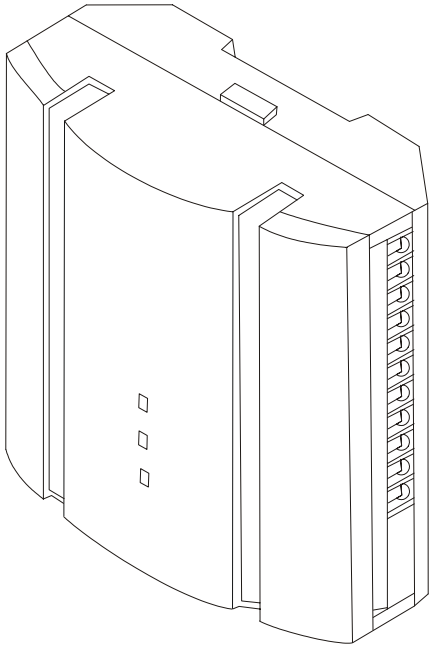
iWorX MPU-1 Application Manual

MPU-1

The MPU-1 is a self-contained microprocessor-based controller for multiplexed zone package units. Applications include packaged rooftop DX units with up to two stages of cooling, two stages of heating, economizer, and bypass damper.



Overview

Digital inputs are provided for fan status, mixed air low limit indication, smoke detector, filter status and indoor air quality (IAQ). Analog inputs are provided for mixed air temperature, return air humidity, supply air temperature, and supply duct static pressure. The MPU-1 incorporates digital outputs in the form of triacs for fan start/stop, two cooling stages, two heating stages, and a two-position economizer. In addition, two analog outputs are provided to control a modulated economizer and bypass damper.

The MPU-1 is based on the LonWorks® networking technology. The controller can be networked to a higher-level control system for monitoring and control applications.

Features

- Two stages of cooling
- Two stages of heating
- Modulated bypass damper
- Digital or modulated economizer
- Economizer enabled based on enthalpy calculations or dry bulb
- Minimum cycle timers for stages
- Runtime accumulation for heating, cooling, and fan
- Local backup schedule
- Multiplexed control of 32 zones based on zone demand
- Supply air temperature safety limits
- Time proportioned control of the staged outputs to reduce cycling
- Proportional + Integral control of the modulated economizer
- Proportional + Integral control of static pressure
- LonWorks interface to building automation systems
- Mixed air low limit protection
- Filter status input
- Smoke detection input
- IAQ compensation based on IAQ alarm input or zone controller alarm
- Fan control energized on call for heating, cooling, or ventilation
- Automatic heat/cool changeover
- Automatic configuration with the LCI
- Alarm/Event reporting

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Purpose of This Guide

The *iWorX MPU-1 Application Manual* provides application information for the MPU-1 Controller.

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

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

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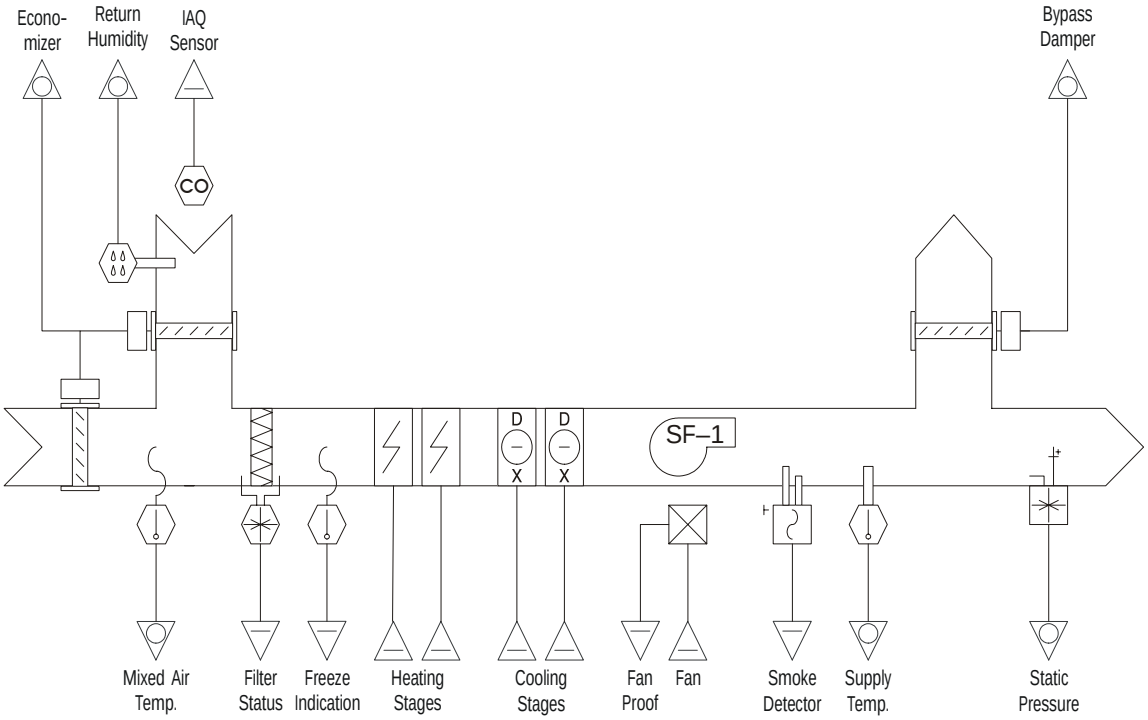
Applicable Documentation

Part Number	Description	Audience	Purpose
iWorX-MPU-INS-100	iWorX MPU Series Installation Instructions	– Application Engineers – Installers – Service Personnel – Start-up Technicians	Provides instructions for setting up and using the iWorX MPU-1 Controller.
iWorX-VAV1-APP-100	iWorX VAV-1 Application Manual	– Application Engineers – Wholesalers – Contractors	Provides specific application information about the VAV-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 MPU-1 is a multiplexed package unit controller that permits a single zone package unit to operate multiple zones. Figure 1, and Figure 2 illustrate typical MPU-1 applications. The MPU-1 operates in conjunction with up to 32 multiplexed zone controllers. The control is achieved by multiplexing the primary supply air between cooling and heating based on the various demands from the Zone Controllers. In addition to multiplexing, the MPU-1 controls an economizer and bypass damper.

