A. O. SMITH WATER PRODUCTS COMPANY
TECHNICAL TRAINING DEPARTMENT
EMC 5000 CONTROL SYSTEM REFERENCE MANUAL
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INTRODUCTION

This reference manual will cover the **EMC 5000** control system (EMC - Energy Management Control). The EMC 5000 control system includes several components: a **UIM** (User Interface Module), a **CCB** (Central Control Board), and a **PDB** (Power Distribution Board). The EMC 5000 can control products with single or multiple stages of heating. The first stage ignition control is built into the CCB circuit board. Multiple stage products will also have one **FCB** (Flame Control Board) for each additional stage of heating.

**Be sure to review the Boiler Controls and Operating Temperatures sections.**

**Genesis boilers** (300-305 Series 300,000 - 750,000 Btu/hr) are equipped with the EMC 5000 control system covered here. These "300-305" Series Genesis boilers are two stage (50% or 100%) boilers. Equinox outdoor/rooftop water heaters use a similar display with a different ignition control board, this reference does not apply to the Equinox.

**EMC 5000 FEATURES INCLUDE**

- **EMI / RFI filtering** - built into the circuit boards. (EMI = Electro Magnetic Interference, RFI = Radio Frequency Interference) Helps prevent or eliminate erratic operation caused by EMI/RFI.
- **Silicon nitride ignitor** - more durable/longer life ignitors.
- **Help screens** - text based operational information to help the user understand how to change settings and navigate the menu screens.
- **Self diagnostics** - text based diagnostic information (error and fault messages) on board to help service technicians quickly and accurately service the boiler.
- **Error code log** - will retain a 9 event history (plus the current event) of error codes with a time stamp. This will help diagnose load and/or environmental conditions that may be contributing to a problem with operation or a lock-out.
- **Short cycling protection** - if any stage logs more than 30 cycles in one hour the control enters a short cycle prevention condition. The boiler will continue to operate in this mode. The UIM will display and log a “Short Cycle Cond” error message with the yellow Standby system status LED flashing. The CCB will add a 180 second delay before activating any stage’s call for heat after the last call for heat during this operating mode.

The short cycle protection mode can be ended (reset) by touching the Select button on the UIM while the error message is displayed.

- **Temperature probe filtering** - The inlet, outlet, and remote loop/tank temperature probes are read every 1/2 second by the CCB and are filtered for 4 seconds. This filtering will help prevent rapid short cycling caused by momentary fluctuations in temperature.
- **Pressure/flow switch filtering** - input switches such as air pressure switches are read every second by the CCB and are filtered (de-bounced) for 6 seconds. This desensitizes the input signal and will help prevent nuisance error/fault conditions due to momentary fluctuations caused by wind gusts or blower speed changes. The flow switch is filtered for 4 seconds.
- **Network capability** - multiple boilers can be networked together (daisy chained) with standard Category 5/6 network cable and given individual network addresses.
- **Remote access/monitoring** with PC Networking software on Windows based computers via direct or modem connection.
- **Access/monitoring with future A. O. Smith EMS controller.** (Energy Management System)
UIM - USER INTERFACE MODULE - OVERVIEW

The UIM is an assembly that consists of several electronic components. The main circuit board in the assembly is the UIB (User Interface Board) which houses the communications port. The UIB relays user input and data to and from the CCB, controls the LCD, and activates the LEDs. Mounted to the UIB is a TSB (Touch Sensor Board) containing the touch sensor pads that are the user input buttons. There is a LCD module mounted to the UIB that displays operational information and diagnostic messages in plain English.

| LEDs (Light Emitting Diode) | • Three “System Status” LED lights: Service, Standby, Running. Located to the right of the LCD.  
|                            | • Eight “Stage Status” LED lights. Located on the lower right. |
| LCD (Liquid Crystal Display) | • LCD display - 4 lines, up to 20 characters per line.  
|                            | • 10 different screens - Menus, Temperatures, System Status, Control States, User Settings, Configuration Settings, Log & System Information, Current Error, Error History, and Reload Defaults.  
|                            | • Text based operational and diagnostic information. |
| User Input Buttons | • Select - Menu - Help - Up - Down.  
|                   | • 5 touch sensitive buttons for user input. Located on the lower left portion of the UIM.  
|                   | • No moving parts - no pressure is required; these buttons activate on finger presence. |
| Settings / Memory | • Non volatile memory; once new settings are confirmed (touching the Select button) they remain in memory. |
System Status LED Lights

The three “System Status” LED lights on the upper right portion of the UIM convey operational information about the entire system.

The red Service LED will be continuously illuminated for soft lock-outs and flashing on and off for hard lock-outs. Soft lock-outs will automatically reset without user input or by touching the Select button while the error screen is displayed. Hard lock-outs can only be reset by touching the Select button while the error screen is displayed. **Power interruptions will not reset hard or soft lock-outs.**

The yellow Standby LED is illuminated whenever the system set point has been satisfied.

The green Running LED is illuminated continuous whenever a call for heat is active. It will flash on and off when the control is in the initialization mode or when touch buttons are being calibrated.

Stage Status LED Lights

The red Stage Service LEDs are only on when the System Service LED above is on. They will indicate which FCB or heating stage has the error.

The green Stage Running LEDs indicate flame has been proved on that particular stage unless the dip switch on the FCB for sensing flame is turned off. With the flame sensing dip switch turned off on the FCB the green Stage Running LED indicates the gas valve is currently energized.
Select Button is used to:
- Enter menu screens.
- Activate adjustment mode for various settings. The [>] will be flashing slowly to the left of the menu item when the adjustment mode is active.
- Confirm and store new values and settings in memory.
- Reset the control when in a lock-out condition.

Menu Button is used to:
- Display a list of available menu screens.
- Abort or cancel new values and settings, returning to last saved value.

Help Button is used to:
- Touch once to display helpful information about the current menu screen. Touch a second time to return to previous screen.
- Touched from the main menu screen and the UIM displays general information on how to use the EMC 5000 user interface.

Up and Down Buttons are used to:
- Scroll up and down lists of menu screens and menu items. When the current menu contains more than four lines of text, Up and Down arrows will appear on the right side of the LCD screen indicating more information is available off screen.
- Change values for user settings and set points. (Select key must be touched once more to confirm and store the new value in memory)
UIM - USER INTERFACE MODULE - CHANGING SETTINGS

The sequence of LCD screen displays below is an example of how to navigate the menus and change the Operating Set Point.

Screen Display 1: shows the temperatures screen. This is the default display screen the UIM comes to rest at after 30 to 60 seconds without any user input. The Menu button is touched once to enter the Menus screen containing 9 different sub menus.

Screen Displays 2 - 4: show the first four lines of the Menus screen. The Down button is touched several times to navigate to the User Settings menu on line four. The [>] sign on the left moves down one line each time the down button is touched. Also notice the down arrow that appears on the lower right corner, this indicates there are more menu items below the four lines being displayed. Up arrows appear on the top right corner when there are more menu items above.

Screen Display 5: the Select button is touched once to enter the User Settings menu.

Screen Display 6: shows the first four lines of the User Settings menu. Touching the Select button while the [>] sign is lined up with the “Oper Setptn” menu item activates the adjustment mode for this menu item. (Oper Setptn = Operating Set Point)

---

The Operating Set Point can now be changed. The [>] sign begins to flash on and off slowly indicating the adjustment mode is active for this setting. Touching the Up button once at this point would change the Operating Set Point 1 degree higher. Touching the Down button once would lower the setting by 1 degree. Touch the Up or Down button continuously and the setting will start to ramp up or down rapidly.

Release the Up or Down button when the desired setting is reached.

Touch the Select button once to confirm and store the new value in memory.
UIM - USER INTERFACE MODULE - MENU SCREENS

At the top center of the UIM panel is the LCD. This LCD is used to provide information to the user through menu activated screens. Within each of the screens, helpful context sensitive information can be displayed at any time by touching the “Help” button. Touching the help button once more returns the user to the previous screen.

The 10 available screens are:

**Menu Screen:**

Displayed when the “Menu” button is touched. This screen is the selection point for the other menu screens.

**Temperatures Screen (Default Screen):**

Displays the sensed temperatures of the Outlet, Inlet, and optional remote Loop/Tank probes. This screen also displays the calculated temperature rise (Outlet minus Inlet) through the boiler, sometimes referred to as the Delta T (ΔT). Shorted and disconnected probes will have “Short” and “----” displayed to the right. The Temperatures Screen is the default screen the boiler will come to rest at without any user input for approximately 60 seconds. **There are no adjustable user inputs available from this screen.**

**System Status Screen:**

This screen is used to view the status of switch inputs and output states. An asterisk (*) is displayed next to the label when the status is “True” (the description is fulfilled). For example; if water is flowing, as detected by the flow switch, an asterisk (*) will appear in front of the Flow label (i.e. *Flow). **There are no adjustable user inputs available from this screen.**

**Control States Screen:**

The software state that the CCB and FCB micros are in, is displayed here. **There are no adjustable user inputs available from this screen.**

**User Settings Screen:**

This screen is used to enter values for various user settings such as operating set point, stage Setpnt differentials, and pump post circulate time, etc. The Select button must be touched to confirm and enter new settings into memory.

**Configuration Settings Screen**

Displays the status of the SW1 dip switches (page 13) on the CCB and all S1 dip switches (page 18) on any installed FCBs. **There are no adjustable user inputs available from this screen.**
UIM - USER INTERFACE MODULE - MENUS

Log & System Info Screen:
This screen displays the following:

- Elapsed hours of operation (Total time system has been powered up)
- Number of running minutes (Number of minutes system has been in the run mode)
- Number of cycles for each stage (Number of times stage has been in heat mode)
- kBtu rating of the boiler (0 to 5750Kbtu in 10 kBtu increments)
- Software revision level of the CCB and FCB micro-controllers.

kBtu rating is the only adjustable user input available from this screen.

Current Error Screen:
Displays the current error the system has detected, plus a timestamp of when the error occurred. (The timestamp is based on the elapsed hours value at the time the error occurred. It is displayed in hours and minutes). This error remains displayed as long as it is still valid. When cleared it is moved to the Error History Screen. The system will automatically jump to this screen when an error is detected. It will also go to this screen upon power-up if an error was still valid when power was turned off.

Errors are cleared from this screen by touching the Select button.

There are no adjustable user inputs available from this screen.

Error History Screen:
This screen displays a list of the last 9 errors (with timestamps) that have occurred. The last error to occur is displayed first. The actual date and time of the event can be calculated by subtracting the error time stamp from the elapsed hours of operation in the Log & System Info Screen. This can be helpful when determining if the error is related to environmental or load conditions.

There are no adjustable user inputs available from this screen.

