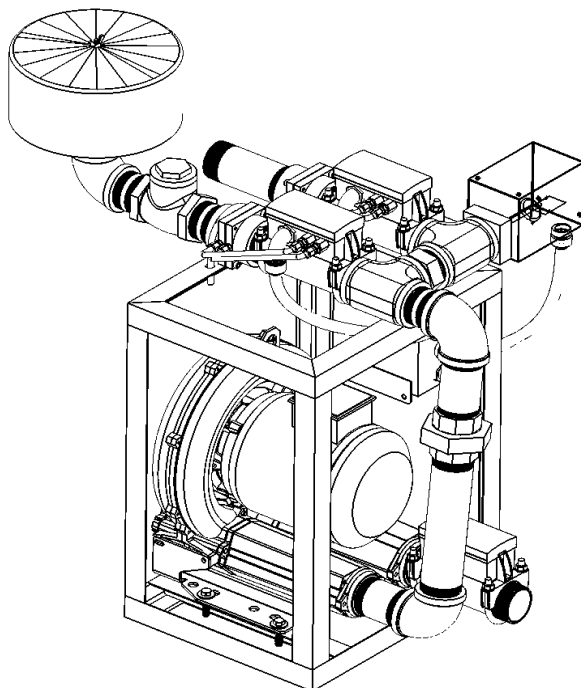


UPC·MARATHON

# EXOINJECTOR™

## Installation and Operation Manual



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## MANUAL #: 422

Revision #	Revision Date	Revision Description
001	12/19/2012	Reformatted document created and approved for release

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For all questions or concerns regarding the operation of the **ExolInjector™**, please consult the last page of this manual for contact information.



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# 1 EXPRESS WARRANTY ON UPC-MARATHON EQUIPMENT

**United Process Controls Inc. (hereinafter referred to UPC-Marathon)** warrants products for a period of one (1) year from the date of shipment from UPC-Marathon to the original purchaser to be free from defects in material and workmanship under normal recommended use, service, inspection, and maintenance. Normal recommended use, service, inspection, and maintenance, mean:

1. Not to be used in excess of nor below the rated capacity, pressure, and temperature ranges specified in the applicable quotation, purchase order, acknowledgment, marketing literature, nameplate, specification sheet, or the Installation, Operation, Inspection, and Maintenance Manual (THE MANUAL); and
2. Using only clean gases free of solids and other contaminants not considered constituents of the gas; and
3. Installation, operation, inspection, and maintenance in compliance with THE MANUAL; and
4. The UPC-Marathon products being used only in:
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  - b. Non-corrosive environments; and
  - c. Completely protected from moisture, rain, snow, or other outside environments; and
  - d. Not to be used below 32 °Fahrenheit (0 °Celsius) unless precautions are taken for low temperature conditions as shown in THE MANUAL.
5. Being used only for applications permitted by THE MANUAL or other UPC-Marathon literature or special applications approved in a separate written authorization by UPC-Marathon.

## WARRANTY EXCEPTIONS

This Warranty does not apply to damage caused by any or all of the following circumstances or conditions:

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2. Parts, accessories, materials, or components not obtained from nor approved in writing by UPC-Marathon;
3. Any consequential or incidental damages including but not limited to loss of use, loss of profits, loss of sales, increased costs, arising from the use of any product system or other goods or services manufactured, sold, or provided by UPC-Marathon;
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1. The performance or nonperformance of any obligations set forth in this Warranty and Warranty Policy;
2. Any agreement including specifications between UPC-Marathon and the customer;
3. Negligence, active, passive or otherwise of UPC-Marathon or any of agents or employees;



4. Breach of any judicially imposed warranty or covenant of workmanship, durability or performance; and
5. Misrepresentation (under the Restatement, common law or otherwise) and/or strict liability involvement;
6. Liability for fraud-in-the-inducement.

## **WARRANTY FIELD SERVICE**

If Warranty Field Service is rendered at the request of the purchaser or user and the difficulty is found not to be with UPC-Marathon's product, the purchaser shall pay the time and expense (at the prevailing rate at the time of the service) of UPC-Marathon's field representative(s). Charges for service, labor, and other expenses that have been incurred by the purchaser, customer, or agent without written approval of UPC-Marathon will not be accepted. The OEM or other reseller is responsible for transmitting installation and operating instructions, THE MANUAL or other service literature supplied by UPC-Marathon with the equipment.

## **2 DESCRIPTION**

### **Mixing System**

The ExoInjector™ is a precision gas mixing system and exothermic gas generator control system integrated into one package. The ExoInjector™ mixing system designed by UPC-Marathon utilizes electronic flow measurement and a precision gas injection valve to constantly monitor and control the ideal gas mixture required to generate high quality exothermic gas.

The ExoInjector™ incorporates the latest technology in regenerative blower design that is capable of significant turndown for exothermic gas generators. When combined with the patented mixing system, the ExoInjector™ delivers flow on demand throughout the working range of any generator down to 20% of rated capacity. This feature eliminates exothermic gas waste during production while maintaining the precise gas mixture and ratio adjustment capability required to control gas quality throughout the turndown range.

### **Temperature Control (Optional)**

The integrated temperature control logic of the ExoInjector™ will monitor a single temperature zone or multiple temperature zones and provides an output (relay or signal) that can be used to accurately control the temperature of any exothermic gas generator. The thermocouple required to monitor temperature, and valves required to control temperature, are not included with the ExoInjector™ system but can be purchased separately from UPC-Marathon.

### **Paperless Chart Recorder**



The ExoInjector™ integrates a full-color touch-screen paperless chart recorder to monitor all critical process variables of an exothermic gas generator. The data and backup files are stored and maintained on the touch-screen in an encrypted format for a period of 5+ years. The data can be exported to CSV format for easy review within a spreadsheet application (i.e. MS Excel or similar).

### Custom Designed System

The ExoInjector™ is a precision mixing system that is assembled, calibrated, and fully tested to perform to the exact requirements of a specific exothermic gas generator. The system is not designed to be interchangeable with any other generator without written approval of the new generator application from UPC-Marathon.

## 3 SPECIFICATIONS

Maximum Flow Capability .....	Calibrated to Order – Indicated on Serial Tag
Minimum Flow Range.....	20% of Maximum Flow
Temperature Limits .....	32°F to 130°F
Flow Meter Pressure Limits.....	5 psig maximum
Inlet Gas Supply Pressure.....	0.25 - 3 psig (min-max)
Control Power Required .....	85-264VAC (50/60 HZ)

Horsepower .....	2.0 HP
Power Supply .....	3 Phase 230/460 VAC 50/60 Hz
Power Required .....	1.63

Horsepower .....	3.0 HP
Power Supply .....	3 Phase 230/460 VAC 50/60 Hz
Power Required .....	2.30 kW

Horsepower .....	4.0 HP
Power Supply .....	3 Phase 230/460 VAC 50/60 Hz
Power Required .....	2.97 kW

### 3.1 Modbus Communication

Standard communication between the HMI and the control system is handled via ModbusRTU (RS232 or RS485) or ModbusTCP/IP (Ethernet) as required. Additional communications ports are available but can vary by type depending on the control system specified when ordering and provided with the system. A modbus register address list and other communication details are provided as an attachment to this manual. Contact UPC-Marathon support team with any questions regarding communication setup of this device.





### **CAUTION: REMOTE CONNECTION CONSIDERATIONS**

Connection of industrial equipment to a remote network opens the system to security and safety vulnerabilities. Access to any industrial equipment including the ExoInjector™ over a network must be strictly controlled so that only those trained in the operation of the equipment can modify parameter values within the system. Further, precautions should be integrated to prevent parameters from being modified accidentally and set to values outside of safe ranges.

