

### IMPORTANT APPLICATION INFORMATION

**NOTE: The Ion™ Zoning System IS NOT compatible with all ICP® communicating indoor equipment. See the Ion™ System Control product data for more information.**

The Ion™ Zoning System is controlled using duct static pressure measurements. Communicating two-stage gas furnaces that use PWM ECM blower motors do not support static pressure measurement and therefore are not compatible with the Ion™ Zoning System. For these furnaces, use the Observer® Zoning System instead.

**NOTE: Only use modulating dampers provided by ICP for use with the Ion™ Zoning System. Dampers provided by other companies are NOT compatible with the Ion™ Zoning System.**

**NOTE: Observer® System accessories, except for certain dampers (see damper list), are NOT compatible with the Ion™ Zoning System.**

Use the Observer® Zoning System, or equivalent, for non-compatible indoor units, such as non-communicating indoor units. The Observer® Zoning System may also be used in retrofit applications where it is impractical to change existing zone dampers.

### INTRODUCTION

The Ion™ Zoning System provides the ability to control 2, 4, or 8 zones in a residential or light commercial application. Each constructed zone should support the minimum airflow of the equipment selected. Consult the Ion™ System Control Product Guide to determine minimum airflow requirements.

The Ion™ Zoning System can only be used with compatible Ion™ System indoor equipment. See the Ion™ System Control equipment Product Data for details. To achieve the best operating and comfort it is recommended that the Ion™ System compatible multi-stage compressor units be selected in the design of the zoning system. See the equipment Product Data sheets for more information. The multiple stage, and especially modulating, communicating ICP HVAC equipment, provide some leeway in the system minimum airflow requirements, allowing more effective zoning operation.

Ion™ Zoning incorporates cutting edge technology that sets it apart from any other zoning system on the market today.

- It does not require a bypass damper or leaving air temperature sensor, yet the HVAC equipment is always protected from limit trips and coil freezing.
- It does not require a separate field installed power transformer.
- System can handle up to five dampers per zone.
- Ion™ Zoning automatically identifies all communicating installed equipment.
- Patented Automatic Duct Assessment ensures that Ion™ Zoning delivers superior and quiet comfort with any reasonable duct system.

### ION™ SYSTEM COMPONENTS

The Ion™ System uses a serial communication bus to pass information between major system components. 24 VAC control signals are gone (with the exception of driving dampers and conventional outdoor units). This means that Ion™ Zoning will use compatible ICP communicating indoor components only. A system will consist of some or all of the following:

- A communicating ICP furnace or fan coil (required). See the Ion™ System Control Product Data for more information regarding compatible equipment.
- An ICP communicating or non-communicating Mainline AC or HP (multi-stage equipment is recommended). See the Ion™ System Control Product Data for more information regarding compatible equipment.
- Dual Fuel System – ICP communicating gas furnace with ICP Mainline HP. See the Ion™ System Control Product Data for more information regarding compatible equipment.
- An Ion™ System Control (SYST0101CW)
- One or two Ion™ Damper Control Modules (SYST0101ZP)
- Remote Room Sensors (SYSTXIIRRS01)
- Modulating dampers (ZDAMPREC, ZDAMPRND, DAMPSL)

Following is a brief description of each of these components.

#### **Ion™ System compatible gas furnace or fan coil:**

The Ion™ System is a fully communicating control system. Only ICP communicating, modulating variable speed furnaces, ICP communicating, variable-speed fan coils are acceptable indoor units that work with the Ion™ Zoning System; see the Ion™ System Control Product Data sheet for details. Communication takes place over a four-wire communicating communication bus.

The Ion™ Zoning System compatible fan coils will operate with any Ion™ System or Mainline AC or HP or any conventional single-stage AC or HP. The Ion™ Zoning System compatible gas furnaces will operate with any ICP communicating AC or HP, or any conventional single-stage AC.

**NOTE:** A Communicating Relay Module (CRM) may be required to connect the Ion™ System Control indoor units to non-communicating outdoor and compressor units, especially multi-stage heat pump versions.

#### **Ion™ System Control:**

If the Ion™ System compatible gas furnace, or fan coil could be considered the heart of the system then the Ion™ System Control could be considered the brain. It is the user access into the Ion™ Zone System. It allows the user to operate, program, setup, monitor, and troubleshoot the system.

From the Ion™ System Control, the program schedules and desired setpoints, fan speeds, and a number of other selections can be set for each individual zone. It will also notify the homeowner of any maintenance reminders or problems in the system.

#### **Ion™ Damper Control Module:**

The Damper Control Module receives signals from the Ion™ System Control, and then turns on the equipment and modulates the necessary dampers to maintain space temperature. Major components are connected directly to the Damper Control Module. One Damper Control Module will serve up to four zones. If more than four zones exist, a second damper control module is added to the system to allow for up to eight zones.

#### **Remote Room Sensors:**

The Ion™ System Control serves several different purposes. Along with its control of the system it is also the default temperature and humidity sensor for zone one. If needed this Ion™ System Control can be installed in a remote location with a Remote Room Sensor or a Smart Sensor (when available) in the Zone 1 space. However in this situation the Ion™ System Control will still need to be located where it will accurately sense space humidity as the humidity sensor cannot be remotely located.

All other zones will need a Remote Room Sensor to allow the Ion™ System Control to know the temperature in each of its zones.

Remote Room Sensors are two wire sensors that are home run back to the Ion™ Damper Control Module. However, it is always recommended to run at least four wires for possible future installation of Smart Sensors at some point in the future.

#### **Modulating Dampers:**

ICP's Ion™ compatible dampers are of the modulating type and come in various sizes. They are powered open, and powered closed using a 24 VAC three wire connection and are modulated to maintain space temperature.