Figure 1: Multiplexed Package Unit - Modulated Economizer



The starting and stopping of the supply air fan is controlled by the MPU-1. The fan is energized when the there is a call for heating or cooling from the Zone Controllers. During the occupied periods, the fan can be configured to run continuously.

The enthalpies of the outside and inside air are calculated periodically. A comparison is performed to determine if “free cooling” is available. If “free cooling” is available, the economizer is enabled. Optionally, free cooling can be determined by a dry bulb comparison of the outside air temperature and average zone temperature.

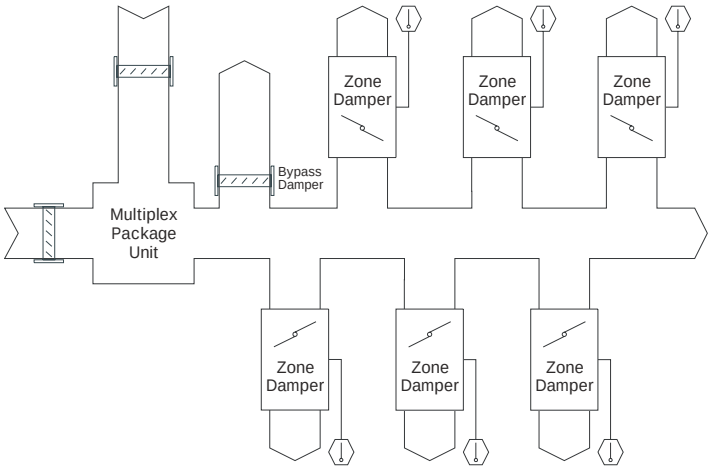
The economizer can be configured as two-position (digital) or modulated (analog). If enabled, the two-position economizer output is energized when there is a call for cooling. It is used as the first stage of cooling to take advantage of the energy savings. The two-position economizer output is off when the economizer is disabled.

When “free cooling” is available, the modulated economizer position is calculated by a Proportional + Integral (P+I) control loop based on the mixed air temperature and setpoint. As the temperature increases above the mixed air setpoint, the economizer damper shall be modulated open. The economizer shall be modulated closed as the temperature decreases below the mixed air setpoint. The economizer is modulated to its minimum position when the economizer is disabled. The economizer can optionally be disabled during unoccupied periods.

The bypass damper operates to maintain a configurable system static pressure setpoint. The bypass damper position is calculated by a Proportional + Integral (P+I) control loop based on the measured static pressure and setpoint. As the pressure increases above the pressure setpoint, the bypass damper is modulated open. The bypass damper is modulated closed as the pressure decreases below

the pressure setpoint. Heating and cooling changeover setpoints are provided to prevent zone thermal shock during mode changes.

Figure 2: Multiplexed Zone Control System



A digital input is provided to monitor the Indoor Air Quality (IAQ). A CO2 sensor providing a contact closure can be connected directly to the MPU-1. In addition, an alarm condition can be signalled by one of the Zone Controllers. When an alarm condition exists, the MPU-1 energizes the supply air fan and override the static pressure setpoint to the IAQ alarm setpoint. The economizer is overridden to the minimum ventilation position. After a programmable time delay, the economizer is overridden open to supply fresh air to the zones. Optional heating and cooling outside air temperature lockouts are provided for the economizer. If the IAQ sensor is connected directly, an IAQ alarm is reported to the LCI and all of the Zone Controllers.

The MPU-1 scans all associated Zone Controllers to collect system demand data. The total heating and cooling demands are accumulated. The greatest demand determines the control mode.

When the system cooling demand is greater than the system heating demand, the system enters cooling mode. The cooling stages are sequenced on and off with a time-proportioned control algorithm to minimize excessive cycling. The sequencing is based on the supply air temperature and cooling setpoint. The cooling and heating demands are continually re-evaluated during the cooling mode. The MPU-1 is capable of periodically re-evaluating the cooling mode and switching to the heating mode when the temperature demand is greater for heating. The cooling stages are interlocked with the economizer control. If the economizer is enabled, the cooling stages do not sequence on until the economizer has reached its open position.

When the system heating demand is greater than the system cooling demand, the system enters heating mode. The heating stages are sequenced on and off with a time-proportioned control algorithm to minimize excessive cycling. The sequencing is based on the supply air temperature and heating setpoint The MPU-1 is capable of periodically re-evaluating the heating mode and switching to the cooling mode when the temperature demand is greater for cooling.

The MPU-1 optionally has the capability of monitoring the supply air temperature to determine if the heating and cooling are operating properly. During the cooling mode, if the supply air temperature fails to drop below the cooling operational limit after a pre-determined time period, the cooling stages shut down and a cooling failed alarm is reported to the LCI. During the heating mode, if the supply air temperature fails to rise above the heating operational limit after a pre-determined time period, the heating stages shut down and a heating failed alarm is reported to the LCI.

As a safety device, the MPU-1 can optionally monitor the supply air temperature to determine if the heating stages have failed on. If the supply air temperature rises above the heating high limit setpoint, the fan energizes. If the supply air temperature does not drop below the setpoint after a pre-programmed time delay, the bypass damper is overridden closed. A heating high limit exceeded alarm is

reported to the LCI and all of the Zone Controllers.

The MPU-1 operates in one of two states: occupied or unoccupied. A host device on the network determines the active operating mode. An optional backup schedule is provided for cases when the host device is not available.

The MPU-1 monitors a digital input to determine the presence of smoke. When the input indicates smoke, the controller immediately turns off the fan and all stages of heating and cooling. An alarm is reported to the LCI when this condition exists.

