ZEPIR0AAS02MODG

ZMOTION™ Detection Module

Product Specification

PS028405-1010

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Revision History

Each instance in the revision history table reflects a change to this document from its previous revision. For more details, refer to the corresponding pages or appropriate links given in the table below.

Date	Revision Level	Description	Page Number
October 2010	05	Replaced all instances of *ePIR* with *advanced passive infrared*.	All
September 2010	04	Fixed formatting and pagination issues.	All
September 2010	03	Replaced Zilog logos, ePIR with ZMOTION, and Zdots with Module. Updated Figure 11.	All
October 2008	02	Updated Related Documents section (changed 88-pin SOIC to 28-pin SOIC for Z8FS040AHJ20SG). Removed references to GP and General Purpose.	All
October 2008	01	Original issue	All

Table of Contents

Chapter 1 Architectural Overview

Zilog's ZMOTION™ Detection Module is a complete and fully functional motion detection solution ideal for lighting control and other occupancy and proximity detection applications. It is a board level module that combines the unique features of Zilog's Z8FS040 Motion Detection Microcontroller with a Pyroelectric Sensor and a low profile Fresnel lens.

The surface mount pyroelectric sensor and Fresnel lens combine to provide the lowest possible profile without sacrificing performance. The module is only 25.5 mm x 16.7 mm (a little over ½ square inch) so it can easily fit into many size constrained applications.

The ZMOTION™ Detection Module can operate in a simple Hardware mode which provides an output signal when motion is detected; or in an advanced asynchronous serial mode when greater control over the motion detection performance is required. In both modes sensitivity and delay time can be controlled to match the application requirements.

It is an excellent choice for lighting controls, access control, display systems, and general purpose proximity sensing. It is also an easy way to add energy management capability to various applications such as vending machines and appliances; and Zilog's Evaluation Kit makes it quick and easy to integrate into your own custom application.

Features

Key features of the ZMOTION™ Detection Module include:

- Complete, fully functional motion detection including Fresnel lens
  - Comes pre-programmed with motion detection software
- Small form factor—25.5 mm x 16.7 mm
- Up to 5 m x 5 m, 60 degree detection pattern.
- Sensitivity control via simple hardware configuration
- Advanced serial (UART) based configuration and interface
- SLEEP mode for low power applications
- No temperature compensation required
- Input to support CDS photocell input for ambient light detection
- Minimal components ensure highest possible Mean Time Between Failures (MTBF)
- Application code can also be modified to support custom solutions
- Complete development system available
- Operates from 2.7 V to 3.6 V power supply
- Simple 8-pin interface
- Standard operating temperature: 0 °C to 70 °C

ZEPIR0AAS02MODG Block Diagram

Figure 1 displays the block diagram of the ZMOTION™ Detection Module.

Figure 1. ZMOTION™ Block Diagram

Figure 2 displays the ZMOTION™ Detection Module.

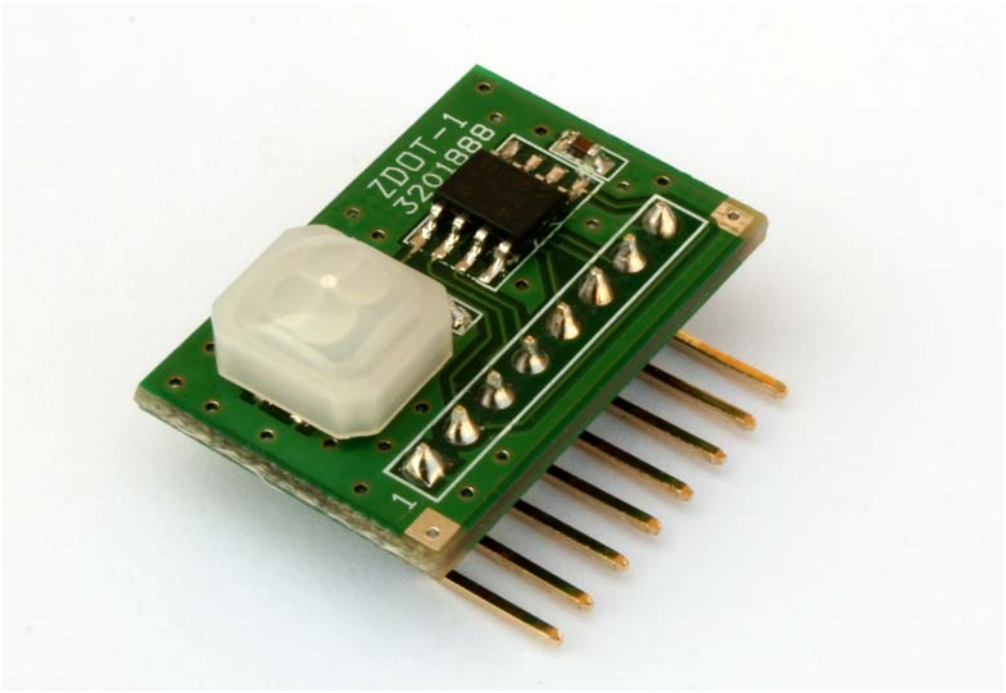


Figure 2. The ZMOTION™ Detection Module

Pin Description

Table 1 lists the pin and signal description for ZMOTION™ Detection Module.

Table 1. Pin Description

Pin#	Signal Name	Hardware Interface Mode	Serial Interface Mode	Comments
1	GND	Ground	Ground	—
2	VDD	Supply Voltage	Supply Voltage	—
3	RXD / DLY	DLY — Delay (analog input)	RXD — Receive Data (digital input)	—
4	TXD / SNS	SNS — Sensitivity (analog input)	TXD — Transmit Data (digital output)	Mode Select during reset
5	/MD/RST	Motion Detect (digital output)	Configurable: /RST - Reset (digital input) / MD Motion Detect (digital input)	Default is /RST (Reset) in Serial Interface Mode
6	LG	Light Gate(analog input)	Light Gate (analog input)	If unused, connect to V_{dd}
7	/SLP/DBG	/SLP — Sleep (digital input)	/SLP — Sleep (digital input)	DBG is used for programming and debug
8	GND	Ground	Ground	—

Operational Modes

The ZMOTION™ Detection Module operates in following two modes:

- Hardware Interface Mode
- Serial Interface Mode

Hardware Interface Mode

The Hardware Interface Mode is explained below:

- Basic configuration via hardware interface pins
- Allows you to adjust sensitivity and delay
- Optional ambient light input
- SLEEP mode to reduce power consumption

Serial Interface Mode

The Serial Interface Mode is explained below:

- Advanced configuration and status via serial interface
- /MD, LG and /SLP remain functional
- The serial interface runs at: 9600 bps, no parity, 8 data bits, and 1 stop bit, no flow control

Setting Operation Mode

Serial Interface Mode Selection

To select Serial Interface Mode, provide a pull up resistor from TXD/SNS to V_{dd} during power ON or when exiting SLEEP Mode (typically 100 K). The device detects that the voltage on the pin is greater than 2.5 V and enables the TXD and RXD signals. /MD, LG and /SLP remain active also. This resistor will have no effect on the transmitted data.

Hardware Interface Mode Selection

The Hardware Interface Mode is selected when TXD/SNS is between 0 V and 1.8 V during power ON or when exiting SLEEP Mode.

For examples of using the ZMOTION™ Detection Module in Hardware and Serial Interface Modes, see Appendix A—Hardware Interface Mode on page 52 and Appendix B—Serial Interface Mode on page 53.

Signal Descriptions (Hardware Interface Mode)

GND - Ground - Pin 1 and Pin 8

Both Pin 1 and Pin 8 ground signals are tied together on the ZMOTION™ Detection Module PCB and are connected to power ground.

VDD - Supply Voltage - Pin 2

Provides power to the ZMOTION™ Detection Module. For power consumption, see Electrical Characteristics on page 49.

RXD/DLY - Delay - Pin 3

A high impedance analog input pin that sets the time for the /MD (Motion Detect) pin to remain active once motion has been detected. Provide a voltage between 0 and 2 V to

select a delay of 2 seconds to 15 minutes (see Table 2). Typically a simple resistor divider or trim pot is used to set the voltage.

Table 2. Delay Time and Voltage on DLY

Delay Time	Voltage on DLY
2 sec	0 V
5 sec	0.2 V
10 sec	0.4 V
30 sec	0.6 V
1 min	0.8 V
2 min	1.0 V
3 min	1.2 V
5 min	1.4 V
10 min	1.6 V
15 min	1.8 V

TXD/SNS - Sensitivity - Pin 4

A high impedance analog input that sets the Module's sensitivity to motion. Provide a voltage between 0 V and 1.8 V to adjust the sensitivity to meet the application requirements. A lower voltage means higher sensitivity. Typically a simple resistor divider or trim pot is used to set the voltage.

1.8 V = Lowest Sensitivity

0 V = Highest sensitivity

This signal also determines the interface mode of the Module. At power ON and when exiting SLEEP Mode, the signal is sampled and if it is greater than 2.5 V (for example, pulled to V_{DD} via resistor), then **Serial Interface Mode** is entered and the pin is converted to TXD. If the signal is between 0 V and 1.8 V, **Hardware Interface Mode** is selected.

/MD - Motion Detect - Pin 5

An active Low output that is activated when motion is detected. The time that this signal remains active is set by the DLY signal. This signal is actively driven High.

0 = Motion detected

1 = No motion detected

LG - Light Gate - Pin 6

A high impedance analog input. This pin should be provided with a voltage that is proportional to the amount of ambient light in the environment (typically provided via a CDS photo cell or similar circuit). The signal is used internally to gate the /MD output signal such that it does not activate in the presence of daytime ambient light. When the voltage on this pin is lower than 1.0 V, the /MD signal will not activate even when motion is detected. If /MD is in an active state when LG transitions below 1.0 V, the current DLY time is completed before /MD is deactivated. If LG is unused, connect to V_{dd}.

GND to 1.0 V = /MD is activated when motion is detected

1.0 V to V_{dd} = /MD does not activate when motion is detected

/SLP - SLEEP Mode - Pin 7

An active Low digital input. When at logic ‘0’, the Module enters low power SLEEP mode. The Module does not detect any motion and /MD is driven inactive. When SLP is at logic ‘1’, the Module exits SLEEP mode and begins detecting motion. This signal must be held at logic ‘1’ during power ON.