The dampers are non spring return and have specific drive timing allowing the system to track the dampers position. Because of this, non-ICP dampers may not be substituted.

ICP modulating dampers are designed to draw less current than many other dampers allowing up to five dampers to be connected to a single zone output – while allowing the equipment transformer to still provide all power. The Zoning Control module only cycles one zone at a time thus minimizing the load on the system transformer.

The design requirement for the Ion™ Zoning system does not require the installation of a bypass damper, leaving air temperature sensor (LAT), or a heat pump sensor (HPT). The Outdoor Air Temperature (OAT) sensor is installed on all Ion™ System compatible equipment and will not require an additional installation of an OAT sensor unless Ion™ compatible equipment is not used, or the dealer wishes to install the OAT sensor in a different location. The use of a barometric bypass damper or a dump zone without a damper will cause erratic operation of the zoning system and create comfort control issues.

## **PLANNING THE INSTALLATION**

### **Selecting Zones**

**Usage:** Group together rooms that have similar usage, occupancy, and heat load.

**Levels:** Different levels in a home need to be separate zones. Each level may be further divided into zones.

**Comfort vs. energy saving:** If energy saving is an objective, areas which will be unoccupied at different times need to be separated so they can selectively be setback. If maximum comfort is desired, areas with different heat loss/gain as well as different levels need to be separated. Zones in which different comfort temperatures are desired also need to be separated.

**Existing ductwork:** If the installation is a retrofit, the existing duct system may limit zone selection options. See ACCA/ANSI Manuals D and Zr for more information.

**Multiple dampers:** Up to five dampers may be used in a zone by electrically connecting them in parallel.

**Damper types:** Round, rectangular, or rectangular slip-in dampers may be intermixed in any arrangement. Only modulating dampers provided by ICP are compatible with the system.

**Multi-capacity equipment:** For best results, choose HVAC system components with more than one stage of heating and/or cooling capacity. This allows a wider range of operation for the zoning system, as the zoning system can stage-down the equipment as fewer zones are calling for heating or cooling. Of course, modulating equipment is the best. Ion™ System compatible indoor sections typically feature two or more stages of capacity for heating, including the modulating gas furnaces, and multi-stage heat pumps. Ion™ System outdoor/compressor sections feature capacities from single-stage to 5-stage. If more than four zones are desired, a multi-stage compressor is recommended to be able to quietly and reliably supply reduced capacity to calls from smaller zones.

#### **How does the Ion™ System Control the Zones?**

The Ion's sophisticated algorithms were constructed to maintain comfort to the occupants by continuously monitoring each zone's temperature to satisfy the comfort conditions. If a zone cannot handle the minimum equipment cfm, the Ion™ System Control will find a zone that is slightly out from the setpoint and open the damper to allow the system to run. If none of the

zones are away from the setpoint the lon™ System Control looks for unoccupied zones or setback zones to allow the system to run to satisfy the original zone caller.

Zones that do not handle minimum equipment airflow will cause other zones to be heated or cooled above or below their setpoint temperatures. If this is an acceptable alternative then the undersized zones will not present any major issues. In most circumstances this is not an acceptable situation and the only way to relieve this to make sure each zone handles the minimum airflow of the installed equipment, or to design the system with HVAC equipment with multiple stages of heating and cooling.

Remember the lon™ System tries to satisfy all zones simultaneously so it is common for zones to open incrementally to satisfy the comfort points. HOWEVER, the default mode of operation is to NOT rapidly switch back and forth between heating and cooling modes; this helps to reduce energy usage. Note that operation with modulating equipment will tend to match the needs of the calling zones with heating and cooling, and further delay transitions to the opposite system mode of operation. For satisfying simultaneous demands for heating and cooling, select the appropriate simultaneous demand option, if available for that system; be aware that energy usage will likely increase with using the lon™ Zoning System to satisfy simultaneous heating and cooling demands.

#### Ductwork and variable speed ECM indoor blower motors

The variable speed ECM indoor blower motor has changed many of the aspects of designing the ductwork system. In many circumstances the ECM variable speed motor provides better airflow in marginal duct systems; however, if proper techniques are not used, they can also create issues that are not easily corrected after installation.

#### Where to start:

It is necessary to start the design process with a good heat loss/gain calculation for the structure and each conditioned area of the structure. Equipment should be selected that matches the heat loss/gain to maintain the best comfort.

From an efficiency standpoint, bigger is not better. Bigger wastes energy, shortens the life expectancy of the equipment and may leave the customer feeling uncomfortable in the process. While usually not a good idea in any case, oversizing equipment in zoning systems is not recommended. If allowed by local building codes, select equipment that is sized to match the load, or is slightly undersized.

**DESIGN TIP:** ALWAYS use industry-standard design tools for determining proper system design.

Use design guide materials such as the Air Conditioning Contractors of America (ACCA) Manuals J, D, and Zr.

#### Determine airflow for each living space

After completing the heat loss/gain calculation it is necessary to determine the required airflow, in cfm, to each living space. This step is crucial in delivering comfort to the customer and is necessary to design an efficient duct system. The duct system should deliver the calculated airflows to each zone in order to maintain temperature throughout the home.

#### Determine the necessary equipment

Before concentrating on the design of the duct system a selection of equipment must be conducted. The equipment will dictate the design criteria for the duct system. It is important to remember that with variable speed equipment it is possible to require more cfm for heating than cooling. The variable speed equipment is very flexible in match-ups with outside air conditioner and heat pump units requiring the designer of the system to pay close attention to each piece of equipment's airflow requirements.

