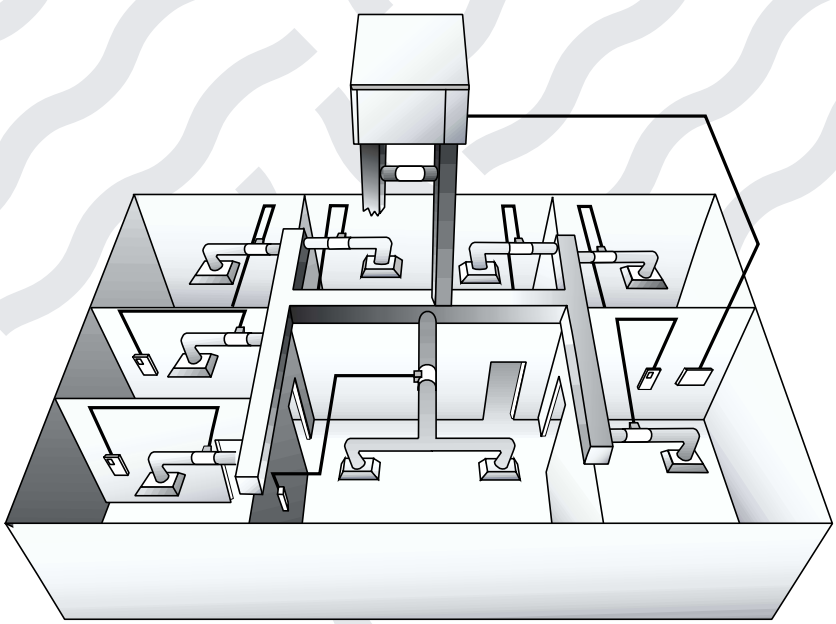
Zonex SYSTEMS

*comfort you control*

## Vote Based Auto Changeover VAV

# Select-Temp

## A Modulating System



## Zoning Systems

That's all we do.

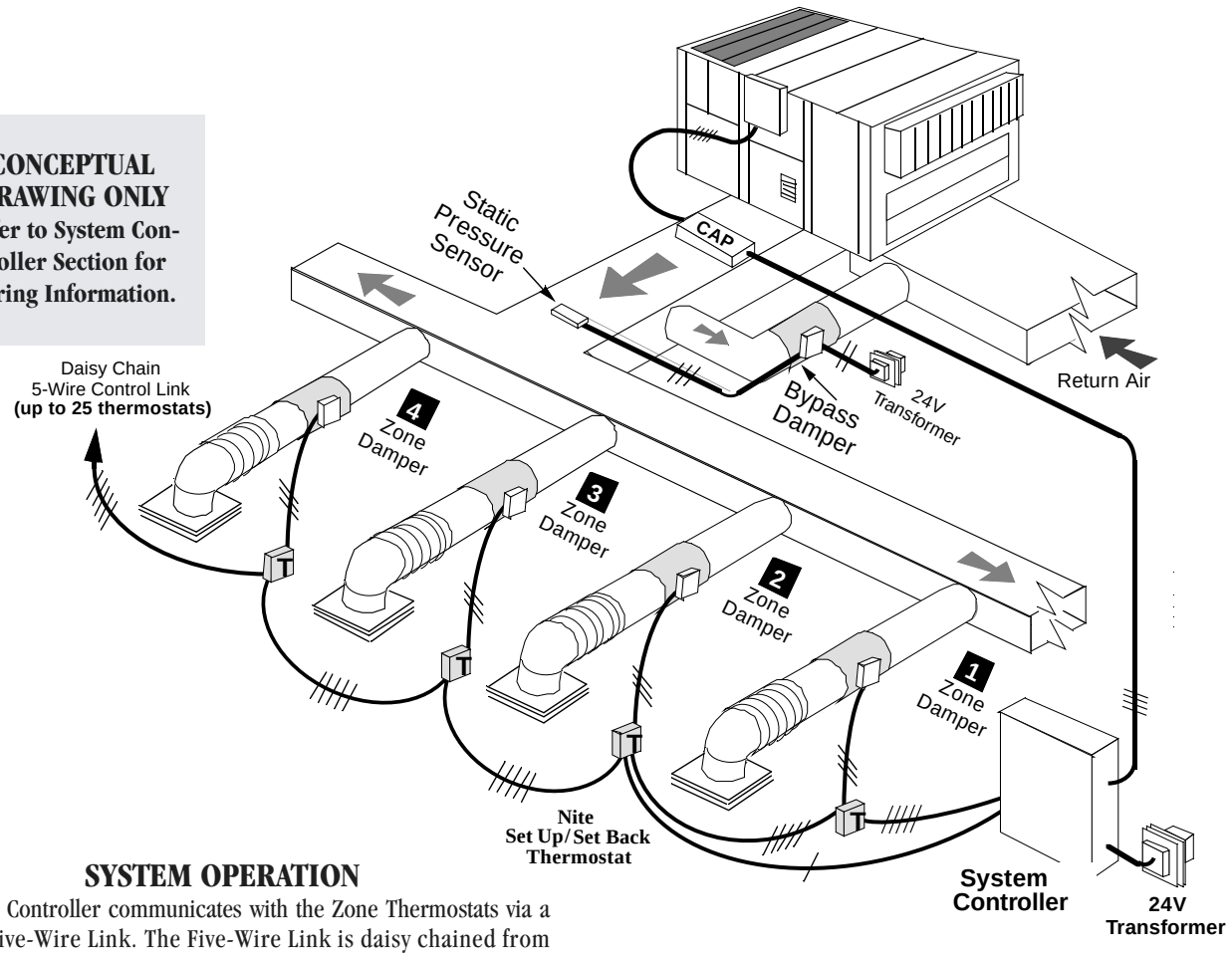
Part #STMAN
Rev. February 2003

**TABLE OF CONTENTS** **Page**

# SELECT-TEMP – VOTE BASED AUTO CHANGEOVER VAV

SELECT-TEMP is a commercial modulating zone control system that enables you to take a heating/cooling unit and control 2-25 separate zones per HVAC unit. The System provides the Building Owner, Engineer, Architect and Contractor with a reliable fully modulating zoning system. SELECT-TEMP provides building comfort while protecting the HVAC equipment. SELECT-TEMP VAV is available at a price far below the elaborate, expensive and complex control systems currently on the market.

**CONCEPTUAL DRAWING ONLY**
**Refer to System Controller Section for Wiring Information.**




## SYSTEM OPERATION

The System Controller communicates with the Zone Thermostats via a patented Five-Wire Link. The Five-Wire Link is daisy chained from thermostat to thermostat using standard five-conductor thermostat wire. The System Controller polls each zone every 120 seconds and registers the number of thermostats calling for heating and cooling. The System Controller then runs the HVAC unit in the mode with the most calls. If the majority changes, the System Controller will automatically change over to the new mode of operation.

The zone thermostats control the zone dampers. The System Controller tells the zone thermostats what mode the HVAC unit is running in. The zone thermostats then modulate the zone dampers to a position that will match the supply to the load. When the HVAC unit is running, if a zone thermostat is not calling or is calling for the opposite mode, its corresponding damper closes to the minimum position. When the HVAC unit is not running, the thermostats open all the zone dampers a minimum of fifty percent to provide ventilation if the indoor blower fan is running continuously.

While the HVAC unit is running, the Capacity Controller monitors the leaving air temperature from the HVAC unit and will cycle the HVAC unit off and on to maintain the air temperature within a preset range to eliminate coil freeze-up and premature heat exchanger failure.

## SELECT-TEMP
## Zonex Systems Supplied Components



## SELECT-TEMP
## Field Supplied Components

# SELECT-TEMP – A Modulating System – Component Selection Guide

**Auto changeover for 2 to 25 zones**

## CONTROLLERS

**GAS ELECTRIC**
(101ASSB)

**Capacity Controllers**
1 Stage only – (TRLAT) or
(101 CAPGE)
1 or 2 Stage -(CAPL-2)
3 or 4 Stage-(CAPL-4)

**HEAT PUMP ❶**
1 or 2 Stage Heat Pump
with Auxiliary or Electric Heat
(STACB-HP)

**Capacity Control**
LAS (Included with Controller)

Optional
Outdoor – T-Stat
(field supplied)

## ZONE THERMOSTATS

**Auxiliary Heat Stat**
For
Reheat/Baseboard
(STAHTS)

**Zone Stat**
(STDIGI)

Optional
**Nite Set Stat**
one/system
(STNSTS)
requires time clock

## ZONE DAMPERS

Round (STMPD size) up to1.75" SP
❷ Rectangular (STMRTD W x H) up to 1" SP
Heavy Duty Rectangular (STCD W x H) up to 1.75" SP
or
❸ D-Fusers
6 X (Number of Dampers or D-Fusers) = VA for the
24V AC Controller Transformer

## ELECTRONIC BYPASS DAMPERS

**Round**
(STMPD size)

**Rectangular**
(STCD W x H)

## BYPASS CONTROLLER

Static Pressure Control
(101ASPC)

24V 40VA Independent Transformer
for Bypass damper (field supplied)

## COMPLETE SYSTEM

❶ Some Heat Pumps utilize Gas/Electric thermostats. For this type of Heat Pump, use the Gas/Electric parts selection and field modify the capacity control heat cutoff setpoint to 118° F.

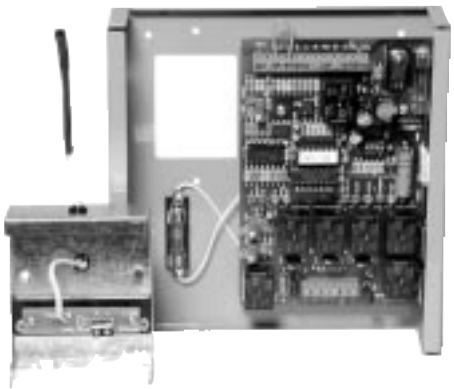
❷ Use heavy duty rectangular dampers on systems of 7.5 tons and above, or where unit ESP exceeds 1.0".

❸ D-Fuser is a combination fully modulating damper and diffuser. Available with inlet collar sizes from 6-10".

# SYSTEM CONTROLLERS


**Dimensions 7" x 7" x 2.5"**

**Gas Electric System Controller (101ASSB)**



**Heat Pump System Controller with LAS Sensor (STACB-HP)**

# SYSTEM CONTROLLERS – GAS/ELECTRIC (101ASSB)

## OVERVIEW

Constant volume air conditioning units have limitations. Select-Temp overcomes many of them, converting any air conditioning unit into a complete zone control system.

The 101ASSB is a Gas/Electric System Controller that will control up to 25 zones for the Select-Temp zoning system. The System Controller selects the mode of operation based on a majority calls basis. It is used in conjunction with a Capacity Controller. The Capacity Controller controls the HVAC system staging. Capacity Controllers are available for one, two, three and four stage systems. Refer to Capacity Controller section (pg. 24) for further information.

The 101ASSB is a vote based, auto changeover System Controller. It polls each zone every 120 seconds, registering heat or cool calls. Majority wins, and the Controller operates the HVAC system in that mode until all calls are satisfied or it detects a majority of offsetting calls.

The System Controller should be located in an accessible, conditioned space. The Controller does not sense temperature; it simply receives data from the zone thermostats. The Controller communicates with the thermostats through a five-wire link. These five wires are daisy chained to each zone thermostat. This simple patented wiring process eliminates home run wiring.

## OPERATION

When heating or cooling calls are sent to the System Controller, the controller will treat these calls as votes.

**COOL CALLS –** If the majority of calls are for cooling, the System Controller will turn on the compressor and fan. The air conditioner will continue to operate until all cooling calls are satisfied or the majority changes to heating.

**HEAT CALLS –** If the majority of calls are for heat, the System Controller will turn on the heat. If the fan switch is set for auto, the bonnet control or a delay relay will start the fan. When all heating calls are satisfied or the majority changes to cooling, the gas valve will turn off.

**CHANGEOVER –** If the system is running in one mode and the majority of calls changes to the other mode, a timer will start. The System Controller will give the current operating mode another 4 minutes to try and satisfy the zone(s) calling. It will then go into a 4-minute purge cycle before switching modes.

**PURGE MODE –** When a heat or cool call is satisfied or before changing modes, the System Controller will go into a 4-minute purge cycle. The compressor or gas valve will turn off and the indoor blower will continue to run. The dampers of any zone thermostat not satisfied in the previous mode will remain open. This allows the supply air to adjust to room temperature before changeover or ventilation while providing a time delay to prevent short cycling.

**VENTILATION –** When no zones are calling, all zone dampers open a minimum of 50% after the purge mode. This permits ventilation in all zones if the blower fan is on continuously.

**SET UP/SET BACK MODE –** Unoccupied set up/set back is available if the optional time clock and Nite Set STNSTS thermostat are used. The time clock determines the mode of operation, occupied or unoccupied. During the unoccupied period, the System Controller locks out all zone thermostats except the STNSTS from making heat or cool calls. If the System Controller and STNSTS thermostat are configured for set back operation, the STNSTS thermostat can make only heat calls. If configured for set up, the STNSTS thermostat can make only cool calls.

# SYSTEM CONTROLLERS – GAS/ELECTRIC (101ASSB)

## COMPONENTS

The 101ASSB System Controller consists of the following:

**A.** TB1 (Terminal Block 1): Wires to daisy chain, transformer and time clock.
TC1, TC2 – Time clock switch terminals.
Closed = occupied mode.
Open = unoccupied mode.
S – Unoccupied (Nite) mode call.
Y – Cool call.
W – Heat Call.
Rd – Damper modulation enable signal.
B – 24V AC common. Same terminal as TR2.
G – 24V AC hot. Same terminal as TR1 when PWR switch ON.
TR2 – 24V AC common.
TR1 – 24V AC hot.

**B.** Jumpers J1 and J2:
J1 – Not used.
J2 – Set back/set up jumper.
On both pins = set back mode (heat)
On only one pin = set up mode (cool)

**C.** Microcontroller: Responsible for zone communication, activation and control of system outputs based upon zone demand. Occasionally software upgrades may become available. If so, the 101ASSB software can be field upgraded by changing this microcontroller.

**D.** Off board fuse: One amp. Protects Y and W terminals of TB1.

**E.** Status lights: Refer to status light section for details.

**F.** TB2 (Terminal Block 2): Wires to Capacity Controller and HVAC unit.
R – HVAC unit 24V AC power
W1 – Heat enable
Y1 – Cool enable
G – Indoor blower fan enable

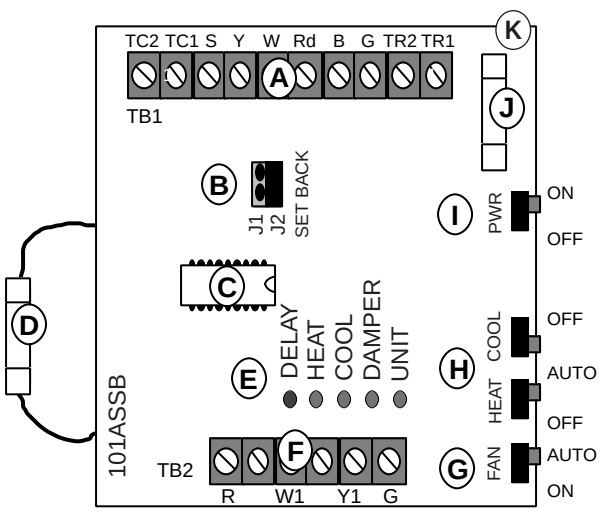
**G.** FAN switch:
AUTO – Turns on indoor blower fan when unit is running in cool mode.
ON – Indoor blower fan runs continuously.

**H.** COOL and HEAT mode switches:
AUTO – Accepts calls from thermostats.
OFF – Ignores calls.

**I.** Power switch. When on, applies 24V AC power to G of TB1.

**J.** On board fuse. One amp. Protects 101ASSB board only.

**K.** Circuit board # - Reference for technical assistance.




## STATUS LIGHTS

| | |
|---|---|
| DELAY | On when HVAC unit energized. Flashing when in purge/delay mode. |
| HEAT* | On in heat mode. |
| COOL* | On in cool mode. |
| DAMPER | When on, dampers of zones not calling for present mode are closed. |
| UNIT | On when HVAC unit energized. |

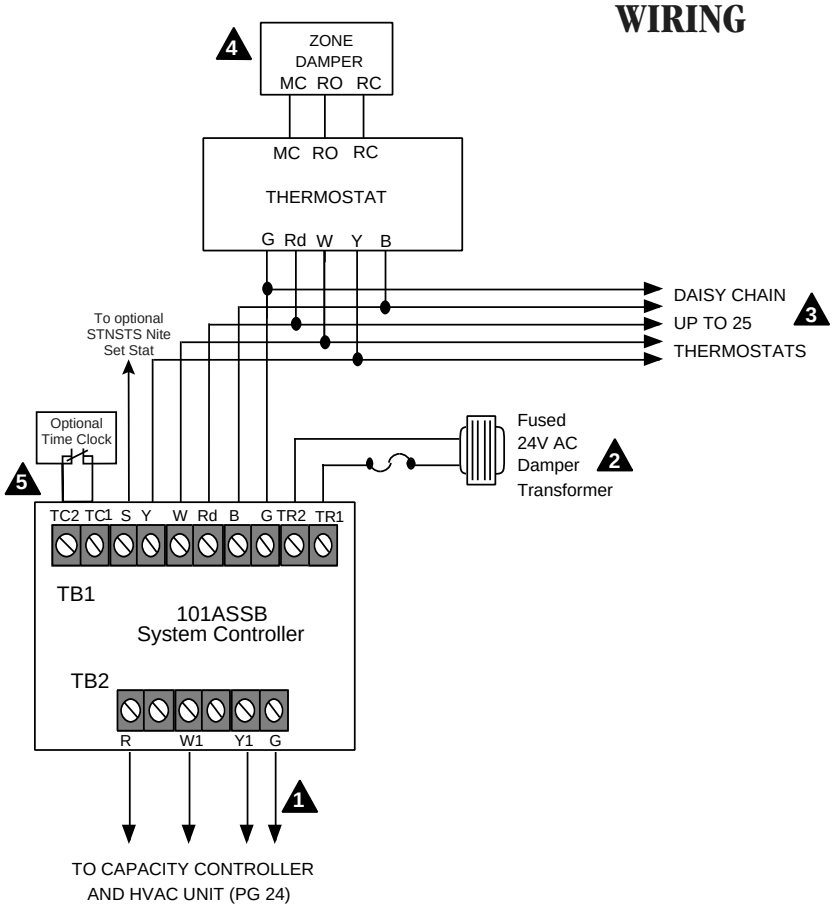
LEGEND:
0=OFF 1=ON

| Status Lights | | | | | Mode | Function |
|---|---|---|---|---|---|---|
| Delay | Heat* | Cool* | Damper | Unit | | |
| 0 | 1 | 0 | 0 | 0 | Heat, no calls | HVAC unit off. All dampers open. |
| 0 | 0 | 1 | 0 | 0 | Cool, no calls | HVAC unit off. All dampers open. |
| 1 | 1 | 0 | 1 | 1 | Heat call | Heat energized. Heat calling zone dampers open. |
| 1 | 0 | 1 | 1 | 1 | Cool call | AC energized. Cool calling zone dampers open. |
| FLASH | 1 | 0 | 1 | 0 | Purge heat | Blower fan on, HVAC unit off. Heat calling zone dampers open. |
| FLASH | 0 | 1 | 1 | 0 | Purge cool | Blower fan on, HVAC unit off. Cool calling zone dampers open. |

*MODE LIGHTS TOGGLE BETWEEN HEAT AND COOL EVERY 120 SECONDS. THIS INDICATES THE SYSTEM CONTROLLER IS POLLING FOR HEAT OR COOL CALLS.

# SYSTEM CONTROLLERS - GAS/ELECTRIC (101ASSB)

## WIRING




1. If the heater does not turn on the blower fan, a blower fan relay must be installed. See page 36.
2. 24V damper/thermostat transformer. Requires in-line fuse. See table on page 36 for sizing transformer and fuse.
3. Refer to page 35 for Five Wire Link wire sizing.
4. If using more than one damper per thermostat, refer to Slaving Zone Dampers section, page 20.
5. If using time clock, remove factory installed jumper between TC1 and TC2. Otherwise, leave jumper in place.

