Hoffman Controls

Installation & Operating Instructions

200-3 Series

Electronic VAV Flow Controller

General

1. This instruction is a guide for connecting and operating the 200-3 Series Flow Controller with the 207 Series Thermostat and the 241-2 Series Actuator.
2. A digital DC volt meter (DVM) is required for calibration. (See 200-3 Series Calibration Instructions.)

Installation

Wiring

1. Select the appropriate wiring diagram that describes the functions required for the model controller, thermostat and interface when used. Note: The 200-2 and 200-3 Controllers's wiring diagrams are included in the 207 Series Thermostat wiring diagrams and the 202 Interface Product Data sheets.

   When the 202 Series Interfaces are used they incorporate the following auxiliary functions; heat staging, dual flow, offset (night setback), auto changeover, proportional heat, and time base heat. These functions require a “plug-in” interface card to the flow controller. When using an interface card, refer to the correct wiring diagram for the interface card selected.
2. Use 20 gauge wire or larger for all connections between components. Keep all signal wires separated from power lines to avoid introduction of “electrical noise” into the system.

   Note: 200-3 Flow controller terminals 1 & 2 and 3 & 4 are common and internally connected. The 24V-AC terminals 3 and 4 are circuit ground.
3. When multiple flow controllers are required to be interconnected, polarity of the 24V AC transformer outputs must be observed.

Transducer Assembly/Connections

1. Use industry approved pneumatic tubing for connecting the barbs on the onboard transducer to avoid air leaks.
2. Locate the controller so that the length of pneumatic tubing from the velocity pickup probe to the on-board transducer does not exceed 18”.
3. Route pneumatic tubing to avoid sharp turns and tubing kinks that would restrict airflow through the tubing to the transducer.
4. Use caution when attaching/inserting tubing on the barb of the transducer.
5. If tubing must be removed from barb, always cut off tubing, cut it lengthwise at the transducer connection and gently remove it.

CAUTION

Do Not Attempt To Pull Tubing Off. The transducer tips provide calibrated orifices and must not be damaged.

Determining Damper Shaft Rotation

Determine the degree of damper shaft rotation, from fully closed to fully open. In order to place the stop pins correctly, the damper shaft rotation to close must be determined. Reference the drawing below to determine the correct rotation of your application.

(Facing damper shaft)
CW TO OPEN, CCW TO CLOSE

(Facing damper shaft)
CCW TO OPEN, CW TO CLOSE

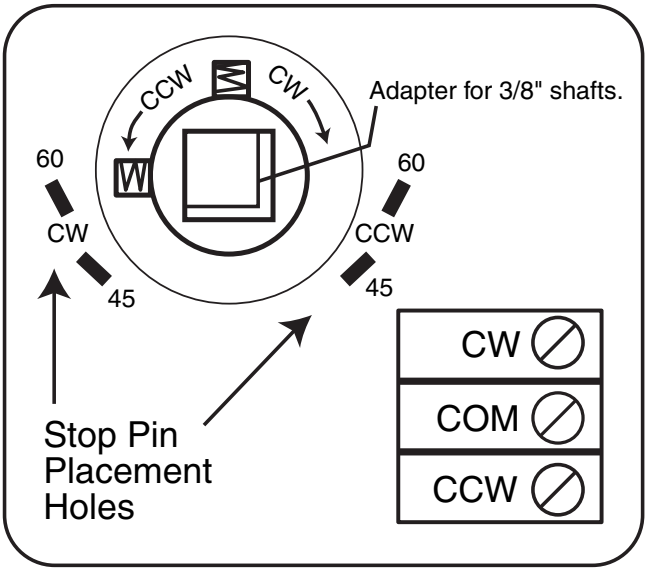
Figure 1

Determining Damper Shaft Rotation

Stop Pin Installation

- If damper rotation is 90°, no stop pin is required.
- If the rotation is 60° or 45° follow the steps below.

1. If your application is the factory standard (CW to close), insert the stop pin in the CCW slot on the RIGHT side of the actuator. Insure the stop pin passes completely through the actuator assembly for correct seating. Lightly tap the stop pin to seat it correctly.
2. If your application is CCW to close, the actuator motor must be rotated to the closed position. To accomplish this, connect a 24V AC source to actuator COM and actuator CCW. Apply power until the motor has rotated fully CCW. Remove 24V AC leads. Insert the stop pin in the CW slot on the LEFT side of the actuator and seat, as described in the sections above.



