

RCS

Model ZC6R

**6 ZONE HVAC CONTROL UNIT
with RS232/485 Serial Communications**

(Rev E)

INSTALLATION AND OPERATION MANUAL

DCN: 141-00324-06

Rev 6

6/14/04

***** 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 ZC6R HVAC Control Unit, when connected to a HVAC mechanical system, provides typical thermostat functions for up to 6 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 ZC6R. 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 **RCSLink1** products, such as Model TS15 and TS36, can be used with the ZC6R.

Remote Sensors. RCS remote temperature sensors that are **RCSLink1** products, such as Model RS10B can be used in place of the Wall Display Units. RCS Model OS10B Outdoor Sensor can be used for the outside remote sensor.

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 ZC6R is 100% Heat Pump compatible with changeover valve operation that can be selected for either changeover with cooling or with heating.

Multi-Stage HVAC Compatibility. The ZC6R 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. All stages stay on until setpoint is reached.

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 Zone Control Unit 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 ZC6R Zone Control Unit has both RS232 and RS485 serial communications ports, but ONLY ONE can be selected. 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 RS232/485 protocol manual.

Up to 15 ZC6Rs can be networked together in a HVAC control network along with other RCS communicating thermostats. RCS Network Automation Control Units, such as the CommStar models CS30/308/48, can provide complete schedule and event control of these units and supports graphical keypads or PC displays.

Outside Temperature Operation

The ZC6R can use and display outside temperature information from a sensor attached to the ZC6R 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 TS15 WDU can view the outside temperature by pressing the up/down arrows simultaneously. A TS36 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 ZC6R. When a outside temp sensor is attached to the ZC6R, 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.

If an active sensor is disconnected, the temperature will be shown and reported as "0" temperature. A disconnected sensor should be un-enrolled by resetting (power cycle) the ZC6R so that it will not appear. Once an OT sensor is enrolled it will also inhibit outside temperature data from the network from being accepted and it will be ignored.

Reporting Outside Temperature on the Network. When an Outside Temp Sensor is attached to the ZC6R 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 ZC6R, outside temperature data can be received from the network and the ZC6R will treat it just like a local sensor is installed. ***If a local outside temp sensor has been installed on the ZC6R, 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 ZC6R.

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 the setpoint.

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

FAN MODE SELECTION. For normal Heat Pump Operation, set the FAN/HEAT selection dipswitch, SW1-2, to OFF for standard fan operation,

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 SW1-3 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 SW1-3 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 zone 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 Zone 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

have been recently completed and the MOT delay timer is still active.
be noticeable when you change a zone setpoint and it does not respond immediately due to another call

The ZC6R can be setup for either RS-232 or RS-485 serial communications that allows remote commands generated by other systems to be received by the ZC6R. 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 ZC6R 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-232 connections are point to point and the ZC6R controller is directly connected to a dedicated port on the remote host system. For RS-232 communications, the ZC6R address is always set to 1.

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. RS232 controllers MUST be addressed as device 1. RS485 controllers can be addressed from 1 to 15 by setting dipswitch SW1. Network address 0 is reserved for the Host control unit.

Communications Parameters. The ZC6R serial communications setup is 9600 baud, 8 data bits, no parity and 1 stop bit. Flow control is set to none.

RS232/RS485 Selection. The ZC6R can be setup for either RS-232 or RS-485 communications. Note that only one communications option can be selected at a time. Set the shunts on jumpers JP2 and JP3 to the communications option desired.

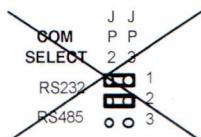
RS232 Setup
Set shunts on JP2/3
to positions 1 & 2

J J
COM P P
SELECT 2 3
RS232 1
RS485 2
o o 3

RS485 Setup
Set shunts on JP2/3
to positions 2 & 3.

J J
COM P P
SELECT 2 3
RS232 1
RS485 2
o o 3

Caution: Do not install shunts across jumpers JP2 and JP3.



The RS232 network connects to the RJ45 jack, J18, using the modular data cable and DB9 adapter supplied. This connects directly to a PC compatible serial com port on the host system.

The RS485 network connects to the screw terminal connector, J17. 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 ZC6R are powered off different power sources.

TX/RX Activity LEDs. The TX (red) and RX (green) LEDs will blink when data communications is occurring. These are useful to troubleshoot and to confirm that the network setup is correct.

Communications Protocol

The ZC6R 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 ZC6R HVAC control unit.

