Purge and Shutoff Station
HPM Series

Instruction Manual

Integrated Time Systems, Inc.

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1. DESCRIPTION

The **HPM Series** is a group of CMOS, microprocessor-based, **Purge and Shutoff Stations** designed to monitor and control gas delivery manifolds. Since all models include an Emergency Shutoff Subsystem, these units are particularly useful on gas cabinets where toxic or flammable gases are stored. All electronics are contained in a single enclosure with a hinged front panel to provide access to the circuit boards and sensor terminals.

Each of these generic models is supplied in various configurations customized to the installation. Most models provide a variety of pre-programmed, automatically sequenced purge recipes as well as safety-monitored manual controls. In addition, the dual-cylinder units provide automatic crossover from an empty cylinder to a full cylinder to maintain a continuous supply of gas to process tools.

One member of this series, referred to as **Model 621,** provides manual and/or automatic control of a single cylinder, 8-valve gas manifold. Another version, the **Model 625**, controls a two-cylinder, 12-valve gas manifold. A third version, **Model 652**, controls a two-cylinder, 2-valve gas manifold without automatic purging capability.

> *Information in this manual applies to any model in the HPM series. Examples of recipes, menu items and sensor lists are provided for tutorial purposes. These items may vary slightly from those described in this manual as appropriate for particular installations.*

1.1. Front Panel Overlay

A membrane front panel, using metallic snap-action switch domes on a printed circuit board base, provides a reliable operator interface with tactile feedback. Discrete LED's indicate the status of the various solenoids and sensors, while a 4-line Vacuum Fluorescent Display (VFD) displays operator prompts and programming information.

Following is a description of the major display and control areas on the **HPM** front panel overlay:

1.1.1. Gas Panel Flow Diagram

On most models, the major portion of the front panel contains a plumbing diagram representing a typical gas delivery manifold. This diagram may differ slightly depending on whether the manifold includes a High Flow Valve and whether the manifold includes a single shared Excess Flow sensor or two independent sensors.

In this section of the front panel, each pilot solenoid is represented by a symbol containing an LED at its center and a membrane switch button to its side or top. The LED's display the status of the various pilot solenoids, while the membrane buttons permit manual actuation of individual solenoids.

Following is a list of the electrically actuated pilot solenoids as represented on the front panel overlay:

CSV #1 & CSV #2	Cylinder Safety Valve (no corresponding pilot valves)
ESV #1 & ESV #2	Emergency Shutoff Valves
PGI #1 & PGI #2	Purge Gas Inlets
HPV #1 & HPV #2	High Pressure Vents
HPI #1 & HPI #2	High Pressure Isolation Valves
VAV	Vacuum Assist Valve
LPV	Low Pressure Vent
LPI	Low Pressure Isolation
HFV	High Flow Vent (optional)

Also represented in this portion of the overlay are the sensors that are critical to the execution of an automatic purge sequence:

Excess Flow (either 1 shared sensor or 2 independent sensors)
Low Purge Pressure
Low Cylinder 1& 2, (Pressure or Weight)
Low Vacuum
Excess Process Pressure

An LED at each sensor location displays the current status of the particular sensor. In general, a lighted LED indicates an unsafe or undesirable condition.

1.1.2. ESS Sensor Display

The ESS Sensor display is located at the upper right corner of the front panel. In general, this section contains two LED's, a left and a right, for each digital sensor or signal input. In some installations, one or more rows, each containing a left LED and a right LED, is split into two sections to display two similar variables such as *Cylinder 1 Select* and *Cylinder 2 Select*.

Generally, the LED's in the leftmost column of the ESS Sensor Display indicate the current status of the sensors, while the LED's in the rightmost column display any latched alarm conditions.

1.1.3. Programming Functions

The lower-left corner of the front panel contains those displays and controls required during programming operations. Included is a key-operated switch to enable programming and four membrane-switch buttons labeled: MODE, EXIT, UP/YES & DOWN/NO.

1.1.4. Purge Functions

On most models, the purge controls are located at the bottom of the front panel to the right of the Programming Functions. Included is a key-operated switch to enable purge modes and four membrane-switch buttons labeled: PURGE UP 1, PURGE DOWN 1, PURGE UP 2 & PURGE DOWN 2.

1.1.5. System Status

To the right of the Purge Control section is the System Status section. This area includes a red LED that lights during alarm conditions and a red LED that lights to indicate watchdog timer failure. Also included are an ALARM SILENCE membrane switch button and a STATION RESET button.

1.1.6. Emergency Stop

At the lower right corner of the front panel overlay is a red mushroom switch labeled EMERGENCY STOP. This switch provides a manual override, which disables all pneumatic outputs.

1.2. Rear Panel Connections

All electrical and pneumatic connections, with the exception of the sensor connections, are available at the bottom of the rear panel. Following is a description of those connections:

1.2.1. AC Power Entry

An AC power entry module is sometimes provided at the lower left corner of the rear panel. This module combines three functions:

- power entry
- fuse
- line voltage selection

1.2.2. Solenoid Outputs

A 12-position pneumatic connector is provided for access to the internal pilot solenoids.

1.2.3. Air Supply Inlet

A quick-disconnect pneumatic connector provides air pressure to the internal pilot solenoids.

1.2.4. Sensors

An AMP Circular Plastic Connector is installed at the bottom of the rear panel for sensor connections. This connector is wired to a sensor terminal board inside the enclosure.

1.2.5. Remote Connector

An AMP Circular Plastic Connector, located at the bottom right corner of the rear panel, provides electrical signals for accessory devices such as a **Model 605 Remote Panel** or a **Model 604 Enunciator & Control Station**. Several of the output signals on this connector may be user-configured from the menu.

2. INSTALLATION

2.1. Physical Requirements

The **HPM Series** is designed to mount on the top surface on a cylinder storage cabinet. Four captive fasteners are provided to secure the electronics enclosure to the storage cabinet. The fasteners are mounted on 9.0 inch by 3.0 inch centers and require 10/32 machine screws. The machine screws can protrude into the cabinet up to 1 inch without risk of contacting internal components.

While the enclosure is only 5.5 inches deep, additional clearance should be provided for the electrical and pneumatic connectors (see *Rear Panel Drawing* on page 51).

2.2. AC Power

The **HPM Series** may be configured during manufacture for either rigid conduit wiring or flexible line cord power entry. The power board design provides a 6-pin terminal strip for power entry, as well as an optional fuse holder and an optional voltage-selector slide switch.

> *Note: Damage to the electronics may result if an incorrect line voltage is selected! Regardless of how the unit is configured, the proper AC line voltage must be selected before power is applied.*

2.2.1. Line Cord

Those units intended for use with a flexible line cord contain a power-entry module that permits operation at either 120 volts or 240 volts AC. These units do not include the optional fuse holder and voltage-selector slide switch. Instead, selection of line voltage is performed by changing the orientation of a small circuit board located just under the fuse in the power entry module. The units are shipped from the factory configured for 120-volt operation.

To access the line voltage selector, unplug the AC line cord and slide the clear fuse cover to the left. The small, rectangular circuit board may be pulled from its socket using a bent paper clip to hook onto the round hole in the board. Orient the board such that the proper power line voltage (120 or 240) will be visible under the fuse and reinstall the board in its socket.

To replace the fuse, unplug the line cord and slide the clear fuse cover to the left. A plastic pull lever labeled *FUSE PULL* releases the fuse from its compartment. The power entry module is fitted with a 2 amp, 250 volt, 3AG fuse.

2.2.2. Rigid Wiring

Those units that connect to the AC power source via rigid conduit include a fuse holder and a voltage-selector slide switch on the circuit board instead of a power entry module.

To connect AC power to these units, use the three pins of the terminal block labeled *WHT*, *BLK* and *GRN* as indicated on the board as the *RIGID WIRING* option. In all cases, the pin labeled

GRN must be connected to EARTH ground. When connected to 115 VAC, the pin labeled *WHT* must be connected to the neutral side of the power line and the pin labeled *BLK* must be connected to the hot side. When connected to 230 VAC, the two power lines may be connected to the *WHT* and *BLK* pins regardless of wire color.

Before changing the line voltage switch, insure that the unit is not connected to an AC power source. Using a 3/16" flat bladed screwdriver, slide the switch actuator *UP* for 115 VAC operation, or *DOWN* for 230 VAC operation. In both cases, text on the switch actuator indicates the selected voltage. The units are shipped from the factory configured for 115 VAC operation.

Before replacing a fuse, insure that the unit is not connected to an AC power source. Use a 3/16" flat bladed screwdriver to depress the cap of the fuse holder and rotate it counterclockwise. Once released, the fuse cap and fuse will spring out enough to become accessible. The fuse holder must be fitted with a 2 amp, 250 volt, 3AG fuse.

2.3. Air Inlet

A male quick disconnect fitting, part number N3-203B, is provided on the rear panel for connection to a compressed air or N2 pressure source for the pneumatic actuators. The supplied mating female fitting, part number K2-20404, accepts 1/8" I.D. tubing.

The pneumatic pressure source must be regulated high enough to reliably drive the process gas pneumatic actuators (generally 75 psi minimum), yet low enough so as not to damage the pilot solenoids (100 psi maximum).

2.4. Solenoid Connections

A 12-position pneumatic connector provides access for up to (12) pilot solenoids. Pin numbers are stamped onto the back plate of the connector. The connector may be configured for use with 1/8" OD tubing or with 4MM tubing. Most of the connectors with Push-Lock fittings are sized for 1/8" OD tubing while those without Push-Lock fittings are sized for 4MM tubing.

Solenoid functions are listed below. Note that there are usually no pilot valves associated with the CSV #1 and CSV #2 functions as these valves are typically operated manually.

Valve	Label	Function
S1	HFV	High Flow Vent
S2	ESV #1	Emergency Shutoff Valve for Cylinder #1
S3	PGI #1	Purge Gas Inlet for Cylinder #1
S4	HPV #1	High Pressure Vent for Cylinder #1
S5	HPI #1	High Pressure Isolation for Cylinder #1
S6	VAV	Vacuum Assist Valve
S7	LPV	Low Pressure Vent
S8	LPI	Low Pressure Isolation
S9	ESV #2	Emergency Shutoff Valve for Cylinder #2
S10	PGI #2	Purge Gas Inlet for Cylinder #2
S11	HPV #2	High Pressure Vent for Cylinder #2
S12	HPI #2	High Pressure Isolation for Cylinder #2

2.5. Sensor Wiring

There are (16) digital inputs on all versions of the **HPM Series**. Twelve of these are available at the sensor connector and four are available at the remote connector. All digital inputs are optically isolated and require approximately 1-milliamp to activate. This current for the sensor inputs may be obtained from the internal power supply by providing a contact closure or a transistor closure between the particular sensor input pin and any of the *Sensor Common* pins.

The internal sensor connections are made via screw-down terminal lugs on a printed circuit board. This board is mounted inside the electronics enclosure on the rear wall. The screw-lugs are grouped in seven rows of six pins each. The pins are arranged as follows:

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6
Row 1	V2(+)	V2(+)	V2(+)	V2(+)	V2(+)	V2(+)
Row 2	Sensor 1	Sensor 2	Sensor 3	Sensor 4	Sensor 5	Sensor 6
Row 3	Sensor 7	Sensor 8	Sensor 9	Sensor 10	Sensor 11	Sensor 12
Row 4	V2(-)	V2(-)	V2(-)	V2(-)	V2(-)	V2(-)
Row 5	V1(+)	V1(+)	V1(+)	V1(+)	V1(+)	V1(+)
Row 6	Analog 1	Analog 2	Analog 3	Analog 4	Analog 5	Analog 6
Row 7	V1(-)	V1(-)	V1(-)	V1(-)	V1(-)	V1(-)

The digital *Sensor Inputs* on rows 2 and 3 are internally connected to the cathodes of optical isolators via current limiting resistors. The anodes of the optical isolators are internally connected to the positive side of an isolated, adjustable power supply labeled V2(+). This supply is also available at the pins on Row 1 for use as sensor power and is typically adjusted for 24 VDC. The *Sensor Common* pins on Row 4 are connected to the return side of the V2 power supply

The analog inputs on Row 6 are referenced to the return side of the V1 power supply available on Row 7. Since the V1 supply also powers the solenoids, it is always adjusted for 24 VDC. The positive side of V1 is available on the pins on Row 5.

