

Home Automation Notes

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Home Automation Presentations

I gave several home automation presentations to different groups. The PowerPoint slide show decks for these presentations can be seen in the links below.

- [Rev A - Sun City Life Long Learning Club Presentation \(May 2023\)](#)
- [Rev B - Sun City Computer Club Presentation \(September 2023\)](#)
- [Rev C - Not yet presented – changes suggested from previous presentation](#)

Rev A – I think this was overly technical and poorly organized. It presented the material in a bottom-up manner; starting at the lowest level and working up to actual usages. Most of the audience was bored by the time the interesting part came up.

Rev B – This was much better as it started out with examples of what you can do with home automation and then went into the details of how it works. This was much better received and people left excited about trying it out.

Rev C – This is Rev B with some minor cleanup and clarifications.

Some Things the System Automates

Here is a partial list of things that are automated by the home control system:

1. Cable modem power cycled at 3:25am
2. Fountain pump on from sunrise to sunset when wind speed < 15mph
3. Solar screen down from sunrise+7 hours till sunset-10 minutes
 - a. Down if temperature $\geq 85F$ and wind speed < 15mph
 - b. Up if temperature $\leq 75F$ and wind speed ≥ 20 mph
4. Opening front door causes solar screen to go up for 10 minutes
5. Dining room chandelier light on causes solar screen to go up until turned off
6. Outer door bell plays bell sound and raises solar screen for 3 minutes
7. Opening either the big/little garage doors causes the garage ceiling lights to turn on for 5 minutes then turn off.
8. If either the big/little garage doors are left open > 3 minutes, an alarm sound will play in the house and an email will be sent out.
9. As soon as either the big/little garage door is opened the word "garage" will be spoken by the hallway speaker.
10. When the door from the house to the garage is opened, the garage ceiling lights turn on for 3 minutes then turn off.
11. From sunset to 9pm the back porch lights are on
12. From sunset to sunrise – 1hr opening either the sliding door or the back bedroom door will cause the back porch lights to turn on for 10 minutes then turn off.
13. From sunrise to 9pm the vase twinkly light turn on (except when TV is on)
14. From sunset to sunrise the front porch light turns on
15. From sunset to 9pm the kitchen and living room ceiling lights and china cabinet lights turn on (except when TV is on)
16. From sunrise – 1hr to sunrise + 30 minutes the kitchen counter lights turn on
17. Irrigation valve run times are adjusted daily based upon many weather conditions
18. Irrigation valve "days to water" (per water department rules) are automatically adjusted based upon the season.
19. A/C usage and outside temperature is tracked hourly and reported via email
20. Door/Window open times are tracked hourly and reported via email
21. Etc...

Insteon Devices are Obsolete

I had previously been using Insteon devices for my home control applications and wanted to continue using them as I was comfortable with their operation.

However, I quickly found out that Insteon devices had become obsolete and were no longer supported. In fact, it was very difficult to even find them for sale any more. It became obvious that they had been replaced with Z-Wave devices for good reason as they provided much better functionality.

Controller Support for Z-Wave Devices

One of the things I disliked about Insteon was that controller support for devices was hard coded to the device ID. In other words, when a new device came out, you had to wait until your controller program was updated to recognize that device.

From my initial investigation, it appeared to me that Z-Wave devices solved this problem by reporting information about their capabilities in a generic way so that any controller adapt and provide an interface for any device.

However, after buying several Z-Wave devices and finding they didn't fully work with my controller, I realized that this was not true.

