iWorx by Taco Electronic Solutions

Application Guide

505-024

LHP2 Water Source Heat Pump Loop Controller

Self-Contained Interoperable Controller Model UCP-1

SUPERSEDES: April 14, 2011 EFFECTIVE: January 12, 2015

Table of Contents

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505-024, Effective: January 12, 2015

LHP2

The iWorx® LHP2 is a self-contained, microprocessor-based controller for supervisory central liquid source heat pump central plant control applications. Applications include central plant controller applications with one cooling tower and one or two single-stage boilers. Applications may also include two water pumps configured for lead/lag or continuous operation.

Overview

Analog inputs are provided for measuring the temperatures of the boiler supply and tower return water, as well as the heat pump supply and return water. Digital inputs are provided for pump, fan, and boiler flow proof, as well as cooling tower basin level.

The LHP2 incorporates digital outputs in the form of triacs to control the boilers, circulation pumps, tower spray pump, tower fan, tower damper, and tower sump/make-up water valve. In addition, analog outputs are provided to control a tower bypass valve and a variable speed tower fan.

The controller is based on the LonWorks® networking technology. The controller can be networked to a higher-level control system for monitoring and control applications, and provides heated or chilled water in response to demand from other controllers.

Features

- Modulated cooling tower bypass valve
- Modulated cooling tower fan
- Minimum on and off cycle timers for circulation pumps and boilers
- Runtime accumulation for boilers, pumps, and tower fans
- Lead/lag operation of circulation pumps and boilers
- Maximum of 60 zones (cooling/heating demand units)
- Proportional + Integral control of the modulated bypass valve
- Proportional + Integral control of a variable speed tower fan
- LonWorks interface to building automation systems
- OAT low limit protection and local OAT Sensor
- Flow proof inputs
- Adjustable cooling tower setpoint
- Adjustable boiler (heat addition) setpoints
- User selectable analog or digital cooling tower fan
- Automatic configuration with the Local Control Interface (LCI)
- Alarm/Event reporting
- Real Time Clock

PURPOSE OF THIS GUIDE

The *iWorx® LHP2 Application Guide* provides application information for the LHP2 controller.

The reader should understand basic HVAC concepts, intelligent environmental control automation, and basic LonWorks networking and communications. This Application Manual is written for:

- Users who engineer control logic
- Users who set up hardware configuration
- Users who change hardware or control logic
- Technicians and field engineers

REPRESENTATIONS AND WARRANTIES

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APPLICABLE DOCUMENTATION

See the table below for additional documentation that may be applicable to this controller.

Description	Audience	Purpose
iWorx® LCI Application Guide, Document No. 505-002	– Application Engineers – Installers – Service Personnel – Start-up Technicians – End user	Provides instructions for setting up and using the iWorx® Local Control Interface.
iWorx® HPU2 Application Guide, Document No.505-025	– Application Engineers – Installers – Service Personnel – Start-up Technicians – End user	These controllers may operate in conjunction with the LHP2. Application manuals provide specific application information about these controllers, including sequence of operation and configuration information.
http://www.iWorxWizard.com	– Application Engineers – Wholesalers – Contractors	An on-line configuration and submittal package generator based on user input. Automatically generates bill of materials, sequence of operations, flow diagrams, wiring diagrams, points and specifications.
Additional Documentation	*LonWorks FTT-10A Free Topology Transceiver User's Guide,* published by Echelon Corporation. It provides specifications and user instructions for the FTT-10A Free Topology Transceiver. See also: www.echelon.com/support/documentation/manuals/transceivers.	

INSTALLATION INSTRUCTIONS

General

CAUTION: This symbol is intended to alert the user to the presence of important installation and maintenance (servicing) instructions in the literature accompanying the equipment.

CAUTION: Risk of explosion if battery is replaced by an incorrect type. Contains lithium type battery; dispose of properly.

WARNING: Electrical shock hazard. Disconnect **ALL** power sources when installing or servicing this equipment to prevent electrical shock or equipment damage.

505-024, Effective: January 12, 2015

Make all wiring connections in accordance with these instructions and in accordance with pertinent national and local electrical codes. Use only copper conductors that are suitable for 167 °F (75 °C).

Static Electricity

Static charges produce voltages that can damage this equipment. Follow these static electricity precautions when handling this equipment.

- Work in a static free area.
- Touch a known, securely grounded object to discharge any charge you may have accumulated.
- Use a wrist strap when handling printed circuit boards. The strap must be secured to earth ground.

FCC Compliance

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference. This equipment can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment to a power source different from that to which the receiver is connected.
- Consult the equipment supplier or an experienced radio/TV technician for help.

You are cautioned that any changes or modifications to this equipment not expressly approved in these instructions could void your authority to operate this equipment in the United States.

BEFORE INSTALLING

About this Document

The instructions in this manual are for the LHP2 module, which supports heating and cooling of a loop with one or two boilers, and one cooling tower.

Inspecting the Equipment

Inspect the shipping carton for damage. If damaged, notify the carrier immediately. Inspect the equipment for damage. Return damaged equipment to the supplier.

What is Not Included with this Equipment

- A power source for the equipment electronics and peripheral devices.
- Tools necessary to install, troubleshoot and service the equipment.
- The screws or DIN rail needed to mount the device.
- Peripheral devices, such as sensors, actuators, etc.
- Cabling, cabling raceway, and fittings necessary to connect this equipment to the power source, FTT-10A network and peripheral devices.

Equipment Location

Abide by all warnings regarding equipment location provided earlier in this document.

Optimally, the equipment should be installed within a secure enclosure.

If the equipment is to be installed outside, it must be contained within a protective enclosure. The enclosure must maintain internal temperature and humidity within the ranges specified for this equipment.

The equipment must be installed within 500 feet of all input peripherals (smoke detectors, sensors, etc.) that are connected to the equipment.

Selecting a Power Source

This equipment requires a UL recognized Class 2 external power source (not supplied) to operate. The controller power input requires a voltage of 24 Volts AC.

To calculate power source current requirements, add the power consumption of all peripheral devices to that of the controller.

The controller and sensor power supplies can use the same power source. If both are using the same power source, the loads must have EMF protection. This protection can be integral to the load, or installed in the 24 VAC wiring across the load's coil.

To provide necessary RFI and transient protection, the controller's ground (GND) pin (T40) must be connected to earth ground or the earth ground of the packaged unit's enclosure ground. Failure to properly ground the controller may cause it to exceed FCC limits. Excessive noise could also produce inaccurate sensor data. The power source must be capable of operating with this connection to ground.

INSTALLATION

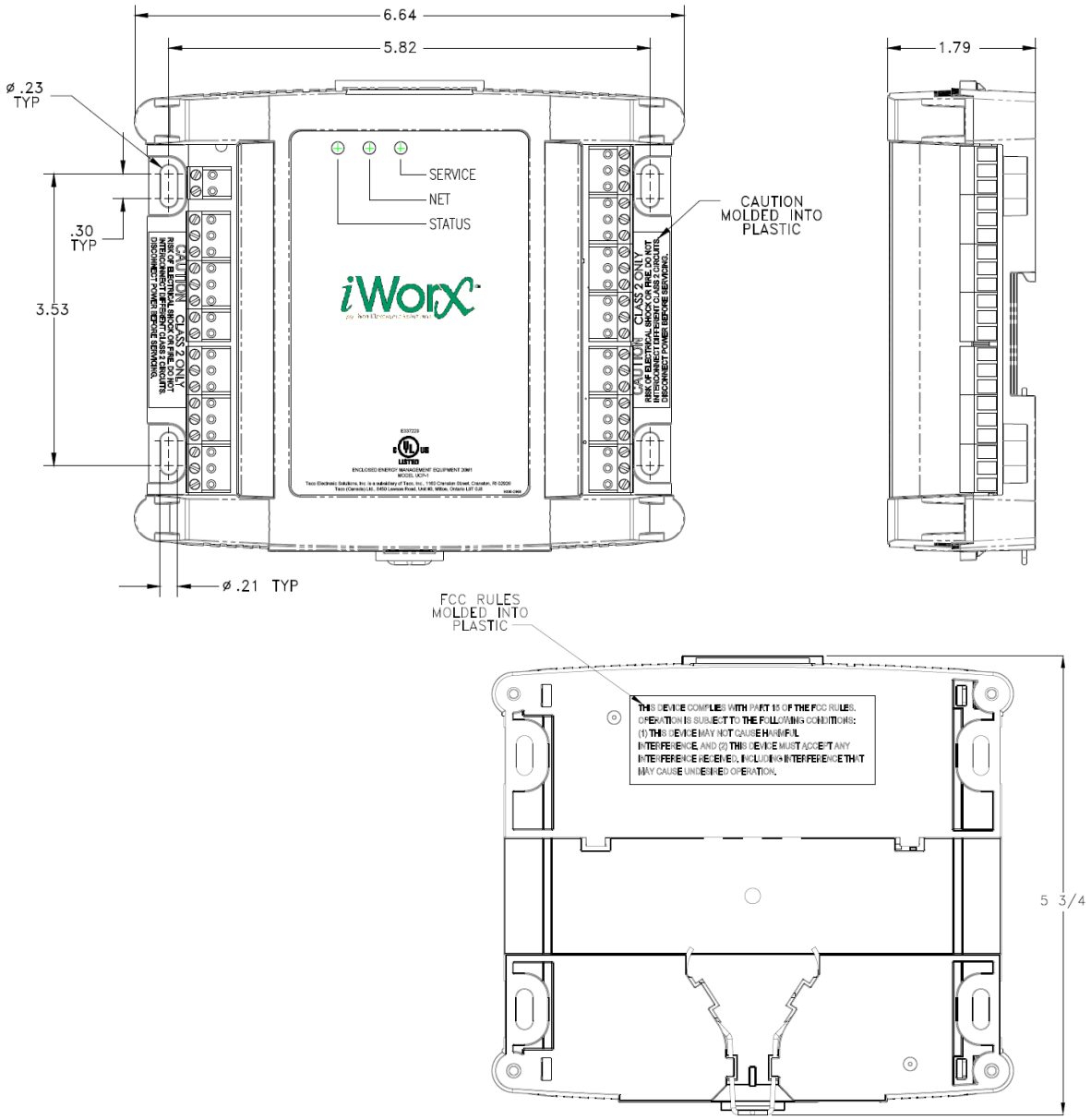
Warning: Electrical shock hazard. To prevent electrical shock or equipment damage, disconnect **ALL** power sources to controllers and loads before installing or servicing this equipment or modifying any wiring.