If a power source other than 24 volts is required to power analog transducers, any of the pins on Row 7 may be connected to any of the pins on Row 4. Once the two power supplies are so commoned, V2 may be adjusted to provide +12 VDC to +30 VDC on all of the pins in Row 1. Note that V2 also powers the digital sensors and must not be adjusted for less than +10 VDC in order for the digital sensors to operate properly.

2.6. Remote Connector

All versions of the **HPM Series** include a chassis-mounted, 16-conductor, AMP Circular Plastic Connector, #206036-1, with 66591-1 pins. The cable-end connector required to mate with the Remote Connector is an AMP #206037-1, with 66592-1 sockets and 206070-1 cable clamp.

The Remote Connector contains the signals required to interface to a **Remote Panel**, an **Enunciator & Control Station** or to a central supervisory system. The typical pin assignments are listed in the table below, however, the exact signal protocols may differ to match the requirements of a particular installation.

The (8) electrical outputs on the Remote Connector are each capable of switching 2 Amps @ 30 VDC for use with various external displays, buzzers and relays. While each output provides a Normally Open relay contact, Relay 8 provides an additional Normally Closed contact. The COMMON contacts of all (8) relays are jumpered together with shorting pins on a header block (JP1 through JP8) on the circuit board. This common signal is then routed to Pin 16 on the Remote Connector as shown in the table below. The header block (JP1 through JP8) also enables the installer to jumper the relay commons to V2(-) at the circuit board instead, but this technique is less flexible than bringing the common out to a connector pin.

Though the relays may be wired to switch any voltage within the 30 VDC limits of the relay contacts and printed circuit board traces, the manufacturer recommends that Relay Common be connected to the return side of the internal 24-volt power supply, V2(-) on Pin 15 on the Remote Connector. Each external device would then have its positive terminal connected to V2(+) on Pin 14 and its negative terminal connected to an appropriate output pin (Pins 5 through 12).

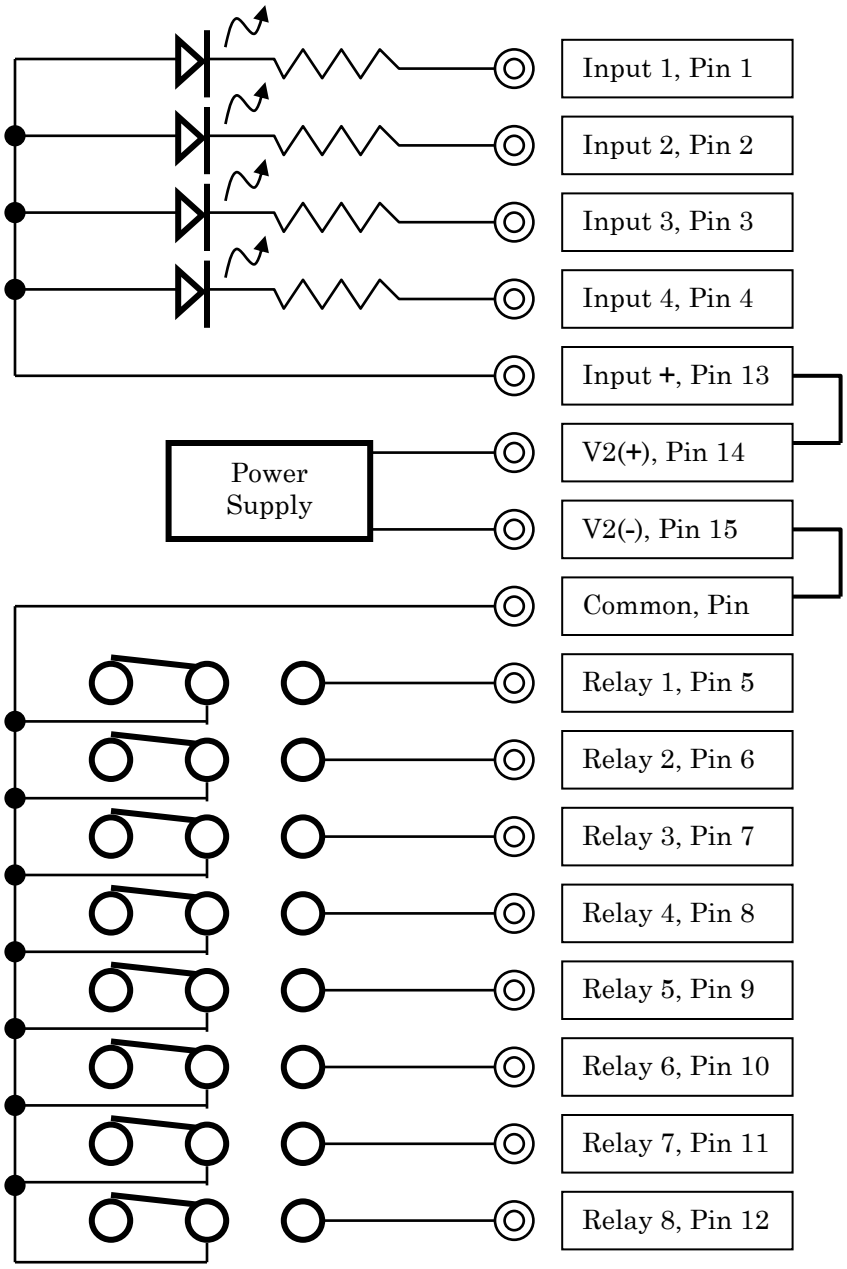
> *Note: Shorting +24 volts DC directly across any relay contact will cause permanent damage to the relay and, possibly, printed circuit board traces.*

An appropriate buzzer for use as a remote annunciator in very noisy environments is Model 450-24VDC, manufactured by Federal Signal Corporation, University Park, Illinois. This horn is available in a variety of mounting configurations and outputs sound at a level of 99 decibels at a distance of 10 feet. This unit is a mechanical buzzer and includes no volume control. When selecting a buzzer be aware that some of the alarm modes pulse the remote annunciator at 5 times per second, 50% duty cycle; some buzzers may not respond to such short pulses. On most units, the software allows the user to select pulsed or steady remote alarm modes.

Following is the pin-out of the signals on the Remote Connector:

Pin	Description	Standard Function	
1	Input 1	Remote Alarm Silence Input	Energize to silence alarm
2	Input 2	Remote Abort Input	Can be inverted from menu
3	Input 3	Tool Request Input	Can be inverted from menu
4	Input 4	Cross-over Inhibit Input (Dual Cylinder only)	Can be inverted from menu
5	Relay 1	Status Output	Can be inverted from menu
6	Relay 2	Alarm LED Output	Can be inverted from menu
7	Relay 3	Buzzer Output	Can be inverted from menu
8	Relay 4	Eminent Cross-over Output (Dual Cylinder only)	
9	Relay 5	Cylinder 1 Online	
10	Relay 6	Cylinder 2 Online (Dual Cylinder only)	
11	Relay 7	Cylinder 1 Low	
12	Relay 8	Cylinder 2 Low (Dual Cylinder only)	
13	Input (+)	Usually jumpered to Pin 14	
14	V2(+)	Usually adjusted for +24 VDC	
15	V2(-)	Usually 24 V Return	
16	Relay Common	Usually jumpered to Pin 15	

Remote Connector



3. OPERATION

3.1. System Readiness

Since gas panels are subject to vibrations during shipment, complete the following checks prior to connection of any hazardous materials:

3.1.1. Visually check all mechanical supports and electrical connections for integrity.

3.1.2. Visually check and leak test all plumbing connections.

3.1.3. Turn all regulators and valves to their *OFF* positions.

3.2. Power Up the Electronics

3.2.1. Apply AC power to the **Series 620.**

3.2.2. During the first 6 to 8 seconds after power is applied, one of the following messages is displayed on the VFD (Vacuum Fluorescent Display):

```
[Parameters in memory]
[have been protected.]
```

or

```
[  Hold 'RESET' to   ]
[ restore defaults.  ]
```

The first message is displayed if the PROGRAM ENABLE key is in the PROGRAM position while the second message is displayed if no key is inserted.

To restore all user-programmable variables to their default values, press the STATION RESET button while the second message is displayed. Otherwise, ignore the message.

3.2.3. During the next several seconds, visually inspect the LED's on the front panel for proper operation. All of the LED's except CPU ALERT should be lighted.

3.2.4. Also during this interval, check the VFD display for proper operation. A message similar to the following should be displayed:

```
[     800-0625-01    ]
[      1/20/2001     ]
```

3.2.5. A hardware failure during ***Power-On-Self-Test*** will cause the system to halt with the SYSTEM FAILURE LED activated and the pneumatic outputs off. Depending on the remaining capabilities of the failed electronics, one of the following messages may be displayed:

```
"  CPU has failed!   ","   Notify Manager   "
"  ROM has failed!   ","   Notify Manager   "
"  RAM has failed!   ","   Notify Manager   "
"Replace RAM Battery!","   Notify Manager   "
"CRYSTAL has failed! ","   Notify Manager   "
"IRQ Hardware Fault! ","   Notify Manager   "
```

Should this occur, disconnect AC power and notify the manufacturer.

3.2.6. When the power-up diagnostics are successfully completed, a message similar to the examples below is displayed:

```
[The manifold is not ]
[    initialized!    ]
        (or)
[    System Ready    ]
[    Selftest OK!    ]
        (or)
[   ESS triggered!   ]
[   Check sensors.   ]
        (or)
[    ESS latched!    ]
[    Press RESET.    ]
```

At this time the pneumatics become activated or not, depending on whether the power-fail sensor is programmed to latch (refer to the '*Auto Power Up*' function) and whether the ESS sensors are safe. If the power-fail sensor is programmed to latch, the alarm sounds and the pneumatics remain de-energized. Press the RESET button to clear this condition. On the other hand, if all ESS sensors are safe and the power-fail sensor is not latched, process gas flow is restored.

3.2.7. Diagnosed and repair any failed sensors before proceeding.

3.3. Using the Menu

Four buttons on the front panel control access to the programmable parameters contained in the three-level menu:

MODE

The MODE button is used initially to enter the menu and, thereafter, to scroll between categories at the same level of the menu. When the end of a particular list of categories is reached, the MODE button backs out of the menu by one level. (See page 46 for a listing of the menu structure.)

EXIT

The EXIT button is used to back out of the menu by one level or to exit the menu.

YES

Unless a target variable is displayed, the YES button leads you deeper into the menu, one level at a time. If a variable is displayed and the RESET key is pressed, the YES key confirms the RESET and causes the displayed variable to be restored to its default value. When a target variable is displayed, the YES button increments the displayed variable.

NO

The NO button scrolls between categories at the same level of the menu similar to the MODE button. When a target variable is displayed, the NO button decrements the displayed variable.

To display or alter a particular variable:

3.3.1. Press the MODE button to access the menu. The first menu category will be displayed.

3.3.2. Repeatedly press the MODE button or the NO button until the desired category is displayed.

3.3.3. Press the YES button to accept the displayed category.

3.3.4. Press the MODE or NO button to step to the variable to be altered.

3.3.5. Press the YES button to accept the displayed variable.

3.3.6. Press the UP or DOWN buttons to alter the variable.

3.4. Manual Operation

A *MANUAL MODE* is provided to permit actuation of any safe combination of pneumatic outputs.

3.4.1. To enter *MANUAL MODE*, the OPERATE/PROGRAM keylock must be actuated. Insert an appropriate key into the OPERATE/PROGRAM keylock and rotate the key to the PROGRAM position.

> *Note: If you make a mistake while performing the following sequences, hit the* EXIT *button to exit the menu, and begin again.*

3.4.2. Press the MODE button once. The VFD will display:

```
[   Modify Status    ]
[      Yes/No?       ]
```

3.4.3. Press the YES button once. The VFD will display:

```
[    Manual Mode     ]
[      Yes/No?       ]
```

3.4.4. Press the YES button again. The VFD will display:

```
[Manual Mode     ]
[Yes/No?       No]
```

3.4.5. Press the YES button again. The VFD will display:

```
[Manual Mode     ]
[Yes/No?      Yes]
```

> *Note: While in* MANUAL MODE*, individual solenoids may be toggled on or off by the user as desired. A special software module ensures that unsafe combinations of valves are not actuated simultaneously (see* Safety Mask*, page 24).*

3.4.6. To turn all solenoids off simultaneously, press STATION RESET. The VFD will display:

```
[Turn off valves?]
[- Yes to confirm]
```

Confirm the request by pressing the YES button to deactivate all solenoids.

