Honeywell

Advanced RTU Controls Retrofit Solution

TYPICAL 5-30 TON

APPLICATION GUIDE

This document contains information about the nationwide opportunity to potentially save substantial energy costs by upgrading existing rooftop units (RTUs).

Section 1 is an overview of why to make such an upgrade; Section 2 explains how to do it.

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SECTION 1: OVERVIEW OF ADVANCED RTU RETROFIT, PAYBACK TIME, AND REBATE INFORMATION

An overview of the potential substantial and immediate cost and energy savings for the building owner, including some payback time estimates and rebate information.

What is the Opportunity?

Rooftop units (RTUs) are used extensively in smaller one- and two-story commercial and institutional buildings such as schools, restaurants, motels, retail stores, and small office buildings all across the country. Rooftop Units serve over 60% of the commercial floor space in North America. There are an estimated 12 million RTUs currently installed and running on commercial buildings in 2016[a]. The average age of these units is 10-14 years[b], and due to lack of appropriate service, many suffer from operational problems including sensors that are out of calibration, refrigeration circuits improperly under and overcharged for a variety of reasons, economizer ventilation cycles that have ceased to function properly, and air flow systems improperly sized delivering substandard air flow.

RTUs that are less than 15 years old, five tons or more, and have been well maintained, with a life-expectancy of at least 5 more years, are often good candidates for controls retrofits. With controls upgrades and RTU maintenance, building owners might achieve significant energy savings.

Individual energy savings and payback results may vary depending on various factors, such as geographic location, choice and cost of equipment installed, cost of energy, existing age and condition of equipment, and as further described in the applicable estimator tools. In addition, it is the responsibility of the servicing mechanical contractor to make the final evaluation for retrofitting existing RTUs for the energy savings opportunities described in this document.

4 Things that Can Substantially Increase RTU Efficiency

After any required basic maintenance on an RTU (duct sealing, replacing broken or worn belts, etc), there are a number of improvements that can be made to substantially increase RTU efficiency. These include:

1. Adding programmable thermostats - see page 3
2. Adding improved Economizer control (combined with air flow verification) - see page 4
3. Adding demand Controlled Ventilation with CO2 sensors - see page 6
4. Adding fan energy savings using VFDs - see page 7

Larger tonnage RTUs, and RTUs with longer occupied times per day will offer the greatest potential savings and quickest payback.

WHAT IS THE COST FOR AN RTU ENERGY CONTROLS RETROFIT?

The parts cost for controls replacement and additions can be $500-2000 per RTU depending on the size of the unit and the changes implemented. This cost includes sensors, an economizer, a damper actuator, a VFD, a thermostat, and other needed parts. Rebates often exist which can help defray or sometimes completely pay for hardware depending on your utility company or state run program.

WHAT IS THE PAYBACK TIME?

This depends on what controls are installed and the size of the RTU (the larger the RTU, the quicker should be the payback). Often, payback will occur anywhere from 6 months to two years[c], depending on which controls are installed and what rebates are available.

Substantial energy savings are possible, and there are case studies which support significant savings with a number of different approaches to RTU controls retrofits, involving installation of new economizers, VFDs, and CO2 sensors may result in such savings. For a few examples, see

http://www.advancedrtu.org/case-studies--guidance.html

WHAT ARE THE REBATES?

There are many rebates offered in cities, states, and provinces across the USA and Canada. Some rebates are tied to specific parts installation (economizer, VFDs, thermostat), and others are tied to an entire retrofit solution.

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[a] EIA2003

[b] http://mn.gov/commerce-stat/pdfs/card-seventhwave-rtu.pdf
http://wcec.ucdavis.edu/wp-content/uploads/2013/12/MTLC-Preliminary-Report.pdf

[c] Economizer Savings Estimator Tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx
VFD Savings Estimator Tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

A good resource for finding local rebates in the US is dsireusa.org. Within minutes, you can identify your state rebates and download the forms necessary to apply for them.

WHERE DOES THE ENERGY SAVINGS COME FROM IN A CONTROL RETROFIT?
Compressors and fans consume most of the electrical energy in an RTU. And the supply fan by itself can often be half or more of the total annual operating cost of an RTU due to the amount of energy used by a typical supply fan. By reducing the equipment run times, optimizing economization, and slowing down the fan speed, significant energy (and energy dollars) can be saved while still maintaining comfort in the space. In addition, you will be helping to reduce the energy consumption of buildings and thus reducing the environmental impact of commercial buildings which consume roughly 18% of the total energy usage in North America, with HVAC accounting for roughly 39% of commercial building energy usage (U.S. Department of Energy (DOE), 2008 Buildings Energy Data Book). A single school district or commercial complex with hundreds of RTU units can yield considerable and immediate energy and cost savings with a properly performed RTU retrofit.

For owners that can't afford an RTU replacement, a controls retrofit should provide an immediate savings on energy bills and potentially delay the cost of a new RTU for 5 or more years (results will vary). The energy cost savings can help fund a new RTU unit at a later date.

GOOD CANDIDATES FOR RETROFIT?
Some RTUs are better candidates than others for an advanced RTU retrofit. Retrofits of RTUs with single speed fans which have existing Honeywell economizer controls mounted are normally good candidates. Other RTUs with non-Honeywell economizers may also be valid candidates, but in those cases, you should check for proprietary communication protocols which may make a retrofit more challenging.

SCOPE OF THE RETROFIT

Programmable thermostats

It is already well known that significant energy savings are possible by setting back the setpoint and shutting off the fan during unoccupied periods. RTUs operating on small to mid-size commercial buildings are often controlled by simple thermostats. By replacing a non-programmable thermostat with a programmable thermostat, and by setting setbacks of at least 5-8 degrees (both heating and cooling) during unoccupied periods, energy savings of up to 15% are possible[a], depending on the amount of weekly unoccupied time, climate zone, and cost of electricity and gas in the area. Shutting down a fan during the unoccupied period (a significant and normally unneeded cost) can raise this energy savings to over 30%[b].

SAVINGS
Honeywell provides for free an Economizer Savings Estimator tool that uses the latest ASHRAE standards and takes into account local climate conditions, and will provide information on estimated savings for any combination of the following:

1. Setback with programmable thermostats
2. Economizer control
3. DCV with CO2 sensors

Visit https://customer.honeywell.com/en-US/support/commercial/se/ese/Pages/default.aspx
to download and use this free tool. Other useful economizer tips and tools are also available on this site, including replacing old economizers with the latest Jade Economizer.

In addition to providing setback, a programmable commercial thermostat can be programmed to shut down the fan during unoccupied periods, which alone should have a significant impact on energy savings if the fan had previously been running 24/7.

REBATES
Rebates exist for replacing non-programmable with programmable thermostats. Check your utility or state for available local rebates on programmable thermostats.

[a] See the Economizer Savings Estimator tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

[b] See the Economizer Savings Estimator tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

Economizers

NOTE: In addition to the information listed here, technical reference 63-8594, Design and Application Guide for Honeywell Economizer Controls, has the most comprehensive and detailed application notes available on economizers and is highly recommended.

Economizers take advantage of cool outside air to cool buildings, rather than (or in addition to) running compressors. Honeywell economizer controls can be found on many RTUs. Honeywell W7459s, W7460, W7212s, W7215s, and the latest Jade W7220s, and OEM variations of these products, have been predominant economizers used in the industry for many years. The new Jade W7220 economizer meets all of the latest codes.

Economizers are wired in between the thermostat and the HVAC equipment, and are typically mounted in the RTU, with outside air and mixed air sensors. The outside air sensor can be a temperature (dry-bulb) or an enthalpy sensor. A return air sensor can also be installed for differential (dual) enthalpy control. The outside air economizer damper actuator is wired to and controlled by the economizer.

How the economizer works: Simply put, an economizer uses outdoor air to cool the building when outdoor conditions are right. When there is a call for cooling, the thermostat closes stage one to the economizer, and the economizer checks to see if the outside air is “fit” for cooling (for example, below 60F, or below 70F with low humidity). If so, the economizer opens the damper actuator from its minimum position, and the damper is modulated to maintain typically 50-55F mixed air temperature. If more cooling is needed, the thermostat calls for second stage, and the economizer will energize the first stage of cooling, so both “cool” outside air and one stage of compressor are cooling the space. In humid locations, an economizer can take outdoor humidity into account in addition to temperature by using enthalpy sensors.

North America features widely different climates. ASHRAE and other standards and code bodies recognize this fact. These different climate zones drive different economizer application practices. For example, air in Honolulu and Miami is almost always hot and humid and has almost no capability to be used to augment the HVAC cooling process. The tables below from ASHRAE standard 90.1 guide the use of the following economizer strategies.