Mounting the Device

1. Select a mounting location. Enclosure mounting is recommended.
2. Hold the controller on the panel you wish to mount it on. With a marker or pencil mark the mounting locations on the panel.
3. Using a small drill bit pre-drill the mounting holes.
4. Using two #6 pan head screws, mount the controller to the panel.
5. Wire the controller (See Routing Cabling to the Device).

505-024, Effective: January 12, 2015

Figure 1: Mounting Dimensions



Routing Cabling to the Device

Cabling used to connect the power source and cabling used to connect the FTT-10A network must remain separated within the control enclosure and wiring conduit.

Grounding the Device

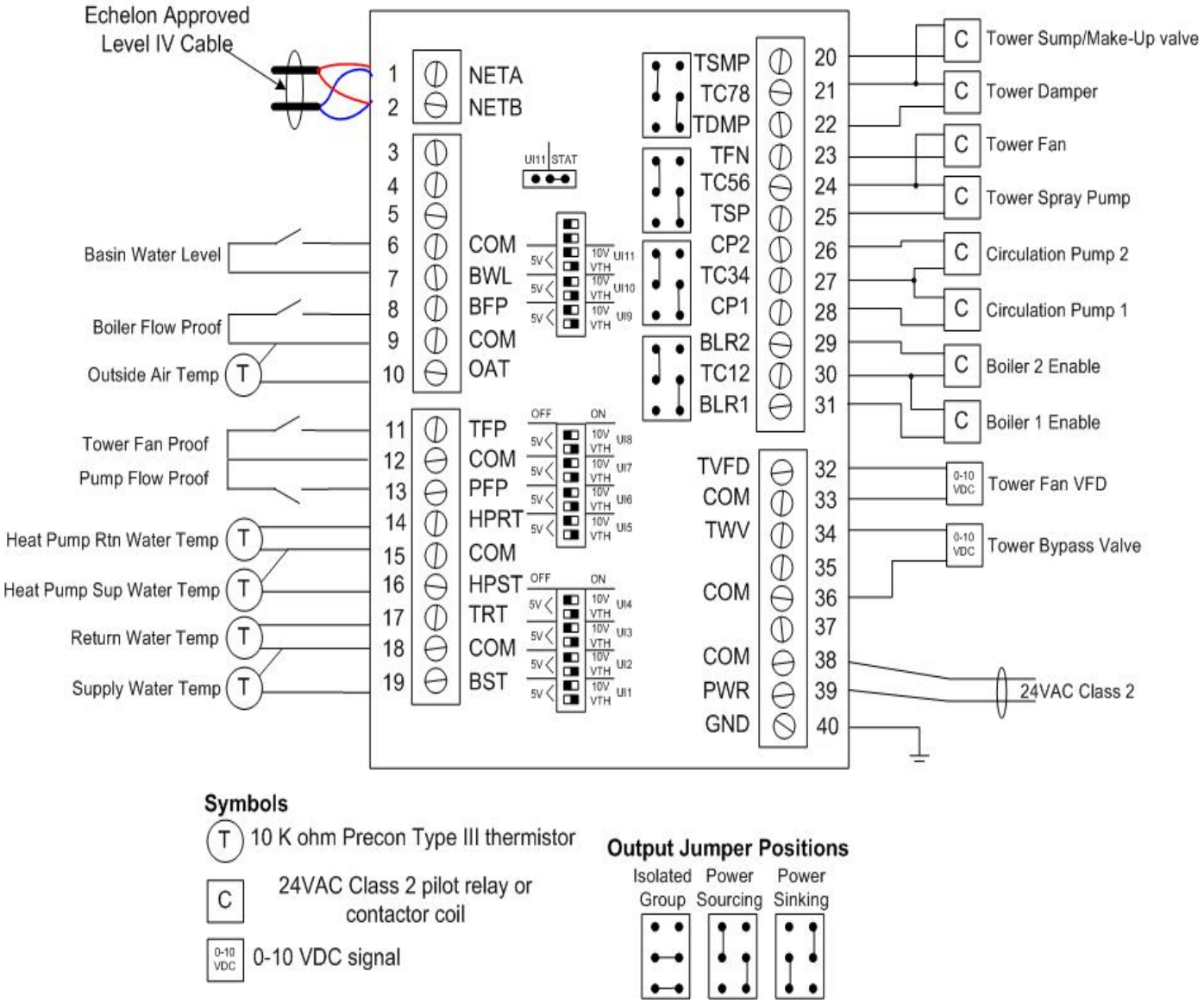
The ground terminal (T40) must be securely connected to earth ground. Failure to properly ground this equipment will result in improper operation. Improper grounding may also increase the risk of electrical shock and may increase the possibility of interference with radio/TV reception.

For best performance, connect the power supply common terminal (T38) to the same external point as the ground terminal (T40).

WIRING INFORMATION

WARNING: Terminals 6, 9, 12, 15, and 18 are connected internally on all LHP2 controllers. Disconnect **ALL** power sources when installing or servicing this equipment to prevent electrical shock or equipment damage.

Figure 2: Typical LHP2 Wiring - Power Sourcing



Symbols

T 10 K ohm Precon Type III thermistor

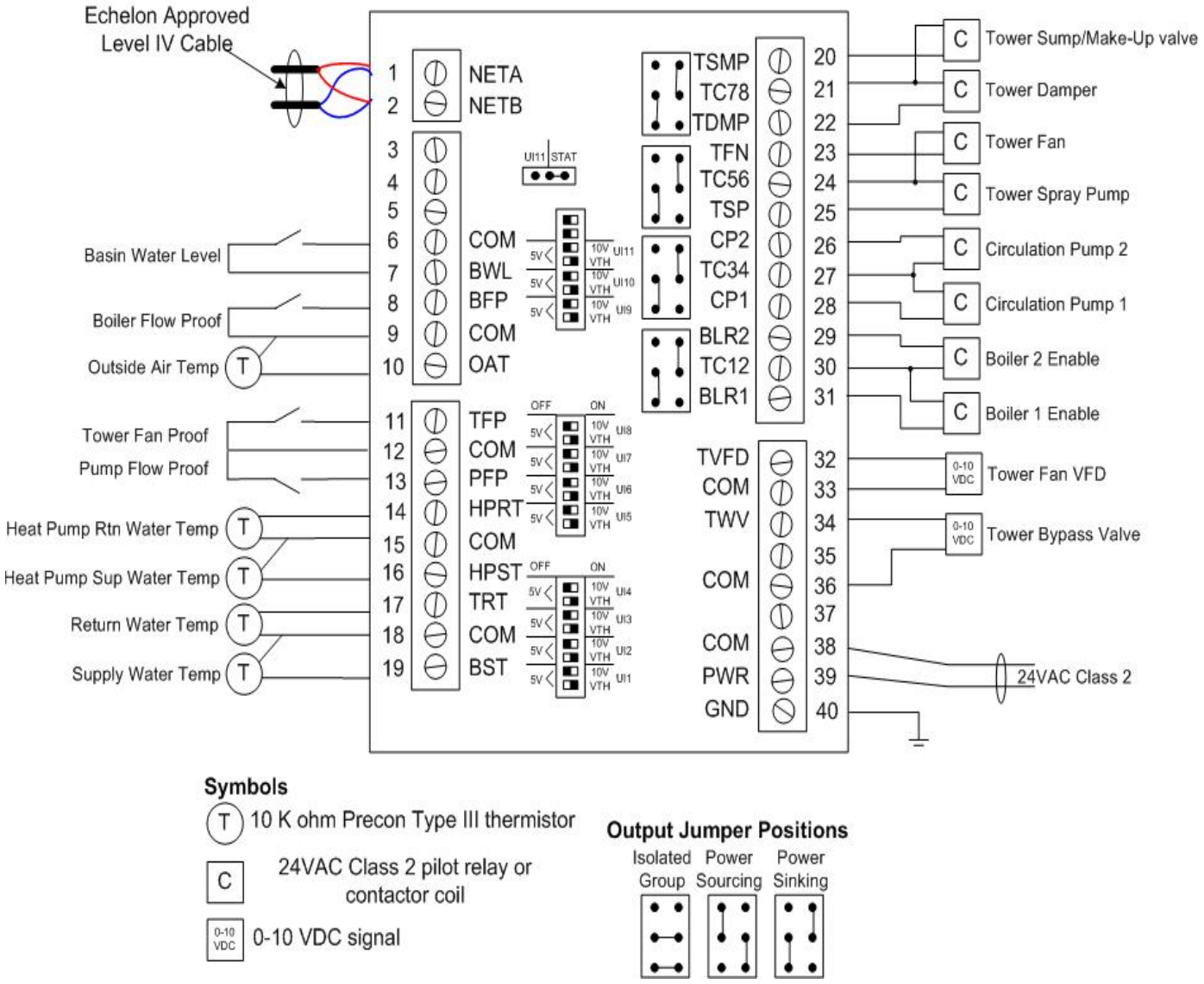
C 24VAC Class 2 pilot relay or contactor coil

