

***Braeburn®***

# Zoning Reference Guide



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This guide is intended to be used as a source of general information and reference guide about zone systems and their associated equipment. It provides an overview of the practices and standards associated with zone system.

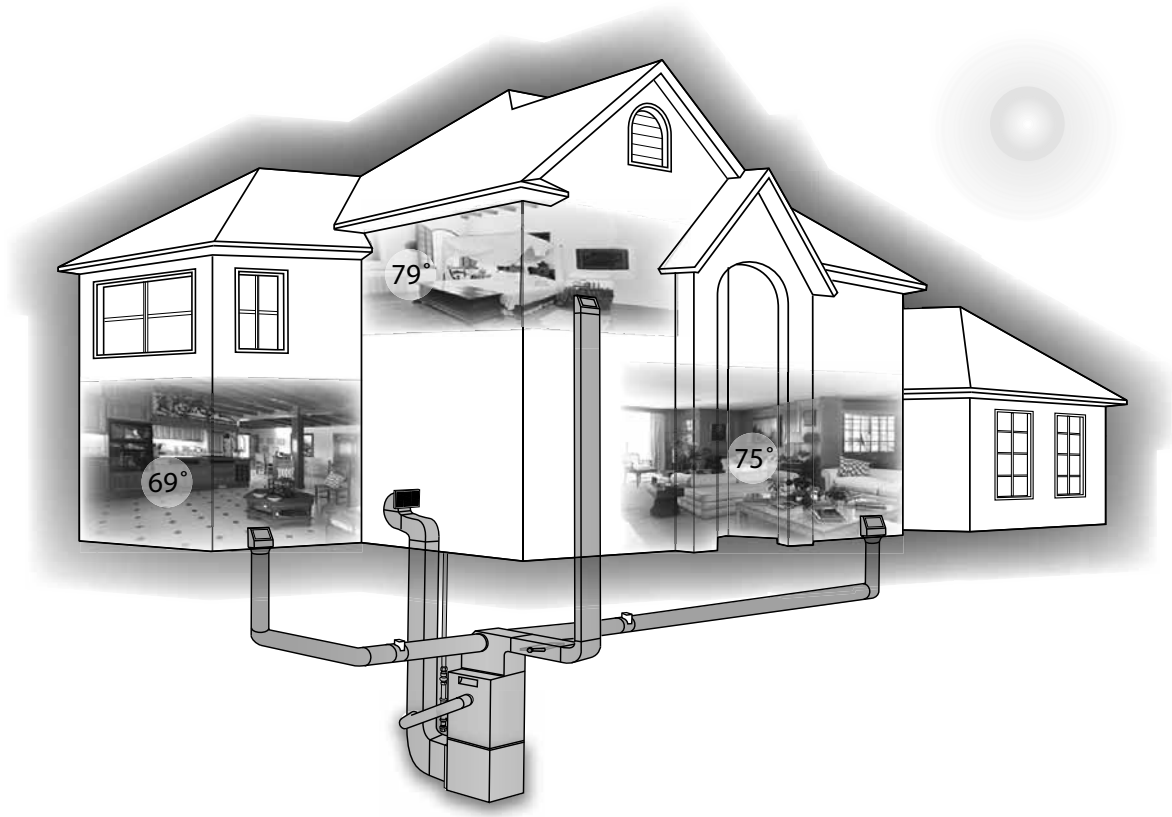
This guide is not intended to be used as an instruction manual by untrained persons, nor to be used as a standard for design, manufacturing, testing, or installation of zone systems.

Although every effort has been made to make the information in this publication accurate, Braeburn assumes no liability for damages that may result from the use of this guide.

## Introduction

### Braeburn Zone Systems: Comfort on Demand

Given the opportunity, more than half of building owners want to improve the comfort and energy efficiency of their home or business.



### Comfort

Why are so many owners dissatisfied with their comfort of their building? Even the best thermostats will only monitor the temperature in the area around the thermostat. Now consider second and third stories or interior walls that divide a building into rooms with different solar, glass, or wind loading. The result can be a 10 degree or more difference between the area around the thermostat and the rest of building.

The result of having a large temperature spread is uncomfortable occupants. According to industry data, even a 5 degree difference will cause a four-fold increase in complaints.

Zoning solves this problem by reducing or completely eliminating the large temperature variation that can come from uneven HVAC loads. Occupant comfort is increased, and complaints can be reduced.

