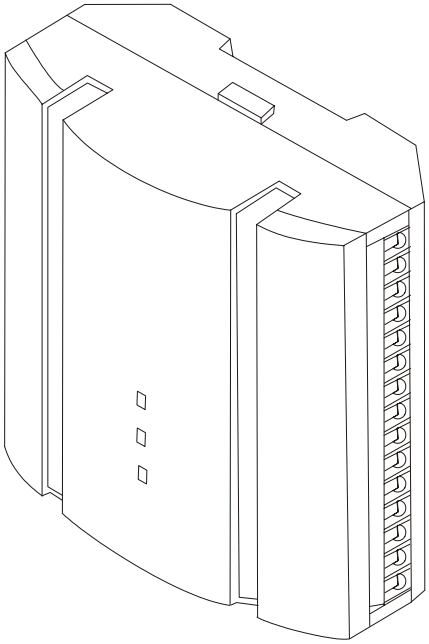
iWorX CCU-1 Application Manual

CCU-1

The iWorX CCU-1 chiller controller is a stand-alone microprocessor based controller for supervisory central chiller control applications that utilize one air-cooled chiller or a water-cooled centrifugal chiller with cooling tower.



Overview

Analog inputs are provided for chilled water supply temperature, chilled water return temperature, condenser water supply temperature, and condenser water return temperature. Digital inputs are provided for chiller pump flow status, condenser pump flow proof, a cooling water demand proof, and a chiller general alarm.

The CCU-1 incorporates digital outputs in the form of triacs for chiller low limit status and the start and stop of the chiller and condenser pumps. In addition, three analog outputs are provided to control a modulated bypass valve, a variable speed fan, and set the adjustable setpoint of the chiller.

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 chilled water in response to demand from other controllers.

Features

- Adjustable chiller setpoint
- Modulated cooling tower bypass valve
- Modulated cooling tower fan
- Minimum cycle timers for chiller On and Off
- Runtime accumulation for chiller, pumps, and fan
- Lead/Lag operation of water pumps
- Maximum of 60 cooling zones
- Proportional + Integral (P+I) control of the modulated bypass valve
- Proportional + Integral (P+I) control of a variable speed fan
- LONWORKS interface to building automation systems
- OAT low limit protection
- Flow proof inputs
- Chiller enable/demand input
- Chiller alarm input
- Automatic configuration with the LCI
- Alarm/Event reporting

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iWorX-CCU1-APP-100

Purpose of This Guide

The *iWorX CCU-1 Application Manual* provides application information for the CCU-1 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

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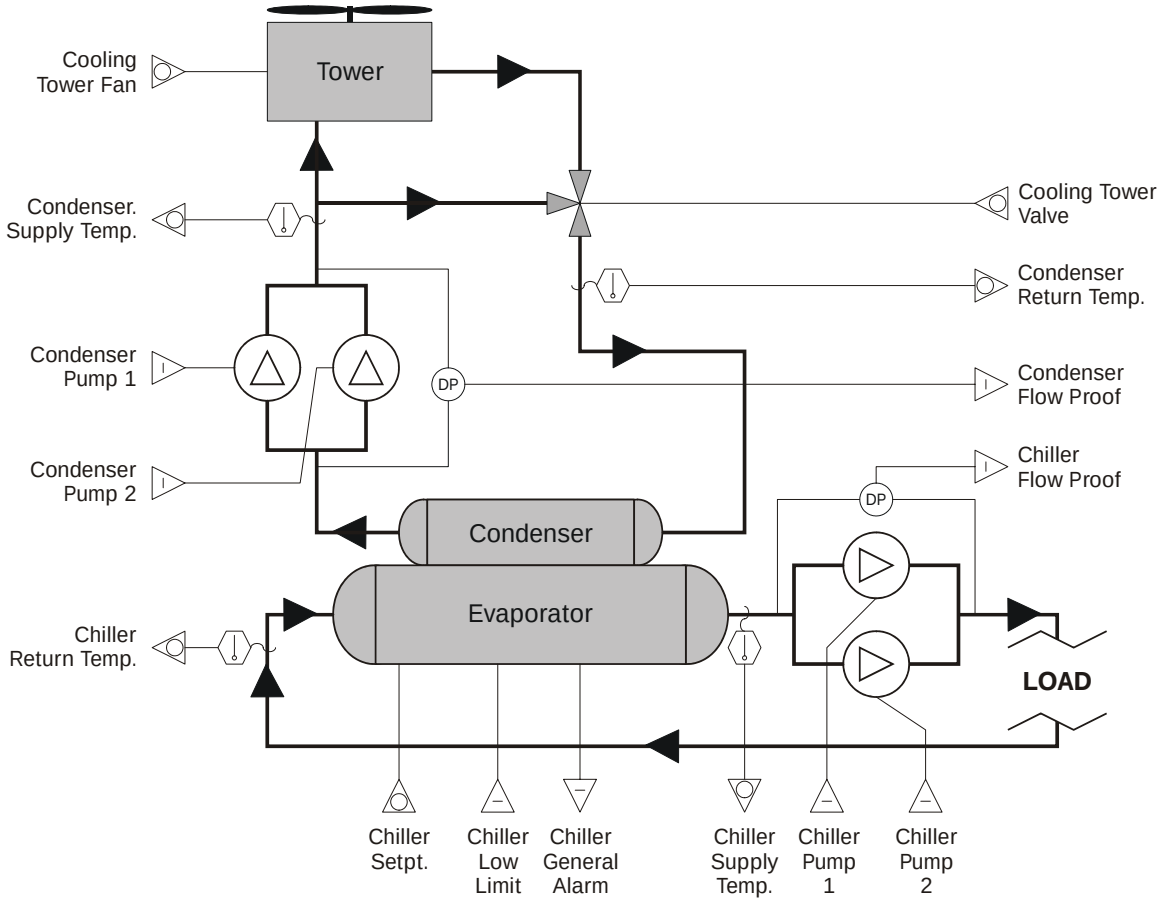
Applicable Documentation