0-10 VDC 0-10 VDC signal

Output Jumper Positions

505-024, Effective: January 12, 2015

Figure 3: Typical LHP2 Wiring - Power Sinking



Symbols

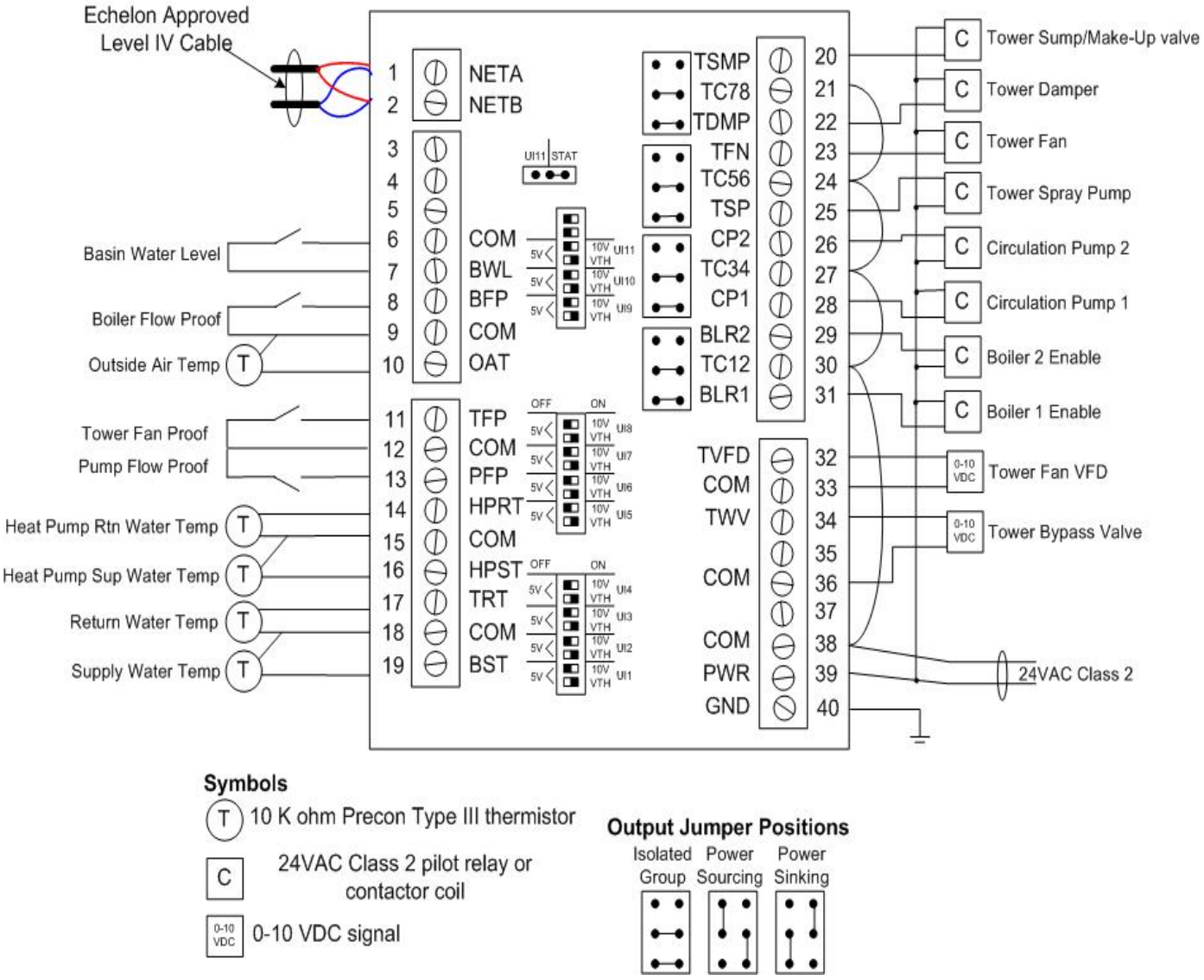
T 10 K ohm Precon Type III thermistor

C 24VAC Class 2 pilot relay or contactor coil

0-10 VDC 0-10 VDC signal

Output Jumper Positions

Figure 4: Typical LHP2 Wiring - Power Isolated



Connecting Input Devices

Boiler Supply Water Temperature (BST)

To connect the boiler supply water thermistor to the unit, attach one wire from the thermistor to BST (T19) and the other wire to the adjacent common (T18). The thermistor used must be a 10K Precon Type III.

Tower Return Water Temperature (TRT)

To connect the return water thermistor to the unit, attach one wire from the thermistor to TRT (T17) and the other wire to the adjacent common (T18). The thermistor used must be a 10K Precon Type III.

505-024, Effective: January 12, 2015

Heat Pump Supply Temperature (HPST)

To connect the heat pump supply water thermistor to the unit, attach one wire from the thermistor to HPST (T16) and the other wire to the adjacent common (T15). The thermistor used must be a 10K Pre-con Type III.

Heat Pump Return Temperature (HPRT)

To connect the heat pump return water thermistor to the unit, attach one wire from the thermistor to HPRT (TI4) and the other wire to the adjacent common (T15). The thermistor used must be a 10K Pre-con Type III.

Pump Flow Proof (PFP)

To connect the pump flow proof switch to the digital input, attach one wire of the contact to PFP (T13) and the other wire to the adjacent common (T12). This must be a dry contact, normally open switch which closes when flow is detected. If a flow proof switch is not installed, the terminals should be connected with a jumper wire.

Tower Fan Proof (TFP)

To connect the tower flow proof switch to the digital input, attach one wire of the contact to TFP (T11) and the other wire to the adjacent common (T12). This must be a dry contact, normally open switch which closes when flow is detected. If a flow proof switch is not installed, the terminals should be connected with a jumper wire.

Outside Air Temperature (OAT)

To connect the outside air temperature thermistor to the unit, attach one wire from the thermistor to OAT (T10) and the other wire to the adjacent common (T9). The thermistor used must be a 10K Pre-con Type III.

Boiler Flow Proof (BFP)

To connect the boiler flow proof switch to the digital input, attach one wire of the contact to BFP (T8) and the other wire to the adjacent common (T9). This must be a dry contact, normally open switch which closes when flow is detected. If a flow proof switch is not installed, the terminals should be connected with a jumper wire.

Basin Water Level (BWL)

To connect the basin water flow proof switch to the digital input, attach one wire of the contact to BWL (T7) and the other wire to the adjacent common (T6). This must be a dry contact, normally open switch which closes when flow is detected. If a flow proof switch is not installed, the terminals should be connected with a jumper wire.

Connecting Output Devices

Boiler 1 & 2 (BLR1, BLR2)

The outputs for the boilers must be connected to 24 VAC pilot relays if the load is greater than 1 Amp for each boiler. If the load is less than 1 Amp, connect boiler 1 to BLR1 (T31) and adjacent TC12 (T30), and connect boiler 2 to BLR2 (T29) and adjacent TC12 (T30).

Circulation Pump 1 & 2 (CP1, CP2)

The outputs for the pumps must be connected to 24 VAC pilot relays if the load is greater than 1 Amp for each pump. If the load is less than 1 Amp, connect pump 1 to CP1 (T28) and adjacent TC34 (T27), and connect pump 2 to CP2 (T26) and adjacent TC34 (T27).

Tower Spray Pump (TSP)

The output for the tower spray pump must be connected to a 24 VAC pilot relays if the load is greater than 1 Amp. If the load is less than 1 Amp, connect the tower spray pump input to TSP (T25) and adjacent TC56 (T24).

Tower Fan (TFN)

The output for the tower fan must be connected to a 24 VAC pilot relays if the load is greater than 1 Amp. If the load is less than 1 Amp, connect the tower fan input to TFN (T23) and adjacent TC56 (T24).

