PCC-III MULTIPLE LOOP CONTROLLER

Overview

Reliable, Flexible Control and Monitoring

The PCC-III Multiple Loop Controller is a boiler or multiple loop process controller. The large I/O quantity, integral Oxygen sensor, highly visible front panel, intuitive “Blockware”, redundant memories, 4-20 mA input and outputs, 120 VAC discrete contact inputs, isolated relay outputs, 24 VDC transmitter power supply, the ability to control electric positioners directly and built-in industry standard communications allows the PCC-III to be integrated into complex systems with a minimum number of external components. The PCC-III is a complete control solution for individual boilers or multiple control loops.

- **Multiple loop controller**
  Large 160 block memory and 18 I/O points as a standard with three (3) additional I/O card slots for available expansion up to 31 I/O.

- **Highly Visible LED Displays**
  - 10 Process Variables displayed with English language description
  - 10 Point (“first-out”) annunciator with English language messages
  - Large 5.1”, 51 segment bargraphs

- **Intuitive “Blockware” configuration language**
  Completely configurable from controller front panel. No external keypads or terminals are required for any reason

- **Dual redundant memory modules**
  Protects configuration data, tuning parameters and operating status information

- **Optically Isolated RS485 Modbus data highway**
  Ensures safe and reliable communications

- **120 VAC Discrete Input, Relay and Triac Output**
  Boiler system compatibility and 24 VDC internal power supply

- **Flush Mounted NEMA 13 Front Panel**

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**User Friendly**

- **Easy Installation** – The PCC-III integrates a flexible, highly visible HMI, up to 31 I/O points (including isolated discrete and analog inputs, relay outputs and triac and 4-20 mA inputs), 24VDC power supplies and network communications into a single panel mounted NEMA 13 controller.

- **Easy to operate** - The PCC-III comes with large numeric and English language displays, pushbuttons and intuitive bargraphs which provide clear process information. A flexible display allows the operator to view up to 10 different process variables, each with up to a 16 character English language description message. The “first-in-first-out” annunciator allows the operator to view the order of alarms and acknowledge each separately. Configurable “lights and buttons” allow incorporation of auxiliary functions into the controller without the addition of external hardware.

- **Easy to configure** - The PCC-III uses an intuitive “Blockware” configuration language. Functions (AIN, PID, LOALM, F(x), etc) are simply copied into a configuration, and then the control signals are “wired” from block to block. Preferred’s innovative PC3_Draw™ for MS Windows® uses a graphical, “drag and drop” interface. Blockware can also be edited directly from the PCC-III front panel or the spreadsheet style PC3_Edit™. The PCC-III includes automated setup tools to help reduce commissioning time and improve control system tuning.
Safe Boiler Operation
The Preferred PCC-III controller, joined with proper fuel and combustion air flow regulating elements, assures accurate and repeatable combustion control. Fuel and air flows are matched in order to maintain proper fuel to air ratio at all times. Too little air causes unburned fuel losses and too much air causes excessive stack losses. Improper fuel air ratio can be DANGEROUS. Any combustion project requires the assessment of existing piping, burner and boiler conditions, process measurements, analyzers, linkages, actuators, control valves, control dampers and operational requirements. Preferred’s focus on combustion applications, with thousands of boiler control system installations, brings the required experience to the evaluation, development and commissioning of each project. With its redundant non-volatile memories and “service manual” mode, the PCC-III Controller is capable of “self-recovery” in the event of a severe 120 VAC electrical power disturbance or some other occurrence that alters data in its memory. Moreover, an integral optically isolated RS485 Data Highway helps prevent a single controller failure from disrupting an entire network.

Lower Installed Cost
When considering any controller, it is important to consider the total “installed” cost. The PCC-III offers the lowest installed cost in the industry. Other controllers routinely require external hardware such as interfacing relays, communication isolators, 24 V power supplies, laptops or configurators and possibly extra controllers to manage a specific application. The PCC-III overcomes many of these issues by incorporating these features into the basic controller. The PCC-III “Z” option card, as an example, eliminates the need for an external flue gas excess oxygen transmitter, while standard 120 VAC inputs and 8 Amp relay outputs eliminate the need for interposing relays. While most other controllers are well over 15” long, the compact PCC-III fits easily into less expensive 8” deep cabinets or enclosures.

