Engineering Guide

Price Intelligent Controller (PIC)

www.price-hvac.com

Contents

Introduction

Direct digital control is a proven control technology that has traditionally been used in large-scale building automation systems. DDC has brought unprecedented control and efficiency to building ventilation. The PIC combines the accuracy of direct digital control with the flexibility of an individual room system, providing maximum control and efficiency.

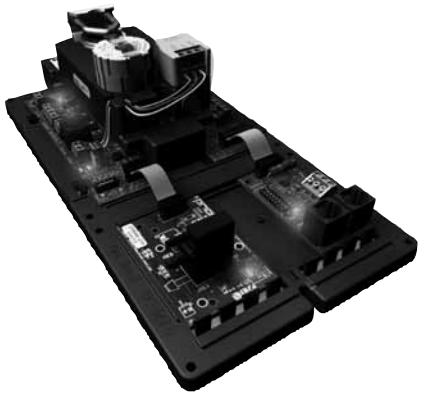
The Price Intelligent Controller (PIC) is a cutting edge control package that offers a new level of zone control. An advanced and configurable proportional integral (PI) controller allows for exceptional user comfort and energy efficiency. Installation of the controller and thermostat is simple and error proof with RJ-45 (network type) connections to the thermostat and BACnet network.

The PIC is designed with a modular architecture. Options such as BACnet networking and airflow sensing are offered as "add-on modules". This allows flexibility to the customer by providing both value in the "core" controller as well as powerful control and communication options with the use of the expansion modules.

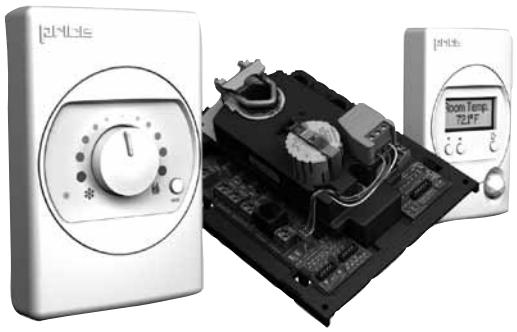
Any PIC ordered with either the BACnet or Pressure Independent Control options will ship with the appropriate modules installed and mounted. Modules may also be field-mounted and connected to the PIC with a single ribbon-type cable.

The PIC is available with several thermostat options allowing the designer to match the specific needs of the customer. Every model of thermostat has an RJ-12 service port allowing setup and configuration access without having to access the plenum.

