iWorx by Taco Electronic Solutions

Application Guide

505-001

BLMC Boiler Control Module

Self-Contained Interoperable Controller Model UCP-1

SUPERSEDES: December 13, 2013 EFFECTIVE: April 10, 2014

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BLMC

The iWorx® BLMC is a stand-alone microprocessor based controller for controlling boilers.

Overview

Boiler pumps and system pumps are controlled by digital outputs. Four analog outputs are provided for controlling up to four 0-10 V modulating boilers.

Analog inputs are provided for measuring the temperature of the outside air, primary loop supply, primary loop return. Digital inputs are provided for status alarms for up to four boilers. Two inputs can be configured to operate as digital inputs for auxiliary demand and zone demand, or as analog inputs for auxiliary temperature and reset temperature.

The controller is based on LONWORKS® networking technology. It can be networked to a higher-level control system for monitoring and control.

Features

- Four modulated boiler outputs
- Provides direct control of individual boiler pumps
- Provides a system output with configurable outdoor cutoff
- Sequential or parallel operation
- Equal run-time rotation with fixed lead and fixed last options
- Auxiliary demand/temperature control with a separate pump
- Outdoor reset or setpoint operation
- Individual temperature setpoint for reset setpoint
- Demand inputs are configurable for dry contact (switch operation) or Temperature
- System Proof input
- Automatic heating shutoff (Warm Weather Shutdown) in warm weather for energy savings
- Maintains primary loop temperature to protect non-condensing boilers
- Night time setpoint shift (also called night setback)
- Boiler status alarms for all connected boilers
- Networked Auxiliary Demand for cascading
- Weekday and weekend scheduling for stand-alone mode
- Optional Display and keypad provided for on-site configuration and/or stand-alone mode
- Automatic configuration with a Local Control Interface (LCI) touchscreen
- Alarm/Event reporting
- LONWORKS® network interface to integrate BLMC with other iWorx® products

PURPOSE OF THIS GUIDE

The *iWorX BLMC Application Guide* provides application information for the BLMC 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 of Taco Electronic Solutions, Inc.

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REPRESENTATIONS AND WARRANTIES

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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

Table 1: Applicable Documentation

Description	Audience	Purpose
iWorx® BLMC Application Guide, Document No. 505-001	– Application Engineers – Wholesalers – Contractors – Start-up Technicians – End user	Provides instructions for setting up and using the iWorx® BLMC.
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.	

INSTALLATION GUIDE

Precautions

General

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

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.

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.

Location

Avoid locations where corrosive fumes, excessive moisture, vibration or explosive vapors are present.

Avoid electrical noise interference. Do not install near large contactors, electrical machinery, or welding equipment.

This equipment is suitable for indoor or outdoor use. Preferably, or as required by National Electrical Code, the unit is intended to be installed within an electrical control enclosure. Operate where ambient temperatures do not exceed 140 °F (60 °C) or fall below 32 °F (0 °C) and relative humidity does not exceed 90%, non-condensing.

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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 document are for the BLMC controllers which support up to four modulating boilers in a hydronic system.

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 outdoors, 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 will be 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 triac output loads 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).

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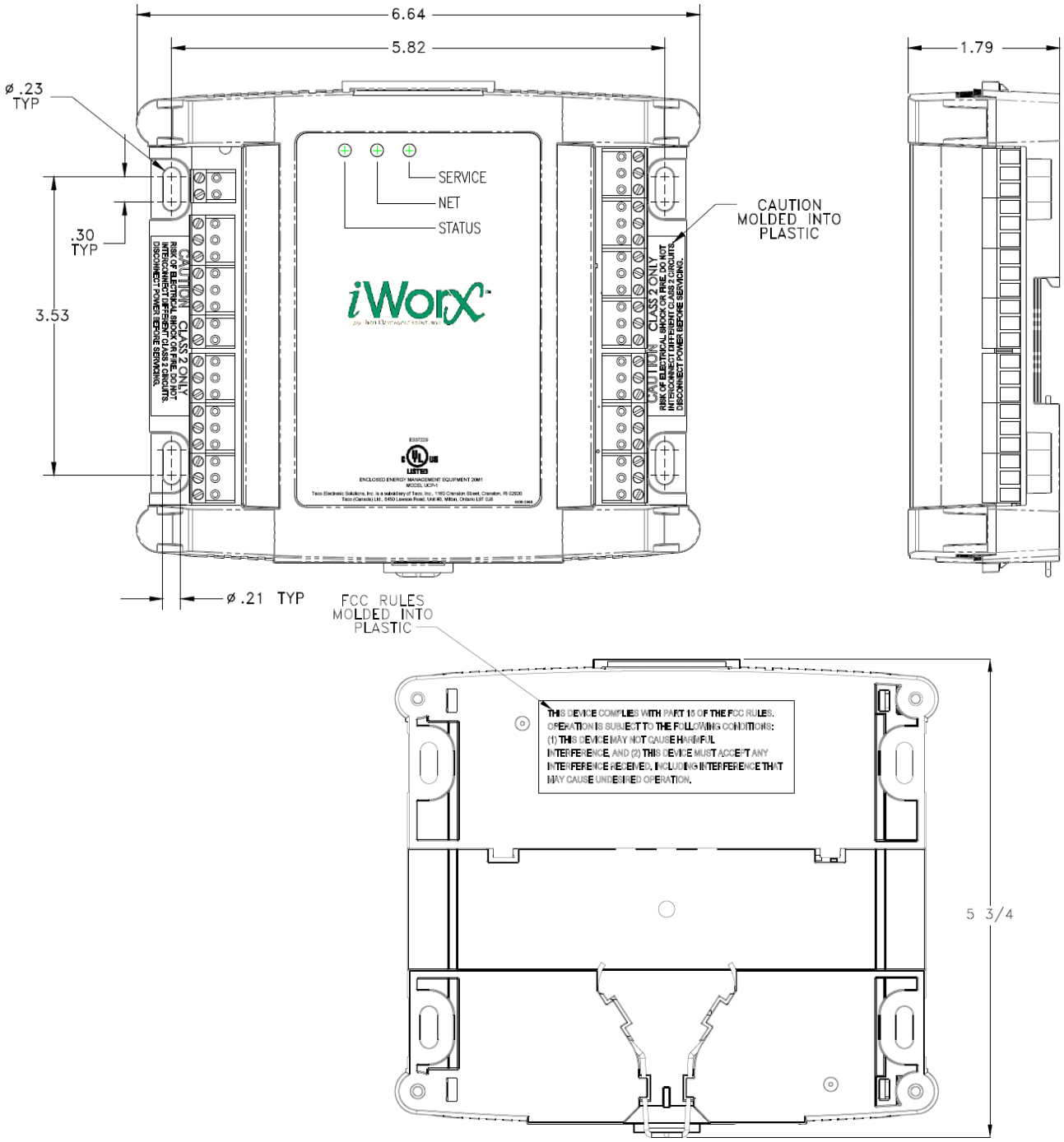
Figure 1: Mounting Dimensions



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.

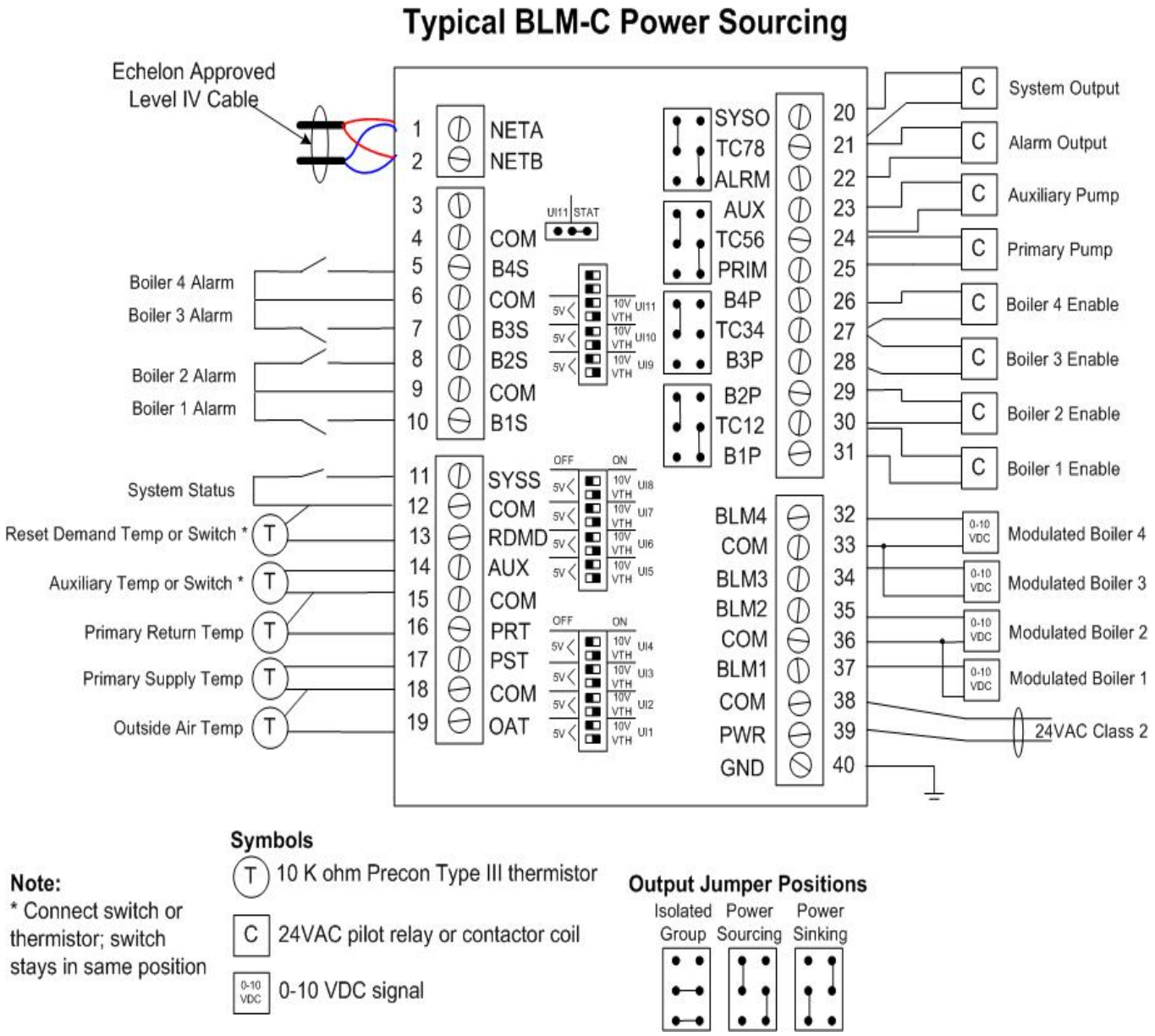
Grounding the Device

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

Figure 2: Wiring Diagram for Power Sourcing applications



Note: Please be aware of the switch positions. They must be set as shown in the drawings.