Part Number	Description	Audience	Purpose
iWorX-CCU-INS-100	iWorX CCU Series Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides instructions for setting up and using the iWorX CCU-1 Controller.
iWorX-LCI1-USR-100	iWorX LCI User's Guide	– Application Engineers – Installers – Service Personnel – Start-up Technicians – End user	Provides instructions for setting up and using the iWorX Local Control Interface.
iWorX-AHU1-APP-100	iWorX AHU-1 Application Manual	– Application Engineers – Wholesalers – Contractors	These controllers may all operate in conjunction with the CCU-1. Application manuals provide specific application information about these controllers, including sequence of operation and configuration information.
iWorX-BZU1-APP-100	iWorX BZU-1 Application Manual		
iWorX-DXU2-APP-100	iWorX DXU-2 Application Manual		
iWorX-FCU1-APP-100	iWorX FCU-1 Application Manual		
iWorX-FCU2-APP-100	iWorX FCU-2 Application Manual		
iWorX-FCU3-APP-100	iWorX FCU-3 Application Manual		
iWorX-FCU4-APP-100	iWorX FCU-4 Application Manual		
iWorX-HPU1-APP-100	iWorX HPU-1 Application Manual		
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.		

Application Description

The CCU-1 chiller controller is a stand-alone microprocessor-based controller for supervisory control of central chiller applications that utilize either an air-cooled chiller or a water-cooled centrifugal chiller with a cooling tower. Two chilled water pumps are configured for lead/lag operation. The CCU-1 provides setpoint adjustment control of the chiller by integrating to the factory mounted chiller controls with a 0-10 VDC setpoint control signal. For chilled water plant applications that utilize a cooling tower, the CCU-1 controller provides control of the tower bypass valve and two cooling tower (condenser) pumps configured in a lead/lag configuration. Outputs are provided for control of the cooling tower bypass valve. Analog outputs are provided to support cooling tower applications with variable fan speed control.

Figure 1: CCU-1 with cooling tower



CCU-1 control starts only if there is a cooling water demand and the outside air temperature (OAT) is above the OAT Lockout setpoint. The CCU-1 operates in conjunction with up to 60 controllers that can require chilled water (FCU-1 through FCU-4, AHU-1, DXU-1, DXU-2, HPU-1). The cooling water demand is obtained by the CCU-1 from controllers that have been grouped with the CCU-1 at the LCI user interface during initial configuration. Cooling water demand can also be communicated through a digital input switch, or through a demand for chiller activation from the LCI.

Initial chiller control activates a chilled water pump. The factory-installed chiller controls, as provided by the chiller manufacturer, detect water flow in the chilled water loop and activate the chiller. An anti-cycle function provides configurable chiller minimum On and Off times.