**NOTE:** The examples used in this Design Guide may represent obsolete equipment, and are for illustration purposes ONLY. Always refer to the latest Product Data sheets for the current lon™ System compatible equipment for proper design guidance.

The flexibility of the (F,G)9MAE1002122, for example, allows the furnace to be matched with a 2, 3, 4, or 5 ton outdoor unit. If matched to a 2 ton unit requiring 700 cfm for high stage operation, and the furnace high stage operation requires 1600 cfm, it is easy to see that the duct system must be able to handle 1600 cfm, not just the cooling airflow of 700 cfm. If the duct work were sized to the condensing unit the furnace would likely experience high limit trips and lock out. The underlined numbers highlight the cfm required to properly design the duct work.

#### Example:

| Furnace          | Low | High        |  | 2-Stage Unit     | Low  | High        |
|------------------|-----|-------------|--|------------------|------|-------------|
| (F,G)9MAE1002122 | 755 | <u>1600</u> |  | (C,H,T)CA724GK*  | 525  | 700         |
|                  | 755 | <u>1600</u> |  | (C,H,T)CA736GK*  | 700  | 1050        |
|                  | 755 | <u>1600</u> |  | (C,H,T)CA748GK*  | 875  | 1400        |
|                  | 755 | 1600        |  | (C,H,T)CA7260GK* | 1225 | <u>1750</u> |

These examples are for illustration purposes only. Always consult the latest Product Data for the equipment under consideration.

#### The Airflow Killer: Ignoring equivalent length

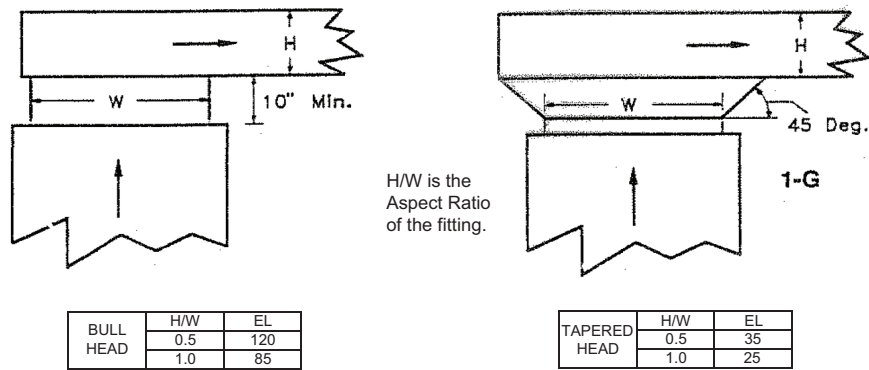
**DESIGN TIP:** Use industry-standard design tools to help design the duct and zoning systems. ACCA and SMACNA produce the industries' recognized standards for the design and application of duct systems. Please consult their publications when designing a duct system. (Reference: Consult the latest editions of ACCA *Manual D* and *Manual Zr* and SMACNA *HVAC Systems—Duct Design*. There are many automated tools based on these manuals as well.)

Not all duct fittings are created equal. When designing a duct system it is beneficial to use fittings that provide less resistance to airflow. In most units the initial takeoffs can add more equivalent length than the duct calculator allows. Typically, duct calculators provide proper sized duct to an equivalent length of 100 feet. Either a less resistive duct fitting should be used or

the additional equivalent length has to be taken into consideration. If the fittings cannot be changed then a bigger size duct must be selected.

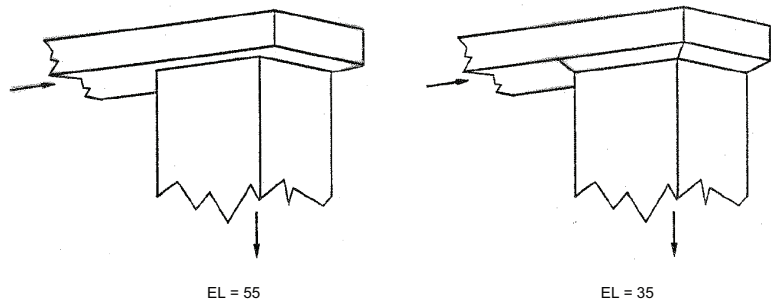
The example below is a common fitting seen on most job sites. The supply and return fitting are already over the duct calculator, (supply air 120 + return air 55), 100 foot of equivalent length and would require the duct work to be extremely large to overcome the resistance. On the right the fittings, (supply air 35 + return air 35 = 70 feet of TEL), provides only 35 foot of equivalent allow the designer a little freedom in the remaining design of the duct system. If the fittings shown in the left images were used on both the supply and return side of the system the duct system would be 175 equivalent length of duct not considering any other length of duct or other fittings. Using the duct calculator to design the duct system in this example would not provide a proper operating duct system if the fitting losses are not recognized and accounted for.

Example: Supply Air Fittings



The H/W Height/Width ratio must be calculated to determine EL equivalent length.

Example: Return Air Fittings



Note that the drop connection is relatively large. This was a common lowboy furnace connection.

Figures and Tables from ACCA Manual D

A10138

**Consider pressure drops:**

“Rules of thumb” have been adopted that could mislead the designer to believe that they are designing a proper duct system. One common “rule of thumb” used throughout the industry is that .1 or .08 per 100 foot are the proper pressure drops to design the duct system to. This is a very misleading assumption due to system accessories like: high efficiency filters, wet evaporator coils, outlet diffuser pressure drops and many other pressure drops that must be considered when designing a proper duct system.

Return air grilles, registers, diffusers, filters, furnace coils, and other necessary duct accessories add pressure drop to the system. When calculating the duct system friction rate each of these external accessories must be accounted for to determine the proper friction rate to design the duct system to. ACCA Manual D presents a table to help determine the proper friction rate for duct design.

