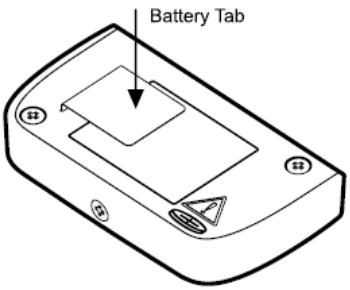
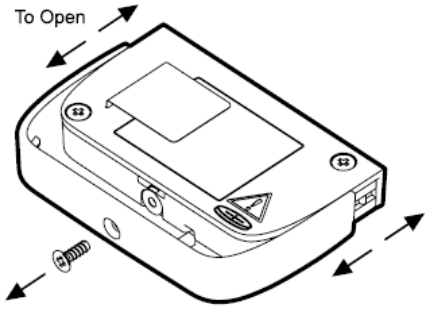
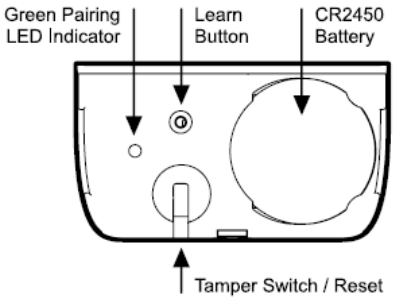
Z-Wave® Long Range Contact Sensor Technical Manual

M/K: DWZW8-ECO

Revision 7







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Product Overview

This is a compact form factor indoor Z-Wave contact sensor for security and home automation applications for use on doors and windows.

Product Specification

- **Z-Wave**
  - Z-Wave® Plus V2
  - Z-Wave® Long Range
  - **Encryption**
    - S0 Encryption for Compatibility
    - S2 Encryption
  - Smart Start (using QR-Code)
- **Operating Frequencies:** 908.42MHz, 916MHz, Z-Wave Long Range (912MHz, 920MHz)
- **Indoor-Operating Temperature:** 0˚ C to 50˚ C (32°F - 122°F)
- **Battery Type:** CR2450 (5 Years)
- **Dimensions:**
  - **Sensor:** 59 mm x 29 mm x 11 mm (2.32” x 1.14” x 0.43”)
  - **Magnet:** 59 mm x 10 mm x 11 mm (2.32” x 0.39” x 0.43”)
  - **Spacer:** 59 mm x 10 mm x 2 mm (2.32” x 0.39” x 0.078”)
- **Range:**
  - Z-Wave: OK – 700 ft

- Z-Wave LR: BETTER – 1000 ft

Definitions

- Controller: A Z-Wave enabled home-automation hub or security panel.
- Device Specific Key (DSK): PIN Code and QR-Code for adding to a Z-Wave network using encrypted S2 communication.
- S2: Secure communication encryption used on the Z-Wave network.
- Smart Start: A method for adding a Z-Wave device to a Z-Wave network via QR-Code.
- Inclusion / Adding / Pairing – Adding to a device to a Z-Wave network.
- Exclusion / Removal / Unpairing – Removing a device from a Z-Wave network or at least unpairing a device from a network that it had been added to previously.
- Node Info Frame – Used for inclusion/Exclusion carrying information about the device.
- Z-Wave Long Range: A longer range mode of Z-Wave communication used on supported Z-Wave Controllers.

Installation

To install the DWZW8-ECO, follow the following steps:

1. Add/Pair Sensor to a Z-Wave network. (See Adding/Removing to a Z-Wave network)
2. Mount the sensor and magnet to a door or window. (See Mounting instructions.)
3. Test that the sensor reports the correct state of the door or window. (See Testing Instructions)

Adding to or Removing from a Z-Wave Network

Adding to a Z-Wave Network:

Power up the sensor by inserting a battery or removing the battery pull-tab. The sensor's LED will "breath" light to dark green to indicate that the sensor is actively looking to be added into a Z-Wave network via Smart Start or is ready to be added via Classic Inclusion / Network Wide Inclusion. If the device has been added to a Z-Wave network already, follow instructions on removing sensor first.

Note: To enable Long Range mode if supported by the Z-Wave Controller, you likely will add it via the Smart Start QR-Code in your Panel/Hub's app.