## **3.2 Data Storage**

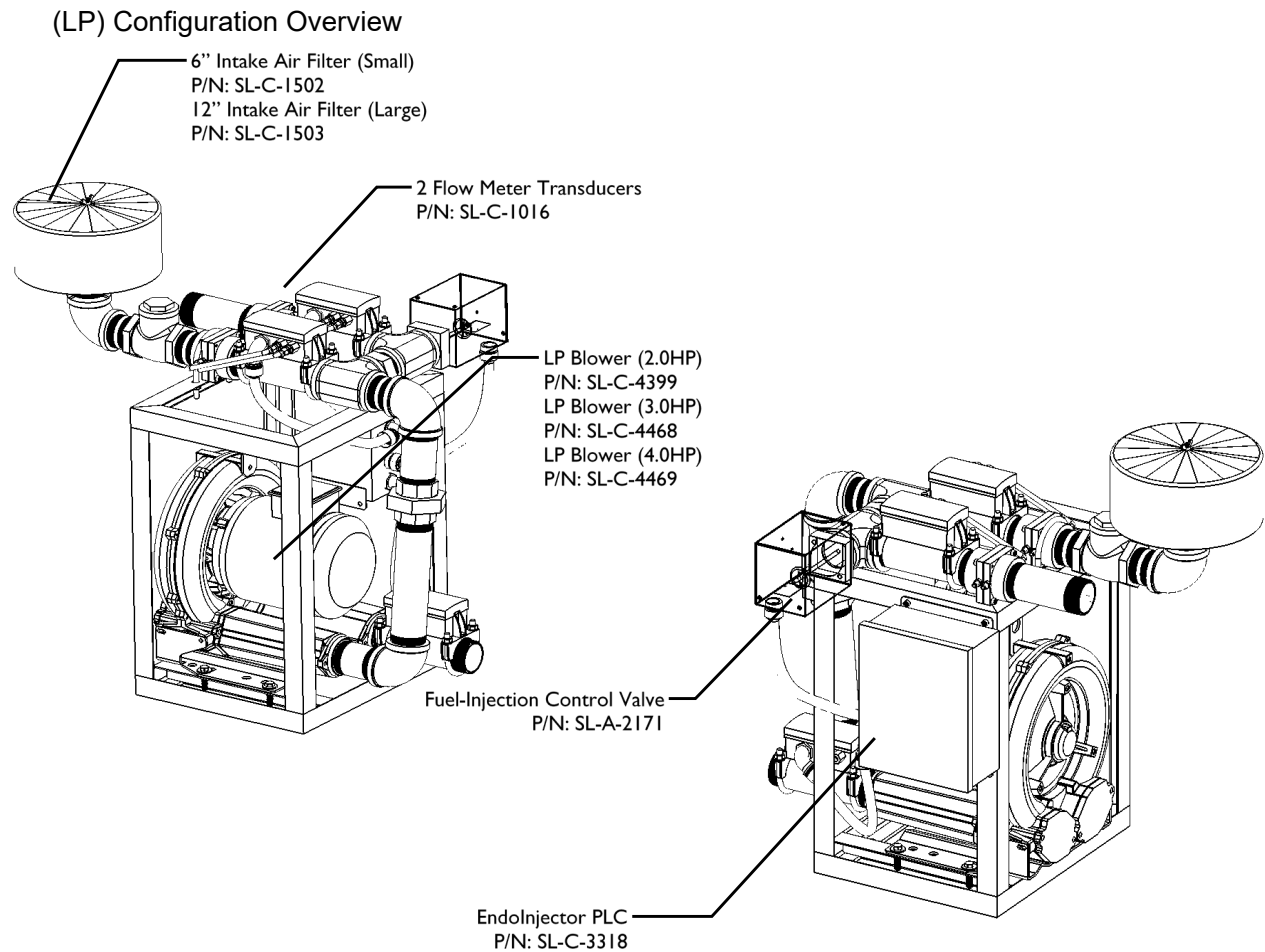
The HMI touchscreen includes a minimum of 7GB of unused internal hard drive space. The ExoInjector™ daily encrypted log files are contained within the UPC-Marathon log directory and a backup file is located in a backup directory. The combined daily file size will consume approximately 300KB per day. Therefore, the actual capacity of the hard drive will be able to maintain over 60 years of log data. However, due to memory life considerations the process log data integrity should be considered maintained locally at the machine for a period of 5+ years. Of course, the actual data may last longer and can be backed up remotely for an indefinite period.

## **4 ELECTRICAL COMPONENT OVERVIEW**

The ExoInjector™ mixing system can be supplied with many different types of controllers depending on customer specifications and specific generator control requirements. The electrical components that are not part of the mechanical assembly are typically packaged separately and found in a box that accompanies the system. Refer to the electrical wiring diagram and material list attached to this manual and ensure that each item detailed in the attached drawing is accounted for and has not experienced physical damage during shipment prior to proceeding with the installation.

## **5 MECHANICAL COMPONENT OVERVIEW**

The ExoInjector mixing system is supplied in a “LP” (Low Pressure Gas Supply) configuration. Every ExoInjector™ contains many individual components that are calibrated, and fully tested to perform as a complete system. The components can be supplied preassembled or as separate sub-assemblies depending on the installation requirements. The diagram(s) below detail the main critical mechanical components of the system. Review each critical component and ensure there is no physical damage to these components during shipping before proceeding to install the system.



## 6 INSTALLATION NOTICE

Only qualified personnel experienced with exothermic gas generator operation and safety requirements shall perform an Exolnjector™ installation. It should be noted that additional mechanical components and interlocks will be required on the generator other than those supplied with the Exolnjector™ system to ensure the generator is safe and meets NFPA 86 (or similar) guidelines.

The Exolnjector™ is a robust industrial device however; some precision measurement components may be susceptible to damage from severe shock. Care should be taken to handle the system during the installation process. The system was not designed to support personnel and should not be used as a step or a support as this could damage components on the system and may cause injury.



## 7 MECHANICAL INSTALLATION

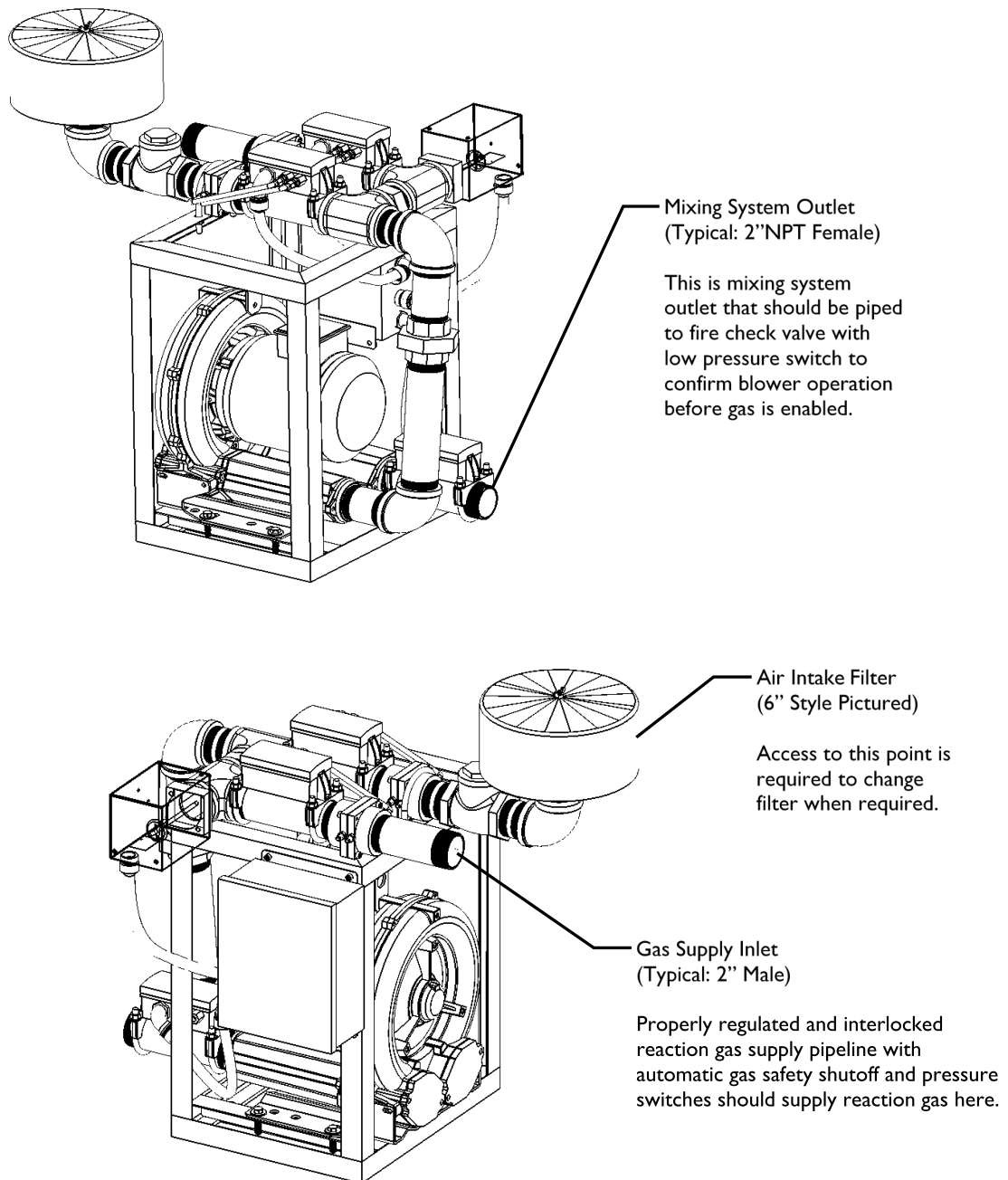
Installation Procedure (Refer to pipeline diagram attached to manual for proper installation)

1. Inspect the mixing system for any damaged or missing components and confirm each component detailed in the “Mechanical Component Review” section of this manual is accounted for based on the configuration provided.
2. Make note of the following locations on the mixing system and consider the best location for the mixing system on the generator to accommodate the piping and access requirements to reach these locations:
  - a. Gas Supply Inlet
  - b. Mixed Gas Outlet
  - c. Air Intake Filter
3. Secure the mixing system to the generator frame using mounting holes on the base of the system. If retrofitting a generator, the old blower motor location is typically a suitable location. The mixing system should be mounted level and should be reasonably insulated from direct radiant heat sources.
4. Attach the reaction gas supply pipeline to the gas inlet on the mixing system. The gas supply must be pressure regulated to a minimum of 0.5 psig and a maximum of 3 psig. Note that the reaction gas piping must contain the required interlocks and components to meet NFPA 86.
5. Attach the mixed gas outlet to an appropriate automatic fire check valve and install a low-pressure air switch to confirm blower operation.
6. Install the Outlet Pressure Transducer to a sense line attached to the generator outlet (after the cooler(s) but before any valves).
7. Install Air Intake Filter.

