How To Install A Home Security System
Part One, Installing Wiring and Sensors

Description:

Installation of your own home security system offers cost savings, increased available options, and flexability for future changes. There are many different kinds of security systems one can obtain as well as "home brew" one using various home automation techniques.

One common element all security systems will have is the installation of sensors for doors and windows, as well as other sensors including the more common ones of glass break and motion sensors. Other sensors may include fire alarms as well as CO sensors.

This "part-one" series is dedicated to the installation of wired magnetic sensors for doors and windows. It also provides a general installation methodology and troubleshooting/general check-out procedure descriptions.

For users installing a Caddx system and who plan on using the Homeseer plugin with it, you may want to refer to Nitrox's new Installation Instructions!

Methodology:

The system chosen for this (my home) installation is a Caddx NX8-E with a 16-Zone Board Expander, and a Relay Expander Board. The kit also included a mounting box, battery, siren, motion sensor, and LCD Keypad.

In addition two more keypads (cheaper LED's), two glass break sensors, and two additional motion sensors were also purchased.

Most of the wiring was run before installation of the drywall. Two conductor (one-pair) and four conductor (two-pair) 22 gauge solid core wiring was mainly used for the remote sensors and keypads. The motion sensors, and glass break sensors required four wires, two for the contact closures and two for the 12 volt power to the sensors. The keypads also required four conductors (power and data lines).

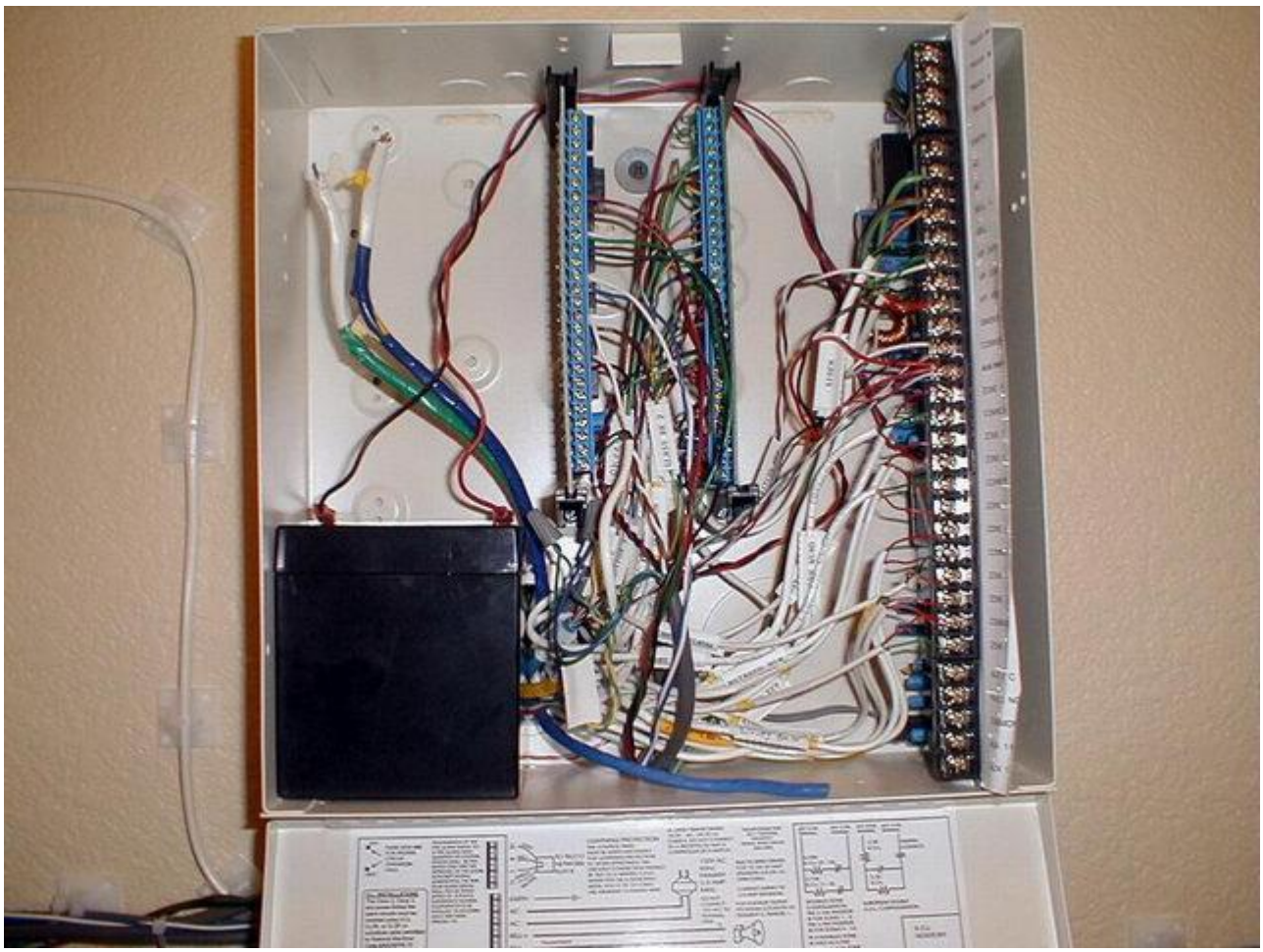
The wiring to the magnetic type door and window sensors required two conductors (contact closure). All of the sensors used here used "contact closure" outputs. In other words, when motion, glass break, or magnetic contact break occured, the sensors outputs went from acting like a closed switch to an open switch. When a switch opens, it will send an alarm condition to the zone/panel that it is wired to.