Actuator Stop Pin Replacement
Figure 2

Mounting Actuator

1. If the damper shaft is 3/8" diameter you will need to insert the angled shaft adapter into the actuator damper shaft bushing. Insure that the adapter is opposite the set screws (see Figure 2). No adapter is needed for 1/2" diameter shaft size.
2. Slide the actuator assembly in place inserting the damper shaft in the actuator's square opening. Rotate the actuator until it is in the desired position. Attach actuator to the terminal box with an #8 x 3/4" sheet metal screw through the mounting tab at the bottom of the actuator.
3. Rotate damper shaft by hand to the fully closed position. With the damper in the closed position, firmly tighten the two set screws to the damper shaft.

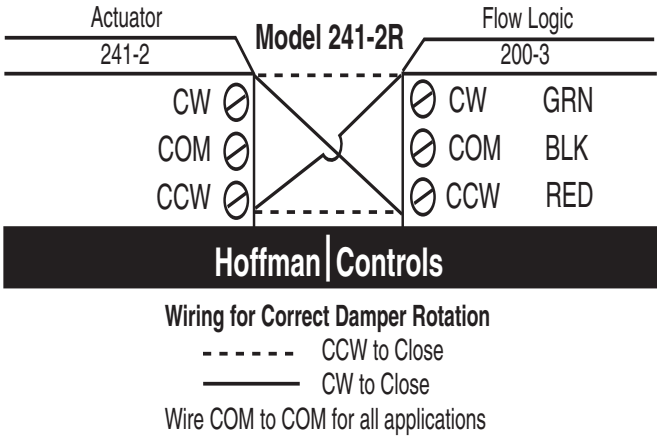
Actuator Wiring

1. The controller and the actuator both have terminals labeled CW, COM, and CCW. The wiring connections between the 200 Series controller and the 241 Series actuator is determined by the rotation direction for damper closure. The direction is determined by looking at the shaft end where it mounts to the actuator. Refer to Figure 1 to determine the damper rotation for your application.
2. After determining correct damper rotation refer to the wiring diagram (see Figure 3).

Direct and Reverse Acting

The controller is shipped factory standard Direct Acting (DA) unless otherwise requested by customer.

The 200 Series controller is typically used in cooling applications in the direct acting mode (the damper opens more as the zone temperature rises above setpoint). A reverse acting controller is typically used in a heating mode (the damper opens more as the zone temperature drops below setpoint).



Wiring Diagram
Figure 3

Applications of Interfaces/Thermostats

1. Dual flow is a function typically used with heating stages. When a heat stage energizes, the dual flow function resets the minimum flow to a higher preset (CFM), in order to meet flow requirements of the heat source.
2. The dual flow function can only be used in the DA mode where the 207-1 AND 207-2 thermostats are connected as follows:
   - Terminal #5 — Thermostat Yellow
   - Terminal #4 — Thermostat Red
   - Jumpers are in the DA position (mode)
   - Remove J1 jumper only

   Dual Flow is not to be used in the Reverse Acting position.
3. When a 207-1FL or 207-2FL thermostat and 202 Series interface utilize the dual flow functions, J1 and J2 must be removed. The dual flow function is available on the 202-10, 202-13A, and 202-14A Series interface cards. See 202 Series Product Data for interface card wiring details.

207-1FL or 207-2FL Thermostats

1. The J1 and J2 jumpers connect the Min. and Max. flow adjustments on 200-2 and 200-3 controllers. When J1 and J2 are removed, the Min. and Max. flow adjustments on the controller are transferred to the 207-FL Series thermostat.
2. **CAUTION:** When using the 207-1FL or 207-2FL thermostats with a 202 interface that have the dual flow function, it is necessary to connect the BRN thermostat wire directly on the 202 interface card (terminal #17). See appropriate wiring connection for specific dual flow functioning interfaces.