The following connections shall be made as described.



## (LP) Configuration

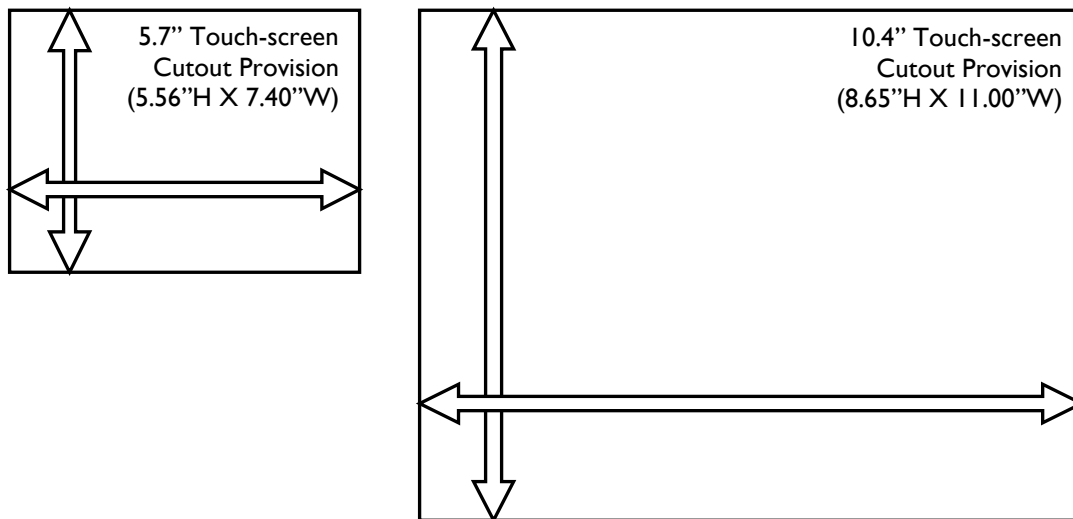


## 8 ELECTRICAL INSTALLATION

It is important to note that there are many different generator manufacturers and the wiring designs and control logic can be very different depending on the manufacturer and age of the



generator. Only a qualified electrician experienced with exothermic gas generator operation and current safety requirements shall perform an ExoInjector installation. Proper safe electrical interlocks must be designed to meet safe generator operation based on NFPA86 guidelines. If necessary, installation supervision and direction of turnkey installation services are available from UPC-Marathon or an UPC-Marathon certified installation professional. The primary consideration is that the ExoInjector™ control system is designed to provide the temperature control, pressure control, and air gas ratio control of an exothermic gas generator. Basic electrical installation includes:



1. Mount the industrial touch-screen supplied with the system into generator control enclosure and ensure the screen is protected from close proximity to direct radiant heat sources or other excessive heat. Ensure proper cutout and do not force into cutout or over tighten mounting brackets as it may deform the touch-screen and cause the touch panel to malfunction.
2. Mount the 24VDC power supply, process controller, and relays supplied with the ExoInjector™ system inside the controls enclosure. If retrofitting to existing generator it is typical to remove temperature controllers installed on generator. However, it is important to make detailed notes of wiring numbers and their purpose so that final terminations can be made with the ExoInjector™ control system.
3. Wire the ExoInjector™ blower motor.

### IMPORTANT

Make sure to check the terminal jumpers inside the motor wiring box and confirm they are positioned properly for the voltage being supplied. (Note: To reduce electrical noise in the DC circuits, it is recommended that the high voltage motor wiring should be conveyed through a separate conduit from any low voltage control wiring.)



4. Wire the mixing system control components together as shown on the attached installation wiring diagram. This wiring diagram only details the control system assembly and integration between mixing system, HMI, and sensors. The wiring diagram does not detail the required integration wiring between the control system and the generator panel and components. This is because the integration wiring and wire numbers will be dependent on the manufacturer and age of the generator equipment. It is important to have a detailed wiring diagram of the generator to use as a guide to locate wire numbers and terminal locations required for proper ExoInjector™ installation and safe generator operation. After the wiring detailed on the attached installation diagram is completed, review the following check list as a guide to ensure proper integration of the relays and control outputs are made to the generator.
  - a. Low Temperature Alarm: The low temperature alarm relay is only energized when the generator temperature is high enough to safely start the mixing system. A normally open contact on this relay should be used in the motor starter circuit to ensure the temperature is safe before the ExoInjector™ mixing system can be allowed to start.
  - b. Critical Alarm Relay (System Enable): The critical alarm relay is only energized when all internal checks and ratio control system confirms system is ok to start. If there is a critical failure this relay will be de-energized. Therefore, it is typical to wire a normally open contact on this relay in series with the low temperature alarm relay. This relay is specific to the ExoInjector™ system and will not be part of existing generator wiring.
  - c. Temperature Control Output: The ExoInjector™ provides both a relay for time proportional control and a 4-20mA signal output for heat control. Either of these outputs can be used to integrate existing heat control components to control the temperature of the generator. The time proportional relay energizes when calling for more heat. The 4-20mA signal increases when calling for more heat.
  - d. Non-Critical Alarm (optional): The Non-Critical alarm relay is simply a deviation alarm relay that will energize when a temperature, flow, or ratio deviation alarm occurs. The relay will only de-energize when all deviation alarms are ok. Therefore, a horn silence circuit will be required if using this relay to sound a horn.
  - e. Horn Output (optional): The horn output is provided on some systems in replacement of the “Non-Critical” alarm. If a horn output is provided, this output is energized when any alarm is present and will de-energize after the silence horn contact is made.
  - f. Temperature Control Wire: A thermocouple (Typically: K or S Type) should be wired to the temperature control input of the ExoInjector™ controller. Note that



the control thermocouple must be separate from the over temperature safety thermocouple.

## **9 SYSTEM OPERATION**

A generator fitted with the ExoInjector™ mixing and generator control system is designed to start and stop the same as a gas generator with a mechanical mixing system. However, the patented advanced control logic and operator interface of the ExoInjector™ mixing system are designed to provide complete monitoring and control of all critical generator variables with an integrated paperless chart recorder to log the generator performance.

The full-color touch-screen provides the main interface between an operator and the ExoInjector™ control system. The ExoInjector™ software is designed to run on any computer operating Microsoft operating system (XP or later) with the .net3.5SP1 Framework or later installed.

### **COMMUNICATION STATUS**

The tip of the logo at the top right of the screen will blink green when communication is established between the HMI and the controller. If the tip is blinking RED then this is an indication that there is no communication link between the HMI and the controller. During startup it may take 5-10 seconds to establish communications however, a prolonged disconnect may be the sign of a communications setup problem or a wiring problem.

### **SYSTEM NAVIGATION BUTTONS**

#### **Generator Button**

The “Generator” button is used to display a graphical representation of generator operation and component status. It should be noted that this is just a graphical summary and actual components may be in different locations from those displayed on the generator panel.

#### **Process Button**

The “Process” button is used to display the main generator process control values screen.

#### **Chart Button**

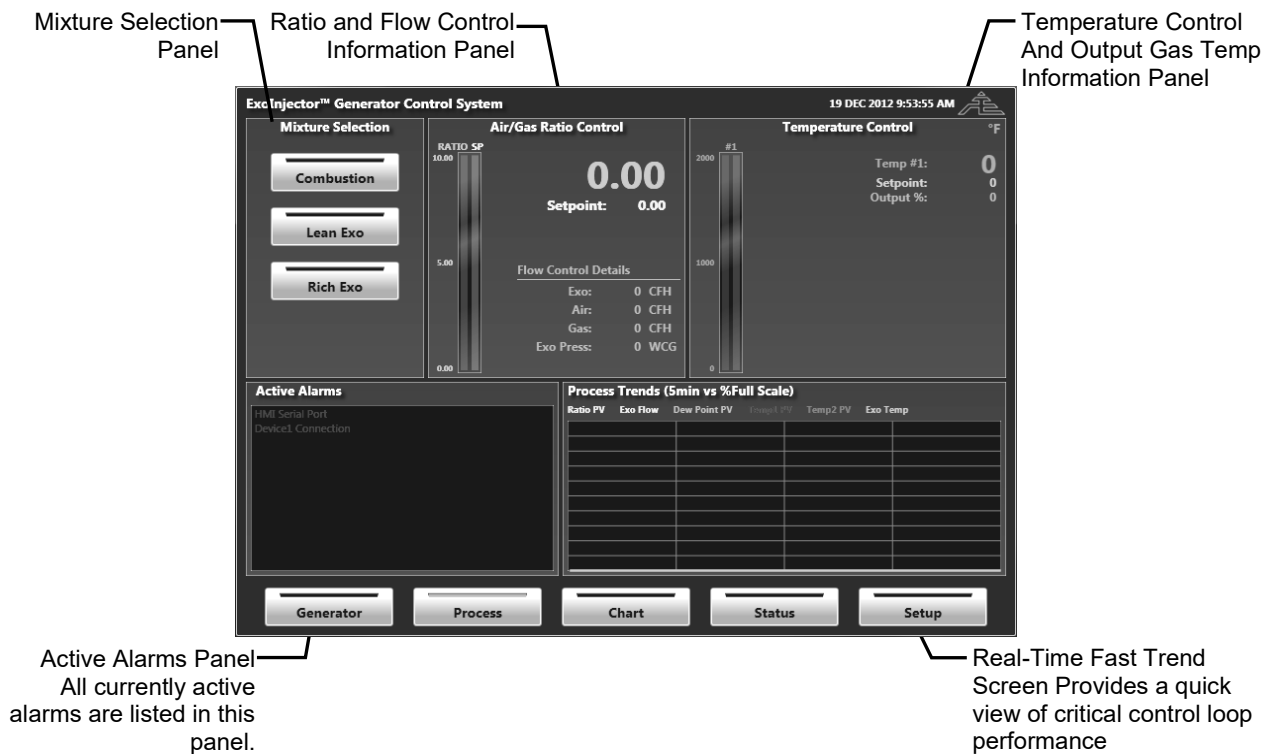
The “Chart” button is used to access the paperless chart recorder.

