ZDP323B Series Digital PIR Sensor with I^2C Interface

Product Specification

Preliminary

PS041703-0324

Warning: DO NOT USE IN LIFE SUPPORT

LIFE SUPPORT POLICY

ZILOG'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF ZILOG CORPORATION.

As used herein

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

Document Disclaimer

Revision History

Each instance in this document's revision history reflects a change from its previous edition. For more details, refer to the corresponding page(s) or appropriate links furnished in the table below.

Date	Revision Level	Description	Pages
April 2022	01	Original issue.	All
Jan. 2024	02	Updated copyright dates	i, ii
		Added note on bandpass output data values.	9
March 2024	03	Corrected Product Brief document number	23

1 Overview

Zilog's ZDP323B series of Digital Passive Infrared (DPIR) sensors combines a dual element PIR sensor with all necessary signal processing and an I^2C communication interface to provide a fully integrated motion sensor, delivering high performance and excellent EMI immunity for the most demanding motion detection applications.

The device is a dual element, balanced differential (series-opposed type) sensor that comes in a 4-pin TO-5 nickel-plated metal can. The sensing elements are placed behind a spectral filter window tuned to 8-13µm wavelength to help block out unwanted IR energy sources.

Communication is supported over an I^2C interface and signal processing is performed digitally with programmable gain, bandwidth, and detection thresholds.

The ZDP323B DPIR sensor should be used in combination with a passive infrared lens.

1.1 Features

- Dual-element balanced differential (series opposed) PIR sensor
- Integrated signal processing with programmable filter/gain profiles
- Programmable thresholds
- I^2C interface with trigger output mode
- Up to 4 devices can be supported on a single I^2C bus
- 10-bit addressing, or General Call supported
- Elements are 0.75mm x 2.3mm spaced 0.6mm apart
- Wide Field of View: 148° x 136°
- Standard 4-pin metal TO-5 package
- Wide operating voltage range of 1.8V to 5.5V
- 3µA operating current
- Operating temperature range of -40°C to +80°C

1.2 Applications

- Video Doorbell
- IP Camera
- HVAC Control
- Home Appliances
- Lighting Control
- Proximity Detection

2 Ordering Information

There are four variations of the ZDP323B series Digital PIR Sensor available, differentiated by their I^2C bus address. All other performance, functions and features remain the same. All devices will also respond to an I^2C General Call transaction.

Table 1 - Ordering Information

Part Number	Description	I^2C Bus Address
ZDP323B1	Digital PIR Sensor; Dual Element, I2C Bus	301h
ZDP323B2	Digital PIR Sensor; Dual Element, I2C Bus	302h
ZDP323B3	Digital PIR Sensor; Dual Element, I2C Bus	303h
ZDP323B4	Digital PIR Sensor; Dual Element, I2C Bus	304h

3 Block Diagram

The device consists of two series opposed PIR sensing elements connected to a FET follower and all other processing required to detect motion. An I^2C interface is provided for communications. The SDA signal can be used as a Motion Trigger output to interrupt or wake up a host processor when motion is detected.

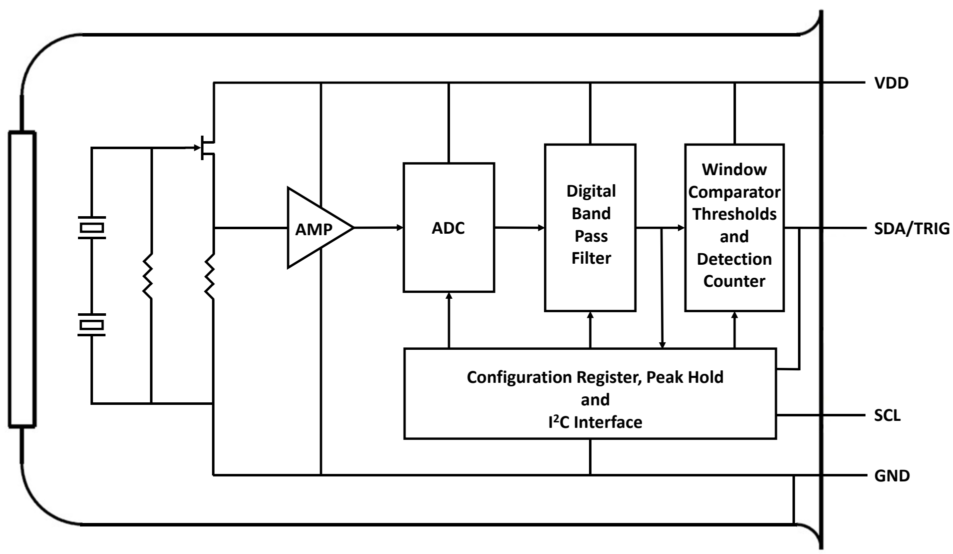


Figure 1 - Block Diagram

3.1 Operation

Refer to Figure 1. An amplifier provides buffering of the PIR signal for the ADC which performs a conversion every 9.5ms and passes the result to the digital bandpass filter. One of several different filter profiles can be selected depending on performance requirements and lens characteristics.

Peak values from the output of the bandpass filter are saved in the Peak Hold register and can be read over the I^2C interface. This is useful for development when selecting the best filter profile for the application requirements and specific lens being used.

If Trigger Output mode is enabled, the output of the digital band pass filter is passed to a digital window comparator with programmable thresholds. When the signal exceeds the selected window threshold, the detection counter is incremented. If the signal still exceeds ½ the selected threshold when the next ADC sample is processed, the detection counter is incremented again, and the Trigger Output (TRIG pin) is driven active for 50µs indicating that a motion event has been detected. When multiple devices are on the same I^2C bus, the Peak Hold value is read to determine which device asserted its Trigger Output.

4 Pin Descriptions

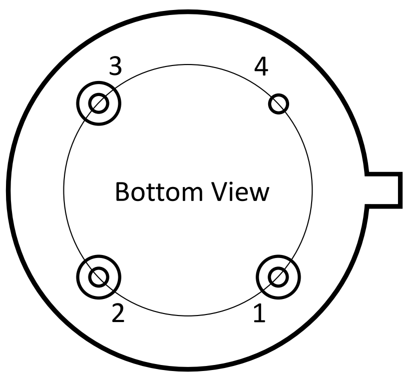


Figure 2 - Bottom View Pin Out

Table 2 - Pin Descriptions

Pin	Name	Description
1	SDA/TRIG	**SDA:** I^2C Serial Data Transfers data to/from external I^2C master. **TRIG:** Motion Trigger Driven low when motion detected
2	VDD	Power Supply
3	SCL	I^2C Serial Clock Serial clock input from extern I^2C master
4	GND	Ground - Case

5 Field of View

The typical Field of View (FOV) of the ZDP323B series Digital PIR Sensor is 148° in the X axis and 136° in the Y axis as shown in the following figure.

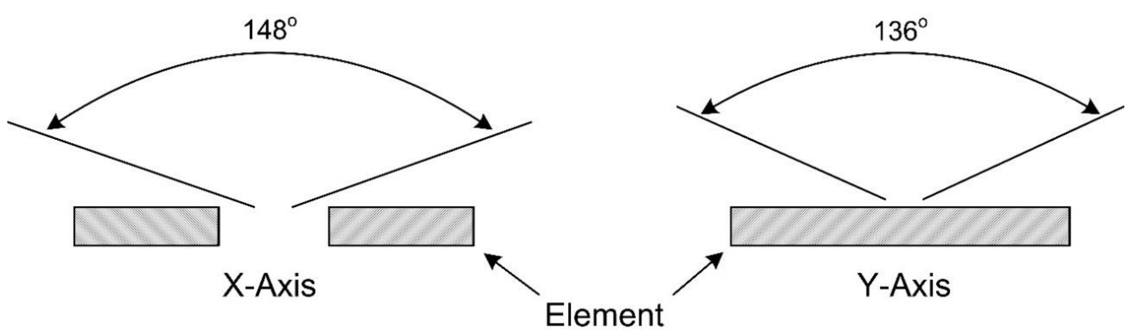


Figure 3 - Field of View

6 Mechanical Dimensions

The dimensions of the ZDP323B series Digital PIR Sensor are shown in the following figures. All dimensions are ±0.2mm unless otherwise stated.