Sensors that require power are 12 volt DC with a battery backup. There are two terminal screws on the NX8-E main board which provide this power. The current draw of each sensor was totalled. This number was then compared to the power that can be provided via this main board (referred to instruction/installation manual). Care should be taken so this number is not exceeded. Do not exceed 90% of the system's current capability.

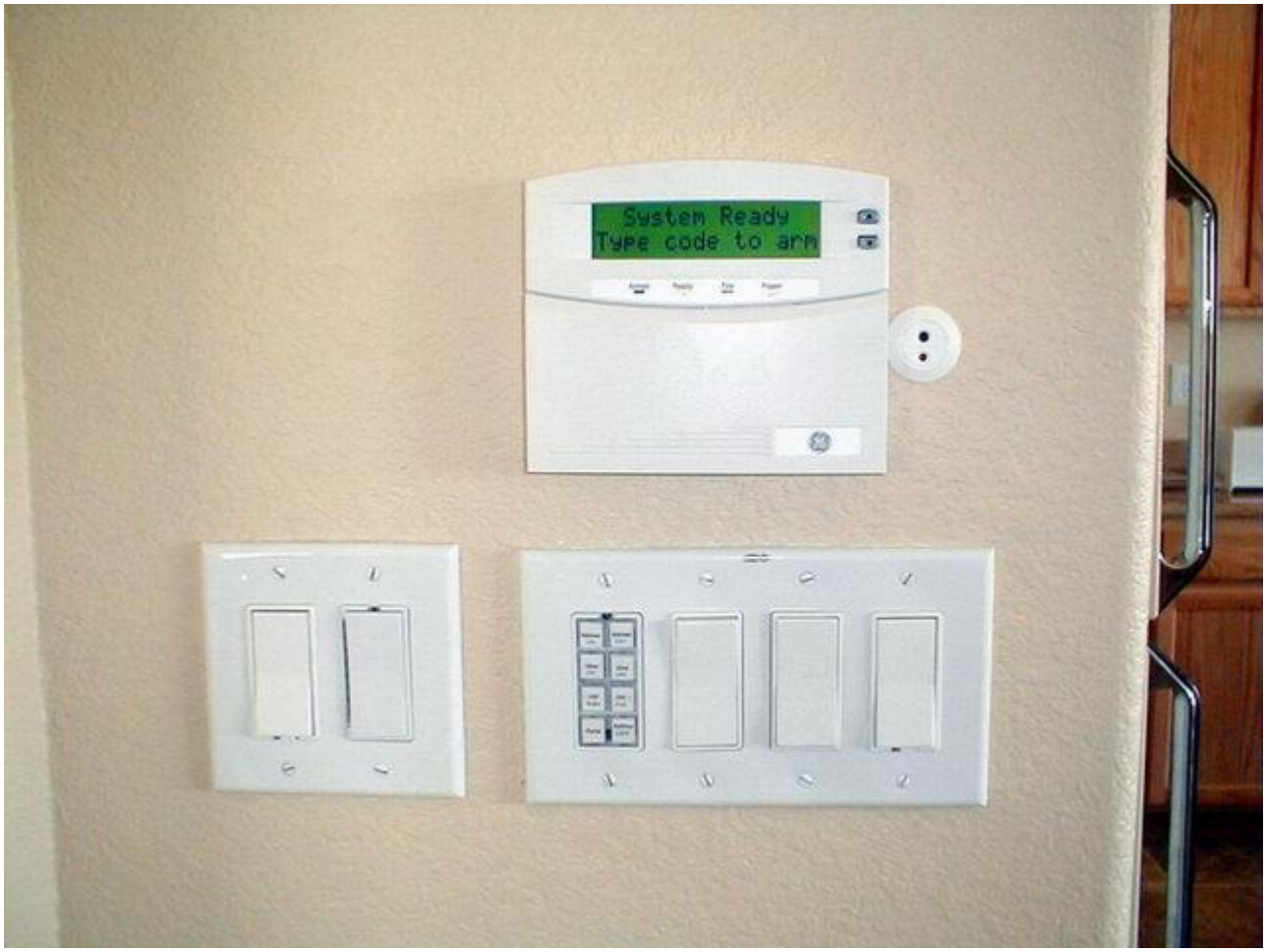
If more power is required additional power supplies must be purchased. Depending on how they are wired into the system, they may or may not utilize any currently provided battery backup. This is the reason for the battery, to provide power to the system in case of a power outage.