The CCU-1 includes support for two chilled water pumps, with only one pump required for normal operation. One of the pumps is designated the lead pump, with the lag pump only being required in the event of a lead pump alarm. Each time the chiller is deactivated, the lead pump designation is transferred to the other pump.

When the chiller is activated, the lead chiller pump is started. If the chiller pump has been commanded on for at least 20 seconds and the chiller 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 chiller pumps fail, all outputs are turned off, all control stops, and a dual pump failure alarm is generated. Manual reset of the CCU-1 controller from the operator interface or by cycling power to the CCU-1 is required to restart control.

The CCU-1 also includes support for two condenser water pumps, with only one pump required for normal operation. One of the pumps is designated 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.

In a water-cooled chiller, when the chilled water pump is started the lead condenser pump is started also. If the condenser pump has been commanded on for at least 20 seconds and the condenser 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 condenser pumps fail, all outputs are turned off, all control stops, and a dual pump failure alarm is generated. Manual reset of the CCU-1 controller from the operator interface or by cycling power to the CCU-1 is required to restart control.

An analog output is provided for setpoint adjustment utilizing the factory-mounted chiller controls. The chiller setpoint adjust feature of the CCU-1 enables the user to change the chilled water supply setpoint through the LCI.

The bypass valve position is calculated by a Proportional + Integral (P+I) control loop based on the condenser water return temperature and the condenser water setpoint. The bypass valve control loop is activated 15 seconds after the condenser water flow proof has confirmed flow. As the temperature increases above the condenser water setpoint, the bypass valve is modulated open. The bypass valve is modulated closed as the water temperature decreases below the condenser setpoint. The cooling tower bypass valve control loop is selectable for direct or reverse acting operation.

The cooling tower fan speed is calculated by a P+I control loop based on the condenser water return temperature and the cooling tower water setpoint. 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 cooling tower water setpoint, the fan speed is increased. The fan speed is decreased as the water temperature decreases below the cooling tower setpoint. The fan speed control loop is selectable for direct or reverse acting operation.

The CCU-1 provides low limit control. When the outside air temperature drops below the low limit setpoint as sensed by an ASM controller on the system network, the chilled water pump energizes and the chiller low limit output is enabled. The chiller low limit output is interfaced to the factory supplied chiller controls to signal the chiller to not start in response to the chilled water pump operation during the low limit condition. The chilled water pump and chiller low limit output de-energizes when the temperature rises 1 °F above the low limit setpoint.

A digital input is provided on the CCU-1 to monitor the status of the chiller’s general alarm. An alarm is reported to the LCI when the chiller reports a general alarm condition.

The CCU-1 monitors the runtime of all four pumps, the chiller, and the fan. When any one of the runtimes exceeds a programmable limit, a maintenance alarm is reported to the LCI.

When the water temperatures exceed a programmable limit, a high limit alarm is reported to the LCI. When the water temperature drops below a programmable limit, a low limit alarm is reported to the LCI. When the water temperature returns to the proper range, a return to normal is generated.

Sequence of Operation

This section describes the detailed sequence of operation for the CCU-1 control algorithms.

Chiller Activation

CCU-1 control starts only if there is a cooling water demand and the OAT acquired from the network via an auxiliary sensor module (ASM) is above the OAT Lockout setpoint. The CCU-1 operates in conjunction with up to 60 controllers that can require chilled water (FCU-1 through FCU-4, AHU-1, DXU-1, DXU-2, HPU-1). The cooling water demand is obtained by the CCU-1 from controllers that have been associated with the CCU-1 at the LCI user interface during configuration. The CCU-1 polls each associated controller to determine if cooling has been requested.

Cooling water demand can also be communicated to the CCU-1 through a digital input switch or a demand for chiller activation at the LCI. Activation through the digital input switch will not override an OAT lockout condition. Activation through the LCI will override an OAT lockout condition.

Initial chiller control activates a chilled water pump. The factory installed chiller controls, as provided by the chiller manufacturer, detect chilled water loop water flow and activate the chiller. An anti-cycle function provides configurable chiller minimum On and Off times.

Chiller Setpoint Adjustment

The CCU-1 provides setpoint adjustment control of the chiller by integrating to the factory mounted chiller controls with a 0-10 VDC setpoint control signal. The chiller setpoint adjustment provides the ability for the user to change the chilled water supply setpoint through the LCI. The analog output has a user adjustable scaling range.