0 = Module disabled - low power SLEEP mode is active

1 = Normal operation

Signal Descriptions (Serial Interface Mode)

GND - Ground - Pin 1 and Pin 8

Both Pin 1 and Pin 8 ground signals are tied together on the ZMOTION™ Detection Module Single Board Computer PCB and are connected to power ground.

VDD - Supply Voltage - Pin 2

This provides power to the Module. For power consumption, see Electrical Characteristics on page 49.

RXD/DLY - Receive Data - Pin 3

This input is the asynchronous serial input used for sending commands and configuration to the Module. It operates at 9600 bps, No Parity, 8 Data Bits, and 1 Stop Bit, no flow control. For a list and description of the commands supported, see Table 3.

TXD/SNS - Transmit Data - Pin 4

This output is the asynchronous serial data output from the Module in response to commands and configuration supplied on the RXD line. It operates at 9600 bps, No Parity, 8 Data Bits, 1 Stop Bit. For more information on the serial command interface, see Serial Interface Commands and Description on page 11.

This signal also determines the interface mode of the Module. At power ON and when exiting Sleep Mode, the signal is sampled and if it is higher than 2.5 V (for example, pulled to V_{DD} via resistor), then **Serial Interface Mode** is entered. If the signal is at a value between 0 V and 1.8 V, **Hardware Interface Mode** is selected.

/MD//RST - Motion Detect and Reset - Pin 5

An active Low output that is activated when motion is detected. The time that this signal remains active is set by the DLY signal. This signal is actively driven High.

0 = Motion detected

1 = No motion detected

As /RST, this pin provides an active low hardware reset signal for the Module. The function of this pin is selected by the ‘C’ serial command. The default value for this pin is /RST.

LG - Light Gate - Pin 6

A high impedance analog input. The signal is used internally to gate the /MD signal such that it does not activate in the presence of daytime ambient light. The voltage applied to this pin should be proportional to the amount of ambient light in the environment (typically provided via a CDS photo cell or similar circuit).

- LG > Light Gate Threshold Register - /MD is activated when motion is detected
- LG < Light Gate Threshold Register - /MD does not activate when motion is detected

If /MD is in an active state when LG transitions above the programmed value, the current DLY time is completed before /MD is deactivated.

If LG is unused, connect to V_{dd}.

/SLP - SLEEP Mode - Pin 7

An active Low digital input. When at logic '0' the Module enters low power SLEEP mode. The Module does not detect any motion and /MD is driven inactive. When SLP is at logic '1' the Module exits SLEEP mode and begins detecting motion. This signal must be held at logic '1' during power ON.

0 = Module disabled - low power SLEEP mode is active

1 = Normal operation

Voltage Brownout Protection and Power-On-Reset

The ZMOTION™ Detection Module contains an internal Reset Controller with a Power-on Reset circuit and Brown out Protection to ensure proper operation. When power is first applied, the POR circuit monitors the supply voltage and holds the Module's MCU in the Reset state until the supply voltage reaches a safe operating level. After the supply voltage exceeds the POR voltage threshold (VPOR), the MCU is released and the Module begins operating. A further delay of typically 20 seconds is included to allow the pyro-electric sensor to stabilize. This value varies depending on environmental conditions. After this delay, the system begins to look for motion. Prior to this delay, the /MD signal remains inactive.

Figure 3 displays Power-on Reset operation. See Related Documents on page 48 for the POR threshold voltage (V_{POR}).

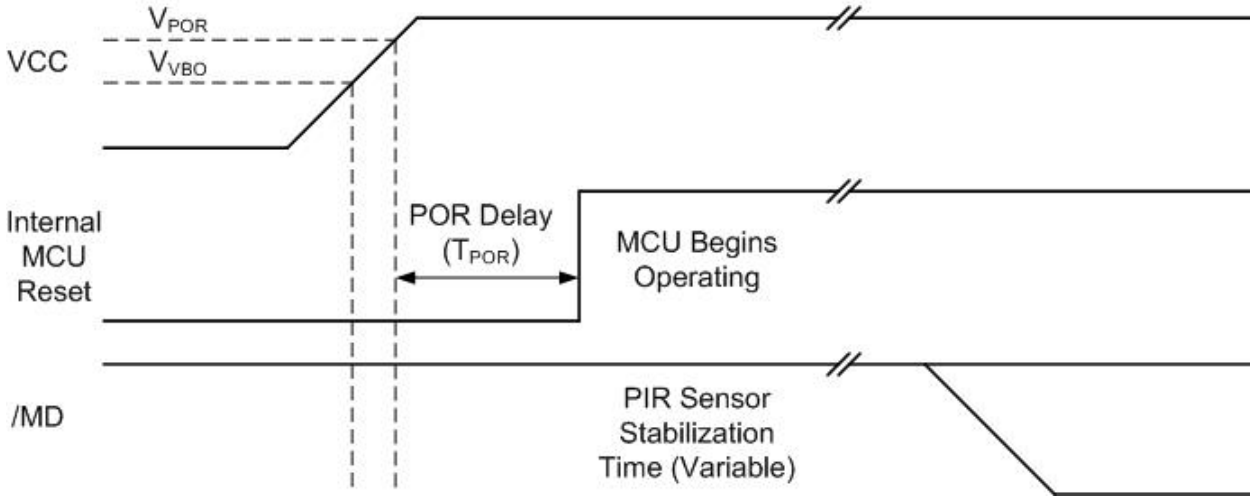


Figure 3. Power-On Reset Operation

The ZMOTION™ Detection Module provides low Voltage Brownout (VBO) protection to ensure proper operation when the supply voltage drops below an unsafe level - below the VBO threshold voltage The VBO circuit senses this condition and forces the Module into the Reset state. While the supply voltage remains below the POR voltage threshold (V_{POR}), the VBO block holds the Module in the Reset.

After the supply voltage again exceeds the Power-On Reset voltage threshold, the Module progresses through a full Power-On Reset sequence, as described in the Power-On Reset section. Figure 4 displays the Voltage Brownout operation. See Related Documents on page 48 for the VBO threshold voltage (V_{VBO}).

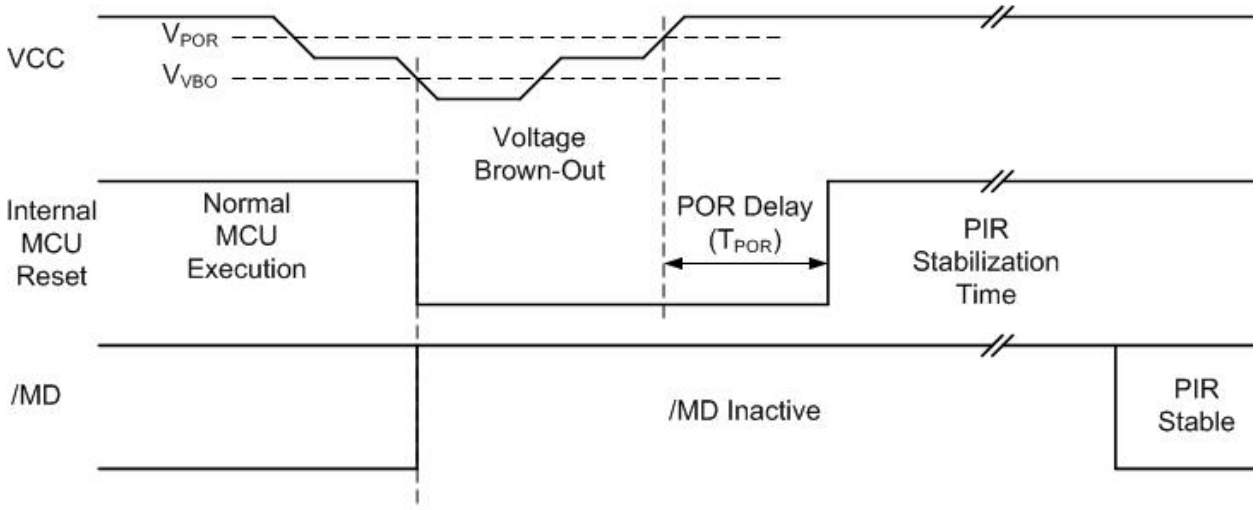


Figure 4. Voltage Brownout Reset Operation

Operation

When power is applied, the TXD/SNS pin is sampled to determine the mode of operation. If the signal is above 2.5 V, serial interface mode is entered. If the signal is between 0 V and 1.8 V hardware interface mode is entered. During this time, the pyro-electric sensor is monitored and the device waits for it to become ready. Once it is stable, the device starts normal operation in the selected mode. In hardware interface mode, the DLY, SNS, LG and /SLP signals are sampled regularly. In serial interface mode, TXD/RXD are used to communicate with the device and LG, /SLP and /MD also provide their defined functions.

Hardware Interface Mode

This mode of operation is selected when the SNS pin is at a value between 0 V and 1.8 V during power ON (or after a reset caused by V_{bo}). Once Hardware Interface mode has been established, this pin becomes the sensitivity input and accepts a voltage between 0 V and 1.8 V to set the motion detection sensitivity level.

0 V = Highest Sensitivity

1.8 V = Lowest Sensitivity

These sensitivity levels are normally achieved with a simple resistor divider or potentiometer resistor divider.

After application of power, the PIR sensor is allowed to stabilize. At this point the MCU waits for the PIR sensor to stabilize - this typically takes 20 seconds, but varies depending on environmental conditions. The software dynamically monitors the pyro-electric sensor during power up and begins detecting motion as soon as the sensor is stable.

The /MD (Motion Detect) pin is driven active (Low) when motion is detected. The time that the signal remains active is determined by the voltage on the delay pin and can be set to a value between 2 seconds and 15 minutes. See Table 2.

The Light Gate signal acts as a disable (gate) for the /MD signal. In a typical application, this signal is a representation of the ambient light in the environment. If there is light detected, the /MD signal does not activate even in the presence of motion. For an example showing how to use the ZMOTION™ Detection Module in Hardware Interface Mode, see Appendix A—Hardware Interface Mode on page 52.

SLEEP Mode in Hardware Interface Mode

In applications where motion detection is not always required, the Sleep signal can be used to put the device into a low power mode. The advantage of this feature vs. removing power from the Module is that the PIR stabilization time is much shorter.

If the Sleep (/SLP) input signal is driven Low, the device enters a low power SLEEP mode and is woken up by deactivating the signal (driving the signal high).

Serial Interface Mode

The Serial Interface mode is implemented as a superset of the features available in Hardware interface mode. The interfacing device (Host) has an expanded feature set and more flexibility with many of those features. The interface is designed to be simple to implement on the host processor and use as few resources as possible.

