

Packaged DX Rooftop Unit Sequence of Operation (RTU)

The Building Management System (BMS) will send the controller a user definable run schedule. If the BMS is not present, or communication is lost, the controller will operate using last known sequence.

Run Conditions - Schedule:
The unit shall run according to a user definable time schedule in the following modes:

Occupied Mode:
Supply fan will run continuously at constant speed and the outside air damper will open to maintain minimum ventilation requirements. Controller shall modulate economizer, and/or stage/cycle DX cooling, or stage/modulate gas heat to maintain the occupied space temperature setpoint. Dehumidification sequence shall be per dehumidification mode below.

The unit shall maintain the following space temperature setpoints: A 74°F (adj.) cooling setpoint and a 70°F (adj.) heating setpoint.

Unoccupied Mode:
The supply fan shall be disabled; the outside air damper shall close, and return air damper remains open. When the space temperature drifts out of the NSB setpoint range, the rooftop unit shall be enabled and cycles to satisfy setpoint. The outside air damper shall remain closed. The unit cycles supply fan, compressors and hot gas reheat to maintain unoccupied humidity setpoints (if HGR is available).

The unit shall maintain the following NSB space temperature setpoints: A 78°F (adj.) cooling setpoint and a 65°F (adj.) heating setpoint.

Optimal Start:
The BAS will monitor the scheduled occupied time, occupied space setpoints and space temperature to calculate when the optimal start occurs.

Staggered start:
This application shall prevent all controlled equipment from simultaneously restarting after a power outage or fire alarm restart. The order in which equipment (or groups of equipment) is started and the time delay between starts shall be user-selectable.

Morning Warm-Up Mode:
During optimal start, if the space temperature is below the occupied heating setpoint a morning warm-up mode will be activated, enabling the heating and supply fan. The outside air damper will remain closed. When the space temperature reaches setpoint of 70°F (adj.), the unit will transition to the occupied mode. Dehumidification is suspended during this mode.

Morning Cool-Down Mode:
During optimal start, if the space temperature is above the occupied cooling setpoint, morning cool-down mode will be activated, enabling the fan and cooling or economizer. The outside air damper will remain closed, unless economizing. When the space temperature reaches occupied cooling setpoint of 74°F (adj.), the unit will transition to the occupied mode.

Zone Setpoint Adjust:
Setpoints to be adjusted at BMS interface.

Zone Unoccupied Override:
A timed local override control shall allow an occupant to override the schedule and place the unit into an occupied mode for 2 hours (adj.). At the expiration of this time, control of the unit shall automatically return to the schedule.

Minimum Outside Air Ventilation - Carbon Dioxide (CO2) Control:
When in the occupied mode, the controller shall measure the return air CO2 levels and open the outside air damper from min. to max. position on rise of CO2 concentration above setpoint of 900 ppm (adj.). Outside air damper is at min. position when zone CO2 is below CO2 setpoint of 700 ppm (adj.).

Carbon Dioxide (CO2) Concentration Monitoring:
Alarms shall be provided as follows:
- High Zone Air Carbon Dioxide Concentration: If the return air CO2 concentration is greater than 1500 ppm (adj.) for 30 minutes when in occupied mode.

Dehumidification mode:
Factory installed hot gas reheat will allow application of dehumidification. During occupied mode, dehumidification is enabled when the space relative humidity is greater or equal to 60% R.H. (adj.) and is disabled at 54% R.H. (adj.). On a call for dehumidification, the reheat valve and compressor will be enabled. When the humidity control setpoint is satisfied, the reheat valve and compressor will be disabled. If there is a call for cooling from the space temperature controller, while in dehumidification, the reheat valve will be disabled and the compressor continues to run.

During unoccupied mode, dehumidification operates when the space wet bulb temperature is greater than set point of 62°F WB (adj.). When operating in dehumidification mode the unit shall go to 100% cooling and enable the hot gas reheat in order to maintain space temperature set point. The unit shall stay in dehumidification mode until the wet bulb temperature of the space is less than 60°F WB (adj.).

If the relative humidity rises above the space set point upper limit while in economizer, dehumidification takes precedence, and unit shall come out of economizer and go into dehumidification.

Economizer Control (Comparative Enthalpy):
Economizer shall be enabled using comparative enthalpy. Outside air (OA) enthalpy is compared with Return air (RA) enthalpy point. The economizer will be enabled when OA enthalpy is less than RA - 3.0 BTU/LB. The economizer will be disabled when OA enthalpy is greater than RA enthalpy for 15 minutes (adj.).