## Energy Savings

Up to 30 percent of the costs of heating and cooling can be reduced by making sure areas are not over or under air conditioning. Usually, parts of buildings are improperly air-conditioned when the centrally located thermostat responds to the temperature around the thermostat and areas away from the thermostat are already too hot or too cold, or do not need to be conditioned.

Costs are also increased when the areas away from the thermostat are not occupied. Without zoning control, the average heating or air conditioning system will send conditioned air throughout the entire house or building even if there are no plans for the area to be occupied or used.

Zoning solves this problem by guiding conditioned air to the areas that are in use or actually require air-conditioning. Using setback thermostats will result in additional savings by making sure the zone panel only calls for conditioning at the right time. The result can be up to a 30 percent savings in energy costs.

## What is a Zoning System?

A zoning system is made up of the following items:



THERMOSTAT in each zoned area.

The thermostats can be off-the-shelf, single stage, programmable or non-programmable units. They do not need any special connections or settings.



ZONE CONTROL PANEL with a power transformer.

Zone panels run off the same kind of power transformer as thermostats and air conditioning equipment. The zone control panel is the “brains” of the system, and has a built in computer to monitor the thermostats, the HVAC equipment and to open and close the dampers. The transformer is the usual 40VA, 24 VAC type.



DAMPERS for each of the zoned areas.

Dampers are usually wired and powered directly from the zone control panel. The job of the dampers is open or close and let conditioned air flow to where it is needed. The dampers can be either power open-power close or spring return with power close.



**BYPASS DAMPER for the system.**

Most HVAC equipment is designed to operate with air flowing through the entire system. When zoning is applied to a system, and only a few dampers are open, the bypass damper relieves excess air pressure back into the return air.



**SUPPLY AIR TEMPERATURE SENSOR.**

To help ensure the system runs at the proper temperature when only a few dampers are open, a supply air temperature sensor may be used by the zone panel to moderate the system output.



**SYSTEM DUCTWORK AND HVAC EQUIPMENT.**

Properly sized ductwork and equipment is the key to a successful zoning installation. Cost savings will be made when installing one properly sized HVAC system with zoning verses installing two or more separate systems. A later section of this guide will help your understanding of the special requirements of ductwork for zoning systems.

## The Braeburn Advantage

### The Best Value in Zoning Today

Braeburn is one of the fastest growing indoor comfort and climate control manufacturers in the United States. Our dedicated team of specialists will help provide the best value for your customers' application requirements. Braeburn products are available to contractors via our global network of HVACR distributors.

Founded in 2001, our corporate headquarters is located in Montgomery, Illinois – just west of Chicago. This facility is the central hub for all of our customer service, engineering, and business activities. Braeburn offers a complete line of zone control products that are shipped to our global customers from our modern UPS Supply Chain Solutions distribution center in Louisville, Kentucky. Our thermostats, zone panels, round dampers, and accessories generally ship within 24 hours from our main distribution center in Louisville. Rectangular dampers are custom made to order and shipped within 72 hours from our manufacturing facility in Lubbock, Texas.

At Braeburn, we're committed to providing you the quality you would expect from a world class company. Our *Quality by Design* product philosophy focuses on core engineering, manufacturing, and reliability testing processes to ensure you receive the product quality you can count on with every job!

From our Builder and Premier thermostats to our complete line of zone controls, we provide solutions to lower energy costs and increase comfort in any home or business environment. Our innovative value-added features, reliability, and contemporary designs make us the brighter choice in indoor comfort and climate control. It's easy to see why Braeburn is *The Best Value in Zoning Today*.



