CONSUL™
SIEMENS S7-313C PLC
DUAL SOURCE CONTROLLER

OPERATION & MAINTENANCE MANUAL

Part Number S052-0102, Rev B1

Dec. 15, 2008

MATHESON TRI•GAS
ask. . .The Gas Professionals™

166 Keystone Drive
Montgomeryville, PA 18936
Telephone: 215-641-2700
Fax: 215-641-2714

Trademark Information

Auto-Purge is a registered trademark of Matheson TriGas.
Consul, Centurion, Auto-Guard, GEMS, and GEMS-Simon are trademarks of Matheson TriGas.
Teflon is a registered trademark of E.I. du Pont de Nemours and Company.
Kwik Bolt® is a registered trademark of Hilti.
Beldfoil® and Flamarrest® are registered trademarks of Belden.
Ethernet is a registered trademark of Digital Equipment Corporation, Intel, and Xerox Corporation.
Purifilter is a trademark of Black & Decker.

Other product and company names mentioned in this manual may be the trademarks of their respective owners.

Scope of this Document

This document describes the installation, operation, and maintenance of the Consul™ Siemens PLC Dual Source Controller.

For information about the installation, operation, and maintenance of the Centurion™ Dual Source Manifold, refer to the appropriate manual.

Document Revision History

Document	Part No.	Edition	Status	Issued
Consul™ Siemens PLC Dual Source Controller Operation & Maintenance Manual	S052-0102	Revision A	Obsolete	March 6, 2006
		Revision B1	Current	Dec. 15, 2008

TABLE OF CONTENTS

FIGURES

TABLES

1. PRODUCT DESCRIPTION

The CONSUL™ Siemens PLC Dual Source Controller works with the Centurion™ Dual Process Gas Source Manifold Assembly. Both of these products are described in this section.

1.1 CONTROLLER MODEL CONSUL™

The CONSUL™ Dual Source Controller, model Siemens S7-313C PLC, automatically monitors and controls all of the process and purge gas electrical components and pneumatically actuated valves present in a compatible dual gas source manifold assembly. Many features of the controller promote safety, dependability, ease of use, economy, and minimal requirement for maintenance. Because operation can be fully automatic, efficiency is enhanced and human error is virtually eliminated.

Configurable software and accessory equipment modules can accommodate diverse applications. (See Matheson part numbers S081-0575 to S081-0580, and S081-0592). The controller can either function independently or the optional communication kit (part number S086-0179) allows it to communicate with a host computer via an Ethernet network, enabling centralized, facility-wide equipment monitoring, control and data collection. (See Figure 1.)

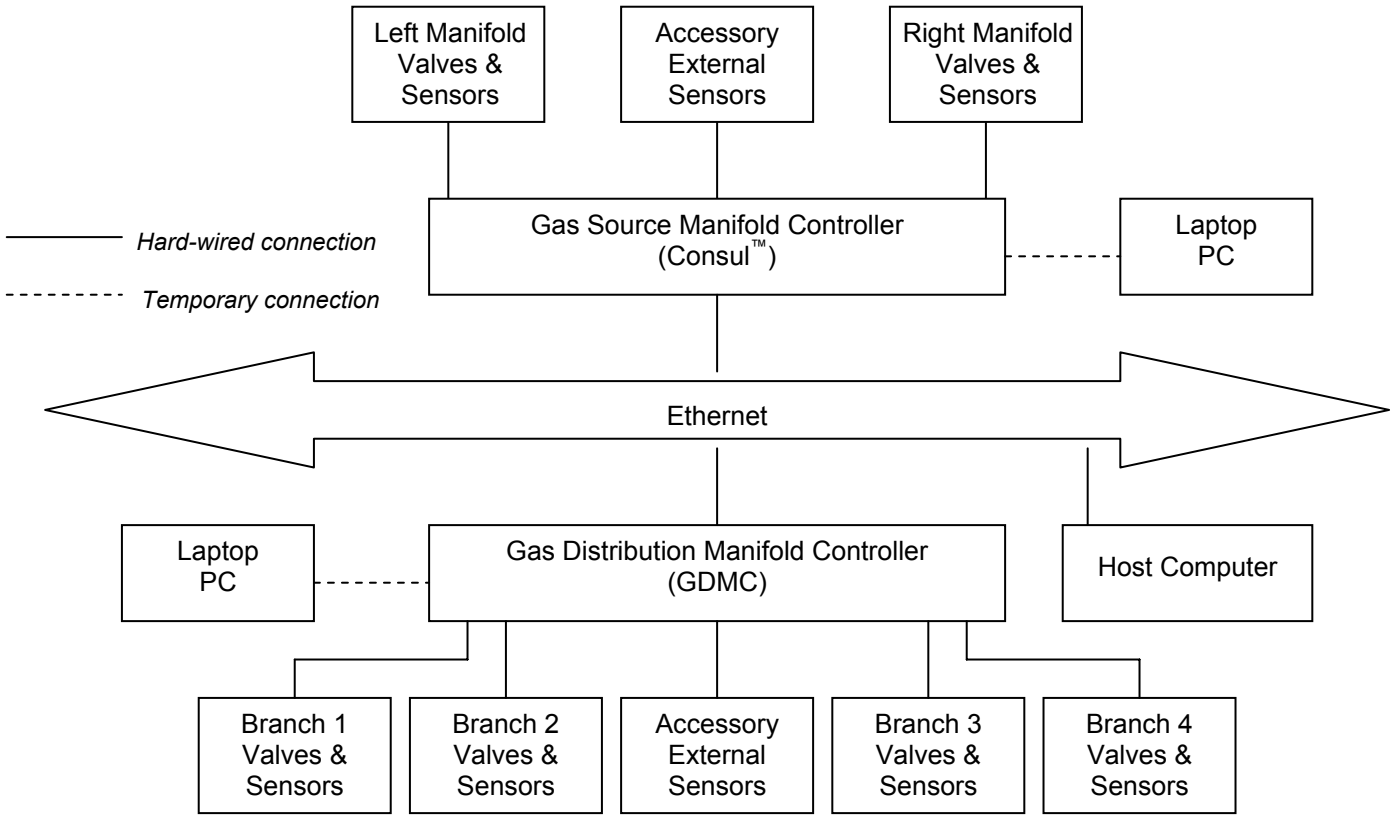


Figure 1. Typical Network Deployment of Consul™ Siemens PLC Modules

The controller, with its PLC and software, is the nerve center for all manifold operations, both automatic and manual. The controller provides the following functions:

- Automatically monitors all manifold assembly sensors and transmitters.
- Automatically or manually controls all pneumatically actuated valve state changes.
- Generates alarms to alert users of error conditions or faults.
- Generates data on manifold operation and alarm triggering.
- Manages either 1 or 2 process gas source manifolds, with up to 32 pneumatically actuated valves.
- Manages process gas source automatic switchover equipment on dual source cabinets.
- Controls the automatic sequence execution of all purge procedures.
- Manages up to 24 enclosure digital sensor inputs (e.g., fire or hazardous gas), 48 digital outputs, and 12 analog inputs. Add-in modules can expand digital inputs & outputs and analog inputs.
- Includes a manual, mechanical shutdown switch that simultaneously closes *all* pneumatically actuated valves on both manifolds.
- Continuously updates and displays manifold status information on a door-mounted color touchscreen user interface.

Typical controller options include:

- Ethernet network connection for data collection and equipment monitoring and control (part number S086-0179).

1.2 DUAL PROCESS GAS SOURCE MANIFOLD ASSEMBLY

The associated Dual Process Gas Source Manifold Assembly consists of all piping and other components that contact process gas, purge gas, and vacuum generator supply gas. The manifold assembly consists of the following parts:

- 2 manifolds: left panel (sometimes called manifold A) and right panel (sometimes called manifold B). (See Figure 2.)
- 1 gas cylinder enclosure that contains the process gas source cylinders**,** piping, sensors (e.g., manifold enclosure exhaust pressure switch), and other components that are shared by the two manifolds. The enclosure is typically located immediately below the controller enclosure (see Figure 3).
- A color touchscreen user interface that is installed on the gas cylinder enclosure door and is connected to the controller via a dedicated communications port.

The functions of the manifolds are:

- The Centurion™ Gas Source Manifold (GSM) receives unregulated process gas from a gas cylinder and delivers regulated gas to process equipment or to a gas distribution manifold (GDM). When identical process gases are supplied to both manifolds, an automatic switchover device enables uninterrupted delivery of process gas.

- To perform automated purge procedures when changing a cylinder, performing manifold maintenance (such as replacing a valve), or maintaining a tool at the process gas destination. Purging removes the process gas before these procedures to protect the operator from contacting a hazardous material. Also, atmospheric gases invariably enter the manifold space during these procedures, thereby contaminating the process gas stream. Manufacturing processes typically cannot be resumed until this contaminated space has been suitably diluted and pure process gas is again available. Automated purge procedures alternately evacuate and pressurize pertinent manifold space regions with a compatible purge gas until contaminants have been suitably diluted. Once purging is complete, pure process gas can again be reintroduced into the manifold. A common purge gas source and vent line typically serves both manifolds. A single vacuum generator is provided for both manifolds. (see figure 2)

The controller automatically monitors manifold sensors and transmitters, checks for process alarms, and provides optional network communications. The controller also manages pneumatic actuation of all manifold valves via dedicated solenoid valves contained within the controller. Authorized users can manually override automatic valve control, enabling manual opening or closing of any pneumatically actuated valves for specialized purging, maintenance or research purposes.