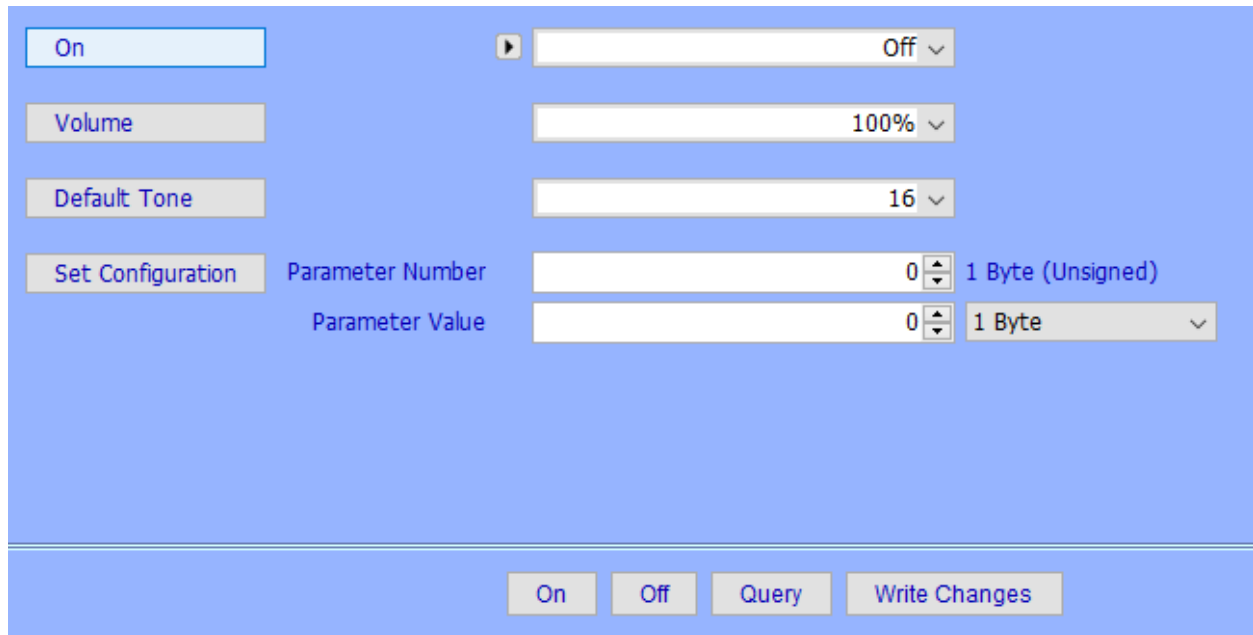
It now appears to me that Z-Wave device actually report "classes" (ex: basic button press, etc...) of functionality to the host, and that these basic classes need to be supported by the host before that functionality can be used. So, what can occur, when you buy a new Z-Wave device is that some of the functionality works, and other features do not!

You need to pay close attention to the advertisement, and read all the warnings, to make sure it actually works with your controller BEFORE you purchase the Z-Wave device.

Device Configuration

Many Z-Wave devices (but not all) have various configuration parameters that you can change. These are described in the installation notes paper that came with your device – so don't throw it away, you may need it later.

In order to be common to all devices, the configuration is done generically as shown below. Make sure that set the values exactly as shown in your device's setup paper.



The screenshot shows a configuration interface with a light blue background. At the top left is a button labeled "On". To its right is a dropdown menu currently set to "Off". Below these are two more dropdown menus: "Volume" set to "100%" and "Default Tone" set to "16". A "Set Configuration" button is positioned to the left of two input fields: "Parameter Number" and "Parameter Value", both containing the value "0". To the right of these fields is a dropdown menu set to "1 Byte (Unsigned)". Below the "Parameter Value" field is another dropdown menu set to "1 Byte". At the bottom of the interface are four buttons: "On", "Off", "Query", and "Write Changes".

Each device can have from 0 to many Configuration Parameters, each of which is identified by its ordinal Parameter Number. To determine the meaning of each configuration parameter, you need to refer to the manual that came with your device – you should find something like the following:

Parameter 1 – auto off time value (4 bytes) in seconds

To set this value to 30 seconds, you would enter 1 (the parameter number) in the "Parameter Number" field, 30 (your timeout value) in the "Parameter Value" field, and "4 Bytes" in the field size field, then you would press the "Set Configuration" button.

