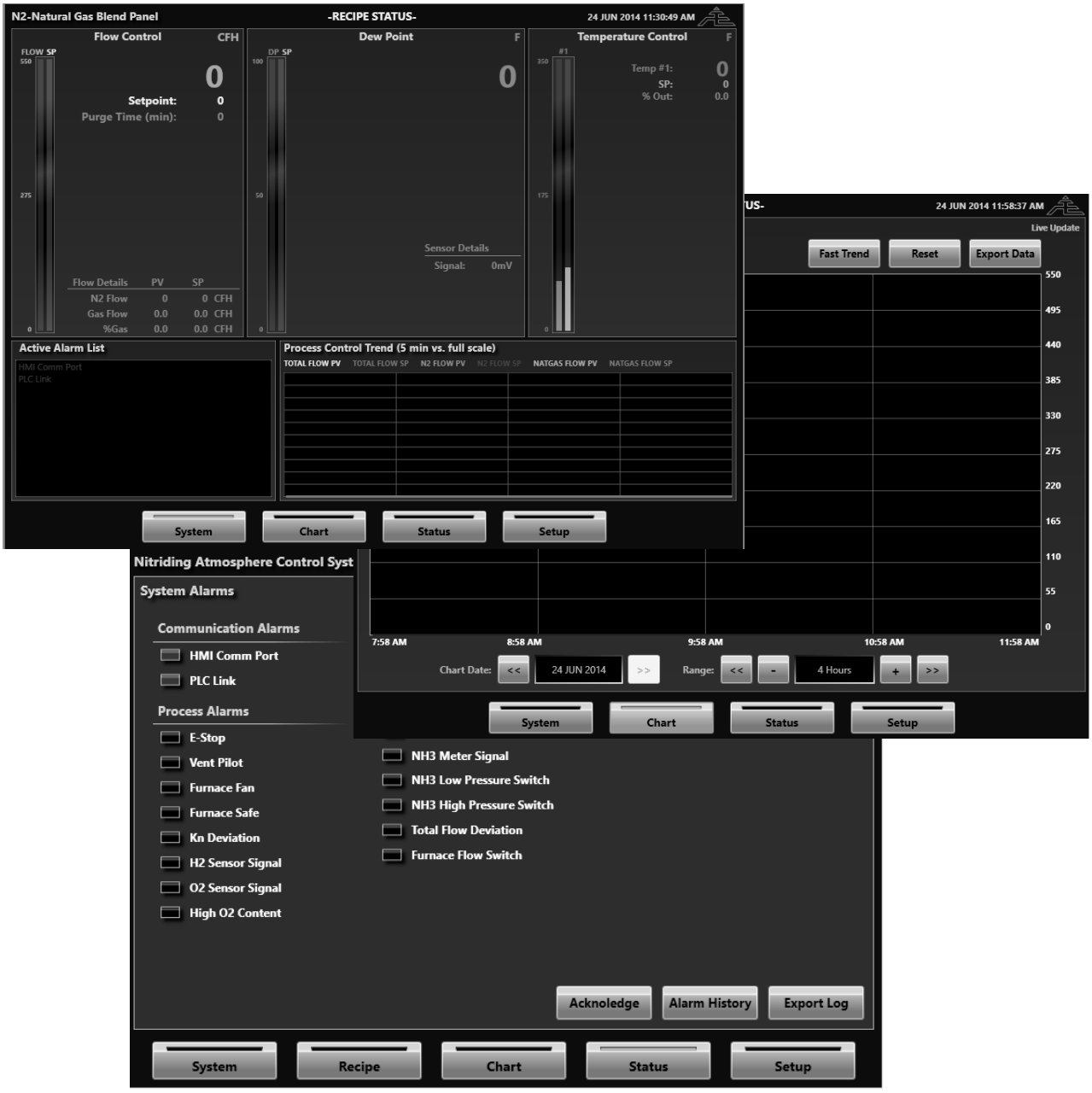
UPC·MARATHON

ActivePLC™
Programmable Logic Controller



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MANUAL #: 207

Revision #	Revision Date	Revision Description
006	31/10/2019	

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COMMUNICATION

Communication between the HMI and the PLC is handled via ModbusRTU. The typical installation utilizes a TCP/IP Ethernet connection between the touch-screen and PLC Ethernet port. No external communication has been provided at this time. Future expansion of communications is possible but will require engineering support from UPC-Marathon**.**

DATA STORAGE

The HMI touch-screen includes a minimum of 7GB of unused internal hard drive space. The daily encrypted log files are contained within the AEC program "log" and "log/backup" directories. 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/hardware life considerations the process log data integrity should be considered maintained for a period of 5+ years. Of course, the actual data may last longer and can be backed up remotely for an indefinite period.

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TECHNICAL ASSISTANCE

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

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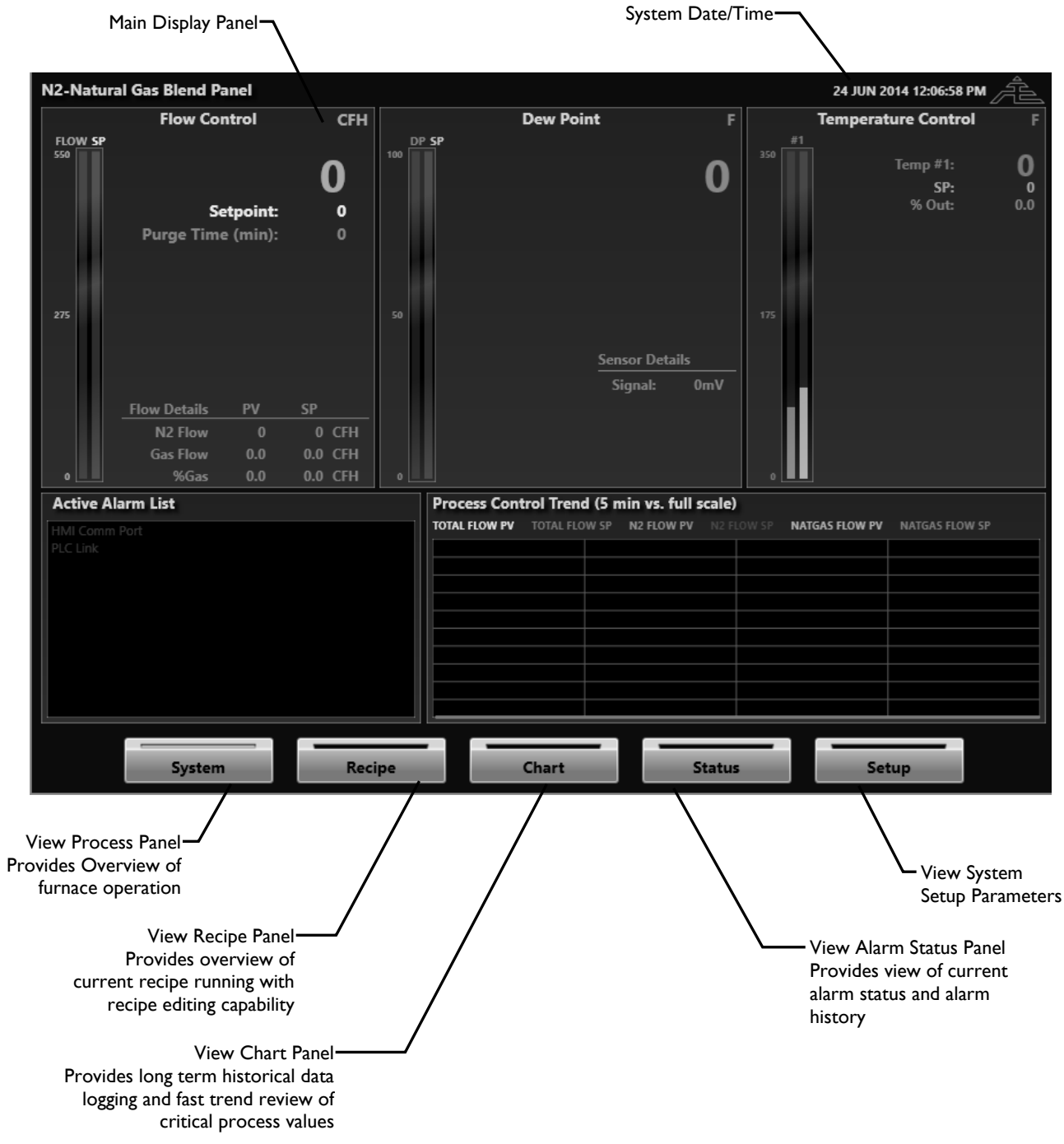
2 OPERATOR INTERFACE OVERVIEW

The full-color touch-screen provides the main interface between an operator and the control system. The software is designed to run on any computer operating Microsoft operating system (XP, Vista, or Win7) with the .net3.5SP1 Framework or later installed.

2.1 General Overview



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2.2 System Overview Panel

The system overview panel provides detailed information regarding all process information.

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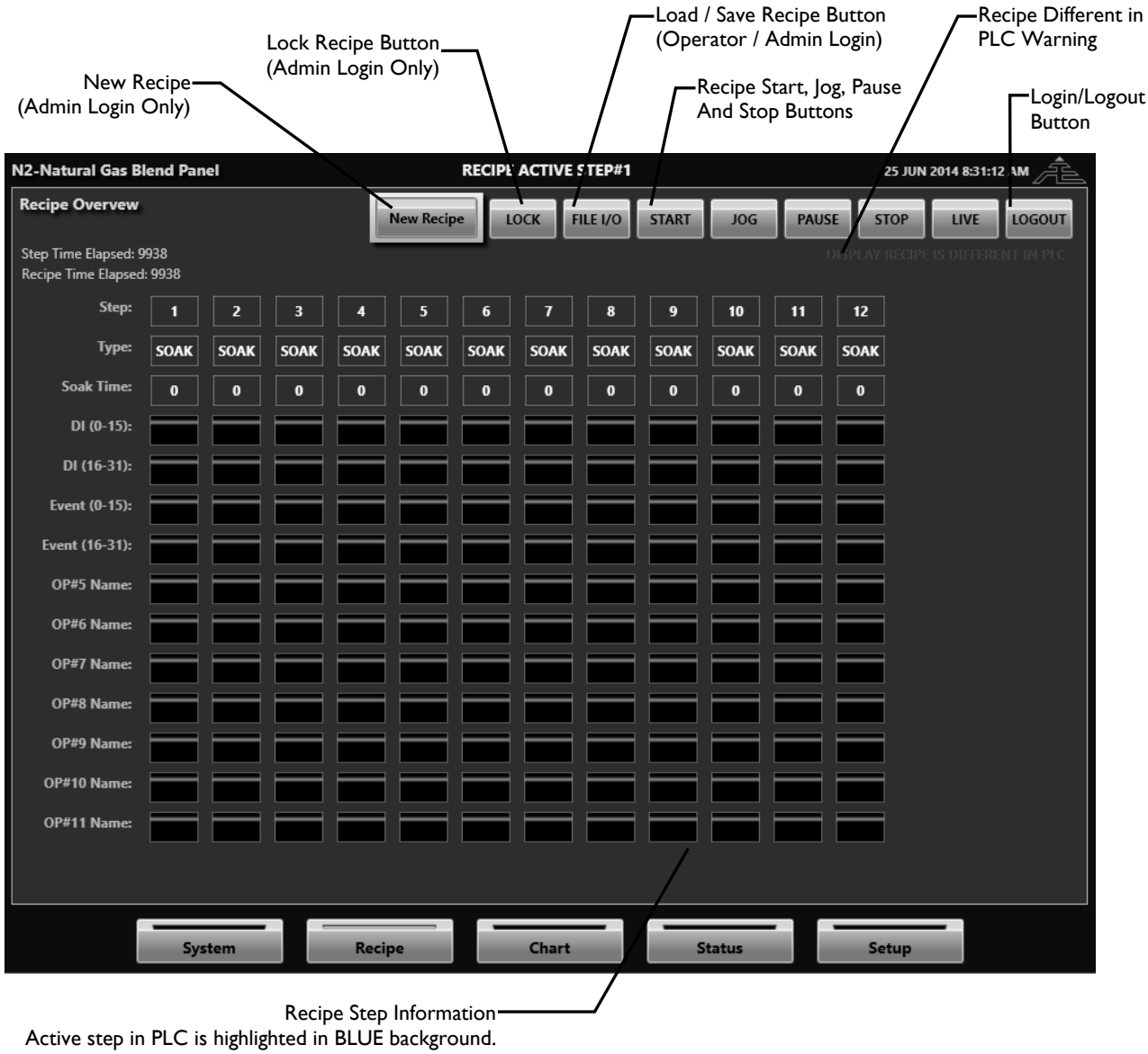
2.3 Recipe Overview Panel

The recipe overview panel provides detailed information regarding the setpoint and required events to occur during the operation of the furnace. The panel will typically display (by default) the recipe currently stored inside the PLC. However, this panel is also used to create and edit recipes as well. Therefore, whenever the recipe displayed on the screen is different than the recipe running in the PLC as warning message will be displayed on the screen in RED to inform the operator of this status.

Important Recipe Notes:

1. *Recipe steps will only advance to the next step when all of the operations AND soak time are achieved.*
2. *If a recipe is in a "pause" state, the soak time will pause while all other operations in the step continue following the operation settings for that step.*



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2.4 Recipe edit Procedures

Critically Important Safety Note

Only qualified personnel experienced with furnace control equipment, operation, and safety requirements shall attempt to create or edit any furnace recipe. The system was designed to be self-testing and provide alarm feedback and alarm history when conditions are not safe. However, the system will do what it is programmed to do! Improper recipes or incorrect settings can result in significant property damage and/or personnel harm.

Load or Save a Recipe Procedure (User or Administrator Level)

1. From the “Recipe Panel” press the “Login” button
2. Enter the User Login Password (Default = 2)
3. Press the “File I/O” button
4. To Load a recipe to the screen
    a. To load a stored recipe from the disk, press the “Disk” button under the “Load Recipe From” title
5. To Save a recipe to the Disk, press the “Disk” button under the “Save Recipe to” title.
6. To make the current recipe “Active in the PLC”, press the “Live” button.
    a. Note: Saving a recipe to the PLC will make it the “Active Recipe” and this recipe will run when the “Start Recipe” button is pressed.

Create a New Recipe Procedure (Administrator Level ONLY)

A new recipe can be created at any time, even when the system is currently running a different recipe. It is important to understand that the recipe that is displayed on the screen is completely independent from the recipe currently stored and/or running in the PLC. Only the recipe currently stored in the PLC should be considered the active recipe. Anytime the recipe in the PLC is different from the displayed recipe a warning message will display on the screen. Load the recipe from the PLC to display the active recipe. Only when the recipe displayed on the screen is the same as the recipe in the PLC will the warning message go away.

