

RS232/485 Thermostat

Model TR15-485
Model TR15-232
Model TR15R-485
Model TR15R-232

INSTALLATION AND OPERATION MANUAL

Applies to the following revisions and later.

TS15 WDU Rev 07
HCUR-232 HVAC Control Unit PCB Rev E
HCUR-485 HVAC Control Unit PCB Rev E

DCN: 141-00370 Rev 03
4/00

***** 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.

TR15 OPERATION

The TR15 Thermostat provides typical thermostat functions as well as the capability to send and receive information via RS232 or RS485 communications. This RS232/485 communications capability allows the thermostat's setpoint, mode and fan operation to be changed remotely. In addition, the remote systems can request status of the thermostat's temperature, setpoints, modes, and other system information.

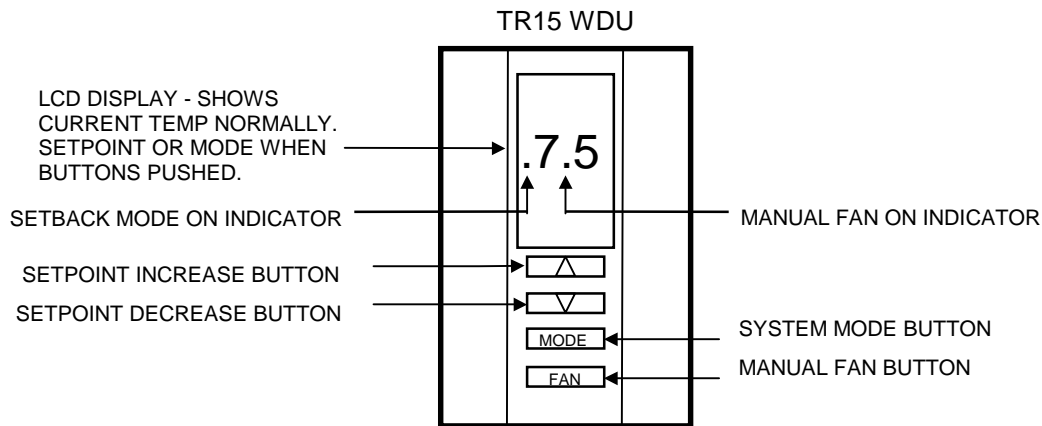
The TR15 consists of two parts, a **Wall Display Unit (WDU)** and a **Control Unit**. The Wall Display Unit looks like a traditional thermostat and is the wall mounted user interface for the TR15. It provides display, control pushbuttons, and the temperature sensor. The WDU connects to the Control Unit by a 4 wire cable. The Control Unit connects to the HVAC system in place of a standard thermostat and provides thermostatic control of the system. In addition, the Control Unit sends and receives data and commands via the on-board RS-232 and RS-485 ports for remote control of the system.

The Model TR15R is available for use with a remote temperature sensor such as the RS15.

TR15 Wall Display Unit

The WDU has a two digit backlit LCD display, control buttons for changing the Setpoint (Up and Down), Mode (Off, Heat, Cool, Auto) and manual fan (On/Auto) functions and a digital temperature sensor. The LCD display serves as a common display for current temperature, setpoint, mode and manual fan status. The display normally shows current temperature and switches to show setpoint or mode when those buttons are pushed. Remote sensor versions do not have an internal sensor and have a connection for a remote sensor, such as the RS15 wall mounted temperature sensor.

Any changes in temperature, or control button operations, are transmitted to the Control Unit. Updates in setpoint or mode can also be received by the WDU from the Control Unit. When updates are received, they are displayed for 3 seconds and then the display returns to the current temperature.

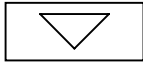
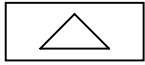


LCD Display

The LCD display normally shows the current temperature. Whenever any of the control buttons are pushed, the LCD display will change to show that function's current status. The LCD display will stay in the new display mode as long as buttons are being pushed. After 3 seconds of no activity, the display will change back to show current temperature. The right decimal point on the LCD display will turn on whenever manual fan is on. The left decimal point will blink whenever the setback mode is active.

Remote changes in setpoint or modes that are received from the Control Unit will cause the LCD display to switch and display the updated data for 3 seconds and then return to current temperature.

Control Buttons



Setpoint UP and DOWN Buttons

The **UP** and **DOWN** buttons control the setpoint temperature. Pushing the **UP** or **DOWN** button once will cause the LCD display to change to show the **current setpoint temperature**. Pushing the button again (before the display switches back to current temperature) will decrement or increment the setpoint value by one degree. Pushing and holding a button down will cause the setpoint to continuously change until the button is released. After 3 seconds of no activity, the LCD display will change back to show the current temperature and the new setpoint value will be transmitted to the Control Unit.

The setpoint can be set from 40°F to 99°F (5°C to 37°C).