# SYSTEM CONTROLLERS – HEAT PUMP (STACB-HP)

## Overview

The STACB-HP Heat Pump Controller greatly simplifies coordination of single stage or two stage Heat Pumps with dampered zone systems. The Controller communicates to the zone dampers through a five wire link. These five wires are daisy chained to each zone thermostat. This simple patented wiring process eliminates home run wiring. The STACB-HP has a built-in capacity control system which uses an LAS (included with the Controller) for capacity control. Refer to the section on Capacity Control LAS for more information.

## Operation

The Controller operates the Heat Pump using signals from each zone thermostat in the system. When heating or cooling calls are sent to the controller, it treats these calls as votes. If the majority of calls are for cooling, the Controller will operate in the cool mode and, after a time delay, turn on the compressor* and fan. The Heat Pump will continue to operate in the cool mode until the majority of calls shift to heating or all cooling calls are satisfied. If the majority of calls are for heating, the Controller will operate in the heat mode and after a time delay, turn on the compressor* and fan. The Heat Pump will continue to operate in the heat mode until the majority of calls shift to cooling or all heating calls are satisfied.

Second stage operation is based on the leaving air temperature of the unit. The LAS reports the discharge temperature to the Controller. Four minutes after initiating cooling, the Controller checks the LAS. If the discharge temperature is above 60°, the second stage is turned on. Two minutes after initiating heating, the Controller checks the LAS. If the discharge temperature is below 95°, the second stage is turned on.

The Heat Pump Controller is also set up to operate electric strip heat in the Heat Pump. The Controller monitors the air temperature leaving the Heat Pump coil. When there is a call for heat and the air leaving the coil is not above 85°, the electric strip will turn on after an eight minute delay. This operation can be modified, if desired by an outdoor thermostat.

The Heat Pump Controller simplifies system wiring. The Controller terminals connect directly to the Heat Pump terminal strip. (**Heat Pump thermostats are not used for this system**). Relays, timers and other miscellaneous controls are not required.

****The reversing valve is energized depending on the O/B jumper setting.***

## OPERATION (Continued)

The STACB-HP Select-Temp Heat Pump controller has a series of lights which indicate different operations. These are labeled "Heat," "Cool," "Damper," "Pump," "Rev. Valve," "Y1 Cool", "Y2 Cool," "Y1 Heat" and "Y2 Heat." The "Heat" and "Cool" lights indicate, when illuminated, the present mode of operation. These lights will momentarily toggle to the other mode every 120 seconds when polling. Polling is when the controller checks to see how many heat and cool calls are being made. If there are no calls, the "Heat" or "Cool" light will be on based on the last operating mode. The "Damper" light indicates that a thermostat is calling and that power is being supplied to the damper motors. The "Pump" light indicates that the first stage pump is operating. The "Rev. Valve" light indicates that the reversing valve is activated, or when it flashes, that a time delay is active. The "Y1" and "Y2" Cool and Heat lights are part of the Capacity Control function included on the Heat Pump Controller. See the section on Capacity Control LAS operations, page 29.

When power is first turned on, if there are no calls for cooling or heating, the "Heat" light will be the only light illuminated, with the exception of the "Rev. Valve" light. It will also be on if jumper J1 is removed, ("B" operation). When there is a cooling or heating call, the "Damper" and "Heat" or "Cool" lights will turn on and the Heat Pump Controller will run through a time delay cycle (approximately four minutes.) This time delay will be indicated by the "Rev. Valve" light flashing. After the time delay, the "Pump" light will illuminate, indicating that the first stage pump has started. The "Rev. Valve" light will continue to flash, indicating that second stage operation is necessary. This decision is based on the leaving air temperature, which will not have changed since the first stage pump has just been started. There is a four-minute time delay before the second stage pump can be activated allowing the first stage pump time to reach a temperature that will satisfy the system load. After the four-minute time delay, the leaving air temperature must be under 95° for heating and over 60°for cooling to bring on the second stage. When the first stage pump achieves a satisfactory leaving air temperature, the "Rev. Valve" light will stop flashing and the second stage pump will be activated. After the four-minute time delay, if one stage cannot satisfy the building load, the second stage will begin to operate.

When the "Rev. Valve" light is not indicating a time delay by flashing, it will stay illuminated only when the reversing valve is operated.

If the majority of calls change and the system needs to change over, a four minute time delay will begin. This time delay allows the system to try and satisfy the current mode before changing over. At the end of the four minutes, the "Rev. Valve" light will again start to flash, the "Pump" light will go out and the new mode light will turn on. This indicates that a four minute time delay between cooling and heating is activated. Cooling or Heating are locked out until this time delay is over. This protects the unit from short cycling. When the time delay has ended, the "Pump" light will illuminate.

If all zones satisfy, the "Pump" and "Damper" lights will go out. The "Heat" or "Cool" lights will be on based on the last mode of operation.

If your system includes auxiliary heat, it will be activated by the "W" terminal on the STACB-HP Select-Temp Heat Pump Controller. Auxiliary heat will be activated when the following conditions are met. The "Heat" and "Damper" lights are on indicating a heat call; the "Pump" light is on and the "Rev. Valve" light is not flashing, indicating that first and second stage are activated; four minutes after the "Rev. Valve" light stops flashing the auxiliary heat will be activated if the leaving air temperature is below the Electric Heat setpoint (factory set at 85°). The time delay before bringing on the auxiliary heat gives the second stage time to raise the leaving air temperature over 85°. Even if the system is single stage, the controller will still delay the electric heat until after the second stage time delay is satisfied.

The reversing valve is controlled by the "O/BL" terminal. This terminal should be connected to the Heat Pumps terminal strip according to the unit manufacturer's recommendations. Jumper J1 on the Heat Pump board needs to be adjusted to operate with the different manufacturers' designs. The Heat Pump board is shipped from our factory ready to operate a heat pump unit which requires the "O" wire to energize the reversing valve in cooling. If the reversing valve needs to be activated for the "BL" terminal, jumper J1 needs to be removed from the Controller board. Refer to the Heat Pump Controller drawing on the previous page for the location of jumper "J1". Remove the jumper from the board to activate the reversing valve using the "BL" terminal.

**SET UP/SET BACK MODE –** Unoccupied set up/set back is available if the optional time clock and Nite Set STNSTS thermostat are used. The time clock determines the mode of operation, occupied or unoccupied. During the unoccupied period, the System Controller locks out all zone thermostats except the STNSTS from making heat or cool calls. If the System Controller and STNSTS thermostat are configured for set back operation, the STNSTS thermostat can make heat calls. If configured for set up the STNSTS thermostat can make cool calls.

**Warning:** For heat pumps using standard gas/electric thermostats, do not use the STACB-HP System Controller. Instead, use the 101ASSB System Controller and the CAPL-2 Capacity Controller.

# SYSTEM CONTROLLERS – HEAT PUMP (STACB-HP)

## OPERATION SUMMARY TABLE

| POWER UP, NO CALLS: | |
|---|---|
| STATUS LIGHTS: | |
| DAMPER | OFF |
| REV. VALVE | NOTE 1 |
| HEAT* | ON |
| COOL* | OFF |
| PUMP | OFF |
| TB2: | |
| Y1 | OFF |
| Y2 | OFF |
| G | OFF |
| W | OFF |
| O/BL | NOTE 1 |

| CALL (HEAT/COOL): | 1ST STAGE | 2ND STAGE | AUX. HEAT |
|---|---|---|---|
| | | DELAY IN MINUTES | |
| STATUS LIGHTS: | 0 | 4* | 8 |
| DAMPER | ON | ON | ON |
| REV. VALVE | FLASH | NOTE 1 | NOTE 1 |
| HEAT | ON FOR HEAT | ON FOR HEAT | ON FOR HEAT |
| COOL | ON FOR COOL | ON FOR COOL | ON FOR COOL |
| PUMP | ON | ON | ON |
| TB2: | | | |
| Y1 | ON | ON | ON |
| Y2 | OFF | ON | ON |
| G | ON | ON | ON |
| W | OFF | OFF | NOTE 2 |
| O/BL | NOTE 1 | NOTE 1 | NOTE 1 |

| MODE CHANGE: | | 1ST STAGE | 2ND STAGE | AUX. HEAT |
|---|---|---|---|---|
| | | DELAY IN MINUTES | | |
| STATUS LIGHTS: | O | 4 | 8 | 10 | 12 |
| DAMPER | ON | ON | ON | ON | ON |
| REV. VALVE | CONTINUE PREVIOUS MODE OPERATION | FLASH | FLASH | NOTE 1 | NOTE 1 |
| HEAT* | | ON FOR HEAT | ON FOR HEAT | ON FOR HEAT | ON FOR HEAT |
| COOL* | | ON FOR COOL | ON FOR COOL | ON FOR COOL | ON FOR COOL |
| PUMP | | OFF | ON | ON | ON |
| TB2: | | | | | |
| Y1 | | OFF | ON | ON | ON |
| Y2 | | OFF | OFF | ON | ON |
| G | | OFF | ON | ON | ON |
| W | | OFF | OFF | OFF | NOTE 2 |
| O/BL | | NOTE 1 | NOTE 1 | NOTE 1 | NOTE 1 |

NOTE 1: On if: a) In cool mode and reversing valve set for "O" operation (J1 jumper installed).
b) In heat mode and reversing valve is set for "BL" operation (J1 jumper removed).

NOTE 2: On when in heat mode and supply air temperature below Electric Heat setpoint. Heat, Cool, and Fan switches in AUTO position. Capacity Controller lights off. Delay times are approximate.

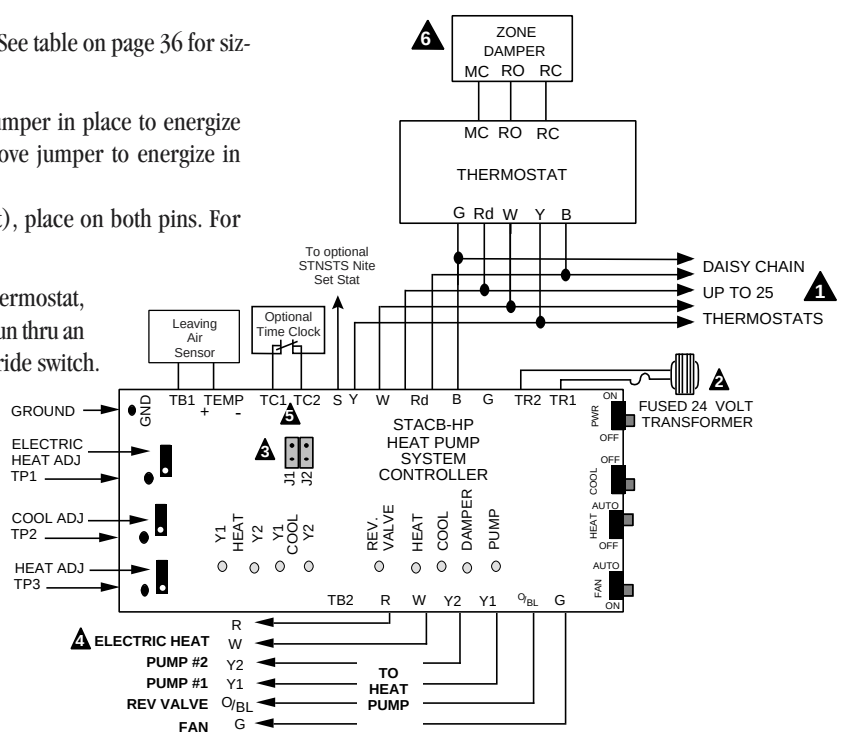
*Momentarily toggles to opposite mode every 120 seconds.

## WIRING

### NOTES:

1. Refer to page 35 for 5-wire link wire sizing.
2. 24V damper transformer. Requires in-line fuse. See table on page 36 for sizing transformer and fuse.
3. J1 – Reversing Valve Selection Jumper. Leave jumper in place to energize reversing valve in cool mode, "O" mode. Remove jumper to energize in heat mode, "B" mode.
   J2 – Set back/Set up jumper. For set back (heat), place on both pins. For set up (cool) place on only one pin.
4. If the heat pump does not include an outdoor thermostat, it is recommended that the "W" wire to the unit is run thru an optional outdoor thermostat with a manual override switch.
5. If using time clock, remove factory installed jumper between TC1 and TC2. Otherwise, leave jumper in place.
6. If using more than one damper per thermostat, refer to Slaving Zone Dampers section, page 20.

**NOTE**:
**If the Heat Pump system does not have rev. valve inputs, use the 101ASSB, (Gas/Electric Controller).**



# SELECT-TEMP SYSTEM START UP

1. Turn off all thermostats (power switch on bottom right of thermostat).
2. At System Controller, set FAN switch to ON. Verify indoor blower fan turns on.
3. At System Controller, set HEAT and COOL switches to OFF and FAN switch to AUTO. Cycle PWR switch OFF and then ON. Verify the indoor blower fan is off.
4. On the System Controller, ensure that only the HEAT or COOL light is on. If no lights are on, ensure voltage at TR1 and TR2 is between 24V and 29V, transformer in line fuse is not blown and the fuse on System Controller circuit board is not blown. For the heat pump System Controller (STACB-HP), if the red HEAT Y1 Y2 lights are on, there is either a break on the LAS wiring or the LAS is defective. If the green COOL Y1 Y2 lights are on, there is either a short on the LAS wiring or the LAS is defective.
5. **Cool mode test.** Perform steps 5.1 through 5.10 if there is a cooling system.
   - 5.1 At the System Controller, set the HEAT switch to OFF, COOL switch to AUTO and the PWR switch to ON.
   - 5.2 Make a cool call at the first thermostat by turning it on and lowering the cool setpoint at least two degrees below room temperature.
   - 5.3 At the System Controller, ensure the DAMPER and COOL lights turn on. If not, possible problems are: Blown off board fuse at System Controller (fuse to left), break in Y wire of 5 Wire Link, break in Y wire at thermostat, no power at thermostat, defective thermostat. If off board fuse is found blown, check for short on 5 Wire Link between G and Y or Rd and Y.
   - 5.4 When the UNIT/PUMP light turns on at the System Controller, verify the compressor and blower fan turn on. Could take up to 4 minutes.
   - 5.5 At the System Controller disconnect the R wire on the bottom terminal block (TB2). This will turn off the compressor and blower fan.
   - 5.6 Turn off thermostat.
   - 5.7 For the heat pump System Controller (STACB-HP), ensure the DAMPER light turns off. For the gas/electric System Controller (101ASSB), ensure the DELAY light starts flashing.
   - 5.8 At the System Controller, cycle the PWR switch OFF and then ON. This will reset the timer.
   - 5.9 Repeat steps 5.1 through 5.8, skipping steps 5.4 and 5.5 for all other zone thermostats.
   - 5.10 At System Controller, reconnect the R wire on TB2.
6. **Heat mode test.** Perform steps 6.1 through 6.10 if there is a heating system.
   - 6.1 At the System Controller, set the COOL switch to OFF, HEAT switch to AUTO and the PWR switch to ON.
   - 6.2 Make a heat call at the first thermostat by turning it on and raising the heat setpoint at least two degrees above room temperature.
   - 6.3 At the System Controller, ensure the DAMPER and HEAT lights turn on. If not, possible problems are: Blown off board fuse at System Controller (fuse to left), break in W wire of 5 Wire Link, break in W wire at thermostat, no power at thermostat, defective thermostat. If off board fuse is found blown, check for short on 5 Wire Link between G and W or Rd and W.
   - 6.4 When the UNIT/PUMP light turns on at the System Controller, verify the heating unit turns on. Could take up to 4 minutes.
   - 6.5 At the System Controller disconnect the R wire on the bottom terminal block (TB2). This will turn off the heating unit.
   - 6.6 Turn off thermostat.
   - 6.7 For the heat pump System Controller (STACB-HP), ensure the DAMPER light turns off. For the gas/electric System Controller (101ASSB), ensure the DELAY light starts flashing.
   - 6.8 At the System Controller, cycle the PWR switch OFF and then ON. This will reset the timer.
   - 6.9 Repeat steps 6.1 through 6.8, skipping steps 6.4 and 6.5 for all other zone thermostats.
   - 6.10 At System Controller, reconnect the R wire on TB2.
7. Set system up for normal operation.

End of test.

# SELECT-TEMP THERMOSTAT

## OVERVIEW

The Zonex Systems Select-Temp thermostats are auto changeover zone thermostats with modulating damper control. They are specifically designed for use with the Zonex Systems Select-Temp zoning system. They represent the latest in solid state design and manufacturing techniques.

Room temperature and setpoints are displayed on a bright and easy to read LED digital display. The thermostats are the ultimate in simplicity to operate. Two push buttons set the desired setpoint(s). The setpoints are stored in battery free nonvolatile memory. The heat and cool setpoints can be set to the same or different temperatures. The heating setpoint can never be higher than the cooling setpoint and vice versa. If the setpoints are crossed while adjusting, both setpoints will be equal.


### Features:

Large, bright LED display
Auto Changeover
Non-volatile, battery free memory
Small attractive design
Simple, single potentiometer calibration
Environmentally safe, mercury free
1 degree Fahrenheit accuracy
Dual setpoint capability
Simple two push button operation
Locking setpoints
Remote sensor capability

### Mounting instructions:

Mount directly to the wall or onto a vertical mounted 4 x 2 electrical outlet box.

### Specifications:

| | | |
|---|---|---|
| Control Range: | 55 to 86 F | |
| Min. Heat/Cool Diff: | 4 degrees | |
| Accuracy: | 1 degree F at 75F | |
| Min. Dead Band: | 2 degrees | |
| Part Number: | Zone Stat | STDIGI |
| | Nite Stat | STNSTS |
| | Aux Heat | STAHTS |
| Dimensions: | 4 1/2"H x 2 7/8" W x 1"D | |
| Color: | Off white | |

## THERMOSTAT MODELS

Zonex Systems manufactures three models of thermostats for the Select-Temp System: STDIGI, STAHTS and STNSTS. Only Zonex Systems Select-Temp thermostats can be used with the Select-Temp zoning system.

**STDIGI –** Standard zone thermostat. Single stage heat/cool, auto changeover. Use this thermostat for all zones not using an STAHTS or STNSTS thermostat.

**STAHTS –** Auxiliary heat thermostat. Single stage cool, three stage heat. Auto changeover. Use this thermostat if you need to control one or two stages of auxiliary heat (i.e. Radiant ceiling panel, radiant baseboard, hot water valves, duct heaters or control fan powered mixing boxes). Do not use this thermostat for controlling multistage central heating. Multistage central heating is controlled by the System Controller and/or Capacity Controller.

**STNSTS –** Combination zone and nite set thermostat. Use this thermostat if you desire unoccupied set back or set up. Auto changeover in occupied mode, manual changeover in unoccupied mode. Separate heat/ cool setpoints are stored in the thermostat, occupied and unoccupied. A time clock connected to the System Controller determines the mode of operation. When the time clock switch is closed, the system is in occupied mode and the thermostat runs off the occupied setpoints. When the time clock switch is open, the system is in unoccupied (nite) mode and the STNSTS thermostat will make calls based on the nite setpoints but damper control is still based on the occupied setpoints. In nite mode, the System Controller will respond to heat or cool calls from the STNSTS thermostat only. The mode of operation in nite mode must be selected for either heat or cool using selection jumpers on the thermostat and System Controller. **Use only one per Select-Temp system. Requires an additional wire (S) between the System Controller and thermostat.**

# SELECT-TEMP THERMOSTAT

## OPERATION

Each Select-Temp thermostat monitors room temperature and the mode the system is running in. This information is compared to the setpoints stored in the memory of the thermostat. Based on this information, the thermostat initiates heat or cool calls and modulates its corresponding zone damper(s).

**No calls –** When no zone thermostats are calling, the HVAC unit will be off and all zone dampers will open a minimum of 50% for ventilation.

**Cool call –** When the room temperature rises 2 degrees above the thermostat's cool setpoint, the green Cool Call Light is turned on and a cool call is initiated to the System Controller. When the room temperature drops to the cool setpoint, the Cool Call Light is turned off and the cool call is removed.

**Heat call –** When the room temperature drops 2 degrees below the thermostat's heat setpoint, the red Heat Call Light is turned on and a heat call is initiated to the System Controller. When the room temperature rises to the heat setpoint, the Heat Call Light is turned off and the heat call is removed.