7. From the “Recipe Panel” press the “Login” button
8. Enter the Administrator Password (Default = 22)
9. Press the “Edit Recipe” button
    a. This will display the “Recipe Edit Options Panel” and unlock the recipe for editing.
10. Press the “New Recipe” button
    a. This will clear the currently display recipe and assign the first step with a 1-minute soak time.
    b. Press any Event or Setpoint instruction on the step to change it.
11. When the recipe displayed is finished, press the “File I/O” button
12. Press the Save to “Disk” button to save the recipe locally to the screen.
13. When finished creating or editing any recipe it is recommended load the active PLC recipe to the screen so there is no accidental confusion on what the active recipe is.
14. Press the “Admin Login” button to logout.
    a. Note: Leaving the Recipe panel will also automatically logout any user/admin.

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Edit a Recipe Procedure (Administrator Level ONLY)

A new recipe can be created at any time, even when the system is currently running a different recipe. It is important to understand that the recipe that is displayed on the screen is completely independent from the recipe currently stored and/or running in the PLC. Only the recipe currently stored in the PLC should be considered the active recipe. Anytime the recipe in the PLC is different from the displayed recipe a warning message will display on the screen. Load the recipe from the PLC to display the active recipe. Only when the recipe displayed on the screen is the same as the recipe in the PLC will the warning message go away.

1. From the “Recipe Panel” press the “Login” button
2. Enter the Administrator Password (Default = 22)
3. Load the desired recipe to edit to the screen.
4. Press the “Edit Recipe” button
    a. This will display the “Recipe Edit Options Panel” and unlock the recipe for editing.
5. Press the “New Recipe” button
    a. This will clear the currently display recipe and assign the first step with a 1-minute soak time.
    b. Press any Event or Setpoint instruction on the step to change it.
6. When the recipe displayed is finished, press the “File I/O” button
7. Press the Save to “Disk” button to save the recipe locally to the screen.
8. When finished creating or editing any recipe it is recommended load the active PLC recipe to the screen so there is no accidental confusion on what the active recipe is.
9. Press the “Admin Login” button to logout.
    a. Note: Leaving the Recipe panel will also automatically logout any user/admin.

2.5 Recipe Step Instructions

Recipes each contain up to 16 steps and each step is composed of a number of different instructions to perform during that step. This method provides a very easy overview of the entire recipe at a glance. The following is a list of step instructions that have been programmed into this system. Any combination of these steps can be used to build the desired process within the furnace. The only exception to this rule is the very first step. It must contain an “Atmosphere Purge” event and cannot contain any instruction to allow ammonia or other flammable gasses into the furnace.

Step Type (OFF / SOAK / GSOAK)

A SOAK step will advance only when the time elapses and all of the other operations have reached their desired setpoint. Note that if any operation setpoint or deviation setpoint is 0 then that operation will be considered complete during that step.

A step of type “GSOAK” step will start counting once all other operations have completed. Once the step time reaches the soak time setpoint then the step will advance.

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A step of type “OFF” will be skipped complete. No process values or events will change during this step.

Soak Time (1 – 9,999 minutes)

Defines the desired time to remain at this step.

DI (0-15) , DI (16-31)

In these 2 digital input operations up to 32 inputs can be enabled during each step and decide whether each input needs to turn off or turn on before advancing. Once all enabled inputs are in their desired state then the DI operation is complete.

Event (0-15), Event (16-31)

In these 2 event operations up to 32 events can be enabled during each step. The operation will always be considered complete, however these events can be used and pointed to other areas of the PLC such as digital outputs, logic bits, timer bits etc., given the user the ability to do a wide variety of logical events during the recipe.

Recipe Operation #5-11

Recipe operations#5-11 are used to change process variables within the program. Each operation has “setpoint”, “deviation sp”, “ramp toggle” and “ramp time” parameters. If the ramp toggle is off then the setpoint will be moved to the location defined in the recipe setup section. The operation will then be complete when the difference between the process variable and final setpoint is less than the deviation setpoint, however if a setpoint or deviation setpoint is set to 0 then the operation will automatically be complete. If the ramp toggle is on then the setpoint will be added or subtracted at a rate defined by the ramp time. Again, the operation will be complete once the difference between the process variable and final setpoint is less than the deviation setpoint.

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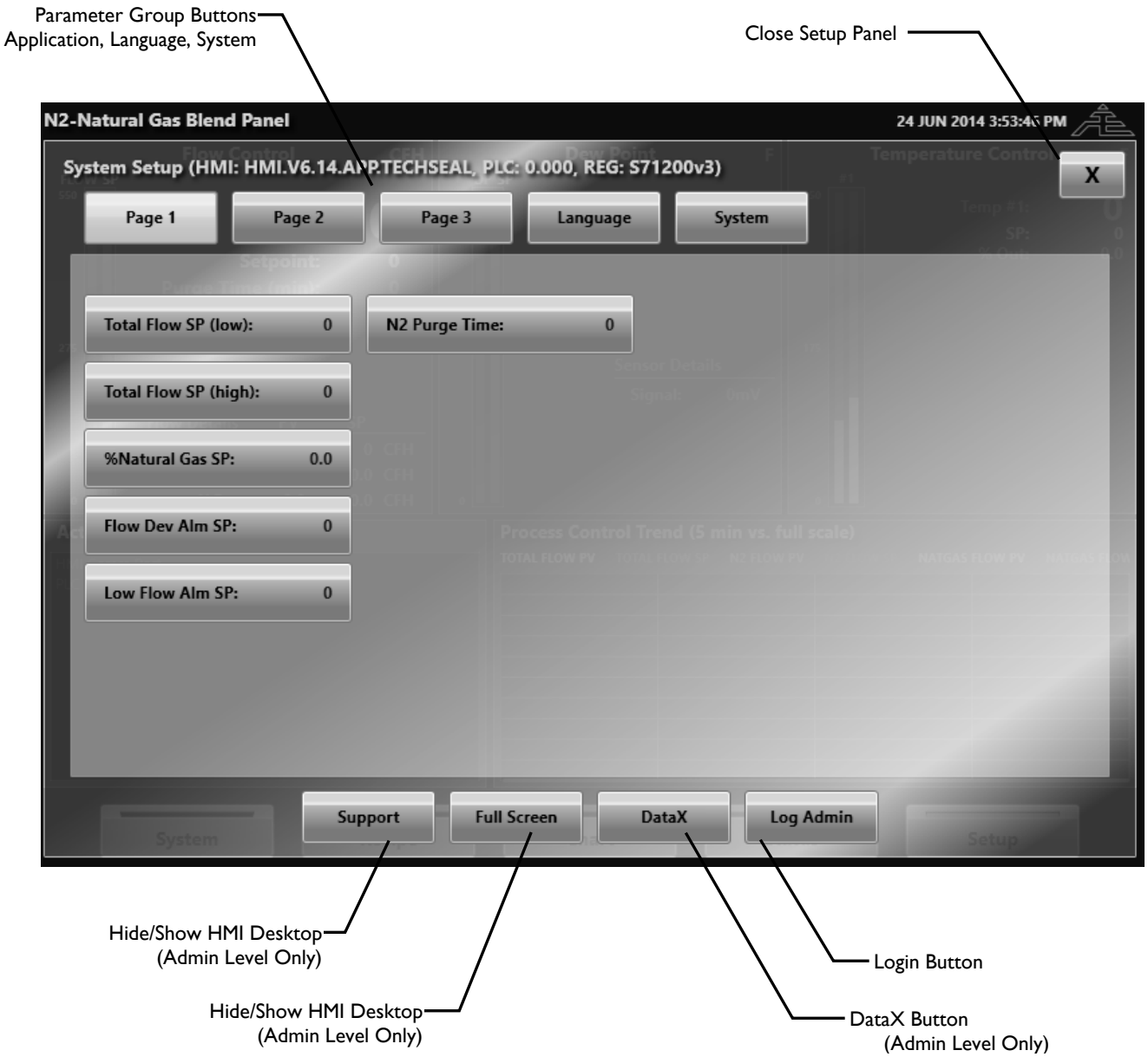
2.6 Setup Screen Overview

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. Some of the buttons detailed below will not be available unless logged in as “ADMIN”.



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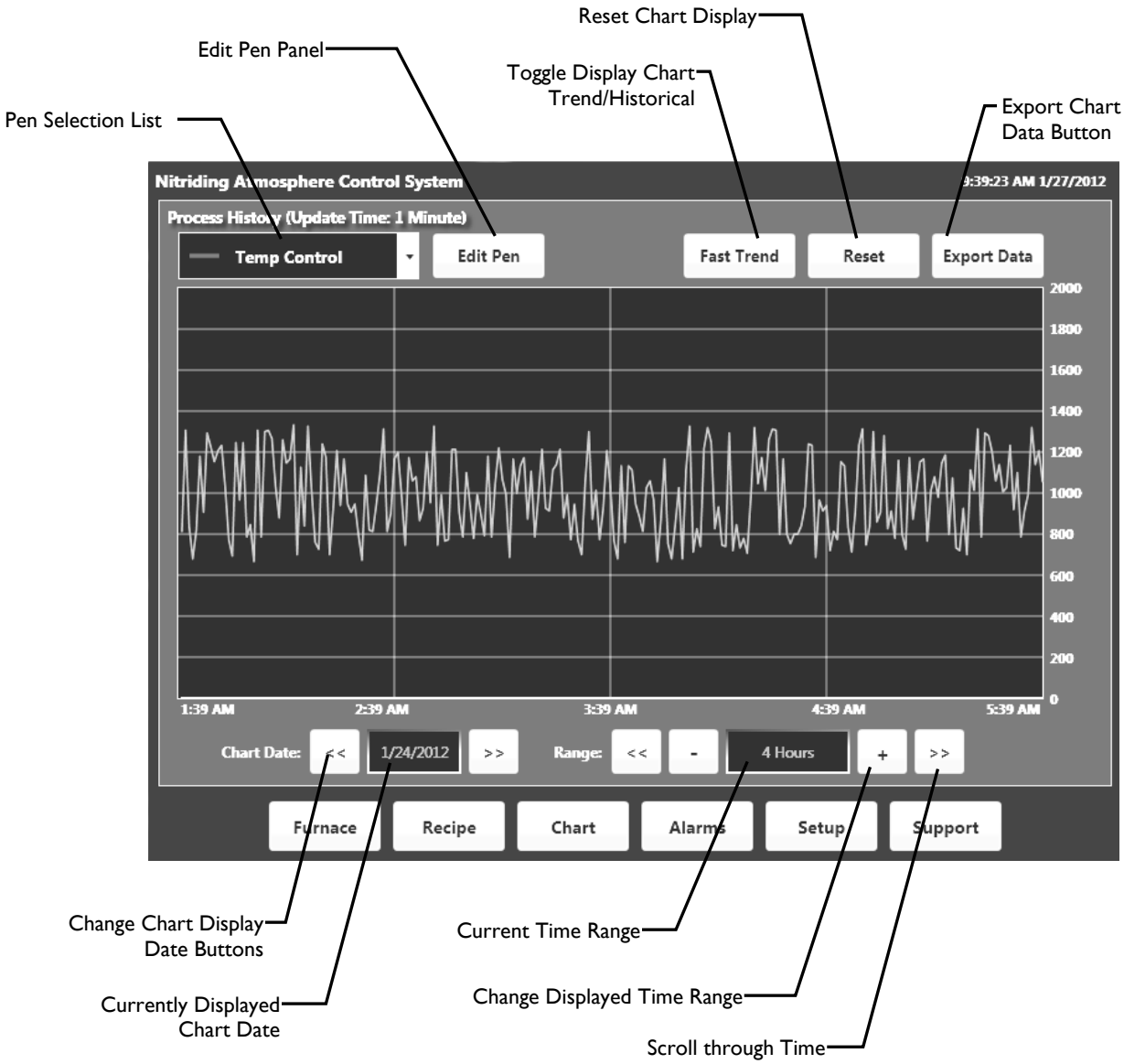
2.7 Paperless Chart Recorder

Pressing the “History” button on the main screen opens the paperless chart recorder. The paperless chart recorder displays the long-term historical data for all 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.

2.7.1 Paperless Chart Recorder Overview



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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 15minutes 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).

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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.

2.8 Alarm Status Screen

Pressing the “Status” button on the main screen opens the alarm status screen that indicates current system alarm status. The lists of alarms will turn green, yellow, grey or red depending on status of the alarm being described. Red indicates an active non-silenced alarm, yellow indicates an active but silenced alarm, green indicates that the alarm is OK and grey indicates that the alarm is not active (based on alarm setup parameters).

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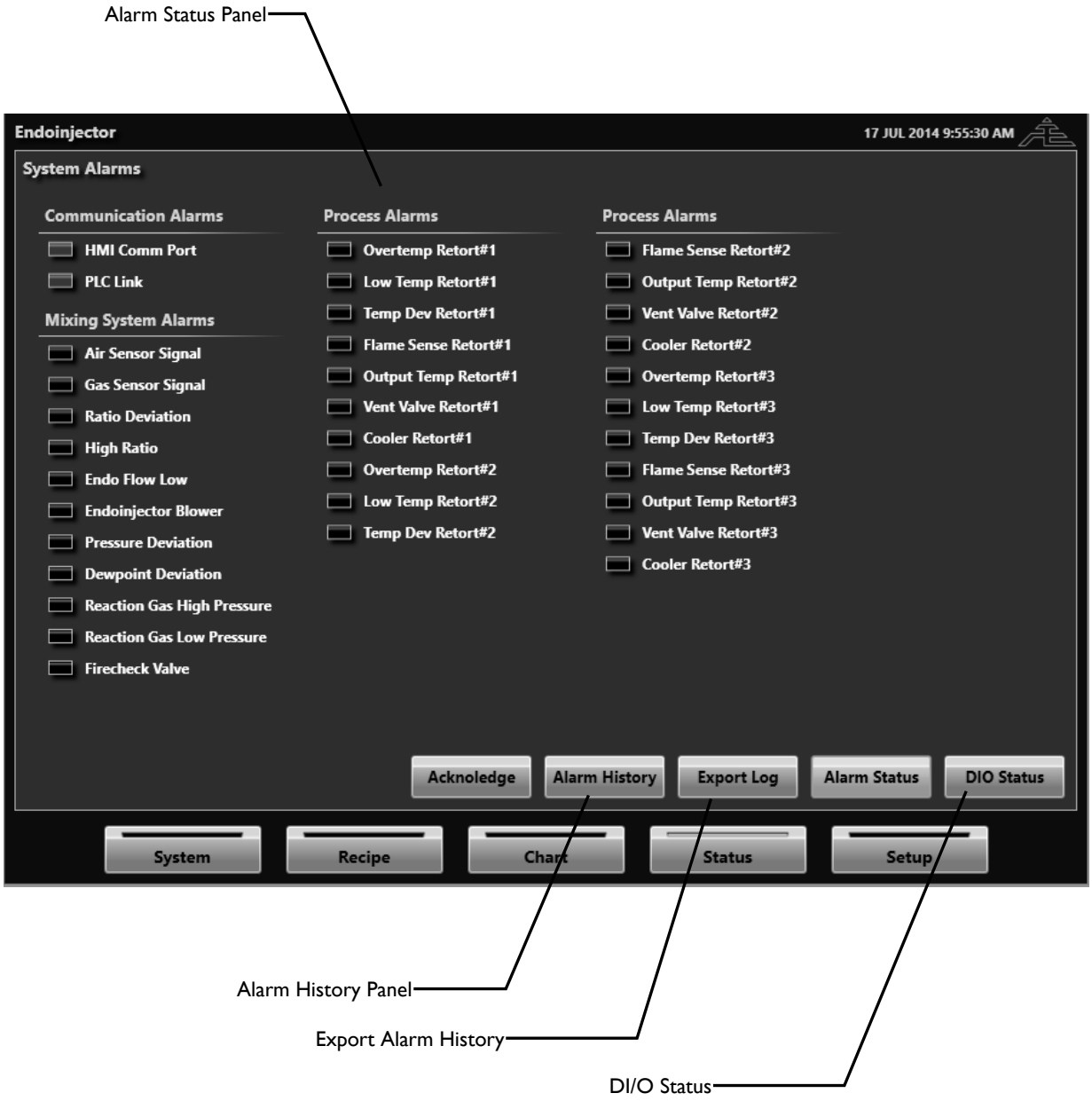

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3 SYSTEM SETUP

3.1 System Setup Screen Main Buttons

Page 1-5 *(not protected)*

The flow button provides access to the parameters involved in the setup and control of the process gas mixture.