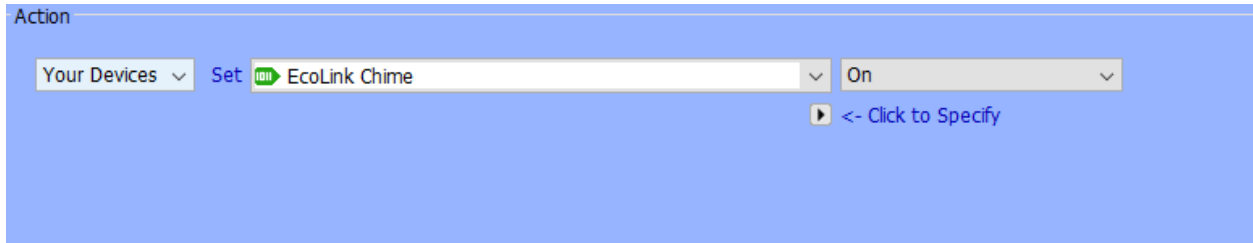
Once you have set all of the values, you need to invoke the "Write Changes" feature to actually cause them to be permanently written to your device.

IMPORTANT – writing the changes takes a significant amount of time – much longer than turning a device on/off. I have not found exactly how long it takes, but it appears that it can be up to several minutes before the changes are actually written.

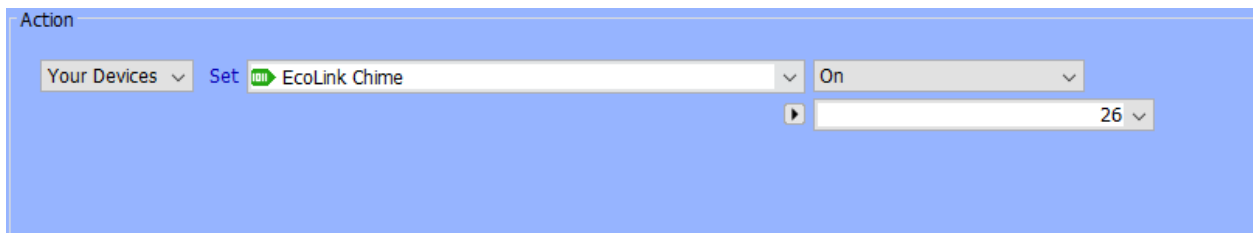
On my controller, the "Write Changes" button border starts a very subtle blinking which presumably stops when the changes have been written, however I wish that it was clearer and simply presented a dialog box with "Changes Written" so it would be clearer.

Note about Using Default Values

I had initially thought that I needed to change the default value every time I wanted to use a feature – which was tedious because it took so long. In this example it was a chime, and I wanted to change which music was played.



However, when I dug deeper, it turned out that you can specify which music is played, and not rely on the default value as follows by clicking on the “Click to Specify” button and specifying music item #26.



Products Installed in my Home

eISY Home Controller

This is available at Universal Devices [here](#) for \$360 (note: you will also need the [ZMatter USB Dongle](#) for \$126.) I had been using Universal Device's Policy Pro, and before that, ISY controller for years before and was happy with them so I upgraded to their eISY controller which is very nice.

I would definitely recommend this if you are a techie and interested in pushing the boundaries of your home control system – it has a lot of features. I highly recommend this – the only downside is the documentation is a little weak and you have to spend some time getting up speed on how it works.

Here is a link of my notes about how to get started with the eISY controller:

- [Getting Started \(general - Policy\)](#)
- [eISY Tips](#)
- [Adding Z-Wave Devices](#)
- [Zooz Zen32 scene controller Tips](#)
- [Sensing Switch Movement](#)

Important: this should be plugged into a UPS – otherwise variable values will be lost on power cycles (there is a way to do this in software but it is ugly, slow, and needlessly wears down the flash memory.)

This supports X-10, Insteon, Z-Wave, Zigbee, Matter, openADR and WiFi devices as well as many data sources over the internet (such as weather stations, etc.)



Ecolink Z-Wave 700 Chime + Siren

This is Z-Wave Plus S2 Enabled, with Battery Backup, Security Intruder (ISZW7-ECO) and available from Amazon [here](#) for \$69. This unit works very nicely with the Polisy Pro.