A digital input is provided on the MPU-1 to monitor the status of the air filter. An external pressure switch is wired to the input to determine when the filter becomes dirty. An alarm is reported to the LCI when this condition exists.

Mixed air low limit protection is provided through a digital input. If a low limit condition exists, the MPU-1 turns off all stages of heating and cooling along with the supply air fan. An alarm is reported to the LCI when this condition exists.

The MPU-1 monitors an input to determine if the fan is operating properly. When the input indicates a fan failure, the controller immediately turns off the fan and all stages of heating and cooling. An alarm is reported to the LCI when this condition exists.

The MPU-1 monitors the runtime of the cooling stages, heating stages and fan. When any one of the runtimes exceeds a programmable limit, a maintenance alarm is reported to the LCI.

Sequence of Operation

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

Operational Mode

The MPU-1 operates in one of four operating modes: primary heating, primary cooling, primary fan only, and primary off. The operating mode determines whether warm or cool air is supplied to the zone controllers. The MPU-1determines the operational mode based on the zone demand information supplied by each of the associated zone controllers. At least once every 5 seconds a different zone controller is polled. Each zone controller transfers its zone demand information to the MPU-1 over the communications network. The following information is transferred to the MPU-1 controller:

- Zone temperature
- Calculated Heating Setpoint
- Calculated Cooling Setpoint
- IAQ Sensor Status (safe, alarm)
- Local Alarm (VAV-1 shutdown)
- Occupancy Mode (occupied, unoccupied, occupied extension)
- Supplemental heat status (on, off)

A zone heating demand is recognized when the zone temperature of a zone is at least 1.0 ° F below the calculated heating setpoint. The total heating demand is the sum of all zones requiring heating.

A zone cooling demand is recognized when the zone temperature of a zone is at least 1.0 ° F above the calculated cooling setpoint. The total cooling demand is the sum of all zones requiring cooling.

The system operational mode is determined by the greatest total demand value. When there is demand for both heating and cooling, the system switches between heating and cooling based on a configurable changeover time. Note that minimum cycle times for the heating and cooling stages are enforced before an operational mode change can take place. Also, a minimum 5-minute off-cycle is enforced before switching modes and following controller startup or reset.

When all zone demands have been satisfied (zone demand = 0), the operational mode is set to primary off indicating no heating or cooling is being provided. When there is neither heating nor cooling, but the supply fan is on, the operational mode is set to primary fan only.

The heating mode can be disabled during warm weather by setting the outdoor air temperature (OAT) heating lockout. If the OAT is above the heating lockout temperature, the primary heating mode is disabled and the MPU-1 can only be in the primary off or primary cooling modes. This feature requires that a controller that broadcasts the OAT, such as an iWorX ASM-1 or ASM-2, be installed on the network.

The MPU-1 can also be configured to only enter primary cooling or primary heating mode when a minimum number of zones require cooling or heating. Setting the *Zone Limit* to a higher number prevents a small number of zones from affecting the desired operating mode of the whole space by instructing the MPU-1 to not change operating modes until at least that number of zones require heating or cooling.

The current operational mode information is periodically transferred to the VAV-1 over the communications network. The following information is transferred to the VAV-1 from the primary air source controller:

- Operational Mode (primary cool, primary heat, primary fan only, primary off)
- Alarm Conditions (IAQ Mode, Heat Failed On)
- Supply Air Temperature

Occupancy Mode

A remote device on the network provides the current occupancy mode. There are two modes of occupancy: occupied and unoccupied.

In addition, the current occupancy mode is periodically retrieved from each of the zone controllers. If at least one zone controller is currently in occupancy extension mode the occupancy mode is overridden to the occupied state.

The current occupancy mode can affect the operation of the economizer, fan and bypass damper.

Setpoint Calculations

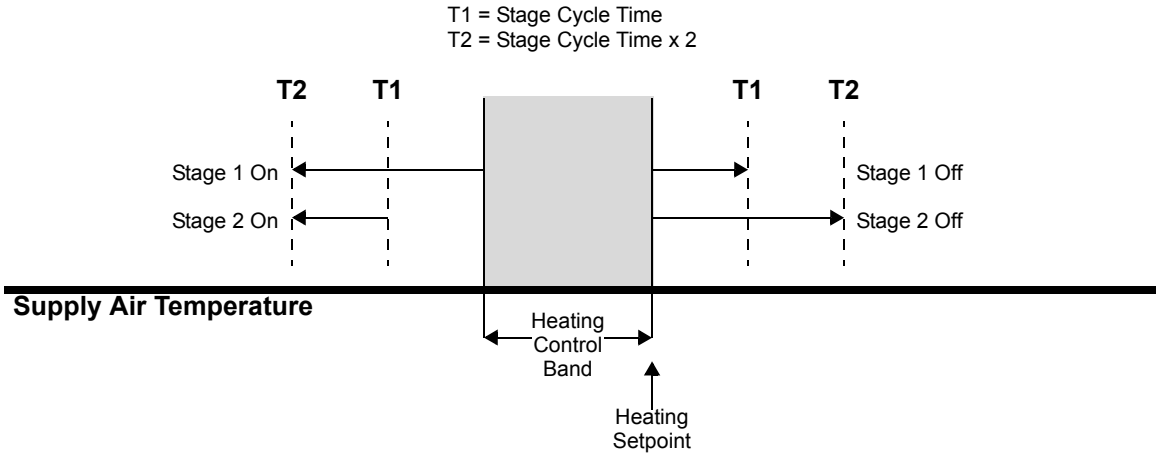
The supply air heating and cooling setpoints are programmable values. The effective setpoint is a calculated value based on the current operating mode. The effective setpoint is set to the heating setpoint when the operational mode is heating. It is set to the cooling setpoint when the operational mode is cooling.