#### **Status Button**

The “Status” button is used to view active system alarms and communications status.







## 10.1 Mixture Selection Panel

The three selection buttons in this panel allow the user to easily select between three configurable Air/Gas Ratios to allow for simple generator operation.

**Combustion** is generally used at generator start up and will run a default 10.0 Air to Gas Ratio (can be adjusted in the Setup menu. See pages 17-18.)

**Lean Exo** will run a default 8.5 Air to Gas Ratio (can be adjusted in the Setup menu. See pages 17-18.) The products of a rich exothermic gas mixture generally include CO<sub>2</sub>, H<sub>2</sub>O, and N<sub>2</sub>.

**Rich Exo** will run a default 7.5 Air to Gas Ratio (can be adjusted in the Setup menu. See pages 17-18.) The products of a rich exothermic gas mixture generally include CO<sub>2</sub>, CO, H<sub>2</sub>, H<sub>2</sub>O, and N<sub>2</sub>.

## 10.2 Ratio and Flow Control Panel

The ratio and flow control panel provides detailed information regarding the mixing system operation. Note: The bar graph scales are dependent on the pen scales defined within the paperless chart recorder and can be changed using the “edit pen” button on the history screen.



**Air/Gas Ratio** is the currently measured air flow divided by the currently measured gas flow passing through the mixing system. This value represents the actual mixture of air and gas being introduced into the gas generator and is directly correlated to the quality of the exothermic gas produced. The actual ratio is controlled to the “Ratio Setpoint” by the fuel-injection control valve. It should be understood that depending on the ratio the products of the exothermic gas will vary.

**Ratio Setpoint** is the desired mixture of air and gas that should be introduced into the generator. This value can be changed depending on the type of exo gas required, with the values set in the “Setup” screen.

**Exo Flow** is a calculated value that represents the amount of exothermic gas being produced by the generator. It is calculated using the following equation:  $\text{Exo Flow} = (\text{Air Flow} + \text{Gas Flow}) \times (\text{Expansion Factor})$

**Air Flow** is the actual calibrated measurement of air passing through the ExoInjector mixing system. This value is measured using the air flow transducer mounted to the mixing system. A calibration curve detailing the transducer performance in relation to the factory calibrated flow measurements is attached to this manual. The air flow meter has integrated test ports that can be used to certify the meter calibration while in operation.

**Gas Flow** is the actual calibrated measurement of gas passing through the ExoInjector mixing system. This value is measured using the gas flow transducer mounted to the mixing system. A calibration curve detailing the transducer performance in relation to the factory calibrated flow measurements is attached to this manual. The gas flow meter has integrated test ports that can be used to certify the meter calibration while in operation.

**Exothermic Gas Pressure** (*Optional*) indicates the generator output exothermic gas pressure based on pressure transducer.

**Premix Gas Pressure** (*Optional*) indicates the premix gas pressure before the retort based on pressure transducer.

### 10.3 Temperature Control Panel (*Optional*)

The temperature control panel provides detailed information regarding the temperature of the exothermic gas generator. The temperature panel is expandable to 3 separate temperature control loops that can be simultaneously viewed within this panel. Note: The bar graph scales are dependent on the pen scales defined within the paperless chart recorder and can be changed using the “edit pen” button on the history screen.

**Temperature** is the actual temperature within the hot zone of an exothermic gas generator. This value is measured by an industrial thermocouple. Note: a value of >3000 means that



there is an open loop on the thermocouple input and the thermocouple is either not wired correctly or has failed.

**Temperature Setpoint** is the desired temperature within the hot zone of an exothermic gas generator. This value is typically set by the generator operator to a value of 1900degF or 1950degF for normal generator operation.

**%Output** value represents the PID control output signal used to control the temperature of the generator. The actual output can be either a time proportional (relay type) control or a 4-20mA control signal. If the temperature is lower than the temperature setpoint then the %output will increase. The increase in %output will result in the temperature control relay being energized “more often” and also result in the 4-20mA signal to increase in current.

**Output Exo Temperature** (*optional*) The system provides a thermocouple input to monitor gas output temperature. This temperature is critical to ensure that the generator cooler is working properly. A high output temperature alarm function is also included. The setup for this output temperature alarm is described in the system setup section of this manual.

## 10.4 Process Control Trend Panel

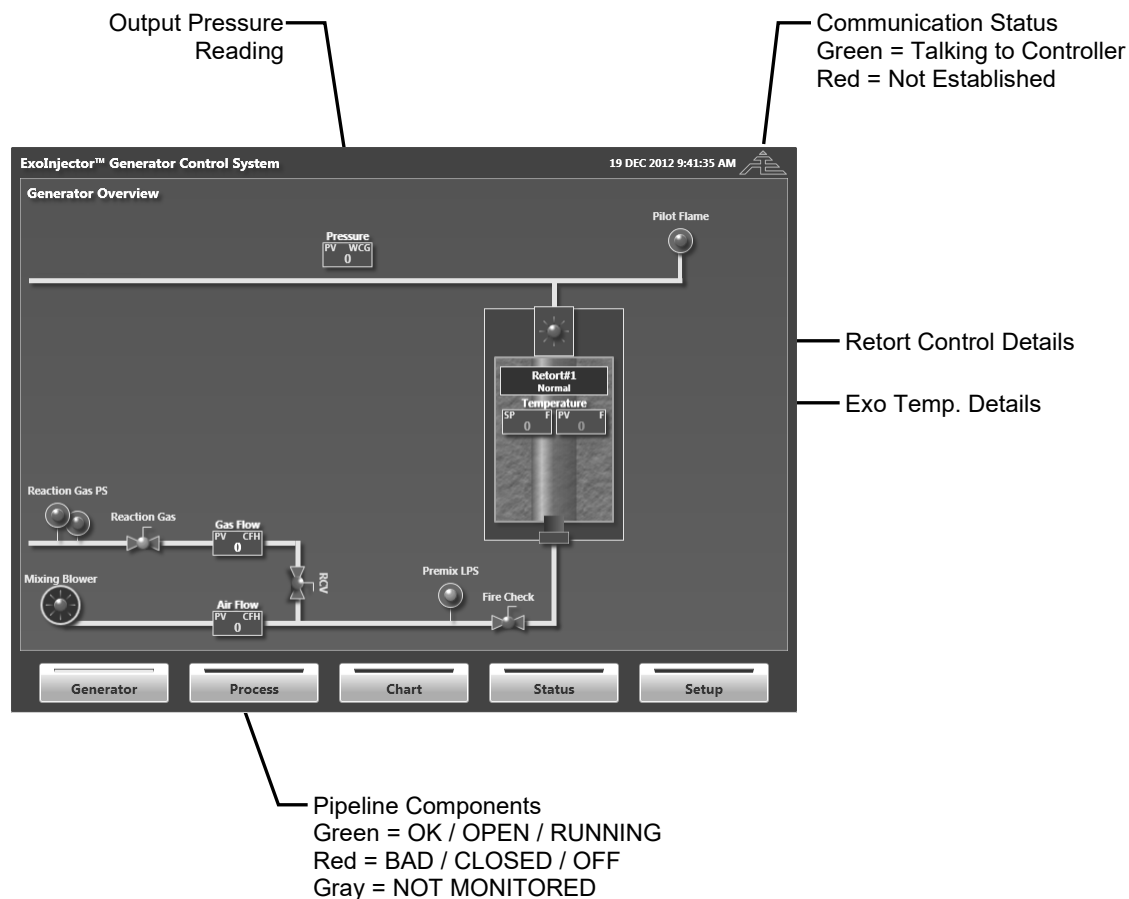
The process control trend panel is updated every second to display actual control characteristics of the mixing system that might not be seen on the one-minute storage interval of the historical log found in the paperless chart recorder. The trend panel is not the same as the paperless chart recorder in that all the data is updated much more quickly (1 second intervals) and the trend data is not stored longer than 4 minutes. The primary function of the trend panel is to provide real time feedback of system operation to better tune and confirm minimal control oscillations during system operation.

**Trend Panel Setup:** Double tapping on the trend title will display the trend pen selection menu. Select a value to display for each pen and close the setup screen. Changes are immediate. Note: The trend pen scaling and color is dependent on the setup for those values within the paperless chart recorder and can be changed using the “edit pen” button on the chart screen.

## 10.5 Active Alarm Panel

The active alarm panel displays all currently active alarms in RED. Detailed alarm status and alarm history can be found in the “Status” screen that will be displayed by pressing the “Status” button at the bottom of the screen.

