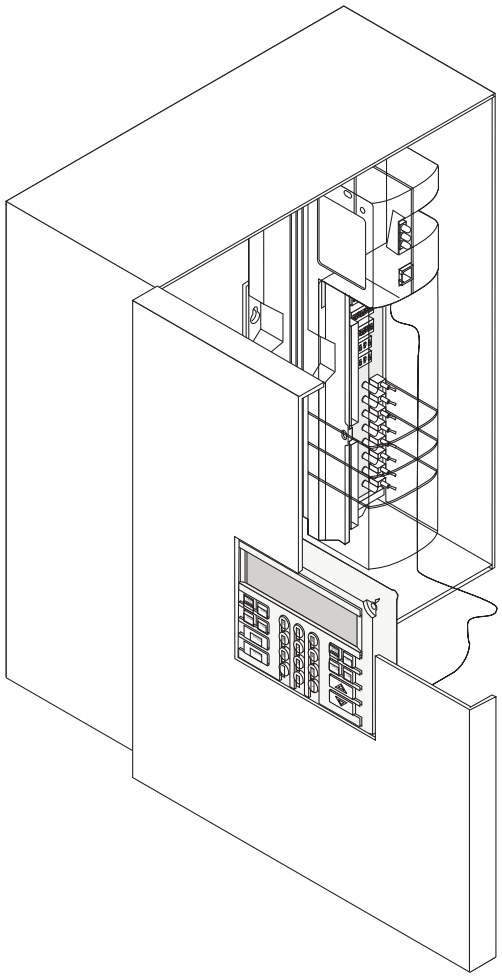
Carrier®

Product Data

50RLP
Water Source Heat Pumps
System Control Panel

AQUAZONE™



Single packaged system control panel for use with Aquazone™ water source heat pumps in stand-alone or direct digital control applications using the Carrier Comfort Network (CCN).

- Includes pre-programmed 6400 main logic controller
- Compatible for use in boiler/tower or geothermal WSHP arrangements
- Controls up to two water-circulating pumps
- Monitors water temperature and initiates up to eight stages of cooling tower and/or boiler operation
- Capability to work with variable speed pumping arrangements for maximum energy efficiency
- Provides system control for both stand-alone and DDC WSHP systems
- Controls up to 18 zones of WSHP units in stand-alone operation
- Works with factory-installed PremierLink™ controllers on WSHP units in a DDC type system

Features/Benefits

Carrier's Aquazone System Control Panel provides the ultimate solution for coordinating, monitoring, and managing boiler/tower or geothermal water source heat pump (WSHP) systems.

Flexible controls for all WSHP system applications

Whether your water source heat pump system design involves a boiler tower, geothermal or variable speed pumping arrangement, Carrier's Aquazone System Control Panel has the capability to adapt.

The diverse functionality of this multi-purpose loop control panel design makes it one the most user friendly and complete loop controllers available. This unique and sophisticated control panel was designed to work exclusively with Carrier Aquazone™ water source heat pump products including all variations and styles of horizontal, vertical, console, rooftop, and water-to-water products.

The functionality of the panel provides simple to complex operating strategies to maximize energy efficiency and manage coordination for the WSHP units, as well as, typical ancillary equipment such as multiple boilers, cooling towers, and pumps.

Choice of control strategies for Aquazone WSHP systems

The Aquazone System Control Panel accommodates both stand-alone and direct digital control (DDC) for Aquazone WSHP units.

Stand-alone WSHP unit operation (non-communicating)

All Aquazone water source heat pumps feature state-of-the-art microprocessor-based unit controllers. The standard Complete C unit controller package provides all the advantages of Carrier controls engineering including random start, refrigerant protection, voltage protection, automatic intelligent reset, accessory outputs, water temperature monitoring, water and air coil freeze protection, alarm relays, and LED visual output.

For more sophisticated features, a larger transformer, and multiple accessory options, the Deluxe D unit controller can be selected as an upgrade.

