A new level of control for even the most specialized commercial building applications.

Combines the accuracy of direct digital control with the flexibility of an individual room system to provide maximum control and efficiency.

**Price Intelligent Controller**

A UNIVERSAL DDC CONTROLLER WITH BACNET INTEROPERABILITY

**PIC FEATURES:**
- Fast and errorproof RJ-45 thermostat connections.
- Integrated actuator.
- 24 VAC binary switched outputs that are field switchable between hot and common.
- Analog (0-10 VDC) outputs that are configurable for heating, cooling, fan, and auxiliary.
- Field installable expansion modules for BACnet MS/TP and VAV flow sensing.
- Pluggable terminal blocks for easy field wiring.
- Diagnostic LEDs showing status of each output, including damper direction.

A new level of control for even the most specialized commercial building applications.

Combines the accuracy of direct digital control with the flexibility of an individual room system to provide maximum control and efficiency.
Various thermostat options allow the designer to match the specific needs of the customer.

- **THERMOSTAT SUPPLIED BY OTHERS**
  This option allows PIC to interface to a third-party thermostat or control system.

- **ROOM SENSOR THERMOSTAT**
  This model measures room temperature. Temperature set-points are set through software.

- **DIAL THERMOSTAT**
  This model measures room temperature and features a dial adjustment and an occupancy button with LED.

- **LCD THERMOSTAT**
  This model measures room temperature and houses a LCD screen with push button set-point adjustment.

- **LCD THERMOSTAT with MOTION SENSOR**
  All the features of the LCD Thermostat plus the added value of a motion sensor that allows for automatic detection of space occupation.

- **WIRELESS THERMOSTAT**
  Provides the user with the freedom of accurate system control anywhere in the occupied space. Position in the best possible location for optimal temperature control.

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**Computer Accessibility**
If any changes are needed, the PIC interface cable and software can be used to make changes easily after installation.

**BACnet Expansion Module**
This allows for full control and setup of the PIC on a BACnet MS/TP network.

**VAV Expansion Module**
Using a state-of-the-art air flow sensor with the PIC's proportional integral control allows for fast and reliable air flow control.

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www.price-hvac.com for additional product information, including product videos and brochures.
System Controls

Price Intelligent Controller

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 air flow 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.

The PRICE LINKER 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 G-21 for more information on setup tools)

DDC vs. Analog Electronic Controls

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.
System Controls
Price Intelligent Controller

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 LINKER) 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
- 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, (11 standard outputs in total)
- 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 air flow sensing for trueVAV control
- BACnet module (optional) provides a native BACnet MS/TP interface

Thermostat Options

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Room Sensor Thermostat (PIC-TS-SENS)</td>
<td>This economical model of thermostat measures room temperature. The set-point 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.</td>
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<tr>
<td>Dial Thermostat (PIC-TS-DIAL)</td>
<td>This model measures room temperature and features a dial adjustment and an occupancy button. Temperature set-point limits are set through software/BACnet.</td>
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<tr>
<td>LCD Thermostat (PIC-TS-LCD)</td>
<td>This model measures room temperature and features an LCD screen with an advanced menu structure and three pushbuttons. Temperature set-point limits are set through software/BACnet. Balancing and modification to the controller setup can be accomplished from the LCD screen.</td>
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<tr>
<td>LCD Thermostat with Motion Sensor (PIC-TS-MOTION)</td>
<td>This model possesses the same features as the LCDT-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.</td>
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<tr>
<td>PRICE Wireless Thermostat</td>
<td>The Price Wireless Thermostat System provides both sensor inputs and a point of control for Price controllers. The Dial thermostat can be mounted in any location and needs no wiring. This makes it ideal for glass offices and cubicles.</td>
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</tbody>
</table>

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System Controls

CO2/Humidity Thermostat

Product Information

The new Price CO2/Humidity thermostat option offers the latest in sensor technologies. Using an on board non-dispersive infrared (NDIR) sensor, the thermostat can accurately measure CO2 levels without the need for recalibration. (Chemical sensors on the other hand require constant replacement.) CO2 levels are displayed on the thermostat’s LCD screen and are also available as a BACnet point displaying CO2 in parts per million (PPM).

The on board surface mount technology humidity sensor is fully factory calibrated and has a wide operating range with high accuracy. The humidity reading is available on the LCD thermostat screen and as a BACnet point when used with the Price Intelligent Controller (PIC).

Please note the CO2/Humidity thermostat is intended to be used with the Price Intelligent Controller (PIC) as a single device solution. (Both the thermostat (temperature/set point) and monitoring (CO2/Humidity) in one clean package.)

Two pre-tested CO2 control sequences are available for the PIC.

1. Purge mode
   a. While the space CO2 is below the adjustable threshold, the VAV box is controlled normally based on room temperature load
   b. If the space CO2 level rises above the user-set threshold, the controller will command the VAV box to deliver a pre-set maximum air volume into the space.
   c. Once the CO2 level drops back below the threshold, the VAV box returns to its normal control mode based on room temperature load.