Multiple Loops
Due to its ability to handle several control loops, application of a single PCC-III may allow a reduction in the total number of controllers necessary for an installation. The large 160 function block configuration memory allows any function to be assigned to each block, providing unequalled flexibility and enough power to handle just about any boiler control strategy.

Expandable I/O
The wide variety of PCC-III option boards allow one to expand the I/O capabilities of a given controller to fit any application. Refer to the specifications page for expansion card possibilities. Up to 15 analog inputs can be used to support complex control strategies or satisfy data acquisition needs. The PCC-III can be equipped with up to 6 relay outputs. These outputs are rated for up to 8 A inductive loads and can be used on most applications without external “helper” relays. Additionally, the PCC-III offers Triac outputs to drive reversible AC electric actuators, solenoids, horns and other devices. The “G” Triac Output option card includes a “position feedback” potentiometer or 4-20 mADC inputs for closed loop servo positioning.
PCC-III MULTIPLE LOOP CONTROLLER

Applications

PCC-III Multiple Loop Controller Example Applications:

Boiler Monitoring
- Flue Gas Oxygen Monitoring with ASME “By Losses” Efficiency Calculation for One (1) or Two (2) Boilers
- Data Acquisition with up to 15 Analog Inputs or 13 Digital Inputs

Header Temperature or Pressure Control
- Two (2) or Three (3) Boiler Modulating Lead/Lag Control
- Plant Master Modulating Control

Single Point Positioning Combustion Control
- Firing Rate Control
- Firing Rate Control with Oxygen Trim Control using Link Trim Actuator (LTA) or Fuel Trim Output
- Firing Rate Control with Draft or Drum Level Control

Parallel Positioning Combustion Control
- Firing Rate Control
- Firing Rate Control with Oxygen Trim Control
- Firing Rate Control with Oxygen Trim Control and Variable Speed Drive (VSD) Combustion Air Fan Control

Fully Metered Combustion Control
- Firing Rate Control
- Firing Rate Control with Oxygen Trim Control
- Firing Rate Control with Oxygen Trim Control and Variable Speed Drive (VSD) Combustion Air Fan Control

Refer to Engineering Data Section for features and Benefits of Single Point Positioning, Parallel Positioning and Fully Metered Combustion Control System.
Combustion Control Features
Combustion is a demanding process control application. The following are some of the PCC-III features developed to meet those demands.

Multiple Function Generator F(x) blocks
The F(x) block is used to “characterize” or “curve fit” an analog signal by allowing each value of the input to be assigned an independent output value. The PCC-III’s F(x) block allows 11 breakpoints to define the input vs. output profile. The blocks are used to set up feedforward and remote setpoint signals as well as linearize relationships. For example, in combustion air flow control applications, F(x) blocks are used to “characterize” the Air Flow Demand signal to create Air Flow Controller and Oxygen Trim Controller setpoints. The example shown to the right uses separate F(x) blocks to “characterize” different setpoints for gas and oil firing. The PCC-III has the capacity to use as many F(x) functions as are required by the application.

“Learn Mode”
The PCC-III “Learn Mode” feature allows multiple F(x) block input vs. output profiles to be entered simultaneously. This capacity is best described with an example (refer to the example blockware diagram at right). During commissioning, the control technician adjusts air and fuel flows manually to establish optimal firing conditions for a particular load point. With the conditions set, the technician simply presses the “store” button for the PCC-III to store (learn) the current firing rate, oxygen value and burner air flow rate into the appropriate F(x) blocks simultaneously. This causes considerable time in commissioning, as well as an optimally “characterized” process.