Language *(not protected)*

The temperature button provides access to the parameters required to setup the temperature control loop.

System Button *(Admin Level Only)*

The system button provides access to the main system configuration parameters. These parameters are critical to the operation of the generator and only accessible in ADMIN level.

Full Screen Button *(Admin Level Only)*

The full screen button will keep the HMI software running but allow the administrator to access the windows operating system.

DataX Button *(Admin Required)*

The DataX button opens a “data exchange” panel that allows direct read/write access to the Modbus registers of the controller. The Modbus register list is attached to this manual. However, it is strongly recommended to contact UPC-Marathon before making any changes to the Modbus register values directly. Never change a Modbus register without knowing what the value is responsible for. Changing values without knowing what each register is responsible for can cause major problems and possibly unsafe situations to occur.

Login Button *(not protected)*

The login button will prompt the operator to enter a password to access either the USER or ADMIN level of parameters. The default passwords are “as shipped” but can be customized using the “Change Pswd” button that appears when logged in.

USER Default Password = 2
ADMINSTRATOR Default Password = 22
ENGINEERING Password = 00 + (Month + Day)
ENGINEERING Password Example (January 1st) = 00 + (1 + 1) = 002

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3.2 System Setup Parameters *(Engineering Level)*

These parameters are used to setup the basic system and safety configuration for the system. Changes to these parameters will take effect immediately. All parameters are only editable in ENGINEERING Level.

The ActivePLC™ platform is comprised of “function blocks” where every variable within the block has a defined Modbus register or bit within a 4000 register array. Below is a graphical outline of the general flow of the ActivePLC™ and the “function blocks” that it contains.

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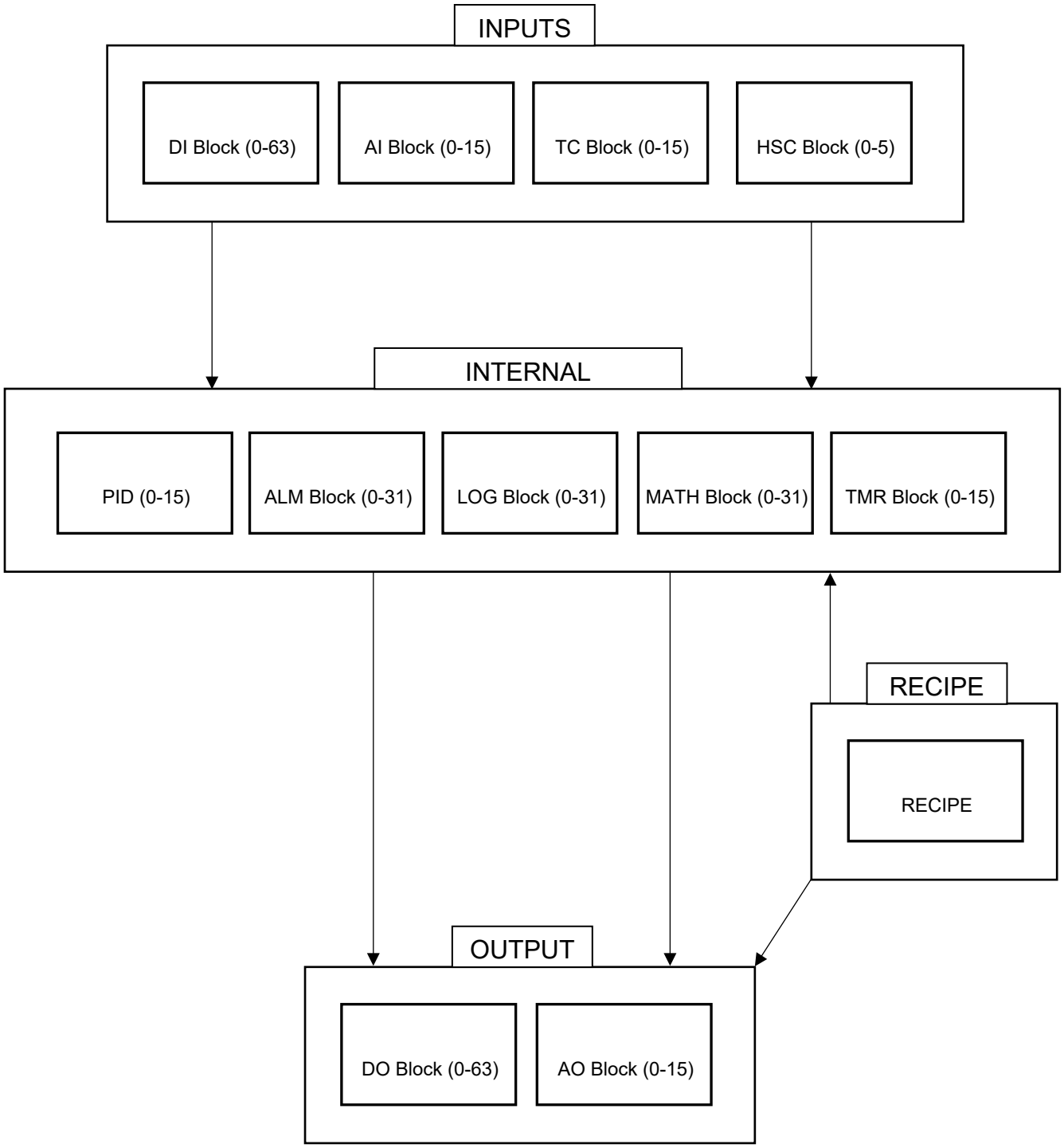

3.3 Signal Overview *(Admin Level)*

User Password
The user password button is used to change the user / first level password.

Admin Password

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The admin password button is used to change the administration / second level password.

Display Flow
This button allows for any flow process variable in the software to be rescaled to the flow unit that is selected.

Display DP Unit
This button allows for any dewpoint process variable to display as degrees Celsius or degrees Fahrenheit if applicable to the system.

Display Temperature Unit
This button allows for any temperature process variable to display as degrees Celsius or degrees Fahrenheit.

Display Pressure Unit
This button allows for any pressure process variable in the software to be rescaled to the pressure unit that is selected if applicable to the system.

3.4 Communication Setup *(Engineering Level)*

Controller Type
Changes the type of PLC controller that the HMI will communicate to.

HMI Comm Protocol
Changes the type of communication protocol.

Device IP Address
Changes the IP address to match that of the device in which the HMI will communicate with.

3.5 Device Setup (*Engineering Level)*

Device Units
Changes the units that are used in the PLC.

IP Address / Subnet Address / Change Device IP
These buttons will allow for a PLC IP address change. The IP address and subnet buttons can be updated to any desired addresses. Once the IP address and subnet buttons have values then the “change device IP” button will physically change the PLC’s IP address. The “Device IP Address” button in the communication setup will need to be updated to match what the PLC IP address was changed to.

Recipe Available / Enable
Enables and either hides or shows the recipe screen. Certain PLC’s will not have recipe available.

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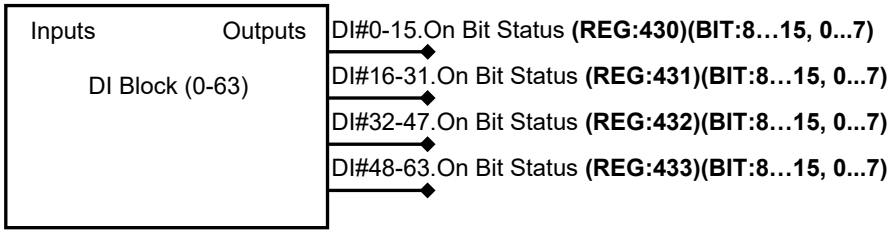
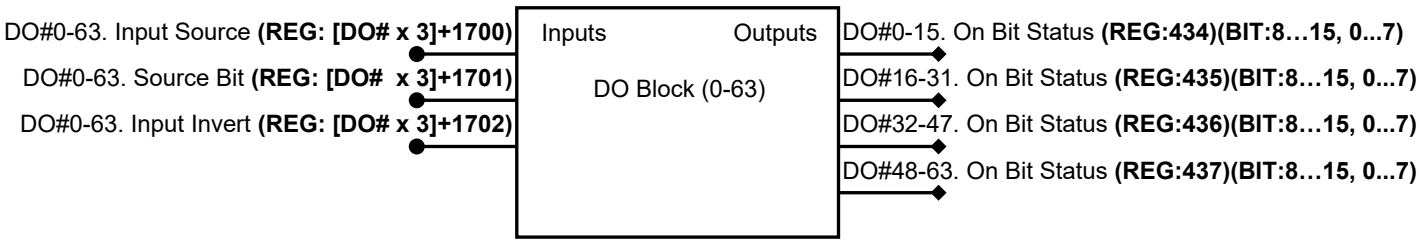
Recipe Start Source (Register / Bit)
Modbus register and bit number that will point to a bit to turn on and start the recipe.

Recipe Stop Source (Register / Bit)
Modbus register and bit number that will point to a bit to turn off and stop the recipe.

3.6 Digital Input Setup *(Engineering Level)*



3.7 Digital Output Setup *(Engineering Level)*



Input Source / Source Bit
Modbus register and bit number "source". The bit contained in this Modbus register/bit number will be used as the digital output.

Input Invert
Inverts the digital output signal.

ModbusArray[Input Source.Input Source Bit] = **BitA**

[BitA]ON = **Output Bit On** … IF Input Invert = **FALSE**
[BitA]ON = **Output Bit Off** … IF Input Invert = **TRUE**

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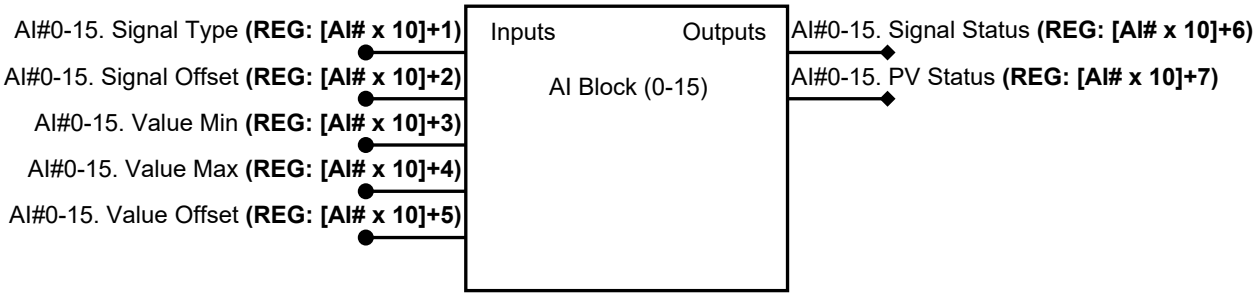
3.8 Analog Input Setup *(Engineering Level)*

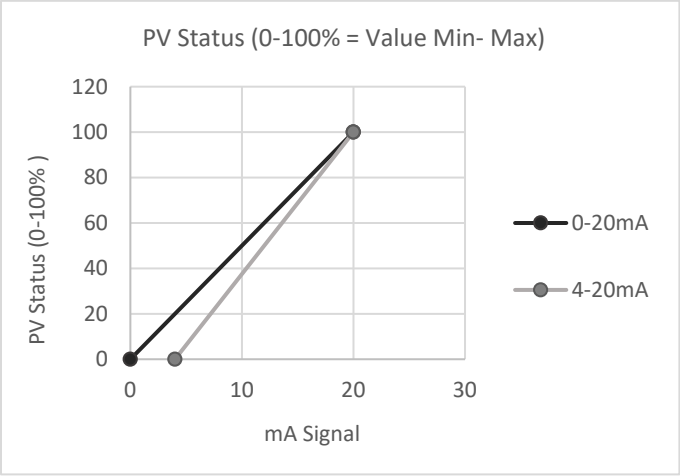


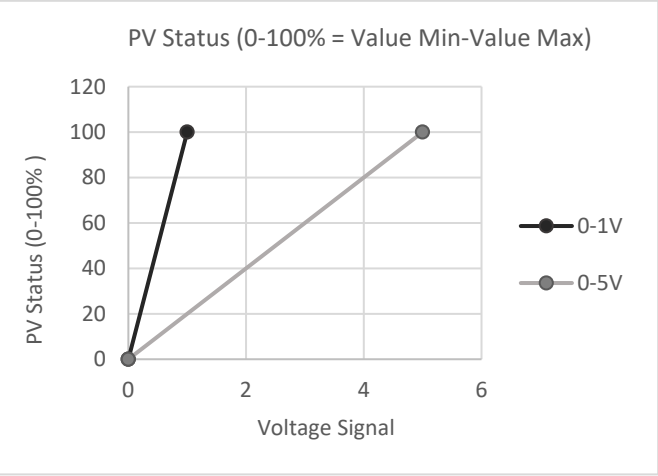
Signal Type
Used to change the analog input signal type between 0-20mA, 4-20mA, 0-5V and 0-1V.

Signal Offset
Used to add or subtract a value to the analog input signal.

Value Min / Max
Used to scale the analog input signal to a number between the min and max range.

Value Offset
Used to add or subtract an offset value to the scaled analog input signal.





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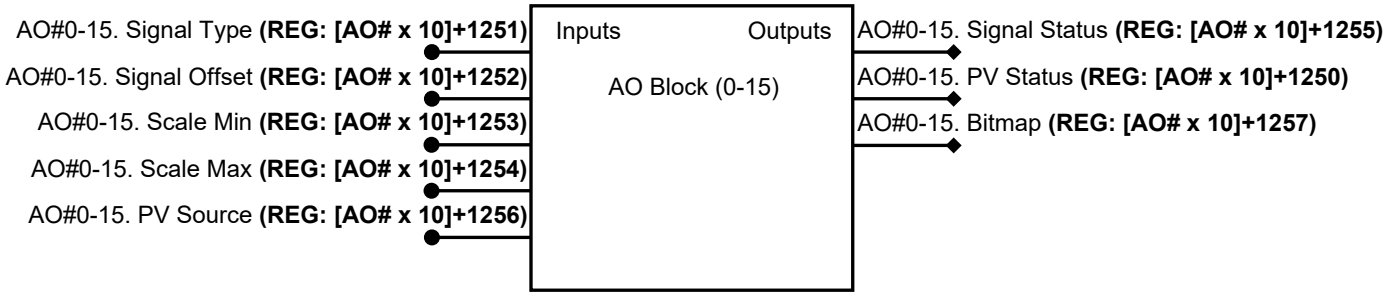
3.9 Analog Output Setup *(Engineering Level)*



PV Source
Modbus register "source". The value contained in this Modbus register will be used as the analog output process variable.