This mode of operation is selected when the SNS pin is above 2.5 V during power ON (or after a reset caused by V_{bo}). Typically this signal is tied to V_{dd} through a pull-up resistor. Once Serial Interface mode has been established, this pin becomes the Transmit Data (TXD) output and is used to send responses to commands given to the device.

The serial interface is asynchronous and is set to:

- 9600 Baud
- No Parity
- 8 Data Bits
- 1 Stop Bit

- No flow control

In Serial Interface Mode, commands are sent to the device over the RXD input pin and responses are sent from the device over the TXD output pin. The other signals on the device (/MD, LG, /SLP) remain active in Serial Interface mode.

Motion Detect (/MD) output is driven active for the time set by the Output Activation Time command when motion is detected. The signal is also gated by the (Light Gate) LG input. For an example showing how to use the ZMOTION™ Detection Module in Serial Interface Mode, see Appendix A—Hardware Interface Mode on page 52.

SLEEP Mode in Serial Interface Mode

In applications where motion detection is not always required, the Sleep signal can be used to put the device into a low power mode. The advantage of this feature vs. removing power from the Module is that the PIR stabilization time is much shorter.

If the Sleep (/SLP) input signal is driven Low, the device enters a low power SLEEP mode and is woken up by either deactivating the signal (driving the signal high) or sending a character over the serial interface - the character is received and processed.

Serial Interface Commands and Description

The Serial Interface operates as a Host-Client relationship where the Module is the client. Commands are sent from the Host and the Module responds with the requested information or confirmation. The only exception is when the Module is configured for "/MD Unsolicited" operation. In this mode, the Module will send Motion Detected information without first receiving a command from the host. All commands sent to the ZMOTION™ Detection Module are in ASCII character format, but the data sent to and from the Module may be ASCII or decimal.

There are three types of commands accepted by the Module:

- Read Commands
- Write Commands
- Confirmation Commands.

Read Command Structure

Read Commands are used to request information from the Module. Read Commands are sent from the Host and the ZMOTION™ Detection Module responds with the requested data.

- All read commands are initiated by single lower-case letters.
- Once received, the device returns the applicable value as described in the Serial Commands on page 15.

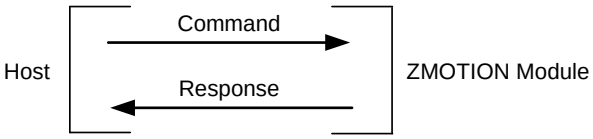


Figure 5. Read Command Structure

Write Command structure

Write Commands are used to update configuration of the ZMOTION™ Detection Module. The command is sent from the Host, and the Module responds with the current value as an acknowledgment. Then the Host sends the new data and the Module responds with an 'ACK'.

- All write commands are initiated by single upper-case letters.
- Once a write command is received the device returns the current value, and expects an appropriate single-byte data value.
- When the data value is received, the device returns an 'ACK'. If no data is received after the inactivity timeout of 2.5 seconds, the device returns a 'NACK'.

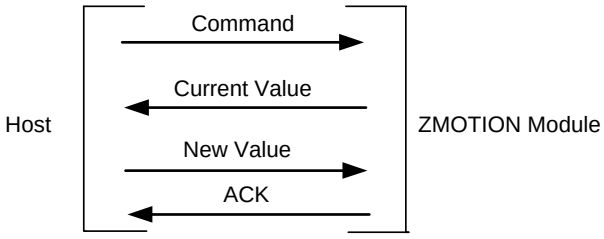


Figure 6. Write Command Structure

Confirmed Command Structure

Certain commands require a specific sequence of characters to be sent in order to help prevent accidental initiation. These commands require a 4-character confirmation sequence. Once a command requiring confirmation is received, the device returns an 'ACK'.

- If the sequence is correct, the device returns an 'ACK' and executes the command.
- If the sequence is incorrect, or there is an inactivity delay of more than 2.5 seconds between any characters of the sequence, the device immediately sends a 'NACK' and does not execute the command.

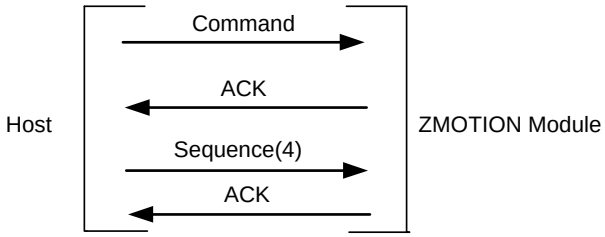


Figure 7. Confirmed Command Structure

Notes: 1. ACK = 0x06 (ASCII ACK character).

2. NACK = 0x15 (ASCII NACK character). The Module will respond with a 'NACK' on all unrecognized commands, and when command requiring data (that is, Write, Clear, and Confirmation types) does not receive the required data within the inactivity timeout period.

Table 3. Summary of Serial Interface Commands

Command	Name	Value [Default]	Command	Name	Value [Default]
0x61 - 'a'	Read Motion Status	‘Y’, ‘N’, ‘U’	0x6D - 'm’	Read Motion Detected Unsolicited Mode	‘Y’,’N’ [N]
0x62 - 'b’	Read Current Light Gate Input Level	0 - 255	0x4D - 'M’	Write Motion Detected Unsolicited Mode	‘Y’,’N’
0x63 - 'c'	Read /MD//RST Pin Configuration	'M', 'R' [R]	0x6F - 'o'	Read /MD Current Output Active Time	0 - 255 [0]
0x43 - 'C'	Write /MD//RST Pin Configuration	'M', 'R'	0x4F - 'O'	Write /MD Output State	0 - 255
0x64 - 'd'	Read /MD Activation Time	0 - 255 [2]	0x70 - 'p'	Read Ping Value	0 - 255 [1]
0x44 - 'D'	Write /MD Activation Time	0 - 255	0x50 - 'P'	Write Ping Value	0 - 255
0x65 - 'e'	Read Hyper Sense Setting	'Y', 'N' [N]	0x72 - 'r'	Read Range Setting	0 - 15 [0]
0x45 - 'E'	Write Hyper Sense Setting	'Y', 'N'	0x52 - 'R'	Write Range Setting	0 - 15
0x66 - 'f'	Read Frequency Response Setting	'H', 'L' [L]	0x73 - 's'	Read Sensitivity	0 - 255 [16]
0x46 - 'F'	Write Frequency Response Setting	'H', 'L'	0x53 - 'S'	Write Sensitivity	0 - 255
0x68 - 'h'	Read Motion Detection Suspend Setting	'Y', 'N' [N]	0x75 - 'u'	Read Dual Directional Mode	'Y', 'N' [N]
0x48 - 'H'	Write Motion Detection Suspend Setting	'Y', 'N'	0x55 - 'U'	Write Dual Directional Mode	'Y', 'N'
0x69 - 'i'	Read Module Software Version	0 - 255	0x76 - 'v'	Read Single Directional Mode	'A', '+', '-' [A]
0x6B - 'k'	Read Serial Interface Command Mode	'D', 'A' [D]	0x56 - 'V'	Write Single Directional Mode	'A', '+', '-'
0x4B - 'K'	Write Serial Interface Command Mode	'D', 'A'	0x58 - 'X'	Module Reset	'1', '2', '3', '4'
0x6C - 'l'	Read Light Gate Threshold	0 - 255 [100]	0x79 - 'y'	Read Sleep Time	0 - 255 [0]
0x4C - 'L'	Write Light Gate Threshold	0 - 255	0x59 - 'Y'	Write Sleep Time	0 - 255
			0x5A - 'Z'	Sleep Mode	'1', '2', '3', '4'

Serial Commands

Motion Status

The current status of detected motion can be read and cleared through this command. When motion has been detected the value is set to 'Y' and latched until read with the 'a' command. Once cleared, the status remains at 'N' until motion is again detected.

Command: Read Motion Status "a" (0x61)

Description

This command returns the current status of detected motion. The current status is set to 'N' when read.

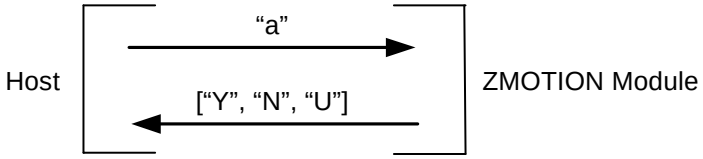
Return Values

'Y' = Motion Detected

'N' = No Motion Detected

'U' = PIR Sensor has not stabilized after power up

Normal Command Sequence



Note: *This value is independent of the /MD output state or the /MD Activation Time (see commands 'o'/'O' and 'd'/'D').*

Light Gate Level

These commands control and monitor the signal associated with the LG (Light Gate) pin. This is typically relative to the ambient light detected by an externally connected CDS photocell. The range is 0 to 255, with 0 indicating maximum ambient light and, 255 indicating minimum ambient light. See Appendix A—Hardware Interface Mode on page 52 and Appendix B—Serial Interface Mode on page 53 for recommended CDS Photo Cell connections. The 'b' command reads the current signal level present on the pin.

The "L" command sets the Light Gate Threshold value. This value is used in conjunction with the signal on the LG pin to internally "Gate" the /MD signal such that it does not activate in the presence of ambient light. When the signal on the LG (Light Gate) pin is below this value, the /MD output signal remains inactive even when motion has been detected. When the signal on the LG (Light Gate) pin is above this value, the /MD signal activates normally when motion has been detected.

Command: Read Current Light Gate Input Level "b" (0x62)

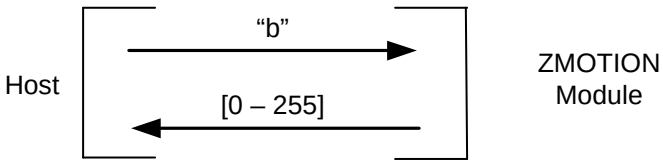
Description

The "b" command returns the current signal level present on the LG (Light Gate) pin.

Return Values

0 - 255 (decimal)

Normal Command Sequence



Command: Read Light Gate Threshold "l" (0x6C)

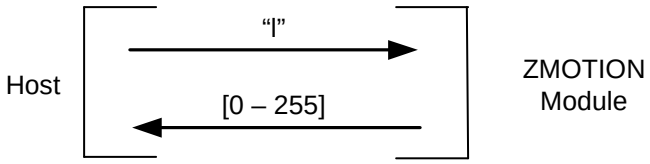
Description

The "l" command Returns the current Light Gate threshold value set by the "Write Light Gate Threshold command.