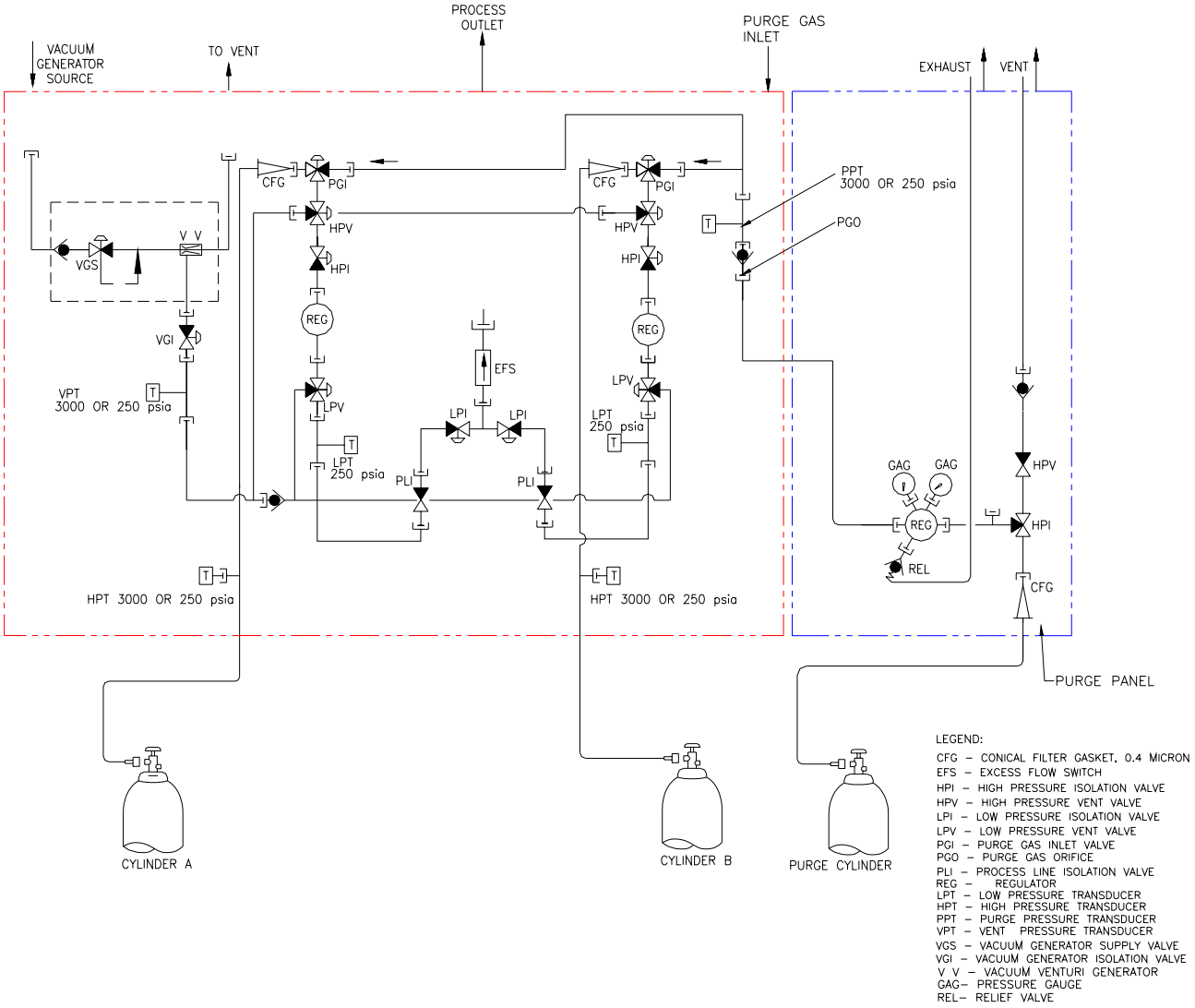


Figure 2. Typical Manifold Assembly Flow Diagram
(Components shown are typical. Actual equipment may vary.)

Figure 3. Front View of 2CE Centurion™ Gas Cabinet

2. ENGINEERING DATA

2.1 UTILITIES REQUIRED

Electric power

Line voltage: 120 / 230 VAC, single phase. Set via selector switch on power supply. Also requires alternate fuse arrangement.

Frequency: 50-60 Hz (47-63 Hz)

Current (typical): 2.1 A at 120 VAC or 1.3 A at 230 VAC

Voltage range: 85-132 V or 170-264 V

Line fuse rating: 120 VAC operation single fuse, Class CC 5A
230 VAC operation dual fuse, Class CC 3A

An internally threaded 3/4-inch bulkhead connector is provided for conduit installation

Pneumatic supply gas

Composition: dry nitrogen or air

Purity: filtered to remove particles with diameters >10 micron

Pressure: 80 psig (482 kPa); regulated

Enclosure purge gas *(on Z-purged models)*

Composition: dry nitrogen or air

Purity: filtered to remove particles with diameters >10 micron

Flow rate: 15 slpm, minimum

2.2 ANALOG INPUTS

All analog inputs are pre-configured in the Consul™ software.

Current-output, loop powered sensor requirements:

Excitation voltage: 24 V DC, non-isolated

Output current (referenced to ground): 4-20 mA

Output impedance: 500 ohm maximum

2.3 DIGITAL INPUTS

Any digital sensor with either a suitable dry-contact output or sinking transistor output can be directed to any available controller digital input channel.

- Dry-contact output sensor requirements:

  Logic, high: closed contact

  Logic, low: open contact

  Typical on (high) current: 10 mA DC

- Transistor output sensor requirements:

  Logic voltage, high: 24 V DC

  Logic voltage, low: 0 V DC

  Excitation voltage: 24 V DC

  Open-circuit supply voltage: 24 V DC, maximum

- Sinking transistor output sensor requirements:

  Logic, high: 3 V DC, 10 mA

  Logic, low: 12 V DC

  Excitation: 24 V DC, 20 mA

2.4 DIGITAL OUTPUTS

- All digital outputs are of the dry-contact type.

  Contact rating: 24 V DC at 0.5 A maximum

2.5 SOLENOID VALVES

- Solenoid valves control the flow of actuation gas to individual pneumatically actuated valves.

  Voltage: 24 V DC nominal ±10%

  Power: 0.8 W

  Inlet orifice: 0.6 mm

  Pneumatic supply gas pressure at valve inlets: 80 psig (551 kPa) typical

2.6 COLOR TOUCHSCREEN

The primary user interface is a backlit color active matrix thin film transistor (TFT) touchscreen display. The user interacts with the controller and cabinet via this touchscreen. These displays differ in size, as shown in Table 1. The display is connected to the PLC via a dedicated communications port on the PLC.

Table 1. Touchscreen Dimensions

Display Dimensions	Pro-face GP2400-TC41-24V	Siemens MP370
Height	170 mm (6.7 in)	275 mm (10.8 in)
Width	215 mm (8.5 in)	355 mm (14.0 in)

2.7 SIEMENS S7-313C PLC

The Consul™ Dual Source Controller uses the Siemens S7-313C Programmable Logic Controller (PLC). The S7-313C controller consists of the following:

- S7-313C Processor with 32 KB of main memory.
- Digital Inputs on base PLC: 24 inputs; 24 V DC.
  Digital Outputs on base PLC: 16 outputs; 24 V DC, 0.5 A.

Analog Inputs on base PLC: 4 inputs; 4: ±10 V, 0 to 10 V, ±20 mA, 0/4 to 20 mA; 1: 0-600Ω, PT100.

- 1 Digital Output Module (EM 322): 32 outputs.
- 1 Analog Input Module (EM 331): 8 inputs.

2.8 CONTROLLER ENCLOSURE

Ruggedly constructed of 0.090 inch thick aluminum sheet with a light gray, corrosion-resistant, matte finish on all surfaces.

- Rated for indoor use only
- 239 mm (9.4 in) high x 635 mm (25 in) wide x 297 mm (11.7 in) deep
- Quick disconnect on the top surface is provided for pneumatic actuation gas
- Three identical female threaded 3/4-inch hub connectors are provided on the top surface for electric power cable and auxiliary signal cable conduits
- Front panel mounted rotary disconnect actuator

2.9 ENVIRONMENTAL CONSIDERATIONS

- Enclosure-to-ground resistance: 0.1 ohm minimum
- Electromagnetic emission: conforms to FCC Class B limits with 5 dB margin
- Electromagnetic immunity: no effect detected with respect to cellular telephone and radio frequencies at 3 V/m
- Static discharge protection: 10 kV dc

3. SAFETY

3.1 SAFETY PRECAUTIONS

Use the following safety precautions when installing, operating, or performing maintenance on the CONSUL™ Siemens PLC Dual Source Controller.

⚠ CAUTION

IMPROPER LIFTING OF HEAVY EQUIPMENT CAN CAUSE SERIOUS INJURY AND DAMAGE EQUIPMENT

Only workers who have been trained in NIOSH-approved lifting techniques should be assigned to heavy equipment moving, installation, or removal efforts. Avoid personal injury and damage to equipment — use approved lifting techniques only.

⚠ CAUTION

FAILURE TO OBSERVE SAFETY PRECAUTIONS CAN RESULT IN SERIOUS INJURY

Never attempt to circumvent compressed gas equipment safety precautions. Compressed gases and associated equipment are potentially dangerous; they must be used only by persons that have been formally trained. Only by strictly adhering to all safety precautions can risk of personal injury or damage to equipment be avoided. Follow all safety precautions to the letter.

⚠ WARNING

DANGER OF ELECTRIC SHOCK

Dangerous voltages exist on the PLC CPU, I/O modules, terminal block, and other components inside the controller enclosure. Accidental contact with controller internal electrical circuitry can result in severe injury, death, or damage to equipment.

Interrupt electrical power to the controller before attempting maintenance on controller internal electrical circuitry or components.

General Precautions

- This manual cannot replace formalized training in compressed gas equipment safety practices; accordingly, this section is intended only as a reminder for properly trained personnel that already understand and adhere to accepted safety practices.
- Only trained personnel should install, operate, and maintain gas control equipment.
- Follow all installation, operation, and maintenance instructions to the letter. Always replace all components, fasteners, labels, and other items exactly as originally installed; do not adjust, modify, install, or remove anything without authorization.
- Failure to follow recommended procedures may result in serious personal injury or death and equipment failure or contamination.
- Material Safety Data Sheets (MSDS) for all gases used in the facility should be available for consultation by all concerned personnel. These data sheets are obtainable from gas suppliers.
- Personnel working with hazardous gases or contaminated components must be provided with suitable protective gear.
- If fire, release of hazardous gases, or another potentially dangerous situation arises, latch the Local Shutdown switch if possible, then evacuate all personnel from the facility.

Operation Precautions

- Equipment not in proper operating condition should be shutdown immediately. Do not attempt to use equipment that is not operating properly.
- Never attempt to defeat interlocks or other safety devices.
- Manual valve operation may override safety interlocks that would normally protect equipment and personnel during automatic valve operation. Be especially attentive when valves are operated manually (i.e., in manual valve operation mode).
- To avoid injury and discourage tampering, the manifold assembly door should remain closed and secured during typical operation. The door should be opened only when visually checking manifold assembly operation or making adjustments. If the facility exhaust equipment is not functioning, do not open the manifold assembly enclosure door.

