SmartZone 2X/4X
Zone Controllers

System Manual

v 1.0

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This manual is a supplement to be used with the SmartZone 2X and 4X Install Guides. For additional technical assistance go to www.ecojay.com or call the ECOJAY Technical support line at 888-523-3265.

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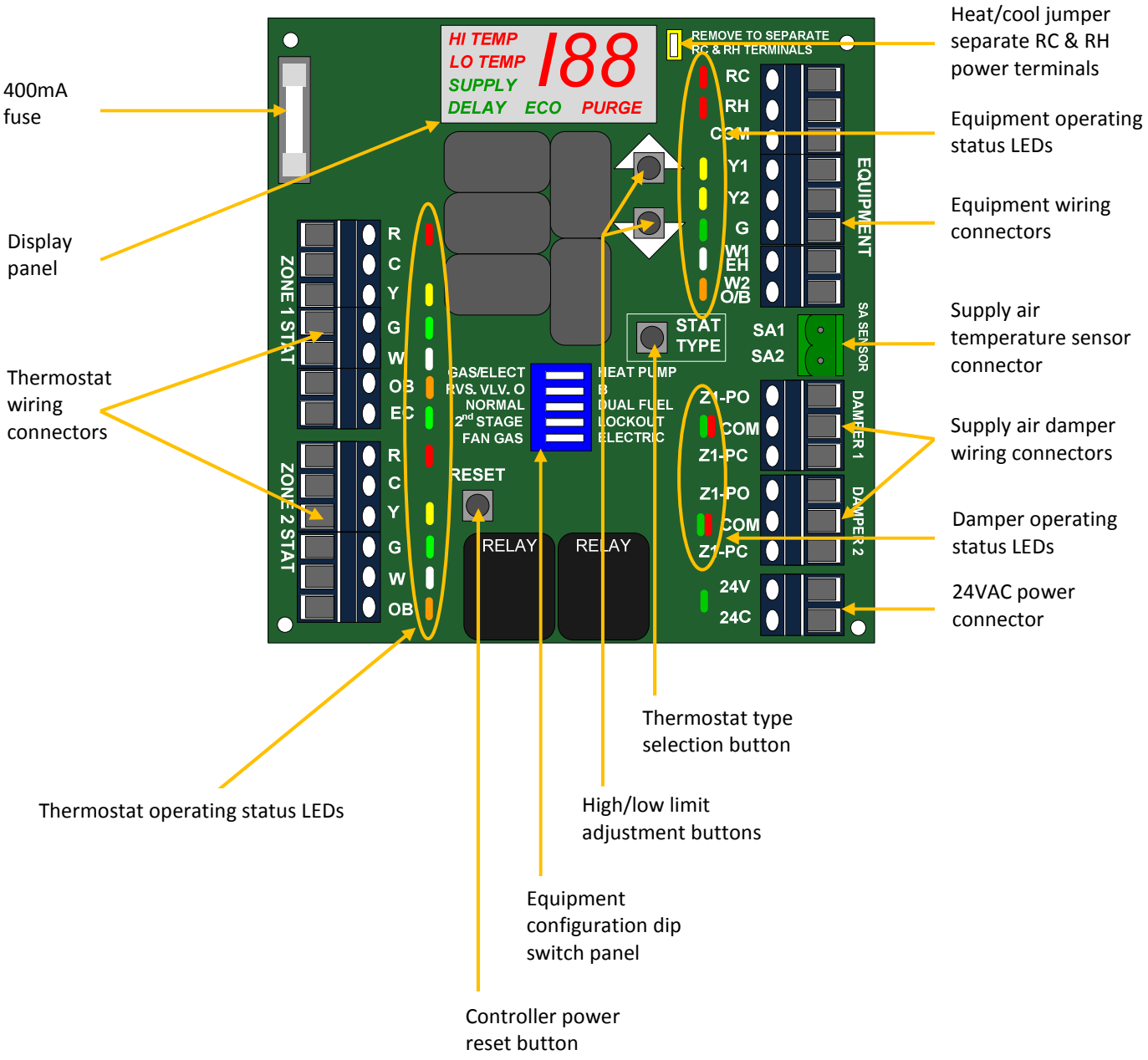
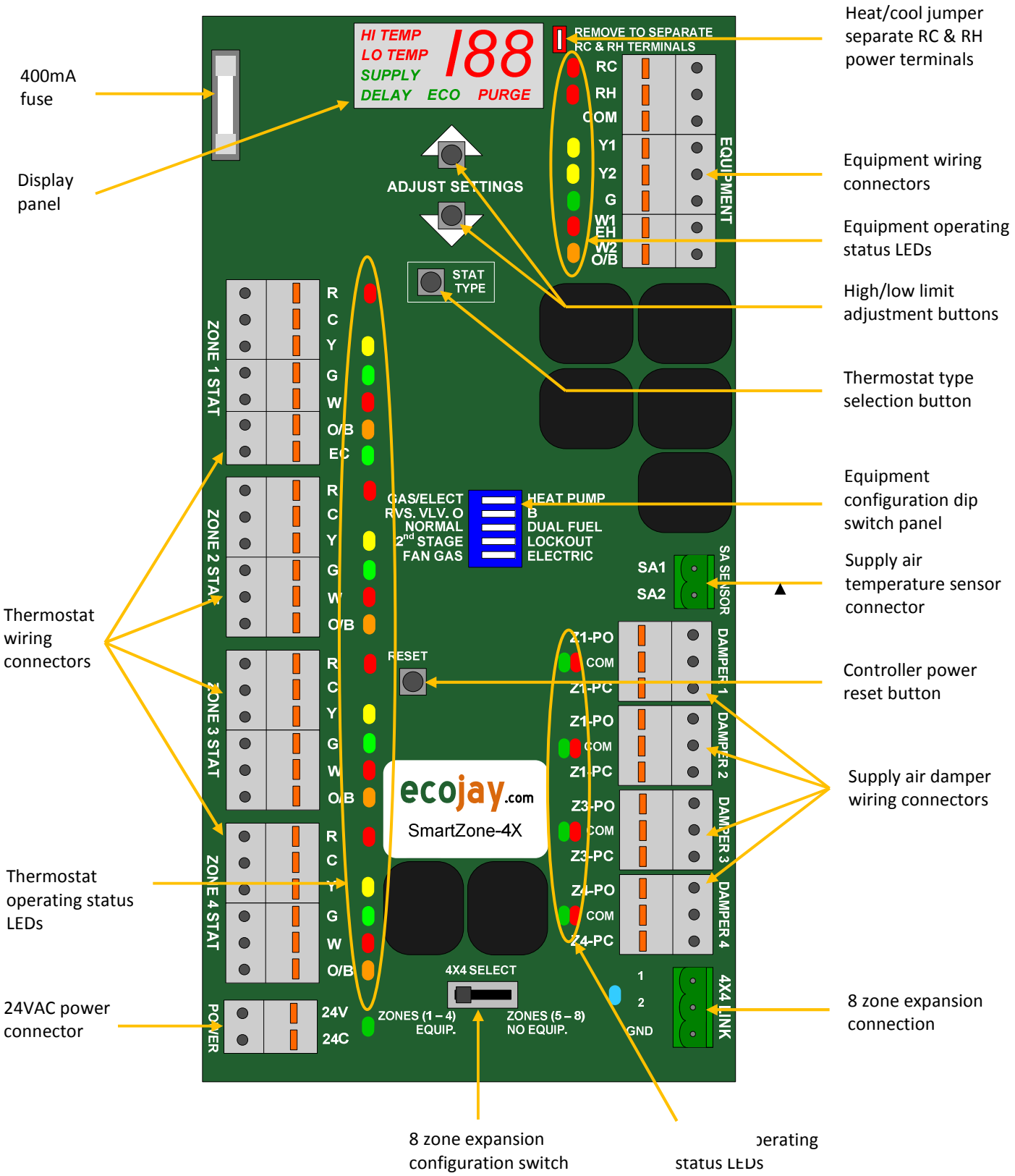
ZS2X



SmartZone 4X (Four Zone Panel)
ZS4X



Bolded and ***italicized*** text are used to indicate terms that are listed and defined in the glossary found at the end of this manual.