Price Intelligent Controller with VAV and BACnet modules

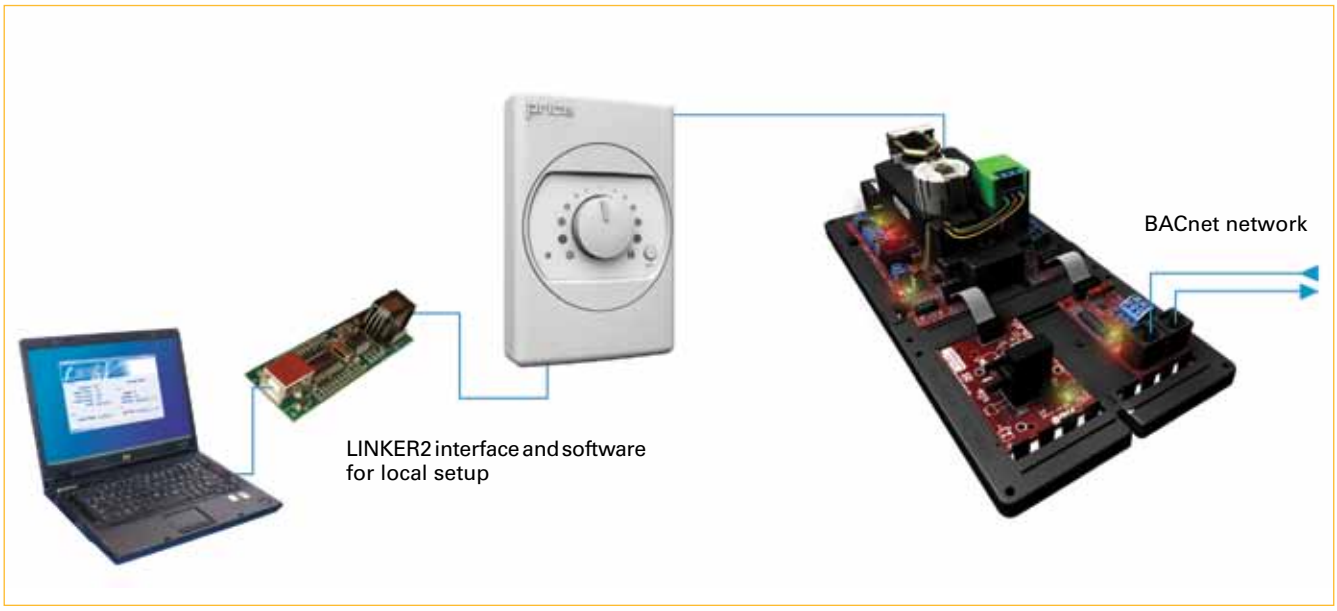


Price Intelligent Controller with Dial and LCD motion thermostats



Introduction

The price LINKER2 setup tool (combined with FREE software) can be used to reconfigure the PIC from this service port. A stand-alone setup tool "LCD-SETUP" is available. Alternative methods of reconfiguration include the LCD thermostats, BACnet software. (see page F2-21 for more information on setup tools)



DDC vs. Analog Electronic Contols

The PIC is a Direct Digital Controller (DDC). The PIC offers many advantages over the older analog electronic style controllers.

1. Full tunable Proportional + Integral control for fast, accurate control with little overshoot.
2. Digital thermostats with setup and balancing functions.
3. Multiple customizable outputs (Binary and Analog).
4. Native BACnet module for interface to building automation and polling systems.
5. Sequence of operation changeable in the field if required.

PIC Features

The Price Intelligent Controller comes with the following standard features:

- Stand-alone or BACnet network operation (with the optional BACnet expansion module)
- Integrated actuator
- Service port on all thermostat models provides a computer interface (using the Price USB LINKER2) for setup/balancing when LCD thermostat is not available/sufficient.
- A range of thermostat options from a room sensor thermostat up to a motion controlled LCD thermostat.
- Expansion modules add additional functionality when required

Price Intelligent Controller (PIC)

- Fast and error proof RJ-45 thermostat connections
- LED's on the PIC indicate the status of all outputs, aiding with troubleshooting.
- Adjustment of sequence parameters, settings, and **balancing** are possible from the password-protected service menu of LCD thermostats.
- A variety of Heat control interfacing is available. 24 VAC Binary, PWM, Analog 2-10V, 0-10V, etc
- 24 VAC binary switched outputs field switchable between hot and common
- Analog (0-10 VDC) outputs fully configurable for heating, cooling, fan, and auxiliary
- VAV module (optional) provides airflow sensing for true VAV control
- BACnet module (optional) provides a native BACnet MS/TP interface

Thermostat Options

Room Sensor Thermostat (PIC-TS-SENS)

Dial Thermostat (PIC-TS-DIAL)

LCD Thermostat (PIC-TS-LCD)

LCD Thermostat with Motion Sensor (PIC-TS-MOTION)

Wireless Dial Thermostat

Room Sensor Thermostat (PIC-TS-SENS)
This economical model of thermostat measures room temperature. The setpoint can be set from a hidden dial on the back of the T-Stat, through free setup software, or through a BACnet system. This eliminates the problem of unauthorized tampering without the need for visually unappealing thermostat lock boxes.

Dial Thermostat (PIC-TS-DIAL)
This model measures room temperature and features a dial adjustment and an occupancy button. Temperature set point limits are set through software/BACnet.

LCD Thermostat (PIC-TS-LCD)
This model measures room temperature and features an LCD screen with an advanced menu structure and 3 pushbuttons. Temperature set point limits are set through software/BACnet.

Balancing and modification to the controller setup can be accomplished from the LCD screen.

LCD Thermostat with Motion Sensor (PIC-TS-MOTION)
This model possesses the same features as the LCD T-Stat with the addition of a passive infrared motion sensor. The motion sensor allows for automatic detection of space occupancy and therefore can save energy by shutting down during unoccupied periods.

Wireless Dial Thermostat
This model allows you to place the thermostat in any location including glass walls, cement walls, etc. No wiring needed for the remote Dial thermostat. A local indicator LED shows battery life when pressed.