# 11 GENERATOR SCREEN OVERVIEW



## Pipeline Components

The Pipeline components section is intended for status indication only and should be considered for reference and troubleshooting purposes only. Components shown on this screen indicate the standard generator components found on most generators. However, actual components may differ and/or the location of these components may be different than those pictured in the pipeline diagram. Consult the generator manufacturer drawings and diagrams for actual component locations. If the LED on the screen for a component is “GRAY” then that is an indication that the component is not being monitored by the control system.

## Retort Control Details

The retort control section indicates the temperature control, flame sensor, high/low fire, retort inlet valve, and cooler status for each retort. The temperature of the retort will fade from gray thru red to yellow depending on the temperature PV measured by the thermocouple for that retort. A flame will be present when the flame sensor detects a flame and the size of the flame will change depending on the status of the temperature control relay.



## 12 SETUP SCREEN OVERVIEW

The setup panel organizes all setup parameters into specific groups. These groups are accessed using the “Parameter Group” buttons located at the top of the setup screen. It should be noted that all parameters are password protected to provide “READ ONLY” access to control parameters. It is not possible to change system parameter setting if not logged into the system.

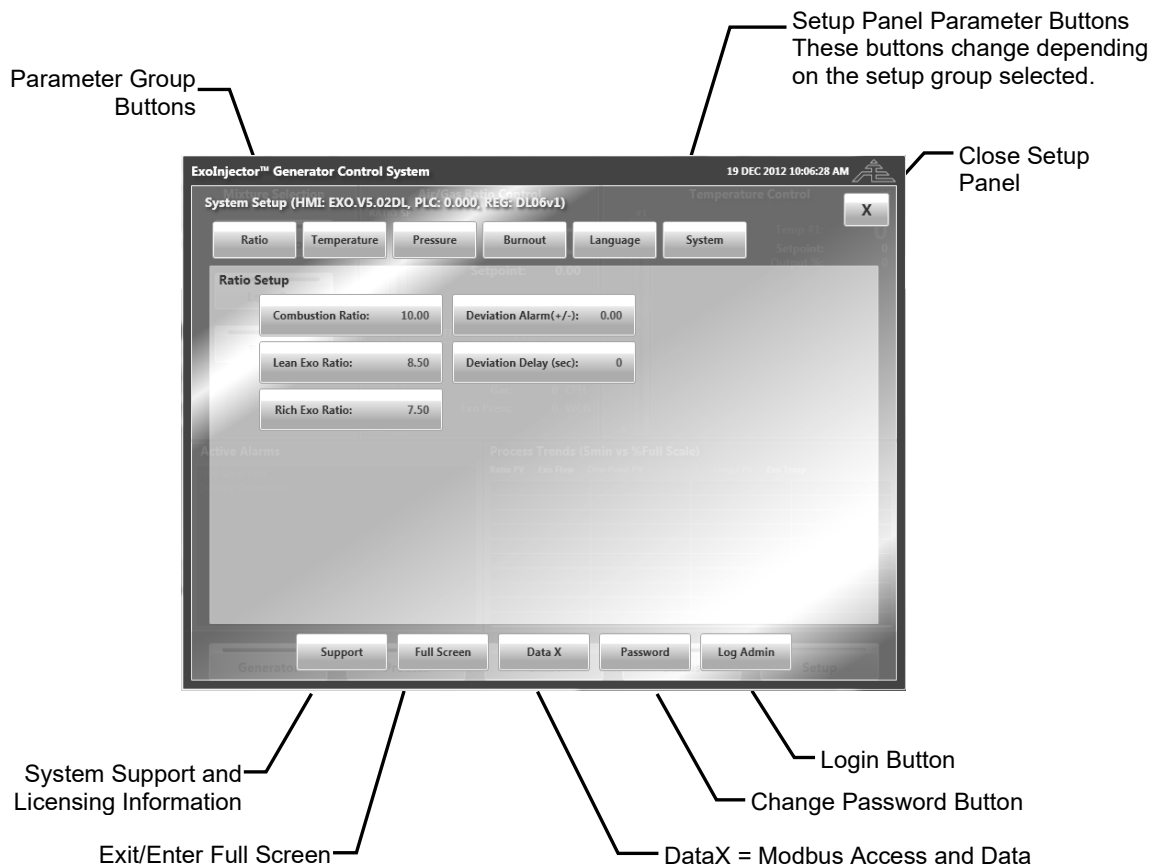
### Login Permissions

The ExoInjectorV5 software provides 3 levels of access to the system configuration setup screen.

**USER LEVEL** (Default = 2): Provides access to standard system set points and tuning variables.

**ADMINISTRATION LEVEL** (Default = 22): Provides access to critical control parameters and alarm setpoint variables.

**ENGINEERING LEVEL** (Contact UPC-Marathon): Provides access to modbus mapping and controller setup functions.





## 12.1 Ratio Setup Parameter Group (User,Admin, Eng Levels)

These parameters define the control of the air/gas mixing function of the ExoInjector. Changes to these parameters will take effect immediately. All parameters are only editable in USER, ADMIN, and ENG levels.

### **Combustion Ratio Set Point** (Default = 9.00)

Air/Gas Ratio to be introduced during combustion to provide gas to the burner. The default setting of 10.00 may differ slightly due to specific generator characteristics. If the burner is having trouble lighting then the Combustion Ratio Set Point should be adjusted to provide proper burner control. NOTE: If the required air/gas ratio must be greatly adjusted this could indicate an issue with the burner or flame sensor. Consult the generator manual for troubleshooting guidelines or contact UPC-Marathon for further support.

### **Lean Exo Ratio Set Point** (Default = 8.50)

Air/Gas Ratio to be introduced while the generator is making “Lean” Exo Gas. The default setting of 8.50 may differ slightly due to specific generator characteristics. Consult the generator manual for troubleshooting guidelines or contact UPC-Marathon for further support.

### **Rich Exo Ratio Set Point** (Default = 7.50)

Air/Gas Ratio to be introduced while the generator is making “Rich” Exo Gas. The default setting of 7.50 may differ slightly due to specific generator characteristics. Consult the generator manual for troubleshooting guidelines or contact UPC-Marathon for further support.

### **Ratio Deviation Alarm / Delay** (Default = 0.10 / 30sec)

This value defines the limit for the ratio deviation alarm and the time required outside of this range before an alarm is sounded. When the actual air/gas ratio deviates from the ratio setpoint by more than this value for more than the delay time a Ratio Deviation Alarm will occur.

## 12.2 Temperature Setup Parameter Group (User,Admin,Eng Levels)

These parameters define the characteristics of the temperature control for the gas generator. Changes to these parameters will take effect immediately. All parameters are only editable in USER, ADMIN, and ENG levels.

### **Temperature Loop Selection Buttons**

When more than 1 temperature control loop is activated, the buttons at the bottom of the temperature control setup screen provide a way to toggle which temperature loop is displayed and is edited from the screen. It is important to review these buttons to confirm the correct temperature loop is selected prior to making any parameters changes.

### **Temperature Setpoint**

The temperature setpoint is the desired temperature to control the gas generator hot zone.



### **Temperature Deviation Alarm / Delay**

The deviation alarm value determines when a temperature deviation alarm should be triggered.

### **Control Mode (Auto/Manual)**

The control mode defines the PID control active status for the temperature control loop. Typically, this parameter is left in “AUTO” mode but can be changed to “Manual” mode during initial system startup or for troubleshooting reasons. It should be fully understood that when the loop is in manual mode, the temperature is not under control and can go higher than desired. It is always recommended to check the over temperature controller (not included with ExoInjector™ system) prior to placing temperature PID in manual mode to ensure temperature will shut down if excessive temperature is reached.

### **Low Temp Alarm (Default: 1400F)**

The low temperature alarm is a critical safety setpoint. When the actual control temperature is higher than this value the low temperature alarm relay will energize. This relay must be wired into the motor start circuit for the ExoInjector™ mixing system so that if the temperature goes below this low temperature setpoint the mixing system must stop and the reaction gas must automatically be isolated. The minimum setpoint of this value shall be 1400degF per NFPA 86 guidelines.

### **Control Cycle Time (sec)**

The control cycle time is used to setup time proportional control of the relay output used for temperature control. This time value represents the amount of time to divide between high fire and low fire based on the %output of the temperature control PID loop. The %output represents the % of the control cycle time to remain at high fire. For example, if the Control Cycle time was set to 20 seconds and the temperature control %output was 75% then the temperature control relay would remain energized 15 seconds and de-energized 5 seconds.

### **Off Delay Time (sec)**

Some burners and flame safety devices require that the burner be at high fire for a minimum amount of time before returning to low fire. This parameter will set the minimum amount of time in seconds that burner must remain at high fire before the burner can turn off (or return to low fire).

### **Control Output (%)**

The control output in the temperature setup panel is the same as the %output as detailed on the temperature detail panel on the main screen. The value is READ ONLY when temperature PID control is in AUTO mode. However, the %Output can be changed when PID is in MANUAL mode.

### **Control PID Values**



PID settings can vary widely depending on the controller hardware incorporated with the system. If not familiar with the controller setup parameters for that hardware, contact UPC-Marathon for advice regarding initial settings and tuning recommendations.

