iWorx by Taco Electronic Solutions

Application Guide

505-037-3

FCU4 Fan Coil Unit

Self-Contained Interoperable Controller Model UCP-1 for Software Version 3

SUPERSEDES: November 24, 2014 EFFECTIVE: October 26, 2015

Plant ID: 001-4061

Table of Contents

THIS PAGE LEFT BLANK INTENTIONALLY

505-037-3, Effective: October 26, 2015

FCU4

The FCU4 Fan Coil Unit is a microprocessor-based controller for four-pipe fan coil units with one coil for heating and one coil for cooling.

Overview

The controller provides BTU energy monitoring for one heating loop and one cooling loop. It also measures supply water temperature, flow, and return water temperature of each loop. Inputs for fan proof, occupancy sensor, and indoor air quality (digital or analog) are also provided. Space temperature and humidity are sensed by a two-wire serial interface to an iWorx® TS 300 series thermostat.

The controller incorporates digital outputs in the form of triacs for three-speed fan operation, two heating stages, and two cooling stages. The heating and cooling stages may also be configured for floating setpoint operation.

The controller also incorporates 0-10VDC outputs for damper modulation, fan modulation, and cold/hot water modulation.

Features

- Two stages of cooling or floating point or 0-10 VDC
- Modulated control with digital enable signal for cooling
- Two stages of heating or floating point or 0-10 VDC
- Modulated control with digital enable signal for heating
- Three-speed fan control
- Modulated fan control
- User configured combination of digital and analog fan control
- Fan control energized on call for heating, cooling, IAQ and dehumidification
- Fan status input for additional safety interlocks
- Damper modulation to control two speeds of air velocity
- Dehumidification (cooling coil must be upstream of heating coil)
- External Dehumidification
- Optional BTU energy monitoring
- Optional Water Flow metering
- IAQ detection, configurable for digital or analog sensors
- Individual temperature setpoints for occupied/unoccupied heat and cool
- Thermostat with space temperature, space humidity, setpoint adjust, fan override, occupancy override
- Optional use of Precon type III temperature sensor for controlling to duct temperature
- Commissioning mode for direct control
- Automatic Calibration of Air Flow Constant (K)
- Calculation of Air Flow Constant (K) from Sensor gain and duct cross sectional area
- LonWorks interface to building automation systems and host products
- Automatic configuration with the LCI2
- Datapoints exposed through network variables
- Alarm/Event reporting

PURPOSE OF THIS GUIDE

The *iWorx® FCU4 Application Guide* provides application information for the Fan Coil Unit 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

This Document is subject to change from time to time at the sole discretion of Taco Electronic Solutions, Inc. All updates to the Document are available at www.taco-hvac.com. When installing this product, it is the reader's responsibility to ensure that the latest version of the Document is being used.

iWorx® products shall only be used for the applications identified in the product specifications and for no other purposes. For example, iWorx® 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 used for such purposes.

Taco Electronic Solutions, Inc. will not be responsible for any product or part not installed or operated in conformity with the Document and instructions or which has been subject to accident, disaster, neglect, misuse, misapplication, inadequate operating environment, repair, attempted repair, modification or alteration, or other abuse. For further information, please refer to the last page of this Document for the company's Limited Warranty Statement, which is also issued with the product or available at www.taco-hvac.com.

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.
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.	

505-037-3, Effective: October 26, 2015

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.

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 FCU4 module which supports a fan coil unit.

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

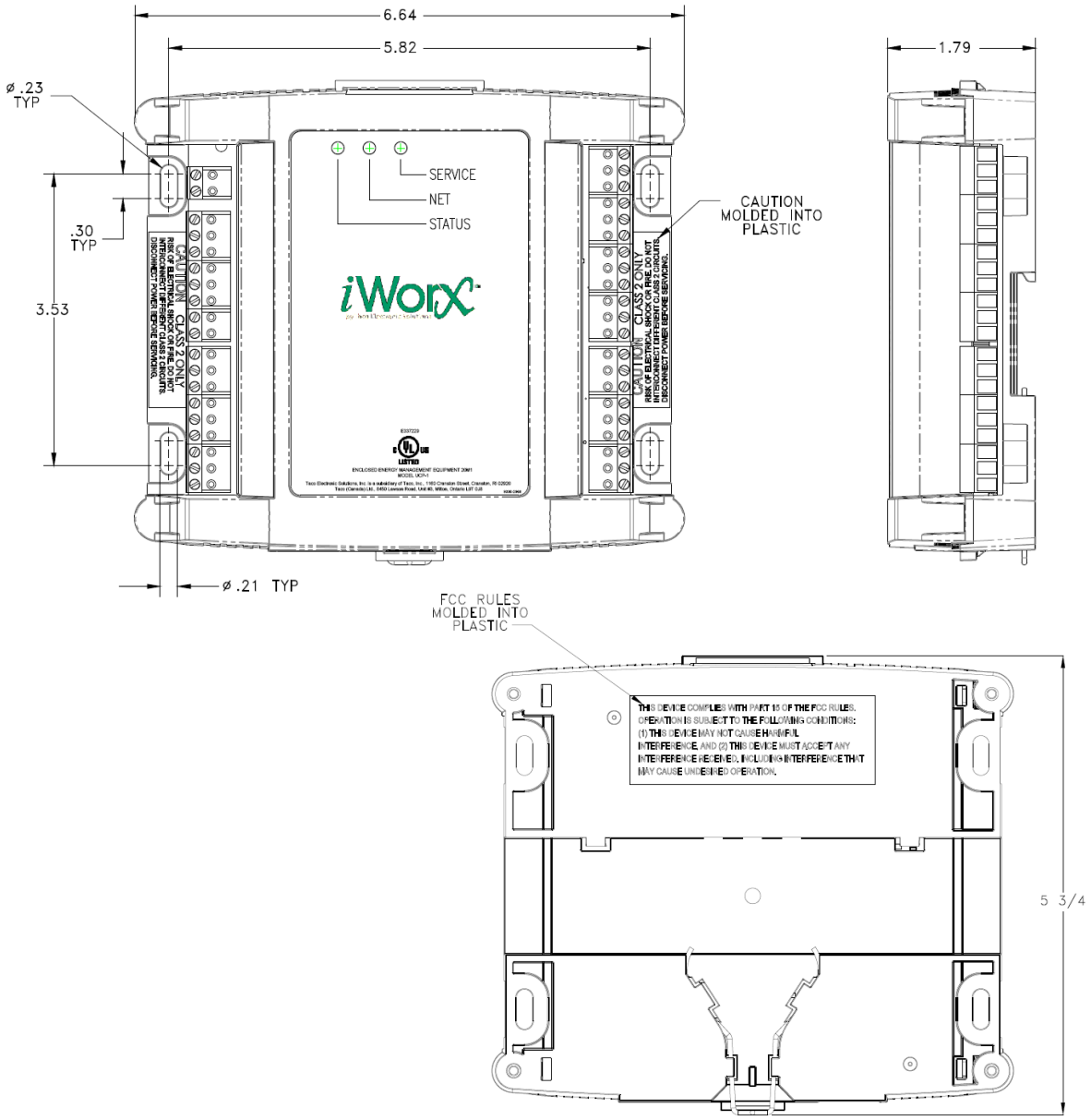
Warning: Electrical shock hazard. To prevent electrical shock or equipment damage, disconnect **ALL** power sources to controllers and loads before installing or servicing this equipment or modifying any wiring.

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).

505-037-3, Effective: October 26, 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

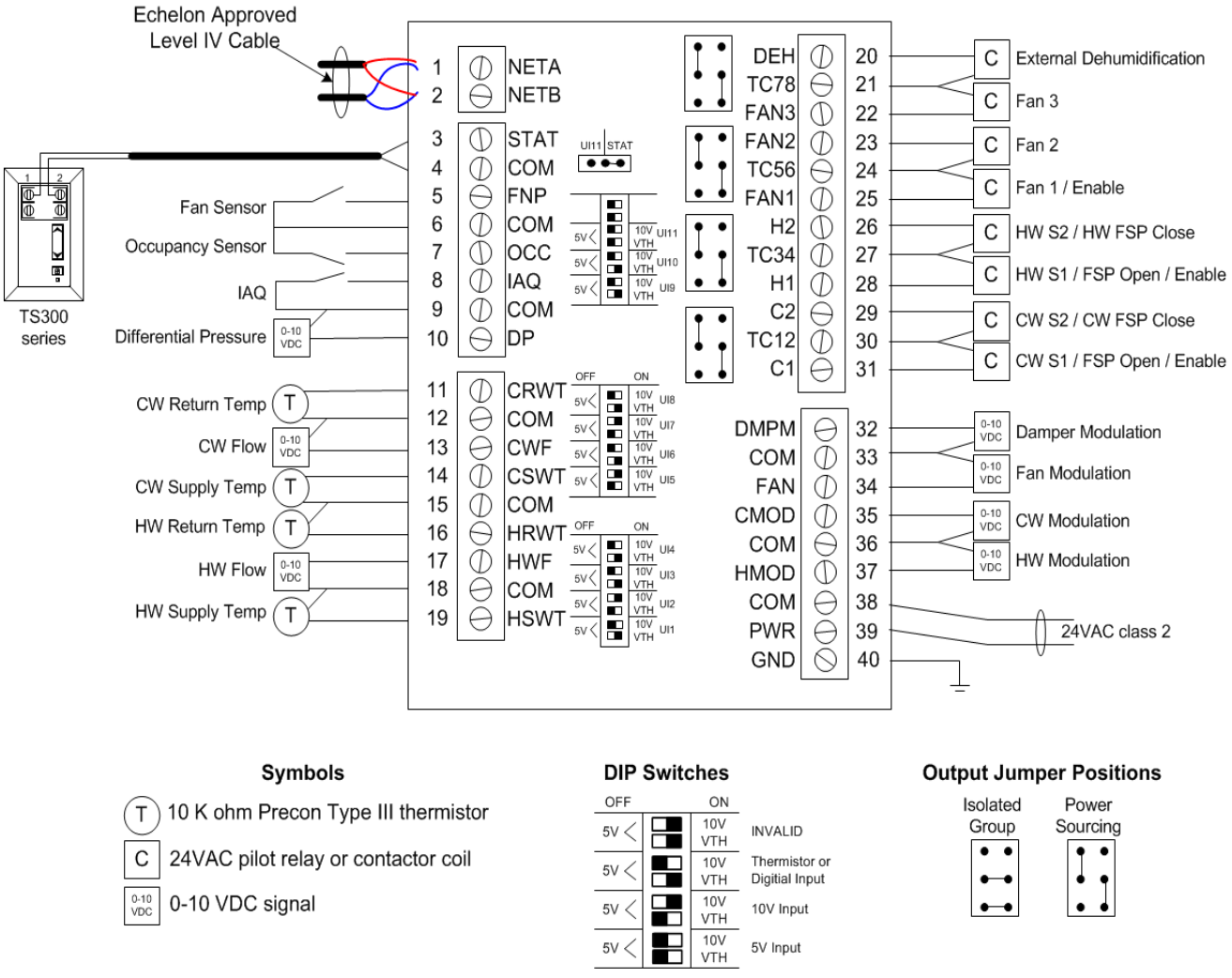
The ground terminal (T40) must be securely connected to earth ground. Failure to properly ground this equipment will result in improper operation. Improper grounding may also increase the risk of electrical shock and may increase the possibility of interference with radio/TV reception.

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

WIRING INFORMATION

WARNING: Terminals 4, 6, 9, 12, 15, and 18 are connected internally on all FCU4 controllers. Disconnect **ALL** power sources when installing or servicing this equipment to prevent electrical shock or equipment damage.