Heating Sequence

The heating sequence is initiated when the current operating mode calls for heat. The electric heating stages are sequenced based on the supply air temperature, heating setpoint and control band. When the supply air temperature drops below the heating setpoint minus the control band, a stage is turned on. If the supply air temperature remains below the control band for an additional time-period, the next available stage is turned on. If all zone temperature readings are within 0.5 °F of their setpoints, the next stage does not cycle on. This cycle continues until all available stages have been energized.

As the supply air temperature rises above the heating setpoint, the first available stage is turned off. If the supply air temperature remains above the heating setpoint for an additional time-period, the next available stage is turned off. This cycle continues until all available stages have been de-energized. If the supply air temperature rises above the heating setpoint plus control band all of the stages immediately cycle off.

Figure 3: Heat Sequence



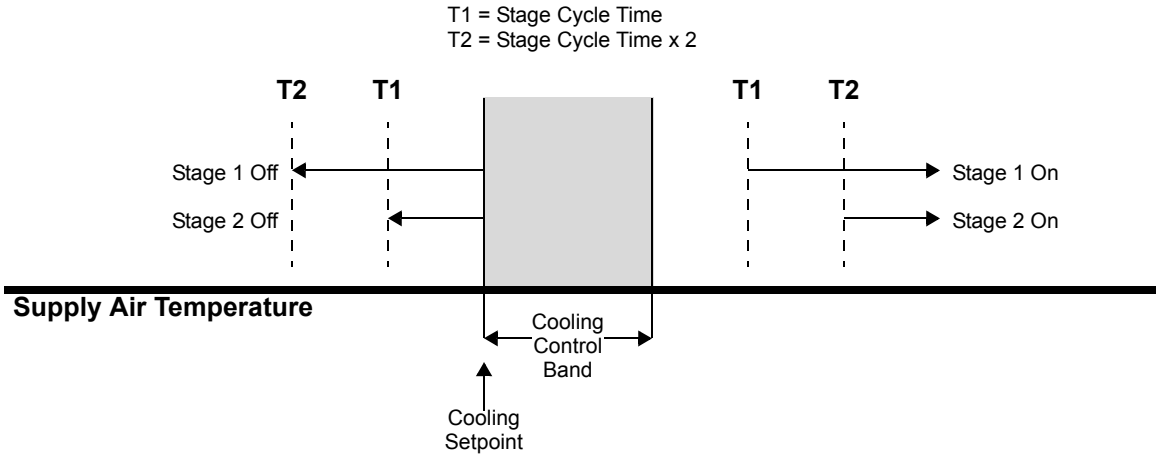
Cooling Sequence

The cooling sequence is initiated when the current operating mode calls for cooling. The cooling compressor stages are sequenced based on the supply air temperature, cooling setpoint and control band. When the supply air temperature rises above the cooling setpoint plus the control band, a stage is turned on. If the supply air temperature remains above the cooling control band for an additional time-period, the next available stage is turned on. If all zone temperature readings are within 0.5 °F of their setpoints, the next stage does not cycle on. This cycle continues until all available stages have been energized.

In order to provide maximum energy savings, the cooling stages are interlocked with the economizer. When the economizer is enabled, the cooling stages are prevented from energizing before the economizer has reached its maximum position.

As the supply temperature drops below the cooling setpoint, the first available stage is turned off. If the supply air temperature remains below the cooling setpoint for an additional time-period, the next available stage is turned off. This cycle continues until all available stages have been de-energized. If the supply air temperature drops below the cooling setpoint minus control band all of the stages immediately cycle off.

Figure 4: Cooling Sequence



Economizer Operation

The MPU-1 provides support for either two-position or modulated economizer types. A configuration parameter is provided to allow selection of the economizer type. Both economizer types are enabled based on the availability of “free cooling” from the outside air. In order to provide maximum energy savings, the cooling stages are interlocked with the economizer. When “free cooling” is available, the cooling stages are prevented from energizing before the economizer has reached its maximum position. Free cooling can be determined by enthalpy comparisons or dry bulb comparison.

Dry Bulb Comparison

Free cooling can be determined based on the outside air temperature and average zone temperature. When the outside air temperature is below the average zone temperature by a programmable amount, free cooling is enabled. When the outside air temperature rises above the average zone temperature, free cooling is disabled.

Enthalpy Calculation

An enthalpy calculation is performed periodically to determine if “free cooling” is available. The outside enthalpy is calculated based on the outside air temperature and humidity. The outside temperature and humidity are measured by an external device (such as an ASM-1 or ASM-2) on the network and sent to the controller. The same calculation is performed on the inside air based on the space temperature and return air humidity. The inside enthalpy minus the outside enthalpy must be greater than the Free Cooling Setpoint in order for the economizer to be used for free cooling.

Optionally, an external device can measure the indoor air humidity globally. In this case, a return air humidity sensor would not be required at each MPU-1.

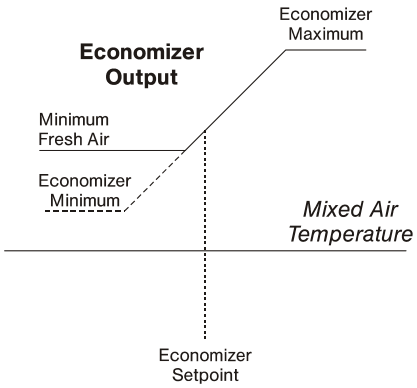
Two-position Economizer Control

If present, the two-position economizer is enabled when there is “free cooling” available as determined by the enthalpy calculations. When the economizer is enabled, the economizer digital output is energized. When the economizer is disabled, the economizer output is de-energized. A configuration parameter is available to optionally disable the economizer during unoccupied periods. During IAQ alarm conditions the economizer is enabled to provide fresh air to the zones.

Modulated Economizer Control

If present, the modulated economizer is enabled when there is “free cooling” available as determined by the enthalpy calculations.

Figure 5: Economizer Control



When the economizer is enabled, a Proportional + Integral (P+I) control loop modulates the economizer output. The P+I control loop modulates the economizer position to maintain a constant mixed air temperature

The economizer is modulated by P+I control loop based on the mixed air temperature setpoint and mixed air temperature. The P+I control loop modulates the economizer to maintain a constant mixed air temperature. As the temperature increases above the economizer setpoint, the economizer is modulated open. The economizer is modulated closed as the temperature decreases below the economizer setpoint.