> *Note: The controller will remain in* MANUAL MODE *until the EXIT button is pressed or until power fails.*

3.5. Purge Gas Setup

The following steps must be performed whenever a purge gas cylinder is installed. This procedure assumes that the valves on the purge gas panel are manually operated as is usually the case.

3.5.1. Position the purge gas cylinder inside the gas cabinet and align it with the purge panel CGA connection.

3.5.2. Inspect the CGA connection for cleanliness; then install and leak check the cylinder.

3.5.3. Open the purge gas cylinder valve momentarily; then close it.

3.5.4. Open the purge gas vent valve momentarily; then close it.

3.5.5. Repeat steps 3 & 4 above to eliminate atmosphere from the purge gas panel.

3.5.6. With the purge gas vent valve still closed, open the purge gas cylinder valve.

3.5.7. Set the purge gas pressure regulator to the desired setting (approx. 80 psi).

3.5.8. Open the low-pressure purge gas valve to introduce purge gas into the process gas panel.

3.6. Process Gas Setup

3.6.1. Position the process gas cylinder inside the gas cabinet and align it with the process panel CGA connection.

3.6.2. Inspect the CGA connection for cleanliness; then install the cylinder.

> *Caution: On systems that contain a manually operated cylinder valve, do not open the process gas cylinder valve at this time!*

3.6.3. Select *Manual Mode* from the menu and activate the *PGI* and *ESV* outputs to expose the CGA connection to purge gas.

3.6.4. Check the CGA connection for leaks.

3.6.5. Select *Initialize HP* from the *Special Recipes* section of the menu and execute the recipe.

3.6.6. Select *Manual Mode* from the menu and activate the *PGI* and *HPI* outputs to expose the pressure regulator to purge gas.

3.6.7. Adjust the pressure regulator to the desired setting.

3.6.8. Select *Initialize LP* from the *Special Recipes* section of the menu and execute the recipe.

3.6.9. When system initialization is complete, the user may execute the PURGE UP recipe from the controller keypad. The system will complete this procedure by opening the process isolation valve (*LPI*).

3.7. Running Purge Recipes

The standard **Series 620** is preprogrammed to execute (5) different purge recipes (see *Recipe Structure* on page 25). Four of these recipes are accessible from buttons on the front panel labeled PURGE DOWN and PURGE UP, while the remaining three recipes are accessed from the programming menu.

RECIPE	PURPOSE	ACCESSED VIA:
Initialize HP	Initialize High-Pressure section of manifold after maintenance.	Menu
Initialize HP & LP	Initialize High-Pressure and Low-Pressure sections of the manifold after maintenance.	Menu
Initialize PL	Initialize Process Lines after maintenance.	Menu
Purge Up Cyl 1	Purge High-Pressure section of manifold after installation of cylinder 1.	PURGE UP buttons
Purge Down Cyl 1	Prepare manifold for removal of cylinder 1.	PURGE DOWN buttons
Purge Up Cyl 2	Purge High-Pressure section of manifold after installation of cylinder 2.	PURGE UP buttons
Purge Down Cyl 2	Prepare manifold for removal of cylinder 2.	PURGE DOWN buttons

Use the following procedure to initiate the *Purge Up* and *Purge Down* recipes:

3.7.1. Insert an appropriate key into the DISABLE/ENABLE keylock and rotate the key to the ENABLE position.

3.7.2. Press the appropriate PURGE UP button to purge the high-pressure section of the manifold after installation of a new cylinder. Alternately, press the PURGE DOWN button to prepare the manifold for removal of an empty cylinder.

3.7.3. Respond to the confirmation request on the VFD display by pressing the YES button.

3.7.4. During the course of the selected recipe, perform the actions as requested on the VFD display.

3.7.5. When the recipe is complete, rotate the DISABLE/ENABLE key to the DISABLE position and remove the key.

Note: See the discussion on Using the Menu *on page 11 to access the remaining recipes.*

4. THEORY OF OPERATION

Much of the information contained in this section is provided for documentation purposes and is not required for normal operation**.**

4.1. CPU Board

The CPU board used in the **HPM Series** is a general-purpose board that is used in several different products. Following is a description of several sub-circuits contained on the board.

4.1.1. Watchdog Timer

This circuit generates the CLEAR signal which is used on I/O board(s) to force all outputs to their off condition. Software must trigger this circuit at least every 1.6 seconds for outputs to remain energized. This timer is also cleared by the RESET signal generated by the Low Voltage Detector described below. The microprocessor can read the output of the watchdog timer for diagnostics purposes.

4.1.2. Low Voltage Detector / Reset Generator

This circuit contains a 'band-gap' voltage reference to monitor the microprocessor's power supply. A reset signal is sent to the microprocessor and to the watchdog timer (which forces outputs off) whenever the regulated power supply drops below 4.6 volts. Since all of the circuitry is CMOS and would operate reliably down to about 3.5 or 4 volts, this circuit provides more than adequate low-voltage protection.

4.1.3. Lithium Battery

A Lithium battery is provided on the CPU board to protect user- programmed variables during power outages. The unit will continue to operate properly with an expended battery, but user-programmed variables will be lost during power outages. (See page 41 for information regarding battery maintenance.)

4.1.4. Slow-Clock Circuit

This circuit reduces the microprocessor clock frequency by a factor of 10 whenever I/O operations are taking place and during power failures (on products that have a Ni-Cad battery). During I/O operations, this speed reduction permits use of slower CMOS display drivers. During power failures, it results in lower power consumption and longer battery life.

4.1.5. AC line Digital Filter and Interrupt Generator

This circuit filters the incoming AC line frequency to remove any spurious noise pulses and to convert the sine wave to a square wave. The resulting signal generates an interrupt to the microprocessor for use in systems that require accurate 50 or 60 cycle line-frequency timing.

4.1.6. Memory Types

The Purge & Shutoff System contains three types of memory:

- ROM (Read Only Memory),
- Volatile static RAM (Random Access Memory), and
- Non-volatile static RAM (lithium battery protected).

The operating system software (program) is stored in ROM by the manufacturer and cannot be altered by the distributor or end-user. This information is not lost during power failures of any duration. The particular device used for this purpose is more accurately referred to as Electrically Programmable Read Only Memory (EPROM), but the more generic term, ROM, is used throughout this manual.

The Random Access Memory (RAM) is used by the microprocessor to store temporary variables, status flags and timers. This information can be randomly accessed and altered by the microprocessor at any time.

A large portion of RAM is protected during power failures by a lithium battery. This memory is used to store various user-programmable variables such as time delays and number of times to repeat a purge sequence, etc. During power-up, the user is given the option of restoring these variables to their default values (see ***Power-On-Self-Test,*** page 17).

4.2. Power-On-Self-Test

When AC power is applied to the **Series 620.** The following message is displayed for 6 to 8 seconds on the VFD (Liquid Crystal Display):

```
[Hold 'RESET' to ]
[restore defaults]
```

During this time, the user is given the opportunity to restore the user-programmable variables to their default values. If the STATION RESET button is not depressed while the message is displayed, the previous settings of the variables are retained during the subsequent memory test and initialization.

During the next phase of the ***Power-On-Self-Test***, a software module tests several hardware subsystems. This module includes a lamp test, an EPROM checksum test, a RAM pattern test, a watchdog timer test, a crystal test, and a line frequency check. During the several seconds while the software is performing these tests, the user is given the opportunity to visually inspect the LED's on the front panel for proper operation. All of the LED's except CPU ALERT should be lighted.

Also, during this interval, a message is displayed on the VFD indicating the software version and date as indicated below. In the event it becomes necessary to alter the software configuration, record this data and contact Customer Service with your new requirements.

The information displayed during ***Power-On-Self-Test*** should match the information typed on the ROM label (see *Changing ROMs*, page 40).

```
[   800-0621-04  ]
[      4/3/97    ]
```

A hardware failure during ***Power-On-Self-Test*** will cause the system to halt with the SYSTEM FAILURE LED activated and the pneumatic outputs off. Depending on the remaining capabilities of the failed electronics, one of the following messages may be displayed:

```
"  CPU has failed!   ","   Notify Manager   "
"  ROM has failed!   ","   Notify Manager   "
"  RAM has failed!   ","   Notify Manager   "
"Replace RAM Battery!","   Notify Manager   "
"CRYSTAL has failed! ","   Notify Manager   "
"IRQ Hardware Fault! ","   Notify Manager   "
```

When the power-up diagnostics are successfully completed, one of the two following messages will be displayed:

```
[  System Ready  ]
[  Selftest OK!  ]
```

(or)

```
[ESS triggerred! ]
[Check sensors.  ]
```

At this time the pneumatics become activated or not, depending on whether the power-fail sensor is programmed to latch and whether the ESS sensors are safe. If the power-fail sensor is programmed to latch, the alarm sounds and the pneumatics remain de-energized until the RESET button is pressed. On the other hand, if all ESS sensors are safe and the power-fail sensor is not latched, process gas flow is restored.

4.3. Power Line 50/60 Hertz Detection

All versions use the waveform of the AC power line for all timing functions. The incoming AC waveform is digitally filtered to remove extraneous noise and then applied to the various counters in the microprocessor for use as a time base.

During ***Power-On-Self-Test*** the software uses the internal crystal to determine whether the incoming waveform is 60 Hertz or 50 Hertz. In most locations, the power line accuracy is better than can be achieved with a crystal time base, but the accuracy of the internal crystal is more than adequate to determine which frequency the local power grid uses.

If either the internal crystal or the power line frequency is out of tolerance to the extent that an accurate determination of line frequency cannot be made, the software defaults to the line frequency contained in a user-programmable value that can be accessed from the menu. In those cases when the unit is able to accurately determine power line frequency (100% of the time in locations where the power grid is stable), the software sets this user-programmable value to match the actual measurement.

With this technique, the unit is able to operate on marginal power lines using a 'best guess' technique on those occasions when the frequency cannot be measured accurately. In addition,

the user can manually change the default selection for use in locations where the power grid is **never** in tolerance.

In the event of a total hardware failure that prevents the unit from detecting the power line at all, the unit displays an **'IRQ Hardware Fault!'** message and will not allow the system to operate.

4.4. Setup Parameters and Process Variables

Different types of variables are stored in different memory types depending upon whether they are to be user-programmable and whether they must be protected during power failures.

Each Setup Parameter and each Process Variable has four values associated with it:

- Default Value
- Present Value
- Lower Limit
- Upper Limit

Default Value - This is the value the parameter has on power-up the first time the unit is initialized. Default Values are stored in ROM and may be specified by the distributor or user, but altered only by the manufacturer. The user has the option of restoring all programmable parameters to their default values at any time.

Present Value - Any of the parameters that have been re-programmed by the user may have a Present Value different from the Default Value. This value is stored in the battery-backed RAM and is protected during power failures.

Lower Limit - A Lower Limit value is stored in ROM for each parameter that is user-programmable. The operating system prevents the user from decrementing a particular Present Value below its Lower Limit.

Upper Limit - An Upper Limit value is stored in ROM for each parameter that is user-programmable. The operating system prevents the user from incrementing a particular Present Value above its Upper Limit.

4.5. Operating Modes

The software of the **Series 620** is structured so as to manage three non-overlapping operational modes. One and only one of these three modes is active at all times after ***Power-On-Self-Test*** is complete.

Mode:	Description:
Operate	Normal state; gases may be flowing or not depending on the status of the ESS sensors, etc.
Purge	Active while a recipe is being executed
Manual Mode	Accessed via programming menu

4.6. Emergency Shutoff System

The **HPM Series Purge and Shutoff Stations** contain a complete emergency shutoff module that works independently of the purge sequencing functions. This software module processes an array of data relating to the various external sensors and causes alarms to sound, displays to light and solenoids to de-energize in response to those sensors. This module is also responsible for providing the purge-sequencing module with information regarding *Excess Flow*, *Low Purge Pressure* etc.

The standard hardware configuration provides for (12) optically-isolated digital inputs accessible at terminal screws inside the enclosure and (4) auxiliary inputs accessible at the Remote Connector. In addition, the ESS module processes several of the front panel switches so as to unify all of the input functions. In other words, the ESS module links the ALARM SILENCE button on the front panel to the Alarm Silence function. It also links the EMERGENCY STOP mushroom switch to the Local Abort function. Any other digital input could also be configured to cause those same functions.

Each of the sensors processed in this module has several attributes associated with it. Some of those attributes are the same regardless of operating mode (for example, debounce time), while others vary depending on mode. For example, spurious Excess Flow signals must be ignored during purge recipes, but monitored during Operate Mode and Manual Modes.