Chiller Pump Control

The CCU-1 includes support for two chilled water pumps, with only one pump required for normal operation. One of the pumps is designated the lead pump, with the lag pump only being required in the event of a lead pump alarm. Each time the chiller is deactivated, the lead pump designation is transferred to the other pump.

When the system is activated, the lead chiller pump is started. If the chiller pump has been commanded on for at least 20 seconds and the chiller 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 chiller pumps fail, all outputs are turned off, all control stops, and a dual pump failure alarm is generated. Manual reset of the CCU-1 controller from the operator interface or by cycling power to the CCU-1 is required to restart control.

Condenser Pump Control

The CCU-1 also includes support for two condenser water pumps, with only one pump required for normal operation. 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 chiller is deactivated, the lead pump designation is transferred to the other pump.

When the chilled water pump is started, the lead condenser pump is started also. If the condenser pump has been commanded on for at least 20 seconds and the condenser 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 condenser pumps fail, all outputs are turned off, all control stops, and a dual pump failure alarm is generated. Manual reset of the CCU-1 controller from the operator interface or by cycling power to the CCU-1 is required to restart control.

Cooling Tower Bypass Valve Control

The cooling tower bypass valve is controlled when the CCU-1 is configured for a water cooled chiller. The bypass valve position is calculated by a Proportional + Integral (P+I) control loop based on the condenser water return temperature and the condenser water setpoint. The bypass valve control loop is activated 15 seconds after the condenser water flow proof has confirmed flow.

As the temperature increases above the condenser water setpoint, the bypass valve is modulated open. The bypass valve is modulated closed as the water temperature decreases below the condenser setpoint. The cooling tower bypass valve control loop is selectable for direct or reverse acting operation

To prevent the integral component from becoming too large, there is anti-wind up reset protection. 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 = *CondenserRetWtrTemp* - *RetWtrSp*
$I = I + (K_i \times Error)$
$ValvePosition = (K_P \times (Error + I)) + 50.00\%$

The valve can be set for reverse action by exchanging the maximum and value settings during configuration. That is, if the default maximum of 10 Volts and default minimum of 0 Volts are being used for reverse action, set the minimum to 10 Volts and the maximum to 0 Volts.

Cooling Tower Variable Speed Fan Control

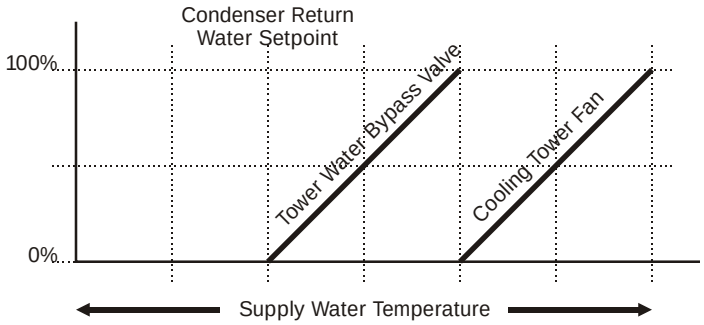
The cooling tower variable speed fan is controlled when the CCU-1 is configured for a water cooled chiller. The cooling tower fan speed is calculated by a P+I control loop based on the condenser water return temperature and the cooling tower water setpoint. The fan speed control loop is activated 15 seconds after the cooling tower bypass valve has modulated to its 100% position (full flow through tower).

As the temperature increases above the cooling tower water setpoint, the fan speed is increased. The fan speed is decreased as the water temperature decreases below the cooling tower setpoint. The fan speed control loop is selectable for direct or reverse acting operation.

To prevent the integral component from becoming too large, there is anti-wind up reset protection. 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 = *CondenserRetWtrTemp* - *CtFanSp*
I = *I* + (K_i x *Error*)
ValvePosition = (K_P x (*Error* + *I*)) + 50.00%

Figure 2: Cooling Tower Sequence



The valve can be set for reverse action by exchanging the maximum and value settings during configuration.

Chiller Low Limit Control

The CCU-1 provides low limit control. When the outside air temperature drops below the low limit setpoint as sensed by the ASM on the network, the CCU-1 energizes the chiller low limit output and starts the chilled water pump. The chiller low limit output is interfaced to the factory supplied chiller controls to signal the chiller to not start in response to the chilled water pump operation in the low limit condition. The chilled water pump and chiller low limit output de-energizes when the temperature rises 1 °F above the low limit setpoint.

Chiller Alarm Status

The chiller alarm status input is monitored to determine if the chiller is operating properly. The input is used to indicate that an alarm occurred or maintenance is required on the chiller. The unit is not shut down due to a chiller alarm.