Adding via Smart Start

1. (Optional) Remove the sensor's battery, so it is off.
2. When the sensor is powered up and not included in a network, it is ready for SmartStart. On your Z-Wave Controller's app, follow instructions on adding via QR-Code or Smart Start.
3. If the sensor is off, put battery into the device. The device may take a few minutes to be added.

Adding via Classic Inclusion / Network-Wide Inclusion

After Classic Inclusion, this device will automatically try to add via Network Wide Inclusion such that the device can be included into the Z-Wave network over the mesh network and not directly near the main controller.

1. If your Z-Wave controller supports S2 encryption, locate the PIN Code (DSK) which will enable S2 communication. It is located below the Smart Start QR-Code that is on the box and on the device itself.
2. Follow the instructions of the Z-Wave controller to put the Z-Wave controller into manual or classic Z-Wave inclusion mode.
3. Press the learn button on the sensor. The sensor will attempt to add itself.
4. If prompted, enter the Pin Code (DSK) into the Controller's user interface which enables S2 communication.

While being added, the sensor's LED will blink green rapidly.

If successfully added, the sensor's LED will turn green for three seconds.

Summary of Status LED Behavior when Adding to a Z-Wave Network

Status LED	Status Description	Recommendation
Breathing green once a second	Not added / Ready for Adding to a Z-Wave network.	Follow instructions above for adding.
Blinking rapidly green	Device is actively being added to a Z-Wave network.	Enter DSK if prompted. Do not remove power.
Green on for three seconds	Device is successfully added.	
Red on for three seconds	Device was NOT added successfully.	This can happen for a variety of reasons. If using S2, check that the DSK was entered correctly, and that the sensor is not out of range of the controller.

Removing from A Z-Wave Network:

On power-up, if the sensor's LED is NOT breathing green every second, then it is included in a Z-Wave network and can be removed. There are two methods to removing the sensor from a Z-Wave network: Exclusion or performing a factory reset (see the section on Factory Reset).

After trying Classic Exclusion, this device will automatically attempt to be removed via Network Wide Exclusion such that the device can be excluded from the Z-Wave network over the mesh network and not directly near the main controller.

1. Follow the Z-Wave controller's instructions on putting the Z-Wave controller into removal/exclusion mode.
2. Press the sensor's learn button.
3. Upon successful removal, the sensor's Status LED will turn red for 1 second. Then the Status LED will continuously "breathe" green three times every three seconds to indicate that it is ready to be added again.
4. If not successful, exclusion will timeout after 5 seconds. After which time, you may try again.

Factory Reset

Factory resetting the sensor will default all configurations and remove the device from the previous Z-Wave network. After factory reset, it is possible that the old sensor will still appear as an orphaned node on the Z-Wave controller, so you would need to follow your Hub/Panels instructions on force removing the orphaned node. *Note: Factory reset only works when the device is already added into a Z-Wave network. If the sensor is not included in a network, then it cannot be factory reset.*

1. Hold the learn button for 3 seconds. The LED will blink red rapidly during this time.
2. When the sensor's LED lights green for five seconds, release the button. The sensor is now ready to be added to a Z-Wave network.

LED

Note: The LED will be off most of the time if installed correctly with the case on.

The LED can be used to diagnose problems with the sensor. To conserve power, once the sensor is installed and added to a Z-Wave network with the case on, the LED will stay off except if it drops offline. When installed and added to a network, on open or closing the door/window or the case of the sensor, it will blink either quickly green (sensor is offline) or breath red 3 times (sensor is online).

Event	LED Behavior
Not yet added to a network / Smart Start Inclusion	Breathing green 3 times for 3 seconds
Classic Inclusion	Blinking green continuously (500ms on/off)
Inclusion failed	Red on for 3 seconds
Exclusion	3 seconds red
Factory Default Wait	Blinking red (50ms on/off) for 10 seconds
Factory Default Success	5 seconds green
Powered on when included	5 seconds green
Device Offline	Blink red 3 times (1000ms on/off)

Troubleshooting

Problem	Possible Cause	Solution
Unable to add device to Z-Wave network	Device was not properly excluded from a previous Z-Wave network	Try removing the device by putting the Z-Wave controller into exclusion mode and then pressing the sensor's learn button. You can also factory reset the device in the case of a missing or inoperative Z-Wave controller.
Can't see door/window open close	Poor communication link	Open the case and observe the LED when you open and close the door/window. If it is short green LED blink, then it it's not a problem with the sensor. If the sensor breaths 3 times red, then it is out of range of the Z-Wave Controller.
Unable to determine if it's learned into a Z-Wave Controller.	Device might not have been added successfully.	Insert the battery, if the device is continuously blinking green, then it is not added to a Z-Wave network. Try to add it. Otherwise, it is already added. Factory default the sensor, and try to add it again.

