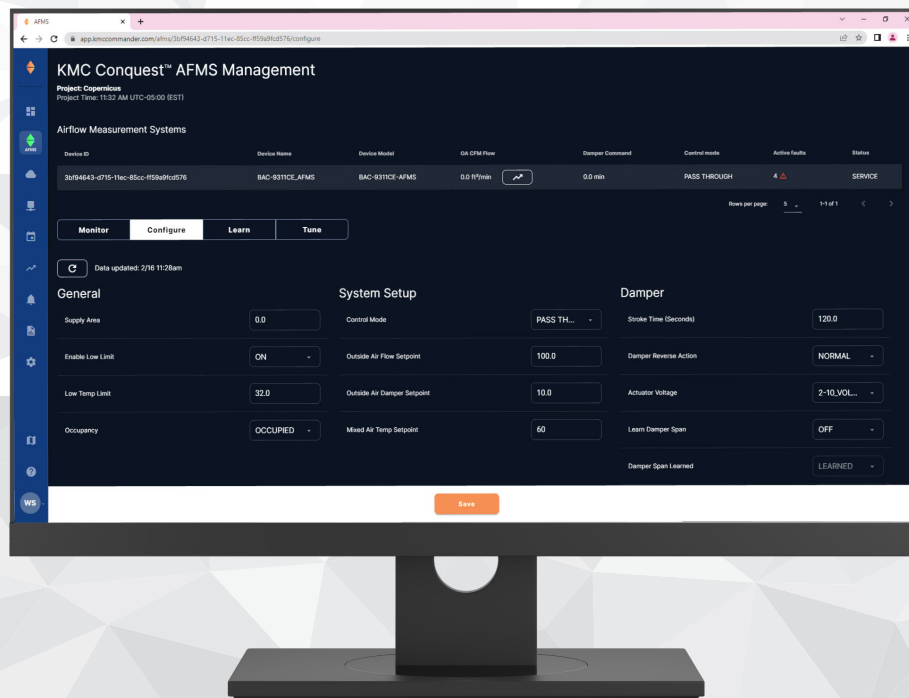




## Application Guide



# Table of Contents

<b>Managing a KMC Conquest AFMS</b>	<b>3</b>
About the AFMS Module	3
Prerequisites	3
Setting Up an AFMS	3
<b>Setting AFMS Parameters</b>	<b>4</b>
Before Beginning	4
Setting the Parameters	4
<b>Calibrating the AFMS's Sensors</b>	<b>6</b>
<b>Running AFMS Learning Mode</b>	<b>7</b>
Before Starting Learning Mode	7
Checking Learn Ready Status	7
Interpreting Learn Ready Status	7
Manually Starting Learning Mode	8
Enabling Learning Mode to Auto Start	8
Alternative to Running Learning Mode	9
<b>Controlling Airflow with an AFMS</b>	<b>10</b>
About	10
Controlling Outside Air Flow	10
Controlling Mixed Air Temperature	10
Commanding a Damper Position	10
Enabling Pass Through	11
<b>Monitoring with an AFMS</b>	<b>12</b>
Accessing Monitoring	12
Monitoring Operation	12
Monitoring Faults	12
<b>Accessing the Damper Characterization Table</b>	<b>14</b>
Manually Entering Damper Characterization Data	14
Accessing the AFMS Table	14
Interpreting the AFMS Table	14
Calculating the damper characterization data	14
Verifying the Damper Characterization Data	15
<b>Important Notices</b>	<b>16</b>
Trademarks	16
Patents	16
Terms of Use	16
EULA (End User License Agreement)	16
Copyright	16
Disclaimers	16

# Managing a KMC Conquest AFMS

## About the AFMS Module

The KMC Commander **AFMS** module allows you to configure, control, tune, and monitor the operation of a [KMC Conquest Airflow Measurement System](#) (AFMS). The icon appears in KMC Commander's side navigation bar after an AFMS controller is discovered and saved in **Networks Explorer**.