The following page contains a list of attributes that may be assigned in ROM to each of the sensors.

Sensor Attribute Table

Attribute	Function
Window	This optional parameter assigns the sensor to one of the (10) ESS display windows. If omitted, the sensor doesn't display on the ESS graphics.
Debounce Time	This determines whether the response time is user-programmable or fixed.
Polarity	This adapts the software to whether the sensor is wired for 'safe when energized' or 'safe when open'.
Latching	This determines whether the sensor should automatically reset itself when the monitored parameter becomes safe. For example, an *Excess Flow* sensor would need to be latched in software because shutting off the gas flow cause the signal from the sensor to go away.
Remote Alarm Silence	The Remote Alarm is an optional buzzer connected to the Remote Connector. This sensor attribute determines whether the sensor generates a Remote Alarm Silence function. The Remote Alarm Silence does not clear the Local Alarm.
Remote Warning Alarm	This determines whether the sensor generates a Remote Warning Alarm. The 'Warning Only' alarms are less attention getting than ESS alarms.
Remote ESS Alarm	This determines whether the sensor generates a Remote ESS Alarm.
Local Alarm Silence	This determines whether the sensor generates a Local Alarm Silence function. The Local Alarm is the buzzer on the front panel. The Local Alarm Silence clears both the Local Alarm and the Remote Alarm.
Local Warning Alarm	This determines whether the sensor generates a Local Warning Alarm.
Local ESS Alarm	This determines whether the sensor generates a Local ESS Alarm.
Purge Enable	This determines whether this input enables the purge recipes. Usually, only the DISABLE/ENABLE keylock on the front panel generates Purge Enable.
Program Enable	This determines whether this input enables programming functions. Usually, only the OPERATE/PROGRAM keylock on the front panel generates Program Enable.
Reset	This determines whether this input generates a reset function. Usually, only the RESET button on the front panel generates the reset function.
ESS Shutoff 2	This determines whether this input should shut off valve pattern 2 when the sensor is unsafe.
ESS Shutoff 1	This determines whether this input should shut off valve pattern 1 when the sensor is unsafe.
Excess Process Pressure	This attribute tells the software that this input is connected to a Excess Process Pressure sensor.
Low Vacuum	This attribute tells the software that this input is connected to a Low Vacuum sensor.
Low Cylinder Pressure	This attribute tells the software that this input is connected to a Low Cylinder Pressure sensor.
Low Purge Pressure	This attribute tells the software that this input is connected to a Low Purge Pressure sensor.
Excess Flow	This attribute tells the software that this input is connected to a Excess Flow sensor.

4.7. Analog Inputs

4.7.1. Description

The **Purge and Shutoff Station** provides an optional analog-to-digital converter subsystem with (8), 8-bit analog inputs. Six of these inputs are available on the I/O Terminal Board for use with weight, flow or pressure transducers and the remaining two are pre-wired to measure internal power supplies.

Ten times per second, each of the eight channels is measured and the most recent eight readings from each channel are summed. This technique results in a new, stable, 11-bit value each 0.1 second for each channel. These 11-bit values are then rounded down to 8-bits each such that the full-scale value of each channel is divided into 256 intervals.

The eight values are then converted to engineering units (PSIG, Volts, Kilograms, Liters per Minute, etc.) for display purposes and for limit checking. This conversion is accomplished by way of indexed tables that allow for nonlinear transducers with non-zero offsets. The display and limit checking modules handle values in the range of –999 to +9999 Engineering Units (PSIG, Volts, Kilograms, Liters per Minute, etc.).

The display software monitors the operation of the Vacuum Fluorescent Display (VFD). When the VFD is not displaying a critical message, the analog software 'steals' the last two seconds of each 8-second display cycle to display the reading from one of the analog transducers. During these two seconds, the parameter name, the value and the name of the Engineering Units is displayed. During the last two seconds of the next display cycle, the next transducer is displayed, and so on. If the user needs to display a particular transducer for a prolonged period of time, rather than wait for that particular transducer to be displayed, the user may press the ALARM SILENCE switch. This stops the display sequence at whichever sensor is currently displayed for 30 seconds. Repeatedly pressing ALARM SILENCE advances through all installed transducers and resets the 30-second timeout with each key press. Pressing any other switch on the front panel reverts the display to its normal 8-second sequence.

The limit checking software allows for up to (8) comparison tests to be performed ten times per second. Each of these tests may be configured to compare the value from any analog channel with a value programmed by the user. As with other parameters programmed by the user, constraints may be placed on the range of programmable values to avoid unsafe conditions. Each of these tests may be configured to treat the setpoint as a maximum value or as a minimum value as determined by the parameter being measured. In addition, each of the tests may be made conditional. For example, consider a system wherein two cylinders are configured for auto-crossover. Each of the cylinders might be monitored with an analog pressure transducer at the pigtail. When cylinder #1 is selected, the LOW CYLINDER CONTENTS display would display the results of a test based on the transducer on cylinder #1. On the other hand, when cylinder #2 is selected, the LOW CYLINDER CONTENTS display would display the results of a test based on the transducer on cylinder #2. That is, the first test would be conditional based on the Cylinder Select variable having the value '1' and the second test would be conditional based on the Cylinder Select variable having the value '2'.

After the analog comparison tests are completed, each pass/fail result is mapped onto a particular digital sensor. This allows the analog transducers to serve any function that a signal from a digital sensor or from a remote panel might serve. In addition, this technique allows the (12) sensor bypass switches to be used to bypass the analog transducers just as though the signals were originating from digital switches instead of from analog transducers.

4.7.2. Input Circuit

Each analog input signal on the **Purge and Shutoff Station** is routed through a simple signal conditioner before being sent to the Analog-to-Digital converter. Depending on the characteristics of the transducer, the signal conditioner may consist of a voltage divider (for 0 to 10 volt signals), a loop resister (for 4 to 20 milliamp signals), a zener diode (to clamp excessive voltages) and/or a self-resetting fuse (to protect the Analog-to-Digital converter).

4.7.3. Conversion Tables

Each analog transducer model requires a unique software conversion table to prepare the data for display and analysis.

The full-scale reference of the Analog-to-Digital converter is calibrated at 5.12 volts. Since the converter is an 8-bit converter with a resolution of 1/256, an input signal of 5.00 volts results in a binary reading of 250. Similarly, an input signal of 5.10 volts results in a binary reading of 255 (the maximum value) and an input signal of 0 volts results in a binary reading of 0 (the minimum value).

The conversion table for each transducer must convert the converter's binary reading into a positive or negative integer value appropriate for display in engineering units.

As an example, the Setra, Model 215-101-07-MT2 pressure transducer outputs 0.2 volts at -14.7 lbs. to 5.2 volts at 3000 lbs. This is an example of a linear relationship with a non-zero offset. The conversion table for this transducer was generated using the equation:

$$\mathrm{Pr}\,essure = (BinaryValue - (10 + 250 * 14.7 / 3014.7)) * 3014.7 / 250$$

In this equation, the constant '10' is the binary representation of 0.2 volts, the transducer's minimum output. The constant '250' is the binary representation of 5.00 volts, the full scale range of the transducer. Similarly, the 14.7 is the pressure at atmosphere which converts to '0' for display purposes and the 3014.7 is the full range of the transducer.

As a further example, the Setra, Model 215-101-04 pressure transducer outputs 0.2 volts at -14.7 lbs. to 5.2 volts at 250 lbs. The conversion table for this transducer was generated using the equation:

$$\mathrm{Pr}\,essure = (BinaryValue - (10 + 250 * 14.7 / 264.7)) * 264.7 / 250$$

The previous examples represent simple linear conversions. More complex conversion tables can be generated from characterization curves or from power series expansion equations as required by the transducer. No provision is currently available to individually calibrate or 'tweak' each analog input to allow for 'out-of-family' transducers.

4.8. SafeCheck

The operating system software of the **Purge and Shutoff Station** internally manages (24) output functions. Twelve (12) of these functions control the status of the solenoid valves on the power board, four (4) functions control the output signals on the Remote connector, and the remaining eight (8) functions are flags which are used to communicate status information amongst various recipes.

A software module called **SAFCHK** tests for unsafe combinations of output functions ten times each second. This module is executed in all operating modes, including *OPERATE*, *PURGE* and *MANUAL* and a separate set of unsafe conditions can be specified for each mode. Although the software allows an unlimited number of potentially unsafe combinations to be evaluated, the required testing can usually be achieved with four or five sets of conditions. The standard list of tests is detailed below, however, variations in the manifold design dictate exactly what tests are included in each operating system ROM.

In most installations, the **SAFCHK** module is used to test for unsafe combinations of the pilot valves which control the pneumatic actuators on the gas manifold.

Each test executed by the **SAFCHK** module contains two basic elements:
- which outputs ***MUST BE ON*** to satisfy this particular test?, and
- what ***UNSAFE COMBINATION*** is this test checking for?

When no ***MUST BE ON*** functions are specified, the ***UNSAFE COMBINATION*** will be forced OFF, only if **all** of the individual outputs listed in the ***UNSAFE COMBINATION*** are ON. An example of this type of test would be "*Don't turn on the High Pressure Vent (HPV) and the Low Pressure Vent (LPV) at the same time*."

When one or more **MUST BE ON** functions are specified, the **UNSAFE COMBINATION** will be forced OFF if **all** of the individual outputs listed in the **UNSAFE COMBINATION** are ON and not all of the **MUST BE ON** functions are ON. An example of this type of test would be "*Don't turn on the High Pressure Vent (HPV) unless the Vacuum Assist Valve (VAV) is on.*"

The type of checks described above is repeated for as many **UNSAFE COMBINATION**s as are listed in the operating system ROM. The tests included in a typical ROM include:

- *Don't turn on all (8) valves at the same time (PURGE , OPERATE* or *MANUAL).*
- *Don't turn on the HPV and the LPV at the same time (PURGE , OPERATE* or *MANUAL).*
- *Don't turn on the ESV and the HPI and the LPV at the same time (PURGE , OPERATE* or *MANUAL).*
- *Don't turn on the ESV and the HPV at the same time (OPERATE* or *MANUAL).*
- *Don't turn on the CSV and the ESV and the HPV at the same time (PURGE , OPERATE* or *MANUAL).*

When all of the tests are complete, any functions that have been forced OFF are indicated on the front panel graphics by flashing LED's. In addition, an appropriate message flashes on the Vacuum Fluorescent Display for several seconds after the unsafe combination first occurs. If more than one unsafe combination is detected and corrected, the VFD displays the highest priority message as determined by the order of the tests in the ROM table.

4.9. Recipe Structure

The **Purge & Shutoff System** is capable of executing any of several built-in, table-driven recipes. The two most frequently used recipes, 'Purge Up' AND 'Purge Down', are accessed by way of keys on the membrane front panel, while remaining recipes are accessed via the programming menu. The exact structure of each recipe is specified by the distributor and/or end-user and becomes part of the firmware (ROM). Typically, the recipes themselves do not vary much from system to system - only the values of user-programmable variables change. (See the appendix for listings of the built-in recipes.)

Each recipe of the **Purge and Shutoff Station** may contain up to 99 steps. Any step may branch to any other step up to 9999 times, so the effective number of steps in a recipe is practically unlimited.

Each step of all recipes contain several parameters, some of which are specified by the distributor and others which are programmable by the user. Basically, each step first executes a timed delay, then a sensor delay. After the sensor delay (when the specified sensors are satisfied), either the next step is executed or a branch to some other step occurs.

The elements of each step are:

ON/OFF Functions

There are twenty-four (24) ON/OFF functions that may be turned ON, turned OFF, or left alone at the beginning of each step of each recipe. Twelve (12) functions control the status of the solenoid valves on the power board. Four (4) functions control the output signals on the Remote connector, and the remaining eight (8) functions are flags which may be used to communicate status information amongst various recipes.

DELAY Flags *(see DELAY and ABORT Mask below)*

Twenty-four (24) functions are monitored to determine the delay portion of each step. For example, the sensors that are displayed on the front panel graphics (Excess Flow, Low Purge Pressure, Low Cylinder Pressure, Low Vacuum and Excess Process Pressure) represent five of these functions.

The 24-bit ***DELAY Flag*** pattern determines what combination of the sensors and keys must be 'safe' after the TIME delay specified above before the operating system advances to the next step or branches to the specified step.