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

K_p = Proportional Gain
K_i = Integral Gain

$$Error = MixedAirTemp \angle EconSp$$

$$I = I + (K_i \times Error)$$

$$EconPosition = (K_p \times (Error + I)) + 50.00\%$$

When the economizer is disabled, it modulates to the minimum position. A configuration parameter is available to optionally disable the economizer during unoccupied periods. During IAQ alarm conditions the economizer is enabled to provide fresh air to the zones.

Bypass Damper Control

Static pressure control is achieved by modulating a bypass damper between the fully open (bypass) and fully closed position based on the measured static pressure in the supply duct. The static pressure sensor input has maximum range of 5.000" W.C. with a minimum resolution of 0.005" W.C.

The bypass damper is modulated by a P+I control loop based on the static pressure loop setpoint and the supply static pressure measurement. The P+I control loop modulates the damper to maintain a constant static pressure within the supply air duct. As the supply static pressure decreases 0.025" W.C. below the static pressure loop setpoint, the bypass damper is modulated closed. The bypass damper modulates open as the supply static pressure increases to 0.025" W.C. above the static pressure loop setpoint. When the static pressure is within ±0.025” W.C. of the static pressure setpoint, the damper remains at its current position.

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

K_p = Proportional Gain
K_i = Integral Gain

$$Error = MixedAirTempSupplyStaticPressure \angle LoopSetpoint$$

$$I = I + (K_i \times Error)$$

$$BypassPosition = (K_p \times (Error + I)) + 50.00\%$$

A separate static pressure setpoint is provided to increase the supply static pressure when an IAQ alarm condition exists. The bypass damper control maintains the IAQ alarm pressure setpoint as long as an IAQ alarm condition exists.

The bypass damper modulates to the full open (bypass) position prior to the fan energizing. During operational mode changes the bypass damper remains open until the supply air temperature has reached the programmable cooling and heating setpoints. This prevents thermal shock in the zones.

Programmable minimum and maximum outputs are provided for the bypass damper. These settings can be reversed for reverse-action. Overrides are provided to assist in system air balancing during commissioning.

Analog Outputs

The modulated Economizer and Bypass Damper analog outputs support normal and reverse actuation. Making the analog output's minimum voltage scaling parameter less than the maximum enables normal actuation. Making the analog output's maximum scaling parameter less than the minimum enables reverse actuation.

Fan Operation

During occupied periods, the fan may either always run or cycle off when there is no demand for heating or cooling. The fan is interlocked with the cooling and heating stages. If there is a call for heating or cooling the fan immediately energizes. During unoccupied period, the fan always cycles off when there is no demand for heating or cooling. During IAQ alarm conditions the fan energizes to provide fresh air to the zones.

MPU-1 and VAV-1 Communications

The MPU-1 and its associated VAV-1 controllers transfer information, depending on the number of VAV-1 controllers configured. The MPU-1 polls a VAV-1 controller every 5 seconds to transfer information necessary for control. The following information is transferred from the MPU-1 to the VAV-1 controller:

- Operational Mode: primary cool, primary heat, and primary off
- Occupancy Mode: occupied, unoccupied, and bypass
- Alarm Conditions: IAQ Mode and Heat Failed On

The following information is transferred from the VAV-1 to the MPU-1 controller:

- Zone temperature
- Calculated Heating Setpoint
- Calculated Cooling Setpoint
- IAQ Sensor Status (safe, alarm)
- Local Alarm (VAV-1 shutdown)
- Occupancy Mode: occupied, unoccupied, and occupied extension)
- Supplemental heat status: on, off

Supply Air Temperature Monitoring

The MPU-1 monitors the supply air temperature to determine if the heating and cooling stages are operating properly. During heating mode, if the supply air temperature does not rise above the heat mode alarm setpoint after a 10-minute delay a heat mode alarm is generated. During cooling mode, if the supply air temperature does not drop below the cool mode alarm setpoint after a 10-minute delay, a cool mode alarm is generated.

The MPU-1 has provisions for detecting a gas valve that has been become stuck in the open position. The stuck gas valve sequence helps to prevent overheating the HVAC unit.

During periods when the operational mode is primary off or primary fan only, if the supply air temperature rises above 175 °F the system fan is started. If the supply air temperature does not drop below 150 °F after 5 minutes, the bypass damper closes and an alarm is sent to the zone controllers and LCI. The zone controllers react to the alarm by positioning their dampers to the maximum position.

During periods when the operational mode is primary cooling if the supply air temperature does not drop below 100 °F after 15 minutes the cooling mode is terminated and the MPU-1 enters the primary off operational mode. The primary off logic then checks for the stuck gas valve condition.

Fan Proof

When there is a call for heating or cooling the fan output energizes. A fan status input is provided for monitoring the operation of the fan. A 30 second delay is imposed when the fan is initially turned on. If at any time after the delay, the fan proof indicates the fan is not running, a fan failure condition is generated. The heating, cooling, bypass damper and economizer are interlocked with the fan. When a fan failure condition exists, the heating stages, cooling stages and the fan immediately turns off. In addition, the economizer closes and the bypass damper opens. The MPU-1 must be reset to clear this condition.

Indoor Air Quality Compensation

The MPU-1 is capable of performing two modes of Indoor Air Quality Compensation. The first is to read an IAQ sensor placed in the return air duct and connected to a discrete input on the MPU-1. The second is to receive an IAQ alarm from one of the zone controllers.

Return Air IAQ

The MPU-1 can read the status of an IAQ sensor placed in the return air duct. When the IAQ sensor indicates that contaminates are above a preset limit, the MPU-1 energizes the fan. After a preset time delay, the economizer is enabled to supply fresh air to the zones. All of the zones are made aware of the IAQ alarm condition. Any zone configured to participate in return air IAQ modulates its damper open. Heating and cooling operate as normal.