## Prerequisites

1. Install a KMC Conquest AFMS (the controller and all system components).

**Note:** See the *Airflow Measurement System Installation Guide*, found on any [AFMS controller's](#) product page.

2. Select the application (on the AFMS controller) needed for the equipment.



**Caution:** Select the application *before* configuring other settings. Changing applications after configuration will restore most parameters to their defaults. See "Selecting an Application" in the *KMC Conquest AFMS NetSensor Application Guide*, found on any [AFMS controller's](#) product page.

**Note:** Complete basic configuration using a Conquest NetSensor, KMC Connect software, TotalControl software, and/or the KMC Converge module for Niagara WorkBench.

3. Set the AFMS controller's communication parameters.

**Note:** See the above note on the basic configuration methods.

4. In **Networks Explorer**, discover, save, and assign a profile (with trended points) to the AFMS controller.

**Note:** For details, see the [Discovering Devices](#) and [Assigning Device Profiles](#) topics on KMC Commander Help.

## Setting Up an AFMS

To set up an AFMS using the KMC Commander **AFMS** module, complete the following processes in this order:

1. [Setting AFMS Parameters on page 4](#)
2. [Calibrating the AFMS's Sensors on page 6](#)
3. [Running AFMS Learning Mode on page 7](#)

**Note:** In environmental conditions where you can't run Learning Mode, see [Manually Entering Damper Characterization Data on page 14](#).

# Setting AFMS Parameters

## Before Beginning

Before setting a KMC Conquest Airflow Measurement System's parameters in **AFMS**, ensure that the [Prerequisites on page 3](#) have been met.



**Caution:** Select the appropriate application on the AFMS controller *before* configuring other settings. Changing applications after configuration will restore most parameters to their defaults. See "Selecting an Application" in the *KMC Conquest AFMS NetSensor Application Guide*, found on any [AFMS controller's](#) product page.

## Setting the Parameters

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. Select the **Configure** tab.
3. For **Supply Area**, enter the measurement (in square feet) of the cross section where the supply airflow pickup tubes were installed.

**Note:** For guidance about the location of the pickup tubes, see "Mounting the Supply Airflow Pickup Tubes" in the *Airflow Measurement System Installation Guide*, found on any [AFMS controller's](#) product page.

4. Choose to either leave **Enable Low Limit** set to **ON** (the default), or to turn it **OFF**.



**Warning:** **ON** is recommended to prevent freezing of equipment. If not needed (due to your equipment's particular nature), you might choose to turn it **OFF**.

5. Either leave **Low Temp Limit** set to the default (37°F), or adjust the value.

**Note:** If the mixed air temperature reaches the **Low Temp Limit** set here (and **Enable Low Limit** is set to **ON**) the outside air damper will modulate toward closed to prevent freezing of the equipment.

6. For **Stroke Time (Seconds)**, enter the time (in seconds) that it takes for the damper to go from 100% open to 100% closed.
7. For **Damper Reverse Action**:
  - Select **NORMAL** if the greater the output signal to the damper actuator is, the more the damper opens (if 10 volts = 100% open).
  - Select **REVERSE** if the greater the output signal to the damper actuator is, the more the damper closes (if 10 volts = 100% closed).
8. For **Actuator Voltage**, select the voltage range of the damper actuator (2 to 10 volts or 0 to 10 volts).

9. Select **ON** for **Learn Damper Span**.

**Note:** Before the AFMS controller can run **Learning Mode**, it must learn the minimum and maximum incline of the damper using the inclinometer.

10. Select **Save**.

**Note:** "The process of updating points is successfully started" appears briefly. When the damper has stroked the opening, **Damper Span Learned** will report **LEARNED**.

Continue to [Calibrating the AFMS's Sensors on page 6](#).

# Calibrating the AFMS's Sensors

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. Select the **Tune** tab.
3. Under **Offset** for **Supply Air Flow**, enter the CFM offset (determined by a TAB technician) for the supply air pressure transducer.
4. Under **Multiplier** for **Supply Air Flow**, enter the multiplier (determined by a TAB technician) for the supply air pressure transducer.
5. Under **Offset** for **Outside Air Temp**, **Return Air Temp**, and **Mixed Air Temp**, enter the °F offsets (determined by a TAB technician) for the outside, return, and mixed air temperature sensors.
6. Select **Save**.