## Understanding Zoning Duct Systems

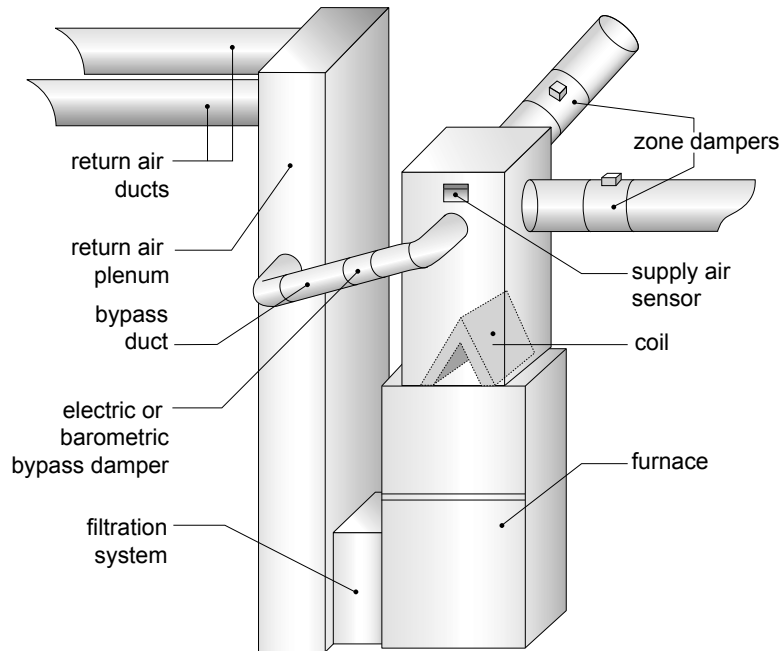
When designing and installing zoned ductwork, follow all codes and regulations having authority over the installation. The following tips should help your zoning installation:

- The HVAC system must be sized to provide conditioning for the entire area. Whenever possible, do not over or under size the equipment. Better results will be achieved with capacity control such as equipment staging.
- Zone controls are not intended to balance air flow. Using good design practices and a properly balanced flow will give the best results.
- Areas that have extreme differences in temperature that would require constant opposite calls may get better results with additional HVAC equipment. Opposite mode calls work best with zoning when the calls are transition in nature rather than constant opposite modes.
- When determining duct sizes for zoning, we recommend both the “whole building load calculation” as well as a “room-by-room load calculation”.
- Once the total CFM of the system has been determined, size the dampers using the damper chart below. Consider using at least the design CFM to leave margin for the maximum CFM when multiple dampers are closed. The total CFM of the system should be at least the total design CFM of the dampers.
- The duct system for each branch should be designed to accommodate the maximum design CFM for each damper. Following this guideline will help ensure that the system is quiet even when only a single zone is receiving airflow.

### Damper Sizing Chart

Damper Size	Design CFM	Maximum CFM
6 Inch	100	200
7 Inch	150	250
8 Inch	200	300
9 Inch	300	450
10 Inch	400	600
12 Inch	600	900
14 Inch	1000	1400
16 Inch	1500	2000

## Understanding Bypass System Ductwork



In many zoning installations it is necessary to install a bypass damper. A bypass damper will help the HVAC equipment maintain rated CFM past the heat exchangers and blower motor. If a system does not have a bypass, and only a few dampers are open, excess supply plenum pressure may be created. The result can be system limit trip-outs, excess noise, coil icing, or other problems. The bypass damper is installed in the bypass system duct.

### ***What is a Bypass System Duct?***

It is a connection between the supply side and the return side air plenum. The connection uses a bypass damper to open when needed. The bypass damper can either be electric, that opens a damper with an electric motor when needed, or barometric (think barometer) that opens up a weighted door when the system pressure increases.

Braeburn recommends using one of three methods to control excess supply plenum pressure. The best method will be determined based on the specific requirements of the application such as cost, type of duct system used, actual duct design, and the ability to install a bypass duct in tight equipment locations.

Three common methods are:

1. Eliminate the bypass by oversizing each branch of the duct system so that each branch is capable of flowing the system CFM.



2. Install a barometric bypass damper in the bypass duct from the supply plenum to the return air plenum. Size the bypass duct by using a formula that subtracts the smallest zone CFM from the total system CFM to determine the bypass CFM. As an example with a total system CFM of 1200 and a smallest zone CFM of 700, the bypass needs to be  $1200-700=500$  CFM.
3. Install an electric bypass damper in the bypass duct from the supply plenum to the return air plenum. Sizing an electric bypass damper using the same sizing formula as the barometric bypass damper.

### ***Eliminate the Bypass by Oversizing Each Branch***

This option is usually used on two zone systems that are about the same size and HVAC load. It can be acceptable to oversize the ductwork in each zone so that when only one of the two zones is open, all the air produced by the indoor blower is applied to the open zone. Many installers have been successful by sizing each zone to handle about 75% of the system CFM. This duct design has advantages and disadvantages. One advantage is that no bypass duct or damper is required; and the system's operating temperature and pressure should be normal. One disadvantage is lower duct pressure when both zones are calling. This means that the system's ability to throw the air to the outside walls may be diminished. Carefully calculating the face velocity in FPM at the diffusers can help.