There is only **ONE** setpoint for the WDU, and it is used for both heating and cooling. The displayed setpoint shows the setpoint of the **current mode** of the system. If you change modes, this same setpoint will be used for the new mode, unless otherwise changed by local (buttons) or remote updates.

MODE

MODE Button

The **MODE** button controls the HVAC system mode. To see what mode the HVAC is in, push the **MODE** button once and the LCD display will change to show the current mode. Pushing the **MODE** button again while the MODE is being displayed, will cause the mode and display to change to the next mode. The system mode cycles from **Off** to **Heat** to **Cool** to **Auto** and back to **Off** again with each push of the **MODE** button. Any change in the system mode is transmitted to the Control Unit.

FAN

FAN Button

The **FAN** button controls the HVAC system's manual fan. Pushing the **FAN** button once will turn the fan On and pushing it again will turn the fan to the Auto mode (OFF unless turned on by the furnace or AC). The right decimal point of the LCD display will come on when the manual fan is ON. Changes in the fan mode will be transmitted to the Control Unit.

Temperature Display

The WDU will normally display the current temperature from the internal digital temperature sensor or a remote sensor. The sensors have an accuracy of +/- 1°F(+/- .5°C) and a range of -67°F(-55°C) to 257°F(125°C). The WDU will display temperatures from 0°F/C to 127°F/C. Temperatures less than 0° will be displayed as 00°, temperatures over 100° will be displayed without the leading 1 (example: 102 as 02°.)

Temperature Display Calibration (New Feature for TS15 WDU Rev 07 and later)

The TS15 and TS15R Wall Display Units have the capability for the user to adjust the calibration of the unit from the front panel. If you desire to change the displayed temperature calibration, you may do so by adjusting the Calibration Offset.

What you are adjusting. You are adjusting a calibration *OFFSET*. This allows for the temperature measured by the WDU to be added or subtracted by an offset of 0 to + or - 7 degrees.

When in the Calibration Mode, the LCD screen will be displaying a number from 0 to +/- 7. This is the current calibration offset. The factory default is usually "0" but may be set to a factory offset also.

For instance, if the display shows 70 degrees and the desired temperature display is 72 degrees, you would change the calibration offset by increasing it 2 degrees. If the offset was 0 degrees, then the new offset would be 2 degrees and this is what is displayed on the calibration offset display.

If the display shows 70 degrees and the desired temperature display is 68 degrees, you would change the calibration offset by decreasing it 2 degrees. If the offset was 0 degrees, then the new offset would be -2 degrees. **Remember: what you are changing is a number from 0 to +/- 7.**

How to enter the Calibration Mode and view the Calibration Offset.

To enter into the calibration mode, FIRST press and HOLD the “MODE” button and then simultaneously press the “FAN” button until “CO” appears on the LCD display.

Release the buttons and the current calibration offset number will appear on the LCD display. This is usually “0” but may be any number from 7 to -7.

When viewing the calibration offset only and you do not change it, the display will automatically revert back to current temperature display after 20 seconds of no activity.

How to change the Calibration Offset.

Enter into the calibration mode as described above. This will display the current Calibration Offset. Determine how many degrees you want to change the temperature calibration, a maximum of + or - 7 degrees.

Adjust the Calibration Offset by pressing the UP or DOWN buttons. Each button press increments the offset by 1 degree. You will see the offset displayed on the LCD screen.

When you are done with adjusting the calibration offset, the WDU will automatically store the new offset and return to the current temperature screen after 3 seconds of no activity.

The new temperature offset will be calculated and displayed on the next temperature update cycle. It may be several seconds before you see the temperature change.

Wall Display Unit “CF” Error Display

If the WDU is not properly wired or if communications to the Control Unit is interrupted, the LCD display will display “CF” to denote communication failure. Momentary display of “CF” caused by bad or lost data, will clear automatically when data communication is restored. If the “CF” display stays on, check wiring for problems. A continuous “CF” display may indicate a problem with the Control Unit or the WDU itself. To verify WDU operation, replace the unit with another known good unit.

CAUTION!

USE CARE WHEN WIRING UP THE WDU TO CONTROL UNIT TO BE SURE TO WIRE IT CORRECTLY. DOUBLE CHECK IT! INCORRECT WIRING WILL DAMAGE THE WDU AND IS NOT COVERED UNDER WARRANTY.

Wall Display Unit INSTALLATION

WDU Location. Choose a location that best represents the temperature of the area to be controlled. Avoid locations that are subject to drafts, from doors and windows, or areas with direct sunlight exposure.

WDU Mounting

Route the wires to the WDU through the access hole in the back of the case. Mount the WDU to the wall with the screws and anchors provided. Be sure to plug any large access hole in the wall with sealer or insulation to prevent wall drafts from affecting WDU operation.

