AFMS with STE-9xxx NetSensor

Application Guide

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INTRODUCTION

While possible, completing checkout and commissioning of an Airflow Measurement System using a STE-9000 Series NetSensor is difficult, due to the nature of the NetSensor interface. Preferably, if available, use one of the following configuration tools:

- **KMC Connect Lite app** (to configure basic communication settings only)
- **BAC-5051(A)E router** (See the application guide, *BAC-5051(A)E Pages for Configuring an AFMS*.)
- **Ethernet model AFMS** configuration web pages (See the application guide, *TrueFit AFMS Ethernet Model Configuration Web Pages*.)
- **KMC Connect** or **KMC Total Control** software
- KMC N4 Workbench software with **KMC Converge** modules

In all cases, use the *Note Sheets for AFMS Checkout and Commissioning* together with the best available configuration tool's application guide.

CONNECTING A NETSENSOR

A digital **STE-9000 Series NetSensor** can be used for configuring the controller.

Plug an **Ethernet patch cable** 1 connected to an **STE-9000 Series NetSensor** into the (yellow) **ROOM SENSOR port** of the controller.

⚠ CAUTION

On "E" models, do NOT plug a cable meant for Ethernet communications into the Room Sensor port! The Room Sensor port powers a NetSensor, and the supplied voltage may damage an Ethernet switch or router.

SELECTING AN APPLICATION

List of Applications

TrueFit Airflow Measurement System (AFMS) controllers come with the following applications.

TRF-9311C(E)-AFMS:

- AFMS-E (standard AFMS application with English units–the default)
- AFMS-M (standard AFMS application with metric units)

TRF-5901-C(E)-AFMS:

- AFMS-E (standard AFMS application with English units–the default)
- AFMS-M (standard AFMS application with metric units)
- AFMPA--E (OAD pressure assist AFMS application with English units)
- AFMPA-M (OAD pressure assist AFMS application with metric units)
- AFMRD-E (RAD pressure assist AFMS application with English units)
- AFMRD-M (RAD pressure assist AFMS application with English units)

NOTE: Select the desired application before configuring other settings. Changing the application later would reset most settings back to their defaults.

About the OAD Pressure Assist Application

When to Select the OAD Pressure Assist Application

The OAD pressure assist application (AFMPA-E or AFMPA-M) on a TRF-5901C(E)-AFMS should be selected if a transducer and airflow pickup tubes and were installed at the outside air damper for pressure assist measurements. This should be done if the RTU/AHU/UV has any of the following non-standard features:

- a relief fan that is not constant speed, or is not commanded to operate via mixed air damper position
- a return fan that is not controlled by a supply fan / return fan offset
- a bypass damper utilized to bypass a heat recovery system
- return VAV boxes
- a supply to return bypass (typically found in zone damper applications, or where a bypass damper is used in place of a VFD)

If any of these non-standard features are present, the pressure of the unit's mixed and/or return air sections may change, which will affect airflow. The OAD pressure assist application measures and accounts for these pressure changes in the airflow measurement calculations.

How the Pressure Assist Application Works

During its learn mode, the standard application records the percentage of outside verses return airflow in the mixed air chamber at each position of the unit's damper. The OAD pressure assist application's learn mode records this as well as the differential pressure and airflow rate across the outside air damper. Thereafter, the OAD pressure assist application programming can adjust the outside verses return airflow calculation accordingly using the additional measurements.

About the RAD Pressure Assist Application

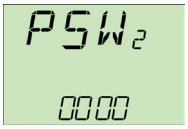
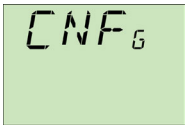
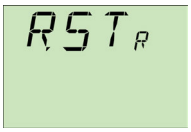
When to Select the RAD Pressure Assist Application

The RAD pressure assist application (AFMRD-E or AFMRD-M) on a TRF-5901C(E)-AFMS should be selected if a transducer and airflow pickup tubes were installed at the return air damper for pressure assist measurements. This should be done if the unit has more than one outside air damper.

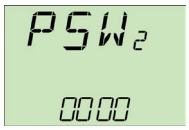
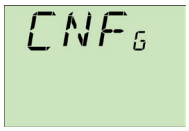
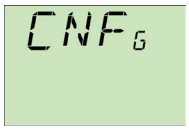
How the RAD Pressure Assist Application Works

During its learn mode, the standard application records the percentage of outside verses return airflow in the mixed air chamber at each position of the unit's damper. The RAD pressure assist application's learn mode records this as well as the differential pressure and airflow rate across the return air damper. Thereafter, the RAD pressure assist application programming can adjust the outside verses return airflow calculation accordingly using the additional measurements.