Note that not all commands in the protocol document are applicable to or supported by the ZC6R. The protocol document has an appendix that identifies ZC6R 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.

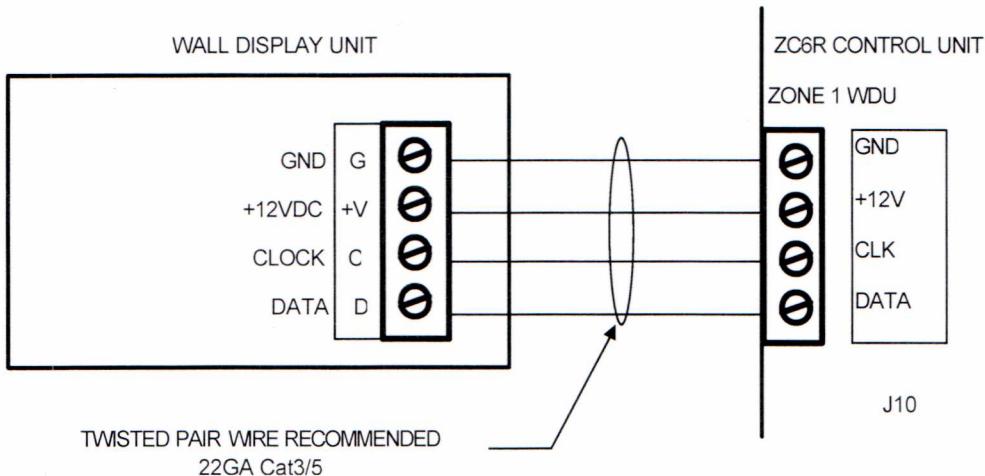
Mount the Control Unit in a vertical position on a wall or sturdy structural member. The unit may be mounted on the HVAC system but care should be taken to avoid the hot burner section or high vibration areas.

WIRING

Wiring To The Wall Display Units

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

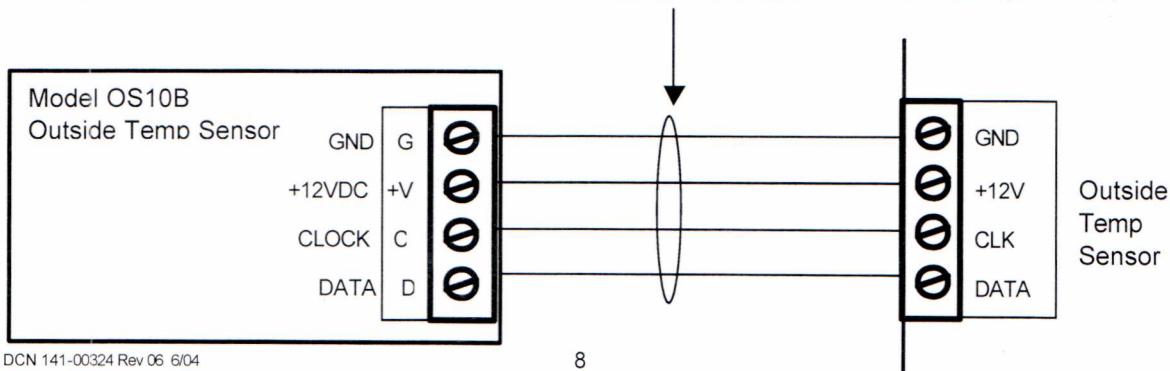
The Control Unit connects to each zone's Wall Display Unit or Sensor by four wires. In retrofit applications, the existing thermostat wiring may be used, however, for best results and in new construction, a Category 5 twisted pair cable is recommended.



CAUTION! Do not mis-wire the Wall Display Units – damage may result. Check the wiring before applying power to the ZC6R.

Wiring To The Outside Temp Sensor (if installed)

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

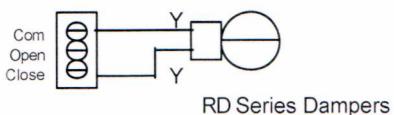


Wiring To The Zone Dampers

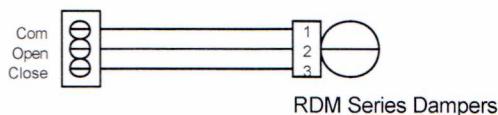
Wire specification: 3 conductor, standard 18GA thermostat wire.