Boiler Efficiency Function Block
The boiler efficiency function allows real time calculation of the boiler’s efficiency with results displayed on the controller’s front panel, recorder and/or data acquisition system. Boiler efficiency is calculated using the ASME “by losses” method. This function requires inputs of flue gas temperature, combustion (ambient) air temperature, percent oxygen in the flue gas, and percent firing rate to evaluate the efficiency. Not only does this function help establish “on-line” fired equipment efficiency, but it also helps detect changes in efficiency, alerting operating personnel of potential maintenance concerns before they become a problem. The results of efficiency calculations can also be used in advanced control applications.
PCC-III MULTIPLE LOOP CONTROLLER

Configuration

Programming configurations is a challenging task for most programmable controllers. The PCC-III multiple loop controller is the exception to this rule with three different ways to create configurations. Configurations can always be made directly from the faceplate of the controller, using the built-in edit buttons, but the task is made even easier with Preferred’s PC3_Edit™ and PC3_Draw™ software. Both programs allow the user to design Blockware configurations and upload/download them to the PCC-III controller through the PC3-Link™ cable connecting the serial port of your computer to a standard RS232 connection on the PCC-III controller. PC3_Edit™ provides a straightforward spreadsheet style interface while PC3_Draw™ uses a powerful object-oriented visual interface. Both programs are built for MS Windows®.

PC3_Edit™
The “point and click” simplicity of the PC3_Edit™ software makes “Blockware” configuration simple and intuitive. The program uses a straightforward spreadsheet format with a convenient fill-in-the-blanks approach. Each Block has an unlimited length “comments” field for clear documentation. The “Blockware” data and comments can be printed to any MS Windows® compatible printer. The generated configurations are then easily downloaded to the controller through the PC3-Link™ cable.

PC3_Draw™
The powerful object-oriented CAD interface in PC3_Draw™ makes the program the ideal choice for rapid “Blockware” programming in a visual environment. The program is built on a Visio® platform with extensive Visual Basic automation. Standard functions are included in menus of pre-drawn figures for each PCC-III Blockware function type. Functions are simply dragged onto the drawing page and connected with “smart connector” lines to interconnect the blocks. Block inputs are automatically generated by placing the block connections. Double clicking on any block allows the user to edit data within the block. Drawings can be printed on any MS Windows® compatible printer or plotter. “Blockware” data can also be printed in the PC3_Edit™ tabular format.

Whatever the configuration needs, Preferred Instruments has an easy solution for you. Whether it’s the straightforward approach of PC3_Edit™ or the more robust graphical abilities of PC3_Draw™, configurations will never be the chore they used to be.
### PCC-III MULTIPLE LOOP CONTROLLER

#### Specifications

**Mechanical**
- **Case Size:** 7.38" H X 3.00" W X 7.75" D
- **Enclosure Type:** Flush panel mounted
- **Front Panel Size:** 8.00" H X 3.75" W
- **Panel Cutout:** 7.50" H X 3.13" W (+/- .062)
- **Weight:** 6 lbs. (excluding option boards)

**Environmental**
- **Operating Temp:** 32° to 122° F (0° to 50° C)
- **Storage Temp:** -20° to 150° F (-28° to 65° C)
- **Humidity Limits:** 15 to 95% (noncondensing)
- **Front Panel:** NEMA 13/IP65

**Performance**
- **Accuracy:** 0.025% Analog Inputs and Outputs, 70° F
- **Resolution:** 16 bit input/16 bit output
- **Microprocessor:** 32 bit, 256k RAM
- **Execution Cycle:** Ten per second
- **Non-Voltatale Memory Life:** 10.8 - 30 years, Blockware dependent

**Operator Control Panel**
- **Displays:**
  - Alphanumeric: 8 character LED (0.2")
  - Numeric: 4.5 digit LED (0.43")
- **Bargraphs:**
  - PV & SP: 51 segment LED (5.1")
  - Output: 21 segment LED (2.1")
- **Pushbuttons:**
  - Membrane, tactile feedback
  - LED, splashproof
- **Faceplate:**
  - Mylar, splashproof
- **Alarm Annunciator:** 10 point, first out
- **Status Indicators:** 6 LED, configurable
- **User Defined Pushbuttons:** 4 configurable

**Configuration**
- **Language:**
  - Function block style, 60 functions, 160 Blocks
  - 4 password levels
  - Redundant memories
- **User Interface:**
  - Fully front face configurable
  - 4 dedicated EDIT keys located under hinged cover
- **Laptop (optional):** PC3_Edit™ spread sheet based editor or PC3_Draw™ graphical, object-oriented editor

