

***RCS***

**Model ZCV2/ZCV4**  
**HVAC ZONE CONTROL UNIT**  
**with RS485 Serial Communications**

**INSTALLATION AND OPERATION MANUAL**

DCN: 141-01012-01

Rev 01

10/29/04

**\*\*\* IMPORTANT NOTICE \*\*\***

**DO NOT USE THIS PRODUCT FOR BUILDING FREEZE PROTECTION! YOU ARE ADVISED TO  
INSTALL A MECHANICAL FREEZE PROTECTION DEVICE ON YOUR SYSTEM FOR THIS PURPOSE.**

The ZCV series of HVAC Zone Control Units includes 2 and 4 zone controllers. The units allow a single HVAC mechanical system to be divided into fully independent zones. Zone control is accomplished with individual “thermostats” or temperature sensors in each zone and motorized zone dampers to control the flow of air to each zone.

Each zone “thermostat” is a RCS Wall Display Unit (WDU) or a zone temperature sensor. The Wall Display Unit looks like a traditional thermostat and is the wall mounted user interface for each zone of the ZCV controller. It provides visual display of temperature, setpoints and modes, the control pushbuttons, and the zone temperature sensor. The WDU’s connects to the Zone Control Unit by a 4 wire cable, which can be existing thermostat wires in retrofit applications or Category 5 wiring in new construction.

The Zone Control Unit connects to the HVAC system at its standard thermostat connections. Electrically, it functions just like a regular thermostat to the HVAC system, provides the thermostatic control of each zone and sends the appropriate heating and cooling calls to the HVAC mechanical system.

**Wall Display Units.** RCS Wall Display Units that are **RCSLink2** products, such as Model TS16 and TS40 can be used with ZCV series controllers.

**Standard or Heat Pump HVAC Systems.** The Zone Control Unit is compatible with either standard Gas/Electric or Heat Pump HVAC systems. System type is selectable. The ZCV series is 100% Heat Pump compatible with changeover valve operation that can be selected for either changeover with cooling or changeover with heating.

**Multi-Stage HVAC Compatibility.** The ZCV series HVAC outputs supports 2 stages of heating and 2 stages of cooling for Standard systems, and 3 stages of heating and 2 stages of cooling for Heat Pump systems.

Stage one comes on at 1 deg from setpoint, stage two comes on at 3 deg from setpoint and stage 3 heating for heat pump systems comes on at 5 degrees from setpoint. Stage 1 and 2 operation will stay on until setpoint is reached. For Heat Pump systems, the stage 3 auxiliary or heat strip heating will go off at 3 degrees from setpoint.

**Fully Independent Zones.** Each zone is fully independent and can be set to any setpoint or mode. Mixed modes are allowable among the zones, that is, one zone may be set to heating while another may be set to cooling. The system is fully automatic and has auto changeover capability. Heating calls are give priority over cooling calls. The Zone Control Unit monitors the setpoint and modes of all zones and determines what Heating calls will be satisfied first and when all heating calls are satisfied, the system mode will switch to cooling to satisfy all cooling calls.

**Fail Safe Zone Damper Operation.** The ZCV series uses normally open dampers for fail safe operation. In the event that zonal control is lost, all dampers are open so that heating or cooling to all zones is possible until zone control can be restored. During normal operation, when a zone calls for cooling, *all other zones not calling will be closed*. At the end of the call, all dampers will return to open. This “all zones normally open mode” also allows for system wide ventilation.

**Fresh Air Venting.** A vent damper relay output is provided for fresh air venting operation.

**Remote Communications.** The ZCV series control units have RS485 serial communications ports. It can send and receive data and commands by serial communications to allow remote control of the system. Commands including requesting status of zone temperature, setpoint, heating/cooling mode and fan mode as well as setting any zone setpoint or mode. Individual and global zone commands are allowed. Refer to the RCS RS232/485 protocol manual.

Up to 254 ZCVs can be networked together in a HVAC control network along with other RCS communicating thermostats. RCS Automation Control Units, such as the CommStar Models CS30/308/48, can support up to 32 HVAC zones.

## Outside Temperature Operation

The ZCV series can use and display outside temperature information from a sensor attached to the ZCV Outside Temp Sensor Input or from outside temperature data received from the network. In either case, the outside temperature will be displayed on all zone WDU's. A TS16 WDU can view the outside temperature by pressing the up/down arrows simultaneously. A TS40 WDU will show the outside temperature at the top center of the screen when outside sensor data is available.

**Outside Temp Sensor Attached to the ZCV.** When a outside temp sensor is attached to the ZCV, it is "enrolled" as an active sensor when the unit powers up and initializes. Changes in outside temperature are sent to the wall display units for local display and also reported on the network.

