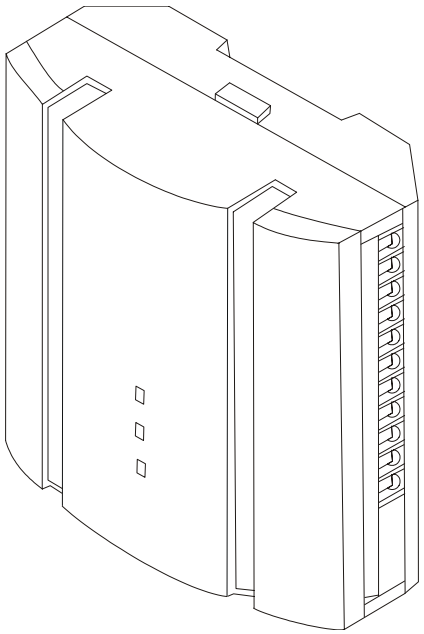
iWorX BZU-1
Application Manual

BZU-1

The BZU-1 boiler zone unit is a microprocessor based controller for adding additional heating zones to hydronics systems that are being controlled by an iWorX BLR Series boiler controller. It may also be used as a stand-alone zone controller. This application includes control of up to five heating zones or snow melt zones and a common heat source.



Overview

Five analog inputs are provided for zone temperature sensors. A digital input is available for a plant alarm. Up to five zone valves or pumps are controlled by digital outputs. An additional digital output is provided for a heat demand output.

The controller is based on the LonWorks® networking technology, and communicates with the BLR Series controller over the network. The controller can also be networked to a higher-level control system for monitoring and control applications.

Features

- Control of up to five heating zones with individual sensor inputs and isolated outputs
- Networking capability of up to 8 units (40 zones)
- Individual temperature setpoints for occupied heating of each zone
- Common temperature setpoint for unoccupied heating
- Proportional plus integral (P+I) control of heating
- Heat demand output for a common pump or non-networked heat source
- Heat demand and snow melt demand communicated to a BLR-1 boiler control
- Outdoor cutoff temperatures available when used with a BLR-1
- Snow melt mode with melting and idling setpoints when used with a BLR-1
- LonWorks® interface to building automation systems and host products
- Automatic configuration with a Local Control Interface (LCI) touchscreen
- Alarm/Event reporting

innovex TECHNOLOGIES

Innovex Technologies
511 Braddock Avenue
Turtle Creek, PA 15145
www.innovextechnologies.com

iWorX is a trademark of Innovex Technologies
LON, LonWorks, & LonMark are trademarks of Echelon Corporation

Printed in the USA 2006.04.17

iWorX-BZU1-APP-100

Purpose of This Guide

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

Copyright Notice

This document copyright © 2006, Innovex Technologies. All other intellectual property rights and copyrights related to or arising from these products belong to a third party.

The confidential information contained in this document is provided solely for use by Innovex Technologies employees, licensees, and system owners, and is not to be released to, or reproduced for, anyone else. Neither is it to be used for reproduction of this control system or any of its components.

All specifications are nominal and may change as design improvements occur. Innovex Technologies shall not be liable for damages resulting from misapplication or misuse of its products.

Applicable Documentation

Part Number	Description	Audience	Purpose
iWorX-BZU-INS-100	iWorX BZU Series Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides instructions for setting up and using the iWorX BZU-1 Controller.
iWorX-BLR1-APP-100	iWorX BLR-1 Application Manual	– Application Engineers – Wholesalers – Contractors	Provides specific application information about the BLR-1, including sequence of operation and configuration information.
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.
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 iWorX BZU-1 is a self-contained interoperable controller for zone valves or pumps in a hydronics system. The BZU-1 maintains the temperature of up to five zones by operating zone valves or pumps in cooperation with a BLR-1 boiler controller. It may also be used as a stand-alone zone controller with a non-networked heat source.

This product is not intended for safety or limiting functions.

The temperature in each zone is controlled individually. Separate occupied temperature setpoints can be set for each zone, and an unoccupied temperature setpoint is common to all zones. Occupancy is determined by the associated LCI group or may be set to occupied for the individual zones.