Components

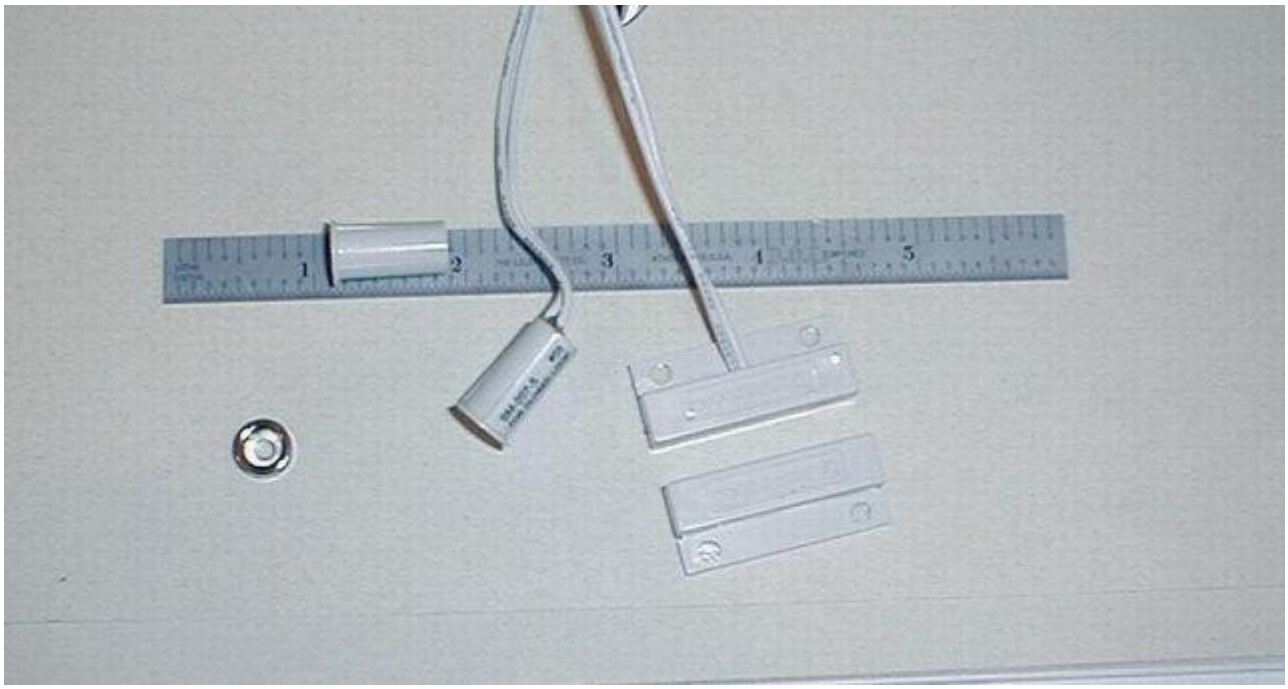
Below are pictures of some of the components that will be used.