ModbusArray[PV Source] = **PV Status**

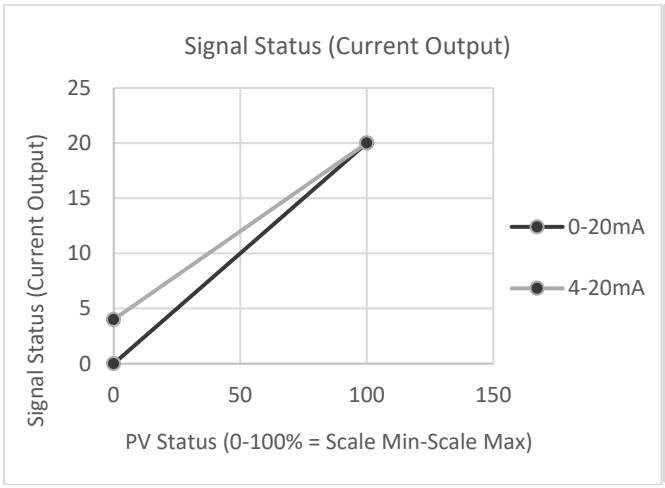
Type
Used to change the analog output signal type between 0-20mA, 4-20mA, 0-5V and 0-1V.

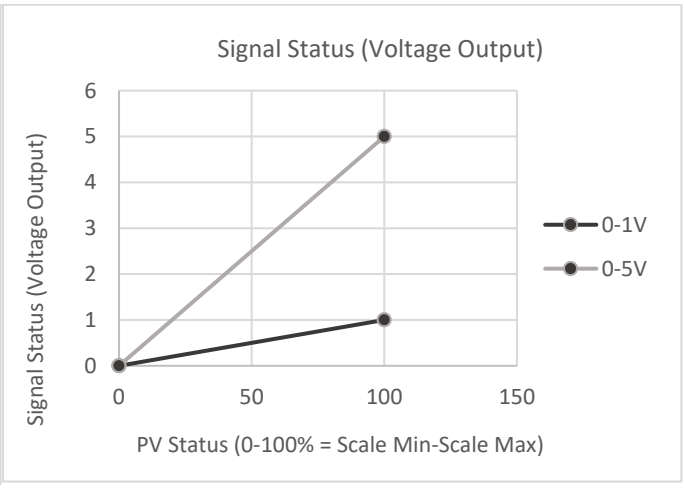
Signal Offset
Used to add or subtract a value to the analog output signal.

Scale Min / Max
Used to determine the scale of the process variable which allows the process variable to be scaled to an output based on the analog output type.

Bitmap
Output "bitmap" register used for different analog output bit functions:

[Reg].Bit0 = **ON** … If PV Status > Scale Min
[Reg].Bit1 - [Reg].Bit15 = **UNUSED**





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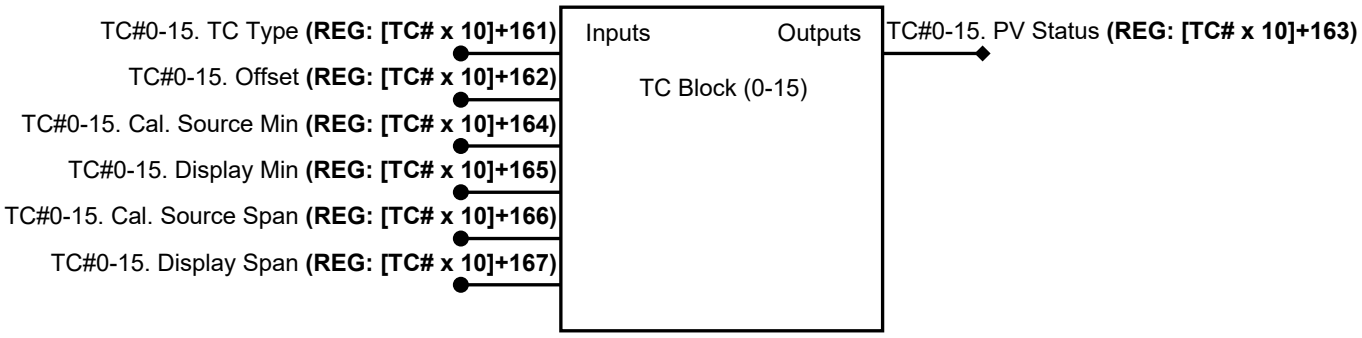
3.10 Thermocouple Setup *(Engineering Level)*



TC Type
This button is used to change the thermocouple type of each TC input.

Offset
This button is used to put a temperature offset on the thermocouple temperature reading.

Cal. Source Min / Span, Display Min / Span: (Calibration Procedure)
These 4 buttons are used for calibration on each of the thermocouple inputs. If any of these 4 buttons are set to 0 then no calibration curve will be applied. In order to calibrate the input, 2 sourced signals are needed (first = low reading, second = high reading).

1. Source the first temperature and enter the sourcing instrument temperature in the “Cal. Source Min” button.
2. Enter what the temperature is displaying on the screen under the “Value” area in the “Display Min” button.
3. Repeat steps 1 and 2 for a higher sourced temperature and enter values in the “Cal. Source Span” and “Display Span” buttons respectively. If all 4 values are entered then the thermocouple reading will be offset based on the calibration points entered.

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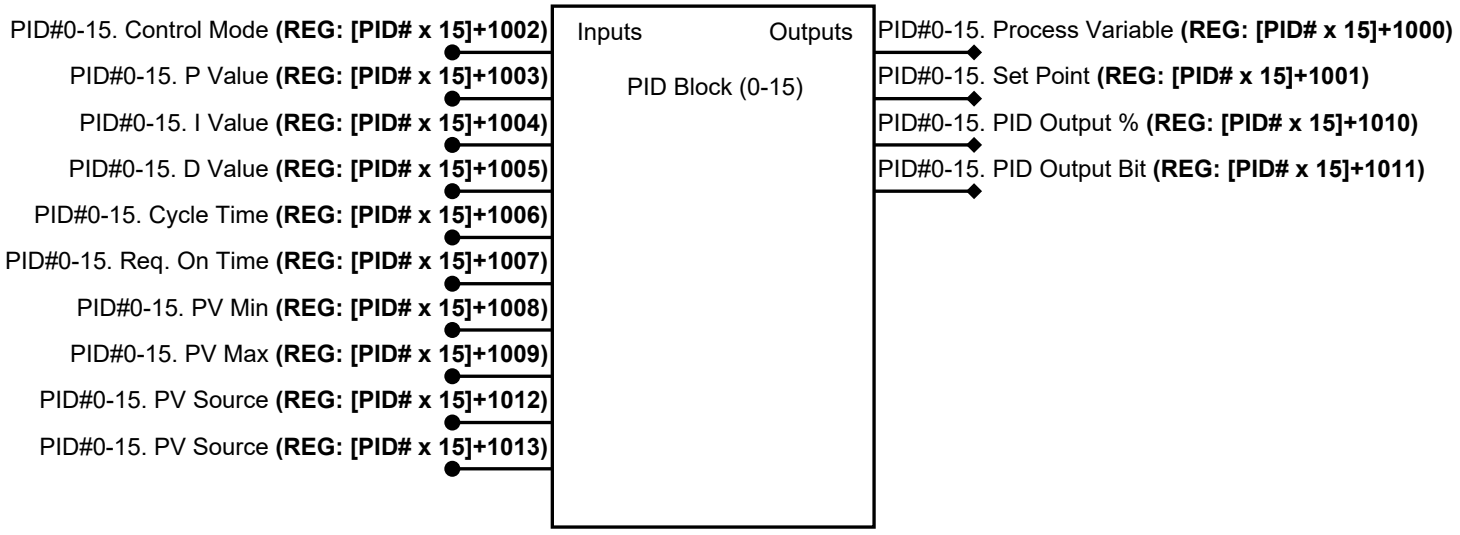
3.11 PID Setup (Engineering Level)



PV Source
Modbus register “source”. The value contained in this Modbus register will be used as the PID process variable.

ModbusArray[PV Source] = **PV Status**

SP Source
Modbus register “source”. The value contained in this Modbus register will be used as the PID setpoint. If this value is 0 then the setpoint can be changed from the setpoint button in the PID setup.

ModbusArray[SP Source] = **SP Status**

Set Point
This button is used to change the setpoint value in which the PID is controlling to. This may be changed when the recipe is not running. When the recipe is running the set point from the recipe will be used in the PID.

Control Mode
This button is used to change the PID control from auto to manual mode. In auto mode the PID control output will change based on the setpoint given. In manual mode the PID output is determined by the setting in the “PID Output” button.

PID Output
This button is in a “read only” state when the control mode is in auto mode. In this state the button will show a value between 0 and 100%. When the control mode is in manual mode then this button is able to accept a setpoint value between 0 and 100%.

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PV Min / Max
Used to determine the scale of the process variable which allows the process variable to be scaled to a value that the PID loop will respond to.

P, I and D Values
Proportional, Integral and derivative values used for each of the PID loops.

Req. On Time (sec)
Amount of time that the PID digital output bit will turn on during the cycle time regardless of the PID output percentage.

Cycle Time (sec)
The cycle time is a setpoint used when the PID output is meant to be used as a digital output signal. If the control output is at 100% then the digital output will be on for the duration of this cycle time. If the control output is at 50% then the digital output will be on for half of the cycle time and off for the remainder. If the control output is at 0% then the digital output will be off during the entire cycle time. Any control output between those values will be at some proportional on /off time adding up to the full cycle time.

[Cycle Time * (PID Output/100.0)] = **Control Time**
Control Time = Amount of time “PID output bit” is energized within set cycle time

PID Reset
Resets the PID loop under certain internal PID alarm conditions.

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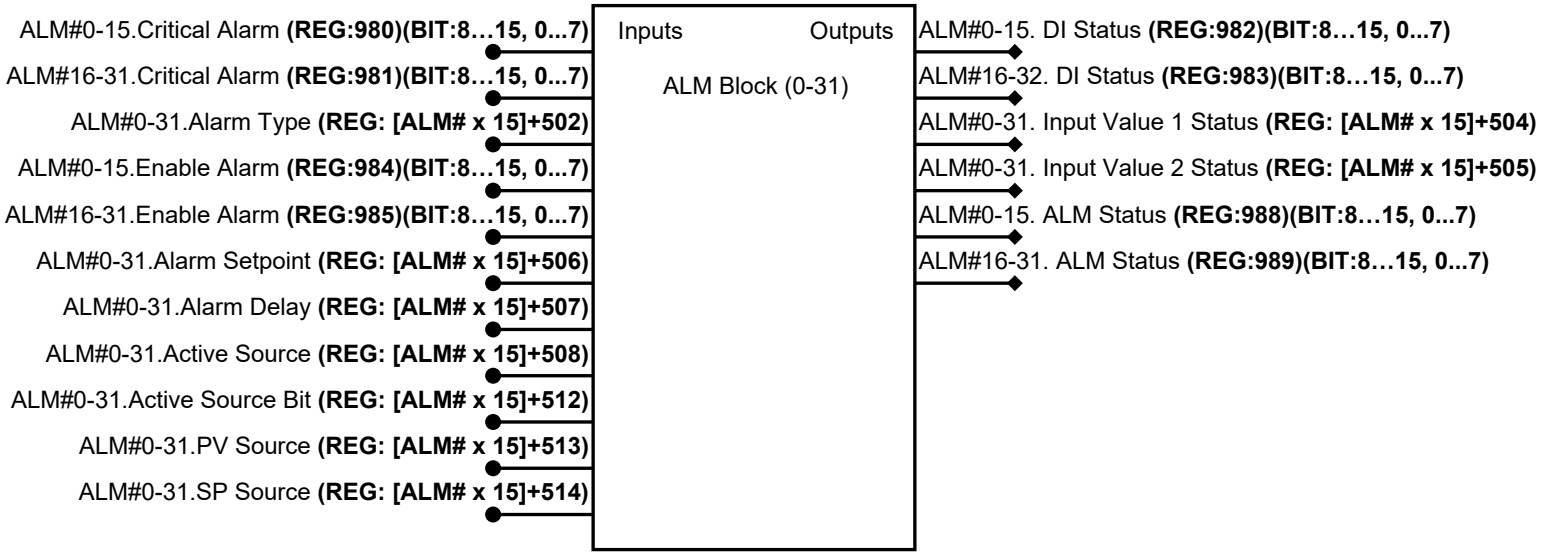
3.12 Alarm Setup (Engineering Level)



PV Source
Modbus register “source”. The value contained in this Modbus register will be used as the alarm process variable for PV dev, PV low and PV high alarm types. For digital input alarm types this is the Modbus register source for the desired bit.

If Type = PV Dev, PV Low, PV High… ModbusArray[PV Source] = **PV Status**

SP Source
Modbus register “source”. The value contained in this Modbus register will be used as the alarm setpoint for PV dev alarm types. For digital input alarm types this is the Modbus register bit number for the desired bit.

If Type = PV Dev, PV Low, PV High… ModbusArray[SP Source] = **SP Status**
If Type = Input ON, Input Off… ModbusArray[PV Source.SP Source] = **DI Status**

Enable Alarm
Enables or disables the alarm. If disabled the alarm will disappear from the “Status” screen.

Critical Alarm
The critical alarm button is used to select whether an alarm will be critical. If this button is true and the alarm is active, then the critical alarm relay will “de-energize”. If this button is false and the alarm is active, only the horn bit will “energize”.

Enable Horn
Enables or disables whether the alarm will activate the alarm horn output.

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Alarm Setpoint
This button is used to change the alarm setpoint value. This setpoint value only applies to “PV dev”, “PV low” and “PV high” alarm types.

Alarm Delay
The alarm delay button is used to change the delay timer in which the alarm will “energize”. If the alarm is true the timer will start. When the timer exceeds the alarm delay setpoint the alarm will show that it is active and sound the alarm. If the alarm is not true during this timer, then the timer will go back to zero and the alarm will never show that it was active.

Active Source / Active Source Bit
Modbus register and bit number “source”. The bit contained in this Modbus register/bit number will be used to activate/deactivate the alarm. If the “active source” is set to 0 then the alarm will always be active. If the “active source” has a number associated with it and the bit it NOT energized then the alarm will be inactive and will be grey in color on the “status screen”.

Alarm Type
This button is used to select the type of alarm.