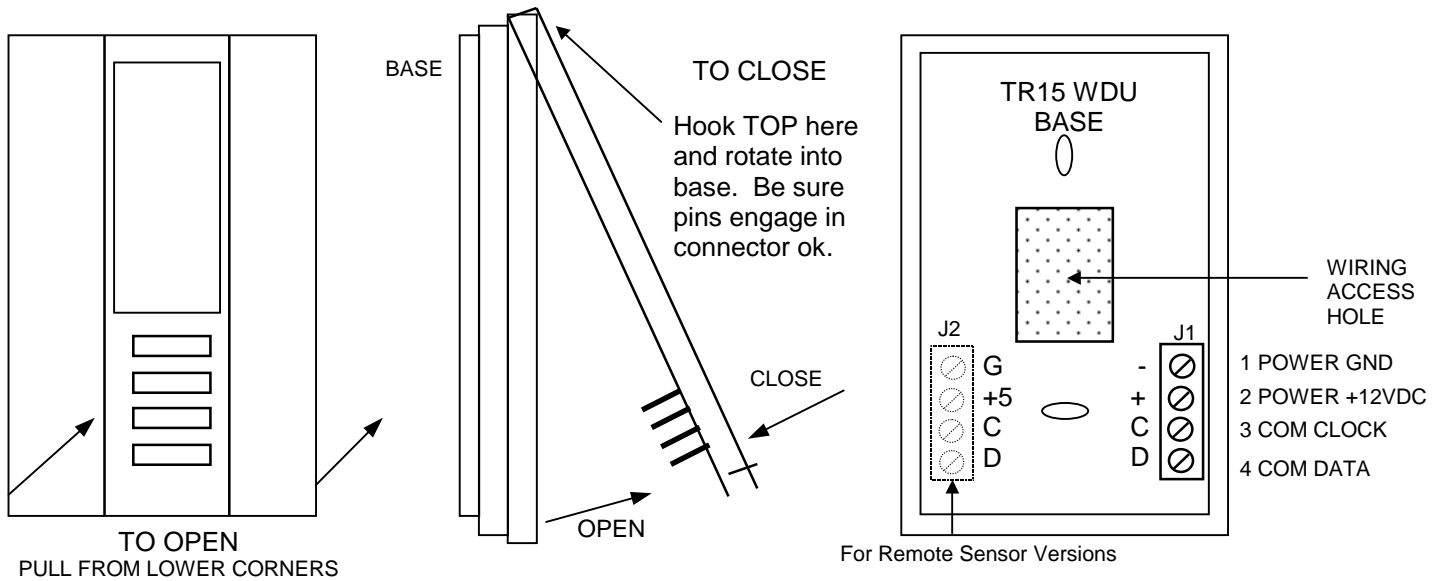
WDU Prewiring

The recommended wiring to the WDU from the Control Unit should be a two twisted pair cable, 24 Ga minimum. Cat 5 cable is acceptable. In retrofit applications the existing thermostat wiring (a least 4 wires) may be adequate. However, such non-twisted wiring may be subject to interference due to adjacent high voltage wiring.

WDU To Control Unit Wiring

Wiring the WDU is simply connecting the four wire cable from the Control Unit to the WDU terminal block. Two wires are for data and two are for power. WDU power is 12VDC and provided by the Control Unit.

CAUTION: DO NOT MISWIRE THE POWER AND DATA LINES...DAMAGE WILL RESULT!!! CHECK YOUR WIRING BEFORE APPLYING POWER...



OPENING AND CLOSING THE WDU CASE

TR15 WDU WIRING DIAGRAM

Remote Sensor Version

Model TR15R has an addition connector, J2, on the WDU base for connection of an external remote temperature sensor. Follow the wiring diagram with the remote sensor to connect to the WDU.

TR15 CONTROL UNIT

The TR15 Control Unit works in conjunction with the Wall Display Unit to provide thermostatic control of the HVAC system. In addition, the Control Unit can receive RS232/485 serial commands for remote control of the setpoints, temperatures and modes of the thermostat. It also responds to requests for status information.

The TR15 Control Unit connects to the HVAC system the same as, and in place of, a standard thermostat. The Control Unit works with either standard Gas/Electric or Heat Pump HVAC units.

Actual thermostatic control of the HVAC system is provided by the Control Unit. Changes in the current temperature, setpoint, system or fan modes are sent to the Control Unit either from the WDU or via serial communications commands. The Control Unit monitors this information and operates the HVAC system accordingly.

Standard HVAC Systems Operation

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

Standard System Mode Selection. To set the Control Unit for standard GAS/ELECTRIC operation, leave the dipswitch SW1-1 set to the STD SYS position (OFF-default).

Fan Mode Selection. Normally, GAS heating systems DO NOT require fan calls along with the heat call due to thermostatic fan operation in the furnace. For Gas systems, dipswitch SW1-2 should be set to the STD FAN position (OFF). Electric and hydronic heating systems generally DO require that a fan call be generated along with the heat call. For these systems, dipswitch SW1-2 should be set to the FAN/HEAT position (ON). Be sure to check your HVAC system's requirements.