Return Values

0 - 255 (decimal)

Normal Command Sequence



Command: Write Light Gate Threshold "L" (0x4C)

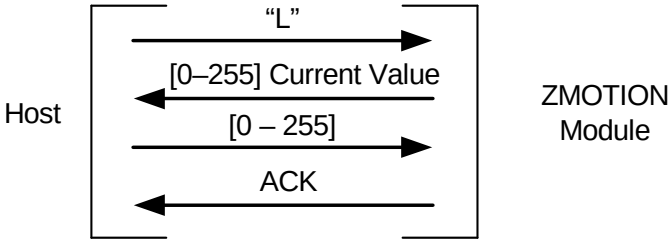
Description

The "L" command sets the Light Gate Threshold value.

Input Values

0 - 255 (decimal)

Normal Command Sequence



/MD/RST Pin Configuration

The /MD//RST pin can be configured to function as either the Motion Detect output or the Reset input. This command selects between the two modes. As /RST, a low on this pin causes the Module to perform a full hardware reset. See Signal Descriptions (Serial Interface Mode) on page 6 for more information.

Command: Read /MD//RST Pin Configuration "c" (0x63)

Description

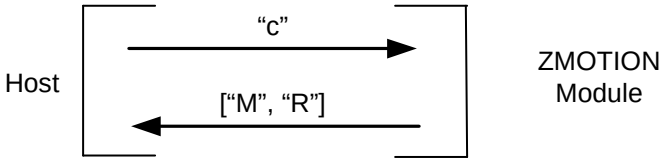
This Read command returns the configuration mode of the /MD//RST pin as set by the "C" command.

Return Values

'M' = /MD//RST pin configured as /MD

'R' = /MD//RST pin configured as /RST

Normal Command Sequence



Command: Write /MD//RST Pin Configuration "C" (0x43)

Description

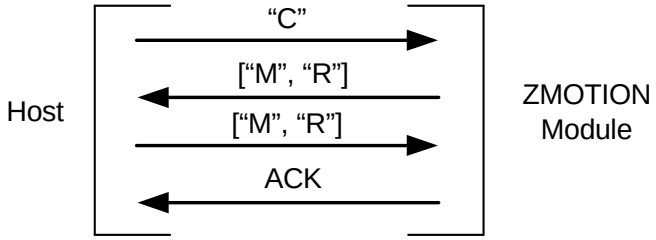
Configures the /MD//RST pin as either /MD (Motion Detect output) or /RST (Module Reset).

Input Values

'M' = Configure /MD//RST pin as /MD

'R' = Configure /MD//RST pin as /RST

Normal Command Sequence



/MD Activation Time

The length of time that the /MD pin is held active when motion is detected is configured by this command. See Table 6 for corresponding values.

Command: Read /MD Activation Time "d" (0x64)

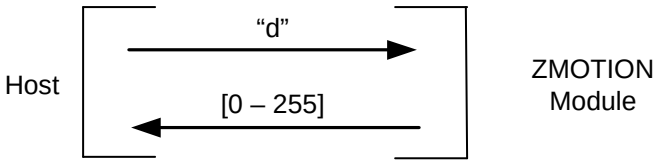
Description

Returns the /MD pin output activation time value used when motion is detected.

Return Values

0 - 255 (decimal) — See Table 6.

Normal Command Sequence



Command: Write /MD Activation Time "D" (0x44)

Description

Selects the /MD pin output activation time value used when motion is detected.

Input Values

0 - 255 (decimal) - See Table 6.

Normal Command Sequence

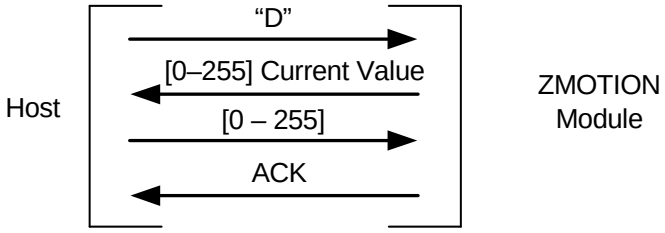


Table 4. /MD Output Activation Time Values

Command Value	/MD Output Activation Time
0	Output does not activate on motion
1–127	1–127 seconds
128	Output does not activate on motion
129–255	1–128 minutes

Hyper Sense

Hyper Sense Mode allows smaller signal changes to be considered valid motion events. This significantly increases sensitivity at the cost of more potential false motion detections. The typical application for this mode is in occupancy sensing where it is enabled after valid 'normal' motion has already been detected.

Command: Read Hyper Sense Setting "e" (0x65)

Description

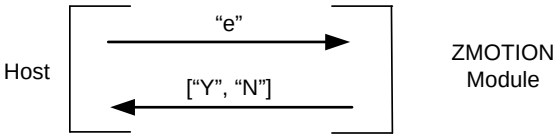
This command returns the current status of the Hyper Sense setting.

Return Values

'Y' = Hyper Sense Enabled

'N' = Hyper Sense Disabled

Normal Command Sequence



Command: Write Hyper Sense Setting "E" (0x45)

Description

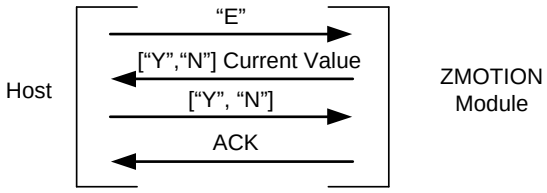
This command enables and disables Hyper Sense mode.

Input Values

'Y' = Hyper Sense Enabled

'N' = Hyper Sense Disabled

Normal Command Sequence



Frequency Response Setting

The Frequency Response setting controls sensitivity to targets producing lower frequencies. When set to "H", sensitivity to targets producing lower frequencies is reduced. This also has the effect of reducing the distance that the ZMOTION™ Detection Module can see.

Command: Read Frequency Response Setting "f" (0x66)

Description

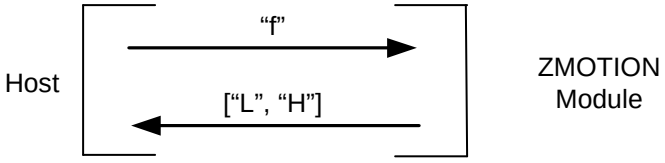
This command returns the current Frequency Response setting of the Module.

Return Values

L = Low and High frequency targets detected

H = Low frequency target sensitivity reduced

Normal Command Sequence



Command: Write Frequency Response Setting "F" (0x46)

Description

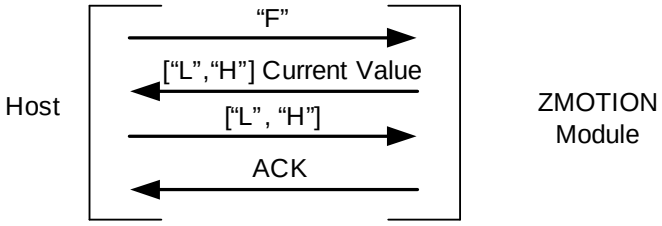
This command sets the Frequency Response of the Module.

Input Values

L = Low and High frequency targets detected

H = Low frequency target sensitivity reduced

Normal Command Sequence



Motion Detection Suspend

This command enables and disables motion detection by the ZMOTION™ Detection Module. When set to 'N', the Module detects motion. When set to "Y", motion detection is suspended. While Motion Detection Suspend is a method to temporarily disable motion detection, the /MD pin may still be *manually* driven active/inactive via the "O" (Write / MD Output State) command.

Command: Read Motion Detection Suspend Setting "h" (0x68)

Description

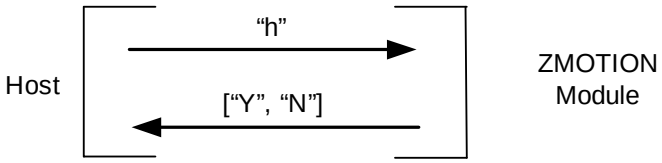
This read command returns the current Motion Detection Suspend setting.

Return Values

Y = Motion Detection is suspended

N = Motion Detection is active

Normal Command Sequence



Command: Write Motion Detection Suspend Setting "H" (0x48)

Description

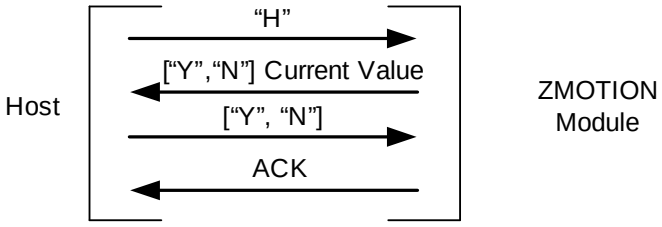
This write command enables and disables motion detection by the ZMOTION™ Detection Module.

Input Values

Y = Motion Detection is suspended

N = Motion Detection is active

Normal Command Sequence



Software Revision

The software in the ZMOTION™ Detection Module is made up of two parts:

- Advanced passive infrared software engine
- Application software

The S/W Revision command returns the revisions of this software.

The advanced passive infrared software engine is locked into the device and cannot be changed. This software provides all of the algorithms and processing functions required for motion detection - Refer to product specification for the Z8FS040 ZMOTION™ MCU for more details on the operation of this software.

The application software provides the Serial and H/W Interface Mode functionality. It uses the services provided by the advanced passive infrared software engine for all of the motion detection functions. This application software is available for download and can be modified for custom applications. Please see the Zilog Web Site to obtain the application software project.

See Appendix C on page 54 for version information.

Command: S/W Revision "i" (0x69)

Description

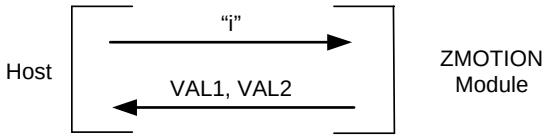
The 'i' command returns the revision of the software programmed into the ZMOTION™ Detection Module. The first value returned is the application software revision. The second value returned is the advanced passive infrared software engine revision. See Table 8 and Table 9 in Appendix C for a description of software revisions.

Return Values

VAL1 = 0 - 255 (decimal) - Application S/W Version

VAL2 - 0 - 255 (decimal) - ZMOTION™ S/W Engine Version

Normal Command Sequence



Serial Interface Command Mode

The serial interface can operate in either ASCII or ASCII/Decimal modes. The default is ASCII/Decimal where commands are sent as ASCII characters, but numeric values sent and returned are decimal. In ASCII mode, all commands and numeric values are sent and returned in ASCII. This is useful for demonstration purposes or when using a terminal to control and monitor the ZMOTION™ Detection Module.

