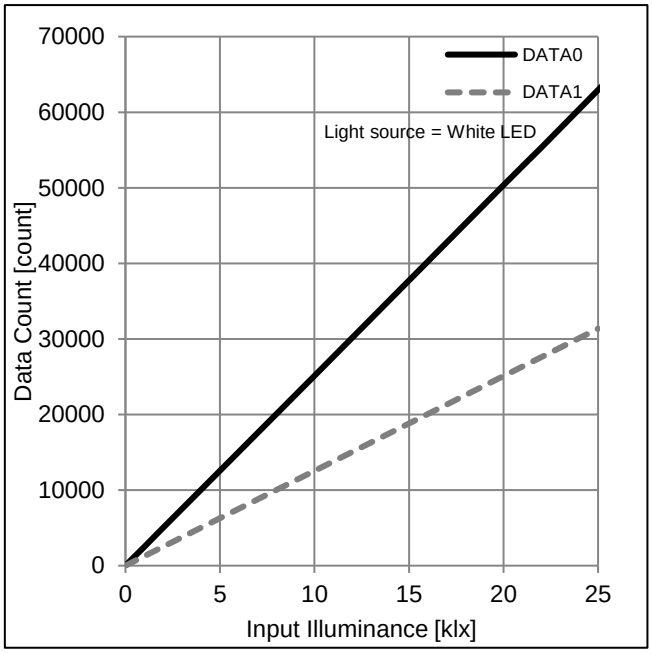


Figure 5. Data Count vs Input Illuminance
(100 ms mode, x8 gain mode)

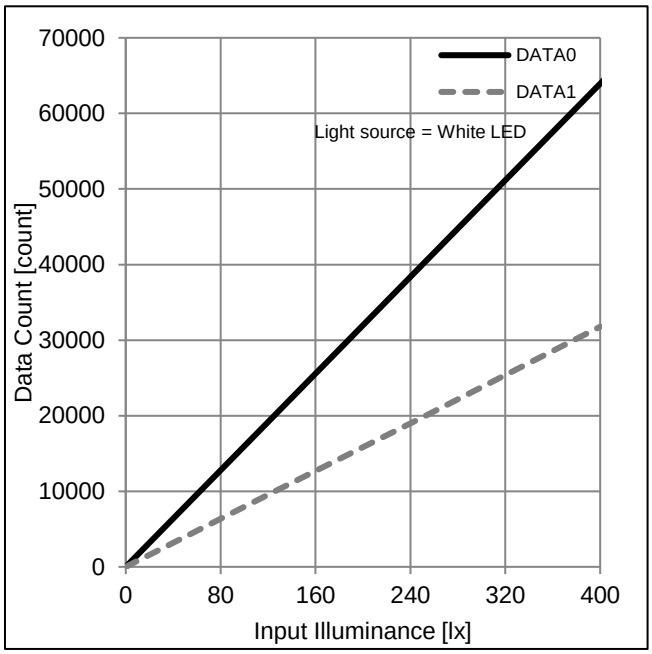


Figure 6. Data Count vs Input Illuminance
(100 ms mode, x512 gain mode)