The only confusing issue for me was when trying to play sounds, I thought I had to change the default sound first and then play it. But I later realized that there is an option to specify which sound to play in the play command.

This is great for being notified that the garage door was left open or any other alerts.



ENERWAVE Z-Wave Plus Dual Relay Module

This is available from Amazon [here](#) for \$47.99. I used this to replace the up/down switch for my front door solar screen motor assembly. This works very nicely and was easy to install. In my case I ignored the switch sensor wires and just attached the motor control wires because I didn't want the manual switch to interfere with the home controller if the user forgot to place the rocker switch back into the neutral position after manually changing the screen state.

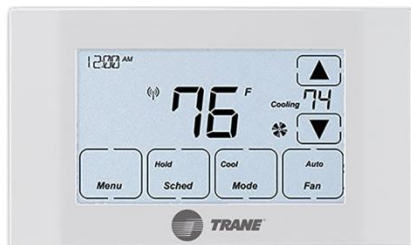
One drawback is that my application turns on either the up or down motor (and never BOTH at the same time) and this switch cannot be configured for this sort of operation – it is meant to control two motors with distinct operations such as a fan and a light in a ceiling fan. Fortunately, my screen motor controller handles the case of both motors on at the same time properly and causes the 'up' motor to run rather than having both motors catch on fire trying to fight each other.



TRANE 14942771 Thermostat

This is available from Amazon [here](#) for \$102.02.

This works very nicely and I highly recommend it.



Ecobee Intelligent Technology Z-Wave Garage Door Tilt Sensor

This is available from Amazon [here](#) for \$11.70.

This is a great sensor to tell if your garage door is open or closed. It was easy to install and get working on the Polisy controller. I highly recommend it. The only issue I am having is determining if the battery is low and needs to be replaced. The “battery level” reported always comes back as 0% right now, but there does seem to be a way to change the configuration to detect this and I need to do more research.



Minoston Z-Wave Plug with Energy Monitoring

This is available from Amazon [here](#) for \$27.99. This device worked almost perfectly with the Polisy controller. The only minor issue was that there appeared to be no way to turn it on/off from the controller after pairing. The solution was very simple – you have to “query” the device once and then the on/off controls will appear on the Polisy screen. This is 100x better than the [Neo Smart Plug](#) that I tried before and I highly recommend this device.



EZFlora Insteon Sprinkler Controller

I purchased these years ago for my old ISY controller (I've forgotten the price) and I've been very happy with them as they've been working for years without problem. There are probably newer fancier ones but I'll stick with these until they eventually break.



I later decided to remove these as they would intermittently fail to communicate. I believe this is due to the obsolete Insteon technology and the fact that the unit is relatively far from the home controller with no other Insteon devices in between to relay the RF commands. I replaced them with the Zooz ZEN17 (seen [Relay Section.](#))

Zooz 700 Series Z-Wave Universal Relay ZEN17

This is available from Amazon [here](#) for \$43.30. This product worked very nicely and requires only a 24VAC transformer and some jumper wires to simulate a two channel sprinkler controller.



This has configurable auto-off timers (among other things) for each relay so it is easy to prevent the relay from staying on too long in case of system failure. They are configured as follows:

- Relay 1
 - Parm15 (1 byte dec) = 0 (0=minutes - default, 1=seconds, 2=hours) Auto turn off units
 - Parm6 (4 bytes dec) = 60 (default=0/off) Auto turn off value for 1 hour
- Relay 2
 - Parm17 (1 byte dec) = 0 (0=minutes - default, 1=seconds, 2=hours) Auto turn off units
 - Parm8 (4 bytes dec) = 60 (default=0/off) Auto turn off value for 1 hour

Important Notes

1. The default mode causes the relays to immediately turn off after you turn them on which is undesirable. To resolve this change configuration parameters 2 & 3 to have a value of 2 (toggle switch.)
2. The documentation states that you can use "12-24 V DC/AC" on the 2-pin power screw down connector. This is false and very frustrating as the unit behaves very erratically when power is below 14V – so make sure you are using 14-24V OR alternatively use the USB-C power connector.
3. This unit has firmware bug that prevents you from changing the state of relay 1 and then immediately changing the state of relay 2 (or vis-versa.) If you try to do this, the command to relay 2 will be ignored. The fix is very simple – just add a 2 second delay between the two commands and everything will work as expected.
4. Make sure that configuration parameters 6 & 8 are zero, otherwise the unit will mysteriously turn the relay off after a period of time without any command from your home controller.