For example, the data for the Sensitivity command is a value from 0 to 255. In ASCII/Decimal mode this would be sent as a single byte (0x00 to 0xFF). In ASCII mode, this would be sent as 3 bytes: '0','0','0' to '2','5','5'. All values are sent as 3 characters.

Command: Read Serial Interface Command Mode "k" (0x6B)

Description

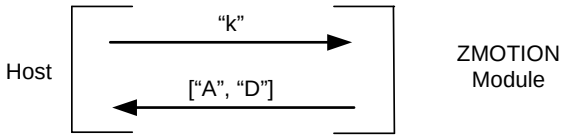
This command returns the current command interface mode.

Return Values

'A' = ASCII Mode Enabled

'D' = ASCII/Decimal Mode Enabled (Default)

Normal Command Sequence



Command: Write Serial Interface Command Mode “K” (0x4B)

Description

This command selects the command interface mode.

Input Values

'A' = ASCII Mode Enabled

'D' = ASCII/Decimal Mode Enabled

Normal Command Sequence

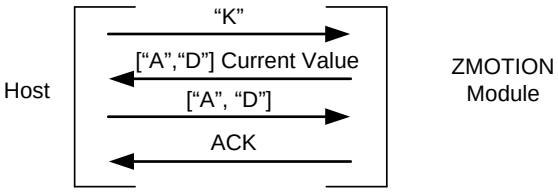


Table 5. /MD Output Activation Time Values

Command Value	/MD Output Activation Time
0	Output does not activate on motion
1–127	1–127 seconds
128	Output does not activate on motion
129–255	1–128 minutes

Motion Detected Unsolicited Mode

This mode allows the ZMOTION™ Detection Module to send motion detection status to the Host unsolicited (without first sending the 'a' command). The Module will send an 'M' to the Host every time motion is detected. When Unsolicited mode is not used, the Host must poll the Module using the 'a' command or read the Current Output Active Time using the "o" to determine motion detection status.

Command: Read Motion Detected Unsolicited Mode "m" (0x6D)

Description

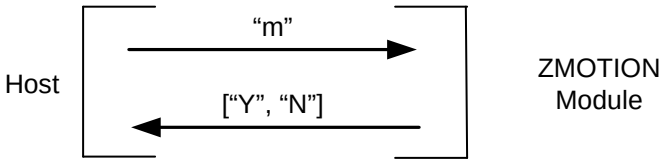
This read command returns the Motion Detected Unsolicited Mode currently selected.

Return Values

‘Y’ = Unsolicited mode is enabled. Module sends an 'M' each time motion is detected.

‘N' = Unsolicited mode is disabled.

Normal Command Sequence



Command: Write Motion Detected Unsolicited Mode "M" (0x4D)

Description

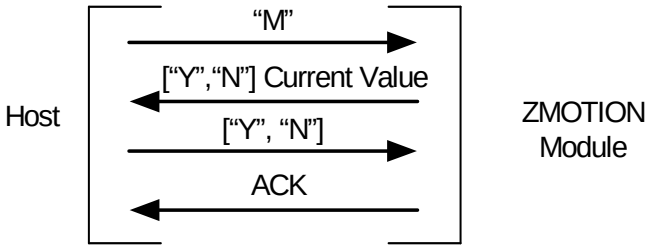
Enable/disable Motion Detected Unsolicited Mode

Input Values

'Y' = Unsolicited mode is enabled. Module sends an 'M' each time motion is detected.

'N' = Unsolicited mode is disabled.

Normal Command Sequence



/MD Current Active Output Time

This command directly controls the /MD output pin. The "O" command activates the /MD output pin for the amount of time specified in the command; it is a manual override of the current state of /MD and is independent of motion detection. The valid range is listed in Table 6. The "o" command is used to read the remaining time that /MD will be held active - as initiated by this command or by detected motion. If motion is detected after the "O" command is given, the /MD output time restarts at the /MD Activation Time set by the "D" command.

Command: Read /MD Current Output Active Time "o" (0x6F)

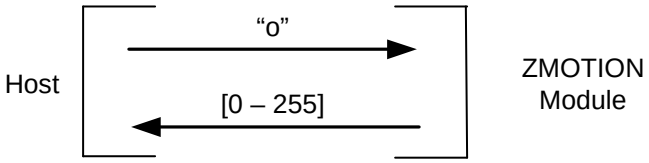
Description

Returns the remaining time that the /MD output pin will be held active.

Return Values

0 - 255 (decimal) - See Table 6.

Normal Command Sequence



Note: *This command is still valid if the /MD pin is configured for /RST. The command returns the state of /MD pin as if it was configured to indicate motion.*

Command: Write /MD Output State "O" (0x4F)

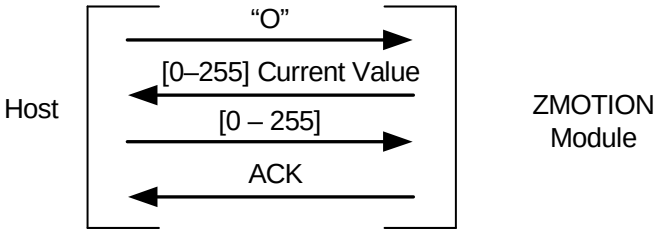
Description

Activates the /MD output pin for the amount of activation time desired.

Input Values

0 - 255 (decimal) - /MD activated for the selected amount of time. See Table 6.

Normal Command Sequence:



Notes: 1. This command does not affect the Read Motion Status command ('a') or the Clear Motion Status command ("'A'").

2. If the /MD pin is configured as Reset, the value is saved as if the /MD pin is configured to indicate motion.

Table 6. /MD Output Activation Time Values

Command Value	/MD Output Activation Time
0	Output does not activate on motion
1–127	1–127 seconds
128	Output does not activate on motion
129–255	1–128 minutes

Ping

This command provides a simple method to ping the ZMOTION™ Detection Module to ensure it is responding to commands. The "P" writes a value (typically a 1 or a 2) that can be read back using the "p" command. The "P" command only accepts a single character written whether it is in ASCII mode or ASCII/Decimal mode ("K" command). For example, sending the command "P", "1" will return '0', '4', '9' in ASCII mode and 0x31 (49 decimal) in ASCII/Decimal mode.

Command:Read Ping Value

"p" (0x70)

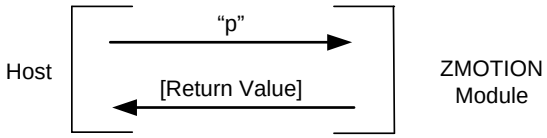
Description

This command returns the last written Ping value.

Return Values

Last value written using the "P" command. The default value is 1.

Normal Command Sequence



Command: Write Value Ping
"P" (0x50)

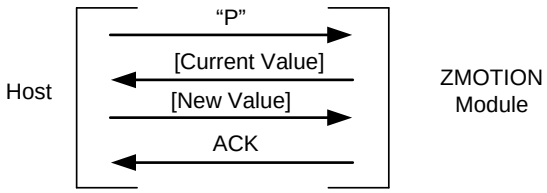
Description

This write command stores a value that can be read by the "p" command.

Input Values

0 - 255 (decimal) - Value is stored and read by 'p' command

Normal Command Sequence



Range Setting

This command determines the relative range of motion detection. Larger values decrease the range of detection. Range is also dependent on target size, speed, and relative temperature. For example, a range control setting that rejects one target of a particular size at a given distance does not guarantee that a larger target will be rejected at the same distance.

Command: Read Range Setting "r" (0x72)

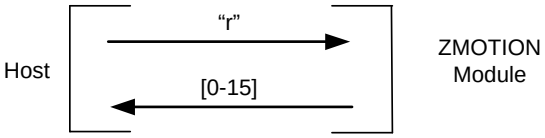
Description

This command returns the current range setting.

Return Values

0 - 15 (decimal)

Normal Command Sequence



Command: Write Range Setting "R" (0x52)

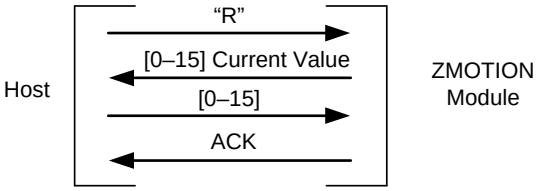
Description

This command sets the Range value.

Input Values

0 - 15 (decimal)

Normal Command Sequence



Sensitivity

This command controls how sensitive the ZMOTION™ Detection Module is to motion. Larger values provide lower sensitivity and also have the effect of reducing the range. Smaller values provide higher sensitivity.

Command: Read Sensitivity "s" (0x73)

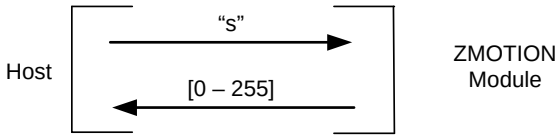
Description

This command returns the current motion detection sensitivity setting.

Return Values

0 - 255 (decimal)

Normal Command Sequence



Command: Write Sensitivity "S" (0x53)

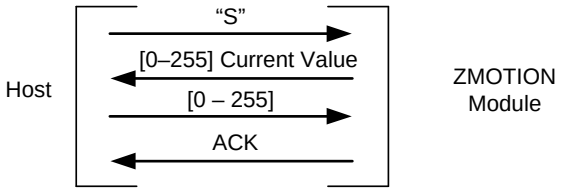
Description

This command sets the motion detection sensitivity.

Input Values

0 - 255 (decimal)

Normal Command Sequence



Directional Detection

Directional Detection places the ZMOTION™ Detection Module in a mode that detects both positive and negative motion directions. When Dual Direction Mode is enabled via the 'U' command, motion is detected in either direction and the 'a' and 'M' commands are enhanced to respond with a '+' or '-' to indicate the direction of the motion target. Single Direction Mode is enabled via the 'V' command and is similar to the 'U' command except motion is detected in only one of the '+' or '-' directions as set when the 'V' command is issued. The 'a' and 'M' commands are not modified when in Single Direction Mode.

The signal generated by the pyro-electric sensor used to discern direction can vary from device to device, but is consistent for a particular device. Therefore, the '+' and '-' direction settings can mean either left to right or right to left motion, but will always be the same for that particular device. Each device can be calibrated simply by creating motion in one or both directions and observing the results. Other factors such as where the target starts motion will affect the directional detection capabilities of the ZMOTION™ Detection Module. Directional detection works best when the target moves horizontally starting from outside of the range (left or right side) of Module and through the beams of the detection pattern. If the target begins motion while inside the Module detection pattern area, an incorrect direction can be reported.