Figure 2: FCU4 Wiring Example - Power Sourcing



Symbols

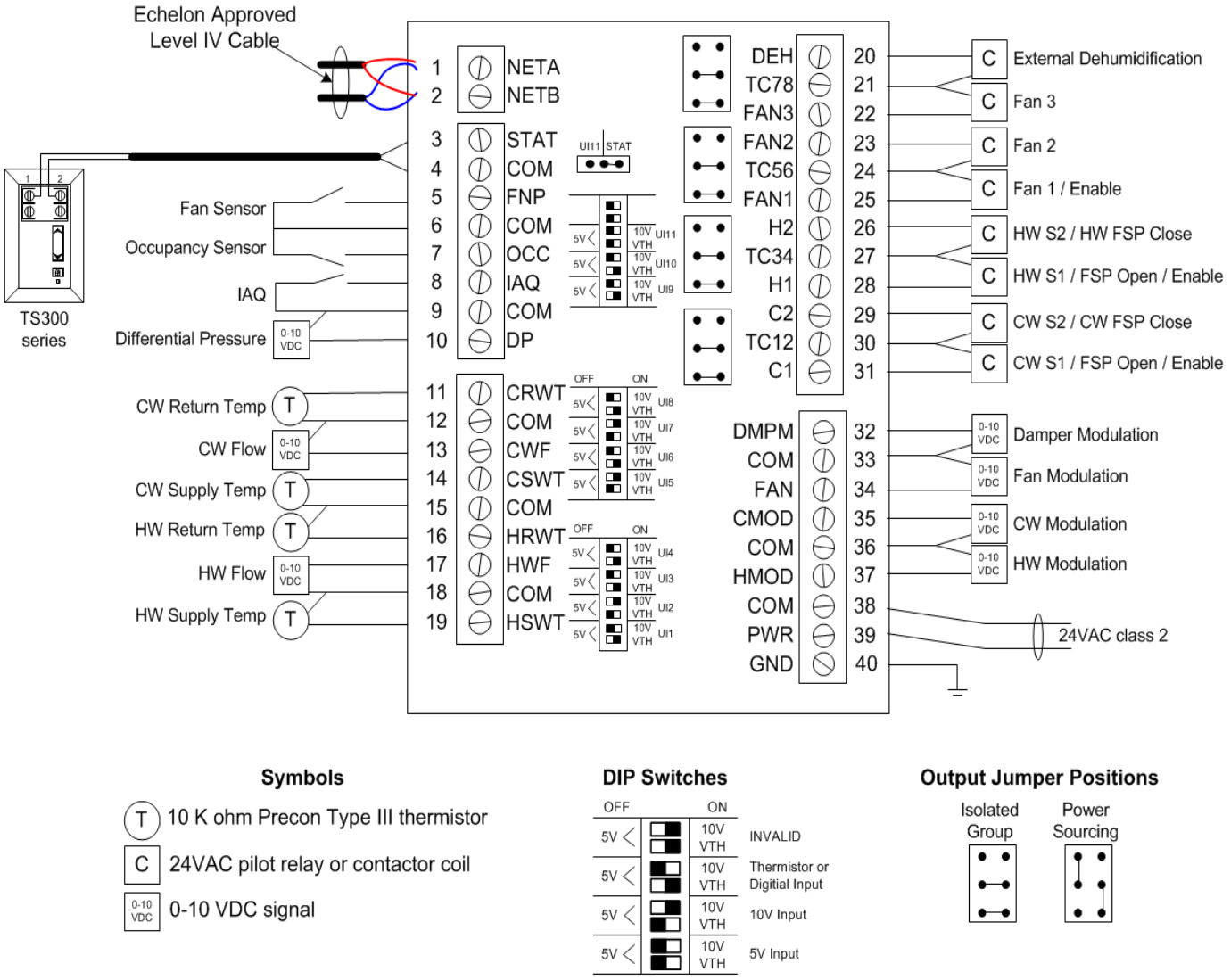
- T — 10 K ohm Precon Type III thermistor
- C — 24VAC pilot relay or contactor coil
- 0-10 VDC — 0-10 VDC signal

DIP Switches

Output Jumper Positions

505-037-3, Effective: October 26, 2015

Figure 3: FCU4 Wiring Example - Power Isolated

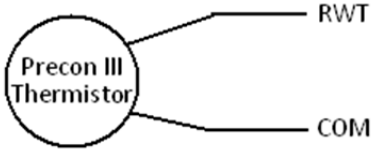


Connecting Input Devices

The figures below demonstrate typical sensor wiring.

Precon II or III sensors are wired as a standard thermistor. One terminal is connected to a common pin, the other to the RWT input. DIP switches for inputs connected to Precon II or III sensors must be configured for VTH input.

Figure 4: Precon III Sensor Wiring



Hot Supply Water Temperature (HSWT)

To connect the Hot Supply Water Temperature sensor to the unit, attach one wire from the thermistor to HWST (T19) and the other wire to the adjacent common (T18). Depending on the type of sensor, the DIP switch settings must be changed. Please refer to the Wiring Information for the sensor types and the corresponding DIP switch settings.

Hot Water Flow (HWF)

To connect the Hot Water Flow sensor to the unit, attach one wire from the sensor to HWF (T17) and the other wire to the adjacent common (T18). The sensor must be of the 0-10 Volt type.

Hot Return Water Temperature (HRWT)

To connect the Hot Return Water Temperature sensor to the unit, attach one wire from the thermistor to HRWT (T16) and the other wire to the adjacent common (T15). Depending on the type of sensor, the DIP switch settings must be changed. Please refer to the Wiring Information for the sensor types and the corresponding DIP switch settings.

Cold Supply Water Temperature (CSWT)

To connect the Cold Supply Water Temperature sensor to the unit, attach one wire from the thermistor to CSWT (T14) and the other wire to the adjacent common (T15). Depending on the type of sensor, the DIP switch settings must be changed. Please refer to the Wiring Information for the sensor types and the corresponding DIP switch settings.

Cold Water Flow (CWF)

To connect the Cold Water Flow sensor to the unit, attach one wire from the sensor to CWF (T13) and the other wire to the adjacent common (T12). The sensor must be of the 0-10 Volt type.

Cold Return Water Temperature (CRWT)

To connect the Cold Return Water Temperature sensor to the unit, attach one wire from the thermistor to CRWT (T11) and the other wire to the adjacent common (T12). Depending on the type of sensor, the DIP switch settings must be changed. Please refer to the Wiring Information for the sensor types and the corresponding DIP switch settings.

Differential Pressure (DP)

To connect the Differential Pressure sensor to the unit, attach one wire from the differential pressure transmitter to DP (T10) and the other wire to the adjacent common (T9). Depending on the type of sensor, the DIP switch settings must be changed. Please refer to the Wiring Information for the sensor types and the corresponding DIP switch settings.

Indoor Air Quality (IAQ)

To connect the Indoor Air Quality sensor to the unit, attach one wire from the sensor to IAQ (T8) and the other wire to the adjacent common (T9). This may be a dry contact normally open switch or a 0-10 Volt type.

If the Indoor Air Quality sensor is an analog device, the sensor gets connected to the terminals mentioned above, but the dip switch settings must be changed to reflect a 0-10V input. Please refer to the Wiring Information for the corresponding DIP switch settings.

Occupancy Sensor (OCC)

To connect the Occupancy Sensor to the unit, attach one wire from the sensor to OCC (T7) and the other wire to the adjacent common (T6). This must be a dry contact normally open switch.

Fan Proof (FNP)

To connect the Fan Proof to the unit, attach one wire to FNP (T5) and the other wire to the adjacent common (T6). This must be a dry contact normally open switch.

505-037-3, Effective: October 26, 2015

Thermostat or Precon III Temperature Sensor (STAT)

To connect the TS300 thermostat, attach one wire from the thermostat to STAT (T3) and the other wire to the adjacent common (T4). Jumper W15 must be set to “STAT” when using the TS300 thermostat.

To connect a Precon sensor, attach one wire from the sensor to STAT (T3) and the other wire to the adjacent common (T4). Additionally, Jumper W15 must be set to “UI11” and UI11 must be configured for VTH input.

Connecting Output Devices

Heat Modulation (HMOD)

The heat modulation output can be set to 0-10 V max through the control logic. Connect the positive wire from the heating valve/pump to HMOD (T37) and the other wire to COM (T36).

Cool Modulation (CMOD)

The cool modulation output can be set to 0-10 V max through the control logic. Connect the positive wire from the cooling valve/pump to CMOD (T35) and the other wire to COM (T36).

Fan Modulation (FAN)

The fan modulation output can be set to 0-10 V max through the control logic. Connect the positive wire from the fan to FAN (T34) and the other wire to COM (T33).

Damper Modulation (DMPM)

The damper modulation output can be set to 0-10 V max through the control logic. Connect the positive wire from the damper to DMPM (T32) and the other wire to COM (T33).

Cooling Stage 1 / Cooling FSP Open / Cooling Enable (C1)

The cooling stage 1 output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect cooling stage 1 to C1 (T31) and TC12 (T30).

If this input is used for cooling floating setpoint open or cooling enable signal, connect one wire to C1 (T31) and the other to TC12 (T30).

Cooling Stage 2 / Cooling FSP Close (C2)

The cooling stage 2 output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect cooling stage 2 to C2 (T29) and TC12 (T30).

If this input is used for cooling floating setpoint close, connect one wire to C2 (T29) and the other to TC12 (T30).

Heating Stage 1 / Heating FSP Open / Heating Enable (H1)

The heating stage 1 output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect heating stage 1 to H1 (T28) and TC34 (T27).

If this input is used for heating floating setpoint open or heating enable signal, connect one wire to H1 (T28) and the other to TC34 (T27).

Heating Stage 2 / Heating FSP Close (H2)

The heating stage 2 output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect heating stage 2 to H2 (T26) and TC34 (T27).

If this input is used for heating floating setpoint close, connect one wire to H2 (T26) and the other to TC34 (T27).

Fan 1 / Fan Enable (FAN1)

The fan output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect fan 1 to FAN1 (T25) and TC56 (T24).

If this is used for fan enable, connect one wire to FAN1 (T25) and the other to TC56 (T24).

Fan 2 (FAN2)

The fan output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect fan 2 to FAN2 (T23) and TC56 (T24).

Fan 3 (FAN3)

The fan output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect fan 3 to FAN3 (T22) and TC78 (T21).

Dehumidification (DEH)

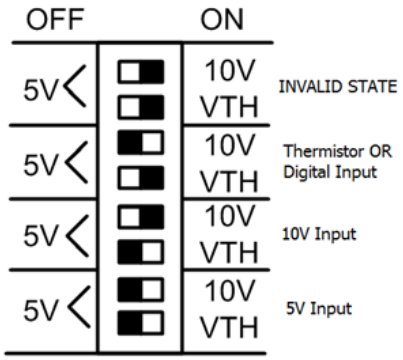
The external dehumidification output must be connected to a 24 VAC pilot relay if the load is greater than 1 Amp. If the load is less than 1 Amp, connect the external dehumidification load to DEH (T20) and TC78 (T21).

Setting DIP Switches

Each input has a corresponding pair of DIP switches. The DIP switches are in three black cases with white switches located near the inputs. While holding the board with the inputs facing down, the pair of DIP switches furthest to the right corresponds to the right-most input (HSWT). The next pair of DIP switches corresponds to the next input (HWF) and so on.

DIP switch pairs must be set properly for each input to operate correctly as shown in the figure below.

Figure 5: DIP Switch Settings



NOTE: The DIP switches are black boxes with white switches. The drawing above is a negative image; the position of the switch is shown as black.

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.