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Figure 3: Wiring Diagram for Power Sinking applications

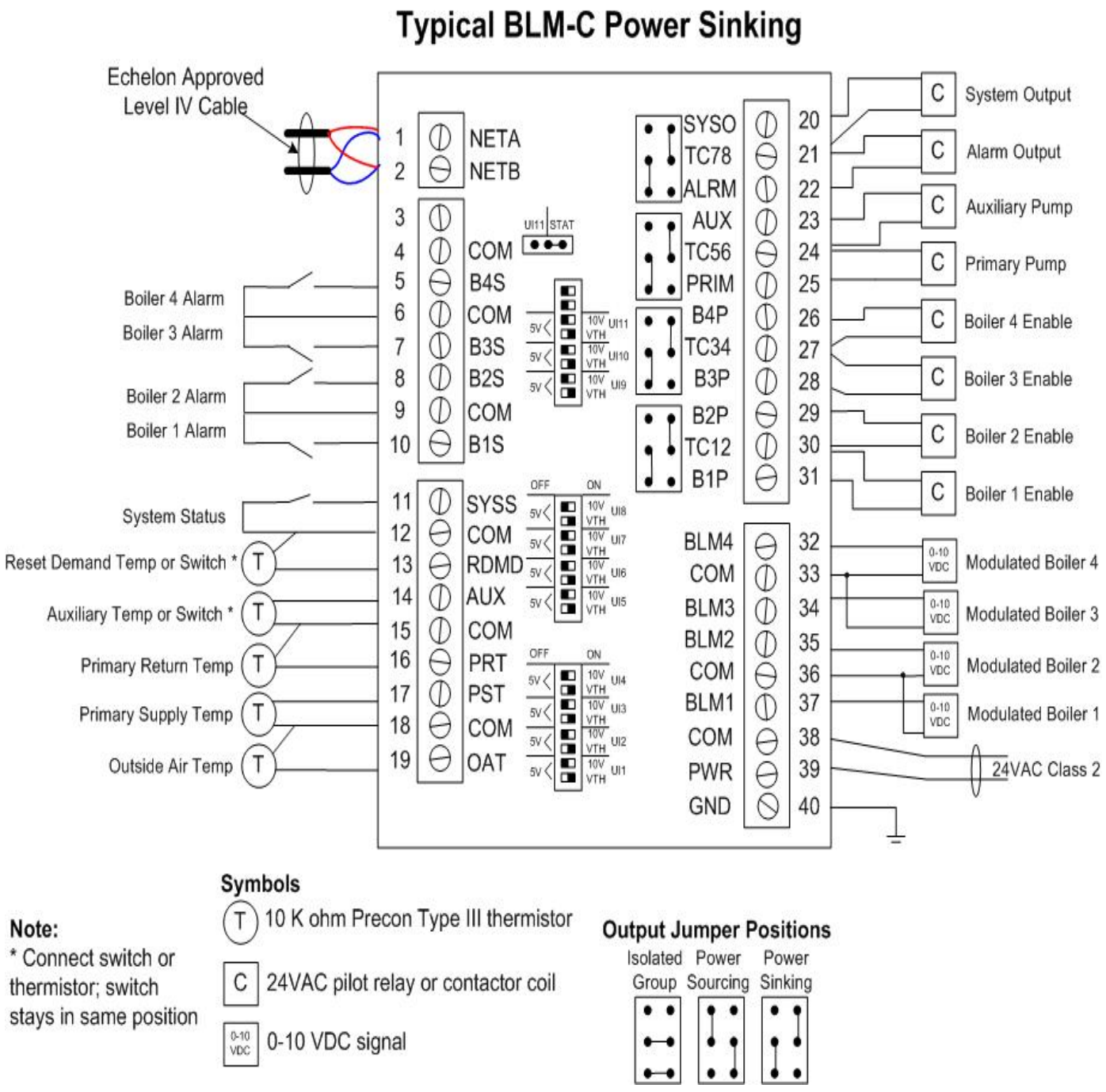

Figure 4: Wiring Diagram for Power Isolated applications

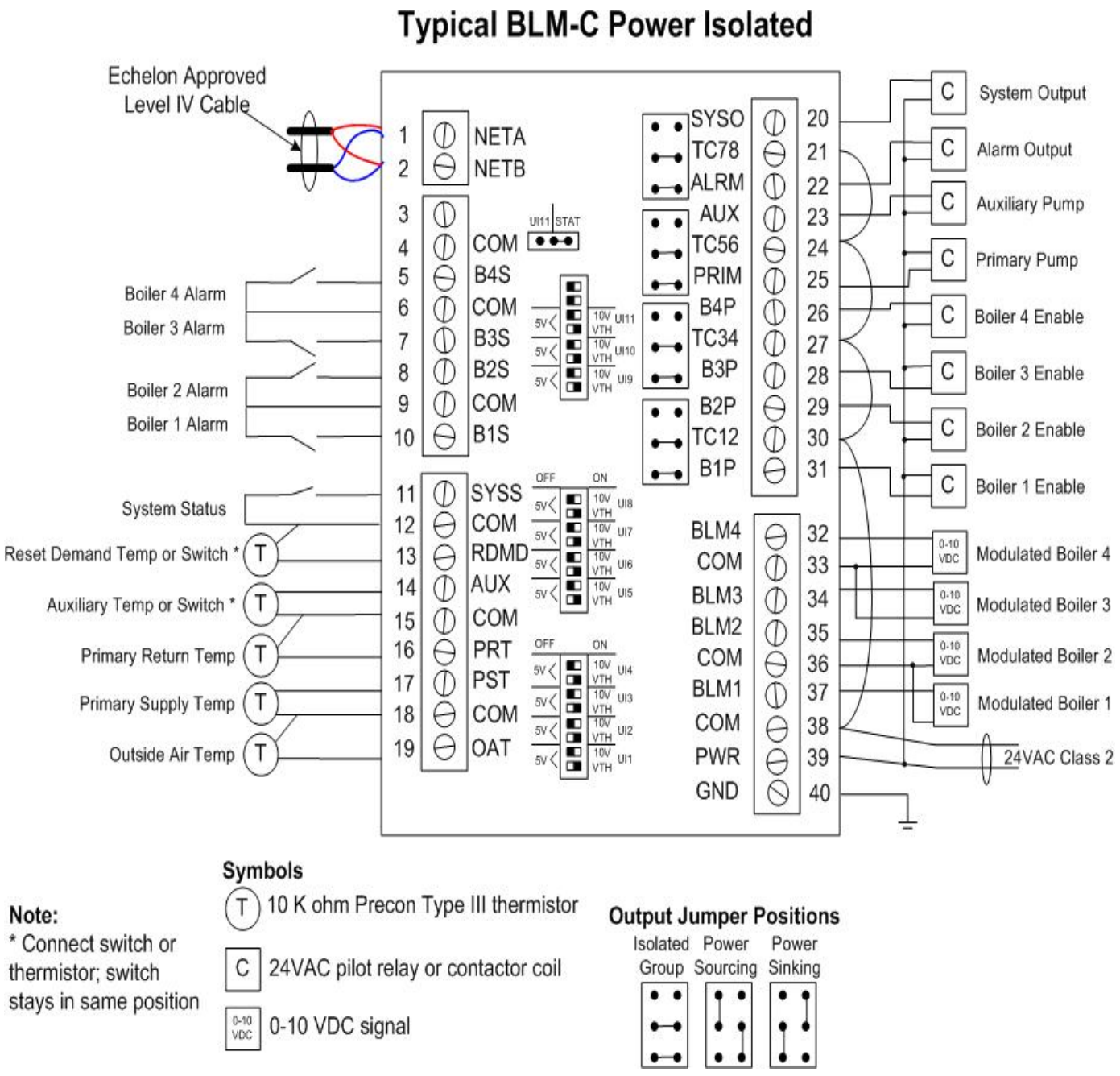

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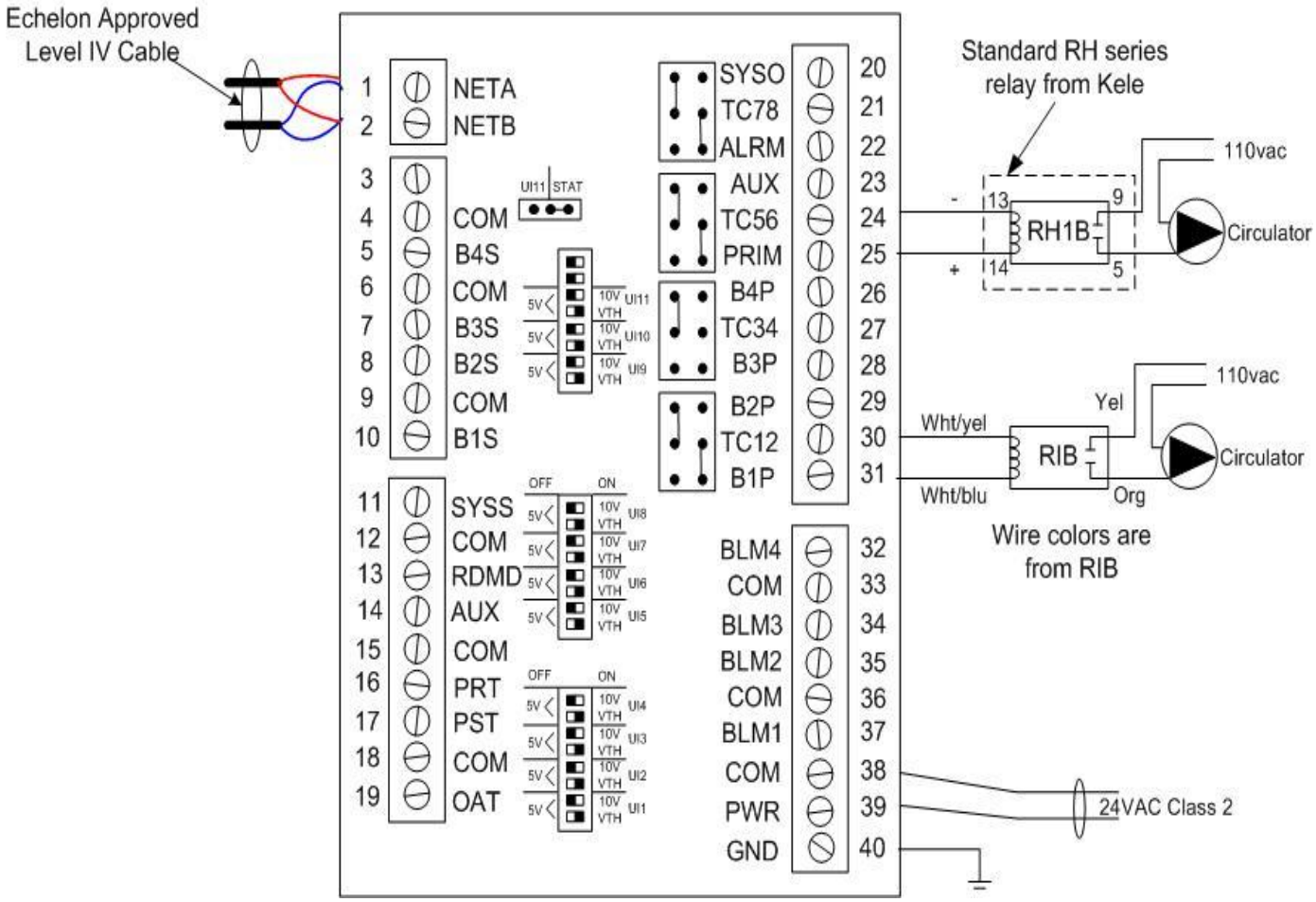
Figure 5: Wiring detail for Power Sourcing operation with different relays



Connecting Input Devices

Outside Air Temperature (OAT) (Optional)

To connect the Outside Air thermistor to the unit, attach one wire from the thermistor to OAT (T19) and the other wire to the adjacent common (T18). The thermistor used must be 10K Precon Type III. This Thermistor is optional and the position can be left open in networked applications, when the Outside Air Temperature is communicated through an ASM2.

Primary Supply Temperature (PST)

Included with the BLMC controller are two (2) 10K Precon Type III bullet sensors that can be used for measuring the Primary & Return Water Temperatures. These sensors are suitable for typical BLMC applications. For applications requiring faster response to changes in the Primary Supply water temperature or for applications utilizing a well, you must install an A/10KS-I well sensor. This sensor and associated wells can be purchased separately from Automated Components, Inc. ACI's web site is: http://www.workaci.com.

To connect either the bullet or well sensor to the Primary (System) Supply Water temperature input of the unit, attach one wire from the to PST (T17) and the other wire to the adjacent common (T18). The thermistor used must be 10K Precon Type III.

Primary Return Temperature (PRT) (Optional)

To connect the Primary (System) Return Water thermistor to the unit, attach one wire from the thermistor to PRT (T16) and the other wire to the adjacent common (T15). The thermistor used must be 10K Precon Type III. This Thermistor must be populated when running differential snowmelt sequences.

Auxiliary Switch/Demand or Auxiliary Temperature (AUX)

To connect the Auxiliary Switch/Demand to the digital input, attach one wire of the contact to AUX (T14) and the other wire to the adjacent common (T15). This must be a dry contact normally open switch. An Auxiliary Temperature is installed in the same way as the switch.

Reset Switch/Demand or Reset Temperature (RDMD)

To connect the Reset Switch/ Demand to the digital input, attach one wire of the contact to RDMD (T13) and the other wire to the adjacent common (T12). This must be a dry contact normally open switch. The Reset Temperature Sensor is installed the same way as the switch.

Boiler 1 Status (B1S)

To connect the Boiler 1 Status to the digital input, attach one wire of the contact to B1S (T10) and the other wire to the adjacent common (T9). This must be a dry contact normally open switch.

Boiler 2 Status (B2S)

To connect the Boiler 2 Status to the digital input, attach one wire of the contact to B2S (T8) and the other wire to the adjacent common (T9). This must be a dry contact normally open switch.

Boiler 3 Status (B3S)

To connect the Boiler 3 Status to the digital input, attach one wire of the contact to B3S (T7) and the other wire to the adjacent common (T6). This must be a dry contact normally open switch.

Boiler 4 Status (B4S)

To connect the Boiler 4 Status to the digital input, attach one wire of the contact B4S (T5) and the other wire to the adjacent common (T6). This must be a dry contact normally open switch.

System Status Input (SYSS)

This digital input operates as a system proof input. The boilers will not operate, if the system proof does not receive a contact closure within 1 min of start of operation. To connect the system status, attach one wire of the contact to SYSS (T11) and the other to the adjacent common (T12). This must be a dry contact normally open switch.