Installation / Maintenance Precautions

- Disconnect electrical power prior to disassembly or replacement of electrical components and prior to connecting or disconnecting wiring, including sensor output leads.
- Make sure the manifold assembly enclosure exhaust is functioning properly before starting a maintenance procedure. Accidental process gas release is more likely to occur during maintenance than during typical day-to-day operations.
- Whenever feasible, close the process gas delivery line isolation valve (PLI) before starting a maintenance procedure. If this practice is followed and an accidental gas release occurs, it will involve only a small volume of gas. Although this practice is strictly required for manifold assembly maintenance only, its general adoption is not without merit.
- Equipment used with hazardous gases must be thoroughly purged prior to disassembly.
- Vent all equipment prior to disassembly.
- Unexpected jet noise accompanying the release of a high-pressure gas can frighten workers and cause an accident.
- Even though equipment may have been properly purged, trace amounts of hazardous gases may remain. For this reason, components and piping that have been exposed to hazardous gases

should be carefully labeled with the names of the gases and either properly stored or discarded in accordance with pertinent safety ordinances and regulations.

- Mechanical or electrical maintenance should follow pertinent lockout/tagout procedures described in OSHA document 29 CFR 1910.147 (Control of Hazardous Energies, Lockout /Tagout) and 29 CFR 1910.331-335 (Electrical Safety-Related Work Practices, Chapter XVII, 7–1–92 Edition).

3.2 PERSONNEL TRAINING

Equipment should be *operated* only by personnel trained in the principles of gas control equipment operation. Equipment should be *installed or repaired* only by personnel who, in addition to the above training, are trained and experienced in electromechanical installation and repair techniques. Untrained personnel should not be entrusted with these responsibilities; they could injure themselves or co-workers and damage equipment, resulting in unexpected downtime and expense.

Before starting a job, all personnel responsible for equipment installation or operation must fully understand the specific procedures to be accomplished and all pertinent safety considerations. Because optional or non-standard components often exist, installation, operation, and maintenance details may differ substantially from the necessarily generic instructions provided in this manual.

If facility personnel are not confident in their abilities to install or operate the equipment, Matheson Tri-Gas Field Service should be contacted for assistance. Matheson specialists are available on request to assist equipment owners and provide authoritative training in all aspects of equipment installation, operation, and maintenance.

4. INSTALLATION

NOTE: *Refer to Chapter 3. Safety Precautions before performing any installation procedures.*

4.1 EQUIPMENT UNPACKING & INSURANCE CLAIMS

If installation has been contracted with Matheson Tri-Gas, please do not unpack any equipment, as our field service engineers prefer to open the boxes themselves. However, you should carefully inspect the exteriors of all packages on arrival, as described below.

Because all shipments are FOB from the Matheson Tri-Gas factory, the title to purchased goods passes to the customer upon pickup by the carrier. Therefore, damage to the equipment sustained during transit is the responsibility of the carrier, with whom insurance claims for damage should be filed. Please inspect all shipping cartons immediately upon receipt. Should damage or stains be observed, immediately notify the carrier and request that an insurance claims agent be present when the carton is opened. Should any damage be discovered, retain the carton, contents, and all packing materials for inspection by the insurance claims agent.

4.2 ENCLOSURE

Figure 4 shows the penetrations in a typical gas cylinder enclosure. Components inside a typical controller enclosure are shown in Figure 5. The following checklist describes how to anchor the enclosures.

1. The cylinder enclosure and controller enclosure typically are shipped from the factory as a stacked assembly. However, if the enclosures have been shipped separately, securely bolt the two enclosures together using eight 1/4–20 bolts, lock washers, and nuts in the existing holes in the 4 corners of each enclosure. The lock washers should be placed *immediately under* the nuts.

2. In accordance with UBC requirements for earthquake zone 4 installations, level and anchor the stacked assembly to an architecturally stable concrete floor with a compressive strength of 2000 psi at 28 days using four 3/8–inch diameter x 2-1/2–inch long Hilti® stainless steel Kwik Bolt® fasteners with washers through the holes provided at each corner of the floor panels. The enclosures are not intended for exterior installations.

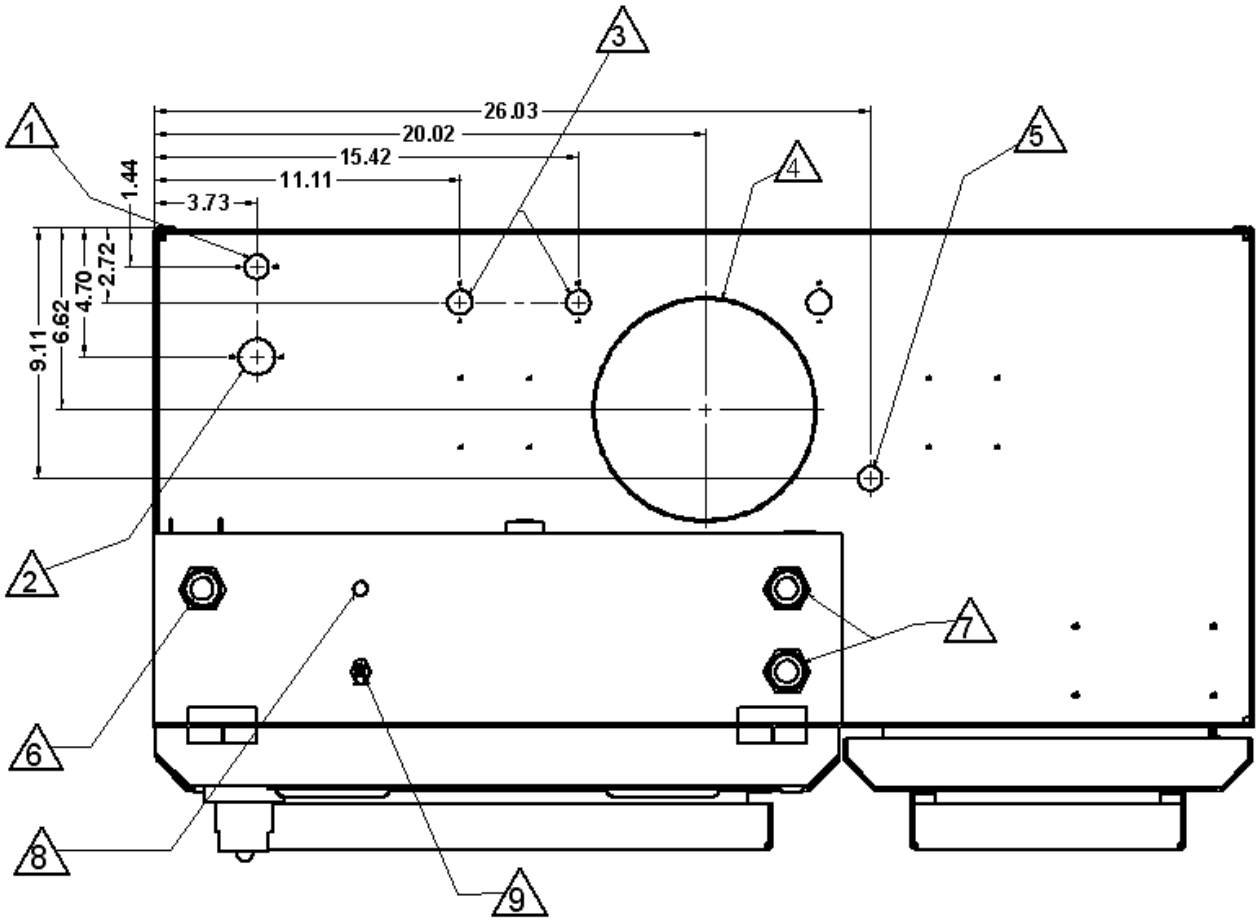


Figure 4. Typical Controller Enclosure Penetrations

LEGEND

1 VACUUM GENERATOR SUPPLY: ¼" FEMALE FACE SEAL WITHIN ENCLOSURE.
2 VACUUM GENERATOR EXHAUST OUTLET: ½" FEMALE FACE SEAL WITHIN ENCLOSURE.
3 PROCESS GAS OUTLET: SINGLE OR DUAL OUTLET CONFIGURATIONS AVAILABLE. ¼" FACE SEAL WITHIN ENCLOSURE.
4 ENCLOSURE EXHAUST CONNECTION: 8" ID.
5 ENCLOSURE SPRINKLER CONNECTION: ½" MALE NPT AT ROOF.
6 CONTROLLER POWER SUPPLY: ¾" BULKHEAD CONDUIT CONNECTOR TO TERMINAL.
7 CONTROLLER EXTERNAL INPUT/OUTPUT CONNECTIONS: ¾" BULKHEAD CONDUIT CONNECTIONS TO TERMINAL BLOCKS.
8 CONTROLLER PNEUMATIC GAS SUPPLY: QUICK DISCONNECT FOR ¼" OD X 1/8" ID POLYURETHANE TUBING.
9 CONTROLLER Z-PURGE (OPTION): QUICK DISCONNECT FOR ¼" OD X 1/8" ID POLYURETHANE TUBING.

4.3 UTILITIES

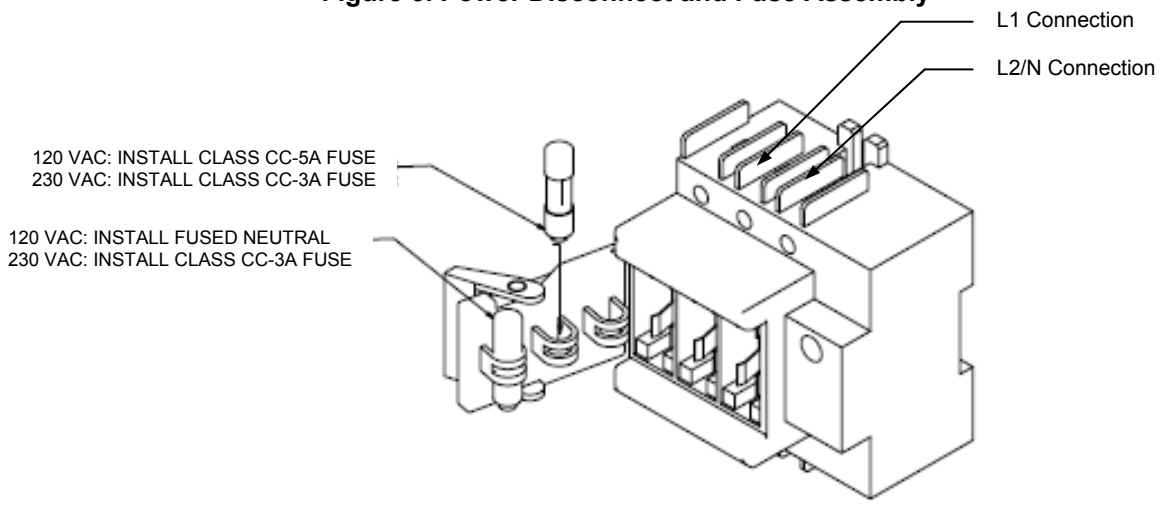
1._____Connect 3/4-inch electrical conduit to the three 3/4-inch threaded conduit connectors on the top of the controller enclosure.