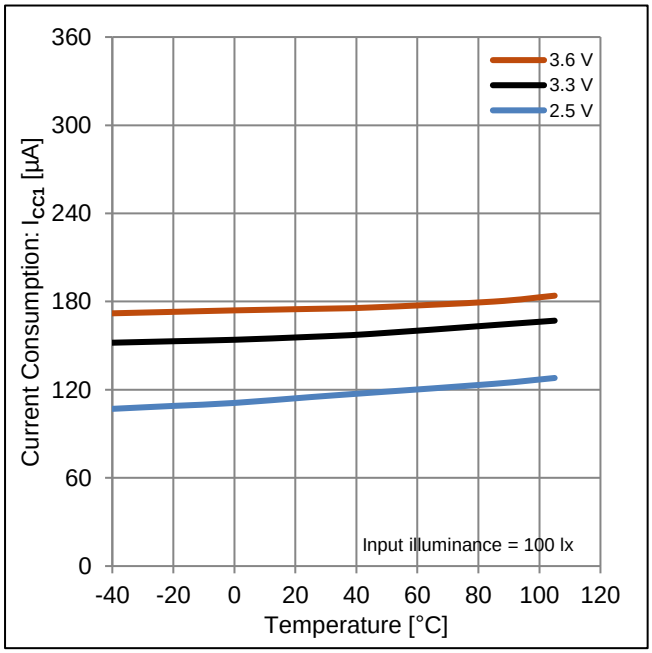


Figure 7. Current Consumption vs Temperature

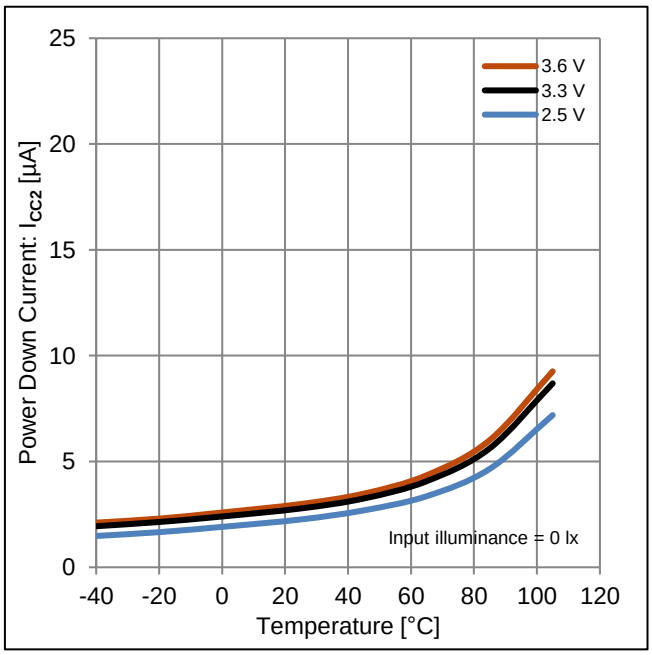
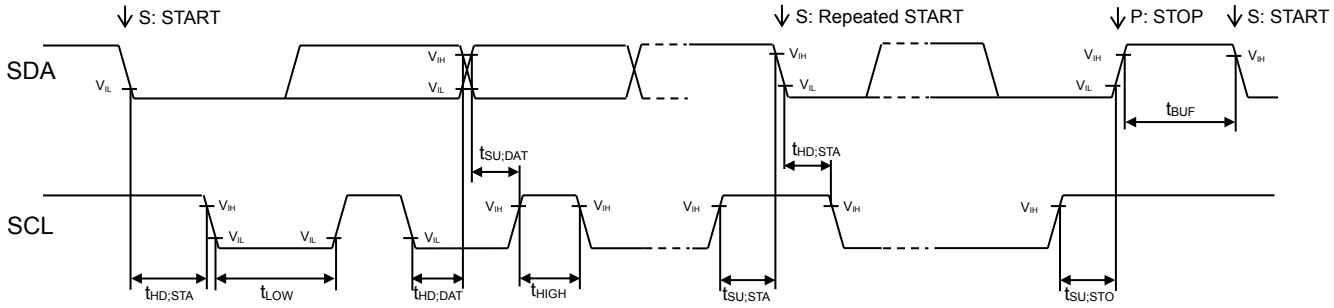


Figure 8. Power Down Current vs Temperature

I²C bus Timing Characteristics

Unless otherwise specified Ta = -40 °C to +105 °C, V_{CC} = 2.5 V to 3.6 V



Parameter	Symbol	Min	Typ	Max	Unit
SCL Clock Frequency	f_{SCL}	0	-	400	kHz
'L' Period of the SCL Clock	t_{LOW}	1.3	-	-	µs
'H' Period of the SCL Clock	t_{HIGH}	0.6	-	-	µs
Setup Time for Repeated START	$t_{SU;STA}$	0.6	-	-	µs
Hold Time for START	$t_{HD;STA}$	0.6	-	-	µs
Data Setup Time	$t_{SU;DAT}$	100	-	-	ns
Data Hold Time	$t_{HD;DAT}$	0	-	-	µs
Setup Time for STOP	$t_{SU;STO}$	0.6	-	-	µs
Bus Free Time between STOP and START	t_{BUF}	1.3	-	-	µs

I²C bus Communication

1. Write Format

(1) Indicate register address

S	Target Address	W 0	ACK	Register Address	ACK	P

(2) Write data after indicating register address

S	Target Address	W 0	ACK	Register Address	ACK

Data specified at register address field	ACK	…	ACK	Data specified at register address field + N	ACK	P

2. Read Format

(1) Read data after indicating register address

S	Target Address	W 0	ACK	Register Address	ACK

S	Target Address	R 1	ACK	Data specified at register address field	ACK

Data specified at register address field + 1	ACK	…	ACK	Data specified at register address field + N	NACK	P

(2) Read data from the specified register

S	Target Address	R 1	ACK	Data specified at register address field	ACK

Data specified at register address field + 1	ACK	…	ACK	Data specified at register address field + N	NACK	P

: from controller to target : from target to controller

I²C bus Target Address

The target address is selectable from 2 addresses by the ADDR pin.

ADDR	Target Address
L	0111000
H	0111001

Register MAP*(Note 1)*

Register Address	Register Name	R/W	D7	D6	D5	D4	D3	D2	D1	D0
0x40	SYSTEM_CONTROL	R/W	SW_ RESET	0	PART_ID					
0x41	MODE_CONTROL	R/W	0	0	0	MEAS_ MODE	0	DATA_GAIN[1:0]		MEAS _EN
0x42	INTERRUPT	R/W	VALID	INT_ STATUS	0	0	INT_EN	PERSIST [2:0]		
0x43	TH_LOW	R/W	TH_LOW_data [7:0]							
0x44		R/W	TH_LOW_data [15:8]							
0x45	TH_HIGH	R/W	TH_HIGH_data [7:0]							
0x46		R/W	TH_HIGH_data [15:8]							
0x50	DATA0	R	DATA0_data [7:0]							
0x51		R	DATA0_data [15:8]							
0x52	DATA1	R	DATA1_data [7:0]							
0x53		R	DATA1_data [15:8]							
0x7E	MANUFACTURER_ID	R	MANUFACTURER_ID							

(Note 1) Do not write any commands to other addresses except above. Do not write '1' to the field in which value is '0' in above table.