Runtime Accumulations

The total runtime is accumulated for the chiller, chiller pump 1, chiller pump 2, condenser pump 1, condenser pump 2, and fan output. The runtimes can be used to indicate that maintenance is required on the equipment controlled by these outputs. An operator or maintenance personal 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 can occur, you must use the LCI to configure the controller.

Digital Input Alarms

The CCU-1 monitors the status of the digital inputs and generates alarms for the following events:

- Chiller General Alarm

Maintenance Alarm

A CCU-1 provides programmable runtime limits for generating runtime maintenance alarms. When the chiller runtime, pump runtime or fan runtime exceeds these limits, a maintenance alarm is sent to the LCI.

Water Temperature Alarms

After a 1 minute delay following chiller startup, the CCU-1 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.

Pump Alarms

If the chiller pump has been commanded on for at least 20 seconds and the chiller 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 chiller pumps fail, all outputs are turned off, all control stops, and a dual pump failure alarm is generated. Manual reset of the CCU-1 controller from the operator interface or by cycling power to the CCU-1 is required to restart control.

If the condenser pump has been commanded on for at least 20 seconds and the condenser 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 condenser pumps fail, all outputs are turned off, all control stops, and a dual pump failure alarm is generated. Manual reset of the CCU-1 controller from the operator interface or by cycling power to the CCU-1 is required to restart control.

Automatic Configuration

The CCU-1 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 CCU-1 when the controller's service pin is pressed. The controller's status light flashes green until the controller is configured, and will be 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 CCU-1 with LNS or other LONWORKS tools if they wish.

The LCI also provides network supervision of the CCU-1. The LCI periodically sends a "ping" message to the CCU-1, 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.

CCU-1 Configuration

Once the CCU-1 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 CCU-1, and the meanings and default values for controller parameters. For more information on using the LCI, see the *iWorX LCI User's Guide.*

Setup

The Setup screen gives you access to controller settings.

Cooling Tower Fan

This wizard enables you to view and set parameters directly related to control of the cooling tower fan. The maximum and minimum voltages for the fan output are shown on a line graph on the right of the screen. There are also a number of other setpoints listed below the graph.

Table 1: Cooling Tower Fan settings

Table 2:

Setting	Range	Default	Description
Cooling Tower Fan Setpoint	32.00 to 80.60 °F (0 to 27.00 °C)	50.0°F (10.0 °C)	Temperature setpoint for P+I control of the cooling tower fan.
Cooling Tower Fan Minimum	0.0 to 10.0 Volts	0.0 Volts	Minimum voltage of the cooling tower fan output.[a]
Cooling Tower Fan Maximum	0.0 to 10.0 Volts	10.0 Volts	Maximum voltage of the cooling tower fan output.[a]
Cooling Tower Fan Kp	0.00 to 100.00% per degree of temperature	50.00%	Proportional gain for P+I control of the cooling tower fan.
Cooling Tower Fan Ki	0.00 to 100.00%	0.05%	Integral gain for P+I control of the cooling tower fan.

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

Cooling Tower Valve

This wizard enables you to view and set parameters directly related to control of the cooling tower valve. The open and close voltages are shown on a line graph on the right of the screen. There are also a number of other setpoints listed below the graph.

Table 3: Cooling Tower Valve settings

Table 4:

Setting	Range	Default	Description
Cooling Tower Valve Setpoint	32.00 to 80.60 °F (0 to 27.00 °C)	44.9 °F (7.2 °C)	Temperature setpoint for P+I control of the cooling tower valve.
Cooling Tower Valve Minimum	0.0 to 10.0 Volts	0.0 Volts	Minimum voltage of the cooling tower valve output.[a]
Cooling Tower Valve Maximum	0.0 to 10.0 Volts	10.0 Volts	Maximum voltage of the cooling tower valve output.[a]
Cooling Tower Valve Kp	0.00 to 100.00% per degree of temperature	50.00%	Proportional gain for P+I control of the cooling tower valve.
Cooling Tower Valve Ki	0.00 to 100.00%	0.05%	Integral gain for P+I control of the cooling tower valve.

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

Alarm Limits

This screen displays the setpoints that relate specifically to alarms.