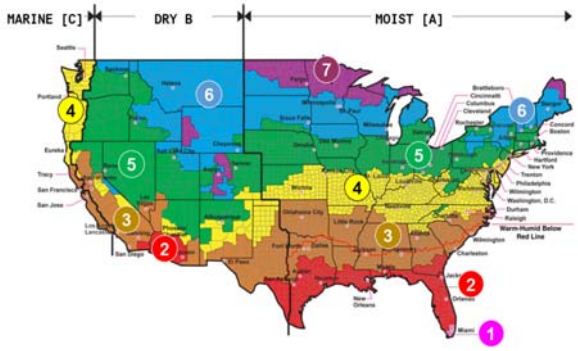


Fig. 1. Permissible Economizer Control Types and High Limit, Changeover options.[a]

ASHRAE 90.1 PERMISSABLE ECONOMIZER CONTROL TYPES, HIGH LIMIT, CHAGEOVER OPTIONS		
CONTROL TYPE	ALLOWED IN CLIMATE ZONES	HIGH LIMIT, CHANGEOVER SETPOINT
FIXED DRY BULB TEMP	1B, 2B,3B,3C,4B,4C,5B,5C,6B,7,8	OUTDOOR AIR TEMP > 75°F
	5A, 6A	OUTDOOR AIR TEMP > 70°F
	1A,2A,3A,4A	OUTDOOR AIR TEMP > 65°F
DIFFERENTIAL DRY BULB TEMP	1B, 2B, 3B, 3C, 4B, 4C, 5B,5C,6B,7,8	OUTDOOR AIR TEMP > RETURN AIR TEMP
FIXED ENTHALPY WITH FIXED DRY BULB TEMP	ALL	OUTDOOR AIR ENTHALPY > 28 BTU/LB OR OUTDOOR AIR TEMP > 75°F
DIFFERENTIAL ENTHALPY WITH FIXED DRY	ALL	OUTDOOR AIR ENTHALPY > RETURN AIR ENTHALPY OR OUTDOOR AIR TEMP > 75°F

[a] Pacific Northwest National Laboratory & Oak Ridge National Laboratory August 2010 http://www1.eere.energy.gov/buildings/publications/pdfs/building_america/ba_climateguide_7_1.pdf

Strategy: Differential Enthalpy with Fixed Dry Bulb Temperature Limit

This technique can be used in all climate zones and offers good energy savings.[a]

How does it work? If there is a call for cooling and outdoor air enthalpy is less than return air enthalpy and the outdoor air temperature is below high limit (see Fig. 1 above), outdoor air will be used to attempt to cool your customer's building.

Strategy: Fixed Enthalpy with fixed dry bulb temperature

This technique can be used in all climate zones. HVAC professionals like this method as it's relatively simple to deploy and only requires one enthalpy sensor.

How does it work? If there is a call for cooling and the outdoor air enthalpy is less than the outdoor air enthalpy set point (changeover setpoint) and the outdoor air temperature is below high limit (see Fig. 1 above), outdoor air will be used to attempt to cool your customer's building.

Strategy: Differential (Dry bulb) Temperature

This technique is suggested to be used in zones 1B, 2B, 3B, 3C, 4B, 4C, 5A, 5B, 5C, 6A, 6B, 7, and 8 as shown on the map. This method is restricted to the fewest number of zones.

How does it work? If there is a call for cooling and outdoor air temperature is less than the return air temperature, outdoor air will be used to attempt to cool your customer's building.

Strategy: Fixed Dry bulb Temperature

This technique is suggested to be used in zones 1A, 2A, 3A, 4A, 5A, 6A, 1B, 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, and 8. See map.

This method is probably the simplest strategy to deploy and understand. This technique was widely used before humidity sensing technology became cost effective. Because the temperature setting must be set conservatively to avoid economizing with humid air, it will not save as much energy as the single or dual enthalpy strategies in humid zones.

How does it work? If there is a call for cooling and outdoor air temperature is below the high limit changeover set point (see Fig. 1 above), outdoor air will be used to attempt to cool your customer's building.

REBATES
Economizer rebates are available from $5 to $50/ton. Check with your local utilities and state programs for available rebates.

SAVINGS
Honeywell provides for free an Economizer Savings Estimator tool that uses the latest ASHRAE standards and takes into account local climate conditions, and will provide estimated savings information for any combination of the following:

1. Setback with programmable thermostats
2. Economizer control
3. DCV with CO2 sensors

Visit https://customer.honeywell.com/en-US/support/commercial/se/ese/Pages/default.aspx to download and use this free tool. Other useful economizer tips and tools are also available on this site, including replacing old economizers with the latest Jade Economizer. Payback for installing an economizer control with new economizer sensors, or replacing a faulty economizer, can be typically anywhere from less than a year to up to two years[b] depending on climate location, equipment efficiency, utility costs, and parts and installation cost. Enter your specifics into the free tool above to estimate your savings.

Also available is a free on-line Jade economizer demo:
https://customer.honeywell.com/en-US/support/commercial/demos/jed/Pages/default.aspx

[a] See the Economizer Savings Estimator tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

[b] See the Economizer Savings Estimator tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

Demand Control Ventilation (CO2 sensors)

What is the Opportunity?

Many buildings are still ventilated at ventilation rates assuming maximum occupancy. But almost all buildings never maintain maximum occupancy during all occupied times. In fact, many buildings maintain occupancy at just a small fraction of maximum occupancy for long periods of occupied time. This means that we can be spending huge amounts of energy to condition large amounts of outside air that is not needed. So can we reduce the ventilation rate during partial occupancy periods? Yes, and this is supported and promoted by ASHRAE 62.1. A typical payback depends on the type of building and other factors.

What Do Codes Say?

ASHRAE standard 62.1 (adopted by IECC and IMC codes, which are in turn adopted in many state and local codes) calls for certain ventilation rates based on:

1. The baseline square footage ventilation to rid the building of VOCs (from paint, rugs, etc)
   — PLUS —
2. The level of occupancy (cfm/person).

These two are added together to get the required ventilation rate. This means that if we know the occupancy of a building (number of people in the space), then rather than ventilating for maximum occupancy, we can lower the ventilation to the space to meet the standard required ventilation for the occupancy in that space. This can apply to office spaces, retail, classrooms, auditoriums, sporting venues, conference rooms, movie theaters, libraries, malls, and many other buildings, with some exceptions. Check your local codes for exact requirements.

These codes normally apply not just to new construction, but to renovations and building upgrades.

How Can We Measure the Number of People in the Space?

One method accepted by almost all codes and the most common method is with the use of CO2 sensors, which measure the rise in CO2 based on level of occupancy. People exhale CO2, so this becomes a good indicator of the number of people and the level of “fresh air” in the space. CO2 measurements do not measure the level of pollutants in a space, but they do a good job of measuring levels of occupancy, and this is what we need to be able to lower ventilation rates to save energy and meet codes.

CO2 sensors are best mounted in the space, but can also be mounted in the return air duct if code allows and if it will still provide a good indication of space levels of CO2. In zoned spaces, putting CO2 sensors in the return air is not a good option – in this case, they should be installed in the tenant space.

What to do?

Wire the CO2 sensor to the economizer, and set the CO2 ppm and ventilation settings at the economizer (Jade W7220 or W7212 for instance). That’s all! Older economizer controls like the W7459, found in many RTUs, may not have the option for CO2 input, so we recommend the economizer be replaced with the W7220. Thousands of buildings now use CO2 for Demand Controlled Ventilation.

REBATES
Rebates do exist for CO2 installation. Check your local, state, and utility programs.

SAVINGS
Honeywell provides access to some really helpful free tools that allow you to understand how an economizer works, and how much energy savings are possible using programmable thermostats, economizers, and CO2 sensors for demand control ventilation.

A free tool is provided by Honeywell to estimate these savings, and is based on the latest ASHRAE and CEC Title 24 guidelines. Free On-line Energy Savings Estimator:
https://customer.honeywell.com/en-US/support/commercial/se/ese/Pages/default.aspx

This tool allows you to include Demand Controlled Ventilation DCV (or not) in your economizer savings estimation. Results will vary based on design maximum occupancy (people/1000 ft^2) and how much the levels of occupancy drop below the maximum design during the day. The tool allows you to enter actual occupancy as a percent of maximum design occupancy for each hour of the weekday and weekend. For some types of buildings, where actual occupancy can drop well below the design maximum occupancy for long periods of time, savings may be great and payback quick.

Depending on the climate zone, type of building, occupancy levels, etc, payback for economizers or economizers with DCV (CO2 sensors) can typically provide payback within one or two years[a]. We encourage you to use the Energy Savings Estimator software to enter your own specific conditions and calculate your own savings estimate.