NOTE: This manual reflects features and zone controller operations for firmware version 3E and hardware version 1.2. The firmware version will be displayed for 2 seconds on the SmartZone controller display panel during power up. The hardware version is imprinted on the from front bottom left-corner of the zone controller.

General Sequence of Operation

Thermostat Call Registration

The zone controller must register a zone thermostat call for heat or cool before it is able to determine the appropriate actions to be performed. A zone thermostat's call is registered if the 'Y' (yellow), 'G' (green) or 'W' (red) LED is illuminated on the corresponding zone connector located on the zone controller. Registered zone thermostat calls are passed to Call Management for determining further action. When a thermostat satisfies and de-energizes 'Y', 'G' or 'W' the corresponding LED on the zone connector is turned off and the call is dropped from Call Management.

NOTE: To avoid continuous fan operation and unnecessary energy usage, set all zone thermostats' fan switch to 'AUTO'.

Call Management

The ECOJAY call management firmware dynamically evaluates and adjusts the zone controller's actions for equipment and zone damper operation. The actions taken are affected by changing equipment operating conditions and as individual zone thermostats initiate and satisfy calls. Call management is responsible for operating the HVAC equipment in a manner that efficiently, effectively and safely maintains occupant comfort.

Call Management evaluates zone thermostat calls based on the following rules and takes the actions described for each.

If the equipment is not energized and the only calls are requesting compressor operation:

- The compressor is energized and corresponding calling zone dampers remain open when the 3 minute ***short cycle timer*** has elapsed. All non-calling or opposing mode zone dampers will be closed.
- The equipment is de-energized when the 15 minute ***opposing mode timer*** elapses, or if no opposing calls exist, when all zone thermostat calls are satisfied, whichever comes first.
- The 3 minute ***short cycle timer*** is reset and restarted when a compressor ('Y') call on the equipment connector is de-energized.

If the equipment is not energized and no other calls or only heat calls (non-heat pump) are pending:

- The heating system is energized and dampers for the corresponding calling zones are opened.
- The equipment is de-energized when the 15 minute ***opposing mode timer*** elapses, or if no opposing calls exist, when all zone thermostat calls are satisfied, whichever comes first.

If the equipment is energized in the same mode as the mode call by the zone thermostat:

- The corresponding zone dampers are opened and their LEDs illuminated green.
- The equipment is de-energized when the 15 minute ***opposing mode timer*** elapses, or if no opposing calls exist, when all zone thermostat calls are satisfied, whichever comes first.

If the zone controller has a mix of heating and cooling (opposing) calls from zone thermostats:

- Zone dampers are opened and their corresponding LEDs are illuminated green for those zones with ***active mode*** calls.
- Zone dampers are closed and their corresponding LEDs are illuminated red for those zones with ***opposing mode*** or no pending calls.
- After 15 minutes of run-time the equipment is de-energized and the fan ('G') remains energized for 3 minutes to purge temperature from the supply air plenum. After the 3 minute purge is complete, the 15 minute ***opposing mode timer*** is reset and restarted, and the equipment is

energized in the previously ***opposing mode*** (which now becomes the ***active mode***). Active mode zone dampers are opened and opposing mode dampers are closed with their corresponding LEDs illuminated green and red respectively. This mode switching process for managing opposing calls will continue indefinitely until all calls are satisfied or all remaining calls are for the same mode (heat or cool).

- The equipment is de-energized when the 15 minute ***opposing mode timer*** elapses, or if no opposing calls exist, the equipment will remain energized until all zone thermostat calls are satisfied, whichever comes first.

Staging Control

General Staging Operations

NOTE: SmartZone controllers require only single stage thermostats as on-board dynamic staging controls operate the staging sequences.

SmartZone uses time and supply air temperature to dynamically match equipment capacity to load with 2heat/2cool stages for gas/electric systems and 3heat/2cool stages for heat pump systems with auxiliary heat. Staging parameters will vary based on the type of equipment configured on the zone controller. Refer to the following sections for specific staging rules applicable to the equipment in use.

The following equipment connectors are used to connect to the equipment for staging purposes.