Both the Complete C or Deluxe D options are selected as part of the Aquazone product model nomenclature. Stand-alone unit control and operation can be accomplished with either controller in combination with a choice of thermostats specifically designed for the Aquazone family of products. When utilizing the Aquazone system control panel with this type of controls strategy, occupancy schedules for up to 18 zones of water source heat pump units can be controlled. In addition, system information from circulating pumps, cooling towers, and boilers are managed and coordinated to control heat rejection, addition, and water circulation.

Direct Digital Control (DDC) WSHP unit operation

For a more sophisticated control strategy, the Aquazone System Control Panel is utilized in conjunction with water source heat pump units with factory-installed PremierLink™ communicating controllers. In this fashion, water source heat pump information from the PremierLink controllers is sent over the Carrier Comfort Network (CCN) to a central computer terminal, enabling convenient monitoring, control, and diagnostic capabilities for the system.

Implementing a DDC system is as simple as specifying the PremierLink option in any Aquazone model nomenclature. PremierLink controllers provide the best type of temperature control available and the flexibility to control all modes of operation. PremierLink controllers transmit unit number, zone temperature, zone temperature set points, discharge air temperature, fan status, stages of heating, stages of cooling, leaving-water temperature, and alarm status information.

In combination with the System Control Panel's ability to control and monitor ancillary equipment, this approach may be the most user friendly, cost effective, and complete water source heat pump control system ever developed.

Manage and control the entire WSHP system

No matter what the application requirements are for loop water temperature flow and temperature control, the Aquazone System Controller provides the ultimate in flexibility to accommodate all systems. In addition to incorporating water source heat pump units, the System Control Panel also integrates several control schemes for monitoring and controlling the three most common ancillary equipment types, which include heat rejection equipment such as cooling towers, adding heat to the water loop with boilers or heat exchangers, and water circulation pumps.

Heat rejection and additional equipment

In a typical water source heat pump system, the common water loop, which is connected to all the individual WSHP units, is maintained between 60 F and 95 F for a boiler/tower type system (by the heat rejection and addition equipment). Within this temperature range, units can cool or heat as required from the same water source. In applications involving a ground loop, ground water, or other geothermal heat source or sink, the minimum loop temperature may be designed to extend below 60 F. The system control panel coordinates and controls all ancillary equipment to achieve the design objectives for the water loop.

Water circulation

The most typical system water flow application involves a continuous, constant, flow-type system, with water circulation via one or two pumps. The system control panel has the capability to control one or two pumps in start/stop or lead/lag operation.

However, in some applications, a variable pumping arrangement may be utilized to further conserve energy beyond the existing efficient operation of any water source heat pump system. This type of system is easy to implement with all Aquazone WSHP products and the System Control Panel. Systems of this type require the capability to handle variable flow, which is made easy with the factory installation of two-way water control valves on most Aquazone WSHP products. In addition, the System Control Panel includes the unique capability to operate circulation pumps for a variable speed operation. The Aquazone System Control Panel is the only WSHP loop controller that has this capability in the industry.

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Features/Benefits (cont)

Specific operational capabilities to control the WSHP units and ancillary equipment

WSHP zone operation — When a dedicated thermostat is utilized for each unit, occupancy schedules for coordinating either 10 or 18 zones may be selected. These schedules may be broadcast over the communications network to coordinate occupancy control of each zone with a Carrier 6400 controller or other CCN controllers. Schedules may also be used to drive discrete outputs on up to two accessory input/output modules. These outputs will control relays to coordinate occupancy of non-communicating (i.e., without PremierLink™ controller) water source heat pumps and thermostats. When any schedule is occupied, the System Controller will control the pumps to maintain water flow to the heat pumps and maintain the loop temperatures within the required temperature range for the system.

Networked systems — For network applications, the system control panel supports many network functions as part of a CCN-type of installation. These include (but are not limited to) machine operation, data reporting/modification, data collection, alarms and diagnostics, occupancy/timed override, and broadcast.