**Communication**
- **Network:**
  - Protocol: Modbus (ASCII or RTU mode)
  - Speed: 1200 to 38,400 baud
  - Type: RS485, optically isolated
- **Configuration Speed:** 1200 to 38,400 baud
- **Type:** RS232 with telephone modular handset connector

### Electrical

<table>
<thead>
<tr>
<th>Input/Output (Standard - no option cards)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Analog Inputs:</strong></td>
</tr>
<tr>
<td><strong>Type:</strong></td>
</tr>
<tr>
<td><strong>Analog Outputs:</strong></td>
</tr>
<tr>
<td><strong>Type:</strong></td>
</tr>
<tr>
<td><strong>Discrete Inputs:</strong></td>
</tr>
<tr>
<td><strong>Type:</strong></td>
</tr>
<tr>
<td><strong>Discrete Outputs:</strong></td>
</tr>
<tr>
<td><strong>Type:</strong></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

### Input/Output Option Cards

**Option Board A:**
- **Analog Inputs:** Quantity: 5
- **Type:** 4 - 20 mADC, 0 - 5 VDC

**Option Board F:**
- **Analog Inputs:** Quantity: 3
- **Type:** 4 - 20 mADC, 0 - 5 VDC

**Option Board G:**
- **Triac Output:** Quantity: 2 pair
- **Type:** 2 A 24 - 120 VAC

**Option Board J:**
- **Digital Inputs:** Quantity: 4
- **Type:** 120 VAC, Optically-Isolated

**Option Board S:**
- **Triac Output:** Quantity: 1 pair
- **Type:** 2 A 24 - 120 VAC

**Option Board Z:**
- **Analog Input:** Quantity: 3
- **Type:** 120 VAC, Optically-Isolated
- **Triac Output:** Quantity: 1 pair
- **Type:** 2 A - 120 VAC
PCC-III MULTIPLE LOOP CONTROLLER
Standard Configuration

A number of common controller configurations can be ordered pre-programmed into the PCC-III to perform a variety of different control functions including:
- Plant Master
- Single Point Positioning (Jackshaft) Boiler Master
- Parallel Positioning Boiler Master
- Fully Metered Boiler Master
- Feedwater Control
- Condensate Level Control
- Stand-Alone Oxygen Analyzer

Note: although the controllers are provided pre-programmed, there will still be additional field programming required to enter site-specific data into the controllers including: transmitter ranges, customized text descriptions, tuning parameters, etc.

Plant Master Configuration Options:

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Catalog Number</th>
<th>PCC-III Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plant Master (current outputs)</td>
<td>Includes steam header pressure control. This controller may be combined with any boiler Submaster controller to form a complete system.</td>
<td>PC3-00003C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Plant Master with 3 Steam Boiler Lead/Lag</td>
<td>Includes steam header pressure control and lead/lag sequencing for three boilers. External lead boiler selector switch and Boiler Submaster Controllers are required.</td>
<td>PC3-10013C</td>
<td>PCC-III-J000</td>
</tr>
</tbody>
</table>

Single Point Positioning Boiler Master Configuration Options:

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Catalog Number</th>
<th>PCC-III Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Boiler Submaster Jackshaft (current outputs)</td>
<td>Includes boiler steam pressure control for a boiler equipped with a jackshaft. This is a complete system.</td>
<td>PC3-10103C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Steam Boiler Submaster Jackshaft (triac outputs)</td>
<td>Includes boiler steam pressure control for a boiler equipped with a jackshaft. This is a complete system.</td>
<td>PC3-10013C</td>
<td>PCC-III-G000</td>
</tr>
<tr>
<td>Hot Water Boiler Submaster Jackshaft</td>
<td>Includes hot water generator temperature control for a hot water generator equipped with a jacks haft. This is a complete system.</td>
<td>PC3-10153C</td>
<td>PCC-III-Z000</td>
</tr>
<tr>
<td>Oxygen Trim w/Efficiency Jackshaft (Z-board)</td>
<td>Includes oxygen trim logic for a jackshaft-equipped boiler. Fuel trim equipped pressure regulator and I/P converter are required. Configuration is set up for use with Preferred’s ZP Oxygen Analyzer. This controller may be used as a stand alone system or combined with PC3-10103 or PC3-10153 to form a complete system.</td>
<td>PC3-10313C</td>
<td>PCC-III-Z000</td>
</tr>
<tr>
<td>Oxygen Trim w/Efficiency Jackshaft (Z-board)</td>
<td>Includes oxygen trim logic for a jackshaft-equipped boiler. Differential link trim actuator is required. Configuration is set up for use with Preferred’s ZP Oxygen Analyzer. This controller may be used as a stand-alone system or combined with PC3-10103 or PC3-10153 to form a complete system.</td>
<td>PC3-10363TA</td>
<td>PCC-III-ZG00</td>
</tr>
<tr>
<td>Boiler Submaster/ Draft, Jackshaft</td>
<td>Includes boiler steam pressure control and draft damper control for a jackshaft-equipped boiler. This is a complete system.</td>
<td>PC3-12043C</td>
<td>PCC-III-0G00</td>
</tr>
</tbody>
</table>
## PCC-III MULTIPLE LOOP CONTROLLER

### Standard Configuration

### Parallel Positioning Boiler Master Configuration Options:

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Catalog Number</th>
<th>PCC-III Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boiler Submaster/ Fuel/Air Ratio, Parallel Positioning (no Oxygen Trim)</td>
<td>Includes boiler steam pressure control with fuel valve, air-fuel ratio logic and air damper control configuration for parallel positioning field equipment. This is a complete system.</td>
<td>PC3-12053C</td>
<td>PCC-III-0000</td>
</tr>
</tbody>
</table>

### Fully Metered Boiler Master Configuration Options:

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Catalog Number</th>
<th>PCC-III Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Boiler Submaster/ Fuel Flow, Full Metering</td>
<td>Includes boiler steam pressure control and one (1) fuel valve control configured for fully metered field equipment. This configuration is used with PC3-12073C.</td>
<td>PC3-12033C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Air Flow/ Oxygen Trim, Full Metering</td>
<td>Includes air-fuel ratio logic, air damper control and oxygen trim logic configuration for fully metered field equipment. Configuration is set up for use with Preferred’s ZP Oxygen Analyzer. This configuration is used with PC3-12033C or PC3-12493C.</td>
<td>PC3-12073C</td>
<td>PCC-III-Z000</td>
</tr>
</tbody>
</table>

### Auxilliary Configuration Options:

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Catalog Number</th>
<th>PCC-III Model Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>One Element Drum Level</td>
<td>Feedwater valve control using drum level measurement.</td>
<td>PC3-10213C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Two Element Drum Level</td>
<td>Feedwater valve control using steam flow and drum level measurements.</td>
<td>PC3-10203C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Three Element Drum Level</td>
<td>Feedwater valve control using steam flow, drum level and feedwater flow measurements.</td>
<td>PC3-10223C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Condensate Tank Level</td>
<td>Condensate valve control with condensate level measurement.</td>
<td>PC3-10263C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Deaerator Tank Level</td>
<td>Condensate flow valve control with Deaerator level measurement.</td>
<td>PC3-10273C</td>
<td>PCC-III-0000</td>
</tr>
<tr>
<td>Oxygen Analyzer w/ Efficiency</td>
<td>Stand alone oxygen analyzer configuration. Configuration is set up for use with Preferred’s ZP Oxygen Analyzer.</td>
<td>PC3-11033C</td>
<td>PCC-III-Z000</td>
</tr>
<tr>
<td>Standard PID Controller</td>
<td>Standard PID logic with high and low alarm.</td>
<td>PC3-STD PID</td>
<td>PCC-III-0000</td>
</tr>
</tbody>
</table>
1. Specify the PCC-III catalog number as shown below.
2. Consult factory for pre-configured combustion control strategies that may be included for an additional cost.
3. Optionally specify PC3_Edit™ or PC3_Draw™ programming packages.
4. Optionally specify the “DCS-III” Controller for monitoring applications. The “DCS-III” is a PCC-III Controller without faceplate and case. It is supplied with a bracket for mounting on an enclosure sub panel.