Reload Defaults Screen:
From this screen the user can restore the factory default values for screen adjustable configurations by touching the Select button. See page 45 for default values.
CCB - CENTRAL CONTROL BOARD - OVERVIEW

The CCB is the main controller. All instructions for heating and temperature control originate from this circuit board. Operational information and conditions are monitored by the CCB. Diagnostic and operational messages are generated by the CCB and sent to the UIM. Many of the boiler’s (water heater) external components, such as ignitors, blowers, and temperature probes are directly connected through one of the CCB’s 15 Molex/AMP plug connectors. The CCB also contains ignition circuitry for the first stage of heating.

Wiring and connection details given here reference 300-305 Series Genesis boilers.

The wiring and connection information given in this document are in reference to how the EMC 5000 controls and circuit boards connect on the 300-305 Series Genesis boilers. This control system may be used on other products such as future Legend boilers and while most wiring and connection information will be the same, some things will differ.

The CCB circuit board measures approximately 13” x 7” and has many features. The CCB circuit board has been divided into sections in the illustration below, each section will be covered in the pages that follow.

The pages that follow reference the CCB circuit board as oriented in this illustration. The 10 Master Control SW1 dip switches (Section D, see 13) should be on the left.
EMC 5000 CONTROL SYSTEM - AOS

CCB - SECTION A

The upper left corner of the CCB contains the following sockets/components:

- **Red LED** (illuminated when the F1 fuse is open or missing)
- **F1 Fuse** (7.5 amp automotive fuse - 24 VAC transformer protection)
- **J3 Socket** (24 VAC power supply from transformer)
  - Pin 1 - 24 VAC line
  - Pin 2 - 24 VAC line
  - Pin 3 - Ground
The upper middle section of the CCB contains the following sockets/components:

**J4 Socket (Outputs/Inputs)**
- Pin 1 - 24 VAC power vent kit (optional)
- Pin 2 - Power vent air press switch proving signal
- Pin 3 - 24 VAC line power vent kit (optional)
- Pin 4 - 24 VAC line low water cut off (optional)
- Pin 5 - Low water cut off proving signal
- Pin 6 - 24 VAC line low water cut off (optional)
- Pin 7 - 24 VAC line alarm bell circuit (optional)
- Pin 8 - 24 VAC line alarm bell circuit (optional)
- Pin 9 - Spare - not used
- Pin 10 - Spare - not used

**J5 Socket (Inputs)**
- Pin 1 - 24 VAC flow switch
- Pin 2 - 24 VAC flow switch
- Pin 3 - 24 VAC low gas press switch (optional)
- Pin 4 - 24 VAC low gas press switch (optional)
- Pin 5 - 24 VAC blocked flue switch
- Pin 6 - 24 VAC blocked flue switch
- Pin 7 - 24 VAC IRI gas valve prover switch (optional)
- Pin 8 - 24 VAC IRI gas valve prover switch (optional)
- Pin 9 - Spare - not used
- Pin 10 - Spare - not used

**J11 Socket (Enable/Disable or Tstat circuit)**
- Pin 1 - 24 VAC to dry control contacts
- Pin 2 - 24 VAC to dry control contacts
- Pin 3 - Spare - not used

**J19 Socket**
- Pin 1 - 24 VAC - 1st stage gas valve solenoid
- Pin 2 - 24 VAC - 1st stage gas valve solenoid

**J17 Socket (Blower Prover / Hi Gas Press Switch)**
- Pin 1 - 24 VAC blower prover switch - high speed
- Pin 2 - 24 VAC blower prover switch - high speed
- Pin 3 - 24 VAC high gas press switch (optional)
- Pin 4 - 24 VAC high gas press switch (optional)
- Pin 5 - Blower prover low speed (N/A on Genesis)
- Pin 6 - Blower prover low speed (N/A on Genesis)

† J4 Socket Pins 1-8 provide 24 VAC circuits for optional components and equipment. These are switched 24 VAC control circuits with a maximum amp rating of 1 amp. When these optional components are used the CCB must be configured to recognize and enable the components by setting the SW1 dip switches accordingly. See page 13.

‡ J17 Socket Pins 5 & 6 (switched 24 VAC) reserved for products with two speed blowers (IE Legend boilers) to connect a low speed blower prover switch. Genesis blowers use single speed blowers, these pins are not used on Genesis. Ensure SW2 dip switch (see page 16) IS NOT set for 2 speed blower on Genesis blowers.
The upper right corner of the CCB contains the following sockets/components:

**J2 Socket** (Pump relay coil; IRI gas valve relay coil)
- Pin 1 - 120 VAC switched hot wire to pump relay coil
- Pin 2 - 120 VAC neutral wire to pump relay coil
- Pin 3 - 120 VAC hot wire to IRI gas valve solenoid coil or remote IRI gas valve relay coil (IRI optional)
- Pin 4 - 120 VAC neutral wire to IRI gas valve solenoid coil or remote IRI gas valve relay coil (IRI optional)

**J15 Socket** (120 VAC power to 1st stage blower)
- Pin 1 - 120 VAC switched hot wire to 1st stage blower *low speed* (N/A on Genesis)
- Pin 2 - 120 VAC switched hot wire to 1st stage blower *high speed*
- Pin 3 - 120 VAC neutral wire to 1st stage blower
- Pin 4 - Ground

**J1 Socket** (CCB power supply from PDB)
- Pin 1 - 120 VAC hot wire
- Pin 2 - 120 VAC neutral wire
- Pin 3 - Ground

**J14 Socket** (Silicon Nitride ignitor power)
- Pin 1 - Ignitor hot wire (variable voltage)
- Pin 2 - Spare - not used
- Pin 3 - Ignitor neutral wire

**J18 Socket** (Not used)

**F2 Fuse** - (5.0 amp fuse ignitor circuit protection)

**JP4 Jumper** - Should be on - removed during manufacturing only

**J16 Flame** - Flame sensor connects 1st stage heat

**JP2 Jumper** - Not used with current application

**JP3 Jumper** - Should be on - removed during manufacturing only
EMC 5000 CONTROL SYSTEM - AOS

CCB - SECTION D

CCB Master Control Dip Switches

System configurations can be changed on the CCB and FCB circuit boards with dip switches. This page explains how the Master Control dip switches (SW1) are configured on the CCB. These dip switch/configuration settings can be viewed from the "Configuration Settings" menu screen on the UIM. (see page 7)

<table>
<thead>
<tr>
<th>Switch</th>
<th>Type of boiler application</th>
<th>Switch</th>
<th>Type of boiler application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch 1</td>
<td>On = GB</td>
<td>Switch 9</td>
<td>Off 1 stage</td>
</tr>
<tr>
<td></td>
<td>235° max high limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70° to 220° Oper Set Point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 2</td>
<td>Number of trials for ignition</td>
<td>Switch 10</td>
<td>On 2 stage</td>
</tr>
<tr>
<td></td>
<td>On = 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>70° to 190° Oper Set Point</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 3</td>
<td>IRI gas valve option</td>
<td></td>
<td>Off IRI not present</td>
</tr>
<tr>
<td></td>
<td>On = IRI gas valve present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 4</td>
<td>Controlling probe</td>
<td></td>
<td>Off Inlet</td>
</tr>
<tr>
<td></td>
<td>On = Loop/Tank (Remote)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 5</td>
<td>Power vent kit present</td>
<td></td>
<td>Off No</td>
</tr>
<tr>
<td></td>
<td>On = Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 6</td>
<td>Low water cut off present</td>
<td></td>
<td>Off No</td>
</tr>
<tr>
<td></td>
<td>On = Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 7</td>
<td>Low gas pressure switch present</td>
<td>Switch 8</td>
<td>On 3 stage</td>
</tr>
<tr>
<td></td>
<td>On = Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 8</td>
<td>Spare</td>
<td></td>
<td>Off 4 stage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagram:

- Switches 1 to 8
- Switches 9 and 10: Number of stages
- SW1: Diagram with labels:
  - # of Stages
  - Spare
  - Low Gas
  - LWCO
  - Pur Unt
  - Tank Cont
  - IRI Gas
  - Ign Try3
  - Type GB

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CCB - SECTION E

The lower left corner of the CCB contains the following sockets/components:

**J6 Socket (Gas valve relay power)**
- Pin 1 - 24 VDC gas valve relay circuit
- Pin 2 - Not used
- Pin 3 - 24 VDC gas valve relay circuit
- Pin 4 - Ground

**J7 Socket (Outlet probe)**
- Pin 1 - 24 VDC manual reset ECO
- Pin 2 - 24 VDC manual reset ECO
- Pin 3 - Not used
- Pin 4 - 0 - 5 VDC outlet temperature probe
- Pin 5 - 0 - 5 VDC outlet temperature probe
- Pin 6 - Not used

**J8 Socket (Inlet probe)**
- Pin 1 - Not used
- Pin 2 - 0 - 5 VDC inlet temperature probe
- Pin 3 - 0 - 5 VDC inlet temperature probe
- Pin 4 - Not used

† **J9 Socket (Remote loop/tank probe)**
- Pin 1 - Not used
- Pin 2 - Not used
- Pin 3 - 0 - 5 VDC loop/tank temperature probe
- Pin 4 - 0 - 5 VDC loop/tank temperature probe

† J9 Socket Pins 3 & 4 - the remote loop/tank temperature probe connects here. Remote tank temperature probe is factory supplied on GW models and is optional on GB models. This temperature probe is used as a "primary system control" sensor that works with the EMC 5000 control to provide system temperature information used to activate and deactivate the call for heat. It is recommended that it be installed in a storage tank's thermostat connection or in the return line from a hydronic heating system loop.
CCB - SECTION F

This section of the CCB contains the communication or “Comm” ports:

ICSP Port
The ICSP port (In Circuit Serial Programming) is used for programming the CCB board. **DO NOT plug any device or cable into this port.** This port is used by A. O. Smith engineering personnel only. Damage caused by plugging cables/devices into this port would not be covered under warranty.

External Comm Ports (2)
These ports are used to connect external communication devices such as a modem or direct connect a PC. These can also be used to network boilers together using standard Category 5/6 network cable. One port would receive a cable from the previous boiler and the second port would be connected to the next boiler in the network. Up to 31 boilers can be networked (daisy chained) together in this way. For a boiler to be “seen” on the network it’s default network address of 0 must be changed to a number between 1 and 31 in the User Settings menu from the UIM. Each boiler on the network would need to have a different network address.

Internal Comm Ports (2)
These are parallel ports used to connect internal components that communicate with the CCB. One is reserved for the UIM and the other would be used to connect the stage 2 FCB on products with two or more stages of heating. Because these ports are parallel it does not matter which one connects to the UIM or FCB.

JP1 Jumper
A jumper is installed between the two pins of JP1 on the CCB whenever an external communications network/cable is longer than 2000 feet. On multiple boiler networks the jumper would be installed on the last boiler only (furthest away) on the network. This jumper **would not** be installed on any other boilers in the network.
EMC 5000 CONTROL SYSTEM - AOS

CCB - SECTION G

Along the bottom edge of the CCB there is a second dip switch (SW2). This page details and explains the SW2 dip switch. There are 3 switches on SW2: switch 1 is a spare, switches 2 and 3 must be configured correctly.