**Example:****Manufacturer's Blower Data**

Step 1)

External Static Pressure (ESP)= 0.6 IWC cfm= 1200 From Product Data (PDD)

**Device Pressure Losses****IWC**

Direct expansion refrigerant coil 0.27  
 Electric resistance heating coil 0  
 Hot water coil 0  
 Heat Exchanger 0  
 Low efficiency filter 0  
 Step 2) High or mid-efficiency filter 0  
 Electronic filter 0  
 Humidifier 0  
 Supply outlet 0.03  
 Return grille 0.03  
 Balancing damper 0.03  
 Other device

|                                          | PD<br>from<br>PPD | Sum of<br>Component<br>PD | Pressure<br>Difference (Pd) |
|------------------------------------------|-------------------|---------------------------|-----------------------------|
| Available Total External Static Pressure |                   |                           |                             |
| Step 3) Available Static Pressure        |                   |                           |                             |
| ASP=(ESP-DPL)=                           | 0.6               | 0.36                      | 0.24 IWC                    |

|                                      | Supply | Return | TEL |      |
|--------------------------------------|--------|--------|-----|------|
| Step 4) Total Effective Length (TEL) |        |        |     |      |
| Supply-side TEL + Return-side TEL=   | 200    | 200    | 400 | Feet |

Step 5)  $FR = Pd * 100 / TEL$  0.060 Friction Rate = Pressure difference\*100/TEL

Table from ACCA Manual D

The above example shows that the unit duct design currently under consideration has an equivalent duct length of 400 feet. ACCA uses TEL which stands for Total Effective Length and means the same as equivalent length. This duct system would require that .06 friction rate be used to design the duct system. The wet evaporator coil, supply outlet, return grille, and balancing damper pressure drops are used to calculate the friction rate of the duct system to select the duct work for this system. To calculate the Friction Rate (FR) multiply the Pressure Difference (Pd) by 100 then divide the result by the Total Effective Length (TEL).

**Example:**

Friction Rate = Pressure Drop X 100 / Total Equivalent Length  
 FR = Pd X 100 / TEL  
 FR = (.24 X 100 = 24 / 400) = .06

**The remaining ductwork system should be designed around a FR of .06.**

**Duct sizing**

Although larger ductwork is usually better, the Ion™ Zoning System will make the best possible use of any existing duct system. If the Ion™ System is being forced by load requirements and/or small ducts toward a point where a limit would trip or a coil would freeze, it will take actions to avoid these events. These actions can include partially opening selected dampers, reducing system airflow to its lowest reliable level, and ultimately staging down equipment. There is no need to balance ducts as required with a non-zoned system. The Ion™ System modulates dampers automatically to provide duct balancing. Dampers open only as far as needed to provide necessary conditioning.

While bigger ducts are normally better, grille design is important as well. A larger grille will be quieter, but may not give enough air velocity to cover the entire space. A smaller grille provides better air velocity into the space, but may create excessive noise. Consult with the grille manufacturer's specifications to obtain the best compromise between noise and exit velocity.

Return ducts: Returns in each zone are desirable but not necessary if reasonable space exists under doors to allow supplied air to escape. It is good practice to place returns at points where uncomfortable temperatures may collect. Low levels to pull cold air from floors and high levels to pull hot air from ceilings.

**Why no bypass, LAT, or HPT sensors?**

Not only does the Ion™ Zoning System not need a bypass, but a bypass must not be used. Ion™ System compatible indoor equipment have both full-feature variable-speed blowers and modulating dampers. ICP patented algorithms are used to:

- Maintain a safe airflow through the equipment to prevent coil freezing, limit trips, and uncomfortable leaving air temperatures

- Limit maximum airflow into each zone to prevent excessive air noise
- Simultaneously satisfy the setpoint demands of all the zones

At initial power up and daily thereafter (at user selected time, or 1 pm every day by default), the system measures the size of each zone duct and learns the maximum cfm capacity of each zone based on its size and an installer set noise limit. This feature is called Automatic Duct Assessment. The Ion™ System also calculates the minimum cfm required to maintain equipment safety at all times. The Ion™ Zoning System knows the actual cfm being delivered to each zone at all times. Combining these, it positions all dampers to optimally meet the three requirements above. If all three above conditions cannot be simultaneously met by the system, then the system will invoke a patented dynamic algorithm sequence. This includes using the variable speed blower to reduce total system airflow to a safe minimum, cracking open the zone dampers in a controlled manner to bleed excess air first into unoccupied zones and then into setback zones while preventing over-conditioning of these zones. Ion™ System does not require a leaving air temperature sensor primarily because there is no bypassed air to affect leaving air temperature. Minimum airflow is always maintained through the system to guarantee system acceptable leaving air temperatures to aid in preventing limit trips. Typical zoning systems with conventional blowers require LAT monitoring for the following reasons:

- The bypass dumps too much conditioned air back into the equipment return causing excessive leaving air temperature.
- System air flow cannot be maintained due to high static pressure, and low air flow can cause excessive LAT.

If the indoor air blower contained with the Ion™ System indoor section cannot deliver the required cfm, it signals the Ion™ System Control, which responds to reduce the static pressure.

### Equipment sizing

When selecting heating and cooling equipment sizes, use the same rules as for un-zoned equipment. In general, do not oversize or undersize equipment due to zoning.