**Reporting Outside Temperature on the Network.** When an Outside Temp Sensor is attached to the ZCV Outside Temp Sensor Input, the outside temperature will be reported on the network in response to the Request Status message R=1. The outside temperature shows up as "OA=xx" in the status message data string.

**Displaying Network Outside Temp Data.** If a local outside temp sensor is **not** connected to the ZCV, outside temperature data can be received from the network and the ZCV will treat it just like a local sensor is installed. ***If a local outside temp sensor has been installed on the ZCV it will inhibit network outside temp data from being accepted.*** This is true even if a outside sensor was enrolled and then disconnected but has not been un-enrolled by resetting the ZCV.

Note that **network provided** outside temp data will NOT be reported in Request Status R=1 message response (no "OA=" data will appear).

## STANDARD HVAC SYSTEMS OPERATION

In the **HEAT** mode, the heating system will be turned on at one deg below the setpoint and will turn off at the setpoint. In the **COOL** mode, the cooling system will be turned on at one deg above the setpoint and will turn off at the setpoint. In the **AUTO** mode, the current heating or cooling operating mode will operate as usual with the one deg setpoint control. In order for the system to change operating mode from heating to cooling, the temperature must rise three deg above the setpoint. On subsequent calls after a change over has occurred, the system will operate normally with the one deg setpoint control. This difference of three degrees on changeover helps to prevent the system from overshooting and oscillating between heating and cooling. Changes from cooling to heating works similarly, with the three deg changeover difference being three deg below the setpoint.

**STANDARD GAS/ELECTRIC MODE SELECTION.** To set the Control Unit for standard GAS/ELECTRIC operation, leave the dipswitch SW1-1 set to OFF (default setting).

**FAN MODE SELECTION.** Normally, GAS heating systems DO NOT require fan calls along with the heat call due to thermoswitch fan operation in the furnace and dipswitch SW1-2 should be set to OFF (default setting) for standard fan operation. Electric and hydronic heating systems generally DO require that a fan call be generated along with the heat call and dipswitch SW1-2 should be set to ON position for fan with heat operation. Be sure to check your HVAC system's requirements.

## HEAT PUMP HVAC SYSTEMS OPERATION

The heat pump system mode works similarly to the standard systems. Normal heating/cooling calls and auto-changeover function the same as standard systems. The major difference is the auxiliary heat. Heat pump systems use the compressor for the primary heating/cooling source. During conditions of high heating requirements, additional heat stages, usually electric strip heaters, may be used. The third stage of heating will be turned on when the current temperature falls 5 deg below the current setpoint and will turn off at 3 degrees below the setpoint.

**HEAT PUMP MODE SELECTION.** To set the Control Unit for Heat Pump operation, set the STD/HP dipswitch SW1-1 to ON.

**CHANGEOVER SELECTION.** Heat Pump systems change from heating to cooling by reversing the direction of refrigerant flow in the system. This change over is controlled by the changeover (sometimes referred to as reversing valve) output (O/B terminal) from the Control Unit. Most heat pump systems are designed to work normally in the heating mode and require a change over output for cooling. Set CO SEL switch SW1-2 to CO/CL (default) for this type system. Check your HVAC system requirements for correct settings. If your system requires change over with heating, set SW1-2 to CO/HT. The changeover relay will stay on until the MOT expires before dropping out. If another call commences before the MOT timeout, it will avoid unnecessary cycling of the changeover valve.

### Minimum Run Time (MRT)

The ZCV control unit has a Minimum Run Time after the start of any heat or cool call. This 6 minute minimum run time assures even heating and cooling cycles. Minimum Run Time will keep the system on even if you change the setpoint to a temperature that would satisfy the call, until it expires. Changing the Mode to OFF will cancel the MRT and the system will turn off immediately.

### Minimum Off Time (MOT)

The ZCV control unit has a Minimum Off Time after any heat or cool call. This 6 minutes delay prevents rapid heating/cooling cycles and also provides "short cycle protection" for compressor calls. This delay may be noticeable when you change a zone setpoint and it does not respond immediately due to another call have been recently completed and the MOT delay timer is still active.

The ZCV series controllers have RS-485 serial communications that allows remote commands generated by other systems to be received by the ZCV. These remote commands can change the individual zone setpoint, temperature and modes or may request current status of a zone temperature, setpoint and mode. Remote commands received by the ZCV to change a zone setpoint or mode are sent to the zone WDU to update its display. Whenever new commands are received, the WDU will switch its display to show the updated information for three seconds and then return to the current temp display.