“Input ON” … [DI Status]ON = **Alarm Status Bit ON**
“Input OFF” … [DI Status]OFF = **Alarm Status Bit ON**
“PV Low” … [PV Status] < [Alarm Setpoint] = **Alarm Status Bit ON**
“PV High” … [PV Status] > [Alarm Setpoint] = **Alarm Status Bit ON**
“PV DEV” … ABS[PV Status-SP Status] > [Alarm Setpoint] = **Alarm Status Bit ON**

Active Latch Enable
If “Active Latch Enable” is true, the alarm will continue to stay active even when the alarm is cleared. The alarm will become unlatched or “reset” when the alarm reset bit is turned on. The “alarm reset” button is setup under “Setup>Login>System>Device”.

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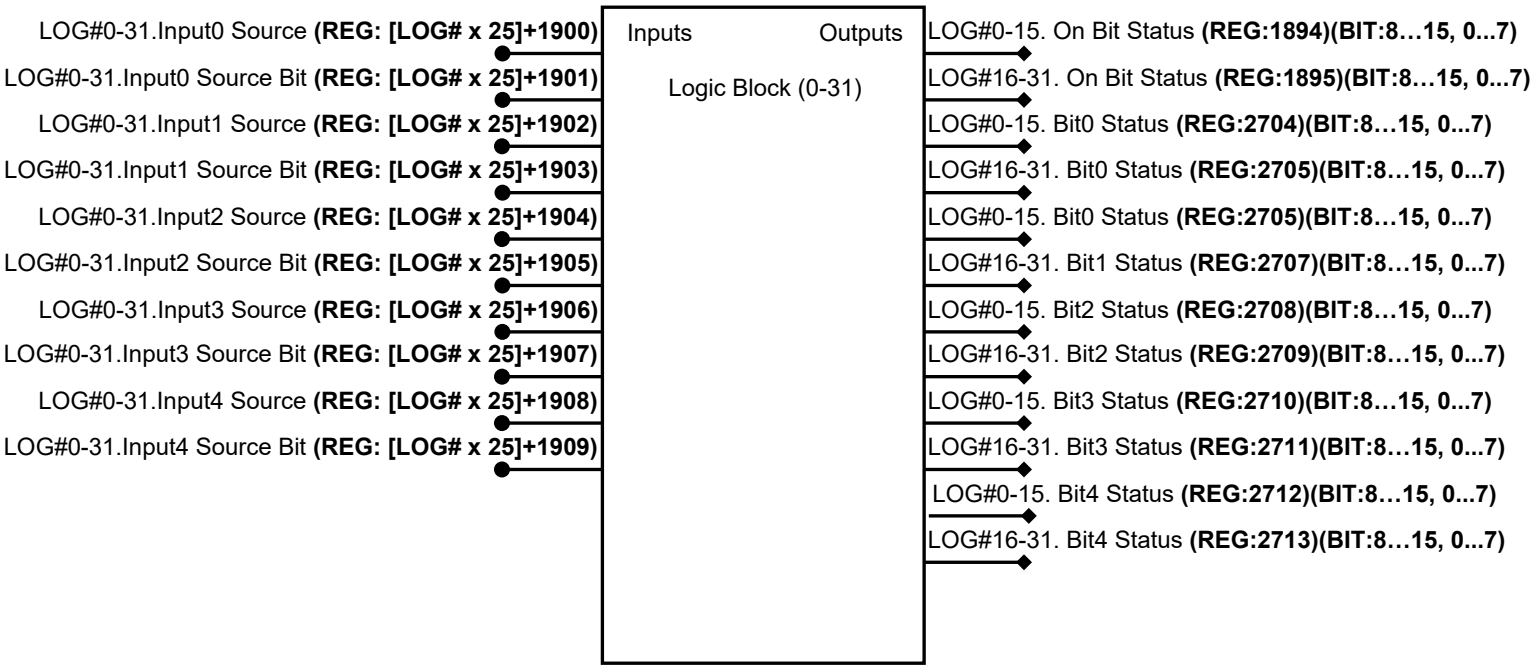
3.13 Logic Setup (Engineering Level)



Input Source / Input Source Bit
Modbus register and bit number "source". The bit contained in this Modbus register/bit number will be used for each respective logic bit.

Input Source Invert
Inverts the logic bit signal.

Type
Changes the type of the logic block between AND, OR, Value Select, Greater Than and Less Than. For a more detailed explanation of each type see "Logic Detail" section.

NOTE: If any source button is equal to zero, then the bit will be ignored in the logic.

"***AND"***
ModbusArray [Input0 Sourc.Input0 Source Bit] = **BitA**
ModbusArray [Input1 Source, Input1 Source Bit] = **BitB**
ModbusArray [Input2 Source, Input2 Source Bit] = **BitC**
ModbusArray [Input3 Source, Input3 Source Bit] = **BitD**
ModbusArray [Input4 Source, Input4 Source Bit] = **BitE**

[BitA & BitB & BitC & BitD & BitE] = **Output Bit ON**

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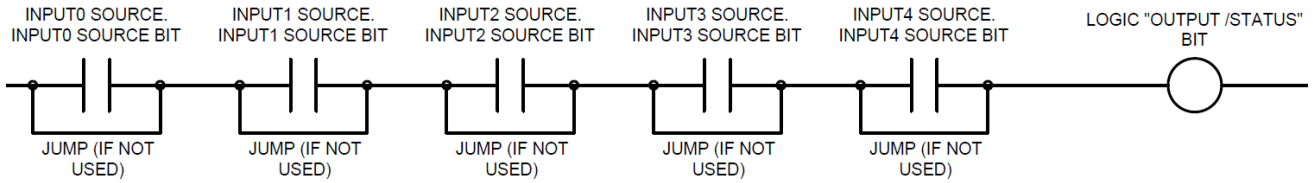

"***OR"***
ModbusArray [Input0 Sourc.Input0 Source Bit] = **BitA**
ModbusArray [Input1 Source, Input1 Source Bit] = **BitB**
ModbusArray [Input2 Source, Input2 Source Bit] = **BitC**
ModbusArray [Input3 Source, Input3 Source Bit] = **BitD**
ModbusArray [Input4 Source, Input4 Source Bit] = **BitE**

[BitA // BitB // BitC // BitD // BitE] = **Output Bit ON**

"***Value Toggle"***
ModbusArray [Input0 Sourc.Input0 Source Bit] = **BitA**
ModbusArray [Input1 Source] = **ValueA**
ModbusArray [Input2 Source] = **ValueB**
ModbusArray [Input3 Source.Input3 Source Bit] = **BitB**

[BitA]ON … ValueA = **Output Value**
[BitA]OFF … ValueB = **Output Value**
[BitB]ON … **Prevents any move from occurring**

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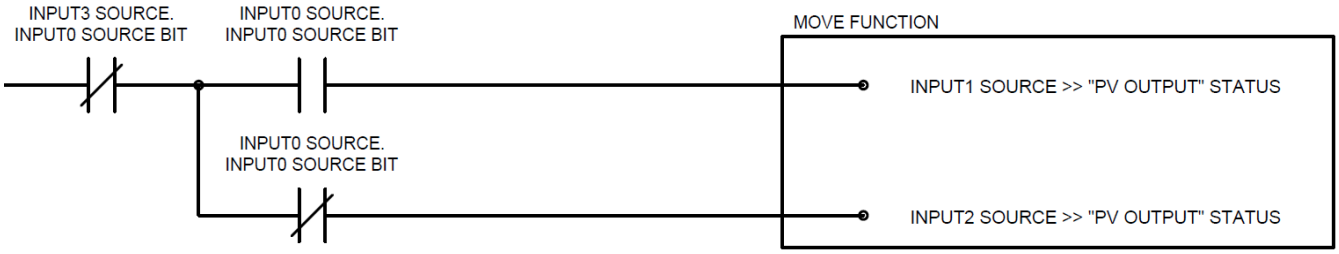


"***A>B***"
ModbusArray [Input0 Source] = **ValueA**
ModbusArray [Input1 Source] = **ValueB**

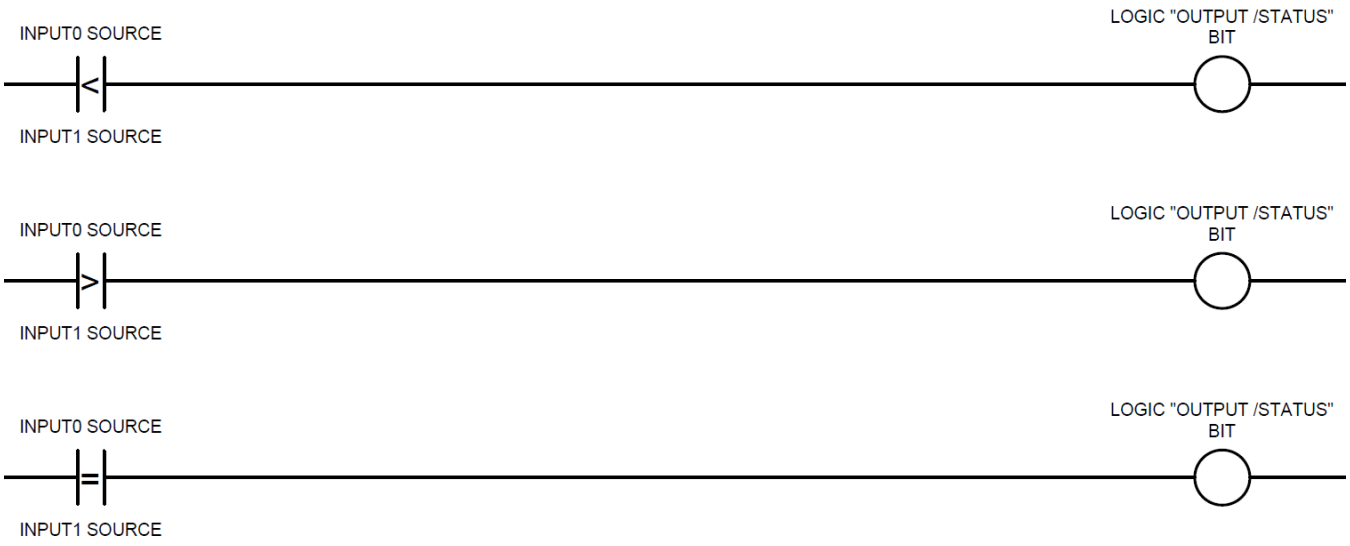
[ValueA > ValueB] = **Output Bit On**

"***A<B***"
ModbusArray [Input0 Source] = **ValueA**
ModbusArray [Input1 Source] = **ValueB**

[ValueA < ValueB] = **Output Bit On**

"***A=B***"
ModbusArray [Input0 Source] = **ValueA**
ModbusArray [Input1 Source] = **ValueB**

[ValueA = ValueB] = **Output Bit On**



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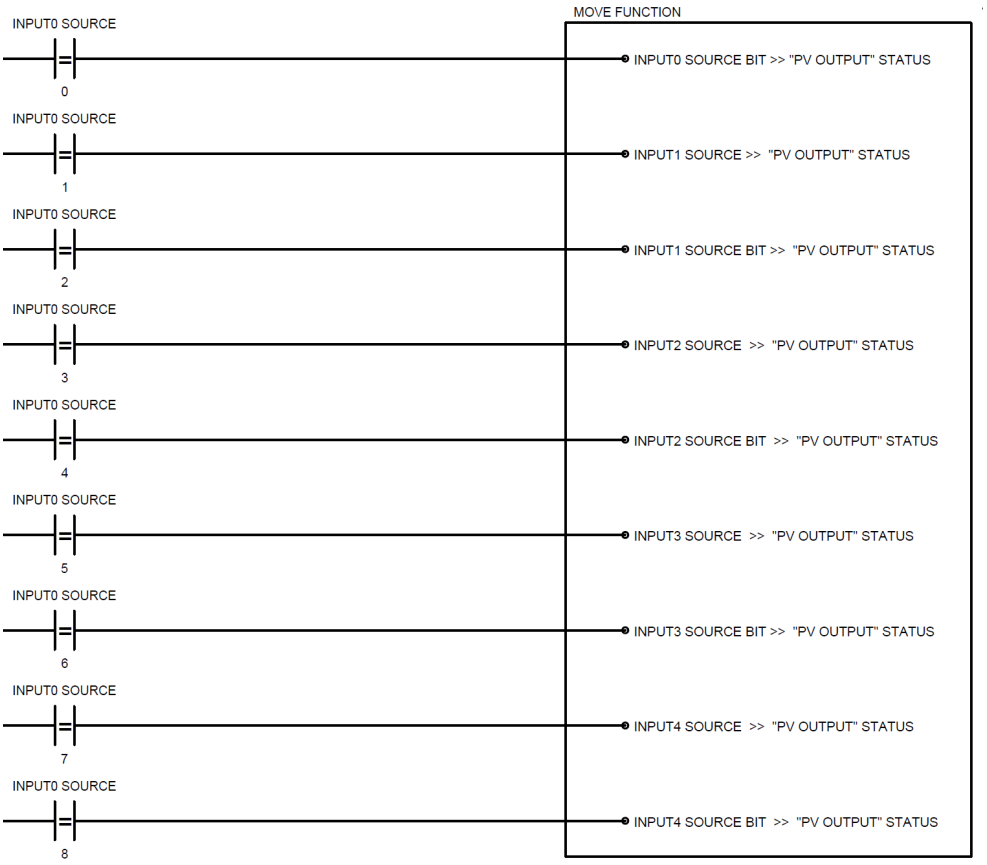
“***Value Move”***
ModbusArray [Input0 Source] = **ValueA**
ModbusArray [Input0 Source Bit] = **ValueB**
ModbusArray [Input1 Source] = **ValueC**
ModbusArray [Input1 Source Bit] = **ValueD**
ModbusArray [Input2 Source] = **ValueE**
ModbusArray [Input2 Source Bit] = **ValueF**
ModbusArray [Input3 Source] = **ValueG**
ModbusArray [Input3 Source Bit] = **ValueH**
ModbusArray [Input4 Source] = **ValueI**
ModbusArray [Input4 Source Bit] = **ValueJ**

[ValueA] = 0 … ValueB = **Output Value**
[ValueA] = 1 … ValueC = **Output Value**
[ValueA] = 2 … ValueD = **Output Value**
[ValueA] = 3 … ValueE = **Output Value**
[ValueA] = 4 … ValueF = **Output Value**
[ValueA]= 5 … ValueG = **Output Value**
[ValueA] = 6 … ValueH = **Output Value**
[ValueA] = 7 … ValueI = **Output Value**
[ValueA] = 8 … ValueJ = **Output Value**



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"***Cycle Bit"***

The cycle bit logic type can activate up to 16 bits (total bits) while turning on a certain number of bits at a time (bits on each cycle). After the bits have cycled from on to off, the next bits in the sequence will turn on.