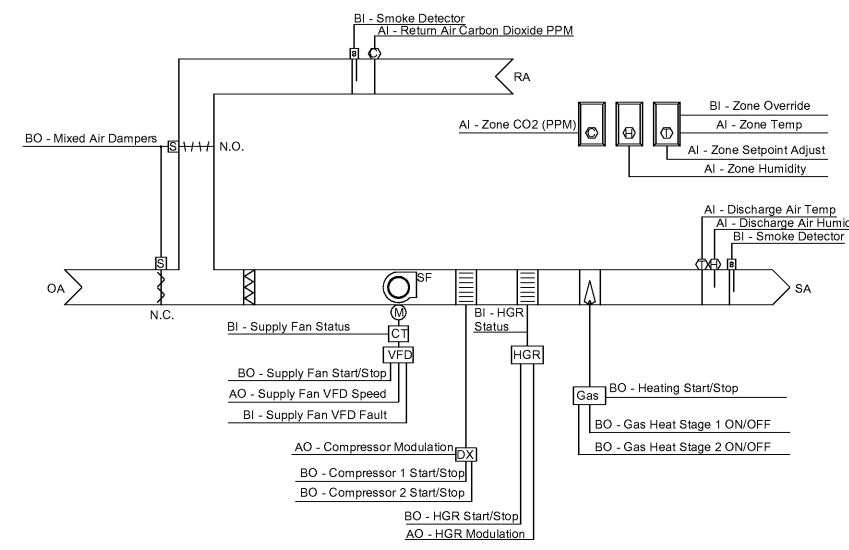
The controller shall modulate the O.A. and R.A. dampers to maintain proper supply air temperature to maintain space setpoint. If there is a need for additional cooling after outside air damper has been opened to 100% for 5 minutes the economizer cycle will be abandoned and mechanical cooling enabled to maintain set point.

Supply Fan Operation:
The supply fan shall run anytime the unit is commanded to run, unless shutdown on safeties. The supply fan shall be enabled while in the occupied mode and cycled on during the unoccupied mode. A current switch shall monitor fan operation.

Supply/Exhaust fan Alarms:
Alarms shall be provided as follows:
- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.

System Shutdown:
On a signal from the BMS or from the fire alarm system the RTU shall be shutdown with the supply fan de-energized and the O.A. damper shall be closed. Upon fire alarm reset, unit shall return to operating mode.

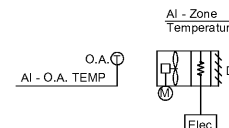
Filter status:
A differential pressure switch will monitor the differential pressure across the filter when the fan is running. If the switch closes for 2 minutes after a request for fan operation a dirty filter alarm will be annunciated at the BMS. Set the differential pressure switch to close at a differential pressure of 0.9" WC (adj.).



RTU 1-12

POINT NAME	HARDWARE POINTS					SOFTWARE POINTS						
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	SHOW ON GRAPHIC	
ZONE TEMPERATURE	X								X		X	
ZONE HUMIDITY	X								X		X	
RETURN AIR CO2 PPM LEVEL	X								X		X	
ZONE HUMIDITY SETPOINT					X				X		X	
ZONE TEMP. SETPOINT					X				X		X	
RETURN AIR CO2 PPM SETPOINT					X				X		X	
ZONE SETPOINT ADJUST	X								X		X	
ZONE OVERRIDE			X						X		X	
DISCHARGE AIR TEMP	X								X		X	
FAN STATUS			X						X		X	
FAN START/STOP			X						X		X	
COMPRESSOR 1 START/STOP			X						X		X	
COMPRESSOR 2 START/STOP			X						X		X	
COMPRESSOR 1 STATUS			X						X		X	
COMPRESSOR 2 STATUS			X						X		X	
COMPRESSOR MODULATION		X							X		X	
GAS HEATING STAGE 1 ON/OFF				X					X		X	
GAS HEATING STAGE 2 ON/OFF				X					X		X	
HOT GAS REHEAT ENABLE				X					X		X	
HOT GAS REHEAT MODULATION		X							X		X	
HOT GAS REHEAT STATUS			X						X		X	
OUTSIDE AIR HUMIDITY	X								X		X	
OUTSIDE AIR TEMPERATURE	X								X		X	
ECONOMIZER STATUS			X						X		X	
MIXED AIR DAMPER ENABLE/DISABLE			X						X		X	
MIXED AIR DAMPER POSITION			X						X		X	
SUPPLY AIR SMOKE DETECTOR								X	X		X	
RETURN AIR SMOKE DETECTOR								X	X		X	
FILTER DIFFERENTIAL PRESSURE		X							X		X	
HIGH RETURN AIR CO2 PPM CONCENTRATION									X		X	
UNIT ALARM									X		X	
SUPPLY FAN FAILURE									X		X	
SUPPLY FAN IN HAND									X		X	
SCHEDULE							X					