### ***Install a Barometric Bypass***

This low cost option uses a short duct between the supply plenum and the return air plenum. The Braeburn barometric bypass is installed in this duct. The purpose of the bypass duct is to allow the excess pressure from the supply plenum to escape into the return air plenum. Excess pressure is routed to the return air plenum by adjusting the bypass damper. The bypass damper is adjusted so that when all zones are open the bypass damper is lightly closed. As supply dampers close and pressure builds in the supply air plenum, the pressure pushes the bypass damper open. A simple, adjustable weight is used to properly position the damper.



Adjusting a barometric bypass damper is simple and requires no instruments.

1. Install the bypass damper with the arrow pointed from the supply side to the return side.
2. Ensure the damper blade pivot shaft is horizontal to the ground and the large part of the damper blade is down.

3. In normal operation, the weight arm will lift up when pressure increases. If the air is flowing left to right, position the weighted arm at 4:00. If the air is flowing right to left, position the arm 8:00 when no zones are calling.
4. Adjust the weighted arm so that the damper is barely closed when all zones are calling.

### ***Install an Electric Bypass***

This option also uses a short duct between the supply plenum and the return air plenum, but uses an electrically controlled damper to reduce excess plenum pressure. The electrically controlled damper is powered from a static pressure sensor that is mounted into the plenum. As pressure increases in the supply plenum, the static pressure sensor will register this increase and power the motorized damper open slowly so as to relieve the excess pressure. As the pressure is removed, the static pressure sensor will stop opening the damper when the plenum pressure becomes less than the set-point on the static pressure sensor.



Installing an electric bypass requires just a few steps.

1. Install a power open / power close damper and bypass duct from the supply side to the return side.
2. Mount the static pressure controller on a vertical surface near where the pressure sensor will be installed into the supply plenum.
3. Mount the pressure sensor into the supply plenum so the air blowing past the tube, and not directly into the end.
4. Wire the damper, the static pressure controller and the start position relay as shown in the SPC instructions.
5. Turn the HVAC blower on high and insure all zones are open.
6. Use a flat head screwdriver to slowly turn the setscrew on the SPC clockwise. When you start to get near the right adjustment point, the damper blade on the bypass damper will start to close and then stop. Continue moving the setscrew clockwise until the damper is barely closed. The proper set-point is when all zones are calling with the fan on high, and the bypass damper is just staying closed.
7. Confirm the wiring by turning off all zones. The bypass damper should power open and stay open. If the wiring is wrong, startup will be noisy because the bypass damper will power close when the zones are turned off.

## Understanding Zone Controllers

Braeburn zoning controllers serve as the brains of the zoning system. The zone controllers have a built-in computer to monitor the thermostats and the HVAC equipment, and to open and close the dampers. All equipment is connected to the zone panel.

- The zone panel has connections to hook up thermostats.
- The zone panel has connections to the HVAC equipment.
- The zone panel has connections to power the zone dampers.
- The zone panel has a connection for 24-volt power just like the HVAC equipment.
- The 3-zone panel has connections to the air plenum to monitor the air supply temperature.

When the zone panel is running, here is what happens:

At rest, when no zones are calling for heating or cooling, all dampers are open and the fan is off.

As soon as a thermostat calls for a temperature change in one or more of the zones, the zone panel reacts by making several changes. First, all dampers other than the calling zone(s) close. Then, the heating or cooling equipment is turned on along with the corresponding fan control. The system continues in this state until one of two things happen:

The first case occurs when the zone is satisfied. The equipment is turned off, along with the fan control, and all dampers return to their open state.

The second case occurs when a zone is heating or cooling and an opposite call occurs from one or more of the other thermostat zones. An opposite call is a call for heating when the system is already cooling, or a call for cooling when the system is already heating. The opposite call can be handled one of two ways:

- **Zone 1 Priority** ensures opposite calls are only answered if they are either from zone 1, or match the last call from zone 1. This method is used when you have an area that should get the highest priority, and the kind of call from that area sets the mode (heating or cooling) for the rest of the building.

The zone panel can also be configured to handle opposite mode calls with a timer. This mode is called All Priority.

- **All Priority** allows the existing call to continue for 15 or 20 minutes, and then starts to switch over even if the first call is not done. The switchover starts with a purge, where the heating or cooling equipment is shut off, while the fan continues to run with the dampers left just like they were. With the equipment off, and the fan running, the conditioned air is “purged” from the system until the air is nearly room temperature. At that time, the zone controller switches on the equipment for the opposite mode, and opens the dampers for the opposite calling zone, and closes the original calling zone dampers. The switchover is now complete.