Table 5: Alarm Limits settings

Table 6:

Setting	Range	Default	Description
Chiller Minimum On	0 to 180 minutes	30 minutes	Minimum amount of time the chiller must remain on.
Chiller Minimum Off	0 to 180 minutes	30 minutes	Minimum amount of time the chiller must remain off.
Chiller Minimum Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	37.9 °F (3.3 °C)	Chiller supply temperature below which an alarm is generated.
Chiller Maximum Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	54.9 °F (12.7 °C)	Chiller supply temperature above which an alarm is generated.
Chiller Minimum Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	37.9 °F (3.3 °C)	Chiller return temperature below which an alarm is generated.
Chiller Maximum Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	54.9 °F (12.7 °C)	Chiller return temperature above which an alarm is generated.
Condenser Min. Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Condenser supply temperature below which an alarm is generated.
Condenser Max. Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	59.9 °F (15.5 °C)	Condenser supply temperature above which an alarm is generated.
Condenser Min. Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Condenser return temperature below which an alarm is generated.
Condenser Max. Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	59.9 °F (15.5 °C)	Condenser return temperature above which an alarm is generated.
Water Temp. Alarm Hysteresis	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.

Chilled Water Setpoints

This screen displays just the setpoints that relate directly to the chilled water being produced by the chiller.

Table 7: Chilled Water Setpoints settings

Table 8:

Setting	Range	Default	Description
Chiller Setpoint	32.00 to 80.60 °F (0 to 27.00 °C)	44.9 °F (7.2 °C)	Desired temperature of the chiller supply.
Chiller Minimum	32.00 to 80.60 °F (0 to 27.00 °C)	39.9 °F (4.4 °C)	Minimum output temperature for chiller setpoint adjustment scaling.
Chiller Maximum	32.00 to 80.60 °F (0 to 27.00 °C)	59.9 °F (15.5 °C)	Maximum output temperature for chiller setpoint adjustment scaling.

Chiller

Press this button to enable the chiller regardless of cooling demand or OAT lockout. When the chiller is enabled in this way, the button changes to display the “On”. Press the button again to switch the chiller back to automatic operation.

Grouping Buttons

These three buttons enable you to configure which devices on the network are being supplied with chilled water by the current CCU-1.

Press **Add New Device** to see a list of available devices. Use the up and down arrow keys to select a device (use **Page Up** and **Page Down** if the list is longer than one screen), then press **Select** to move it to the list of devices in the CCU-1's group.

Press **Devices in Group** to see a list of devices that are currently in the CCU-1's group. If you wish to remove a device from this list, use the up and down arrow keys to select a device (use **Page Up** and **Page Down** if the list is longer than one screen), then press **Delete**.

Press **Send Grouping** to inform the CCU-1 which devices are associated with it.

List All Settings

This screen displays all setpoints used by the CCU-1 controller. Use the up and down arrow keys to select a value to change, then use **–** or **+** to increase or decrease the value (or utilize **USE KEYS** to directly enter the desired value). Press **Save** to save your changes or **Back** to return to the Setup screen.

Table 9: All CCU-1 Settings

Setting	Range	Default	Description
Chiller Enable	Auto, On	Auto	Set to "On" to enable the chiller regardless of cooling demand.
Cooling Tower Valve Setpoint	32.00 to 80.60 °F (0 to 27.00 °C)	44.9 °F (7.2 °C)	Temperature setpoint for P+I control of the cooling tower valve.
Cooling Tower Fan Setpoint	32.00 to 80.60 °F (0 to 27.00 °C)	50.0°F (10.0 °C)	Temperature setpoint for P+I control of the cooling tower fan.
Cooling Tower Valve Kp	0.00 to 100.00% per degree of temperature	50.00%	Proportional gain for P+I control of the cooling tower valve.
Cooling Tower Valve Ki	0.00 to 100.00%	0.05%	Integral gain for P+I control of the cooling tower valve.
Cooling Tower Fan Kp	0.00 to 100.00% per degree of temperature	50.00%	Proportional gain for P+I control of the cooling tower fan.
Cooling Tower Fan Ki	0.00 to 100.00%	0.05%	Integral gain for P+I control of the cooling tower fan.
Cooling Tower Valve Minimum	0.0 to 10.0 Volts	0.0 Volts	Minimum voltage of the cooling tower valve output.[a]
Cooling Tower Valve Maximum	0.0 to 10.0 Volts	10.0 Volts	Maximum voltage of the cooling tower valve output.[a]
Cooling Tower Fan Minimum	0.0 to 10.0 Volts	0.0 Volts	Minimum voltage of the cooling tower fan output.[a]
Cooling Tower Fan Maximum	0.0 to 10.0 Volts	10.0 Volts	Maximum voltage of the cooling tower fan output.[a]
Chiller Setpoint	32.00 to 80.60 °F (0 to 27.00 °C)	44.9 °F (7.2 °C)	Desired temperature of the chiller supply.
Chiller Minimum	32.00 to 80.60 °F (0 to 27.00 °C)	39.9 °F (4.4 °C)	Minimum output temperature for chiller setpoint adjustment scaling.
Chiller Maximum	32.00 to 80.60 °F (0 to 27.00 °C)	59.9 °F (15.5 °C)	Maximum output temperature for chiller setpoint adjustment scaling.
Chiller Runtime Limit	0 to 65535 hours	1000 Hours	Runtime limit for chiller after which a maintenance alarm is generated.
Fan Runtime Limit	0 to 65535 hours	1000 Hours	Runtime limit for cooling the tower fan after which a maintenance alarm is generated.