**Note:** For more information on the AFMS's sensors, see the *Airflow Measurement System Selection Guide*, found on any [AFMS controller](#)'s product page.

Continue to [Running AFMS Learning Mode on page 7](#).

# Running AFMS Learning Mode

## Before Starting Learning Mode

For valid results, first ensure that:

- The parameters are set correctly. (See [Setting AFMS Parameters on page 4.](#))
- The sensors are calibrated. (See [Calibrating the AFMS's Sensors on page 6.](#))
- The supply air fan is running at a normal, steady rate (without hunting or sporadic spikes).
- If the unit has a heat recovery wheel, it is turned off.
- If any heating or cooling sources are located upstream of the MAT sensor, they are turned off.
- If the unit has a bypass damper, it is set to 100% open.

## Checking Learn Ready Status

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. Select the **Learn** tab.
3. Take note whether **Learn Ready** reports **READY** or **NOT READY**.

## Interpreting Learn Ready Status

If **READY** is reported, you may manually start **Learning Mode**. (Continue to [Manually Starting Learning Mode on page 8.](#))

If **NOT READY** is reported:

- Check **Sensor Fault**. If **FAULT** is reported, fix any faults found.

**Note:** Go to **Monitor** to find more detailed information on faults. (See [Monitoring with an AFMS on page 12.](#))

- Ensure that **Learn Damper Span** has completed.

**Note:** (Under **Configure**,) **Learn Damper Span** must currently be **OFF**, and **Damper Span Learned** must report **LEARNED**.

- **Mixed Air Temp Low Limit Control** may be **ACTIVE**. If that is the case, continue to [Enabling Learning Mode to Auto Start on page 8.](#)

**Note:** Go to **Monitor** to find **Mixed Air Temp Low Limit Control**. Go to **Configure** to find **Enable Low Limit** and **Low Temp Limit**. (See [Setting AFMS Parameters on page 4](#) for important guidance on Low Limit.)

- Check **Min Delta Temp**. If the current  $\Delta T$  (the absolute difference between the outside and return air temperatures) is less than the minimum difference allowed, then continue to [Enabling Learning Mode to Auto Start on page 8](#).

**Note:** Go to **Monitor** to find **Outside Air Temp** and **Return Air Temp**. Calculate the absolute difference, then compare to **Min Delta Temp**.

## Manually Starting Learning Mode

If **Learn Ready** reports **READY** (see [Checking Learn Ready Status on page 7](#)), you may start **Learning Mode** manually.

1. Leave **Min Delta Temp** set to the default, or adjust it if needed.

**Note:** If the  $\Delta T$  becomes less than the **Min Delta Temp**, the AFMS controller will abort Learning Mode. This is to insure that the controller does not receive unusable learning samples. Setting the **Min Delta Temp** at a 10°F or larger difference is recommended.

2. Leave **Time Between Samples (Seconds)** set to the default, or adjust it if needed.

**Note:** Most often, **Time Between Samples (Seconds)** can be left on the default (60 seconds). You might increase the value if the damper **Stroke Time** (see [Setting AFMS Parameters on page 4](#)) is longer than that of a typical unit, or if the damper actuator requires extra time to respond. You might decrease it if a large  $\Delta T$  is present and time at the site is limited. However, too little time between samples could result in inaccurate measurements.

3. For **Learning Mode**, select **ON**.
4. Select **Save**.
5. Wait for **Learning Mode** to complete.

**Note:** To calculate the total time (in minutes) that **Learning Mode** should take to complete, multiply **Time Between Samples (Seconds)** by 91, then divide by 60.

**Note:** **Learn Timer** shows the elapsed time since **Learning Mode** started.

## Enabling Learning Mode to Auto Start

If **Learn Ready** reports **NOT READY** because of currently unfavorable temperatures (see [Interpreting Learn Ready Status on page 7](#)) you may enable the AFMS controller to automatically start **Learning Mode** when it detects favorable temperatures at a later time.