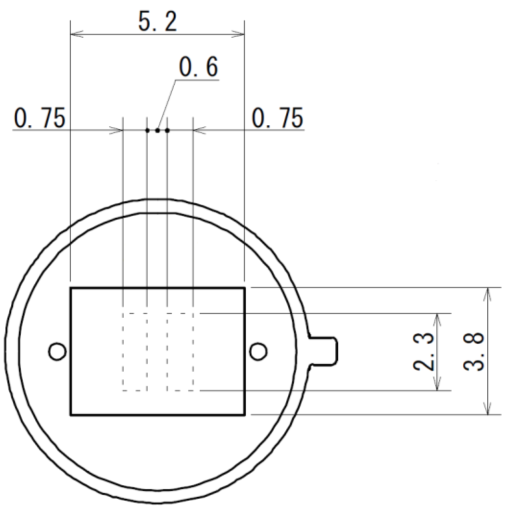


Figure 4 - Top View

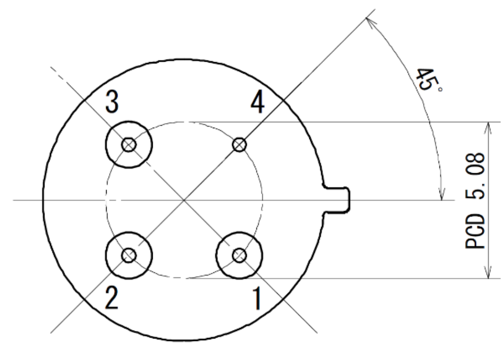


Figure 5 - Bottom View

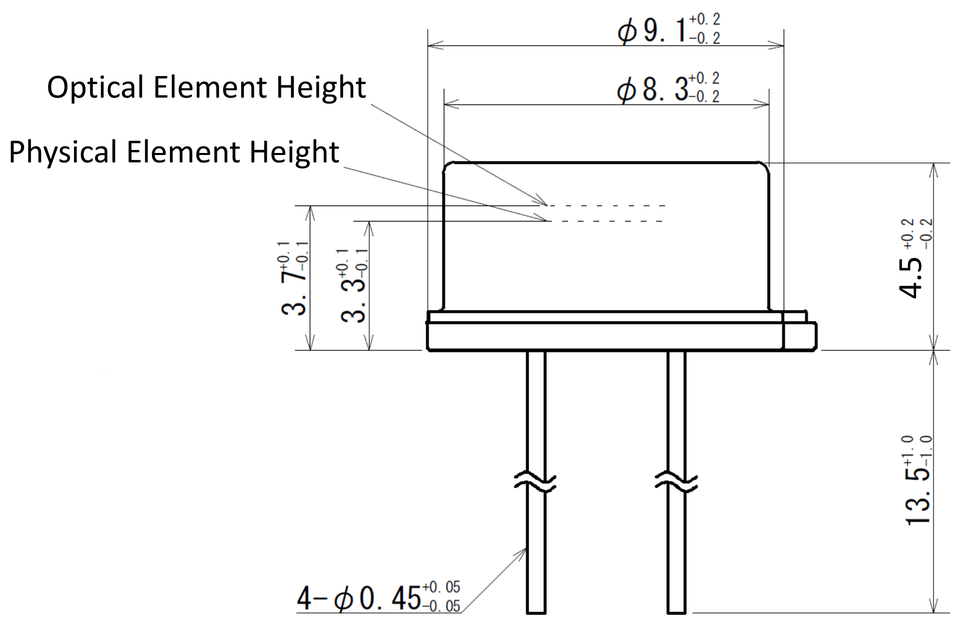


Figure 6 – Side View

Note: The Optical Element Height specified provides the effective focal length required for the lens. The higher distance as compared to the Physical Element Height is due to the refraction caused by the window material.

7 Device Markings

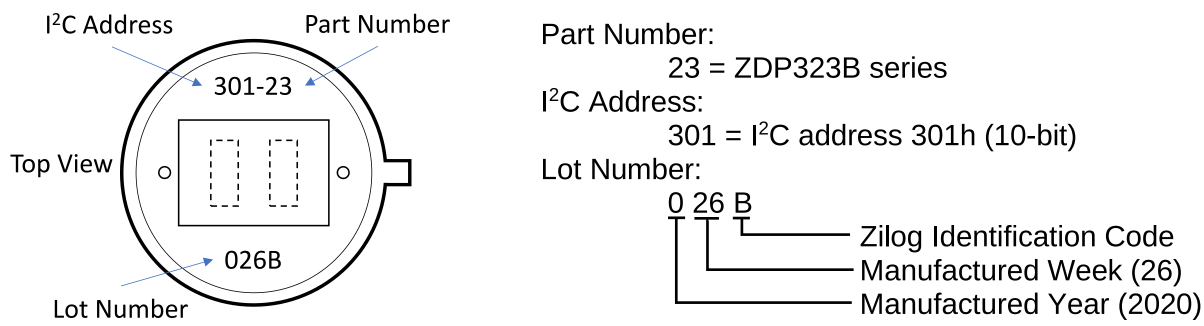


Figure 7 - Device Markings

8 Recommended Circuit

The recommended SDA and SCL pull up resistor value for 100KHz I^{2}C operation is 100KΩ.

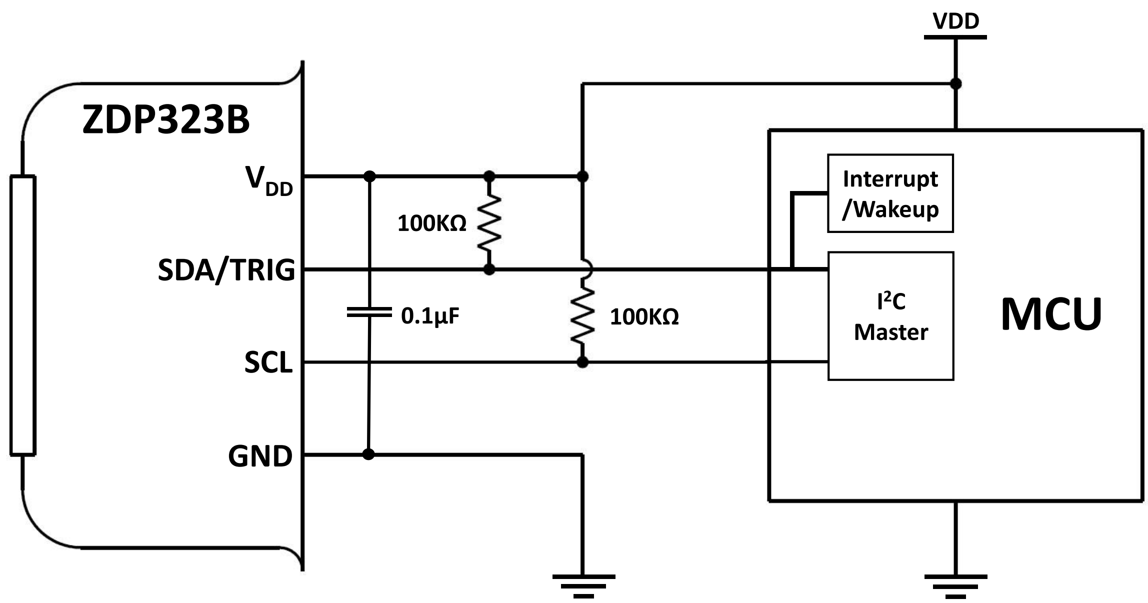


Figure 8 - Recommended Interface Circuit

Note: The 0.1µF decoupling capacitor is not required in all applications. Include this capacitor in designs where the supply voltage is not well regulated or contains significant noise.

9 Communications Interface

9.1 I²C Bus Mode

The ZDP323B Digital PIR Sensor provides an I²C interface to communicate with a host MCU. The I²C interface operates as a slave device and supports standard mode (100 KHz) and fast mode (400 KHz) operation.

9.2 I²C Slave Addressing

There are four unique 10-bit I²C addresses to choose from, which are differentiated by the last digit in the part number (see Table 3 below). This allows up to four ZDP323 devices to share the same I²C bus.

All devices also respond to the I²C 7-bit General Call transaction. This is recommended for applications where the ZDP323 Digital PIR Sensor is the only device on the I²C bus as it provides a simpler communications method with less overhead.