505-037-3, Effective: October 26, 2015

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

Hot Supply Water Temperature, Hot Return Water Temperature, Cold Supply Water Temperature, Cold Return Water Temperature

- 0-10 VDC VFTS/VTS, Precon Type II or III 10K Thermistor

Cold Water Flow, Hot Water Flow, Differential Pressure

- 0-10 Volts DC

Occupancy Sensor, Fan Proof Sensor

- Dry Contact, Normally Open, 5 Volts DC Max

IAQ Sensor - can be configured as one of the following:

- Dry Contact, Normally Open, 5 Volts DC Max
- 0-10 Volts DC

Outputs

Heat Modulation, Cold Modulation, Fan Modulation, Damper Modulation

- 0-10 Volts DC, 2K Ohm minimum

Cooling Stage 1 / Cooling FSP Open / Cooling Enable, Cooling Stage 2 / Cooling FSP Close, Heating Stage 1 / Heating FSP Open / Heating Enable, Heating Stage 2 / Heating FSP Close, Fan 1 / Fan Enable, Fan 2, Fan 3, External Dehumidification

- 24 Volts AC, 1 Amp at 50 °C, 0.5 Amps at 60 °C, limited by Class 2 supply

Power

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
- 42.4 Volts DC max
- 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

505-037-3, Effective: October 26, 2015

APPLICATION DESCRIPTION

The FCU4 controller maintains the temperature of a space at defined setpoints. Four possible configurations for the FCU4 are shown in the illustrations that follow; other configurations may also be possible:

- Fan coil unit with two stages of cooling and modulated heating
- Fan coil unit with analog modulated valves
- Fan coil unit with analog modulated injection pumps
- Fan coil unit with floating setpoitn valves

Figure 6: FCU4 with Two Stages of Cooling and Modulated Heating

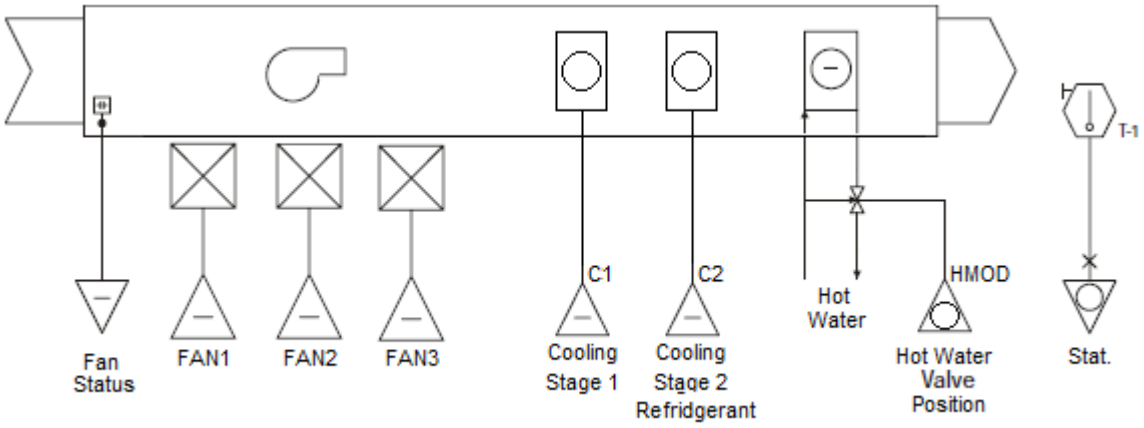


Figure 7: FCU4 with Modulated Valves

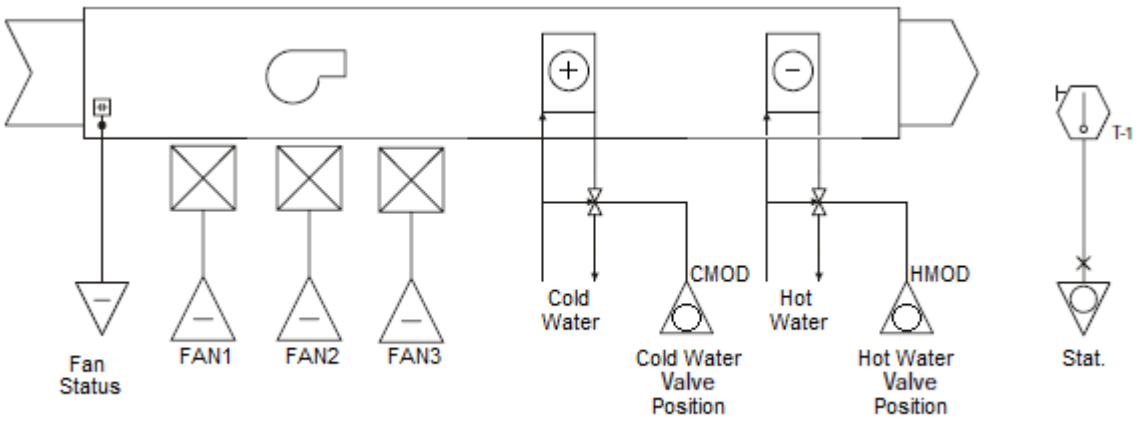


Figure 8: FCU4 with Modulated Pumps

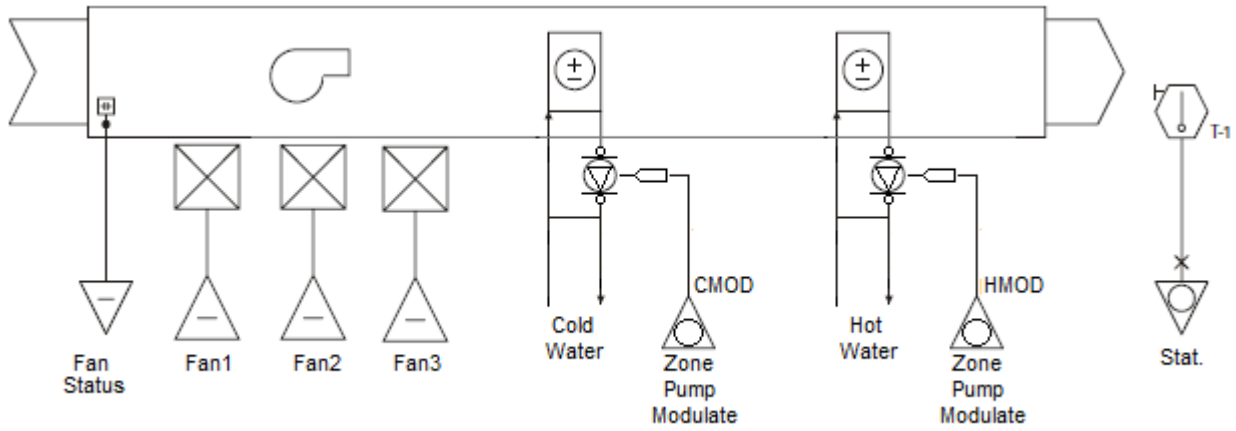
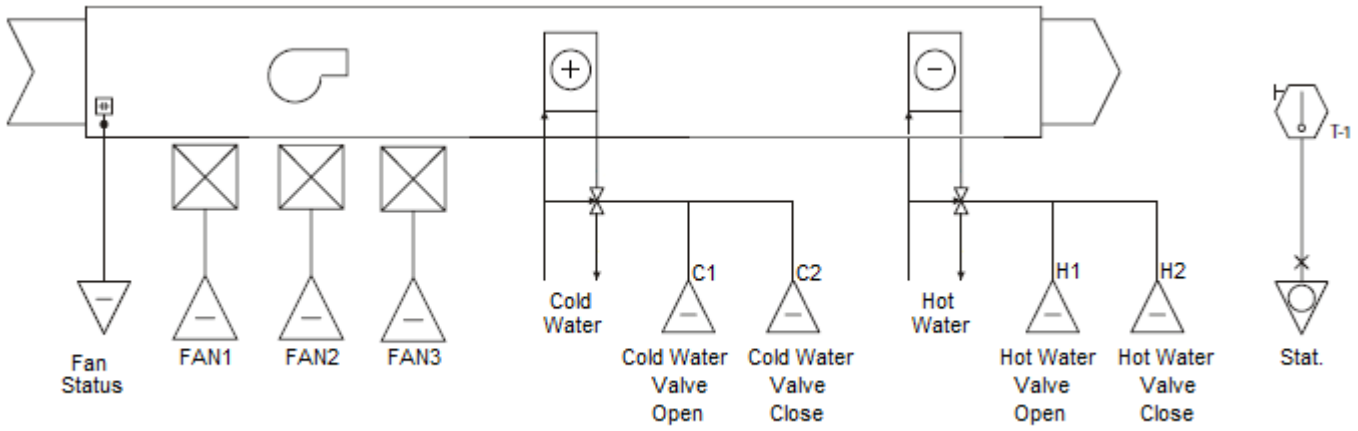


Figure 9: FCU4 with Floating Setpoint Valves



The FCU4 can control heating only, cooling only, or heating and cooling fan coil units. All control is based on the current space requirements.

Room temperature control for four-pipe, dual-coil configurations is achieved by modulating analog cooling and heating valves, floating setpoint cooling and heating valves or discrete cooling and heating stages.

The FCU4 controls the supply air fan. The fan is energized when there is a call for heating or cooling. During the occupied periods, the fan type can be configured to *On* (force the fan to run always).

The Fan Operating Mode can be *Fan 1*, *Fan 2*, or *Fan 3* as set by the user, *Auto Fan* (one of the same three fans dynamically chosen by the FCU4 based on cooling/heating output, *Modulated* (fan output to match the cooling/heating output on analog output), or *Configured* (Digital *and* analog fan outputs when dehumidifying, heating, cooling and IAQ Max are enumerated in the *FanConfig* setting).

505-037-3, Effective: October 26, 2015

The controller controls the damper modulation to a configured value for an air flow setpoint. There are two air flow setpoints: one for Unoccupied mode and one for Occupied mode. The flow value constant that represents the rate of air flow at 1 inch of pressure (i.e. "K") may be entered directly, calculated from sensor gain and duct cross sectional area, or calibrated using a known air flow.

When cooling, the cooling output is calculated by a Proportional + Integral control loop based on the space temperature and the cooling setpoint. As the temperature increases above the cooling setpoint, the output is modulated open. As the temperature decreases below the cooling setpoint, the output is modulated closed. When unoccupied mode is entered, the cooling setpoint is set up to the unoccupied setpoint.

When heating, the output is calculated by a Proportional + Integral control loop based on the space temperature and the heating setpoint. As the temperature decreases below the heating setpoint, the output is modulated open. As the temperature increases above the heating setpoint, the output is modulated closed. When unoccupied mode is entered, the heating setpoint is set back to the unoccupied setpoint.

Each controller interfaces to a local thermostat or Precon sensor. Depending on the model, the thermostat includes a space temperature sensor, space humidity sensor, temperature setpoint adjustment, occupancy override and a fan selection.

The controller normally operates in one of two states: occupied or unoccupied. The LCI determines the active operating mode. The controller maintains the comfort level to a user-defined setpoint during the occupied period. The controller uses setup and setback values during the unoccupied period to maintain the space temperature. An optional backup schedule is provided to use when the LCI is not available.

A digital input is provided to monitor the status of the supply air fan. If the fan is energized and no air flow is detected the controller turns off all stages of heating and cooling along with the supply air fan within 30 seconds. The controller returns to normal operation after it is reset. An alarm is reported to the LCI when this condition exists.

The controller monitors the runtime of the fan, heating and cooling outputs. When the runtime of any of these exceeds a programmable limit, a maintenance alarm is reported to the LCI.

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

An Indoor Air Quality input is provided. If an IAQ condition is indicated and the controller is in Occupied mode, the supply air fan is energized. If the condition remains active for a configurable period of time, an alarm is generated and the IAQ input is indicated on the LCI Inputs screen.

The Indoor Air Quality may be configured as a digital input or a 0-10V analog input. If the sensor is the analog type then the sensor minimum, maximum, setpoint, offset, and deadband are configurable.