2. Pull the electrical power supply conductors into the conduit. (line: brown, neutral: blue, ground: green/yellow) See Figure 5.

120 VAC operation is the default. To change to 230 VAC operation (see Figure 6):

- Set the power selector switch on the power supply module to 230V.
- Change the two fuses to part number S602-0266 Class CC 3A.

Figure 5. Power Disconnect and Fuse Assembly



3. Using 1/4–inch polyurethane tubing and the pneumatic actuation gas 1/4-inch male inlet connector provided (P/N S404-0101), connect a source of clean, dry, pressure-regulated nitrogen or air to the mating female pneumatic actuation gas inlet connector on the top surface of the controller enclosure. See item 8 in figure 4.

4. For the optional Z-Purge feature, connect a source of clean, dry, pressure-regulated nitrogen or air to the one-touch ¼-inch fitting on the Banjo valve on the top of the controller enclosure. See item 9 in figure 4.

4.4 ACCESSORY MONITORS & CONTROLS

1. Connect the Magnehelic exhaust probes. For single exhaust systems, there is a 10-32 hose barb fitting attached to Exhaust 1, a plug in Exhaust 2, and no connection to the atmospheric reference. Install the exhaust probe into the exhaust duct, and connect it to the hose barb fitting in Exhaust 1 using the provided ¼-inch blue polyurethane tubing. Do not connect anything to the atmospheric reference port. For dual exhaust systems, use Exhaust 2 for the second exhaust monitoring probe. Direct the output to either a facility exhaust system monitor or the appropriate controller digital input channel. Follow SEMI S2–93 safety regulations.

2. Install hazardous-gas detection equipment as mandated by pertinent safety ordinances and regulations. Connect the gas detection system to the Consul controller on connector J9 of the S085-0208 system I/O board. A normally closed contact (safe condition) is required.

3. For flammable process gases, install a fire sensor within the manifold enclosure.

4.5 EXTERNAL DIGITAL CONNECTIONS

The following configurable signal connections are typically available:

- 4 user digital inputs: J1 on S085-0207.
- 4 user relay outputs: J2 on S085-0207.

Definitions and functionality assigned to user inputs and outputs are factory programmable only.

See Table 2 for inputs and outputs. Refer to the Appendix for detailed wiring diagrams. ***NOTE:*** *Systems can be customized, so your system configuration may not have all of the listed I/O.*

Digital inputs and digital outputs are connected to the user I/O board via 2 female-threaded 3/4-inch conduit hubs on the controller enclosure top panel (see Figure 6).

Figure 6. Typical PLC in Controller Enclosure

CPU DIGITAL INPUTS FROM SENSORS

The PLC CPU has 24 digital inputs. Each of these inputs can accommodate an optional digital sensor.

NOTE: *Instructions in this section are pertinent only if the specified options have been implemented.*

Three types of optional digital (switch-type) sensor signals are connected to PLC digital input:

- Remote Shutdown signal
- Sensors for the manifold assembly enclosure (e.g., fire, toxic gas, exhaust pressure, high temperature, pneumatic gas pressure, and purge gas pressure)

Connect these inputs as follows: (Refer to Table 2 and the wiring diagrams in the Appendix)

1. Extend and connect the cable from the normally closed, dry contact Remote Shutdown signal from the facility to digital input 0.0 on the PLC CPU (S085-208, Connector J13, pins 3 & 4).

2._____Extend and connect the cables from another optional switch or digital output sensor to the available digital input at slot 0 or slot 2 on the PLC CPU. *Note:* The software must be preconfigured to accept this optional input. Any of these standard inputs that are not part of the configuration are jumpered to ignore the input.

Table 2. Digital Inputs & Outputs and Analog Inputs

PLC CPU X12			PLC CPU X11			EM 322		EM 331	
Byte. bit	16 Digital Inputs	16 Digital Outputs	Byte. bit	8 Digital Inputs	4 Analog Inputs	Byte. bit	32 Digital Outputs	Channel	8 Analog Inputs
0.0	Remote S/D	Left Red LED	2.0	A EFS (left)	Analog Input 1	2.0	SV1: VGS	0	A HPT (Left Cylinder Pressure)
0.1	Local S/D	Left Amber LED	2.1	Spare Input 1	Analog Input 2	2.1	SV2: Valve2	1	A LPT (Left Delivery Pressure)
0.2	Exhaust Switch 1	Left Green LED	2.2	Spare Input 2	Analog Input 3	2.2	SV3: VGI	2	VPT (Vacuum Pressure)
0.3	Exhaust Switch 2	Horn	2.3	N_2 Pressure Switch	Analog Input 4	2.3	SV4: LPI A	3	A SCL (Left Cylinder Scale)
0.4	Fire Detector 1	Right Red LED	2.4	B EFS (right)		2.4	SV5: HPV A	4	B HPT (Right Cylinder Pressure)
0.5	Fire Detector 2	Right Amber LED	2.5	Spare Input 3		2.5	SV6: HPI A	5	B LPT (Right Delivery Pressure)
0.6	Gas Alarm	Right Green LED	2.6	Spare Input 4		2.6	SV7: LPV A	6	PPT (Purge Pressure)
0.7	Temperature Switch	Valve Enable	2.7	Z Purge Switch		2.7	SV8: PGI A	7	B SCL (Right Cylinder Scale)
1.0	User Input 1	User Output 1				3.0	SV9: Valve 9		
1.1	User Input 2	User Output 2				3.1	SV10: Valve 10		
1.2	User Input 3	User Output 3				3.2	SV11: Valve 11		
1.3	User Input 4	User Output 4				3.3	SV12: LPI B		
1.4	Aux Input 1	Aux Output 1				3.4	SV13: HPV B		
1.5	Aux Input 2	Aux Output 2				3.5	SV14: HPI B		
1.6	Aux Input 3	Aux Output 3				3.6	SV15: LPV B		
1.7	Aux Input 4	Aux Output 4				3.7	SV16: PGI B		
						4.0	SV17: Spare		
						4.1	SV18: Spare		
						4.2	SV19: Spare		
						4.3	SV20: Spare		
						4.4	SV21: Spare		
						4.5	SV22: Spare		
						4.6	SV23: Spare		
						4.7	SV24: Spare		
						5.0-5.7	Not wired		

NETWORK COMMUNICATION CONNECTIONS *(OPTIONAL)*

Via an Ethernet network, the controller can communicate with a host computer. See Figure 6 for the location of the optional Ethernet module in the enclosure, and see Figure 7 for a typical Ethernet network configuration.

1. Using Belden #1599A Solid Conductor, Shielded, Plenum Jacketed, Twisted Pair Cable or its generic equivalent (see Table 3), connect the controller to a suitable Ethernet hub (Bay Networks - Baystack 153, 12 ports or equivalent). Cable length must not exceed 100 m (328 ft).

2. Using Belden #8259 (RG-58A/U Type) 50Ω Transmission and Computer Cable or its generic equivalent (see Table 3), interconnect all Ethernet hubs to a host computer. Maximum cable length per Thin Net segment (without repeater) is 185 m (607 feet).

Figure 7. Typical Ethernet Network Configuration

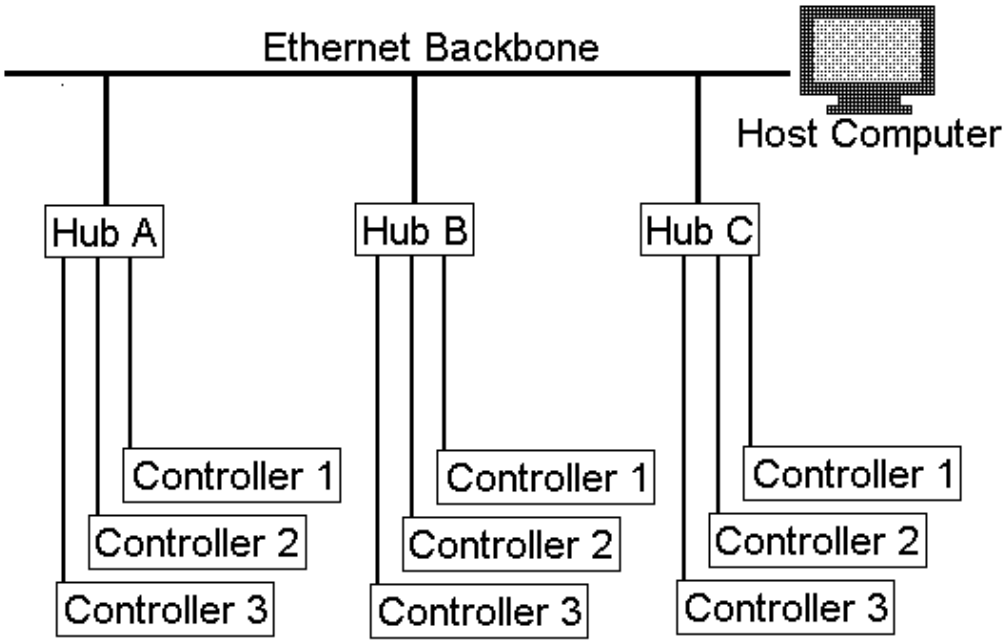


Table 3. Network Cable Characteristics

Belden Number*	Description
1599A	Bare 24 AWG solid copper, Teflon® FEP insulated, twisted pairs. Beldfoil® shield with drain wire, ripcord, natural gray or blue plenum Flamarrest® or fluorocopolymer jacket.
8259	Tinned 20 AWG stranded (19 X 33) copper, polyethylene insulated. Tinned copper braid 95% coverage shield; black jacket. Generic equivalent is RG-58A/U type cable.

*From *Belden Master Catalog*

4.6 PNEUMATIC MANIFOLD OUTPUTS

The digital output module has a single solenoid valve manifold with 16 solenoid outputs. It is expandable to up to 24 solenoid valves. (See Table 4.)

Table 4. Typical Solenoid Assignments *(actual assignments may vary)*

Left Side Group			Right Side Group			Extra Group		
Port No.	**Color**	**Valve**	**Port No.**	**Color**	**Valve**	**Port No.**	**Color**	**Valve**
1	Pink	VGS	9	Pink	HPA	17	Pink	AGO B
2	White	ACV A	10	White	ACV B	18	White	
3	Orange	VGI	11	Orange	LPA	19	Orange	AGC B
4	Grey	LPI A	12	Grey	LPI B	20	Grey	PSO B
5	Yellow	HPV A	13	Yellow	HPV B	21	Yellow	PSO B
6	Violet	HPI A	14	Violet	HPI B	22	Violet	AGC A
7	Green	LPV A	15	Green	LPV B	23	Green	
8	Blue	PGI A	16	Blue	PGI B	24	Blue	AGO A

* All valves listed in Table 4 may not be present, depending upon the user's configuration.