Device part numbers end in 1, 2, 3 or 4 to identify the specific 10-bit I²C address the device is using (301h to 304h). The specific addresses are listed in Table 3 along with the recommended part numbers to use depending on the number of Digital PIR sensors on a shared I²C bus.

For example, if only a single Digital PIR sensor is on the I²C bus, the ZDP323B1 is recommended. If two Digital PIR sensors are on the same I²C bus, it is recommended to select the ZDP323B1 and ZDP323B2 sensors.

Table 3 - I²C Slave Addresses

Part Number	I²C Bus Address	Number of Digital PIR Devices on Same I²C Bus			
		1	2	3	4
ZDP323B1	301h	X	X	X	X
ZDP323B2	302h		X	X	X
ZDP323B3	303h			X	X
ZDP323B4	304h				X

9.3 Power On Initialization

The device is ready for communications 0.5 seconds after V_{DD} reaches the minimum supply voltage of 1.8V. No communication should be attempted prior to this time.

After 0.5 seconds, the Configuration Register may be written and stability time delay T_{STAB} started.

9.4 Writing to the Configuration Register

The Configuration Register data consists of 56 bits and controls the operation of the Digital PIR Sensor. The device can support either a 10-bit I^2C transaction or a 7-bit General Call transaction. Both transaction types are shown in the following figures.

The configuration register bits are sent to the sensor directly after sending the slave address (or General Call Address). No internal device addressing is required. Configuration bits are sent sequentially starting with bit 55 (Most Significant Bit first).

If the configuration register is not set after power on, the default values are applied for Detection Threshold, Digital band pass filter step and Digital band pass filter type.

See Table 4 for configuration register bit definitions and default values.

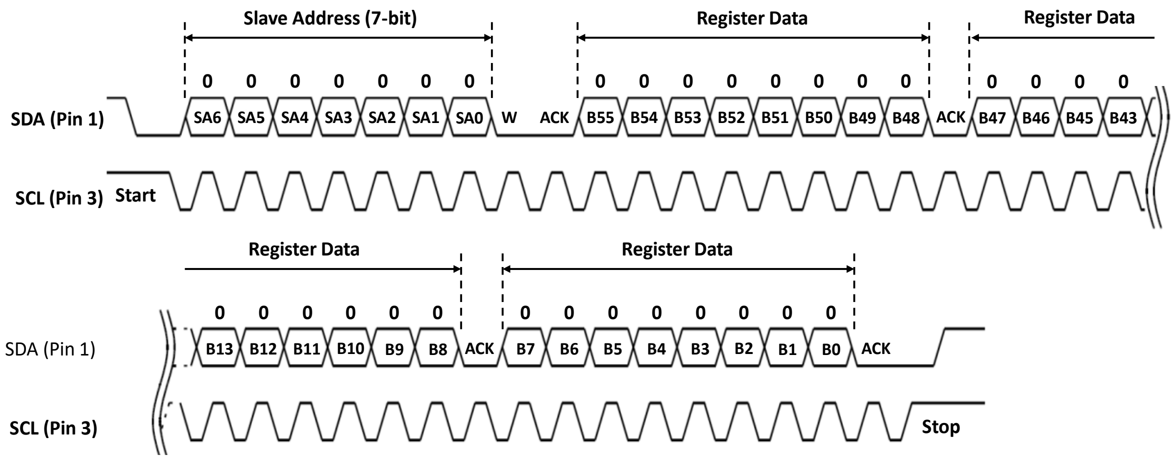


Figure 9 - Configuration Register Write (7-bit Address)

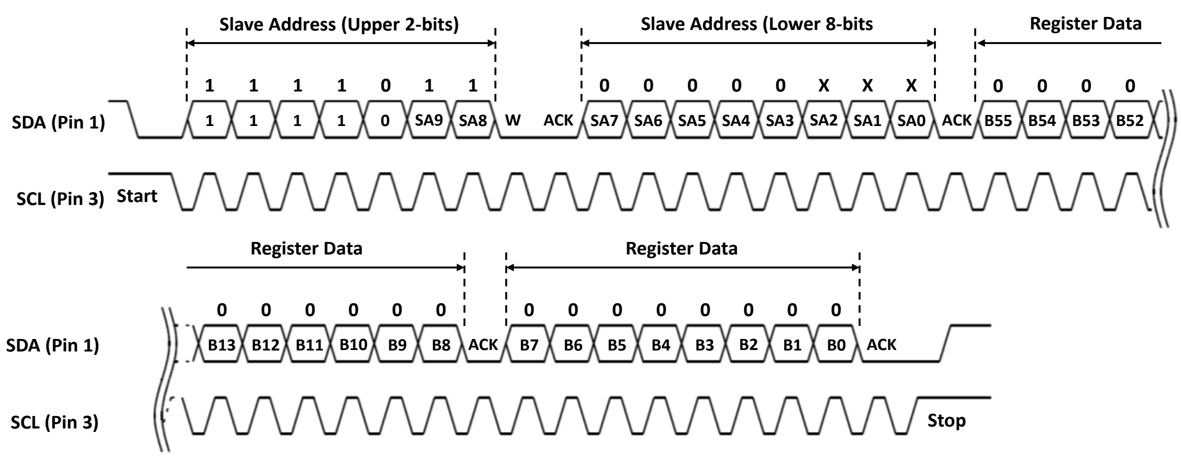


Figure 10 - Configuration Register Write (10-bit Address)

9.4.1 Reading Peak Hold Data

The ZDP323B Digital PIR Sensor tracks the peak value from the output of the bandpass filter which can be read over the I²C interface. This value is provided in a 12-bit, signed, 2's compliment format.

The peak hold value is tracked each time the bandpass filter output is updated. The output value from the bandpass filter is compared against the current peak hold value. If the absolute value of the bandpass filter output is greater than the current peak hold absolute value, it is saved as the new peak hold value.

Figure 11 shows the I²C transaction used to read the Peak Hold Data using the 7-bit General Call transaction and Figure 12 shows the I²C transaction required to read the Peak Hold Data using a 10-bit address.

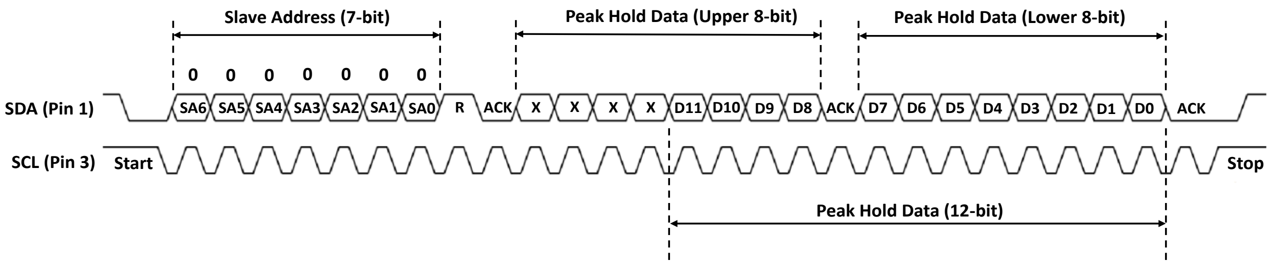


Figure 11 - Peak Hold Data Read (7-bit Address)