UltraPro Z-Wave Smart Rocker Light Switch

This is available from Amazon [here](#) for \$59.01 (for 2 switches.) These switches worked perfectly and I highly recommend them. The QuickFit feature is MUCH better than other models that have wires coming out the back and require wire nuts in the junction box. This is much cleaner and worth any extra cost.



EVA LOGIK Z-Wave Plus Smart Dimmer Light Switch 3 Way

This is available from Amazon [here](#) for \$31.99. This 3 way switch is a revolutionary improvement over the other solutions that require 2x Z-Wave switches – this only requires 1x Z-Wave switch and uses the existing old fashioned manual switch that is already in the wall.

The documentation is excellent, the only glitch I ran into was that the diagram of the old fashioned switch was backwards from what I had – mine had two of the wires reversed – but the documentation showed that the connection was to the “common” which is marked on most switches so I quickly resolved the issue.

My only comment about the switch is that it takes a few seconds to turn off (but on is very quick.) It’s sort of annoying at first, but after a few tries, it becomes a “who cares” item.



Zooz 700 Series Z-Wave Plus Mesh Network Scene Controller ZEN32,

This is available from Amazon [here](#) for \$37.95. I originally tried this with my Polisy Pro controller, but the controller wasn't smart enough to recognize the scene buttons which was disappointing. However, the new eISY controller handles them just fine which is great! This allows you to use the scene buttons as generic user buttons to be able to trigger events in your house.

See the following [link](#) for more details on how this works.



What is even cooler is that you can order custom button keys with your own working printed on them. Follow this [link](#) for more information.



Enbrighten Z-Wave Smart Rocker Light Dimmer

This is available from Amazon [here](#) for \$44.98. The installation was easy and the unit worked the first time.



I originally had issues using it in on the kitchen ceiling lights because there was a significant amount of flickering that made it unacceptable. I later tried it in the living room ceiling lights and it worked much better with only a slight flicker as fade up approached 100%. Perhaps this is because there are only 4 bulbs in the living room (vs. 9 in the kitchen.) By using “fast on” (which immediately jumps to 100%) and “off” (which slowly fades to 0%) I am able to create an acceptable lighting effect for movie watching.

Ecolink Z-wave Plus Rare Earth Magnets Door & Window Sensor

This is available from Amazon [here](#) for \$35.79. This works perfectly with the Polisy controller.

Additionally it provides a second switch interface (in addition to the magnetic reed switch) so that you can control it with other switches (ex: a relay, or mechanical switch.) This is very nice for my application because I want to trigger this device using a relay controlled from a PIC processor, so it means I don't have to hack the board up removing the reed switch and trying to solder wires to the reed switch pads!

The actual board inside is 1.4"x0.7", so it's not as big as it looks in the picture (which includes a large CR123A battery.)