Connecting Output (Power Sourcing)

Boiler Enable Output or Boiler Pumps (B1P, B2P, B3P, B4P)

The outputs for the Boiler Enable/Pumps must be connected to 24 VAC pilot relays.

- Connect B1P (T31) to load. Use TC12 (T30) as common.
- Connect B2P (T29) to load. Use TC12 (T30) as common.
- Connect B3P (T28) to load. Use TC34 (T27) as common.

  Connect B4P (T26) to load. Use TC34 (T27) as common.

Pump Outputs (PPMP, AUX)

The outputs for the zone valves or pumps must be connected to 24 VAC pilot relays.

- Primary Pump - Connect PPMP (T25) to load. Use TC56 (T24) as common.
- Auxiliary Pump - Connect AUX (T23) to load. Use TC56 (T24) as common.

Unit Alarm (ALRM)

The Unit Alarm output must be connected to 24 VAC pilot relays.

Connect ALRM (T22) to load. Use TC78 (T21) as common.

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System Output (SYSO)

The System Output must be connected to 24 VAC pilot relays.

- Connect SYSO (T20) to load. Use TC78

Note: For safety reasons dampers or indoor air quality equipment must not be connected to this output!

Modulated Outputs (BLM1, BLM2, BLM3, BLM4)

The modulated outputs can be set to 0-10 V through the control logic. The control signal input of the actuators connects to the 0-10V outputs of the BLMC BLM1 (T37). See Wiring Details for further details.

NOTE For Power Sinking, Power Isolated, and more detailed Power Sourcing wiring, please refer to Figures 2,3,4 and 5 accordingly.

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).

Ground (GND)

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

SPECIFICATIONS

Electrical

Inputs

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

Outside Air Temperature, Primary Supply Temperature, Primary Return Temperature, (optional Aux Temperature, Reset Temperature)

- Precon Type III or Type II 10K Thermistor

Aux Demand, Zone Demand, System Proof

- Dry Contact
- Normally Open

BLM1, BLM2, BLM3, BLM4 Status

- Dry Contact
- Normally Open or Closed (Software Configurable)

Outputs

Aux Pump, Primary Pump, Boiler 1-4 Enable or Pump, Unit Alarm, System Output

- 24 Volts AC
- 1A @ 50C, 0.5A @ 60C, limited by the Class 2 supply rating.

Modulating Outputs for Boiler 1-4

- 0-10V
- 2K Ohm Minimum load
- 8 bit resolution

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).

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.

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Mechanical

Housing

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

Weight

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

Electronics

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

Environmental

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

Agency Listings

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

Agency Compliances

- FCC Part 15 Class A

APPLICATION OVERVIEW

Modulated Boiler Control

Four modulating boilers may be controlled by a BLMC Boiler Controller. All enabled modulating boilers are staged in the selected mode. The boilers may be fired sequentially or in parallel.

The boilers may be rotated for equal run time, while maintaining selected boilers as fixed lead or standby units.

The primary supply temperature is maintained at the calculated primary or auxiliary setpoint depending on which is calling and the priority setting. Demand signals may come from analog or digital inputs to the BLMC, or from networked devices. The demand signals may have their own setpoint associated with them, or they may use the outdoor reset curve defined in the BLMC. The outdoor reset curve allows for weather-compensated supply temperatures and warm weather shutdown of heating loads.

Auxiliary Temperature Control

The temperature of a buffer tank, DHW, or heating zone may be controlled by the Auxiliary Temperature Control. The Auxiliary Output is turned on and the boilers are operated to maintain the desired temperature.