ABORT Flags *(see DELAY and ABORT Mask below)*

A 24-bit pattern similar to the pattern of the Delay Flags above determines what combination of sensors and keys must be safe to avoid an abort to the specified abort step.

COUNT

This 16-bit pattern points to the memory location where the number-of-branches out of this particular step is stored. The COUNT variable may point to an address of a fixed value in ROM, or it may point to a user-programmable variable stored in battery-backed RAM or it

may point to a RAM variable which a host computer may have access to. A value of '0' will be interpreted as '1' by the operating system since each step must be executed at least once. For each step of each recipe, the distributor or end-user may specify whether the COUNT value is user-programmable or fixed. The range of acceptable values for the variable pointed by this address is 0 to 9999.

TIME

This 16-bit pattern points to the memory location where the time delay for this particular step is stored. This interval determines how long the operating system will wait before checking sensors or keys (if any). The TIME variable may point to an address of a fixed value in ROM, or it may point to a user-programmable variable stored in battery-backed RAM or it may point to a RAM variable which a host computer may have access to. For each step of each recipe, the distributor or end-user may specify whether the COUNT value is user-programmable or fixed. The range of acceptable values for the variable pointed by this address is 0 to 9999 seconds.

NEXT

This 2 digit number determines what step will be executed next if the COUNT value above is greater than 1. After the specified number of branches has occurred, the step following the current one will be executed.

BRANCH

This 2 digit number determines the number of the step where the operating system will resume execution if any of the ABORT sensors specified above fail.

MESSAGE

This 16-bit pattern points to the memory location where the message or prompt to be displayed during this step is stored. The MESSAGE variable may point to an address of a fixed message in ROM, or it may point to a RAM variable which a host computer may have access to. The distributor or end-user may specify a 32-character text of the message for each step of the recipe.

DELAY and ABORT Mask:

The following (24) bits determine which sensors or keys will be monitored during the delay portion of each step. The same bits are used to determine whether an ABORT will occur at any time during a step.

0 This bit is set 'unsafe' when the specified *Excess Flow* sensor(s) are unsafe.

1 This bit is set 'unsafe' when the specified *Low Purge Pressure* sensor(s) are unsafe.

2 This bit is set 'unsafe' when the specified *Low Cylinder Pressure* sensor(s) are unsafe.

3 This bit is set 'unsafe' when the specified *Low Vacuum* sensor(s) are unsafe.

4 This bit is set 'unsafe' when the specified *Excess Process Pressure* sensor(s) are unsafe.

5 This bit is set 'unsafe' when any combination of *ESS Shutoff 1* sensors is active.

6 This bit is set 'unsafe' when any combination of *ESS Shutoff 2* sensors is active.

7 This bit is set 'unsafe' when any combination of *Reset* sensors is active.

8 This bit is set 'unsafe' when any combination of *Programming Function* inputs is active.

9 This bit is set 'unsafe' when any combination of *Purge Enabled* inputs is active.

10-12 not yet specified

13 This bit is forced 'safe' when the 'NO' key has recently been pressed. If this bit is monitored in the ON portion of a DELAY mask, the next step will not be executed until the 'NO' key is pressed. If monitored in the OFF portion of an ABORT mask, the ABORT branch will be executed when the 'NO' key is pressed.

14 This bit is forced 'safe' when the 'YES' key has recently been pressed. If this bit is monitored in the ON portion of a DELAY mask, the next step will not be executed until the 'YES' key is pressed. If monitored in the OFF portion of an ABORT mask, the ABORT branch will be executed when the 'YES' key is pressed.

15 This bit is forced 'unsafe' at all times. It may be monitored to force an unconditional ABORT branch to another step or to cause an unconditional DELAY.

16-23 These flags may be set by the *ON/OFF* functions listed in the preceding section and monitored by the *DELAY* and/or the *ABORT* functions.

4.10. Remote Connector Signals

The Remote Connector contains eight output signals and four input signals, some of which may be configured by the end-user using functions selected from the menu.

> *Note: See the discussion on* wiring the Remote Connector *on page 7 for further detail. Also see the section on Menu Functions on page 30. The Remote Connector functions are near the end of the menu.*

4.10.1. Signal Definition

Status Output - indicates the readiness of the gas cylinder to provide gas to the process tool. The requirements depend on which cylinder is selected as follows (X='don't care'):

Selected Cylinder =	*Cylinder #1*	*Cylinder #2*
Cylinder 2 ESS Conditions	*X*	*OK*
Cylinder 1 ESS Conditions	*OK*	*X*
Low Cylinder 2	*X*	*OK*
Low Cylinder 1	*OK*	*X*
Cylinder 2 Purged Down	*X*	*X*
Cylinder 2 Purged Up	*X*	*Yes*
Cylinder 1 Purged Down	*X*	*X*
Cylinder 1 Purged Up	*Yes*	*X*
Process Line Initialized	*Yes*	*Yes*
Low Pressure Initialized	*Yes*	*Yes*
High Pressure Initialized	*Yes*	*Yes*
Cylinder 2 Enabled	*X*	*Yes*
Cylinder 1 Enabled	*Yes*	*X*
High Flow Vent	*X*	*X*
High Pressure Isolation #2	*Off*	*On*
High Pressure Vent #2	*X*	*Off*
Purge Gas Isolation #2	*X*	*Off*
Emergency Shutoff Valve #2	*X*	*On*
Cylinder Valve #2	*X*	*On*
Low Pressure Isolation	*On*	*On*
Low Pressure Vent	*Off*	*Off*
Vacuum Valve	*X*	*X*
High Pressure Isolation #1	*On*	*Off*
High Pressure Vent #1	*Off*	*X*
Purge Gas Isolation #1	*Off*	*X*
Emergency Shutoff Valve #1	*On*	*X*
Cylinder Valve #1	*On*	*X*

Alarm LED Output - provides alarm status to a remote LED or to remote supervisory equipment. This output is not affected by the *Remote Alarm Silence Input* or by the *Alarm Silence* pad on the front panel.

External Buzzer Output - connects to a remote audible alarm or to remote supervisory equipment. This output is de-activated by the *Remote Alarm Silence* and by the *Alarm Silence* pad on the front panel.

Remote Alarm Silence Input - silences the *External Buzzer Output*.

Remote Abort Input - causes selected valves to be de-energized and alarms to sound. This function can be activated by opening a contact or by closing a contact as selected from the menu.

Remote Disable Input – allows the gas supply to be remotely disabled without triggering alarms.

4.11. Menu Functions

This section details some sections of the menu that are not covered elsewhere. The exact menu structure varies by installation as noted. See page 46 for a summary listing of a typical menu.

4.11.1. Modify Status

The ***Modify Status*** section of the menu permits the user to alter various status flags and variables that control the operating state of the controller. Some of these functions are controlled automatically and are included on the menu to permit manual intervention.

Manual Mode; default is 'No'

- **No** Normal state.
- **Yes** Allows users to manipulate valves via membrane switches on front panel.

Enable Cyl 1; default is 'Yes' (Dual Cylinder only)

- **No** Cylinder 1 is not available for Auto-Crossover. Gets set upon low cylinder detection.
- **Yes** Cylinder 1 is available for Auto-Crossover. Gets set after Purge Up.

Enable Cyl 2; default is 'Yes' (Dual Cylinder only)

- **No** Cylinder 2 is not available for Auto-Crossover. Gets set upon low cylinder detection.
- **Yes** Cylinder 2 is available for Auto-Crossover. Gets set after Purge Up.

Enable Xover; default is 'Yes' (Dual Cylinder only)

- **No** Disables Auto-Crossover function.
- **Yes** Enables Auto-Crossover, assuming that other conditions are satisfied.

Select Cylinder; default is '1' (Dual Cylinder only)

- **Down** Puts Cylinder 1 online, assuming valves have been manually enabled.
- **Up** Puts Cylinder 2 online, assuming valves have been manually enabled

Cyl 1 Purged UP; default is 'No'

- **No** Clears a variable that tracks whether the cylinder has been successfully purged up.
- **Yes** Sets the 'Purged Up' variable.

Cyl 1 Purged DW; default is 'No'

- **No** Clears a variable that tracks whether the cylinder has been successfully purged down.
- **Yes** Sets the 'Purged Down' variable.

Cyl 2 Purged UP; default is 'No'

- **No** Clears a variable that tracks whether the cylinder has been successfully purged up.
- **Yes** Sets the 'Purged Up' variable.

Cyl 2 Purged DW; default is 'No'

No Clears a variable that tracks whether the cylinder has been successfully purged down.

Yes Sets the 'Purged Down' variable.

HP Initialized; default is 'No'

No Clears a variable that tracks whether the High Pressure sections of manifold have been successfully initialized.

Yes Sets the 'High Pressure Initialized' variable.

LP Initialized; default is 'No'

No Clears a variable that tracks whether the Low Pressure section of manifold has been successfully initialized.

Yes Sets the 'Low Pressure Initialized' variable.

PL Initialized; default is 'No'

No Clears a variable that tracks whether the Process Line has been successfully initialized.

Yes Sets the 'Process Line Initialized' variable.

4.11.2. Modify Counts

The ***Modify Counts*** section of the menu permits the user to set the number of times certain sections of the purge recipes are repeated. Each of these variables has a range of adjustment defined by a lower limit and an upper limit. See page 46 for a detailed listing of a typical menu.

4.11.3. Modify Times

The ***Modify Times*** section of the menu permits the user to set the duration of certain steps of the purge recipes. These variables are adjusted in one-second increments. Each of these variables has a range of adjustment defined by a lower limit and an upper limit. See page 46 for a detailed listing of a typical menu.

4.11.4. Sensor Debounce

The ***Sensor Debounce*** section of the menu permits the user to set time delay before unsafe sensors are acknowledged. These variables are adjusted in one-tenth second increments. Each of these variables has a range of adjustment defined by a lower limit and an upper limit. See page 46 for a detailed listing of a typical menu.

4.11.5. Special Recipes

The ***Special Recipes*** section of the menu permits the user to execute additional recipes that are not otherwise available from the front panel purge controls. See page 46 for a detailed listing of a typical menu.

4.11.6. Hardware Setup

The ***Hardware Setup*** section of the menu permits the user to perform system tests and to adjust some system parameters, including analog comparator limits, in installations where analog transducers are used. The programmable functions are listed below in the order they may appear in a typical menu:

Reset Flow Valve; default is 'No' (optional)

No Normal state.

Yes Outputs a pulse to excess flow sensors that require a pneumatic reset.

Lamp Test; default is 'No'

No Normal state, LED's are not forced on.

Yes Energizes all front panel LED's, except CPU Alert, for a visual test.

Auto Power Up; default is 'No'

No Return from power failure causes alarm; cylinder(s) remains off.

Yes Return from power failure allows cylinder(s) to return to previous state.

Delay Alarm Time; default is 30 seconds

Down Decreases amount of time before alarm sounds during purge recipe while awaiting user response.

Up Increases alarm delay during purge recipe.

Repeat Selftest; default is 'No'

No Normal state.

Yes Causes Selftest module to be re-executed. May de-energize outputs.

Cyl 1 Low Limit; default depends on transducer

Down Decreases Cylinder 1 Low Pressure/weight transducer trip point.

Up Increases Cylinder 1 Low Pressure/weight transducer trip point.

Cyl 2 Low Limit; default depends on transducer

Down Decreases Cylinder 2 Low Pressure/Weight transducer trip point.

Up Increases Cylinder 2 Low Pressure/Weight transducer trip point.

Vacuum Hi Limit; default depends on transducer

Down Decreases maximum Vacuum transducer trip point.

Up Increases maximum Vacuum transducer trip point.

Purge Lo Limit; default depends on transducer

Down Decreases minimum Purge Pressure transducer trip point.

Up Increases minimum Purge Pressure transducer trip point.

4.11.7. Configure Remote

The ***Configure Remote*** section of the menu permits the user to redefine some of the signals on the Remote Connector. The programmable functions are listed below in the order they appear in the menu:

Invert Status; default is 'No'

No *STATUS* output is energized when the cylinder is ready to provide gas to the tool.
Yes *STATUS* output is energized when the cylinder is off-line.

Invert Alarm LED; default is 'No'
No *ALARM LED* output is de-energized during alarm conditions.
Yes *ALARM LED* output is energized during alarm conditions.

Invert Buzzer; default is 'No'
No *BUZZER* output is energized during alarm conditions.
Yes *BUZZER* output is de-energized during alarm conditions.