A temperature sensor is monitored in each zone. The pump/valve output for each zone is operated based on a proportional plus integral (P+I) control loop that determines a heat demand value. The heat demand output is turned on when any zone demand output is on.

The “zones” may be indoor spaces with room temperature sensors, snow melt slabs with embedded sensors, or other radiant panels with embedded or surface sensors. A snow melt mode may be selected, which is communicated to the BLR-1 so that it operates the appropriate snow melt functions.

The BZU-1 may be set to communicate its heat demand to the BLR-1, which then provides the appropriate supply temperatures. The BZU-1 may be configured for a secondary loop supply, which uses the injection functions of the BLR-1, or it may be set to use only the primary loop as a supply.

The commissioning switch displayed on the LCI can be set to turn on all five zone outputs and the heat demand output simultaneously for test purposes.

The plant alarm input may be used to send an alarm to the LCI when the digital input changes state.

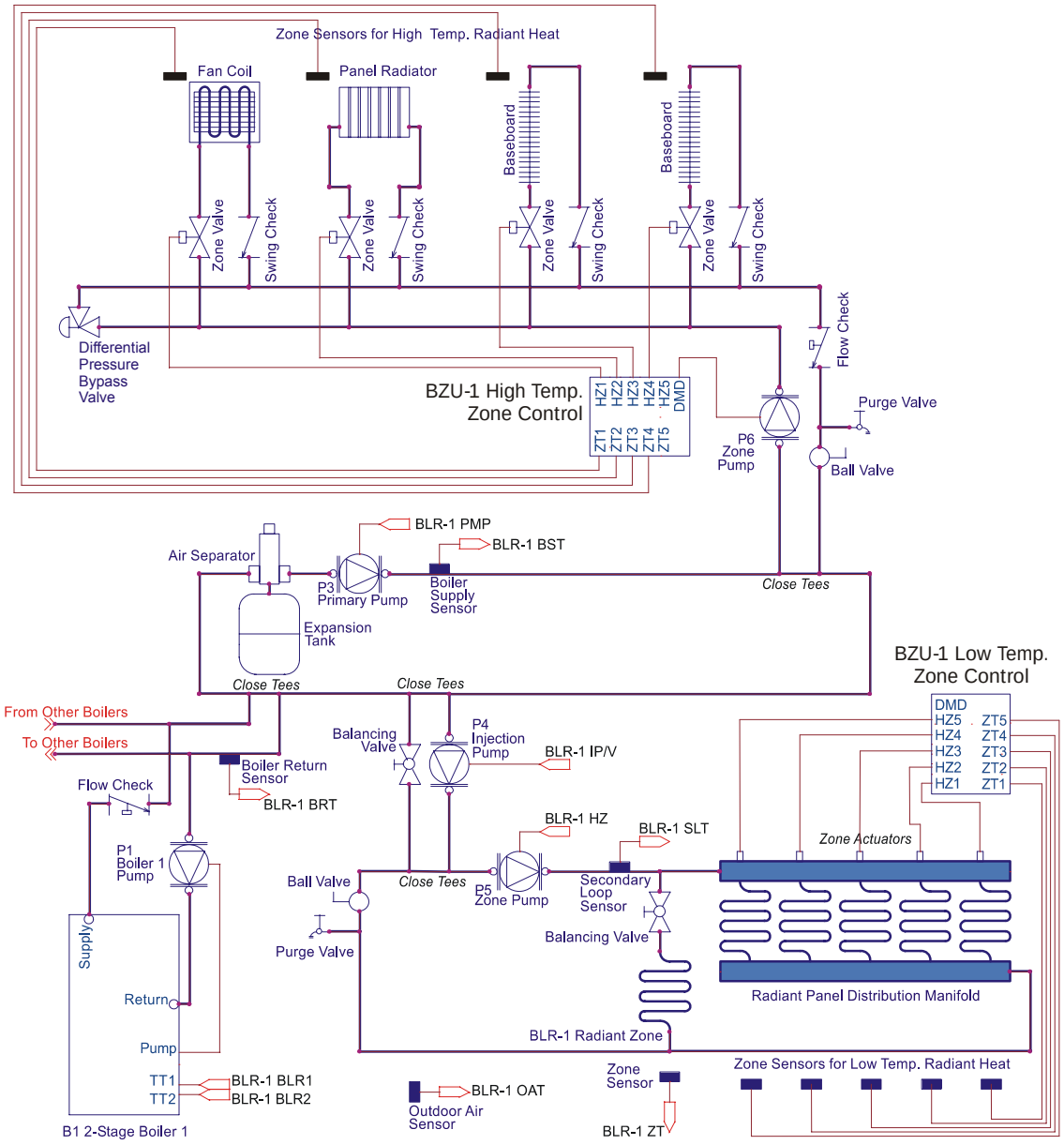
The outputs are capable of switching low voltage, low current; therefore, auxiliary relays or contactors are required for pumps or valves that exceed the output ratings.