Optional Expansion Modules

BACnet Module (PIC-BAC)

With native BACnet MS/TP compatibility, the PIC can tie into an existing or future BACnet compliant BAS system for maximum flexibility.

When connected, the network monitors all of the controller's functions and variables, assigns set points, and initiates occupied, unoccupied and night setback modes taking advantage of the level of control and visibility inherent to BAS systems.

A computer on the BACnet network can also be used to configure the PIC instead of using the keypad on the LCD T-Stat.

Each PIC on the BACnet network can relay data containing a variety of setup and room condition information. This can be read by other controllers (such as the Price PDRC rooftop controller) allowing for intelligent decisions to be made at the air supplier level. See the PDRC Engineering Guide for more information.

BACnet Module (PIC-BAC)

VAV Module (PIC-VAV)

The VAV module increases the PIC's functionality by adding pressure independent air flow control. The airflow transducer contained in this module used in conjunction with Price's SP300 flow sensor provides consistent, highly accurate readings. These readings are not affected by mounting direction.

VAV Module (PIC-VAV)

Installation and Setup

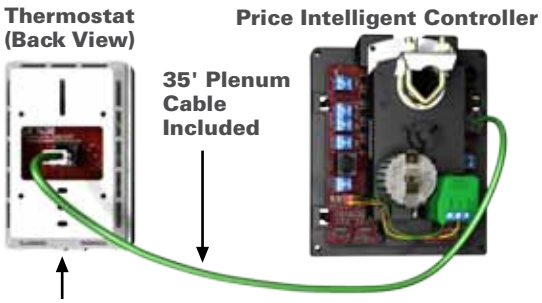
Installation and configuration of the PIC is easy. All wiring terminals are of the pluggable type – allowing the contractor to make connections quickly and easily.

Thermostat and BACnet network connections are made using modular (RJ-45) connectors. Plenum-rated and factory tested RJ-45 cables are provided by Price where required.

The PIC comes factory calibrated and mounted to PriceVAV boxes, but may also be ordered stand-alone for retrofit jobs.

Installing the PIC

1. Mount the controller onto the duct with the damper shaft going through the PIC's actuator. Tighten the screws on the actuator.
2. Secure the back end of the controller using the supplied anti-rotational bracket.
3. Connect any of the controller's outputs as required.
4. Power the PIC using 24 VAC.



Installing a Thermostat

1. Install the thermostat back-plate to a standard electrical box or directly to drywall using anchors (supplied by others.)
2. Connect the T-Stat to the PIC's T-Stat jack using the supplied plenum-rated modular (network type) cable.
3. Clip the thermostat onto the back-plate and tighten the set screw.

Setup of the PIC

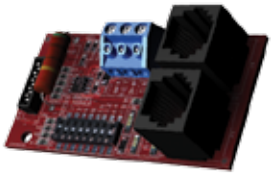
The PIC comes pre-calibrated from the factory. However if field conditions require readjustment the Service/Maintenance personal may change PIC settings.

There are several ways to access setup variables in the PIC:

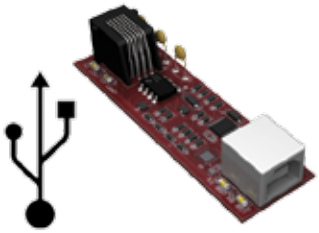
1. Through the password protected menu structure built into the LCD thermostats
2. Through the BACnet network (for controllers ordered with the BACnet option, or those with the BACnet module field-installed)
3. Through the service jack located on the bottom of each thermostat and the Price LINKER2. The LINKER2 is a USB 2.0 interface to Price controls. It is used in conjunction with FREE setup and balancing software available from Price.
4. Using the stand-alone setup tool: LCD-SETUP. This special setup tool resembles the LCD thermostat in both appearance and menu function. It can be plugged into either the DialThermostat or the Room SensorThermostat and used to setup the controller when a computer is not available.

LCD Thermostats

BACnet Module



Price LINKER2 (setup Tool)



Stand-Alone LCD-SETUP

Typical Application - Overview

The PIC can be factory configured to any one of more than 35 standard sequences, as well as special sequences if required. There are three categories of sequences: Single Duct, Constant Volume Fan Powered (series box), and Variable Volume Fan Powered(parallel box). Each of these types have different options: VAV vs VVT, field wired vs factory wiring, cooling-only vs HCCO, and various heat control types. The following is a description of the different options.