Local Zone IAQ

The MPU-1 can receive the status of local IAQ sensors connected to discrete inputs on each zone controller. When the local zone IAQ sensor indicates that contaminates are above a preset limit, the MPU-1 energizes the fan. After a preset time delay, the economizer is enabled to supply fresh air to the zones. Only the MPU-1 and local zone controller participates in local zone IAQ. Heating and cooling operate as normal.

Smoke Detection

A smoke detector input is provided. If the smoke detector indicates smoke is present then all of the stages and the fan turn off. Once the situation has been corrected, reset the controller to clear this condition.

Mixed Air Low Limit Detection

An input is provided for a mixed air low limit detection device. If a low limit condition is detected, all of the stages and the fan turns off. Once the low limit is corrected, reset the controller to clear this condition.

Filter Status

The filter status input is monitored to determine if the filter is operating properly. The input is used to indicate that maintenance is required on the filter. The unit is not shutdown due to a filter alarm.

Local Backup Schedules

A remote device on the network normally provides the current operating mode. A local backup schedule is provided for cases when the remote device is not available. When the controller detects that the remote device is not available, it resorts to the local backup schedule.

The schedule defines an occupied and unoccupied period within the day. The user configures the occupied and unoccupied times that are used in determining the current operating mode of the controller.

Runtime Accumulations

The total runtime is accumulated for the heating, cooling, and fan outputs. The runtimes can be used to indicate that maintenance is required on the equipment controlled by these outputs. An operator or maintenance personnel can reset the runtime once servicing has been performed. The runtimes are accumulated in volatile memory (RAM). Once a day they are backed up to non-volatile memory (EEPROM). When the MPU-1 is reset, the runtimes are copied from EEPROM to RAM.

Alarms and Events

The MPU-1 detects certain alarm conditions and sends them to the LCI. Before this can occur, the MPU-1 must have been configured by the LCI.

Digital Input Alarms

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

- Fan Failure
- Smoke Detect
- Mixed Air Low Limit
- Dirty Filter
- CO_2 Alarm

Supply Air Temperature Alarms

The following alarms can be generated based on supply air monitoring.

- Cooling Failed
- Heating Failed
- Heat Stuck On

Maintenance Alarm

A MPU-1 provides programmable run limits for generating runtime maintenance alarms. When the cooling runtime, heating runtime or fan runtime exceeds these limits, a maintenance alarm is sent to the LCI.

Automatic Configuration

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

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

MPU-1 Configuration

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

Setup

Heating/Cooling Settings

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

Table 1: MPU-1 Heating/Cooling Settings

Setpoint	Range	Default	Description
Occupied Heating Setpoint	80.00 to 130.00 °F (26.67 to 54.44 °C)	90.00 °F (32.22 °C)	Temperature below which heating should be enabled.
Occupied Cooling Setpoint	45.0 to 65 °F (7.22 to 18.33 °C)	55.00 °F (12.78 °C)	Temperature above which cooling should be enabled.
Stage Control Band	0.00 to 10.00 °F (0.00 to 5.56 °C)	1.00 °F (0.56 °C)	Value added to cooling setpoint or subtracted from the heating setpoint to indicate when the second stage of heating or cooling should be enabled.
Stage Timer	0 to 255 minutes	5 minutes	The amount of time between stage cycles.
Changeover Time	0 to 255 minutes	15 minutes	Minimum amount of time between heating and cooling modes.
Heating Stages	0 to 2	2	Number of heating stages that are available.
Cooling Stages	0 to 2	2	Number of cooling stages that are available.
Fan Type	Auto, On	Auto	Set to "On" to enable continuous operation during occupied mode. Otherwise, fan switches on and off automatically according to the control algorithm,

Pressure Setup

Displays MPU-1 setpoints that specifically relate to static pressure.

Table 2: MPU-1 Pressure Setup

Setting	Range	Default	Description
Static Pressure Setpoint	0.00 to 5.00” W.C. (0 to 1246 Pa)	1.00” W.C. (249 Pa)	Setpoint for supply air static pressure.
Damper Minimum Output	0.0 to 10.0 Volts	0.0 Volts	Minimum output voltage for the bypass damper.[a]
Damper Maximum Output	0.0 to 10.0 Volts	10.0 Volts	Maximum output voltage for the bypass damper.[a]
Pressure Proportional Gain	0 to 100% per 0.1” W.C.	5.00%	Proportional gain of the static pressure P+I control loop.
Pressure Integral Gain	0.00 to 100.00%	0.05%	Integral gain of the static pressure P+I control loop.
Static Pressure Minimum	0.00 to 5.00” W.C. (0 to 1246 Pa)	0.00” W.C. (0 Pa)	Static pressure to report when the analog input receives 0 volts.
Static Pressure Maximum	0.00 to 5.00” W.C. (0 to 1246 Pa)	4.00” W.C. (996 Pa)	Static pressure to report when the analog input receives 10 volts.
IAQ Alarm Pressure Setpoint	0.00 to 5.00” W.C. (0 to 1246 Pa)	2.00” W.C. (498 Pa)	Static pressure setpoint used when an IAQ alarm is present.

a. Reverse the minimum and maximum values for reverse damper actuation.

Economizer Settings

Displays MPU-1 setpoints that specifically relate to economizer operation.