Application Example

Figure 1 represents a possible application for the BZU-1 controller. This application shows two BZU-1 controllers, one on a secondary loop and one on the primary loop of a hydronics system. The BZU-1 on the secondary loop could be used for indoor heating or snow melt zones.

Note that this is a generalized drawing. It may not be appropriate for some installations, and is not intended to show all piping components and detail. Relays are not shown for line voltage devices; for clarity, only the controlling signal is shown. Systems must be designed in accordance with basic hydronic principles as well as local and national codes. The system designer must ensure safety requirements and protection of the system components.

Figure 1: Multizone Radiant Heat System



NOTE: In this configuration, the BLR-1 Zone receives heat when any of the other zones are calling for heat, unless a thermostat-controlled zone valve is installed in the circuit.

Sequence of Operation

This section describes the detailed sequence of operation for the BZU-1 control strategy. The italicized terms refer to the settings available on the LCI. (See “BZU-1 Configuration” on page 8.)

Operational Modes

The BZU-1 always operates as a five-zone controller in the heating mode. The *Snow Melt Mode* switch determines whether the BZU-1 operates as an indoor zone controller or a snow melt zone controller in conjunction with the BLR-1. The primary difference is in the use of the occupied and unoccupied set-points.

Occupancy and Zone Setpoints

Indoor Zone Control

If the *Snow Melt Mode* switch is off, the BZU-1 is in the normal indoor zone control mode. The occupancy of all five zones is determined by the group occupancy status communicated from the LCI. At the LCI group level, the occupancy may be scheduled or manually set to the occupied state. At the BZU-1 zone level, each zone may be individually set to the occupied state by turning on the *Zone 1/2/3/4/5 Override* switch. When in the unoccupied state, each zone is controlled to the common *Unoccupied Setpoint*. When occupied, each zone is controlled to its individual *Zone 1/2/3/4/5 Occupied Setpoint*.

Snow Melt Mode

If the *Snow Melt Mode* switch is on, the BZU-1 is in the snow melt mode. The occupied and unoccupied setpoints are used as the melting and idling setpoints, respectively. The group occupancy status from the LCI is ignored. The “occupancy” of all five zones is instead determined by the status of the snow melt demand from the BLR-1. If either the external snow melt switch or the BLR-1's Snow Melt Override switch is on, the BZU-1 zones are set to the “occupied” state. At the BZU-1 zone level, each zone may be individually set to the “occupied” state by turning on the *Zone 1/2/3/4/5 Override* switch. When in the “unoccupied” state, each zone is controlled to the common *Unoccupied Setpoint*, which is the idling temperature to be maintained in the slab. When “occupied”, each zone is controlled to its individual *Zone 1/2/3/4/5 Occupied Setpoint*, which is the targeted melting temperature when snow melt is required.

For Snow Melt to function at the BZU-1 level, *Snow Melt System* must be enabled for the BLR-1.

Outdoor Temperature Limits

The outdoor air temperature (OAT) is communicated from the BLR-1 to allow for warm weather shutdown, as well as snow melt disabling in extreme cold weather. When the OAT is greater than the *OAT Heating Cutoff*, zone heating is disabled, whether configured for indoor heating or snow melt.