### Airflow and temperature control

The Ion™ System measures the actual temperature in each zone to 1/16 degree Fahrenheit and responds to these very small changes. The system continually calculates how far each zone is away from its setpoint to an accuracy of 1/16 degree. Most other zoning systems only know whether a zone is above or below its setpoint but not how far off it is from setpoint or how long it has been away from setpoint. The Ion™ System uses a proportional-integral (PI) algorithm to maintain zone temperatures. Ion™ Zoning System dampers continuously modulate to any position between fully open and closed rather than only being just open or closed. With these unique capabilities, the patented algorithms have been designed to simultaneously keep all zone temperatures within 1/2 degree Fahrenheit of their setpoints, for either the heating or cooling modes. The following is a list of exceptions that can cause the zones to **not** maintain temperature setpoints:

- When the equipment runs out of capacity to carry the total load.
- Zones in close proximity to each other cannot be made to hold significantly different temperatures, even with dampers fully open or closed.
- A setback temperature in a zone that is too high in cooling or too low in heating when the rest of the zones have comfort settings.
- When the installer, using the Ion™ System Control service screens, sets the zone to a low air flow limit to maintain very low noise levels. (Example: A zone set to low airflow may not be able to reach comfort setpoints.)

### Zoning duct assessment

The duct assessment time is selectable to any hour of the day or night. The duct assessment will take approximately 1-1/2 minutes per zone to complete. The system will first open all zones and drive the blower to 175 cfm/ton of cooling (or the minimum indoor unit's airflow, whichever is greater). It will then take a static pressure measurement. The system will then close all zones and open one zone at a time, taking a static pressure measurement for each zone. The system will then close all zones and take a pressure measurement, getting a value for the duct leakage up to and through the dampers. With these static pressure measurements, the system will calculate the relative size of each zone as well as the percent leakage through the dampers.

### Blower Cutback

Blower cutback is a feature in the Ion™ System Control that is designed to protect the indoor unit from extremely high static pressure situations. The process begins when the indoor blower motor sets a cutback "flag" which tells the system control that the RPM is at the maximum allowed by the motor. This is typically around 1300 RPM.

### Zoned System Cutback

When the motor sets a cutback flag, the requested cfm begins to back down in 50 cfm increments. This will be seen in the furnace or fan coil Status screens. The cfm request is reduced until either the indoor motor removes the cutback flag (RPM is sufficiently reduced), or the airflow request is at the minimum allowed. If minimum airflow is requested before the cutback flag is removed, the system will attempt to dump air using the same method as Airflow Limiting (stage down, dump to unoccupied zones, adjust setpoints etc.). If the cutback flag is still active after dumping, the system will shut down and set an EXCESS STATIC PRESSURE fault in the Last 10 System Events. The system will start again when more zones call for conditioning, and airflow restrictions no longer exist. UNKNOWN will be displayed for Static Pressure while blower cutback is active.

### Zoned System Staging – Normal Operation

Each zone's temperature is continually measured to within 1/16 degree. When any zone's demand is greater than 0.8 degree or the average of all zone demands is greater than 0.5 degree, the equipment is turned on or staged up one stage if it is already on. When the average demand of all zones is zero, the equipment turns off or stages down. This provides temperature control in all controlled zones within less than one degree of setpoint. Note that when a damper is closed, its zone is satisfied. If other zones still have demands, the equipment will continue to run and this closed zone may become over conditioned due to

air crossing over from other zones. Under these conditions, zone temperatures cannot be controlled accurately in the affected zones.

### **Zoning Airflow Limits and Equipment Protection**

The maximum airflow allowed into a zone is based on the relative size of the zone determined by the duct assessment, and the airflow limits selected for each zone. Airflow limits are set to high as factory default. The following equation shows how a zone's maximum airflow is determined. The default airflow limit of high is 2.0, or 200%.  $(450 \text{ cfm})(\# \text{ nominal tons})(\text{airflow limit})(\text{Zone \%} + \text{leak \%})$

Example: if a zone is determined to be 25% of the entire system and the leakage is 15% with a 5 ton condenser and a 100-20 furnace. Use the greater of  $(450) \times (5) = 2250$  or high heat airflow which, in this case, is 1510 cfm. If the condenser was a 3 ton,  $450 \times 3 = 1350$ , and high heat airflow would be used instead.

$450 \times 5 \times 2.0 \times (.25 + .15) = 1800 \text{ cfm}$ . This airflow multiplier limit can be adjusted to reduce or increase allowable noise levels; Low = 100%, Med = 150%, High = 200%, Max = 210%

If the system determines that with the selected airflow limit, the allowable airflow into a zone is not sufficient for the equipment to operate correctly, and that zone has a call for conditioning, the system will take the following 4 steps:

1. Reduce airflow if possible
  - a. Minimum of 275 cfm per ton minimum in high stage cooling (325 if Dehum airflow set to High). 175 cfm per ton in low stage cooling. (225 if Dehum airflow set to High)
  - b. Comfort Heat airflow is minimum for heat pump heating  $(3.5 \times \text{outdoor temp} + 137) \text{ cfm / ton}$
  - c. Use heat pump comfort airflow as minimum if AC airflow is efficiency or MAX
  - d. No adjustment for furnace heating
2. Dump air to zones set to Unoccupied
  - a. Unoccupied zones may be conditioned up to the most conditioned setpoint.
3. Dump air to zones with less conditioned setpoints
  - a. Zones with less conditioned setpoints may be conditioned to within 3 deg of the most conditioned setpoint.
  - b. Increase or decrease all zones an additional 0.75 deg
4. Stage down equipment
  - a. Equipment will stage down or shut off if necessary
  - b. Last 10 System Events will record an AIRFLOW LIMITED event
  - c. If shut down occurs, other zones need to call before equipment will resume operation

### **Minimum Equipment Airflows in Zoned Systems**

NOTE: The Ion™ System Control displays the CFM corresponding to the selected airflow limit. No manual calculation is required to determine airflow.