The system will continue in this state until either the call is satisfied, or if the opposite mode calls, in which case, the entire purge/changeover cycle will start over again. This normal operating mode for the zone panel will continue until all thermostats no longer call for heating or cooling.

## Using the Zone Panel with Multi-Stage Equipment

All Braeburn zone panels are designed to work with multi-stage HVAC equipment. The 2-zone panel will work with two heating stages and one cooling stage. The 3-zone panel will work with up to three heating and two cooling stages. If multi-stage equipment is attached to the zone panel, additional features will be used to maximize occupant comfort and economy.

The Braeburn 2-Zone Panel monitors the amount of time a heating call has lasted. Calls that do not last very long will make maximum use of the more economical first stage. If the call is not satisfied after 20 minutes, the zone panel automatically activates the second stage.

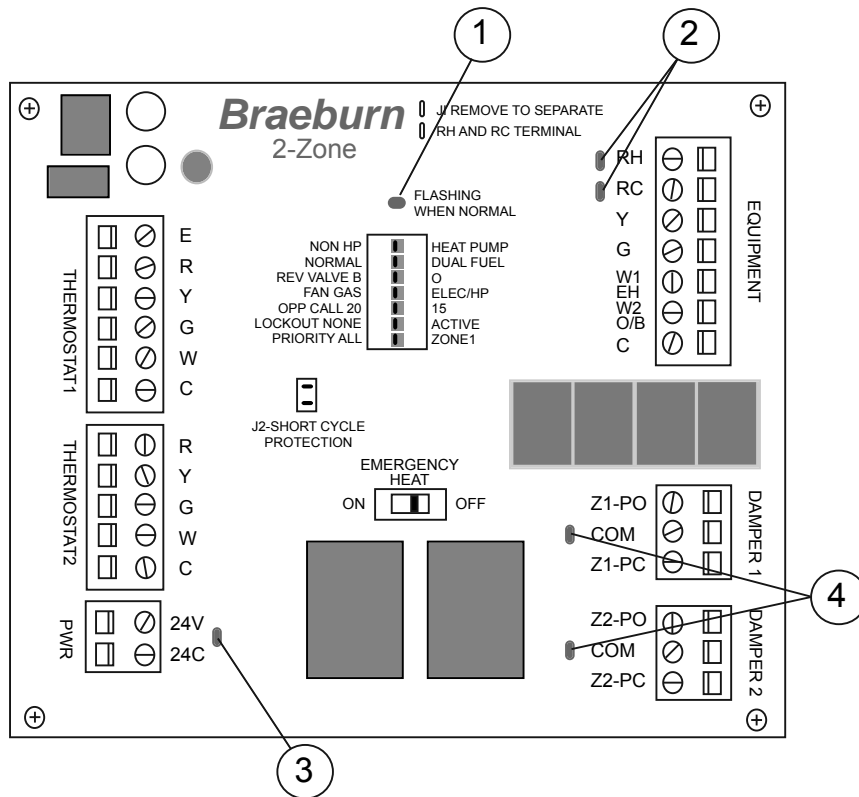
The Braeburn 3-Zone Panel monitors time and the plenum temperature to maximize economy. The plenum temperature sensor helps the equipment stage by looking at the supply temperature and comparing it to the high or low limit. If the temperature differs by more than the fixed amount from the limit, the zone panel will permit staging. If the supply temperature approaches the limit, the panel will shut off the second stage. If the supply temperature crosses the high or low limit, the panel turns off the equipment, and switches the fan on until the temperature comes back into limits. The 3-zone panel can also control a two speed fan. Depending on the installer preferences, the fan can switch to high speed if either two zones or two stages are calling.

## Understanding the Zone Controller Display

All Braeburn Zone panels provide easy to read indicators to determine the state of the zone panel. By looking at the indicators, it is easy to determine the status of the dampers and equipment.