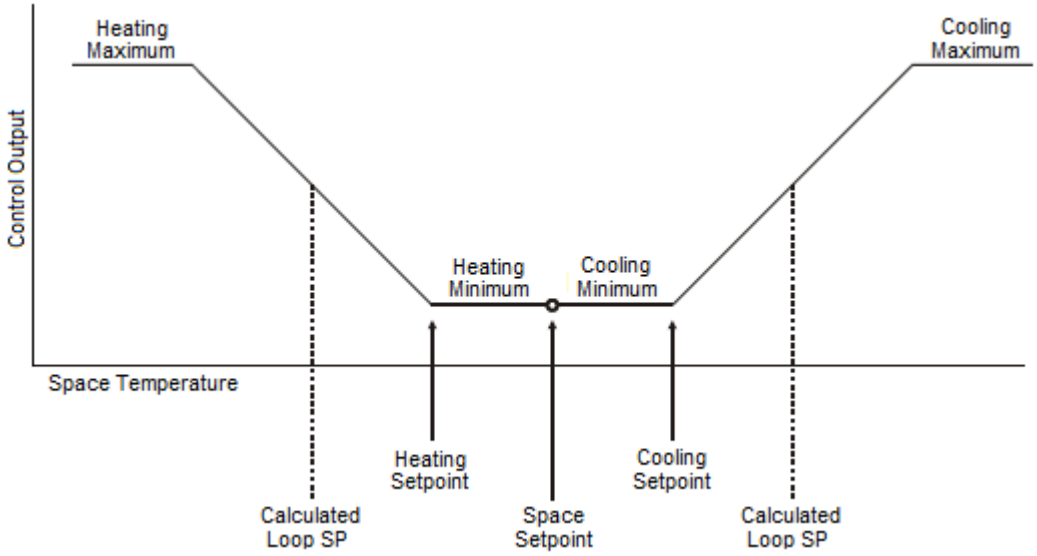
The controller monitors the volumetric flow and supply and return temperatures through the two coils. The values are measured every second and an average is calculated every minute. The system calculates an energy rate value in BTU/Hr, the volume flow rate in gallons per minute, the total volume for the day in gallons, the grand total volume also in gallons, total BTU used for the day and total BTU used. Separate outputs are reported for heating and cooling coils.

The controller's outputs may be manually changed through the LCI using the Commissioning configuration settings. The Fan may be set to one of three digital fan outputs or an analog output from 0 to 100 percent. The Hot Water and Cold Water control outputs may be Analog, Floating Setpoint or Staged. Analog output may control either modulating valves or pumps. When analog outputs are used, the corresponding digital outputs (enable) will turn ON if the analog outputs are greater than zero.

SEQUENCE OF OPERATION

This section describes the detailed sequence of operation for the FCU4 control algorithms.

Figure 10: Cooling and Heating Control



Space Temperature Setpoint Operation

The space setpoint for the occupied and unoccupied modes are programmable values.

Setpoints in Occupied Mode

The heating and cooling setpoints for the occupied periods are programmable offsets from the space setpoint. The zero energy band (ZEB) is the band between the heating and cooling setpoints where there is no heating or cooling demand.

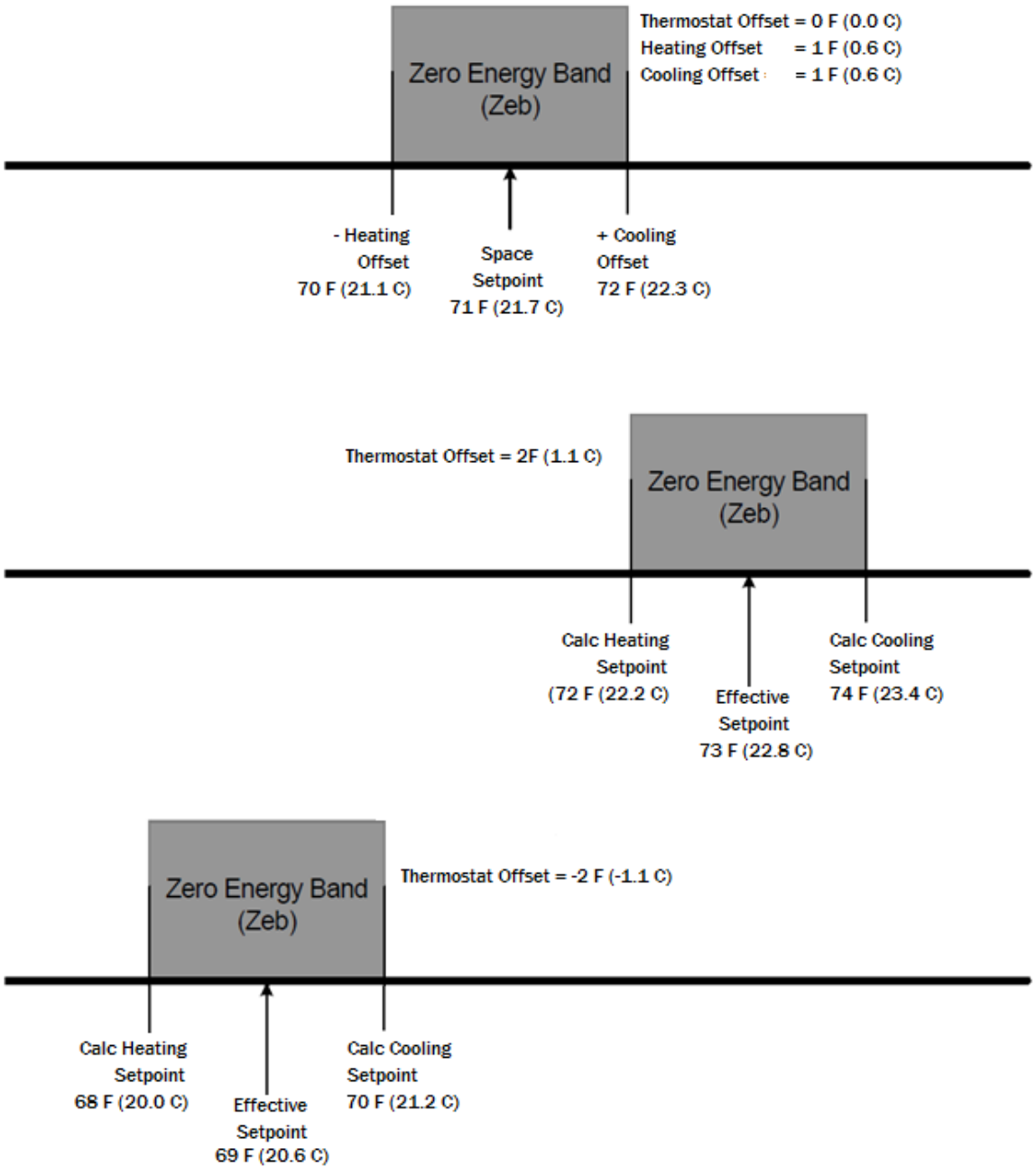
The effective setpoint is a calculated value based on the space setpoint and the thermostat setpoint offset value. The thermostat setpoint offset is used to increase or decrease the space setpoint from the local thermostat in occupied mode only. The thermostat setpoint offset is limited to plus or minus the programmed setpoint adjustment limit. The thermostat setpoint offset affects the calculated heating and calculated cooling setpoints by an equal amount.

NOTE: The actual programmed heating and cooling setpoints are not changed by the thermostat setpoint offset; the offset is simply added to the programmed setpoints to derive the calculated values. If a thermostat is not used the the thermostat offset values are zero.

$$CoolingSp = SpaceSp + CoolingOffset$$
$$HeatingSp = SpaceSp - HeatingOffset$$
$$ZebOcc = CoolingSp - HeatingSp$$
$$EffectiveSetPoint = SpaceSp \pm ThermostatSpOffset$$
$$CalcCoolingSp = CoolingSp \pm ThermostatSpOffset$$
$$CalcHeatingSp = HeatingSp \pm ThermostatSpOffset$$

505-037-3, Effective: October 26, 2015

Figure 11: Setpoint Adjustment (Occupied Mode)

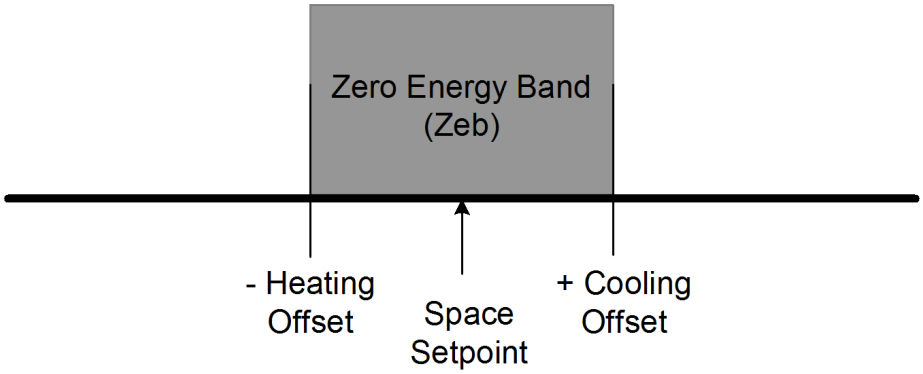


Setpoints in Unoccupied Mode

The heating and cooling setpoints for the unoccupied periods are directly programmable; they are not programmed as offsets. The zero energy band (ZEB) for unoccupied mode is calculated as the cooling setpoint minus the heating setpoint. The space setpoint for unoccupied mode is calculated as the temperature that is halfway between the cooling setpoint and the heating setpoint, or midway into the zero energy band.

$$ZebUnOcc = CoolingSp - HeatingSetpoint$$
$$SpaceSp = HeatingSp + (ZebUnocc / 2)$$

Figure 12: Space Setpoint Calculation (Unoccupied Mode)



Cooling Control

The calculated cooling loop setpoint is derived from the calculated cooling setpoint and the loop proportional gain:

$$CalcCoolingLoopSp = CaclCoolingSp + 1/(2Kp)$$

The analog cooling output is modulated by a Proportional + Integral (P+I) control loop based on the cooling loop setpoint and space temperature. The P+I control loop will modulate the output to maintain a constant space temperature. As the temperature increases above the cooling loop setpoint, the output is modulated higher. As the temperature decreases below the cooling loop setpoint, the output is modulated lower. When unoccupied mode is entered, the cooling setpoint is set up through a separate unoccupied cooling setpoint.

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:

$$Kp = Proportional\ Gain$$
$$Ki = IntegralGain$$
$$Error = SpaceTemp - CoolingLoopSp$$
$$I = I + (Ki \times Error)$$
$$CoolOutput = (Kp \times (Error + 1)) + 50.00\%$$

Heating Control

The calculated heating loop setpoint is derived from the heating setpoint and the loop proportional gain:

$$CalcHeatingLoopSp = CaclHeatingSp - 1/(2Kp)$$

The analog heating output is modulated by a Proportional + Integral (P+I) control loop based on the heating loop setpoint and the space temperature. The P+I control loop will modulate the pump or valve to maintain a constant space temperature. As the temperature decreases below the heating loop setpoint, the output is modulated higher. As the temperature increases above the heating loop setpoint, the output is modulated lower. When unoccupied mode is entered, the heating loop setpoint is set back through a separate unoccupied heating setpoint.

505-037-3, Effective: October 26, 2015

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:

Kp = Proportional Gain
Ki = Integral Gain
Error = HeatingLoopSp - SpaceTemp
$I = I + (Ki \times Error)$
$HeatOutput = (Kp \times (Error + 1)) + 50.00\%$

Floating Setpoint Configuration

The controller may be configured for a four-pipe fan control unit with floating setpoint actuated valves. In this configuration, the controller uses two digital outputs for heating valve open and heating valve close and two digital outputs for cooling valve open and close.

The controller modulates a floating-setpoint valve actuator based on its full-stroke travel time and a calculated desired position. The desired position is calculated by a Proportional + Integral (PI) control algorithm based on the space temperature and calculated setpoint.

The actuator travel time is used to track the current valve position. When the current valve position is below the desired valve position, the valve open output is energized. When the current valve position is above the desired valve position, the valve close output is energized. Both outputs are off when the current position equals the desired position.