[a] See the Economizer Savings Estimator tool:
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

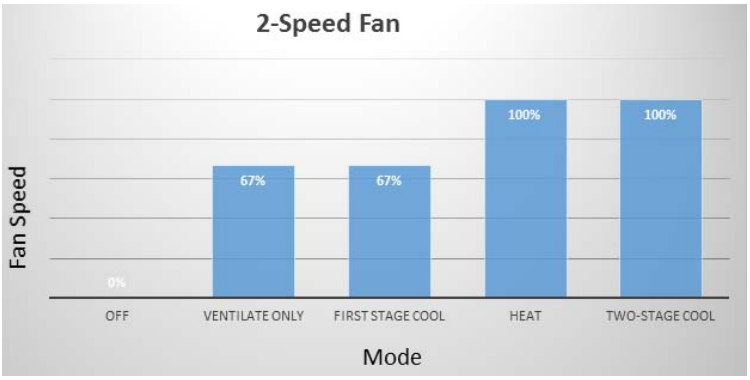
Variable Frequency Drives (VFDs) for Two Speed Fan Operation

Currently many existing RTUs run a single speed supply fan at high speed 100% of the time during all modes. The supply fan is a very big hog of energy usage in an RTU, often exceeding 50% of the total annual energy usage of an RTU, especially in temperate climates. Cut down the fan speed, you should save big bucks fast.

The energy savings grows exponentially with fan speed reduction, so for instance, reducing the fan speed by 10% can reduce fan energy usage by 27%. Reducing fan speed by 33% can reduce energy usage by 69%![a]

How it Works

With a VFD, a simple approach is to adjust for two speeds depending on the mode. For instance, it might run at 100% during two stage cooling and all stages of heating, and at 67% during one stage of cooling or for ventilation during occupied hours. Reducing the supply fan speed to 2/3 of full speed for ventilation and low speed cool is also an approach taken in both ASHRAE 90.1 (since 2010) and IECC 2015 for certain types of equipment, as a means to reduce energy.



Please check the rooftop equipment specs to understand how low the fan speed can be set in which modes without damaging the equipment. The cost of a VFD is now often less than the cost of a two stage motor, so it can be less expensive to purchase a VFD than it is to buy and replace the single stage motor with a two stage motor. Plus you get soft start and some other features with the VFD that help extend the life of the motor.

⚠ CAUTION

Check if the fan motor is inverter-duty rated, which is often the case on newer RTUs.
If it isn't, you may want to discuss with the building owner before putting a VFD on a non-inverter-rated motor. Some motors can fail prematurely when running at lower than designed speeds for long periods of time. You can replace the fan motor with an inverter-rated motor if required.

REBATES
Rebates for VFDs can range from $40-$90 per fan HP (Horsepower). Check your local utility and state or local rebate offers.

SAVINGS
Honeywell provides VFD Savings estimator tools at
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

The quick estimator tool is good for general approximations, and the standard estimator allows for a little more input detail like the load profile.

Using the Honeywell standard estimator tool, by reducing the fan speed to 70% of full speed on a 5HP motor running 14 hours a day, with half of those hours being ventilation or low stage cool at 70% of full speed, savings is approximately $1153, assuming $0.12/KwH. The cost of an average 5HP VFD, plus installation, will often run at about $800-1200, so a payback in less than a year is possible, and that is without counting rebates, which might run $200-$500 (check your local rebate offers).

Other References

Building Codes by State: https://www.energycodes.gov/status-state-energy-code-adoption

Substantial energy savings are possible by retrofitting RTUs with advanced controls, and there are case studies which back up these savings opportunities. See http://www.advancedrtu.org/case-studies--guidance.html.

[a] Using Standard Fan Affinity Laws. See our savings calculators at
https://customer.honeywell.com/en-US/support/commercial/se/Pages/default.aspx

SECTION 2: PARTS LIST AND INSTRUCTIONS

This section contains step-by-step description of the actual retrofit, the readily available control parts needed, as well as mounting, wiring, and programming tips.

Parts List

You won't need all of these parts. Pick the ones you need from each group. Notice the y-packs that include multiple parts in one box.

Part Number	Description	Notes
Thermostats		
TH8320R1003	VisionPro Commercial Prog. Stat w/econ occ interlock	
YTHM5421R1010/U	(EIM) Equip. Interface Module w/RAS & DAS sensors	
Other Thermostat Options		
YTHX9421R5085WW	Prestige Kit-replaces TH8320 & YTHM5421 (Adds color screen)	
THM6000R1002	Redlink Internet Gateway-for remote access	
THM4000R1000	Wireless adaptor for moving antenna below metal decking	
Economizer and Economizer Sensors and Parts (What is Sylk? See appendix for an explanation for this bus that provides additional diagnostics and other benefits)		
W7220A1000	Jade Economizer Controller	
C7400S1000	Communicating (Sylk) Outside temp & hum sensor	Enthalpy
C7400S1000	Communicating (Sylk) Return air temp & hum sensor (for differential enthalpy)	Enthalpy
C7250A1001	Outside temp (often called dry-bulb, an option to single or differential enthalpy)	Dry bulb
C7250A1001	Mixed Air Temp Sensor (required with every W7220)	
50053060-001	Duct Mounting Kit C7400S & C7250 (3 @ 8.86)	Provides proper mounting for proper sensing
Y-Packs, which have a 5-year warranty and include combinations of a Jade economizer, actuators, and sensors, are also available. See"Appendix" on page 23.		
CO2 sensor options (What is Sylk? See appendix for an explanation for this bus that provides additional diagnostics and other benefits)		
TR40-CO2	Sylk CO2 sensor, set bus address to 6 using TR40 dip switches for use with W7220.	
C7232A1016	0/2-10Vdc, 0/500-1500/2000ppm Selectable ppm, Wall-mounted CO2 sensor, no LDC display	
C7632A1004	Fixed 0-10Vdc, 0-2000ppm, no LDC display, set zero to 400ppm and span to 1600 in Jade Economizer Controller,	
C7232B and C7632B, C7262A are other CO2 options, for duct or wall, with or without display, see form 63-9285 to see all of the options for CO2 and other sensors.		

Part Number	Description	Notes
Variable Frequency Drive (VFD) options		
HVFDSD3C0075G100 HVFDCD3C0075F00 HVFD2D3C0075	7.5hp, 460V, SmartVFD HVAC, NEMA 1, 12Amps 7.5hp, 460V, SmartVFD Compact, 12Amps 7.5hp, 460V, SmartVFD HVAC2, 12Amps, motor pre-heat	Pick the drive that matches the fan motor HP or Current.
HVFDSD3C0050G100 HVFDCD3C0050F00 HVFD2D3C0050	5hp, 460V, SmartVFD HVAC, Nema 1, 9.6Amps 5hp, 460V, SmartVFD Compact, 9.6Amps 5hp, 460V, SmartVFD HVAC2, 9.6Amps, motor pre-heat	
HVFDSD3C0030G100 HVFDCD3C0030F00 HVFD2D3C0030	3hp, 460V, SmartVFD HVAC, Nema 1, 5.6Amps 3hp, 460V, SmartVFD Compact, 5.6Amps 3hp, 460V, SmartVFD HVAC2, 5.6Amps, motor pre-heat	
HVFDSD3C0020G100 HVFDCD3C0020F00 HVFD2D3C0020	2hp, 460V, SmartVFD HVAC, Nema 1, 4.8Amps 2hp, 460V, SmartVFD Compact, 4.8Amps 2hp, 460V, SmartVFD HVAC2, 4.8Amps, motor pre-heat	
Actuator options (What is Sylk? See appendix for an explanation for this bus that provides additional diagnostics and other benefits)		
*MS3110J1008	Economizer Sylk Actuator, Spring Return, 88 lb-in torque	20 ton
MS3105J3030	Economizer Sylk Actuator, Spring Return, 44 lb-in torque	5-10 ton
MS3103J1030	Economizer Sylk Actuator, Spring Return, 27 lb-in torque	5 ton
*Only one Sylk DCA allowed on the Jade economizer; Otherwise use 2 or 3 MS7505A2030 as needed. Pick the actuator to meet or exceed the torque of the replaced actuator. Note: Many Y7220 and YL7220 Economizer y-packs include the actuator.		

INSTALLATION WORKFLOW – INSTALLATION OF PARTS

NOTE: For best results, we recommend you replace all existing parts as described. Don't skimp. You are "renovating" the RTU to extend its useful life and make it perform even better than when it was new. While in there, put all new equipment in.

1. Replace the thermostat

Install a VisionPro or Prestige thermostat (see parts list) with the EIM. Replace the existing thermostat in the space, then install the EIM in a protected location. Follow the instructions that come with the thermostat. The room display, economizer, transformer, and VFD will get wired into the EIM, so consider that also when selecting a location.

2. Install a CO2 sensor in the space

- Best mounted in the space, but can also be mounted in the return air duct if code allows.
- If TR40-CO2, must set address to 6 with dip switches on back of device. If C7232 or C7262, set for 2-10Vdc and 0-2000ppm with dip switches on device. If C7632, 0-10Vdc and 0-2000ppm is the fixed setting, and can be accommodated at the Jade economizer set-up.