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Spare</th>
<th>On</th>
<th>Off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch 2</td>
<td>High gas pressure switch present</td>
<td>On = Yes</td>
<td>Off = No</td>
</tr>
<tr>
<td>Switch 3</td>
<td>Number of blower speeds</td>
<td>On = 1 speed</td>
<td>Off = 2 speed</td>
</tr>
</tbody>
</table>

† High gas pressure switch is optional; this switch must be set to “Off” if there is not a high gas pressure switch installed on the boiler.
‡ Genesis boilers do not use multiple speed boilers; this switch should always be set to “On” for Genesis products.
FCB - FLAME CONTROL BOARD - OVERVIEW

FCB circuit boards will only be present on boilers with multiple heating stages. The CCB circuit board is the main control board and activates all heating stages; it also contains the first stage flame control hardware and software. There will be one FCB circuit board for all additional stages. Example: a 4 stage boiler will have 1 CCB circuit board and 3 FCB circuit boards.

The CCB communicates with the FCB (s) through a communication (Category 5) cable. FCB circuit boards may or may not have a blower, ignitor, and/or flame sensor connected depending on the type of product (Genesis/Legend) and which stage (2, 3, or 4) the FCB is assigned to operate. FCBs will monitor flame sensors and will energize blowers and ignitors for their assigned stage when these components are connected. FCB circuit boards will always energize the gas valve for their assigned stage.

Wiring and connection details given here reference 300-305 Series Genesis boilers.

The wiring and connection information given in this document are in reference to how the EMC 5000 controls and circuit boards connect on the 300-305 Series Genesis boilers. This control system may be used on other products such as future Legend boilers and while most wiring and connection information will be the same; some things will differ.

The FCB circuit board has been divided into sections in the illustration below, each section will be covered in the pages that follow.
**EMC 5000 CONTROL SYSTEM - AOS**

**FCB - SECTION A**

Not all FCB circuit boards on multi stage boilers will have a blower, ignitor, or flame sensor connected to them. Some stages will share a blower and some stages will ignite (carry over) from an adjacent burner on a previous stage. Shown here are the S1 dip switches that must be set properly to configure the FCB for stage address and the components connected to the FCB circuit board. These dip switch/configuration settings can be viewed from the “Configuration Settings” menu screen on the UIM. (see page 7)

<table>
<thead>
<tr>
<th>Switch 1</th>
<th>Spare</th>
<th>On =</th>
<th>Off =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch 2</td>
<td>High gas pressure switch present</td>
<td>On = Yes</td>
<td>Off = No</td>
</tr>
<tr>
<td>Switch 3</td>
<td>Number of blower speeds</td>
<td>On = 1 speed</td>
<td>Off = 2 speeds</td>
</tr>
<tr>
<td>Switch 4</td>
<td>Ignitor connected</td>
<td>On = Yes</td>
<td>Off = No</td>
</tr>
<tr>
<td>Switch 5</td>
<td>Blower connected</td>
<td>On = Yes</td>
<td>Off = No</td>
</tr>
<tr>
<td>Switch 6</td>
<td>Flame sensor connected</td>
<td>On = Yes</td>
<td>Off = No</td>
</tr>
<tr>
<td>Switch 7</td>
<td>FCB Stage Address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Switch 8</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Switch 7

- Off: Not Allowed
- On: 2nd stage address
- Off: 3rd stage address
- On: 4th stage address

†. High gas pressure switch is optional; this switch must be set to “Off” if there is not a high gas pressure switch installed on the boiler.

‡. Genesis boilers do not use multiple speed boilers; this switch should always be set to “On” for Genesis products.

---

**Diagram:**

- **S1**
- **Int. Comm**
- **J10 & J12 Parallel Internal Communication Ports**

These are parallel ports for communication between the CCB and FCB(s) circuit boards.

Category 5 cables are connected between the CCB and 2nd stage FCB and between the 2nd, 3rd and 4th stage FCBs on boilers with 3 and 4 stages of heating.
FCB - SECTION B

The upper right corner of the FCB contains the ignitor fuse, flame sensor connect, and the JP1 jumper.

**F1 Fuse** - 5.0 amp fuse ignitor circuit protection.

**J4 Flame** - Flame sensor connect.

Note: flame sensor may or may not be connected to FCB board depending on which stage the FCB controls, what model boiler etc. If a flame sensor is connected, the #6 switch on the S1 dip switches must be “on” to configure the FCB properly. (see page 18)

**JP1 Jumper** - N/A with current configurations - may be used as a spare if present.
FCB - SECTION C

The lower left corner of the FCB contains the following:

**J9 Socket** (Blower prover and/or high gas pressure switch when used)
- Pin 1 - 24 VAC blower prover switch (not connected if the FCB does not energize a blower)
- Pin 2 - 24 VAC blower prover switch (not connected if the FCB does not energize a blower)
- Pin 3 - 24 VAC high gas pressure switch (optional)
- Pin 4 - 24 VAC high gas pressure switch (optional)
- Pin 5 - Spare - not used
- Pin 6 - Spare - not used

**J11 Socket** (Not used)

**J6 Socket** (24 VAC to this stage gas valve solenoid)
- Pin 1 - 24 VAC gas valve solenoid
- Pin 2 - 24 VAC gas valve solenoid

**J7 & J8 Socket** (Board to board 24 VDC gas valve relay power - in series with ECO limit switch)
- Pin 1 - VDC Gas Valve Relay Power (ECO interrupt)
- Pin 2 - Spare - not used
- Pin 3 - VDC Gas Valve Relay Power (ECO interrupt)
- Pin 4 - Ground

**F2 Fuse** (24 VAC power supply fuse - 3 amp)
FCB - SECTION D

The lower right corner of the FCB contains the following:

**J5 Socket** (24 VAC - 24 volt power supply to FCB)
- Pin 1 - 24 VAC line
- Pin 2 - 24 VAC line

**J2 Socket** (Blower - 120 VAC power to blower when used - N/A Genesis 300-750)
- Pin 1 - 120 VAC hot wire to blower low speed - *if 2 speed blower is connected* (N/A Genesis 300-750)
- Pin 2 - 120 VAC hot wire to blower high speed - *if blower is connected* (N/A Genesis 300-750)
- Pin 3 - 120 VAC neutral wire to blower (N/A Genesis 300-750)
- Pin 4 - Ground

**J1 Socket** (120 VAC power supply - N/A on Genesis 300-750)
- Pin 1 - 120 VAC hot wire (N/A Genesis 300-750)
- Pin 2 - 120 VAC neutral wire (N/A Genesis 300-750)
- Pin 3 - Ground

**JP2 Jumper** - Should be on - removed during manufacturing only

**J3 Socket** (Not used)

**J13 Socket** ((Silicon Nitride ignitor power - N/A on Genesis 300-750))
- Pin 1 - Ignitor hot wire (variable voltage) - *if ignitor is connected* (N/A Genesis 300-750)
- Pin 2 - Spare - not used
- Pin 3 - Ignitor neutral wire - *if ignitor is connected* (N/A Genesis 300-750)

†. **FCB J1, J2, and J13 sockets** are not wired on Genesis 300-750. These models do not energize a blower, ignitor, or flame sensor for the 2nd heating stage so there is no need for 120 VAC power supply to the 2nd stage FCB board. Other/future products equipped with the EMC 5000 controls may have blowers, ignitors, and/or flame sensors connected to FCB boards; these sockets will be utilized as needed.
PDB - POWER DISTRIBUTION BOARD - OVERVIEW

The PDB provides connection points for line-input (120 VAC) power, the pump, and the transformer. It distributes the line-input power and the transformer output (24 VAC) power to necessary locations. It also contains fuses for the pump, the CCB, and each of the FCBs. The PDB also contains circuitry for EMI/RFI (line noise see page 2) power supply protection.

Wiring and connection details given here reference 300-305 Series Genesis boilers.

The wiring and connection information given in this document are in reference to how the EMC 5000 controls and circuit boards connect on the 300-305 Series Genesis boilers. This control system may be used on other products such as future Legend boilers and while most wiring and connection information will be the same; some things will differ.

The PDB circuit board has been divided into sections in the illustration below, each section will be covered in the pages that follow.

The pages that follow reference the PDB circuit board as oriented in this illustration. The terminal strip (Section A) should be on the left.
PDB - SECTION A

The left side of the PDB circuit board contains a terminal strip (TB1) used to connect the 120 VAC power supply to the boiler, the pump relay, and the pump motor. GW models will have a factory mounted pump powered by the pump relay; GB models are not equipped with factory pumps. Review the output specification table (page 44) for field supplied pumps.

Power supply must be dedicated/isolated: 120 VAC, single phase, with a grounded neutral line, per NEMA standards using a 20 amp dedicated circuit breaker. External control or temperature probe wiring must also be in dedicated conduits.

**Important Service Note:**

Power supplied for the pump bypasses the boiler on/off switch. The breaker/disconnect switch must be located and secured to turn all 120 VAC power off inside the boiler cabinet.
PDB - SECTION B

The mid section of the PDB contains the fusing for the following:

- **F1 Fuse** - 10 amp 240 VAC - European Models only
- **F2 Fuse** - 20 amp 120 VAC - Pump
- **F3 Fuse** - 3 amp 120 VAC - Transformer Primary Winding
- **F4 Fuse** - 10 amp 120 VAC - FCB 4 Power Supply (4 stage boilers only)
- **F5 Fuse** - 10 amp 120 VAC - FCB 3 Power Supply (3 & 4 stage boilers only)
- **F6 Fuse** - 10 amp 120 VAC - FCB 2 Power Supply (2, 3, & 4 stage boilers only)
- **F7 Fuse** - 15 amp 120 VAC - CCB Power Supply

† For outputs up to 5 amps, use on-board remote pump relay connected to TB1 terminal board (see page 23).
For outputs between 5 and 20 amps, use an external contactor and supply 120 VAC pump power through on-board 20 amp fuse. For outputs above 20 amp, use an external contactor and feed the power through discrete wires from a separate branch circuit. Pump power is not passed through the on-board 20 amp fuse; use external breaker.
PDB - SECTION C

The upper right corner of the PDB contains the following:

**J2 Socket** (24 VAC Outputs)
- Pin 1 - 24 VAC Hot to CCB J3 Socket
- Pin 2 - 24 VAC Return to CCB J3 Socket
- Pin 3 - Ground to CCB J3 Socket
- Pin 4 - 24 VAC Hot to Stage 2 FCB J5 Socket (2, 3, & 4 stage boilers only)
- Pin 5 - 24 VAC Return to Stage 2 FCB J5 Socket (2, 3, & 4 stage boilers only)
- Pin 6 - N/A
- Pin 7 - N/A
- Pin 8 - 24 VAC Hot to Stage 3 FCB J5 Socket (3 & 4 stage boilers only)
- Pin 9 - 24 VAC Return to Stage 3 FCB J5 Socket (3 & 4 stage boilers only)
- Pin 10 - 24 VAC Hot to Stage 4 FCB J5 Socket (4 stage boilers only)
- Pin 11 - 24 VAC Return to Stage 4 FCB J5 Socket (4 stage boilers only)
- Pin 12 - N/A

**J1 Socket** (100VA Transformer 120 VAC x 24 VAC)
- Pin 1 - 24 VAC Return
- Pin 2 - 24 VAC Hot
- Pin 3 - 120 VAC Hot to Transformer
- Pin 4 - 24 VAC Return
- Pin 5 - 24 VAC Hot
- Pin 6 - 120 VAC Neutral to Transformer
PDB - SECTION D

The lower right corner of the PDB contains the J3 Socket and the JP1 jumper. The J3 Socket is described here the JP1 jumper is described on page 27.