Invert Rem Abort; default is 'No'
No *REMOTE ABORT* occurs when contacts open.
Yes *REMOTE ABORT* occurs on contact closure.

Enable Abort Alm; default is 'Yes'
No *ABORT ALARMS* do not appear on Remote Connector.
Yes *ABORT ALARMS* appear on Remote Connector.

Enable Warn Alm; default is 'Yes'
No *WARNING ALARMS* do not appear on Remote Connector.
Yes *WARNING ALARMS* appear on Remote Connector.

Enable Purge Alm; default is 'No'
No *PURGE ALARMS* do not appear on Remote Connector.
Yes *PURGE ALARMS* appear on Remote Connector.

Pulse Alarm LED; default is 'Yes'
No ALARM LED output is steady.
Yes ALARM LED output pulses according to type of alarm.

Pulse Ext Buzzer; default is 'Yes'
No EXTERNAL BUZZER output is steady.
Yes EXTERNAL BUZZER output pulses according to type of alarm.

4.12. Dual Cylinder Considerations

There are several variables and sensors that interact to report or control which cylinder is online in a dual-cylinder installation. This list of primary variables includes *Select Cylinder, HPI 1, HPI 2, Enable Cylinder 1* and *Enable Cylinder 2*.

These variables are examined or changed in the following areas of operation as follows:

4.12.1. Cylinder AutoSelect

AutoSelect is a sequence of events that is triggered by the *Select 1* and *Select 2* switches on the front panel. This sequence is also triggered when the user changes the value of the *Select Cylinder* variable from the menu.

Once triggered, the *AutoSelect* sequence is cancelled under any of the following conditions:

- The controller is running a purge recipe.
- The user is accessing the program menu.
- Either *PGI 1* or *PGI 2* is on.
- Either *HPV 1* or *HPV 2* is on.
- *LPV* is on.
- *LP Initialized* = 'NO'.
- *HP Initialized* = 'NO'.
- *PL Initialized* = 'NO'.
- Any sensor that would cause a shutdown condition is triggered.
- The selected cylinder is not enabled (via *Enable Cylinder x*).
- The selected cylinder is not purged up.

If none of the previous conditions exist, the *AutoSelect* sequence proceeds as follows:

- Display " Selected cylinder is being activated! "
- Turn off *HPI 1* and *HPI 2* and wait 1 second.
- Turn on the appropriate *CSV* indicator and wait 1 second.
- Turn on the appropriate *ESV* valve and indicator and wait 1 second.
- Turn on the appropriate *HPI* valve and indicator, set *Select Cylinder* to the appropriate value and wait 1 second.
- Turn on the *LPI* valve and indicator and wait 1 second.
- Clear the " Selected cylinder …" display.

4.12.2. Crossover

The dual cylinder version of the **HPM Series 620** allows for an empty cylinder to be automatically disconnected and a full backup cylinder to be connected to maintain process continuity.

4.12.2.1. Sequence of events during automatic crossover:

- The online cylinder is detected to be empty by an electronic scale or by a pressure transducer.
- All of the conditions listed in the next section are checked to determine if the crossover function is enabled.

- The *Enable Cylinder x* variable for the online cylinder is set to 'NO'.
- The *Select Cylinder* variable is set to '0'.
- A *Crossover Dwell* timer is activated to allow the *HPI* solenoid on the empty cylinder to close completely.
- The sensors are examined and the *Enable Cylinder* variables are checked to determine if there is an available cylinder.
- The *Select Cylinder* variable is set to the first available cylinder (usually the opposite of the cylinder that was just taken offline). If the system is not configured for Cross Purge, the *Purge Select* variable is set to the cylinder that was just taken offline.

4.12.2.2. Conditions which disable crossover:

Several parameters prevent the automatic selection of a backup cylinder when the online cylinder becomes empty.

- The menu parameter, *Enable Xover*, prevents crossover when set to NO. This remains in effect until *Enable Xover* is set to YES.
- When the *Crossover Inhibit* signal on the remote connector is energized, the crossover function is disabled. This remains in effect until *Crossover Inhibit* is de-energized.
- While the menu is being accessed, the crossover function is disabled. This includes *MANUAL MODE* operation.
- If a cylinder shutoff sensor is tripped (for example, Excess Flow), the crossover function is disabled. This remains in effect until after the sensor becomes safe. In addition, if the sensor is a latching sensor, the RESET key must be pressed.
- The crossover function is disabled while a purge recipe is being executed. This remains in effect until the recipe is complete or until the recipe is aborted.
- One of the two cylinders must be selected and online.

While any of the previous conditions exist, the crossover function is disabled and a *Xover Inhibit* LED in the upper right section of the front panel is lighted. After all conditions are satisfied, a 10-second timer is activated. During this 10 second interval, the *Xover Inhibit* LED flashes, but the crossover function remains disabled. This prevents a crossover from occurring while the system is in a transitory condition. When 10 seconds has elapsed, the LED is extinguished and the crossover function is enabled.

4.12.2.3. *Enable Cylinder* variables.

The *Enable Cylinder* variables prevent a cylinder that has not been properly purged from being selected. In normal operation, the *Enable Cylinder* variable for a particular cylinder is set to 'NO' when the cylinder is determined to be empty. When a PURGE UP recipe is completed on that cylinder, the appropriate *Enable Cylinder* variable is set to 'YES'. These variables may also be set manually from the menu.

4.12.2.4. *Crossover Dwell* variable.

The *Crossover Dwell* variable determines the amount of time after an empty cylinder is turned off before the reserve cylinder is turned on. This time interval may be changed from the menu and prevents cross talk between the two cylinders.

4.12.3. Manual Mode selection of HPI 1 and HPI 2.

Another condition that affects the value of *Select Cylinder* is triggered when the user turns *HPI 1* or *HPI 2* on or off in *Manual Mode*. When this occurs, the software automatically sets *Select Cylinder* to an appropriate value as follows:

HPI 1	**HPI 2**	**Cylinder Select is set to:**
OFF	OFF	0
ON	OFF	1
OFF	ON	2
ON	ON	3

* Note that a safety patch in the software prevents both *HPI* valves from being energized at the same time. The user can set both *HPI* variables to 'ON' in *Manual Mode*, but the software will not allow the actual valves to be energized.

5. SPECIFICATIONS

The specifications listed below relate to the requirements and capabilities of the components contained in the **Purge & Shutoff System** electronics enclosure only. The requirements of the various actuators, vacuum generator, and sensors located in the cylinder storage cabinet must be considered separately.

5.1. Microprocessor

Microprocessor:	8 bit, CMOS, (Harris CDP1805CE).
EPROM:	32 kilobyte x 8 bit, CMOS, UV erasable.
RAM:	32 kilobyte x 8 bit, CMOS, static.
Crystal:	3.6864 MHz.

5.2. AC Power Requirements

Frequency:	50 Hertz (+/- 3.5%) or 60 Hertz (+/-5%).
Voltage @ 60 Hertz:	100 to 125 VAC or 200 to 250 VAC, user selectable.
Voltage @ 50 Hertz:	110 to 125 VAC or 220 to 250 VAC, user selectable.
Current:	fused internally at 2 amps.
Power:	25 watts maximum.

5.3. Pneumatic Requirements

Gas:	dry, compressed air or inert gas.
Pressure:	regulated at 75 to 100 psi (recommended 85 psi).

> *Note: The input pressure must be adequate to activate the pneumatic actuators, but must not exceed 100 psi. Minimal flow is required by the internal pilot solenoids only during switching. The pneumatic actuators and vacuum assist generator determine the overall flow requirements.*

5.4. Digital Sensor Inputs

Quantity:	(12)
Trigger:	1 mA @ 5 to 40 VDC (24 volts when using internal power supply), edge or level sensitive as determined by software.
Timing:	Signals must be present greater than 0.1 seconds to guarantee detection.

5.5. Remote Connector, Electrical Outputs

Quantity:	(8)
Relay Contacts:	(7) with Form 'A' contacts (Normally Open), (1) with Form 'C' contacts (both Normally-Open and Normally-Closed). Contacts are rated at 2 Amps, 30 Volts DC.

Note: The function of these outputs varies by installation, typical uses include:

- *Horn or buzzer on remote panel.*
- *Status LED on remote panel.*
- *Alarm LED on remote panel.*
- *Status signals to centralized alarm system.*

5.6. Remote Connector, Electrical Inputs

Quantity:	(4)
Trigger:	1 mA @ 5 to 40 vdc (24 volts when using internal power supply), edge or level sensitive as determined by software.
Timing:	Signals must be present greater than 0.1 seconds to guarantee detection.

Note: The function of these inputs varies by installation, typical uses include:

- *Alarm Silence input from remote panel.*
- *Abort input from remote panel.*

5.7. Pneumatic Outputs

Quantity:	(7) to (12) as required by application.
Solenoid:	Humphrey, Mini-Mizer, M3E1 24VDC PCM MTL.
Maximum flow:	1.5 SCFM each @ 100 psi.

5.8. Timing

Resolution:	0.1 sec.
Accuracy:	determined by accuracy of power line frequency; typically 0.01% short term error, or 3 seconds maximum long term accumulated error; automatically adapts to 50 or 60 Hertz.

5.9. Physical

Width:	12.20 inches.
Height:	12.81 inches.
Depth:	5.50 inches.
Weight:	15 pounds.
Paint:	Cardinal, high bake, water-based.

6. MAINTENANCE

6.1. Changing ROMs

The **Series 620 Purge & Shutoff System** requires a 200 nanosecond or faster, 32K x 8 CMOS ROM (generic part number 27C256) for storage of the program and configuration data. The following information is provided in the event that it becomes necessary to update a ROM in the field.

6.1.1. Before opening the cabinet, insure that the AC power cord is disconnected from the unit.

6.1.2. To gain access to the electronics, unscrew the two panel fasteners located on the front panel approximately 1/2" below the top of the enclosure.

6.1.3. Swing the front panel down being careful not to stress the hinges or internal cables.

6.1.4. The ROM is located inside the cabinet on the CPU module. The CPU module is the 4.0" by 7.5" printed circuit board just inside the front panel.

> *Note: As you face the front of the enclosure, looking down into the exposed front panel assembly, the ROM is plugged into a socket labeled R0 located at the right edge of the board.*
>
> *Each ROM is identified with an adhesive label. Information on the label includes:*
> *1.) a configuration number (ex: 800-0625),*
> *2.) a version number (ex: -00), and*
> *3.) the date the software was compiled (format: yymmdd).*
>
> *Do not confuse the ROM with two smaller IC's (PLDs) which are also identified with adhesive labels.*

6.1.5. To replace the ROM, gently pry the old ROM from its socket using a small flat-bladed screwdriver. Prepare the new ROM by straightening the leads against a flat surface. For easy insertion, the leads should be perpendicular to the surface of the ROM package.

6.1.6. Install the new ROM being careful to orient pin 1 in the same direction as pin 1 on the other ICs. Check to insure that none of the pins are bent under or improperly seated in the socket.

6.1.7. Swing the cabinet cover closed and tighten the panel fasteners.

6.1.8. Reconnect the AC power cord.

6.1.9. Watch the Vacuum Fluorescent Display on the front panel as the **Purge and Shutoff Station** performs its ***Power-On-Self-Test***. If the display sequences through the initial messages (see page 17), the ROM is successfully installed.

6.2. Calibrating Analog Inputs

Units manufactured after June 1996 may contain a power board identified as 9990153D. This board allows for analog inputs for use with weight, pressure or flow transducers.

The Analog-to-Digital converter circuit on this board included two adjustment potentiometers; a full scale reference adjustment labeled INREF and an offset adjustment labeled BOFS. These potentiometers are adjusted during manufacture and should remain stable during the life of the equipment. It would be prudent, however, to check the calibration periodically, perhaps once every three years. If the unit contains a lithium battery on the CPU board, as all current designs do, this would be a good time to also replace the battery.

Seven test points are available at the left edge of the power board to provide access to the signals required for analog calibration. The test points are labeled: DGND, +10V, -10V, +5V, AGND, INREF and VREF. Only the AGND, INREF and VREF are required for calibration purposes.

Before adjusting either of the potentiometers, insure that the unit has been powered up and operational for at least 30 minutes to allow the circuitry to stabilize. In addition, a high quality digital voltmeter (DVM) with at least 4000-count resolution must be used.

To begin calibration, set the DVM to any DC Volts range that enables reading a 5-volt signal to 0.01-volt accuracy. Place the Black lead on the test pin labeled AGND and the Red lead on the test pin labeled VREF. The DVM should now read 4.98 volts to 5.02 volts. If this reading is out of range, contact the manufacturer or replace the REF02 at U10 or the 7661 at U9 as required.