When airflow limits are set to Max, the maximum airflow allowed into a particular zone is 210% of the assessed airflow for that zone. Example: If a zone size is determined to be 25% of the entire system, the leakage is 15% and the maximum airflow is 2250  $\Rightarrow [(450)(5)]$ . Airflow into this zone is  $450 \times 5 \times 1.5 \times (.25 + .15) = 1350 \text{ cfm}$ . Minimum airflow for a t ton system in high stage is  $275 \text{ cfm / ton} = 1375 \text{ cfm}$ .

The zoning system uses the chart below to determine the minimum airflow that must be achievable before the system will turn on or continue to run. Using the previous example, in cooling, a 2-stage, 5-ton system's minimum airflow per the chart is 275 cfm / ton (1375 cfm). The maximum airflow allowed into a zone set to MAX airflow limit is 1050 cfm. The system will not turn on in high stage because this is below the minimum airflow required for high stage. The minimum airflow for low stage is 175 cfm / ton (875 cfm). The system will turn on in low stage and attempt to run full low stage airflow. This will depend on the type of outdoor unit installed and the current humidity demand. A typical 2-stage Bristol compressor system will run about 220 cfm / ton when set to efficiency low stage airflow which is 1100 cfm for a 5 ton. This is slightly higher than maximum allowed into the zone, but well above the minimum for reliable operation. The system will turn on in low stage and reduce the airflow to 1050 cfm which is the maximum airflow allowed into that zone set at MAX airflow limit. If the zone is very restrictive the system will attempt to dump air into other zones per the steps shown in the Airflow Limits and Equipment Protection section above (beginning with step 2 since this is already the minimum airflow). If all steps are unsuccessful, the system will shut down and register an EXCESS STATIC PRESSURE event in the last 10 system events.

### **Unoccupied zones / Setback zones**

If any zones within the building will not be occupied, it is highly desirable to put the zone into the Away Activity setting. The Away temperature settings for a particular zone can be set in the Comfort Profiles menu, independent of other zones. Away can be permanently set for a zone by selecting the Hold time period in the Activity settings. It can also be programmed for a certain period within the Scheduling menu.

Unoccupied zones may be used by the system as a dump zone. If the system determines that it will supply too much air into the zones with demand, it will open the unoccupied zone's damper until the unoccupied zone's temperature is equal to the most demanding zone's set temp. Once the Unoccupied zone's temperature reaches the most demanding zone's set temp, dumping of air will stop and the Unoccupied zone's damper will close. The system will then start to dump into zones that are setback farther than three degrees from the demanding zone. If the setback zone's temperature is within three degrees of the most demanding zone, then dumping of air will stop and the system will stage down equipment, or even turn off.

The use of Unoccupied zones can help the system run longer, and can help satisfy demanding zones that are too small to run by themselves.

| APPLICATION                           | MINIMUM AIR FLOW PER ZONE TO KEEP SYSTEM RUNNING |                     |                                                                                                                  |
|---------------------------------------|--------------------------------------------------|---------------------|------------------------------------------------------------------------------------------------------------------|
|                                       | COOLING                                          |                     | HEATING                                                                                                          |
|                                       | HIGH STAGE / SINGLE STAGE                        | LOW STAGE           |                                                                                                                  |
| Furnace + Air Conditioner             | 275 / 325 cfm / ton                              | –                   | Low Stage furnace Airflow                                                                                        |
| Dual Fuel                             | 275 / 325 cfm / ton                              | 175 / 225 cfm / ton | Above heat pump Lockout: Comfort heat pump Heating Airflow<br>Below heat pump Lockout: Low Stage furnace Airflow |
| Heat Pump + Fan Coil + Electric Heat  | 275 / 325 cfm / ton                              | 175 / 225 cfm / ton | Comfort heat pump Heating Airflow or Efficiency heat pump airflow depending on airflow setting                   |
| Furnace Only                          | –                                                | –                   | Low Stage furnace Airflow                                                                                        |
| Heat Pump + Fan Coil + Hot Water Coil | 275 / 325 cfm / ton                              | 175 / 225 cfm / ton | Comfort heat pump Heating airflow or Efficiency heat pump Airflow depending on airflow setting                   |
| Fan Coil + Hot Water Coil             | 275 / 325 cfm / ton                              | 175 / 225 cfm / ton | Hot Water heating selected airflow                                                                               |