Table 3: MPU-1 Economizer Settings

Setting	Range	Default	Description
Economizer Setpoint	40.00 to 70.00 °F (4.44 to 21.11 °C)	55.00 °F (12.78 °C)	Setpoint used fro controlling the modulated economizer.
Economizer Minimum Output	0.0 to 10.0 Volts	0.0 Volts	Minimum output voltage for the modulated economizer.[a]
Economizer Maximum Output	0.0 to 10.0 Volts	10.0 Volts	Maximum output voltage for the modulated economizer.[a]
Economizer Type	Disabled, 2 State Unoccupied On, 2 State Unoccupied Off, Modulated Unocc. On, Modulated Unocc. Off,	Disabled	If using an economizer, set this field to a value that describes the type of economizer and whether it should be enabled during unoccupied periods.
Economizer Proportional Gain	0.00 to 100.00% per °F	5.00%	Proportional gain of the economizer’s P+I control loop.
Economizer Integral Gain	0.00 to 100.00%	0.05%	Integral gain of the economizer’s P+I control loop.
Minimum Fresh Air	0.00 to 100.00%	0.00%	Minimum fresh air position for the modulated economizer.
Free Cool Setpoint	0.0 to 60.0 BTU/lb. (0.0 to 139.6 kjoule/kg)	5.0 BTU/lb. (11.6 kjoule/kg)	Difference between inside enthalpy and outside enthalpy that enables or disables the economizer.[b]

a. Reverse the minimum and maximum values for reverse actuation.
b. This value is only used for “Return Air Humidity Sensor” and “Global Indoor Humidity Sensor” free cooling types.

Grouping Buttons

These three buttons enable you to configure which zone controllers on the network are to be considered as being grouped with the current MPU-1. These devices control sub-zones of the MPU-1's overall system.

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

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

Press **Send Grouping** to program the device list into the memory of the MPU-1 so that it can cooperate with those devices even if it loses contact with the LCI.

List All Settings

Displays all of the MPU-1's setpoints and editable settings and provides access to edit all MPU-1 parameters from a single screen.

Table 4: All MPU-1 Settings

Setting	Range	Default	Description
Commissioning			
– Override Mode	Off, Damper Percentage, Damper Fully Open, Damper Fully Closed	Off	Set to any value besides "Off" to place the controller into that override mode.
– Damper Percentage	0.00% to 100.00%	0.00%	Damper setting to use when the controller is placed in "Damper Percentage" override mode.
Supply Air Cooling Setpoint	45.00 to 65.00 °F (7.22 to 18.33 °C)	55.00 °F (12.77 °C)	Temperature setpoint for cooling mode.
Supply Air Heating Setpoint	80.00 to 130.00 °F (26.66 to 54.44 °C)	90.00 °F (32.22 °C)	Temperature setpoint for heating mode.
Supply Air Cooling Limit	0.00 to 30.00 °F (0.00 to 16.66 °C)	10.00 °F (5.55 °C)	Minimum temperature change from cooling setpoint in 10 minutes to avoid a cooling failed alarm.
Supply Air Heating Limit	0.00 to 30.00 °F (0.00 to 16.66 °C)	10.00 °F (5.55 °C)	Minimum temperature change from heating setpoint in 10 min. to avoid a heating failed alarm.
Heating Stages	0 to 2	2	Number of heating stages that are available.
Cooling Stages	0 to 2	2	Number of cooling stages that are available.
Stage Control Band	0.00 to 10.00 °F (0.00 to 5.56 °C)	1.00 °F (0.56 °C)	Value added to cooling setpoint or subtracted from the heating setpoint to indicate when the second stage of heating or cooling should be enabled.
Stage Timer	0 to 255 minutes	5 minutes	The amount of time between stage cycles.
Changeover Time	0 to 255 minutes	15 minutes	Minimum amount of time between heating and cooling modes.

Table 4: All MPU-1 Settings (Continued)

Setting	Range	Default	Description
Fan Type	Auto, On	Auto	Set to “On” to enable continuous operation during occupied mode. Otherwise, fan switches on and off automatically according to the control algorithm,
Economizer Type	Disabled, 2 State Unoccupied On, 2 State Unoccupied Off, Modulated Unocc. On, Modulated Unocc. Off,	Disabled	If using an economizer, set this field to a value that describes the type of economizer and whether it should be enabled during unoccupied periods.
Economizer Setpoint	40.00 to 70.00 °F (4.44 to 21.11 °C)	55.00 °F (12.78 °C)	Setpoint used for controlling the modulated economizer.
Economizer Proportional Gain	0.00 to 100.00% per °F	5.00%	Proportional gain of the economizer’s P+I control loop.
Economizer Integral Gain	0.00 to 100.00%	0.05%	Integral gain of the economizer’s P+I control loop.
Minimum Fresh Air	0.00 to 100.00%	0.00%	Minimum fresh air position for the modulated economizer.
Economizer Minimum Output	0.0 to 10.0 Volts	0.0 Volts	Minimum output voltage for the modulated economizer.
Economizer Maximum Output	0.0 to 10.0 Volts	10.0 Volts	Maximum output voltage for the modulated economizer.
Free Cool Type	Return Air Humidity Sensor, Global Indoor Humidity Sensor, Dry Bulb Temperature Comparison	Return Air Humidity Sensor	Type of free cooling comparison to perform.
Free Cool Setpoint	0.0 to 60.0 BTU/lb. (0.0 to 139.6 kjoule/kg)	5.0 BTU/lb. (11.6 kjoule/kg)	Difference between inside enthalpy and outside enthalpy that enables or disables the economizer.[a]
Economizer Drybulb Setpoint	0.0 to 20.0 °F (0.0 to 11.1 °C)	5 °F (2.78 °C)	Difference between zone temp. and outside temp. that enables of disables the economizer.[b]
Static Pressure Minimum	0.00 to 5.00” W.C. (0 to 1246 Pa)	0.00” W.C. (0 Pa)	Static pressure to report when the analog input receives 0 volts.
Static Pressure Maximum	0.00 to 5.00” W.C. (0 to 1246 Pa)	2.00” W.C. (498 Pa)	Static pressure to report when the analog input receives 10 volts.
Static Pressure Setpoint	0.00 to 5.00” W.C. (0 to 1246 Pa)	1.00” W.C. (249 Pa)	Setpoint for supply air static pressure.
IAQ Alarm Pressure Setpoint	0.00 to 5.00” W.C. (0 to 1246 Pa)	1.50” W.C. (374 Pa)	Static pressure setpoint used when an IAQ alarm is present.
Pressure Proportional Gain	0 to 100% per 0.1” W.C.	25.00%	Proportional gain of the static pressure P+I control loop.
Pressure Integral Gain	0.00 to 100.00%	0.05%	Integral gain of the static pressure P+I control loop.
Damper Minimum Output	0.0 to 10.0 Volts	0.0 Volts	Minimum output voltage for the bypass damper.
Damper Maximum Output	0.0 to 10.0 Volts	10.0 Volts	Maximum output voltage for the bypass damper.
IAQ Delay Time	0 to 1000 minutes	10 minutes	Delay before reporting a global IAQ alarm.
Fan Runtime Limit	0 to 65535 hours	1000 hours	Runtime limit for fan after which a maintenance alarm is generated.