4.7 POST-INSTALLATION START UP

⚠ WARNING

TEST ALL EQUIPMENT BEFORE PLACING IN SERVICE

Operating this equipment without prior testing, modifying this equipment, or circumventing operating procedures recommended in this manual can result in injury or equipment damage.

Under no circumstances should this equipment be used for controlling a hazardous gas until suitability for service has been demonstrated. Matheson Tri-Gas assumes no liability for damages resulting from equipment operation. The user is ultimately responsible for equipment integrity and safety.

Follow all installation and operation instructions to the letter. If questions arise, call a supervisor or contact the Matheson Tri-Gas Technical Service Department for advice.

After installing all equipment and prior to start up:

1._____Turn on electrical power.

2._____Calibrate all sensors.

3._____Test all energized circuits.

4._____For each manifold:

_____Verify that all optional digital inputs are set as described in Table 2.

_____Verify that all optional digital outputs are set as described in Table 2.

_____Verify that all optional analog inputs are set as described in Table 2.

_____Verify that all alarm setpoints are correctly set as described in Table 6 (see *6.4 Setting Alarm Limits*).

_____For network installations, provide each connected device with a unique network address.

4.8 POST-INSTALLATION TESTS

1._____Verify that all alarm circuits function properly.

2._____When indicated, test and verify controller enclosure and manifold assembly enclosure exhaust static pressures and volumetric flow rates.

3._____Verify that all manifold assembly enclosure exhaust destination and duct construction materials are suitable for the intended process gas.

4._____Verify that the manifold assembly enclosure exhaust pressure switch functions properly.

5._____Verify that all Shutdown switches function properly.

5. GENERAL OPERATION

NOTE: *Refer to Chapter 3. Safety Precautions before operating the system.*

⚠ IMMEDIATE ACTION

FOR POTENTIALLY DANGEROUS SITUATIONS

If fire, release of hazardous gases, or another potentially dangerous situation occurs:

1. Press the front-panel red SHUTDOWN switches.
2. Immediately evacuate all personnel to a safe location.

⚠ DANGER

OPERATING THROUGH AN OPEN ENCLOSURE DOOR MAY INCREASE EXPOSURE TO HAZARDOUS GAS

If equipment fails when a hazardous process gas is used, the gas could be released inside the enclosure. When the enclosure door is open, exhaust performance is impaired, and personnel are at risk for exposure to this gas. For this reason, opening or closing valves and other manual operations on an operational manifold should be performed through the opened enclosure window only, and with the door closed. The enclosure door should be opened only when you cannot perform an operation through the window. Do not block closure of the door or window; when finished, allow it to close in the normal manner.

This section includes a general description of the user interface for the Consul™ Dual Source Controller. It also describes the Login/Logout procedure that users perform to gain access to displays that they are authorized to view.

5.1 USER INTERFACE

All indicators and controls are on the front panel of the enclosure. They provide manifold and controller status information and enable user interaction with the manifold and controller. They include the LED indicators on the controller enclosure, the local shutdown switch and the touchscreen on the manifold enclosure door (see Figure 4).

SHUTDOWN SWITCHES

A manually actuated, mechanically latching Local Shutdown switch is located on the front panel of the gas cabinet operator display panel. When actuated, this switch closes all pneumatically actuated valves on the manifold.

Since all pneumatically actuated manifold valves are normally closed and the switch latching is mechanical, the Local Shutdown state is retained when controller electrical power is interrupted.

LED INDICATORS

Red, yellow, and green LED indicators for each manifold are located on the front panel of the controller enclosure. These indicators reflect the current status of the left and right manifolds. Illumination of an indicator can be either flashing or steady.

- **Red LED indicator**:
  - *Flashing:* A shutdown alarm has been triggered, but not acknowledged.
  - *Steady:* A shutdown alarm has been acknowledged, but not cleared.
- **Yellow LED indicator**:
  - *Flashing:* Indicates either:
    A user action is required for an active purge procedure.
    A warning alarm has been triggered, but not acknowledged.
  - *Steady:* Indicates either:
    A purge procedure is occurring.
    A warning alarm has been acknowledged, but not cleared.
- **Green LED indicator**:
  - *Steady:* Service status or ready for service (Standby). ***NOTE:*** Service status means that the system is functioning in normal operation mode, providing gas.
- **LED indicator not lit**:
  - Manual operation is occurring.
  - A shutdown has been started manually (using the touchscreen).

TOUCHSCREEN

The touchscreen provides the primary local user interface. Buttons appear on all displays to help you navigate through the system. Typically, buttons have a blue background. If a button is not available to a user due to an insufficient access level or system status, that button may appear gray.

NOTE: In this manual, buttons appear in **bold** and display names appear in *italics*.

Figure 10 shows the relationship between all of the displays. Table 5 summarizes all displays and how to access them. The displays will be discussed in more detail in other sections of this manual.

Accessing Displays

Most displays are accessible only by navigating through the display hierarchy using the touchscreen buttons. In other words, each display allows access to some displays using the buttons. However, the following displays can be accessed from all screens:

- Press the **HOME** button to access the *Main Menu* screen.
- Press the **ALARMS** button to access the *Active Alarms* screen.

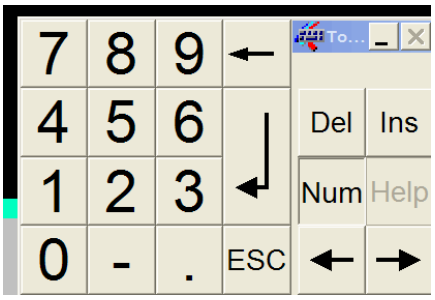
Typically, pressing the **EXIT** button takes you to the previous screen.

Editing Displays

Information in some display fields is editable. To enter information in these fields, just select the field on the touchscreen by pressing it with your finger. The system responds in one of the following ways:

- When only a few factory-established options are allowed, touch the field with your finger to scroll through or toggle the options.
- Fields requiring a numerical entry automatically display a numeric keypad when the field is selected. The keypad contains the following options (see Figure 9):
  - ← (backspace key on top): Deletes a single character in the keypad box.
  - ↵: The enter key. It copies the text in the keypad box to the selected field, then closes the keypad.
  - **ESC**: Deletes the entire entry and closes the keypad box.
  - **Del**: Deletes the selected characters in the keypad box.
  - **Ins**: Inserts characters without deleting existing text.
  - **Num**: Switches between the numeric and the alphanumeric keypads.
  - ← and → (bottom arrows): Moves the cursor in the keypad box left or right, respectively, so you can edit an entry.

Figure 9. Numeric Keypad



- Other fields are editable using a modified alphanumeric keypad that is automatically displayed when the field is selected. A box appears above the keypad that displays the text that you are entering. The keypad contains the standard alphanumeric keys, the options available in the numeric keypad, and the following additional options:
  - ⇧: Shift key. The shifted keys are displayed on the keypad for one button push.
  - ⇩: Caps lock. The shifted keys are displayed on the keypad until you toggle the Caps lock button.

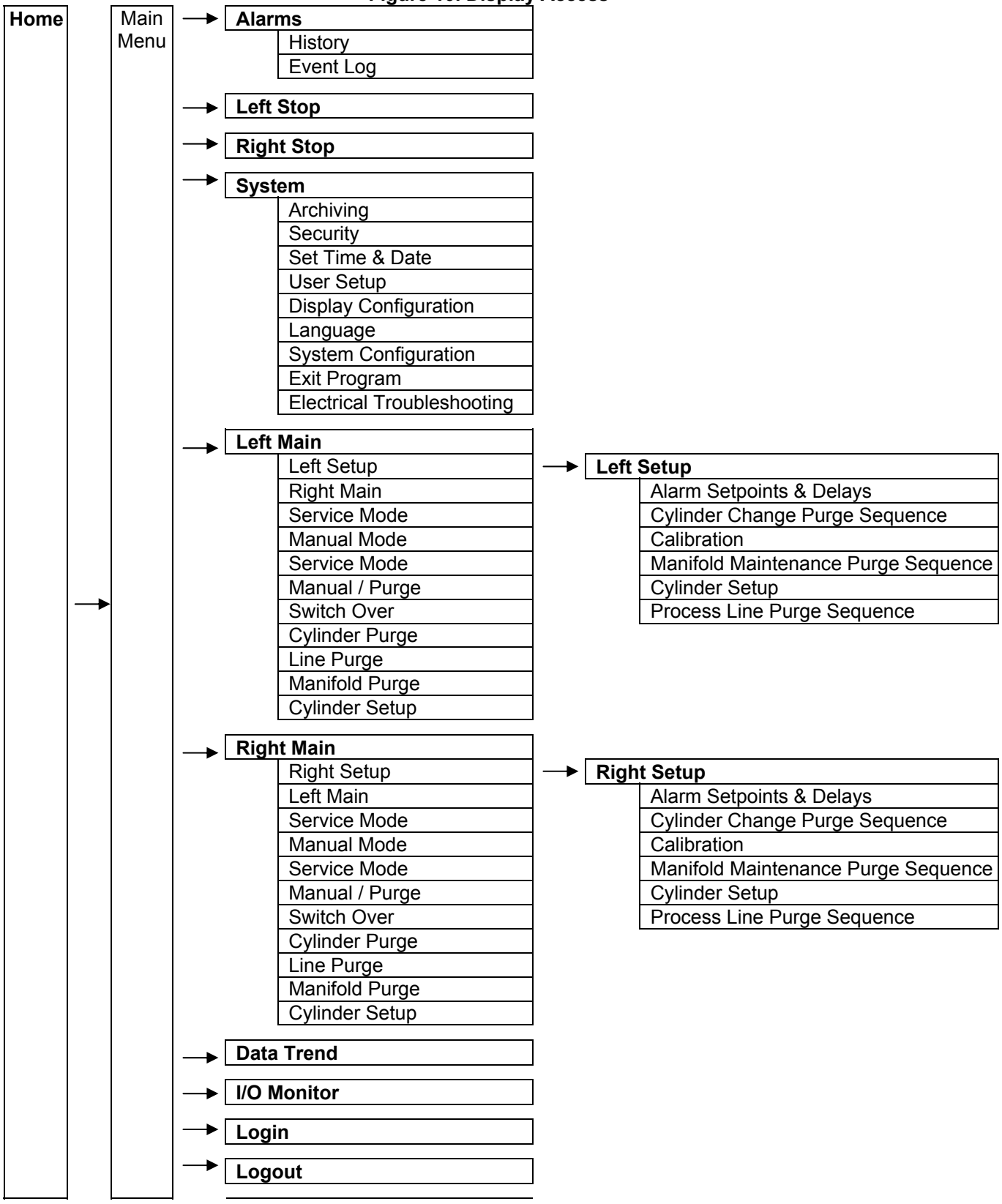
Color Conventions

Displays use the following color conventions:

- **Buttons**: When you press a button on the touchscreen, it gives you access to a new display or function, if permissible. Most buttons have a blue background. If a button is not available to a user due to an insufficient access level or system condition, that button appears gray.
- **Valves**: Several displays contain process & instrumentation drawings. The color of the valve symbol indicates its state: green means open and red means closed. Also, the orientation of the valve changes depending on its state: when the valve opening lines up with the process line, this indicates that the valve is opened; when the valve opening is perpendicular to the process line, this indicates that the valve is closed. ***NOTE:*** For certain custom applications, the valve color has been reversed so that green indicates closed and red indicates open.
- **Manifold Status**: The box where the status is displayed uses the following conventions:
  - *Red* indicates that the manifold is shutdown or stopped.
  - *Yellow* indicates that the manifold is being purged.
  - *Green* indicates that the manifold is in Service (normal operation) or ready for Service (Standby).
  - *White* indicates that the manifold is being controlled manually, either for service or a purge operation.