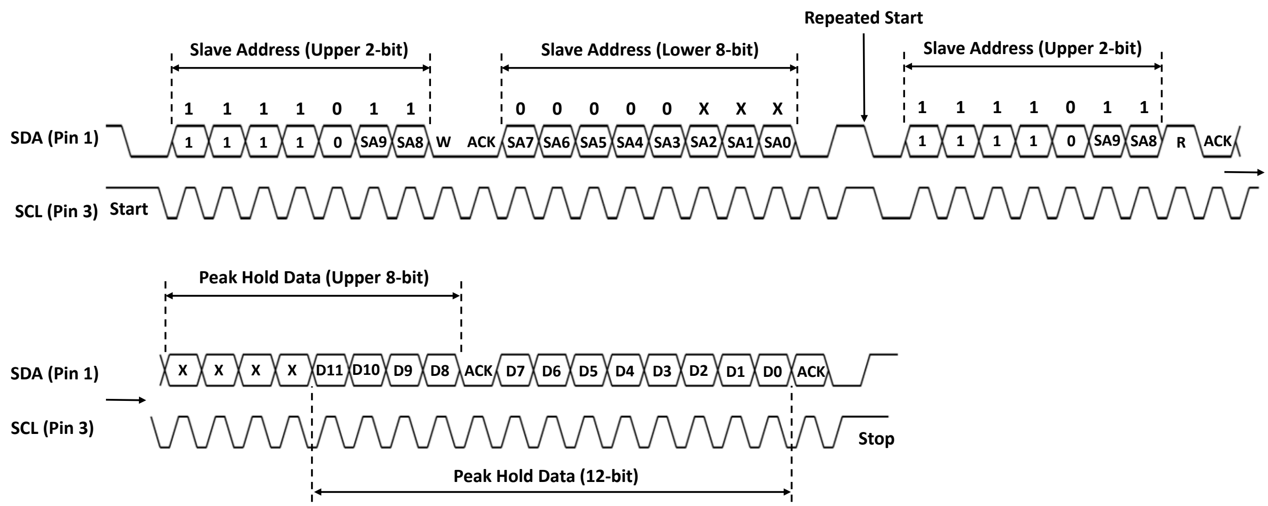


Figure 12 - Peak Hold Data (10-bit Address)

When the Peak Hold value is read, it is reset to 0 and tracking starts over. If the Peak Hold Data is read at a rate shorter than T_{CYC}, the value returned could be 0 (since it has not been updated since the last read). Therefore, it is recommended to read the Peak Hold data at a rate not less than ~10ms.

The Peak Hold value should not be read until the sensor stability time (T_{STAB}) has completed.

9.5 Trigger Output Mode

The ZDP323B Digital PIR Sensor can operate in a Trigger Output Mode to signal a host MCU when a motion event is detected. When Trigger Output Mode is enabled, the SDA/TRIG pin is driven active low when the sensor signal meets the defined motion detection qualification parameters.

9.5.1 Enabling and Disabling Trigger Output Mode

Trigger Output Mode is enabled by writing control register TRIGOM (Bit 23) to a 1 and is disabled by writing it to a 0. The default state is disabled.

When enabled, the SDA/TRIG pin remains open drain (external pull up resistor required) until a qualified motion event is detected. SDA/TRIG is driven low for 50µs when a motion event is detected.

When Trigger Output mode is enabled, if the SCL pin is driven low while the SDA/TRIG pin is active (low), and an I^2C START condition is satisfied, the SDA/TRIG pin is released automatically, and the sensor operates as slave. The ensures an I^2C master can write to and read from the device while Triggered Output Mode is enabled.

9.6 Detection Counter

This ZDP323B features a detection counter, which controls the Trigger Output. The Detection counter is set to 1 when the signal output of the Bandpass Filter exceeds the Detection Threshold level set in the Configuration Register (bits 15 to 22). If the next bandpass filter output exceeds ½ the Detection Threshold, the counter is incremented to 2 and the Trigger Output is activated.

The Detection Counter is cleared under the following conditions:

- After activating the Trigger Output.
- When the bandpass filter output is less than ½ the Detection Threshold.
- When an I^2C Start condition is satisfied.

Caution: Since the Detection Counter is reset on each I^2C Start condition, the Trigger Output will not be asserted if the I^2C Master continuously communicates with the device. If the I^2C Master needs to continually communicate with the device (monitoring Peak Hold data), Trigger Output Mode should be disabled.

Note:

The bandpass filter sampling period is more frequent than the Trigger output update period which can result in a situation where the Trigger Output deactivation appears delayed as compared to the output data. This can result in the output data being up to +/- 3 counts outside of the programmed threshold value.

Refer to the flow chart in Figure 13 and the operation example in Figure 14 for more details.

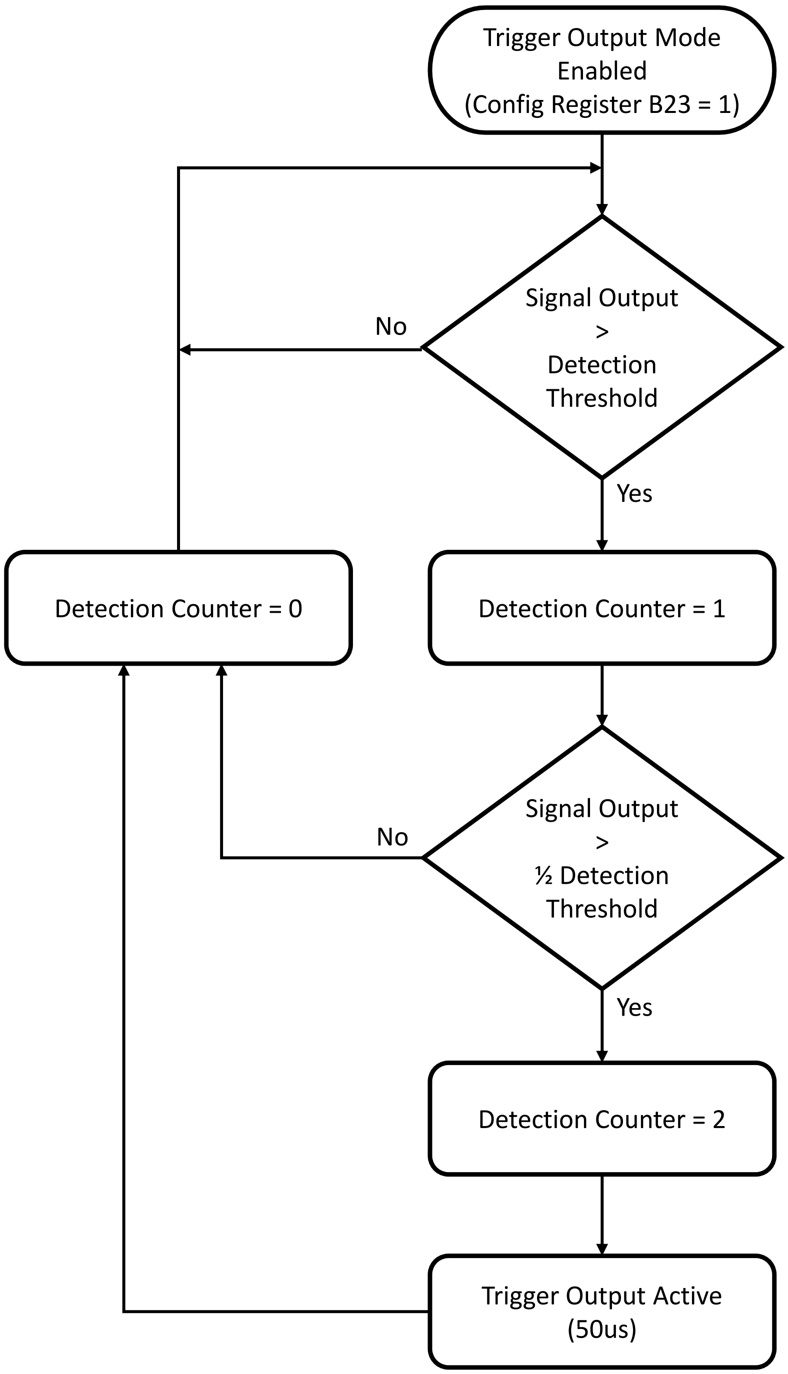


Figure 13 - Detection Counter Flow Chart

9.6.1 Trigger Output Operation Example

Refer to Figure 14 for the following description.

A:	I²C transaction. Host MCU enables Trigger Output mode by setting TRIGOM (Configuration register bit 23) to a 1. The Detection Counter is reset to 0.
B:	Signal Output exceeds Detection Threshold; Detection Counter = 1
C:	Signal Output still exceeds ½ Detection Threshold; Detection Counter = 2; Trigger Output (SDA/TRIG) activated (driven low) for 50µs.
D:	I²C transaction. Host MCU disables Trigger Output mode by writing TRIGOM to 0.
E:	I²C transaction. Host reads Peak Hold data. This is required when multiple ZDP323B devices are connected on the same I²C bus. Reading Peak Hold data allows the Host MCU to determine which device activated the Output Trigger since the Peak Hold data value will be greater than the Detection Threshold. If only a single device is on the I²C bus, steps D and E are not necessary.