1 CONTROLS - RTU 1-12 NTS



POINT NAME	HARDWARE POINTS					SOFTWARE POINTS						
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	SHOW ON GRAPHIC	
O.A. TEMPERATURE	X								X		X	
ZONE TEMPERATURE	X								X		X	
TOTALS	2	0	0	0	0	0	0	0	2	0	2	

Run Condition - Cycle:
The BMS shall enable the heater when the outside air temperature is less than 65°F (adj.). The unit shall run continuously and shall maintain a heating setpoint of 72°F (adj.).

2 CONTROLS - EUH NTS

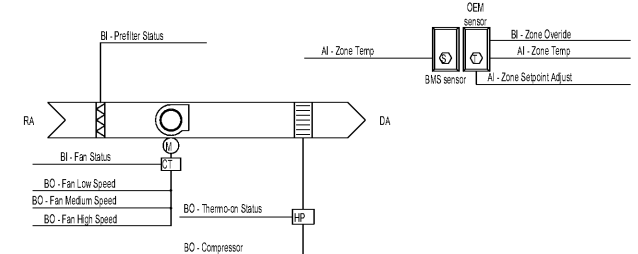
Emergency Shutdown Button:
The manually operated emergency stop button will stop the operation of system fan(s) in an emergency on each recirculating air system. Upon status restoration after emergency shutdown restoration, systems shall automatically restart and return to their normal mode of operation. Adjustable delay controls shall be provided to sequentially stage starting of equipment to prevent electrical surges and spikes on start-up.

Smoke Detectors:
Contractor shall install a smoke detector approved for duct installation located in the main supply duct for each recirculating air system having 2000 CFM capacity or more to automatically stop the fan, per NFPA 90A. Smoke detectors furnished by Division 26 contractor.

Fire Alarm Interlock:
Contractor shall provide a relay interlock with the building fire alarm system, such that all recirculating air conditioning units stop on alarm. Extend control circuits to the fire alarm panel. Provide interlock for all rooftop units, fan coil units, water source heat pump units and rooftop heat recovery units.

3 CONTROLS - FIRE ALARM INTERLOCK, EQUIPMENT INTERLOCK AND EMERGENCY STOP NTS

POINT NAME	HARDWARE POINTS					SOFTWARE POINTS						
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	SHOW ON GRAPHIC	
ZONE TEMPERATURE	X								X		X	



4 CONTROLS - MAHU (DATA ROOM) NTS

5 CONTROLS - ERU 1-3 (CONSTANT VOLUME) NTS

6 CONTROLS - EF (PRESSURE SWITCH) NTS

7 CONTROLS - EF (THERMOSTAT) NTS

8 CONTROLS - EF (INTERLOCK W/ LIGHTS) NTS

Dedicated Outside Air Unit w/ Energy Recovery Sequence of Operation

The Building Management System (BMS) will send the controller a user definable run schedule. If the BMS is not present, or communication is lost, the controller will operate using last known sequence.

Run Conditions - Schedule:
The unit shall run according to a user definable time schedule in the following modes:

Occupied Mode:
The supply fan will run continuously at constant speed after the damper has fully open. The exhaust fan will run continuously at constant speed with E.A. damper open. The energy recovery wheel will be controlled. Controller will modulate/stage DX cooling, enable hot gas reheat, and/or gas heat to maintain discharge neutral air to space at 70°F (adj.) and 55% (adj.) RH. OAT is greater than 60°F or 74°F (adj.) when OAT is less than 60°F. The compressor/gas heat shall operate subject to safety interlocks and controls.

Unoccupied Mode:
The unit is disabled, supply/exhaust fans off, and the outside air/exhaust air dampers shall close. Unit can be started to occupied mode from BMS for 2 hours) (adj.)

Staggered start:
This application shall prevent all controlled equipment from simultaneously restarting after a power outage or fire alarm restart. The order in which equipment (or groups of equipment) is started and the time delay between starts shall be user-selectable.