### Airflow summary

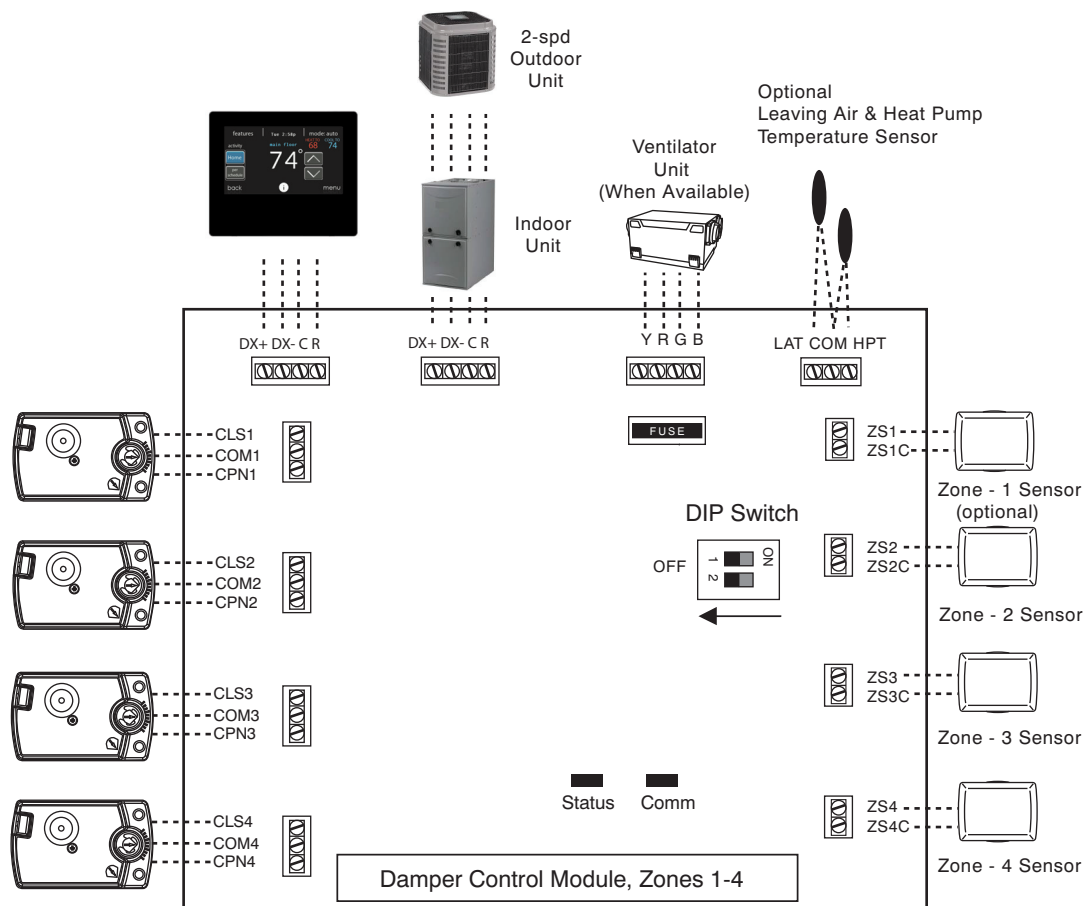
The variable speed blower and the damper control algorithms work in conjunction to automatically maintain safe airflow levels through the equipment under all conditions. Also, the airflow into any zone is limited to a maximum value. This value is set (Low, Medium High, Maximum) for each zone by the installer in the Ion™ System Control install/service screens. The default factory setting is "HIGH". The higher this setting, the more air can be delivered into a zone. Unoccupied zones are used in a controlled manner to receive excess air when needed. In a system where there are many zones of different sizes and loads, ducts that are small or when there is evidence of zones not meeting setpoints, the installer's remedy is to:

- Create unoccupied zones within the system
- Increase zone airflow limits in problem zones.

## PERFORMING THE INSTALLATION

### Review the wiring diagram

The drawing below shows the Damper Control Module and all of its connection points. Please consult Ion™ Damper Control Module and Ion™ System Control installation instructions for in-depth installation, sequence of operations and troubleshooting information.



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Please refer to current Product Data and Price Pages for a complete list of part numbers and options.

## Install and wire

Follow the Installation Instructions supplied with the Zone Control, Smart Sensors (if available), Remote Room Sensors, Damper Control, and Dampers to do the physical installation. Because of its low power usage, no separate transformer is needed (ONLY 5 Zone dampers per Zone). Mark each Damper and Remote Room Sensor wire at the Damper Control end so they do not become mixed up. Any connection format for the communications bus is acceptable: home run, t-taps, daisy chain or multi drop loop. When installing more than one wire under a terminal, twist the wires together to ensure proper contact in the communications terminal block. Seal behind the Zone Control and any Smart Sensors or RRS's to prevent air currents within walls from affecting temperature readings. If you have more than 4 zones a second Ion™ Damper Control Module is necessary. Wire the communications connection to the first Ion™ Damper Control Module and turn the dip switch setting on the second Ion™ Damper Control Module to the ON position.

## Powering up

At power up, the system will proceed through its normal auto configuration process, finding and adapting itself to the indoor and outdoor units. All zones with Remote Room Sensors will automatically be learned. Zones with Smart Sensors will need to have zone numbers entered at each Smart Sensor. The Ion™ System Control will inform you of this if needed. Use Smart Sensor Installation Instructions to set zone numbers. An Ion™ Zoning System can have a mix of Remote Room Sensors or Smart Sensors.

**NOTE: If the communicating indoor unit is NOT compatible with Ion™ Zoning, the discovery of the zoning system will be skipped. See the notes at the beginning of this document, and the Ion™ System Control Product Data.**

## Startup and automatic duct assessment

The system performs an initial startup automatic duct assessment that can take up to 6 minutes to complete. The blower is run at a constant low airflow of 175 cfm per ton (equipment is off) with all ducts closed (to measure leakage), then with each zone individually opened, and finally with all zones open. In each case the static pressure is measured using a patented proprietary algorithm based on the speed of the blower motor and other characteristics. From these static pressure measurements, the system computes the relative capacities of each zone's ducts. This assessment is automatically repeated at 1:00 pm, or the alternatively selected time, each day to adjust for changes in the duct system due to blockage of registers and filter usage.

**NOTE:** The damper leakage measured is the air leakage up to and through the closed dampers. It does not measure duct leakage after the dampers.