Table 4: All MPU-1 Settings (Continued)

Setting	Range	Default	Description
Cooling Runtime Limit	0 to 65535 hours	1000 hours	Runtime limit for cooling after which a maintenance alarm is generated.
Heating Runtime Limit	0 to 65535 hours	1000 hours	Runtime limit for heating after which a maint. alarm is generated.
Occupied Time			
– Hours	0 to 23	0	Time to begin occupied period for the local backup schedule.
– Minutes	0 to 59	0	
Unoccupied Time			
– Hours	0 to 23	0	Time to end occupied period for the local backup schedule.
– Minutes	0 to 59	0	
OAT Heating Lockout	32.00 to 621.80 °F (0.00 to 327.67 °C)	80.00 °F (26.67 °C)	If the OAT is above this limit, heating mode is disabled.
Zone Limit	0 to 60	1	Minimum number of zones that must signal demand to activate heat/cooling,

a. This value is only used for “Return Air Humidity Sensor” and “Global Indoor Humidity Sensor” free cooling types.
b. This value is only used for “Dry Bulb Temperature Comparison” free cooling.

Inputs

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

Table 5: MPU-1 Inputs

Input	Range	Description
Supply Air Temperature	-22 to 122 °F (-30 to 50 °C)	Temperature reported by the SAT sensor.
Return Air Humidity	0.00 to 100.00%	Humidity reported by the RAH sensor.
Mixed Air Temperature	-22 to 122 °F (-30 to 50 °C)	Temperature reported by the MAT sensor.
Fan Status	Off, On	Status of the fan proof switch (FNP)
Low Limit	Normal, Freeze	Status of the mixed air low limit indication switch (MLL).
Filter Status	Normal, Dirty	Status of the filter switch (FIL).
Smoke Detector	Normal, Smoke	Status of the smoke detector (SMK).
Indoor Air Quality	Normal, Alarm	Status of the IAQ alarm sensor.
Inside Enthalpy	0.0 to 60.0 BTU/lb. (0.0 to 139.6 kjoule/kg)	Calculated inside air enthalpy.
Outside Enthalpy	0.0 to 60.0 BTU/lb. (0.0 to 139.6 kjoule/kg)	Calculated outside air enthalpy.
Supply Air Static Pressure	0.00 to 5.00” W.C. (0 to 1246 Pa)	Static pressure reported by the static pressure sensor (SPR).

Outputs

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

Table 6: MPU-1 Outputs

Output	Range	Description
Heating Output	0.00% to 100.00%	Heat output currently being supplied to the space.
Cooling Output	0.00% to 100.00%	Current state of the cooling outputs.
Fan Output	0.00% or 100.00%	Current state of the fan output.
Economizer Output	0.00% to 100.00%	Current state of the economizer output.
Damper Bypass	0.00% to 100.00%	Current state of the bypass damper output.
Mode	Off, Heat, Cool, Fan Only	Current mode of the MPU-1.

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

Runtimes/Limits

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

Table 7: MPU-1 Runtimes/Limits

Setting	Range	Default	Description
Fan Runtime	0 to 65535 Hours	0 Hours	Current fan runtime.
Fan Runtime Limit	0 to 65535 Hours	1000 Hours	Runtime limit for fan after which a maintenance alarm is generated.
Cooling Runtime	0 to 65535 Hours	0 Hours	Current cooling runtime.
Cooling Runtime Limit	0 to 65535 Hours	1000 Hours	Runtime limit for cooling after which a maintenance alarm is generated.
Heating Runtime	0 to 65535 Hours	0 Hours	Current heating runtime.
Heating Runtime Limit	0 to 65535 Hours	1000 Hours	Runtime limit for heating after which a maintenance alarm is generated.

Troubleshooting

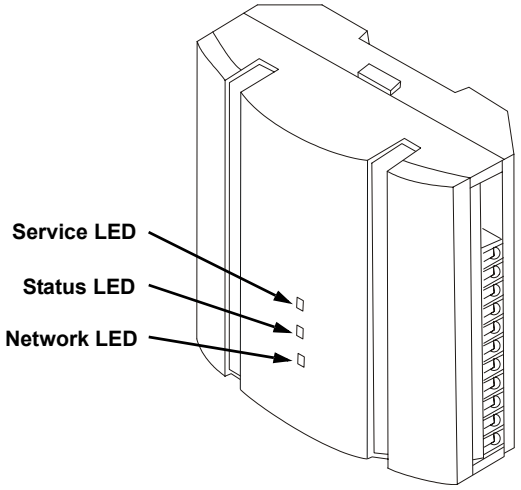
Diagnostic LEDs

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 8: 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 6: Diagnostic LEDs



Troubleshooting Tips

Controller is not running and Status LED is not illuminated.

No power to controller. Verify the voltage on the controller's power connector (24 VAC).

How do I reset the controller?

The controller can be reset by the LCI, or you can cycle power to the controller. Refer to the LCI documentation for more information on resetting the controller using the LCI.

Can my iWorX system contain multiple MPU-1 controllers?

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

Can I reverse the minimum and maximum values for the bypass damper?

Yes. This will result in reverse damper action.

Can I use the bypass damper outputs to control a VFD instead?

Yes.

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.