3. Replace the economizer

- More than likely your RTU has an existing W7459, W7460, or W7212 installed. If you are replacing a W7459 and an M7415, you will want to replace with a W7220 and a M7215. Mount the W7220 in a place that is easy to see and access.

- Mark the wires (and/or take a photo of wiring), then remove wires and economizer control and replace with the W7220 Jade. You can wire back the transformer and compressor output wires (R, C, Y1-O, and Y2-O if applies).
- Refer to Honeywell Tech tips for replacing older Honeywell economizers and motors with the Jade economizer and actuators. Tech tips can be found at:

https://customer.honeywell.com/en-US/support/commercial/se/ese/techtips/Pages/default.aspx

4. Replace the economizer sensors

- Replace the existing mixed air sensor with a C7250A1001, and the outdoor sensor with the C7400S1000. If desired, you can set up for dual enthalpy by installing a C7400S1000 in the return air duct as well. In addition to getting optimal savings, adding the return air sensor allows you to use the auto-calibration feature in the W7220 which will automatically calculate Min and Max damper positions for you based on required cfm a huge time saver (Note: auto-calibration is not available for two speed fan with VFD installation). Wire these sensors back to the W7220 economizer.
- We strongly recommend that you use the 50053060-001 duct mounting kit with the return air and mixed air sensors. Incorrect temperature readings can occur if the sensors are mounted directly on sheet metal, which can result in inaccurate and non-optimized ventilation rates, especially when using the Mixed Air Formula described in the Economizer section below.

5. Replace the existing damper actuator with a Sylk actuator

- Sylk actuators have a a 5-year warranty, and the Sylk communication gives added benefits vs a 2-10Vdc actuator. Wire back to the economizer. If you are replacing a foot mounted black motor with a direct coupled sylk actuator, you will need to remove the linkages.

6. Install the VFD

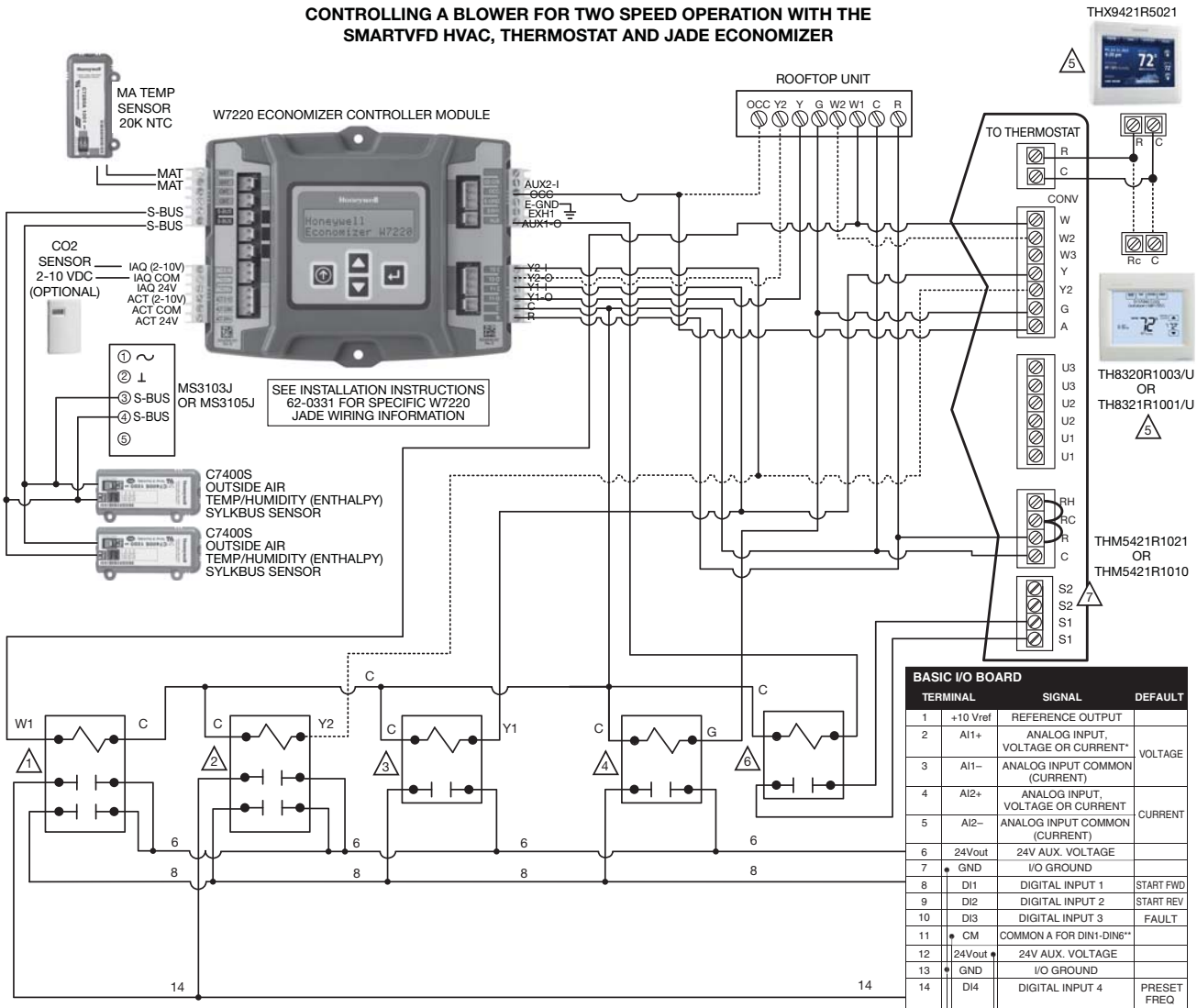
- The VFD can be installed in any convenient location in the RTU. Honeywell VFDs are rated UL508C. Follow the mounting instructions provided in the relevant installation instructions. Creating a bracket that optimizes accessibility might be a good idea.

7. Install 4 relays in a convenient location in the RTU

- The relays can be installed in any convenient location in the RTU. Install a fifth relay if Fault Detection and Diagnostics is desired.

INSTALLATION WORKFLOW – WIRING THE DEVICES

8. Follow the wiring diagram for the chosen VFD to wire the devices together. A similar wiring is also available in the Jade economizer installation instruction, 62-0331.



BASIC I/O BOARD			
TERMINAL		SIGNAL	DEFAULT
1	+10 Vref	REFERENCE OUTPUT	
2	AI1+	ANALOG INPUT, VOLTAGE OR CURRENT*	VOLTAGE
3	AI1–	ANALOG INPUT COMMON (CURRENT)	
4	AI2+	ANALOG INPUT, VOLTAGE OR CURRENT	CURRENT
5	AI2–	ANALOG INPUT COMMON (CURRENT)	
6	24Vout	24V AUX. VOLTAGE	
7	GND	I/O GROUND	
8	DI1	DIGITAL INPUT 1	START FWD
9	DI2	DIGITAL INPUT 2	START REV
10	DI3	DIGITAL INPUT 3	FAULT
11	CM	COMMON A FOR DIN1-DIN6**	
12	24Vout	24V AUX. VOLTAGE	
13	GND	I/O GROUND	
14	DI4	DIGITAL INPUT 4	PRESET FREQ SELECT 1
15	DI5	DIGITAL INPUT 5	PRESET FREQ SELECT 2
16	DI6	DIGITAL INPUT 6	FAULT RESET
17	CM	COMMON A FOR DIN1-DIN6**	
18	AO1	ANALOG SIGNAL (+OUTPUT)	OP FREQ
19	AO-/GND	ANALOG OUTPUT COMMON	
30	+24 Vin	24V AUXILIARY INPUT VOLTAGE	
A	RS485	DIFFERENTIAL RECEIVER/ TRANSMITTER	
B	RS485	DIFFERENTIAL RECEIVER/ TRANSMITTER	