**J3 Socket** (120 VAC Outputs)
- Pin 1 - 120 VAC Hot to CCB J1 Socket
- Pin 2 - 120 VAC Neutral to CCB J1 Socket
- Pin 3 - Earth Ground to CCB J1 Socket
- Pin 4 - 120 VAC Hot to Stage 2 FCB J1 Socket (2, 3, & 4 stage boilers only)
- Pin 5 - 120 VAC Neutral to Stage 2 FCB J1 Socket (2, 3, & 4 stage boilers only)
- Pin 6 - Earth Ground to Stage 2 FCB J1 Socket (2, 3, & 4 stage boilers only)
- Pin 7 - 120 VAC Hot to Stage 3 FCB J1 Socket (3 & 4 stage boilers only)
- Pin 8 - 120 VAC Neutral to Stage 3 FCB J1 Socket (3 & 4 stage boilers only)
- Pin 9 - Earth Ground to Stage 3 FCB J1 Socket (3 & 4 stage boilers only)
- Pin 10 - 120 VAC Hot to Stage 4 FCB J1 Socket (4 stage boilers only)
- Pin 11 - 120 VAC Neutral to Stage 4 FCB J1 Socket (4 stage boilers only)
- Pin 12 - Earth Ground to Stage 4 FCB J1 Socket (4 stage boilers only)
- Pin 13 - Spare 120 VAC Hot
- Pin 14 - Spare 120 VAC Neutral
- Pin 15 - Spare Earth Ground
PDB - POWER SUPPLY TEST

The lower right corner of the PDB also contains two jumpers and three power supply status LED lights. With power applied the green DS2 LED should always be lit. The JP1 jumper is used to activate a power supply test function. The JP2 and JP3 jumpers are used for manufacturing purposes only.

Power Test Procedure:

Turn power off to the boiler at the breaker or disconnect switch. Disconnect the wiring plugs at J1, J2, and J3 Sockets on the PDB. Relocate jumper JP1 from the “Run” pins to the “Test” pins (see pages 25 and 26). Turn power back on and note which LEDs are illuminated. If the power supply is properly connected the Yellow and Green LEDs should be illuminated and the red LED should be off. If any other combination of LEDs are illuminated refer to the table below for the problem indicated and what corrective action must be taken.

Note:

The JP1 jumper should be in the run position during normal operation. Leaving the jumper in the test mode when operating the system may cause trouble with Ground Fault Interrupters.

The wire harnesses that normally connect to J1, J2, & J3 should be disconnected while performing this test. Leaving them connected will not cause damage but the status indicated by the LED’s will be incorrect.

<table>
<thead>
<tr>
<th>LINE CONNECTION STATUS</th>
<th>DS1 YELLOW LED</th>
<th>DS2 GREEN LED</th>
<th>DS3 RED LED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proper Connection</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Open Ground</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Reverse Polarity</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Open Hot</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>Open Neutral</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>Reverse Hot &amp; Ground</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>Hot wire on Neutral connect &amp; Open Neutral wire</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
</tbody>
</table>
ERROR MESSAGES - TROUBLESHOOTING

The EMC 5000 control system performs exhaustive self diagnostics and displays detected fault conditions on the UIM (see page 4). Error messages are displayed in plain English text (sometimes abbreviated). There are approximately 80 different error messages. Some of the more common error messages will be covered in this section. For a more comprehensive list of error messages consult the owner’s manual that came with the boiler.

The troubleshooting procedures shown here relate to the EMC 5000 control system on Genesis boilers GW/GB 300 - 750 (300 - 305 Series).

The first column in the tables that follow show the actual error message as displayed by the UIM along with a brief explanation. The second column details some common things that should be checked and/or repaired.

To reset the EMC 5000 control:

Reset the EMC 5000 control by touching the Select button while the “Current Error” menu screen (see page 8) is displayed by the UIM.

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Display Fail”</td>
<td>• Plug UIM comm cable into the other “internal” comm port on the CCB. (see page 15)</td>
</tr>
<tr>
<td></td>
<td>• Check comm cable to the UIM. Turn off power and install a new/different comm cable. (standard Cat 5 network cable)</td>
</tr>
<tr>
<td>Communication between the CCB and UIM has been interrupted - the CCB is having trouble communicating with the UIM.</td>
<td>• If a FCB board is present (2-4 stage boilers), switch the comm cables for the FCB and UIM.</td>
</tr>
<tr>
<td></td>
<td>If the problem follows the cable IE: comm failure now occurs with the FCB, (see error message below) - replace the defective comm cable. (standard Cat 5 network cable)</td>
</tr>
<tr>
<td></td>
<td>• Inspect all communication ports on CCB and UIM for damage or wear - replace any board/component with comm ports that fail to establish and maintain communications when comm cables are known to be good.</td>
</tr>
<tr>
<td>“Comm. Fail Stg _”</td>
<td>• If the stage reported in the error message is stage 1 - replace the CCB (stage 1 ignition control resides on the CCB circuit board).</td>
</tr>
<tr>
<td>Communication between the CCB and FCB has been interrupted - the CCB is having trouble communicating with the FCB. Stage number will be shown at the end of the displayed message in place of the underscore shown above.</td>
<td>• FCB comm cable on reported stage 2, 3, or 4 is loose/missing/unplugged - repair/replace.</td>
</tr>
<tr>
<td></td>
<td>• Ensure SW1 (CCB page 13) and S1 (FCB page 18) number of stages &amp; stage address dip switches are properly configured for the boiler.</td>
</tr>
<tr>
<td></td>
<td>• Review checks listed above for “Display Fail” error message.</td>
</tr>
<tr>
<td>DISPLAYED MESSAGE INDICATES/CONDITION</td>
<td>CHECK/REPAIR</td>
</tr>
<tr>
<td>---------------------------------------</td>
<td>--------------</td>
</tr>
</tbody>
</table>
| **“Low AC Voltage”** Line voltage to boiler is less than 90 VAC. Polarity is reversed with no earth ground present. | • Perform Power Supply Test Procedure described on page 27 - correct any problems indicated by test results.  
• Ensure power supply polarity is not reversed and boiler is properly grounded.  
• Check incoming power supply, wiring, and all line voltage connections on the boiler and at the breaker or disconnect switch - repair/restore 115 - 120 VAC power supply to boiler. |
| **“Low 24 VAC”** Voltage from transformer is less than 18 VAC. | • Check 7.5 amp F1 fuse on CCB (page 10).  
• Check high (115 - 120 VAC) voltage to primary coil of transformer - restore high voltage.  
• Secure power to boiler; temporarily disconnect load wiring from secondary coil on transformer. Turn power back on and check voltage at secondary coil - if secondary (24 VAC) voltage remains low - replace transformer.  
• Check all 24 VAC wiring for worn/damaged connections or wires - replace/repair as necessary.  
• Check for excessive 24 VAC loads (gas valve solenoids, relays etc) on transformer. Remove or replace any loads that exceed amp ratings given in Output Specifications on page 44.  
• Take amp reading on transformer secondary coil - it should not exceed 17.6 amps on the 24 VAC power supply. See Input Power and Circuit Protection specifications on page 43. If amp draw on secondary coil of transformer exceeds maximum requirement - determine cause and eliminate excessive amp draw. |
| **“Low Water”** Water is not being sensed by optional LWCO (low water cutoff) device’s sensor. | • Ensure there is water in the lines/boiler.  
• Remove and clean LWCO sensor.  
• SW1 #6 dip switch is configured for LWCO present when the optional control is not installed on the boiler. This will return a “Low Water” error message. Check “Config Settings” menu screen (see page 7) to confirm correct LWCO dip switch setting. Set SW1 #6 dip switch on the CCB correctly. (see page 13)  
• Check all wiring, plugs, and sockets (J4 socket on the CCB board - see page 11) for good connections - repair/replace damaged/worn parts. |
### ERROR MESSAGES (CONT)

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>“No Flow”</strong></td>
<td>• Ensure pump is running - check all wiring, connectors, and pump relay - make necessary repairs to restore power to pump.</td>
</tr>
<tr>
<td>Normally open contacts on factory mounted flow switch are not closing or are not remaining closed after the pump is energized.</td>
<td>• Ensure the boiler, supply/return lines, storage tank, building loop, and all water system components are purged of air.</td>
</tr>
<tr>
<td>Water flow rate at the outlet of boiler is below the activation point for the flow switch. Factory mounted flow switch is a normally open switch that closes its contacts at approximately 25 GPM. (GPM = gallons per minute)</td>
<td>• Check all wiring and connectors between the flow switch and the CCB J5 Socket (see page 11). Repair/replace anything damaged or worn as necessary.</td>
</tr>
<tr>
<td><strong>Operational Note:</strong></td>
<td>• Check condition of flow switch and paddle - replace worn or missing paddle - replace flow switch if damaged or defective.</td>
</tr>
<tr>
<td>Boiler outlet valves are often partially closed to regulate water flow through the boiler. It is also common to have a bypass line with a valve installed between the inlet and outlet lines of the boiler. The bypass valve is often partially open to increase inlet water temperature in order to prevent condensation from forming on the boiler’s heat exchanger.</td>
<td>• De-lime boiler if necessary - this will improve flow rate and reduce the ΔT.</td>
</tr>
<tr>
<td>Adjust the outlet valve to achieve manufacturer’s required ∆T. Genesis; 20 - 40°F ∆T.</td>
<td>• Check temperature rise or Delta T (expressed as: ∆T) through the boiler with all stages firing. Ensure ∆T is not above 40°F on Genesis boilers. Check for any restrictions or partially closed valves that could lead to reduced flow rate/excessive ∆T on boiler. See the Operational Note in the left column of this table.</td>
</tr>
<tr>
<td>Adjust the bypass valve, if present, to maintain a minimum inlet water temperature of 115° when possible.</td>
<td><strong>IF</strong> ∆T on Genesis with all stages firing <strong>is</strong> between 20° and 40°F adjust setting screw on flow switch to close contacts while the pump is running. If flow switch cannot be adjusted to close contacts when flow rate through the boiler is correct as evidenced by the proper temperature rise (∆T) through the boiler - replace the flow switch.</td>
</tr>
<tr>
<td>Always read and follow the installation and operation requirements contained in the owner’s manual that came with the boiler.</td>
<td>• Turn off power to the boiler and TEMPORARILY INSTALL JUMPER WIRE across the flow switch wiring terminals. Turn power back on and reset the control - see page 28.</td>
</tr>
</tbody>
</table>