RS-485 connections are a twisted pair multi-drop network that can have up to 255 devices connected to one pair of wires. With use of a RCS Star Wiring Hub, wiring can also be “star” or “homerun” from each connected device to the host system, such as RCS CommStar network control units.

**Network Addressing.** The RS485 address is set from the Wall Display Unit. Network address 0 is reserved for the Host control unit and address 255 is reserved for global commands.

Each zone in the ZCV control unit has its own RS485 address. When you set the address for the control unit, you are setting the **base address for Zone 1**.

For example: a 4 zone control unit set to address 1, each zone address is as follows:

Zone 1 = network address 1  
Zone 2 = network address 2  
Zone 3 = network address 3  
Zone 4 = network address 4

Note that zone addresses are assigned to all zones on the zone controller, even if they are not used. The next control unit would need a base address of 5 for the example above.

TS40 WDU's can set any address from 1 to 254. TS16 WDU's can set addresses from 1 to 99.

**Communications Parameters.** The ZCV serial communications setup is 9600 baud, 8 data bits, no parity, 1 stop bit and no flow control.

The RS485 network connects to the screw terminal connector. The D+ and D- connections are required. The ground connection is optional, but can improve long distance communications and may be needed when the host and ZCV units are powered from different power sources.

### Communications Protocol

The ZCV series Zone Controllers uses the RCS serial communications protocol for HVAC control devices. This is a simple ASCII message protocol.

Refer to the RCS RS-232/485 communications protocol document, PN: 150-00225, for detailed information on serial commands to communicate with the ZCV HVAC control units.

Note that not all commands in the protocol document are applicable to or supported by the ZCV series. The protocol document has an appendix that identifies ZCV series commands.

## LOCATION AND MOUNTING

Install the Control Unit in a protected, convenient, INDOOR location near the HVAC system or in a service accessible area such as an equipment closet or garage.

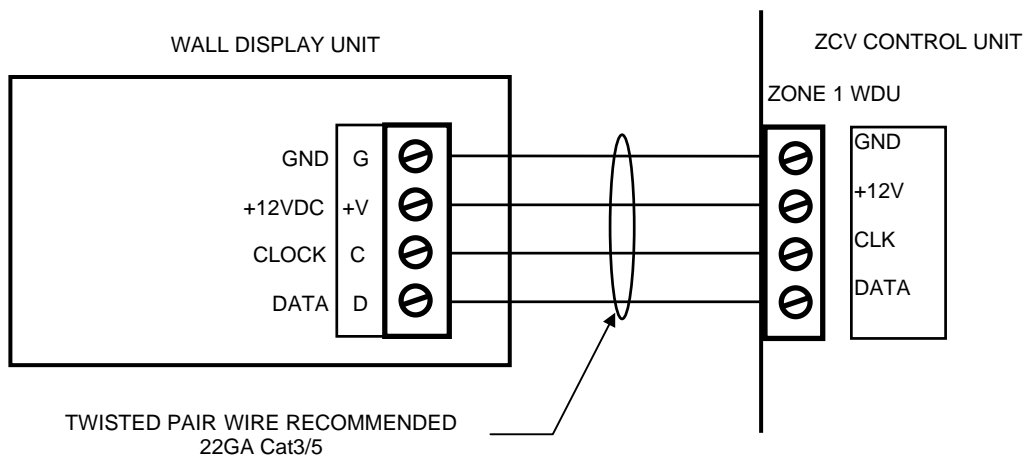
Mount the Control Unit in a vertical position on a wall or sturdy structural member. The unit may be mounted on the HVAC system but care should be taken to avoid the hot burner section or high vibration areas.

## WIRING

### Wiring To The Wall Display Units

**Wire specification:** 4 conductor, 18Ga thermostat wire, 22Ga twisted pair or Cat 3/5 wire (preferred)

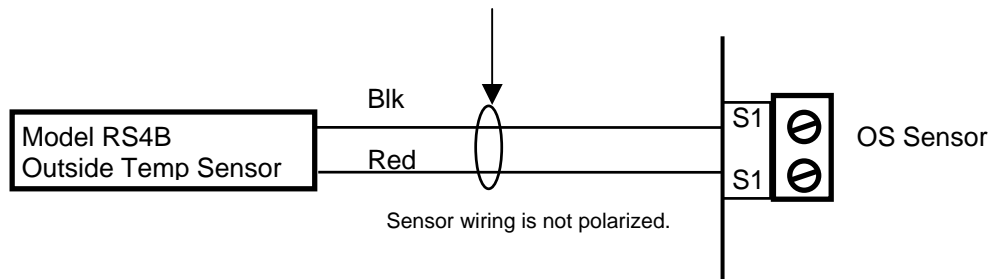
The Control Unit connects to each zone's Wall Display Unit or Sensor by four wires. In retrofit applications, the existing thermostat wiring may be used, however, for best results and in new construction, a Category 5 twisted pair cable is recommended.