For the Auxiliary Heat thermostat, STAHTS, only: When the room temperature drops 2 degrees below the thermostat's heat setpoint, a first stage heat call is initiated to the System Controller and the red Heat Call Light is turned on. When the room temperature rises to the heat setpoint, the Heat Call Light is turned off and the first stage heat call is removed. Second stage is initiated (HT2 Light on, G made to W2) when the room temperature drops 3 degrees below the heat setpoint. Second stage is de-energized (HT Call Light off, G broken from W2) when the room temperature rises to 1 degree below the heat setpoint. Third stage heat is initiated (HT3 Call Light on, G made to W3) when the room temperature drops 4 degrees below the heat setpoint. Third stage heat is de-energized (Heat 3 Call Light off, G broken from W3) when the room temperature rises to 2 degrees below the heat setpoint.

**Set back/Set up call:** In unoccupied (nite) mode, the System Controller locks out all zone thermostats except the STNSTS from making heat or cool calls. If the System Controller and STNSTS thermostat are configured for set back operation, the STNSTS thermostat can make heat calls. If configured for set up, the STNSTS thermostat can make cool calls. In set back mode, when the STNSTS thermostat senses the room temperature drop of 2 degrees below the nite heat setpoint, the Nite Call Light on the STNSTS is turned on and a nite call is initiated to the System Controller (G made to S). The System Controller interprets this as a heat call and energizes heat. In set up mode, when the STNSTS thermostat senses the room temperature rise of 2 degrees above the nite cool setpoint, the Nite Call Light is turned on and a nite call is initiated to the System Controller (G made to S). The System Controller interprets this as a cool call and energizes cooling.

**Damper Control –** The Select-Temp thermostat will modulate the damper within a 10 step range, each increment to equal 10% of the damper stroke. Each pulse duration is 9 seconds, for a 90 second total from full closed to full open.

When the room temperature begins to recover within 2 degrees from setpoint, the damper will begin to modulate closed. For each two-tenths degree F. variance from setpoint, the damper will pulse one increment/decrement. When setpoint is reached, the damper will be closed 100%. If the room temperature begins to exceed a 2.4 degree overshoot/undershoot from setpoint, the damper is pulsed an additional 135 seconds to ensure travel completion, and to reset damper positioning before pulse removal.

When all zones are satisfied, and the 4 minute purge cycle is completed, all zone dampers are checked for their position by the Select-Temp thermostat. If the damper is less than 50% open, the damper is pulsed an additional 50% from its present location for ventilation purposes. Example: If the damper is open 10% at the time of purge cycle completion, the damper will travel to 60% open.

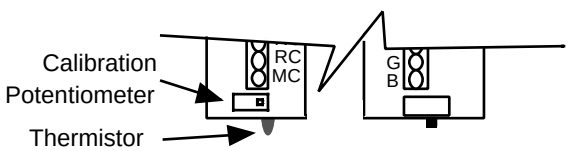
# SELECT-TEMP THERMOSTAT

## OPERATING INSTRUCTIONS

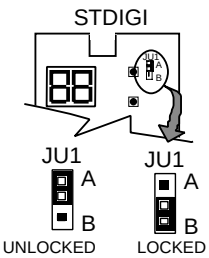
### CALIBRATION

The Select-Temp thermostats are factory calibrated. If calibration is ever required, with the thermostat cover on, place the sensor probe of an accurate digital thermometer next to the blue thermistor in the lower left corner of the thermostat. Note the calibration degree error, prior to cover removal. Remove cover, and adjust the potentiometer adjacent to the thermistor until the display is equal to the desired temperature. Each 1/2 turn is approximately equal to 1 degree change.

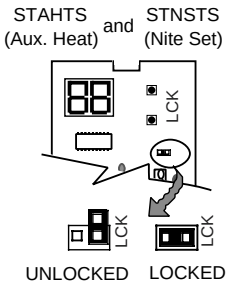
**Note:** It could take up to 6 seconds for the thermostat to recognize the change. Be sure to keep your hand away from the thermistor to prevent a false temperature reading. Do not take temperature reading with thermostat cover off.

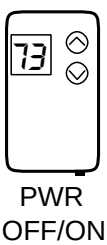



### SETPOINT LOCK




A jumper, located under the cover of the thermostat, is provided to lock the setpoints to prevent the user from changing them. To lock the setpoints, set jumper as shown below.

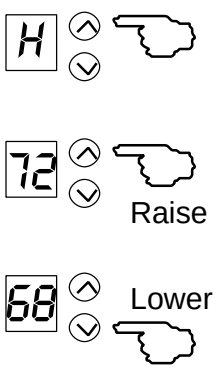



### POWER SWITCH

Slide the power switch to the right to turn on the thermostat and to the left to turn it off.

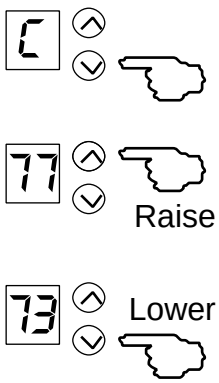
### VIEW/CHANGE HEAT SETPOINT




To display the heat setpoint, press and hold the top (UP) button until H is displayed and then release. The heat setpoint value will immediately follow.

To change, while the heat setpoint is displayed, immediately press the top (UP) button to raise or bottom (DN) button to lower the setpoint. When at desired setting, release button. Setpoint will be stored in nonvolatile memory. A few seconds later display will return to room temperature.

### VIEW/CHANGE COOL SETPOINT




To display the cool setpoint, press and hold the bottom (DN) button until C is displayed and then release. The cool setpoint value will immediately follow.

To change, while the cool setpoint is displayed, immediately press the top (UP) button to raise or bottom (DN) button to lower the setpoint. When at desired setting, release button. Setpoint will be stored in nonvolatile memory. A few seconds later display will return to room temperature.

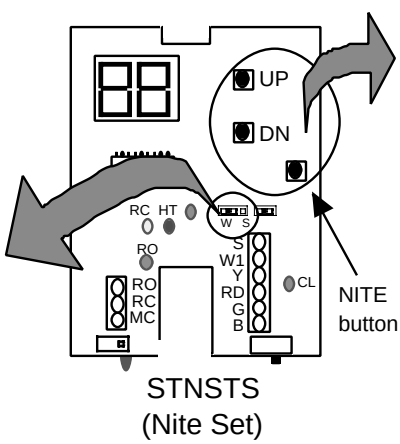
### SET UP/SET BACK SETPOINTS

The STNSTS thermostat has nite (unoccupied) set up (summer) or set back (winter) capability. To use this feature you need to designate the thermostat for either set up or set back and assign the set up/set back setpoints.

### SET UP/SET BACK DESIGNATION

For set up (summer), place the Nite Selection Jumper on S and the center pin. For set back (winter), place jumper on W and center pin. Must also change Jumper J2 on the System Controller.

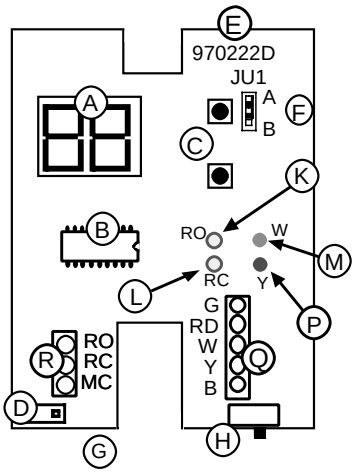




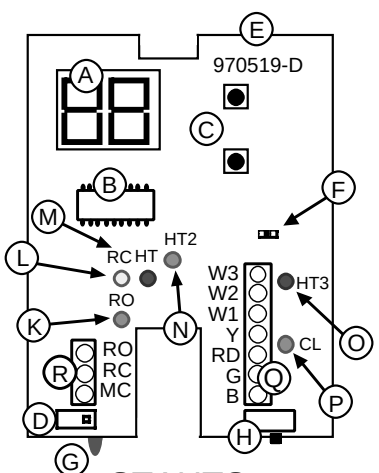

### SET UP/SET BACK SETPOINTS

To view and change the set up (cool) and set back (heat) setpoints, remove the cover and press and hold the Nite button. While pressing the Nite button, follow the standard procedure for viewing and changing the setpoints.

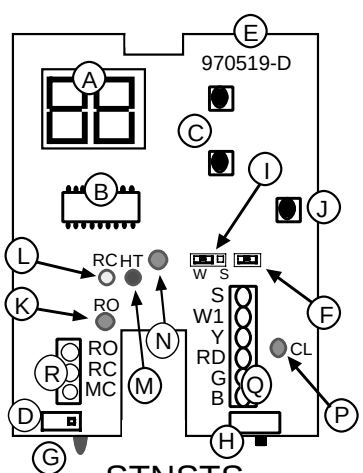
# SELECT-TEMP THERMOSTAT




STDIGI




STAHTS
(Aux. Heat)




STNSTS
(Nite Set)

## COMPONENTS

A. **Digital Display –** Large two digit LED. Displays room temperature and setpoints.

B. **Microcontroller –** Responsible for zone communication with System Controller, and damper pulse functions. Microprocessor can be field upgraded in STDIGI thermostats only.

C. **Setpoint Push Buttons –** For viewing/changing setpoints. Press top button to view heat setpoint and to raise setpoint temperature. Press bottom button to view cool setpoint and to lower setpoint temperature.

D. **Calibration Potentiometer (R11) –** Calibration potentiometer (R11) – Used to calibrate display temperature. Thermostats are factory calibrated, however field adjustments can be made, if required.

E. **Circuit Board Part Number –** Current circuit board numbers are: STDIGI- 970222D, STAHTS and STNSTS-970519D. This documentation applies only to these circuit boards.

F. **Lock Jumper –** Prevents user from changing setpoints. To lock: For STDIGI, place jumper on center pin and B. For STAHTS and STNSTS, place jumper on both pins. To unlock: For STDIGI, place jumper on center pin and A. For STAHTS and STNSTS, place jumper on one pin only.

G. **Room Temperature Sensor.**

H. **Power Switch –** Slide to right to turn on.

I. **Nite Selection Jumper –** On STNSTS thermostat only. Place on center pin and W for set back (winter) operation. Place on center pin and S for set up (summer) operation. Must also change corresponding jumper on System Controller.

J. **Nite Push Button –** On STNSTS thermostat only. For viewing/changing nite (unoccupied) setpoints. Used in conjunction with the setpoint Push Buttons. To view/change nite setpoints, press and hold Nite button and then view/change setpoints as specified in paragraph C.

K. **Run Open Light –** On when thermostat is opening zone damper.

L. **Run closed Light –** On when thermostat is closing zone damper.

M. **Heat Call Light –** On when thermostat is making a heat call.

N. **Heat 2/Nite Call Light –** On STNSTS and STAHTS thermostats only. For STAHTS thermostat, light on when thermostat is making a second stage heat call. For STNSTS thermostat, light on when making a set back heat call and the W/S jumper is on W, or when making a set up cool call and the W/S jumper is on S.

O. **Heat 3 Call Light –** On STAHTS thermostat only. Light on when thermostat is making a third stage heat call.

P. **Cool Call Light –** On when thermostat is making a cool call.

Q. **Daisy Chain Terminal Block:**

| | |
|---|---|
| G – | 24V AC power. |
| B – | 24V AC rtn. |
| Rd – | Damper modulation enable signal |
| Y – | Cool call. |
| W/W1 – | Heat, 1st stage call. |
| W2 – | Heat, 2nd stage call. (STAHTS thermostat only). |
| W3 – | Heat, 3rd stage call. (STAHTS thermostat only). |
| S – | Nite call. (STNSTS thermostat only). |

R. **Zone Damper Terminal Block:**

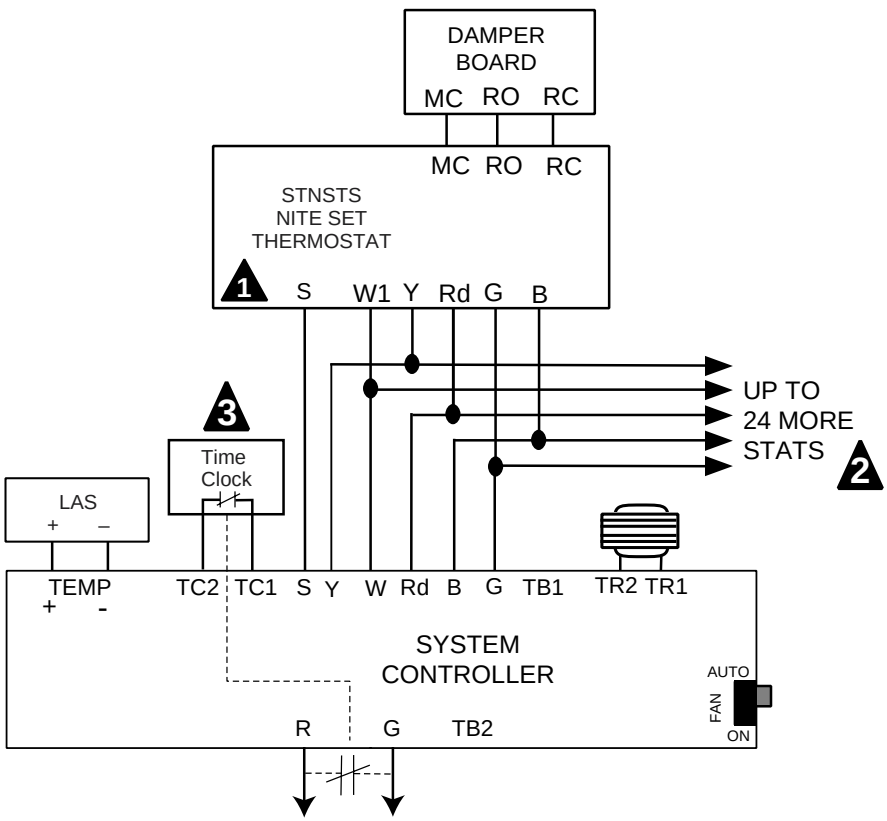
| | |
|---|---|
| RO – | Run open. |
| RC – | Run closed. |
| MC – | Motor common. |

## STNSTS NITE SET THERMOSTAT WIRING AND CONFIGURATION

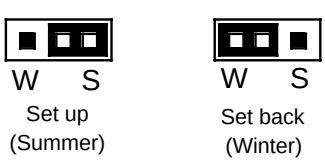
1 ***Extra wire (S) required between STNSTS Nite Set thermostat and System Controller. This wire not used on any of the other zone thermostats.***

2 Use only one STNSTS Nite Set thermostat per system. Use STDIGI or STAHTS thermostats for the other zones.

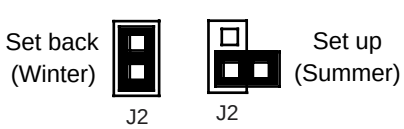
3 Time clock: Required when using the STNSTS Nite Set thermostat. Switch connected between TC1 and TC2 terminals of TB1 on the System Controller. Occupied mode when switch is closed. Unoccupied when switch is open. Be sure to remove factory jumper between TC1 and TC2. To run blower fan continuously during occupied mode and intermittently (only when HVAC unit is running) during unoccupied mode, use two pole time clock. Connect second pole between R and G terminals of TB2 on the System Controller and put FAN switch to AUTO. Switch must be closed in occupied mode.




On the STNSTS thermostat, must configure Nite Selection Jumper for either set up or set back. Refer to thermostat operation instruction, pg. 11, for further information.



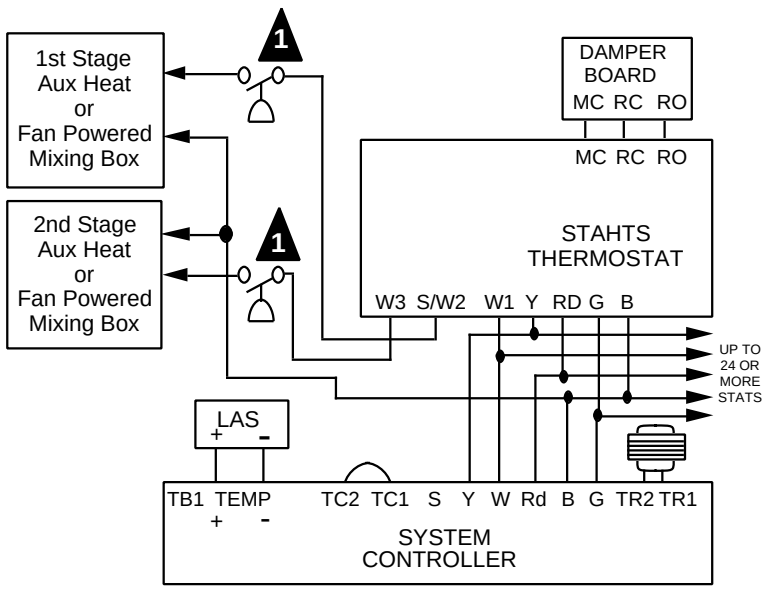

On the System Controller, must configure jumper J2 for either set up or set back. Refer to corresponding System Controller section, pg. 3 or 4 for further information.




**NOTE:**
**The STNSTS thermostat and the System Controller must have the same settings (Winter or Summer) for proper operation.**

## AUXILIARY HEAT WIRING AND CONFIGURATION

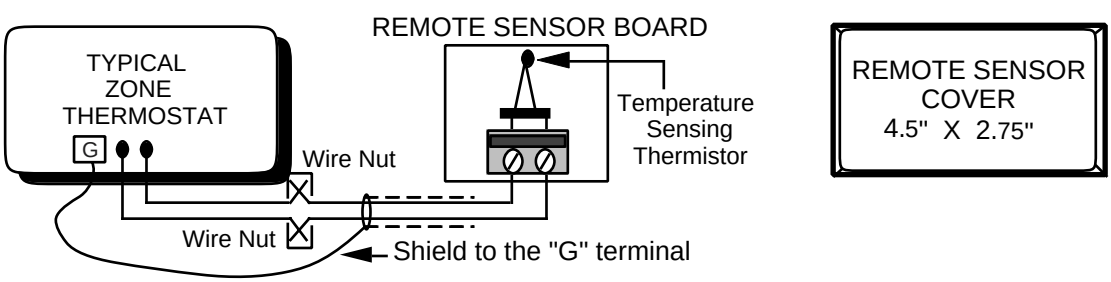
1 If using duct heaters, use a pressure switch downstream of the zone damper. Also, set a minimum damper position to prevent electric heat failure.




## REMOTE THERMOSTAT SENSOR

You can order the STDIGI, STNSTS, and STAHTS thermostats with a remote sensor. Remote sensors are useful if you would like to place the thermostat control in another location. Simply add "RS" at the end of the part number to order with remote sensor; i.e.: "STNSTSRS".

**Wiring:** The remote sensor must be wired with a minimum 18ga, two conductor, shielded cable, with a maximum length of 200 feet. The wires have no polarity. Use field supplied wire nuts to connect the sensor. Flare back and tape off the cable shield closest to the sensor. Connect the shield at the thermostat end to the "G" terminal on the stat terminal.



# SELECT-TEMP TIME CLOCK

A time clock is needed for Set up/Set back operation. The time clock designates what times the building is occupied and what times the building is unoccupied.

Zonex Systems offers the two channel STCLOCK for use with the Select-Temp system. Only one channel is required for set back operation of the controller, with an auxiliary channel which can be used to control an exhaust fan, parking lot lights, sprinklers, etc.