Command: Read Dual Direction Mode "u" (0x75)

Description

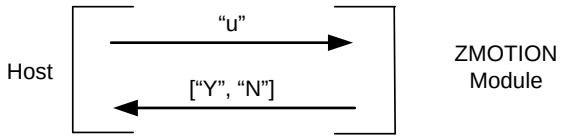
The 'u' command returns the current Dual Direction Mode setting.

Return Values

'N' = Dual Direction Mode Disabled

'Y' = Dual Direction Mode Enabled

Normal Command Sequence



Command: Write Dual Direction Mode "U" (0x55)

Description

Enable directional detection in both '+' and '-' directions.

When Dual Direction mode is enabled, the 'a' command (Read Motion Status) and 'M' command (Motion Detected Unsolicited Mode) provide the directional information:

'+' = Motion detected in the '+' direction

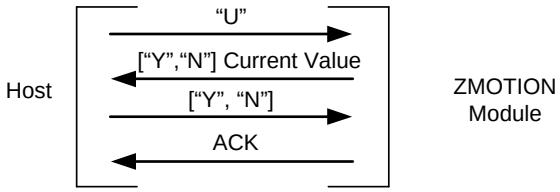
'-' = Motion detected in the '-' direction

Input Values

'N' = Dual Direction Mode Disabled

'Y' = Dual Direction Mode Enabled

Normal Command Sequence



Command: Read Single Direction Mode "v" (0x76)

Description

The 'v' command returns the current setting of the Single Direction Mode.

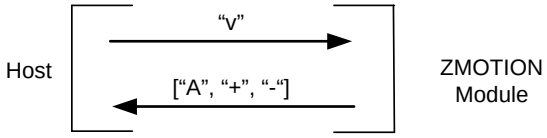
Return Values

'A' = Single Direction Mode Disabled

'+' = Single direction mode set to detect motion only in the "+" direction

'-' = Single direction mode set to detect motion only in the "-" direction

Normal Command Sequence



Command: Write Single Direction Mode "V" (0x56)

Description

The 'V' command selects the direction of motion to be detected. When Single Direction Mode is enabled, motion status is reported only when motion is detected in the direction specified. For example, if '+' direction is specified, then the 'a' command (Read Motion Status) will return a 'Y' only when motion is detected in the '+' direction. If motion is detected in the '-' direction, the 'a' command would return 'N'.

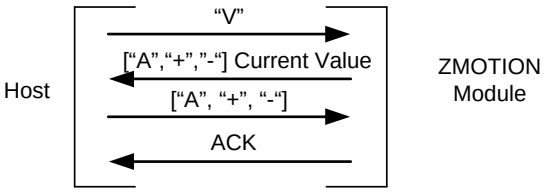
Input Values

'A' = Single Direction Mode Disabled

'+' = Detect motion only in the "+" direction

'-' = Detect motion only in the "-" direction

Normal Command Sequence



Module Reset

This command forces the ZMOTION™ Detection Module to perform a reset. All configuration and status are returned to default values — see Table 3.

This is a special command that requires confirmation. Once "X" is received, the Module sends an 'ACK' and expects the 4-digit confirmation sequence ("1", "2", "3", "4").

Once this sequence is received the device sends an 'ACK' and performs a reset. If the confirm sequence is incorrect or the inactivity timeout is exceeded, the device will send a 'NACK' and ignore the reset request.

Command: Module Reset "X" (0x58)

Description

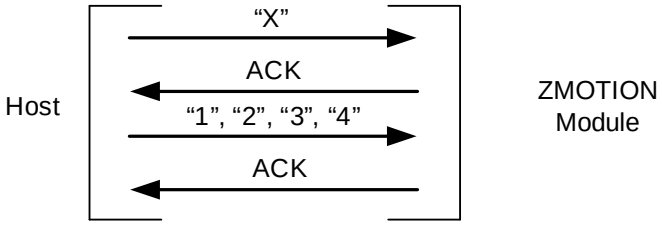
Reset the ZMOTION™ Detection Module.

Return Values

ACK = Reset command accepted

NACK = Reset command not accepted

Normal Command Sequence



Command: Read Sleep Time "y" (0x79)

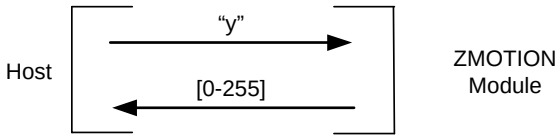
Description

This command returns the current sleep time setting in seconds.

Return Values

0 - 255 (decimal)

Normal Command Sequence



Command: Write Sleep Time "Y" (0x79)

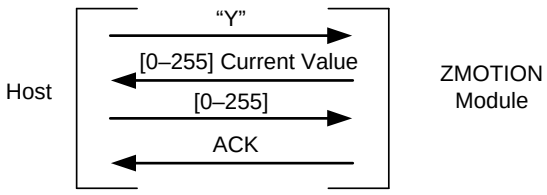
Description

This command sets the Sleep time in seconds. A value of 0 disables the sleep timer and wake up is initiated only by a transition on the /SLP pin or when a character is received over the serial interface (The character is received and processed).

Input Values

0 - 255 (decimal)

Normal Command Sequence



Sleep Mode

This command places ZMOTION™ Detection Module into Sleep Mode. Sleep Mode Enable is a special command that requires confirmation. Once the "Z" is received, the Module sends an 'ACK' and expects the 4-digit confirmation sequence ("1", "2", "3", "4"). Once this sequence is received the device sends an 'ACK' and enters low power Sleep Mode for the number of seconds set by the 'Y' (Write Sleep Time) command. If the confirm sequence is incorrect or the inactivity timeout is exceeded, the device will send a 'NACK' and ignore the reset request.

Sleep mode is exited automatically when the sleep time expires or by a transition on the /SLP pin or by sending a character over the serial interface - this character is ignored. A value of 0 for sleep time disables the sleep timer.

Command: Sleep Mode Enable "Z" (0x5A)

Description

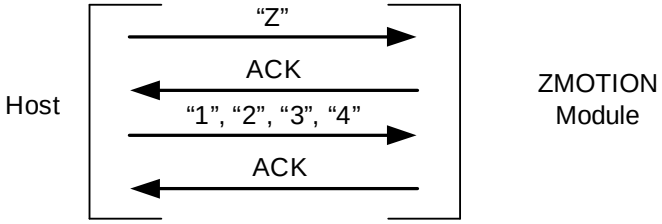
The 'Z' command places the ZMOTION™ Detection Module into low power Sleep mode.

Return Values

ACK = Sleep command accepted

NACK = Sleep command not accepted

Normal Command Sequence



Detection Pattern

The Fresnel lens directs the infrared energy from the target on to the pyro-electric sensor. Figure 8 shows the coverage area provided by the ZMOTION™ Detection Module. It provides a 60 degree cone with 4 beams. The two inner beams provide greater range than the two outer beams. The actual range is affected by ambient temperature and the settings provided to the Module (Sensitivity, Range, Hyper Sense and Frequency Response all contribute to the range performance).