Cooling towers (heat rejection) — Five modes of operation may be utilized including: 2, 4, 6, or 8 stages of operation, or the capability to send out a 4 to 20 mA signal for variable speed operation of the cooling tower fans.

Boilers (heat addition) — Five modes of operation may be utilized including: 2, 4, 6, or 8 stages of operation, or control of a modulating hot water/steam valve for a hot water or steam to water heat exchanger via a 4 to 20 mA signal.

Circulating pumps — Multiple control options are available for circulation pumps including start/stop or lead/lag operation for single or dual pumps. Also included is the unique option to implement a variable speed flow operation with the capability to send a 4 to 20 mA signal to control variable speed motors.

Model number nomenclature

50 RLP 0 0 0 0

Unit Type
50 – Heat Pump

Series
RLP – Aquazone™ System Control Panel

System Heat Rejection
0 – 2-Stage Card (2 Stages of Cooling Tower Operation)
1 – 4-Stage Card (4 Stages of Cooling Tower Operation)
2 – 2 and 4-Stage Cards (6 Stages of Cooling Tower Operation)
3 – Two 4-Stage Cards (8 Stages of Cooling Tower Operation)
4 – No Card, Variable Speed Cooling Tower Operation

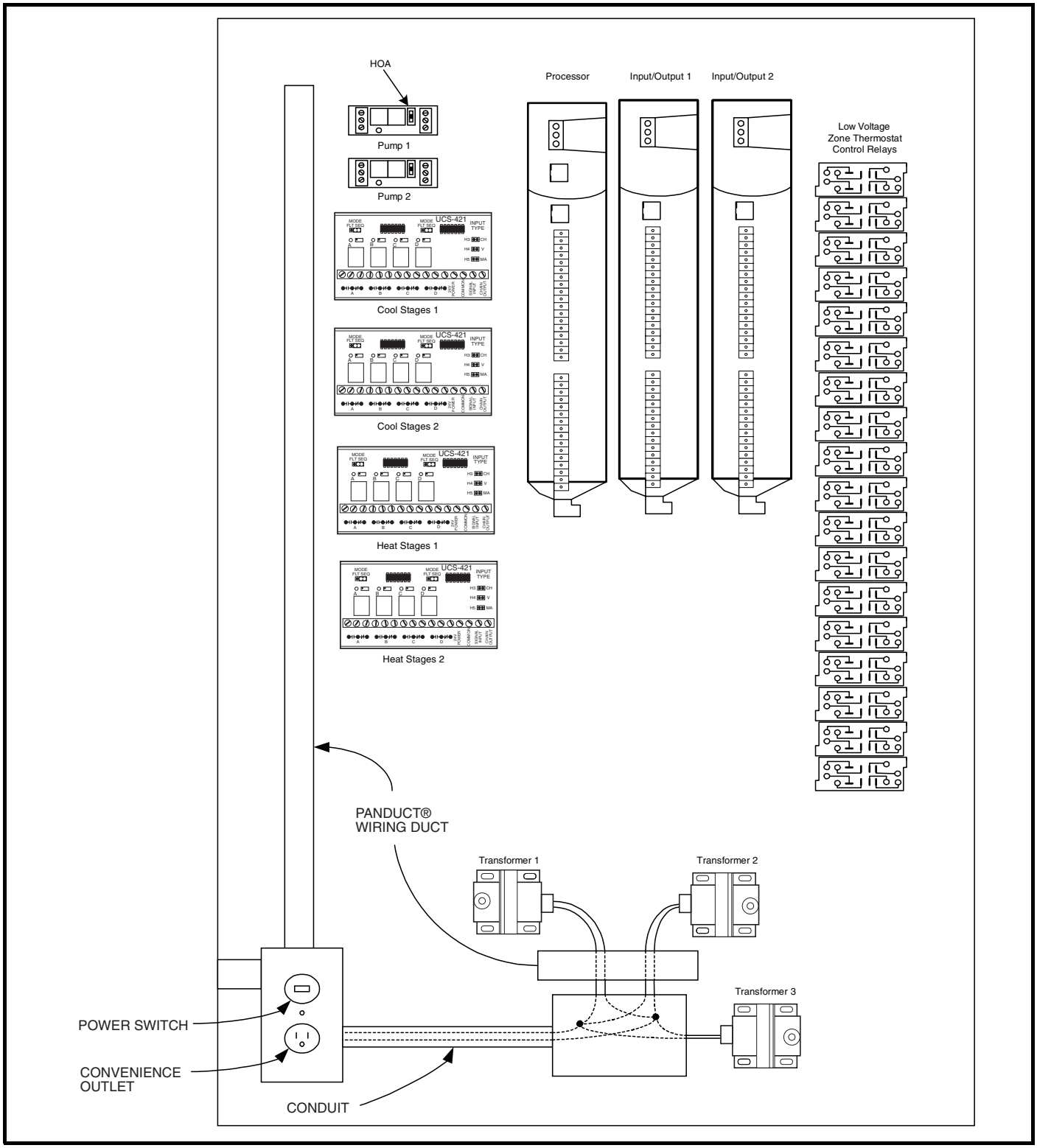
System Heat Addition
0 – 2-Stage Card (2 Stages of Boiler Operation)
1 – 4-Stage Card (4 Stages of Boiler Operation)
2 – 2 and 4-Stage Cards (6 Stages of Boiler Operation)
3 – Two 4-Stage Cards (8 Stages of Boiler Operation)
4 – No Card, Modulating Valve Operation for Steam or Hot Water