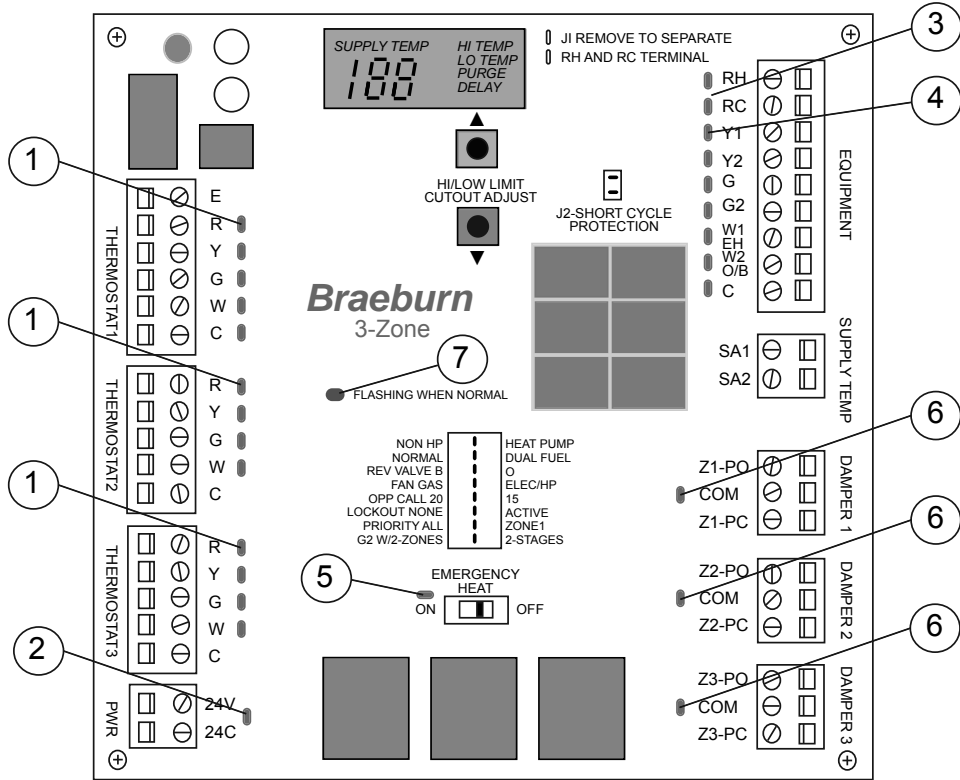
### Braeburn 2-Zone Panel Indicators

Function	Color	Callout	Description
Panel Heartbeat	Green	1	Flashes once per second when normal
Equipment RH Power	Red	2	Indicates power at equipment RH terminal
Equipment RC Power	Red	2	Indicates power at equipment RC terminal
Panel Power	Green	3	Indicates 24VAC available to panel
Zone 1 Damper	Dual	4	Red when closed; green when open
Zone 2 Damper	Dual	4	Red when closed; green when open



**Braeburn 3-Zone Panel Indicators**

<b>Function</b>	<b>Color</b>	<b>Callout</b>	<b>Description</b>
Thermostat 1,2 and 3 R	Red	1	Zone thermostats power monitor
Thermostat 1,2 and 3 Y	Yellow	1	Zone thermostats compressor call
Thermostat 1,2 and 3 G	Green	1	Zone thermostats fan call
Thermostat 1,2 and 3 W	White	1	Zone thermostats heating call
Panel Power	Green	2	Indicates 24VAC available to panel
Equipment Rh Power	Red	3	Indicates Power at equipment Rh terminal
Equipment Rc Power	Red	3	Indicates Power at equipment Rc terminal
Equipment Y1	Yellow	4	Indicates a first stage compressor call
Equipment Y2	Yellow	4	Indicates a second stage compressor call
Equipment G	Yellow	4	The zone panel has turned on Fan Stage 1
Equipment G2	Yellow	4	The zone panel has turned on Fan Stage 2
W1/E/W3	White	4	Heating call depending on configuration
W2 / O - B	Orange	4	Heating or valve control depending on configuration
EM Heat	Yellow	5	Indicates Emergency Heat has been activated
Zone 1 Damper	Dual	6	Red when closed; green when open
Zone 2 Damper	Dual	6	Red when closed; green when open
Zone 3 Damper	Dual	6	Red when closed; green when open
Panel Heartbeat	Green	7	Flashing once per second when normal