System Operation

1. Apply 24V AC to terminals #2 and #3 of the 200-3.
2. 207 Series Thermostat:
   a. Space temperature must be between 65°F and 85°F (airflow not required).
   b. **DA Mode:** Connect a DVM between terminals #4 (-) and #6 (+) on the 200-3. Turn setpoint to 65°F or lower and note that the voltage is 10.0V DC or less.
   c. **RA Mode:** Connect a DVM between terminals #4 (-) and #6 (+) on the 200-3. Turn setpoint to 85°F or above and note that the voltage is 10.0V DC or greater.
3. 200-3 Temperature Circuit:
   a. Turn Max. and Min. adjustment trimmers fully CW.
   b. Connect the DVM from terminals #8 (+) to #4 (–).
   c. The following conditions will occur for different models.
      - Set thermostat to 65°F or less:
        – DA Mode – DVM is equal to or greater than 16VDC.
        – RA Mode – DVM is equal to or less than 11.1VDC.
      - Set thermostat to 85°F or greater:
        – DA Mode – DVM is equal to or less than 11.1VDC.
        – RA Mode – DVM is equal to or greater than 16VDC.
4. 200-3 Velocity Circuit:
   a. Connect the DVM from terminals #7 (+) to #4 (–).
   b. Airflow required.
   c. DVM should read 11.1V DC nominal (zero flow) to 16.5V DC nominal (4000 FPM).
   d. If the air volume requirement through the terminal box is between the Min. and Max. flow limits and the terminal box is under control, the Vt (# 8) and Vv (# 7) voltages will be equal within ± 0.3V DC.

Minimum and Maximum Flow Limits

Flow Limit Calibration Adjustments on Thermostat with Thermostat Simulator

Special Equipment/Instructions

1. HCC 207 Series thermostat simulator (207-TSA).
2. 207-FL Series Max./Min thermostat board.
3. Digital voltmeter (DVM), accurate to three places.
4. Airflow or airflow measuring device is not required.

Connections

1. Connect DVM to the Vt (+) test post and GND (–) post on 207-1FL or 207-2FL board in thermostat.
2. Connect 207-1FL or 207-2FL thermostat leads and simulator (207-TSA) to 200-2 or 200-3 Series logic terminals as follows:

Simulator to 200-2 or 200-3 Terminals	207FL Stat to 200-2 or 200-3 Terminals
RED #4	ORG #12
YEL #5	BRN #11
BLK #6	BLU #8

If thermostat and simulator are wired to 200-2 or 200-3 logic at thermostat:

a. Open BLK lead to wire nut inside the 207-FL thermostat.

b. Connect BLK simulator lead to BLK wire to logic (leave BLK lead to thermostat open).

c. "Piggyback" RED simulator lead to RED test post on the thermostat.

d. "Piggyback" YELLOW simulator lead to YELLOW test post in the thermostat.

3. Make sure J1 and J2 jumpers are removed on the 200-2 or 200-3 logics (See Figure 4).

4. Connect 24V AC supply, 20VA minimum, to terminal #2 and terminal #3 on 200-2 or 200-3 Series logics.

Adjusting Minimum/Maximum Flow Levels

1. Determine the two voltages which correspond to the Min. and Max. velocities from the velocity vs. FPM curve (HCC Document # 200-3 0400-57 Velocity vs. Volts). Vv voltages will be the limits to be set in for Vt.

2. Set thermostats Min./Max. pots CW Max.

3. Set 207-TSA simulator knob so that the DVM reads maximum voltage greater than 16 volts.

4. Adjust thermostats Max. Flow pot CW to set in desired voltage of 1.

Example: 2500 FPM Max. Limit = 15.3V

5. Set 207-TSA knob to opposite end of scale so that DVM reads minimum voltage, less than 11.1V DC. If it does not reverse the 207-TSA YELLOW and RED leads and reset knob to less than 11.1V DC. Return connections to original setting after Min. adjustment.

6. Adjust thermostats Min. Flow pot CCW until DVM reads the desired voltage of 1.

7. Summary: Max. Vt = 16.0V DC Min. Vt = 12.2V DC

For these results, simulator is turned to its extreme in both directions.

8. Disconnect 207-TSA leads and reconnect BLK thermostat lead in thermostat and replace wire nut.

Summary

1. Flow Limits may be adjusted without airflow across the sensor.

2. Flow Limits may be adjusted utilizing a 207 or 207-FL Series thermostat connected to logic in lieu of the thermostat simulator. (See Installation and Operating Instructions for 207 Series thermostat.)

3. The order of Min./Max. adjustment may be reversed.

Flow Limit Calibration Adjustments on Logic with Thermostat Simulator

Special Equipment/Instrumentation

1. HCC 207 Series thermostat simulator (207-TSA).

2. Airflow or airflow measuring device is not required.

Connections: Simulator to 200-2 or 200-3 logics

1. Cooling — RED to #4 BLK to #6 YEL to #5

2. Heating — RED to #5 BLK to #6 YEL to #4

3. DVM to Vt on 200-3 logic, terminals #8(+) and #4(-).

4. 24V AC supply, 20VA minimum to terminal #2 and #3 on 200-2 or 200-3 logics.

5. It is permitted to only disconnect BLK lead from thermostat (terminal #6) and connect simulator to terminal #6. Then piggyback the simulator to terminal #5 and #4 with the YEL and RED thermostat leads respectively.