System Pumping Operation
0 – Both Relays, Start/Stop or Lead/Lag Operation for Single or Dual Pumps
1 – No Relays, Variable Frequency Pump Operation**

WSHP Zone Operation
0 – 10 Relays, Control 10 Zones for Stand-Alone WSHP Units*
1 – 18 Relays, Control 18 Zones for Stand-Alone WSHP Units*
2 – No Relays, Carrier Comfort Network (CCN) System†

*Option is utilized with Aquazone Thermostat for each WSHP unit.
†Option is utilized with PremierLink DDC control option on individual WSHP units.
**Accepts signals from a variable frequency device.

Dimensions


HOA
Pump 1
Pump 2
UCS-421
Cool Stages 1
Cool Stages 2
Heat Stages 1
Heat Stages 2
Processor
Input/Output 1
Input/Output 2
Low Voltage
Zone Thermostat
Control Relays
PANDUCT®
WIRING DUCT
Transformer 1
Transformer 2
Transformer 3
POWER SWITCH
CONVENIENCE
OUTLET
CONDUIT

Specifications

Description

The 50RLP Aquazone™ System Control Panel is designed to allow a service person or building owner to configure, operate, and efficiently manage a water source heat pump system. The panel consists of Carrier 6400 Comfort Controllers and can be used in both stand-alone and CCN applications. The panel includes room to add up to two input/output modules for extended timeclock control of a system thermostat controller for non-communicating WSHPs. The panel also allows for the installation of staged output transducers for each of the heat source and heat rejection source analog outputs.

Electrical characteristics

The control panel is powered from a nominal 24 vac power source.

Communications

Adjustable from 9600, 19,200, and 38,400 bps.

Dimensions

Height: 42 inches

Width: 30 inches

Depth: 7 inches

Service dimensions

Height: 54 inches

Width: 42 inches

Depth: 36 inches

Specified sensing temperature range

Water and air temperature sensor range: –40 to 245 F
System differential pressure range: 0 to 50 psi.