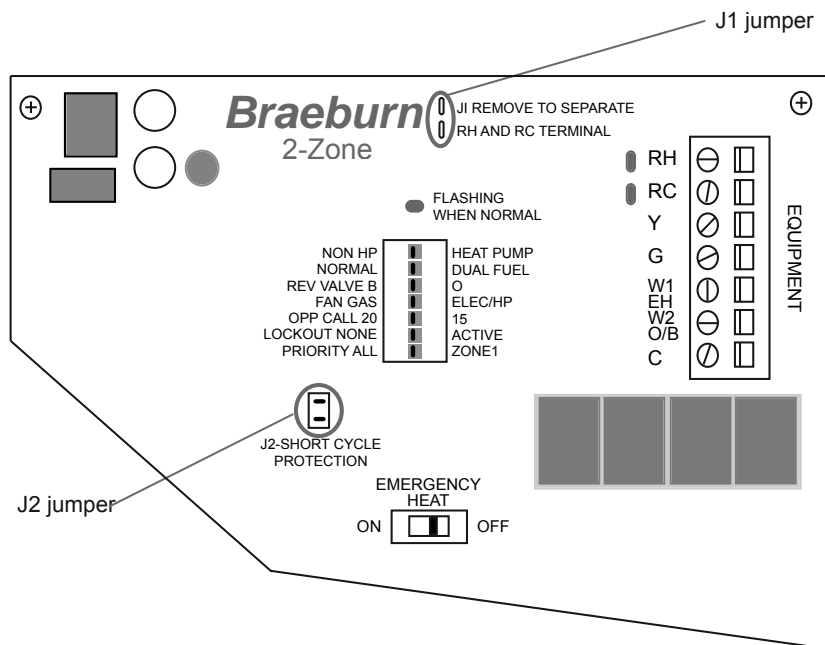
## Configuring Zone Panels

All Braeburn Zone Panels feature easy to configure DIP switches that eliminate concerns about configuration loss after a power failure. The installer can also tell at a glance that the panel is set up properly prior to leaving the job site. Which is faster for the installer? Go back through 25 menu steps verses one glance at the DIP switches to insure a panel is set up properly.

Both the 2-zone and the 3-zone panel use similar DIP switch setup, while the 3-zone has additional features for temperature control of staging.

### Braeburn 2 Zone Panel Configuration

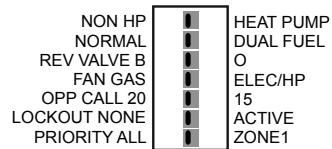
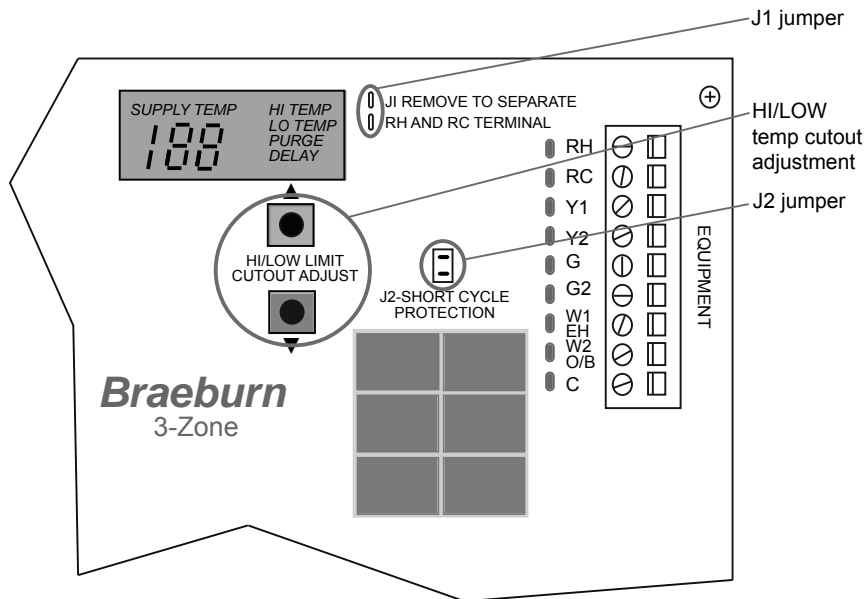
Switch Number	Switch Label	Switch Function
1	Non-HP / Heat Pump	Conventional or heat pump control of W/Y
2	Normal / Dual Fuel	HP 1st stage lockout on 2nd stage call
3	Rev Valve B / O	O/B terminal active in heating (B) or cooling (O)
4	Fan Gas / Elec & HP	Fan controlled by HVAC system or panel
5	Opp Call 20 / 15	Opposite call answer time in minutes
6	Lockout None / Active	2nd stage lockout without 2 zones calling
7	Priority All / Zone 1	Changeover priority zone 1 or first call
J1	Separate RH RC	Remove for dual transformer installation
J2	Short Cycle Protection	When on, panel provides compressor short cycle protection. When off, HVAC equipment provides short cycle protection