### **12.3 Pressure Setup Parameter Group (User,Admin,Eng Levels)**

This parameter group is only available when pressure control is enabled from the system setup screen. The pressure control feature can only be used on “LP Configuration” systems that utilize Variable Frequency blower motor controls. Changes to these parameters will take effect immediately. All parameters are only editable in USER, ADMIN, and ENG levels.

#### **Pressure Setpoint**

The pressure setpoint is the desired generator outlet pressure the system should maintain

#### **Pressure Deviation Alarm / Delay**

The deviation alarm value determines when a pressure deviation alarm should be triggered.

#### **Control Gain**

The control gain defines how fast the system responds to deviations from setpoint. A larger gain value will force the system to respond faster, however, if the gain is too large the system may become unstable and cause pressure fluctuations.

#### **Control Rate**

The control rate defines how quickly to make changes. A larger rate will slow down the iterations of the control loop but may make the system to slow to respond to pressure changes.

### **12.4 Burnout Setup Parameter Group (User,Admin,Eng Levels)**

This parameter group is only available when retort burnout control is enabled from the system setup screen. The retort burnout control feature can only be used on PLC control systems that have been programmed to interact with specific generator burnout air components. Changes to these parameters will take effect immediately. All parameters are only editable in USER, ADMIN, and ENG levels.

#### **Burnout Start Buttons**

The burnout start button will set the appropriate retort temperature to 1500degF and wait for the temperature to reach this setpoint before energizing the retort 1 burnout relay.

#### **Burnout Stop Buttons**

The burnout stop button will halt the retort burnout process for the retort. If the burnout relay for that retort is energized, then the burnout relay will de-energize immediately. No changes will be made to temperature setpoint for that retort.

#### **Burnout Time (min)**





The burnout time is the amount of time to energize the retort burnout relay for that retort. It should be noted that the burnout time and relay will stop if the temperature rises by more than 50deg above setpoint.

### **Burnout Status Messages**

“Burnout Pending” – Burnout has been started but the temperature is not within 50deg of setpoint

“Burnout Active” – Burnout relay is energized, and timer is counting. Remaining time is displayed with this message.

“Burnout Complete” – Indicates that the burnout timer has completed normally and that the relay has been de-energized.

“Burnout Stopped” – Indicates that the burnout was manually interrupted and that the relay is de-energized.

## **12.5 Language Setup Parameter Group (User,Admin,Eng Levels)**

The ExoV5 HMI software is designed to be completely multi-language capable and can be changed while online. To change the language, select the flag of the country and all text and alarm messages will be in the predominant language of that country. If the language (or flag) desired is not found, contact UPC-Marathon support team to request a language/flag addition to the HMI program.

### **Editing the HMI Text Tag File**

All displayed text on the HMI is locally stored as “tags” in the file “setup/EXOV5tags” text lookup file. However, it is **STRONGLY** recommended not to edit this file directly using a text editor. Instead, it is recommended to use the “EXOV5tags\_Master Excel File” located in the same directory to edit any tags and use the procedure outlined here to update the EXOV5tag file.

1. Using MS Excel, open the “EXOV5tags\_Master Excel File” located in the setup directory.
2. Edit the text as desired for the language selection desired  
Note: The first 2 columns indicate the tag number and brief usage description for the tag and each column afterwards contains the text for each specific language.
3. Save the changes to the “EXOV5tags\_Master Excel File”
4. Now, while still in the excel program, press “CTRL+A” to select all items
5. Press “CTRL+C” to copy all items in the Excel sheet.
6. Open “EXOV5tags.txt” file located in the setup directory using notepad program or similar.
7. Press “CTRL+A” to select all items in the text file.
8. Press “CTRL+V” to paste all items from the excel file into the text file.
9. Save revised EXOV5tags file (Note: filename cannot be changed).

### **Finding Which Tag to Edit**



If unsure which tag number is used for a specific item on the HMI, double tap on the main title of the HMI (always located at the top left of the screen) and this will change the HMI screen so that it displays the tag number for each text item on the screen. To revert back to the language selection, double tap on the main title again.

Note: If the screen is using a language other than English, double tapping on the main title will convert the screen to English first, another double tap on the main title will convert the text to tag number assignments, and a final double tap will convert the screen back to the previously displayed language.

### **12.5.1 System Setup Parameter Group (ADMIN, ENG Levels Only)**

The ExoV5 HMI software has been designed to work with many different controllers and generator configurations. Parameters contained within the “System Setup” group are items that usually are only setup once during system installation and should not require frequent changes. It should be understood that parameters contained within the “System Setup” group can directly affect the safety of the generator. Only persons trained and experienced with generator setup and operation should attempt to change these parameters without direct support from UPC-Marathon.

### **12.5.2 System Signal Overview (ADMIN, ENG Levels Only)**

The signal overview is a direct reading of the analog signals connected to the controller. It is primarily used for troubleshooting wiring and setup issues.

### **12.5.3 System Communication Setup (ENG Level Only)**

This section contains parameters that affect how the HMI will communicate with the control device(s).

#### **Controller Type**

Select the modbus register lookup table to use with the installed controller. This parameter should only be changed with the support of UPC-Marathon.

#### **HMI Comm Protocol** (*Serial, TCP, or DEMO mode*)

Select the communication link type between the HMI and controller device. Demo mode will provide a demonstration mode that simulates values for training and presentation purposes.

#### **HMI Serial Port** (*Serial protocol only*)

Select the serial com port used to connect the HMI to the controller device.

#### **HMI Baud Rate** (*9600, 19200*) (*Serial protocol only*)

Select the serial baud rate used to communicate to the controller device.

#### **HMI Parity** (*Even, Odd, None*) (*Serial protocol only*)



Select the serial parity used to communicate to the controller device.

**Device IP** (*TCP protocol only*)

Enter the IP address of the controller device.

**Enable Animation**

Toggle if the screen uses animations. Turning animations off can make slow HMI screens more responsive.

**Display Generator Screen**

Toggle if the if the HMI should allow a visual representation of the generator. Some controller types do not provide adequate feedback from generator sensors and devices and therefore, this screen can be hidden to avoid confusion over component status.

**Display Retort Number**

Identify the number of retorts to display on the generator overview screen. Note: this parameter will be over written by the temperature loops active if a suitable graphic is not available to represent the temp loop and retort combination.

### 12.5.4 System Device Setup (ENG Level Only)

This section contains parameters that define setup items specifically involved in how the HMI and Device are used with the generator equipment.

**Device#1 Temp Unit**

Informs the HMI of what temperature units are used within the controller device. This parameter **MUST** equal the temperature units within the control device. Note: changing this parameter does not change the units within the control device only how the HMI interacts with the controller.

**Device#1 Flow Unit**

Informs the HMI of what flow units are used within the controller device. This parameter **MUST** equal the flow units within the control device. Note: changing this parameter does not change the units within the control device only how the HMI interacts with the controller.

**Device#1 Press Unit**

Informs the HMI of what pressure units are used within the controller device. This parameter **MUST** equal the pressure units within the control device. Note: changing this parameter does not change the units within the control device only how the HMI interacts with the controller.

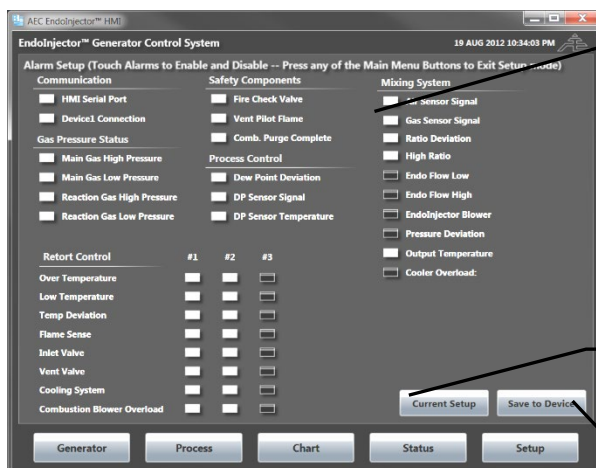
**Retort Burnout Enable**

Informs the HMI if retort burnout capabilities are available within the connected controller. This parameter **MUST** equal the status of retort burnout capability within the controller. Note: changing this parameter enable burnout capability within the control device it only enables the burnout features on the HMI.



## Device Alarm Setup (CAUTION!!!)

This is used to setup what alarms are enabled or disabled in both the HMI AND THE CONTROLLER. Note: Changing alarm enable/disable status actually changes the usage of alarms in the controller. If an alarm is “disabled” it will both be hidden on the HMI and disabled in the controller. Alarms should only be disabled when the generator does not require the alarm, the installation does not provide the necessary input signals to the controller, or alternate safeties have been installed. Exercise caution when disabling any alarms. Some alarms are critical to the safe operation of the equipment and are required to meet NFPA86 guidelines. Alarms must only be disabled if alternate safety measures are installed separate from the Exolnjector control device.



### Alarm Enable Status

White = Alarm Enabled

Black = Alarm Disabled

(Press Alarm LED to Change Enable Status)

### Note

Changing alarm status does not change immediately in the controller. Changes must be saved to the control device using the “Save to Device” button.

Load Current Alarm Setup from Controller

Save Alarm Setup to Controller

## 12.5.5 System Flow Setup (ADMIN, ENG Level Only)

This section contains parameters that define setup items specifically involved in the flow control sensor for the Exolnjector™ and flow display on the HMI.