Mounting

The sensor must be mounted properly to operate correctly.

The Sensor can be mounted using either the included:

- Double-sided tape
  - When using the double-sided tape, it's imperative that the surface of the door or window where the tape attaches to be clean/free of dirt or dust.
  - Using rubbing alcohol to first clean the surface of the door or window where the tape will be attached greatly improves performance of the tape.
- Mounting bracket and screws.
  - See diagram below on how the mounting bracket attaches to the sensor.
- The sensor can be mounted:
  - Directly to a door or window and the magnet to the outside edge of the door or window,
  - Or mount the magnet to the door or window and the sensor to the outside edge. The magnet must be within ½ of an inch of the sensor when the door or window is fully closed without impeding the door or window's travel.
  - Depending on the outside edge of the door or window, it can be a challenge to mount the sensor close enough to the magnet, so included is a spacer to help with alignment.

Using Spacers with Mounting Bracket

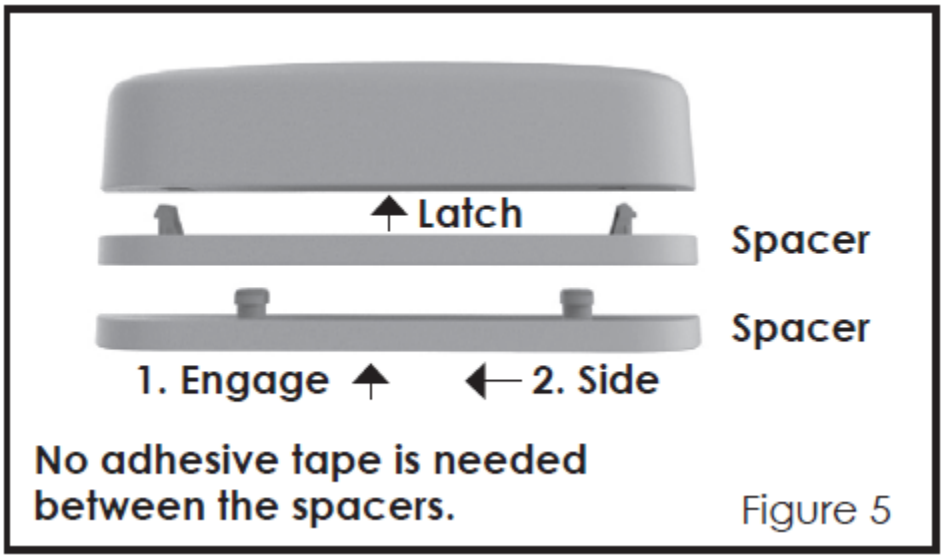


Figure 5

Double-Sided Tape on Sensor

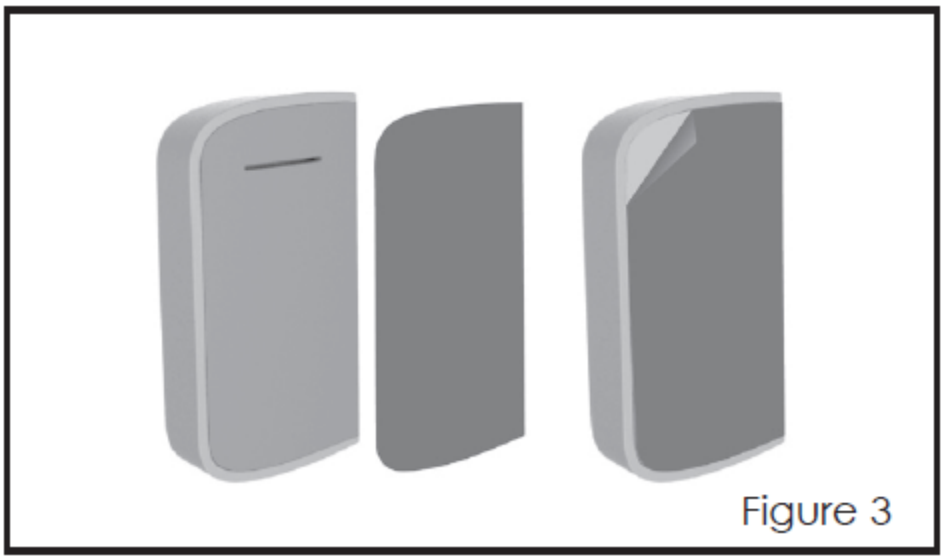
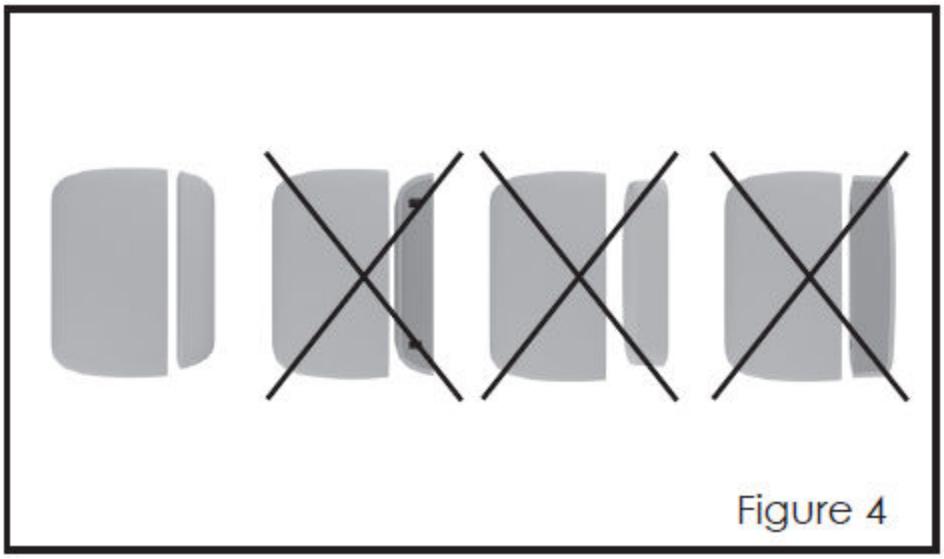


Figure 3

Correct Orientation of Magnet to Sensor



What is Z-Wave?

The Z-Wave protocol is an interoperable, wireless, RF-based communications technology designed specifically for control, monitoring and status reading applications in residential and light commercial environments. Mature, proven and broadly deployed (with over 35 million products sold worldwide), Z-Wave is by far the world market leader in wireless control, bringing affordable, reliable, and easy-to-use 'smart' products to many millions of people in every aspect of daily life. Certified Z-Wave devices regardless of manufacturer can work together to form a Z-Wave mesh network. Always on Z-Wave devices can act as repeaters in the mesh increasing range and redundancy.