I/O BOARD ON SMART DRIVE VFD HVFDSD

1 RELAY 1, DPDT RELAY, NO CONTACTS CLOSED FOR HIGH SPEED FAN WITH W1 CALL

2 RELAY 2, DPST RELAY, NO CONTACTS CLOSED FOR HIGH SPEED FAN WITH Y2 CALL

3 RELAY 3, SPST RELAY, NO CONTACTS CLOSED FOR LOW SPEED FAN WITH Y1 CALL

4 RELAY 4, SPST RELAY, NO CONTACTS CLOSED FOR LOW SPEED FAN WITH G CALL

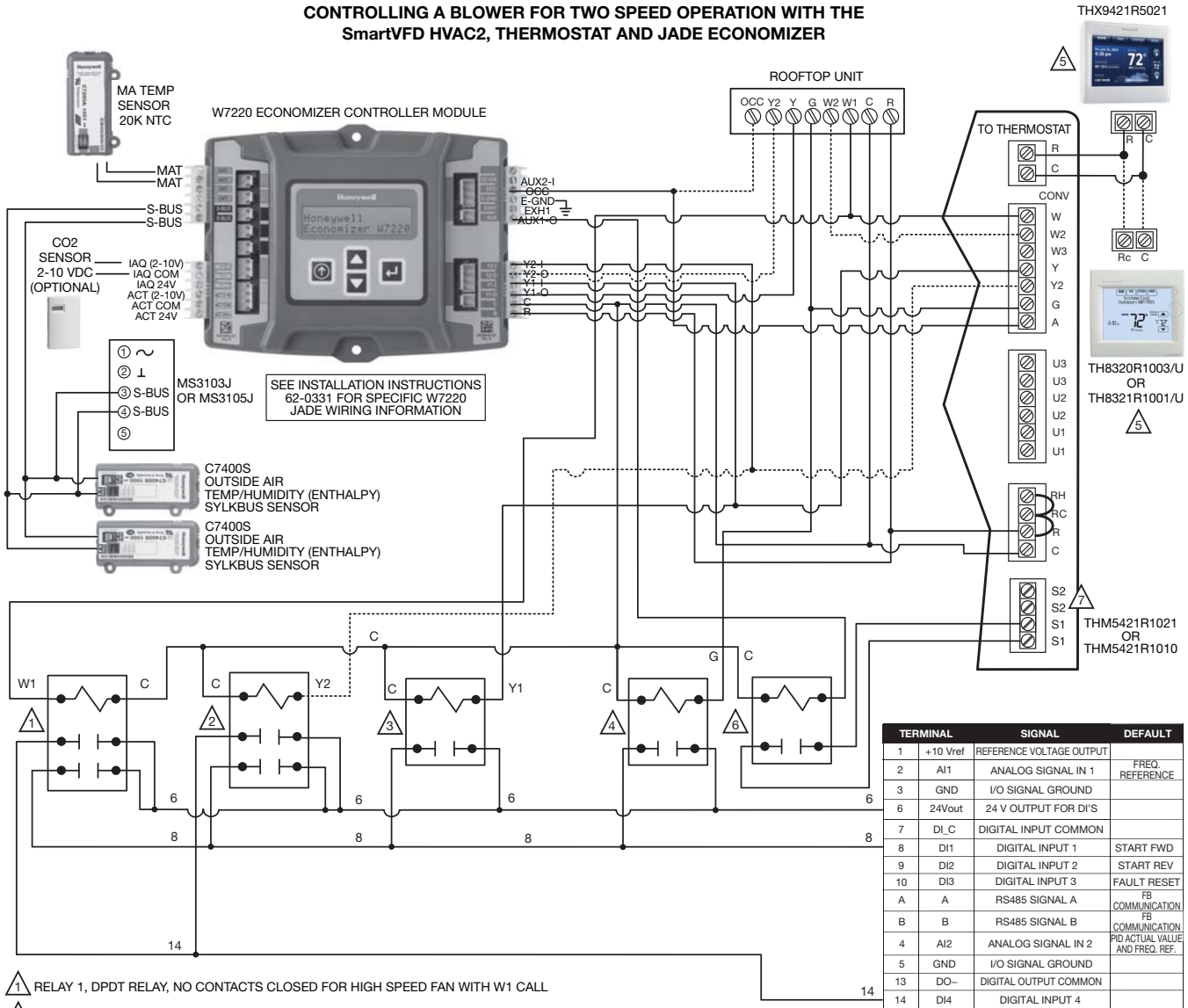
5 THE THM5421R1021 EIM (EQUIPMENT INTERFACE MODULE) CAN BE USED WITH THE THX9421R5021, OR THE TH8110R1008, TH8321R1001 OR TH8320R1003 THERMOSTATS. ONLY 1 THERMOSTAT CAN BE USED PER EIM. THE THX9421R5021 PRESTIGE IAQ THERMOSTAT ALWAYS REQUIRES R AND C WIRE CONNECTIONS AT THE SUBBASE TO POWER THE DISPLAY OF THE THERMOSTAT. THE TH8110 AND TH832X MODELS CAN BE BATTERY POWERED. THE RC AND C CONNECTIONS ARE OPTIONAL ON THE TH8110R1008, TH8321R1001 OR TH8320R1003 WHEN THEY ARE LINKED TO AN EIM AND USED WITH BATTERIES. THE TH8110R1008 MODEL ONLY CONTROLS 1 SPEED HEAT OR COOL, AND THE TH8110R1008 AND TH8320 DO NOT CONTROL HUMIDITY.

6 FOR FAULT DETECTION AND DIAGNOSTICS (FDD) REQUIRED BY CEC TITLE 24, USE THE AUX1-O OUTPUT ON JADE TO ENERGIZE THE S1-S1 TERMINALS ON THE EIM THROUGH THE RELAY SHOWN, AND CONFIGURE THE FAULT AS "ECONOMIZER FAULT" IN THE THERMOSTAT SET UP.

7 OTHER FAULT INPUTS CAN BE WIRED TO THE S2-S2, (AND S3-S3, AND S4-S4 NOT SHOWN) TERMINALS ON THE EIM: FOR INSTANCE, THE PRESTIGE DUCT SENSORS FOR DELTA T FAULT, OR CUSTOM FAULTS SUCH AS VFD FAULT, CONDENSATE FAULT, ETC, TO GIVE VISIBILITY TO THESE FAULTS AT THE THERMOSTAT.

MCR36711

Fig. 2. RTU retrofit wiring using the HVFDSDxxxx SmartVFD HVAC and four relays.



TERMINAL		SIGNAL	DEFAULT
1	+10 Vref	REFERENCE VOLTAGE OUTPUT	
2	AI1	ANALOG SIGNAL IN 1	FREQ. REFERENCE
3	GND	I/O SIGNAL GROUND	
6	24Vout	24 V OUTPUT FOR DI'S	
7	DI_C	DIGITAL INPUT COMMON	
8	DI1	DIGITAL INPUT 1	START FWD
9	DI2	DIGITAL INPUT 2	START REV
10	DI3	DIGITAL INPUT 3	FAULT RESET
A	A	RS485 SIGNAL A	FB COMMUNICATION
B	B	RS485 SIGNAL B	FB COMMUNICATION
4	AI2	ANALOG SIGNAL IN 2	PID ACTUAL VALUE AND FREQ. REF.
5	GND	I/O SIGNAL GROUND	
13	DO–	DIGITAL OUTPUT COMMON	
14	DI4	DIGITAL INPUT 4	
15	DI5	DIGITAL INPUT 5	
16	DI6	DIGITAL INPUT 6	
18	AO	ANALOG OUTPUT	OUTPUT FREQUENCY
20	DO	DIGITAL SIGNAL OUT	ACTIVE = READY
22	RO1 NO	RELAY OUT 1	ACTIVE = RUN
23	RO1 CM		
24	RO2 NC	RELAY OUT 2	ACTIVE = FAULT
25	RO2 CM		
26	RO2 NO		

IO BOARD ON COMPACT OR HVAC2 VFD

1 RELAY 1, DPDT RELAY, NO CONTACTS CLOSED FOR HIGH SPEED FAN WITH W1 CALL

2 RELAY 2, DPST RELAY, NO CONTACTS CLOSED FOR HIGH SPEED FAN WITH Y2 CALL

3 RELAY 3, SPST RELAY, NO CONTACTS CLOSED FOR LOW SPEED FAN WITH Y1 CALL

4 RELAY 4, SPST RELAY, NO CONTACTS CLOSED FOR LOW SPEED FAN WITH G CALL

5 THE THM5421R1021 EIM (EQUIPMENT INTERFACE MODULE) CAN BE USED WITH THE THX9421R5021, OR THE TH8110R1008, TH8321R1001 OR TH8320R1003 THERMOSTATS. ONLY 1 THERMOSTAT CAN BE USED PER EIM. THE THX9421R5021 PRESTIGE IAQ THERMOSTAT ALWAYS REQUIRES R AND C WIRE CONNECTIONS AT THE SUBBASE TO POWER THE DISPLAY OF THE THERMOSTAT. THE TH8110 AND TH832X MODELS CAN BE BATTERY POWERED. THE RC AND C CONNECTIONS ARE OPTIONAL ON THE TH8110R1008, TH8321R1001 OR TH8320R1003 WHEN THEY ARE LINKED TO AN EIM AND USED WITH BATTERIES. THE TH8110R1008 MODEL ONLY CONTROLS 1 SPEED HEAT OR COOL, AND THE TH8110R1008 AND TH8320 DO NOT CONTROL HUMIDITY.

6 FOR FAULT DETECTION AND DIAGNOSTICS (FDD) REQUIRED BY CEC TITLE 24, USE THE AUX1-O OUTPUT ON JADE TO ENERGIZE THE S1-S1 TERMINALS ON THE EIM THROUGH THE RELAY SHOWN, AND CONFIGURE THE FAULT AS "ECONOMIZER FAULT" IN THE THERMOSTAT SET UP.