The controller re-calibrates the valve when a reset has occurred or when entering the unoccupied mode. The actuator is driven closed for the motor travel time and the current position is set to zero.

Modulated Configuration

The controller may be configured for a two- or four-pipe fan control unit. Analog outputs may be used for modulating pumps or valves. Modulated outputs also have a corresponding digital output (enable) that is energized whenever the analog output is greater than zero.

Staged Configuration

The controller may be configured for staged output. Two stages for heating and two stages for cooling are available. The stages are sequenced based on the air temperature, air temperature setpoint and the control band.

When the air temperature rises above the cooling setpoint plus the control band, the first cooling stage is turned on. If the temperature remains above the control band for an additional configurable time period, the second stage is turned on. If the temperature falls below the control band, the second stage is not turned on. If the temperature falls below the setpoint, all cooling stages are turned off immediately.

When the air temperature falls below the heating setpoint minus the control band, the first heating stage is turned on. If the temperature remains below the control band for an additional configurable time period, the second stage is turned on. If the temperature rises above the control band, the second stage is not turned on. If the temperature rises above the setpoint, all heating stages are turned off immediately.

Dehumidification

> **NOTE:** For proper operation of dehumidification using the fan coils, the cooling coil must be upstream of the heating coil; external dehumidification does not require specific placement of the coils.

If the Dehumidification Setpoint is set to zero, then dehumidification is disabled.

When the humidity is above the non-zero Dehumidification Setpoint, dehumidification begins. Dehumidification stops when the humidity drops below the Dehumidification Setpoint minus three percent.

An external dehumidification output is provided to use in addition to, or in replace of, dehumidification using the cooling coil. The external dehumidification output is energized whenever there is a need for dehumidification.

Cooling is used for dehumidification when the temperature is above the *Cooling Setpoint* minus the *Shutoff Offset*.

During Dehumidification, the operating mode is displayed as *Dehumid*, the modulating output or floating point output for cooling is set to 100%, and the external dehumidification output is energized.

Energy Monitoring

The FCU4 monitors supply and return temperatures and volumetric flow rate of hot and cold water loops. From these values, energy and volumetric data are calculated and made available to the LCI to display and log.

The most common installation option is to install the VFTS sensor in the Supply Water position. For accurate temperature and BTU measurement, use Precon sensors for both supply and return..

The water temperature sensor inputs are for thermistor or VFTS/VTS type sensors. The controller reads the temperature sensors once per second and makes the temperatures available to the LCI where they are displayed in the controller's Inputs screen.

The flow sensor inputs are scaled voltage inputs from VFTS devices. The controller reads the flow sensors once per second and makes the flow rates available to the LCI where they are displayed in the controller's Inputs screen.

The heat and cool loop temperature and flow sensors are disabled by default. To enable temperature, flow or BTU monitoring, each zone’s "Zone Type" must be configured in the *Heat/Cool Loop Settings* configuration screen:

- **Temp Only**: monitors only the zone temperatures, displayed on LCI Inputs screen each second.
- **Flow Only**: monitors only the volumetric flow, displayed on LCI Inputs screen each second.
- **BTU Zone**: monitors both temperature and flow, and calculates BTU energy and volume data each minute.
- **Disabled**: disables all monitoring for this zone.

BTU energy and volume data that is calculated each minute is displayed on the LCI in the controller's *Outputs* screen. Each zone has the following data:

- Daily Heating BTUs (BTU)
- Life Heating BTUs (BTU)
- Daily Cooling BTUs (BTU)
- Life Cooling BTUs (BTU)
- Daily Volume (GAL)
- Life Volume (GAL)

Daily BTU totals and Daily Volume totals are reset to zero each day at midnight. Life totals are not reset at midnight. All totals may be reset to zero by selecting **Reset Totals** from the configuration page on the LCI.

In addition to acquiring BTU data and making it available to the LCI, the controller may be configured to log the Daily BTUs and Daily Volume data. This logging occurs each day at midnight before the data has been reset to zero. The logged data are stored on the controller until it is uploaded to the LCI (manually or automatically).

505-037-3, Effective: October 26, 2015

Each zone has both Heating and Cooling BTUs. The meaning of each depends on the configuration of the zone's "Zone Mode":

Zone Mode	Description
Auto	If the supply temperature is greater than the return temperature (i.e. the zone is heating) then BTUs are added to the Heating BTUs. If the supply temperature is less than the return temperature (i.e. the zone is cooling), BTUs are added to the cooling BTUs.
Heat	If the supply temperature is greater than the return temperature (i.e. the zone is heating) then BTUs are added to the Heating BTUs. If the supply temperature is less than the return temperature, BTUs are subtracted from the heating BTUs.
Cool	If the supply temperature is less than the return temperature (i.e. the zone is cooling) then BTUs are added to the Cooling BTUs. If the supply temperature is greater than the return temperature, BTUs are subtracted from the cooling BTUs.

The FCU4 uses the following formula to calculate the rate of heat energy flow:

$$q = (8.01 \times rho \times cp) \times f \times (dT)$$

Where:

- q = the rate of heat energy flow (BTU/hr)
- rho = density (lb/ft3)
- cp = specific heat (Btu/lb/°F)
- f = flow rate (gpm)
- dT = temperature change of fluid (°F)
- 8.01 = units conversion factor

To retrieve saved logs, select the "Retrieve Logs" button on the controller's screen.

> **NOTE:** If the LCI prompts for the media instead of displaying the logs, select "\CF Card", then select the controller and the "Retrieve Logs" button again. This happens the first time each day that the logs are retrieved.

A total of six logs are displayed as follows:

Log Name	Description of Log Contents
Zone 0 Cool	31 daily totals of Heat loop COOLING BTUs in ascending order by date.
Zone 0 Heat	31 daily totals of Heat loop HEATING BTUs in ascending order by date.
Zone 0 Volume	31 daily totals of Heat loop volume in ascending order by date.
Zone 1 Cool	31 daily totals of Cool loop COOLING BTUs in ascending order by date.
Zone 1 Heat	31 daily totals of Cool loop HEATING BTUs in ascending order by date.
Zone 1 Volume	31 daily totals of Cool Loop Volume in ascending order by date.

The controller is able to store 31 days of logged data. If the logged data is not uploaded after 31 days, the logs are automatically uploaded and saved on the LCI.

Logged data are saved in non-volatile memory on the controller before it is uploaded to the LCI - no data are lost if power is lost to the controller or LCI. If power is lost for more than one day, data for missed days shows a zero value. If power is lost for more than 31 days, logged data that has not been uploaded to the LCI is lost.

All logs uploaded to the LCI (manually or automatically) are available on the CF card.

Damper Modulation

One analog input for differential pressure (DP) and one analog output for damper modulation (DMPM) are provided. Normally, the damper is modulated based on the air velocity as determined from the differential pressure input to either its Unoccupied (minimum) or Occupied (maximum) configuration setting. See Also “Box Damper” on page 37.

Damper output may be overridden during commissioning (see “Commissioning Mode” on page 28) or by a LON network manager through the use of the nviOutOverride SNVT (see “Network Inputs” on page 30).

The Box Damper configuration setting contains an Occupied and an Unoccupied flow rate. The Occupied and Unoccupied flow rates are configured based on the dynamics of the application.

There are three ways to configure the flow constant (K):

- The value provided by the box manufacturer is entered in the *Box Damper* configuration screen.
- The **Area** and **Sensor Gain** are entered in the *Box K Calc* configuration screen and the controller calculates the flow constant.
- The actual air flow is measured by a qualified air balancer - the air flow is entered in the *Commissioning* configuration screen and the controller calculates the flow constant (calibration).

The *Pressure Sensor* configuration setting contains a minimum and maximum voltage and minimum and maximum pressure. These values are provided by the pressure sensor manufacturer; recommended sensors and values are shown in “KELE DPA Series Differential Pressure Transmitters.”

KELE DPA Series Differential Pressure Transmitters

KELE Part #	Min Voltage	Max Voltage	Min Pressure	Max Pressure
DPA-2-10	2	10	0	2
DPA-3-10	2	10	0	3
DPA-5-10	2	10	0	5

To disable damper modulation, set both the minimum and maximum voltage levels for the pressure sensor to zero.

The damper is normally modulated to provide airflow at the minimum setpoint. When the space is occupied, the damper is modulated to the maximum setpoint.

Indoor Air Quality

An indoor air quality (IAQ) input is provided. The IAQ sensor can be a digital sensor providing an on/off signal or a configurable analog sensor.

Setting up the digital sensor requires only the *Delay* setting to be configured. An IAQ condition is said to exist if the digital IAQ input is *On*.

Setting up the analog sensor requires the settings *Deadband, Delay, Min, Max, Setpoint* and *Offset* to be configured. An IAQ condition is said to exist if the analog IAQ sensor input exceeds the configured setpoint.

When an IAQ condition exists, the supply air fan is energized immediately to supply air to the space. The Delay setting determines the time delay to wait before signaling an IAQ Alarm. This delay affects the Alarm only; the fan will operate without delay.

Fan Configuration and Operation

The operation of the fan depends on the Occupancy Mode as shown on the Inputs screen of the LCI (*Occ* or *Unocc*), the configured Fan Type (*Auto* or *On*) and the configured Fan OpMode (*Not Used, Fan 1, Fan 2, Fan 3, Auto Fan, Modulated* or *Configured*).

If the Fan OpMode is set to *Configured*, then the fan operation also depends on the Unit Status / Mode as shown on the Outputs screen on the LCI (*heating*, *cooling*, *dehumid*), whether there is an IAQ condition, and the Fan Config configuration setting.

505-037-3, Effective: October 26, 2015

The configuration setting Fan Type determines when the fan runs if the Occupancy Mode is *Occ* (occupied):

- On:The fan runs all the time
- Auto: The fan runs only if there is a heating or cooling demand

The Fan OpMode determines which of the fan outputs are used when the fan runs:

- Off: There is no fan output.
- Fan1, Fan 2, or Fan 3: Digital Output FAN1, FAN2, or FAN3 is used.
- Auto Fan: Digital Outputs FAN1, FAN2, and FAN3 are used.
- Modulate: Analog Output FAN is used.
- Configured: Digital and Analog outputs per *Fan Config*.

The *Configured* setting requires that the user populate an additional configuration parameter (Fan Config) to define both the digital output (FAN1, FAN2, or FAN3) and the analog output (0 to 100%) used for cooling, heating, dehumidification, and maximum (or IAQ) conditions.

If the application requires configured analog outputs with a shared fan enable, the digital outputs must be set to the same fan (FAN1, FAN2, or FAN3).

Fan operation in unoccupied mode where the fan type is ignored, is identical to the fan operation in occupied mode if the fan type is Auto and there is no IAQ alarm. In both cases, the fan operation is determined by the Fan OpMode and the heating/cooling/dehumid state of the controller.

A complete description of all possibilities for Normal fan operation based on Occupancy Mode, Fan Type, Fan OpMode and Heating/Cooling/Dehumid Mode is summarized in Table , “Normal Fan Operation,” on page 26.

In addition to the fan operation described here, fan outputs may be overridden during commissioning (see “Commissioning Mode” on page 28) or by a LON network manager through the use of the nviOutOverride SNVT (see “Network Inputs” on page 30).

> **NOTE:** If a fan status switch is not provided, the input must be jumpered to the adjacent common. After a fan failure, the controller's status LED turns solid red. To return the controller to normal operation after the failure condition is resolved, reset the controller by removing and reapplying power or by using the controller reset feature on the LCI. (See *iWorx® LCI2 Application Guide* for details.)