1. Leave **Min Delta Temp** set to the default, or adjust it if needed.



**Note:** If the  $\Delta T$  becomes less than the **Min Delta Temp**, the AFMS controller will abort Learning Mode. This is to insure that the controller does not receive unusable learning samples. 10°F or more **Min Delta Temp** is recommended.

2. Leave **Auto Start Delta Temp** set to the default, or adjust it if needed.

**Note:** When the  $\Delta T$  reaches the **Auto Start Delta Temp**, Learning Mode will start. Learning Mode will complete if the  $\Delta T$  remains greater than the **Min Delta Temp** for the entire duration. An **Auto Start Delta Temp** that is at least 10°F more than **Min Delta Temp** is recommended.

3. Leave **Time Between Samples (Seconds)** set to the default, or adjust it if needed.

**Note:** Most often, **Time Between Samples (Seconds)** can be left on the default (60 seconds). You might increase the value if the damper **Stroke Time (Seconds)** (found under **Configure > Damper**) is longer than that of a typical unit, or if the damper actuator requires extra time to respond.

4. For **Auto Learn Enable**, select **ON**.

5. Select **Save**.

**Note:** See the **Date of Last Learn** and the **OAT When Learned** once **Learning Mode** has run automatically.

## Alternative to Running Learning Mode

While not ideal, the damper characterization data can be calculated and entered manually. This should only be done if – in the allotted time for setting up the AFMS – the  $\Delta T$  is unlikely to remain greater than the **Min Delta Temp** for the duration of **Learning Mode**. See [Manually Entering Damper Characterization Data on page 14](#) for guidance.

# Controlling Airflow with an AFMS

## About

After [Setting Up an AFMS on page 3](#), you can control outside air flow, or control mixed air temperature. Also, for setup or maintenance purposes, you can command a damper position.

Alternatively, you can pass through control of the damper actuator to an external controller, using the AFMS for measurement and monitoring only. (See [Monitoring with an AFMS on page 12.](#))

## Controlling Outside Air Flow

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. Select the **Configure** tab.
3. From the **Control Mode** dropdown menu, select **OA FLOW CTRL**.
4. Enter an **Outside Air Flow Setpoint** (as CFM).
5. Select **Save**.

**Note:** The outside air damper will modulate to maintain the **Outside Air Flow Setpoint**. If **Enable Low Limit** is **ON** and the mixed air temperature reaches the **Low Temp Limit**, the damper will modulate toward closed to prevent freezing of the equipment. If an occupancy sensor is used, this **Control Mode** will only be active when the served space is occupied.

## Controlling Mixed Air Temperature

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. From the tabs that appear, select **Configure**.
3. From the **Control Mode** dropdown menu, select **MAT CTRL**.
4. Enter a **Mixed Air Temp Setpoint**.
5. Select **Save**.

**Note:** The outside air damper will modulate to maintain the **Mixed Air Temp Setpoint**. If **Enable Low Limit** is **ON** and the mixed air temperature reaches the **Low Temp Limit**, the damper will modulate toward closed to prevent freezing of the equipment. If an occupancy sensor is used, this **Control Mode** will only be active when the served space is occupied.

## Commanding a Damper Position

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. From the tabs that appear, select **Configure**.

3. From the **Control Mode** drop-down menu, select **DMPR POSITION CTRL**.
4. Enter an **Outside Air Damper Setpoint** (0–100% open).
5. Select **Save**.

**Note:** The AFMS controller will command the damper to the **Outside Air Damper Setpoint**. If **Enable Low Limit** is **ON** and the mixed air temperature reaches the **Low Temp Limit**, the damper will modulate toward closed to prevent freezing of the equipment. If an occupancy sensor is used, this **Control Mode** will only be active when the served space is occupied.

## Enabling Pass Through

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. From the tabs that appear, select **Configure**.
3. From the **Control Mode** drop-down menu, select **PASS THROUGH**.
4. Select **Save**.

**Note:** The external controller (if the AFMS controller is wired to one) will be allowed to control the damper actuator. (For wiring details, see the *Airflow Measurement System Installation Guide*, found on any [AFMS controller](#)'s product page.) This **Control Mode** will only be active when **Learn Damper Span** and **Learning Mode** (under the **Learn** tab) are **OFF**.



