

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

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

Control Logic

DCV Control: 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, 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 full open. During 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, outside air damper will open more. When the outside air damper is full open and CO₂ concentration is still higher than the set point, fan speed is modulated to maintain the return air CO₂ set point.

Heating Control: Heating call is initiated by T-stat or the BAS system. Digi-RTU modulates the fan speed to maintain the supply air temperature at 105°F. The minimum fan speed is limited at 35 Hz.

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

Combined Economizer and Mechanical Cooling Control: The fan and compressor speed is controlled at 48 Hz (adjustable) when compressor is on while the outside air enthalpy or temperature is lower than the high limit of the economizer. The outside air damper is full open.

Cooling Control: Cooling call is initiated by the T-Stat or BAS system. Digi-RTU will turn on all compressors and modulate both the indoor fan and compressors speed to maintain the room temperature set point. The speed varies from as low as 30 to 60 Hz (adjustable).

Demand Control: Digi-RTU reduces and controls demand by following methods:

1. Digi-RTU takes advantages of excessive RTU capacities. RTU is often oversized by 20 to 40%. Digi-RTU reduces 15 minute peak demand by modulating both the fan and compressor speed.
2. Digi-RTU improves the roof top unit efficiency by 20 to 40% during peak hot weather conditions. It reduces peak cooling period energy consumption or demand, even when units are not oversized.
3. Digi-RTU sets up the high limit to between 45 to 60 Hz (adjustable) to limit the peak demand based on the oversizing of RTU.

Demand Response:

Digi-RTU has the following option to integrate with demand response requirement:

1. Reset the room temperature based on the demand response system's request.
2. Turn on and off the RTU units at the request.
3. Modulate both compressor and fan speed to ensure the unit power under the required value from the DR system. If the unit power is higher than the required value, both the fan and compressor speed will be reduced. DR system can limit the unit power level as low as 40% of the rated capacity.

T-Stat Integration: Digi-RTU works with any existing T-stat.

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

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 the information, Digi-RTU detects and reports 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.