For a more complete look at Z-Wave technology for non-technologists, and to learn more about Z-Wave's role as a key enabling technology for the Internet of Things and connected objects, please visit z-wave.com.

What is Z-Wave Long Range?

Engineered to provide significantly extended wireless range and support robust networks, Z-Wave LR extends Z-Wave connectivity beyond the boundaries of the home and accelerates the adoption of Z-Wave in other verticals such as light commercial, hospitality, and multi-dwelling units (MDU). Z-Wave Long Range is an extra 100kbps DSSS OQPSK modulation addition to the Z-Wave protocol. The modulation is treated as a fourth channel – allowing gateways to add LR nodes to the existing Z-Wave channel scanning. Currently, Z-Wave LR is only available for the US market however, the Technical Workgroup is evaluating and testing to ensure compliance and to be able to support Europe and APAC regions in the future.

Heartbeat

The “Heartbeat” is a configurable timer that regularly sends updates to the Lifeline association group which also allows the device to check its battery under load of the transmitter and comply with a UL requirement of security sensors to report regularly about once an hour instead of only on an event. The heartbeat function is implemented in this device as a Battery Report. It is configured using the Configuration Command Class parameter number 7, and by default it is configured to be off.

Battery

Note: While the features around the battery are heavily configurable for this device, the default configuration of the features around the battery should be sufficient for most users.