## TIME CLOCK FEATURE LIST

| | STCLOCK | Note |
|---|---|---|
| OUTPUT | 2 SPDT RELAYS | |
| SWITCH RATING | 16A-250VAC | |
| POWER BACK-UP | 2 WEEK BATTERY | |
| SUPPLY VOLTAGE | 24VAC, 4VA | |
| SHORTEST SWITCH TIME | 1 MINUTE | |
| CLOCK DISPLAY | 12 OR 24 HR FORMAT | |
| TERMINAL CONNECTIONS | SCREW TERMINAL, 16 AWG WIRE | |
| DAYLIGHT TIME CHANGEOVER | MANUAL OR AUTOMATIC | |
| HOLIDAY SCHEDULES | ONE | A |
| REMOTE CONTROL | NO | |
| PROGRAM DAYS | 7 DAY | B |
| MAX SCHEDULES | 42 TOTAL | C |
| MANUAL OVERRIDE | TEMPORARY, CONTINUOUS | D |
| SET BACK - NO ZONE | NO | E |

**Notes:**

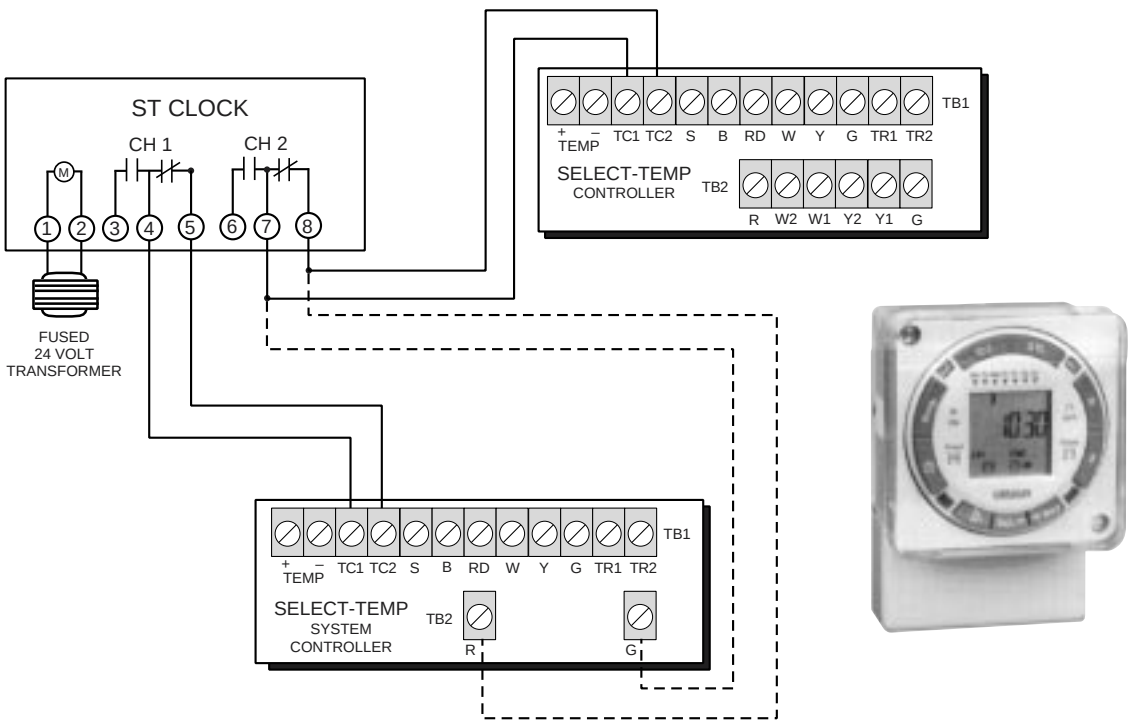
A. An "8th day," or Holiday program schedule can be entered for use on holidays or vacation periods. More than one ON or OFF time can be entered for the Holiday program. Up to 6 days in advance of a holiday, the Holiday program can be assigned to run. The Holiday program can run from 1 to 99 days.

B. Separate programs per channel can be assigned for each day of the week.

C. A schedule is one ON or OFF time. Up to 42 schedules can be assigned to any channel on any day.

D. The program for each channel can be independently overridden either temporarily or continuously. During temporary override, the output will reverse, ON to OFF or OFF to ON, until the next scheduled time when the programmed output will resume. Continuous override permanently turns ON or OFF the output until manually discontinued.

# SELECT-TEMP TIME CLOCK






- - - - Optional wiring. To run blower fan continuously in occupied mode and intermittently in unoccupied, wire channel 2 to R and G on TB2 of System Controller. Otherwise, Channel 2 can be used to control a second System Controller.

# ZONE DAMPERS

*Zonex Systems* zone dampers are used in cooling/heating systems to provide room by room zone control. The damper is provided with a factory mounted terminal board and zone actuator. Each zone damper is controlled by a zone thermostat. More than one damper can be controlled by one zone thermostat; see Slaving Dampers, page 20. Use this table to determine which zone dampers to use.

| DAMPER TYPE | MAXIMUM DIFFERENTIAL PRESSURE | MAXIMUM SYSTEM SIZE | MAXIMUM DUCT SIZE |
|---|---|---|---|
| ROUND MEDIUM PRESSURE | 1.75" | ANY SIZE | 18" |
| RECTANGULAR – MED. PRESSURE | 1" | 7.5 TONS | 24"W x 20"H |
| RECTANGULAR – HEAVY DUTY | 1.75" | ANY SIZE | 48"W x 48"H |
| D-FUSER | 0.1" | ANY SIZE | 10" |

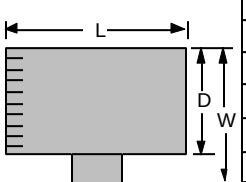
Maximum Differential Pressure refers to the maximum static pressure drop in inches of water column between the input (upstream) of the zone damper and the output (downstream) when the damper is closed.

## ROUND MEDIUM PRESSURE ZONE DAMPERS

*Zonex Systems* round medium pressure zone dampers are recommended for systems with a maximum differential static pressure up to 1.75". This power open / power close damper is manufactured from 20-22 gauge galvanized steel with rolled-in stiffening beads for superior rigidity. Mechanical minimum and maximum set stops are provided and easily adjustable. The damper is elliptical, which allows the airflow to be tracked linearly. The damper pipe is furnished with one crimped end and one straight end for easy installation. A hat section supports a reversing, 24V ac, 60Hz, 2.2 watt motor. A magnetic clutch allows for continuous power to the motor and longer motor life. Two set screws connect the motor to the damper shaft, allowing quick motor replacement if necessary. Motor drive time from full open to full close is 90 seconds.

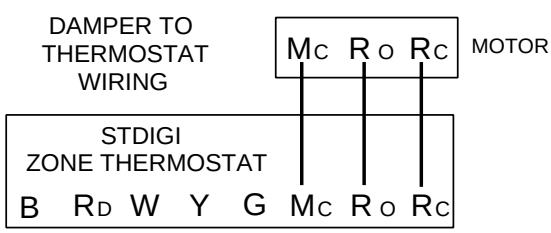
**MEDIUM PRESSURE (STMPD)**

## ROUND MEDIUM PRESSURE DAMPER PART NUMBERS AND SIZES




ROUND DIMENSIONAL DATA

| PART # | SIZE | D | L | W |
|---|---|---|---|---|
| STMPD06 | 6 | 6" | 10" | 10" |
| STMPD08 | 8 | 8" | 10" | 12" |
| STMPD10 | 10 | 10" | 12" | 14" |
| STMPD12 | 12 | 12" | 14" | 16" |
| STMPD14 | 14 | 14" | 16" | 18" |
| STMPD16 | 16 | 16" | 18" | 20" |
| STMPD18 | 18 | 18" | 20" | 22" |




## TYPICAL ROUND CAPACITIES

These air quantities were derived from a duct sizing chart 0.1" friction loss per 100' of duct. All CFMs listed are approximate. For accurate selection use duct sizing table or device.

| Duct Diameter | Nominal CFM | Duct Velocity FPM | Damper ΔP " WC |
|---|---|---|---|
| 6" | 110 | 540 | .014 |
| 8" | 250 | 700 | .015 |
| 10" | 410 | 750 | .015 |
| 12" | 660 | 850 | .022 |
| 14" | 1000 | 925 | .035 |
| 16" | 1450 | 1070 | .036 |
| 18" | 2000 | 1100 | .036 |

# ZONE DAMPERS

## RECTANGULAR ZONE DAMPERS

The rectangular zone dampers come in either medium pressure or heavy duty. For systems under 7.5 tons use medium pressure dampers. For systems 7.5 tons or over use heavy duty dampers. Motor drive time open and close is 90 seconds.

## RECTANGULAR MEDIUM PRESSURE ZONE DAMPERS

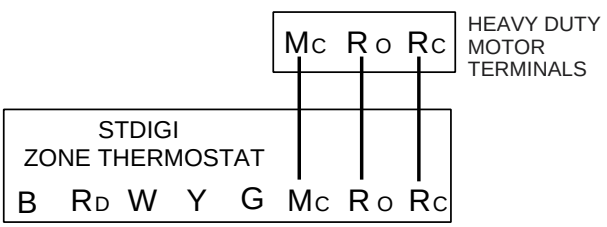
*Zonex Systems'* rectangular medium pressure dampers are recommended for systems under 7.5 tons with a maximum differential static pressure of 1". These are power open, power close dampers. They are constructed from heavy duty aluminum and stainless steel. The damper is an opposed blade type that slips into a 3-1/4 inch wide cutout in the existing duct and attaches with screws via a duct mounting plate. The duct mounting plate is 5 inches wide. A hat section supports a reversing, 24V ac, 60Hz, 2.2 watt motor. A magnetic clutch allows for continuous power to the motor and longer motor life. Two set screws connect the motor to the damper shaft, allowing quick motor replacement if necessary. Motor drive time from full open to full close is 90 seconds.

## RECTANGULAR HEAVY DUTY ZONE DAMPERS

*Zonex Systems'* rectangular heavy duty dampers are recommended for systems 7.5 tons or larger with a maximum differential static pressure of 1.75". These are power open, power close dampers made of 20 gauge "snap-lock" steel frame with S & Drive duct connections. Allow a 16 inch gap in the duct for the damper. Formed steel blade stops incorporate a gasket for quiet operation and improved structural rigidity. Rectangular dampers under 10" in height incorporate a single blade design. Dampers 10" or over use opposed blade design. A full stall motor, drawing 2.2W, and a terminal board control the damper position.

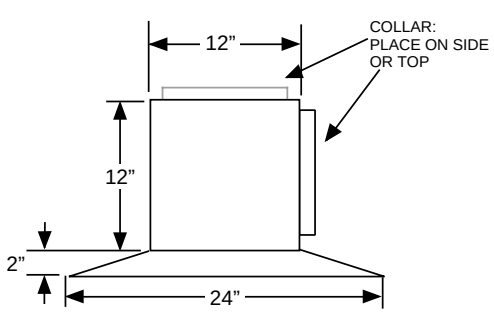
**MEDIUM PRESSURE (STMRTD) AND HEAVY DUTY (STCD) RECTANGULAR DAMPERS**

## HEAVY DUTY DAMPER TO THERMOSTAT WIRING




## D-FUSER ZONE DAMPER

*Zonex Systems'* D-Fuser is a combination zone damper and diffuser. It mounts in a standard 2' x 2' T-bar ceiling opening, providing for simple installation and easy maintenance access. The D-Fuser is a cone shaped fluidic nozzle with a platen that modulates up and down to control air flow. As the platen moves up, the air volume is reduced but the air velocity and throw remain constant. This keeps the air hugging the ceiling which maximizes room air mixing and minimizes the "waterfall" effect. The D-Fuser is a power open, power closed damper using a 24VAC 60HZ 5W motor. Motor drive time from full open to full close is 90 seconds. The D-Fuser connects to round duct either on the side or top. Collars are available for 6", 7", 8", 9" and 10" duct.



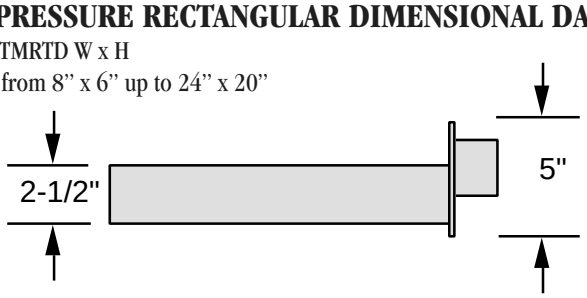

At neck velocities up to 700 FPM NC less than 30.

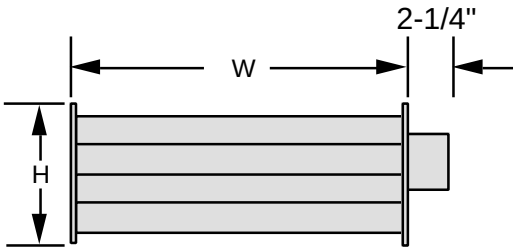
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6" | Neck Vel | 400 | 500 | 600 | 700 | 800 | 900 |
| | ΔP | 0.011 | 0.016 | 0.023 | 0.035 | 0.04 | 0.055 |
| | CFM | 80 | 98 | 120 | 135 | 157 | 176 |
| | Throw 50 FPM | 4' | 4' | 5' | 6' | 6' | 7' |
| 8" | Neck | 400 | 500 | 600 | 700 | 800 | 900 |
| | ΔP | 0.019 | 0.03 | 0.045 | 0.056 | 0.041 | 0.093 |
| | CFM | 140 | 170 | 207 | 247 | 280 | 315 |
| | Throw 50 FPM | 5' | 6' | 7' | 8' | 9' | 10' |
| 10" | Neck Vel | 400 | 500 | 600 | 700 | 800 | 900 |
| | ΔP | 0.029 | 0.045 | 0.066 | 0.09 | 0.12 | 0.146 |
| | CFM | 218 | 273 | 330 | 382 | 438 | 497 |
| | Throw 50 FPM | 6' | 8' | 9' | 10' | 11' | 12' |

# ZONE DAMPERS

## MEDIUM PRESSURE RECTANGULAR DIMENSIONAL DATA

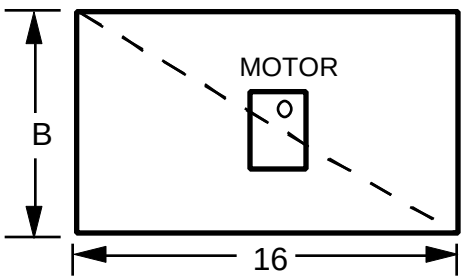
Part Number STMRTD W x H
Sizes available from 8" x 6" up to 24" x 20"

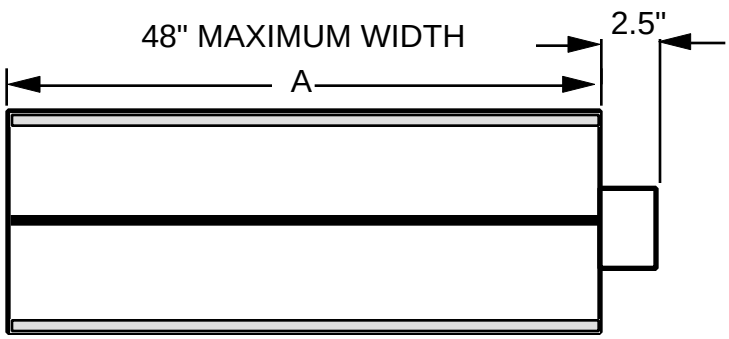



## HEAVY DUTY RECTANGULAR DIMENSIONAL DAMPER

Part Number STCD W x H
Sizes available from 8" x 8" up to 48" x 48"




| WIDTH | HEIGHT | DEPTH |
|---|---|---|
| A | B | 16" |

Rectangular dampers should operate at 1500 FPM.
E.G. A 24" x 12" damper = 2 square feet.
2 square feet X 1500 FPM = 3000 CFM.

## RECTANGULAR DAMPER CAPACITIES*

Dampers listed below are standard sizes. For larger sizes and capacities contact the factory.

| HEIGHT IN INCHES | WIDTH IN INCHES 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|
| 6 | 200 | 250 | 310 | 390 | 440 | 500 | 570 | 630 | 700 |
| 8 | 280 | 390 | 490 | 590 | 680 | 770 | 900 | 960 | 1090 |
| 10 | 390 | 510 | 650 | 800 | 950 | 1100 | 1220 | 1400 | 1500 |
| 12 | 490 | 650 | 850 | 1000 | 1200 | 1400 | 1600 | 1850 | 2000 |
| 14 | | | 1000 | 1250 | 1500 | 1750 | 2000 | 2250 | 2500 |
| 16 | | | 1200 | 1500 | 1800 | 2100 | 2450 | 2300 | 3000 |
| 18 | | | 1400 | 1750 | 2100 | 2500 | 2850 | 3080 | 3600 |
| 20 | | | | | | | | | 4000 |

* These air quantities were derived from a duct sizing chart .1" friction loss per 100' of duct. All CFMs listed are approximate. For accurate selection use duct sizing table or device.

# ZONE DAMPERS

## SIZING ZONE DAMPERS

If the ductwork already exists, simply size the damper to fit the ductwork. For new systems or retrofit jobs:

a) Determine CFM from heat gain or loss calculations.
b) Select damper size using either the round capacities chart, the rectangular capacities chart or by using a duct sizing table or calculator.
c) Select a *Zonex Systems* damper to fit the duct size selected for that zone.

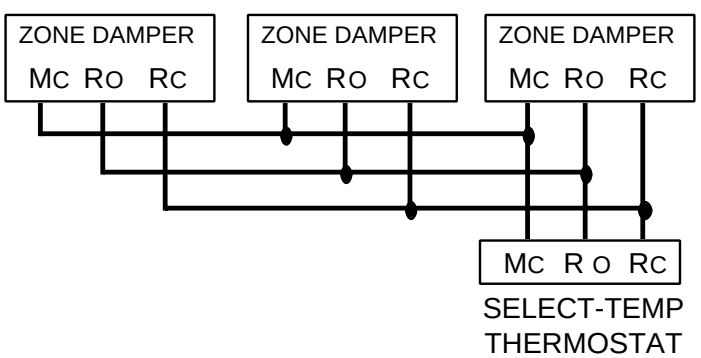
Make sure your zone dampers match the type specified in the table showing Maximum Differential Pressure.

## INSTALLATION NOTES

1. Do not exceed 700 FPM in a register/diffuser branch duct.
2. If a damper is installed within 3 feet of register/diffuser, install sound attenuating flex duct between damper and outlet.
3. Zone dampers should be preceded by 2'-4' of straight pipe where possible.
4. In attic installations and high humidity areas, the *Zonex Systems* damper should be insulated along with the duct work. The hat section on the round damper is delivered with insulation between the hat section and pipe. Therefore, insulation should be applied to the round pipe and be butted against the hat section, (do not insulate the motor). The motor generates enough heat so no condensation will develop on it.
5. Remember to allow a 16-inch gap in the duct for Heavy Duty rectangular dampers.
6. Medium pressure rectangular dampers slide into a 3¼-inch wide cutout in the side of the preexisting ductwork.

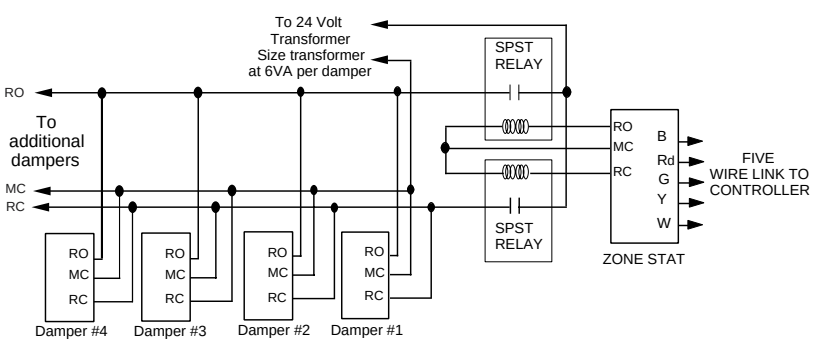
## SLAVING UP TO THREE ZONE DAMPERS

Up to three dampers can be directly controlled by one thermostat. To wire two to three zone dampers to one thermostat, use the following diagram shown. Remember to size the damper power transformer for the total number of zone dampers. Refer to the Transformer Sizing Table on page 36 and Five Wire Link Sizing Table on page 35.




## SLAVING MORE THAN THREE ZONE DAMPERS

Use the following diagram when a thermostat will be controlling more than three zone dampers. Use an additional 24V transformer sized at 6VA per damper to power the slaved dampers.



# BYPASS DAMPERS – ELECTRONIC

## ELECTRONIC BYPASS DAMPERS

Bypass dampers are used to provide constant air delivery through the air handling unit. This is done by bypassing excess air from the supply duct back to the return duct. As a zone is satisfied its zone damper closes. When this happens, the bypass damper opens just enough to bypass the excess air. This will control static pressure and noise at the diffusers.

The Electronic Bypass Damper can be used on any size system. The damper can be round or rectangular and multiple dampers can be slaved together. The Electronic Bypass Damper consists of a medium pressure round or a heavy duty rectangular damper and a static pressure sensor.

**RECTANGULAR & ROUND BYPASS DAMPER WITH THE STATIC PRESSURE CONTROL**

## SIZING ELECTRONIC BYPASS DAMPERS

When only the smallest zone is calling, the maximum amount of excess supply air will flow through the bypass damper.