Panel input/output connections, types, and ratings

Processor module

Loop Water Flow: Digital Input (24 VDC)

System Supply Water Temperature: Analog Input (10K thermistor)

System Return Water Temperature: Analog Input (10K thermistor)

System Differential Pressure: Analog Input (4-20 mA)

Remote Occupied Mode: Digital Input (24 vdc)

System Shut Down: Digital Input (24 vdc)

Override Input for Zones 1 and 2: Digital Input (24 vdc)

Pump Number 1 and 2 Speeds: 4-20 mA

Cooling Tower 1 and 2 Speed/Level: 4-20 mA

Heat Source 1 and 2 Speed/Level: 4-20 mA

System Enable for Zone 1 and 2: Digital Output (24 vdc)

First optional I/O module

Override Input for Zone 3 to 10: Digital Input (24 vdc)

System Enable for Zone 3 to 10: Digital Input (24 vdc)

Second optional I/O module

Override Input for Zone 11 to 18: Digital Input (24 vdc)

System Enable for Zone 11 to 18: Digital Input (24 vdc)

Pump control

Occupancy Schedule 65 to 82: Internal Parameter

Override Input 1 to 18: Discrete Inputs

System Enable Outputs: Discrete Outputs

Remote Occupied Mode: Discrete Input

System Differential Pressure: Analog Input

System Differential Pressure Set Point: User Configuration

Loop Water Flow: Discrete Input

Control Type: User Configuration

Pump Number 1 and 2 Speeds: Analog Output

Shut Down Command: Communicated Output

Heat rejection control

System Supply Water Temperature: Analog Input

System Return Water Temperature: Analog Input

System Loop Temperature Set Points: User Configuration

Fluid Cooler/Tower Control Type: User Configuration

Loop Water Flow: Discrete Input

Cooling Tower 1 and 2 Speed/Level: Analog Output

Heat addition control

System Supply Water Temperature: Analog Input

System Return Water Temperature: Analog Input

System Loop Temperature Set Points: User Configuration

Boiler Control Type: User Configuration

Loop Water Flow: Discrete Input

Boiler 1 and 2 Speed/Level: Analog Output

Network supported functions

Machine Operation: Set point, configuration control, and forcing of input/output states from Service Tool, ComfortVIEW™, or ComfortWORKS® software.

Data Reporting/Modification: Reporting of operating data, including all status display screens to ComfortVIEW, Service Tool, or ComfortWORKS software.

Data Collection: Providing a set of software and/or hardware points for data collection and tracing.

Alarms and Diagnostics: Reporting of alarm/alerts and return-to-normal conditions to CCN.