The sensor uses a CR2450 Li-Ion battery which allows for a smaller sensor size, but most coin-cell type batteries have the following challenges for wireless sensor type devices:

Li-Ion Coin-Cell Battery Challenges	Explanation	Solution
Inaccurate battery level / life readings.	The voltage is not linear over a coin-cell’s battery life, so the sensor reports battery level as levels of Good, Low, and Dead.	The sensor reads its battery’s voltage when at peak load of the transmitter being on, and the battery voltage is averaged over several readings.
Sensitive to low temperatures	Li-Ion batteries are negatively affected by cold temperatures creating opportunities for more low-battery reports than desirable.	The battery state doesn’t latch. The sensor uses configurable hysteresis to transition from one battery state to another.
User-requirements differ greatly	Users have different requirements / preferences for how they want the battery reported since it’s such a crucial aspect of the sensor, and their application may be drastically different.	How the sensor reports battery is heavily configurable.
Low-Temperature Low-Battery warnings cause truck rolls	If a sensor is professionally installed, a latching low battery can cause expensive truck rolls if installed in an area with cold temperatures.	The sensor’s low-battery report has temperature context and is non-latching, so a user will have more information

Battery Report Version 3

7	6	5	4	3	2	1	0
Command Class = COMMAND_CLASS_BATTERY							
Command = BATTERY_REPORT							
Battery Level							
Battery Charging Status		Rechargeable	Back-up Battery	Overheating	Low Fluid	Replace/recharge status bit-mask	
Reserved						Low Temperature Status	Disconnected

Above is a Command Class Battery, Battery Report Frame version 3 which has two important features:

1. Reporting the battery as a percentage
2. Able to communicate that the battery temperature could be impacting battery level using the "Overheating" or "Low Temperature Status."

Battery Voltage Monitoring

Even though the Command Class Battery, Battery Report shows the battery as a percentage, coin-cell Li-Ion batteries generally do not change their voltage over much of their battery life, so the sensor can only sense if the battery is OK, Low (Change soon) or Dead (Change Now). Because user applications of contact sensors differ greatly, we made the thresholds configurable. The battery monitoring inside the sensor has the following features:

- Battery voltage measured with averaging ensuring accurate readings.
- Battery voltage measured under maximum load during transmission.
- Configurable battery voltage levels of Low and Dead
- Configurable battery voltage hysteresis prevents extraneous battery reports and allows for the battery level to not have to latch in low or dead.
- Configurable regular Battery Reports / readings with the Heartbeat (see Heartbeat)
- Battery temperature monitoring using a Battery Report and Battery Health Report

Thresholds	Default (Recommended)	Minimum	Maximum	Configurable
OK	3000mv	3000mv	3000mv	No
OK -> Low	2200mv	2100mv	2700mv	Yes
Low -> Dead	2000mv	1800mv	2099mv	Yes
Dead -> Low	2100mv	-	-	Calculated to half-way between (Ok->Low) and (Low->Dead)
Low -> OK	2600mv	-	-	Calculated to half-way between (OK) and (OK->Low)
Hysteresis	3 consecutive readings	1	32	Yes
Average Samples	8	1	16	Yes

Hysteresis

For the battery level to change from Ok to low, or from low to dead and back, the battery voltage needs to read consecutively the number of times configured in a row to transition to a new state prompting a Battery Report to the lifeline. This number of consecutive battery readings is hysteresis and is configurable.

Battery Temperature

Using the Battery Command Class version 3, the sensor can communicate when the battery is below or above normal operating temperature which could potentially impact battery performance/life and cause a low-battery warning. This extra information allows more complex logic for some applications that may want to delay alerting the user a low battery condition to see if the battery level returns to a normal state when it

warms up again. ***Monitoring or reacting to the low or high temperature bits being set is purely optional and not required or even recommended.***

When the sensor detects that the battery in the sensor has crossed a threshold, it will also send a Battery Health report which contains the temperature of the battery (it's more accurately the PCB temperature in Celsius.) Knowing the temperature of the battery could be helpful in designing a system that notifies users of low battery. The Battery Health report isn't used for anything else other than the temperature.

Single-Shot Wake-Up Timer

The Single-Shot Wake-Up timer will wake up the sensor and have it send a Wake-Up Notification to the Master Node ID without having to change the Wake-Up Notification timer. This is configured via the Configuration Command Class.