(0x40) SYSTEM_CONTROL

Fields	Function
SW_RESET	All registers are reset and this IC is in power down state by software reset. 0: Software reset is not done. 1: Software reset is done.
PART ID	Part ID 0x16 (Read only register)

Default value 0x16

(0x41) MODE_CONTROL

Fields	Function
MEAS_MODE	Measurement mode for DATA0, DATA1 Data 0: 100 ms mode 1: 200 ms mode Measurement time is specified in Electrical Characteristics.
DATA_GAIN [1:0]	ADC Gain setting for DATA0 and DATA1 Data. 00: x1 gain mode 01: x8 gain mode 10: x64 gain mode 11: x512 gain mode
MEAS_EN	0: Disable measurement 1: Enable measurement

Default value 0x02

Register MAP - continued

(0x42) INTERRUPT

Fields	Function
VALID	Measurement data update flag (Read only register). This register is cleared and turns to '0' by changing resister setting (Object register: 0x41 to 0x46) or reading VALID register. 0: Measurement data is not updated. 1: Measurement data is updated.
INT_STATUS	Interrupt status flag (Read only register) 0: Interrupt is inactive. 1: Interrupt is active.
INT_EN	Interrupt function setting 0: Interrupt function is inactive. 1: Interrupt function is active.
PERSIST [2:0]	Interrupt persistence function. 000: At the end of the measurement, the interrupt is active regardless of the interrupt threshold. 001: Interrupt status is updated at each measurement end. 010: Interrupt status is updated if 2 consecutive threshold judgments are the same. 011: Interrupt status is updated if 3 consecutive threshold judgments are the same. : : 110: Interrupt status is updated if 6 consecutive threshold judgments are the same. 111: Interrupt status is updated if 7 consecutive threshold judgments are the same.