Minimum Run Time. The Control Unit has a minimum runtime in either heating or cooling of 4 minutes. The system will continue to operate **even if the setpoint is satisfied or changed** until MRT time-out. If the system mode is changed to off, the minimum run time is canceled and the system will go off immediately.

Short Cycle Protection (SCP) Delay. The Control Unit has a short cycle protection (SCP) delay of 5 minutes after any compressor operation. This delay prevents a subsequent compressor call until the delay times out. This delay is to allow the compressor head pressure to bleed off before starting again. The SCP is active in either STD or HP modes. In the Heat Pump mode, it effects both heating and cooling cycles. **The Status LED on the Control Unit circuit board will blink twice during SCP delay periods.**

Heat Pump HVAC System Operations

The heat pump system mode works similarly to the standard systems. Normal heating/cooling calls and auto-changeover function the same as standard systems. In addition, Heat Pumps have a second stage of heating. Heat pump systems use the compressor for the primary heating/cooling source. During periods of high heating requirements, additional heat stages, usually electric strip heaters, may be used. These second stages of heating will be turned on when the current temperature falls four degrees below the current setpoint and will turn off when the difference is reduced to two degrees below the current setpoint.

Heat Pump Mode Selection. For Heat Pump operation, set SW1-1 to the HP SYS position (ON).

Fan Mode Selection. Set the Fan selection, SW1-2, to the STD FAN position (OFF).

Change Over Selection. Heat pump systems change from heating to cooling by reversing the direction of Freon flow in the system. This change over is controlled by the change over (sometimes referred to as reversing valve) output 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 dipswitch SW1-3 to the CO/CL position (OFF-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 the CO/HT position (ON). After the change over relay output is first activated, it will stay on continuously even when there is no call until it is turned off by changing to the opposite mode. This prevents continuously cycling of the reversing valve with each call as a system is generally in heating or cooling mode for extended periods.

Emergency Heat Mode. When the Control Unit is selected for a Heat Pump system, there is an Emergency Heat Mode that can be enabled from the WDU mode selection. In the event of a compressor failure, the “EH” mode can be selected. When in this mode, the second stage heating (heat strips) will be used for stage one heat calls. This mode is for temporary use until the compressor can be repaired.

Fahrenheit or Centigrade Selection

Fahrenheit or Centigrade mode is selected by dipswitch SW1-4. In the OFF position, Fahrenheit mode is selected. Set SW1-4 ON to select Centigrade mode. This sets the mode for both Control Unit and WDU.

Status LED

The Control Unit has a Status LED on the circuit board that will normally blink on and off slowly as a system heartbeat. During short cycle protection delay periods, the LED will blink twice for each heartbeat. This indicates that the compressor is locked out during this time.

REMOTE OPERATION

The TR15 has either a RS-232 or a RS-485 interface that will allow remote commands generated by other systems to be received by the TR15. These remote commands can change the setpoint, temperature and mode of the system or may request current status of temperature, setpoint and mode. Remote commands received by the TR15 are decoded to a new setpoint or a new mode and are sent to the TS15 WDU to update its display. Whenever new commands are received, the TS15 will switch it's 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 controller is directly connected to a dedicated port on the remote system. RS-485 connections are a twisted pair multi-drop network that can have up to 256 devices connected to one pair of wires. The TR15 Control Unit is addressable as systems 1 to 15 via dip switch SW1. (System address “0” is reserved for the host system)

The TR15 uses a communications format of 9600 baud, no parity, 8 data bits and 1 stop bit.

REMOTE COMMANDS

Refer to the RS-232/485 Message format document, DN:150-00225, for detailed information on remote commands to communicate with the TR15 thermostat.

CONTROL UNIT INSTALLATION

LOCATION AND MOUNTING

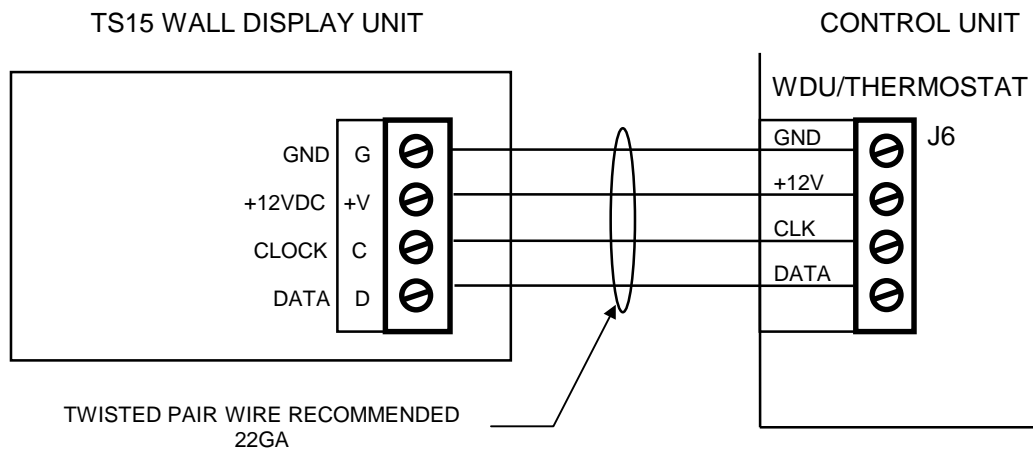
Install the Control Unit in a protected, convenient, INDOOR location near the HVAC system or in a service accessible area such as an equipment closet or garage.