Table 9: All CCU-1 Settings

Setting	Range	Default	Description
Pump Runtime Limit	0 to 65535 hours	1000 Hours	Runtime limit for pumps after which a maintenance alarm is generated.
Outdoor Air Temp. Lockout	32.00 to 140.00 °F (0.00 to 60.00 °C)	51.9 °F (11.1 °C)	Outdoor air temperature below which the chiller is disabled.
Outdoor Air Temp. Low Limit	32.00 to 140.00 °F (0.00 to 60.00 °C)	32.0 °F (0.0 °C)	Outdoor air temperature below which low limit control is enabled.
Chiller Type	Water Cooled, Air Cooled,	Water Cooled	Type of chiller being controlled.
Chiller Minimum On	0 to 180 minutes	30 minutes	Minimum amount of time the chiller must remain on.
Chiller Minimum Off	0 to 180 minutes	30 minutes	Minimum amount of time the chiller must remain off.
Chiller Minimum Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	37.9 °F (3.3 °C)	Chiller supply temperature below which an alarm is generated.
Chiller Maximum Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	54.9 °F (12.7 °C)	Chiller supply temperature above which an alarm is generated.
Chiller Minimum Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	37.9 °F (3.3 °C)	Chiller return temperature below which an alarm is generated.
Chiller Maximum Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	54.9 °F (12.7 °C)	Chiller return temperature above which an alarm is generated.
Condenser Min. Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Condenser supply temperature below which an alarm is generated.
Condenser Max. Supply Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	59.9 °F (15.5 °C)	Condenser supply temperature above which an alarm is generated.
Condenser Min. Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	42.9 °F (6.1 °C)	Condenser return temperature below which an alarm is generated.
Condenser Max. Return Temp.	32.00 to 140.00 °F (0.00 to 60.00 °C)	59.9 °F (15.5 °C)	Condenser return temperature above which an alarm is generated.
Water Temp. Alarm Hysteresis	0.00 to 10.00 °F (0.0 to 5.5 °C)	5.0 °F (2.7 °C)	Offset subtracted from the min. water temp. setpoints to form the water temp. low limit alarm setpoint and added to the max. water temp. setpoints to form the water temp. high limit setpoint.
Zone Limit	0 to 60	1	Number of zones that must signal demand to activate cooling mode.

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

Inputs

The Inputs screen displays the current values of the CCU-1's inputs. These values cannot be changed.

Table 10: CCU-1 Inputs

Input	Range	Description
Outside Temperature	-22.00 to 122.00 °F (-30.00 to 50.00 °C)	Outside air temperature reported by an external temperature sensor over the network.
Chiller Flow	Off, On	Status of the CFP switch.
Condenser Flow	Off, On	Status of the CDFP switch.
Chiller General Alarm	Off, On	Status of the chiller's alarm output.
Cooling Water Demand	Off, On	Status of the CWD switch.
Chiller Supply Temperature	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by CWS sensor.
Chiller Return Temperature	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by CWR sensor.
Condenser Supply Temp.	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by CDS sensor.
Condenser Return Temp.	-30.00 to 230.00 °F (-34.40 to 110.00 °C)	Temp. reported by CDR sensor.

Outputs

This screen displays the current values of the CCU-1's outputs. These values cannot be changed.