Caddx NX8-E Main Board, Expansion Board, Relay Board, & Battery Supply in Supplied Metal Locking Box. (Notice the white sensor wiring)



LCD Keypad, and (round) Glass Break Sensor

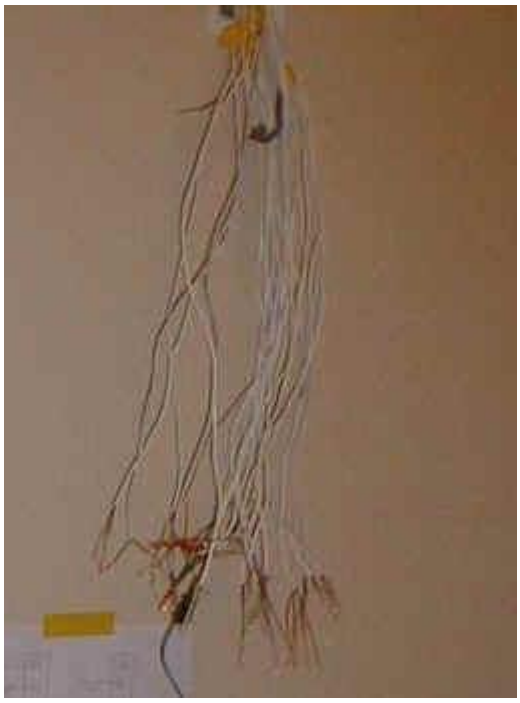


Window and Door Magnetic Sensors (Three Types)

Wiring Installation

Single pair wiring was landed to each door and window in the house. Two pair wiring was run to each location where a glass break, key-pad, or motion detector would mount. All the wiring was run to a central "home-run" location. The location of the "Home Run" was where the metal box would be mounted. This location should be in your wiring closet or basement landing area. A phone line should also be available at the mounting box location.

Leave enough slack in the wiring for box mounting in the home run location as shown below.



The location of where you will drill the hole to mount the sensor in a door or window will depend on how practical it is to mount a magnet/sensor combination at that location.

For instance, lets say you drill a hole for a magnet sensor in the window type shown below, half-way up the left side of the frame.

You can easily mount the sensor part (wired part) in that hole. To mount the magnet you then take the window out of the frame. When you do this you realize that a slide stays intact onto the frame (it has a permantely steel roped wire attaching it and also has a pully wheel right near where the magnet was supposed to go.

It would be impossible to mount a magnet on this track, but you could mount a magnet on the bottom part of the left track, or even on the bottom part of the window itself.

Therefore it would have been better to drill the hole towards the bottom of that window instead of half way up the left side (this topic will be covered in greater detail later).

When running the wiring to the doors and windows, drill through the studs for horizontal runs, and clamp to the center of the studs for vertical runs. If using staples to secure the wiring to the stud, insure that it does not crush the cable.

Drill through the door and window frames and run the wiring through this hole. The type of sensors used will determine the diameter of the hole needed in the frame. In this case a 3/8" hole was needed. Note that you may need an extra long bit to drill all the way through the door/window frame. Leave about six inches of wire sticking through the mounting hole. Refer to the pre-drwalled prints below.

Please remember that this gauge of wiring is fragile and can be "opened" when pulled on to hard and "shorted" when stapled to tight.