**Warning:** The **Enable Low Limit** and **Low Temp Limit** do *not* apply when in **PASS THROUGH**. Ensure the external controller has its own low limit and other safeties configured to prevent equipment damage.

# Monitoring with an AFMS

## Accessing Monitoring

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. Select the **Monitor** tab.

## Monitoring Operation

Label	Description
<b>Outside Air Flow</b>	The AFMS controller's current outside air CFM calculation displays here.
<b>AFMS Status</b>	<b>NORMAL</b> = No faults are detected. <b>LEARN MODE</b> = <b>Learning Mode</b> is <b>ON</b> . (See <a href="#">Running AFMS Learning Mode on page 7.</a> ) <b>SPAN MODE</b> = <b>Learn Damper Span</b> is <b>ON</b> . (See <a href="#">Setting AFMS Parameters on page 4.</a> ) <b>SERVICE</b> = One or more faults are detected. (See <a href="#">Monitoring Faults on page 12.</a> )
<b>Control Mode</b>	The saved <b>Control Mode</b> ( <b>OA FLOW CTRL</b> , <b>MAT CTRL</b> , <b>DMPR POSITION CTRL</b> or <b>PASS THROUGH</b> ) displays here. (See <a href="#">Controlling Airflow with an AFMS on page 10.</a> )
<b>Damper Position</b>	The damper's percentage open displays here.
<b>Occupancy</b>	The default is <b>OCCUPIED</b> . If an occupancy sensor is used and the served space is vacant, <b>UNOCCUPIED</b> will display.
<b>Outside Air Temp</b>	The outside air temperature sensor's measurement displays here.
<b>Return Air Temp</b>	The return air temperature sensor's measurement displays here.
<b>Mixed Air Temp</b>	The mixed air temperature sensor's measurement displays here.

## Monitoring Faults

Label	Description
<b>Outside Air Sensor Fault</b>	<b>FAULT</b> = The outside air temperature sensor is missing or shorted.
<b>Return Air Sensor Fault</b>	<b>FAULT</b> = The return air temperature sensor is missing or shorted.
<b>Mixed Air Sensor Fault</b>	<b>FAULT</b> = The mixed air temperature sensor is missing or shorted.
<b>Sensor Fault</b>	<b>FAULT</b> = One or more of the three temperature sensors is missing or shorted.
<b>Damper Control Fault</b>	If the saved <b>Control Mode</b> is <b>DMPR POSITION CTRL</b> (see <a href="#">Commanding a Damper Position on page 10</a> ), <b>FAULT</b> will display if the damper position is more than 15% off from the <b>Outside Air Damper Setpoint</b> for longer than the <b>Stroke Time (Seconds)</b> (found under <b>Configure &gt; Damper</b> ). This indicates that the damper is not moving properly.

Label	Description
<b>Outside Air Control Fault</b>	If the saved <b>Control Mode</b> is <b>OA FLOW CTRL</b> (see <a href="#">Controlling Outside Air Flow on page 10</a> ), <b>FAULT</b> will display if <b>Outside Air Flow</b> is more than 15% off from the <b>Outside Air Flow Setpoint</b> for longer than the <b>Stroke Time (Seconds)</b> (found under <b>Configure &gt; Damper</b> ). This indicates that the damper is not moving properly.
<b>Mixed Air Flow Fault</b>	If the saved <b>Control Mode</b> is <b>MAT CTRL</b> (see <a href="#">Controlling Mixed Air Temperature on page 10</a> ), <b>FAULT</b> will display if <b>Mixed Air Temp</b> is more than 15°F off from the <b>Mixed Air Temp Setpoint</b> for longer than the <b>Stroke Time (Seconds)</b> (found under <b>Configure &gt; Damper</b> ). This indicates that the damper is not moving properly.
<b>Outside Air Flow Fault</b>	<b>FAULT</b> = The calculation of the airflow based on the damper characterization data (see <a href="#">Accessing the Damper Characterization Table on page 14</a> ) has differed from the calculation using the current temperatures by more than the tolerance (20% difference default) for longer than 10 minutes. Ensure that the equipment is in the same physical condition as it was when <b>Learning Mode</b> was run. <b>Learning Mode</b> may need to be run again and/or sensors re-calibrated.
<b>Mixed Air Temp Low Limit Control</b>	<p><b>ACTIVE</b> = The damper is modulating toward closed to prevent freezing of the equipment because the <b>Mixed Air Temp</b> is lower than the <b>Low Temp Limit</b> (found under <b>Configure &gt; General</b>).</p> <p><b>INACTIVE</b> = Either the <b>Mixed Air Temp</b> is higher than the <b>Low Temp Limit</b>, or <b>Enable Low Limit</b> is set to <b>OFF</b>.</p> <p>See the related low limit information in <a href="#">Setting AFMS Parameters on page 4</a>.</p>