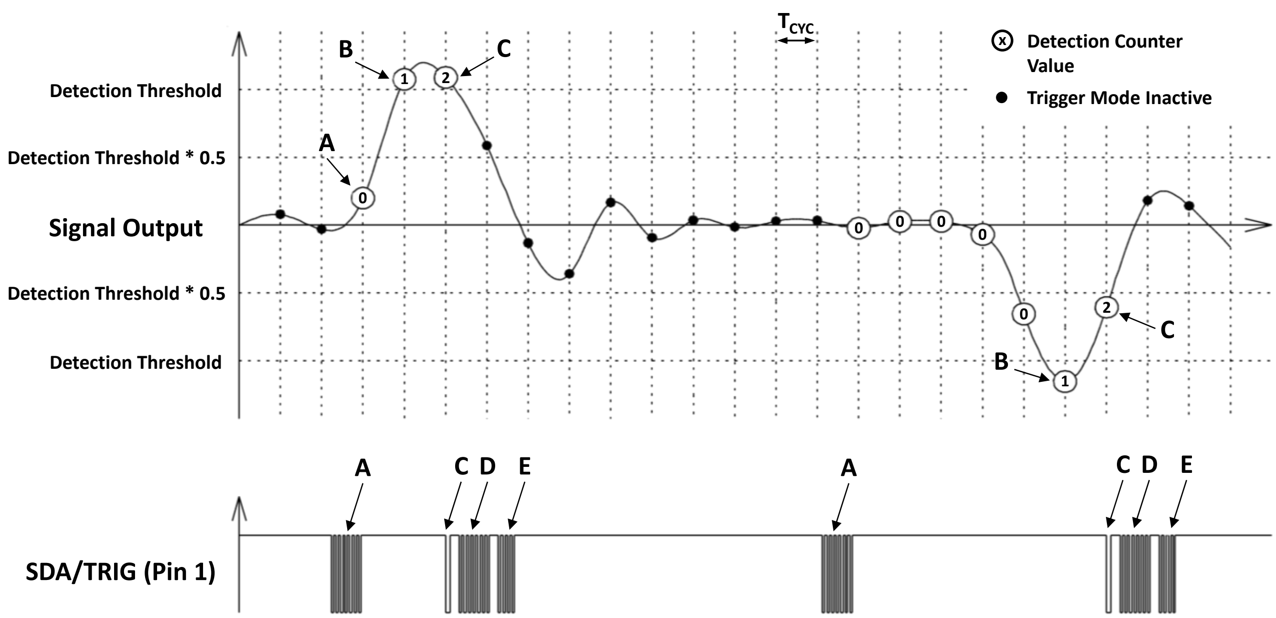


Figure 14 - Trigger Output Mode Example

Note:

Trigger Output mode should be enabled only when the signal output is less than the ½ Detection Threshold. The following procedure can be used to ensure this:

1. Write the Detection Threshold (Configuration register bits 15 to 22) to its maximum value (FFh).
2. Continually read the Peak Hold value every 10ms until the value is below ½ the Detection Threshold value (7Fh).
3. Write the Configuration register with the required Detection Threshold, filter selection and Trigger Output mode enabled.

10 Device Reset

The ZDP323B Digital PIR Sensor can be reset by the following methods:

1. Write to the Configuration Register with default values as described in section 9.4 and 13.
2. Power cycle. The supply voltage should be held below 0.5V for 30ms or longer. After a power cycle, the Configuration Register values will be at their reset value described in Table 4.

11 Stability Time

After the device is powered on, or any time the Bandpass filter settings are changed, the device must be allowed to stabilize before motion can be detected reliably. Sensor Data values and the Trigger Output should be ignored until the stability time has finished. This time is defined by T_{STAB} in Table 9.

12 Operation Examples

The following sections provide an example of operating the ZDP323B Digital PIR Sensor in a single device application (Figure 15) and a multiple device application (Figure 16).

12.1 Single Device Operation

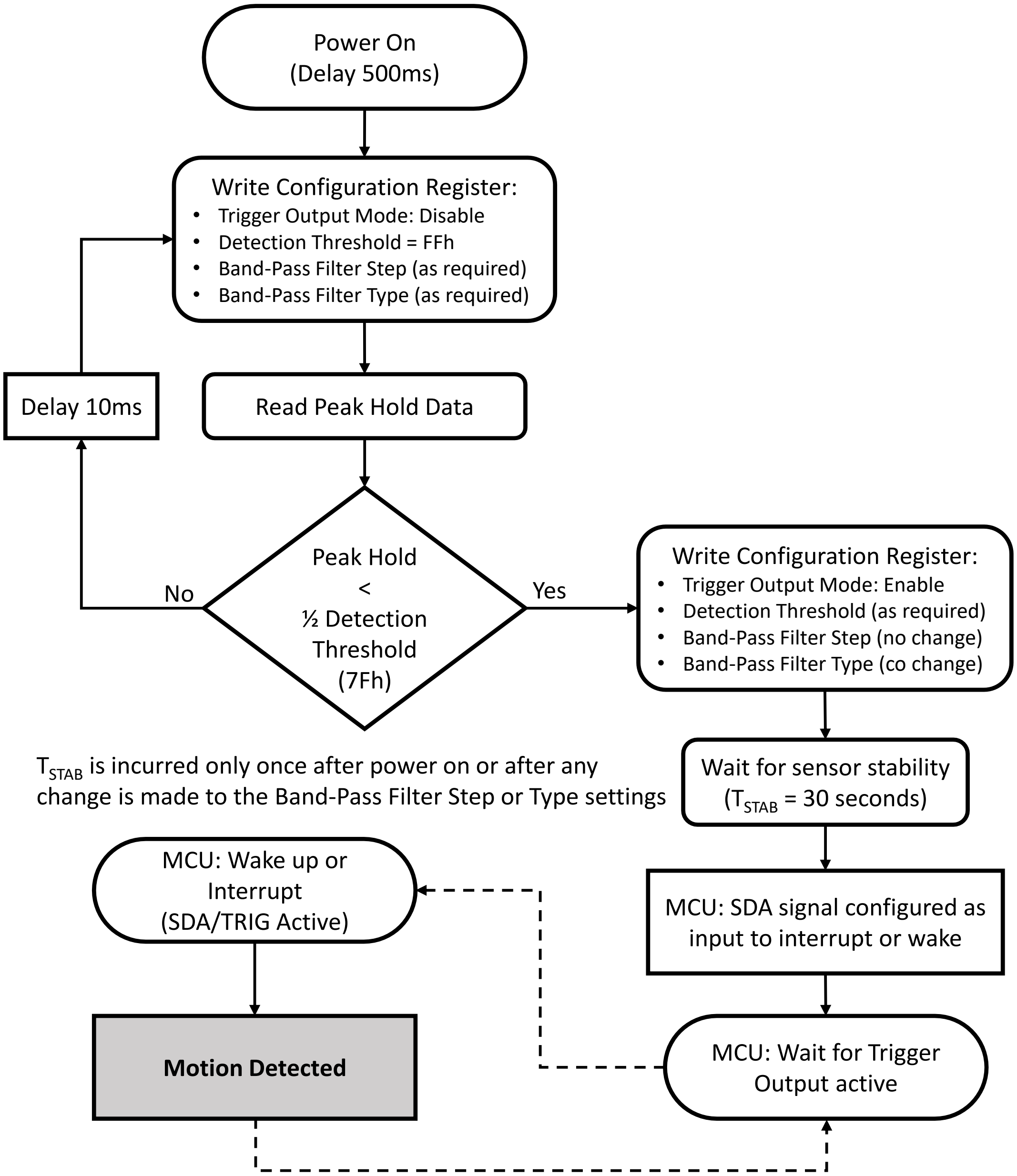
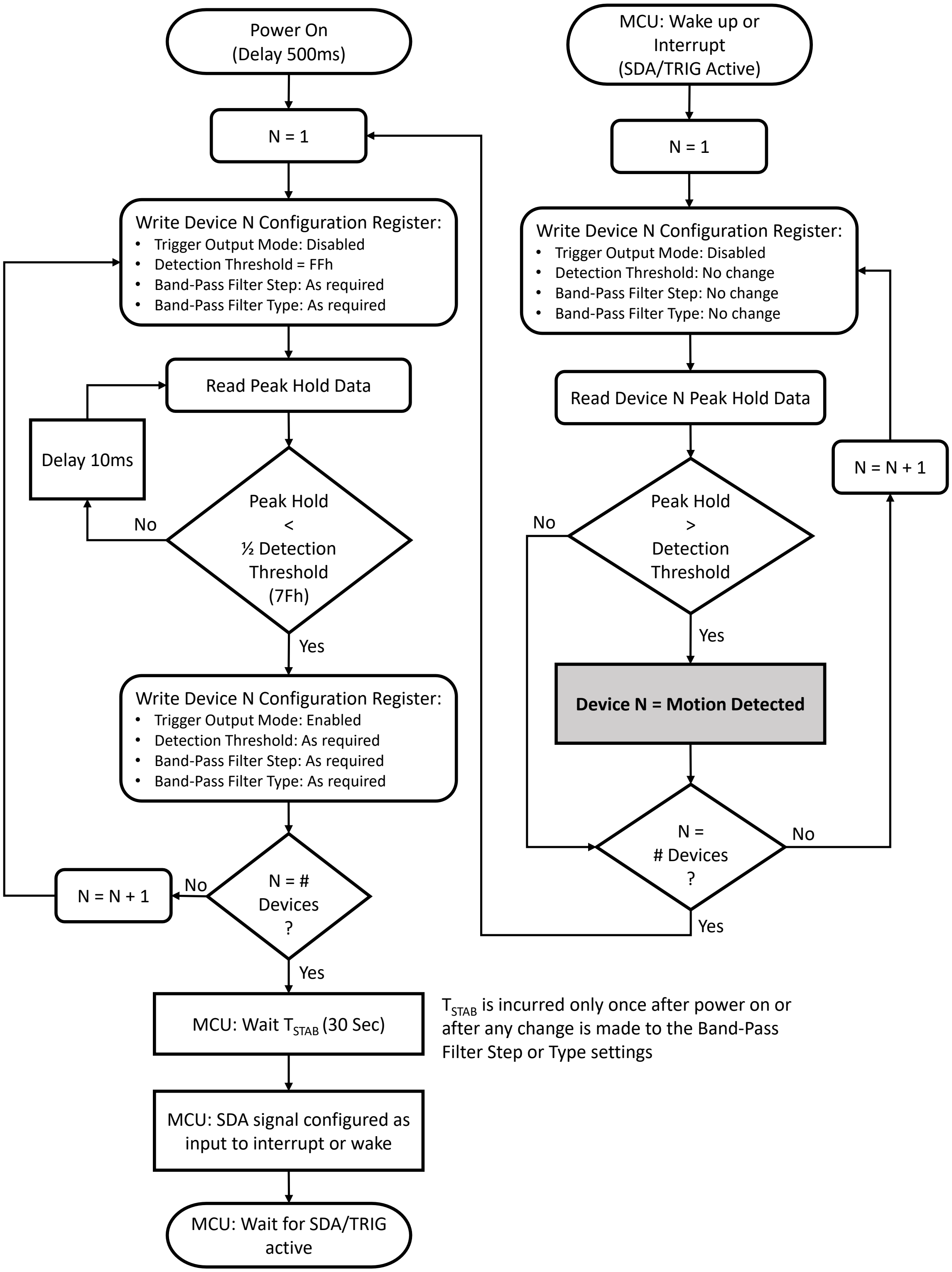