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.

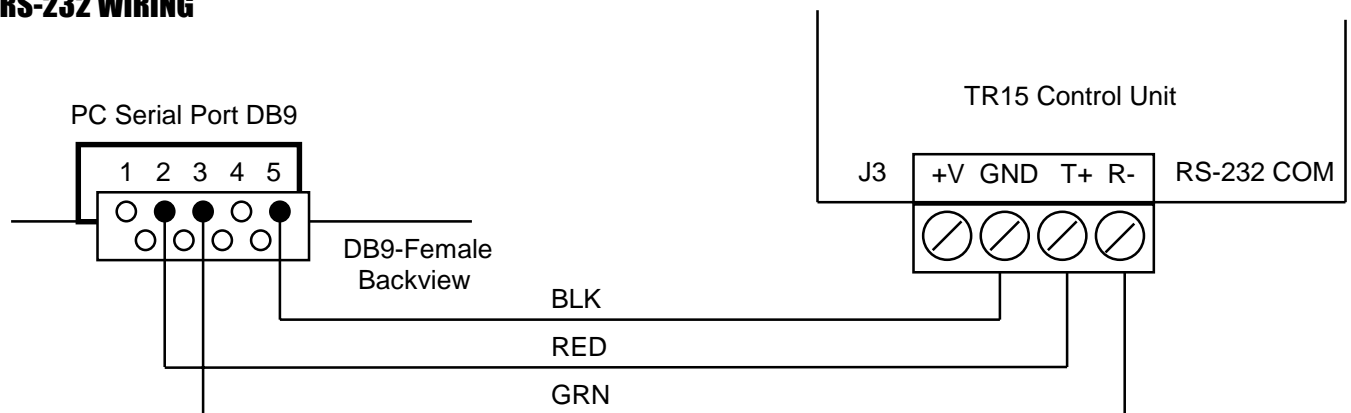
CONTROL UNIT WIRING

WIRING TO THE WALL DISPLAY UNIT

The Control Unit connects to the TS15 Wall Display Unit by four wires. In retrofit applications, the existing thermostat wiring may be used, however, for best results and in new construction, a 24GA, two twisted pair cable, such as Cat 5, is recommended.

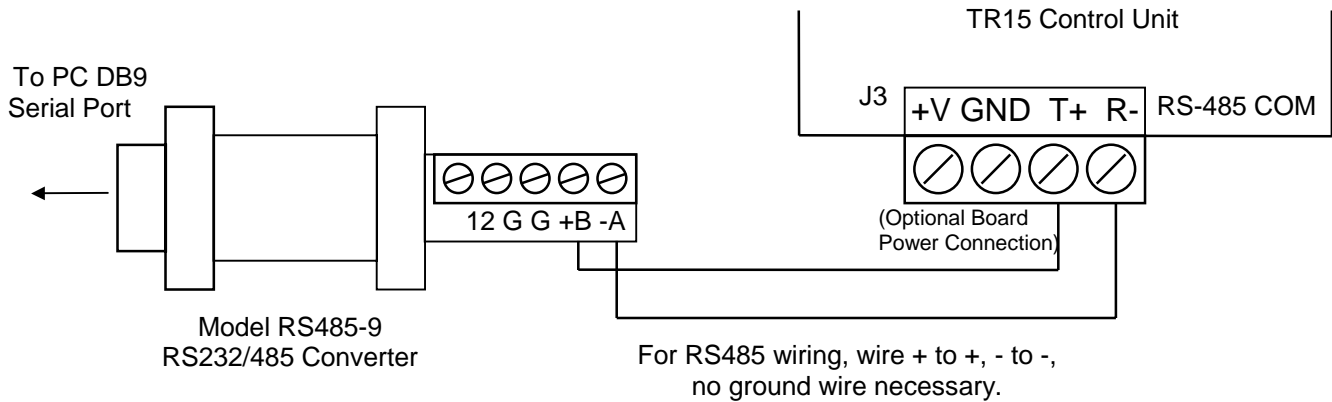


RS-232 WIRING



RS-485 WIRING

Several RS-485 wiring connections are possible. For a direct connection to a PC, a RS232 to RS485 converter can be used as shown below. Optionally the units may be connected to a RS485 Hub for both power and data distribution.