Table 11: CCU-1 Outputs

Output	Range	Description
Chiller Pump 1	Off, On	Status of chiller pump 1.
Chiller Pump 2	Off, On	Status of chiller pump 2.
Condenser Pump 1	Off, On	Status of condenser pump 1.
Condenser Pump 2	Off, On	Status of condenser pump 2.
Chiller Low Limit	Off, On	Status of the chiller low limit output.
Cooling Tower Valve	0.00% to 100.00%	Status of the cooling tower valve output.
Cooling Tower Fan	0.00% to 100.00%	Status of the cooling tower fan output.
Mode	Off, Cooling	Current mode of the chiller system.

This screen also displays the current status of each device in the CCU-1's group. Each device is displayed on its own line, and is identified as being off or in cooling mode.

Runtimes/Limits

This screen shows all runtime totals and runtime limits for the CCU-1. To reset a runtime total to zero, use the up and down arrows to highlight the value, and then press **Reset**. To change a value, highlight it and press **Select**.

Table 12: CCU-1 Runtimes/Limits

Setting	Range	Default	Description
Fan Runtime	0 to 65535 hours	N/A	Current cooling tower fan runtime.
Fan Runtime Limit	0 to 65535 hours	1000 hours	Runtime limit for cooling tower fan after which a maintenance alarm is generated.
Chiller Runtime	0 to 65535 hours	N/A	Current chiller runtime.
Chiller Runtime Limit	0 to 65535 hours	1000 hours	Runtime limit for chiller after which a maintenance alarm is generated.
Chiller Pump 1 Runtime	0 to 65535 hours	N/A	Current runtime total of chiller pump 1.
Chiller Pump 2 Runtime	0 to 65535 hours	N/A	Current runtime total of chiller pump 2.
Condenser Pump 1 Runtime	0 to 65535 hours	N/A	Current runtime total of condenser pump 1.
Condenser Pump 2 Runtime	0 to 65535 hours	N/A	Current runtime total of condenser pump 2.
Pump Runtime Limit	0 to 65535 hours	1000 hours	Runtime limit for system pumps after which a maintenance alarm is generated for that pump.

Troubleshooting

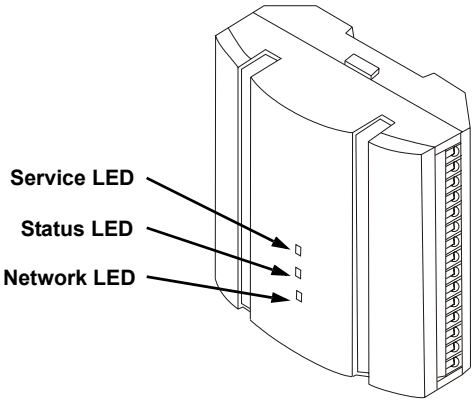
Diagnostic LEDs

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 top to bottom on the unit.

Table 13: Diagnostic LEDs

LED	Indication
Service	– Illuminated when the service pin is pushed
Status	– Solid green when running and configured by an LCI – Flashing green when running and NOT configured by an LCI – Solid red when a fault condition exists
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

Figure 3: Diagnostic LEDs



Troubleshooting Tips

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).

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.

Can my iWorX system contain multiple CCU-1 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 (T28) 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 CCU-1?

Use the CCU-1's grouping mechanism, specifically **`Add New Device`** on the CCU-1 Setup screen of the LCI.

What is `Send Grouping` for, and when do I press it?

This button stores network information into the CCU-1 about the controllers in its group. Press this button when you have made any changes to the grouping.

What iWorX controllers can be part of a CCU-1's group?

Only FCU-1, FCU-2, FCU-3, FCU-4, AHU-1, DXU-1, DXU-2, and HPU-1 controllers can be part of the CCU-1's group and demand cooling from it.

Several controllers are requesting cooling, but the chiller and pumps have not been enabled.

The "Zone Limit" setting may be set higher than the number of zones that are currently requesting cooling. The chiller and pumps will not be enabled until the number of zones requesting cooling is greater than the Zone Limit setting.

If the number of controllers requesting cooling exceeds the Zone Limit setting, but the chiller is still not enabled, the outside air temperature may be less than the "Outdoor Air Temp. Lockout" setting.

I only have one chiller pump; 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 chiller pump outputs in parallel from the controller to the existing pump and the system will operate normally. The same can be done for the condenser pump outputs if you have only one condenser pump.

The LCI is reporting a dual pump failure. How do I know which pumps have failed?

Check the pump alarms that precede the dual pump failure alarm. These two alarms will indicate which two pumps have failed, the chiller pumps or the condenser pumps.