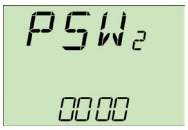
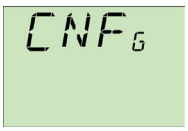
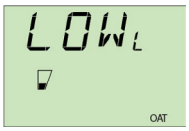
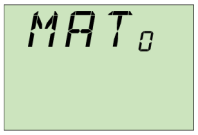
How to Select an Application

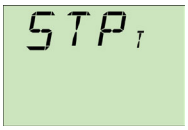
STEPS	DISPLAY
1. From the home display, press the Up and Down buttons together for at least 6 seconds. 2. Enter the level 2 password. The display changes to CNFG after Password 2 is correctly entered. NOTE: For the default level 2 password, see the *Conquest Controllers Default Password Technical Bulletin (TB150716)* after logging into the **KMC website**.	
3. At the CNFG display, press the Enter button to enter the Configuration menu.	
4. From the STPT display, press the Up or Down buttons to cycle to the RSTR display. 5. At RSTR, press the Enter button to access the **restore application** options. NOTE: RSTR will stop flashing and an application option will flash in the lower display. 6. Press the Up or Down buttons to cycle to the desired application. 7. Press the Enter button to make the choice. NOTE: The controller will restart for the change to take effect.	

CONFIGURING COMMUNICATION SETTINGS

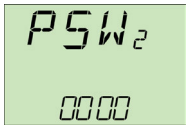
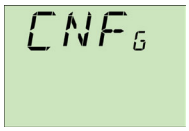
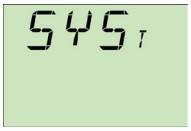
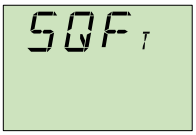
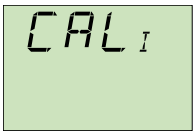
STEPS	DISPLAY
1. From the home display, press the Up and Down buttons together for at least 6 seconds. 2. Enter the level 2 password. The display changes to CNFG after Password 2 is correctly entered. NOTE: For the default level 2 password, see the *Conquest Controllers Default Password Technical Bulletin (TB150716)* after logging into the **KMC website**.	
3. At the CNFG, press the Up or Down buttons to cycle to the COMM.	
4. At COMM, press the Enter button to select the **Communication parameters** menu. 5. Use the Up, Down, and Enter buttons as needed to set the device instance, MAC address, and/or baud rate. NOTE: When all communication parameters have been configured, the display will automatically return to flashing CNFG.	
6. Continue to step 3 of the next section of this application guide to configure offsets and delta-T setpoints. (See **Configuring Offsets and Delta-T Setpoints on page 6**.)	

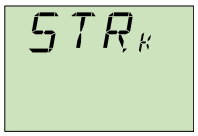
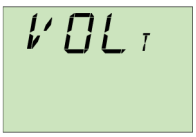
CONFIGURING OFFSETS AND DELTA-T SETPOINTS

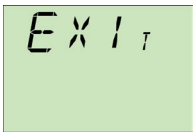
STEPS	DISPLAY
1. From the home display, press the Up and Down buttons together for at least 6 seconds. 2. Enter the level 2 password. The display changes to CNFG after Password 2 is correctly entered. NOTE: For the default level 2 password, see the *Conquest Controllers Default Password Technical Bulletin (TB150716)* by logging into the **KMC website**.	
3. From CNFG, press the Enter button to enter the Configuration menu.	
4. From STPT, press the Enter button to enter the **Setpoints** sub-menu.	
5. At LOWL, press the Up or Down buttons to input the **low temperature limit** value. 6. Press the Enter button to save the value and advance to OATO.	
7. Press the Up or Down buttons to input the **outdoor air temperature offset**. 8. Press the Enter button to save the value and advance to RATO.	
9. Press the Up or Down buttons to input the **return air temperature offset**. 10. Press the Enter button to save the value and advance to MATO.	
11. Press the Up or Down buttons to input the **mixed air temperature offset**. 12. Press the Enter button to save the value and advance to MDEL.	

STEPS	DISPLAY
13. Press the Up or Down buttons to input the **minimum delta T.** NOTE: The minimum delta T is the temperature difference below which Learn mode will halt. If the difference between the outdoor and return air falls below this value during the Learn mode process, Learn mode will not complete. 14. Press the Enter button to save the value and advance to ADEL.	
15. Press the Up or Down buttons to input **the delta T needed to auto-start learn mode**. NOTE: The default is 20 degrees Fahrenheit difference, which is the recommended minimum. It cannot be decreased to less than 15 degrees Fahrenheit difference. 16. Press the Enter button to save the value and automatically go back to the flashing STRT display.	
17. Continue to step 3 of the next section of this application guide to configure the system settings. (See **Configuring System Settings on page 8**.)	