Example: ModbusArray [Input2 Source] = **ValueA** = 5.
ModbusArray [Input3 Source] = **ValueB** = 3.
ModbusArray [Input0 Sourc.Input0 Source Bit] = **BitA**

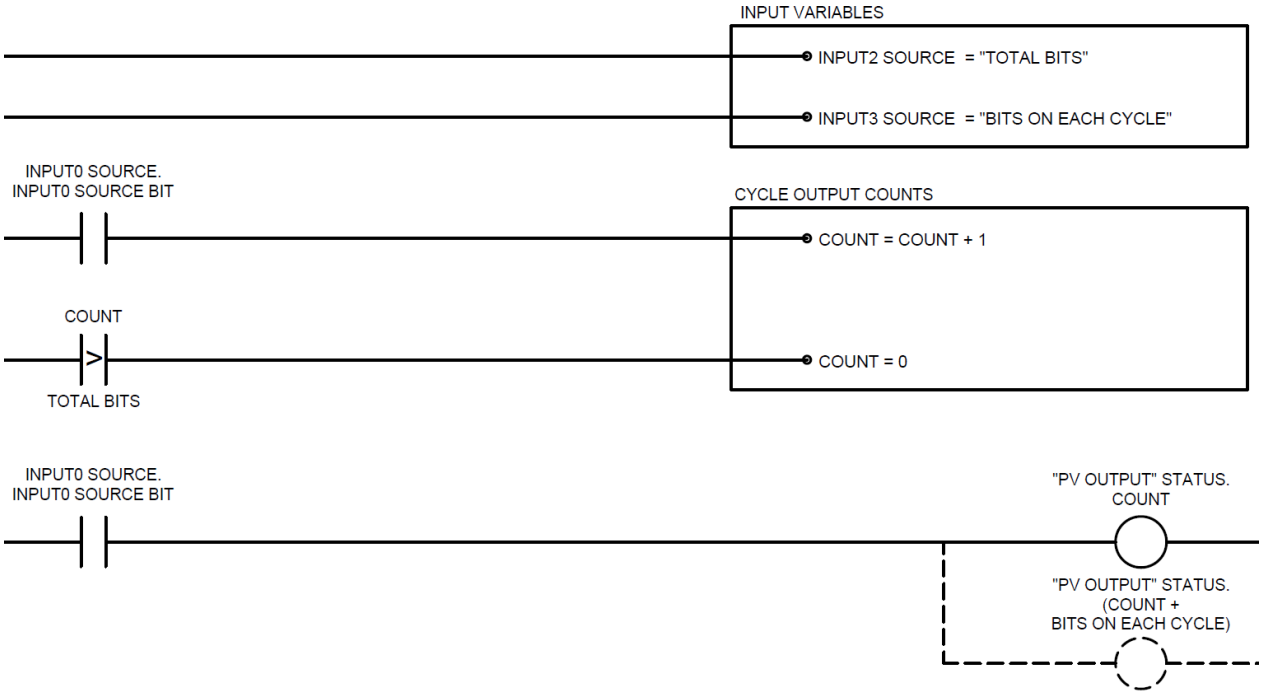
START of CYCLE [BitA] = ON … **[OUTPUT VALUE].0** = ON
[OUTPUT VALUE].1 = ON
[OUTPUT VALUE].2 = ON

2nd Stage of CYCLE [BitA] = ON … **[OUTPUT VALUE].3** = ON
[OUTPUT VALUE].4 = ON
[OUTPUT VALUE].0 = ON

3rd Stage of CYCLE [BitA] = ON … **[OUTPUT VALUE].1** = ON
[OUTPUT VALUE].2 = ON
[OUTPUT VALUE].3 = ON

4th Stage of CYCLE [BitA] = ON … **[OUTPUT VALUE].4** = ON
[OUTPUT VALUE].0 = ON
[OUTPUT VALUE].1 = ON

4th Stage of CYCLE [BitA] = ON … **[OUTPUT VALUE].2** = ON
[OUTPUT VALUE].3 = ON
[OUTPUT VALUE].4 = ON …*Back to Start of Cycle*



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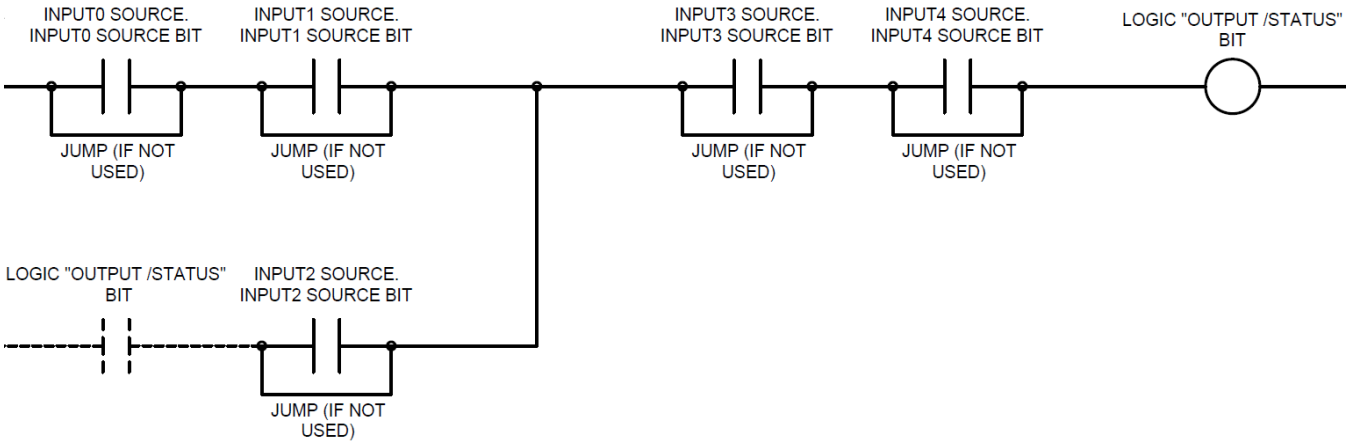
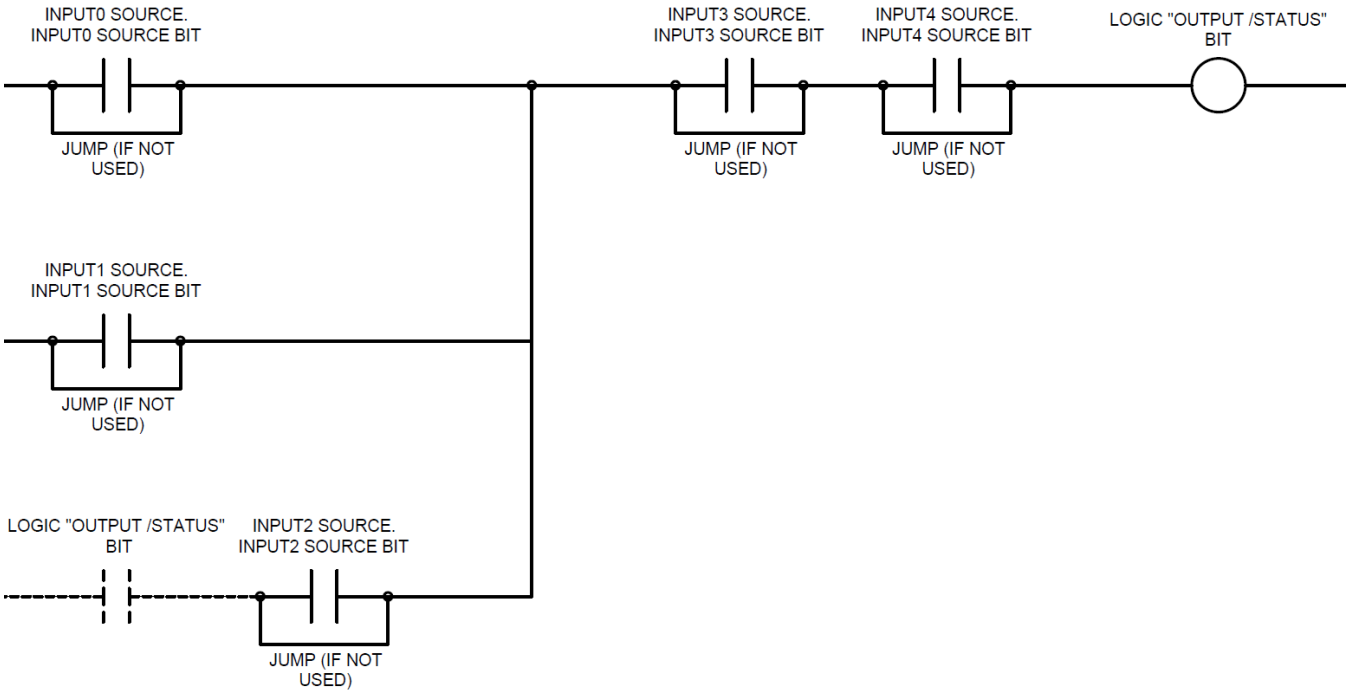
"***LatchA"***

The LatchA and LatchB logic types are setup to include an internal "latching" function. This allows for latching circuits to be done using only 1 logic block. Each circuit is pre-configured in the diagrams below.



"***LatchB"***



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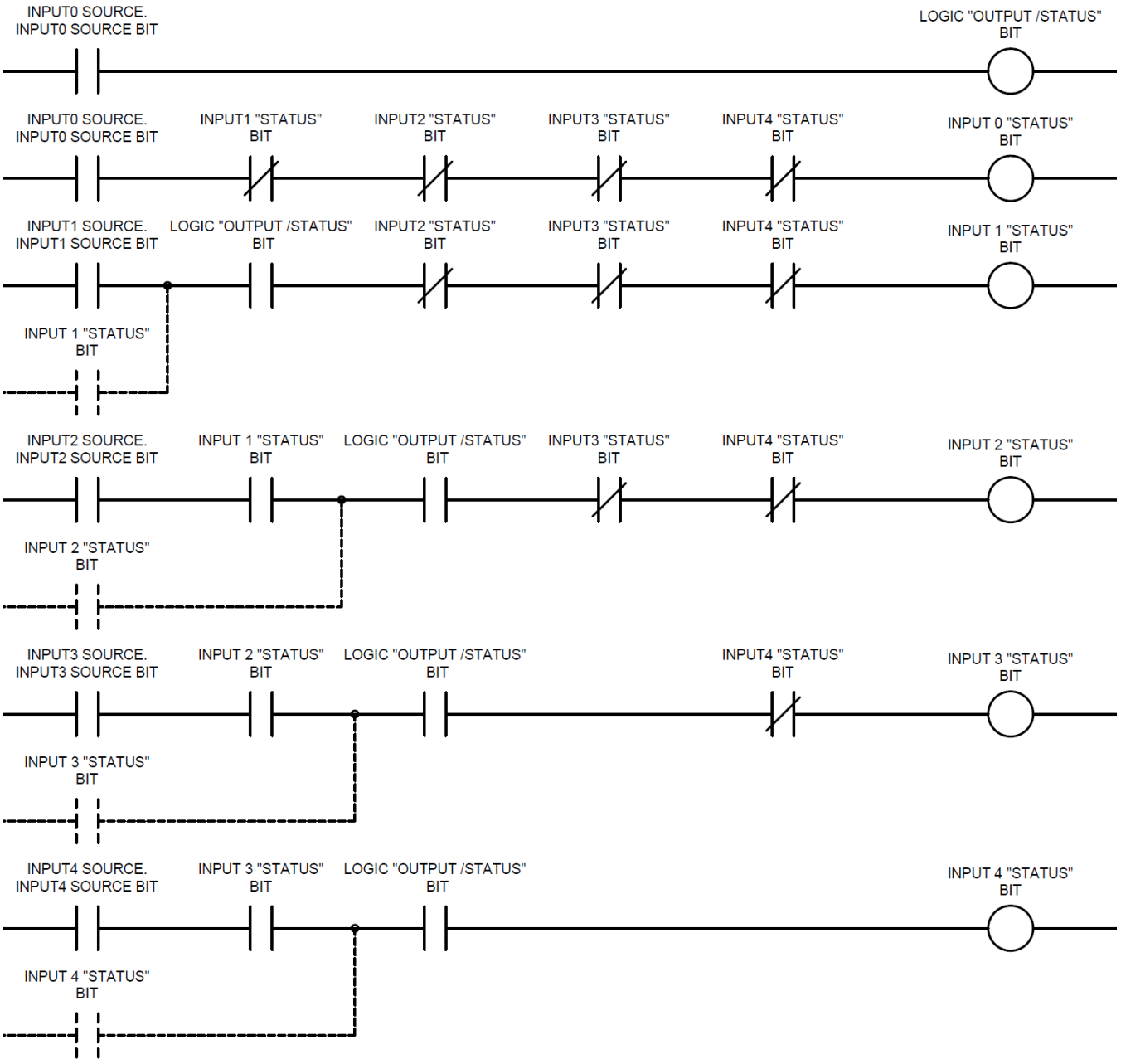
"***SequenceA***"

The SequenceA logic type is designed to provide a sequence or cascading bit function. The sequence starts and is "enabled" when Input0source/bit is active. When Input0source/bit is active then Input0 Status bit will also become active. When Input1source/bit becomes active, Input0 Status bit will become inactive and Input1 Status bit will become active. This sequence continues through all 5 bits in the LOGIC block, turning on only 1 bit at a time.



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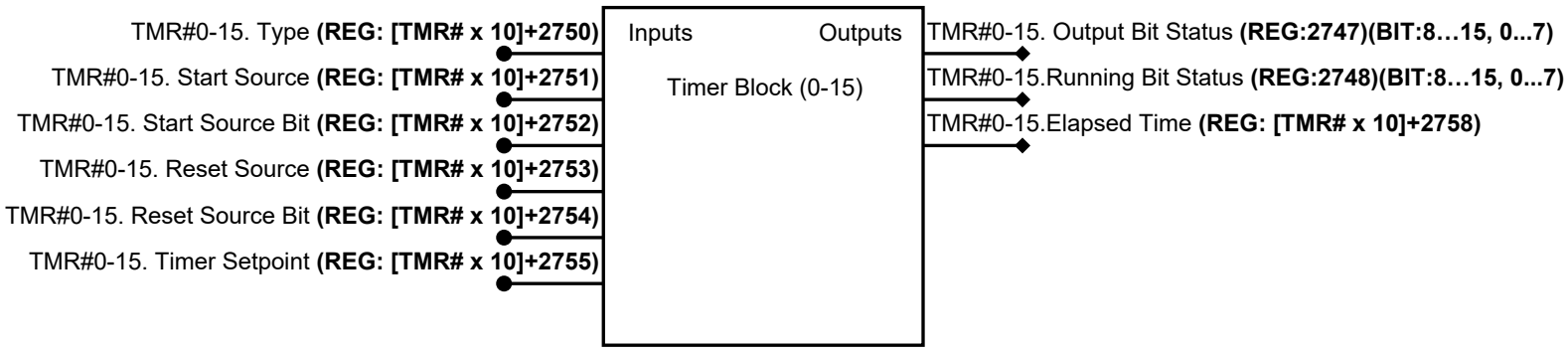
3.14 Timer Setup (Engineering Level)



Start Source / Source Bit
Modbus register and bit number “source”. The bit contained in this Modbus register/bit number will be used to “enable”/”start” the timer.