Default value 0x01

(0x43 / 0x44) TH_LOW

Fields	Function
TH_LOW_data [15:0]	Interrupt threshold lower level

Default value 0x0000

(0x45 / 0x46) TH_HIGH

Fields	Function
TH_HIGH_data [15:0]	Interrupt threshold upper level

Default value 0xFFFF

(0x50 / 0x51) DATA0

Fields	Function
DATA0_data [15:0]	DATA0 measurement result

Default value 0x0000

(0x52 / 0x53) DATA1

Fields	Function
DATA1_data [15:0]	DATA1 measurement result

Default value 0x0000

(0x7E) MANUFACTURER_ID

Fields	Function
MANUFACTURER_ID	MANUFACTURER_ID: 0xE0

Default value 0xE0

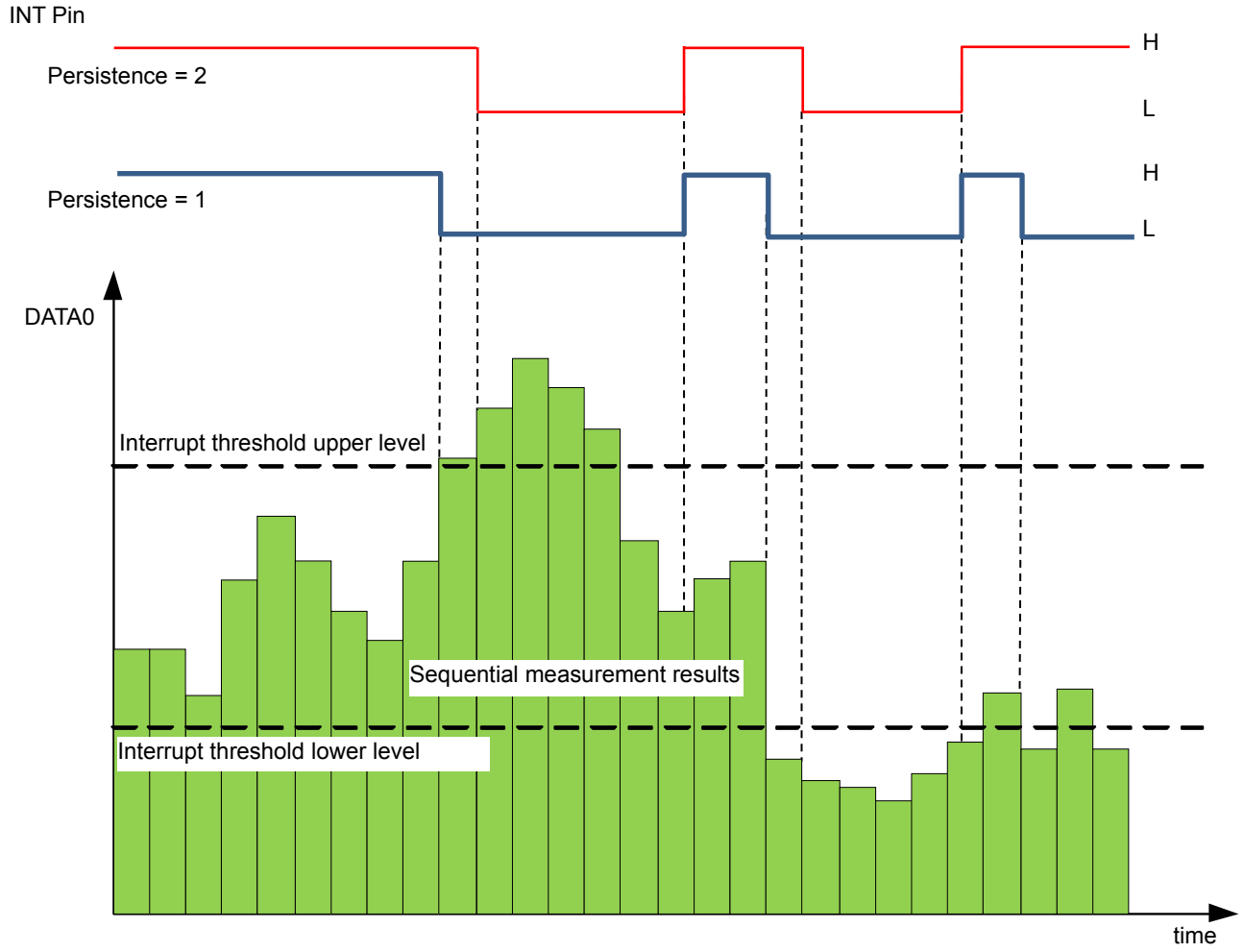
Interrupt function

Interrupt function compares DATA0 measurement result to preset threshold level. This IC uses two threshold levels (upper and lower). If measurement result is outside of the two thresholds, the INT pin outputs 'L'. Interrupt function is able to set at INTERRUPT register. And interrupt threshold is defined at TH_HIGH register and TH_LOW register.

The INT pin is high impedance when VCC is supplied.
There are three methods to return interrupt inactive.

1) Write any register at 0x41 to 0x46
2) Read INTERRUPT register
3) Send software reset command

EX) Interrupt behavior example



Illumination Calculation

BU27100NUC-MZ has two outputs, DATA0 (0x50, 0x51) for detecting visible light, and DATA1 (0x52, 0x53) for detecting visible light and infrared light. Lux value can be calculated by using two outputs. The calculation formula depends on the characteristic of optical window.

The example of the calculation formula for no optical window is shown as follows.
Adequate evaluation in a set environment is required to set the calculation formula.

Ex) No optical window (IC only)

$$D0 = D_{CH0}/DATA\_GAIN/MEAS\_MODE \times 512 \times 200$$

$$D1 = D_{CH1}/DATA\_GAIN/MEAS\_MODE \times 512 \times 200$$

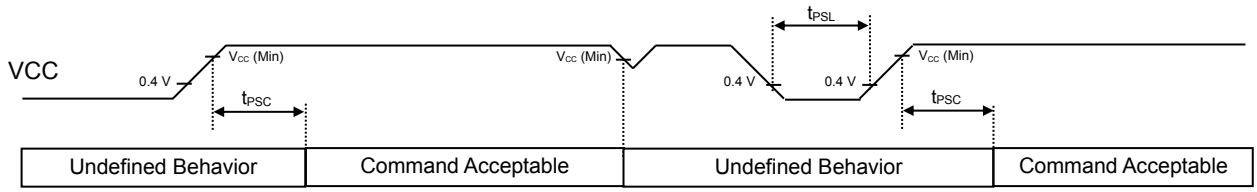
$$If\ (D1/D0 < 0.45)\quad Lux = (0.00361 \times D0 - 0.00163 \times D1) \times \left((D1/D0 - 0.45) \times 1.4 + 1\right)$$

$$else\qquad\qquad Lux = (0.00361 \times D0 - 0.00163 \times D1) \times \left((D1/D0 - 0.45) \times 0.2 + 1\right)$$

where:
$DATA\_GAIN$ is GAIN setting 1 or 8 or 64 or 512
$MEAS\_MODE$ is MEAS MODE setting 100 (100 ms) or 200 (200 ms)