Equipment Connector	
Y1	Stage 1 for Compressor
Y2	Stage 2 for Compressor
W1	Stage 1 for heating system; Auxiliary heat (electric or dual fuel for heat pump)
W2	Stage 2 for heating system

Equipment with single stage capability only must use 'Y1' (compressor) and 'W1' (gas/electric furnace; auxiliary heat for heat pump) equipment connectors on the zone controller.

Gas/Electric Equipment Staging

Cooling Stage 1 – energized when a cool call is received or the controller is in changeover from heat to cool.

Cooling Stage 2 – energized after 8 minutes of continuous compressor run time when the difference between the supply air LOW TEMP cutout setting and supply air temperature is greater than 10^{O}F. Stage 2 will be de-energized when the difference between the supply air LOW TEMP cutout setting and supply air temperature is less than 4^{O}F. NOTE: The 3 minute short cycle timer will lockout 2nd stage until the short cycle timer has elapsed.

Heating Stage 1 – energized when a heat call is received or the controller is in changeover from cool to heat.

Heating Stage 2 - energized after 8 minutes of continuous heating system run time if the difference between the supply air HIGH TEMP cutout setting and supply air temperature is greater than 25^{O}F. Stage 2 will be de-energized when the difference between the supply air HIGH TEMP cutout setting and supply air temperature is less than 10^{O}F.

Heat Pump Equipment (w/electric aux heat) Staging

Cooling Stage 1 – energized when a cool call is received or the controller is in changeover from heat to cool.

Cooling Stage 2 – energized after 8 minutes of continuous compressor run time when the difference between the supply air LOW TEMP cutout setting and supply air temperature is greater than 10^{O}F. Stage 2 is de-energized when the difference between the supply air LOW TEMP cutout setting and supply air temperature is less than 4^{O}F.

NOTE: The 3 minute short cycle timer will lockout 2nd stage until the short cycle timer has elapsed.

Heating Stage 1 – energized when a heat call is received or the controller is in changeover from cool to heat.

Heating Stage 2 - energized after 4 minutes of continuous compressor run time if the difference between the supply air HIGH TEMP cutout setting and supply air temperature is greater than 15^{O}F. Stage 2 is de-energized when the difference between the supply air HIGH TEMP cutout setting and supply air temperature is less than 5^{O}F.

Aux Heat (Stage 3) - energized after 6 minutes of continuous compressor run time if the supply air temperature is less than 90^{O}F. Aux heat is de-energized when the supply air temperature is greater than 100^{O}F.

Emergency Heat – calls for emergency heat can only be initiated from a heat pump thermostat connected to the 'W' connector on zone 1. The controller is latched in emergency heat on 'W1' and 'G' until the EH call is removed from the zone 1 thermostat. The compressor is de-energized during a call for emergency heat. **NOTE: A call for any mode (other than emergency heat) must be energized from the zone 1 thermostat to unlatch emergency heat mode on the controller before the controller will be able to resume normal operation.**

Heat Pump Equipment (w/Dual Fuel) Staging

Cooling Stage 1 – energize stage 1 when a cool call is received or the controller is in changeover from heat to cool.

Cooling Stage 2 – energize stage 2 after 8 minutes of continuous compressor run time when the difference between the supply air LOW TEMP cutout setting and supply air temperature is greater than 10^{O}F. Stage 2 is de-energized when the difference between the supply air LOW TEMP cutout setting and supply air temperature is less than 4^{O}F. NOTE: The 3 minute short cycle timer will lockout 2nd stage until the short cycle timer has elapsed.

Heating Stage 1 – energize stage 1 heat when a heat call is received or the controller is in changeover from cool to heat.

Heating Stage 2 - energize stage 2 after 4 minutes of continuous compressor run time if the difference between the supply air HIGH TEMP cutout setting and supply air temperature is greater than 15^{O}F. Stage 2 is de-energized when the difference between the supply air HIGH TEMP cutout setting and supply air temperature is less than 5^{O}F.

Aux Heat (gas) – energize the gas heating system (W1) and de-energize the compressor after 6 minutes of continuous compressor run time if the supply air temperature is less than 90^{O}F. Aux heat (W1) will remain energized until all heating calls are satisfied or at changeover when the 15 minute ***opposing mode timer*** elapses (see Opposing Call Control).