ModbusArray [Start Source.Start Source Bit] = **Start Bit ON**

Reset Source / Source Bit
Modbus register and bit number “source”. The bit contained in this Modbus register/bit number will be used to “reset” the timer.

ModbusArray [Reset Source.Reset Source Bit] = **Reset Bit ON**

Time Setpoint
Time setpoint that when exceeded turns on the output bit of the timer.

Type
Changes the type of the timer block between On Delay(sec), On Delay(min), Off Delay(sec) and Off Delay(min).

“***Cycle Timer”***
Start Source = **Input PV**
Start Source Bit = **Input PV Min**
Reset Source = **Input PV Max**
Timer Setpoint = **Cycle Time**

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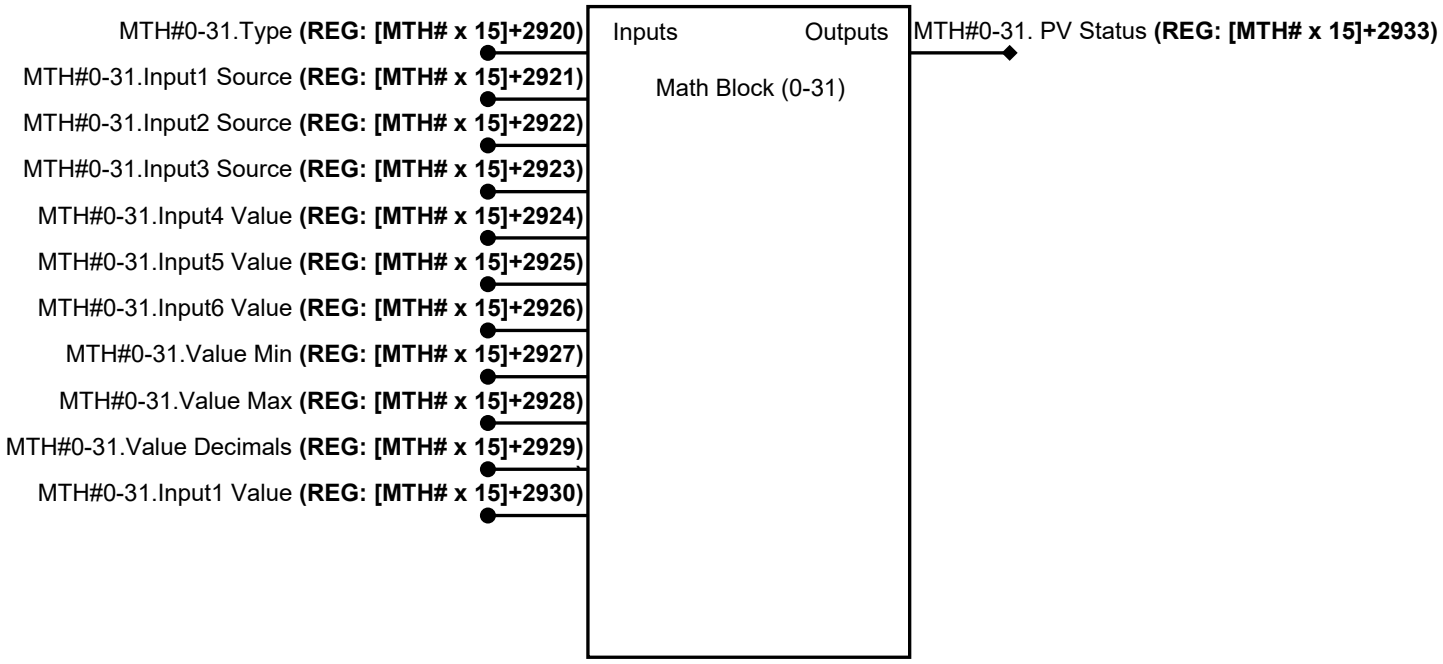
3.15 Math Setup (Engineering Level)



Input Source (1-3)
Modbus register "source". The value contained in the Modbus register will be used for each respective variable. If these "source" values are set to 0 then the respective user "Input Value" will be used.

ModbusArray [Input Source 0] = **Input Value 0**
ModbusArray [Input Source 1] = **Input Value 1**
ModbusArray [Input Source 2] = **Input Value 2**

Input Value (1-6)
Constant values that are user defined used for math functions.

Value Min / Max
Minimum and maximum values in which the output of the math block will not exceed.

Value Decimals
Amount of decimals that are desired in the output value of the math block.

10^("Value Decimals") = **Output Multiplier (OM)**

Type
Changes the type of the math block between many different simple and complex math functions. For a more detailed explanation of each type see "Math Detail" section.

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“ADD”
[Input Value 0 + Input Value 1]*OM = **PV Status Output**

“SUBTRACT”
[Input Value 0 - Input Value 1]*OM = **PV Status Output**

“MULTIPLY”
[Input Value 0 * Input Value 1]*OM = **PV Status Output**

“DIVIDE”
[Input Value 0 / Input Value 1]*OM = **PV Status Output**

“DEVIATION”
ABS[Input Value 0 - Input Value 1]*OM = **PV Status Output**

“% Relative Humidity”
Input1 Value = **Dewpoint (˚F)**
Input2 Value = **Temperature (˚F)**

“Dewpoint Probe”
Input1 Value = **Temperature (˚F)**
Input2 Value = **Probe Millivolts (mV)**
Input3 Value = **H Factor (typically 400)**

“% Carbon Probe”
Input1 Value = **Temperature (˚F)**
Input2 Value = **Probe Millivolts (mV)**
Input3 Value = **CO Factor (typically 200)**

“Scale Input”
Input1 Value = **Input PV**
Input2 Value = **Input PV Min**
Input3 Value = **Input PV Max**
Input4 Value = **Scaled Output Min**
Input5 Value = **Scaled Output Max**

“% Oxygen Probe”
Input1 Value = **Temperature (˚F)**
Input2 Value = **Probe Millivolts (mV)**

“Kn Calculation”
Input1 Value = **% Hydrogen (100%x10)**
Input2 Value = **% NH3 (100%x10)**

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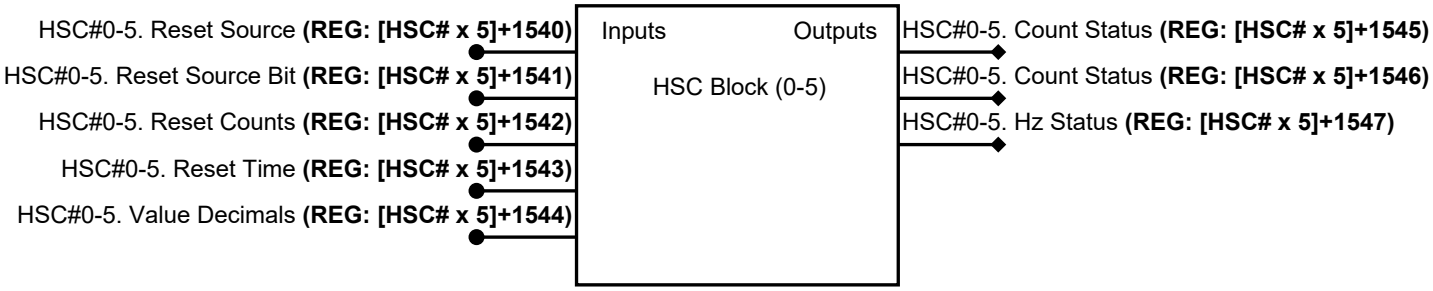
3.16 High Speed Counter Setup *(Engineering Level)*



Reset Source / Source Bit
Modbus register and bit number “source”. The bit contained in this Modbus register/bit number will be used to “reset” the high speed counter.

ModbusArray [Reset Source.Reset Source Bit] = **Reset Bit ON**

Value Decimals
Amount of decimals that are desired in the output counts and time of the HSC block.

10^(“Value Decimals”) = **Output Multiplier (OM)**

Reset Counts
Number of counts that will trigger the high speed counter block to reset.

[Reset Counts]*OM = **Actual Reset Counts**

Reset Time
Amount of time that will trigger the high speed counter block to reset.

[Reset Time]*OM = **Actual Reset Time**

3.17 Recipe Setup (OP#5 – 11) *(Engineering Level)*

PV Source (Reg)
Modbus register “source”. The value contained in the Modbus register will be used for the recpipe process variable.

SP Source (Reg)
Modbus register “source”. The value contained in the Modbus register will be used for the recpipe set point.

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3.18 HMI Setup (Engineering Level)

This section of the setup is used to enable, disable and set the size of all the possible screens that can be used in the “System” view of the HMI.

3.19 Curves (Engineering Level)

This section of the setup is where calibration curves can be entered. Each calibration curve can be linked to any of the math blocks when “Cal-Curve” type is used.

4 HMI CONFIGURATION MODE OVERVIEW

The ActivePLC™ platform is equipped with a fully customizable HMI (ActiveHMI™). In order to enable, disable and set up different features in the HMI, the “HMI configuration mode” needs to be turned on. This can be done in the “setup” section of the HMI when logged in with an ADMINSTRATOR or ENGINEERING level password and clicking on the AEC logo in the upper right corner. Once in HMI configuration mode the logo will turn yellow.

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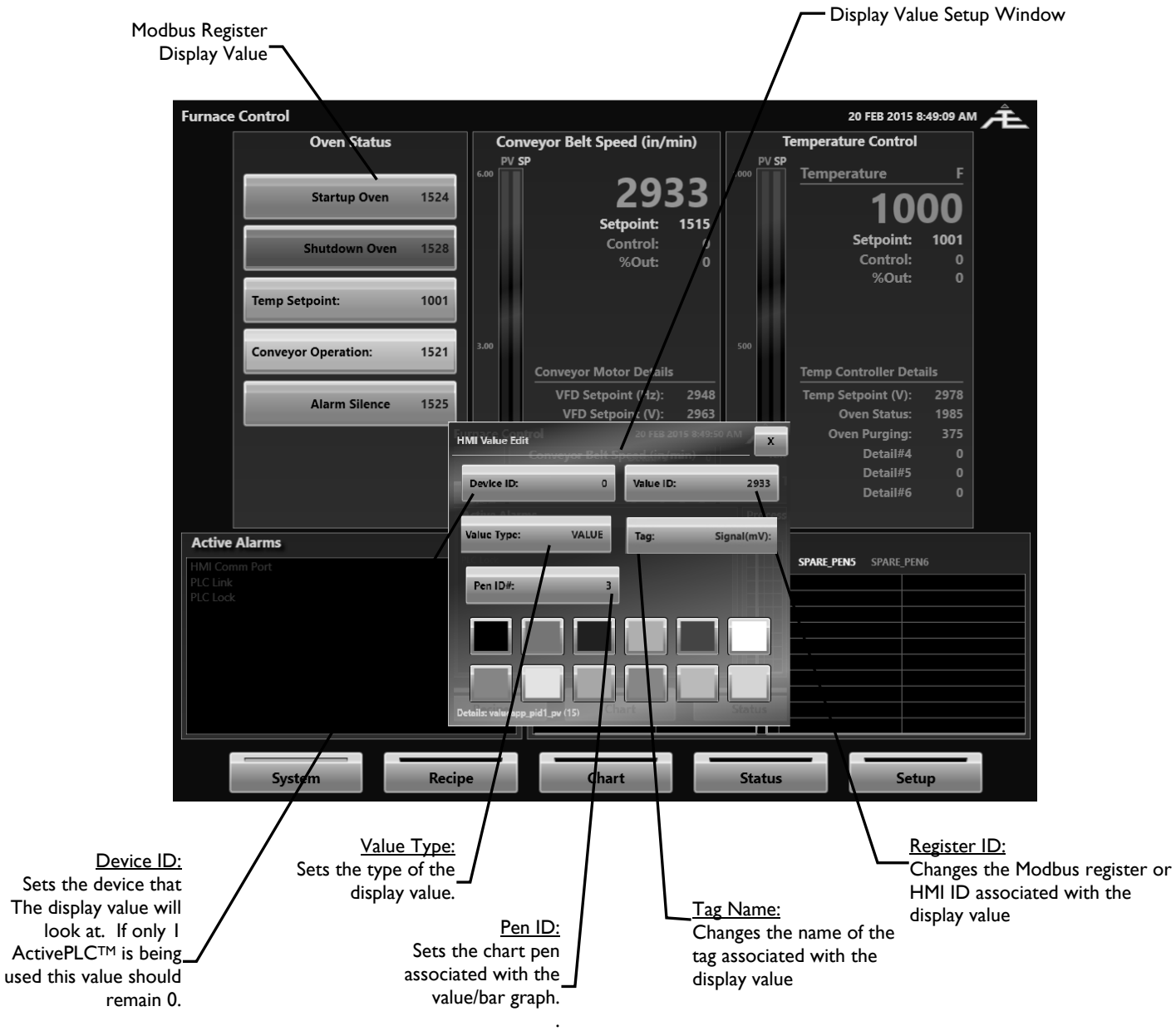
4.1 System Screen

In HMI configuration mode the system screen shows all possible values that can be configured on each panel. The numbers that appear are the Modbus register numbers that each value is configured with. By simply clicking on the value the Modbus register, device ID and tag for that display value can be changed. By entering a 0 into the register number the display value will be hidden when HMI configuration mode is turned off. Enabling, disabling and sizing of all the system panels are done under “Setup>System>HMI” with an engineering level password.
NOTE: For referencing bits, the “HMI ID” number will need to be used instead of the Modbus register number. This along with all Modbus register information can be found using the “**ActivePLC™ Lookup Tool**”. Modbus register information can also be found throughout the system setup if the upper left corner of the screen is double clicked while NOT in HMI configuration mode.