Power Supply Sequence

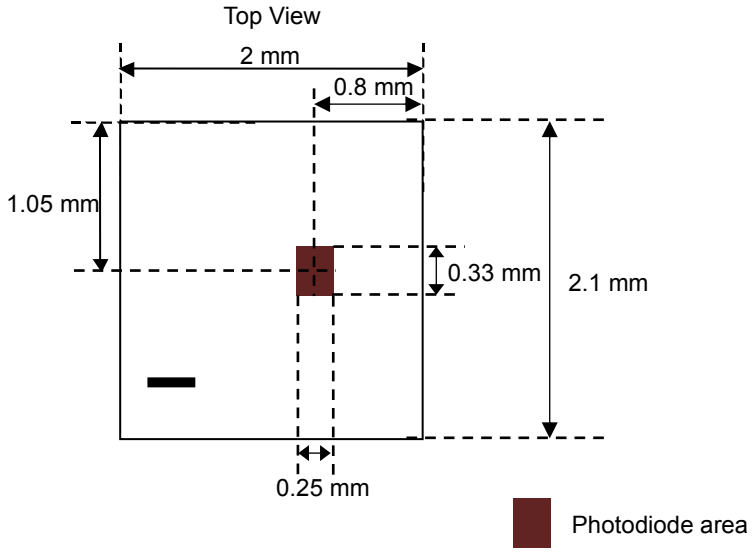
Unless otherwise specified Ta = -40 °C to +105 °C



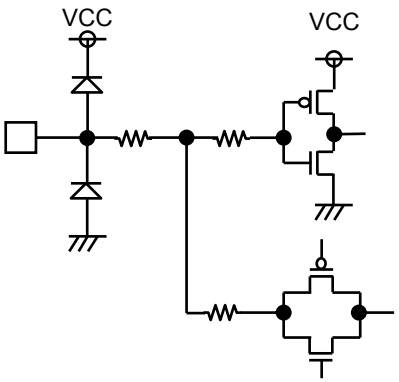
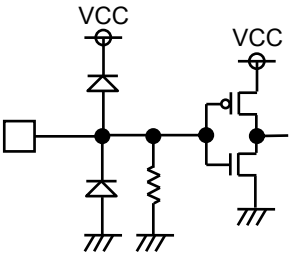
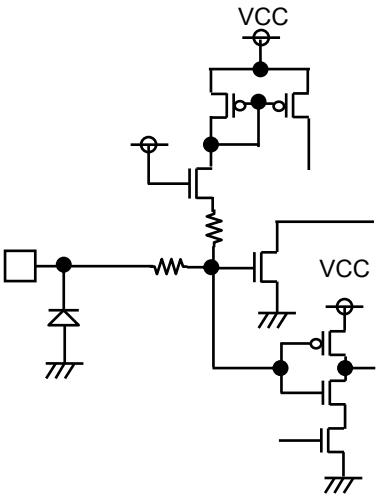
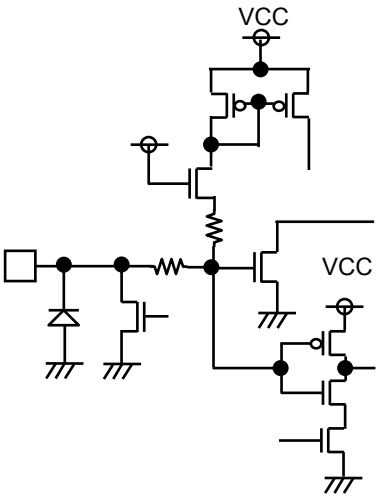
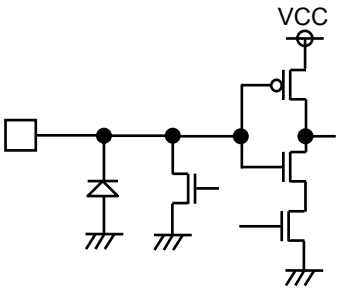
Parameter	Symbol	Min	Typ	Max	Unit
Command Input Wait Time after Power-up	t_{PSC}	100	-	-	µs
Power Down Time	t_{PSL}	1	-	-	ms

Command input is available after "t_{PSC}" from VCC is supplied.
If VCC voltage is below the recommended operating range, internal state is "Undefined Behavior". In this case, once power down and power up again.
Keep V_{CC} < 0.4 V for "t_{PSL}" or more before VCC is supplied again.

Optical Design for the Device



I/O Equivalence Circuits

Pin Name	Equivalence Circuit	Pin Name	Equivalence Circuit
ADDR		TEST1 TEST2	
SCL		SDA	
INT		-	-

Operational Notes

1. **Reverse Connection of Power Supply**
   Connecting the power supply in reverse polarity can damage the IC. Take precautions against reverse polarity when connecting the power supply, such as mounting an external diode between the power supply and the IC's power supply pins.

2. **Power Supply Lines**
   Design the PCB layout pattern to provide low impedance supply lines. Furthermore, connect a capacitor to ground at all power supply pins. Consider the effect of temperature and aging on the capacitance value when using electrolytic capacitors.

3. **Ground Voltage**
   Ensure that no pins are at a voltage below that of the ground pin at any time, even during transient condition.