6. Be sure J1 and J2 are not removed on 200-2 or 200-3 logics. (See Figure 4).

7. Connect 24V AC supply, 20VA minimum to terminal #2 and #3 on 200-2 or 200-3 logics.

Adjusting Minimum/Maximum Flow Levels

1. Determine the two voltages which correspond to Min. and Max. velocities from the velocity vs. FPM curve (HCC Document # 200-3 0400-57 Velocity vs. Volts). Vv voltages will be the limits to be set in for Vt.

2. Set Min./Max. pots CW Max.

3. Set 207-TSA simulator knob so that the DVM reads maximum voltage greater than 16 volts.

4. Adjust Max. Flow pot CCW to set in desired voltage of 1.

5. Set 207-TSA knob to opposite end of scale so that DVM reads minimum voltage — less than 11.1V DC. If it does not, reverse the 207-TSA YELLOW and RED leads and reset the knob to less than 11.1V DC. Return connections to original setting after Min. adjustment.

6. Adjust Min. Flow pot CCW until DVM reads the desired voltage of 1.

7. Summary:

Max. Vt > 16.0V DC Min. Vt < 12.2V DC

For these results, the simulator is turned to its extreme in both directions.

8. Remove the simulator leads.

9. Reconnect the thermostat leads to the 200-2 or 200-3 logics.

Summary

1. Flow Limits may be adjusted without airflow across the sensor.
2. Flow Limits may be adjusted utilizing a 207 or 207-FL Series thermostat. (See Installation and Operating Instructions for 207 Series Thermostat.)
3. The order of Min./Max. adjustment may be reversed.

Flow Limit Calibration Adjustments on Thermostat with 207-FL Series Thermostat

CAUTION

70° and 80°F thermostat environment is required for these instructions.

1. Digital voltmeter (DVM), accurate to three places.
2. HCC, 207-1FL or 207-2FL Series wall thermostat.
3. Airflow or airflow measuring device is not required.

Connections

1. Set DVM to read DC volts (0 – 20 volts DC scale).
2. Connect DVM RED (+) meter lead to the Vt test post on FL board in thermostat.
3. Connect DVM BLK (–) meter lead to GND test post on FL board in thermostat.
4. Connect 207-1FL or 207-2FL thermostat leads to 200-2 or 200-3 logic terminals as follows: (6 wires)

200-2 or 200-3 logics	200-2 or 200-3 logics
RED #4	ORG #12
YEL #5	BRN #11
BLK #6	BLU #8

5. Be sure J1 and J2 jumpers are removed on the 200-2 or 200-3 logics. (See Figure 4).
6. Connect 24V AC supply, 20VA minimum, to 24V AC terminals (#2 and #3) on 200-2 or 200-3 logics.
7. DVM should read 11.5V DC or less to 16.3V DC or more.

Adjusting Min./Max. Flow Levels

1. Determine the voltage required to limit the Min. and Max. flow levels from the velocity vs. FPM curve (HCC Doument # 200-3 0400-57 Velocity vs Volts).
2. Set the 207 Series thermostat setpoint to below 65°F for (DA) and above 85°F for (RA) control.

CAUTION

Thermostat environment must be between 70° and 80°F.

3. Adjust Max. Flow pot until DVM reads the desired voltage as required for Max. Flow Limit as selected from velocity volts vs. FPM curve.

   Example: 2500 FPM Max. Limit 15.3 volts.
4. Set the 207 Series thermostat setpoint to above 85°F for (DA) and below 65°F for (RA) control.
5. Adjust Min. Flow pot until DVM reads the desired voltage as required for Min. Flow Limit as selected from velocity volts vs. FPM curve.

   Example: 400 FPM Min. Limit 11.4 volts.
6. This completes the flow setting.

Summary

1. Flow Limits may be adjusted without airflow across the sensor.
2. Flow Limits may be adjusted from 40°F to 120°F temperature °F environment if a 207-TSA Series thermostat simulator is used for calibration.
3. The order of Min./Max. adjustment may be reversed.

Troubleshooting Guide

General

This procedure should be used to troubleshoot the Series 200-2 or 200-3 direct acting (cooling) controller when used with a 207 Series thermostat. The following equipment is required:

- HCC 207-TSA Thermostat Simulator

  or
- DC Digital Voltmeter (DVM) 0 – 20V DC Span

3. Measure voltage between terminals #4 (–) RED and #5(+) YELLOW on the controller. Reading should be 20VDC ± .2VDC (power supply to thermostat). If not, replace controller.
4. Turn setpoint on thermostat to 65°F. Measure voltage between terminals #4 (–) and #6 (+) on the controller.