7 OTHER FAULT INPUTS CAN BE WIRED TO THE S2-S2, (AND S3-S3, AND S4-S4 NOT SHOWN) TERMINALS ON THE EIM: FOR INSTANCE, THE PRESTIGE DUCT SENSORS FOR DELTA T FAULT, OR CUSTOM FAULTS SUCH AS VFD FAULT, CONDENSATE FAULT, ETC, TO GIVE VISIBILITY TO THESE FAULTS AT THE THERMOSTAT.

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Fig. 3. Figure showing RTU retrofit wiring using the HVFDCDxxxx or HVFD2D SmartVFD Compact or HVAC2 and four relays.

INSTALLATION WORKFLOW – PROGRAMMING THE DEVICES

9. Program the VFD
If using the SmartVFD HVAC, HVFDSDxxxxxxx

a. Program the SmartVFD as per application manual 38-00002.
b. Set the low speed fan during VFD setup at parameter P1.8 of the start-up wizard.

P1.8	Minimum frequency	0.00	P1.9	Hz	Varies	101	Minimum allowed frequency reference.

c. Or the low speed fan can be set in the VFD setup at parameter P3.3.1

P3.3.1	Minimum frequency	0.00	P3.3.2	Hz	20.00	101	Minimum allowed frequency reference.

d. Configure the VFD to drive the fan at high speed by setting parameter P3.3.12.

P3.3.12	Preset frequency 1	P3.3.1	P3.3.2	Hz	10.00	105	Select with digital input: Preset frequency selection 0 (P3.5.1.16)

NOTE: If digital input 4 is being used by an auto bypass, then wire the relays 1 and 2 to digital input 5 (terminal 15) instead of digital input 4 (14). Also configure P3.3.13, preset frequency 2 instead of P3.3.12, preset frequency 1.

IF USING THE SMARTVFD COMPACT MODEL HVFDCD, OR HVAC2 MODEL HVFD2D

a. Program the SmartVFD as per user manual 62-0312 (Compact) or 31-00108 (HVAC2).
b. Set low speed fan during VFD setup at parameter P3.1

P3.1	Min frequency	0.00	P3.2	Hz	0.00	101	

c. Configure the VFD to drive the fan at high speed by setting parameter P3.5

P3.5	Preset speed 1	0.00	P3.2	Hz	10.00	105	Activated by digital inputs

Operation for all VFDs

1. When the thermostat calls for ventilation-only or first stage cooling, the fan will operate at the minimum frequency of the VFD. The fan call may be for independent fan or with fan-on in occupied. This is the lower of the two fan speeds. Digital input 1 is energized in this operation and will start the fan forward and run at the minimum frequency.
2. When the thermostat calls for heating or second stage cooling, the fan will operate at the preset speed 1 of the VFD. This is the higher of the two fan speeds. Digital input 4 as well as digital input 1 are energized in this operation which will start the forward and run it to preset frequency 1.

10. Program the Economizer

Please refer to the following documents for programming the economizer: Jade economizer W7220 product data sheet, form 63-2700; and Design and Application Guide for Honeywell Economizer Controls, Technical Reference Manual 63-8594. The latter is an excellent explanation for how an economizer works, including ventilation with a CO2 sensor. The following is some specific detail related to a VFD/CO2/Jade retrofit for a 2 speed fan.

COMMON QUESTION:
How do you program VENTMIN and VENTMAX in a Jade economizer in a 2-speed fan application with a CO2 sensor?

NOTE: If there is no CO2 sensor, but you still plan to set this up for a 2-speed fan, the menu will only show MIN POS L and MIN POS H, so you would still need to follow these procedures, but only for two airflows, not 4 airflows.

IMPORTANT

Follow these steps in order, because some of the menu items in Jade will remain hidden unless certain parameters are set first.

1. In SYSTEM SETUP menu, set AUX2 IN for W (HEAT (W1))

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
SETPOINTS	ERV OAT SP	32ºF	0 to 50 ºF; increment by 1	Only when AUX1 O = ERV
	EXH1 SET	50%	0 to 100%; increment by 1	Setpoint for OA damper position when exhaust fan 1 is powered by the economizer. With 2-speed fan units Exh1 L (low speed fan) and Exh1 H (high speed fan) settings are required. Default for Exh1 L is 65% and Exh1 H is 50%
	EXH2 SET	75%	0 to 100%; increment by 1	Setpoint for OA damper position when exhaust fan 2 is powered by the economizer. Only used when AUX1 O is set to EHX2. With 2-speed fan units Exh2 L (low speed fan) and Exh2 H (high speed fan) settings are required. Default for Exh2 L is 80% and Exh2 H is 75%
SYSTEM SETUP	INSTALL	01/01/11		Display order = MM/DD/YY Setting order = DD, MM, then YY.
	UNITS DEG	ºF	ºF or ºC	Sets economizer controller in degrees Fahrenheit or Celsius.
	EQUIPMENT	CONV	CONV HP	CONV = conventional. HP O/B = Enables Heat Pump mode. Use AUX2 I for Heat Pump input from thermostat or controller (O or B terminal).
	AUX2 IN	n/a	Shutdown (SD) Heat (W1) HP(O) HP(B)	In CONV mode: SD = Enables configuration of shutdown (default); W = Informs controller that system is in heating mode. If using 2-speed fan mode, you must program CONV mode for W. Shutdown is not available in the two-speed fan mode. In HP O/B mode: HP(O) = energize heat pump on Cool (default); HP(B) = energize heat pump on Heat.
	FAN SPEED	1 speed	1 speed/ 2 speed	Sets economizer controller for operation of 1 speed or 2 speed supply fan. The controller does not control the fan but positions the OA and RA dampers to the heating or cooling mode settings. 2-speed fan option also needs Heat (W1) programmed in AUX 2 In.
	FAN CFM	5000cfm	100 to 50000 cfm; increment by 100	This is the capacity of the fan. The value is found on the label from the RTU manufacturer. The cfm of the fan is only used with DCV CAL ENABLE AUO
	AUX1 OUT	NONE	NONE ERV EXH2 SYS	NONE = not configured (output is not used) ERV= Energy Recovery Ventilator EXH2 = second damper position 24 Vac out for second exhaust fan. SYS = use output as an alarm signal
	OCC	INPUT	INPUT or ALWAYS	When using a setback thermostat with occupancy out (24 Vac), the 24 Vac is input “INPUT” to the OCC terminal. If no occupancy output from the thermostat then change program to “ALWAYS” OR add a jumper from terminal R to OCC terminal.

2. In SYSTEM SETUP menu, set Fan Speed to 2SPEED.
3. In SETPOINTS menu, set DCV set to whatever local code might require. 1100ppm is the default, and is acceptable in almost all situations.
4. In SETPOINTS menu, set VENTMIN and VENTMAX.

Menu	Parameter	Parameter Default Value	Parameter Range and Increment	Notes
SETPOINTS	DRYBLB SET	63ºF	48 to 80 ºF; increment by 1	Dry bulb setpoint will only appear if using dry bulb change over. Setpoint determines where the economizer will assume outdoor air temperature is good for free cooling; e.g.; at 63 ºF setpoint unit will economizer at 62 ºF and below and not economize at 64 ºF and above. There is a a 2 ºF deadband.
	ENTH CURVE	ES3	ES1, ES2, ES3, ES4, or ES5	ES curve will only appear if using enthalpy changeover. Enthalpy boundary “curves” for economizing using single enthalpy.
	DCV SET	1100ppm	500 to 2000 ppm increment by 100	Displays ONLY if a CO2 sensor is connected. Setpoint for Demand Control Ventilation of space. Above the setpoint, the OA dampers will modulate open to bring in additional OA to maintain a space ppm level below the setpoint.
	MIN POS	2.8 V	2 to 10 Vdc	Displays ONLY if a CO2 sensor is NOT connected.
				With 2-speed fan units MIN POS L (low speed fan) and MIN POS H (high speed fan) settings are required. Default for MIN POS L is 3.2V and MIN POS H is 2.8V.
	VENTMAX	2.8 V	2 to 10 Vdc	Displays only if a CO2 sensor is connected. Used for Vbz (ventilation max cfm) setpoint. VENTMAX is the same setting as MIN POS would be if you did not have the CO2 sensor.
			100 to 9990 cfm increment by 10	If OA, MA RA and CO2 sensors are connected and DCV CAL ENABLE is set to AUTO mode, the OA dampers are controlled by CFM and displays from 100 to 9990 cfm.
			2 to 10 Vdc*	With 2-speed fan units VENTMAX L (low speed fan) and VENTMAX H (high speed fan) settings are required. Default for VENTMAX L is 3.2V and VENTMAX H is 2.8V.
	VENTMIN	2.25 V	2 to 10 Vdc	Displays only if CO2 sensor is connected. Used for Va (ventilation min cfm) setpoint. This is the ventilation requirement for less than maximum occupancy of the space.
			100 to 9990 cfm increment by 10	If OA, MA RA and CO2 sensors are connected and DCV CAL ENABLE is set to AUTO mode, the OA dampers are controlled by CFM and displays from 100 to 9990 cfm.
			2 to 10 Vdc*	With 2-speed fan units VENTMIN L (low speed fan) and VENTMIN H (high speed fan) settings are required. Default for VENTMIN L is 2.5V and VENTMIN H is 2.25V.