4. **Ground Wiring Pattern**
   When using both small-signal and large-current ground traces, the two ground traces should be routed separately but connected to a single ground at the reference point of the application board to avoid fluctuations in the small-signal ground caused by large currents. Also ensure that the ground traces of external components do not cause variations on the ground voltage. The ground lines must be as short and thick as possible to reduce line impedance.

5. **Recommended Operating Conditions**
   The function and operation of the IC are guaranteed within the range specified by the recommended operating conditions. The characteristic values are guaranteed only under the conditions of each item specified by the electrical characteristics.

6. **Inrush Current**
   When power is first supplied to the IC, it is possible that the internal logic may be unstable and inrush current may flow instantaneously due to the internal powering sequence and delays, especially if the IC has more than one power supply. Therefore, give special consideration to power coupling capacitance, power wiring, width of ground wiring, and routing of connections.

7. **Testing on Application Boards**
   When testing the IC on an application board, connecting a capacitor directly to a low-impedance output pin may subject the IC to stress. Always discharge capacitors completely after each process or step. The IC's power supply should always be turned off completely before connecting or removing it from the test setup during the inspection process. To prevent damage from static discharge, ground the IC during assembly and use similar precautions during transport and storage.

8. **Inter-pin Short and Mounting Errors**
   Ensure that the direction and position are correct when mounting the IC on the PCB. Incorrect mounting may result in damaging the IC. Avoid nearby pins being shorted to each other especially to ground, power supply and output pin. Inter-pin shorts could be due to many reasons such as metal particles, water droplets (in very humid environment) and unintentional solder bridge deposited in between pins during assembly to name a few.

9. **Unused Input Pins**
   Input pins of an IC are often connected to the gate of a MOS transistor. The gate has extremely high impedance and extremely low capacitance. If left unconnected, the electric field from the outside can easily charge it. The small charge acquired in this way is enough to produce a significant effect on the conduction through the transistor and cause unexpected operation of the IC. So unless otherwise specified, unused input pins should be connected to the power supply or ground line.

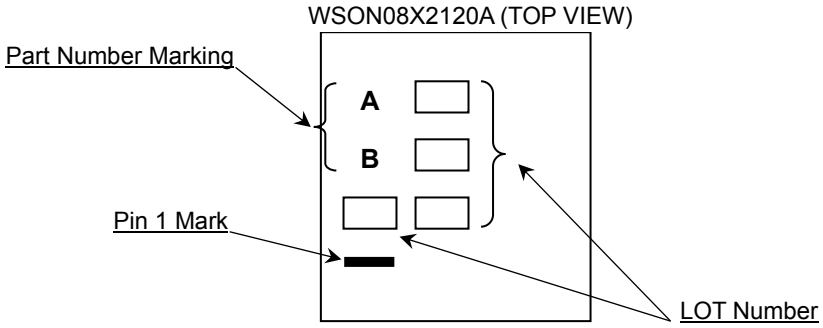
10. **Regarding the Input Pin of the IC**
    In the construction of this IC, P-N junctions are inevitably formed creating parasitic diodes or transistors. The operation of these parasitic elements can result in mutual interference among circuits, operational faults, or physical damage. Therefore, conditions which cause these parasitic elements to operate, such as applying a voltage to an input pin lower than the ground voltage should be avoided. Furthermore, do not apply a voltage to the input pins when no power supply voltage is applied to the IC. Even if the power supply voltage is applied, make sure that the input pins have voltages within the values specified in the electrical characteristics of this IC.

11. **Ceramic Capacitor**
    When using a ceramic capacitor, determine a capacitance value considering the change of capacitance with temperature and the decrease in nominal capacitance due to DC bias and others.