CONFIGURING SYSTEM SETTINGS

STEPS	DISPLAY
1. From the home display, press the Up and Down buttons together for at least 6 seconds. 2. Enter the level 2 password. The display changes to CNFG after Password 2 is correctly entered. NOTE: For the default level 2 password, see the *Conquest Controllers Default Password Technical Bulletin (TB150716)* after logging into the **KMC website**.	
3. From CNFG, press the Enter button to enter the **Configuration** menu.	
4. From STPT, press the Up or Down buttons to cycle to SYST.	
5. At SYST, press the Enter button to enter the **System settings** sub-menu.	
6. At SQFT, press the Up or Down buttons to enter the supply air area (**the square foot measurement of the supply air duct** at the point where the pressure flow pickup tubes were installed). 7. Press the Enter button to save the value and advance to CALI.	
8. Press the Up or Down buttons to input the **calibration multiplier** (obtained from a balancer). 9. Press the Enter button to save the value and advance to OFFS.	

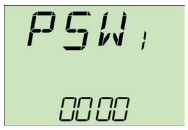
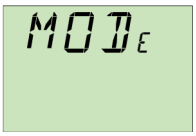
STEPS	DISPLAY
10. Press the Up or Down buttons to input the **calibration offset** (obtained from a balancer). 11. Press the Enter button to save the value and advance to `STRK`.	
12. Press the Up or Down buttons to enter the **time in seconds that it takes for the damper to go from open to closed.** 13. Press the Enter button to save the value and advance to `REV`.	
14. Press the Up or Down buttons to toggle choices for the **direction that the damper moves**: `NORMAL` (normal) or `REVERSE` (reverse-action). 15. Press the Enter button to save the choice and advance to `IREV`.	
16. Press the Up or Down buttons to toggle choices for the **inclinometer action**: `NORMAL` or `REVERSE`. NOTE: For the standard (AMSO) application or OAD Pressure Assist (AMSOP) application, if the inclinometer was mounted on a horizontal return air damper blade because the outside air damper blades are vertical, then you must set the **inclinometer action** to **REVERSE.** 17. Press the Enter button to save the choice and advance to `VOLT`.	
18. Press the Up or Down buttons to toggle choices for the **voltage of the actuator**: 2-10 volts or 0-10 volts. 19. Press the Enter button to save the choice and advance to `ENLL`.	

STEPS	DISPLAY
20. Low limit is ON by default. If not needed, press the Up or Down buttons to toggle it to OFF. **⚠ CAUTION** **Low limit is recommended to prevent freezing of the equipment.** NOTE: The default low limit is 37 degrees Fahrenheit. The low temperature limit value can be changed later in the Setpoints menu. (See **Configuring Offsets and Delta-T Setpoints on page 6**.) 21. Press the Enter button to save the choice and advance to SPAC.	
22. Press the Up or Down buttons to enter the area in cubic feet of the space served by the unit. NOTE: This allows the correct air exchanges per hour to show on the home display. 23. Press the Enter button to save the value and return to the flashing STPT display.	
24. Press the Up or Down buttons several times to cycle to EXIT.	
25. Press the Enter button to return to the home display.	

LEARNING DAMPER STROKE

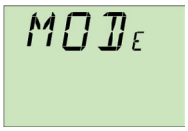
Accessing the Command Menu

Before the AFMS can run Learning Mode, it must first learn the minimum and maximum angles of the damper stroke using the inclinometer. The menu option to start **Learn Damper Stroke** is accessed from the Level 1 **Command menu**. Follow the steps below to access the Command menu.

STEPS	DISPLAY
1. From the home display, press the Enter button to access the Level 1 menus. (If a Level 1 password was set up, enter it.) **NOTE:** If Level 1 is already on the Command menu, the display will now show MODE. In that case, skip to **Starting Learn Damper Stroke on page 12**	
2. Press the Enter button several times until MENU shows on the display. 3. Press the Up or Down buttons to select COMMAND, then press the Enter button to make the choice and return to the home display.	
4. Wait about 5 seconds, then press the Enter button to access the Command menu. **NOTE:** If Level 1 switched to the Command menu, MODE will now show on the display. **NOTE:** If you accessed Level 1 again too quickly, it will not have completed switching to the Command menu. It will still be on whatever menu it was before. In that case, repeat steps 2 to 4.	