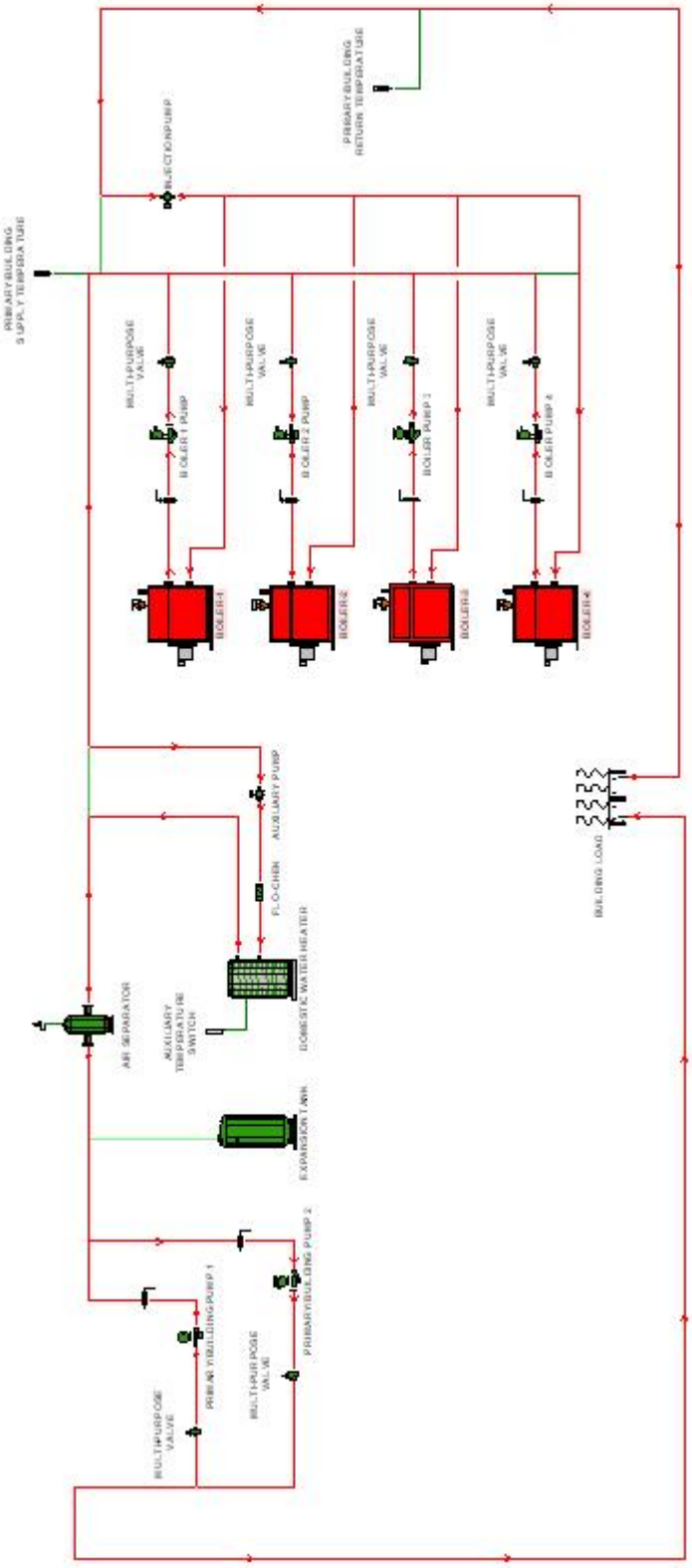
External Demand

Non-networked devices may signal a demand to the boilers by means of a contact closure at the Zone Demand input. Networked devices may also communicate either type of demand.

Alarms

An internal alarm condition will generate an alarm message to be displayed on the LCI-2 and if configured be emailed to a specified receiver.

Typical four boiler application with DHW and a Building load



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SEQUENCE OF OPERATION

Power-up

On power-up, all outputs remain off until valid temperature measurements have been obtained and the necessary network communications (such as outdoor air and primary loop temperatures) have been completed.

Boiler Demand

A demand for the boilers may come from one or more sources which can call for one of three adjustable setpoints.

Types of demands:

- Zone Demand
- Auxiliary demand
- Networked demand from Zone Controllers
- Networked demand from a cascading boiler setup

A demand for the Reset Setpoint (determined by the outdoor reset curve) may come from the Zone Demand input or a networked zone demand from a mixing control or zone control. A demand for Setpoint may come from a networked Setpoint demand from a mixing control or zone control. There is also a Demand Input for Auxiliary Demand which can be configured to be treated as a setpoint or reset setpoint. All Demand Inputs can be configured to take a digital signal as an input or a temperature sensor reading.

If there are simultaneous primary and auxiliary demands, the system setpoint depends on the priority setting. See “Priority Settings” on page 23. If there is no demand signal, the setpoint defaults to 5°C (41°F) for freeze protection.

Demand is calculated by a proportional and integral feedback algorithm according to the difference between the boiler loop temperature and the boiler setpoint. Differentials are determined automatically by the proportional and integral algorithm.

Setpoint Determination

Effective Setpoint is the calculated setpoint for the primary supply temperature when a demand is present at any of the demand inputs, or when a networked device has a demand.

If more than one setpoint is being called for, the priority of the Auxiliary determines how the setpoint is calculated (see priority).

Reset Setpoint Calculation

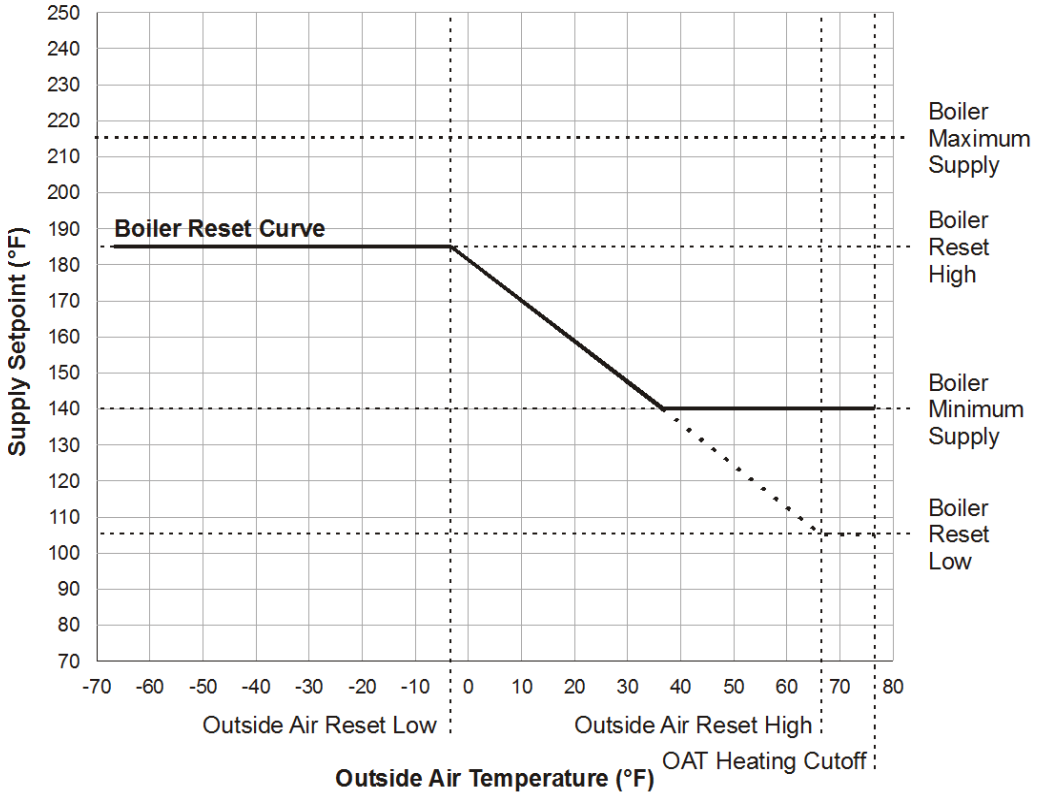
For the Reset Setpoint the outdoor reset curve is used. The outdoor reset curve is defined by five temperature settings. *Reset Low (OAT Settings)* is the outdoor design temperature at which the primary loop setpoint is at its highest, *Max Setpoint (Pri System Setp)*. The setpoint is at its lowest value, *Min Setpoint (Pri System Setp),* when the outdoor temperature is at or above the *Reset High (OAT Settings)* setting. The *Outdoor Cutoff* is the outdoor temperature above which a demand is ignored. Heating is enabled when the outdoor temperature drops 5°F below the cutoff and there is a heat demand.

Max Supply Temp is the temperature that the primary loop is not allowed to exceed. If this temperature is reached, the boiler outputs are turned off. If the Max Supply Temp is exceeded by 5°F, an alarm is generated and the boilers are shutdown. The pump will continue to operate as long as there is a call. The alarm is cleared when the temperature drops below the setting, and normal control resumes when the temperature drops 5°F below the setting.

Min Supply Temp is the minimum operating temperature that is maintained when there is a heat demand.

The *Min Return Temp* is maintained whenever there is a demand. The supply setpoint is raised, if necessary, to maintain the return temperature at the required level. The value of this setting is also available to networked mixing controls to allow load reduction when the return temperature is too low.

Figure 6: The Boiler Reset Curve



Setpoint Calculation with Thermistor

If the *Pri Input Type* in the Call Settings structure input is configured for *"Sensor"* (Temperature), the *Pri Sensor Setp Settings* are observed but the Supply Temperature is controlled. Whenever the Temperature on the *Zone Demand* input is less than the Setpoint Temperature, a call for heat is created. If the Temperature measured on the *Zone Demand* input is not reached, while the Supply Temperature has reached the calculated Reset Setpoint, the Setpoint is increased by one Deg F every 2 minutes until the *Max Supply Temp* is reached.