Normal Fan Operation

Occupancy Mode	Fan Set / Fan Type	Fan Set / Fan Op Mode	Mode	Fan Operation
Unocc	-	Not Used	-	All fan outputs are off
		Fan 1, Fan 2, Fan 3		Fan is digital output: FAN 1, FAN 2, or FAN 3 - the selection is configured in *Fan Set / Fan OpMode*
		Auto Fan		Fan is digital output: fan choice based on Heat/Cool demand
		Modulated		Fan is analog output: speed based on Heat/Cool demand
		Configured	Heating	Analog / digital outputs set to configured values for Heating
			Cooling	Analog / digital outputs set to configured values for Cooling
			Dehumid	Analog / digital outputs set to configured values for Dehumid
Occ	Auto	Not Used	-	All fan outputs are off
		Fan 1, Fan 2, Fan 3		Fan is digital output: FAN 1, FAN 2, or FAN 3 - the selection is configured in *Fan Set / Fan OpMode*
		Auto Fan		Fan is digital output: fan choice based on Heat/Cool demand
		Modulated		Fan is analog output: speed based on Heat/Cool demand
		Configured	Heating	Analog / digital outputs set to configured values for Heating
			Cooling	Analog / digital outputs set to configured values for Cooling
			Dehumid	Analog / digital outputs set to configured values for Dehumid
		Not Used	An IAQ Condition Exists	All fan outputs are off
		Fan 1, Fan 2, Fan 3		Fan is digital output: FAN 1, FAN 2, or FAN 3 - the selection is configured in *Fan Set / Fan OpMode*
		Auto Fan		Fan is digital output: FAN 3
		Modulated		Fan is analog output: speed is 100%
		Configured		Analog / digital outputs set to the Maximum of configured settings
	On	Not Used	-	All fan outputs are off
		Fan 1, Fan 2, Fan 3		Fan is digital output: FAN 1, FAN 2, or FAN 3 - the selection is configured in *Fan Set / Fan OpMode*
		Auto Fan		Fan is digital output: FAN 1
		Modulated		Fan is analog output: 33%
		Configured		Analog / digital outputs set to Minimum of configured settings

Thermostat

If *Thermostat Type* is configured to *SLink* (the default), then the space temperature value, setpoint adjustment, fan auto/on status (depending on the thermostat model), and occupancy override request are monitored by the thermostat and sent to the controller. If configured to one of the Precon sensors, then only the space temperature is monitored.

The controller automatically detects a failure of the thermostat. When the thermostat (or Precon sensor) fails, the valves close, the fan turns off, and control is disabled.

> **NOTE:** The thermostat must be connected. The status LED on the controller blinks red if the thermostat is not connected. Once the controller begins receiving temperature data, the status LED turns green indicating normal operation.

When the thermostat is put into occupied mode for the purpose of changing the temperature setpoint settings, the amount of extended occupancy is accumulated. The extended occupancy time is accumulated in minutes and is viewed from the LCI under "Thermostat Settings." The extended occupancy time is backed up to non-volatile memory at 11:00 pm. The user can clear the accumulated extended occupancy from the LCI.

505-037-3, Effective: October 26, 2015

Local Backup Schedules

The LCI normally determines the operating mode. Local weekday and weekend backup schedules for situations when the LCI is not available may be configured. When the controller detects that the LCI is not available (after 10 minutes without communication), it resorts to the local backup schedules. If the local backup schedules are disabled, the controller defaults to the occupied mode.

Occupied and Unoccupied times determine the operating mode of the controller when it is running a backup schedule. By default, both the unoccupied and occupied times are set to zero, which disables the local backup schedule causing the controller to default to the occupied mode of operation if it cannot communicate with the LCI.

Runtime Accumulations

The total runtimes are accumulated for the heating, cooling, and fan outputs. The runtimes are used to indicate that maintenance is required on the equipment controlled by these outputs. The runtimes are reset by an operator or maintenance person once servicing has been performed.

Hydronic Zone Interaction

The controller can be configured to be part of a hydronic zone. Although the controller acts as master on the network and initiates network communication to the associated BZU Zone controller, it receives various information from the BZU and gets configured in the BZU controller screen.

For a residential environment, the BZU and its attached Thermostats allow certain user interactions that are communicated to the controller. The BZU input takes precedence over the internal controller calculation. The following variables can be set by the BZU:

- Occupied Setpoint
- Unoccupied Setpoint
- HVAC-Mode
- Fan-Mode

Occupied Setpoint

The Occupied Setpoint is determined by the BZU and depends on the BZU configuration. It can be in three modes:

- Master
- Average
- Lowest

The Controller does not need to know the specific BZU settings and takes the Occupied Setpoint.

Unoccupied Setpoint

The Unoccupied Setpoint is communicated from the BZU; there is one setting for all zones.

HVAC-Mode

The HVAC mode can be:

- Heat
- Off
- Cool
- Auto

The format of the HVAC mode is a SNVT_hvac_mode enumeration.

Fan-Mode

The FAN mode can be:

- On

- Auto

In the “On” mode, the fan is overridden to "on" by the BZU. The BZU setting takes precedence over local DXU4 settings. In the “Auto” mode, the DXU4 follows any of its internal settings which can be *Auto*, *Auto no Heat*, or *Auto Radiant*.

Commissioning Mode

The FCU provides the ability to override normal operation through the LCI using the Commissioning mode. The Commissioning mode is accessed using the Commissioning Mode configuration structure.

When Commissioning mode is enabled, values in the Commissioning structure are used for outputs.

Commissioning Fan Outputs

The choices for fan outputs are:

- Not Used: All fan outputs (FAN 1, FAN 2, FAN 3 and FAN) are de-energized.
- Fan 1, Fan 2, Fan 3: The corresponding fan output (FAN 1, FAN 2 or FAN 3) is energized.
- User Defined: Fan analog output (FAN) is modulated to the user supplied value (%). If the value is greater than zero, the fan enable signal (FAN1) is energized.

Commissioning Box Damper Output

The choices for the Box Damper actuator output (DMPM) are:

- No Flow: Box Damper is set to 0%.
- UnOcc Flow: Box Damper is modulated based on air flow to the Box Damper / UnOcc Flow value.
- Occ Flow: Box Damper is modulated based on air flow to the Box Damper / Occ Flow value.
- 100% Flow: Box Damper is set to 100%.
- User Defined: Box Damper is modulated based on air flow to the user supplied value (%).

Commissioning Heat and Cool Outputs

The choices for the heat and cool stage outputs (H1, H2, C1, C2) are *Off* and *On*.

The hot water and cold water modulated outputs (HMOD, CMOD) are set directly (not modulated) to the user supplied values in Hot Water AO and Cold Water AO.

Commissioning External Dehumidification Output

The choices for the external dehumidification output (DEH) are *Off* and *On*.

Alarms and Events

The controller will detect certain alarm conditions and send them to the LCI. The LCI must be used to configure the controller before this can occur.

Fan Status Alarm

The controller monitors the status of the fan status digital input and generates an Equipment Status Alarm if detected.

Thermostat Failure

The controller automatically detects the presence of the local thermostat and monitors its status. If the thermostat fails to communicate with the controller, a Thermostat Failed Alarm is generated and the controller's status LED will turn red.

Maintenance Alarm

The controller provides a single programmable runtime limit for generating a runtime Maintenance Alarm. When the fan runtime exceeds this limit, a Maintenance Alarm is sent to the LCI.

505-037-3, Effective: October 26, 2015

Indoor Air Quality Alarm

The controller generates an IAQ alarm when the IAQ sensor detects inadequate indoor air quality. This alarm is sent only when the IAQ condition has existed for a configurable amount of time (*IAQ Settings* / *IAQ Delay Time*).

Space Temperature Alarms

The controller generates high and low limit alarms for the space temperature. A programmable space temperature alarm limit offset may be configured. The temperature limits are calculated based on the control setpoints, alarm limit offset, and control band:

$$HighLimit = CalcCoolingSp + AlarmLimitOffset + CoolBand$$
$$LowLimit = CalcHeatingSp - AlarmLimitOffset - HeatBand$$

When the measured space temperature exceeds the high limit, a high limit alarm (Space Temperature High Limit Alarm) is generated. When the space temperature drops below the low limit, a low limit alarm is generated (Space Temperature Low Limit Alarm).

A return to normal alarm is generated when the space temperature is between the high and low limit (Space Temperature Return to Normal). To reduce / eliminate nuisance alarms, space temperature alarms are not reported for 30 minutes after the controller switches between the unoccupied and occupied modes of operation.

CONTROLLER IDENTIFICATION

The controller must be configured by the LCI2 to set the controller's schedules, change its setpoints, etc. To allow the LCI to identify the FCU4, the controller's service pin must be pressed after the controller is installed and the LCI is active on the network. The controller's status light flashes green until it is configured, and is solid green after it is configured.

Network Inputs

The FCU4 allows a network manager to write to Network Input Variables for the purpose of overriding the configuration, operation and outputs of the FCU4. The variables are listed below and in Table on page 31.

Values written to NVIs have absolute priority over any other controller operation.

- *nviSpaceTemp* overrides the space temperature as obtained from the thermostat, sensor, or ASM module and is used by the controller for temperature control. Writing to this variable will also be reflected in the controller's output of the space temperature as displayed on the LCI.
- *nviSpaceHumidity* overrides the space humidity as obtained from the thermostat, sensor, or ASM module and is used by the controller for dehumidification control. Writing to this variable will also be reflected in the controller's output of the space temperature as displayed on the LCI.
- *nviSetpoint* overrides the setpoint as obtained from the thermostat, the LCI or from a pre-configured schedule. Writing to this variable will also be reflected in the controller's output of the effective setpoint as displayed on the LCI.
- *nviOccCmd* overrides the occupancy as obtained from the thermostat. Writing to this variable will also be reflected in the controller’s output of the occupancy mode. Note that this is NOT the occupancy sensor. The occupancy sensor hardware input (OCC) will still be displayed on the LCI based on its configuration.
- *nviResetRuntime* is a command to reset the fan, heating and cooling runtimes. If the value sent is 0, then no reset occurs; if the value sent is 1, then the runtimes are reset.
- *nviSysTime* is a time stamp to set the date and time. Writing to this variable will change the time on the device and will affect all time-related functions such as schedules.
- *nviOutOverride* is a structure (defined below) that overrides the hardware digital and analog outputs on the FCU4. These values allow the network controller to directly control the analog and digital outputs of the board. Additionally, the two floating setpoint outputs may be set directly.

  NOTE: the FCU4 makes no attempt to interpret the outputs; assigning meaningless outputs (such as setting a digital output in both the digOut array and the fpOut array, or assigning values to FAN1 and FAN2 but leaving FAN3 as 0xFF) will have unpredictable results.

505-037-3, Effective: October 26, 2015

Network Variable Inputs (NVIs)

Internal Variable Name	Format	Range	Description
nviSpaceTemp	SNVT_temp_p	-29 to 230°F (-34 to 110°C)	Space temperature
nviSpaceHumidity	SNVT_lev_percent	0 to 100 percent	Space humidity
nviSetpoint	SNVT_temp_p	-29 to 230°F (-33 to 210°C)	Setpoint
nviOccCmd	SNVT_occupancy	0=Occupied 1=Unoccupied 2=Bypass 3-Standby	Occupancy Command
nviResetRuntime	SNVT_lev_disc	0=no reset 1=reset runtimes	Resets fan, heating, and cooling runtimes
nviSysTime	SNVT_time_stamp	Date/Time	System time
nviOutOverride	Structure	Structure	Output override

Output Override Structure (NVI)

Name	Type/Range	Default	Description
digOut[8]	Unsigned Byte: 0=OFF 1=ON 0xFF=no override	0xFF 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF 0xFF	digOut[0] = TO1 (pin 31) C1 digOut[1] = TO2 (pin 29) C2 digOut[2] = TO3 (pin 28) H1 digOut[3] = TO4 (pin 26) H2 digOut[4] = TO5 (pin 25) FAN1 digOut[5] = TO6 (pin 23) FAN2 digOut[6] = TO7 (pin 22) FAN3 digOut[7] = TO8 (pin 20) DEH
aOut[4]	SNVT_lev_percent: 0% to 100% 32767=no override	32767 32767 32767 32767	aOut[0] = AO 0 (pin 37) HMOD aOut[1] = AO 1 (pin 35) CMOD aOut[2] = AO 2 (pin 34) FAN aOut[3] = AO 3 (pin 32) DMPM
fpOut[4]	SNVT_lev_percent: 0% to 100% 32767=no override	32767 32767 32767 32767	fpOut[0] = TO1=FSP Op, TO2=FSP Cl fpOut[1] = TO3=FSP Op, TO4=FSP Cl fpOut[2] = unassigned fpOut[3] = unassigned

Inputs

The Inputs screen lists the inputs of the FCU4 and shows their current values. None of these values can be changed from this screen.

