Digi-RTU Control Logic

Technologies

1. Demand controlled ventilation (DCV).
2. Variable fan speed and airflow.
3. Variable compressor speed.
4. Optimal compressor sequence and on/off control.
5. Enhanced economizer operation.
6. Optimal operation schedule and room temperature set point reset.

Benefits

1. Ensures satisfactory indoor air quality (ASHRAE Standard 62.1 and or CA Title 24)
2. Decrease fan power by 50% to 90%
3. Decrease compressor energy by 25% to 40%
4. Decrease peak demand by 30% to 50%
5. Decrease heating energy consumption by 10% to 50%
6. Reduce compressor cycling by 80%.
7. Typical energy cost savings: $0.45 to $1.00/ft2/yr

Control Logic

DCV Control: The Digi-RTU measures the return air CO2 concentration and modulates the outside air damper and fan speed to maintain the set point of the return air CO2 concentration. During both cooling and heating modes, the outside air damper is modulated to satisfy the set point. During ventilation mode, the outside air damper is modulated first. The fan speed will be modulated once the outside air damper is fully open. During the economizer cycle, DCV is disabled provided the CO2 concentration is lower than the set point.

Ventilation Control: When there is no cooling or heating call, the fan speed is set at the minimum speed of 20 Hz (adjustable). If the return air CO2 level is higher than the required level, the outside air damper will open more. When the outside air damper is fully opened and CO2 concentration is higher than the set point, the fan speed will be modulated to maintain the return air CO2 set point.

Economizer Control: During the economizer cycle, the Digi-RTU manages the room temperature at or below the room set point by modulating the fan speed between 20 Hz and 48 Hz (adjustable). The outside air damper is modulated to maintain supply air temperature between 55°F to 65°F.

Combined Economizer and Mechanical Cooling Control: The fan and compressor(s) speeds are controlled at 48 Hz (adjustable) when compressor is ON while the outside air enthalpy or outside air temperature is lower than the high limit of the economizer. The outside air damper is modulated to maintain supply air temperature between 55° to 60° F.

Cooling Control: Cooling calls are initiated by the existing T-Stat or BAS system. The Digi-RTU will turn ON all compressor(s) and modulate both the indoor fan and compressor(s) speeds to maintain the room temperature at set point. The speed varies from as low as 30 Hz (adjustable) to 60 Hz (adjustable).

Heating Control: Heating calls are initiated by the existing T-stat or the BAS system. The Digi-RTU responds by modulating the fan speed to maintain the supply air temperature at 105°F. The minimum fan speed limit is 35 Hz.

T-Stat Integration: The Digi-RTU is compatible with any existing T-stat that is currently in the space.

BAS Integration: The Digi-RTU is compatible with any existing BAS system. It provides native Modbus and BACNet communication protocol. There is an available Gateway for other communication protocols.

Demand Control: The Digi-RTU reduces and controls demand using the following methods:

1. The Digi-RTU is designed to resolve inherent RTU excess capacity, traditionally between 20 to 40%. The Digi-RTU reduces 15-minute peak demand by modulating both the fan and compressor speed.
2. The Digi-RTU improves the roof top unit's efficiency between 20 to 40% during peak hot weather conditions. It reduces peak cooling period energy consumption or demand even the units are not oversized.
3. The Digi-RTU is capable of establishing a high limit of 45 Hz (adjustable between 45 hz to 60 hz), of the compressor(s) speed to limit the peak demand based on the oversizing of RTU.

Demand Response:
Digi-RTU has the following options to integrate with demand response requirements:

1. Responds to a reset of the room temperature set-point based on a DR system request
2. Turns ON and OFF the RTU unit at the request of a DR system request
3. Modulates both compressor(s) and fan speed to ensure the unit's power is under the required value from the DR system. If the unit power is higher than the required value, both the fan and compressor(s) speeds will be reduced. The DR system can limit the unit power level to as low as 40% of the rated capacity.

Fault Detection: Digi-RTU receives the following information: fan power, compressor power, fan current, compressor current, fan speed, compressor speed, compressor status, fan airflow, heater status, supply air temperature, return air temperature, discharge air temperature, return air CO2 concentration, damper position command, heating and cooling call, and room temperature set points. With this information the Digi-RTU is capable of detecting and reporting the following faults:

1. Air-temperature sensor failure;
2. Economizer malfunction;
3. Excessive outside air;
4. Ductwork blockage and low airflow;
5. Under/over refrigerant charge;
6. Phase drop out and or contactor failure, and
7. Compressor failure, condenser fan failure, and indoor fan failure.

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