## CFM CALCULATION

To determine the proper size bypass damper:

A) Calculate total air volume at 400 CFM per Ton.
B) Calculate air volume of smallest zone in CFM .
C) Calculate bypass CFM by subtracting the smallest zone air volume from the total. (A - B = C).

## ROUND BYPASS DAMPER SELECTION

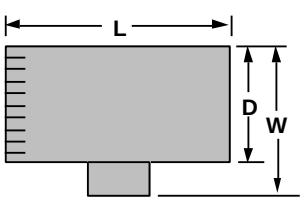
Once you know the bypass CFM requirement as determined in the "CFM calculation" section, use the ROUND BYPASS SELECTION TABLE. From the table, select the bypass damper with the CFM rating equal to or greater than the value calculated in step C of CFM Calculation.

**Example:** We know the smallest zone air volume is 250 CFM and we have a four ton system. Thus the air volume we need to bypass is ((400 X 4) -250) which equals 1350 CFM.

Never exceed 16 inches for the round bypass damper. If you need to bypass more, either use a rectangular bypass or slave multiple round bypass dampers.

**ROUND DIMENSIONAL DATA**

| PART # | SIZE | D | L | W |
|---|---|---|---|---|
| STMPD06 | 6 | 6" | 10" | 10" |
| STMPD08 | 8 | 8" | 10" | 12" |
| STMPD10 | 10 | 10" | 12" | 14" |
| STMPD12 | 12 | 12" | 14" | 16" |
| STMPD14 | 14 | 14" | 16" | 18" |
| STMPD16 | 16 | 16" | 18" | 20" |

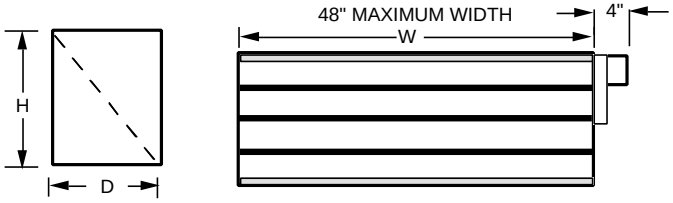



## RECTANGULAR BYPASS DAMPER SELECTION

Once you know the bypass CFM requirement as determined in the "CFM calculation" section, use the RECTANGULAR BYPASS SELECTION TABLE, on page 22. From the table, select the bypass damper with the CFM rating equal to or greater than the value calculated in step C of CFM Calculation.

**Example:** We know the smallest zone air volume is 250 CFM and we have a 7-1/2 ton system. Thus the air volume we need to bypass is ((400 X 7.5) -250) which equals 2750 CFM. Using the RECTANGULAR BYPASS SELECTION TABLE, we see the smallest damper we can use is a 12" x 22" or a 22" x 12".

RECTANGULAR BYPASS DAMPERS
SELECT FROM 8 X 8 THRU 48 X 48




| WIDTH | HEIGHT | DEPTH |
|---|---|---|
| W | H | 16" |

Part Number STCD W X H

Rectangular bypass dampers should operate at 1500 FPM*
E.G. A 24" x 12" damper = 2 square feet.
2 square feet X 1500 FPM = 3000 CFM.
* FPM = Feet Per Minute

# BYPASS DAMPERS – ELECTRONIC

## RECTANGULAR BYPASS SELECTION TABLE

| HEIGHT IN INCHES ↓ / WIDTH IN INCHES → | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 28 | 32 | 36 | 40 | 44 | 48 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **8** | 667 | 833 | 1000 | 1167 | 1333 | 1500 | 1667 | 1833 | 2000 | 2333 | 2667 | 3000 | 3333 | 3667 | 4000 |
| **10** | 833 | 1042 | 1250 | 1458 | 1667 | 1875 | 2083 | 2292 | 2500 | 2917 | 3333 | 3750 | 4167 | 4583 | 5000 |
| **12** | 1000 | 1250 | 1500 | 1750 | 2000 | 2250 | 2500 | 2750 | 3000 | 3500 | 4000 | 4500 | 5000 | 5500 | 6000 |
| **14** | 1167 | 1458 | 1750 | 2042 | 2333 | 2625 | 2917 | 3208 | 3500 | 4083 | 4667 | 5250 | 5833 | 6417 | 7000 |
| **16** | 1333 | 1667 | 2000 | 2333 | 2667 | 3000 | 3333 | 3667 | 4000 | 4667 | 5333 | 6000 | 6667 | 7333 | 8000 |
| **18** | 1500 | 1875 | 2250 | 2625 | 3000 | 3375 | 3750 | 4125 | 4500 | 5250 | 6000 | 6750 | 7500 | 8250 | 9000 |
| **20** | 1667 | 2083 | 2500 | 2917 | 3333 | 3750 | 4167 | 4583 | 5000 | 5833 | 6667 | 7500 | 8333 | 9167 | 10000 |
| **22** | 1833 | 2292 | 2750 | 3208 | 3667 | 4125 | 4583 | 5042 | 5500 | 6417 | 7333 | 8250 | 9167 | 10083 | 11000 |
| **24** | 2000 | 2500 | 3000 | 3500 | 4000 | 4500 | 5000 | 5500 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 | 12000 |
| **28** | 2333 | 2917 | 3500 | 4083 | 4667 | 5250 | 5833 | 6417 | 7000 | 8167 | 9333 | 10500 | 11667 | 12833 | 14000 |
| **32** | 2667 | 3333 | 4000 | 4667 | 5333 | 6000 | 6667 | 7333 | 8000 | 9333 | 10667 | 12000 | 13333 | 14667 | 16000 |
| **36** | 3000 | 3750 | 4500 | 5250 | 6000 | 6750 | 7500 | 8250 | 9000 | 10500 | 12000 | 13500 | 15000 | 16500 | 18000 |
| **40** | 3333 | 4167 | 5000 | 5833 | 6667 | 7500 | 8333 | 9167 | 10000 | 11667 | 13333 | 15000 | 16667 | 18333 | 20000 |
| **44** | 3667 | 4583 | 5500 | 6417 | 7333 | 8250 | 9167 | 10083 | 11000 | 12833 | 14667 | 16500 | 18333 | 20167 | 22000 |
| **48** | 4000 | 5000 | 6000 | 7000 | 8000 | 9000 | 10000 | 11000 | 12000 | 14000 | 16000 | 18000 | 20000 | 22000 | 24000 |

Bypass air in CFM. Calculated at 1500 FPM.
Formula used: B = W X H / 144 X 1500, where B = Bypass air in CFM, W = damper width in inches, H= damper height in inches, 144 = 144 sq. inches per sq. ft., 1500 = 1500 FPM.

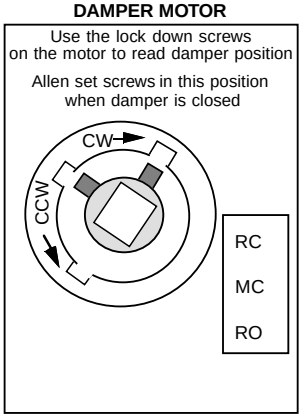
## PROPER BYPASS INSTALLATION WITH ECONOMIZER

To size the bypass damper(s), subtract the smallest calling zone CFM from the total unit CFM. The difference is the CFM required to bypass. Refer to the bypass damper selection table on p. 21-22 to determine required dimensions.

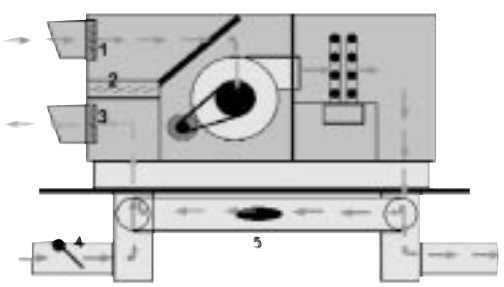
**IMPORTANT NOTE:** USE OF A BAROMETRIC TYPE BACKDRAFT DAMPER UPSTREAM OF THE BYPASS RETURN TAKE-OFF IS SUGGESTED WHEN AN ECONOMIZER IS INSTALLED. Refer to #4 on RTU diagram. If back draft measures are not taken, it is possible to pressurize the return, and force bypass air into the conditioned space through the return grill(s). Erratic zone temperature control may occur if the return duct becomes pressurized.

## BYPASS POSITION INDICATORS

**ROUND AND RECTANGULAR HEAVY DUTY BYPASS DAMPER MOTOR**

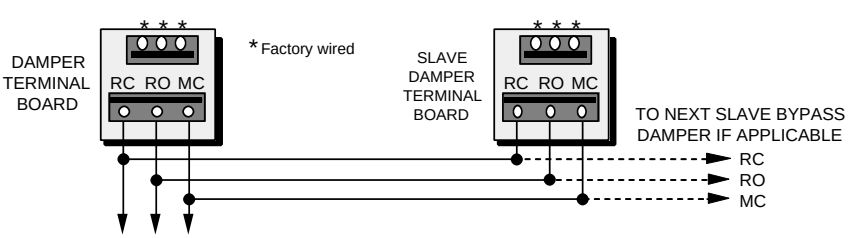



1. Outside Air Intake
2. Mixing Damper for Outside Air & Return Air
3. Pressure Relief of Outside Air from Building
4. Barometric Damper to Prevent Return Air Pressurization
5. Modulating Bypass Damper




## SLAVING BYPASS DAMPERS

Use only one Pressure Sensor when slaving two or more Bypass Dampers together. Connect the Pressure Sensor to one damper as described above. Connect the slave dampers in parallel as shown. The slaved dampers will self synchronize each time the dampers reach full open or full close.



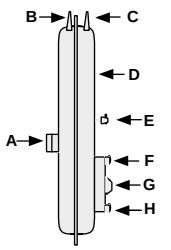

To Static Pressure Controller As Shown On The Bypass Wiring Diagram On The Next Page

# BYPASS DAMPER – STATIC PRESSURE CONTROLLER

The Static Pressure Controller controls a standard medium pressure round damper (STMPD) or the heavy duty rectangular damper (STCD) by maintaining constant static pressure in the duct downstream of the bypass takeoff. As the zone dampers close, the static pressure increases. When this happens, the static pressure controller opens the bypass damper to bring the static pressure back to the setpoint.

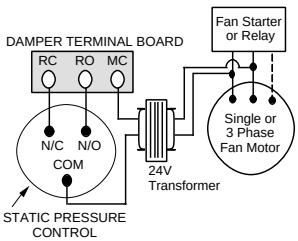
## STATIC PRESSURE CONTROLLER DESCRIPTION

A: Mounting tabs.
B: Supply air barb.
C: Reference air, "LOW", barb.
D: Diaphragm must be mounted vertically.
E: Pressure adjusting screw.
F: Normally closed, N/C, terminal.
G: Normally open, N/O, terminal.
H: Common, COM, terminal.

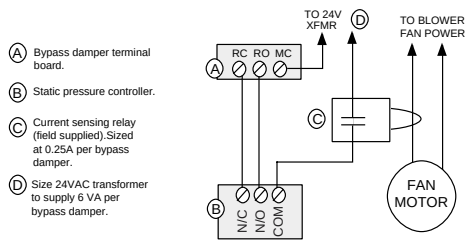



*Zonex Systems* recommends de-energizing the bypass damper when the blower fan turns off. If not installed as recommended, when the blower fan turns off, the bypass will fully close. Then when the blower fan turns back on, there could be excessive air supplied to the calling zone, causing excessive air noise, until the bypass is able to open sufficiently.

**HARD WIRED TO BLOWER FAN**

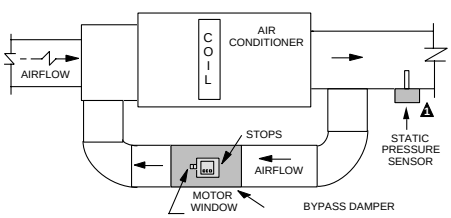



**ALTERNATE WIRING USING CURRENT SENSING RELAY**




## STATIC PRESSURE CONTROLLER INSTALLATION

a) Select location for pressure sensor tube. Location should be in supply duct, downstream of bypass takeoff, upstream of any zone dampers and perpendicular to the air flow.
b) Drill 5/16" hole at selected location for pressure sensor tube.
c) Mount Static Pressure Controller near the drilled hole with the diaphragm of the sensor vertical. The controller must be mounted on a stable, non vibrating surface.
d) Attach 5/16" pressure sensor tube, supplied, to the barb of the Static Pressure Controller located closest to the mounting tabs. The other barb, labeled "LOW", is left open if the Controller is in the conditioned building. If the Controller is located outside the building, another tube, not provided, must be connected between the "LOW" barb and a location inside the building.
e) Remove the terminal cover and wire as shown in the wiring diagram.
f) Reattach terminal cover. Installation is complete. Proceed to Static Pressure Controller Setup.




## STATIC PRESSURE CONTROLLER SETUP

a. At the system controller:
   1. Disconnect the Y wire on the bottom terminal block, TB2.
   2. Set HEAT switch to OFF.
   3. Set COOL switch to ON.
   4. Set Fan switch to ON.
   5. Set PWR switch to ON.
b. Lower the cool setpoint on all zone thermostats to their lowest setting.
c. The blower fan should be running at high speed and all zone dampers should be fully open.
d. The bypass damper should be in the full closed position. Adjust the 101ASPC static pressure switch CW to ensure damper remains in the closed position.
e. Remove wires from the 101ASPC static pressure switch (C, NO, & NC).
f. Connect a Volt / Ohm Meter (VOM) to the common (C) and normally open (NO) terminals of the 101ASPC static pressure sensor.
   1. Verify open between C and NO terminals.
   2. Verify continuity between C and NC terminals.
g. Turn the adjustment screw CW on the 101ASPC until continuity is read between C and NO terminals – STOP.
h. Slowly turn the adjusting screw CCW until the VOM reads open then turn adjusting screw CW until continuity is read at the meter – STOP.
i. The 101ASPC static pressure switch is now calibrated. Reconnect all wiring and set all switches to their normal operating position.

Note: The reversing motor used on Zonex Systems' bypass dampers allows voltage to be read on both terminals (RC & RO). To determine if the static sensor is opening or closing the damper, remove wires from RC (run closed) or RO (run open) before checking voltage.

## BYPASS CHECKOUT FOR STATIC PRESSURE CONTROLLER

a) Have at least half of the zones call for heating or cooling.
b) Check to be sure the calling zone dampers are open (air is flowing).
c) Verify that the bypass damper is slightly open by looking at the pointer on the damper. See the drawing on the previous page.
d) If the open zones are not noisy, the pressure control is calibrated.

[1]For the Heat Pump System Controller (STACB-HP), disconnect Y1 and Y2 on TB2. For GE systems that run the blower fan at a higher speed in cool mode than in fan only mode, don't disconnect Y from TB2 of System Controller. Instead, disable the compressor(s) by disconnecting it directly at the compressor contactor(s) and, if using the CAPL-2 or CAPL-4 Capacity Controller, turn its power switch off to enable all stages.

# CAPACITY CONTROLLERS

An HVAC system is sized to handle the load of an entire home or building. Because of this, when all the zones are not calling, the load to the HVAC system can diminish below its designed capacity. Left unchecked, the A/C coil could freeze up causing compressor slugging or the furnace could overheat causing premature heat exchanger failure. To compensate for this, a Capacity Controller is needed.

The basic function of the Capacity Controller is to monitor the leaving air temperature and cycle the unit on and off to maintain a leaving air temperature within set parameters. *Zonex Systems* offers five unique capacity controllers for the Select-Temp system to meet all your application needs: TRLAT, 101CAPGE, CAPL-2, CAPL-4 and LAS.

**CAPACITY CONTROLLER SELECTION**

Select the Capacity Controller best suited for your application based on the following table and feature list.

| P/N | GE/HP | # STAGES | ECONO CNTRL | CUT-IN | SET-POINT | LEAVING AIR DISPLAY | COMPRESSOR MIN. RUN | FAN CONTROL |
|---|---|---|---|---|---|---|---|---|
| 101CAPGE | GE | 1 HT, 1 CL | NO | NO | FULL RANGE | YES | NO | NO |
| TRLAT | GE | 1 HT, 1 CL | NO | NO | 4 HT, 4 CL | NO | NO 1 | YES |
| CAPL-2 | GE | 2 HT, 2 CL | YES | YES | FULL RANGE | YES | YES | YES |
| CAPL-4 | GE | 4 HT, 4 CL | YES | YES | FULL RANGE | YES | YES | YES |
| 101ALAS | HP | 3 HT, 2 CL | NO | NO | FULL RANGE | NO | NO | NO |

1 4 minute minimum run is initiated after first limit cycle has occurred.

## FEATURE LIST

**GE/HP –** Gas/Electric or Heat Pump. For Gas/Electric HVAC systems, select GE. For heat pumps select HP unless heat pump uses GE thermostats (no external reversing valve control), then select GE.

**# STAGES –** Maximum number of HVAC system heat and cool stages.

**ECONO CNTRL –** This feature treats the economizer as another stage of cooling to provide enhanced supply air temperature control. Recommended for HVAC systems with an economizer.

**CUT-IN** – This advanced feature separates the cut-in setpoint from the cut-out setpoint. This permits better staging and leaving air temperature control. Example: Without this feature, in cool mode with a cut-out setpoint of 48 degrees, the compressor will turn off if the leaving air drops below 48 and, after a time delay, turn back on when the air rises above 48. With this feature, if the cut-out is 48, the cut-in will be 58. If the air drops below 48 the compressor will turn off. It will not turn on until the air temperature rises above 58 and a time delay has elapsed. This gives longer compressor running times and maintains a more comfortable leaving air temperature.

**SETPOINT** – Number of setpoints available for heat and cool.

**LEAVING AIR DISPLAY** – Digitally displays the leaving air temperature. This is useful for troubleshooting and system monitoring.

**COMPRESSOR MIN. RUN** – Runs the compressors a minimum of four minutes whenever they are energized. This ensures proper oil return and increased compressor life.

**FAN CONTROL** – Runs the indoor blower fan during capacity cut-out. This ensures the heat exchanger properly cools down and the AC coil warms up during capacity cut-out. It also provides better zone temperature control by providing conditioned air during capacity cut-out periods. This feature is not provided or necessary for heat pumps because blower fan is continuously energized as long as there is a call. This feature is also not necessary if blower fan is run continuously.

# CAPACITY CONTROLLERS – TRLAT

## OVERVIEW

The *Zonex Systems* TRLAT is a single stage Gas/Electric or Heat Pump Capacity Controller However, the heat pump feature is not compatible with the Select-Temp Zoning Systems so we will only address the Gas/Electric features. If you have a heat pump that uses heat pump controls, refer to the 101ALAS Section, on page 29.

The TRLAT Capacity Controller protects both the air conditioner and furnace. It simply measures the leaving air temperature. If the air gets too cold (drops below the cool cutout setpoint), it breaks the "Y" connection, disengaging the compressor. If the air gets too warm (rises above the heat cut-out setpoint), it breaks the "W" connection, de-energizing the furnace. To prevent short cycling, the compressor or furnace cannot reenergize for at least four minutes after cut-out. The heating and cooling cut-out setpoints can be changed by the installer.

## OPERATION

**Cool mode:** If the leaving air temperature drops below the TRLAT cooling setpoint (field settable to 41, 44, 47 or 50 degrees Fahrenheit), the Y (Controller) breaks from Y (Unit) and makes to G. This turns off the compressor and keeps the indoor blower fan running to warm up the evaporator. Four minutes after the leaving air temperature rises above the cooling setpoint, Y (Controller) makes to Y (Unit) and breaks to G. This restarts the compressor and returns indoor blower fan control to the System Controller.

**Heat mode:** If the leaving air temperature rises above the TRLAT heating setpoint (field settable to 125, 140, 150 or 160 degrees Fahrenheit), the W (Controller) breaks from W (Unit) and makes to G. This turns off the heater and keeps the indoor blower fan running to cool down the heater. Four minutes after the leaving air temperature drops below the heating setpoint, W (Controller) makes to W (Unit) and breaks to G. This restarts the heater and returns indoor blower fan control to the heater or System Controller.

**Cut-out disable:** The cool cutout is disabled in heat mode. The heat cutout is disabled in cool mode. This permits the heat to turn on in a cold building and the air conditioner to turn on in a hot building. For heat pumps, this also prevents the compressor from cycling off when the heat pump is in defrost mode. The O/B (Controller) input tells the TRLAT which mode of operation (heat or cool) is active.