Ecolink Z-Wave PIR Motion Detector Pet Immune

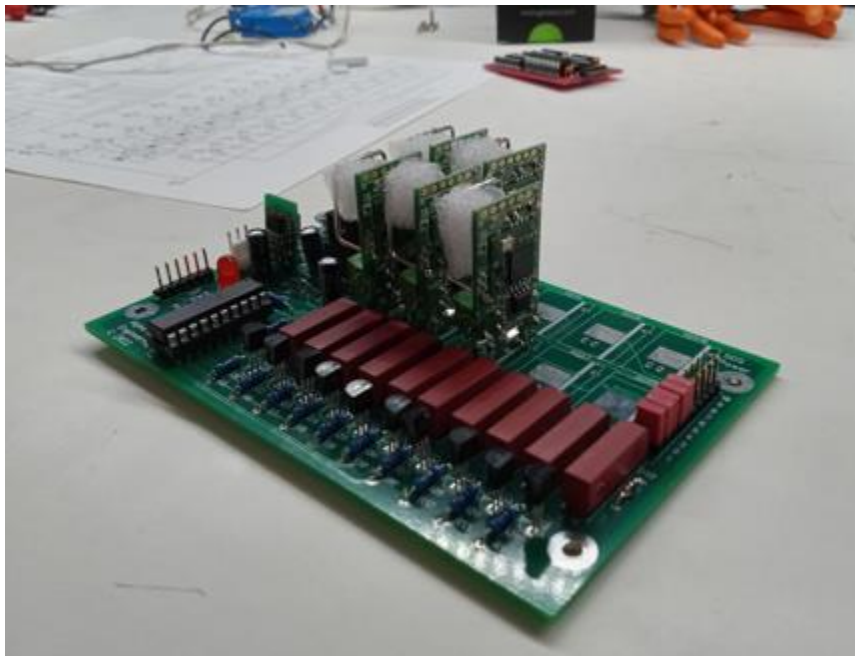
This is available from Amazon [here](#) for \$43.29. This works well with the Polisy controller. See notes about setting this up and customizing it [here](#).



Serial to Z-Wave Custom PCB

I needed a way to bridge the sensors on my home alarm system to my home automation system and designed a custom PCB to accomplish this.

You can see the full details of this in this link: [760015xx Z-Wave Bridge PCB](#)

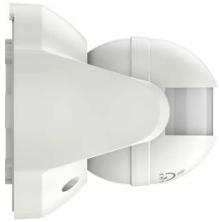


Products that I Tried BUT Failed to Work Properly

Zooz Z-Wave Plus S2 Outdoor Motion Sensor ZSE29

This is available from Amazon [here](#) for \$44.95. I was planning on using this by the front door to raise the door solar screen when someone was at the door. However, the unit was completely un-reliable, sometimes it would work briefly, and then stop working, one of the adjustment components fell out of the unit, and after hours of fighting with it, I finally gave up and took it down.

I do NOT recommend this product.



Ring Alarm Contact Sensor (2nd Gen)

This is available from Amazon [here](#) for \$19.99. I was planning on using this to convert my alarm signals to Z-Wave via a custom PIC board design. This was cheaper (buy about \$15) than the Ecolink door sensor, and was smaller – a benefit when you are trying to cram 10 of them onto a PCB.

The unit did connect with Polisy and published a bunch of device nodes. Sadly, however, none of the nodes would tell you the open/closed state of the door so this sensor is useless! I would assume that this would work with a Ring controller and they have probably implemented a custom interface so that you can only use it with their products.

I do NOT recommend this product – unless perhaps you are using a Ring home controller.



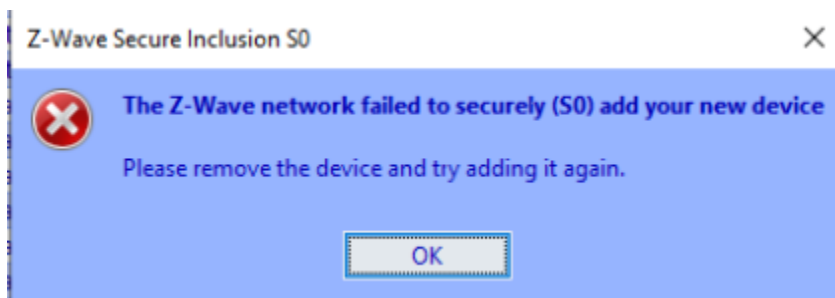
NEO Smart Plug, Z-Wave Plug Outlet with Timing and Energy Monitoring

This is available from Amazon [here](#) for \$24.99. Feature wise, these are very cool because they allow you to monitor the plugs energy usage (as well as turn it on/off.) Sadly they are totally unreliable.