**CAUTION!** Do not mis-wire the Wall Display Units – damage may result. Check the wiring before applying power to the Control Unit.

### Wiring To The Outside Temp Sensor (if installed)

**Wire specification:** 2 conductor, 22Ga twisted pair or Cat 3/5 wire (preferred)

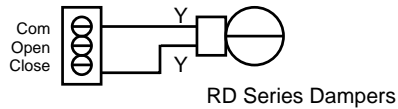


## Wiring To The Zone Dampers

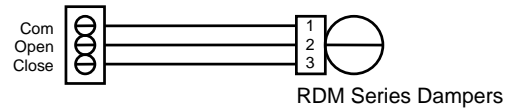
**Wire specification:** 3 conductor, standard 18GA thermostat wire.

The ZCV HVAC Control Unit has zone damper output relays plus a fresh air vent damper output. These SPDT relays are rated at 1 Amp, 24VAC. Zone outputs support either two wire (normally open, power close/spring return) or three wire dampers (power open, power close).

### Two Wire Damper Wiring



### Three Wire Damper Wiring



## ZONE DAMPERS

ZCV zone dampers are Normally Open dampers. Without any heat/cool calls, all dampers are open. When a zone calls for heat/cooling, any zone NOT calling is closed.

This provides two important functions. First, if there is a zone output failure, the zone is still capable of getting heating or cooling. Second, it allows for ALL zone ventilation during periods of no heating or cooling (continuous fan mode).

**xxRDNO series dampers.** These economy dampers feature an extra rigid barrel with a self sealing blade that provides a 99% seal. They are 24VAC, 2 wire, 2 position, power close/spring return, normally open dampers. Current draw is 0.5 amps each.

**xxRDMNO-FP series dampers.** These heavy duty style dampers have the same extra ridge barrels of the RD series, coupled with a commercial heavy duty 3 wire damper motor. These wire as 24VAC common, power open and power close. Current draw is 0.1 amps max each.

***The xxRDMNO-FP dampers are strongly recommended for use with the ZCV control unit.***

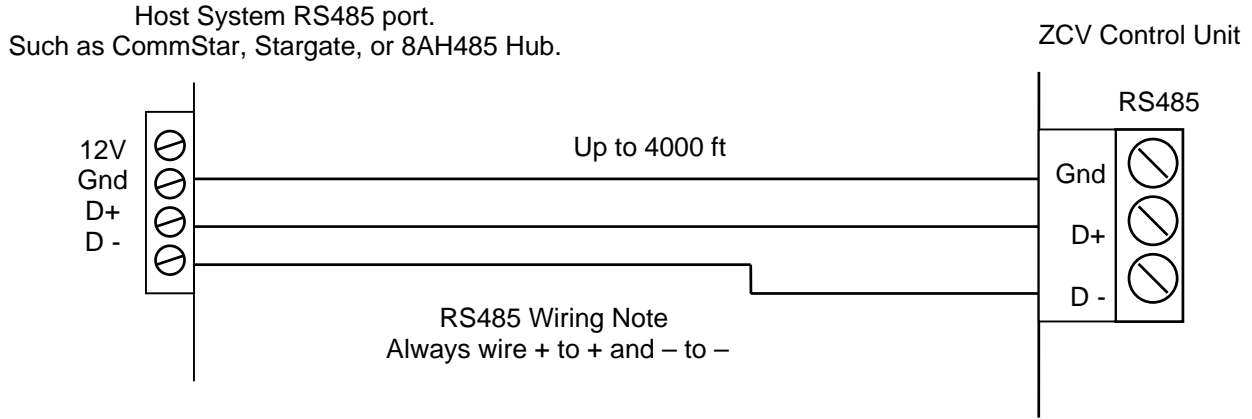
## POWER

The Control Unit requires 24VAC Power. Power is provided by an external transformer (not supplied). Calculate the size of the transformer VA rating for the number of dampers attached for the worst case load when only one zone calls and all others close.

Each RD series damper requires 0.5 amps. Each RDM series dampers requires 0.1 amps. 40VA equals 1.67 amps or three RD dampers active at any one time (4 zones total). 75 VA equals 3.125 amps for 6 RD dampers active.

**RS485 Wiring**

The RS485 communications port is a 2 wire, half-duplex network connection. Ground is optional, but recommended for best noise immunity. Either wire in a daisy chain connection or connect to a RCS RS485 hub to allow star or homerun wiring.