If configured for the *Snow Melt Mode*, zone heating is also disabled when the OAT is below the *Snow Melt Cutoff*. If the BLR-1's Snow Melt Override switch is on, the outdoor temperature limits are overridden for all zones. At the BZU-1 zone level, turning on the *Zone 1/2/3/4/5 Override* switches overrides the outdoor limits for the individual zones.

If there is not a BLR-1 on the network, the OAT defaults to 32 °F (0 °C).

Zone Output Operation

The five zone outputs may be used for on/off valves, pumps or other heat sources. If not disabled by the outdoor limits, the outputs for each zone are operated to maintain the zone setpoints established above. The outputs are controlled by proportional plus integral (P+I) feedback loops that compare the individual zone temperatures (*Zone 1/2/3/4/5 Temperature*) with the respective setpoints (*Zone 1/2/3/4/5 Setpoint*).

When the demand for a zone reaches at least 10%, the output is turned on to open the valve or operate the pump. The output remains on until the demand drops to 5% or less. For each output, a five-second on-delay and a minimum on time of one minute protect against short cycling. The status of each output is displayed on the LCI (*Zone 1/2/3/4/5 Output*).

Proportional + Integral Tuning

The zone demands are calculated as a percentage such that the value is 1% for every degree centigrade that the temperature is below the setpoint, multiplied by the proportional gain. The integral term is added to that percentage to eliminate any offset. The proportional gains and integral times are adjustable by using the corresponding LCI settings (*Zone 1/2/3/4/5 Proportional Gain* & *Zone 1/2/3/4/5 Integral Time*). The proportional gain determines the effective temperature differential for the zone. For example, with a proportional gain of 20, the demand reaches 10% at 0.5°C (0.9°F) below the setpoint (output turned on), and drops to 5% when within 0.25 °C (0.45 °F) of setpoint (output turned off). To operate with a wider differential (less frequent cycling of the output), decrease the proportional gain. The integral time determines how quickly an offset is corrected. To allow the offset to remain for a longer period (resulting in less cycling of the output), set the integral time to a longer period (or set it to zero to disable the integral function).

Demand Outputs & BLR-1 Communication

When any of the zones outputs is turned on, the *Heat Demand* output is turned on. This may be used to operate a supply pump for the zone circuits or to signal a heat demand to a non-networked boiler control or other heat source. If the *BLR Heat Demand* setting is on, then the status of this output is communicated to the BLR-1 as a primary loop demand. If the outdoor temperature is below the OAT heating cutoff of the BLR-1, the primary pump is turned on and the boilers are controlled to provide water at the appropriate outdoor reset setpoint.

The greatest of the five zone demands is displayed as the *Maximum Zone Demand*. If the *BLR Zone Demand* setting is on, then this maximum value is communicated to the BLR-1 as a sub-zone demand for the secondary loop. If the outdoor temperature is below the OAT heating cutoff of the BLR-1, the BLR-1 zone pump is operated and the injection output is controlled to provide the appropriate outdoor reset temperature in the secondary loop. The boilers and primary pump are operated as needed to meet the injection demand.

If the BZU-1 zones are on the secondary loop of the BLR-1, only the *BLR Zone Demand* setting needs to be on, since the demand for the boiler is dictated by the injection requirements. This method fires the boiler only as needed. However, both BLR-1 settings, the *BLR Heat Demand* and the *BLR Zone Demand* may be turned on. The effect of this is to create a demand for the boiler whenever a BZU-1 zone is calling. This serves to keep the boiler in a standby mode that could reduce cycling as the demand from the secondary loop varies.

Additional Features

Commissioning Switch

To allow simple commissioning, a single switch setting can be adjusted at the LCI. By setting the *Commissioning Switch* to “On”, all six digital outputs are turned on simultaneously.

Alarm Monitoring

The controller will detect certain conditions and send them to the LCI as alarms. These alarms are displayed and recorded for later access, but do not alter the system operation.