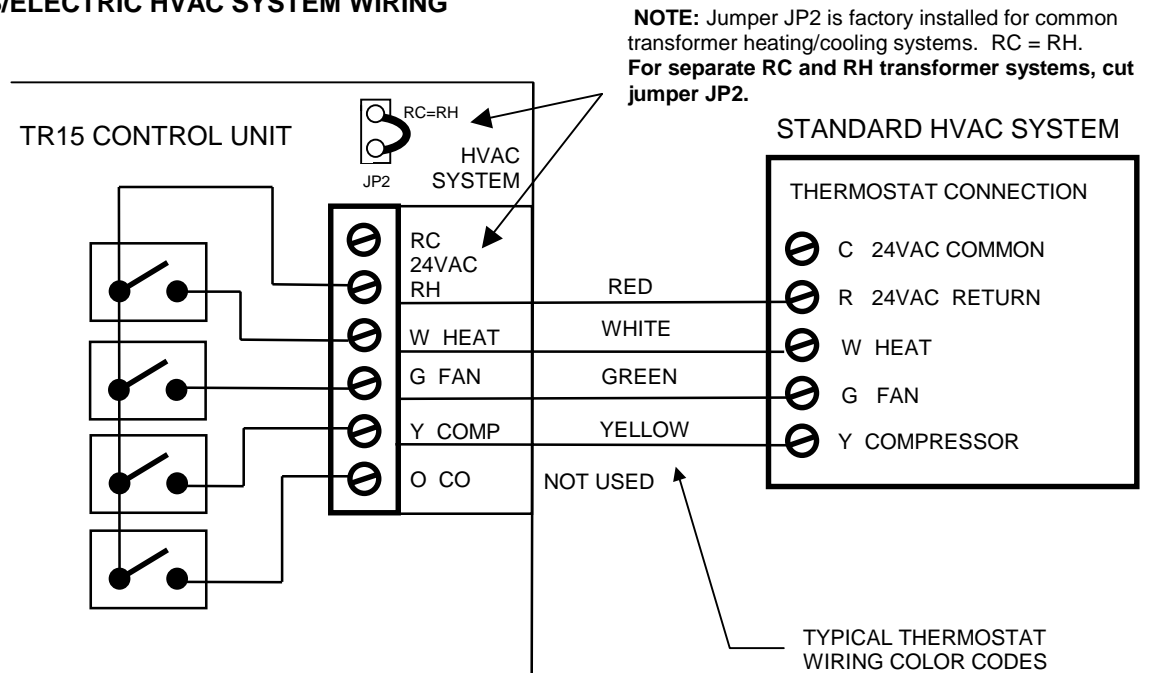
Refer to RCS 485Hub-8 for information on wiring to a RS485 wiring distribution hub.

HVAC SYSTEM CONNECTION

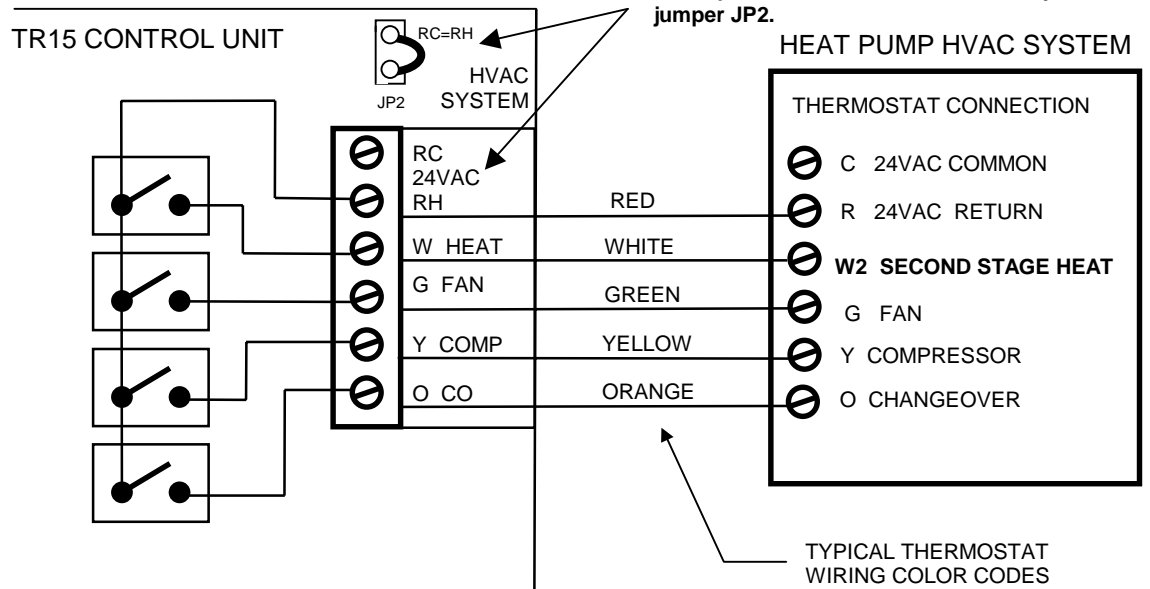
Electrically, the Control Unit looks like a standard thermostat to your HVAC system. All connections to the HVAC systems are made at the normal thermostat connection on the HVAC unit.