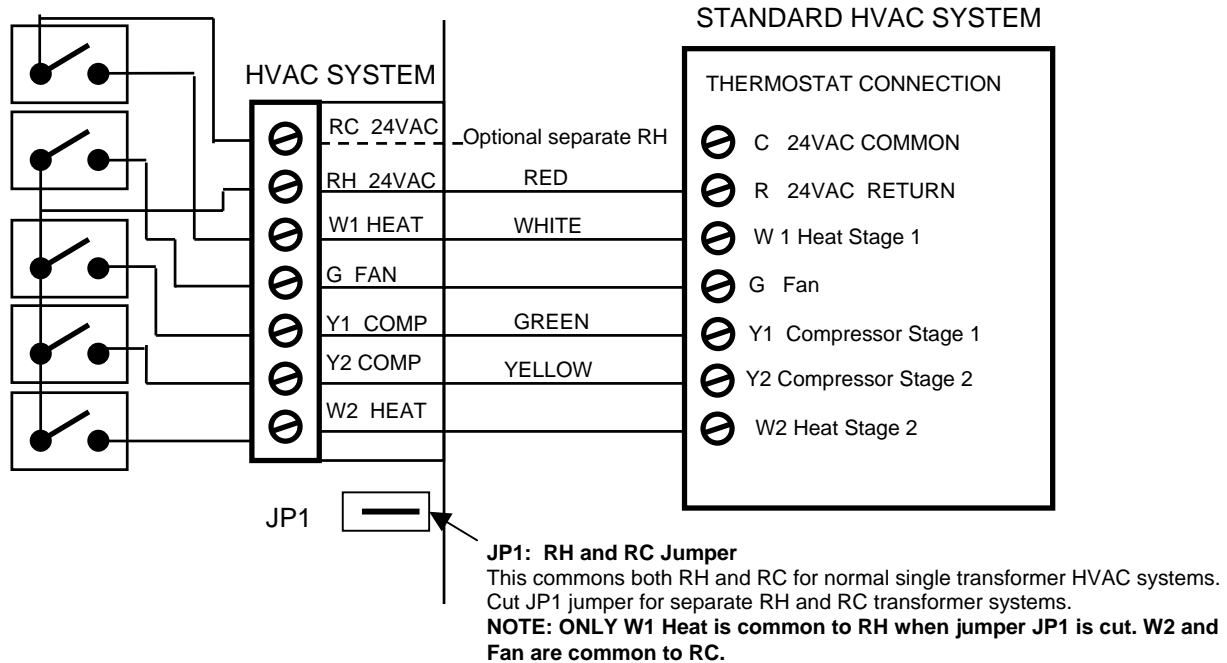
# HVAC SYSTEM CONNECTION

Electrically, the ZCV Control Unit looks like a standard thermostat to your HVAC system. All connections to the HVAC systems are made at the normal thermostat connection on the HVAC unit.

Refer to the following HVAC wiring information for the type of HVAC system, Standard or Heat Pump, that the ZCV control unit is being connected to. Refer to your HVAC system's documentation for specific information on its thermostat connections.

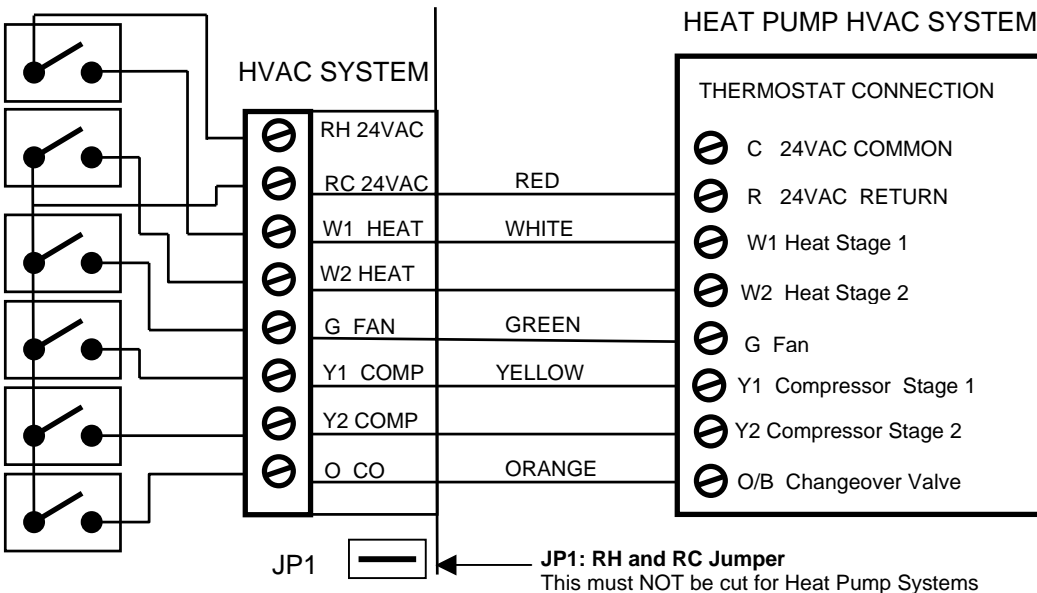
## STANDARD GAS/ELECTRIC HVAC SYSTEM WIRING