Application Level Retry Attempts

The sensor ensures robust communication by adding additional retry attempts on top of the Z-Wave protocol's retry attempts for all unsolicited messages. The sensor performs additional retry attempts under the following conditions:

- When the sensor doesn't receive an Acknowledgement (ACK)
- When using Encryption S0/S2 and Supervision Encapsulation and the sensor doesn't receive a Supervision Report

Both the number of retry attempts and the timeout waiting for a Supervision Report are configurable via the Configuration Command Class.

	Default	Min	Max
Transmit Attempts	3	1 (No Retries)	10
Supervision Report Timeout	500ms	10ms	2000ms

If the sensor detects a change in contact state or tamper state, and application level retry attempts are active, then it may or may not stop the retry attempts for a current event or wait until that event is finished based on the following table:

New Event	Will Stop/Override Active Event	Behavior
Contact Open	Contact Closed	Contact Closed events canceled if active before transmitting Contact Open Events.
Contact Closed	None	Contact Open events will continue until exhausted before transmitting Contact Closed event.

Case Open	Case Closed	Case Closed events canceled if active before transmitting Case Open Events.
Case Closed	None	Case Open events will continue until exhausted before transmitting Case Closed event.

Z-Wave Device Class and Command Class Information

This device conforms to the Z-Wave+ V2 Notification Sensor specification.

Meta-Data

Information	**Values**	**Command Class Command**
Manufacturer ID	0x014A	Manufacturer Specific Report
Product Type	0x0004	
Product ID	0x07EB	
Generic Device Class	0x07 (GENERIC_TYPE_SENSOR_NOTIFICATION)	Node Info Frame
Specific Device Class	0x01 (SPECIFIC_TYPE_NOTIFICATION_SENSOR)	
Z-Wave+ Version	0x02	Z-Wave Plus® Info Report
Role Type	0x06 (ROLE_TYPE_SLAVE_SLEEPING_REPORTING)	
Node Type	0x00 (NODE_TYPE_ZWAVEPLUS_NODE)	
Installer Icon type	0x0C07	
User Icon Type	0x0C07	
SDK Version	7.19.1	Version Z-Wave Software Report
Framework API Version	10.19.1	
Framework Build	0x0090	

Z-Wave Command Classes

Command Class Name	Value	Version	Secured with S2
Z-Wave Plus® Info	0x5E	2	No
Association	0x85	2	Yes
Association Group Info	0x59	3	Yes
Battery	0x80	3	Yes
Configuration	0x70	4	Yes
Device Reset Locally	0x5A	1	Yes
Firmware Update Metadata	0x7A	5	Yes
Indicator	0x87	3	Yes
Manufacturer Specific	0x72	2	Yes

Multi-Channel Association	0x8E	3	Yes
Wake Up	0x84	3	Yes
Notification	0x71	8	Yes
Power Level	0x73	1	Yes
Security 2	0x9F	1	No
Security 0	0x98	1	No
Supervision	0x6C	2	Yes
Version	0x86	3	Yes

Basic Command Class

The sensor does not support the Basic Command Class.

Association Groups

The door window sensor supports one Association group: the “Lifeline” group which can have up to 5 nodes in the group for Classic Z-Wave. All unsolicited Z-Wave messages are transmitted to the node in the Lifeline group such as Notification Reports, Battery Reports, and Device Reset Locally notifications.

Wake-Up Command Class

While included into a Z-Wave network, the sensor will send a Wake-Up Notification to the configurable Master Node ID which allows for a controller to configure the sensor, check status, or perform an Over-The-Air firmware update. The sensor will send a Wake-Up Notification in the following conditions:

- Regularly, with the Wake-Up Notification timer configured with the Wake-Up Command Class
- Once with the Single-Shot Wake-Up timer configured with the Configuration Command Class
- When the sensor’s case is removed
- If requested via a Supervision Report (See Supervision Command Class) in response to the sensor sending a Supervision Get

Indicator

The Indicator Command Class can be used to blink the device’s red LED with the Identify indicator.