Refer to the following HVAC wiring information for the type of HVAC system, standard or heat pump, that the TR15 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



POWER

The Control Unit requires 12VDC, 200ma max. Power is provided by an external transformer at jack J4 (Caution, center ground plug-ins only). 12VDC power can also be provided to the control unit on J3 positions 1 and 2, for network powered applications.

SYSTEM CHECKOUT

It is strongly recommended that you hook-up and run a simple bench test of the Thermostat before installing this controller. Not only will this save you time in system checkout but will also familiarize you with the TR15 operation.

QUICK TEST – TR15 Thermostat

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

REMEMBER, THERE IS A 5 MINUTE DELAY BETWEEN COOLING CALLS FOR STD SYSTEMS OR BOTH HEAT AND COOL CALLS FOR HEAT PUMP SYSTEMS. (resetting power will cancel delays)

1. Connect a **TS15 Wall Display Unit** to the **Control Unit** with a short (12 inch) 4 wire cable.
2. Connect the 12VDC transformer to the Control Unit.
3. Plug the transformer into a 110v outlet and apply power to the Control Unit. Verify Status LED is On and blinking.
4. Verify the TS15 display comes on and shows the current temperature.
 - a. If no display or a “CF” display is shown on the TS15, **double check your wiring**.
 - b. Do not proceed until the current temperature is displayed on the TS15. Try swapping TS15's.
5. With the current temperature displayed on the TS15, we have verified communication between it and the Control Unit is OK. Any problems will result in a “CF” (Communications Failure) display on the TS15.
6. Press the Fan button on the TS15. The Control Unit Fan LED and relay should turn on.
7. Press the Fan button again. The Fan LED and relay should turn off.
8. Press the Mode button until the TS15 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 TS15 is showing “O” for OFF. The Heat LED and relay will turn OFF.
11. Press the Mode button until the TS15 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 TS15 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 TR15 are working and communicating correctly.

Install Wall Display Unit, Control Unit, Set Dipswitch SW1 and Retest.

It is recommended that you install the TR15 and then rerun the quick test BEFORE you connect the Control Unit to the HVAC system. OBSERVE THE OUTPUT LEDS TO CONFIRM CORRECT SWITCH SETTINGS. You will be confident that the TR15 is working correctly before you attempt to interface the HVAC system.

QUICK TEST - Serial Communications with a PC

Before you start:

Connect the TR15 Control Unit and the Wall Display Unit as instructed in the thermostat quick test. Connect TR15-232 Thermostat connector J3 to a PC Serial COM port. Follow wiring diagram on page 8. For TR15-485 Thermostats, you must use a RS232/485 converter (Model RS485-9) (See page 9) Set the TR15 Thermostat Control Unit Dip Switch to Address 1. Power up thermostat. Be sure the thermostat is working OK.

Setup of Windows Communications Software:

1. From the Windows/Programs/Accessories/Communications program group, select **Hyper Terminal**,
2. From the Hyper Terminal window, start the terminal emulator program by clicking on HYPERTERM.EXE
3. **“Connection Description”** window will open. Enter name as **RCS**. Click OK.
4. **“Connect to”** window will open. In “connect using” select: **“Direct to Com1”** (or Com2 which ever Com port you have connected to.) Click OK.
5. **“Com1 properties”** window will open. In **Port Settings**, set the following:
6. Set “Bits per second” to **9600**
7. Set “Data Bits” to **8**
8. Set “Parity” to **none**
9. Set “Stop Bits” to **1**
10. Set “Flow Control” to **none**.
11. Click OK
12. **RCS-HyperTerminal** communication window will open.
13. From **File** menu, select **Properties**.
14. In the **Connect To** window: select **Settings** Tab.
15. Select **ASCII setup**
16. Under **ASCII Sending**, check the **“Echo typed characters locally”** box. (Note: Win98 First Edition may not echo characters locally properly, it still sends them ok)
17. Under **ASCII Receiving**, Check **“Append line feeds to incoming line ends”**.
18. Click on OK to close window. (twice)
19. **Turn caps lock on. All ASCII commands must be in capitals.**
20. Set the Setpoint to 70° on the WDU.
21. Set the Mode to Off.
22. Set the Fan mode to Off.
23. Type “A=1 R=1” and hit return.
24. TR15 should respond with A=00 O=1 T=xx SP=70 M=O FM=0
(xx is the current temp displayed on WDU)

25. Type “A=1 SP=77” and hit return.
26. TR15 should change and show a new setpoint of 77 degrees.
27. Type “A=1 M=H” and hit return.
28. TR15 should change and show a new mode of H(eat).