Temperature Sensor Alarm

If the analog input from a thermistor is outside of the expected range of the thermistor (-60 °F to 230 °F [-51 °C to 110 °C]), this alarm will be sent to the LCI. An alarm of this type is most likely due to a wiring fault causing the input to be shorted or open. An open sensor results in a reading of -60 °F (-51 °C), while a short appears as 230 °F (110 °C).

Plant Alarm

A digital input is available to monitor an alarm signal from the system. This may be derived from multiple sources such as limit switches or motor overloads. A dry contact is used to change the state of the BZU-1 input. If the alarm is enabled (on the “System Tuning – Sensors” screen), the signal generates an alarm at the LCI. The alarm is cleared when the contact returns to the normal state, which may be selected as “Normally Open” or “Normally Closed” on the “System Tuning – Sensors” screen.

Automatic Configuration

The BZU-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 BZU-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 BZU-1 with LNS or other LONWORKS tools if they wish.

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

BZU-1 Configuration

Once the BZU-1 is properly installed and recognized by the LCI, the LCI touchscreen can be used to configure the settings of the controller. This section describes the commands available on the LCI for configuration of the BZU-1, and the meanings and suggested values for controller parameters. For more information on using the LCI, see the *iWorX LCI User's Guide.*

Overview

The Overview screen lists the major inputs and outputs of the BZU-1, and shows their current values. None of these values can be changed from this screen.

Table 1: Overview Fields

Setting	Range	Description
Zone 1 Temperature	-60 to 230 °F (-51 to 110 °C)	Measured temperature of each zone.
Zone 2 Temperature		
Zone 3 Temperature		
Zone 4 Temperature		
Zone 5 Temperature		
Occupancy	Occupied, Unoccupied	Occupancy status of the zone according to schedule or override.
Maximum Zone Demand	0.00% to 100.00%	Highest demand of the five zones.
Zone 1 Setpoint	-58 to 203 °F (-50 to 95 °C)	Current setpoint for each zone.
Zone 2 Setpoint		
Zone 3 Setpoint		
Zone 4 Setpoint		
Zone 5 Setpoint		
Heat Demand	Off, On	Status of the heat demand output.
Zone 5 Output	Off, On	Status of each zone output.
Zone 4 Output		
Zone 3 Output		
Zone 2 Output		
Zone 1 Output		

Adjustments

This screen lists adjustments that system managers may modify periodically during normal operation.

Table 2: Adjustments Fields

Setting	Range	Default	Description
Zone 5 Override	Off, On	Off	If set to "On", heating is enabled for that zone at the occupied setpoint, regardless of outside air temperature or occupancy status.
Zone 4 Override			
Zone 3 Override			
Zone 2 Override			
Zone 1 Override			
Unoccupied Setpoint	-58 to 203 °F (-50 to 95 °C)	59.0 °F (15.0 °C)	Setpoint to maintain in each zone when unoccupied (or idling in snow melt mode).
Zone 5 Occupied Setpoint	32 to 203 °F (0 to 95 °C)	68.0 °F (20.0 °C)	Setpoint to maintain in each zone when occupied (or when there is a snow melt demand).
Zone 4 Occupied Setpoint			
Zone 3 Occupied Setpoint			
Zone 2 Occupied Setpoint			
Zone 1 Occupied Setpoint			

Commissioning

The commissioning screen lists the parameters that control the basic functionality of the BZU-1. These values are used primarily during commissioning of the system. Once these values are set to optimum levels, they should not need modification.

Table 3: Commissioning Fields

Setting	Range	Default	Description
Commissioning Switch	Off, On	Off	If set to “On”, all outputs are turned on simultaneously.
Boiler Zone Demand	Off, On	Off	If set to “On”, the max. zone demand is communicated to the BLR-1 as a subzone demand for the injection pump (secondary loop).
Boiler Heat Demand	Off, On	Off	If set to “On”, the heat demand is communicated to the BLR-1 as a demand for the reset temperature from the primary loop.
Snow Melt Mode	Off, On	Off	If set to “On”, the BLR-1 is notified of the snow melt demand when there is a zone demand.
Snow Melt Cutoff	-67 to 41 °F (-55 to 5 °C)	14.0 °F (-10.0 °C)	Outside air temperature below which snow melt is disabled.
OAT Heating Cutoff	32 to 80 °F (0 to 27 °C)	68.0 °F (20.0 °C)	Outside air temperature above which heating is disabled.