If this error message continues with the jumper wire installed and ONLY if all the above checks have been performed - replace the CCB board. (reporting false error messages)

**REMOVE JUMPER WIRE FROM FLOW SWITCH IMMEDIATELY AFTER PERFORMING THIS TEST. FAILURE TO DO SO CAN RESULT IN PROPERTY DAMAGE AND/OR PERSONAL INJURY.**
### ERROR MESSAGES (CONT)

| DISPLAYED MESSAGE INDICATES/CONDITION | CHECK/REPAIR
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>“Blower Prov Stg_”</td>
<td><strong>Blower Prover Switch Contacts Are Closed Blower Motor Is Not Energized/Starting</strong></td>
</tr>
<tr>
<td>Normally open Blower Prover pressure switch contacts were closed at the beginning of the heat sequence before the blower was energized. (control <em>does not</em> energize blower in this condition)</td>
<td>- Turn off power to boiler and disconnect the wires to the Blower Prover Switch - check for continuity between the terminals of the Blower Prover Switch with an ohm meter. If there is continuity through the switch contacts - replace the switch (this is a normally open switch).</td>
</tr>
<tr>
<td><strong>OR</strong></td>
<td>- Check Blower Prover Switch circuit for a wiring error, check for a jumper wire on the blower prover switch, correct wiring/remove jumper.</td>
</tr>
<tr>
<td>Normally open Blower Prover pressure switch contacts did not close after blower was energized. (control <em>does</em> energize blower in this condition)</td>
<td>- Ensure S1 dip switch #5 on the FCB is set correctly. (see page 18) Not all FCBs have blowers connected, stage 2 FCBs on Genesis 300 - 750 do not. If this dip switch is configured FOR a blower when there is not one present - the EMC 5000 control would display this error message.</td>
</tr>
<tr>
<td>Stage number will be shown at the end of the displayed message in place of the underscore shown above. Stage 1 blower is controlled by the CCB. Stages 2-4 blowers (if present) are controlled by corresponding stage's FCB.</td>
<td>- Turn off power to boiler and manually open the Blower Prover Switch circuit by disconnecting one wire from the switch. Turn power back on and activate a call for heat. (System “Running” LED should be illuminated see page 4)</td>
</tr>
<tr>
<td><strong>See introduction on page 2 for CCB/FCB information.</strong></td>
<td><strong>Blower motor should now be energized. See the Operational Note in the left column of this table.</strong></td>
</tr>
<tr>
<td><strong>Operational Note:</strong> At the beginning of the heat sequence the EMC 5000 control will check the normal state of the Blower Prover Switch contacts. The control must sense the switch contacts (circuit) are open.</td>
<td><strong>Check for 120 VAC at CCB J15 socket for 1st stage blower. (see page 12)</strong></td>
</tr>
<tr>
<td>If the contacts (circuit) are sensed closed, the control will lock-out and display the “Blower Prov Stg_” error message. The blower motor will not be energized.</td>
<td>Check all wiring and connectors between blower motor and the CCB J15 socket. Ensure all connectors and wiring are in good condition - repair/replace anything damaged or worn as necessary.</td>
</tr>
<tr>
<td>If the Blower Prover Switch contacts (circuit) are sensed open, the control will advance in the Sequence of Operation (see page 37) and energize the blower. After energizing the blower motor, the control must now see the Blower Prover Switch contacts (circuit) close. If the contacts do not close after the blower is energized, the EMC 5000 control will lock-out in this condition and display the same “Blower Prov Stg_” error message.</td>
<td>- If the CCB <strong>IS NOT</strong> sending 120 VAC power to the blower motor with Blower Prover Switch circuit open and a call for heat activated - replace CCB for stage 1 errors. See the 3rd bullet above for Stg 2 error messages on Genesis 300 - 750.</td>
</tr>
<tr>
<td></td>
<td>- If the CCB <strong>IS</strong> sending 120 VAC power to the blower motor and the blower motor is not starting with all connectors and wiring in good condition - replace the blower motor.</td>
</tr>
</tbody>
</table>
## ERROR MESSAGES (CONT)

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Blower Prov Stg_&quot; (cont)</td>
<td>Blower Prover Switch Contacts Are Open Blower Motor Is Energized And Starts</td>
</tr>
<tr>
<td>Normally open Blower Prover pressure switch contacts were closed at the beginning of the heat sequence before the blower was energized. (control does <strong>not</strong> energize blower in this condition)</td>
<td>• Check sensing tubes from the Blower Prover Switch to the sensing ports on the control shelf - ensure the sensing tubes are not kinked and are properly connected at both ends. See operational note in the left column of this table.</td>
</tr>
<tr>
<td>OR</td>
<td>Ensure both seals for the sensing ports on the control shelf are not leaking - repair as necessary. Remove the bottom front jacket (combustion chamber cover) and ensure the sensing tube that connects between the control shelf sensing port and the inlet to one of the burners is connected properly at both ends.</td>
</tr>
<tr>
<td>Normally open Blower Prover pressure switch contacts did not close after blower was energized. (control <strong>does</strong> energize blower in this condition)</td>
<td>• Check all wiring and connectors between the Blower Prover Switch and the CCB J17 Socket (see page 11) - Repair/replace anything damaged or worn as necessary.</td>
</tr>
<tr>
<td>Stage number will be shown at the end of the displayed message in place of the underscore shown above. Stage 1 blower is controlled by the CCB. Stages 2-4 blowers (if present) are controlled by corresponding stage's FCB.</td>
<td>• Ensure the bottom front jacket (combustion chamber cover) is properly installed and that the gasket around this panel is not leaking.</td>
</tr>
<tr>
<td>See introduction on page 2 for CCB/FCB information.</td>
<td>• Disconnect the two sensing tubes from the sensing ports on the control shelf - take air pressure readings with a digital manometer directly from these two sensing ports with the blower running. The difference between the two readings must be at least +0.2&quot; W.C. for the Blower Prover Switch contacts to close.</td>
</tr>
<tr>
<td><strong>Operational Note:</strong> Genesis 300 - 750 (300 - 305 Series) boilers use a dual pressure Blower Prover Switch that has two sensing tubes. One senses the static pressure in the combustion chamber and one senses pressure at the inlet to one of the main burners.</td>
<td>If the difference between the two pressure readings is not at or above +0.2&quot; W.C. - check for excessive equivalent feet of exhaust vent or intake air pipe or excessive number of elbows used in either (see the installation manual that came with the boiler for complete venting installation instructions/requirements), check for restrictions in the exhaust vent or intake air pipe, check for excessive dirt or debris on the combustion blower wheel.</td>
</tr>
<tr>
<td><strong>Service Note:</strong> Continuity (open or closed) of Blower Prover Switch contacts can be checked with an ohm meter during blower operation.</td>
<td>• If the difference between the two pressure readings taken was at or above +0.2&quot; W.C. and the Blower Prover Switch will not close it's contacts - replace the Blower Prover Switch. See Service Note in the left column of this table.</td>
</tr>
<tr>
<td>Turn off power to the boiler and disconnect both wires to the Blower Prover Switch and tape off the ends. Turn power back on and activate a call for heat. Check for continuity between the two wiring terminals of the Blower Prover Switch while blower is operating at full speed. Make sure sensing tubes are reconnected during this test.</td>
<td>Note whether continuity IS sensed (closed contacts) or continuity IS NOT sensed (open contacts).</td>
</tr>
</tbody>
</table>
## ERROR MESSAGES (CONT)

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>“Blocked Flue”</strong></td>
<td><strong>• Turn off power to boiler and disconnect the wires to the Blocked Flue Switch - check for continuity between the terminals of Blocked Flue Switch with an ohm meter. If there IS NOT continuity through the switch contacts - replace the switch (this is a normally closed switch).</strong></td>
</tr>
<tr>
<td>Normally closed Blocked Flue pressure switch contacts are open.</td>
<td><strong>• Check all wiring and connectors between the Blocked Flue Switch and the CCB J5 Socket (see page 11). Repair/replace anything damaged or worn as necessary.</strong></td>
</tr>
<tr>
<td><strong>Service Note:</strong></td>
<td><strong>• TEMPORARILY INSTALL JUMPER WIRE between the two wires that connect to the Blocked Flue Switch - reset and restart the boiler. If this error message continues to be displayed - replace the CCB. (reporting false error messages)</strong></td>
</tr>
<tr>
<td>Continuity (open or closed) of Blocked Flue Switch contacts can be checked with an ohm meter during boiler operation with all stages firing.</td>
<td><strong>• REMOVE JUMPER WIRE FROM BLOCKED FLUE SWITCH IMMEDIATELY AFTER PERFORMING THIS TEST. FAILURE TO DO SO CAN RESULT IN PROPERTY DAMAGE AND/OR PERSONAL INJURY.</strong></td>
</tr>
<tr>
<td>Turn off power to the boiler - disconnect both wires from the Blocked Flue Switch wiring terminals. <strong>TEMPORARILY INSTALL JUMPER WIRE</strong> between these two wire ends that are now disconnected. Turn power back on and activate a call for heat. Check for continuity between the two wiring terminals of the Blocked Flue Switch while blower is operating at full speed. Make sure sensing tube is connected during this test.</td>
<td><strong>• Disconnect the sensing tube from the Blocked Flue Switch at the sensing port on the divider panel inside the boiler. Take an air pressure reading with a digital manometer from this sensing port with all stages firing.</strong></td>
</tr>
<tr>
<td>Note whether continuity IS sensed (closed contacts) or continuity IS NOT sensed (open contacts).</td>
<td><strong>• If the pressure reading taken is at or above +0.2” W.C. - check for excessive equivalent feet or excessive number of elbows in exhaust vent, (see the installation manual for venting requirements), check for/eliminate any restrictions in the exhaust vent.</strong></td>
</tr>
<tr>
<td><strong>REMOVE JUMPER WIRE FROM BLOCKED FLUE SWITCH IMMEDIATELY AFTER PERFORMING THIS TEST. FAILURE TO DO SO CAN RESULT IN PROPERTY DAMAGE AND/OR PERSONAL INJURY.</strong></td>
<td><strong>• If the pressure reading taken is below +0.2” W.C. perform a continuity test on the Blocked Flue Switch contacts as described in the Service Note in the left column of this table. If the Blocked Flue Switch contacts are open during operation - replace the Blocked Flue Switch.</strong></td>
</tr>
</tbody>
</table>
## ERROR MESSAGES (CONT)