* These menu items show up in 2-speed application with CO2.

VENTMIN and VENTMAX will show up only when a CO2 sensor is being used. When the Jade economizer is set up for two speed fan, these will show up in the Jade menu as VENTMAX H, VENTMIN H, VENTMIN L, and VENTMIN L. These correspond to the minimum and maximum damper positions (Vdc output to actuator) during both the low fan speed and high fan speed. All four of these need to be set.

NOTE: Note: When using a single speed fan, the Jade economizer has an auto calibrate method that will set these Vdc actuator outputs automatically if you simply enter the desired cfm air flowrate for VENTMIN and VENTMAX. But in 2-speed fan, this auto-calibrate feature is not available. So follow the steps below for a 2-speed fan.

How do you set VENTMAX H, VENTMIN H, VENTMAX L, and VENTMIN L?

The best method for setting these values is to actually measure outdoor airflow with airflow measuring equipment. Adjust the damper position until you measure the correct minimum and maximum outdoor airflow in both low and high speed fan settings. Then simply enter these damper positions (Vdc) into the W7220 economizer.

A second method, which is not as accurate as direct measurement, is to use the Mixed Air Formula to determine the percentage of outside air by measuring the Mixed Air, Outdoor Air, and Return Air temperatures. For a good explanation of this method, see the Design and Application Guide for Honeywell Economizer Controls, Technical Reference Manual 63-8594. Note: the fan must be running with the panels on the unit to take the mixed air sensor measurements. Drill a hole in the side of the unit and insert accurate temperature probe to measure the MA temperature. An averaging sensor is recommended. The hole must be sealed when measurements are completed.

First, determine what the required minimum and maximum outdoor air ventilation rates (cfm) should be. This will be a combination of base ventilation + ventilation for occupancy, as described earlier in this document. Reference local codes and/or ASHRAE standard 62.1 to determine these ventilation rates, and record them below. MIN will be based on no occupancy (just ventilation based on square footage for the particular building type during occupied hours), and MAX will be during maximum occupancy. Remember, you don't need to over-ventilate, just ventilate enough to meet code and maintain indoor comfort in order to save energy.

MIN Ventilation rate _____ cfm

MAX Ventilation rate_____cfm

Then use this basic equation:

$$\text{MA Temp} = \left[\text{RA Temp X } \frac{\text{\% Return Air}}{100\%}\right] + \left[\text{OA Temp X } \frac{\text{\% Outside Air}}{100\%}\right]$$

Where: % Return Air = (100% – % Outside Air)

Since Return Air Temp, Outside Air Temp, and Total Fan cfm are known, this formula will determine the Mixed Air Temperature required for a specified percentage of Outside Air at current conditions.

With the fan running at low speed, the installer can then adjust damper position by adjusting the MIN damper position on the economizer until the desired Mixed Air Temperature is reached. When the desired Mixed Air Temperature is reached, record the damper output %. This will be the desired damper position at low speed.

Damper position_____% at VENTMIN at Low speed fan

Damper position_____% at VENTMAX at Low speed fan

Now set the fan to high speed and repeat the above and record.

Damper position_____% at VENTMIN at High speed fan

Damper position_____% at VENTMAX at High speed fan

After converting to Vdc, you can now enter these values for VENTMAX H, VENTMIN H, VENTMIN L, and VENTMIN L into Jade.

This method is not as accurate as actually measuring the airflow. However, it is better than leaving the settings at the default in the economizer (something that should not be done). A few things should be done to increase the accuracy of this method.

1. The greater the temperature differential between outdoor air and return air temperature the better. You want a minimum of 10ºF (6ºC) between outdoor and return air, but the greater the differential, the more accurate this method will be. We suggest picking a day and time when you might have a 20ºF differential if possible (a 50ºF or 95ºF outdoor temperature for instance).
2. Use accurate temperature sensors and place them in a good location: Outdoor air at the intake but shaded, for instance. Mixed air in the discharge air stream (after the coils, but with no heating or cooling energized), to get a well mixed air with an averaging sensor, if possible. And return air before it reaches any mixing with outdoor air.

Example for determining VENTMIN and VENTMAX in a two speed application:

BUILDING SPECIFICATIONS:
- Office space - 100,000 ft^2
- Air handler (supply fan) capacity 20,000 cfm (566 m3/min.)
- Maximum Occupancy (People in area) – 250
- Assume base rate for office buildings is 5 cfm per person
- Assume building effluent (base) rate is 0.06 cfm per square foot of space.

MIN ventilation rate is with no people in the building:

VENTMIN = 100,000 ft^2 x 0.06 cfm/ ft^2 = 6000 cfm.

VENTMAX = VENTMIN (base or effluent rate) + required cfm/person x # people

VENTMAX = 6000 cfm + 5cfm/person x 250 people = 6000+1250 = 7250cfm

MIN Ventilation rate __6000__ cfm

MAX Ventilation rate__7250__cfm

Next, you calculate the required % Outside Air to provide 6000cfm and 7250 cfm:

VENTMIN = 6000cfm required/20,000 total = 30% outdoor air

VENTMAX = 7250cfm required/20,000 total = 36% outdoor air

Next, you are on the rooftop and you measure:
- Outside Air Temperature = 50°F
- Return Air Temperature = 72°F

Using the equation:

$$\text{MA Temp} = \left[\text{RA Temp X } \frac{\%\text{ Return Air}}{100\%}\right] + \left[\text{OA Temp X } \frac{\%\text{ Outside Air}}{100\%}\right]$$

Where: % Return Air = (100% – % Outside Air)

Desired MA Temp (mixed air temperature) at VENTMIN:
MA Temp = [72F x 30/100] + [50F x 70/100] = 56.6°F

Desired MA Temp (mixed air temperature) at VENTMAX:
MA Temp = [72F x 36/100] + [50F x 64/100] = 57.9°F

With the fan running at low speed, adjust the damper position by adjusting the VENTMIN setting on Jade until the mixed air temperature is 56.6°F. Record the damper position shown in the STATUS menu of Jade, Damper Out (for example, 10%). Record this. Now adjust damper until MA temp is 57.9°F, record this. Repeat for high speed fan.

Fan Running at Low Speed:
VENTMIN L: Damper Out % at 56.6°F mixed air_____10% (example)___= .10*8+2= 2.80V.

VENTMAX L: Damper Out % at 57.9°F mixed air_____15% (example)____= .15*8+2= 3.20V.

Repeat with Fan running at High Speed:
VENTMIN H: Damper Out % at 56.6°F mixed air_____8% (example) __=.08*8+2= 2.65V.

VENTMAX H: Damper Out % at 57.9°F mixed air_____12% (example)_ _=.12*8+2= 2.95V.

You can now enter these values into the Jade economizer in the Setpoints menu.

ECONOMIZER SEQUENCE OF OPERATION

Sequence of Operation of Jade economizer with and without DCV

1. Thermostat goes into occupied mode and closes the “OCC” contact on the Jade W7220 economizer.
2. Damper positions itself from fully closed to minimum position.
   a. If no DCV (CO2 sensor), damper positions itself to the minimum position based on assumed maximum occupancy of the space. This position is fixed for the duration of the occupied mode.
   b. If there is DCV (CO2 sensor), the damper positions itself to minimum position (VENTMIN) based on ventilation of VOCs for the size and type of space. Then as people enter the space, CO2 rises, and the damper will reposition to maintain below the maximum CO2 ppm level set in the Jade economizer, not to exceed the VENTMAX setting in Jade.
3. The damper economizer may also be “economizing” (bringing in cool air to help cool the space on a call for cooling). In this case, whichever demand is higher (ventilation or economization) will take precedence.

Fig. 4 illustrates how damper position changes with occupancy and ppm levels. For more details, see the Jade economizer product data sheet, form 63-2700.

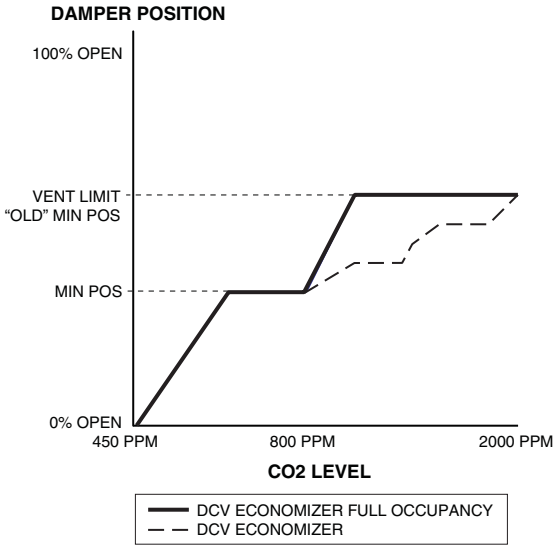


Fig. 4. Damper position changes relative to occupancy and CO2 levels.