Installation for these was very painful for the following reasons:

If you try to add them to the Z-Wave mesh and they are any distance (I tried from about 30-40 feet) from the Polisy controller, the “add” will fail with the mysterious warning shown below.



In order to add them, you need to move them right next to the Polisy controller during the add process, after which you can unplug them and move them where you actually need to use them.

Even when they are near the Polisy controller, I had to add/remove them several times before they would correctly populate in the Policy device list. Usually after 3-4 tries, all 4 nodes will show up in the device list.

The next problem is that, once placed in their final location, they perform erratically – working one minute and being off-line the next minute. After much frustration, I found that they eventually stabilize and start working reliably if you just leave them alone for a long period of time (at least 20-30 minutes.) I suspect that moving them after they are added causes the mesh network to break, and require the controller time to re-map them into the mesh into a location appropriate for their new physical location.

Even when they stabilize, they still fail to communicate every 10 minutes or so which is unacceptable for critical applications which can leave the switch in the wrong state. You would need to write all sorts of manual retry logic to overcome this – much easier to buy a reliable switch.

Motion Sensors

Off the shelf motion sensors are almost useless for doing real time home automation due to their incredibly slow response time. It can take up to several MINUTES before motion is detected! If you are trying to turn on a light when motion occurs (ex: in the garage when you are taking the trash out) you could be in and out of the room before the light turns on.

There is, of course, a reason for this – battery life.

Motion sensors are generally battery powered and only wake up every few minutes to check for motion. This is what allows the battery to last for months.

Some motion sensors have a “test” mode that can be activated with a jumper inside the motion sensor. When enabled, this mode disables the power saving mode and allows the motion sensor to check for motion every few seconds. This mode makes the motion sensor actually useful, however in a test I ran, it drained the battery in about 2 days.

Removing the Battery

In order to use “test” mode, you need to remove the battery and hard wire a 3VDC power module into the unit. Here are some important things to remember.

You should also add a 220uF capacitor across the power module wires to smooth the voltage. Power modules are not well regulated as a rule.

Do NOT attempt to regulate the power module voltage down to 3.0VDC using resistors. This will cause the power module to mysteriously fail in operation – although it will appear to power up and be working (the LED will be blinking, etc.) The reason for the failure is that the module draws more power when it is communicating over Z-Wave – for example when trying to add the module to the mesh. This surge in current across the resistor causes a drop in voltage that is significant enough to cause the unit to fail.

As the unit has its own voltage regulator it is OK if the input voltage is in the 3.0-3.5VDC range.



Important Operational Notes

Pairing the Sensor

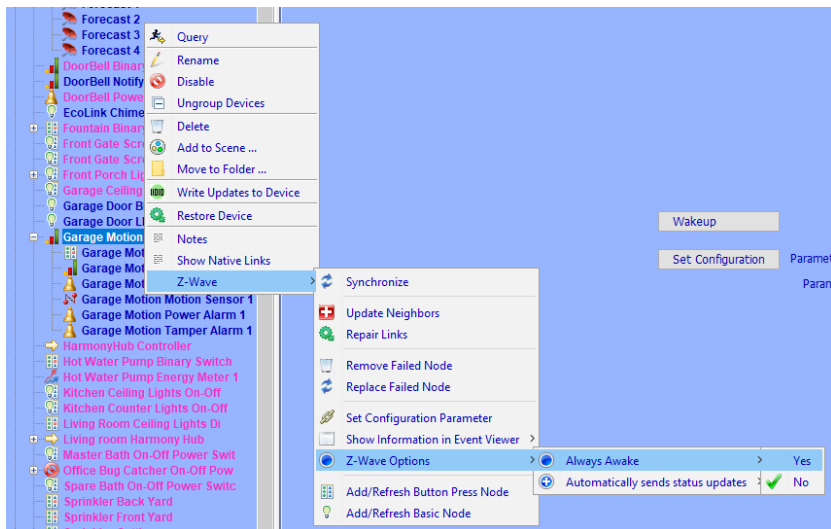
When trying to add the sensor to the Z-Wave mesh, it can be quite frustrating because the sensor only wakes up every few minutes talk to the controller – this can result in it taking a long time to recognize the motion sensor.