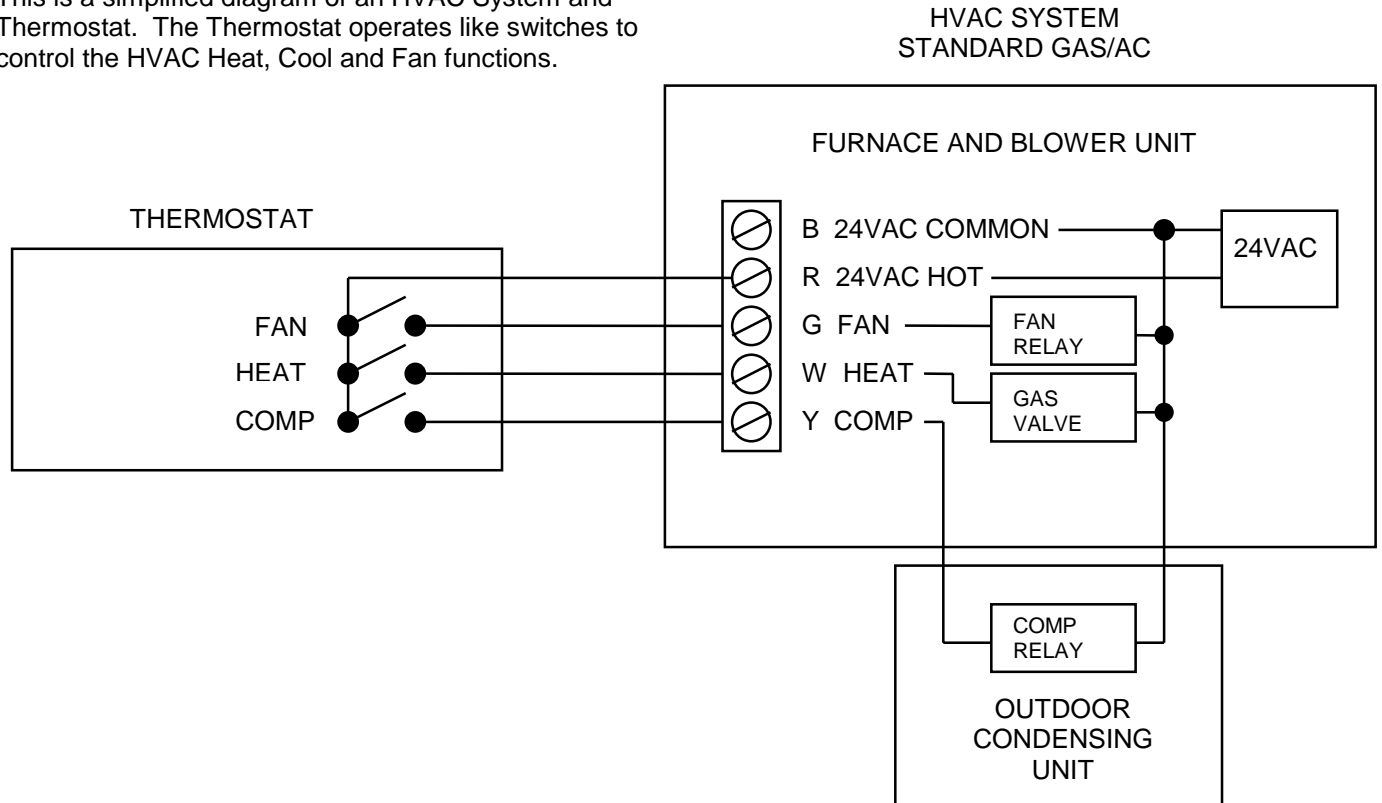
If you get a response from the TR15 and it changes settings as directed, you can be sure the communications is working OK. If not, check the cabling, Control Unit setup, Windows Hyper Terminal setup and commands for proper settings.

QUICK TEST - HVAC SYSTEM

The TR15 Control Unit connects to the HVAC system at the normal thermostat connections on the HVAC unit. Standard thermostat control of 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 system. 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 Heat, Cool and Fan functions.



Since the thermostat interface is simple switch closures, if you have difficulty with the Control Unit and HVAC interface you can always verify HVAC system operation by shorting across the HVAC system terminals as follows:

For Standard HVAC systems:

FAN operation: Short across R and G (Fan) terminals.

HEAT operation: Short across R and W (Heat) terminals (Fan is not usually necessary for gas furnaces).

COOL operation: Short across R and Y (Compressor) and G (Fan) terminals.

For Heat Pump systems (with Change Over for cooling):

FAN operation: Short across R and G terminals.

HEAT Stage 1 operation: Short across R and Y (Compressor) and G (Fan) terminals.

HEAT Stage 2 operation: Short across R and W (Heat Strips) and G (Fan) terminals.

COOL operation: Short across R and Y (Compressor) and O (Change Over) and G (Fan) terminals.

If the Control Unit output LEDs are ON and you suspect you are not getting an output from the relays, perform the above shorting test to verify that the HVAC system is working OK. If the HVAC system responds correctly to the shorted terminals, then the output relay is suspect.