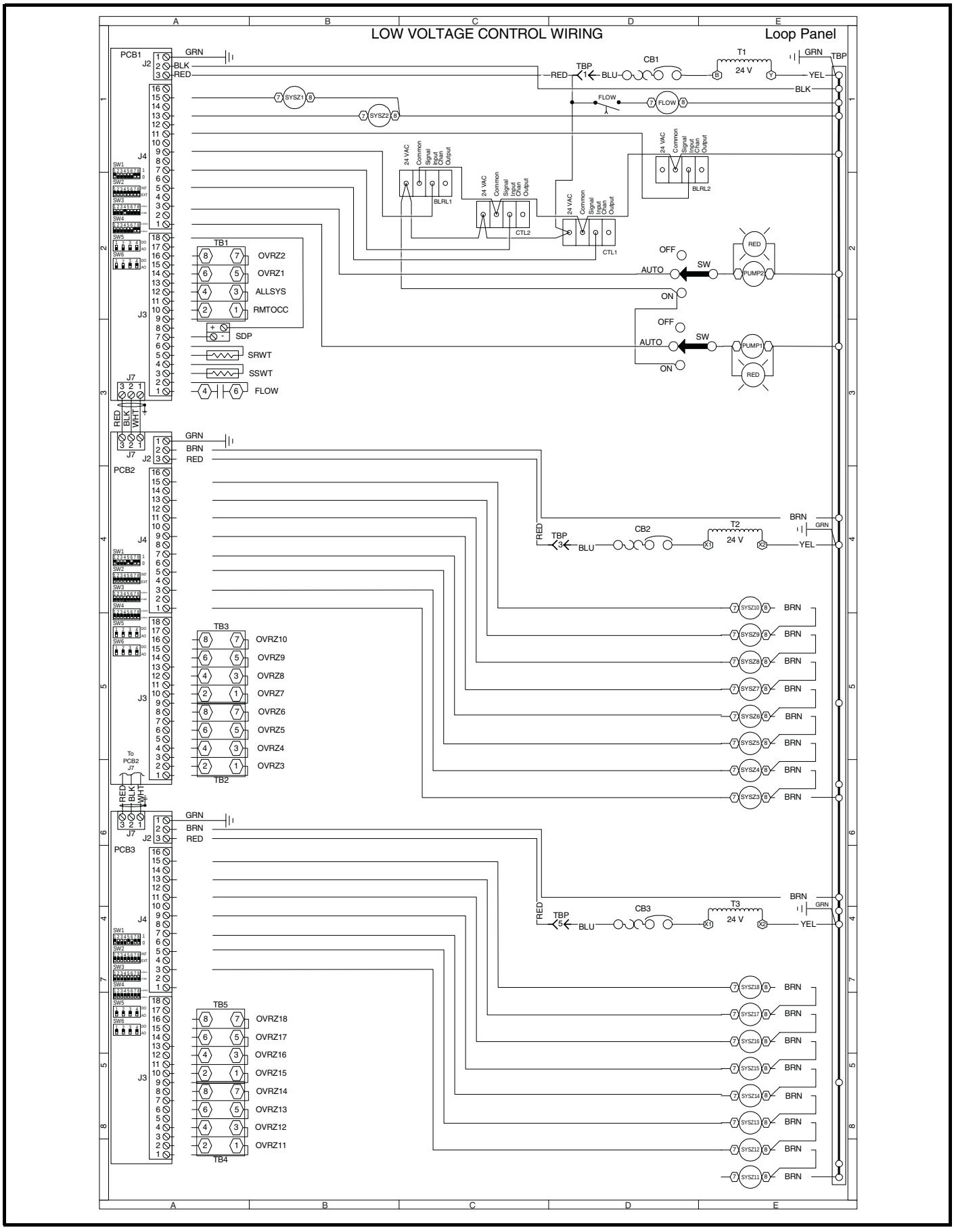
Occupancy/Timed Override: Time schedule/occupancy control with the capability to operate in several configurations.

Broadcast — Integrated with the controller software to receive time, day of week, and date messages from CCN.

Compliance and approvals

Listed under UL 873. CE Mark, CSA compliant

Typical wiring diagram



Guide specifications

HVAC Guide Specifications — Aquazone™ System Control Panel

Carrier Model Number:**50RLP**

Part 1 — General

1.01 DEVICE DESCRIPTION

A. The system control panel shall consist of a centrally located, pre-programmed microprocessor-based control panel with the capability to coordinate, manage, and operate a water source heat pump system.

B. The system control panel shall be CE Mark, CSA and UL 873 recognized.

Part 2 — Products

2.01 GENERAL DESCRIPTION

A. The system control panel shall be factory tested and assembled and have the capability to operate and manage both water source heat pump units and ancillary equipment including circulation pumps and heat rejection/addition equipment.

B. The system control panel shall provide loop control functions for systems with stand-alone (i.e., non-communicating) water source heat pumps, installed with normal thermostats.

C. The system control panel shall accommodate and work in a direct digital control (DDC) type of system operation with water source heat pumps having factory-mounted PremierLink™ controls or other CCN (Carrier Comfort Network) communicating controls.

D. The central main logic processing control module shall consist of a 6400 comfort controller, pre-programmed and packaged in a NEMA rated enclosure. The panel enclosure shall have a lockable access door to prevent unauthorized access.