Tower Damper (TDMP)

The output for the tower damper must be connected to a 24 VAC pilot relays if the load is greater than 1 Amp. If the load is less than 1 Amp, connect the tower damper input to TDMP (T22) and adjacent TC78 (T21).

Tower Sump (TSMP)

The output for the tower sump must be connected to a 24 VAC pilot relays if the load is greater than 1 Amp. If the load is less than 1 Amp, connect the tower sump input to TSMP (T20) and adjacent TC78 (T21).

Cooling Tower Valve (TWV)

The cooling tower bypass valve output can be set to 0-10 VDC max through the control logic. Connect the positive wire from the valve actuator to TWV (T34) and the other wire to the adjacent common (T33).

Cooling Tower Fan VFD (TVFD)

The cooling tower fan output can be set to 0-10 VDC max through the control logic. Connect the positive wire from the fan actuator to TVFD (T32) and the other wire to the adjacent common (T33).

Other Connections

Network (LON)

Network wiring must be twisted pair. One network wire must be connected to terminal NETA (T1) and the other network wire must be connected to terminal NETB (T2). Polarity is not an issue since an FTT-10A network is used for communications.

Power (PWR)

Connect one output wire from a 24 VAC power supply to PWR (T39) and the other output wire from the power supply to the adjacent common terminal (T38). T38 must be connected to earth ground.

Ground (GND)

Terminal GND (T40) must be connected to earth ground. Failure to properly ground this equipment will result in improper operation. Improper grounding may also increase the risk of electrical shock, and may increase the possibility of interference with radio and TV reception.

SPECIFICATIONS

Electrical

Inputs

- Cabling: twisted shielded pair, 18 AWG recommended—500 feet max. (152 meters)
- Resolution: 10 bit

  Boiler Supply Temperature, Tower Return Temperature, Heat Pump Supply Temperature, Heat Pump Return Temperature, Outside Air Temperature
- Precon Type III 10K thermistor

  Pump Flow Proof, Tower Fan Proof, Boiler Flow Proof, Basin Water Level
- Dry Contact
- Normally Open
- 5 Volts DC Max

505-024, Effective: January 12, 2015

Outputs

Boiler1, Boiler2, Circulation Pump 1, Circulation Pump 2, Tower Spray Pump, Tower Fan, Tower Damper, Tower Sump

- 24 Volts AC
- 1 Amp at 50 °C, 0.5 Amps at 85 °C, limited by the Class 2 Supply rating

Cooling Tower Valve, Cooling Tower VFD Fan

- 0-10 Volts DC
- 2K Ohm minimum load
- 8 bit resolution

Power Requirements

- 24VAC (20VAC to 28VAC), requires an external Class 2 supply

Power Consumption

- 7.2W with no external loads, maximum limited by the Class 2 supply rating

Recommended Sensor Wire

Cable Type	Pairs	Details	Taco Catalog No.
18AWG	1	Stranded Twisted Shielded Pair, Plenum	WIR-018

FTT-10A Network

- Speed: 78KBPS
- Cabling: Maximum node-to-node distance: 1312 feet (400 meters)
- Maximum total distance: 1640 feet (500 meters)

Cable Type	Pairs	Details	Taco Catalog No.
Level 4 22AWG (0.65mm)	1	Unshielded, Plenum, U.L. Type CMP	WIR-022

For detailed specifications, refer to the *FTT-10A Free-Topology Transceiver User's Guide* published by Echelon Corporation (www.echelon.com/support/documentation/manuals/transceivers).

Mechanical

Housing

- Dimensions: 5.55" (141mm) high, 6.54" (166 mm) wide, 1.75" deep (44 mm)
- ABS

Weight

- Controller Weight: 0.70 pounds (0.32 kilograms)
- Shipping Weight: 1.0 pounds (0.46 kilograms)

Electronics

- Processor: 3150 Neuron 10 MHz
- Flash: 48 Kilobytes
- SRAM: 8 Kilobytes
- Termination: 0.197" (5.0 mm) Pluggable Terminal Blocks, 14-22 AWG

Environmental

- Temperature: 32 °F to 140 °F (0 °C to 60 °C)
- Humidity: 0 to 90%, non-condensing

Agency Listings

- UL Listed for US and Canada, Energy Management Equipment PAZX and PAZX7.

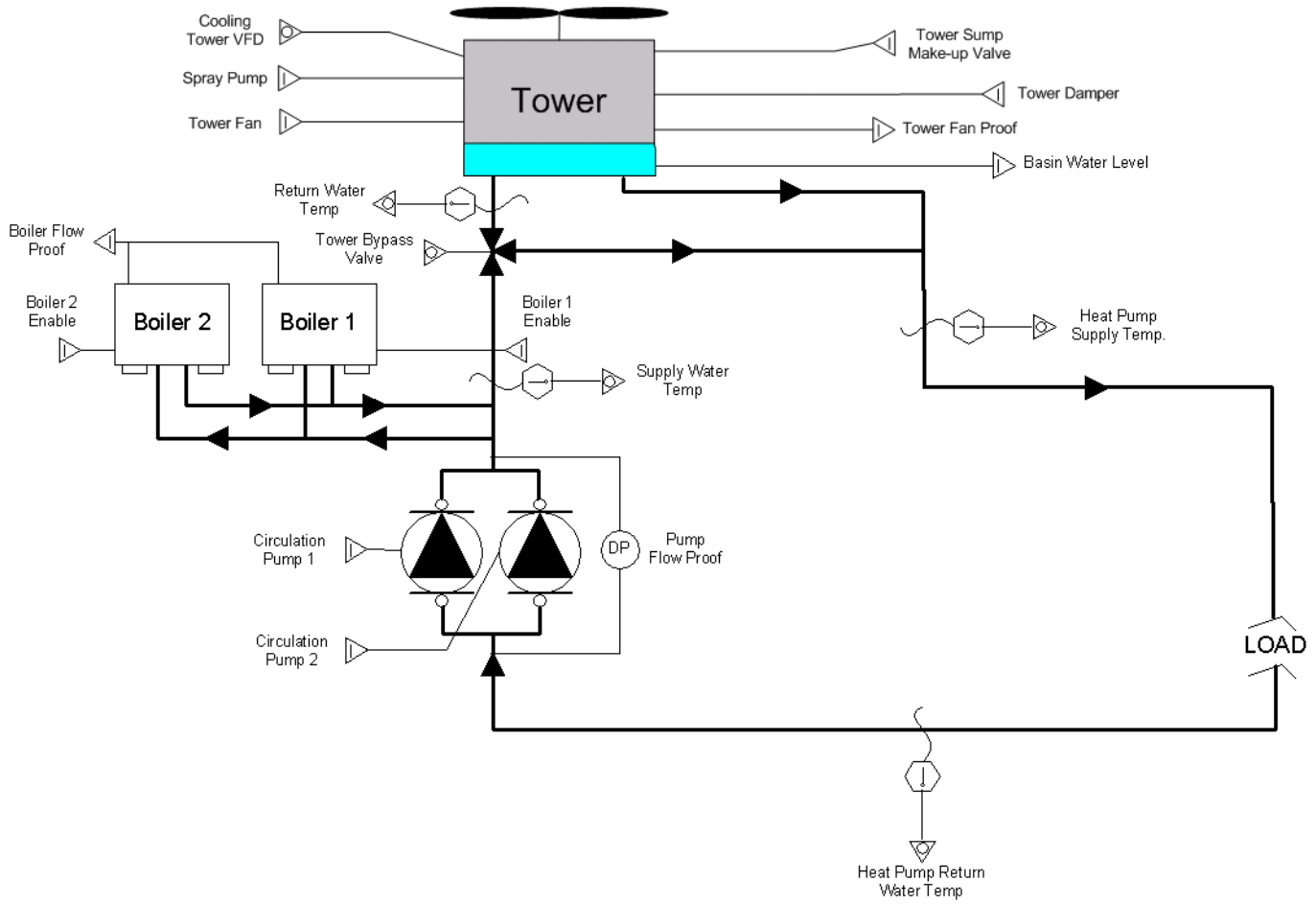
Agency Compliances

- FCC Part 15 Class A

APPLICATION DESCRIPTION

The LHP2 liquid source heat pump controller is a stand-alone, microprocessor-based controller for supervisory central liquid source heat pump plant control applications with a cooling tower and one or two single-stage boilers. Two circulation pumps can be configured for lead/lag or continuous operation. For plant applications that utilize a cooling tower, the LHP2 controls the tower bypass valve, fan (analog or digital control), a damper, and a spray pump. The controller also enables and disables one or two boilers.

Figure 5: LHP2 Loop with Cooling Tower and Boiler



505-024, Effective: January 12, 2015

LHP2 control starts only if there is a sufficient cooling or heating demand. The LHP2 operates in conjunction with up to 60 HPU2 controllers that can require water. The demand is obtained by the LHP2 from controllers (zones) that have been associated with the LHP2 at the LCI user interface during system configuration. Water demand also occurs when the *HeatPmp Supply Temp* is less than the *Lead Boiler* setpoint or greater than the *Tower Bypass SP*, which triggers boiler or cooling tower activation, respectively.

Initial control activates the circulation pump. Pump operation can be configured for continuous circulation or activation only with controller (zone) demand. An anti-cycle function provides configurable minimum On and Off times for the circulation pump. Only one pump is required for normal operation.