The ZC6R HVAC Control Unit has 6 zone damper output relays plus a fresh air vent damper output. These SPDT relays are rated at 1 Amp, 24VAC. Each zone output supports both two wire (normally open, power close/spring return) and three wire dampers (power open, power close).

Two Wire Damper Wiring



Three Wire Damper Wiring



ZONE DAMPERS

ZC6R zone dampers are Normally Open dampers. All dampers are normally open unless there is a heat/cool call in one or more zones. 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 professional 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 ZC6R control Unit.

Other Zone Control Devices

Other zone control devices, such as valves, can be used with the ZC6R. Additional external relays may be required with valves to work with the control unit.

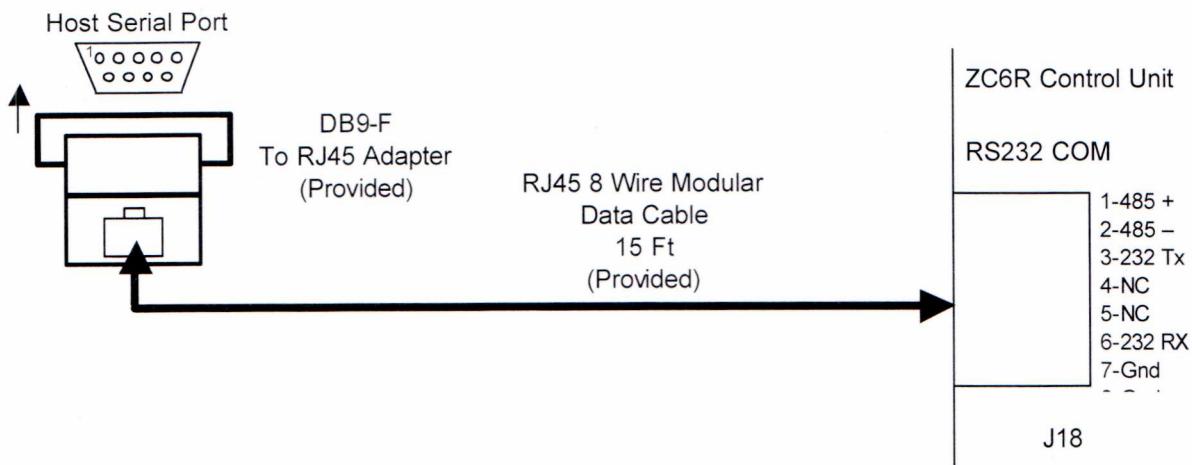
POWER

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.

RS232 Wiring

The RS232 communications port is designed to connect to PC type serial COM port. Connect the RJ45 Data Cable and DB9 adapter provided to the ZC6R RJ45 jack and to a PC compatible COM port.



Custom Serial Cable Wiring

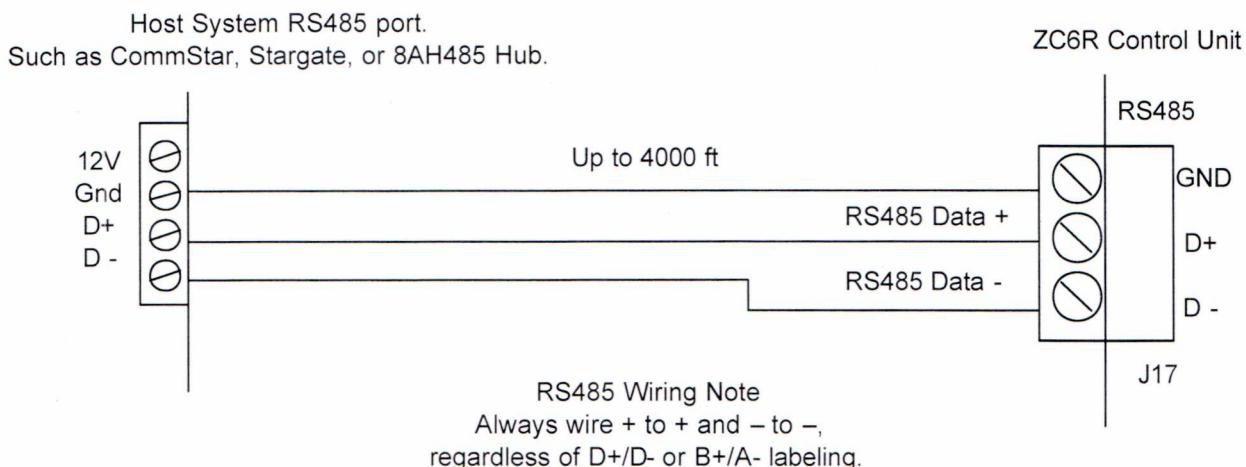
If you need to create a custom RS232 serial cable, the cable pinouts are given below.