Demand Control Ventilation

- Changes ventilation in response to occupancy.
- Minimum pos and DCV Max position varies based on building type.
- Min Pos ventilates for building effluents and low occupancy.
- New DCV Max is “old” min pos for maximum occupancy.

PROGRAM THE THERMOSTAT

Follow the instructions in the thermostat installation manual to program the thermostat.

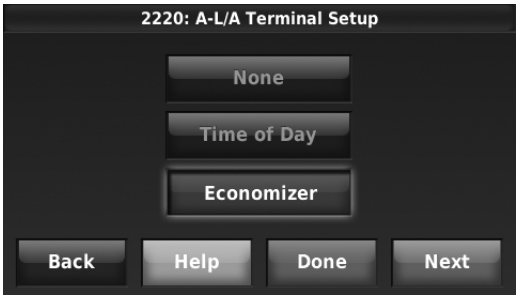
Prestige Thermostat with EIM

The best option is the Prestige thermostat with equipment interface module (EIM). This provides an intuitive touch-screen interface and optional delta T fault detection.

Fig. 5. Prestige thermostat with EIM and discharge air and return air sensors for diagnostics.

Prestige Setup for Economizer Output

1. In the Prestige thermostat settings, set ISU 2220: A/L-A Terminal Setup to Economizer.
2. Press Next or Done, depending on whether you are done with setup.



Prestige Setup for Fault Detection and Diagnostics

The Prestige thermostat allows you to create a custom fault name and instructions. This helps to meet CEC Title 24 2016 and IECC 2015 requirements for fault detection and diagnostics.

1. In the Prestige thermostat settings, use ISU 6000: Select the Dry Contacts in the System to create a Custom Alert. Scroll down the list to Custom Alert, select it, and press Next.

2. Type the alert name into the text box and press Done. The alert name is what appears on the Home screen when the alert is detected. You can edit or confirm the alert name after you enter it.

Installer setup screen

Home screen

3. Type the custom alert message into the text box and press Done. The custom alert message appears when the orange alert button is pressed. This can contain instructions, a phone number to call, etc. You can edit or confirm the alert message after you enter it.

Installer setup screen

User notification screen

VisionPRO Thermostat with EIM

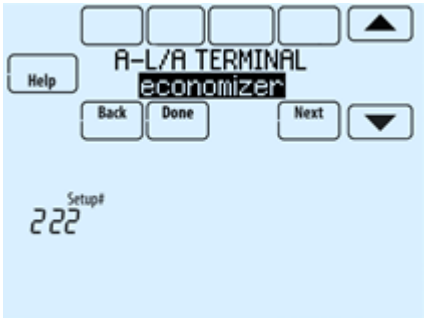
Another very good option is the VisionPro thermostat with EIM.

Fig. 6. VisionPRO thermostat with EIM.

Both options can accept economizer fault detection (FDD) inputs into the Equipment Interface Module (EIM) to meet code. See 69-2490 for Prestige EIM installation.

VisionPRO Setup for Economizer Output

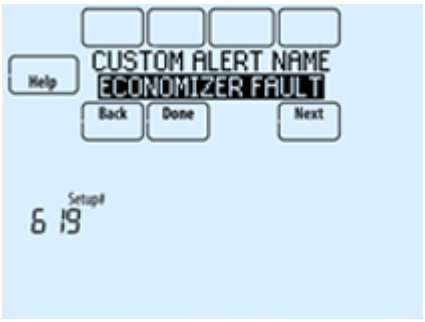
1. In the VisionPRO thermostat settings, set ISU 222 to Economizer.
2. Press Next or Done, depending on whether you are done with setup.



VisionPRO Setup for Fault Detection and Diagnostics

The VisionPRO thermostat allows you to create a custom fault name and instructions. This helps to meet CEC Title 24 2016 and IECC 2015 requirements for fault detection and diagnostics.

1. In the VisionPRO thermostat settings, use ISU 617 create a Custom Alert. Scroll down the list to Custom Alert, select it, and press Next.
2. Use ISU 618 to set the dry contacts to normally open and press Next.
3. In ISU 619 type the alert name into the text box and press Next. The alert name is what appears on the Home screen when the alert is detected. You can edit or confirm the alert name after you enter it.



4. Use ISU 620 to type the custom alert message into the text box and press Done.
   When the EIM S1-S1 contacts are closed by the AUX1-O output on Jade, the Alert Light on the lower right corner of the thermostat shines red. The user is instructed to press the screen for more information, which displays the custom alert message.
   The custom alert message can contain instructions, a phone number to call, etc. You can edit or confirm the alert message after you enter it.

Fig. 7. VisionPRO with alert light on.

Fault Detection and Diagnostic (FDD) Setup

In “Program the Economizer” on page 13, we set up AUX1-O for SYS in the W7220. This allows for fault detection and enables the AUX1-O output to close a thermostat input during a fault.

Program your Prestige or Vision Pro thermostat as described above so that any AUX1-O (fault) output to the Prestige Equipment Interface Module (EIM) is recognized as an Economizer Fault at the thermostat.

Background

Remember that many codes are now requiring fault detection and diagnostics (FDD). IECC 2015, adopted in many states, and CEC Title 24 2016 in California require fault detection. Check your local code for exact requirements and wording.

a. through an energy management system (EMS)
b. annunciated locally on (or near) a thermostat, or
c. reported to a fault management application that notifies a remote HVAC service provider (see your local code for specific wording).

According to these codes, the FDD system shall detect the following faults (taken directly from CEC Title 24 Section 120.1, [similar in wording to IECC 2015]):

a. Air temperature sensor failure/fault;
b. Not economizing when it should;
c. Economizing when it should not;
d. Damper not modulating; and
e. Excess outdoor air.

The Jade economizer detects the faults listed above, and will close the output on AUX1-O to send a signal to the Equipment Interface Module of the thermostat. See “Program the Thermostat” on page 19 to complete this requirement.

APPENDIX

Additional Parts List

Y-Packs, which have a 5-year warranty and include combinations of a Jade economizer, actuators, and sensors, are also available.

Part Number	Description	Notes
Y7220A7215	Logic Module W7220A1000 OAT sensor C7250A1001 MAT Sensor C7250A1001 Black Motor M7215A1008	Dry Bulb with black motor – can be used to replace a W7459 and M7415 black motor.
YL7220A7503	Logic Module W7220A1000 OAT sensor C7250A1001 MAT Sensor C7250A1001 DCA OA MS7503A2030	Dry Bulb w/non-communicating DCA
YL7220AJ3103	Logic Module W7220A1000 OAT sensor C7250A1001 MAT Sensor C7250A1001 DCA OA MS3103J1030	Dry Bulb w/communicating 27 lb-in DCA
YL7220AJ3105	Logic Module W7220A1000 OAT sensor C7250A1001 MAT Sensor C7250A1001 DCA OA MS3105J3030	Dry Bulb w/communicating 44 lb-in DCA
YL7220ACW3103	Logic Module W7220A1000 OAT sensor C7250A1001 MAT Sensor C7250A1001 DCA OA MS3103J1030 CO2 sensor C7632A1004	Dry Bulb w/communicating 27 lb-in DCA and CO2 wall sensor without a display
Y7220S7215	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 Black Motor M7215A1008	Enthalpy with black motor
Y7220SCW7215	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 Black Motor M7215A1008 CO2 Sensor C7232A1016	Enthalpy with black motor and CO2 wall sensor with a display
Y7220SCD7215	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 Black Motor M7215A1008 CO2 Sensor C7232B1014	Enthalpy with black motor and CO2 duct sensor with a display
YL7220S7503	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 DCA OA MS7503A2030	Enthalpy w/non-communicating DCA

Part Number	Description	Notes
YL7220SJ3103	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 DCA OA MS3103J1030	Enthalpy w/communicating 27 lb-in DCA
YL7220SJ3105	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 DCA OA MS3105J3030	Enthalpy w/communicating 44 lb-in DCA
YL7220SCW3103	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 DCA OA MS3103J1030 CO2 Sensor C7232A1016	Enthalpy w/communicating 27 lb-in DCA and CO2 wall sensor with a display
YL7220SCD3103	Logic Module W7220A1000 OAE sensor C7400S1000 MAT Sensor C7250A1001 DCA OA MS3103J1030 CO2 Sensor C7232B1014	Enthalpy w/communicating 27 lb-in DCA and CO2 duct sensor with a display

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