### Flow Display Unit

Select what flow unit to display on the touchscreen. This does not change any parameters in the controller, only how the information is displayed on the HMI.

### Air mA Offset

Offset the mA signal from the air flow transducer.

### Gas mA Offset

Offset the mA signal from the gas flow transducer.

### Exo Expansion Factor



Change the expansion factor used to calculate exothermic gas output flow rate. Exo Flow is a calculated value that represents the amount of exothermic gas being produced by the generator. It is calculated using the following equation:  $\text{Exo Flow} = (\text{Air Flow} + \text{Gas Flow}) \times (\text{Expansion Factor})$ . Typical values for systems using natural gas = 0.83.

**High Ratio Alarm Setpoint** (*Default = 8.0 Nat Gas, 15.0 for Propane Systems*)

Define the maximum ratio limit that is considered safe. If the actual ratio is higher than this for longer than the high ratio alarm delay, then the critical alarm relay will be de-energized which should be interlocked to stop the mixing system. This is a test to ensure that gas supply is provided, and the ratio control valve is functioning.

**High Ratio Alarm Delay (sec)** (*Default = 10 seconds*)

The high ratio alarm delay is the amount of time in seconds that a high ratio situation should be allowed to occur before triggering the critical alarm. Note: Depending on the reaction gas supply pipeline, there is typically a few seconds of time that the blower is started before gas is supplied to the mixing system. It may be necessary to increase this delay parameter to accommodate slower reaction gas introduction.

**Valve Speed Gain** (*FACTORY SET = DO NOT CHANGE THIS VALUE*)

This value defines the response characteristics of the fuel injection control valve. Typically, once this value is set at the factory, it will not require adjustment. Note: as a “rule of thumb” increasing this value will make the valve respond slower.

**Low Flow Alarm**

If the calculated exothermic gas flow rate is lower than this value for a time longer than the flow alarm delay time an alarm will sound.

**High Flow Alarm**

If the calculated exothermic gas flow rate is high than this value for a time longer than the flow alarm delay time an alarm will sound.

**Flow Alarm Delay (sec)**

The high/low flow alarm delay time.

### 12.5.6 System Temperature Setup (ADMIN, (ENG Level Only)

This section contains parameters that define setup items specifically involved in the setup of the temperature control for the ExoInjector™

**# of Temp Loops** (*1, 2, or 3*)

Select how many active temperature control loops are on the generator.

**Temp Display Unit**

Select what temperature unit to display on the touchscreen. This does not change any parameters in the controller, only how the information is displayed on the HMI.



### **Temp TC Type**

Select the TC type used for temperature control. All temperature loops must use the same TC type.

### **Temp#1 Offset**

Offset the temperature signal for the first temperature control loop.

### **Temp#2 Offset**

Offset the temperature signal for the second temperature control loop.

### **Temp#3 Offset**

Offset the temperature signal for the third temperature control loop.

### **Burner Control Type (Premix, Ring, SCR)**

Selection of the temperature control method used for the generator. This selection mainly affects the generator overview display regarding what pipeline diagram to display.

### **Purge Time (sec) (*Premix Control Type Only*)**

Required amount of combustion air purge. Timer will start when the combustion air pressure switch is made. This option is only available when the combustion control type is set to “premix”.

### **Exo Temp Enable**

Select if the output exothermic gas temperature will be monitored.

### **Exo Temp Offset (*Exo Temp Enable = True*)**

Offset the temperature signal for the exothermic gas thermocouple.

### **Exo Temp Alarm (*Exo Temp Enable = True*)**

When the exothermic gas output temperature is above this setpoint an alarm will be triggered.

## **12.5.7 System Pressure Setup (ADMIN, (ENG Level Only)**

This section contains parameters that define setup items specifically involved in the setup of the pressure control for the ExoInjector™. The pressure control is only available on the “LP” configuration systems that utilize a variable speed drive to control the speed of the ExoInjector™ blower.

### **Exo Pressure Sensor Enable**

Indicate if a pressure sensor is attached to monitor the exothermic gas generator output pressure.

### **Exo Pressure Sensor Scale (*Exo Pressure Sensor Enabled*)**



Set the pressure transducer scale that is used to measure the generator output pressure.

**Exo Pressure Sensor mA Offset** (*Exo Pressure Sensor Enabled*)

Input an offset for the exo gas pressure sensor mA signal (displayed on the signal overview screen).

**Premix Pressure Sensor Enable**

Indicate if a pressure sensor is attached to monitor the premix gas pressure.

**Premix Pressure Sensor Scale** (*Premix Pressure Sensor Enabled*)

Set the pressure transducer scale that is used to measure the generator output pressure.

**Premix Pressure Sensor mA Offset** (*Premix Pressure Sensor Enabled*)

Input an offset for the premix pressure sensor mA signal (displayed on the signal overview screen).

**Pressure Display Unit** (*Pressure Control Enabled*)

Select what pressure unit to display on the touchscreen. This does not change any parameters in the controller, only how the information is displayed on the HMI.

**Pressure Control Enable** (*Exo Pressure Sensor Enabled*)

Select if system pressure control should be enabled. Only if the system is provided with a VFD controller to change the speed of the pump.

**Blower Min Hz** (*Pressure Control Enabled*)

Set the minimum speed that the blower should be allowed to run. This setting is used to set a base minimum flow rate through the generator. This value should be set at the frequency where the output flow is approximately 25-30% of rated generator capacity. Therefore, if output demand is reduced further, then the system will not allow the blower to spin slower and the output pressure will rise allowing for a relief regulator to open. The setup should provide that the flow through the ExoInjector™ mixing system is not below 20% of rated capacity.

Note: It is not recommended to run the blower motor at frequencies lower than 20Hz due to higher amperage and heat generated at these lower speeds.

**Blower Max Hz** (*Pressure Control Enabled*)

Set the minimum speed that the blower should be allowed to run. The setting can set to the frequency that provides the maximum flow capacity of the generator. Thus, if additional demand is required, the blower will not increase in speed further than this value so that the system does not produce more exothermic gas than the system was designed.

## 12.5.8 System Calibration Curve Setup (ENG Level Only)

This section contains parameters that define the calibration curves for the air and gas flow transducers attached to the mixing system. DO NOT change these parameters without specific instruction from UPC-Marathon.



### **Air Curve Data**

Indicate each calibration point for the air flow transducer (mA and Flow)

### **Gas Curve Data**

Indicate each calibration point for the gas flow transducer (mA and Flow)

Selecting any button will allow the operator to edit the calibration curve mA or Flow for each calibration point.