**NOTE: For GE systems, a jumper wire (factory installed) must be connected between O/B (Controller) and W (Controller).**

## COMPONENTS

A. Status Lights:
DELAY (red): On when compressor or furnace is disabled.
PWR (green): On when TRLAT is powered. Flash-4 minute minimum run delay.

B. Jumpers:
GE/HP: For gas/electric systems, place jumper on GE and center pin. For heat pumps, place jumper on HP and center pin (Digitract Systems only).
O/B: For heat pumps, if reversing valve is energized in cool mode, place jumper on O and center pin. If reversing valve is energized in heat mode, place jumper on B and center pin.

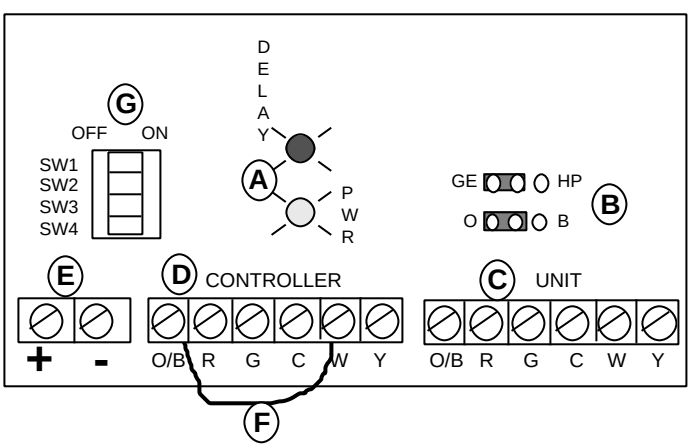
C. Unit terminal block: Connects to HVAC unit. O/B – Reversing Valve; R – 24V AC hot; G – Blower fan; C – 24V AC rtn; W – heat; Y – compressor. See WIRING section on p. 26 for detailed wiring instructions.

D. Controller terminal block: Connects to System Controller. Terminal designations same as for Unit terminal block. See WIRING section on p. 26 for detailed wiring instructions.

E. Leaving Air Sensor (LAS) Terminals: Leaving air temperature sensor is connected to the TRLAT here. Red to + and white to –. The sensor monitors the leaving air of the HVAC system. If preferred, the TRLAT can be mounted up to 500 feet from the sensor. See INSTALLATION section on p. 34 for further information.

F. Jumper wire: Factory installed. Must be connected between O/B (Controller) and W (Controller) for GE systems and removed for heat pumps.

G. Setpoint Select: Sets the heat and cool cutoff setpoints. See SETPOINT SETUP, TRLAT section on p. 26.

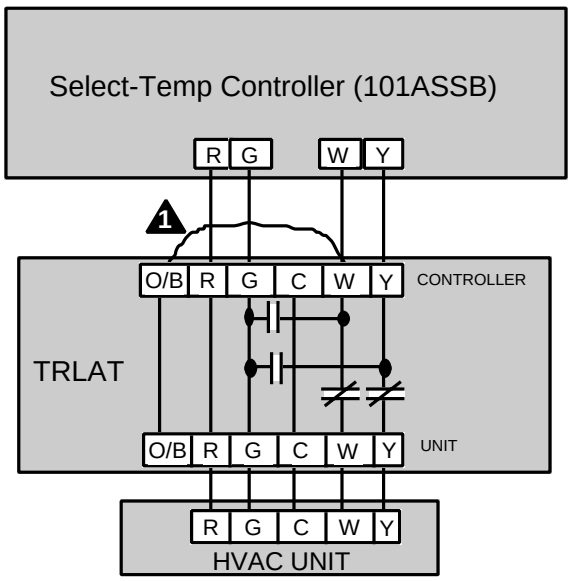


## SETPOINT SET UP, TRLAT

A four pole dip switch is used to designate the desired heat and cool cutoff setpoints. Using the table below, set the switch positions to correspond to the cutoff temperatures desired. For heat pumps, the heat cutoff point is 118° and unchangeable.

| | | **Cool Cut-out** |
|---|---|---|
| SW1 | SW2 | |
| On | On | 50 Deg F |
| On | Off | 47 Deg F |
| Off | On | 44 Deg F |
| Off | Off | 41 Deg F |
| | | **Heat Cut-out** |
| SW3 | SW4 | |
| On | On | 125 Deg F |
| On | Off | 140 Deg F |
| Off | On | 150 Deg F |
| Off | Off | 160 Deg F |

## TRLAT WIRING




The TRLAT is installed as detailed in the Capacity Controllers Installation section, page 34. Wire as shown above.

**1 WARNING**

Jumper wire (factory installed) must be connected for GE applications between W (Controller) and O/B (Controller). If not, the TRLAT will not shut off the heater when the heat setpoint is exceeded.

# CAPACITY CONTROLLERS – 101CAPGE

## OVERVIEW

The 101CAPGE is a single-stage Gas/Electric Capacity Controller that digitally displays leaving air temperature. It should be utilized for single stage applications. For multistage HVAC systems, use either the CAPL-2 or CAPL-4 Capacity Controller.

The *Zonex Systems* 101CAPGE capacity controller protects both the air conditioner and furnace. It simply measures the leaving air temperature. If the air gets too cold (drops below the cool cutout setpoint), it breaks the "Y" connection, de-energizing the compressor. If the air gets too warm (rises above the heat cutout setpoint), it breaks the "W" connection, de-energizing the furnace. To prevent short cycling, the compressor or furnace cannot reenergize for at least four minutes after cutout. The heating and cooling cutout setpoints can be changed by the installer.

The 101CAPGE has a three digit LED display and two push buttons. Normally the leaving air temperature is displayed. When the push buttons are pressed the cut-out setpoints are displayed.

## OPERATION

The 101CAPGE has three modes of operation: In Range, Out of Range and Enable Mode. The 101CAPGE is a single stage capacity control. Omit use of Y2 and W2 terminals, if present.

**In Range –** If the leaving air temperature is between the cool and heat cutout setpoints and the 101CAPGE is not in cutout time delay, light DL1 is off and relay K1 is made, permitting the System Controller to energize the compressor or furnace. The leaving air temperature is displayed on the digital display during this time.

**Out of Range –** If the leaving air temperature drops below the cool cutout setpoint or rises above the heat cutout setpoint, light DL1 is lit and the relay contacts between Y1 Y1 and W1 W1 break, de-energizing the compressor or furnace. Four minutes after the leaving air temperature has returned within operating range light DL1 is turned off and the relay contacts close, making Y1 Y1 and W1 W1 and energizing the furnace or compressor. The leaving air temperature is displayed on the digital display during this time.

**Enable Mode –** On the digital display, "E" followed by the leaving air temperature indicates that the 101CAPGE is in the Enable Mode. The purpose of this mode is to ensure the furnace can turn on in a cold building and the air conditioner can turn on in a hot building. Enable Mode is entered if the leaving air temperature is below the cool cutout setpoint or above the heat cutout setpoint for more than eight minutes. The relay contacts are made during this mode, enabling the furnace or air conditioner to run. After the leaving air temperature has returned within operating range the 101CAPGE will return to normal operation, displaying only the leaving air temperature.

## COMPONENTS

The 101CAPGE consists of the following:

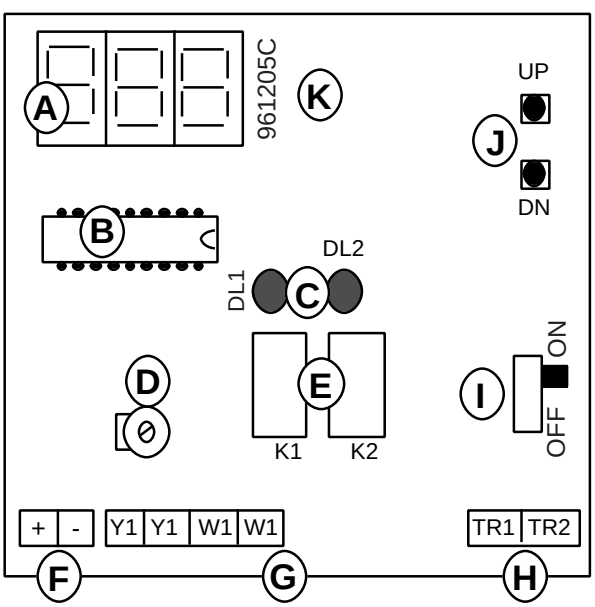
A. **Digital Display –** Three digit LED. Normally displays the leaving air temperature of the HVAC unit. When "E" is displayed, it indicates 101CAPGE is in Enable mode; refer to OPERATION section. When the UP/DN buttons are pressed, the cutout setpoints are displayed. Refer to the setpoint Calibration section for reading and adjusting the setpoints, p. 35.

B. **Microcontroller –** Responsible for activation and control of outputs based upon zone demand and leaving air temperature. Occasionally software upgrades may become available. If so, the 101CAPGE software can be field upgraded by changing this microcontroller.

C. **Cut-out Indicator Lights –** DL1 light is on when relay K1 is energized. DL2 light is on when relay K2 is energized. See E.

D. **Sensor Calibrator** – Leaving air sensor (LAS) calibration – Potentiometer used to calibrate the LAS, if required. Refer to CALIBRATION section on p. 35 for complete instructions.

E. **Relay K1 –** DPDT, NC relay. When K1 is energized, it breaks contact between Y1 Y1 and W1 W1 terminals.




F. **Leaving Air Sensor (LAS) Terminals –** Leaving air temperature sensor is connected to the 101CAPGE here. Red to + and white to –. The sensor monitors the leaving air of the HVAC system. If preferred, the 101CAPGE can be mounted up to 500 feet from the sensor. See INSTALLATION section on p. 34 for further information.

G. **HVAC/System Controller Interface Terminals** – Y1 cycles the compressor output, and W1 cycles the heating output. (Y2 and W2 terminals, if present, are not used.) Connect Y1 and W1 from the system controller's TB2 terminals to Y1 and W1 respectively on the 101CAPGE. Refer to wiring section below for detailed wiring instructions.

H. **Power Source Terminals** – Connect to 24V AC power source. Recommend using either the HVAC unit transformer or the System Controller transformer. 101CAPGE uses less than 2 VA of power. See WIRING section for detailed wiring instructions.

I. **Power Switch** – When off, the display is off, the 101CAPGE is disabled and the relay contacts are closed. The HVAC unit can run at this time but will not have capacity control protection. When the switch is on, the display is on and the 101CAPGE is operational.

J. **Setpoint Adjustment** – Use the UP/DN buttons to view and change the cut-out setpoints. Refer to the Setpoints, Calibration section (Page 35) for reading and adjusting the setpoints.

K. **Board Number** – This number indicates the circuit board number and revision. You may need to know this number if conferring with technical support.

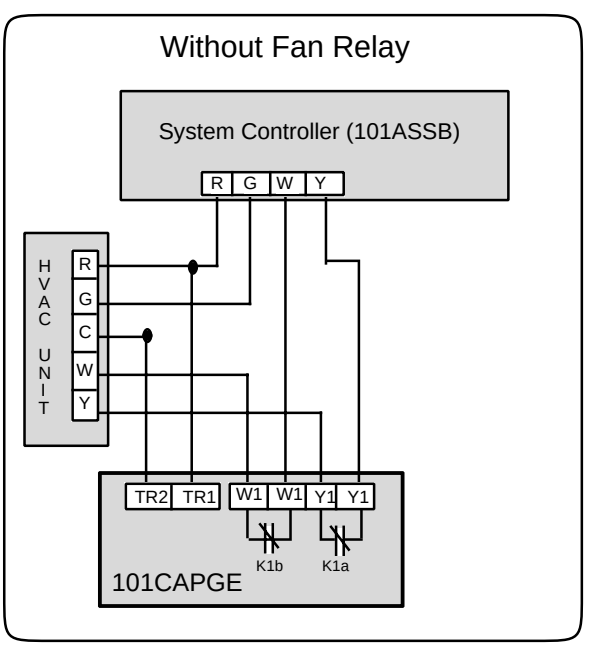
## 101CAPGE WIRING

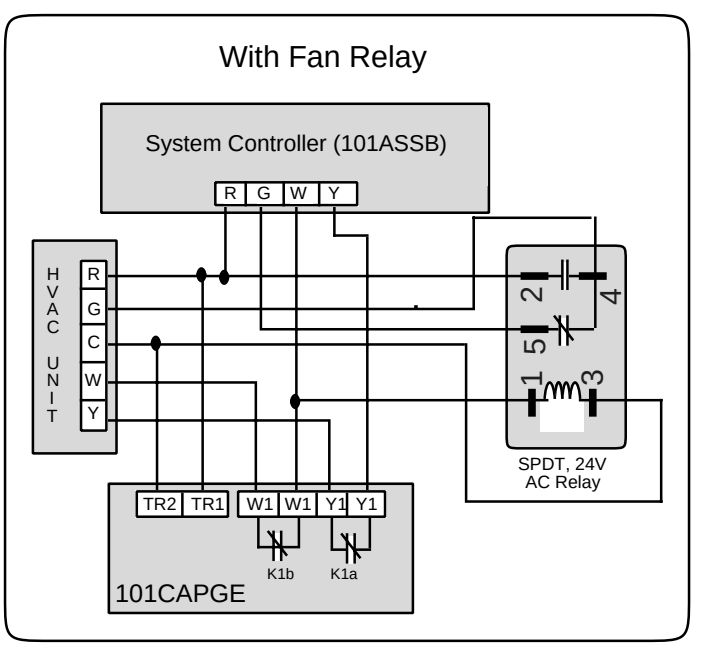
The 101CAPGE is installed as detailed in the Capacity Controllers installation section, Page 34. The following wiring diagrams show how to wire the 101CAPGE to the System Controller and the HVAC unit. Terminals TR1 and TR2 of the 101CAPGE can be wired either to R and C of the HVAC Unit or to TR1 and TR2 of the System Controller.

There are two ways of wiring the 101CAPGE: without a fan relay and with a fan relay.

Use the "Without Fan Relay" drawing if the indoor blower fan will be running continuously or the furnace keeps the indoor blower fan on for at least three minutes after the heat call is removed (W de-energized).

Use the "With Fan Relay" drawing if the indoor blower fan will not be running continuously and the furnace does not keep the indoor blower fan on for at least three minutes after the heat call is removed (W de-energized).



# CAPACITY CONTROLLERS - 101ALAS

## OVERVIEW

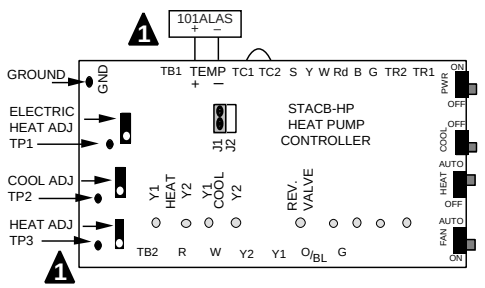
The 101ALAS works with the Select-Temp Heat Pump System Controller (STACB-HP). The 101ALAS provides leaving air temperature readings to the System Controller, which allows it to make capacity control decisions.

## OPERATION

The STACB-HP System Controller has four status lights that represent capacity control. The heat Y1 and Y2 red lights indicate heating operation and the cool Y1 and Y2 green lights indicate cooling operation. Heating and cooling are both marked Y1 and Y2, because those are the terminals on TB2 which are activated when stage one or stage two are requested. Heating or cooling will be initiated depending on the position of the reversing valve. When one of the lights turns on, the leaving air temperature in the duct, sensed by the LAS, has exceeded one of the capacity control temperature triggers. The light will indicate which stage will be turned off. The capacity control factory default limits on heating are 105°F for Y2 (second stage), and 120°F for Y1 (first stage). For cooling, the limits are 50°F for Y2 (second stage), and 45°F for Y1 (first stage). If one of these triggers is exceeded, a stage light will illuminate. The stage will be shut down, and a four-minute time delay will begin. This time delay will also be indicated by the "Rev Valve" light flashing. After the four minute delay, if the leaving air temperature has recovered to an acceptable temperature, the stage which was shut down will restart. If the temperature has not recovered, the time delay will continue. If both first and second stage temperature triggers are exceeded by the leaving air, then a four minute time delay per stage will go into effect.

## MODIFYING SETPOINT ADJUSTMENT

The Heat Pump Controller is designed so that it is possible to modify the capacity control setpoints for cooling, heating (and electric heat on the Heat Pump Controller). If you feel this is necessary, locate the potentiometer that needs modifying and its test point on the diagrams above. "GND" is the ground test point, TP2 is the cool test point and TP3 is the heat test point. (TP1 is the electric heat test point on the Heat Pump Controller). Clip the leads of a digital volt meter, set to 20 volts DC, between the potentiometer test point that needs to be modified and the ground test point. Rotate the corresponding potentiometer until the meter reads the proper voltage according to the tables below.




## WIRING

Install the 101ALAS as detailed in the Capacity Controllers section, p. 34. NOTE: Ensure the red lead is secured to the + terminal, and the white lead is secured to the – terminal.

# LAS VOLTAGE CONVERSION CHARTS

## TABLE 1: CAPACITY CONTROL SETTINGS

**Table 1 below represents the factory default settings.**

| Function | Temp. °F | Test Points | DC Voltage |
|---|---|---|---|
| W2 Auxiliary heat cut in | 85 | TP1 and GND | 3.043 |
| Y2 cool cut out | 50 | TP2 and GND | 2.885 |
| Y2 heat cut out | 105 | TP3 and GND | 3.082 |
| Actual LAT | – | + and – | Per table 2 |

NOTE: The **Y2 cut out** is referenced for the voltage measurement in Table 1 above for the heat and cool modes.

***Cool mode*** – **Y1 cut out** is a fixed 5° differential below the Y2 cut out. The Y2 cut in is a fixed 10° differential above the Y2 cut out temperature. Example:

| Y2 cool OFF | Y2 ON | Y1 OFF |
|---|---|---|
| 50° | 60°F | 45°F |

***Heat mode*** – **Y1 cut out** is a fixed 15° differential below the Y2 cut out. The Y2 cut in is a fixed 10° differential below the Y2 cut out temperature. Example:

| Y2 cool OFF | Y2 ON | Y1 OFF |
|---|---|---|
| 105° | 95°F | 120°F |

***IMPORTANT:*** Use a DVM capable of measuring DC volts, accurate three places to the right of the decimal for all LAS and setpoint measurements.