The LHP2 includes support for lead/lag operation of two circulation pumps. One of the pumps is designated to be the lead pump, with the lag pump only being required in the event of a lead pump failure. Each time the system is deactivated, the lead pump designation is transferred to the other pump. The lead pump designation is switched every twenty-four hours if the pumps are configured to run continuously.

When the system is activated, the lead circulation pump is started. If the circulation pump has been commanded on for at least 20 seconds and the circulation pump flow proof is off, an alarm is initiated and the lag pump is started. The lag pump also triggers an alarm if it has been commanded on for 20 seconds and flow proof is not established. If both pumps fail, all outputs are turned off and all control stops. Manual reset of the LHP2 controller from the operator interface or by cycling power to the LHP2 is required to restart control.

The position of the cooling tower bypass valve is calculated by a Proportional + Integral (P+I) control loop based on the *HeatPmp Supply Temp* and the *Tower Bypass SP*. The bypass valve control loop is activated 15 seconds after the pump flow proof has confirmed flow. As the temperature increases above the *Tower Bypass SP*, the bypass valve is modulated open. The bypass valve is modulated closed as the water temperature decreases below the *Tower Bypass SP*. The cooling tower bypass valve control loop can be set for direct- or reverse-acting operation.

The LHP2 cooling tower consists of three stages of cooling. All “On” and “Off” temperatures and minimum off times are adjustable and should be configured to allow the discharge dampers, spray pump, and tower fan to cycle in sequence and maintain loop water temperature. “Off” temperature setpoints must be lower than their corresponding “On” setpoints. If an “Off” setpoint is set incorrectly to a value greater than it’s corresponding “On” setpoint, the user supplied "Off" setpoint is ignored by the controller and a value 1 °F (0.55 °C) less than the "On" setpoint is used instead. After the tower sump makeup valve is energized, the spray pump can be delayed for an adjustable time period to allow the sump to fill. Setting the *Spray Pump Delay* value to zero configures the system to use an external basin water level float switch to signal when the spray pump should be enabled.

The LHP2 provides low limit control for the tower. When the *Outside Temperature* (as sensed by an ASM controller on the system network or by external controllers on the system network or by LHP2's OAT sensor) drops below the *Tower OAT Low Limit*, the spray pump and tower sump makeup valve are de-energized. When the *Outside Temperature* rises 10°F (5.55°C) above the *Tower OAT Low Limit*, the spray pump and tower sump makeup valve are allowed to energize.

When the tower fan is configured as variable speed, cooling tower fan speed is calculated using a P+I control loop based on the *HeatPmp Supply Temp* and the *Tower VFD Fan SP*. The fan speed control loop is activated 15 seconds after the cooling tower bypass valve has modulated to its 100% position (full flow through tower). As the temperature increases above the *Tower VFD Fan SP*, the fan speed is increased. The fan speed is decreased as the water temperature decreases below the *Tower VFD Fan SP*. The fan speed control loop can be set for direct- or reverse-acting operation.

The LHP2 can activate one or two boilers for heat addition. The boilers are activated when the *HeatPmp Supply Temp* drops below the *Lead Boiler On* or *Lag Boiler On* temperature setpoints. When the controller determines that boiler operation is required, it activates the circulation water pump (if the pump has not been configured to run continuously), and enables one or both boilers. Once enabled from the LHP2 via digital outputs, the factory installed boiler controls (as provided by the boiler manufacturer) detect water loop water flow and activate the enabled boiler(s).

The LHP2 provides low limit control for the circulator pump. When the *Outside Temperature* (as sensed by an ASM controller on the system network or by external controllers on the system network or by LHP2's OAT sensor) drops 0.9°F (0.5°C) below the *Circ OAT Low Limit*, the circulation pump is energized. When the *Outside Temperature* rises 0.9°F (0.5°C) above the *Circ OAT Low Limit*, the circulation pump de-energizes.

The LHP2 monitors the runtime of all pumps, boilers, and fans. When any one of the runtimes exceeds a programmable limit, a maintenance alarm is reported to the LCI.

When the loop temperature exceeds a programmable limit, a high limit alarm is reported to the LCI. When the loop temperature drops below a programmable limit, a low limit alarm is reported to the LCI. When the loop temperature returns to within the proper range, a return to normal alarm is generated.

505-024, Effective: January 12, 2015

SEQUENCE OF OPERATION

This section describes the detailed sequence of operation for the LHP2 control algorithms.

Control Activation

LHP2 control starts only if there is a sufficient cooling or heating demand. The LHP2 operates in conjunction with up to 60 HPU2 controllers that can require water. The demand is obtained by the LHP2 from controllers (zones) that have been associated with the LHP2 at the LCI user interface during system configuration. Water demand also occurs when the *HeatPmp Supply Temp* is less than the *Boiler Setpoints - Lead Boiler On* or greater than the *Tower Bypass SP*, which triggers boiler or cooling tower activation respectively.

Initial control activates the circulation pump. Pump operation can be configured for continuous circulation or activation only with controller (zone) demand. An anti-cycle function provides configurable minimum On and Off times for the circulation pump. Only one pump is required for normal operation.

Circulation Pump Control

The LHP2 includes support for lead/lag operation of two circulation pumps. One of the pumps is designated to be the lead pump, with the lag pump only being required in the event of a lead pump failure. Each time the system is deactivated, the lead pump designation is transferred to the other pump. The lead pump designation is switched every twenty-four hours if the pumps are configured to run continuously.

When the system is activated, the lead circulation pump is started. If the lead circulation pump has been commanded on for at least 20 seconds and the circulation pump flow proof is off, an alarm is initiated and the lag pump is started. The lag pump also triggers an alarm if it has been commanded on for 20 seconds and flow proof is not established. If both pumps fail, all outputs are turned off and all control stops. Manual reset of the LHP2 controller from the operator interface or by cycling power to the LHP2 is required to restart control.

Cooling Tower Bypass Valve Control

The position of the cooling tower bypass valve is calculated by a (P+I) control loop based on the *HeatPmp Supply Temp* and the *Tower Bypass SP*. The bypass valve control loop is activated 15 seconds after the pump flow proof has confirmed flow. As the temperature increases above the *Tower Bypass SP*, the bypass valve is modulated open. The bypass valve is modulated closed as the water temperature decreases below the *Tower Bypass SP*.

Anti-wind up reset protection prevents the integral component from becoming too large. This protection clamps the integral value when all of the components add up to more than 100% or less than 0%. The following equations are used for P+I control:

The following equations are used for P+I control:

K_P = Proportional Gain
K_i = Integral Gain
$Error = HpSuppWtrTemp - TwrBypWtrSp$
$I = I + (K_i \times Error)$
$ValvePosition = (K_P \times (Error + I)) + 50.00\%$

Cooling Tower Variable Speed Fan Control

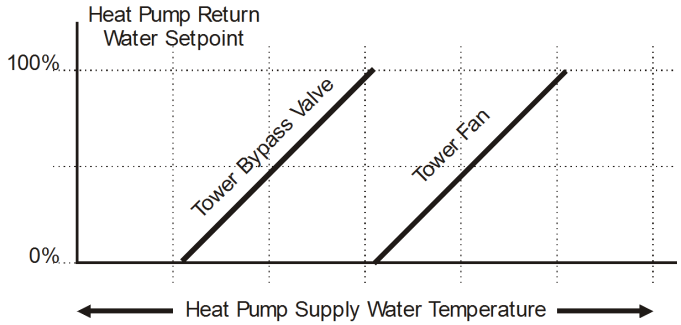
When the tower fan is configured as variable speed, cooling tower fan speed is calculated using a P+I control loop based on the *HeatPmp Supply Temp* and the *Tower Fan VFD SP*. The fan speed control loop is selectable for direct or reverse-acting operation.

The fan speed control loop is activated 15 seconds after the cooling tower bypass valve has modulated to its 100% position (full flow through tower). As the temperature increases above the *Tower Fan VFD SP*, the fan speed is increased. The fan speed is decreased as the water temperature decreases below the *Tower Fan VFD SP*. The fan speed control loop is selectable for direct or reverse-acting operation.

Anti-wind up reset protection prevents the integral component from becoming too large,. This protection clamps the integral value when all of the components add up to more than 100% or less than 0%. The following equations are used for P+I control:

K_P = Proportional Gain
K_i = Integral Gain
$Error$ = $HpSuppWtrTemp$ - $CtVfdFanSp$
I = I + (K_i x $Error$)
$ValvePosition$ = (K_P x ($Error$ + I)) + 50.00%

Figure 6: Cooling Tower Sequence



Cooling Tower Staging

The LHP2 cooling tower consists of three stages of cooling. All “On” and “Off” temperatures and minimum off times are adjustable and should be configured to allow the discharge dampers, spray pump, and tower fan to cycle in sequence and maintain loop water temperature.

“Off” temperature setpoints must be lower than their corresponding “On” setpoints. If an “Off” setpoint is set incorrectly to a value greater than it’s corresponding “On” setpoint, the user supplied "Off" setpoint is ignored by the controller and a value 1 °F (0.55 °C) less than the "On" setpoint is used instead.