Starting Learn Damper Stroke

To make the controller learn the minimum and maximum angles of the damper stroke, follow these steps:

STEPS	DISPLAY
1. From MODE (under the Command menu in Level 1), press Enter once to advance to LSTR.	
2. Press the Up of Down button to toggle **Learn Damper Stroke** to ON. 3. Press the Enter button to make the choice and start Learn Damper Stroke. NOTE: The controller will begin to drive the damper using the actuator.	

STARTING LEARNING MODE

Before Starting Learning Mode

For valid results, ensure that:

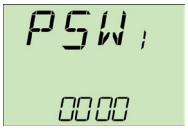
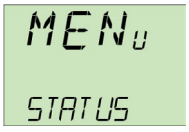
- The square foot measurement of the supply air duct has been entered. (See **Configuring System Settings on page 8.)**
- The controller has learned the minimum and maximum angles of the damper stroke. (See **Learning Damper Stroke on page 11**.)
- The supply air fan is running at a normal, steady rate (i.e. without hunting or sporadic spikes)
- If the unit has a heat recovery wheel, it is turned off.
- If the unit has bypass damper, it is set to 100% open.

NOTE: The heating and cooling functions may be left on, as long as the MAT sensor is located before any heating and cooling sources.

Checking Learn Ready Status

Complete the procedures below to check whether the system is ready to run learning mode now or should be set to run it later.

Accessing Learn Ready Status from the Status Menu

STEPS	DISPLAY
1. From the home display, press the Enter button to access the Level 1 menus. (If a Level 1 password was set up, enter it.) **NOTE:** If Level 1 is already on the Status menu, the display will now show `READY`. In that case, skip to step 5.	
2. Press the Enter button several times until `MENU` shows on the display. 3. Press the Up or Down buttons to select `STATUS`, then press the Enter button to make the choice and return to the home display.	

STEPS	DISPLAY
4. Wait about 5 seconds, then press the Enter button to access the Status menu. **NOTE:** If Level 1 switched to the Status menu, READY will now show on the display. **NOTE:** If you accessed Level 1 again too quickly, it will not have completed switching to the Status menu. It will still be on whatever menu it was before. In that case, repeat steps 2 to 4. 5. Take note of the **learn ready status** - NOT REA (not ready) or READY (ready).	
6. Press the Enter button 3 times to advance to SENF (sensor fault). 7. Take note of whether a sensor fault is indicated at the bottom half of the display - FAULT (fault) or NORMAL (normal).	

Interpreting Learn Ready Status

If the lower half of the READY display shows READY (ready), you may start Learn Mode now. In that case, go to **Manually Starting Learning Mode on page 15**.

The lower half of the READY display shows NOT REA (not ready) if any of the following are true:

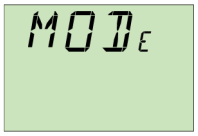
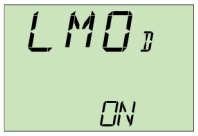
- A sensor fault is detected (a sensor is missing or shorted)
- The controller is in the process of learning the damper stroke
- Low Limit is enabled and the outside air temperature is less than the low temperature limit setpoint (37 degrees Fahrenheit default).
- The current delta-T is less than the minimum delta-T setpoint (10 degrees default difference).

NOTE: To change the low temperature limit and minimum delta-T setpoints, see **Configuring Offsets and Delta-T Setpoints on page 6**.

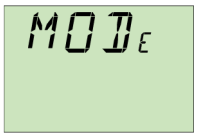
NOTE: The delta-T is the difference between the outside and return air temperatures.

If no sensor fault was detected and the controller is not in the process of learning the damper stroke, you may choose to enable the controller to auto-start learning mode when it detects favorable temperatures at a later time. In that case, go to **Enabling Learning Mode to Auto-Start on page 15**.

Manually Starting Learning Mode

STEPS	DISPLAY
1. Access the Command Menu. See **Accessing the Command Menu on page 11** for details. **NOTE:** MODE will show on the display. 2. Press the Enter button twice to advance to LMOD.	
3. Press the Up or Down button to toggle Learn Mode to ON. 4. Press the Enter button to make the choice and start Learn Mode.	

Enabling Learning Mode to Auto-Start

STEPS	DISPLAY
1. Access the Command Menu. See **Accessing the Command Menu on page 11** for details. **NOTE:** MODE will show on the display. 2. Press the Enter button three times to advance to AUTO.	
3. Press the Up or Down button to toggle Auto-start to ON. 4. Press the Enter button to save the choice.	

The controller will automatically start Learning Mode when the delta-T becomes greater than the delta-T needed to autostart learning mode setpoint (20 degrees default difference.)