Figure 15 - Single Device Operating Example

12.2 Multi-Device Operation



T_{STAB} is incurred only once after power on or after any change is made to the Band-Pass Filter Step or Type settings

Figure 16 - Multi-Device Operating Example

13 Control Register Bit Definitions

The Configuration Register data consists of 56 bits and controls the operation of the Digital PIR Sensor. Several of the bits are reserved and should be set to 0. There are 4 main configuration parameters: Detection Threshold Level, Trigger Output Mode, and Digital Band-Pass Filter Step and Type.

Table 4 - Configuration Register Bit Definitions

Bit	Default	Name	Description
B0 – B7	0	Reserved	These bits are reserved and should be set to 0.
B8 – B14	0	Reserved	These bits are reserved and should be set to 0.
B15	0	DETLVL0	Detection Threshold Level: Sets the upper and lower detection threshold levels used by the window comparator. The value is based on the ADC conversion after the band-pass filter. 3. These bits can be set from 0 to 255. 4. The actual value is 8 times the value set in this field. 5. MSb is B22; LSb is B15 Example: DETLVL[7:0] = 16 → Threshold: ±16 * 8 = ±128 ADC Value DETLVL[7:0] = 100 → Threshold : ±100 * 8 = ±800 ADC Value
B16	0	DETLVL1	
B17	1	DETLVL2	
B18	1	DETLVL3	
B19	1	DETLVL4	
B20	0	DETLVL5	
B21	0	DETLVL6	
B22	0	DETLVL7	
B23	0	TRIGOM	Trigger Output Mode: Disabled = 0; Enabled = 1
B24	1	FSTEP0	Digital Band-Pass Filter Step Selection: Step 1 = 01; Step 2 = 11; Step 3 = 00 (See section 14 for more details)
B25	1	FSTEP1	
B26	0	FILSEL0	Digital Band-Pass Filter Type Selection: Type A = 111; Type B = 000; Type C = 001; Type D = 010 Direct = 011 (Band-Pass Filter Bypassed) (See section 14 for more details)
B27	0	FILSEL1	
B28	0	FILSEL2	
B29 – B31	0	Reserved	These bits are reserved and should be set to 0.
B32 – B39	0	Reserved	These bits are reserved and should be set to 0.
B40 – B47	0	Reserved	These bits are reserved and should be set to 0.
B48 – B55	0	Reserved	These bits are reserved and should be set to 0.