After the tower sump makeup valve is energized, the spray pump can be delayed for an adjustable time period to allow the sump to fill. Setting the *Spray Pump Delay* value to zero configures the system to use an external basin water level float switch to signal when the spray pump should be enabled.

Boiler Activation

The LHP2 can activate one or two boilers for heat addition. The boilers are activated when the *HeatPmp Supply Temp* drops below one of the boiler on setpoints. Boiler On and Off setpoints are located in the Boiler Setpoints screen. If the controller determines that boiler operation is required, it activates the circulation water pump (if the pump has not been configured to run continuously), and enables one or both boilers. Once enabled from the LHP2 via digital outputs, the factory installed boiler controls (as provided by the boiler manufacturer) detect water loop water flow and activate the enabled boiler(s).

When configured for two boilers, one is designated the “lead boiler,” and the other boiler is designated the “lag boiler.” The lead boiler is always enabled first. The lag boiler is enabled as a second stage of heat addition, or in the event of a lead boiler failure. Each time the lead boiler is deactivated, the lead and lag designations are transposed. Both boilers share configurable minimum On and minimum Off times.

505-024, Effective: January 12, 2015

If the *HeatPmp Supply Temp* drops below the *Lead Boiler On* setpoint, the lead boiler's digital output is energized. If the *HeatPmp Supply Temp* rises above the *Lead Boiler Off* setpoint, the lead boiler's digital output is de-energized. If the *HeatPmp Supply Temp* drops below the *Lag Boiler On* setpoint while the lead boiler is on, the lag boiler's digital output is also energized. If the *HeatPmp Supply Temp* rises above the *Lag Boiler Off* setpoint, the lag boiler's digital output is de-energized.

"Off" temperature setpoints must be higher than their corresponding "On" setpoints. If an "Off" setpoint is incorrectly set to lower than it's corresponding "On" setpoint,the user supplied "Off" setpoint is ignored by the controller and a value 1°F (0.55 °C) higher than the "On" setpoint is used instead.

If the lead boiler has been commanded on for at least 30 seconds and the boiler flow proof is off, an alarm is initiated, and the lag boiler is started. The lag boiler also triggers an alarm if it has been commanded on for 30 seconds and boiler flow proof is not established. If both boilers fail, LHP2 boiler control stops and a dual boiler failure alarm occurs and manual reset of the LHP2 controller from the operator interface or by cycling power to the LHP2 is required to restart control.

Low Limit Control

The LHP2 provides low limit control for the circulator pump. When the *Outside Temperature* (as sensed by an ASM controller on the system network or by external controllers on the system network or by LHP2's OAT sensor) drops 0.9°F (0.5°C) below the *Circ OAT Low Limit*, the circulation pump is energized. When the *Outside Temperature* rises 0.9°F (0.5°C) above the *Circ OAT Low Limit*, the circulation pump de-energizes.

The LHP2 provides low limit control for the tower. When the *Outside Temperature* drops below the *Tower OAT Low Limit*, the tower fan, tower bypass, tower damper, the tower spray pump, and tower sump makeup valve are de-energized. When the *Outside Temperature* rises 10°F (5.55°C) above the *Tower OAT Low Limit*, the tower fan, tower bypass, tower damper, tower spray pump, and tower sump makeup valve are allowed to energize.

Real Time Clock (RTC)

The RTC will be set or synced by the LCI each day at midnight.

Runtime Accumulations

The total runtime is accumulated for boiler 1, boiler 2, circulation pump 1, circulation pump 2, and the cooling tower fan. The runtimes can be used to indicate that maintenance is required on the equipment controlled by these outputs. An operator or maintenance personnel can reset the runtime once servicing has been performed. The runtimes are accumulated in non-volatile memory (NVRAM).

Alarms and Events

The controller detects certain alarm conditions and sends them to the LCI. Before this communication can occur, the user must use the LCI to configure the controller.

Digital Input Alarms

The LHP2 monitors the status of the digital inputs and generates alarms for the following events:

Boiler Flow Alarm

The LHP2 generates alarms when a boiler has been started but boiler flow has not been achieved. If the lead boiler's flow proof is off and the boiler has been commanded on for at least 30 seconds, an alarm is initiated and the lag boiler is started. The lag boiler also triggers an alarm if it has been commanded on for 30 seconds and boiler flow proof is not established. If both boilers fail, LHP2 heat addition control stops and a dual boiler failure alarm occurs. Manual reset of the LHP2 controller from the operator interface or by cycling power to the LHP2 is required to restart control.

Circulation Pump (Flow) Alarms

The LHP2 generates an alarm when a pump has been started but flow has not been achieved. If pump flow proof is off and a pump has been commanded on for at least 20 seconds, an alarm is initiated and the lag pump is started. The lag pump also triggers an alarm if it has been commanded on for 20 seconds and pump flow proof is not established. If both pumps fail, LHP2 control stops and a dual circulation water pump alarm occurs, requiring a manual reset of the LHP2 controller from the operator interface or by cycling power to the LHP2.

Tower Fan Failure Alarm

The LHP2 generates an alarm when the tower fan has been started but fan proof has not been established. If the tower fan proof is off and a tower fan has been commanded on for at least 30 seconds, control of the fan stops, and a tower fan failure alarm is initiated. Restoring tower fan control requires a manual reset of the LHP2 controller from the operator interface or by cycling power to the LHP2.

Outside Air Temperature (OAT) Sensor Failure Alarm

The LHP2 generates an alarm when the LHP2's outside air temperature sensor has not been detected by LHP2 OAT sensor or the ASM temperature sensor over the network.

Maintenance Alarm

The LHP2 provides programmable run limits for generating runtime maintenance alarms. When the boiler runtime, pump runtime, or fan runtime exceeds these limits, a maintenance alarm is sent to the LCI.

Water Temperature Alarms

The LHP2 generates high and low limit alarms for the monitored water temperatures. A programmable water temperature alarm limit offset is provided. The temperature limits are calculated based on the alarm limit setpoints and the alarm limit offset.

$$HighLimit = MaxWtrTemp + WtrTempLimit$$
$$LowLimit = MinWtrTemp - WtrTempLimit$$

When the measured water temperature exceeds the high limit, a high limit alarm is generated. When the water temperature drops below the low limit, a low limit alarm is generated. A return to normal is generated when the water temperature is between the high and low limit.

Automatic Configuration

The LHP2 and iWorx® Local Control Interface (LCI) use a self-configuring network management scheme requiring no external tools, binding, or LONWORKS knowledge. The LCI recognizes and configures the LHP2 when the controller's service pin is pressed. The controller's status light flashes green until the controller is configured, and is solid green after the controller is configured. Once the service pin has been pressed, no further action is required by the user; the controller is fully accessible to the LCI. Users may bind to SNVTs on the LHP2 with LNS or other LONWORKS tools if they wish.

The LCI also provides network supervision of the LHP2. The LCI periodically sends a "ping" message to the LHP2, which elicits a response. If the response fails, an alarm is displayed on the LCI. The LCI also uses the "ping" message to refresh the occupancy mode and other system wide data.

Communication with Associated Devices

The controller is capable of communicating and sharing information with other controllers on the network.

Communication with a HPU2

The communication between a LHP2 and up to 60 HPU2s is configured by the LCI. The individual controller screen for the LHP2 displays a button labeled **`HVAC Setup`**; when the user presses this button, the HVAC setup screen displays a **`Members`** button which can be pressed to create an association between a LHP2 and HPU2s. This can only be a one-to-one or one-to-many association, where the LHP2 acts as the master and one or more HPU2s act as a slave.

505-024, Effective: January 12, 2015

During the association process, the LHP2 receives a notice from the HPU2s. Once associated, the LHP2 starts exchanging messages with the associated HPU2s.

When communication gets lost between the HPU2s and the LHP2, the LHP2 attempts to contact the HPU2s every 5 minutes. During this time, the HPU2s react as if the Stat doesn't respond.

Please refer to the *iWorx® LCI Application Guide* for a detailed description of how to associate LHP2 with HPU2-type controllers.

CONTROLLER IDENTIFICATION

Once the LHP2 is properly installed and recognized by the Local Control Interface (LCI), the LCI can be used to configure the settings of the controller. This section describes the commands available on the LCI for configuration of the LHP2, and the meanings and default values for controller parameters. For more information on using the LCI, see the *iWorx® LCI Application Guide.*

Inputs

The Inputs screen displays the current values of the LHP2's inputs. These values cannot be changed.

Input	Range	Description
Outside Temp	-22.00 to 122.00 °F (-30.00 to 50.00 °C)	Outside air temperature reported by an external temperature sensor over the network or ASM temperature sensor over the network or LHP2 OAT sensor.
OA Temp	-22.00 to 122.00 °F (-30.00 to 50.00 °C)	Outside air temperature reported by the OAT sensor connected to the LHP2.
Pump Flow Proof	Off, On	Status of the PFP switch.
Cooling Twr Fan Proof	Off, On	Status of the TFP switch.
Basin Water Level Sw	Off, On	Status of the BWL switch.
Boiler Flow Proof	Off, On	Status of the BFP switch.
Occupancy Mode	Occ, Unocc	Status of occupancy.
Supply Temp	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by BST sensor.
Return Temp	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by TRT sensor.
HeatPmp Supply Temp.	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by HPST sensor.
HeatPmp Return Temp.	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by HPRT sensor.