VAV (Pressure Independent) vs VVT (Pressure Dependent)

Variable air volume (VAV) control can maintain the conditions in a space more accurately. This is due to pressure independence. When the VAV module is present the PIC can maintain airflow at a constant volume independent of duct static pressure changes.

Variable Volume Temperature (VVT) is pressure dependant. This is a more economical technology (initial investment) which will modulate the damper position (%) and does not measure actual air volume entering the space. Actual air volume will vary depending on duct static pressure and other variable.

All Pressure Independent (VAV) sequences start at 2800, 6800, and 8800 (depending on box type). All Pressure Dependent (VVT) sequences start at 2850, 6850, and 8850.

Field vs Factory wiring

Many sequences may appear to be the same with simply the wiring type (field vs. factory) changing. A "factory wired' sequence is chosen if the terminal is to have a factory mounted electric duct heater installed. In these cases, the Price Factory will wire the PIC controller to the duct heater.

Field-wired sequences are used with equipment such as perimeter radiation (baseboard heat) or hot water valves (either mounted to the terminal or externally). These must be wired to the controller's outputs during installation in the field.

Cooling Only vs Heating/Cooling Changeover (HCCO)

All PIC sequences are designed for both cooling-only applications (where only cool air is supplied to the terminal) and for HCCO applications (where both warm or cool air can be supplied to the box). The optional changeover probe (PIC-PRB) allows HCCO operation. If no probe is connected to the PIC, the controller assumes it is receiving cool supply air, and acts accordingly.

Options

There are several optional that are available on every sequence

1. BACnet network interface - A BACnet MSTP interface to connect to a BACnet BMS network.
2. Changover probe - A supply air temperature sensor (**required for heating/cooling changeover systems**)
3. Thermostats - Four models of thermostats are available for every PIC sequence.

Networking

With native BACnet MS/TP compatibility, the PIC can tie into an existing or future BACnet compliant BAS system for maximum flexibility. When connected, the network monitors all of the controller's functions and variables, assigns setpoints, and initiates occupied, unoccupied and night setback modes taking advantage of the level of control and visibility inherent to BAS systems.

A computer running BACnet communication software can connect to each controller.

Master Slave Token Passing (MS/TP)
MS/TP stands for Master Slave Token Passing which is a robust low cost strategy for networking controllers. BACnet MS/TP uses the RS-485 standard which uses 1-pair (2-wires) and a shield. The network wire is connected in a daisy chain configuration to each controller. Typically the terminals are labeled plus (+) and minus (-), but sometimes can be labeled (A) and (B).

MS/TP is much more robust and economical than Ethernet. For example Ethernet can only be run a maximum of 330 feet without a repeater, while RS-485 (MS/TP) can theoretically be run up to 4000 feet without a repeater. Presently it is not cost effective to put Ethernet on each device.

Once a network of controllers is setup using MS/TP the network segment is typically connected to a computer running a graphical software package (sometimes referred to as a front-end).

The software package graphics can typically, show all networked controllers and their variables, trend log and schedule devices and objects. This allows for energy savings and easier setup and maintenance of the system. See the Price Rooftop Unit Controller (PRTU) brochure for more information. Available at www.price-hvac.com.

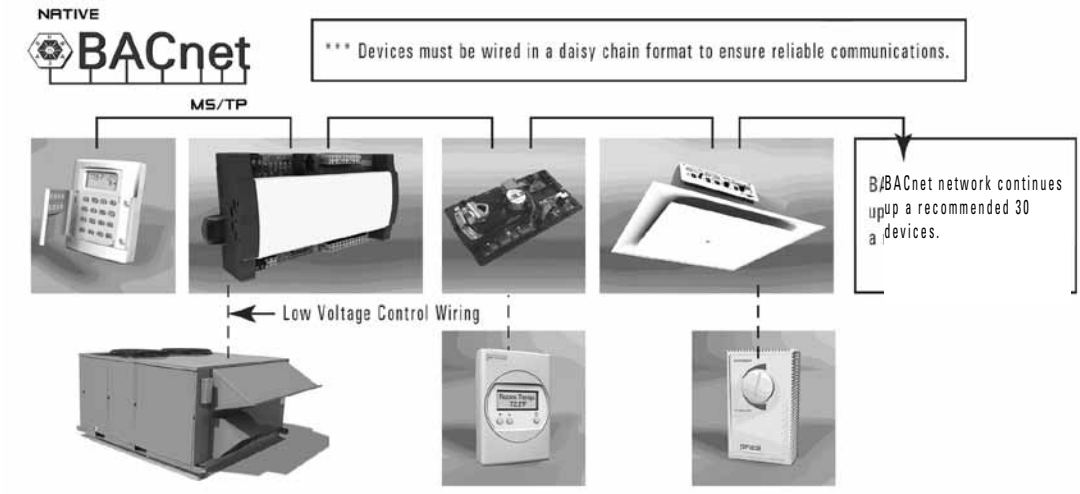
PIC and PRTU: The PIC can be used in conjuction with the Price Rooftop Unit Controller (PRTU). This allows for polling of each zone's demand so that intelligent decisions can be made by the rooftop controller.