If the VREF reading is acceptable, place the Black lead on the test pin labeled AGND and the Red lead on the test pin labeled INREF. Adjust the INREF potentiometer until the DVM reads –5.12 volts.

The BOFS potentiometer must be adjusted using the analog values displayed on the **VFD** display. Jumper at least one of the analog inputs to ground to zero it's input. Press ALARM SILENCE to display the input that is jumpered out. Adjust the BOFS potentiometer until the display reads the value associated with 0 volts. This value differs between different models of transducers and, if not listed below, must be obtained from the manufacturer of the controller. If possible, repeat this procedure with all of the transducer inputs to confirm total operation.

The zero value of transducers, which have been characterized for use with the Series 620 Purge and Shutoff Station, is listed below:

BOFS Value	Transducer
-25 PSIG	Setra, Model 215, 101-04, -14.7 lbs to 250 lbs
-135 PSIG	Setra, Model 215, 101-07-MT2, -14.7 lbs to 3000 lbs

6.3. Lithium Battery

A Lithium battery, part number CR2325, is provided in a socket on the CPU board to protect user- programmed variables during power outages. The manufacturer of this battery specifies a shelf life of 10 years. However, it is recommended that the battery be changed every three or four years to avoid data loss. The unit will continue to operate properly with an expended battery, but user-programmed variables will be lost during power outages.

7. APPENDIX

Appendix 7.1. - Recipe Listings

The following pages contain detailed listings of a generic set of recipes. While the details listed on the forms pertain to actual recipes, specific installations sometimes require minor variations. Page 43 contains a blank form, which may be used as a worksheet to communicate new recipe information to the manufacturer.

Many of the details pertaining to a step of a recipe are contained in the Operating System ROM and may be changed only by the manufacturer. However, those parameters, which are user-programmable, are listed on the forms as a variable name in place of an actual value. These variables are accessed via the programming menu. Following is a description of each of the fields on the forms:

Description *ITEM 1*	Configuration # 800-0621- *ITEM 2*	Page __ of __ *ITEM 3*

Outputs:	Display: *ITEM 5*									Step #: *ITEM 4*
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time: *ITEM 7*
ITEM 6										Loop Count: *ITEM 9*
Delay until:	*ITEM 8*									Next Step: *ITEM 10*
Abort if:	*ITEM 11*									Abort Step: *ITEM 12*

ITEM 1 ***Description:*** **Name of recipe.**

ITEM 2 ***Configuration #:*** **Assigned by manufacturer. 800-0621- represents the partno, while the 2-digit suffix identifies the specific version.**

ITEM 3 ***'Page __ of __'*** **→ Number and total number of pages to this recipe.**

ITEM 4 ***'Step'*** **→ Sequence number of this set of parameters.**

ITEM 5 ***'Display'*** **→ Message, which will be displayed on VFD during this step.**

ITEM 6 ***'Outputs'*** **→ Identifies those outputs, which will be turned ON, and those, which will be turned OFF at the beginning of this step. Unlisted outputs remain unchanged. The output labeled "AUX" is usually used to reset a pneumatically operated Excess Flow sensor/valve.**

ITEM 7 ***'Time'*** **→ Duration of this step (unless an abort occurs). This field may contain a value in the range of 0 to 999.9 seconds or it may contain reference to a variable, which can be accessed via the programming menu.**

ITEM 8 ***'Delay until'*** **→ List of those sensors which must be safe and those sensors which must be unsafe after the timed portion of the step has elapsed before execution proceeds to the next step.**

ITEM 9 ***'Loop Count'*** **→ Number of times to loop out of this step. This field may contain a value in the range of 0 to 9999 or it may contain reference to a variable, which can be accessed via the programming menu. After the loop count is expired, the next step in sequence will be executed.**

ITEM 10 ***'Next Step'*** **→ Destination step when a loop is executed.**

ITEM 11 ***'Abort if'*** **→ List of those sensors which when safe and those sensors which when unsafe cause an immediate abort to the Abort Step.**

ITEM 12 ***'Abort Step'*** **→ Destination step when an Abort is executed.**

Blank Form	Configuration # 800-0621-___	Page __ of __

Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:
Outputs:	Display:									Step #:
	AUX	LPI	LPV	VAV	HPI	HPV	PGI	ESV	CSV	Time:
										Loop Count:
Delay until:										Next Step:
Abort if:										Abort Step:

Appendix 7.2. - Sensor Attribute Form

Configuration #: _____ Date: _____													
Sensor #:	1	2	3	4	5	6	7	8	9	10	11	12	
Window													
Debounce Time, Minimum													
" , Default													
" , Maximum													
Attribute	POM	POM	POM	POM	POM	POM	POM	POM	POM	POM	POM	POM	P
Polarity (0=open is unsafe)													
Latching (1=latched)													
Remote Alarm Silence													
Remote Warning Alarm													
Remote ESS Alarm													
Local Alarm Silence													
Local Warning Alarm													
Local ESS Alarm													
Purge Enable													
Program Enable													
Reset													
ESS Shutoff Pattern 2													
ESS Shutoff Pattern 1													
Excess Process Pressure													
Low Vacuum													
Low Cylinder Pressure													
Low Purge Pressure													
Excess Flow													

- POM = Purge Operate Manual bit pattern (e.g. 101, 001, 111 etc.)
- The (12) sensor columns represent the two rows of 6 sensor terminal pairs.
- Debounce times are in tenths of seconds (999.9 sec).

Appendix 7.3. - Menu Listing

Modify Status		
Manual Mode	Yes or No	Default: No
Enable Cyl 1	Yes or No	Default: Yes
Enable Cyl 2	Yes or No	Default: Yes
Enable Xover	Yes or No	Default: Yes
Select Cylinder	0 to 2	Default: 1
Cyl 1 Purged UP	Yes or No	Default: No
Cyl 1 Purged DW	Yes or No	Default: No
Cyl 2 Purged UP	Yes or No	Default: No
Cyl 2 Purged DW	Yes or No	Default: No
HP Initialized	Yes or No	Default: No
LP Initialized	Yes or No	Default: No
PL Initialized	Yes or No	Default: No
Modify Counts		
Purge Up Counts	1 to 100	Default: 10
Purge Down Counts	1 to 100	Default: 10
HP Init Counts	1 to 100	Default: 10
LP Init Counts	1 to 100	Default: 10
PL Init Counts	1 to 100	Default: 10
Modify Times		
Pressurize HP	0 to 999	Default: 5
Evacuate HP	0 to 999	Default: 5
Pressurize LP	0 to 999	Default: 5
Evacuate LP	0 to 999	Default: 5
Pressurize PL	0 to 999	Default: 10
Evacuate PL	0 to 999	Default: 15
Vent via HPV	0 to 30	Default: 10
Vent ESV via HPV	0 to 30	Default: 10
Xover Dwell Time	0 to 30	Default: 1
Xover Inhibit Delay	0 to 30	Default: 10
Datalog Interval	0 to 9999	Default: 10
Sensor Debounce		
Toxic Alarm	0 to 100	Default: 10
Pneumatic Pressure	0 to 300	Default: 30
Cabinet Exhaust	0 to 600	Default: 30
Vent Purge	0 to 100	Default: 0
PL Containment	0 to 100	Default: 10
Hi Process Pressure	0 to 300	Default: 30
Lo Cyl Contents	0 to 100	Default: 20
Lo Vacuum	0 to 100	Default: 10
Excess Flow	0 to 100	Default: 20
Lo Purge Pressure	0 to 100	Default: 20
Lo Cyl 1	0 to 300	Default: 30
Lo Cyl 2	0 to 300	Default: 30

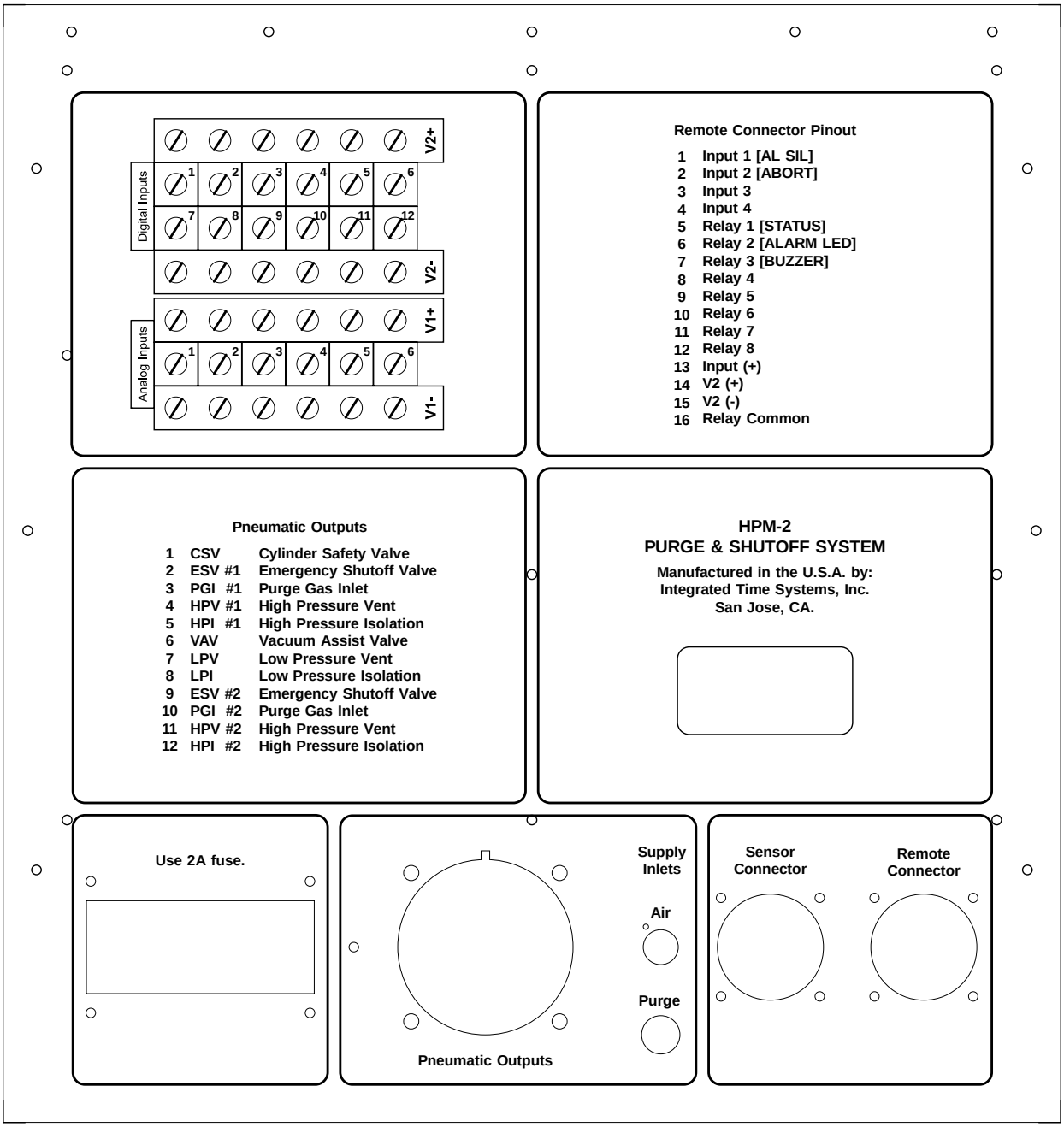
Other Functions		
Initialize HP	Yes or No	Default: No
Initialize HP & LP	Yes or No	Default: No
Initialize PL	Yes or No	Default: No
View Data Log	0 to 255	Default: 0
Erase Data Log	Yes or No	Default: No
Enable Log Disp	Yes or No	Default: No
Set Day of Year	1 to 9999	Default: 1
Set Hour (0-23)	0 to 23	Default: 0
Set Minutes	0 to 59	Default: 0
Hardware Setup		
Autodim Minutes	0 to 9999	Default: 10
Lamp Test	Yes or No	Default: No
Auto Power Up	Yes or No	Default: No
Delay Alarm Time	0 to 9999	Default: 30
Repeat Selftest	Yes or No	Default: No
Cyl Xover Pressure	0 to 3000	Default: 200
Low Cyl Alarm	0 to 3000	Default: 250
Analog Mode (0=OFF)	0 to 3	Default: 3
Device ID#	0 to 99	Default: 0
Default Time Base	50Hz or 60Hz	Default: 60Hz
Configure Remote		
Invert Status Out	Yes or No	Default: No
Invert Alarm LED Out	Yes or No	Default: No
Invert Buzzer Out	Yes or No	Default: No
Invert Abort Input	Yes or No	Default: No
Invert Disable Input	Yes or No	Default: No
Invert Xover Inhibit	Yes or No	Default: No
Enable Abort Alarm	Yes or No	Default: Yes
Enable Warn Alarm	Yes or No	Default: Yes
Enable Purge Alarm	Yes or No	Default: No
Pulse Alarm LED	Yes or No	Default: No