Once the wiring is run, label the wiring using small, rugged tags/tape. You can save a lot of time ringing out wire by purchasing an inductive cable traker shown below:

Basically you connect to whatever you are tracing (in this case it would be the flying leads of say a window. Turn the base unit on, then take the inductive "wand" and trace over the bundle of cables in your homerun location. The closer you get to the correct one the louder the buzzing signal from the wand will be, until you quickly find the correct cable.

Once the wiring is labeled you will want to do two checks, both which wil require a multimeter to measure resistance. First strip back the wiring insulation on all the wiring leads. Make sure that the cable you are going to test has no leads touching each other on either end of the cable. Then set your multimeter on the highest resistance scale possible (if your meter "autoscales" skip this step). Then measure between each cable in its own bundle (for instance in the bundle with only a single pair, you would measure between those two wires. In a two pair bundle you would measure between each possible combination of wires in that bundle.

You want to make sure that the meter reads "infinite" or the same as when you have nothing connected to the meter's leads. This will insure that no short exists between wires in a bundle.

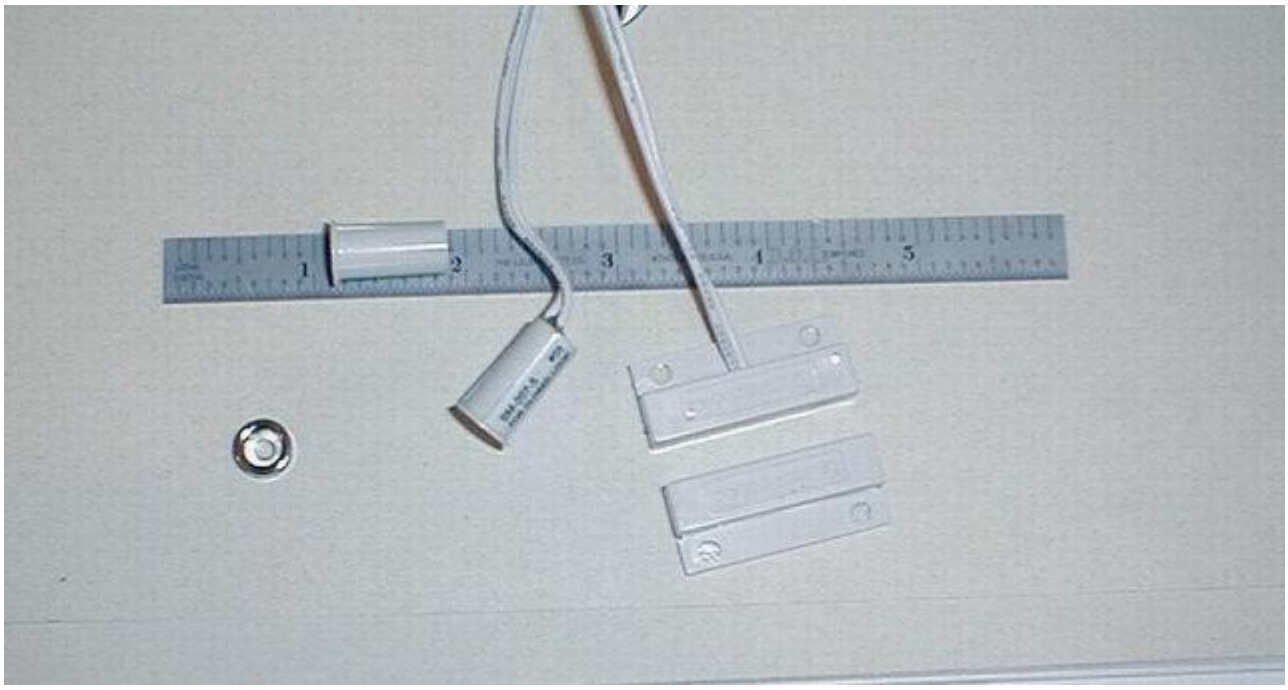
Next you want to insure there is "continuity" between each cable. The easiest way to do this is to use a small wire jumper clip and clip between each lead to say a common lead in the bundle. For instance if you have a yellow, green, black, and red color wires in a bundle, put the first clip on

the black then the other clip on the red. Then go to the other end of the cable and measure between the black and red wire with your meter on the lowest resistance setting possible (again, the autoscale comment). You want to see a near zero reading. The reading will not be exactly zero because there is a few ohms resistance in the wire itself. A reading over five ohms though, would be an item of concern unless the cable is extremely long (I'm guessing over 500 feet).