For more information, see the PRTU installation and service manual.

Network Diagram

Network Compatibility:

Along with the capability for independent control, the PIC offers native BACnet MS/TP compatibility, enabling the package with an existing or future BACnet compliant BAS network for maximum flexibility.



Typical Applications

Single Duct Cooling or Heat/Cool Changeover

In this application, the damper is modulated based on the zone temperature and duct air temperature (with optional chaveover probe) within the minimum and maximum airflow limits. Sequence diagrams: 2800 and 2850

Single Duct Cooling/HCCO With 1-3 Stages of Electric Heat

In electric heat applications, the damper is modulated based on the zone temperature within the minimum and maximum airflow limits. In this application, up to three outputs perform staged on/off control of the heat. Each stage is energized independently based on the heat requirement. Sequence diagrams: 2801, 2802, 2851, and 2852.

Single Duct Cooling/HCCO With Tri-State Modulating Heat

In tri-state modulating heat (usually hot water) applications, both the damper and the hot water valve are modulated based on zone temperature. PI control sends a corresponding clockwise (CW) or counter-clockwise (CCW) signal to a tri-state actuator positioning the valve. (One (1) stage of additional 24VAC binary heat can also be used.) Sequence diagrams: 2803, 2853.

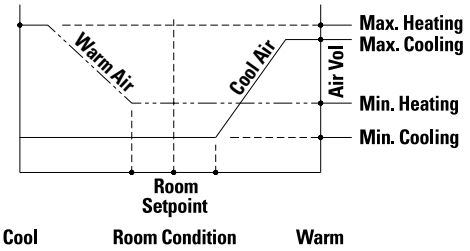
Single Duct Cooling/HCCO With Analog Modulating Heat

In modulating heat (usually hot water or SCR electric) applications, both the damper and the hot water valve are modulated based on zone temperature. PI control determines the desired valve position or SCR heat level and sends a corresponding 0-10V DC signal to the motorized actuator or SCR heater controller. Sequence diagrams: 2804, 2805, 2854, and 2855.

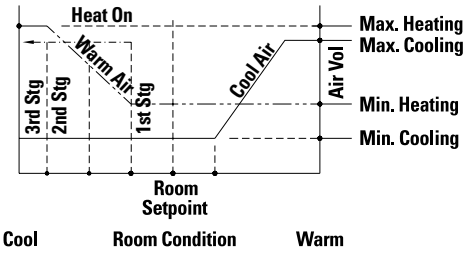
Series Fan Powered and Electric Coil or Proportional Heat

In constant volume applications, the fan operates continuously during occupied periods. The primary flow is modulated between the minimum and maximum cooling set points based on the thermostat demand. When the zone temperature falls below the zone set point the stages of heat will be energized. During unoccupied periods the primary air system is off and the fan runs intermittently to maintain the zone temperature between the night set points. If zone temperatures can not be maintained by the fan alone, heating coils will be energized.