Outputs

This screen displays the current values of the LHP2's outputs. These values cannot be changed.

Output	Range	Description
Mode	Off, Heating, Cooling	Current mode of the liquid source system.
Cooling Tower Valve	0.00% to 100.00%	State of the tower bypass valve output.
Cooling Tower Fan	0.00% to 100.00%	State of the tower fan VFD output.
In Alarm?	No, Yes	Alarm status.
Boiler 1	Off, On	State of the boiler 1 output.
Boiler 2	Off, On	State of the boiler 2 output.
Spray Pump	Off, On	State of the spray pump output.
Circulation Pump 1	Off, On	State of the circulation pump 1 output.
Circulation Pump 2	Off, On	State of the circulation pump 2 output.
Cooling Tower Fan	Off, On	State of the cooling tower fan output.
Cooling Tower Damper	Off, On	State of the tower damper output.
Make Up Valve	Off, On	State of the tower sump/makeup valve output.

505-024, Effective: January 12, 2015

Configuration

This section describes the settings that can be modified.

All Settings

This screen displays all of the LHP2's setpoints and editable settings and provides access to edit all LHP2 parameters from a single screen. Some of the parameters are structures and will be described in individual tables below this table.

Setting	Range	Default	Description
Tower Bypass Sp	32.00 to 109.9 °F (0 to 43.3 °C)	79.9 °F (26.6 °C)	Temperature setpoint for P+I control of the cooling tower bypass valve.
Tower VFD Fan Sp	32.00 to 109.9 °F (0 to 43.3 °C)	89.9 °F (32.2 °C)	Temperature setpoint for P+I control of the cooling tower fan.
Tower OAT Low Limit	0.00 to 50.00 °F (-17.78 to 10.00 °C)	40.0 °F (4.4 °C)	Outdoor air temperature below which low limit control of the cooling tower is enabled.
Tower Bypass Valve	Structure		Tower Bypass Valve Settings
Tower VFD Fan	Structure		Tower Fan Settings
Blr Timing	Structure		Boiler Time Settings
Zone Limit	0 to 60	1	Number of zones that must signal demand to activate cooling mode.
Circ Pump Mode	On Demand, Continuous	On Demand	Run the circulation pumps only when there is demand, or continuously.
Runtime Limits	Structure		Runtime Limit Settings.
Circ OAT Low Limit	0.00 to 50.00 °F (-17.78 to 10.00 °C)	34.9 °F (1.6 °C)	Outdoor air temperature below which low limit control of the circulation pumps is enabled.
Tower Fan Mode	Staged Fan, VFD Fan	Staged Fan	Type of tower fan being controlled.
Spray Pump Delay	0 to 1000 minutes	30 minutes	Delay after the makeup water valve is energized before the spray pump is energized.
Circ Pump Timing	Structure		Circulation Pump Time Settings
Boiler/Tower Temp Limits	Structure		Boiler/Tower Temperature Settings
Heat Pump Limits	Structure		Heat Pump Temperature Settings
Water Temp Limit	0.00 to 10.00 °F (0.0 to 5.5 °C)	5.0 °F (2.7 °C)	Offset subtracted from the minimum water temperature setpoints to form the water temperature low limit alarm setpoint and added to the maximum water temperature setpoints to form the water temperature high limit setpoint.
Cool Tower Setpoints	Structure		Cooling Tower Settings
Boiler Setpoints	Structure		Boiler Settings

Tower Bypass Valve

This screen displays all of the Tower Bypass Valve settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Kp	0.00 to 100.00% per degree of temperature	50.00%	Proportional gain for P+I control of the tower bypass valve.
Ki	0.00 to 100.00%	0.05%	Integral gain for P+I control of the tower bypass valve.
Min AO Voltage	0.0 to 10.0 Volts	0.0 V	Minimum voltage of the cooling tower bypass valve output.[a]
Max AO Voltage	0.0 to 10.0 Volts	10.0 V	Maximum voltage of the cooling tower bypass valve output.[a]

a. To set the valve outputs for reverse action, exchange the minimum and maximum values.

Tower VFD Fan

This screen displays all of the Tower VFD Fan settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Kp	0.00 to 100.00% per degree of temperature	50.00%	Proportional gain for P+I control of the cooling tower fan.
Ki	0.00 to 100.00%	0.05%	Integral gain for P+I control of the cooling tower fan.
Min AO Voltage	0.0 to 10.0 Volts	0.0 V	Minimum voltage of the cooling tower fan output.[a]
Max AO Voltage	0.0 to 10.0 Volts	10.0 V	Maximum voltage of the cooling tower fan output.[a]

a. To set the fan outputs for reverse action, exchange the minimum and maximum values.

Blr Timing

This screen displays all of the Boiler Timing settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Min On Time	0 to 180 minutes	30 minutes	Minimum amount of time the boilers remain on.
Min Off Time	0 to 180 minutes	30 minutes	Minimum amount of time the boilers remain off.

Runtime Limits

This screen displays all of the runtimes and limits settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Boiler	0 to 65535 hours	1000 hours	Runtime limit for boiler after which a maintenance alarm is generated.
Fan	0 to 65535 hours	1000 hours	Runtime limit for cooling tower fan after which a maintenance alarm is generated.
Pump	0 to 65535 hours	1000 hours	Runtime limit for circulation pump after which a maintenance alarm is generated.

Circ Pump Timing

This screen displays all of the Circulation Pump Timing settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Min On Time	0 to 180 minutes	30 minutes	Minimum amount of time the circulation pump remains on.
Min Off Time	0 to 180 minutes	30 minutes	Minimum amount of time the circulation pump remains off.

505-024, Effective: January 12, 2015

Boiler/Tower Temp Limits

This screen displays all of the Boiler and Tower Temperature settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Min Supply Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Minimum supply temperature below which an alarm is generated.
Max Supply Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	109.9 °F (43.3 °C)	Maximum supply temperature above which an alarm is generated.
Min Return Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Minimum return temperature below which an alarm is generated.
Max Return Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	109.9 °F (43.3 °C)	Maximum return temperature above which an alarm is generated.

Heat Pump Limits

This screen displays all of the Heat Pump Temperature settings and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Min Supply Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Minimum supply temperature below which an alarm is generated.
Max Supply Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	109.9 °F (43.3 °C)	Maximum supply temperature above which an alarm is generated.
Min Return Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Minimum return temperature below which an alarm is generated.
Max Return Temp	32.00 to 140.00 °F (0.00 to 60.00 °C)	109.9 °F (43.3 °C)	Maximum return temperature above which an alarm is generated.

Cool Tower Setpoints

This screen displays all of the Cooling Tower Setpoints and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Damper On	32.0 to 140.0 °F (0.0 to 60 °C)	82.0 °F (27.7 °C)	Heat pump supply temperature above which the cooling tower damper is opened.
Damper Off	32.0 to 140.0 °F (0.0 to 60 °C)	79.0 °F (26.1 °C)	Heat pump supply temperature below which the cooling tower damper is closed.
Spray Pump On	32.0 to 140.0 °F (0.0 to 60 °C)	84.0 °F (28.8 °C)	Heat pump supply temperature above which the tower spray pump is enabled.
Spray Pump Off	32.0 to 140.0 °F (0.0 to 60 °C)	81.0 °F (27.2 °C)	Heat pump supply temperature below which the tower spray pump is disabled.
Fan On	32.0 to 140.0 °F (0.0 to 60 °C)	90.0 °F (32.2 °C)	Heat pump supply temperature above which the tower fan is enabled.
Fan Off	32.0 to 140.0 °F (0.0 to 60 °C)	84.0 °F (28.8 °C)	Heat pump supply temperature below which the tower fan is disabled.

Boiler Setpoints

This screen displays all of the Boiler Setpoints and provides access to edit these parameters from a single screen.

Setting	Range	Default	Description
Lead Boiler On	32.00 to 140.0 °F (0 to 60.0 °C)	65.0 °F (18.33 °C)	Heat Pump supply temperature below which to enable the lead boiler.
Lead Boiler Off	32.00 to 140.0 °F (0 to 60.0 °C)	70.0 °F (21.11 °C)	Heat Pump supply temperature above which to disable the lead boiler.
Lag Boiler On	32.00 to 140.0 °F (0 to 60.0 °C)	60.0 °F (15.55 °C)	Heat Pump supply temperature below which to enable the lag boiler.
Lag Boiler Off	32.00 to 140.0 °F (0 to 60.0 °C)	65.0 °F (18.33 °C)	Heat Pump supply temperature above which to disable the lag boiler.

Alarms

The table below describes the alarms the user may encounter and how to reset them.