The *Pri Sensor Setp* can be set for Occupied and Unoccupied Mode, a *Sensor Adjust* can be applied to the temperature reading.

When configured for Master/Slave, the Master BLMC determines the setpoint and sends the information to the Slave BLMC. To eliminate confusion by the operator, it is recommended that the setpoints be set identically in both the Master and Slave BLMCs.

For freeze protection the effective setpoint is always set to 41 Deg F, when there is no demand or the BLMC is in unoccupied mode.

Auxiliary Influences on the effective Setpoint

The *Auxiliary Demand* can be configured to be treated as *Reset Setpoint* or *Setpoint Demand* type and will be calculated accordingly. In *Reset Setpoint* mode, the Auxiliary demand runs at its own reset curve (compare Reset Setpoint Calculation) with a Max Setpoint, Min Setpoint Value. Outside Air temperatures for the *Reset Low, Reset High* and *Outdoor Cutoff* values are shared with the primary loop demand calculation. In *Setpoint Demand* mode, *Max Setpoint* is the Setpoint value and *Min Setpoint* corresponds to the Setback Temperature. If no Setback is desired, Max Setpoint equals Min Setpoint.

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Auxiliary Setpoint Calculation with Thermistor

If the *Aux Demand* Input is configured for *"Sensor"* (Temperature), the *Aux Sensor Setp* are observed. Similar to the Setpoint calculation, the Supply Temperature will be controlled according to the *Aux System Setp*. Whenever the Temperature on the *Aux Demand* input is less than the calculated setpoint, a demand is created.

The Setpoint can be set for Occupied and Unoccupied Mode, a *Sensor Adjust* can be applied to the temperature reading.

Boiler Operation

The BLMC can control four modulating output signals. The modulating stages have similar staging options, but are configured separately. The boilers may be fired sequentially or in parallel.

The controller calculates the demand and stages the boilers accordingly, by modulating the appropriate boiler outputs. The shutdown of the boiler will be accomplished in the reverse order. Boiler modulation will be set to 0. The primary pump runs for *Post Purge Time* after the last Boiler has been shut off.

The boiler demand level is determined by a PID algorithm. The stage turn-on points are determined by the *1st Boiler Enable*. The first boiler stage is turned on at that level, and subsequent stages are turned on depending on the number of boilers and the staging mode.

The *Minimum On Time* setting applies to all stages. Once turned on, a stage remains on (subject to high limits) for at least this amount of time to prevent short cycling. Once turned off, a stage remains off for the *Minimum Off Time*. The *Next Stage Delay* is the time allowed for a newly fired stage to meet the demand before firing another stage.

Boiler Modulation

The output level of each stage is modulated between the turn-on and turn-off points. The *Modulation Mode* setting allows for either parallel or sequential staging. *Staging Type* allows for pure Staging (On/Off Boilers) or Modulation. With sequential modulation, each stage fired goes from 0 to 90% output before firing another stage, and all but the last stage fired remain at 100% while the last one is modulating.

For parallel staging, the outputs of all firing stages converge to modulate at the same level. Stages are turned off according to the sequencing configuration. If stages were turned off and the demand increases, so that additional stages are needed, the *Parallel Enable* determines the % demand at which the stage turns on.

The *Min Voltage* and *Max Voltage* Settings define the operating range in Volt of the Boiler. The output modulates between those two levels and is set to 0V when off. Other signal ranges require external components or converters.

Individual *Modulation Delays* are only observed in "sequential" *Modulation Mode*. In "parallel" *Modulation Mode*, the *Modulation Delay* of the first boiler will be observed for all boilers as startup. As stages are dropping in and out with demand, individual *Modulation Delays* are observed.

Ignition Point defines the Voltage value in the boiler operating range, when the boiler ignites/turns on low fire.

Boiler Protection

To ensure that the temperature of the boiler loop supply or return does not drop below the manufacturer's recommendations, the BLMC maintains the *Min Return Temp* while there is a demand and the Max Differential in the System Settings Structure is set to a value other than zero.

Loads in associated controllers of type BZU or ZXU are held off or reduced until the temperatures are high enough. In addition, while making automatic adjustments to the calculated Setpoint, the primary loop is kept below the *Max Supply Temp*.

Boiler Staging

The default Mode for Boiler Operation is *Parallel Mode*. In this mode all boilers startup at once and get adjusted by the resulting demand. When the setting is changed to "sequential" the boilers are operating in the selected Modulation Mode. In "sequential" modulation, the first boiler starts modulation according to the demand. When a 90% demand is reached, the next boiler starts up and begins modulating after the *Modulation Delay* for the individual boiler has lapsed. The first boiler then increases to 100% and only the last stage is modulating.

In the Staging Type “Staging” and the Modulation Type “sequential”, the control can be used for on/off Boilers. The appropriate outputs for the boilers are used as Boiler Enable signals. With sequential staging, the first boiler starts up at the “1st Boiler On” setting. The following boilers start up at discrete intervals. The intervals can be calculated using the following formula:

Stage Interval = ((100% - “1st Boiler On”)/(Boiler Count))

Boiler stages are turned off as the temperature rises and the demand decreases.

Note that the boiler stages are disabled at different points than where they are enabled. The actual differential is again determined automatically by the control application.

The gain and time values of the boiler demand proportional and integral control loop are preset to typical values but can be modified to match various system requirements. The *Gain* parameter in *System Settings* can be set to faster reaction (+1 or +2) or can be slowed down (-1 or -2).

Enable Order allows the modulating stages to be always fired in *Ascending Order* (1, 2, 3, 4), or the stage with the *Lowest Runtime* is the next one fired, or the boilers get rotated after *Automatic Runtime* hours have expired. *Shutdown Order* allows the modulating stages to be turned off in reverse order (*Last On, First Off*), or based on total run time (*Highest Runtime*). If sequential staging is selected, the next stage in the turn-off order is modulated down to the minimum level before turning off the current modulating stage off.

Any one of the modulating stages may be set to always fire first as the *Fixed Lead*. If set to zero, there is not a fixed lead stage. A fixed lead setting overrides other firing order options.

Any one of the modulating stages may be set to always fire last as the *Fixed Last*. If set to zero, there is not a fixed last stage. A fixed last setting overrides other firing order options.

Note: Fixed Lead and Fixed Last settings are not observed when *Enable Order* is set to *Lowest Runtime* and *Shutdown Order* is set to *Highest Runtime*.

Stage Timing

The *Stage Timing* structure allows the user to configure all stage related times.

Min On Time and *Min Off Time* define the time a stage has to be turned on before it can be turned off again and vice versa. *Next Stage Delay* defines the time that has to pass before another stage gets turned on. Depending on the differential between Demand and Current Temperature, the *Next Stage Delay* may be automatically adjusted.

Primary Pump Operation

The *Operation* setting allows for four different settings, *Off* - when the pump is disabled completely, *On* - when the pump is always on, *Auto* - when the pump is on when there is a demand and *Auto Outdoor Cutoff* - when the pump is observing the outdoor cutoff. See also Table 6.

Post Purge Time is the amount of time that the pump remains on after all stages are off and heat demand ceases, in order to allow for boiler post purge or to prevent cycling of the pump between demand cycles.

If *Pump Exercising* is enabled, the pumps are run sequentially for 15 seconds after a week of non-use.There is a 1-second delay between pumps.

Auxiliary Operation

The *Aux Input* specifies whether or not the input is a temperature or switch. If there is an On/Off Demand the Auxiliary demand is calculated according to the *Aux Call Type*.

The auxiliary temperature control may be used for an indirect DHW tank, a buffer tank, a pool or spa, or any heating zone. The auxiliary demand is calculated based on the *Auxiliary Setpoints* and the PI settings. The auxiliary pump is turned on when an auxiliary call is received and turned off when the call ends.

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Auxiliary Demand

The *Aux Call Type* in the Call Settings Structure allows the auxiliary demand input to be configured for a *Setpoint Demand* or a *Reset Demand*. If “Reset Setpoint” is selected, the Auxiliary setpoint is determined by the outdoor reset curve and the *Aux Temp Setp.* If “Setpoint Demand” is selected, the *Reset Low Temperature* is used in Unoccupied Mode and the *Reset High Temperature* is used in Occupied Mode. Unocc Setback has no effect in Setpoint Demand. The Auxiliary demand is not subject to *Outside Air Cutoff Temp* when it is configured as a setpoint. If the auxiliary call is configured for outdoor reset, it is subject to *Outside Air Cutoff Temp*.

Priority

The *Priority* determines how the demand gets treated. It can be set to Aux, None/Highest Setp, None/Lowest Setp, Pri. If set to *Aux*, the primary pump is shut down, the demand and setpoint are calculated according to the settings. A call for heat from an auxiliary source will be satisfied for a configurable amount of time, before the primary pump will resume to satisfy the demand for the primary/system loop. In “Pri” Priority, the Priority Timeout will be observed and the Aux Demand will be held back. If set to *None/*** *Setp*, the control uses the highest or lowest calculated setpoint (dependant on ****), resulting from the reset curve calculation for the primary and the auxiliary demand. Primary pump and auxiliary pump run at the same time.

Auxiliary Setpoints

Max Setpoint is the Temperature to be maintained, when *Aux Call Type* is set to “Setpoint” and the control is in occupied mode. *Min Setpoint* is the temperature to be maintained when the BLMC is in the unoccupied mode.