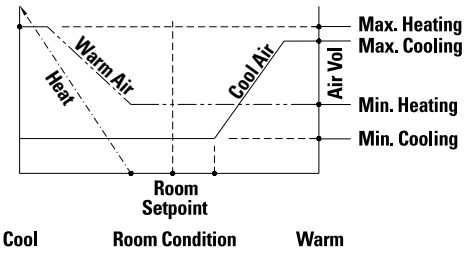
Single Duct Cooling or Heat/Cool Changeover



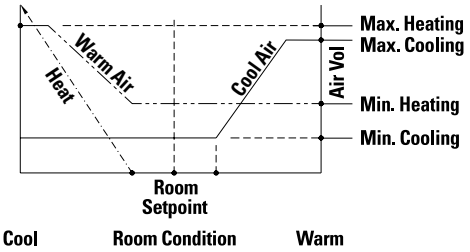
Single Duct Cooling/HCCO With 1-3 Stages of Electric Heat



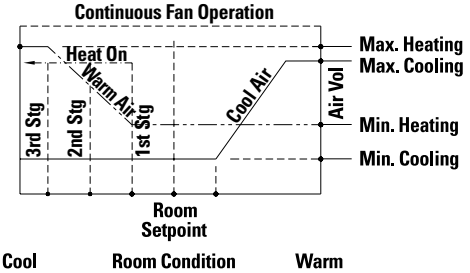
Single Duct Cooling/HCCO With Tri-State Modulating Heat



Single Duct Cooling/HCCO With Analog Modulating Heat



Series Fan Powered and Electric Coil or Proportional Heat



Applications

Parallel Fan Powered and Electric or Proportional Heat

When a variable volume terminal unit is used the fan is off when room temp is above the thermostat set point. During these periods primary airflow modulates within the minimum and maximum limits based on the zone temperature. If the zone temperature cannot be maintained by the fan alone, heating coils will be energized. When the zone temperature drops below the heating set point, the fan is turned on. When the zone temperature rises above the set point, the fan is turned off. In all cases, the fan is subject to a minimum cycle time which is adjustable to prevent short cycling.

Night Setback

Night setback provides a means of conserving energy by changing the temperature setpoints in the unoccupied hours when environmental requirements are reduced. By default, PIC controllers with any sequence can enter night setback. Sequence 9999 details night setback operation and how a controller may enter or exit night setback.

Typically, the heating set point will be reduced to 62°F. The primary trigger for the PIC to enter night setback mode is primary airflow failure. This will occur when the main fan is shut down. The heating set point is then automatically changed to a configurable night set point (62°F by default). If the room temperature falls below the heating set point the box's auxiliary heat will be energized. While in the night setback condition, the box damper is parked slightly open in order to sense the return of primary airflow, at which point the PIC will automatically return to normal operation.

See sequence 9999 for more details.

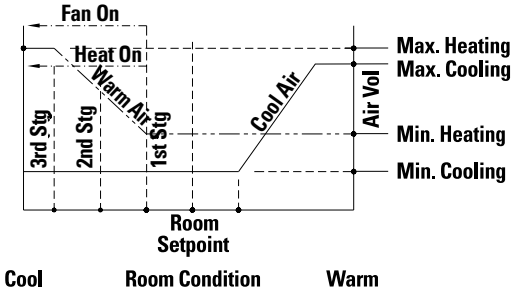
PIC and SCR (Silicon Controlled Rectifier)

The PIC outputs an analog (0-10V) signal for heat applications. For the electric heat, this signal would be tied directly into a SCR device, which provides modulation of an electric duct heater or an electric perimeter heater. This configuration allows full 0-100% control of the electric heater ensuring that the room set points are accurately met without overshoot. This method of control is much more accurate than standard on/off (digital) or staged control.

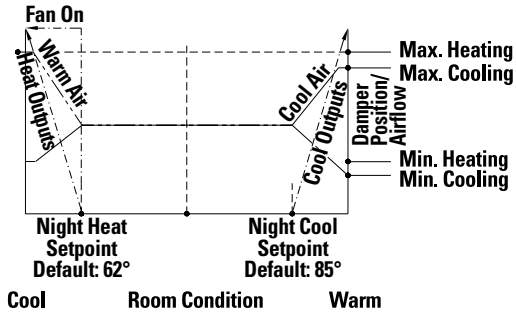
Benefits of SCR control

- Energy efficient - room set points are accurately maintained. Undershoot and overshoot are minimized, thereby increasing comfort while reducing operating costs.
- Noise reduction - Mechanical contactors are eliminated. Noise from contactor switching is completely eliminated resulting in silent operation.
- Increased Reliability -The SCR is a solid state device with no moving parts to wear or break down.