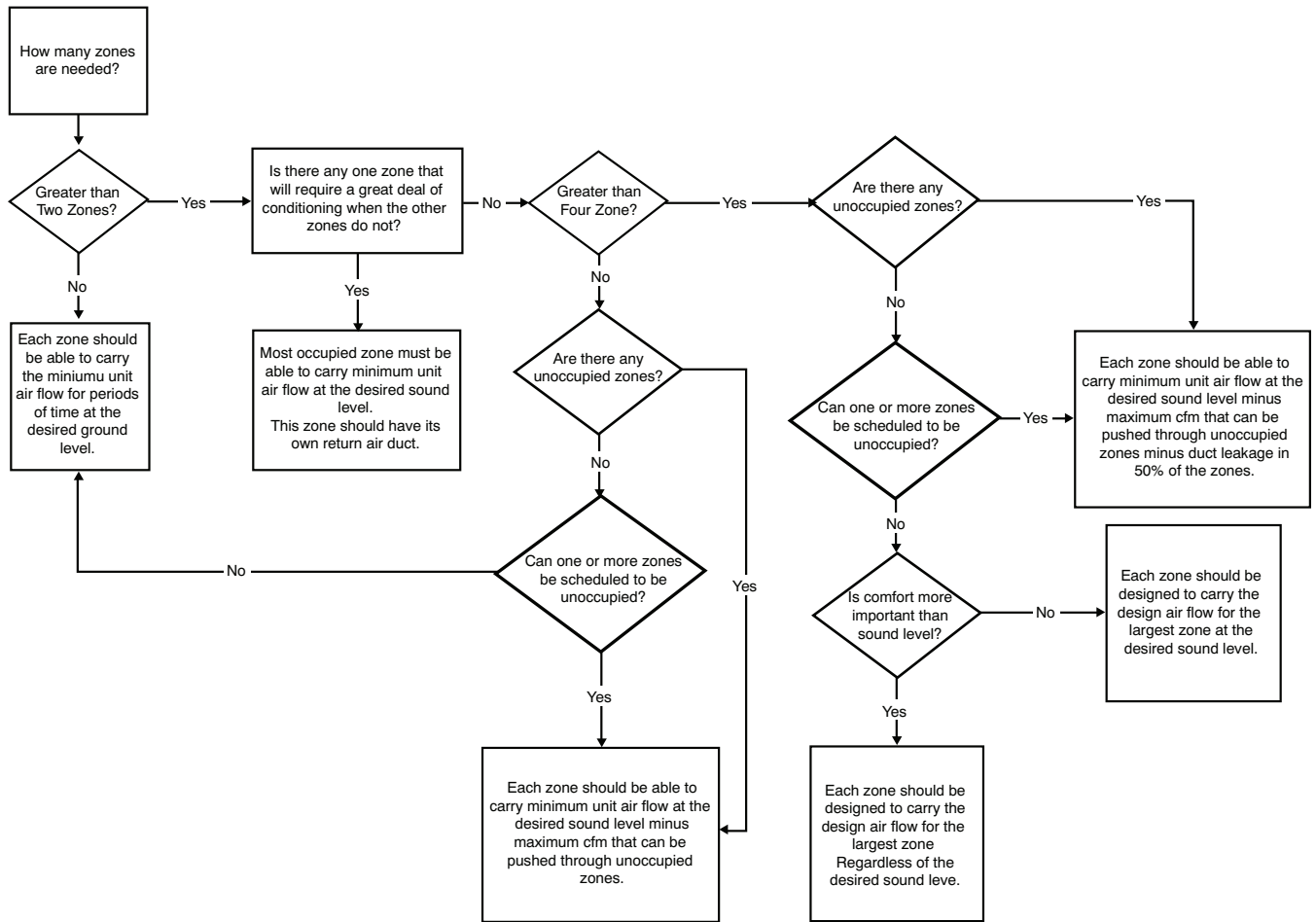
The system automatically adjusts the algorithms to account for the measured leakage. At the end of this automatic process, the Ion™ Zoning System shows you the exact cfm capabilities of each zone and the air leakage (cfm) in the system. The system is then ready to operate.

Once the installation has been completed, the installer should navigate to the Installation & Service screen, then to Checkout, and to Zoning, Airflow Limits. Under Airflow Limits, the installer can set the airflow noise limits for each zone. Touching the Start button will command the indoor unit to run the blower at the CFM displayed for the selected airflow limit. Choose the highest airflow limit (CFM) without causing objectionable air noise. If there is too much air noise, select a lower airflow limit. The system will operate at or below the selected limits for each of the zones.

**Brief summary / Check List**

|                          |                                                                                  |
|--------------------------|----------------------------------------------------------------------------------|
| <input type="checkbox"/> | 1. Heat loss/gain                                                                |
| <input type="checkbox"/> | 2. cfm per room                                                                  |
| <input type="checkbox"/> | 3. Select equipment                                                              |
| <input type="checkbox"/> | a. With variable speed pay close attention to high heat cfm vs. high cooling cfm |
| <input type="checkbox"/> | b. Use the equipment Product Data to determine cfm                               |
| <input type="checkbox"/> | 4. Calculate equivalent length of longest duct runs                              |
| <input type="checkbox"/> | a. Use duct fittings that have low equivalent lengths                            |
| <input type="checkbox"/> | 5. Calculate duct system Friction Rate                                           |
| <input type="checkbox"/> | a. Pressure drops                                                                |
| <input type="checkbox"/> | – Wet evaporator coils                                                           |
| <input type="checkbox"/> | – Supply outlet                                                                  |
| <input type="checkbox"/> | – Return grille                                                                  |
| <input type="checkbox"/> | – Balancing dampers                                                              |
| <input type="checkbox"/> | – Any accessories                                                                |
| <input type="checkbox"/> | (a) Humidifiers                                                                  |
| <input type="checkbox"/> | (b) Electronic air cleaner                                                       |
| <input type="checkbox"/> | (c) Pleated filters                                                              |
| <input type="checkbox"/> | (d) High efficiency filters                                                      |
| <input type="checkbox"/> | 6. Design Duct System using the Friction Rate calculated in step 5.              |

## System Design Parameter Decisions



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