When *Aux Call Type* in the *Call Settings* structure is set to “Reset Setpoint”, *Min Setpoint* and *Max Setpoint* are used as High and Low points for the outdoor reset curve for the auxiliary loop. In this mode *Unoccupied Setback* is observed.

Auxiliary Pump Operation

The Auxiliary Pump can be controlled the same way the Primary/System Pump is controlled (See Top. Primary Pump Operation).

Priority Operation

The auxiliary output may be assigned a priority of Aux, None/Highest Setp, None/Lowest Setp or Pri. An Aux or Pri priority will expire after the *Max Override Time*, and will be re-enabled when the priority load has been enabled for *Max Override Time*. If the expiration time is set to zero, the priority overrides will not expire.

Priority Settings

This screen lists the Priority Settings for the BLMC

Demand #1/ Zone Demand	Demand #2/ AuxDemand	Priority	Boilers	#1 Pump/ Pri Pump[1)]	#2 Pump/ Aux Pump[1)]
None	– None	Any	Off	Off	Off
None	– Call	Any	On - Reset Curve #2 or fixed Setpoint	Off	On
Call	– None	Any	On - Reset Curve #1[2)]	On	Off
Call	– Call	Aux	On - Reset Curve #2 [3)]or fixed Setpoint	Off	On
Call	– Call	None/Highest Setp	On - Higher of Curve #1 and Curve #2 or fixed Setpoint	On	On
Call	– Call	None/Lowest Setp	On - Lower of Curve #1 and Curve #2 or fixed Setpoint	On	On
Call	– Call	Pri	On - Reset Curve #1	On	Off

1) Pumps are always running when the appropriate demand calls for heat even in the case, that the setpoint is reached and the boilers are turned off.
2) Curve #1 is defined in “Reset Settings”
3) Curve #2 is defined in “Aux Settings”

System Output Operation

The System output is turned on when any demand is observed in the system. It can be configured to follow Outdoor cutoff rules. The table below shows the possible operation.

System Output Settings

This table lists the System Outputs of the BLMC.

	Demand #1 (Zone Demand input)	Demand #2 (Aux Demand Input) configured as Zone Demand	Demand #2 (Aux Demand Input) configured as Fixed Setpoint Demand	System Output
Below Outdoor Cutoff	On			On
		On		On
			On	On
Above Outdoor Cutoff	On			Off
		On		Off
			On	On

Alarms

An alarm is communicated to the LCI under the following conditions:

- a Boiler status fault for individual Boilers*
- a high temperature fault on the primary loop (more than 1.5°C (5°F) above the *Max Supply Temp**.
- a low temperature fault on the primary loop (more than 1.5°C (5°F) below the *Min Supply Temp**.
- a low temperature fault on the primary loop (more than 1.5°C (5°F) below the *Min Return Temp**.
- a low temperature fault on the reset temperature sensor (more than 1.5°C (5°F) below the *Zone Settings - Zone Unocc SP*.
- a System Proof fault*

When sensor and status alarms are cleared they are also reported to the LCI. Alarms marked by an * do not have a return to normal message. The alarm input may be enabled or disabled, and may be configured for normally open or normally closed contacts.

System Tuning

The System is already pre-tuned and can be slightly adjusted. In the *System Settings* Structure the *Gain* is by default set to zero. To increase the system responsiveness, increase the *Gain* or decrease it to slow the system down.

Temperature Sensors

If a sensor is not reading as accurate as a temperature gauge or portable device, the sensor can be offset to match the correct reading. An Offset for the Supply and/or Return temperature sensors can be made from the *System Settings* selection. An Offset to the Zone Demand sensor, when configured as a sensor, can be made from the *Zone Settings* selection. An Offset to the Auxilary Demand sensor, when configured as a sensor, can be made from the *Aux Sensor Setp* selection.

Commissioning

To verify the integrity of the wiring and to commission connected pumps or boilers, individual outputs may be turned on regardless of demand, supply temperature or warm weather shut-down.

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Pumps Pri/Aux

The *Pri Pump* and *Aux Pump* selections allow the operator to test the pump by changing the *Pump Operation* setting to "On." Additionally, the output can be configured/commissioned to function as "Off/Auto/Auto WWSD." When set to "ON" the output turns on regardless of demand, supply temperature or WWSD. When set to "OFF" the output remains off when there is a demand. When set to "Auto" the output will turn on when there is a demand. When set to "Auto WWSD" the output will turn on when there is a demand as long as the OAT is not above the WWSD setpoint.

Boiler Outputs

The *Boiler x Settings* selections allow the operator to test the boiler pump or stage by changing the *Blr Operation* setting to "Enable." Additionally, the output can be configured/commissioned to function as "Disable/Auto." When set to "ON" the output turns on regardless of demand, supply temperature or WWSD. When set to "Disable" the output remains off when there is a demand. When set to "Auto" the output will turn on when there is a demand as long as the OAT is not above the WWSD setpoint.

Cascading

The BLMC can be operated in three different *Cascade Settings*, No Cascading, Master BLM and Slave BLM. In the *No Cascading* mode the controller can control up to four stages as described above. In cascading Mode two controllers can be associated to operate up to eight boilers. One BLM* works as the Master BLM and one as the Slave BLM. The Master BLM will be wired with all the needed sensors and demand inputs as well as all the system pump connections. The Slave BLM drives 4 modulating boilers and the appropriate boiler pumps. The Controllers for Master or Slave can be of type BLMC or BLMR.

Associating BLMs must be done according to the operational mode, the BLM is working in. Two modes are possible:

- Networked Mode
- Stand-alone Mode

Networking

If the BLMC is part of a network with the LCI2, it can be configured to be the master of another BLMC and up to 24 BZU series or ZXU1 controllers. The BLMC cannot be associated to more than 24 controllers in total.

Associating a Slave BLMC

If the BLMC is part of a network with a LCI2, it can be configured to be the master of another BLMC. The BLMC which is desired to become the Master BLMC must first be selected from the list of Controllers on the LCI screen. When the *Members* button is selected,the LCI2 displays all possible or already associated controllers. In networked mode, the Master BLMC can be associated to one BLMC controller, which will be operating as a Slave BLMC. Once a BLMC controller is selected as the Slave; the *Save* button must be pressed for the association to be communicated to both the Master and Slave BLMC controllers. Both controllers' *Cascade Settings* will automatically be updated with the correct information.

The Slave BLMC should not have any temperature sensors connected as it will use the Master BLMC temperature readings.

If the BLMC is not part of a LCI2 network and a Slave BLMC is desired, refer to the "Stand-alone" topic below.

Associating a BZU

Since multiple BLMC and BZUx controllers can be a part of an iWorX system, it is necessary to group these controllers so that the BLMC knows which BZUx controllers it may receive a demand from. To associate a BZU Controller to a BLMC Controller start from the BLMC *Edit Controller* screen. Press *Members* to display a list of the BZU units on the network. The member status of each is shown in the right-hand column. A member unit is one that communicates its demand to the BLMC. To change the member status of a BZU controller, just press that controller. It will toggle member or non-member with each press. If a BZU has been selected or deselected, you must press *Save* afterward to confirm the new setting. Up to 24 BZU controllers can be associated to one BLMC controller.

Associating a ZXU1

Since multiple BLMC and ZXU1 controllers can be a part of an iWorX system, it is necessary to group these controllers so that the BLMC knows which ZXU1 controllers it may receive a demand from. To associate a ZXU1 Controller to a BLMC Controller, start from the BLMC *Edit Controller* screen. Press *Members* to display a list of the ZXU1 units on the network. The member status of each is shown in the right-hand column. A member unit is one that communicates its demand to the BLMC. To change the member status of a ZXU1 controller, just press that controller. It will toggle member or non-member with each press. If a ZXU1 has been selected or deselected, you must press *Save* afterward to confirm the new setting. Up to 24 ZXU1 controllers can be associated to one BLMC controller.

Stand-alone

No network manager is present and there are only **two** BLMC controllers connected to each other. The *Cascade Settings* of the controller that is to become the Master BLM has to be set to the *Master BLM* Setting, using the keypad and the other controller has to be set to *Slave BLM*. Following this setup, the service pin of the Master BLM as well as the **Slave BLM** has to be pressed and held down for at least 1 second (in no particular order). This way both BLMC get configured to communicate.

The Display units of the Temperatures can only be adjusted to SI Units or English Units in stand-alone mode. If the BLM is connected to a network, the Engineering Units will be determined by the setting in the LCI2.

Real Time Clock (RTC)

If the BLMC is part of a network with the LCI2, then the RTC will be set or synced by the LCI each day at midnight. The controller will utilize the RTC in conjunction with its local backup schedules during periods when the LCI is not available.

Local Backup Schedules

The LCI normally determines the operating mode. However, you can define local weekday and weekend backup schedules for situations when the LCI is not available. When communication with the LCI has been interrupted for 10 minutes, the controller resorts to its local backup schedules. If the local backup schedules have not been configured, then the controller defaults to the occupied mode.

When communication with the LCI is restored, the controller returns to the operating mode scheduled by the LCI.

Runtime Accumulations/History

The total runtime is accumulated for each boiler stage. The history consists of total hours and minutes the boiler pump/stage output has been on. While there are no alarms to indicate that maintenance is required on a boiler stage, the operator may view the accumulated time from the *Outputs* screen. The runtimes can also be reset by an operator once maintenance has been performed.

To reset the runtimes, the *Reset Runtimes* button must be depressed on the *Edit Controller* screen of the controller.

Boost

The system can be configured to increase the supply water temperature setpoint when the demand is not being satisfied in a timely manner. The need for a temperature setpoint boost may come from outside air infiltration to zones or the transition from unoccupancy to occupancy. The feature has two settings: *Boost Delay* and *Temp Boost*. To enable the feature, *Boost Delay* must be set to a value other than 0 minutes. When *Boost Delay* is configured, the system will increase the supply water temperature setpoint by the amount defined in *Temp Boost*.