Morning Warm-Up Mode:
During optimal start, if the space temperature is below the occupied heating setpoint a morning warm-up mode will be activated, enabling the heating and supply fan. The outside air damper will remain closed. When the space temperature reaches setpoint of 70°F (adj.), the unit will transition to the occupied mode. Dehumidification is suspended during this mode.

Morning Cool-Down Mode:
During optimal start, if the space temperature is above the occupied cooling setpoint, morning cool-down mode will be activated, enabling the fan and cooling or economizer. The outside air damper will remain closed, unless economizing. When the space temperature reaches occupied cooling setpoint of 74°F (adj.), the unit will transition to the occupied mode.

Supply Fan Operation:
The supply fan shall be enabled during occupied mode and disabled during unoccupied mode. The controller monitors fan operation.

Exhaust Fan Status:
The exhaust fan shall be enabled during occupied mode and disabled during the unoccupied mode. The controller monitors fan operation.

Building Pressurization:
Supply fan CFM is balanced per contract documents. Exhaust fan CFM is balanced per contract documents.

System Shutdown:
On a signal from the BMS or from the fire alarm system the unit shall be shutdown with the supply and exhaust fans de-energized; and the O.A. and E.A. damper shall be closed. Upon fire alarm reset, unit shall return to operating mode.

Smoke Control:
Duct mounted smoke detectors located in the supply and return air ductwork shall shutdown the unit with the supply and return fans de-energized and closing the O.A. and E.A. damper upon sensing smoke. A signal from the duct smoke detector shall activate the fire alarm system.

Condensate Overflow Switch Status:
Unit shuts down and BMS alarms upon activation of condensate overflow switch.

Filter status:
A differential pressure switch will monitor the differential pressure across the filter when the fan is running. If the switch closes for 2 minutes after a request for fan operation a dirty filter alarm will be annunciated at the BMS. Set the differential pressure switch to close at a differential pressure of 0.9" WC (adj.).

Supply Fan Alarms:
Alarms shall be provided as follows:
- Failure: Commanded on, but the status is off.
- Running in Hand: Commanded off, but the status is on.

Constant Volume ERU 1-3

POINT NAME	HARDWARE POINTS					SOFTWARE POINTS						
	AI	AO	BI	BO	AV	BV	LOOP	SCHED	TREND	ALARM	SHOW ON GRAPHIC	
DISCHARGE AIR TEMP	X								X		X	
DISCHARGE AIR HUMIDITY	X								X		X	
DISCHARGE HUMIDITY SETPOINT					X				X		X	
DISCHARGE TEMP. SETPOINT					X				X		X	
SUPPLY AIR SMOKE DETECTOR			X						X	X	X	
SUPPLY FAN START/STOP		X							X		X	
SUPPLY FAN STATUS		X	X						X		X	
SUPPLY FAN SPEED									X		X	
EXHAUST FAN START/STOP		X							X		X	
EXHAUST FAN STATUS		X							X		X	
EXHAUST FAN SPEED									X		X	
ENTHALPY WHEEL START/STOP				X					X		X	
ENTHALPY WHEEL STATUS				X					X		X	
COMPRESSOR 1 START/STOP				X					X		X	
COMPRESSOR 1 STATUS		X							X		X	
COMPRESSOR MODULATION		X							X		X	
GAS HEAT START/STOP			X						X		X	
GAS HEAT MODULATION		X							X		X	
HOT GAS REHEAT STATUS		X							X		X	
HOT GAS REHEAT MODULATION		X							X		X	
O.A. DAMPER ENABLE/DISABLE			X						X		X	
O.A. DAMPER STATUS		X							X		X	
RECIR. DAMPER ENABLE/DISABLE			X						X		X	
RECIR. DAMPER STATUS		X							X		X	
WHEEL BYPASS DAMPER STATUS		X							X		X	
WHEEL DIFFERENTIAL PRESSURE		X							X	X	X	
FILTER DIFFERENTIAL PRESSURE		X							X	X	X	
SUPPLY AIR SMOKE DETECTOR			X						X	X	X	
RETURN AIR SMOKE DETECTOR			X						X	X	X	
SUPPLY AIR PRESSURE		X	X						X		X	
CONDENSATE OVER FLOW SWITCH STATUS		X							X		X	
UNIT ALARM			X						X		X	
SCHEDULE							X					

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MECHANICAL EQUIPMENT CONTROLS

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