This step will take up some time, but it could save you a lot of frustration when trying to make all the other items work.

Magnetic Sensor Installation:

There are a variety of magnet door and window sensors available. The ones that I used are shown below.



All of these sensors will have a closed or shorted contact condition when the magnet is "near" the wired sensor. When the magnet moves away from the sensor the contacts will open. The reason this type of sensor was chosen, as mentioned earlier, is because the Caddx system requires this type of contact closure/opening for its zones. An alarmed zone means the contacts to that zone have opened (i.e. not closed or shorted). I believe there are other sensors on the market that can be purchased which provide the reverse of this contact condition. Consider what type of contact condition/sensor is needed for your system.

The magnet on the far left (small round metal object) and the white sensor (middle of picture with wires extending from it) were used on the windows because I did not want to drill a large (and deep) hole in my windows (for magnet mounting) for fear of penetrating the gasket seal (or drilling into the glass itself). This magnet only needed a very small hole and used a short length number six sheet metal screw for mounting.

The large white magnet (on the ruler) and the (same) white sensor were used for the doors. Its magnet is larger than the window one and is better suited for mounting on a door's edge.

The sensor pair on the far right was used when I could/did not want a magnet sensor inside a window pane (or door pane). The exterior mounting required for this sensor has the disadvantage of being seen (WAF), but is a good alternative if you can't use any of the other sensors due to mounting/access limitations.

One other note to mention when selecting your sensors is the "gap" distance. Various sensor combinations have a gap or maximum distance the magnet can be away from the sensor before it "trips". Measure and determine how large a gap you will have between your window/window panes and door/door frames and select the appropriate sensor to accommodate this distance.

Here are some vendor URL listings which show/describe the above sensors:

http://www.seco-larm.com/BCont1.htm

http://www.aesecurity.com/magnetic.htm

http://www.smarthome.com/7358.HTML

Installing Window Sensors:

Attach the wired sensor to the wires extending from your window pane hole. Various methods can be used, but solder and shrink tubing are the best. Try to keep the leads as short as possible so they will not become "kinked" when pushing the sensor back into the hole. (Note that this step was done after the drywall was installed).

Gently push the sensor in so it is flush with the window pane. Now test this sensor by placing a multimeter on the home run end of the wires. Set the meter to the lowest resistance scale. You should see an "infinite" or "open" reading. Place the small magnet directly over the mounted sensor (use tape if doing this step alone). Now the resistance reading should show a near short (just a few ohms).

Remove the magnet from the sensor. Partially close the window so you can mark the height of this sensor on the window. Mark the location in the center pane and make sure that this location will properly align with the sensor when the window is closed.

You may or may not need to remove the window for this next step.

Mark the drill location using a center punch. Drill a hole in the window using the appropriate size bit for the mounting screw that came with the magnet sensor. Drill slowly and make sure you do not drill into the window. Mount the magnet on the window with its proper screw.

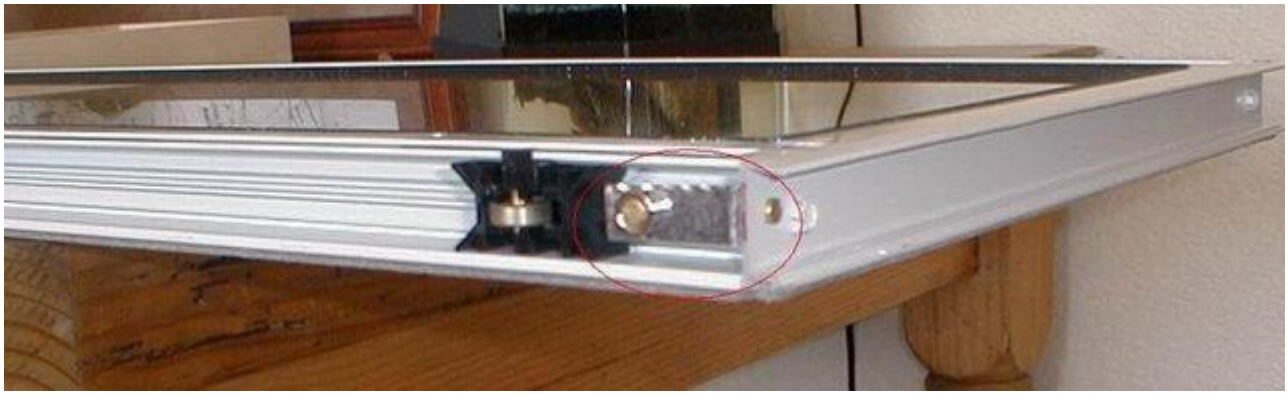
Now test this sensor combination by closing the window and verifying that the meter reads a near short. Open the window and verify that the meter reads an open.