E. The system control panel display shall be factory mounted on the front side of the enclosure. The display shall provide access to all operating and configuration parameters in the loop controller panel not limited to but including: loop water temperatures, control valve position, tower speed, number of stages active for heat addition or rejection, pump speed, pumps active, indication of water flow, and system differential pressure.

F. The system control panel shall have the capability to include one additional input/output module for extended timeclock control of up to 10 non-communicating water source heat pump zones. The input/output module shall control a set of relays to coordinate occupancy schedules for non-communicating water source heat pumps.

G. The system control panel shall have the capability to include a second input/output module for extended timeclock control of up to 18 non-communicating water source heat pump zones. The input/output module shall control a set of relays to coordinate occupancy schedules for non-communicating water source heat pumps.

H. The system control panel shall include a set of staged output transducers, relays, and sensors for 2, 4, 6, or 8 stages of heat rejection equipment operation.

I. The system control panel shall include a set of staged output transducers, relays, and sensors for 2, 4, 6, or 8 stages of heat addition equipment operation.

J. The system control panel shall include a set of transducers, relays, and sensors for the control of up to 2 circulation pumps in either start/stop or lead/lag operation.

K. The system control panel shall include basic 4 to 20 mA controller outputs to control a variable speed motor for heat rejection fans, to control a variable speed motor for water circulation pumps, and to modulate a hot water/steam valve.

2.02 OPERATION

A. Functional:

1. The system control panel shall coordinate the start and stop of the water loop circulating pumps and control the water temperature of the water delivered to the water source heat pump units.
2. The system control panel shall coordinate the shut down of the system in case of fire, loss of water flow, or excessively high or low water temperatures. The system heat rejection equipment will be controlled as needed to maintain the specified loop water temperature.

B. System:

1. The system control panel shall provide up to 10 or 18 designer specified occupancy schedules for coordinating up to 10 or 18 zones of water source heat pumps.
2. System control panel shall have the capability to broadcast schedules over the communications network to coordinate occupancy control of each zone.
3. System control panel shall have the capability to drive discrete outputs for schedules on up to two accessory input/output modules.
4. Input/output modules shall have the capability to control relays to coordinate occupancy of non-communicating water source heat pump units and thermostats.
5. The system control panel shall control water pumps to maintain water flow to the heat pumps and maintain the loop temperatures within the required temperatures for the water source heat pumps to operate when any schedule is occupied.

2.03 NETWORK CAPABILITIES

A. Supported Functions:

1. Machine operation shall include set point and configuration control from Service Tool, ComfortVIEW™, or ComfortWORKS® software. Forcing of input or output states shall be from Service Tool, ComfortVIEW, or ComfortWORKS software.
2. Data reporting and modification shall include reporting of operating data, including all status display screens, to ComfortVIEW, Service Tool, or ComfortWORKS software.
3. Data collection shall include providing a set of software and/or hardware points for data collection and tracing.
4. Alarms and diagnostics shall include reporting of alarm/alerts and return to normal conditions on CCN.

B. Network Support Functions:

Network support functions shall be supported when implementing the system control panel as part of a CCN system.

1. The occupancy/timed override POC (product on board command) function shall have the capability of existing on the controller on a stand-alone basis.
2. The system control panel shall have a hardware clock capable of performing time broadcast functions for synchronizing equipment clocks throughout the system.
3. Occupancy/timed override shall include the time schedule/occupancy control and shall operate in one of the following modes:
   a. Remote Occupancy
   b. Local Schedule
   c. Global Schedule
   d. Receive global schedule from another occupancy POC elsewhere on CCN.