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Flame Stg_&quot;</td>
<td>• Ensure air is purged from supply gas line. Allow several trials for ignition to purge any air from gas train inside the boiler. Boiler may have to be reset several times to allow multiple trials.</td>
</tr>
<tr>
<td>Flame or ignition failure. Error message displayed after 1 or 3 losses of flame or after 1 or 3 failed trials for ignition. EMC 5000 will lock-out after 1 or 3 trials depending on the SW1 #2 dip switch setting on the CCB circuit board. (see page 13)</td>
<td>• Ensure there is an adequate supply of combustion air - check fresh air intake louvers, intake air pipe on direct vent installations etc. See the owner's manual that came with the boiler for combustion air requirements.</td>
</tr>
<tr>
<td>Stage number will be shown at the end of the displayed message in place of the underscore shown above.</td>
<td>• 120 VAC power supply to boiler may have reversed polarity. Correct reversed polarity in power supply. Perform Power Supply Test Procedure described on page 27 - correct any problems indicated by test results.</td>
</tr>
<tr>
<td></td>
<td>• Look through view ports on either side of boiler ensure ignitor is glowing during ignition period.</td>
</tr>
<tr>
<td></td>
<td>If the ignitor is not glowing during ignition period:</td>
</tr>
<tr>
<td></td>
<td>Check 5 amp ignitor fuse on CCB for stage 1 (page 12).</td>
</tr>
<tr>
<td></td>
<td>Check all wiring and connectors between CCB J14 Socket and the ignitor (see page 12) - repair/replace anything worn or damaged.</td>
</tr>
<tr>
<td></td>
<td>Ensure the Blower Prover Switch contacts close after the blower is energized. Perform the check/repair items shown on page 32.</td>
</tr>
<tr>
<td></td>
<td>With ignitor disconnected check A/C volts to ignitor from during ignition period (variable 80 - 120 VAC). If the CCB is not sending any AC voltage to the ignitor and all the above checks are performed and results were successful - replace CCB.</td>
</tr>
<tr>
<td></td>
<td>• Check ignitor resistance with ohm meter at room temperature, (77°F) If ohm reading is not between 11.5 and 18.8 ohms - replace ignitor.</td>
</tr>
<tr>
<td></td>
<td>• Ensure the gas valve for the stage reported by the error message is being energized. Check for 24 VAC at gas valve wiring terminals and at CCB J19 Socket 19 (page 11) or FCB Socket J6 Socket (page 20). Check all wiring and connectors between the socket and the gas valve - repair/replace anything worn or damaged.</td>
</tr>
</tbody>
</table>
### ERROR MESSAGES (CONT)

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>“Flame Stg_” (cont)</strong></td>
<td>• Connect two manometers to the boiler; one to the supply gas pressure test port and the second to the gas valve manifold pressure test port for the stage reported by the error message. Take supply and manifold gas pressure readings while the boiler is firing or trying to fire on the stage indicted by error message. Ensure the supply gas pressures remains within the min and max pressure requirements given in the installation manual that came with the boiler. Adjust supply gas pressure at line regulator. If supply gas pressure drops by more than 1.5&quot; W.C. while firing. Ensure regulator and gas line are sized correctly. Ensure manifold gas pressure is within ± 0.3&quot; W.C. of the correct pressure indicated in the installation manual that came with the boiler. Adjust manifold gas pressure at the stage gas valve indicated by the error message. Check for and clear any restrictions in the gas train on the boiler. Verify burner orifices are not clogged and the correct size on all burners. Visually inspect all burners for any blockage or damage - repair/replace any parts as necessary. If all the above tests have been performed and the gas valve is being energized with 24 VAC and has adequate supply gas pressure at the inlet and will not open and provide adequate manifold gas to the burners - replace the gas valve.</td>
</tr>
<tr>
<td>Flame or ignition failure. Error message displayed after 1 or 3 losses of flame or after 1 or 3 failed trials for ignition. EMC 5000 will lock-out after 1 or 3 trials depending on the SW1 #2 dip switch setting on the CCB circuit board. (see page 13)</td>
<td>Stage number will be shown at the end of the displayed message in place of the underscore shown above.</td>
</tr>
</tbody>
</table>
### ERROR MESSAGES (CONT)

<table>
<thead>
<tr>
<th>DISPLAYED MESSAGE INDICATES/CONDITION</th>
<th>CHECK/REPAIR</th>
</tr>
</thead>
</table>
| **“Flame Stg_” (cont)**                | • If burners ignite but are short cycling:  
  Check all wiring and connectors between the CCB J16 (page 12) or FCB J4 (page 19) connections and the flame sensor for the stage reported by the error message - repair/replace anything worn or damaged.  
  Clean the flame sensor inspect flame sensor insulator for cracks - replace flame sensor if any damage is noted.  
  Check for minimum 2.5 uA flame sensing current with DC mico amp meter.  
  • Install a new flame sensor - retry for ignition. |
| Stage number will be shown at the end of the displayed message in place of the underscore shown above. | |
| **“Igniter Stg_”**                     | • Check all wiring and connectors between ignitor and CCB J14 Socket (see page 12) - repair/replace anything worn or damaged.  
  • Check ignitor resistance with ohm meter at room temperature, (77°F) if ohm reading is not between 11.5 and 18.8 ohms - replace ignitor.  
  • Inspect ignitor assembly - replace ignitor if any signs of excessive wear or damage are evident.  
  • Install a new ignitor - retry for ignition. |
| Ignitor is not drawing correct amperage. Can be caused by disconnected, worn, damaged ignitor. | |
| Stage number will be shown at the end of the displayed message in place of the underscore shown above. | |
EMC 5000 CONTROL SYSTEM - AOS

SEQUENCE OF OPERATION GENESIS 300 - 750 (300-305 SERIES)

EMC 5000 compares the temperature read from the controlling probe (Inlet or remote Tank/Loop) to the Operating Setpoint.

If the temperature read is less than the Operating Setpoint minus Stage 1 Differential AND the Enable/Disable (thermostat) circuit is closed a call for heat is activated.

---

NOTE
The events shown in this flow chart are in sequential order. The EMC 5000 is a multi-task control that performs some functions simultaneously. Only key events are shown in order to provide a general understanding of how the control operates. Event timings can vary depending on actual conditions.

---

Call For Heat is Activated

- CCB board applies power to pump relay
  - Pump Is Energized

  Flow Switch Closes Contacts
  - NO
    - No Flow
      - Error message
  - YES
    - Blower Prover Switch contacts are verified open
      - NO
        - Blower Is Energized
          - NO
            - Blower Prover Switch contacts are verified closed
              - YES
                - Ignitor Is Energized
                  - Ignitor diagnostics are performed
                    - FAILED
                      - Igniter Stg Error message
                    - PASSED
                      - 1st Stage Gas Valve Is Energized

                      1st Stage Flame Is Detected?
                      - NO
                        - Some Genesis boilers will have flame sensors on all stages and some will not. If the boiler was not factory equipped with a Stage 2 flame sensor, flame detection is not required for Stage 2.
                          - If a flame sensor is present for Stage 2, the FCB S1 dip switch #6 must be set to the "on" position. Flame must then be detected or a "Flame Stg2" error message will be displayed.
                        - Carryover Flame From Stage 1 Burners Ignite Stage 2 Burners
                          - NOTE
                            - When water temperature read at controlling probe is heated to Operating Setpoint minus Stage 1 Differential
                              - Stage 2 Gas Valve Is De-Energized
                            - When water temperature read at controlling probe is heated to Operating Setpoint
                              - Stage 1 Gas Valve Is De-Energized

                        - Blower runs for purge period and shuts off.
                          - Pump runs continuous/programmed post circulate period and shuts off.
                          - Boiler goes into Standby Mode
EMC 5000 CONTROL SYSTEM - AOS

BOILER CONTROLS INFORMATION

Boiler controls that are improperly installed or set up can cause serious operational and service related problems such as short cycling and excessive condensation. This section provides information on how the different controls work together or separately to provide proper boiler and system control. A call for heat can be activated or deactivated externally and/or internally:

Externally - aquastat, sequencing panel, or EMS, closing an Enable/Disable Control Circuit provided by the boiler.

Internally - The CCB (page 9) working with a Controlling Probe. The Controlling Probe can be either the Inlet Temperature Probe mounted on the boiler or a remote Tank/Loop Temperature Probe mounted in a storage tank or heating system loop. The CCB will activate and deactivate the call for heat based on an Operating Set Point (local setting) in response to temperature sensed by the controlling probe. This type of boiler control can be a “stand alone” system control or can be used with external controls.

Operational Note - The Operating Set Point and the Enable/Disable Control Circuit are always active.

The Controlling Probe can be either the remote Tank/Loop probe shown here or the Inlet Probe mounted in the water connection header. The controlling probe can be a stand alone system control or be used with an external enable/disable control to provide temperature and/or supervisory enable/disable control. IE: Reset Schedule.

EXTERNAL CONTROLS

Enable/Disable (Tstat - Thermostat) Control Circuit

The Enable/Disable Control Circuit (also referred to as the thermostat or tstat circuit or wires) is always active and must be a closed circuit or the boiler will never fire. Two wires (from CCB J11 Socket - page 11) located in the junction box on the back of the boiler are provided for this circuit. These two wires will be joined together (closed circuit) with a wire nut from the factory. This is a switching circuit; DO NOT apply any external voltage or connect any load (IE relay/contactor coil) to this circuit.

If some form of external control is desired/required, that external control’s “dry” (no power or load) switch contacts would be connected to this circuit through field supplied wiring run in dedicated conduit. The external control can then enable/disable the boiler by closing or opening it’s contacts. When disabled the boiler goes through a normal shut down sequence.

If there are no external control contacts connected to this circuit, the circuit must be physically closed (wire nut) to enable boiler operation. System temperature and boiler operation is then controlled locally by the EMC 5000’s Operating Set Point (pages 6 and 40).
EXTERNAL CONTROLS (CONT)

Types of External Controls

An External Control can be the **Primary System Temperature Control** or a **Supervisory Control** or both. The enable/disable circuit described on the previous page would be field wired to the external control’s dry contacts. Field control wiring should be run in a dedicated conduit.

With any type of external control being used as the Primary System Temperature Control, the **Operating Set Point on the boiler (always active - pages 6 and 40) must be set at least 20° higher than the external control temperature setting** to prevent the Operating Set Point from cycling the boiler off before the desired system temperature is reached. This can cause operational problems such as short cycling.

An external Primary System Temperature Control could be a **Standard Aquastat** installed in a storage tank (domestic water) or in a Tee fitting on a heating loop (heating system).

**EMS (energy management system)** is another type of external Primary System Temperature Control. EMS controls can also provide supervisory enable/disable functionality. System temperature can be controlled by an EMS control equipped with it's own Tank /Loop temperature sensor. Supervisory functionality such as **occupied/unoccupied** and/or **freeze protection** can be set to enable or disable boiler operation based on temperature, time, and event programing.