   Reading should be 9.75V DC or less. If not, proceed to steps 5 and 6.
5. Turn setpoint on thermostat to 85°F. Measure voltage between terminals #4 (–) and #6 (+) on the controller. Reading should be 10.0V DC or more. If not, proceed to Step 6.
6. If either or both voltages in Steps 4 or 5 are not correct, the following voltages should be checked at the thermostat.
   a. Voltage between RED (–) test post and YEL (+) thermostat post should be 20VDC ± 0.2VDC.
   b. Turn setpoint at thermostat to 65°F. Voltage between RED (–) test post and BLK (+) lead should be 9.75V DC or less.
   c. Turn setpoint at thermostat to 85°F. Voltage between RED (–) test post and BLK (+) lead should be 10.0V

DC or more.

d. If any of these voltages are not correct, check wiring between thermostat and controller for correct installation or shorts.

If wiring is proper, replace the thermostat.

Troubleshooting Temperature and Velocity Circuits

This procedure should follow the troubleshooting of the thermostat circuit.

If the air volume requirement through the terminal box is between the minimum and maximum flow limits, and the terminal box is under control, the Vt and Vv voltages will be equal to within ± 0.3VDC. These voltages are measured between terminals #4 (–) and #7 (+) Vv or #8 (+) Vt and should be between 11.1 and 16.5VDC.

If Vt and Vv voltages are not approximately equal, check the following:

Vv and Vt voltages are measured as follows:

Vv = Terminals #7 to #4 (11.1V to 16.5V)Vt = Terminals #8 to #4 (11.1V to 16.5V)

If the air volume requirement through the terminal box is between the Min. and Max. flow limits, then the following should be realized: Vt = Vv ± 0.3V DC

If Vt is not equal to Vv, check the following:

1. If air damper is fully open and Vv is below Vt, determine if there is enough air volume coming to the terminal box to satisfy the need.
2. If Vv voltage is above 17V DC, replace controller.
3. Turn setpoint on thermostat to 65°F, Vt should go to its high limit. If not, replace controller.
4. Turn setpoint on thermostat to 85°F, Vt should go to its low limit. If not, replace controller.
5. Check the tubing between the velocity pickup in the duct and velocity sensor for leaks, kinks and plugging. If the tubing needs replacing, do not remove tubing from velocity sensor. Cut tubing and splice with coupling.
6. Check damper coupling to determine if it is loose on damper shaft. If loose, reposition damper to give full travel between mechanical stops and tighten set screws at its closed position.
7. If performing these steps does not correct the problem, replace the controller.

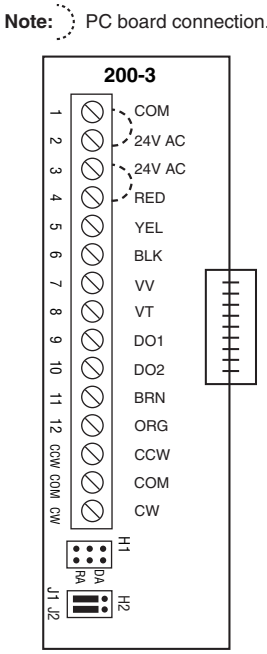
Troubleshooting Actuator Circuit

1. Air box reversed from expected action.
   - **a.** Adjust thermostat to 65°F.
   - **b.** If the damper closes instead of opens, reverse CW and CCW leads to the 200-2 or 200-3 terminals.
2. Damper shaft not coupled to actuator.
   - **a.** Close damper.
   - **b.** Adjust thermostat to 85°F to put actuator in closed damper position.
   - **c.** Tighten screws on coupling to damper shaft.
3. Actuator turns for one direction only.
   - **a.** Uncouple damper shaft from actuator.
   - **b.** Set thermostat at 65°F.
     - Does the actuator move to the open damper position?

       If not, replace the 200-2 or 200-3.
   - **c.** Set thermostat at 85°F.
     - Does actuator move to the closed damper position?

       If not, replace the 200-2 or 200-3.
   - **d.** If the actuator is o.k. as in b. and c. above, disconnect its CW and CCW leads from the controller and put one at a time to terminal #3.
     - Does motor turn CW or CCW?

       If not, replace actuator.
     - If it does, then the damper is probably improperly adjusted.
     - Re-adjust per step 2.



200-3 J1 + J2 Locations
Figure 4