Emergency Heat - calls for emergency heat can only be initiated from a heat pump thermostat connected to zone 1. Controller is latched in emergency heat on 'W1' and 'G' until the EH call is removed from the zone 1 thermostat. The compressor is de-energized during a call for emergency heat. NOTE: A call for heat or cool (other than emergency heat) must be energized from the zone 1 thermostat to unlatch emergency heat mode on the controller before the controller will be able to resume normal operation.

Zone Damper Control

LED Operation

- Damper LEDs are always illuminated – GREEN (open); RED (close).

Conditions for Opening Zone Damper

- Zone dampers are opened for those zones calling for the ***active mode*** registered on the equipment connector.

NOTE: In situations where the zone controller is configured for gas/electric stats on heat pump equipment, the illuminated equipment connector LEDs will differ from the LEDs illuminated on the zone thermostat connectors calling for the same mode. For example, a heat call on a gas/electric stat will illuminate W1 and G, and a heat pump equipment call will illuminate Y1 and G.

- All zone dampers are opened when no calls are registered on the controller.
- During PURGE, dampers are opened on all zones making calls corresponding to the ***active mode***. This applies also to zones that are satisfied but their last call was for the ***active mode***.

Conditions for Closing Zone Damper

- Zone dampers are closed for all zones with pending calls that do not match the ***active mode.***
- Zone dampers are closed for all zones that are satisfied. Note: Dampers for non-calling zones that last called for the ***active mode*** will be opened during PURGE.

Fan Control

Thermostat fan switch control

- Setting any zone thermostat FAN SWITCH to 'ON' will energize the fan until the switch is set to 'OFF' or 'AUTO'. NOTE: To avoid unnecessary energy usage all zone thermostats FAN SWITCH should be set to 'AUTO'.

Gas vs. electric heating system

- The fan will energize 45 seconds after a heat call is energized if the controller is configured for gas heating system (set DIP switch #5 to FAN GAS).
- The fan will energize immediately when a heat call is energized if the controller is configured for electric heating system (set DIP switch #5 to ELECTRIC).

Purge

- Fan is energized after the 15 minute ***opposing mode timer*** elapses and the controller is beginning ***changeover*** to the ***opposing mode***. During ***purge*** the fan is energized for 3 minutes.
- During PURGE, dampers are opened on all zones making calls corresponding to the ***active mode***. This applies also to zones that are satisfied but their last call was for the ***active mode***.

Delay

- Fan is not energized during delay.

Economy Mode

Benefit

The SmartZone Economy Mode offers end users increased flexibility in their efforts to reduce the energy consumed in the heating and cooling of their home or office by providing the capability to switch in or out of Economy Mode.

When Economy Mode is active, only the zone 1 thermostat is able to make equipment calls for heat and cool. The remaining zones will not be able to make calls to the equipment, but will open or close their dampers to take advantage of the ***active mode*** running on the equipment and energized by the zone 1 thermostat.

Application

Devices such as occupancy sensors, wall switches or timers can be used to control the Economy Mode feature based on the application requirements. Refer to the 2X or 4X Install Guides for information on wiring and installation.

Opposing Call Control

Opposing call control involves the management of heating and cooling calls that are registered on the zone controller simultaneously.

Opposing Call Timer

- SmartZone 2X and 4X Zone controllers initiate a fixed 15 minute ***opposing mode timer*** that limits the maximum run time in the ***active mode*** to 15 minutes when opposing calls are registered on the zone controller. The opposing mode timer is initiated when the first ***opposing mode*** call is registered.

Changeover

- Purge energizes the fan to reduce the supply air temperature differential when the 15 minute ***opposing mode timer*** elapses and the controller initiates ***changeover*** to the ***opposing mode***. Purge will operate for 3 minutes and will be illuminated on the display panel until complete.

Electronic Limit Control

Temperature limit controls are designed to shut off the compressor or heating system when supply air temperatures are outside temperature limit control ranges. The temperature cutout limits are factory preset and are field adjustable to accommodate specific site conditions.