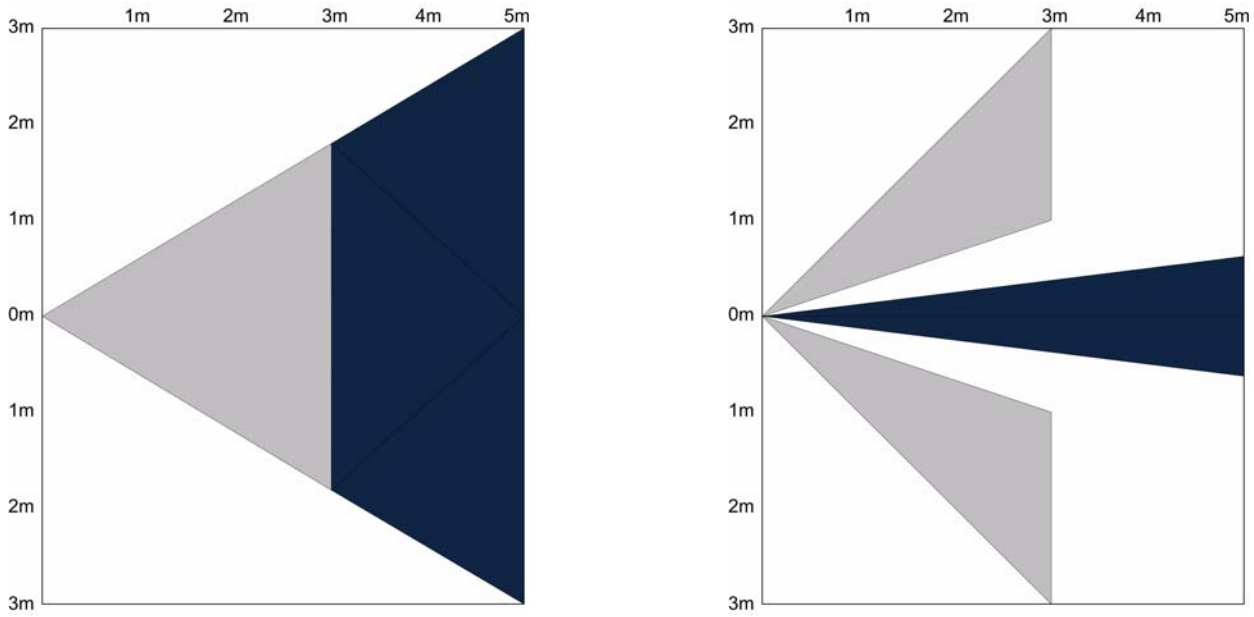


Figure 8. Detection Pattern

Mechanical Information

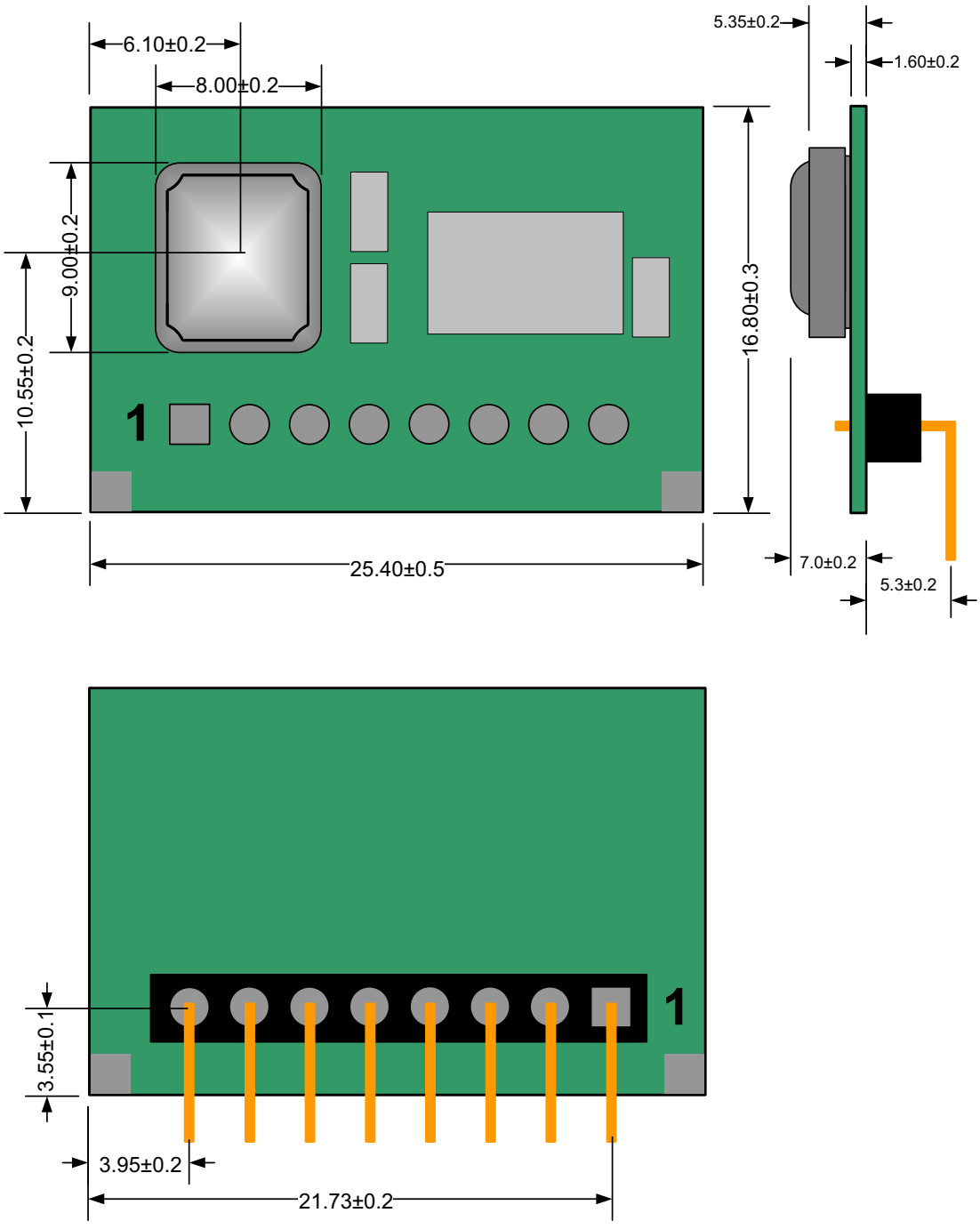


Figure 9. Mechanical Drawing of ZMOTION™ Detection Module

ZMOTION™ Detection Module Schematic

Figure 10 displays the schematic of ZMOTION™ Detection Module.

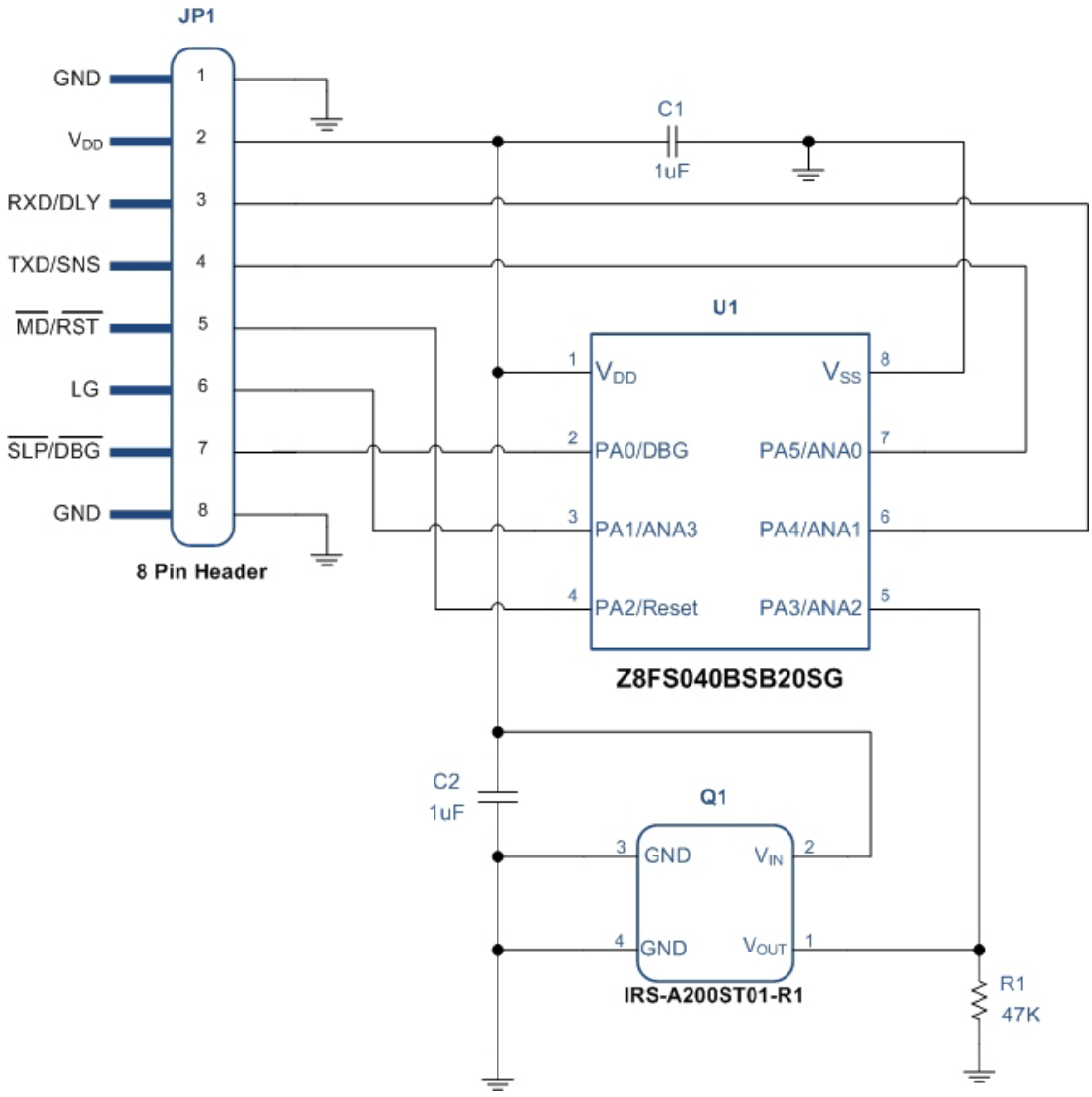


Figure 10. Schematic of ZMOTION™ Detection Module

Related Documents

The related documents for ZMOTION™ Detection Module include:

- ZMOTION™ Detection Module Evaluation Kit User Manual (UM0223)
- Z8 Encore! XP® F082A Series Product Specification (PS0228)
- ZMOTION™ Detection Module Product Brief (PB0223)
- ZMOTION™ Detection Module Development Kit Quick Start Guide (QS0073)
- ZMOTION™ Detection Module Application Walkthrough (AN0307)
- ZMOTION™—A New PIR Motion Detection Architecture White Paper (WP0017)
- Power Management and Customer Sensing with Zilog's ZMOTION™ Detection Module (AN0301)
- ZMOTION™ Detection and Control Family Featuring PIR Technology Product Specification (PS0285)

Related Products

The table below lists the products related with ZMOTION™ Detection Module.

Product Number	Product Description
Z8FS040BSB20EG	ZMOTION™ MCU (8 pin SOIC)*
Z8FS040BHH20EG	ZMOTION™ MCU (20 pin SOIC)*
Z8FS040BHJ20EG	ZMOTION™ MCU (28 pin SOIC)*
ZEPIR000102ZCOG	ZMOTION™ Detection Module Evaluation Kit

Note: *See Zilog's ZMOTION™ Detection and Control Family Featuring PIR Technology Product Specification (PS0285), available on Zilog.com.

Chapter 2 Electrical Characteristics

The data in this chapter is pre-qualification and pre-characterization and is subject to change. For additional electrical characteristics, refer to *Z8 Encore! XP® F082A Series Product Specification (PS0228)*.

Table 5. Electrical Characteristics

Symbol	Parameter	Min	Typ	Max	Units	Conditions
V_{POR}	Power-on Reset Voltage Threshold	2.20	2.45	2.70	V	$V_{DD} = V_{POR}$
V_{VBO}	Voltage Brownout Reset Voltage Threshold	2.15	2.40	2.65	V	$V_{DD} = V_{POR}$
T_{RAMP}	Time for V_{DD} to transition from V_{SS} to V_{POR} to ensure valid Reset	0.10	—	100	ms	—
T_{POR}	Power-on Reset Digital Delay	—	1.0	—	ms	—
V_{DD}	Supply Voltage	2.7	—	3.6	V	—
V_{IL1}	Low Level Input Voltage	-0.3	—	$0.3*V_{DD}$	V	RXD, /RST, /SLP
V_{IH1}	High Level Input Voltage	$0.7*V_{DD}$	—	5.5	V	RXD, /RST, /SLP
V_{OL1}	Low Level Output Voltage	—	—	0.4	V	I_{OL} = 2 mA; V_{DD} = 3.0 V TXD, /MD
V_{OL2}	Low Level Output Voltage	—	—	0.6	V	I_{OL} = 20 mA; V_{DD} = 3.3 V TXD, /MD
V_{OH1}	High Level Output Voltage	2.4	—	—	V	I_{OH} = -2 mA; V_{DD} = 3.0 V TXD, /MD
V_{OH2}	High Level Output Voltage	2.4	—	—	V	I_{OH} = -20 mA; V_{DD} = 3.3 V TXD, /MD
I_{DD} Active	Supply Current in Active Mode	—	8.9 mA	—	—	V_{DD} = 3.3 V
I_{DD} Sleep	Supply Current in Sleep Mode	—	600 uA (Typ)	—	—	V_{DD} = 3.3 V
T_{PIR}	PIR Stabilization Time	—	20	—	seconds	—

Table 5. Electrical Characteristics (Continued)

Symbol	Parameter	Min	Typ	Max	Units	Conditions
Z_{IN}	Analog Pin Input Impedance	—	550	—	KΩ	DLY, SNS, LG
	Serial Interface Inactivity Timeout	—	2.5	—	seconds	—

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 may affect device reliability. For improved reliability, unused inputs should be tied to one of the supply voltages (V_{DD} or V_{SS}).