DB9F pin 2	to	RJ45 pin 3 (Tx)
DB9F pin 3	to	RJ45 pin 6 (Rx)
DB9F pin 5	to	RJ45 pin 7 or 8 (Gnd)



RS485 Wiring

The RS485 communications port is a 2 wire, half-duplex network connection (ground is optional). Either wire in a daisy chain connection or connect to a RCS RS485 hub to allow star or homerun wiring.

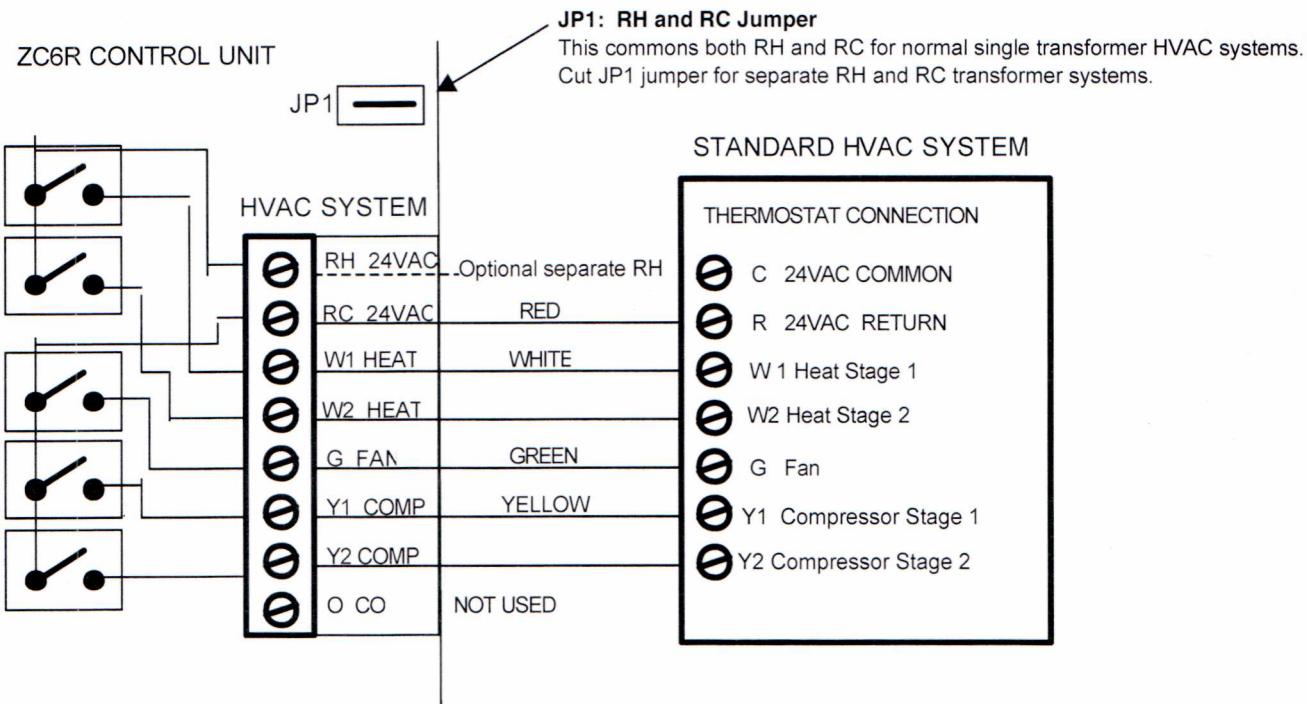


HVAC SYSTEM CONNECTION

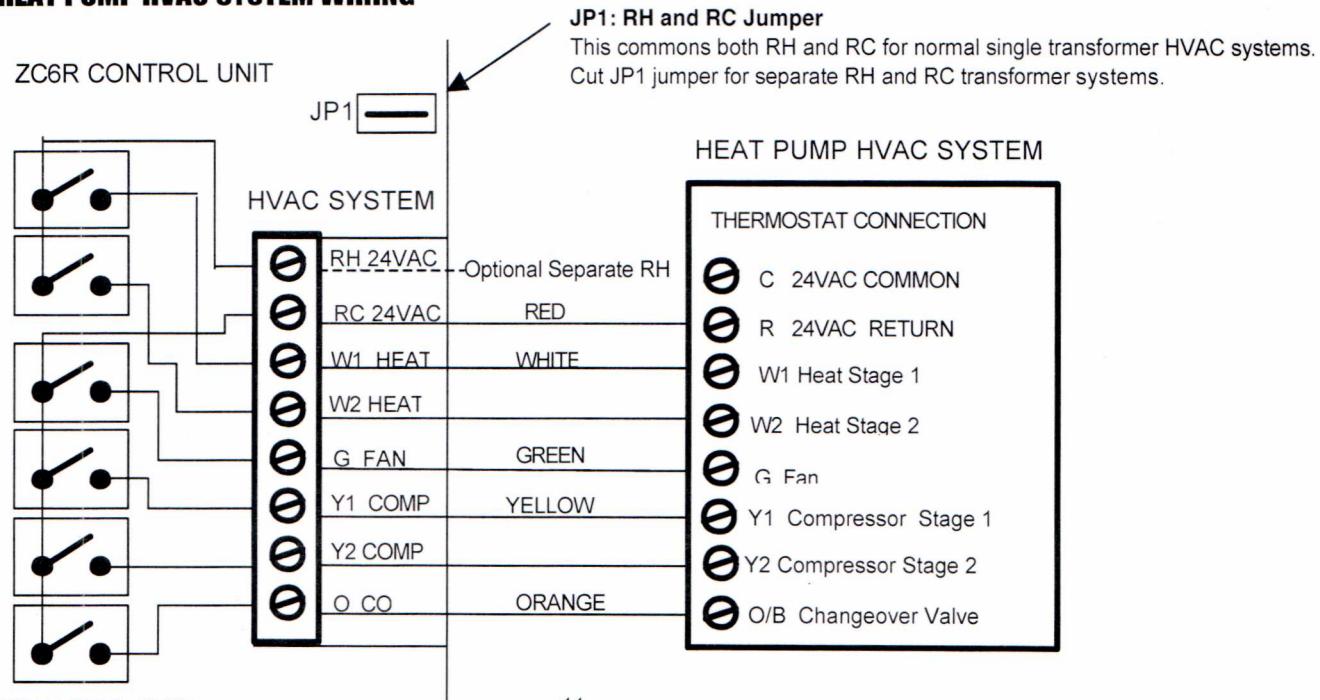
Electrically, the ZC6R Control Unit looks like a standard thermostat to your HVAC system. All connections to the HVAC systems are made at the normal thermostat connection on the HVAC unit.

Refer to the following HVAC wiring information for the type of HVAC system, Standard or Heat Pump, that the ZC6R is being connected to. Refer to your HVAC system's documentation for specific information on its thermostat connections.

STANDARD GAS/ELECTRIC HVAC SYSTEM WIRING



HEAT PUMP HVAC SYSTEM WIRING



TYPIICAL THERMOSTAT
WARNING COLOR CODES



SYSTEM CHECKOUT

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 ZC6R 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 ZC6R's RS-232 connection to a PC serial port (assumed to be Com1 here, if not substitute the correct port number).
2. Set ZC6R Com Port selection to RS232 (JP2/3 shunts on pins 1 & 2)
3. Set ZC6R address to 1 (SW1-5 on, 6,7,8 off)
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. ZC6R should respond with the R=1 status response showing temp, setpoint, mode and fan for zone 1 (and for each connected zone if more than one connected). (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 Z=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 Z=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 RS-232 commands, proceed with installation.

It is recommended that you install the ZC6R and then rerun these quick tests BEFORE you connect the Control Unit to the HVAC system. You will be confident that the ZC6R is working correctly before you attempt to interface the HVAC system.