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CONTROLLER IDENTIFICATION

The controller must be configured by the LCI or the keypad/display in order to set the controller's schedules, change its setpoints, etc. To allow the LCI to identify the BLMC, 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 will be solid green after it is configured in a network. In stand-alone mode the status light will be amber.

Inputs

The Input Screen list the inputs of the BLMC, and shows their current values. None of these values can be changed from this screen.

Name	Range	Description
Outside Temp	-30 to 230°F (-34.5 to 110°C)	Temperature as received from the ASM2; if OA Temp is not populated on the BLMC, then this OA Temp will be used.
OA Temp	-30 to 230°F (-34.5 to 110°C)	Outdoor temperature.
Prim Supply Temp	-30 to 230°F (-34.5 to 110°C)	Primary supply water temperature.
Prim Return Temp	-30 to 230°F (-34.5 to 110°C)	Boiler return water temperature.
Aux Temp	-30 to 230°F (-34.5 to 110°C)	Auxiliary temperature.
Zone Temp	-30 to 230°F (-34.5 to 110°C)	Zone Temperature (when Call Settings: Zone Input type is set to “Sensor”)
OD Cutoff (WWSD)	Off, On	Indicates status of Outdoor Air cutoff (Warm weather shutdown)
Aux Demand	Off, On	Status of the Auxiliary Demand
Zone Demand	Off, On	Status of Zone Demand (when Call Settings: Zone Input type is set to “Switch”)
System Status	Off, On	Status of the System.
Boiler 1 Status	Normal,Alarm	Indicates Boiler activity
Boiler 2 Status	Normal,Alarm	Indicates Boiler activity
Boiler 3 Status	Normal,Alarm	Indicates Boiler activity
Boiler 4 Status	Normal,Alarm	Indicates Boiler activity
Device Fail	Off, On	Indicates a device failure
Post Purge	Off, On	Aux or Pri pump is in post purge mode
Aux Override	Off, On	System is in priority override
Boost	Off, On	System is in boost mode
Temp Alm	Off, On	Temperature alarm is present
Blr Startup	Off, On	One of the boilers is starting up
Freeze Prot	Off, On	System is in Freeze Protection Mode
Blr Prot	Off, On	System is in Boiler Protection Mode

Outputs

The Outputs Screen list the outputs of the BLMC, and shows their current values. None of these values can be changed from this screen

Name	Range	Description
Demand System	0-100%	Calculated demand in % of the complete hydronic system with all incoming individual demands
BLR 1 Out	0-100%	Boiler 1 modulation level
BLR 2 Out	0-100%	Boiler 2 modulation level
BLR 3 Out	0-100%	Boiler 3 modulation level
BLR 4 Out	0-100%	Boiler 4 modulation level
Output Status	Structure	
Boiler 1 Pump	Off, On	Status of Boiler 1 pump
Boiler 2 Pump	Off, On	Status of Boiler 2 pump
Boiler 3 Pump	Off, On	Status of Boiler 3 pump
Boiler 4 Pump	Off, On	Status of Boiler 4 pump
Primary Pump	Off, On	Status of primary pump
Aux Pump	Off, On	Status of auxiliary pump.
Unit Alarm	Normal, Alarm	One of the Boilers indicates status alarm
System Output	Off, On	System Output operation is described in Table 8
Occupied	Occ,Unocc	Occupation according to schedule
BLR 1 History	Structure	
Total Hours	0-65535	Total Boiler 1 Runtime Hours
Total Minutes	0-59	Total Boiler 1 Runtime Minutes
BLR 2 History	Structure	
Total Hours	0-65535	Total Boiler 2 Runtime Hours
Total Minutes	0-59	Total Boiler 2 Runtime Minutes
BLR 3 History	Structure	
Total Hours	0-65535	Total Boiler 3 Runtime Hours
Total Minutes	0-59	Total Boiler 3 Runtime Minutes
BLR 4 History	Structure	
Total Hours	0-65535	Total Boiler 4 Runtime Hours
Total Minutes	0-59	Total Boiler 4 Runtime Minutes

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Configuration

All Settings

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

Name	Range	Default Value	Description
System Settings	Structure		Settings common to all Boilers
Call Settings	Structure		Structure defines Priority settings and Demand Input types for Primary and Auxiliary demands.
Pri System Setp	Structure		Primary Reset Curve Settings
Aux System Setp	Structure		Aux Reset Curve Settings
Zone Settings	Structure		Temperature Settings for the Zone Demand input when Call Settings: Zone Input Type is configured as “Sensor”
Aux Sensor Setp	Structure		Temperature Settings for Aux System Demand Input when configured as Sensor
Pri Pump	Structure		Settings for the Primary/System Pump
Aux Pump	Structure		Settings for the Auxiliary Pump
OAT Settings	Structure		Outside Air Temperature Settings
Stage Settings	Structure		Settings for the staging algorithm
Stage Timing	Structure		Stage Time Values
Boost	Structure		Determines the Setpoint calculation from Unoccupied to occupied mode.
Blr Count	0-4	4	Number of Boilers used
Blr 1 Settings	Structure		Settings specific to this Boiler
Blr 2 Settings	Structure		Settings specific to this Boiler
Blr 3 Settings	Structure		Settings specific to this Boiler
Blr 4 Settings	Structure		Settings specific to this Boiler

Name	Range	Default Value	Description
Blr Status/Alm	Disabled, Switch (Open), Switch (Closed)	Disabled	The alarm can be disabled or enabled
Alarm Delay	0-100min	0min	Alarm will activate after the Boiler Alarm Delay time lapsed
Cascade Settings	No Cascading, Master BLM, Slave BLM	No Cascading	indicated which function the controller serves when it is cascaded
Slave BLM NID	Structure		This is a unique number for the cascading slave controller's neuron chip, this is only filled in, if the controller works as a cascading Master
Time Schedules	Network, BLM	BLM	Schedules are driven by the network connection in the setting "network", when set to "BLM" the controller uses it's internal clock to run schedules. Note: When a network is detected it takes precedence and automatically switches to Network.
Day Of Week	Not set, Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday	Not set	Number of the Day (0=Not set, 1=Sunday, etc.) When a controller has been already configured and a valid setting is detected the current RTC (Real Tie Clock) Setting is displayed.
WDay Occ Time	Structure		Time to begin the occupied period for the local backup schedule on weekdays.
WDay Unocc Time	Structure		Time to begin the unoccupied period for the local backup schedule on weekdays.
WEnd Occ Time	Structure		Time to begin the occupied period for the local backup schedule on weekends.
WEnd Unocc Time	Structure		Time to begin the unoccupied period for the local backup schedule on weekends.

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System Settings

Name	Range	Default Value	Description
Min Supply Temp	50 to 180°F (10 to 82.2°C)	70°F (21°C)	Minimum temperature to be maintained at the primary supply when there is a demand.
Max Supply Temp	100 to 230°F (37.7 to 110°C)	190°F (90°C)	Maximum temperature to be allowed at the primary supply at all times.
Min Return Temp	0 to 160°F (-17.7 to 71.1°C)	50°F (10°C)	Minimum temperature to be maintained at the boiler return when there is a demand.
Supply Sensor Adjust	-10 to 10°F (-5.56 to 5.56°C)	0°F (0°C)	Blr Supply Temperature Offset
Return Sensor Adjust	-10 to 10°F (-5.56 to 5.56°C)	0°F (0°C)	Blr Return Temperature Offset
Max Differential	0 to 40°F (0 to 22.22°C)	0°F (0°C)	Max Temperature Difference between Boiler Supply and Boiler Return Temperature. If set to 0°F Function is deactivated. Note: Set only if Return Temp Sensor is populated!
Gain	-2 to 2	0	Settings for the response of the system. Decreasing the system Gain slows the system down, increasing it, speeds the response time up.
System Output	Off, On, Auto, Auto Outdoor Cutoff	Auto	Determines how the System output operates
Shutdown Mode	Hard, Soft	Hard	Defines the way the system handles an abrupt shutdown request. Hard - makes all the boilers go off immediately. Soft - Boilers ramp down to “Low Fire Point” and turn off.

Call Settings

Name	Range	Default Value	Description
Zone Input Type	Switch, Sensor	Switch	Type of Sensor used for the Input. Input can be a Switch or a Thermistor
Aux Input Type	Switch, Sensor	Switch	Type of Sensor used for the Input. Input can be a Switch or a Thermistor
Aux Call Type	Setpoint, Outdoor Reset	Setpoint	Determines how the boiler setpoint is to be calculated when there is an auxiliary demand. It can be a fixed setpoint or an outdoor reset curve
Priority	Aux, None/Highest SP, None/Lowest SP, Pri	Aux	Priority level for an auxiliary heating demand.
Priority Timeout	0-240min	0min	Maximum Time Aux Demand keeps Aux Priority before other demands can be satisfied, if set to 0 the priority will never expire

Pri/Aux System Setp

Name	Range	Default Value	Description
Reset Low	50 to 180°F (10 to 82.2°C)	80°F (26.6°C)	Lowest supply temperature desired when warm outside or Unoccupied setting when in Setpoint mode.
Reset High	100 to 230°F (37.7 to 110°C)	180°F (82.2°C)	Highest supply temperature desired when cold outside or Occupied setting when in Setpoint mode.
Unocc Setback	-30 to 0°F (-16.6 to 0°C)	0°F (0°C)	Offset for reset curve, when unoccupied mode is detected