Digital Inputs

This screen reports the status of the controller’s digital inputs. These values cannot be changed.

Table 4: Digital Inputs Fields

Setting	Range	Description
Plant Alarm	Off, On	Status of the plant alarm.

System Tuning

P+I Loops

These parameters control the proportional gain and integral time of the controller's proportional plus integral (P+I) control loops. Refer to "Proportional + Integral Tuning" on page 6 before changing these settings.

Table 5: P+I Loops Fields

Setting	Range	Default	Description
Zone 1 Proportional Gain	0 to 100	20.0	Gain used in the P+I loop that controls the output for zone 1.
Zone 1 Integral Time	0 to 1000 minutes	10.0 minutes	Response time of the Integral function for zone 1.
Zone 2 Proportional Gain	0 to 100	20.0	Gain used in the P+I loop that controls the output for zone 2.
Zone 2 Integral Time	0 to 1000 minutes	10.0 minutes	Response time of the Integral function for zone 2.
Zone 3 Proportional Gain	0 to 100	20.0	Gain used in the P+I loop that controls the mixing valve for zone 3.
Zone 3 Integral Time	0 to 1000 minutes	10.0 minutes	Response time of the Integral function for zone 3.
Zone 4 Proportional Gain	0 to 100	20.0	Gain used in the P+I loop that controls the output for zone 4.
Zone 4 Integral Time	0 to 1000 minutes	10.0 minutes	Response time of the Integral function for zone 4.
Zone 5 Proportional Gain	0 to 100	20.0	Gain used in the P+I loop that controls the output for zone 5.
Zone 5 Integral Time	0 to 1000 minutes	10.0 minutes	Response time of the Integral function for zone 5.

Sensors

These settings modify how the controller reacts to readings from the sensors that are connected to the controller. Offsets are added to sensor readings before any further processing is done by the controller. This may be useful for system testing or sensor calibration.

Table 6: Sensors Fields

Setting	Range	Default	Description
Zone 1 Temperature Offset	+/- 999 °	0.0 °F (0.0 °C)	Number of degrees to add to each temperature reading.
Zone 2 Temperature Offset			
Zone 3 Temperature Offset			
Zone 4 Temperature Offset			
Zone 5 Temperature Offset			
Plant Alarm Alarming	Off, On	Off	If set to "On", alarming is enabled for the plant alarm digital input.
Plant Alarm Type	Normally Open, Normally Closed	Normally Open	Controller will report an alarm if the input is *not* in the selected state

Troubleshooting

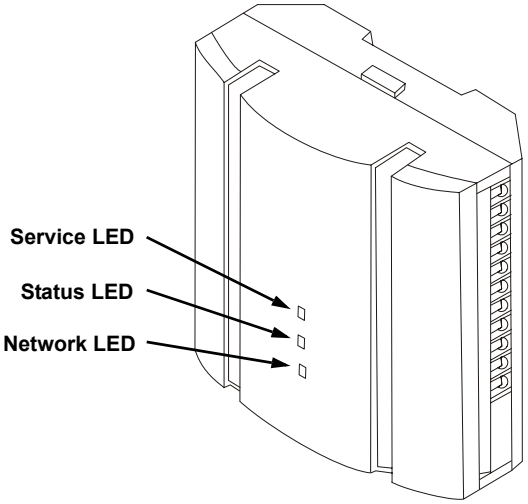
Diagnostic LEDs

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 7: 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 2: 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.

A zone pilot relay will not come on even though the LCI indicates it is on.

Ensure that the controller and output pilot relay have been powered with 24 VAC and the output has been correctly wired to the coil of the pilot relay. Also ensure that the pilot relay has a 24 VAC coil.

The 10K thermistor reading is out of range.

The input is either shorted or open.

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.