## TABLE 2: TEMPERATURE TO VOLTAGE CONVERSION CHART

| Deg. F. | LAS | Y2 Cool OFF | Y2 Heat OFF | W2 ON | Deg. F. | LAS | Y2 Cool OFF | Y2 Heat OFF | W2 ON |
|---|---|---|---|---|---|---|---|---|---|
| 40 | 2.775 | 2.828 | 2.729 | 2.799 | 88 | 3.043 | 3.100 | 2.990 | 3.060 |
| 41 | 2.781 | 2.834 | 2.735 | 2.804 | 89 | 3.048 | 3.105 | 2.995 | 3.065 |
| 42 | 2.787 | 2.839 | 2.740 | 2.810 | 90 | 3.054 | 3.111 | 3.001 | 3.071 |
| 43 | 2.792 | 2.845 | 2.745 | 2.815 | 91 | 3.059 | 3.117 | 3.006 | 3.076 |
| 44 | 2.798 | 2.851 | 2.751 | 2.821 | 92 | 3.065 | 3.122 | 3.012 | 3.082 |
| 45 | 2.803 | 2.856 | 2.756 | 2.826 | 93 | 3.070 | 3.128 | 3.017 | 3.087 |
| 46 | 2.809 | 2.862 | 2.762 | 2.832 | 94 | 3.076 | 3.134 | 3.023 | 3.092 |
| 47 | 2.814 | 2.868 | 2.767 | 2.837 | 95 | 3.082 | 3.139 | 3.028 | 3.098 |
| 48 | 2.820 | 2.873 | 2.773 | 2.842 | 96 | 3.087 | 3.145 | 3.033 | 3.103 |
| 49 | 2.825 | 2.879 | 2.778 | 2.848 | 97 | 3.093 | 3.151 | 3.039 | 3.109 |
| 50 | 2.831 | 2.885 | 2.783 | 2.853 | 98 | 3.098 | 3.156 | 3.044 | 3.114 |
| 51 | 2.837 | 2.890 | 2.789 | 2.859 | 99 | 3.104 | 3.162 | 3.050 | 3.120 |
| 52 | 2.842 | 2.896 | 2.794 | 2.864 | 100 | 3.109 | 3.168 | 3.055 | 3.125 |
| 53 | 2.848 | 2.902 | 2.800 | 2.870 | 101 | 3.115 | 3.173 | 3.061 | 3.130 |
| 54 | 2.853 | 2.907 | 2.805 | 2.875 | 102 | 3.120 | 3.179 | 3.066 | 3.136 |
| 55 | 2.859 | 2.913 | 2.811 | 2.881 | 103 | 3.126 | 3.185 | 3.071 | 3.141 |
| 56 | 2.864 | 2.919 | 2.816 | 2.886 | 104 | 3.132 | 3.190 | 3.077 | 3.147 |
| 57 | 2.870 | 2.924 | 2.822 | 2.891 | 105 | 3.137 | 3.196 | 3.082 | 3.152 |
| 58 | 2.875 | 2.930 | 2.827 | 2.897 | 106 | 3.143 | 3.202 | 3.088 | 3.158 |
| 59 | 2.881 | 2.936 | 2.832 | 2.902 | 107 | 3.148 | 3.207 | 3.093 | 3.163 |
| 60 | 2.887 | 2.941 | 2.838 | 2.908 | 108 | 3.154 | 3.213 | 3.099 | 3.168 |
| 61 | 2.892 | 2.947 | 2.843 | 2.913 | 109 | 3.159 | 3.218 | 3.104 | 3.174 |
| 62 | 2.898 | 2.952 | 2.849 | 2.919 | 110 | 3.165 | 3.224 | 3.109 | 3.179 |
| 63 | 2.903 | 2.958 | 2.854 | 2.924 | 111 | 3.170 | 3.230 | 3.115 | 3.185 |
| 64 | 2.909 | 2.964 | 2.860 | 2.929 | 112 | 3.176 | 3.235 | 3.120 | 3.190 |
| 65 | 2.914 | 2.969 | 2.865 | 2.935 | 113 | 3.182 | 3.241 | 3.126 | 3.196 |
| 66 | 2.920 | 2.975 | 2.870 | 2.940 | 114 | 3.187 | 3.247 | 3.131 | 3.201 |
| 67 | 2.926 | 2.981 | 2.876 | 2.946 | 115 | 3.193 | 3.252 | 3.137 | 3.206 |
| 68 | 2.932 | 2.986 | 2.881 | 2.951 | 116 | 3.198 | 3.258 | 3.142 | 3.212 |
| 69 | 2.937 | 2.992 | 2.887 | 2.957 | 117 | 3.204 | 3.264 | 3.147 | 3.217 |
| 70 | 2.943 | 2.998 | 2.892 | 2.962 | 118 | 3.209 | 3.269 | 3.153 | 3.223 |
| 71 | 2.948 | 3.003 | 2.898 | 2.967 | 119 | 3.215 | 3.275 | 3.158 | 3.228 |
| 72 | 2.954 | 3.009 | 2.903 | 2.973 | 120 | 3.220 | 3.281 | 3.164 | 3.234 |
| 73 | 2.959 | 3.015 | 2.908 | 2.978 | 121 | 3.226 | 3.286 | 3.169 | 3.239 |
| 74 | 2.965 | 3.020 | 2.914 | 2.984 | 122 | 3.232 | 3.292 | 3.175 | 3.245 |
| 75 | 2.970 | 3.026 | 2.919 | 2.989 | 123 | 3.237 | 3.298 | 3.180 | 3.250 |
| 76 | 2.976 | 3.032 | 2.925 | 2.995 | 124 | 3.243 | 3.303 | 3.186 | 3.255 |
| 77 | 2.982 | 3.037 | 2.930 | 3.000 | 125 | 3.248 | 3.309 | 3.191 | 3.261 |
| 78 | 2.987 | 3.043 | 2.936 | 3.005 | 126 | 3.254 | 3.315 | 3.196 | 3.266 |
| 79 | 2.993 | 3.049 | 2.941 | 3.011 | 127 | 3.259 | 3.320 | 3.202 | 3.272 |
| 80 | 2.998 | 3.054 | 2.946 | 3.016 | 128 | 3.265 | 3.326 | 3.207 | 3.277 |
| 81 | 3.004 | 3.060 | 2.952 | 3.022 | 129 | 3.270 | 3.332 | 3.213 | 3.283 |
| 82 | 3.009 | 3.066 | 2.957 | 3.027 | 130 | 3.276 | 3.337 | 3.218 | 3.288 |
| 83 | 3.015 | 3.071 | 2.963 | 3.033 | 131 | 3.282 | 3.343 | 3.224 | 3.293 |
| 84 | 3.020 | 3.077 | 2.968 | 3.038 | 132 | 3.287 | 3.349 | 3.229 | 3.299 |
| 85 | 3.026 | 3.083 | 2.974 | 3.043 | 133 | 3.293 | 3.354 | 3.234 | 3.304 |
| 86 | 3.032 | 3.088 | 2.979 | 3.049 | 134 | 3.298 | 3.360 | 3.240 | 3.310 |
| 87 | 3.037 | 3.094 | 2.984 | 3.054 | 135 | 3.304 | 3.366 | 3.245 | 3.315 |

# CAPACITY CONTROLLERS – CAPL-2

## OVERVIEW

The *Zonex Systems* CAPL-2 is a combination staging and capacity control device for use with gas/electric units and heat pumps that use standard gas/electric thermostats. The CAPL-2 stages two cooling and heating outputs based upon time and temperature conditions. The CAPL-2 monitors the leaving air temperature and stages the cooling or heating to maintain the leaving air temperature within a fixed range. Controlling the staging based on the leaving air temperature ensures the supply always matches the load. This is essential with a zoning system since the load varies substantially as the number of zones calling varies.

**Cool Mode** – When there is a cool call, if the leaving air is above the cool cut-in temperature, the CAPL-2 turns on the next stage compressor after a time delay. If the air gets too cold, it turns off the last stage compressor after that compressor has run a minimum of four minutes. As long as there is a cool call, when a compressor turns off it will stay off for a minimum of four minutes and when a compressor turns on it will run a minimum of four minutes. This prevents short cycling and ensures sufficient compressor oil return. When the cool call is removed, all compressors are immediately turned off.

**Heat Mode (Gas/Electric)** – If the leaving air is below the heat cut-in temperature, it turns on the next heat stage after a time delay. If the air gets too warm, it turns off the last heat stage after a time delay. When the heat call is removed, all heat stages turn off immediately.

**Heat Mode (Heat Pump)** – When there is a heat call, if the leaving air is below the heat cut in temperature, the CAPL-2 turns on the next stage heat after a time delay. If the air gets too warm, it turns off the last stage heat after that stage has run a minimum of four minutes. As long as there is a heat call, when a heat stage turns off, it will stay off for a minimum of four minutes and when a heat stage turns on it will run a minimum of four minutes. This prevents short cycling and ensures sufficient compressor oil return. When the heat call is removed, all compressors are immediately turned off.

## SEQUENCE OF OPERATION

The following sequence of operation assumes the cool cut-out setpoint is 48 degrees Fahrenheit and the heat setpoint is 150 degrees for gas/electric units and 118 degrees for heat pump units. For any other cut-out settings, add or subtract the difference to the values stated. Example: If your actual cool cut-out is 50 degrees, add 2 degrees to each temperature value stated under the Cooling Call section. All temperatures are in degrees F.

**COOLING CALL** (cool setpoint 48): As long as there is a cooling call (YIN energized), the following will occur.

**ECONOMIZER:**

- Typically, equipment manufacturers control their economizer internally, through dry bulb, single or dual enthalpy control. These units do not have separate economizer inputs on their low voltage terminal strip. Units using internal economizer control should be wired with the jumper in the ECOFF position. This will allow for an integrated operation with the first stage compressor, if applicable.
- Upon cooling demand with the jumper in the "ECON" position, there will be a four minute delay prior to energizing output Y1, providing the supply air temperature is above the default setpoint of 58 degrees.

**COMPRESSOR STAGING ON**:

- If the leaving air is 58 degrees or greater, (> or = 10 degrees above the LAS cooling setpoint) Y1 will be energized. After an 8 minute time delay, Y2 will energize if the LAT remains above 58 degrees.

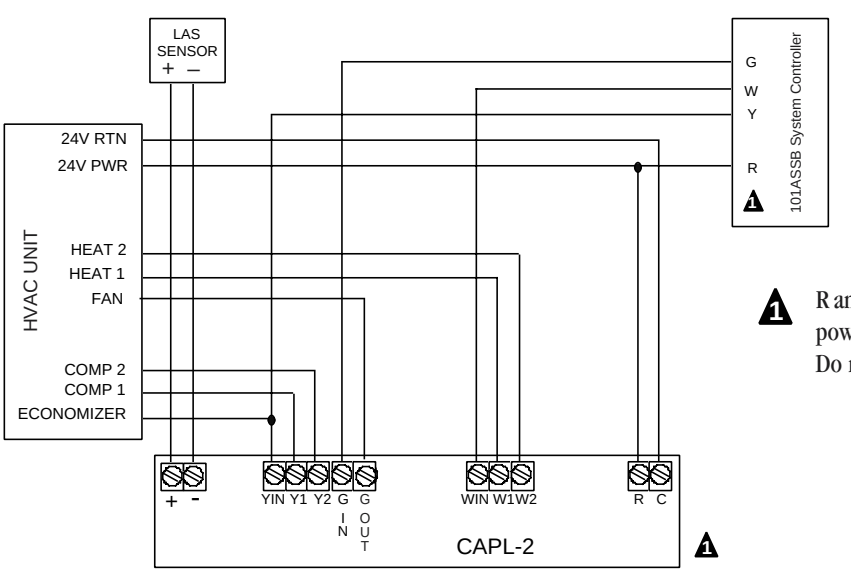
**COMPRESSOR STAGING OFF**:

- If Y2 is energized, and the LAT is between 48 and 52 degrees, (Cooling setpoint plus 4 degrees) Y2 will de-energize. The 4 minute minimum run time must be completed prior to Y2 termination. If the LAT is less than 48 degrees (setpoint) all compressors will turn off upon completion of their 4 minute minimum run time and locked out for 4 minutes.

**NO STAGING:**

- If the **leaving air is equal to or greater than 52 and less than 58 degrees,** then no compressor staging will occur.

**HEATING CALL (Gas / Electric)** (The factory heat setpoint is 150.) Heat setpoint may be field modified to compensate for local temperatures and field conditions. For example, in milder climates the setting may be as low as 110 to 115 degrees. In more severe climates up to 150 degrees. As long as there is a heating call (WIN energized), the following will occur:




1 R and C must be wired to the HVAC system's 24V power supply. R to 24V PWR and C to 24V RTN. Do not use any other 24V source.

**HEAT STAGING ON:**

- If the leaving air is 130 degrees or less, (Heating setpoint minus 20 degrees) W1 will be energized. After a 10 minute time delay, W2 will be energized if the LAT remains below 130 degrees F.

**HEAT STAGING OFF**:

- If the **leaving air is between 145 and 150 degrees** and heat two is running, heat two will turn off. Heat one will turn off after heat two has been off a minimum of four minutes. When heat one shuts off, it is locked out for four minutes.
- If the **leaving air is 150 degrees or greater** then all heat stages will turn off and the indoor blower fan is energized until heat one turns back on or until the heat call is satisfied.

**NO STAGING:** If the **leaving air is greater than 130 and less than or equal to 145 degrees,** then no heat staging will occur.

**HEATING CALL (Heat Pump)** (heat setpoint 118). As long as there is a heating call (WIN energized), the following will occur:

**HEAT STAGING ON:**

- If the **leaving air is 98 degrees or less** and heat one is off, heat one will turn on within four minutes. If heat one is on, heat two will turn on within eight minutes.

**HEAT STAGING OFF**:

- If the **leaving air is between 113 and 118 degrees** and heat two is on, heat two will shut off after running a minimum of four minutes. Heat one will turn off after it has been on a minimum of four minutes and heat two has been off a minimum of six minutes.
- If the **leaving air is 118 degrees or greater** then all heat stages will turn off after the last heat stage running has run for at least four minutes.

**NO STAGING:**

- If the **leaving air is greater than 98 and less than or equal to 113** degrees, then no heat staging will occur.

## COMPONENTS

The CAPL-2 consists of the following:

**A. Digital Display** – Three digit LED. Normally displays the leaving air temperature of the HVAC unit. When the UP/DN buttons are pressed, the cut-out setpoints are displayed. Refer to the Setpoint Calibration section for reading and adjusting the setpoints, page 35.

**B. Microcontroller** – Activates and controls outputs based upon leaving air temperature comparison with programmed setpoints. Occasionally software upgrades may become available. If so, the CAPL-2 software can be field upgraded by changing this microcontroller.

**C. Leaving Air Display Calibrator** – Used to calibrate the leaving air sensor. Turn potentiometer R4 until the displayed temperature equals the measured temperature. Refer to page 35 for calibration procedures.

**D. Economizer Selection Jumper:**

ECON – Place jumper between center and top pins if used with Lennox L series package units equipped with economizers. Contact *Zonex Systems* factory for Lennox wiring details.

ECOFF – Place jumper between center and bottom pins if an economizer is not installed.

**E. Leaving Air Sensor (LAS) Terminals** – Leaving air temperature sensor is connected to the CAPL-2 here. Red to + and white to –. The sensor monitors the leaving air of the HVAC system. If preferred, the CAPL-2 can be mounted up to 500 feet from the sensor. See Installation section for further information.

**F. HVAC/System Controller Interface Terminals** – Y IN – Cool call input, Economizer output; Y1 – Compressor 1; Y2 – Compressor 2; G – Indoor blower fan; W IN – Heat call input; W1 – Heat 1; W2 – Heat 2. See Wiring section for detailed wiring instructions.

**G. HVAC Power Terminals** – Connect to HVAC system 24V AC power source. R is 24 V hot. C is 24 V rtn. Cannot be connected to any other power source. CAPL-2 uses less than 2 VA of power. See Wiring section for detailed wiring instructions.

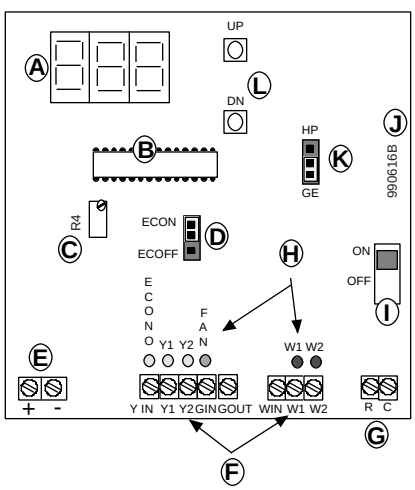
**H. Status Lights – ECONO** – On during cool call. Indicates economizer enabled; Y1 – On when first stage compressor energized; Y2 – On when second stage compressor energized; FAN – On when indoor blower fan energized by System Controller or CAPL-2 (G energized); W1 – On when first stage furnace energized; W2 – On when second stage furnace energized.

**I. Power Switch** – When off, the display is off, the CAPL-2 is disabled and the relay contacts are closed. The HVAC unit can run at this time but will not have staging control or capacity control protection. When the switch is on, the display is on, and the CAPL-2 is operational.

**J. Board Number** – This number indicates the circuit board number and revision. May need to know this number if conferring with technical support.

**K. Heat Pump/Gas Electric selection jumper** – Place at GE position for gas/electric units. Place at HP position for heat pump units that use gas/electric thermostats.

**L. Setpoint Adjustment** – Use the UP/DN buttons to view and change the cutout setpoints. Refer to the Setpoints, Calibration section (Page 35) for reading and adjusting the setpoints.



# CAPACITY CONTROLLERS – CAPL-4

## OVERVIEW

The *Zonex Systems* CAPL-4 is a combination staging and capacity control device in one. It can stage an economizer and up to four compressors and up to four stages of heat. The CAPL-4 monitors the leaving air temperature and stages the cooling or heating to maintain the leaving air temperature within a fixed range. Controlling the staging based on the leaving air temperature ensures the supply will always match the load. This is essential with a zoning system, since the load varies substantially as the number of zones calling varies.

**Cool mode –** When there is a cool call, if the leaving air is above the cool cut-in temperature, the CAPL-4 turns on the next stage compressor after a time delay. If the air gets too cold, it turns off the last stage compressor after that compressor has run a minimum of four minutes. As long as there is a cool call, when a compressor turns off it will stay off for a minimum of four minutes and when a compressor turns on it will run a minimum of four minutes. This prevents short cycling and ensures sufficient compressor oil return. When the cool call is removed, all compressors are immediately turned off.

**Heat mode –** If the leaving air is below the heat cut-in temperature, it turns on the next heat stage after a time delay. If the air gets too warm, it turns off the last heat stage after a time delay. When the heat call is removed, all heat stages turn off immediately.

## OPERATION

The following sequence of operation assumes the cool cut-out setpoint is 48 and the heat is 150 degrees Fahrenheit. For any other cut-out settings, add or subtract the difference to the values stated. Example: If your actual cool cut-out is 50 degrees, add 2 degrees to each temperature value stated under the Cooling Call section. All temperatures are in degrees Fahrenheit.

**COOLING CALL** (cool setpoint 48): As long as there is a cooling call (YIN energized), the following will occur:

**ECONOMIZER:**
As long as there is a cooling call the economizer, if available, is enabled and outside air is supplied based on enthalpy.

**COMPRESSOR STAGING ON:**
If the **leaving air is 58° or greater**, the next compressor will turn on within four minutes. As long as the air temperature remains within this range the next higher compressor will stage on every four minutes.

**COMPRESSOR STAGING OFF:**
If the **leaving air is between 48 and 52°**, the highest compressor stage on will shut off within four minutes. As long as the air temperature remains within this range the next highest running compressor will stage off every four minutes.

If the **leaving air is 48° or less** then all compressors will turn off after the last compressor running has run for at least four minutes.

**NO STAGING:**
If the **leaving air is equal to or greater than 52 and less than 58°** then no compressor staging will occur.

**HEATING CALL** (heat setpoint 150). As long as there is a heating call (WIN energized), the following will occur.

**HEAT STAGING ON:**
If the **leaving air is 130° or less**, the next heat stage will turn on within four minutes. As long as the air temperature remains within this range the next higher heat stage will turn on every four minutes.

**HEAT STAGING OFF:**
If the **leaving air is between 145 and 150°** the highest heat stage on will shut off within four minutes. As long as the air temperature remains within this range the next highest heat will stage off every four minutes.

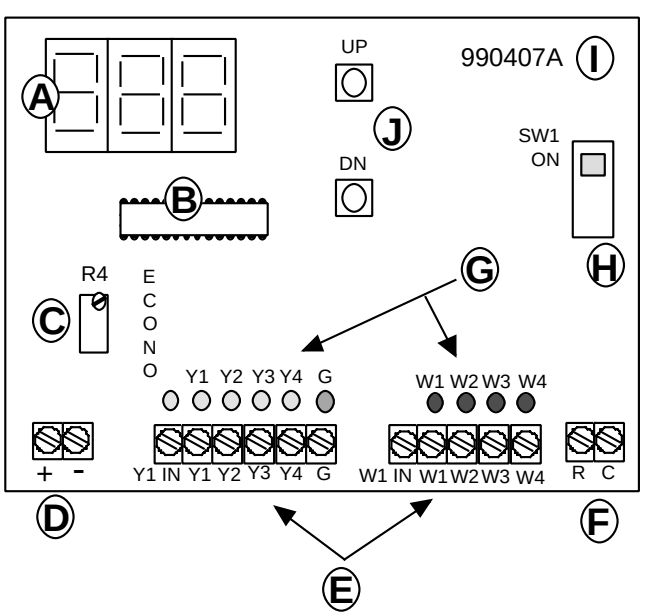
If the **leaving air is 150° or greater** then all heat stages will turn off.

## COMPONENTS

The CAPL-4 consist of the following:

**A. Digital Display –** Three digit LED. Normally displays the leaving air temperature of the HVAC unit. When the UP/DN buttons are pressed, the cut-out setpoints are displayed. Refer to the Setpoint Calibration section for reading and adjusting the setpoints, page 35.