Temperature Limit Control Operation

- If the supply air temperature (as displayed on the controller display panel) exceeds the cutout temperature, a three minute ***short cycle timer*** is initiated and the compressor or heating system is de-energized.
- Fan will continue to be energized
- When the three minute ***short cycle timer*** expires, the controller will energize the compressor or heating system only if the supply air temperature does not exceed the HI and LO TEMP cutout settings.
- Subject to the minimum three minute ***short cycle timer***, the limit controls will continue cycling the compressor or heating system until all calls are satisfied or the ***opposing mode timer*** initiates ***changeover*** to the opposing mode.

Low Temperature Cutout

- Factory default cutout: $< 48^{o}F$
- Adjustment range: $41 – 52^{o}F$

High Temperature Cutout

- Factory default cutout: Heat Pump $> 120^{o}F$; Gas/electric $> 135^{o}F$
- Adjustment range: Heat Pump $110 – 125^{o}F$; Gas/electric $90 – 150^{o}F$

Adjusting Temperature Limit Control Settings

- SmartZone 2X and 4X zone controllers
  1. Press the ↑ or ↓ button respectively for current high or low temp setting.
  2. Continue pressing the ↑ or ↓ button respectively to change the current setting up or down.
  3. When the desired temperature setting is displayed, wait 4 seconds until 'St' is displayed indicating the new setting has been saved.
  4. If configured for heat pump with dual fuel, set dip switch #1 to 'GAS/ELEC' position to set high limit for gas heating system. Dip switch #1 must be in the heat pump position to set high limit for heat pump.

NOTE: Changing temperature limit control settings will alter the staging points for multi-stage equipment. Refer to the section on Staging Controls for additional information.

Equipment Configuration Settings

HVAC Equipment

Gas/Electric

- Set dip switch #1 to 'gas/elect'.
- Set dip switch #5 to 'FAN GAS' for gas heating system; set to 'ELECTRIC' for electric heating system

Heat Pump

- Set dip switch #1 to heat pump (equipment reversing valve LED will illuminate initially at configuration to indicate heat pump is selected)
- Set dip switch #2 to 'O' or 'B' based on the reversing valve operation of the specific manufacturer or equipment used.
- For dual fuel heat pump systems, set dip switch #3 to 'DUAL FUEL'

NOTE: Configuration of dip switch #5 for fan settings is not necessary as the SmartZone controller automatically controls fan operation depending on heat pump equipment configuration and equipment in operation (ie. compressor, electric/gas aux heat).

Thermostats

When using SmartZone on heat pump equipment, the controller allows the option of using less costly gas/electric single stage thermostats. SmartZone will translate the thermostat gas/electric calls to heat pump calls and will also manage multi-stage equipment without multi-stage

thermostats. To configure the use of gas/electric thermostats with heat pump equipment perform the following steps:

- Set dip switch #1 to heat pump.
- Press and release the STAT TYPE SELECT button until the desired zone number is displayed on the display panel (2 zones – 2X; 4 zones – 4X).
- Within 5 seconds after selecting the desired zone number, press the ↓ or ↑ button to select HP (heat pump thermostat type) or GE (gas/electric thermostat type).
- Press the STAT TYPE SELECT button to display the next zone to configure and press the ↓ or ↑ button to select the appropriate thermostat type. Repeat this process until all zones are configured. After 5 seconds elapses from the last button push, the display panel will display 'St' indicating the settings are saved.

8 Zone Expansion (4x4)

Two SmartZone 4X controllers can be easily and quickly connected and configured to create a single zone control system capable of handling up to 8 zones. When configured for 8 zones, one controller will be the primary controller responsible for translating equipment calls from the secondary and primary controller. The secondary controller equipment connectors are not wired to the equipment. The primary controller 4X4 SELECT switch must be set to ZONE (1 – 4) and the secondary controller 4X4 SELECT switch must be set to ZONE (5 – 8). The '4X4 LINK' blue LED will blink when communication is configured on each controller. A solid (non-blinking) blue LED indicates the '4X4 LINK' communication cable or wiring is not installed or wired incorrectly.

NOTE: Configure equipment type on the primary controller. Configure thermostat type on the corresponding zones to each controller.