5.2 DISPLAY SUMMARY

Figure 10. Display Access



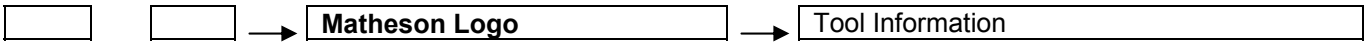

Matheson Logo
Tool Information

Table 5. Summary of Displays

Section	Display	Description	How to Access
7.1	Main Menu	This display allows access to all other displays. It summarizes Left and Right manifold status and operation.	Automatically displayed when power is initially applied to the controller or press **HOME**
5.3	Login	Enables a user to enter their password.	Go to *Main Menu* Press **LOGIN**
6.3	Tool Information	Provides software revision numbers and tool type information. Also includes manufacturer information. For information only.	Go to *Main Menu* Press **MATHESON TRI-GAS**
7.3	Active Alarms	Enables any user or observer to view all triggered alarms that have not been reset.	Go to *Main Menu* or any display Press **ALARMS**
7.3	Alarm History	Lists in reverse chronological order the 250 most recently triggered alarms (most recent is first).	Go to *Main Menu* Press **ALARMS** Press **HISTORY**
7.3	Event Log	Lists in reverse chronological order the 250 most recent user events (most recent is first).	Go to *Main Menu* Press **ALARMS** Press **EVENT LOG**
7.1	Data Trend	Allows users to view a graph of analog values versus time.	Go to *Main Menu* Press **DATA TREND** (also accessible directly from LEFT or RIGHT MAIN)
8.3	I/O Monitor	Allows users to troubleshoot input and output connections by displaying what the PLC actually sees.	Go to *Main Menu* Press **I/O MONITOR** (also accessible directly from LEFT or RIGHT MAIN)
6.	System	This display allows user access to archiving, security, clock, user setup, display configuration, language selection, system configuration, program exit, and electrical troubleshooting.	Go to *Main Menu* Press **SYSTEM** (also accessible directly from LEFT or RIGHT MAIN)
6.9	Archiving	Allows user to stop or start archiving to CompactFlash card.	Go to *Main Menu* Press **SYSTEM** Press **ARCHIVING**
6.1	Security	Allows authorized users to turn security on and off.	Go to *Main Menu* Press **SYSTEM** Press **SECURITY**
6.7	Time & Date Setup	Allows authorized users to set the PLC date and time.	Go to *Main Menu* Press **SYSTEM** Press **SET DATE/TIME**
6.2	User Setup	Enables authorized users to set access rights for various users.	Go to *Main Menu* Press **SYSTEM** Press **USER SETUP**
6.8	Display Configuration	Allows user to set display elements, such as cylinder graph parameters, touchscreen sensitivity, sound, contrast, and clean the screen.	Go to *Main Menu* Press **SYSTEM** Press **DISPLAY CONFIGURATION**
6.8	Language Selection	Allows users to select English (default) or Chinese as the interface screen language.	Go to *Main Menu* Press **SYSTEM** Press **LANGUAGE**

Section	Display	Description	How to Access
8.3	System Configuration	Allows authorized users to adjust purge and vacuum supply bleed behavior, and displays important factory configuration items that differ between cabinet types. Generally used at the factory and by Matheson service personnel.	Go to *Main Menu* Press **SYSTEM** Press **SYSTEM CONFIGURATION**
8.3	Electrical Troubleshooting	Allows authorized users to adjust analog sensor range. Generally used at the factory and by Matheson service personnel.	Go to *Main Menu* Press **SYSTEM** Press **ELECTRICAL TROUBLESHOOTING**
7.1	Left / Right Main Menu	Enables logged-in users to view and adjust manifold operation and settings.	Go to *Main Menu* Press **LEFT MAIN** or **RIGHT MAIN**
6.4	Left / Right Setup	Allows authorized users to change various operating parameters of an individual manifold.	Go to *Main Menu* Press **LEFT** or **RIGHT MAIN** Press **SETUP**
6.4	Alarm Setup	Allows authorized users to set alarm limits for digital and analog inputs and time delays and alarm actions for digital inputs.	Go to *Main Menu* Press **LEFT** or **RIGHT MAIN** Press **SETUP** Press **ALARM SETPOINTS AND DELAYS**
6.6	Cylinder Change / Manifold Maintenance / Process Line Purge Sequence Setup	Enables authorized users to customize the times and cycles of key purge sequence steps.	Go to *Main Menu* Press **LEFT** or **RIGHT MAIN** Press **SETUP** Press **CYLINDER CHANGE** or **MANIFOLD MAINTENANCE** or **PROCESS LINE PURGE SEQUENCE**
6.5	Calibration	Enables authorized users to automatically adjust the analog input signal offset to compensate for transducer output drift.	Go to *Main Menu* Press **LEFT** or **RIGHT MAIN** Press **SETUP** Press **CALIBRATION**
7.5	Cylinder Setup	Allows users to enter process gas name; cylinder code, replacement reminder date and expiration date; and calculates the tare weight for the cylinder or its contents after a cylinder change.	Go to *Main Menu* Press **LEFT** or **RIGHT MAIN** Press **SETUP** Press **CYLINDER SETUP** (also accessible directly from **LEFT** or **RIGHT MAIN**)

5.3 LOGGING IN

Logging in allows authorized users to operate the manifold assembly according to their specific password authorization level. The log in procedure is as follows:

1. Select the number in the *Password* box near the bottom right corner of the *Main Menu* display.
2. Enter your confidential password via the displayed keypad, then press the Enter symbol ↵ .
3. Press the **LOGIN** button.
   - If the entered password is valid, the current user name appears in the *User* box near the bottom right corner of the *Main Menu* display.
   - If the entered password is invalid, an error message will appear stating that access is denied.

Initial Log In

The first time that the system is turned on, security will be enabled and the user will need to log in to initiate operation. Follow these procedures for initial login:

1. Press the **LOGIN** button on the *Main Menu* display.
2. Enter the default password "1234" via the displayed keypad, then press the Enter symbol ↵ . The user will now be logged in as MFG.

The user can then disable security (see *6.1 Setting Security Parameters*) or set security levels for various users via the *User Setup* display (see *6.2 Authorizing Users*). The user may also choose to change the default password given for user MFG, which is default user 1 (see *6.2 Authorizing Users*). It is the user's responsibility to maintain passwords, accounts, and privileges. If a password is forgotten and the system cannot be accessed, it may be necessary for a field service technician to reload the software.

Logging Out

When any user logs on, they will remain logged on until a manual logout.

1. Press the **LOGOUT** button on the *Main Menu* display.

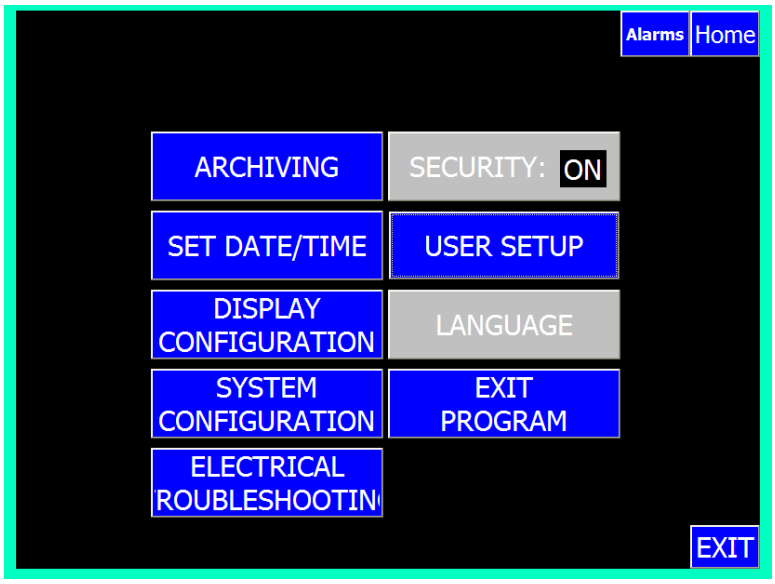
NONE appears in the User box near the bottom right corner of the *Main Menu* display.

6. CONFIGURATION

Various configuration parameters are accessed from either the *System* display (see Figure 11) or the *Setup* display for the manifold (see Figure 12).

To access the *System* display, press the **SYSTEM** button on the *Main Menu* or manifold *Main Menu* display.