Ordering Information

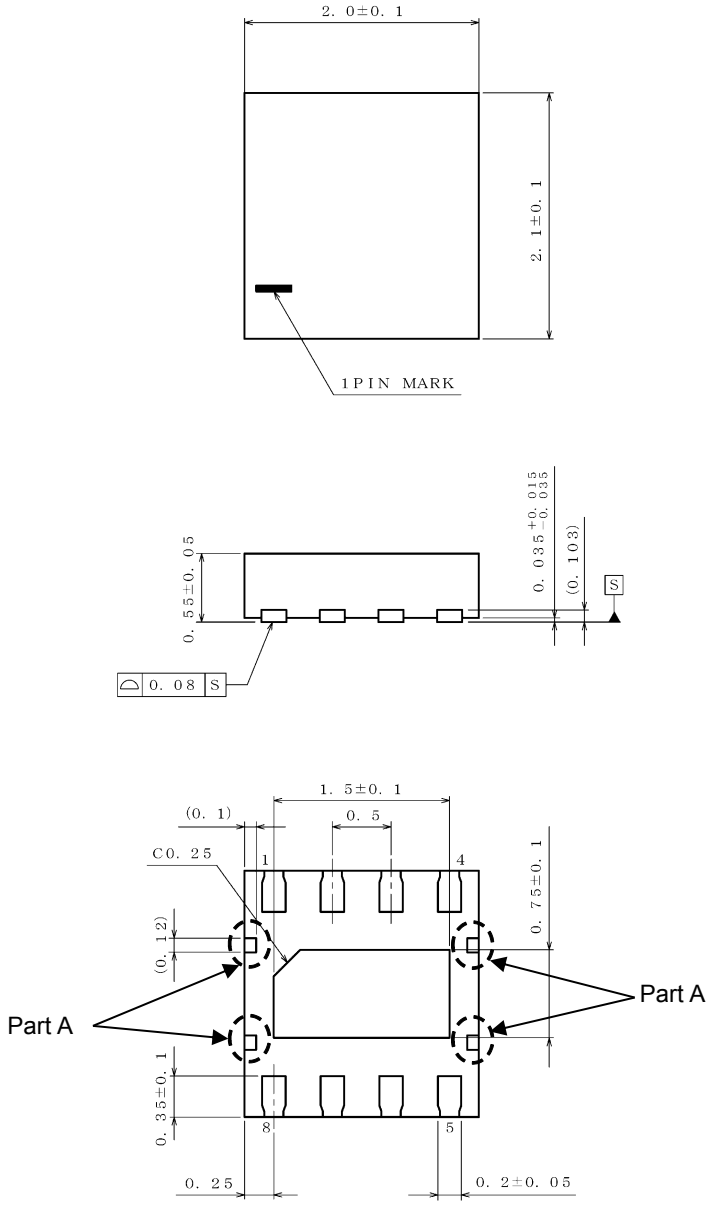
B U 2 7 1 0 0 N U C - M Z E 2		
	Package NUC-Z: WSON08X2120A	Product Rank M: for Automotive Packaging Specification E2: Embossed tape and reel

Marking Diagram



Physical Dimension and Packing Information

Package Name	WSON08X2120A



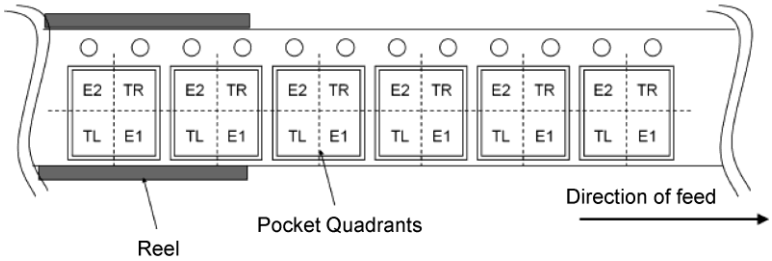
Do not place a land pattern in part A to keep clearance between pin 1, pin 4, pin 5 and pin 8.
Part A is electrically connected to EXP-PAD internally.

(UNIT : mm)

PKG : WSON08X2120A
Drawing No. EX001−0086−1

< Tape and Reel Information >

Tape	Embossed carrier tape
Quantity	4000pcs
Direction of feed	E2 The direction is the pin 1 of product is at the upper left when you hold reel on the left hand and you pull out the tape on the right hand



Revision History

Date	Revision	Changes
24.Apr.2024	001	New Release

Notice

Precaution on using ROHM Products

1. If you intend to use our Products in devices requiring extremely high reliability (such as medical equipment (Note 1), aircraft/spacecraft, nuclear power controllers, etc.) and whose malfunction or failure may cause loss of human life, bodily injury or serious damage to property ("Specific Applications"), please consult with the ROHM sales representative in advance. Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of any ROHM's Products for Specific Applications.

(Note1) Medical Equipment Classification of the Specific Applications

JAPAN	USA	EU	CHINA
CLASSⅢ	CLASSⅢ	CLASSⅡb	CLASSⅢ
CLASSⅣ		CLASSⅢ	

2. ROHM designs and manufactures its Products subject to strict quality control system. However, semiconductor products can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against the physical injury, damage to any property, which a failure or malfunction of our Products may cause. The following are examples of safety measures:
   [a] Installation of protection circuits or other protective devices to improve system safety
   [b] Installation of redundant circuits to reduce the impact of single or multiple circuit failure

3. Our Products are not designed under any special or extraordinary environments or conditions, as exemplified below. Accordingly, ROHM shall not be in any way responsible or liable for any damages, expenses or losses arising from the use of any ROHM's Products under any special or extraordinary environments or conditions. If you intend to use our Products under any special or extraordinary environments or conditions (as exemplified below), your independent verification and confirmation of product performance, reliability, etc, prior to use, must be necessary:
   [a] Use of our Products in any types of liquid, including water, oils, chemicals, and organic solvents
   [b] Use of our Products outdoors or in places where the Products are exposed to direct sunlight or dust
   [c] Use of our Products in places where the Products are exposed to sea wind or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [d] Use of our Products in places where the Products are exposed to static electricity or electromagnetic waves
   [e] Use of our Products in proximity to heat-producing components, plastic cords, or other flammable items
   [f] Sealing or coating our Products with resin or other coating materials
   [g] Use of our Products without cleaning residue of flux (Exclude cases where no-clean type fluxes is used. However, recommend sufficiently about the residue.); or Washing our Products by using water or water-soluble cleaning agents for cleaning residue after soldering
   [h] Use of the Products in places subject to dew condensation

4. The Products are not subject to radiation-proof design.

5. Please verify and confirm characteristics of the final or mounted products in using the Products.

6. In particular, if a transient load (a large amount of load applied in a short period of time, such as pulse, is applied, confirmation of performance characteristics after on-board mounting is strongly recommended. Avoid applying power exceeding normal rated power; exceeding the power rating under steady-state loading condition may negatively affect product performance and reliability.