14 Digital Bandpass Filter Characteristics

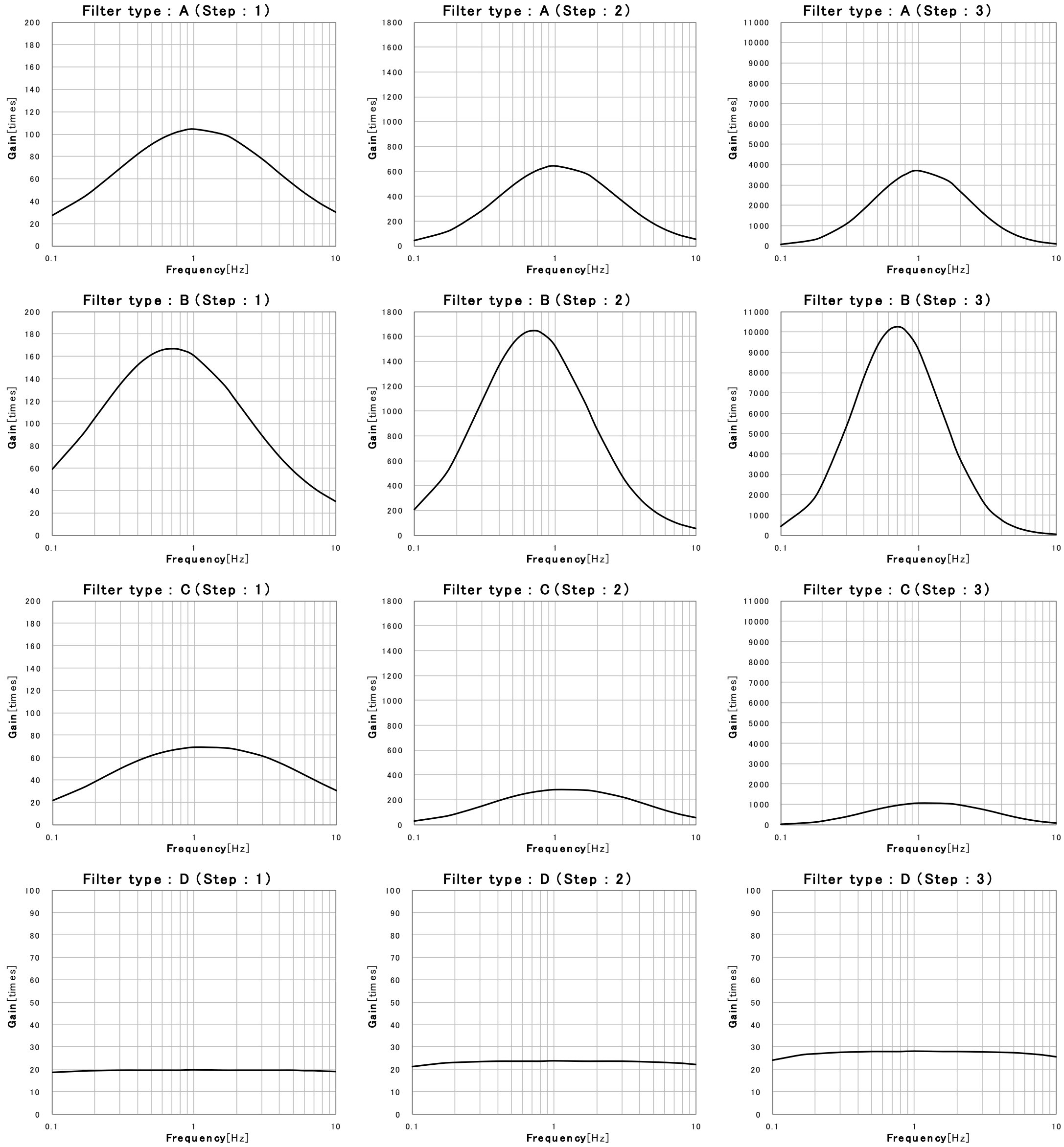


Figure 17 - Band-Pass Filter Characteristics

Table 5 - Band-Pass Filter Parameters

Filter Type	High-Pass Cut-off (Hz)	Low-Pass Cut-off (Hz)	Typical Gain @ 1Hz (Linear)		
			Step 1	Step 2	Step 3
A	0.4	2.7	104.7	642.8	3713.7
B	0.3	1.5	160.7	1521.2	9134.6
C	0.3	5.0	69.0	279.7	1067.9
D	0.01	100.0	19.7	23.6	28.1

15 Electrical Characteristics

15.1 Absolute Maximum Ratings

Stresses greater than those listed in Table 6 can cause permanent damage to the device. These ratings are stress ratings only. Operation of the device at any condition outside those indicated in the operational sections of these specifications is not implied. Exposure to absolute maximum rating conditions for extended periods can affect device reliability.

Ta = 25°C unless otherwise specified.

Table 6 - Absolute Maximum Ratings

Parameter	Min	Max	Units
Supply voltage on V_{DD}	-0.3	+6.5	V
Input Voltage	-0.3	V_{DD} + 0.3	V
Input Current	-10	+10	mA
Output Voltage	GND	V_{DD}	V
Output Current	-4.0	+4.0	mA
Operating Temperature	-40	+85	°C
Storage Temperature	-40	+85	°C

15.2 DC Characteristics

Ta = 25°C ±5°C unless otherwise specified.

Table 7 - DC Characteristics

Symbol	Parameter	Specification	Conditions
V_{DD}	Supply Voltage	1.8 V to 5.5 V	—
I_{DD}	Supply Current	Max: 5.0 µA Typ: 3.0 µA	V_{DD} = 3.0V Excluding external I2C pull-up resistors.
V_{DR}	Data Retention Voltage	Min: 1.8 V	Required supply voltage to maintain register setting data
V_{IH}	High Level Input Voltage	Min: V_{DD} x 0.9	
V_{IL}	Low Level Input Voltage	Max: V_{DD} x 0.1	

15.3 I²C Interface

Table 8 - I²C Interface

Symbol	Parameter	Specification				Units
		Standard Mode		Fast Mode		
		Min.	Max.	Min.	Max.	
F_{SCL}	SCL Clock Frequency	0	100	0	400	KHz
$T_{LOW:SCL}$	SCL Low Time	4.7	-	1.3	-	µs
$T_{HIGH:SCL}$	SCL High Time	4.0	-	0.6	-	µs
$T_{HOLD:START}$	Hold time for Repeated START condition	4.0	-	0.6	-	µs
$T_{SU:START}$	Set-up time for repeated START condition	4.7	-	0.6	-	µs
$T_{HOLD:DATA}$	Data hold time	0(3)	3.45(4)	0(3)	0.9(4)	µs
$T_{SU:DATA}$	Data set-up time	250	-	100	-	ns
$T_{SU:STOP}$	Set-up time for STOP condition	4.0	-	0.6	-	µs
T_R	Rise time of both SDA and SCL signals	-	1000	20	300	ns
T_F	Fall time of both SDA and SCL signals	-	300	-	300	ns
T_{BUF}	Bus free time between a STOP and START condition	4.7	-	1.3	-	µs
C_B	Capacitive load for each bus line		400(2)		400(2)	pF

Notes:

(1) The I²C bus specifications in Table 8 are based on the V_{DD} and GND level within the supply voltage range.

(2) C_B is total capacitance of one bus line.

(3) A device must internally provide a hold time of at least 300nsec. For the SDA signal to bridge the undefined region of the falling edge of SCL.

(4) The maximum $T_{HOLD:DATA}$ has only to be met if the device does not stretch the Low period ($T_{LOW:SCL}$) of the SCL signal.

15.4 Sensor Characteristics

Ta = 25 ±5 °C unless otherwise specified.

Table 9 - Sensor Characteristics

Symbol	Parameter	Specification	Conditions
S_{OUT}	Signal Output	Min: 1200 counts (p-p) Typ: 1800 counts (p-p)	Register Bit [24:25]=11 Register Bit [26:28]=000
N_{OUT}	Noise Output	Max: 250 counts (p-p) Typ: 100 counts (p-p)	Register Bit [24:25]=11 Register Bit [26:28]=000
D_{RES}	Data Output Resolution	12 Bit	MSB is sign(+/-) bit
T_{CYC}	Data Output Data Update Cycle Rate	Typ. 9.5 msec.	—
T_{STAB}	Stability Time	Max: 30 sec. (See section 11)	After applying V_{DD} and after changing digital filter setting.
FOV	Field of View	X Axis: 148° Y Axis: 136°	See Figure 3
-	Filter Substrate	Silicon	
λ(5%)	Cut on Wavelength	5 ±1 µm	
FT	Filter Transmittance	70%	Average from 8 µm to 13 µm

15.5 Environmental Characteristics

Table 10 - Environmental Characteristics

Symbol	Parameter	Specification	Conditions
T_{OPP}	Recommended Operating Temperature	-40 to +80 °C	
T_{STORE}	Recommended Storage Temperature	-40 to +80 °C	
H_{OPP}	Operating Humidity	95 %RH or less	30 °C
H_{STORE}	Storage Humidity	95 %RH or less	30 °C

15.6 RoHS Compliance

This product conforms to the RoHS Directive in force at the date of issuance of this product specification.

16 Packaging

The ZDP323B Digital PIR Sensor is shipped in sheets of 200 pieces, packed in boxes as shown in Figure 18 through Figure 20. The sheets are packed in an inner-box (2 sheets/box = 400 pieces) and 15 inner-boxes are packed in an outer-box for a total of 6,000 pieces per box.

16.1 Sheet and Inner-Box Packaging

1) Standard sheet quantity: 200 pieces
2) Standard inner-box quantity: 2 Sheets (400 pieces)