Table 6. Absolute Maximum Ratings

Parameter	Min	Max	Units
Ambient Temperature Under Bias	0	70	°C
Storage Temperature	-65	+150	°C
Voltage on Any Pin with respect to V_{SS}	-0.3	+5.5	V
Voltage on V_{DD} Pin with respect to V_{SS}	-0.3	+3.6	V
Maximum Output Current from Active Output Pin	-25	+25	mA

Chapter 3 Ordering Information

You can order the ZMOTION™ Detection Module from Zilog® or any of our authorized distributors using the following part numbers. For more information on ordering, please consult your local Zilog sales office. The Zilog website www.zilog.com lists all regional offices and provides additional information about ZMOTION™ Detection Module product line.

Part Numbers

Table 7 lists the part numbers for ZMOTION™ Detection Module and a brief description of each part.

Table 7. Part Numbers

Part Number	Description
ZEPIR0AAS02MODG	ZMOTION™ Detection Module
ZEPIR000102ZCOG	ZMOTION™ Detection Module Evaluation Kit

Appendix A—Hardware Interface Mode

The schematic in Figure 11 shows a typical application example of how to use the Module in Hardware Interface Mode.

Hardware Interface Mode is selected because the Sense pin is between 0V and 1.8V. In this example, the DLY and SNS signals are connected to trim pots for control of the /MD output activation time and the Motion Detection sensitivity respectively. These connections can also be replaced with fixed resistor values in an application where adjustments are not necessary. The Sleep feature is not being used so the /SLP input is left unconnected as there is an internal pull-up resistor to ensure this pin remains inactive. It is also acceptable to tie this pin to Vdd. The /MD signal directly drives a solid state relay and is active low. The LG (Light Gate) signal is connected to a CDS photo cell in a divider configuration with a potentiometer to adjust the light level. The signal is used by the Module to gate the /MD signal such that it does not activate in the presence of daytime ambient light. When the voltage on this pin is lower than 1.0 V, the /MD signal will not activate even when motion is detected.

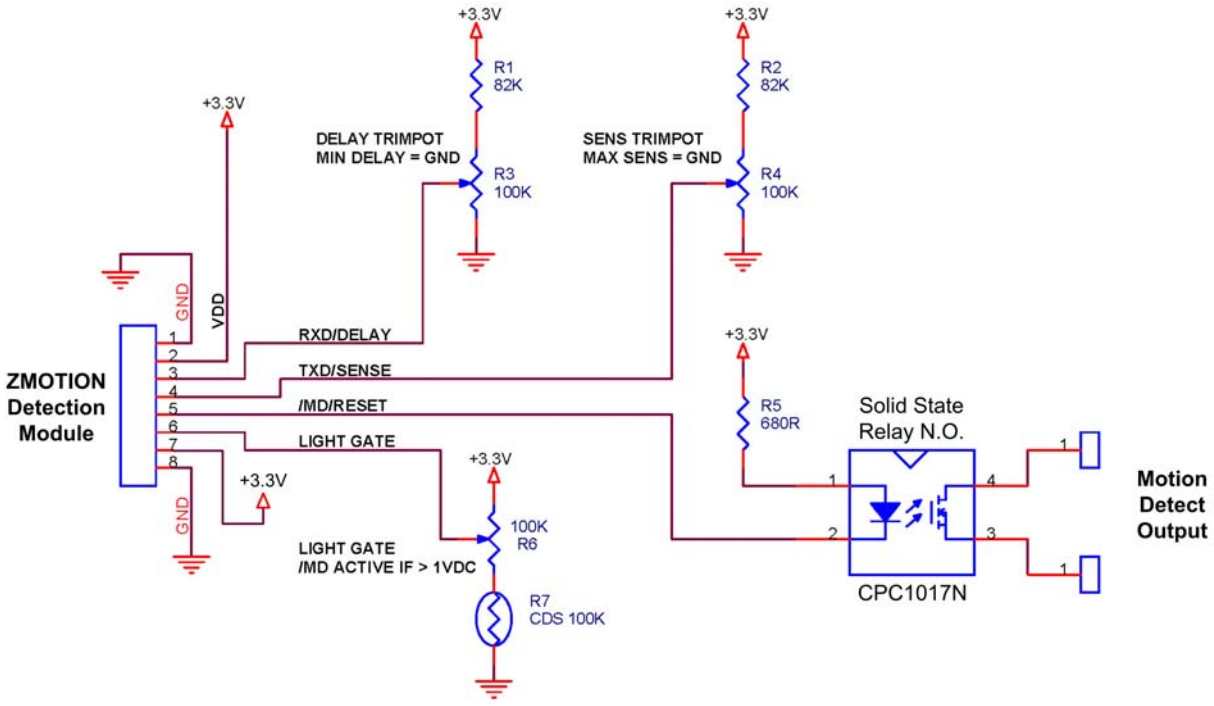


Figure 11. Application Example - Hardware Interface Mode

Appendix B—Serial Interface Mode

The schematic in Figure 12 shows a typical application example of how to use the module in Serial Interface Mode.

Serial Interface Mode is selected because the TXD pin is pulled High via the 10K ohm resistor R1. This High state is only required to be guaranteed during power up. In this example, the RXD and TXD signals are connected to the TXD and RXD signals (respectively) of the Z8F1680. Since the /MD and /SLP signals are still active in the Serial Interface Mode, they are also connected to the host MCU. If they were not connected to the MCU, /MD would typically drive the control circuitry similar the Hardware Interface Mode and /SLP either left unconnected or tied high. /SLP has an internal pull-up to ensure proper operation. The LG (Light Gate) signal is connected to a CDS photo cell in a divider configuration with a potentiometer to adjust the light level. The signal is used by the Module to gate the /MD signal such that it does not activate in the presence of daytime ambient light. When the signal on this pin is lower than lower than the value programmed into the Light Gate Threshold register, the /MD signal will not activate even when motion is detected.

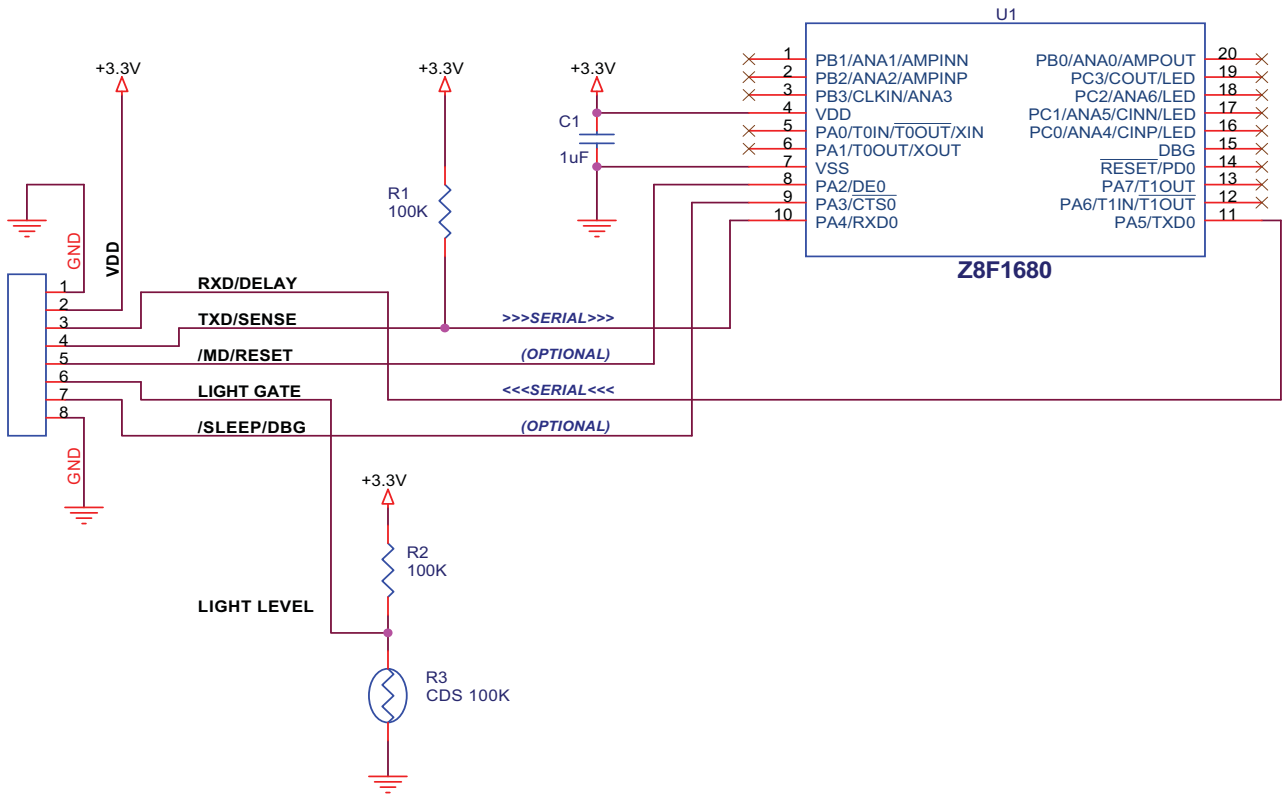


Figure 12. Application Example - Serial Interface Mode

Appendix C

Table 8. ZMOTION™ Detection Module S/W Revision (Application S/W)

Returned Value ('i' command)	S/W Revision	Changes/Updates
1	1.0	Initial Production Release
2	2.0	Support for additional features in ZMOTION™ Detection Module. Added ASCII serial mode, RAM R/W, and sleep timer. Improved sleep mode current.

Table 9. ZMOTION™ S/W Engine Revision

Returned Value ('i' command)	S/W Revision	Changes/Updates
1	1.0	Initial Production Release
2	2.0	Release of ZMOTION™ Detection MCU Family. Improved detection/stability. Added Range, Low Power, Hyper Sense, Advanced API features.

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 at http://support.zilog.com.

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