HVAC SYSTEM QUICK TEST

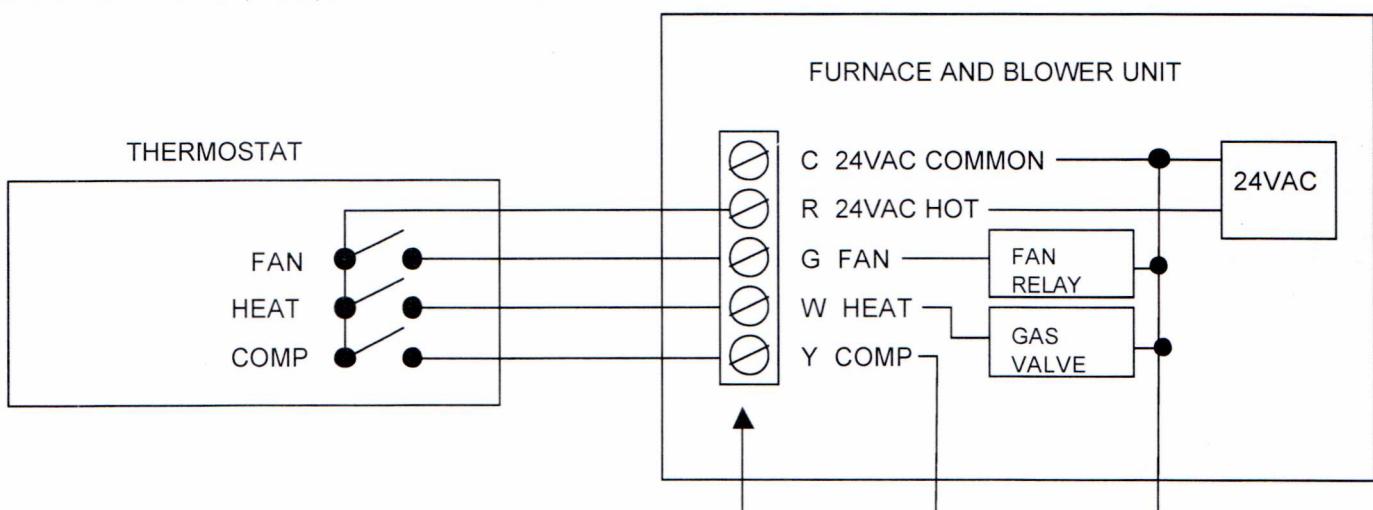
In the event that you have difficulty with the ZC6R controlling the HVAC system, you can perform the following quick test to confirm that the HVAC system is working correctly.

The ZC6R 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.

HVAC SYSTEM
STANDARD GAS/AC



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:

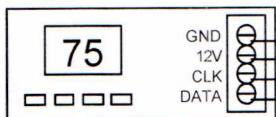
Follow the above test to check the FAN operation. If FAN works OK, then power is verified also. Short across R to Y and R to G. You should get either Heat (normal) or Cool operation depending on the whether your system is changeover with cool (normal) or heat.

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.***

WIRING DIAGRAM

ZC6R Rev E

RCS
Wall Display Units

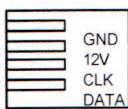


TS15 or TS36

Note: RCS Wall Display Units or Sensors with **RCSLink1** four wire interfaces may be connected to Zones 1 to 6 and the Outside Temp Sensor.

Connect zones in order and do not skip zones. When adding or deleting zones, the system must be powered down and back up to re-register active zones.