## Braeburn 3 Zone Panel Configuration

Switch Number	Switch Label	Switch Function
1	Non-HP / Heat Pump	Conventional or heat pump control of W/Y
2	Normal / Dual Fuel	HP 1st stage lockout on 2nd stage call
3	Rev Valve B / O	O/B terminal active in heating (B) or cooling (O)
4	Fan Gas / Elec & HP	Fan controlled by HVAC system or panel
5	Opp Call 20 / 15	Opposite call answer time in minutes
6	Lockout None / Active	2nd stage lockout without 2 zones calling
7	Priority All / Zone 1	Changeover priority zone 1 or first call
8	G2 W2-Zone / 2 stages	High speed fan will come on when 2 zones or 2 stages call
J1	Separate RH RC	Remove for dual transformer installation
J2	Short Cycle Protection	When on, panel provides compressor short cycle protection. When off, HVAC equipment provides short cycle protection



## Additional Features for the 3-Zone Panels

The Braeburn 3-Zone Panel has additional features to control staging by monitoring the temperature of the HVAC plenum. By using the Hi and Lo Temp cutout switches the installer can configure the panel to operate in the most economical mode.

When the 3-zone panel is configured for a conventional system, the panel will upstage the heating equipment if the plenum temperature is 25 degrees less than the cutout. If the panel is configured for heat pump, staging occurs at 10 degrees less than cutout. The same limits are used for cooling staging.

The limit switches are located directly below the 3-zone panel LED. The display informs the user of the panel condition and the plenum supply temperature.

### Braeburn 3-Zone Panel LED

Function	Color	Description
Purge Indicator	Yellow	Indicates user zone purge underway
Delay Indicator	Yellow	Indicates user panel is in a timed wait period
Lo Temp Indicator	Red	Indicates user Lo Limit has been exceeded
Hi Temp Indicator	Red	Indicates user Hi Limit has been exceeded
Supply Temp Indicator	Red	Indicates supply plenum temperature

## 2-Zone and 3-Zone Panel Checkout

The installer guide for both panels includes a complete checklist for the installer to use to ensure the zoning system is functioning properly. The checkout steps include:

- Apply power to the panel and ensure the panel-condition LEDs illuminate.
- Switch on zone 1 thermostat and ensure conditioned air is only moving into zone 1.
- Switch on the remaining zone thermostats one zone at a time and ensure conditioned air is only moving into that zone.
- Test the emergency heat and air-conditioning equipment if the outside temperature permits.
- Shut off all zones and confirm purge cycle and bypass operates as expected.
- Restore thermostats to their normal operating condition.

## **2-Zone Panel Comfort Features**

- Allows for two separate thermostats to measure the hot and cold spots
- Helps the heating and cooling system to direct energy to where it is needed
- Functions automatically without the homeowner opening and closing vents
- Prevents over-cooling the downstairs to keep the upstairs comfortable
- Works in the spring, summer, winter, and fall

## **2-Zone Panel Economy Features**

- Saves almost \$2000 to the contractor over installing two separate systems
- Uses the homeowner energy dollars wisely by heating and cooling only when and where needed.
- Reduces maintenance costs of two systems to one system
- Built in system purge directs all remaining HVAC energy to the calling zones
- Built in opposite mode calling switches from heating to cooling using time based economy algorithm. Can be priority of zone 1 or from first calling zone

## **3-Zone Panel Comfort Features**

- Allows for three separate thermostats to measure the hot and cold spots
- More precise direction of the heating and cooling system energy to where it is needed
- Functions automatically without the homeowner opening and closing vents
- Can balance an entire house, removing over and under-conditioning problems
- Works in all seasons of the year, spring, summer, winter and fall

## **3-Zone Panel Economy Features**

- Saves almost \$3000 to the contractor over installing 3 separate systems
- Provides even more energy savings by heating and cooling precisely where needed
- Lowers maintenance costs from three systems to one system
- Optimum control of staging based on actual plenum temperature
- Built in system purge directs all remaining HVAC energy to the calling zones
- Built in opposite mode calling switches from heating to cooling using time based economy algorithm (can be priority of zone 1 or the first calling zone)

***Braeburn, The Best Value in Zoning Today***

## Braeburn Products



Braeburn offers a wide variety of indoor control products. From our cost effective thermostat line to our innovative zoning products, we have a solution for residential and commercial applications.

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