Congratulations, you have finished your first sensor installation.

Cases may exist with your window frame location that inhibit access to the side desired for the sensor installation (such as beam corners). If this is the case you may have to be creative with the sensor location.

In the picture below I mounted the sensor on the bottom window track because the sides were against a large support beam (which you are not allowed to drill through).

I then needed to fabricate an angled brace (from soft tin) so I could mount a magnet on the bottom track of the window itself.



Another problem (mentioned above) is caused by windows with side tracks that are not easily removable (tracks remain in place after the window is removed).

The wiring was already installed into a previously drilled hole (security wiring was included with my home) so I just drilled through the front frame at a slight angle into this hole. I then mounted the exterior type window magnet sensor and fished the wires through this hole. I was able to extend both this wire and the security wire through the original hole, solder the wires together, then stuff them back in the larger hole.

The result was an exterior mounted sensor (disadvantage), but I could use the existing routed wiring (advantage) and not have to tear out sheet rock to relocate the wires.

Installing Door Sensors:

The door sensors are a lot easier to install. Just install the wired sensor part into the door frame hole as you did for the window sensor.

Test the sensor with the same method using the resistance meter/readings and magnet as with the window sensors.

Close the door so you can see where the sensor will align with the doors edge. Mark and drill this location with the proper drill size (for the larger white magnet). Install the magnet and test the completed assembly as you did for the window sensor.

I also used this sensor for monitoring my garage doors. The suggested mounting technique is on the floor, but I mounted them on the top of my garage door and frame header. They have a three-inch gap distance and armored cable leads which make them an excellent choice for the garage environment.

Motion Detector Mounting

Motion detectors come in all shapes and sizes with a variety of detection patterns. For this installation motion sensors were chosen that were 12 VDC powered and provided a contact closure output (contacts "opened" when motion was detected). Please read the directions carefully and mount the motion sensor accordingly. Note that some will have jumper or settings inside the motion detector whose settings will depend on the height that they will be mounted at. Some will also have "shadowed" detection patterns that can be customized for you situation (pet immune). Others will also have detection LED indicators to aid you in testing the detection patterns.

Carefully wire the motion sensor's power and output. Attach the home run end to the power supply and the resistance meter to the detector's output. Test the motion sensor by having someone move into the detection pattern while you monitor the resistance readings.

Glass Break Sensors

Choose the glass break sensor location according to the manuals recommendations. For instance, mine needed to be mounted on a side wall of the room, and not towards the center.

Wiring was exactly the same as the motion detectors (in my case). Testing was a little different in that the Caddx system had a "chime" option that would go off during a selected zone's fault. I set

the chime to go off for the glass break sensor, then, using two pieces of wood, clapped the wood together to make a loud crisp sound near the glass break sensor. The chime then went off telling me that the sensor was working properly. The reason this method of testing was used is because I did not know how long the contacts would "open" during a fault and this may not have been able to be detected by the resistance meter.

Mounting Box Installation:

The metal locking box was mounted "over" the home run wiring exit location. Since this is a locking box, and because of its weight, the mounting screws were drilled into the existing studs.

Miscellaneous Notes:

You may want to think of additional places that you would like these types of sensors mounted other than doors and windows. For instance, if your phone and power are accessible from the outside, why not mount some sensors on the inside covers of these locations?