**Reset Control** is another functionality EMS controllers often provide. The EMS system will have an outdoor temperature sensor or external load sensor in addition to a system temperature sensor. Typical Reset Control operation: as the outdoor temperature drops, the system set point is automatically raised to provide more heating capacity as the load increases. As the outdoor temperature rises, the system Setpnt is automatically lowered to provide energy savings during low load conditions. **Ensure reset schedule/program does not lower system below 120°F.**

**Boiler Sequence Controllers** are another type of external control that can sequence multiple boilers on and off as the system load fluctuates using their own Tank or Loop temperature sensing device. These types of controls offer lead/lag operation of multiple boilers to provide equal run time rotation (also available in many EMS controllers) which evens the wear on all boilers over time. Many boiler sequence controllers are also available with Reset Control functionality described above.

---

![Diagram of enable/disable circuit](image-url)
INTERNAL CONTROLS

Operating Set Point (Oper Setpnt)

The Operating Set Point is always active and is a Primary System Temperature Control when there is no external system control in use. The Operating Set Point has a range of 70°F to 190°F for GW models and 70°F to 220°F for GB models. Genesis boilers can be configured as GW or GB using the SW1 #1 dip switch (page 13).

The Operating Set Point is a “local” EMC 5000 User Setting that can be adjusted through the UIM (pages 6 and 45). It will act in response to temperature sensed by the “Controlling Probe.” The controlling probe is either the Inlet thermistor probe or the remote Tank/Loop thermistor probe. SW1 dip switch #4 on the CCB is set to configure one or the other as the Controlling Probe (page 13).

When temperature sensed at the Controlling Probe is Operating Set Point minus the Stage 1 Differential AND the Enable/Disable circuit (page 38) is closed, a call for heat is activated.

With the Inlet Probe configured as the Controlling Probe and being used as the Primary System Control, the pump must be programmed for continuous operation to improve system temperature control and to reduce the possibility of short cycling. The pump can be programmed for 45, 90, or 180 post circulate seconds after the call for heat is satisfied or for continuous operation from the User Settings Menu (page 7) on the UIM. The menu item is labeled “Post Cir Secs.”

DO NOT configure the Inlet Probe as the Controlling Probe. If there is a bypass line installed between the inlet and outlet of the boiler. Bypass lines feed outlet water to the inlet of the boiler to raise the inlet water temperature and prevent condensation from forming on the heat exchanger. This will cause the Operating Set Point to react to false heat and make reliable system temperature control nearly impossible. It can also cause short cycling. If a bypass line is present install a remote Tank/Loop probe in the storage tank (domestic water) or in the return line of the heating loop (heating system) and configure it as the controlling probe.

The remote Tank/Loop thermistor probe will usually provide more reliable system temperature control when installed in the storage tank or in the return line of the heating loop because it senses temperature in the system rather than at the boiler inlet.

When there is an external control (page 39) used as the Primary System Temperature Control always set the boiler’s Operating Set Point at least 20° higher than the Primary System Control setting to ensure reliable system temperature control and avoid short cycling.
INTERNAL CONTROLS (CONT)

Stage Differential (Stage1 Diff)
Each stage will have a Stage Differential set point. Stage differential settings have a range of 1°F to 50°F. This is a “local” EMC 5000 User Setting that can be adjusted through the UIM (pages 6 and 45). When the temperature sensed at the Controlling Probe is less than the Operating Set Point minus the stage 1 differential setting, the first stage of heat will be activated. Stage 2 would be activated when the temperature sensed at the Controlling Probe is less than the Operating Set Point minus the sum of stage 1 and stage 2 differentials. On 3 and 4 stage boilers each successive stage is activated in the same way; the cumulative sum of all previous stage differentials along with the current stage differential are subtracted from the Operating Set Point. Each stage is cycled off when the temperature sensed by the Controlling Probe rises to the Operating Set Point minus the sum of all previous stage differentials.

Automatic High Limit (Hi Limit)
The Automatic High Limit is a safety limit control setting that limits the outlet water temperature from the boiler to a programmed set point. This IS NOT a system temperature control. The Automatic High Limit has a range of 90°F to 210°F for GW models and 90°F to 235°F for GB models. Genesis boilers can be configured as GW or GB using the SW1 #1 dip switch (page 13). This is a “local” EMC 5000 User Setting that can be adjusted through the UIM (pages 6 and 45). The Automatic High Limit acts in response to temperatures sensed by the Outlet thermistor probe on the boiler.
The EMC 5000 control has a fixed minimum dead-band or differential between the Automatic High Limit set point and the Operating Set Point of 20°F to help prevent the possibility of short cycling the boiler between the two settings. The Hi Limit can be programmed for more than 20°F above Operating Set Point but not for less. i.e. If you continued to lower the Hi Limit set point past a setting which is 20°F above the Operating Set Point, the control will automatically start reducing the Operating Set Point to maintain the 20°F dead-band. The Operating Set Point cannot be raised higher than 20°F below the Hi Limit set point. Keep this in mind if the Operating Set Point seems stuck or will not allow higher settings within it’s range. You may have to first raise the Hi Limit set point.
The Automatic High Limit should be set according to operating conditions which can vary. A good initial setting would be Primary System Control Setting (external control or the on-board Operating Set Point) + 30°F. This should prevent short cycling for most operating conditions.

Automatic High Limit Differential (Hi Limit Dif)
The Automatic High Limit Differential has a range of 1°F to 50°F. This is a “local” EMC 5000 User Setting that can be adjusted through the UIM (pages 6 and 45). If the temperature sensed at the Outlet Probe reaches Automatic Hi Limit set point, the control would disable operation by cycling all burners off and shutting down. The boiler would not be enabled until the temperature sensed at the Outlet Probe dropped to Automatic High Limit set point minus Automatic High Limit Differential setting. i.e. Water temperature at the outlet of the boiler reaches 210°F, with an Automatic High Limit setting of 210°F the boiler shuts down. With an Automatic High Limit Differential setting of 20°F, the boiler would not be enabled again until the outlet water temperature dropped to 190°F.
OPERATING TEMPERATURES

Temperature rise through the boiler: 20 - 40°F.

The temperature rise through the boiler should be kept within 20 - 40°F with all stages firing to achieve the proper flow rate which maintains a balance between the harmful effects of calcium/lime accumulation vs. velocity erosion. Install and throttle a flow control valve in the outlet line to ensure proper flow rate/temperature rise.

Bypass Lines - Condensate Control - Minimum Inlet Water Temperature

The inlet water temperature should be a minimum of 120°F during normal operation to prevent condensate from forming on the heat exchanger and then dripping/collecting inside the boiler where it may cause damage. If the boiler condenses regularly even though the required temperature rise is being maintained, the boiler may be undersized. If the cold water make-up line is connected to the inlet of the boiler (Cer-Temp 80 piping), moving it to the boiler outlet can also help prevent condensate formation on the heat exchanger.

Bypass lines feed a portion of the outlet water to the inlet of the boiler which raises the inlet water temperature and helps prevent condensation from forming on the heat exchanger. A bypass line with a flow control valve can be installed between the inlet and outlet lines as shown in the illustration below. **Bypass lines should be installed whenever signs of excessive condensate are noticed or low system temperature operation is anticipated (system temperatures settings of 120°F or less).**

Bypass lines must be installed on the “system side” of the boiler circulation pump. On GB models the circulation pump should be installed on the inlet side of the boiler as shown in the illustration below to achieve optimal performance from the bypass line. The factory mounted pump on GW models is already installed on the inlet side of the boiler.
TECHNICAL SPECIFICATIONS

Input Power and Circuit Protection:

<table>
<thead>
<tr>
<th>Line Input Protection</th>
<th>Dedicated, isolated power supply in dedicated conduit with dedicated 20 amp breaker/fuse protection required.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Line Protection (CCB)</td>
<td>Fused on PDB to 15 amp @ 120 VAC</td>
</tr>
<tr>
<td>Line Protection (FCB's)</td>
<td>Fused on PDB to 10 amp @ 120 VAC</td>
</tr>
<tr>
<td>Line Output (Pump)</td>
<td>Fused on PDB to 20 amp @ 120 VAC</td>
</tr>
<tr>
<td>24VAC Power supply</td>
<td>Limited to 17.6 amp max by wiring and connectors. Below 18 VAC will result in lockout/error displayed</td>
</tr>
<tr>
<td>24VAC Protection</td>
<td>Fused on CCB to 7.5 amp – on FCB’s to 3 amp</td>
</tr>
</tbody>
</table>

†. See page 27 for PDB power supply test procedure to verify correct power supply.

Input Specifications:

<table>
<thead>
<tr>
<th>Temperature Sensors</th>
<th>Outlet, Inlet, Tank (Display accuracy = ± 5.4° F (3°C) Wiring to remote tank/loop probe must be in dedicated conduit.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flame Sensor</td>
<td>Active response when 5uA current (typical) flows across flame. Flame detection failure will occur under 2.5 uA.</td>
</tr>
<tr>
<td>Ignitor - White-Rodgers Si3N4 (Silicon Nitride).</td>
<td>Hot surface ignitor controlled by an independent Micro controller. Cold (77°F) resistance - 11.5 to 18.8 ohms.</td>
</tr>
<tr>
<td>AC Line Polarity Sensor</td>
<td>Detects reversed power connections and unconnected ground leads on power lines referenced to earth ground.</td>
</tr>
<tr>
<td>ECO Switch 24 VDC</td>
<td>Normally Closed bimetal thermostat built into outlet probe, opens on temperature rise @ 244° F ± 5.4° F (118°C ± 3°C)</td>
</tr>
</tbody>
</table>

Enable/Disable Circuit (Tstat CCB J11 Socket - see page 11)

Application Notes:

This is a switching circuit; **DO NOT** apply any external voltage or connect any load (i.e. relay coil) to this circuit.

External control wiring must be in dedicated conduit.

This circuit must be closed or the boiler is disabled.

This circuit can be used to enable/disable boiler with a supervisory control for: night setback, occupied/unoccupied, freeze protection, lead/lag of multiple boilers.

This circuit can also be used with a standard aquastat.

If this circuit is used with an external system temperature control the on board “Oper Setpt” should be set a minimum of 30°F higher than external control set point.

When an external control is not used this circuit must be physically wired together or jumpered to enable operation.