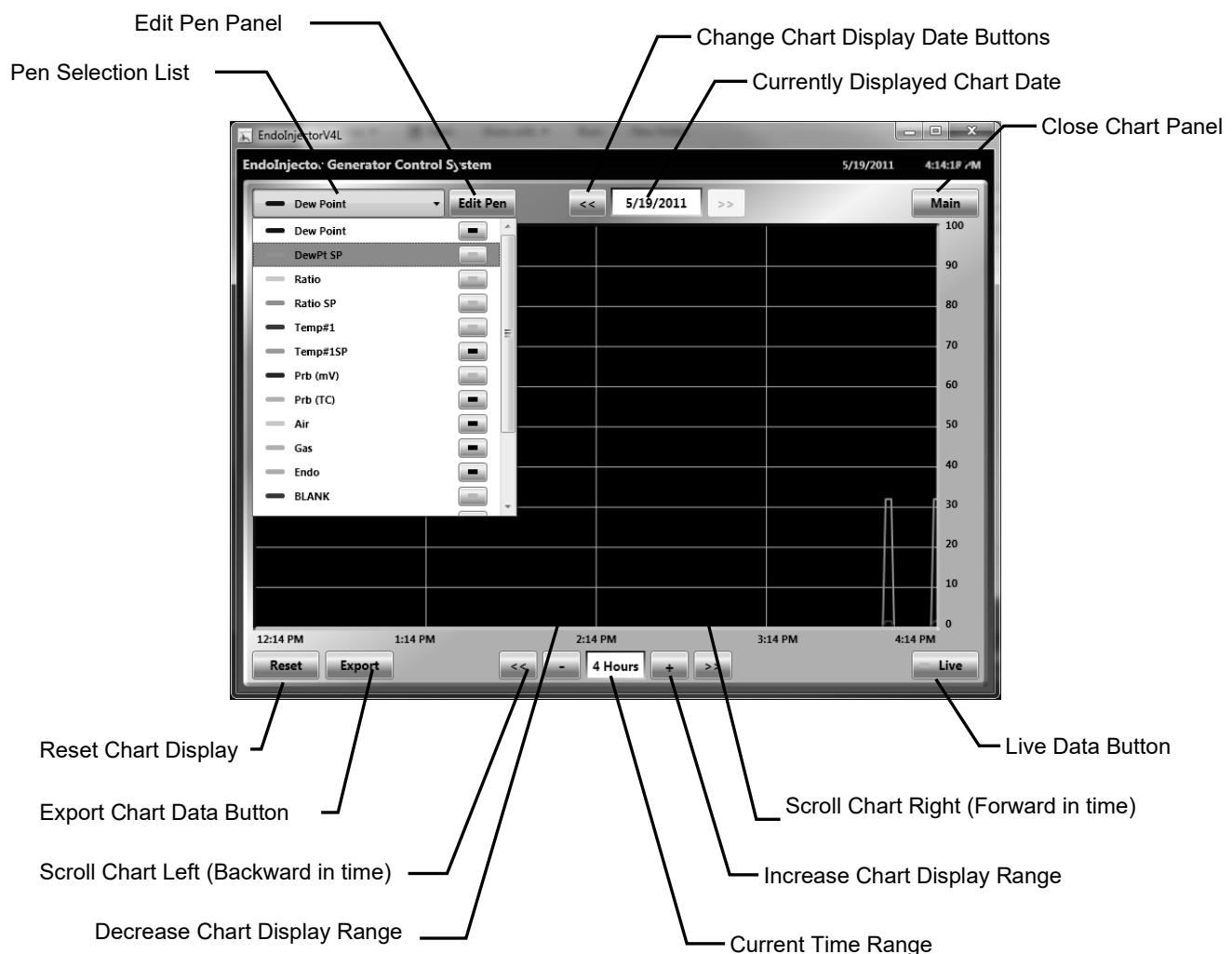




## 13 PAPERLESS CHART RECORDER

Pressing the “History” button on the main screen opens the ExoInjector paperless chart recorder. The paperless chart recorder displays the long-term historical data for all generator process variables. Data is stored once every minute on the touch-screen hard drive in daily encrypted log files that can be exported to CSV files that can be opened in any spreadsheet program (i.e. MS Excel) for detailed investigation and reporting if required. The generator performance data will never overwrite old data since the hard drive space provides 50+ years’ worth of daily storage space. However, for tacking purposes, the data should only be considered archived for 5+ years on the touch screen unless backed up to a remotely maintained data storage center.

### 13.1 Paperless Chart Recorder Overview



### PEN SELECTION LIST



The pen selection list provides a list of all pens available to display, the current pen color for each variable, and a button to display or hide the pen on the chart. Also, selecting a pen will update the scale values on the right of the chart to display the selected pen's scale settings. Each pen is drawn based on their own minimum and maximum scale range. The scale range for each pen can be changed by first selecting that pen in the Pen Selection List and then pressing the "Edit Pen" button. Note: The actual data values are stored regardless of pen scale or display settings.

### **Edit Pen Button**

The edit pen button opens a panel that provides a way to edit the minimum display scale range, maximum display scale range, and pen color selection. Note that each pen is drawn based to its own scale however, actual data stored is not affected by these settings.

### **Currently Displayed Chart Date**

The log data is separated into daily log files. The log file that is currently being displayed is shown in the currently displayed chart date at the top of the chart.

### **Change Chart Display Date Buttons**

The change chart display date buttons are located on either side of the current chart date at the top of the chart screen. Pressing these buttons will increase or decrease the current display date by one day.

### **Current Time Range**

The current time range is found at the bottom of the chart display and represents the amount of time currently displayed from the left to the right on the chart. The default is to display 4 hours of data at a time, but this can be increased to an entire day or decreased to just 15 minutes.

### **Increase / Decrease Chart Display Range Buttons (+ / -)**

The increase and decrease chart display buttons will change the time range of data to display on the chart. Basically, these buttons provide a way to zoom in and out of the data in time. The limit is to increase the range to view an entire day of data or decrease the range to view just 15 minutes of data.

### **Scroll Chart Right / Left ( << / >> )**

The scroll chart buttons provide the means to pan the chart through time. Each press of either of these buttons will scroll the chart by 2 vertical gridlines (1/2 of the time range displayed).

### **Live Data Button**

The live data button indicates and provides a way to turn the chart display on or off so that it automatically updates while viewing the data. When the live button is "on" then the chart will update and scroll automatically from right to left as new data is written to the log file.

### **Reset Chart Display**



The reset chart display will reset the current display date to “today” and the current time range to 4 hours.

### **Export Data Button**

The export data button opens a save dialog window to export the currently displayed daily data to a csv file. Attach a USB storage device to one of the USB ports on the back of the touch-screen then navigate and save the csv file to the storage device so that it can be transferred to another computer for review.

## **14 ALARM STATUS SCREEN**

Pressing the “Status” button on the main screen opens the alarm status screen that indicates current system alarm status.

The visibility of some alarms depends on what alarms are enabled on the system and available on the controller installed.

The lists of alarms will turn green, yellow, or red depending on status of the alarm being described.

**Red** = Active alarm that has not been acknowledged

**Yellow** = Active alarm that has been acknowledged

**Green** = Alarm is OK

**Black** = Alarm status is Unknown due to communication failure

### **14.1 Communication Alarm Status**

COM alarms occur when any failure of the Modbus communication is detected. All other alarms will remain “Black” until all communication alarms are resolved as OK.

#### **HMI Serial Port**

A port open alarm occurs when the com port selected in the setup screen is not actually found on the HMI touch screen. Also, if the communication port of Ethernet is selected then a port alarm will occur when the IP address the HMI is trying to reach to communicate with the ratio controller is not found.

#### **Device Connection**

A ratio controller communication alarm occurs when the ratio controller cannot be found, or a Modbus read or write operation has failed. Typically, this alarm will occur if the polarity of a serial connection is reversed or disconnected.

#### **Gas Pressure Status**

##### **Main Gas High/Low Pressure**

Indication that the high and low main gas pressure switches are ok.



### **Reaction Gas High/Low Pressure**

Indication that the high and low reaction gas pressure switches are ok.

### **Safety Components Alarm Status**

#### **Fire Check Valve**

Indication that the fire check valve switch is ok.

#### **Vent Pilot Flame**

Indication that the vent pilot flame safety is OK. This flame must be present during the mixing system operation.

#### **Combustion Purge Complete**

The combustion purge timer will begin timing when the combustion blower low pressure switch is made. The amount of time required is defined in the system setup menu. Once purged, the timer will reset when the combustion air low pressure switch falls open.

### **Mixing System Alarm Status**

#### **Air / Gas Sensor Signal**

Indication that air or gas sensor is outside normal 4-20mA range

#### **Ratio Deviation**

Indication that air/gas ratio is outside the deviation band for more than the alarm delay period.

#### **High Ratio**

Indication that air/gas ratio is above the high ratio alarm setpoint for more than the alarm delay period.

#### **Exo Flow Low / High**

Indication that calculated exo gas flow is below or above the alarm setpoint for more than the alarm delay period.

#### **Mixing System Alarm Status**

*(continued from previous page)*

#### **ExoInjector™ Blower**

Indication that the blower is not in operation.

#### **Pressure Deviation**

Indication that pressure is outside the deviation band for more than the alarm delay period.

#### **Output Temperature**

Indication that exothermic gas temperature is above the exo temp alarm setpoint. This is an indication that the cooler may not be in operation or requires maintenance..



### **Combustion Blower Overload**

Indication that combustion blower is not in operation due to motor amperage overload.

### **Retort(s) Alarm Status**

#### **Over Temperature**

Indication that the over temperature controller for that retort is tripped open.

#### **Low Temperature**

Indication that temperature of the retort is below the low temperature alarm setpoint.

#### **Temp Deviation**

Indication that temperature of the retort is outside the deviation band for more than the alarm delay period.

#### **Flame Sense**

Indication that flame safety for the retort does not sense a flame or pilot flame present

#### **Inlet Valve**

Indication that inlet valve is open when the temperature is below the low temperature alarm setpoint.

#### **Vent Valve**

Indication that the outlet valve is not in the vent mode before system startup.

#### **Cooling System**

Indication that the cooling system for the retort is not operational.

#### **Cooling System Overload**

Indication that cooling system overload has been tripped.

## **15 MAINTENANCE**

The LP ExoInjector™ is designed as a very robust industrial mixing system and the control logic is setup to monitor critical system faults before damage can occur. However, there are a few recommended items to check regularly on the mixing system to ensure successful system operation over many years.

### **Intake Air Filter**

The intake air filter is the main item of concern that must be checked regularly and changed preemptively to ensure that the blower motor is not overheated or damaged. UPC-Marathon



installs a filter change indicator next to the intake air filter that should be inspected weekly and when the filter change indicator reaches the “RED ZONE” then the filter element should be removed, blown off/cleaned, and then replaced. After resetting the filter change indicator, continue to watch the filter change indicator. If the filter change indicator reaches the “RED ZONE” again then the filter element should be changed. Filter change times will range between monthly to every 6 months depending on the air quality in the room where the ExoInjector is located. In some circumstances, it may be advisable to pipe the incoming air from a separate location.

#### **NOTICE**

Running the blower with the filter change indicator in the “RED ZONE” for an extended period can cause offset in flow transducer readings and will cause the blower to overheat and can cause damage to the blower bearings and motor.



## 16 CUSTOMER SUPPORT

Americas	Asia	Europe
<u><a href="mailto:support.na@upc-marathon.com">support.na@upc-marathon.com</a></u>	<u><a href="mailto:service@mmichina.cn">service@mmichina.cn</a></u>	<u><a href="mailto:support.eu@upc-marathon.com">support.eu@upc-marathon.com</a></u>
<b>USA:</b> +1 414 462 8200	<b>Shanghai:</b> +86 21 3463 0376	<b>France:</b> +33 3 81 48 37 37
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UPC-Marathon brings together leading brands to the heat-treating industry including Atmosphere Engineering, Furnace Control, Marathon Monitors, Process-Electronic, and Waukee Engineering. We provide prime control solutions through our worldwide sales and services network with easy-to-access local support.