**B. Microcontroller –** Brains of the CAPL-4 and where the program resides. Occasionally software upgrades may become available. If so, the CAPL-4 software can be field upgraded by changing this microcontroller.



**C. Thermometer Calibrator –** Calibrates the leaving air temperature thermometer. Turn clockwise to lower temperature. Turn counterclockwise to raise. Refer to CALIBRATION section for complete calibration information.

**D. Leaving Air Sensor (LAS) Terminals –** Leaving air temperature sensor is connected to the CAPL-4 here. Red to + and white to –. The sensor monitors the leaving air of the HVAC system. If preferred, the CAPL-4 can be mounted up to 500 feet from the sensor. See INSTALLATION section for further information.

**E. HVAC/System Controller Interface Terminals –** Y IN – Cool call input, Economizer output; Y1 – Compressor 1; Y2 – Compressor 2; Y3 – Compressor 3; Y4 – Compressor 4; G – Indoor blower fan; W IN – Heat call input; W1 – Heat 1; W2 – Heat 2; W3 – Heat 3; W4 – Heat 4. See WIRING section for detailed wiring instructions.

**F. HVAC power terminals –** Connect to HVAC system 24V AC power source. R is 24 V hot. C is 24 V rtn. Cannot be connected to any other power source. CAPL-4 uses less than 2 VA of power. See WIRING section for detailed wiring instructions.

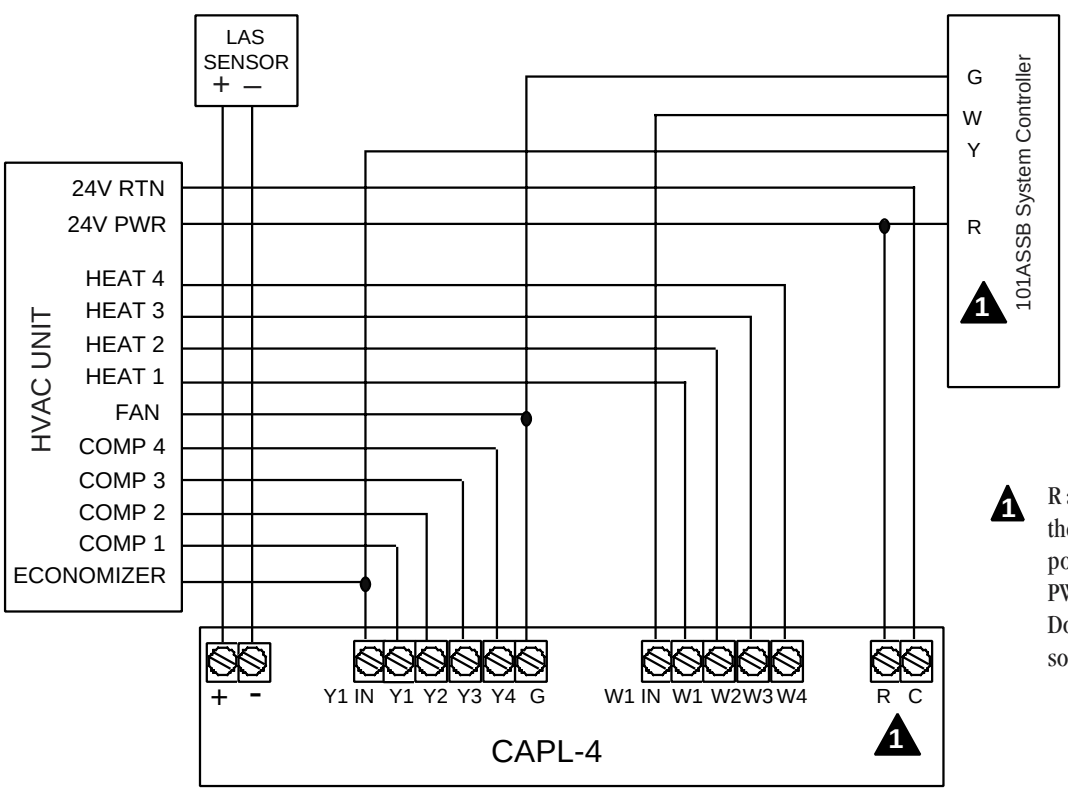
**G. Status Lights –** ECONO – On during cool call. Indicates economizer enabled; Y1 – On when first stage compressor energized; Y2 – On when second stage compressor energized; Y3 – On when third stage compressor energized; Y4 – On when fourth stage compressor energized; FAN – On when indoor blower fan energized by System Controller or CAPL-4 (G energized); W1 – On when first stage furnace energized; W2 – On when second stage furnace energized; W3 – On when third stage furnace energized; W4 – On when fourth stage furnace energized.

**H. Power Switch –** When off, the display is off, the CAPL-4 is disabled and the relay contacts are closed. The HVAC unit can run at this time but will not have staging control or capacity control protection. When the switch is on, the display is on and the CAPL-4 is operational.

**I. Board Number –** This number indicates the circuit board number and revision. May need to know this number if conferring with technical support.

**J. Setpoint Adjustment –** Use the UP/DN buttons to view and change the cut-out setpoints. Refer to the Setpoint, Calibration section (Page 35) for reading and adjusting the setpoints.

## WIRING – CAPL-4




1 R and C must be wired to the HVAC system's 24V power supply. R to 24V PWR and C to 24V RTN. Do not use any other 24V source.

# CAPACITY CONTROLLERS – INSTALLATION

A. Select location to place sensor. For gas/electric HVAC systems, sensor must be in leaving air duct, preferably as far from the coil/heat exchanger as possible but not past the bypass tap. For heat pumps, sensor must be placed between coil and auxiliary heat. If heat pump does not have auxiliary heat, place sensor as specified for gas/electric system. **See Figure 1**.

B. Cut or drill a hole in selected location large enough to fit sensor through.

C. For 101CAPGE, TRLAT, CAPL-2 and CAPL-4, determine if Capacity Controller will be mounted integral with sensor or remote from sensor. Mounting sensor remotely enables you to place the Capacity Controller in a location easily visible and serviceable.

D. For the 101ALAS, or if mounting any other model with the sensor integral with Capacity Controller, place sensor through hole made in duct and mount Capacity Controller to duct with screws. Use grommet or tape to protect sensor wire from sharp edges. **See Figure 2**.

E. If mounting sensor remotely, refer to **Figure 3** and do the following:
1. On Capacity Controller, loosen + and – terminal screws and disconnect sensor.
2. Remove circuit board screws and pull circuit board away from casing.
3. Pull sensor out of casing.
4. Reattach circuit board to casing with screws previously removed.
6. Place sensor in hole made in duct and secure with tape, wire tie or cable clamp. Use grommet or tape to protect sensor wire from sharp edges.
7. Select location for Capacity Controller and mount with screws.
8. Wire sensor to Capacity Controller, red to + and white to –. If less than 200 feet, use separate 18 gauge, two conductor wire. If over 200 feet, use separate two conductor shielded wire and connect shield to TR2 or C terminal of Capacity Controller.

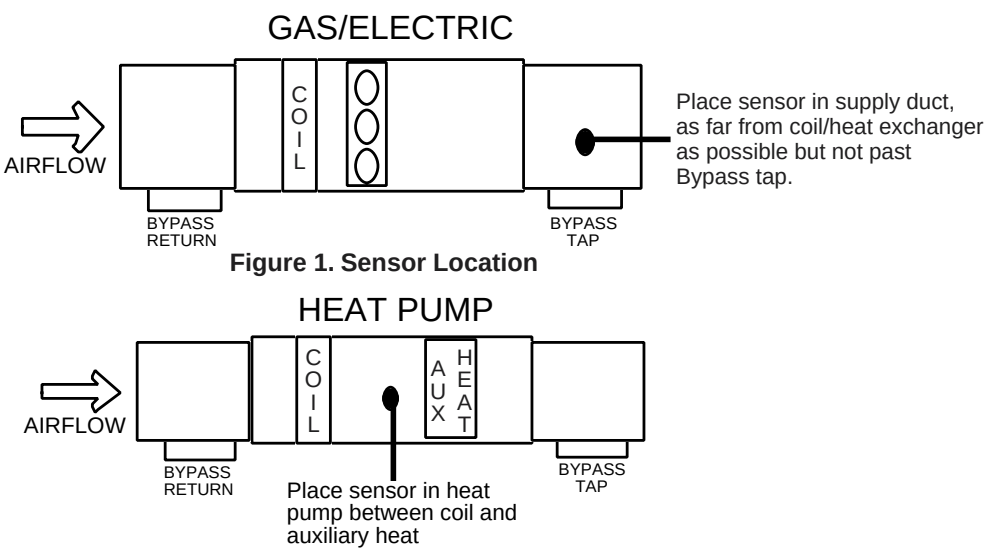



**Figure 1. Sensor Location**

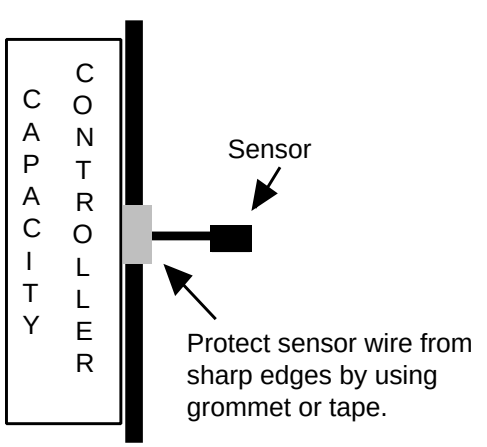



***Figure 2. Capacity Controller Mounted with Sensor***

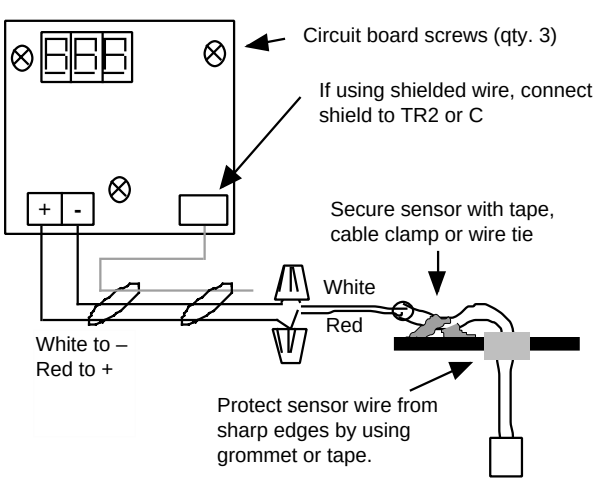



***Figure 3. Capacity Controller with Remote Sensor***

# CAPACITY CONTROLLERS – SETPOINTS, CALIBRATION

## The following applies to the setpoints for:

**101CAPGE**
**CAPL-2**
**CAPL-4**

There are two cut-out setpoints, one for heat and one for cool. The digital display normally displays the leaving air temperature of the HVAC/heat pump unit. By pressing the UP and DN buttons, the setpoints can be viewed and changed.

**Cool Setpoint** – To read the cool cut-out setpoint, press the DN button until "C" appears and then release. The number that follows is the cool cut-out setpoint. After a couple of seconds the leaving air temperature will be redisplayed. To change the setpoint, press the bottom or down button until the "C" is displayed, then immediately after the setpoint is displayed press and hold the UP/DN button till setpoint is at the desired value.

**Heat Setpoint** – To read the heat cut-out setpoint, press the UP button until "H" appears and then release. The number that follows is the heat cut-out setpoint. After a couple of seconds the leaving air temperature will be redisplayed. To change the setpoint, press the top or up button until the "H" is displayed, then immediately after the setpoint is displayed press and hold the UP/DN button till setpoint is at the desired value.

**CALIBRATION**

The digital display normally displays the leaving air temperature of the internal thermometer. This thermometer is factory calibrated. If calibration is ever required, turn the Thermometer Calibrator clockwise to lower the temperature. Turn counterclockwise to raise.

# FIVE WIRE LINK

*Zonex Systems'* patented Five Wire Link is one of the most important elements of the Select-Temp zoning system. Extra care should be made to ensure the wiring is done correctly. The color code must be strictly followed. Ensure the stripped wire leads are not touching each other at the terminal blocks. If putting two wires into one terminal block, use the same gauge wire for both and ensure they are seated properly.

You must ensure the wire is sized properly to match the power needs of the number of thermostats installed. The more zone dampers used, the greater the current draw and the greater the voltage loss on the Five Wire Link. If too much voltage is lost on the Five Wire Link, there will not be enough voltage at the zone dampers to properly operate them. To ensure the correct wire size, use the following table. Select the row matching the number of zone thermostats you have. Move across horizontally to the column that matches the distance from the System Controller to the farthest thermostat. Use the wire size specified at the row/column intersection.

To reduce wire size, you can run more than one Five Wire Link Daisy Chain. Example: If you have 10 thermostats, and the maximum distance is 200 feet, you would need 12 GA wire. If instead, you used two Five Wire Links with 5 thermostats on each, you would now only need 18 GA wire for each daisy chain. Multiple daisy chains are wired color to color at the System Controller.

**NOTE: Never use less than 18 GA wire on the 5 Wire Link.**

| MAXIMUM ZONE THERMOSTATS | WIRE LENGTH 50' | 100' | 150' | 200' |
|---|---|---|---|---|
| 10 | 18 GA | 18 GA | 18 GA | 18 GA |
| 14 | 18 GA | 18 GA | 18 GA | 16 GA |
| 16 | 18 GA | 18 GA | 16 GA | 16 GA |
| 20 | 18 GA | 18 GA | 16 GA | 14 GA |
| 22 | 18 GA | 16 GA | 16 GA | 14 GA |
| 25 | 18 GA | 16 GA | 14 GA | 14 GA |

# TRANSFORMER / FUSE SIZING

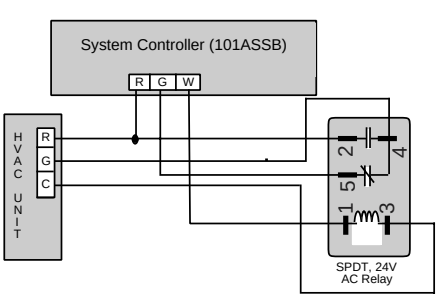
**Transformer/fuse sizing:** The 24V transformer connected to TR1 and TR2 of the System Controller powers the zone dampers, zone thermostats and System Controller. The power rating of the transformer must be sufficient to power the number of dampers used. Also, a properly rated in-line fuse must be used on the secondary of the transformer. To determine the power rating of the transformer and the amperage rating of the fuse, use the table.

| NUMBER OF DAMPERS | MED PRESSURE/HEAVY DUTY (POWER OPEN) DAMPERS | |
|---|---|---|
| | XFMR PWR | FUSE SIZE |
| 1 | 6 VA | 1 AMP |
| 2 | 12 VA | 1 AMP |
| 3 | 18 VA | 1 AMP |
| 4 | 24 VA | 2 AMP |
| 5 | 30 VA | 2 AMP |
| 6 | 36 VA | 2 AMP |
| 7 | 42 VA | 3 AMP |
| 8 | 48 VA | 3 AMP |
| 9 | 54 VA | 3 AMP |
| 10 | 60 VA | 3 AMP |
| 11 | 66 VA | 4 AMP |
| 12 | 72 VA | 4 AMP |
| 13 | 78 VA | 4 AMP |
| 14 | 84 VA | 5 AMP |
| 15 | 90 VA | 5 AMP |
| 16 | 96 VA | 5 AMP |
| 17 | 102 VA | 5 AMP |
| 18 | 108 VA | 6 AMP |
| 19 | 114 VA | 6 AMP |
| 20 | 120 VA | 6 AMP |
| 21 | 126 VA | 7 AMP |
| 22 | 132 VA | 7 AMP |
| 23 | 138 VA | 7 AMP |
| 24 | 144 VA | 7 AMP |
| 25 | 150 VA | 8 AMP |

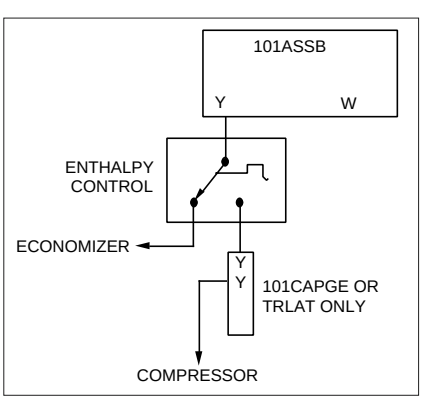
# APPLICATION SCHEMATICS

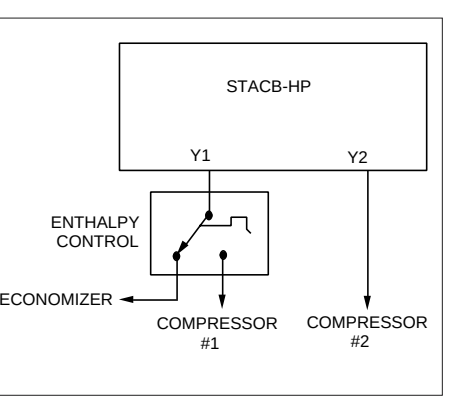
## BLOWER FAN RELAY

If the heater does not turn on the indoor blower fan when heat is on, you must add a blower fan relay as shown below. The relay will energize the fan signal "G" when the heat signal "W" is energized.




## ECONOMIZER INTERFACE FOR SYSTEM CONTROLLERS NOT UTILIZING THE CAPL-2 OR CAPL-4.



## SELECT-TEMP TERMINAL DESCRIPTIONS

**5-Wire Link, Daisy Chain:**

**G** (24 VAC power).

**B** (24VAC common):
At Controller, wire 24 V to TR1 and TR2. Turn on power switch and read 24 V between G and B.

**Rd** Damper modulation enable signal. Allows a STDIGI series thermostat to modulate its respective damper according to setpoint error. This is a 24 VAC signal from Rd and B on the controller, to the thermostat. Rd is active when the "DAMPER" LED is illuminated on the controller. When inactive, the damper will be driven to its ventilation position.

**Y** (Cool call):
Hot when a cool call is recognized by the Controller. When the Controller's Damper and Cool lights are on, there should be 119 mV ac to 2.67 V ac (1 to 25 zones calling) between Y and B. If you have a reading higher than 3V with the Cool and Damper lights on, there is a short between Y and G or Y and Rd.

**W** (Heat call):
Hot when a heat call is recognized by the Controller. When the Controller's Damper and Heat lights are on, there should be 119 mV ac to 2.67 V ac (1 to 25 zones calling) between W and B. If you have a reading above 3V with the Heat and Damper lights on, there is a short between W and G or W and Rd.

## MISCELLANEOUS SYSTEM CONTROLLER TERMINALS

**S** (Nite call). Hot when Nite Call Light of STNSTS thermostat is on.

**TC1 and TC2 (Time Clock)**
Occupied mode when time clock switch is closed. Unoccupied when time clock switch is open. In occupied mode, System Controller looks at Y and W of Daisy Chain inputs. In unoccupied mode, System Controller looks at S input and ignores Y and W of Daisy Chain inputs.

## ZONE THERMOSTAT

**MC** (Motor Common):
Common for 24V damper motor(s). Motor voltages measured in reference to this terminal.

**RC** (Run Closed):
24 VAC between RC and MC when damper motor closing.

**RO** (Run Open):
24VAC between RO and MC when damper motor opening.

**If Controller transformer is blowing:**
Check for short on five wire link between Rd and B, G and B or between Y, W and G.

**If Controller is on and the circuit board fuse is blowing:**
Make sure voltage between TR1 and TR2 is not less than 24 VAC or more than 30 VAC. If voltage is okay, remove 5 wire link and check fuse again. If the fuse blows again, replace the Controller. If voltage is not within range, be sure you have the correct transformer and that the primary voltage is okay. If primary voltage is okay and transformer is correct size, replace transformer.

**If Controller is off and the circuit board fuse is blowing:**
You have a short on the five wire link between either Y and G, W and G, Y and Rd, or W and Rd.

# Select-Temp

## A Modulating System

Zonex SYSTEMS

*comfort you control*


**Hot Line: (800) 228-2966**

5622 Engineer Drive

Huntington Beach, CA 92649

Factory: (714) 898-9963 • Fax: (714) 898-6802

Visit our Web Site http://www.hvaccomfort.com

E-mail us at calecon@hvaccomfort.com


# Zoning

PATENTED PRODUCT




Part #STMAN

Rev. February 2003