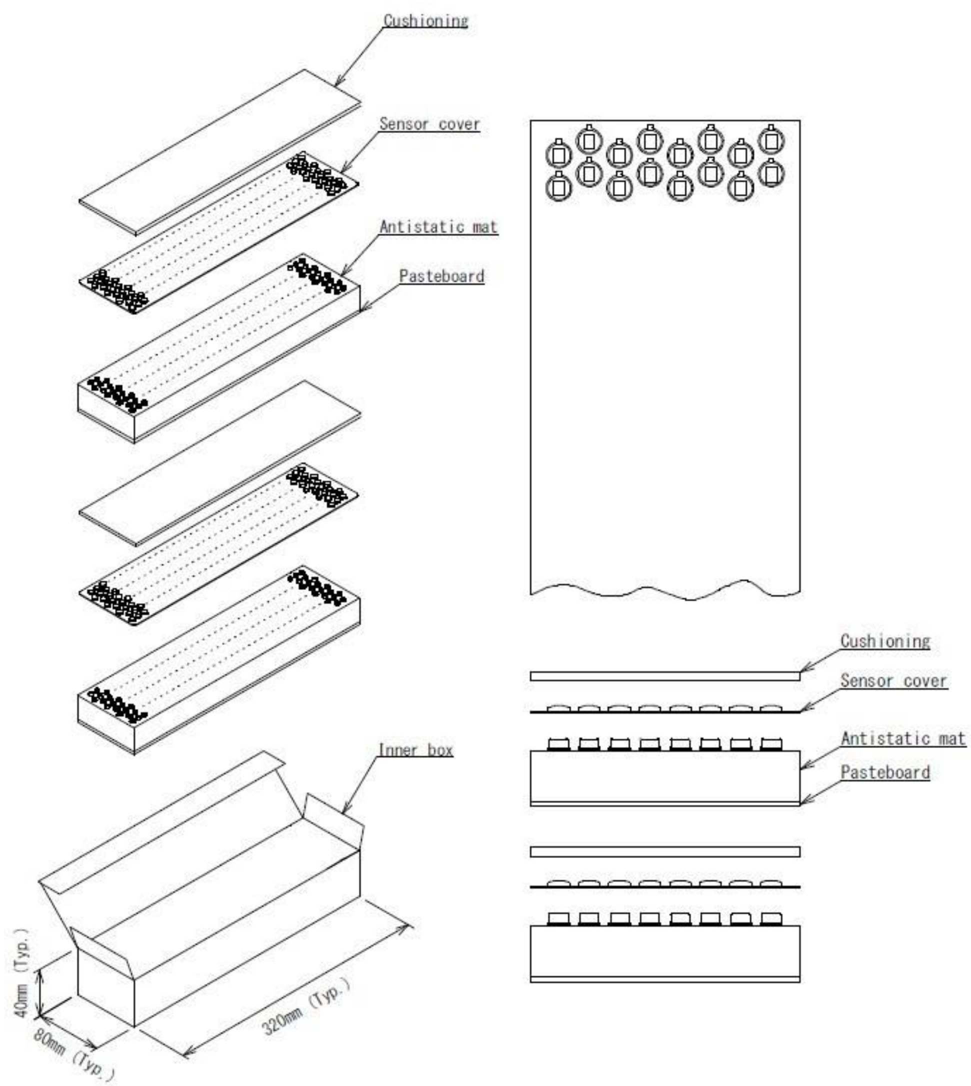


Figure 18 – Sheet & Inner-Box Packaging

3) Standard Box Quantity: 6,000 pieces (15 Inner-Boxes)

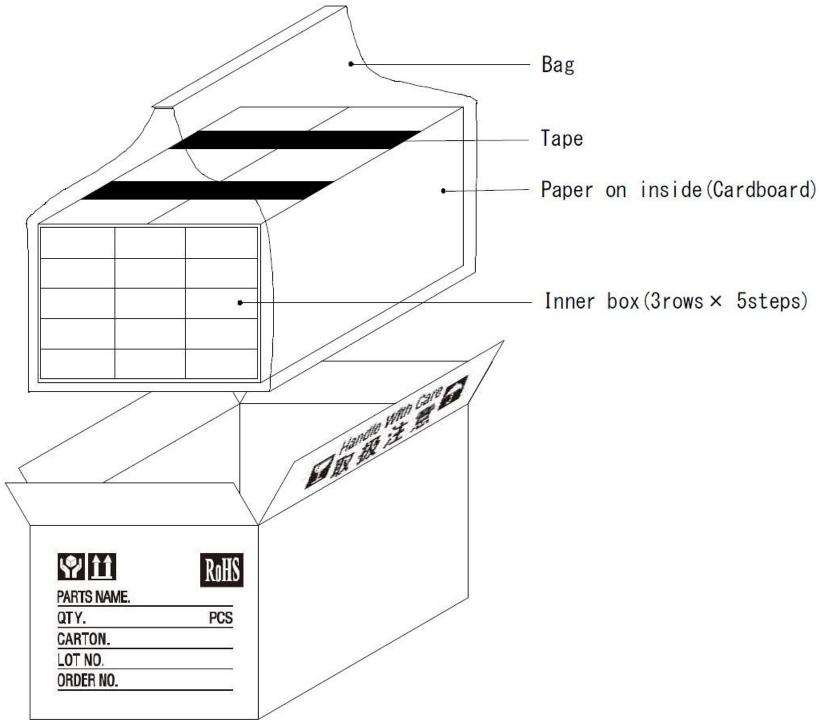


Figure 19 – Outer-Box Packaging

4) The Standard Outer-Box dimensions are shown in Figure 20

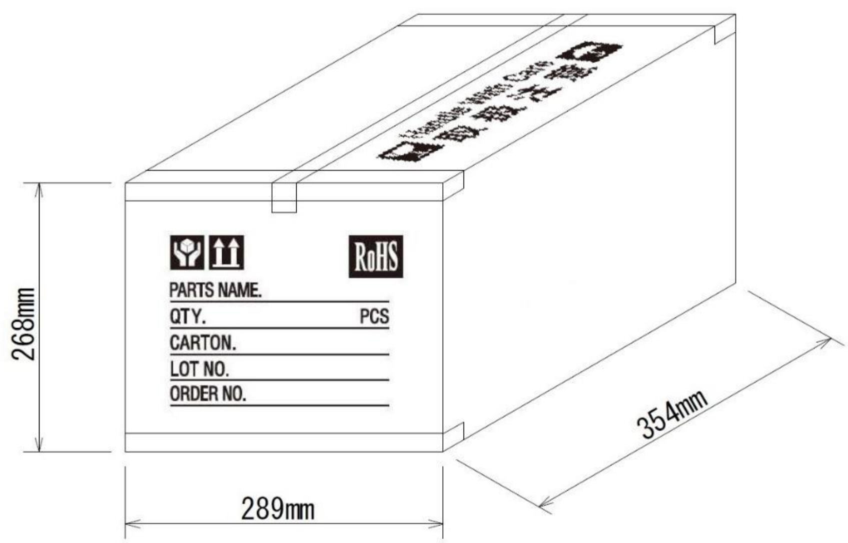


Figure 20 - Standard Outer-Box Dimensions

17 Usage Restrictions and Precautions

This section presents restrictions and precautions that apply to Zilog pyroelectric sensors.

17.1 Design Restrictions and Precautions

If used for outdoor applications, be sure to use a suitable UV optical filter and drip-proof, anti-dew construction. This sensor is designed for indoor use. In cases where secondary accidents due to operational failure or malfunctions can be anticipated, add a failsafe function to the design.

17.2 Usage Restrictions and Precautions

To ensure continued proper operation of the sensor, do not operate it under any of the following conditions:

- Rapid environmental temperature changes
- Strong shocks or vibrations
- In places where there are obstructing materials (glass, fog, etc.) through which infrared rays cannot pass within the detection area
- In fluids, corrosive gases, and sea breezes
- Under continual high-humidity atmospheric conditions
- Exposed to direct sunlight or automobile headlights without appropriate lens filter
- Exposed directly to forced-air currents from a heater or air conditioner

17.3 Handling and Storage Restrictions and Precautions

To prevent sensor malfunctions, operational failure, appearance damage, or any deterioration of its characteristics, do not expose the sensor to any of the following, or similar, handling and storage conditions:

- Strong shocks or continual vibrations
- Static electricity or strong electromagnetic waves
- High temperature and humidity over extended periods
- Corrosive gases or sea breezes
- Dirty and dusty environments that may contaminate the optical window
- Ultrasonic cleaning

17.4 Assembly Restrictions and Precautions

Use soldering iron with controlled heat when soldering

- Avoid extended durations of heat on the sensors' pins. Exposure to excessive heat may cause deterioration of the sensor performance (e.g., durations beyond 5 seconds at 350°C)

18 Related Documents

The documents associated with the ZDP323B Digital PIR sensor are listed below. Each of these documents, and others can be obtained from the ZMOTION Product Page on the Zilog website: http://www.zilog.com.

Table 11 - Related Documents

Document Number	Description
PB0266	Digital PIR Sensor Product Brief
PS0416	ZDP323AA Digital PIR Sensor with UART Interface
PB0263	PIR Sensor Product Brief
PB0264	ZMOTION Lens Product Brief

19 Customer Support

To share comments, get your technical questions answered, or report issues you may be experiencing with our products, please visit Zilog's Technical Support page.

This publication is subject to replacement by a later edition. To determine whether a later edition exists, please visit the Zilog website at http://www.zilog.com.