Notification Command Class

The sensor sends the following Notifications:

DEVICE CONDITION	TYPE	VALUE	EVENT	VALUE	PARAMETER LENGTH	PARAMETERS
Contact Open	HOME SECURITY	0x07	NOTIFICATION_EVENT_HOME_SECURITY_INTRUSION_UNKNOWN_EV	0x02	0	None
Contact Closed			NOTIFICATION_EVENT_NO_EVENT	0x00	1	0x01
Case Open			NOTIFICATION_EVENT_HOME_SECURITY_TAMPERING_COVERING_REMOVED	0x03	0	None
Case Closed			NOTIFICATION_EVENT_NO_EVENT	0x00	1	0x03
Software Error: Watchdog Reset	SYSTEM	0x09	NOTIFICATION_EVENT_SYSTEM_SOFTWARE_FAILURE_WITH_MANUFACTURER_PROPRIETARY_FAILURE_CODE	0x04	1	0x57
			NOTIFICATION_EVENT_NO_EVENT	0x00	1	0x04

**The HEARTBEAT notification is used as an RF-Test notification and is not the sensor's "Heartbeat" function which is a timed battery report.*

Example Notification Payload

Note: The optional parameter field is used to indicate which event is being cleared.

STATE	Example Notification Report	Uses Optional Parameter Field
Contact Open	71 05 00 00 00 FF 07 01 00	No
Contact Closed	71 05 00 00 00 FF 07 00 01 01	Yes
Case Open	71 05 00 00 00 FF 07 03 00	No
Case Closed	71 05 00 00 00 FF 07 00 01 03	Yes
Software Error: Watchdog Reset	71 05 00 00 00 FF 09 00 01 57	Yes
RF-Test Notification Sent on Case Closed	71 05 00 00 00 FF 09 05 00	No
Power-Up	71 05 00 00 00 FF 08 01 00	No
Battery Low	71 05 00 00 00 FF 08 0A 00	No
Battery Dead	71 05 00 00 00 FF 08 0B 00	No
Battery OK	71 05 00 00 00 FF 08 00 00	No

Supervision Command Class

When using S2 encryption, the sensor will encapsulate all unsolicited messages, except for Wake-Up Notifications, to the lifeline encapsulated in a Supervision Get command. If the sensor does not receive a Supervision Report in response to the Supervision Get, the sensor will retry sending the message again. This mechanism ensures that the Z-Wave controller both received and decrypted the message.

In addition, the Z-Wave controller can make the sensor send a Wake-Up Notification by setting a bit in the Supervision Report in response to the sensor sending a Supervision Get.

Configuration

The Door Window sensor supports the nine configuration parameters listed below.

1. COM Attempts

Description	Attempts sensor makes to reach gateway.
Size	1
Format	Unsigned Integer
Read only	No
Min Value	1
Max Value	10
Default Value	3
Read-Only	No
Advanced	Yes

2. Message Supervision Report Wait

Description	(ms) to wait for a superv. report.
Size	2
Format	Unsigned Integer
Read only	No
Min Value	10
Max Value	2000
Default Value	500
Read-Only	No
Advanced	Yes

3. Battery-Low Threshold

Description	Low battery threshold (mv).
Size	2
Format	Unsigned Integer
Read only	No
Min Value	2100
Max Value	2700

Default Value	2200
Read-Only	No
Advanced	Yes

4. Battery-Dead Threshold

Description	**Dead battery threshold (mv).**
Size	2
Format	Unsigned Integer
Read only	No
Min Value	1800
Max Value	2099
Default Value	2000
Read-Only	No
Advanced	Yes

5. Battery Hysteresis

Description	**Consecutive readings past threshold needed.**
Size	1
Format	Unsigned Integer
Read only	No
Min Value	1
Max Value	32
Default Value	3
Read-Only	No
Advanced	Yes

6. Battery Averaging

Description	**Samples to average across.**
Size	1
Format	Unsigned Integer
Read only	No
Min Value	1
Max Value	16
Default Value	8
Read-Only	No
Advanced	Yes

7. Heartbeat Time

Description	**Minutes between heartbeats.**
Size	2
Format	Unsigned Integer
Read only	No
Min Value	15

Max Value	60*12
Default Value	60
Read-Only	No
Advanced	Yes

8. Heartbeat Report Configuration

Description	**Heartbeat Report**
Size	1
Format	Bit Field
Read only	No
Min Value	0x00
Max Value	0x07
Default Value	0
Read-Only	No
Advanced	Yes

9. Single Wake-Up

Description	**Timer to trigger wake-up.**
Size	4
Format	Unsigned Integer
Read only	No
Min Value	0
Max Value	86400
Default Value	0
Read-Only	No
Advanced	Yes