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**Option Card Slot #1:**

<table>
<thead>
<tr>
<th>Option Card Slot #1</th>
<th>Catalog Number: PCC III a b c 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 none</td>
<td></td>
</tr>
<tr>
<td>A AIN 5 ch. 4-20 mADC / 0-5 VDC</td>
<td></td>
</tr>
<tr>
<td>F AIN 3 ch. 4-20 mADC / 0-5 VDC</td>
<td>Combination Board</td>
</tr>
<tr>
<td>F AOUT 2 ch. 4-20 mADC</td>
<td></td>
</tr>
<tr>
<td>G TOUT 2 pair Triac Outputs, 2A 24-120 VAC</td>
<td>Combination Board</td>
</tr>
<tr>
<td>G AIN 2 ch. Pot / 0-5 VDC / 4-20 mADC</td>
<td></td>
</tr>
<tr>
<td>J DIN 4 ch. 120 VAC, Optically Isolated</td>
<td></td>
</tr>
<tr>
<td>J DIN 2 ch. Relay Contact, 8A Inductive</td>
<td></td>
</tr>
<tr>
<td>Z ZP Oxygen Analyzer Amplifier and Stack Temperature Controller</td>
<td></td>
</tr>
</tbody>
</table>

**Option Card Slot #2**

Select card type from the “Slot 1” list above

**Option Card Slot #3**

<table>
<thead>
<tr>
<th>Option Card Slot #3</th>
<th>Catalog Number: PCC III a b c 0</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 none</td>
<td></td>
</tr>
<tr>
<td>S TOUT 1 pair Triac Outputs, 2A 24-120 VAC</td>
<td></td>
</tr>
</tbody>
</table>

Optional Input/Output Board Expansion Examples:

<table>
<thead>
<tr>
<th>PCC-III Model #</th>
<th>4-20 mADC 0-5 VDC AIN</th>
<th>4-20 mADC AOUT</th>
<th>120 VAC DIN</th>
<th>8A (relay) ROUT</th>
<th>2A (triac pairs) TOUT</th>
<th>200 mADC (sinking) DOUT</th>
<th>Total I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCC-III-0000</td>
<td>5</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>18</td>
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<tr>
<td>PCC-III-AA00</td>
<td>15</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>28</td>
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<tr>
<td>PCC-III-F000</td>
<td>11</td>
<td>6</td>
<td>5</td>
<td>2</td>
<td>0</td>
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<td>28</td>
</tr>
<tr>
<td>PCC-III-J000</td>
<td>5</td>
<td>2</td>
<td>13</td>
<td>6</td>
<td>0</td>
<td>4</td>
<td>30</td>
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<tr>
<td>PCC-III-G000</td>
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<td>2</td>
<td>5</td>
<td>2</td>
<td>0</td>
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<tr>
<td>PCC-III-F000</td>
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<tr>
<td>PCC-III-A000</td>
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<td>2</td>
<td>9</td>
<td>4</td>
<td>0</td>
<td>4</td>
<td>29</td>
</tr>
</tbody>
</table>

Note: The examples given in no way reflect the number of option card possibilities. The PCC-III has a total of three (3) option card slots, of which one is designated for use by the "S" card only. The remaining two slots can house any of the remaining option cards in any desired combination.

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specifications subject to change without notice
PCC-III MULTIPLE LOOP CONTROLLER
Suggested Specifications

1. General
Supply a microprocessor-based multiple loop controller suitable for flush mounting on the face of a control panel. The controller shall provide for balanceless-bumpless transfer. In normal operation, this unit receives analog inputs, calculates the output and positions the associated final control element. The operator can manually override this function by selecting the manual mode of operation and adjusting the final control element. Primary operating voltage shall be 120 volts, 60 Hz, single phase. Plug-in field wiring shall allow removal of the controller circuit boards without disconnecting any panel or field wiring from the terminal strips. The controller shall include all necessary 24 VDC power to supply input and output circuits.