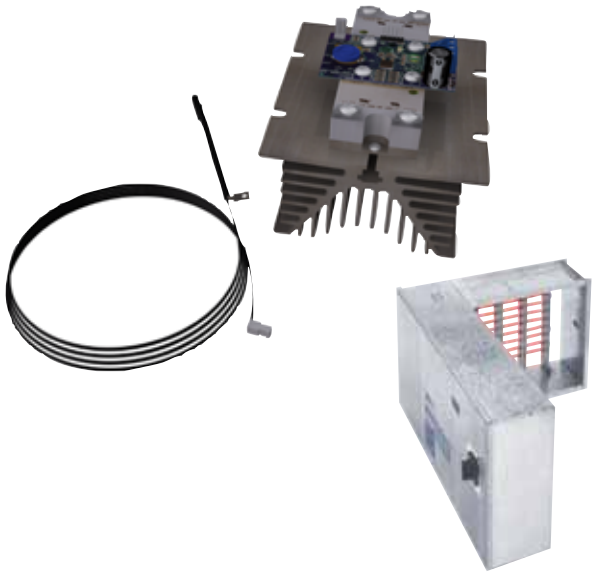
Parallel Fan Powered and Electric or Proportional Heat



Night Setback



SCR (Silicon Controlled Rectifier)



Specifications - PIC

Power Requirements

24VAC, 47-63 Hz 6VA (not including output loading)
NEC Class II.

Ambient Ratings

32° to 131° F (0° to 55° C) 10 to 90% RH
(non-condensing)

Outputs

24VAC Binary (x7). Max 0.5Amps each, MAX 1.85A total Switched HOT or Switched COMMON

- Fan
- Stages of heat or heat open/close (x3)
- Cooling
- Damper CW
- Damper CCW

Analog 0-10 VDC (x4). Max: 10mA each.

- Fan (ecm)
- Heat
- Cool
- Aux

Price Intelligent Controller (PIC)

Inputs

Changeover sensor (10k Type J thermistor)
Contact closure (night setback)
Airflow sensor (optional)
Thermostat inputs

- Room setpoint dial
- Temperature sensor (10K Type J thermistor)
  - Accuracy of +/- 0.5°F from 55°F to 85°F (+/- 0.25°C from 13°C to 25°C)

Communication ports

BACnet MS/TP Connection (optional)

- Communication speeds: 9,600, 19,200, 38,400, 76,800 (default),
- Maximum recommended nodes per MS/TP segment: 30

LINKER2 port

- For local setup using Price LINKER2

Actuator Specifications

35 in-lbs (nominal torque). 90 seconds running time 90° maximum angle of rotation.
External slide knob for manual override.
Less than 35 db (A) noise level

Airflow Sensor Specifications

Optional 0-1 SLM flow sensor.
(0-1" W.C. equivalent)

Tubing Specifications

Flow Sensor tubing must be 1/4 inch outside diameter

Size
11" x 5.75" x 2.75"

Weight
1.8lb. (816g)