### ZCV CONTROL UNIT



## HEAT PUMP HVAC SYSTEM WIRING

### ZCV CONTROL UNIT



It is strongly recommended that you hook-up and run a simple bench test before installing this controller. Not only will this save you time in system checkout but will also familiarize you with the ZCV operation.

### QUICK TEST

NOTE: Before power up, set the dipswitch, SW1, to ALL OFF.

1. Connect a Wall Display Unit to ZONE 1 input on the Control Unit with a short 4 wire cable.
2. Connect the 24VAC transformer to the Control Unit.
3. Plug the transformer into a 110v outlet and apply power to the Control Unit.
4. Verify Power Status LED is **blinking**.
5. Verify the WDU display comes on and shows the current temperature.
  - a. If no display or a "CF" display is shown on the WDU, **double check your wiring**.
  - b. Do not proceed until the current temperature is displayed on the WDU and communications between it and the Control Unit is OK. Any problems will result in a "CF" (Communications Failure) display on the WDU.
6. Press the Fan button on the WDU. The Control Unit Fan LED and relay should turn on. Also all damper LED's should turn on except Zone 1.
7. Press the Fan button again. The Fan LED and all relays should turn off.
8. Press the Mode button until the WDU is showing "H" for Heat Mode.
9. Press the Setpoint Up button until the setpoint is above the current temperature. The Heat LED and relay should come on.
10. Press the Mode button until the WDU is showing "O" for OFF. The Heat LED and relay will turn OFF.
11. Press the Mode button until the WDU is showing "C" for Cool Mode.
12. Press the Setpoint Down button until the setpoint is below the current temperature. The Cool and Fan LEDs and relays should turn on.
13. Press the mode button until the WDU is showing "O" for OFF Mode.
14. All LEDs and relays should turn off.
15. When you have successfully completed all these tests, you have verified that the Control Unit and the WDU are working and communicating correctly.

### RS-232 QUICK TEST with a PC

1. With the Control Unit and WDU connected as above, proceed with connecting the ZCV's RS485 connection to a PC serial port (COM1) using a RS232 to RS485 adapter.
3. Set ZCV address to 1
4. Start the Hyperterm terminal emulator program in Windows/Accessories/Communications/Hyper Terminal.
5. Set Hyperterm communications parameters for COM1 to 9600 baud, no parity, 8 data bits, 1 stop bit and NO flow control.
6. **Set CAPS lock on (Commands are case sensitive).**
7. Send the Request for Status command R=1. Type "A=1 R=1" followed by the carriage return (cr).
8. ZCV should respond with the R=1 status response showing temp, setpoint, mode and fan for zone 1 (A=00 O=1 Z=1 T=(current temp) SP=70 M=0 F=0)
9. Set zone 1 Mode to Heat. Type "A=1 M=H (or 1) cr".
10. Zone 1 WDU should change to show the new mode is "H".
11. Set zone 1 setpoint to 78 degrees. Type "A=1 SP=78 cr"
12. Zone 1 WDU should change to show a setpoint update of "78".
13. If the WDU responds properly to these commands, proceed with installation.

It is recommended that you install the ZCV and then rerun these quick tests BEFORE you connect the Control Unit to the HVAC system. You will be confident that the ZCV is working correctly before you attempt to interface the HVAC system.