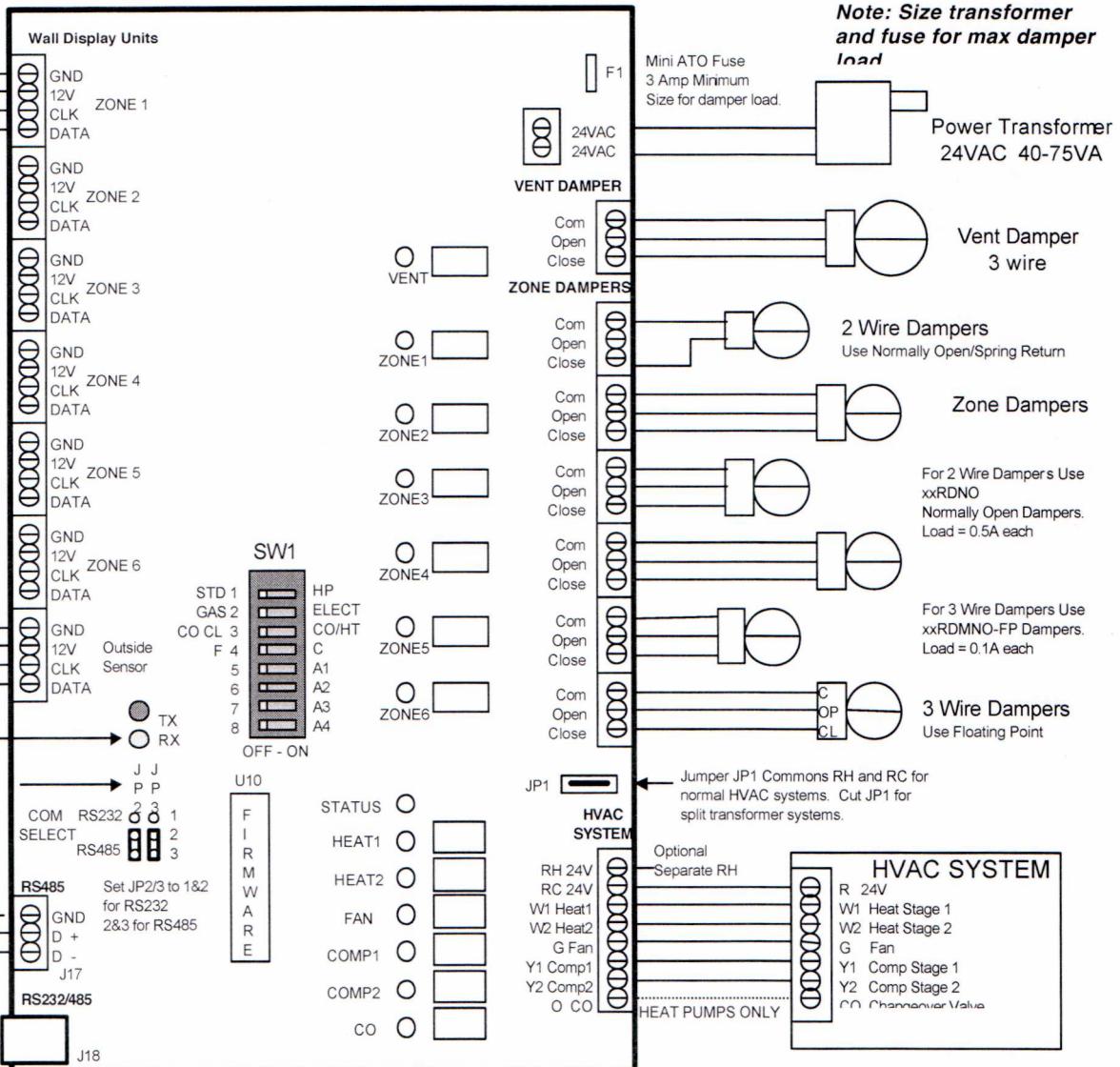
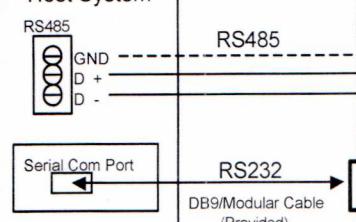
OUTSIDE TEMP SENSOR
OS10B



Serial communications data activity indicators

Select RS232 OR RS485 com port with JP2/3 jumpers

Host System



SW1 DIP SWITCH SETTINGS

SW1-1 STD OR HP SYSTEM SELECT

- OFF - Standard HVAC System
- ON - Heat Pump HVAC System

SW1-2 FAN MODE SELECT

- OFF - Gas
- ON - Electric

SW1-3 CHANGEOVER MODE SELECT

- OFF - Changeover with COOL
- ON - Changeover with HEAT

SW1-4 °F OR °C SELECT

- OFF - °F Mode
- ON - °C Mode

SW1-5,6,7,8 COM ADDRESS SELECT

- | | |
|---|-------------------------------|
| 5 | Address bit 1 (LSB) |
| 6 | Address bit 2 |
| 7 | Address bit 3 |
| 8 | Address bit 4 (MSB)
OFF-ON |

COM Address selection is made by setting the address bits on SW1 positions 5, 6, 7, and 8. The address is set as a **binary 4 bit number**, with position 5 as the least significant bit and position 8 as the most significant bit. Address range is 1 – 15 (0 is reserved for host).

- 5 1
6 0 = 0001 = Address 1 (default)
7 0
8 0

ADDRESS SELECTION TABLE

SW1 - 8 7 6 5	COM ADR	SW1 - 8 7 6 5	COM ADR
0 0 0	0 (resv)	1 0 0 0	8
0 0 0 1	1	1 0 0 1	9
0 0 1 0	2	1 0 1 0	10
0 0 1 1	3	1 0 1 1	11
0 1 0 0	4	1 1 0 0	12
0 1 0 1	5	1 1 0 1	13
0 1 1 0	6	1 1 1 0	14
0 1 1 1	7	1 1 1 1	15