Appendix 1 – Transformer and Fuse Sizing

Transformer Sizing Worksheet Instructions:

1. List each SmartZone controller used and the quantity of 2 and 3-wire dampers on each.
2. For each controller write in the minimum VA required (2X – 14VA, 4X – 1VA) in column A.
3. For each controller write in the quantity of thermostats, 2-wire and 3-wire dampers to be used. Up to 4 2-wire or 10 3-wire dampers can be powered from each zone damper connector.
4. Multiply the 'Quantity' and 'Total VA' for thermostats, 2-wire and 3-wire dampers for each board and write the result in for each.
5. For each SmartZone controller add Columns A, B, C and D, and write the total in Column E.

Column A		Column B			Column C			Column D			Column E
SmartZone Controllers		Thermostats			Power open/close damper (3-wire)			Spring return damper (2-wire damper)			
Zone Control	Total VA	Qty	VA each	Total VA	Qty	VA each	Total VA	Qty	VA each	Total VA	Minimum VA for each board
2X	10		3			3			10		
4X	14		3			3			10		
			3			3			10		
			3			3			10		

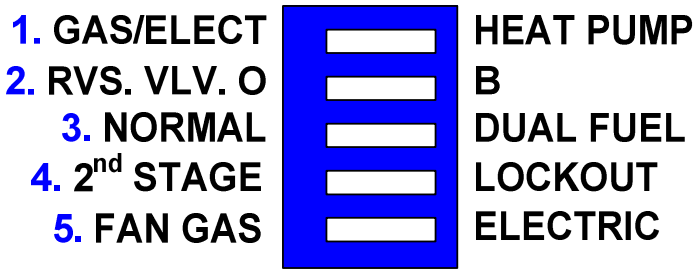
NOTE: To protect the SmartZone Controller(s) from potentially damaging electrical shorts, fusing the transformer(s) powering SmartZone controllers is <u>strongly recommended</u>. The following table should be used to properly size the fuse based on typical transformer VA ratings.

Transformer Fuse Sizing Table

Transformer Size (Voltage Amps)	Fuse Size (Amps) Maximum Recommended
20VA	*1A*
40VA	*2A*
60VA	*2.5A*
75VA	*3A*
100VA	*4A*
150VA	*6A*

NOTE: Exceeding maximum fuse size risks damage to electrical components.

Appendix 2 – Dip Switch Panel



Dip Switch	Switch Position	Function
#1	GAS/ELECT	Standard GE or all electric equipment
	HEAT PUMP	Heat pump equipment
#2	RVS. VLV O	Reversing valve energized in COOLING
	B	Reversing valve energized in HEATING
#3	NORMAL	Operates aux. heat WITH compressor (HP Only)
	DUAL FUEL	Operates aux. heat WITHOUT compressor
#4	2ND STAGE	2nd stage active (normal operation)
	LOCKOUT	2nd stage will not energize if only ONE zone open
#5	FAN GAS	Energizes fan after 45 second delay in heating
	ELECTRIC	Energizes fan immediately with heating

Appendix 3 – Display Panel

Function	Status	Description
HI TEMP	ON	Supply air temperature is exceeding the high limit temperature setting.
	OFF	Supply air temperature is in normal operating temperature range.
LO TEMP	ON	Supply air temperature is below the low limit temperature setting.
	OFF	Supply air temperature is in normal operating temperature range.
SUPPLY	ON	Indicates the digital temperature display is for supply air.
DELAY	ON	Equipment is in short cycle protection mode.
	OFF	Zone controller in normal operating mode.
ECO	ON	Zone controller Economy Mode function is active.
	OFF	Zone controller in normal operating mode.
PURGE	ON	System purging supply air in preparation for changeover. Fan is energized.
	OFF	Purge is not active.
188	ON	3 digit display indicates supply air temperature in Fahrenheit (F).

Glossary

Active mode – the mode of operation (heat or cool) the zone controller equipment LEDs indicate is active on the equipment.

Changeover – the process of changing over from heating to cooling, or cooling to heating.

Opposing mode – pending zone thermostat calls for a mode of operation other than the mode actively running on the equipment.

Opposing mode timer – limits the maximum active mode to 15 minutes run time when opposing calls are registered on the controller.

Short cycle timer – 3 minute delay on break timer to protect equipment.

Purge – process of purging supply air temperature in preparation for ***changeover*** to the ***opposing mode***.