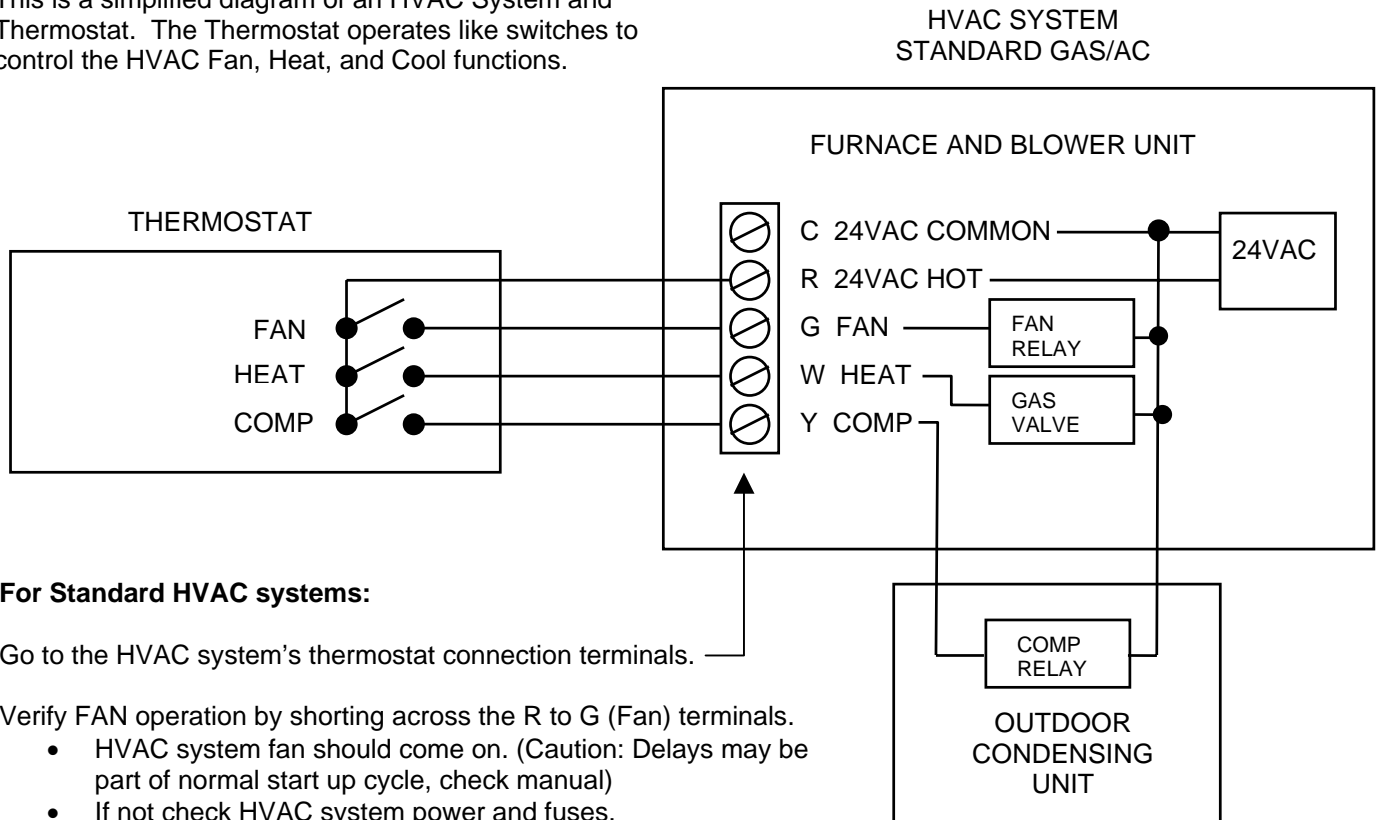
## HVAC SYSTEM QUICK TEST

In the event that you have difficulty with the ZCV controlling the HVAC system, you can perform the following quick test to confirm that the HVAC system is working correctly.

The ZCV Control Unit connects to the HVAC system at the **normal thermostat connections** on the HVAC unit. Standard thermostat control of the HVAC systems consist of contact closures in the thermostat. You can verify that your HVAC system is working correctly by duplicating these contact closures by shorting across the proper terminals on the HVAC systems thermostat connection. Refer to the following HVAC system example.

### HVAC SYSTEM EXAMPLE

This is a simplified diagram of an HVAC System and Thermostat. The Thermostat operates like switches to control the HVAC Fan, Heat, and Cool functions.



#### For Standard HVAC systems:

Go to the HVAC system's thermostat connection terminals.

Verify FAN operation by shorting across the R to G (Fan) terminals.

- HVAC system fan should come on. (Caution: Delays may be part of normal start up cycle, check manual)
- If not check HVAC system power and fuses.
- If power is OK, HVAC system is NOT working correctly.

Verify HEAT operation by shorting across R to W (Heat) terminals (A Fan call is not necessary for gas furnaces).

- Heating operation should start. (Caution: Delays may be part of normal start up cycle, check manual)
- If not, check wiring, check 24VAC power is on R terminal. (measured across R to C).
- If power is OK, HVAC system is NOT working correctly.

Verify COOL operation by shorting across R to Y (Compressor) and R to G (Fan) terminals.