Zone Settings

Name	Range	Default Value	Description
Zone Occ SP	35 to 200°F (1.67 to 93.3°C)	72°F (23°C)	Occupied Setpoint
Zone Unocc SP	35 to 200°F (1.67 to 93.3°C)	65°F (18.3°C)	Unoccupied Setpoint
Zone Offset	-10 to 10°F (-5.56 to 5.56°C)	0°F (0°C)	Offset for Zone Temperature Sensor

Aux Sensor Setp

Name	Range	Default Value	Description
Occ Setpoint	35 to 200°F (1.67 to 93.3°C)	72°F (23°C)	Occupied Setpoint
Unocc Setpoint	35 to 200°F (1.67 to 93.3°C)	65°F (18.3°C)	Unoccupied Setpoint
Sensor Adjust	-10 to 10°F (-5.56 to 5.56°C)	0°F (0°C)	Offset for Zone Temperature Sensor

Pri/Aux Pump

Name	Range	Default Value	Description
Pump Operation	Off, On, Auto, Auto Outdoor Cut-off	Auto	If “On” pump runs continuously during heating season (subject to outdoor cut-off) or for installation
Post Purge Time	0-100 min	0 min	Time the auxiliary pump runs after the demand goes away
Pump Exercise	Off, On	On	If “On” pump is run for 15 seconds once a week

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OAT Settings

Name	Range	Value	Description
Reset Low	-30 to 50°F (-34.5 to 10°C)	0°F (-18°C)	Outside air temperature at which the water temperature is at its highest.
Reset High	41 to 122°F (5 to 50°C)	65°F (18.3°C)	Outside air temperature at which the water temperature is at its lowest.
Cutoff Temp	41 to 122°F (5 to 50°C)	65°F (18.3°C)	Outside air temperature above which the demand is disabled.
Offset	-10 to 10°F (-5.56 to 5.56°C)	0°F (0°C)	Offset for Outdoor Temperature Sensor

Stage Settings

Name	Range	Default Value	Description
Modulation Mode	Parallel, Sequential	Parallel	Parallel modulates all firing boilers together. Sequential modulates only the last stage added.
1st Boiler Enable	0-100%	10%	Demand at which first boiler gets enabled
Fixed Lead	0-4	0	Set to stage to always be fired first. If 0, there is not a fixed lead.
Enable Order	Ascending, Lowest Runtime, Automatic Rotate	Lowest Runtime	Lowest Runtime fires the stage having the lowest hours each time a stage is added. Ascending = 1,2,3,4 regardless of hours. Automatic rotate will reorder the sequence after the lead boiler has been running for Automatic Rotate hours. In ascending mode and automatic rotate mode fixed lead and fixed lag are observed.
Parallel Enable	0-100%	40%	Efficiency Setpoint for parallel modulation Mode
Fixed Last	0-4	0	Set to stage to always be fired last. If 0, there is not a fixed last.
1st Boiler Shutdown	Last On/ First Off, Highest Runtime	Highest Runtime	Highest Runtime turns off the highest cumulative run-time boiler first. Last On/ First Off turns the last boiler that was turned on, off first.
Automatic Rotate	0-168 Hr	0 Hr	When the lead boiler has been on for the time specified in Automatic Runtime, it is turned off and the next stage is fired as needed. Set to 0 to disable.
Staging Type	Staging, Modulating	Modulating	Staging is designed for on/off boilers, Modulating handles modulating boilers.

Stage Timing

Name	Range	Default Value	Description
Min On Time	0-100 min	0 min	Minimum time each stage must stay on once turned on.
Min Off Time	0-100 min	1 min	Minimum time each stage must stay off once turned off.
Next Stage Delay	0-100 min	0 min	Time allowed for temperature to rise before firing another stage.

Boost

Setting	Range	Default	Description
Boost Delay	0-100 min	0 min	Time delay, before the setpoint gets increased by Temp Boost increase degrees. If set to zero, boost mode will not be entered.
Temp Boost	0-30 °F (0-16.7 °C)	10 °F (5.6 °C)	Degrees used to increase the Calculated Setpoint when the system is in Boost mode

Blr 1 - 4 Settings

Name	Range	Default Value	Description
BLR Operation	Disable, Enable, Auto	Auto	Set to ‘Enable’ to force a boiler on for testing. If set to ‘Disable’ the boiler is disabled until set to ‘Auto” or ‘On’.
Min Voltage 0-10V	0-10V	1.8V	Voltage, at which the modulation output is at 0% of its range (the boiler is off)
Max Voltage 0-10V	0-10V	10V	Voltage, at which the modulation output is at a 100% of its range
Ignition Point	0-10V	1.8V	Low Fire/ Ignition Setting in V of the defined range for this Boiler
Modulation Delay	0-255s	120s	Delay for Boiler startup operations, before the modulation begins

Backup Occ Time / Backup Unocc Time for weekdays and weekend

The Backup times for Unoccupied and occupied mode is stored in the controller. The controller uses these times when no network interface to the LCI2 can be found. Weekend and weekdays can operate off different schedule times.

Setting	Range	Default	Description
Hours	0-23	0	Hour to start occupancy/unoccupancy
Minutes	0-59	0	Minute to start occupancy/unoccupancy

Alarms

All Alarms are displayed in the Alarms screen.

Alarm	Range	Alarm Trigger	Alarm Reset
Boiler 1-4 Status Alarm	Normal, Alarm	Individual Boilers enters a Alarm Criteria Setup, configured with the *Alarm Delay* and the *Blr Status/Alarm* Parameter	Individual boiler starts working as configured. See also Electrical Inputs in the Specification Section.
Circulation Supply Water Temp High	Normal, Alarm	Current Max Supply Temp Setpoint +5°F (2.8 °C)	Current Max Supply Temp Setpoint -5°F (2.8 °C)
Circulation Supply Water Temp Low	Normal, Alarm	Current Min Supply Temp Setpoint -5°F (2.8 °C)	Current Min Supply Temp Setpoint +5°F (2.8 °C)
Circulation Return Water Temp Low	Normal, Alarm	Current Max Return Temp Setpoint -5°F (2.8 °C)	Current Max Return Temp Setpoint +5°F (2.8 °C)
Space Temp. Hi Limit	Normal, Alarm	Current Zone Settings Occ Setpoint +5°F (2.8 °C)	Current Zone Settings Occ Setpoint -5°F (2.8 °C)
Space Temp. Lo Limit	Normal, Alarm	Current Zone Settings Unocc Setpoint -5°F (2.8 °C)	Current Zone Settings Unocc Setpoint +5° (2.8 °C)F
System Proof	Normal, Alarm	System Proof input enters Alarm Criteria Setup, when Alarm Delay has lapsed and the Input is still Open	System Proof contact closes

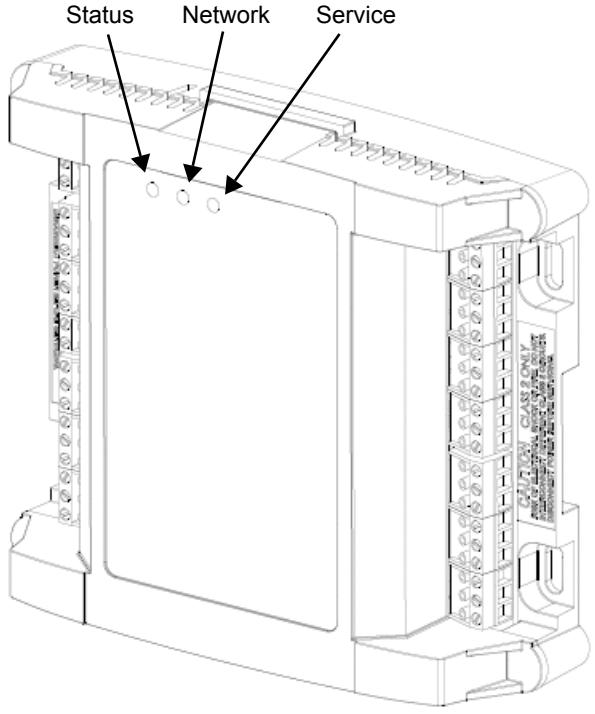
TROUBLESHOOTING

Diagnostic LEDs

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

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

Figure 7: BLMC Controller LEDs



Troubleshooting Tips

The following table provides tips on resolving common issues.

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.
A boiler or pump 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. Ensure that the output jumper is configured for how the output is wired; for example Power Isolated vs Power Sourcing.
There is a "Temperature Sensor Alarm" on the LCI.	The input is either shorted or open. Check the wiring for the indicated sensor.
Thermistor readings fluctuate rapidly, sometimes by several degrees.	The controller may not be properly grounded. The controller's ground (GND) pin (T40) must be connected to earth ground. Also ensure that the controller's digital inputs are dry contacts and that no voltage is being applied or switched to the inputs.
Controller has a demand and the Supply Temperature is well below calculated Setpoint, but the boilers are not coming on.	Are you using a flow check that needs to be wired in to the Status Input? In case you are not using a Boiler Status verification, you must have a jumper across UI6 and Com. Is the system in WWSD? Is the number of boilers in your system set to a value >0?
Controller see an Aux and a Pri call coming in at the same time, but only the Aux call gets serviced.	Is your system set to Aux Priority? Then check if the Priority Timeout is set to a value >0. Otherwise, the Priority call never expires.
My system has a demand, but the boilers are not reacting fast enough.	You can adjust the reaction time in the system settings - Gain parameter. Increase the Gain for faster reaction, decrease to slow it down.
My system is configured for parallel mode, but not all boilers are running.	The demand is not enough for all boilers and the system automatically adjusts to the right number of boilers needed to satisfy the demand. Is one of the boilers in an alarm situation? Check the alarm Output.

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 applications software.

   Controller firmware version number.

   A complete description of difficulties encountered.

Notes:

LIMITED WARRANTY STATEMENT

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

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

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

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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.

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