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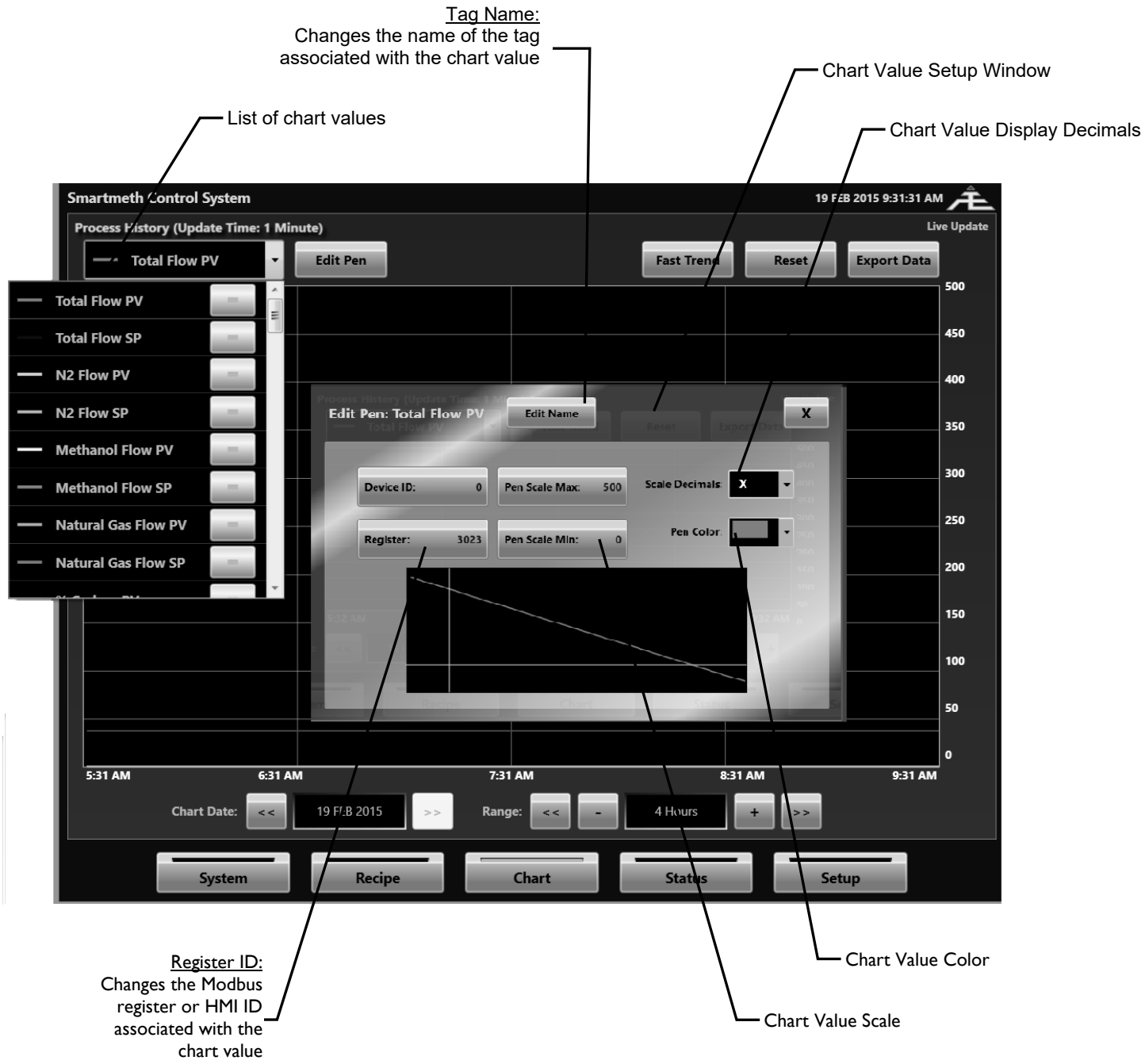
4.2 Chart Screen

In HMI configuration mode all chart data can be configured. The Modbus register ID, tag name, scale, decimals and color of each variable will become editable.



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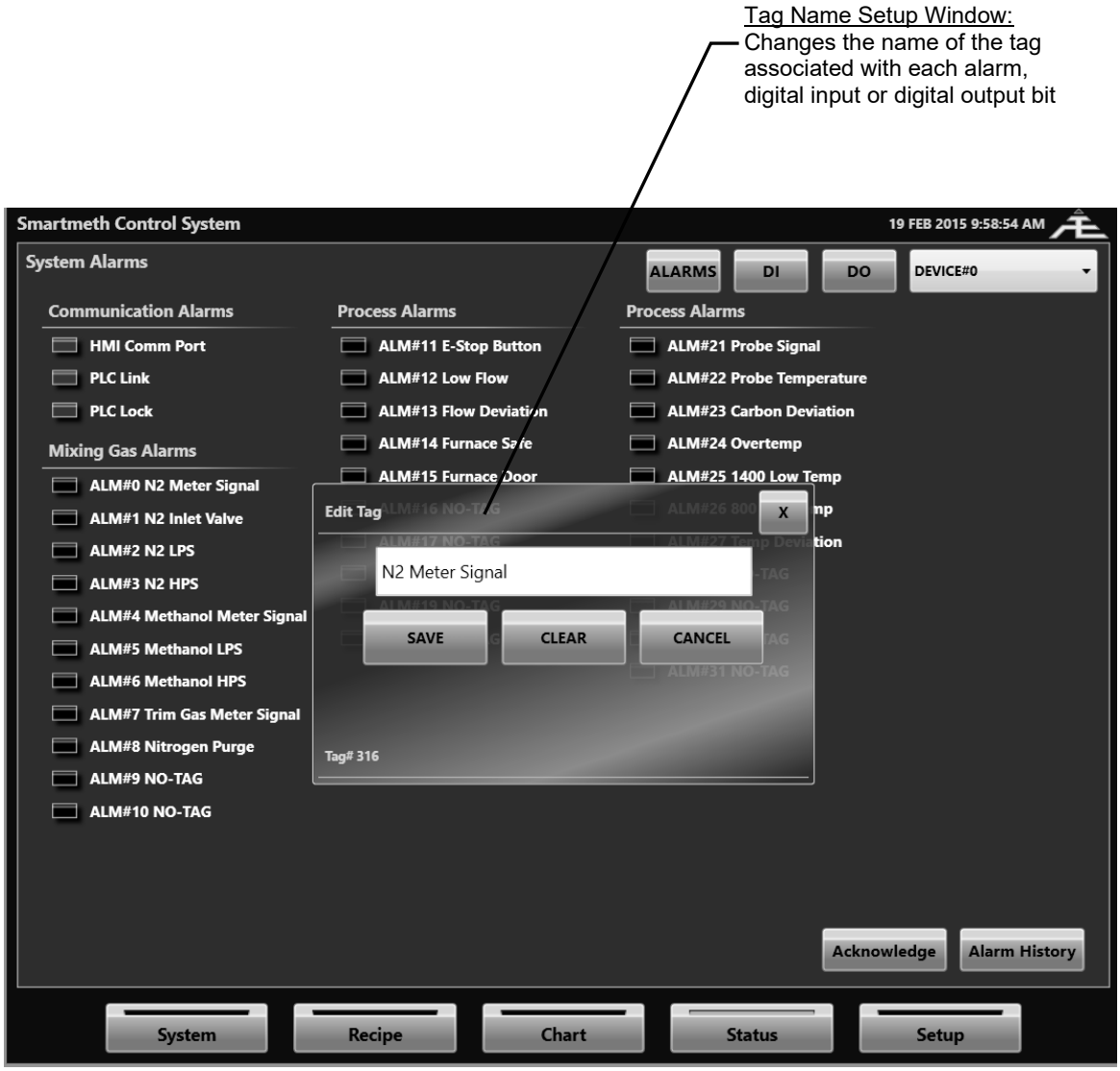
4.3 Status Screen

In HMI configuration mode the tag names of alarms, digital inputs and digital outputs can be configured.



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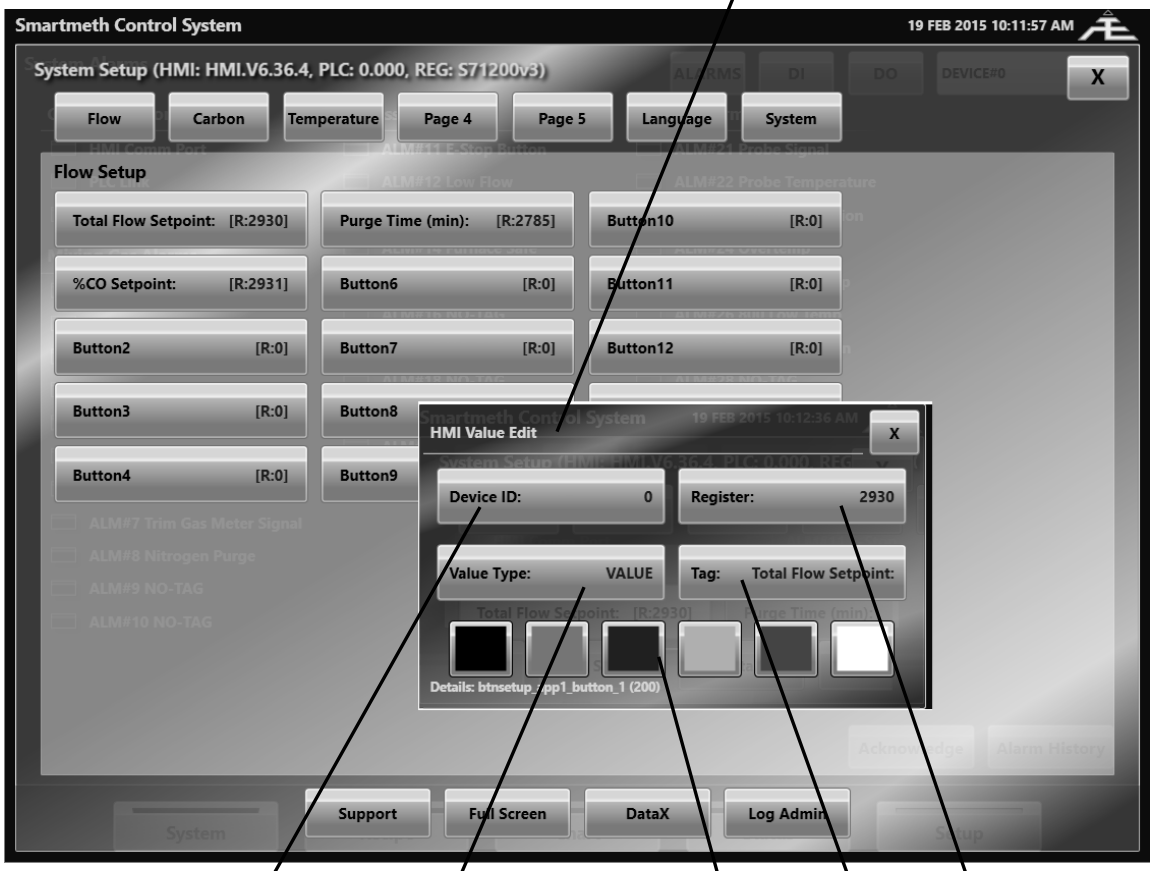
4.4 Setup Screen (Application Pages)

In HMI configuration mode the setup application pages show all possible buttons that can be configured on each page. The numbers that appear are the Modbus register numbers that each button is configured with. By simply clicking on the button the Modbus register, device ID and tag for that display value can be changed. By entering a 0 into the register number the button will be hidden when HMI configuration mode is turned off.



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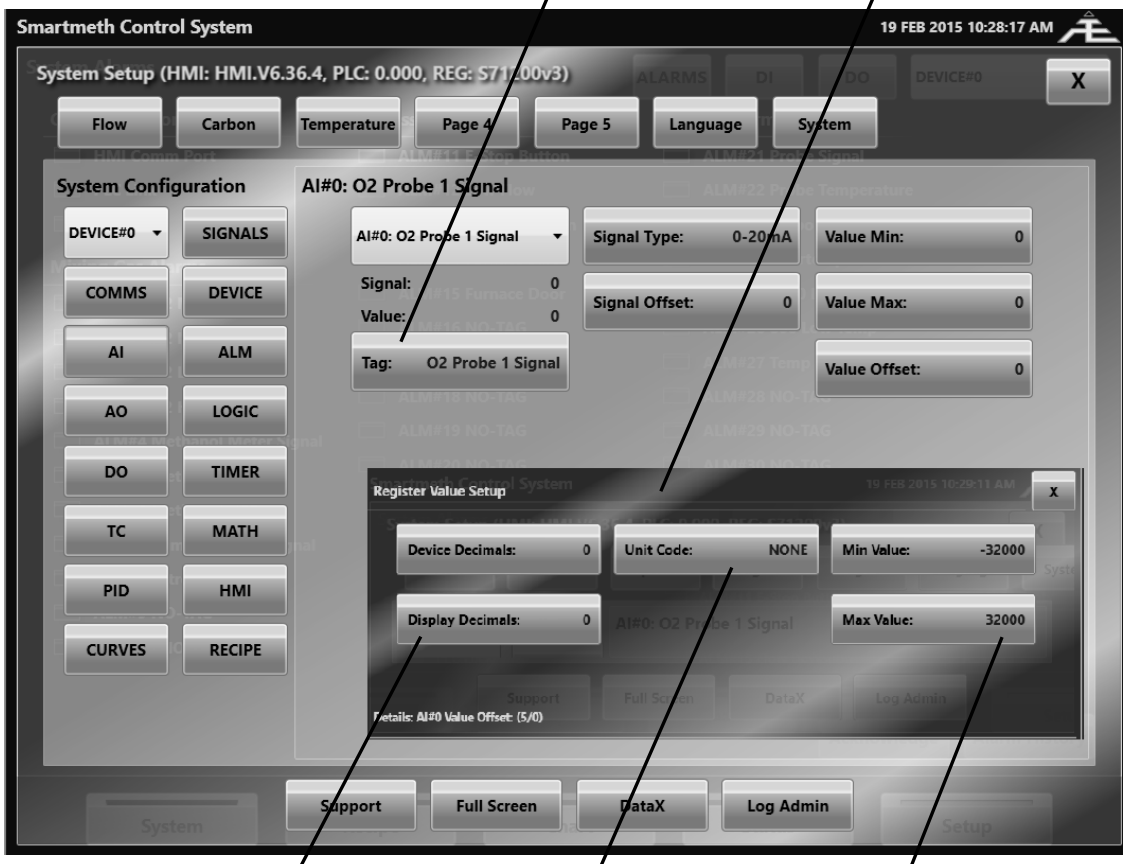
4.5 Setup Screen (System Setup)

In HMI configuration mode the system block setup pages allow for every setup value to be modified. By simply clicking on a button the value decimals, unit type, value min/max and tag can be changed for that associated register.



Tag Name:
Changes the name of the tag associated with block being setup

Register Value Setup Window

Register Value Decimals:
Sets the decimals displayed for the associated register value. **Generally, both "device" and "display" decimals should be set to the same number.**

Register Unit Code:
Sets the units associated with the register value. If this value is set to something other than "none", the value will then be changed when PLC units get changed under "Setup>System>Signals".

Register Value Min/Max:
Sets the minimum and maximum limits for the associated register value.

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5 PLC/HMI BACKUP FILES

After the ActivePLC™ and ActiveHMI™ are configured, a backup file for each can be generated, which contains all the setup settings. Any backup file can also be loaded onto the ActivePLC™ and ActiveHMI™ in order to re-generate the system that has been pre-configured.

Saving PLC Backup File

1. Go to “Setup>Login(Engineering pass)>System>Device”
2. Select “Save PLC>>File”
3. Select the path for the file to be saved
4. Select “Save”

Restoring PLC Backup File

1. Go to “Setup>Login(Engineering pass)>System>Device”
2. Select “Restore FILE>>PLC”
3. Select the PLC backup file that will be loaded to the device
4. Select “OK”

Saving HMI Backup File

1. Go to “Setup>Login(Engineering pass)>System>HMI”
2. Select “Save HMI>>File”
3. Select the path for the file to be saved
4. Select “Save”

Restoring HMI Backup File

1. Go to “Setup>Login(Engineering pass)>System>HMI”
2. Select “Restore FILE>>HMI”
3. Select the HMI backup file that will be loaded to the screen
4. Select “OK”

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6 CUSTOMER SUPPORT

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