PIC - Table of Sequence Diagrams

Number	Sequence Description	Controller	Reheat	Required Accessories
2800	Pressure Independent Cooling or HCCO*	PIC		VAV
2801	Pressure Independent Cooling or HCCO - up to 3 stg Electric Heat - Factory Wired	PIC	EC	VAV
2802	Pressure Independent Cooling or HCCO - up to 3 stg Electric Heat - Field Wired	PIC	24VAC Binary External**	VAV
2803	Pressure Independent Cooling or HCCO -Tri-State modulating HW heat - Field Wired	PIC	HW or Tri-State External	VAV
2804	Pressure Independent Cooling or HCCO - Analog electric heat - Factory Wired	PIC	EC	VAV
2805	Pressure Independent Cooling or HCCO - Analog heat - Field Wired	PIC	0-10V HW or 0-10V External	VAV
2850	Pressure Dependent Cooling or HCCO	PIC		
2851	Pressure Dependent Cooling or HCCO - up to 3 stg Electric Heat - Factory Wired	PIC	EC	
2852	Pressure Dependent Cooling or HCCO - up to 3 stg Electric Heat - Field Wired	PIC	24VAC Binary External	
2853	Pressure Dependent Cooling or HCCO -Tri-State modulating HW heat - Field Wired	PIC	HW or Tri-State External	
2854	Pressure Dependent Cooling or HCCO - Analog electric heat - Factory Wired	PIC	EC	
2855	Pressure Dependent Cooling or HCCO - Analog heat - Field Wired	PIC	0-10V HW or 0-10V External	
6800	CV*, Pressure Independent Cooling or HCCO**	PIC		VAV
6801	CV, Pressure Independent Cooling or HCCO - up to 3 stg Electric Heat - Factory Wired	PIC	EC	VAV
6802	CV, Pressure Independent Cooling or HCCO - up to 3 stg Electric Heat - Field Wired	PIC	24VAC Binary External***	VAV
6803	CV, Pressure Independent Cooling or HCCO -Tri-State modulating HW heat - Field Wired	PIC	HW or Tri-State External	VAV
6804	CV, Pressure Independent Cooling or HCCO - Analog electric heat - Factory Wired	PIC	EC	VAV
6805	CV, Pressure Independent Cooling or HCCO - Analog heat - Field Wired	PIC	0-10V HW or 0-10V External	VAV
6850	CV, Pressure Dependent Cooling or HCCO	PIC		
6851	CV, Pressure Dependent Cooling or HCCO - up to 3 stg Electric Heat - Factory Wired	PIC	EC	
6852	CV, Pressure Dependent Cooling or HCCO - up to 3 stg Electric Heat - Field Wired	PIC	24VAC Binary External	
6853	CV, Pressure Dependent Cooling or HCCO -Tri-State modulating HW heat - Field Wired	PIC	HW or Tri-State External	
6854	CV, Pressure Dependent Cooling or HCCO - Analog electric heat - Factory Wired	PIC	EC	
6855	CV, Pressure Dependent Cooling or HCCO - Analog heat - Field Wired	PIC	0-10V HW or 0-10V External	
8800	VV*, Pressure Independent Cooling or HCCO**	PIC		VAV
8801	VV, Pressure Independent Cooling or HCCO - up to 3 stg Electric Heat - Factory Wired	PIC	EC	VAV

PIC - Table of Sequence Diagrams

Number	Sequence Description	Controller	Reheat	Required Accessories
8802	VV, Pressure Independent Cooling or HCCO - up to 3 stg Electric Heat - Field Wired	PIC	24VAC Binary External***	VAV
8803	VV, Pressure Independent Cooling or HCCO -Tri-State modulating HW heat - Field Wired	PIC	HW or Tri-State External	VAV
8804	VV, Pressure Independent Cooling or HCCO - Analog electric heat - Factory Wired	PIC	EC	VAV
8805	VV, Pressure Independent Cooling or HCCO - Analog heat - Field Wired	PIC	0-10V HW or 0-10V External	VAV
8850	VV, Pressure Dependent Cooling or HCCO	PIC		
8851	VV, Pressure Dependent Cooling or HCCO - up to 3 stg Electric Heat - Factory Wired	PIC	EC	
8852	VV, Pressure Dependent Cooling or HCCO - up to 3 stg Electric Heat - Field Wired	PIC	24VAC Binary External	
8853	VV, Pressure Dependent Cooling or HCCO -Tri-State modulating HW heat - Field Wired	PIC	HW or Tri-State External	
8854	VV, Pressure Dependent Cooling or HCCO - Analog electric heat - Factory Wired	PIC	EC	
8855	VV, Pressure Dependent Cooling or HCCO - Analog heat - Field Wired	PIC	0-10V HW or 0-10V External	

Notes:

*VV is Variable Volume

** HCCO is "Heating/Cooling Changeover". (cool or warm air suppled to terminal)

***External means reheat external to the terminal - non box mounted. (i.e. Perimeter Radiation, etc.)

****NSB is Night Setback

Notes:

Notes:

price®

price INDUSTRIES

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	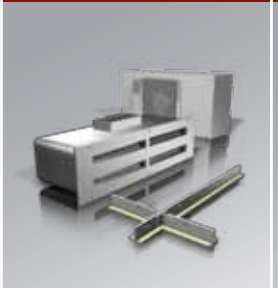			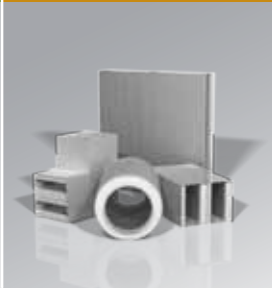

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