Appendix 7.4. - Additional VFD Messages

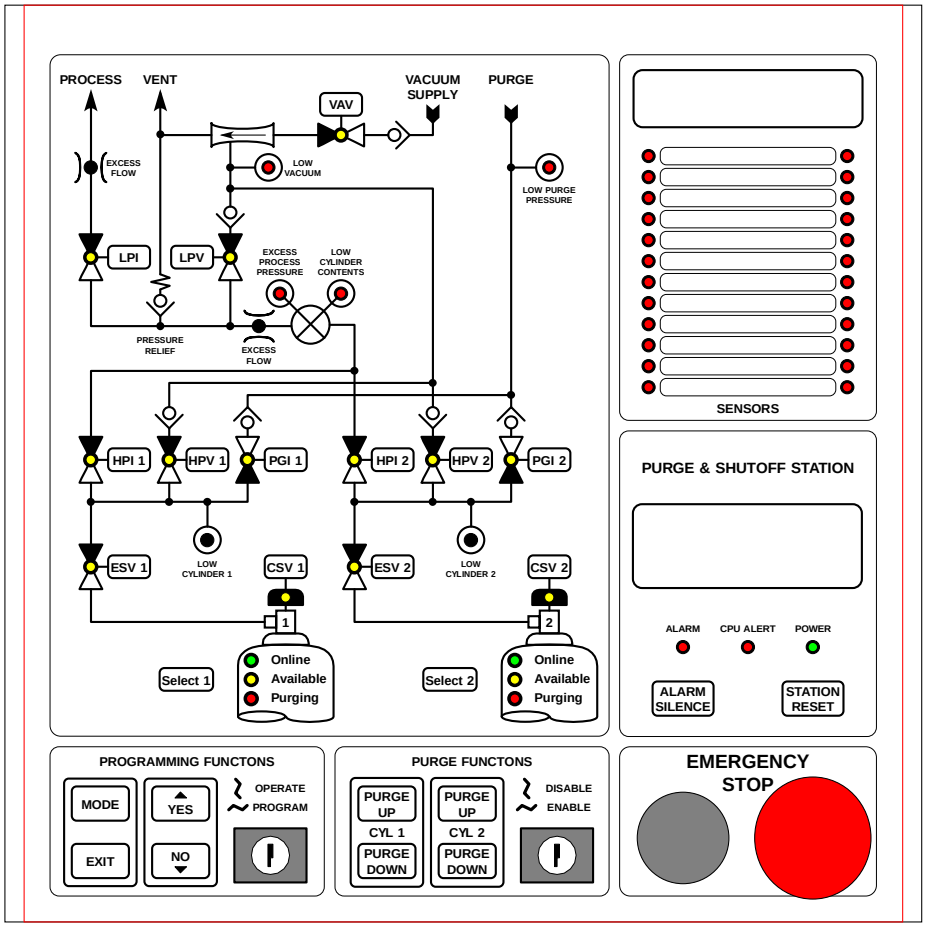
```
"    Model 625-26    |     08/27/2003     "
" All purge and vent |valves must be off! "
" No key detected in |  keylock switch!   "
"   No AUTOSELECT    |   while purging!   "
"  Manifold must be  |purged to AUTOSELECT"
"Cyl SELECT has been |  aborted by user!  "
" Selected cylinder  |      is low!       "
" Selected cylinder  |  is not ENABLED!   "
" Selected cylinder  | is not PURGED UP!  "
" Selected cylinder  |is being activated! "
"                    |                    "
"Enter MANUAL MODE to|  activate valves!  "
"  That request is   |     incorrect!     "
"  That request is   |      unsafe!       "
"  Key required for  |   PROGRAM modes!   "
"  Key required for  |  PURGE functions!  "
"Cannot change valves|   while purging!   "
"   ESS triggered!   |   Check sensors.   "
"    ESS latched!    |    Press RESET.    "
"   Error, Recipe    |    in progress!    "
"  Restore default?  |Press YES to confirm"
"   Abort recipe?    |Press YES to confirm"
"  Turn off valves?  |Press YES to confirm"
"  Repeat selftest?  |Press YES to confirm"
"Hit 'MODE' to access|this menu function! "
"  Purge Up Cyl 1?   |Press YES to confirm"
" Purge Down Cyl 1?  |Press YES to confirm"
"  Purge Up Cyl 2?   |Press YES to confirm"
" Purge Down Cyl 2?  |Press YES to confirm"
"   Initialize HP?   |Press YES to confirm"
"Initialize HP & LP? |Press YES to confirm"
"   Initialize PL?   |Press YES to confirm"
"All valves cannot be| energized at once! "
"   HPV & LPV are    |are not compatible! "
"   ESV, HPI & LPV   |are not compatible! "
"   ESV & HPV are    |are not compatible! "
"   CSV, ESV & HPV   |are not compatible! "
"HPV 1 & 2 cannot be |energized together! "
"HPI 1 & 2 cannot be |energized together! "
" VAV must be ON to  |   energize LPV!    "
"                    |                    "
"    Close CSV 1,    |  then press YES.   "
"    Close CSV 2,    |  then press YES.   "
"  Vacuum Delay...   |  Time = ____ sec.  "
"  Evacuating HP...  |  Time = ____ sec.  "
"   Purging HP...    |  Time = ____ sec.  "
"   Valve Delay...   |  Please wait ...   "
"  Purge Complete!   |Press YES to confirm"
"Is Cyl 1 installed? |Press YES to confirm"
"Is Cyl 2 installed? |Press YES to confirm"
"   Is CGA tight?    |Press YES to confirm"
"  Open CSV valve,   |  then press YES.   "
"  OK to open ESV?   |Press YES to confirm"
```

```
"  OK to open HPI?   |Press YES to confirm"
"   Cyl Available!   |                    "
" PURGE DOWN recipe, |____ loops to go.   "
"  PURGE UP recipe,  |____ loops to go.   "
"  Open VAV valve,   |  then press YES.   "
"  Close VAV valve,  |  then press YES.   "
"   Setting EXCESS   |   FLOW valve ...   "
"  HP Initialized!   | Press YES to Ack.  "
"  LP Initialized!   | Press YES to Ack.  "
"  PL Initialized!   | Press YES to Ack.  "
"  OK to Initialize  |HP section - Yes/No?"
"  Initializing HP,  |____ loops to go.   "
"  OK to Initialize  |  HP & LP section?  "
"  Initializing LP,  |____ loops to go.   "
"   Are both CGA's   |connected to Cyl's? "
"   Purging LP...    |   Time= ____ sec.  "
"  OK to open LPI?   |Press YES to Confirm"
"   Checking flow    |  for closed CSV.   "
" Excess Flow Error! | Press YES to Ack.  "
"   Purge Aborted!   | Press YES to Ack.  "
"  Use Manual Mode   | Press YES to Ack.  "
"  Close CSV 1 & 2,  |  then press YES.   "
" Is CSV 1 closed?   |     YES / NO?      "
" Is CSV 2 closed?   |     YES / NO?      "
" OK to Leak Check?  |     YES / NO?      "
"  OK to open PGI?   |     YES / NO?      "
"  OK to open ESV?   |     YES / NO?      "
"   Leak Check OK?   |Press YES to Confirm"
" Lo Purge Pressure! |   Please Check.    "
"  Venting via LPV   |  Time = ____ sec.  "
"Venting ESV via LPV |  Time = ____ sec.  "
"  Venting via HPV   |  Time = ____ sec.  "
"Venting ESV via HPV |  Time = ____ sec.  "
"  Done! Press YES   |  to turn off PGI.  "
" Testing Vacuum and |Excess Flow sensors."
" Lower Reg Pressure | Press YES to Ack.  "
" Check Reg Pressure | Press YES to Ack.  "
"  OK to open HPI?   |     YES / NO?      "
"  OK to open LPI?   |     YES / NO?      "
" OK to enable HPI?  |     YES / NO?      "
"Unable to evacuate! |  YES to Continue.  "
"   Is CSV closed?   |  YES to Continue.  "
"   Is Vacuum ok?    |  YES to Continue.  "
"  Repeat PURGE UP?  |  YES to Continue.  "
"*Terminator Message*|Should not display! "
"  Checking CSV...   |  Time = ____ sec.  "
"  Evacuate via HPV  |  Time = ____ sec.  "
"Evacuate via HPV/ESV|  Time = ____ sec.  "
"  Checking VAV...   |    Please wait.    "
"Insufficient Vacuum!| Press YES to Ack.  "
"    Please check    |   vacuum supply!   "
"    Purge error!    | Press YES to Ack.  "
"  Please check for  |     open CSV!      "
"  Recipe aborted!   | Press YES to Ack.  "
```

Appendix 7.5. - Rear Panel Drawing



Appendix 7.6. - Front Panel Drawing (Single Pigtail)



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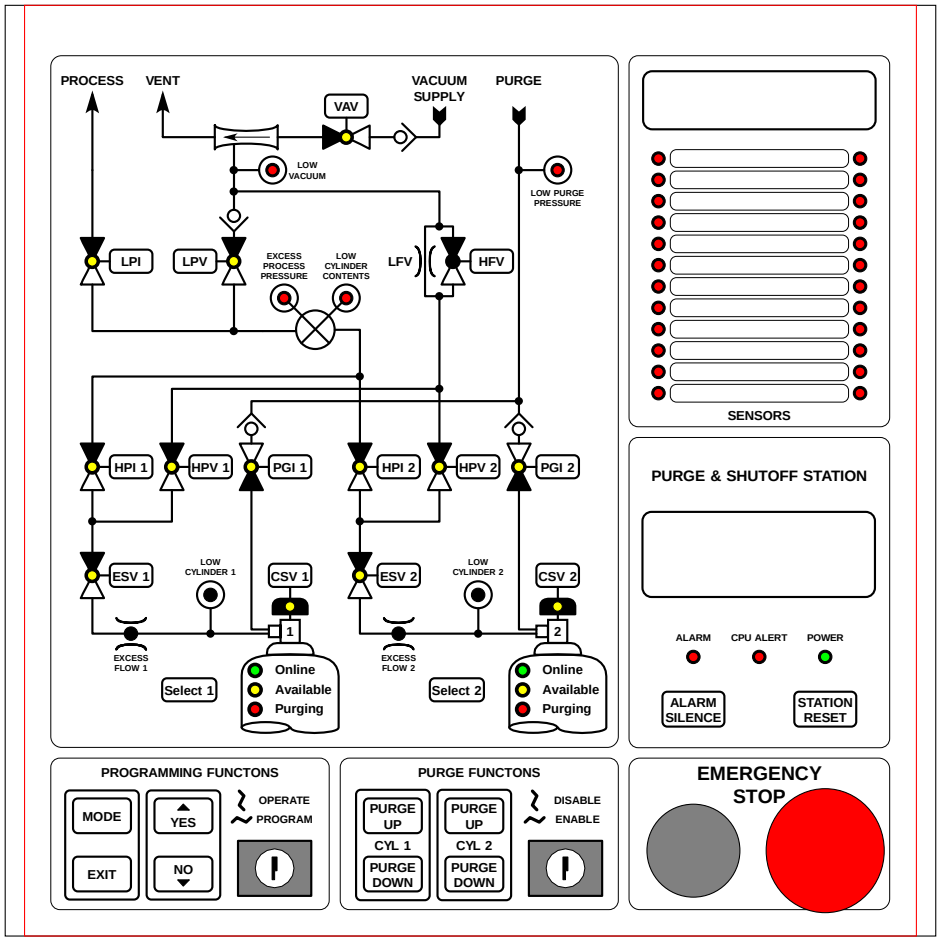
Dual System art: 9712ART.IDW
980109

Appendix 7.7. - Front Panel Drawing (Dual Pigtail)



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980109

Appendix 7.8. - Mounting Template