Part 3 — Execution

3.01 SEQUENCE OF OPERATION

A. Heat Rejection:

1. When the system pumps are operating and there is flow to the system, heat rejection control shall compare the system supply water temperature to the high set point in the system loop temperature set points.
2. If the system supply water temperature approaches the high set point, the controller shall command the heat rejection outputs to hold the system supply water temperature as close as possible to the high set point.
3. If the system return water temperature drops below the system high water temperature set point minus a hysteresis value the heat rejection, outputs shall be disabled.
4. When the cooling tower output control type is set to "variable," the heat rejection outputs shall be calculated using a PID calculation based on the system high temperature water set point. Both outputs shall modulate together.
5. When the heat rejection control type is set to "staged," the outputs will be modulated in a lead/lag configuration. The modulating signal of the lead output will control a transducer of two or four stages.
6. When the lead output is at 100% and the set point is not being maintained, the lag output will be modulated to produce staging from another two or four stage output transducer.
7. The value output by each analog output shall be determined by a PID calculation of leaving water temperature versus the system high leaving water temperature set point.
8. In the event that the system high water temperature set point cannot be maintained and is exceeded by a defined Hysteresis, the heat rejection outputs shall go to maximum output, the system water source heat pumps will stop cooling, and the system pumps shall circulate water until the system temperatures are returned to the normal range. System cooling will then be allowed to continue.

B. Heat Addition:

1. When the system pumps are operating and there is flow to the system, boiler control shall compare the system supply water temperature to the low set point in the system loop temperature set points.
2. If the system supply water temperature approaches the low set point, then the controller shall command the boiler outputs to hold the system supply water temperature as close as possible to the low set point.
3. If the system return water temperature rises above the system low water temperature set point plus a Hysteresis value, the boiler outputs will be disabled.
4. When the boiler output control type is "variable," the boiler outputs will be calculated using a PID calculation based on the system low temperature water set point. Both outputs shall modulate together.
5. When the boiler control type is set to "staged," the outputs shall be modulated in a lead lag configuration. The modulating signal of the lead output shall control a transducer of two or four stages.
6. When the lead output is at 100% and the set point is not being maintained, the lag output shall be modulated to produce staging from another two or four stage output transducer.

7. The value output by each analog output shall be determined by a PID calculation of leaving water temperature versus the system low leaving water temperature set point.
8. In the event that the system low water temperature set point cannot be maintained and is exceeded by a defined Hysteresis, the boiler outputs will go to maximum output, the system water source heat pumps will stop heating, and the system pumps will circulate water until the system temperatures are returned to the normal range. System heating shall then be allowed to continue.

C. Water Circulation:

1. When operational mode is determined by one of the 18 occupancy schedules or occupancy overrides, then the system pumps shall be put in operational mode.
2. If one of the system enable outputs is turned on, then the system pumps shall be put in operational mode.
3. If the remote occupancy input is detected, then the pumps shall be put in operational mode and all 18 schedules overridden to on. This shall energize all 18 system enable outputs.
4. The pump control type shall be configured as either variable flow or constant flow. When the pumps are in operational mode, the pump speed output values shall be determined in one of two ways:
   a. In constant flow mode, the desired output (one or two) shall be ramped to 100% to turn the pumps on in a lead/lag fashion, based on run time.
   b. In variable flow mode, both outputs shall be determined by a Proportional Integral Derivative (PID) calculation, which controls the system differential pressure set point.
5. Whenever the runtime of the lead pump exceeds the runtime of the lag pump by 50 hours or more, then the pump with the lesser runtime will become the lead pump.
6. If the lead pump output is at 100% and the loop water flow input detects no flow, then the lag pump shall be put to 100% to start the lag pump. The lead pump shall be ramped back to zero and alarm condition reported.
7. At each subsequent start-up, the lead pump will be tried again. The user may force the lead pump to start again and turn off the lag pump if the controller detects this state of conditions. The forces will be cleared and the alarm condition cleared from the controller.
8. In the event that the pumps have been commanded to provide water flow but either the flow switch does not indicate flow or the differential pressure sensor does not indicate pressure is present, then the controller shall assume the pumps have failed and command the water source heat pumps to turn off cooling or heat. The system fans shall continue to circulate the air.
9. In the event of a system shutdown command, the controller shall command the water source heat pumps to turn off all cooling and heat sources and circulating fans.