Removing the cover from the motion sensor greatly speeds up the pairing process. This is because the motion sensor constantly talks to the host when it is in “tamper” mode (cover removed.) I highly recommend the following steps when pairing:

1. Unplug the motion sensor (or remove the battery)
2. Remove the motion sensor cover
3. Position the motion sensor near its final destination - don't pair it next to your computer and then move it to the other end of the house.
4. Set your controller in to Z-Wave pairing mode (Add Z-Wave device)
5. Plug the motion sensor into the wall power (or add the battery.)
6. After the motion sensor is paired with your controller
 - a. Replace the motion sensor cover.
 - b. Mount the motion sensor in its final location.

Configuring Polisy for Quicker Response Times

You should configure the device in Policy to be “Always Awake” (after modifying it to use wall power) so that Policy talks to it on a regular basis – and does NOT queue requests to save the sensor's battery.



There will be a bunch of Z-Wave nodes added once your motion sensor is properly integrated into your controller's mesh. Here are the more important nodes that I have found useful.

Notify Sensor

Reports battery level (which should always be 100% once you hard wire it) and allows you to change the device configuration

Home Security Alarm

This reports the "state" of the motion sensor. The value reported will typically cycle through the following values as you remove and replace the sensor cover:

- 0 – IDLE
- 8 – POWER REPORT unit is sending the battery level to the controller
- 3 – TAMPER cover has been removed
 - **IMPORTANT** – in tamper mode, the motion sensor value reported will NOT change. In other words the last motion state (on/off – usually 'on' as your hand is near the sensor) will not change until the cover is replaced (or you manually press the tamper switch in the unit.)

Motion Sensor

This will change from 'off' (no motion detected) to 'on' (motion detected.)

Important – this will only change every 3-4 minutes if you have not added the "test" jumper. With the "test" jumper the motion sensor value will change every 10 seconds or so.

Important – this will not change at all if the device cover is off, or not fully closed (tampered.)

Example Polisy Code to Automate Things

Garage Door Open Warning

A common problem is that you open the garage door and then forget to close it and it stays open for hours, or days until you remember.

By installing the following two items you can get instant notification of this problem.

- [Ecolink Intelligent Technology Z-Wave Garage Door Tilt Sensor](#)
- [Ecolink Z-Wave 700 Chime + Siren](#)

Here is the Polisy logic required to trigger an email and have the siren active whenever the garage door is open longer than 3 minutes. This will terminate the siren sound as soon as the doors are both closed.

```
Program Content for 'Garage Door Open'
If
  'Garage Door BIG State' Status is Open
  Or 'Garage Door LITTLE State' Status is Open
Then
  Wait 3 minutes
  Set 'EcoLink Chime' Volume 100%
  Set 'EcoLink Chime' On with Tone 26
  Send Notification to 'Alec and Marilyn' content [Entry 2]
  $Garage_Door_Left_Open = 1
Else
  $Garage_Door_Left_Open = 0
  Set 'EcoLink Chime' Off
```

Other Examples

Here is a link of my notes about Conserving Irrigation Water with the Polisy controller: [Conserving Water](#)

Here is a link of my notes about Collecting Data with the Polisy controller: [Collecting Data](#).

Here is a link of how to optimize your A/C power usage: [Optimizing AC Power Usage](#)

How to make your own Z-Wave push button device: [Making a Z-Wave Push Button](#)

Here is a link of how to minimize the heat the leaks into your house through the windows: [Minimize Window Heat](#)

Reducing RF Power Issues in your Home

Home Automation systems introduce additional RF energy transmissions in your house. This is due to the fact that they communicate over a new, or possibly already existing RF network, and in all cases add to the number of RF packets that are transmitted every day.

For more information on how to reduce your exposure to RF energy and make your home more secure, please refer to the following document: [RF Power Issues](#).