2. Enclosure
Controllers shall be flush mounted on the control cabinet and shall have NEMA 13 rated (oil/water spray) front panel displays, keyboard, cabinet to case and case to front panel gasketing. Controllers shall be able to operate indefinitely in 120°F locations with no cooling fans. Controller tuning and configuration menus shall be concealed behind a panel front located door.

3. Operator Interface
Digital displays and keypad shall be provided on the controller front panel. The controller shall be capable of displaying up to 10 process variables with English language descriptions. Additionally, controllers shall have a ten point English language “first - out” annunciator. Controllers shall have two 50 segment red LED bargraphs to locally display the process variable and setpoint and one 20 segment red LED bargraph to display the output. All operator pushbuttons shall be of the membrane type and shall have tactile feedback. Status indications shall be long life LEDs.

4. Configuration
Control strategy shall not use “blockware” type language. The controller shall be supplied with an onboard library of 61 analog and discrete functions and have a minimum 160 block memory. Any quantity or combination of function blocks (AIN, PID, LOALM, F(x), etc.) shall be easily copied into a control strategy and “wired” from block to block. The controller shall be capable of calculating real time boiler efficiency based on the ASME “by losses” method. The calculation must use real time inputs of boiler firing rate, flue gas oxygen, flue temperature and fuel selected. Two sets of adjustable fuel chemistry data parameters shall be included, and firing rate scaled radiation losses shall be used for maximum accuracy. Calculations that rely on fixed constants or manually entered values for these conditions are not acceptable. Fuel/Air ratio curve and oxygen trim setpoint curve adjustment shall be automated for rapid, error-free burner setup. Only a single operator action shall be required to store commissioning data into multiple characterizer curves for a particular load point. “examine” and “block force” modes shall be provided to allow rapid system troubleshooting. Each controller shall be completely field configurable from the front panel keypad without the use of external computers or hand-held terminals. Configuration changes, tuning, and oxygen trim setpoint curve adjustment shall be accomplished via a keypad on the controller front panel. Each controller shall have several levels of access security to prevent unauthorized configuration. Provide laptop computer, software, and cables if all forms of controller configuration cannot be performed from the controller faceplate.

5. Input/ Output Signal Types
The Controller shall use 120 VAC for discrete inputs and outputs for system compatibility. Analog inputs shall be 1 - 5V or 4-20 mADC. Analog input and output signals shall be isolated from earth ground for ground loop prevention. The controller shall include optional TRIAC, 24-120 VAC solid state switch output boards to directly interface with electric actuators. Controller I/O quantities shall be expandable with plug-in I/O option cards.

6. Reliability
Control signals that are shared by multiple boilers (e.g. Plant master demand, and RS485 communications links) shall have signal isolators in each boiler section. This is to prevent an equipment or wiring failure in one boiler from shutting down any other boiler. Each transmitter and sensor input channel shall have individual power supply short circuit protection. Configuration and calibration data shall be stored in a non-volatile EEPROM plug-in memory module. In addition, a redundant plug-in backup memory module shall be furnished that will automatically download into the primary memory if primary memory data is corrupted. As an alternate to redundant plug-in memory modules, provide all necessary portable computers, software and hardware to allow configuration downloading and archival.

7. Communication
Each controller shall be equipped with an isolated RS485 communications data highway that communicates in Modbus protocol. Isolation is required to prevent damage to all controllers on the same RS485 cable should a 120 VAC short occur anywhere in the system. The RS485 protocol shall allow: Auto/ Manual mode change, setpoint change, operation of the manual output, silencing of alarms, change of any configuration parameter (including PID tuning constants), change of timers, etc. Controllers shall not depend on a serial communications link to send sensor data required from controller to controller unless the link is fully redundant. Provide all equipment capabilities specified in this paragraph, even if a connecting SCADA system is not included in this project.

8. Quality Assurance
The controllers shall be manufactured and labeled in accordance with UL508A (CSA C22.2 #14 for use in Canada). Inspection and labeling shall be supervised by UL or other OSHA approved Nationally Recognized Test Lab (NRTL). Lack of an NRRTL certified UL508A wiring methods inspection and labeling will be grounds for controller rejection.