2. CO2 airflow control
   a. In this mode, the airflow through the VAV terminal is directly proportional to the CO2 level in the occupied space.
   b. As the CO2 level increases from a user-set minimum level, to a user-set maximum level, the airflow is increased proportionally between the pre-selected minimum and maximum airflow set points.
   c. This control mode is typically applied as a dedicated fresh-air terminal unit.

Key CO2 Features:
- Accurate NDIR sensor
- No need for replacement/recalibration
- Pre-loaded sequences for handling CO2 available in the Price Intelligent Controller (PIC) for terminals
- Monitoring for CO2 available as a BACnet point for BMS integration

Key Humidity Features:
- Wide range humidity readings (5-100%)
- High accuracy sensor with +3% at room temperatures
- Long life, very low drift digital sensor
- Monitoring for Humidity available as a BACnet point for BMS integration
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 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 PRTU rooftop controller) allowing for intelligent decisions to be made at the air supplier level. See the PRTU Engineering Guide for more information.

**VAV Module (PIC-VAV)**
The VAV module increases the PIC’s functionality by adding pressure independent air flow control. The air flow transducer contained in this module used in conjunction with Price’s SP300 flow sensor provides consistent, highly accurate readings.

**Low Flow VAV Module (VAV-LF)**
For applications that require lower minimum airflow a VAV-LF module is available. This option allows minimum flows that are approximately 50% lower than standard. This allows energy savings during low load requirements and helps prevent overcooling (or needing reheat) for the occupied space. This also extends the range of a terminal unit allowing a single size to cover a larger load range.

Installation and Setup

Installation and configuration of the PIC is simple. 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 Price VAV 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 personnel 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 LINKER. The LINKER 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 Dial Thermostat or the Room Sensor Thermostat and used to setup the controller when a computer is not available.

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 dependent. 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 variables. This is ideal for small systems such as rooftop.

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 options that are available on every sequence

1. BACnet network interface - A BACnet MSTP interface to connect to a BACnet BMS network.
2. Changeover probe - A supply air temperature sensor (required for heating/cooling changeover systems)
3. Thermostats - Five 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 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 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 one pair (2-wires) and a ground connection.

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 although has a lower data speed. For example Ethernet can only be run a maximum of 330 ft without a repeater, while RS-485 (MS/TP) can be run up to 4000 ft without a repeater. Presently it is not cost effective to put Ethernet on each device. Price recommends keeping MS/TP network length reasonable to ensure reliable communication and simplify troubleshooting, therefore the maximum MS/TP network segment should ideally not exceed 1050 ft and have no more than 30 devices.

**Network Diagram**

![Network Diagram](network_diagram.png)

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

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) for more information.

**PIC and PRTU**: The PIC can be used in conjunction with the 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 in this section of the catalog.

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**BACnet network continues up a recommended 30 devices.**
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 changeover 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. 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.
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 air flow 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 set-points 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 air flow 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 air flow, at which point the PIC will automatically return to normal operation.

See sequence 9999 for more details.
Applications

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.
Specifications - PIC

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

Ambient Ratings
32º to 131 ºF [0º to 55 ºC] 10 to 90% RH (non-condensing)

Outputs
24 VAC 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

Inputs
Changeover sensor (10kType J thermistor)
Contact closure (night setback)
Airflow sensor (optional)
Thermostat inputs
- Room set-point dial
- Temperature sensor (10KType 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
  LINKER port
- For local setup using Price LINKER

Actuator Specifications
35 in-lbs (nominal torque). 90 seconds running time
90º 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. (0-1in. w.c. equivalent)

Tubing Specifications
Flow Sensor tubing must be 1/4 in. outside diameter

Size
11 in. x 5.75 in. x 2.75 in.

Weight
1.8 lb. [816 g]
# PIC - Table of Sequence Diagrams

<table>
<thead>
<tr>
<th>Number</th>
<th>Sequence Description</th>
<th>Controller</th>
<th>Reheat</th>
<th>Required Accessories</th>
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<tbody>
<tr>
<td>2800</td>
<td>Pressure Independent Cooling or HCCO*</td>
<td>PIC</td>
<td></td>
<td>VAV</td>
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<tr>
<td>2801</td>
<td>Pressure Independent Cooling or HCCO</td>
<td>PIC</td>
<td>EC</td>
<td>VAV</td>
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<tr>
<td>2802</td>
<td>Pressure Independent Cooling or HCCO</td>
<td>PIC</td>
<td>24VAC Binary External**</td>
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<td>2803</td>
<td>Pressure Independent Cooling or HCCO</td>
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<td>HW or Tri-State External</td>
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<td>Pressure Independent Cooling or HCCO</td>
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<td>2805</td>
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<td>0-10V HW or 0-10V External</td>
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**Notes:**

*VV is Variable Volume
**HCCO is ‘Heating/Cooling Changeover’, (cool or warm air supplied to terminal)
***External means reheat external to the terminal - non box-mounted. (i.e. Perimeter Radiation, etc.)
****NSB is Night Setback