NOTE: To change the delta-T needed to autostart learning mode setpoint, see **Configuring Offsets and Delta-T Setpoints on page 6**.

If low limit is enabled (recommended) the controller will only run learning mode if the outside air temperature also remains above the low temperature limit setpoint.

NOTE: To change the low limit setpoint, see **Configuring Offsets and Delta-T Setpoints on page 6**.

SELECTING CONTROL MODES

Selecting a Control Mode from the Command Menu

1. Access the Command Menu. See **Accessing the Command Menu on page 11** for details.

NOTE: The display will then show MODE.

2. Press the Up and Down buttons to toggle to the desired control mode:
   - CFM CTR (**Outside Air CFM Control Mode on page 16**)
   - DMPR PO (**Damper Position Control Mode on page 16**)
   - PASS TR (**Pass Through Control Mode on page 17**)
   - MIXED A (**Pass Through Control Mode on page 17**)
3. Press the Enter button to save the choice.

Outside Air CFM Control Mode

When outside air CFM control mode is selected, the air damper position is modulated to maintain the outside air CFM setpoint.

If the mixed air temperature reaches the low limit, the outside air damper will modulate toward closed to prevent freezing of the equipment.

If an occupancy sensor is used, the control mode will only run when the served space is occupied.

Damper Position Control Mode

When damper position control mode is selected, the air damper is maintained at the damper position setpoint (0-100% open).

If the mixed air temperature reaches the low limit, the outside air damper will modulate toward closed to prevent freezing of the equipment.

If an occupancy sensor is used, the control mode will only run when the served space is occupied.

Pass Through Control Mode

Pass through control mode allows an external controller to control the actuator. This is done by passing the voltage signal from the external controller though the AI3/UI3 terminal (on the AFMS controller) to the damper command analog value (AV7/AO7 on a TRF-5901-AFMS, or AV9/UO9 on a TRF-9311-AFMS).

Pass through will only occur when the AFMS controller is not in learning mode. If learning mode starts, pass through mode will stop until the learning mode sequence completes.

⚠ CAUTION

The external controller must have low limit and other safeties configured to prevent damage to the equipment!

Mixed Air Temperature Control Mode

When Mixed Air Position control mode is selected, the air damper is modulated to maintain the mixed air temperature setpoint.

If the mixed air temperature reaches the low limit, the outside air damper will modulate toward closed to prevent freezing of the equipment.

If an occupancy sensor is used, the control mode will only run when the served space is occupied.

FAULT DETECTION AND DIAGNOSTICS

Object Types Monitored

The controller programming includes four system diagnostic indicators in the form of BACnet binary value objects:

- Missing or shorted temperature sensors (SENF , BV18)
- Damper fault (DMPF , BV19)
- Excess outdoor Air CFM (OAF , BV20)
- Mixed air temperature out of range (MIXF , BV21)

Missing/Shorted Temperature Sensors (BV18)

BV18 is set to Active (Sensor Issue) for any or the following conditions:

- The OAT, MAT, or RAT sensor is missing (powered off or not connected).
- The OAT, MAT, or RAT sensor is shorted.

Damper Fault (BV19)

BV19 is set to Active (On) when all the following conditions are true:

- Damper Position control mode is selected
- The system is not running Learn mode
- The system is not learning the damper stroke
- The damper position is more than 15% off (in either direction) of the damper setpoint for longer (in seconds) than the damper should take to stroke the opening

Excess Outdoor Air CFM (BV20)

BV20 is set to Active (Fault) when all the following conditions are true:

- CFM control mode is selected
- The system is not running Learn mode
- The system is not learning the damper stroke
- The outdoor air CFM (as calculated by the AFMS) is more than 15% off of the Outside Air CFM setpoint, for longer (in seconds) than the damper should take to stroke the opening

Mixed Air Temperature Out of Range (BV21)

BV21 is set to Active (On) when all the following conditions are true:

- Mixed Air control mode is selected
- The system is not running Learn mode
- The system is not learning the damper stroke
- The MAT is more than 5 degrees Fahrenheit off of the MAT setpoint, for longer (in seconds) than the damper should take to stroke the opening

HANDLING PRECAUTIONS

For **digital and electronic** sensors, thermostats, and controllers, take reasonable precautions to prevent electrostatic discharges to the devices when installing, servicing, or operating them. Discharge accumulated static electricity by touching one's hand to a securely grounded object before working with each device.

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SUPPORT

Additional resources for installation, configuration, application, operation, programming, upgrading and much more are available on the KMC Controls web site (**www.kmccontrols.com**). Viewing all available files requires logging in to the site.