IRI Gas Valve Switch

Normally Open, closes to indicate valid valve activation

†. Control System Temperature Accuracy: ± 5.4° F (3°C)

‡. Signal level passed through switches: 24 VAC @ >7ma. (low-level contacts not required)
EMC 5000 CONTROL SYSTEM - AOS

TECHNICAL SPECIFICATIONS

Input Specifications (cont):

†High Blower Prover Pressure Switch Normally Open, closes on a pressure rise at 0.20" water column ± 0.05" (1" on Legend)
†Low Blower Prover Pressure Switch Normally Open, closes on a pressure rise at 0.30" water column (only used on Legend boilers)
†Blocked Flue Pressure Switch Normally Closed, opens on a pressure rise at 0.20" water column ± 0.04" (1" on Legend)
†Low Gas Pressure Switch Normally Open, closes on a pressure rise at 5" ± 0.4" (Nat. Gas) and 10.5" ± 0.4" (Propane) water column
†Water Flow Switch Normally Open, closes when flow rate exceeds an adjustable setting (approximately 25 GPM)
†Power Vent Switch (with optional power vent kit) Normally Open, closed by vent pressure when running
†Low Water Cut Off Switch Normally Closed, opens when water level is low
†Hi Gas Pressure Switch Normally Closed, opens on a pressure rise at 5.25" ± 0.04" (Nat. Gas) and 12.8" ± 1" (Propane)

†. Signal level passed through switches: 24 VAC @ >7ma. (Does not require low-level contacts).

†Output Specifications:

†High Speed Combustion Blower 120 VAC, 50/60 Hz, 3A (CCB J15 Socket, FCB J2)
†Low Speed Combustion Blower 120 VAC, 50/60 Hz, 3A (CCB J15 Socket, FCB J2)
Hot Surface ignitor - Silicon Nitride 120 VAC, 50/60 Hz – limited 5 amps by fuse on CCB/FCB
Gas Valve 24 VAC, 50/60 Hz, Switched 3.5 A
Low Water Cut Off 24 VAC, 50/60 Hz, Not Switched, 1 A
Powered Vent 24 VAC, 50/60 Hz, Switched 1 A
Alarm 24 VAC, 50/60 Hz, Switched 1 A
Spare 24 VAC, 50/60 Hz, Switched 1 A
‡IRI Gas Valve 120 VAC, 50/60 Hz, 5 A, ¾ HP
‡‡Pump 120 VAC, 50/60 Hz, maximum 20 FLA

†. For outputs up to 25A or 1HP @120 VAC connect discrete wires directly to terminals on top of relays. This power should be on a separate branch circuit.
‡. For outputs above 10A use an external relay connected to the output pins on the CCB
‡‡. For outputs up to 20 amps use on board remote pump relay connected to TB1 terminal board (see page 23). For outputs above 20A use an external contactor and feed the power through discrete wires from a separate branch circuit.

†. Total currents are limited by the input circuit breaker and fuses on the PDB, CCB, and FCB. See above
TECHNICAL SPECIFICATIONS

Ignition Timing:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Purge - cold start</td>
<td>32 ± 2 seconds</td>
</tr>
<tr>
<td>Pre-Purge – not cold start</td>
<td>10 ± 2 seconds</td>
</tr>
<tr>
<td>Shutter Adjust</td>
<td>5 minutes</td>
</tr>
<tr>
<td>Pre-Circulate</td>
<td>34 to 45 seconds or until flow is proven</td>
</tr>
<tr>
<td>Ignitor proving time</td>
<td>18 ± 1 seconds</td>
</tr>
<tr>
<td>Ignitor activation period</td>
<td>5 ± 1 seconds</td>
</tr>
<tr>
<td>Trial for ignition period</td>
<td>6 ± 2 seconds</td>
</tr>
<tr>
<td>Flame establishing period</td>
<td>1.5 ± 1.5 seconds</td>
</tr>
<tr>
<td>Flame failure response time</td>
<td>0 to 1.5 seconds</td>
</tr>
<tr>
<td>Inter-Purge</td>
<td>15 ± 2 seconds</td>
</tr>
<tr>
<td>Post-Purge</td>
<td>25 ± 2 seconds</td>
</tr>
<tr>
<td>Pump post-circulate time</td>
<td>Selectable 45, 90, 180 seconds or continuous</td>
</tr>
</tbody>
</table>

Default User Settings/Ranges:

As shipped from the factory the SW1 dip switches (page 13) on the CCB are preset to the appropriate values according to the system that was ordered, either GW or GB. The user settings are also preset to the following default values:

<table>
<thead>
<tr>
<th>GW MODELS</th>
<th>DEFAULT SETTING</th>
<th>ADJUSTABLE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oper Setptn (Operating Setpoint)</td>
<td>145° F (63° C)</td>
<td>70°F to 190°F</td>
</tr>
<tr>
<td>Stage1 Diff (Operating Setpoint Differential)</td>
<td>3° F (2° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Stage2 Diff (Operating Setpoint Differential)</td>
<td>6° F (3° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Stage3 Diff (Operating Setpoint Differential)</td>
<td>6° F (3° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Stage4 Diff (Operating Setpoint Differential)</td>
<td>6° F (3° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Hi Limit (Automatic High Limit Setpoint)</td>
<td>210° F (99° C)</td>
<td>90°F to 210°F</td>
</tr>
<tr>
<td>Hi Limit Dif (Automatic High Limit Differential)</td>
<td>20° F (11° C)</td>
<td>1° to 50°F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>GB MODELS</th>
<th>DEFAULT SETTING</th>
<th>ADJUSTABLE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oper Setptn (Operating Setpoint)</td>
<td>190° F (88° C)</td>
<td>70°F to 220°F</td>
</tr>
<tr>
<td>Stage1 Diff (Operating Setpoint Differential)</td>
<td>3° F (2° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Stage2 Diff (Operating Setpoint Differential)</td>
<td>6° F (3° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Stage3 Diff (Operating Setpoint Differential)</td>
<td>6° F (3° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Stage4 Diff (Operating Setpoint Differential)</td>
<td>6° F (3° C)</td>
<td>1° to 50°F</td>
</tr>
<tr>
<td>Hi Limit (Automatic High Limit Setpoint)</td>
<td>230° F (110° C)</td>
<td>90°F to 235°F</td>
</tr>
<tr>
<td>Hi Limit Dif (Automatic High Limit Differential)</td>
<td>20° F (11° C)</td>
<td>1° to 50°F</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BOTH MODELS</th>
<th>DEFAULT SETTING</th>
<th>ADJUSTABLE RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tempert Units (Temperature Units)</td>
<td>°F</td>
<td>°F or °C</td>
</tr>
<tr>
<td>Post Cir Secs (Post Circulation pump delay)</td>
<td>45 seconds</td>
<td>45, 90, 180, Continuous</td>
</tr>
<tr>
<td>Netwrk Address (Network Address)</td>
<td>0 non-valid address</td>
<td>0 or 1 to 31 valid address</td>
</tr>
</tbody>
</table>
GLOSSARY

\( \Delta T \). Symbol used for "Delta T." Engineering term to convey "temperature rise" or "difference" through a boiler or heat exchanger. i.e. If the inlet water temperature to a boiler is 120°F and the outlet water temperature leaving the boiler is 140°F; the temperature rise through the boiler is 20°F, which is commonly expressed as "20° \( \Delta T \)."

**Blocked Flue Switch.** This is a normally closed air pressure that opens on a rise in pressure. It is used to detect a blocked exhaust vent. Connects to J5 socket on the CCB, see page 11.

**High Blower Prover Switch.** This is a normally open air pressure switch that closes on a rise in pressure. It is used to detect that the blower is running in high speed. Connects to J17 socket on the CCB, see page 11.

**CCB - Central Control Board.** This is the main control circuit board for the EMC 5000. It controls all centralized functions including temperature control, diagnostics, automatic high limit etc. It sends information to/from UIB and FCB(s) and implements the External Network Interface. See page 2 and page 9.

**EJB - External Junction Box.** Abbreviation used in wiring/connection diagrams. This is a wiring box mounted outside of boiler. Connections for 120 VAC supply power, external thermostat/enable/disable control, and remote loop/tank temperature probe are made here.

**FCB - Flame Control Board.** Performs the function of ignition and blower control on additional heating stages 2-4. FCB boards are only used on boilers with more than one stage of heating. Connects to internal communications port on CCB, see page 15.

**High Gas Pressure Switch.** This is a normally closed pressure switch that opens on a rise in pressure. It is used to detect that manifold gas pressure to the burners is maintained below a maximum limit. This is an optional component usually used to satisfy local code requirements. Connects to J17 socket on CCB, see page 11. SW2 dip switches on the CCB (see page 16) and S1 dip switches on the FCB when used (see page 18) are configured to activate this circuit which is then monitored by the CCB.

**Low Blower Prover Switch.** This is a normally open air pressure switch that closes on a rise in pressure. It is used to detect that the blower is running at low speed during the ignitor warm up period. This switch will only be used on boilers equipped with 2 speed blowers such as Legend. Connects to J17 socket on CCB, see page 11.

Note: SW2 dip switches on the CCB (see page 16) and S1 dip switches on the FCB when used (see page 18) are configured for 1 or 2 speed blowers. When these dip switches are set for a 2 speed blower, this circuit will be activated and monitored by the CCB.

**Low Gas Pressure Switch.** This is a normally open pressure switch that closes on a rise in pressure used to detect supply gas pressure is maintained above minimum requirement. This switch is optional (as local code requires) on Genesis boilers and standard on Legend. Connects to J5 socket on CCB, see page 11. The CCB board's master dip switch SW1 (see page 13) must also be configured when a low gas pressure switch is used to activate and monitor this circuit.
GLOSSARY (CONT)

**Low Water Cut Off.** This is an electronic continuity based control used to prove water level in the boiler. This is an optional component usually used to satisfy local code requirements. Connects to J4 socket on CCB, see page 11. The CCB board’s master dip switch SW1 (see page 13) must also be configured to activate and monitor this circuit.

**PDB - Power Distribution Board.** Distributes 120VAC and 24VAC power to CCB and FCB circuit boards. Also provides fusing for these boards and the pump. Contains a test circuit for determining if line power is properly applied to the system. See page 22.

**Power Vent Switch.** This is a normally open air pressure switch that closes on a rise in pressure. It is used to detect that the optional power vent blower is running. This switch is physically installed on the power vent kit. Field supplied wiring would connect the switch contacts to the J4 socket on the CCB, see page 11. The CCB board’s master dip switch SW1 (see page 13) must also be configured when a power vent kit is used to activate and monitor this circuit.

**TSB - Touch Sensor Board.** Circuit board containing touch switch pads (user input buttons) which is a portion of the UIM assembly.

**UIB - User Interface Board.** Part of the UIM assembly. Communicates with the CCB. Controls the operation of the LCD. Receives inputs from the touch switches. Activates the LED’s according to commands sent from the CCB.

**UIM - User Interface Module.** Plastic housing that holds the UIB, LCD, and TSB. Provides means to both send and receive information from the user. Only one cable to the CCB is required for communications and power. Operates on 5 VDC only. Connects to internal communications port on CCB, see page 15.

**Water Flow Switch.** This is a normally open paddle type switch mounted in the outlet of the boiler that closes when water flow through the boiler exceeds the minimum flow “make point” of the switch. This switch does not prove required flow rate only that water present and that it is flowing. Connects to J5 socket on CCB, see page 11.

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