Inputs

Name	Range	Description
Outside Temp	-29 to 230°F (-34 to 110°C)	Outside temperature as received from the ASM2 controller.
Occupancy Mode	Occ Unocc Bypass	Occupied, Unoccupied or Bypass This is a calculated value
Input Status	Structure	Lists all digital inputs (see table below)
Space Temperature	-29 to 230°F (-34 to 110°C)	Input from the thermostat or network
Space Humidity	0 to 100%	Input from the thermostat or network
Velocity Pressure	0.00 W. C. to 10.00 W. C.	Pressure differential from which velocity is calculated
IAQ	0 to 4000 ppm	Reading of the indoor air quality sensor when configured for analog input. This represents a hardware input.
Heating Loop	Structure	Heating Zone Data
Cooling Loop	Structure	Cooling Zone Data

Input Status

Name	Range	Description
Fan Status	Off, On	Fan Proof (FNP)
Occupancy Sensor	Off, On	Occupancy Sensor (OCC)
IAQ Alarm	Normal, Alarm	Indoor Air Quality Alarm

Heat/Cool Zone Inputs

Name	Range	Description
Supply Temp	-29 to 230 °F (34 to 110 °C)	Supply water temperature. This represents a hardware input.
Return Temp	-29 to 230 °F (34 to 110 °C)	Return water temperature. This represents a hardware input.
Flow Rate	0 to 3.4e38 GPM	Volumetric flow rate calculated once per minute.
Energy Rate	0 to 3.4e35 KBTU/Hr	Energy rate calculated once per minute.

Outputs

The Outputs screen lists the outputs of the FCU4 and shows their current values. None of these values can be changed from this screen.

505-037-3, Effective: October 26, 2015

Outputs

Name	Range	Description
Unit Status	Structure*	HVAC mode, alarm state, heating, cooling and fan outputs.
Effective Setpt	-29 to 230 °F(-34 to 110 °C)	Effective setpoint.
Heating Runtime	0 to 65535 Hours	Heating runtime.
Cooling Runtime	0 to 65535 Hours	Cooling runtime.
Fan Runtime	0 to 65535 Hours	Fan runtime.
Damper Position	0 to 100%	Position of damper based solely on Damper Modulation output.
Box Flow	0 to 10,000 CFM	Air flow rate through box.
Application Mode	Auto, Heat, Cool, Off	Application mode where Heat is "Winter Season" and Cool is "Summer Season".
Heat Loop Data	Structure*	BTU meter values for heat loop.
Cool Loop Data	Structure*	BTU meter values for cool loop.

* Structures are defined in tables that follow.

Unit Status

Name	Range	Description
Mode	Auto Heat Cool Off Fan Only	HVAC mode of operation. This parameter provides real-time status of what the controller is actually doing
Heat Output	0 to 100%	Current Heat Output
Cool Output	0 to 100%	Current Cool Output
Fan Output	0 to 100%	Current Fan Output
In Alarm?	No, Yes	Is the unit in an alarm state?

Heat/Cool Loop Data

Name	Range	Description
Daily Heating BTUs	0 to 3.4e35 KBTU	Heating BTUs accumulated since midnight, present day
Life Heating BTUs	0 to 3.4e35 KBTU	Heating BTUs accumulated since last Reset Totals
Daily Cooling BTUs	0 to 3.4e35 KBTU	Cooling BTUs accumulated since midnight, present day
Life Cooling BTUs	0 to 3.4e35 KBTU	Cooling BTUs accumulated since last Reset Totals
Daily Volume	0 to 3.4e38 G	Volume accumulated since midnight, present day
Life Volume	0 to 3.4e38 G	Volume accumulated since last Reset Totals

Configuration

This screen lists all possible settings on the FCU4. Some of the settings are structures themselves and will be described in detail in the tables below.

All Settings

This screen displays all of the controller's settings and provides access to edit all parameters from a single screen.

Setting	Range	Default	Description
Thermostat	Structure	N/A	Thermostat Settings (see below)
Setpoints	Structure	N/A	Setpoint Settings (see below)
Operating Mode	Auto Heat Cool	Auto	Forces the HVAC mode to Heat (Winter), Cool (Summer) or Auto. This configuration setting is reflected in the output called "Application Mode" subject to network overrides.
Staged Cooling	Structure	N/A	Staged Cooling Settings
Modulated Cooling	Structure	N/A	Modulated Cooling Settings
Floating SP Cooling	Structure	N/A	Floating Setpoint Cooling Settings
Staged Heating	Structure	N/A	Staged Heating Settings
Modulated Heating	Structure	N/A	Modulated Heating Settings
Floating SP Heating	Structure	N/A	Floating Setpoint Heating Settings
Fan Set	Structure	N/A	Fan Configuration
Fan Config	Structure	N/A	Fan Speed and Digital Output Choice Configuration
IAQ Mode	Digital Analog	Digital	IAQ Mode
IAQ Settings	Structure	N/A	IAQ Settings
IAQ Sensor	Structure	N/A	IAQ Sensor Settings
Pressure Sensor	Structure	N/A	Pressure Sensor Settings
Box Damper	Structure	N/A	Box Damper Settings
Box K Calc	Structure	N/A	Calculate the flow constant from sensor gain and damper cross sectional area.
Dehumid Set	Structure	N/A	Dehumidification Settings
Runtime Limits	Structure	N/A	Runtime Limits Settings
Heat Loop Settings	Structure	N/A	Heating Coil BTU meter settings
Cool Loop Settings	Structure	N/A	Cooling Coil BTU meter settings
Commissioning	Structure	N/A	Commissioning Overrides of unit’s outputs
Backup Occ. Time	Structure	N/A	Backup Occupied Time
Backup Unocc. Time	Structure	N/A	Backup Unoccupied Time

Thermostat

This screen displays settings related to thermostat and allows access to all of these settings from a single screen.

Setting	Range	Default	Description
Type	Precon III, Precon II, SLink, Not Used	SLink	Thermostat Type
Occupancy extension	0 to 1000	60 min	Occupancy Extension (min)
Alarm temp offset	0 to 10.0 °F (0 to 5.6 °C)	5 °F (2.8 °C)	Space temperature alarm limit offset
Temperature offset	-10.0 to 10.0 °F (-5.6 to 5.6 °C)	0 °F (0 °C)	Space temperature offset
Accumulated Ext Occ	-	-	Accumulated extended occupancy time in hours - read from thermostat

505-037-3, Effective: October 26, 2015

Setpoints

This screen displays settings related to Setpoints.

Setting	Range	Default	Description
Setpoint	50 to 95 °F (10 to 35 °C)	71.0°F (21.2 °C)	Setpoint for occupied time periods
Cooling offset	0 to 10.0 °F (0 to 5.6 °C)	1 °F (0.6 °C)	This value is added to setpoint to calculate the cooling setpoint
Heating offset	0 to 10.0 °F (0 to 5.6 °C)	1 °F (0.6 °C)	This value is added to setpoint to calculate the heating setpoint
SP adjust limit	0 to 10.0 °F (0 to 5.6 °C)	2 °F (1.2 °C)	Maximum setpoint adjustment allowed during occupied periods
Unocc cooling	50 to 95 °F (10 to 35 °C)	82.0°F (27.7 °C)	Cooling setpoint for unoccupied time periods
Unocc heating	50 to 95 °F (10 to 35 °C)	60.0°F (15.5 °C)	Heating setpoint for unoccupied time periods

Staged Cooling / Heating

This screen displays settings related to Staged Cooling or Staged Heating.

Setting	Range	Default	Description
Stages	0-2	0	Number of Heating or Cooling Stages controlled. Set to zero to disable staged cooling.
Control Band	0 to 10.0 °F (0 to 5.55°C)	1.0 °F (0.55 °C)	Value used to modify the calculated heating or cooling setpoints to form the temperature range in which local heating or cooling is enabled.
Stage Time	0 to 255 minutes	5 minutes	The rate at which successive stages are sequenced.

Modulated Cooling / Heating

This screen displays settings related to modulated heating or cooling.

Setting	Range	Default	Description
Gain	-4 to +5	0	Response speed relative to factory default; negative values are slower, positive values are faster.
On	0 to 100%	0.0%	Minimum output to turn on
Ramp Up	0 to 20%	1%	Ramp up percent per second
Ramp Down	0 to 20%	0.5%	Ramp down percent per second
Out Min	0 to 10 V	0 V	Minimum output value
Out Max	0 to 10 V	10 V	Maximum output value

Floating SP Cooling / Heating

This screen displays settings related to floating setpoint heating or cooling.

Setting	Range	Default	Description
Kp	0.0% to 100.0%	5%	Proportional band control constant
Ki	0.0% to 100.0%	0.05%	Integral control constant
Travel time	0 to 600 sec	0 sec	Travel time
Deadband	0.0% to 100.0%	10.0%	Dead band

Fan Set

This screen displays settings related to fan operation.

Setting	Range	Default	Description
Fan Type	Auto, On	Auto	Auto, or On when occupied
Fan OpMode	Not Used, Fan 1, Fan 2, Fan 3, Auto (Fan 1-3), Modulated, Configured	Auto (Fan 1-3)	- Fan 1, 2, 3 - User sets fan choice directly - Auto (Fan 1-3) - FCU4 sets fan choice - AutoModulate - FCU4 sets analog output - Configured - User sets digital and analog outputs to user configured values

Fan Config

This screen displays settings related to fan configuration.

Setting	Range	Default	Description
Fan Dehumidification	Not Used, Fan 1, Fan 2, Fan 3	Fan 1	Fan choice used for dehumidification
Motor Speed Dehumidification	0 to 100%	0%	Fan output used for dehumidification
Fan Cooling	Not Used, Fan 1, Fan 2, Fan 3	Fan 1	Fan choice used for cooling
Motor Speed Cooling	0 to 100%	0%	Fan output used for cooling
Fan Heating	Not Used, Fan 1, Fan 2, Fan 3	Fan 1	Fan choice used for heating
Motor Speed Heating	0 to 100%	0%	Fan output used for heating
Fan Max	Not Used, Fan 1, Fan 2, Fan 3	Fan 1	Fan choice used for IAQ/Max
Motor Speed Max	0 to 100%	0%	Fan output used for IAQ/Max

IAQ Settings

This screen displays settings related to indoor air quality.

Setting	Range	Default	Description
IAQ Delay Time	0 to 1000 min	5 min	Delay after IAQ condition occurs before sending an alarm
Temp Reset Limit	0 to 14.9 °F (0 to 8.3 °C)	0 °F (0 °C)	Not used
Deadband	0 to 400 ppm	100 ppm	Deadband around setpoint for hysteresis

505-037-3, Effective: October 26, 2015

IAQ Sensor

This screen displays settings related to the IQA Sensor.

Setting	Range	Default	Description
Min	0 to 4000 ppm	0 ppm	Minimum of Range
Max	0 to 4000 ppm	2000 ppm	Maximum of Range
Setpoint	0 to 4000 ppm	1200 ppm	Setpoint
Offset	0 to 4000 ppm	0 ppm	Offset

Pressure Sensor

This screen displays settings related to the pressure sensor.