# Accessing the Damper Characterization Table

## Manually Entering Damper Characterization Data

While not ideal, the damper characterization data can be calculated and entered manually in the **AFMS Table**. This should only be done if – in the allotted time for [Setting Up an AFMS on page 3](#) – the  $\Delta T$  is unlikely to be greater than the **Min Delta Temp** for the duration of **Learning Mode**. In that case, for reliability, running Learning Mode at a later available time is still recommended.

### Accessing the AFMS Table

1. Go to **AFMS**, then select the **Device Name** of the AFMS controller.
2. Select the **Tune** tab.

### Interpreting the AFMS Table

Label	Description
<b>OA Fraction</b>	Percentage (expressed as a decimal) of the supply airflow that is outside airflow at the given outside air damper position
<b>Outside Air Closed</b>	Outside air damper at closed position
<b>Outside Air 5</b>	Outside air damper at 0–5% open
<b>Outside Air 10</b>	Outside air damper at 5–10% open
<b>Outside Air 15</b>	Outside air damper at 10–15% open
<b>Outside Air 20</b>	Outside air damper at 10–20% open
<b>Outside Air 30</b>	Outside air damper at 20–30% open
<b>Outside Air 40</b>	Outside air damper at 30–40% open
<b>Outside Air 50</b>	Outside air damper at 40–50% open
<b>Outside Air 60</b>	Outside air damper at 50–60% open
<b>Outside Air 70</b>	Outside air damper at 60–70% open
<b>Outside Air 80</b>	Outside air damper at 70–80% open
<b>Outside Air 90</b>	Outside air damper at 80–90% open
<b>Outside Air 100</b>	Outside air damper at 90–100% open

### Calculating the damper characterization data

Use the %OA equation found in ASHRAE Standard 111, section 7.6.3.3: "Flow Rate Approximation by Temperature Ratio".

**Note:** Find ASHRAE Standard 111 on this page of [read-only versions of ASHRAE standards](#).

**Note:** See [Controlling Airflow with an AFMS on page 10](#) for how to set the outside air damper to the required positions for the measurements.

**Note:** See [Monitoring with an AFMS on page 12](#) for where to find the sensor readings.

Continue to [Managing a KMC Conquest AFMS on page 3](#).

## Verifying the Damper Characterization Data

Should the damper characterization data require verification, measurements should only be made using NIST-traceable instruments and the method described in ASHRAE Standard 111. (See the details in [Manually Entering Damper Characterization Data on page 14](#).)

# Important Notices

## Trademarks

KMC Commander®, KMC Conquest™, KMC Controls®, and the KMC logo are registered trademarks of KMC Controls, Inc. All other products or name brands mentioned are trademarks of their respective companies or organizations. All rights reserved.

## Patents

Pat. <https://www.kmccontrols.com/patents/>

## Terms of Use

<https://www.kmccontrols.com/terms/>

## EULA (End User License Agreement)

<https://www.kmccontrols.com/eula/>

## Copyright

No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language in any form by any means without the written permission of KMC Controls, Inc.

## Disclaimers

The material in this document is for information purposes only. The contents and the product it describes are subject to change without notice. KMC Controls, Inc. makes no representations or warranties with respect to this document. In no event shall KMC Controls, Inc. be liable for any damages, direct or incidental, arising out of or related to the use of this document.