Alarm	Range	Alarm Trigger	Alarm Reset
Maintenance	Normal, Alarm	Occurs when the fan, heating, or cooling operating hours have exceeded their Runtime limit.	To clear the alarm, a user must enter a new value for the alarm limit or reset the accumulated times to zero. To reset a runtime total to zero, use the up and down arrows on the LCI to highlight the value, and then press **Reset**.
Circulation Pump Failure	Normal, Alarm	Occurs when circulation pump 1 or 2 or both are not running after circulation pump 1 or 2 or both have been activated.	The cause of the emergency condition must be resolved.
Boiler Failure	Normal, Alarm	Occurs when boiler 1 or 2 or both are not running after boiler 1 or 2 or both have been activated.	The cause of the emergency condition must be resolved.
Circulation Supply Water Temp	Normal, Alarm	Occurs when the circulation supply water temperature exceeds the specified high limit or drops below the specified low limit.	Automatic when circulation supply water temperature returns within its normal range.
Circulation Return Water Temp	Normal, Alarm	Occurs when the circulation return water temperature exceeds the specified high limit or drops below the specified low limit.	Automatic when circulation return water temperature returns within its normal range.
Heat Pump Supply Water Temp	Normal, Alarm	Occurs when the heat pump supply water temperature exceeds the specified high limit or drops below the specified low limit.	Automatic when heat pump supply water temperature returns within its normal range.

505-024, Effective: January 12, 2015

Alarm	Range	Alarm Trigger	Alarm Reset
Heat Pump Return Water Temp	Normal, Alarm	Occurs when the heat pump return water temperature exceeds the specified high limit or drops below the specified low limit.	Automatic when heat pump return water temperature returns within its normal range.
Fan Failure	Normal, Alarm	Occurs when the fan input detects that the fan is not running after a 30-second grace period after the fan has been activated.	The cause of the emergency condition must be resolved.
OAT Sensor Failure	Normal, Alarm	Occurs when the outside air temperature input detects that the outside air temperature exceeds the specified high limit or drops below the specified low limit.	The cause of the emergency condition must be resolved.

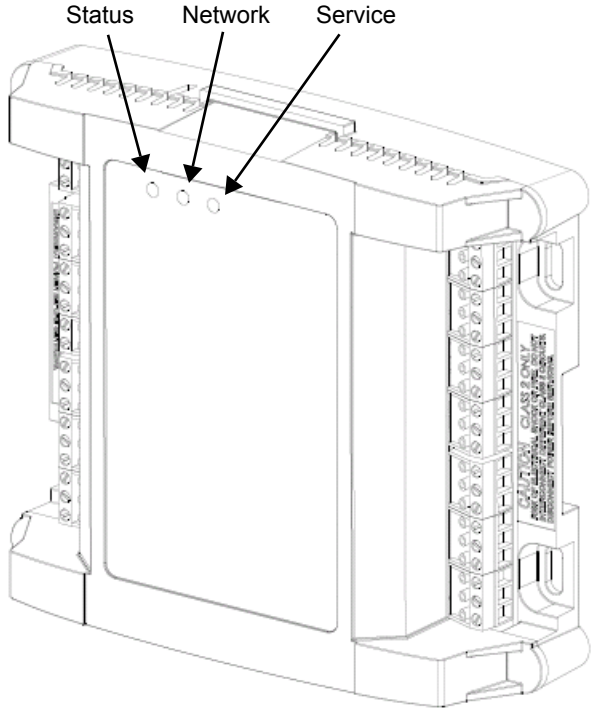
TROUBLESHOOTING

Diagnostic LEDs

The controller has 3 LED indicators. These indicators can aid in troubleshooting equipment operation problems. The following table lists the functions of the controller's LEDs in the order they appear from left to right on the unit.

LED	Indication
Status	– Solid green when running and configured by an LCI (networking) – Flashing green when running and NOT configured by an LCI (stand-alone) – Solid red when a fault condition exists (control shut down) – Blinking Red - the controller has a device failure – Solid Amber - The controller has not received a LCI ping message in over 10 minutes and is part of a network.
Network	– Yellow while the controller is transmitting data onto the FTT-10A network – Green when there is network activity – Off when there is no network activity
Service	– Illuminated when the service pin is depressed or when a controller gets configured by the LCI.

Figure 7: LHP2 Controller LEDs



505-024, Effective: January 12, 2015

Troubleshooting Tips

The table below provides solution to some common problems you may encounter.

Problem	Solution
Controller is not running and Status LED is not illuminated.	No power to controller. Verify the voltage on the controller's power connector (24 VAC).
Fan cycles on for 30 seconds then turns off.	The controller requires proper connection of the equipment status for proper operation. Ensure that your equipment status is working and properly wired to the controller.
The fan will not cycle on after the input fault has been corrected.	If the equipment was previously in a equipment status fault condition, the controller must be reset before proper operation can be restored.
How do I reset the controller?	The controller can be reset by the LCI, or you can cycle power to the controller. Refer to the LCI documentation for more information on resetting the controller using the LCI.
The 10K thermistor is reading at either its maximum or minimum.	The input is either shorted or open.
Can my iWorx® system contain multiple LHP2 controllers?	No, the system can only recognize one.
Thermistor readings fluctuate rapidly, sometimes by several degrees.	The controller is not properly grounded. The controller's ground (GND) pin (T40) must be connected to earth ground. Also ensure that the controller's digital inputs are dry contacts and that no voltage is being applied or switched to the inputs.
How do I associate my other controllers with the LHP2?	Use the LHP2's grouping mechanism, specifically **Members** on the LHP2 *HVAC Setup* screen of the LCI. Only HPU controllers may be associated with the LHP2.
What is **Save** for in the **Members** page, and when do I press it?	This button stores network information into the LHP2 about the controllers in its group. Press this button when you have made any changes to the member grouping.
What controllers can be part of the LHP2's group?	Only HPU2 controllers can be part of the LHP2's group and demand cooling or heating from it.
Several controllers are requesting cooling or heating, but the circulation pump has not been enabled.	The "Zone Limit" setting may be set higher than the number of zones that are currently requesting cooling or heating. The circulation pump will not be enabled until the number of zones requesting cooling or heating is greater than zone limit. If the number of controllers requesting cooling or heating exceeds the zone limit but the circulation pump is still not enabled, the outside air temperature may be less than the "Outdoor Air Temp low limit." See the outside air temperature on LCI input screen.
I only have one circulation pump and/or boiler; how can I disable lead/lag operation?	The lead/lag function is built into the controller and cannot be disabled. However, you can wire both circulation pump outputs in parallel from the controller to the existing pump and the system will operate normally. Do the same for the boiler if the system only has one boiler.
The cooling tower staging does not follow the setpoints that are defined.	Verify that the tower bypass setpoint is lower than the cooling tower setpoints. Remember, staging will not occur until the tower bypass valve has reached the 100% open position. If staging is turning off before the defined OFF setpoints, the tower bypass valve is most likely not fully open.
Does the LHP2 require a reset if a single pump fails?	No, only a dual pump failure requires a reset.
Under what conditions does the LHP2 require a reset for normal operation?	There are four conditions that require a reset: – Dual pump failure – Tower fan failure – Dual boiler failure – OAT sensor failure

Additional Notes

1. To set the fan outputs for reverse action, exchange the minimum and maximum values.

2. To set the valve outputs for reverse action, exchange the minimum and maximum values.

3. to set the fan or valve outputs for reverse action, exchange the minimum and maximum values.

Getting Help

Components within an iWorx® controller, sensor, or power supply cannot be field repaired. If there is a problem with a unit, follow the steps below before contacting your local TES representative or TES technical service.

1. Make sure controllers, sensors, and power supplies are connected and communicating to desired devices.
2. Record precise hardware setup indicating the following:

   Version numbers of application software.

   Device and/or firmware version number.

   A complete description of difficulties encountered.

Notes:

LIMITED WARRANTY STATEMENT

Taco Electronic Solutions, Inc. (TES) will repair or replace without charge (at the company's option) any product or part which is proven defective under normal use within one (1) year from the date of start-up or one (1) year and six (6) months from date of shipment (whichever occurs first).

In order to obtain service under this warranty, it is the responsibility of the purchaser to promptly notify the local TES stocking distributor or TES in writing and promptly deliver the subject product or part, delivery prepaid, to the stocking distributor. For assistance on warranty returns, the purchaser may either contact the local TES stocking distributor or TES. If the subject product or part contains no defect as covered in this warranty, the purchaser will be billed for parts and labor charges in effect at time of factory examination and repair.

Any TES product or part not installed or operated in conformity with TES instructions or which has been subject to accident, disaster, neglect, misuse, misapplication, inadequate operating environment, repair, attempted repair, modification or alteration, or other abuse, will not be covered by this warranty.

TES products are not intended for use to support fire suppression systems, life support systems, critical care applications, commercial aviation, nuclear facilities or any other applications where product failure could lead to injury to person, loss of life, or catastrophic property damage and should not be sold for such purposes.

If in doubt as to whether a particular product is suitable for use with a TES product or part, or for any application restrictions, consult the applicable TES instruction sheets or in the U.S. contact TES at 401-942-8000 and in Canada contact Taco (Canada) Limited at 905-564-9422.

TES reserves the right to provide replacement products and parts which are substantially similar in design and functionally equivalent to the defective product or part. TES reserves the right to make changes in details of design, construction, or arrangement of materials of its products without notification.

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