7. De-rate Power Dissipation depending on ambient temperature. When used in sealed area, confirm that it is the use in the range that does not exceed the maximum junction temperature.

8. Confirm that operation temperature is within the specified range described in the product specification.

9. ROHM shall not be in any way responsible or liable for failure induced under deviant condition from what is defined in this document.

Precaution for Mounting / Circuit board design

1. When a highly active halogenous (chlorine, bromine, etc.) flux is used, the residue of flux may negatively affect product performance and reliability.

2. In principle, the reflow soldering method must be used on a surface-mount products, the flow soldering method must be used on a through hole mount products. If the flow soldering method is preferred on a surface-mount products, please consult with the ROHM representative in advance.

For details, please refer to ROHM Mounting specification

Precautions Regarding Application Examples and External Circuits

1. If change is made to the constant of an external circuit, please allow a sufficient margin considering variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.

2. You agree that application notes, reference designs, and associated data and information contained in this document are presented only as guidance for Products use. Therefore, in case you use such information, you are solely responsible for it and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties arising from the use of such information.

Precaution for Electrostatic

This Product is electrostatic sensitive product, which may be damaged due to electrostatic discharge. Please take proper caution in your manufacturing process and storage so that voltage exceeding the Products maximum rating will not be applied to Products. Please take special care under dry condition (e.g. Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control).

Precaution for Storage / Transportation

1. Product performance and soldered connections may deteriorate if the Products are stored in the places where:
   [a] the Products are exposed to sea winds or corrosive gases, including Cl_2, H_2S, NH_3, SO_2, and NO_2
   [b] the temperature or humidity exceeds those recommended by ROHM
   [c] the Products are exposed to direct sunshine or condensation
   [d] the Products are exposed to high Electrostatic

2. Even under ROHM recommended storage condition, solderability of products out of recommended storage time period may be degraded. It is strongly recommended to confirm solderability before using Products of which storage time is exceeding the recommended storage time period.

3. Store / transport cartons in the correct direction, which is indicated on a carton with a symbol. Otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

4. Use Products within the specified time after opening a humidity barrier bag. Baking is required before using Products of which storage time is exceeding the recommended storage time period.

Precaution for Product Label

A two-dimensional barcode printed on ROHM Products label is for ROHM's internal use only.

Precaution for Disposition

When disposing Products please dispose them properly using an authorized industry waste company.

Precaution for Foreign Exchange and Foreign Trade act

Since concerned goods might be fallen under listed items of export control prescribed by Foreign exchange and Foreign trade act, please consult with ROHM in case of export.

Precaution Regarding Intellectual Property Rights

1. All information and data including but not limited to application example contained in this document is for reference only. ROHM does not warrant that foregoing information or data will not infringe any intellectual property rights or any other rights of any third party regarding such information or data.

2. ROHM shall not have any obligations where the claims, actions or demands arising from the combination of the Products with other articles such as components, circuits, systems or external equipment (including software).

3. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of ROHM or any third parties with respect to the Products or the information contained in this document. Provided, however, that ROHM will not assert its intellectual property rights or other rights against you or your customers to the extent necessary to manufacture or sell products containing the Products, subject to the terms and conditions herein.

Other Precaution

1. This document may not be reprinted or reproduced, in whole or in part, without prior written consent of ROHM.

2. The Products may not be disassembled, converted, modified, reproduced or otherwise changed without prior written consent of ROHM.

3. In no event shall you use in any way whatsoever the Products and the related technical information contained in the Products or this document for any military purposes, including but not limited to, the development of mass-destruction weapons.

4. The proper names of companies or products described in this document are trademarks or registered trademarks of ROHM, its affiliated companies or third parties.

General Precaution

1. Before you use our Products, you are requested to carefully read this document and fully understand its contents. ROHM shall not be in any way responsible or liable for failure, malfunction or accident arising from the use of any ROHM's Products against warning, caution or note contained in this document.

2. All information contained in this document is current as of the issuing date and subject to change without any prior notice. Before purchasing or using ROHM's Products, please confirm the latest information with a ROHM sales representative.

3. The information contained in this document is provided on an "as is" basis and ROHM does not warrant that all information contained in this document is accurate and/or error-free. ROHM shall not be in any way responsible or liable for any damages, expenses or losses incurred by you or third parties resulting from inaccuracy or errors of or concerning such information.