Setting	Range	Default	Description
Min Press	0 to 10 W. C.	0 W. C.	Sensor minimum pressure
Max Press	0 to 10 W. C.	3 W. C.	Sensor maximum pressure
Min V (0-10V)	0 to 10 V	0.0 V	Sensor minimum voltage
Max V (0-10V)	0 to 10 V	10.0 V	Sensor maximum voltage - if 0, then modulation is disabled

Box Damper

This screen displays settings related to the box damper.

Setting	Range	Default	Description
K factor	0 to 10000 CFM (0 to 4720 LPS)	4007 CFM (1891 LPS)	K factor for the box in use
Unoccupied Airflow	0 to 10000 CFM (0 to 4720 LPS)	100 CFM (47.2 LPS)	Unoccupied airflow setting
Occupied Airflow	0 to 10000 CFM (0 to 4720 LPS)	500 CFM (236 LPS)	Occupied airflow setting
Kp	0 to 100%	1.0%	Proportional band control constant
Ki	0 to 100%	1.0%	Integral control constant
Min AO Voltage	0 to 10 V	0 V	Minimum output voltage
Max AO Voltage	0 to 10 V	10 V	Maximum output voltage

Box K Calc

Setting	Range	Default	Description
Area	0.0 to 36.0 sqft	0 sqft	Damper cross sectional area
Sensor Gain	0.0 to 32.768	1.0000	Sensor (i.e. pito tube) gain

Dehumid Set

This screen displays settings related to Dehumidification.

Setting	Range	Default	Description
Type	Occupied Alwaysenabled	Occupied	Type of dehumidification
Setpoint	0 to 100%	0.0%	Dehumidification setpoint. A value of 0.0 disables dehumidification.
Shutoff offset	0 to 10.0 °F (0 to 5.6 °C)	2 °F (1.2 °C)	Dehumidification shutoff offset

Runtime Limits

This screen displays settings related to the runtime limits of the system.

Setting	Range	Default	Description
Cooling	0 to 65535 hours	1000 hours	Cooling coil runtime limit
Heating	0 to 65535 hours	1000 hours	Heating coil runtime limit
Fan	0 to 65535 hours	1000 hours	Fan runtime limit

Heat / Cool Zone Settings

This screen displays settings related to the heat loop or cool loop.

Setting	Range	Default	Description
Zone Type	BTU Zone, Flow Only, Temp Only, Disabled	Disabled	“BTU Zone” - Supply, return and flow are used to calculate BTUs. “Flow Only” - Flow rate is updated on LCI. “Temp Only” - Temperature is updated on LCI. “Disabled” - Inputs are not updated on LCI.
Zone Mode	Auto, Heat, Cool	Heat or Cool	“Auto” - Heating and Cooling BTUs are shown separately. “Heat” - Heating BTUs added and cooling BTUs subtracted. “Cool” - Cooling BTUs added and heating BTUs subtracted. The default is "heat" for heating loop, "cool" for cooling loop.
Meter Type	ACC-VFTS 4-1 (DN8) ACC-VFTS 10-1 (DN10) ACC-VFTS 20-1 (DN20) ACC-VFTS 40-1 (DN25) VTFS 1-20, VTFS 2-40, VTFS 5-100, VTFS 10-200 VTFS 20-400, Disabled	VTFS 1-20	Flow meter sensor type connected to the flow input.

505-037-3, Effective: October 26, 2015

Setting	Range	Default	Description
Media Ratio	100% Water Propylen Glycol 10% Propylen Glycol 20% Propylen Glycol 30% Propylen Glycol 40% Propylen Glycol 45% Propylen Glycol 50% Ethylen Glycol 10% Ethylen Glycol 20% Ethylen Glycol 30% Ethylen Glycol 40% Ethylen Glycol 45% Ethylen Glycol 50% TYFOCO_HTL	100% Water	Water or alcohol ratio.
Supply Sensor	0-5V VFS/RPS, Precon III, Precon II, Not used	Precon III	Temperature sensor connected to the supply input.
Return Sensor	0-5V VFS/RPS, Precon III, Precon II, Not used	Precon III	Temperature sensor connected to the return input.
Enable Logging	Off, On	Off	Enable BTU and Volume logging - BTU Zone type configuration only.
Reset Totals	No, Yes	No	Reset daily and life totals for this zone to zero.

Backup Occ Time / Backup Unocc Time

The Backup times for Unoccupied and Occupied mode are stored in the controller. The controller uses these times when no network interface to the LCI2 can be found.

Setting	Range	Default	Description
Hours	0-23	0	Hour to start occupied/unoccupied mode.
Minutes	0-59	0	Minute to start occupied/unoccupied mode

Commissioning

This screen displays settings that can be used during commissioning to override values from the system.

Setting	Range	Default	Description
Enabled	No, Yes	No	Enable Commissionining
Fan	Not Used, Fan 1, Fan 2, Fan 3, User Defined	Not Used	Fan used when commissioning. Fan 1, Fan 2, Fan 3 are chosen fan outputs User Defined is user-entered analog output value (see below)
Fan Percent	0% to 100%	0.00%	Analog Output used when Fan Speed (above) is set to “User Defined.”

Setting	Range	Default	Description
Box Flow	No Flow, UnOcc Flow, Occ Flow, 100% Flow, User Defined, Calibrate Flow	No Flow	Box Flow when commissioning: *No Flow* and *100% Flow*: close or open the damper all the way. *UnOcc Flow* and *Occ Flow*: set damper to Box Damper settings *UnOcc Flow* and *Occ Flow*. *Calibrate Flow*: Calibrate flow constant using *Box Flow Value*.
Box Flow Value	0 to 1000 CFM	0 CFM	Analog value for “User Defined” Box Flow setting above.
Cold Water AO	0% to 100%	0%	Setting for Cooling Modulation output (CMOD)
Cool Stage 1	Off, On	Off	Setting for Cooling Stage 1 digital output (C1)
Cool Stage 2	Off, On	Off	Setting for Cooling Stage 2 digital output (C2)
Hot Water AO	0% to 100%	0%	Setting for Cooling Modulation output (HMOD)
Heat Stage 1	Off, On	Off	Setting for Heating Stage 1 digital output (H1)
Heat Stage 2	Off, On	Off	Setting for Heating Stage 2 digital output (H2)
External Dehumidification	Off, On	Off	Setting for External Dehumidification (DEH)

Alarms

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

Alarm	Range	Alarm Trigger	Alarm Reset
Fan Failed	Normal, Alarm	The fan is on but air flow is not detected	Equipment failure must be resolved
Thermostat Failure	Normal, Alarm	The thermostat fails to communicate with the controller	Communication is re-established
Maintenance	Normal, Alarm	The fan, heat, or cool runtime exceeds the configured limit	Reset Runtimes button is pressed after servicing equipment
Indoor Air Quality (IAQ)	Normal, Alarm	IAQ condition has existed for a configurable period of time	The IAQ condition has cleared
Space Temperature High Limit	Normal, Alarm	SpaceTemp > (CalcCoolingSp + CoolBand + AlarmLimitOffset)	Space temperature returns back below the high limit
Space Temperature Low Limit	Normal, Alarm	SpaceTemp < (CalcHeatingSp - HeatBand - AlarmLimitOffset)	Space temperature returns back above the low limit
Input 1 Short	Normal, Alarm	HW Supply Temp sensor input indicates a short circuit	Equipment failure must be resolved
Input 1 Open	Normal, Alarm	HW Supply Temp sensor input indicates an open circuit	Equipment failure must be resolved
Input 2 Short	Normal, Alarm	HW Flow sensor input indicates a short circuit	Equipment failure must be resolved
Input 2 Open	Normal, Alarm	HW Flow sensor input indicates an open circuit	Equipment failure must be resolved
Input 3 Short	Normal, Alarm	HW Return Temp sensor input indicates a short circuit	Equipment failure must be resolved

505-037-3, Effective: October 26, 2015

Alarm	Range	Alarm Trigger	Alarm Reset
Input 3 Open	Normal, Alarm	HW Return Temp sensor input indicates an open circuit	Equipment failure must be resolved
Input 4 Short	Normal, Alarm	CW Supply Temp sensor input indicates a short circuit	Equipment failure must be resolved
Input 4 Open	Normal, Alarm	CW Supply Temp sensor input indicates an open circuit	Equipment failure must be resolved
Input 5 Short	Normal, Alarm	CW Flow sensor input indicates a short circuit	Equipment failure must be resolved
Input 5 Open	Normal, Alarm	CW Flow sensor input indicates an open circuit	Equipment failure must be resolved
Input 6 Short	Normal, Alarm	CW Return Temp sensor input indicates a short circuit	Equipment failure must be resolved
Input 6 Open	Normal, Alarm	CW Return Temp sensor input indicates an open circuit	Equipment failure must be resolved

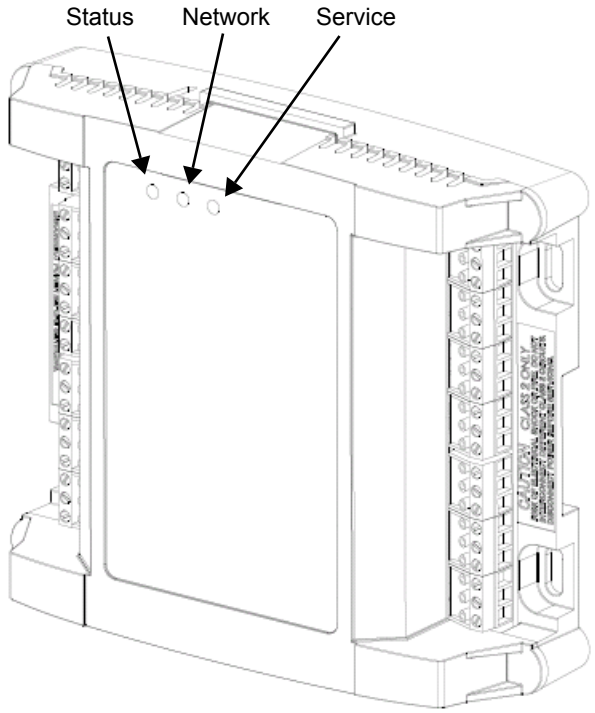
TROUBLESHOOTING

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 13: FCU4 Controller LEDs



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).
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 FCU4 controllers?	Yes, provided that you do not exceed the maximum number of controllers that can be handled by the Local Control Interface (LCI).
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.

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.

505-037-3, Effective: October 26, 2015

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.

TES OFFERS THIS WARRANTY IN LIEU OF ALL OTHER EXPRESS WARRANTIES. ANY WARRANTY IMPLIED BY LAW INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS IS IN EFFECT ONLY FOR THE DURATION OF THE EXPRESS WARRANTY SET FORTH IN THE FIRST PARAGRAPH ABOVE.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR STATUTORY, OR ANY OTHER WARRANTY OBLIGATION ON THE PART OF TES.

TES WILL NOT BE LIABLE FOR ANY SPECIAL, INCIDENTAL, INDIRECT OR CONSEQUENTIAL DAMAGES RESULTING FROM THE USE OF ITS PRODUCTS OR ANY INCIDENTAL COSTS OF REMOVING OR REPLACING DEFECTIVE PRODUCTS.

This warranty gives the purchaser specific rights, and the purchaser may have other rights which vary from state to state. Some states do not allow limitations on how long an implied warranty lasts or on the exclusion of incidental or consequential damages, so these limitations or exclusions may not apply to you.

CONTROLS MADE EASY®

Taco Electronic Solutions, Inc., 1160 Cranston Street, Cranston, RI 02920
Telephone: (401) 942-8000 FAX: (401) 942-2360.

Taco (Canada), Ltd., 8450 Lawson Road, Unit #3, Milton, Ontario L9T 0J8.
Telephone: 905/564-9422. FAX: 905/564-9436.

Taco Electronic Solutions, Inc. is a subsidiary of Taco, Inc.
Visit our web site at: http://www.taco-hvac.com

Printed in the USA