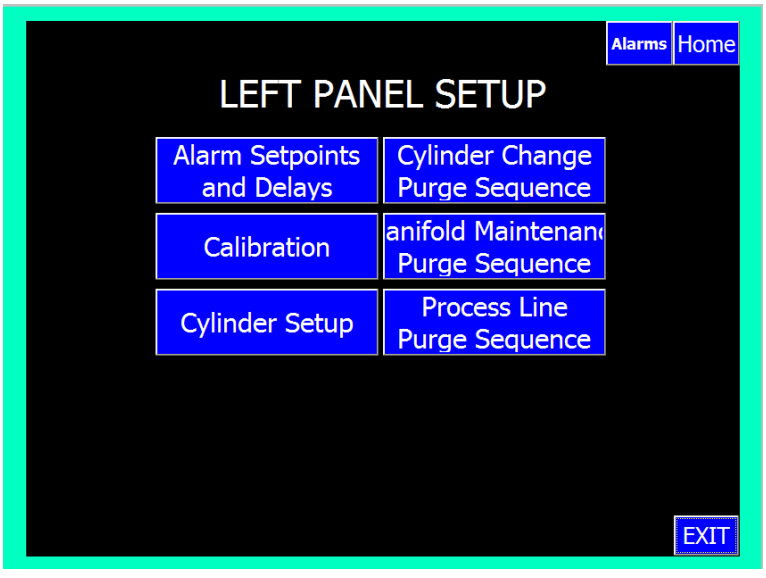
Figure 11. System Display



To view the *Setup* display:

1. Go to the *Main Menu* display.
2. Press the **MAIN** button for the desired manifold.
3. Press the **SETUP** button.

Figure 12. Setup Display (for the left panel)



6.1 SETTING SECURITY PARAMETERS

Disabling Security

You can disable security so that no login is required for any user. In this case, all users will have full access rights. To disable security, proceed as follows:

1. Press the **LOGIN** button on the *Main Menu* display and log in as any user who has access privileges to the *Security* display.
2. Press the **SYSTEM** button.
3. Press the **SECURITY** button to toggle from **ON** to **OFF**.
4. Press the **EXIT** button to return to the *Main Menu*, *Right Main*, or *Left Main* display.

DISABL appears in the User box at the bottom right to indicate that security is disabled.

Enabling Security

When security is disabled, any user can enable security as follows:

1. ***Important!*** When security is enabled, a user must log in to initiate operation. Verify that a usable password is available by checking the *User Setup* display *before* enabling security, as the *User Setup* display will be inaccessible without a valid password once security is enabled. See *6.2 Authorizing Users* for more information on the *User Setup* display.
2. Press the **SYSTEM** button on the *Main Menu* display.
3. Press the **SECURITY** button to toggle from **OFF** to **ON**.
4. Press the **EXIT** button to return the *Main Menu*, *Right Main*, or *Left Main* display.

Password appears in the *User* box at the bottom right to indicate that no user is logged in.

6.2 AUTHORIZING USERS

Users with administrative (user setup) privileges can create various user accounts that have specific access privileges. Depending on the level of access granted, different users can:

- Create and authorize user accounts to access specific displays and functions and exit the screen program.
- Enable or disable login security and access System Configuration and Electrical Troubleshooting screens.
- Access analog sensor auto-calibration.
- Customize purge sequence settings, including settings outside of production ranges.
- Manually actuate valves through the touchscreen.
- Set alarm limits and delays.
- Run selected purge sequences.
- Put a manifold into service without running a purge sequence.

Up to 16 users can be configured. If an operator does not have access privileges (non-authorized users or observers), they can still view information-only screens and acknowledge and reset alarms.

User Setup Display

Initially the system is set up with only one user, MFG, who has full access rights. The default password for this user is “1234”. Once this user has logged in, they can then set up all the other user names, passwords, and access rights, including their own.

To view this display:

1. Select the **SYSTEM** button from the *Main Menu* display.
2. Select the **USER SETUP** button.

To exit the display, press the **EXIT** button to return to the *System* display. Press the **EXIT** button to return to the *Main Menu* display.

Changing User Name

To enter or change a user’s name, perform the following:

1. Press the button in the User Name row (see Figure 13) corresponding to the user to be set. Note that eight users are displayed on the initial screen. The other eight can be viewed by pressing the **Users 9-16** button.
2. Enter the user name on the alphanumeric keypad and press the Enter symbol ↵ . User names can have a maximum of 6 characters.

Changing User Password

To enter or change a user’s password, perform the following:

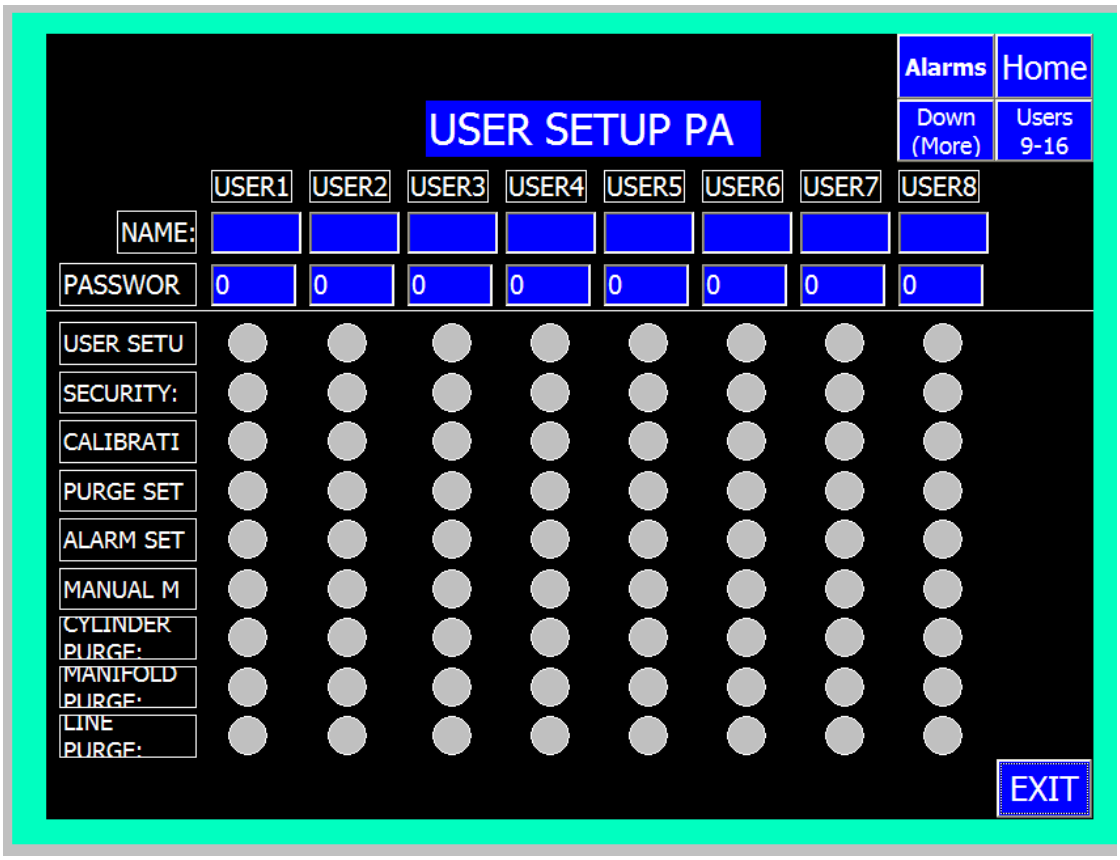
1. Press the button in the Password row below the user for which the password is to be set (see Figure 13).

2. Enter the password on the numeric keypad and press the Enter symbol ↵ . Passwords can have a maximum of 4 numerals.

Setting User Access Privileges

Set access privileges by toggling the button in the correct Access row and User column. A blue button means that the user will have the access privilege. A gray button means that the user will not be able to access that display. Note that the initial screen displays nine access rows. Press the **DOWN (More)** button to display additional access rows.

Figure 13. User Setup Display



6.3 VIEWING ADMINISTRATION INFORMATION

The *Tool Information* display is an information-only display that anyone can access. It provides data on the controller and manifolds, including: (see Figure 14)

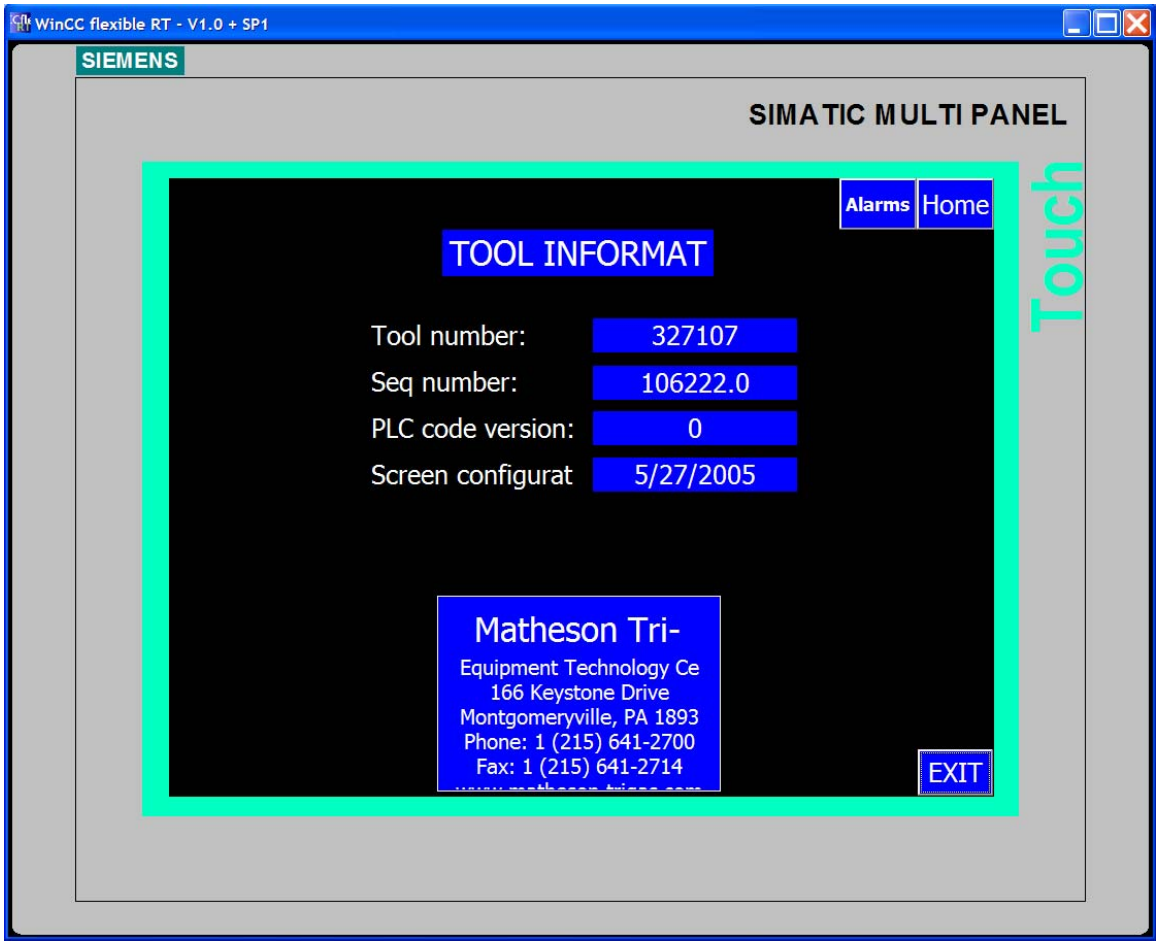
- Tool number
- Sequence number
- PLC code version
- Screen configuration version
- Manufacturer Information

To view this display:

1. Go to the *Main Menu* display.
2. Press the **MATHESON TRI-GAS** button.

Press the **EXIT** button to return to the *Main Menu* display.