- Cooling operation should start. (Caution: Short Cycle Protection 5 minute delays are normal between calls and may delay start)
- If not, check wiring, check 24VAC power is on R terminal (measured across R to C)
- If power is OK, HVAC system is NOT working correctly.

#### For Heat Pump systems:

Follow the above test to check the FAN operation. If FAN works OK, then power is verified also.

Short across R to Y and R to G. You should get either Heat (normal) or Cool operation depending on the whether your system is changeover with cool (normal) or heat.

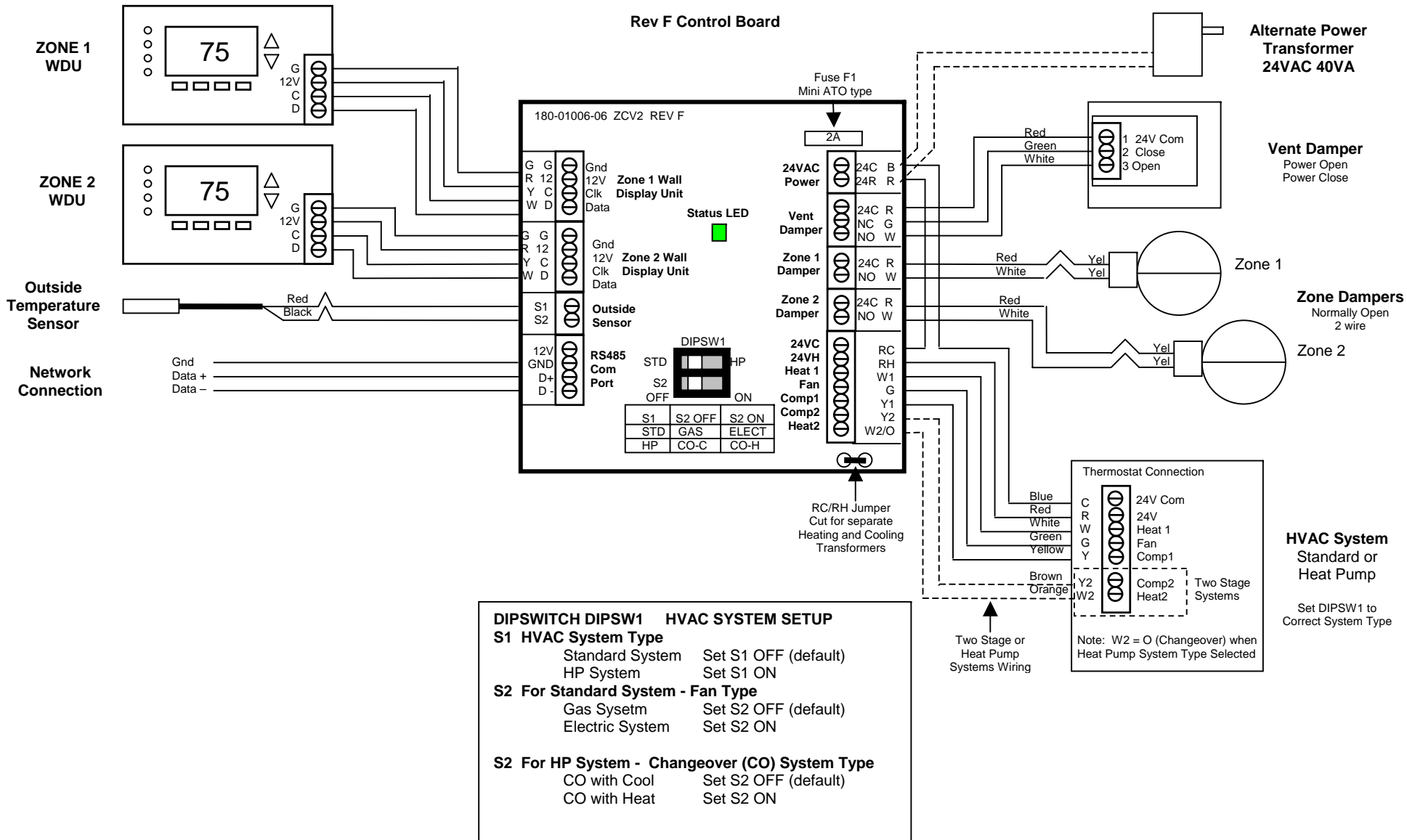
Short across R to Y, R to G and R to O/B(Changeover terminal) to get opposite heat or cool operation from step 2. **If any of these checks fail, the HVAC system is not working correctly.**

# ZCV2

## 2 ZONE HVAC CONTROL UNIT

### Wiring Diagram

Rev F Control Board



# ZCV4

## 4 ZONE HVAC CONTROL UNIT

### Wiring Diagram

Rev G Control Board