Figure 14. Tool Information Display



6.4 SETTING ALARM LIMITS

The *Alarm Setup* displays allow authorized users to customize the setpoints and delay times for selected process and purge alarms. Configurable alarm setpoints are available for transducers and scales, not switches.

A typical alarm setting is as follows (see Figure 16):

Alarm Name	Sensor	Alarm setpoint and delay user setting					Enable:	Shutdown	Warning
							Shutdown Mode	Gray	Blue
High-high delivery pressure (HHDP)	LPT >	0 90	PSIG (-15-100)	for	0 2	seconds (0-10)	Service Mode	Blue	Gray
							Standby Mode	Blue	Gray
							Manual Mode	Gray	Blue

This alarm setting means: The alarm High-high delivery pressure is triggered when transducer LPT is greater than 0 PSIG (settable range is -15 to 100 PSIG; the default is 90 PSIG) for 0 seconds (settable range is 0 to 10 seconds; the default is 2 seconds). This triggers a warning alarm in Shutdown and Manual modes, but triggers a shutdown in Service and Standby modes.

Note that this alarm is also known by the acronym HHDP for high-high delivery pressure. All alarms with separate enable settings for shutdown and warning in the four operational modes (the alarms on pages 3 to 6) can also trigger a shutdown in the three purge modes, depending on the settings for each step.

Other alarms have the following settings (see Figure 15):

Alarm Name	Sensor	Alarm setpoint and delay user setting	Enabled action user setting		
Remote E.M.O. shut down	I0.0	open	In all modes for this panel enabled as:	Blue	Shutdown
				Gray	Warning

This alarm setting means: The alarm Remote E.M.O. shut down is triggered when input I0.0 is open (off). This triggers a shutdown in all operational and purge modes.

Note that this alarm does not delay when its trigger condition becomes true (except to the extent that the hardware protects against momentary transients by sampling). A digital input is listed as the sensor because the trigger is a dry contact, rather than a switch that is integral to the system.

Some alarms have 3 levels: low, low-low, and low-low-low. It is typical to make the low alarm action a warning, the low-low alarm action a switchover (if possible), and the low-low-low alarm action a shutdown. Also, the alarms on *Alarm Setup* pages 1 and 2 are global alarms that are common to both manifolds, while the other alarms are specific to one manifold. Acceptable ranges for alarm setpoints and time delays are listed in Table 6.

Table 6. Default Values and Acceptable Ranges of Alarms

Alarm	Default Setpoint	Acceptable Setpoint Range	Default Time Delay	Acceptable Delay Range
High-high delivery pressure (HHDP)	90 psig	-15-100 psig	2 seconds	0-10 seconds
High excess flow (HOF)	open	N/A	6 seconds	0-10 seconds
High vent pressure (VPT)	-9 psig	-15-0 psig	4 seconds	0-10 seconds
Low purge pressure (PPT)	60 psig	0-100 psig	2 seconds	0-10 seconds
High manifold pressure (HMP)	15 psig	15-40 psig	2 seconds	0-10 seconds
Low manifold pressure (LMP)	15 psig	0-40 psig	2 seconds	0-10 seconds
Low-low cylinder weight (LLCW)*	6 lbs	0-100 lbs	2 seconds	0-10 seconds
Low-low cylinder pressure (LLCP)*	180 psig	-15-3000 psig	2 seconds	0-10 seconds
Low-low delivery pressure (LLDP)	25 psig	-15-100 psig	6 seconds	0-10 seconds
Low-low-low pressure (LLLCP)	150 psig	-15-3000 psig	2 seconds	0-10 seconds
High-high vent pressure (HHVP)	10 psig	-15-100 psig	2 seconds	0-10 seconds
Low-low-low cylinder weight (LLLCW)	5 lbs	0-100 lbs	2 seconds	0-10 seconds
High purge pressure (HPP)	95 psig	50-110 psig	2 seconds	0-10 seconds
High manifold delta pressure (MDP)	4.0 psi	1.0-10.0 psi	2 seconds	0-60 seconds
The following are always warnings:				
High delivery pressure (HDP)	95 psig	-15-120 psig	2 seconds	0-10 seconds
Low cylinder weight (LCW)	8 lbs	0-100 lbs	2 seconds	0-10 seconds
Low cylinder pressure (LCP)	200 psig	-15-3000 psig	2 seconds	0-10 seconds
Low delivery pressure (LDP)	30 psig	-15-100 psig	2 seconds	0-10 seconds

*The Low-Low Cylinder Weight and Pressure alarms are available to allow the option of shutting down the manifold when the cylinder weight or pressure decreases below a certain point. This is to avoid introducing impurities present in the residual liquid or gas that remains as the cylinder contents decrease. If these alarms are to be used, the setpoint should remain the same as the Low Cylinder Weight or Pressure if only a Shutdown is desired. Optionally, the setpoint should be set below the Low Cylinder Weight setpoint if a two-stage alarm is desired (warning followed by shutdown). If only a warning (no shutdown) is desired, the Low-Low Cylinder Weight setpoint should be set to 0 lbs.

To view this display:

1. Press the **ALARM SETPOINTS AND DELAYS** button from the *Setup* display for the manifold (see Figure 12). The *Alarm Setup Page 1* screen is displayed (see Figure 15).
2. To access the *Alarm Setup Page 2* screen, press the **NEXT PAGE** button. To jump to *Alarm Setup Page 8*, press the **LAST PAGE** button. Depending on the page that is displayed, you may get other navigational buttons, such as **PREVIOUS PAGE** and **FIRST PAGE**.

3. The *Alarm Setup* displays show the setpoint for selected alarms, along with a default value below it (see Figure 16). To change the setpoint, select a setpoint, enter a new value from the numeric keypad, then press the Enter symbol.
4. The *Alarm Setup* displays also show the time delay for all alarms, along with a default value below it (see Figure 15). To change the time delay, select a time delay, enter a new value from the numeric keypad, then press the Enter symbol.
5. Select the *Shutdown* or *Warning* indicators to enable alarms for the specified modes. Blue is enabled; gray is disabled. These buttons toggle between enabled and disabled.
6. On the *Alarm Setup Page 8* display (see Figure 17), you have the following options to restore all alarm defaults:
   - Select the **RESTORE LEFT [or RIGHT] PANEL ALARM DEFAULTS** button to restore the factory default setpoints and delay times for all of the alarms on a panel.
   - Select the **RESTORE LEFT [or RIGHT] PANEL ALARM ENABLE DEFAULTS** button to restore the factory default enabling (Shutdown versus Warning) for all of the alarms on a panel.
   - Select the **RESTORE COMMON ALARM DEFAULTS** button to restore the factory default delay times for alarms that are common to both manifolds.
7. Press the **EXIT** button to return to the manifold *Setup* display. Press the **EXIT** button again to return to the manifold *Main Menu*.

Figure 15. Alarm Setup Display Page 1

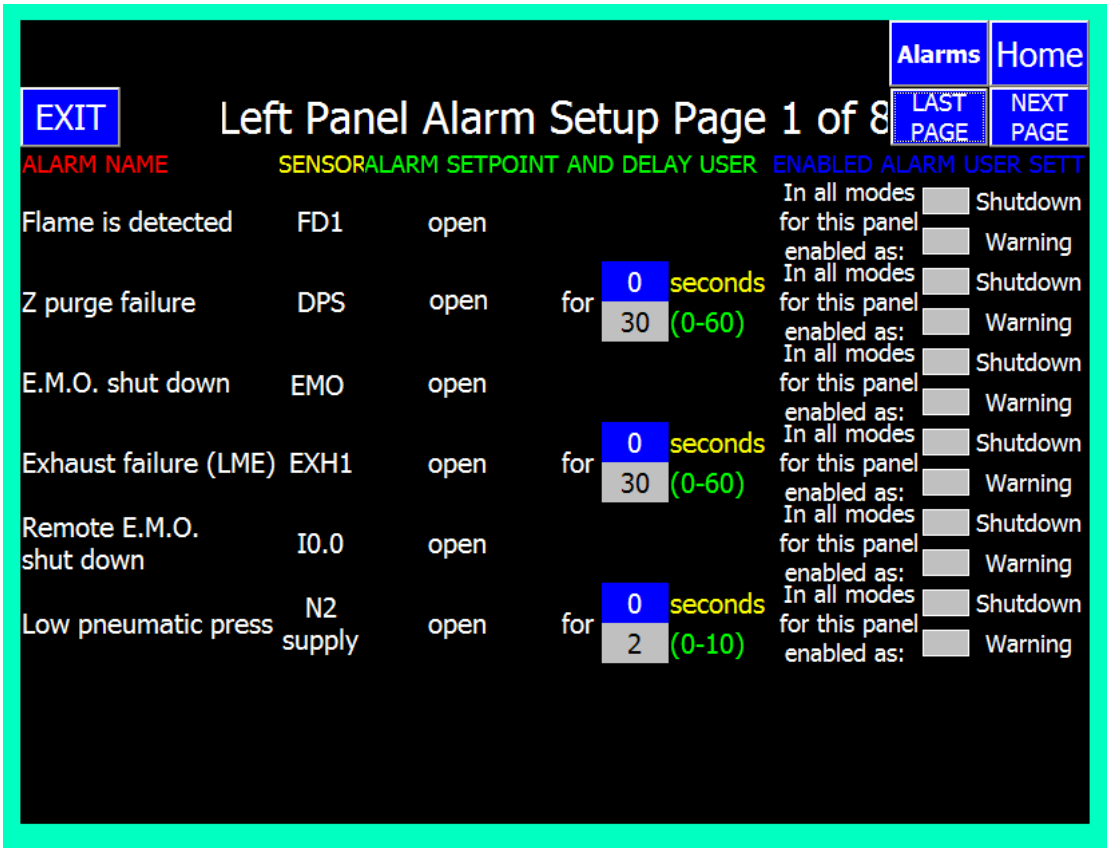


Figure 16. Alarm Setup Display Page 3

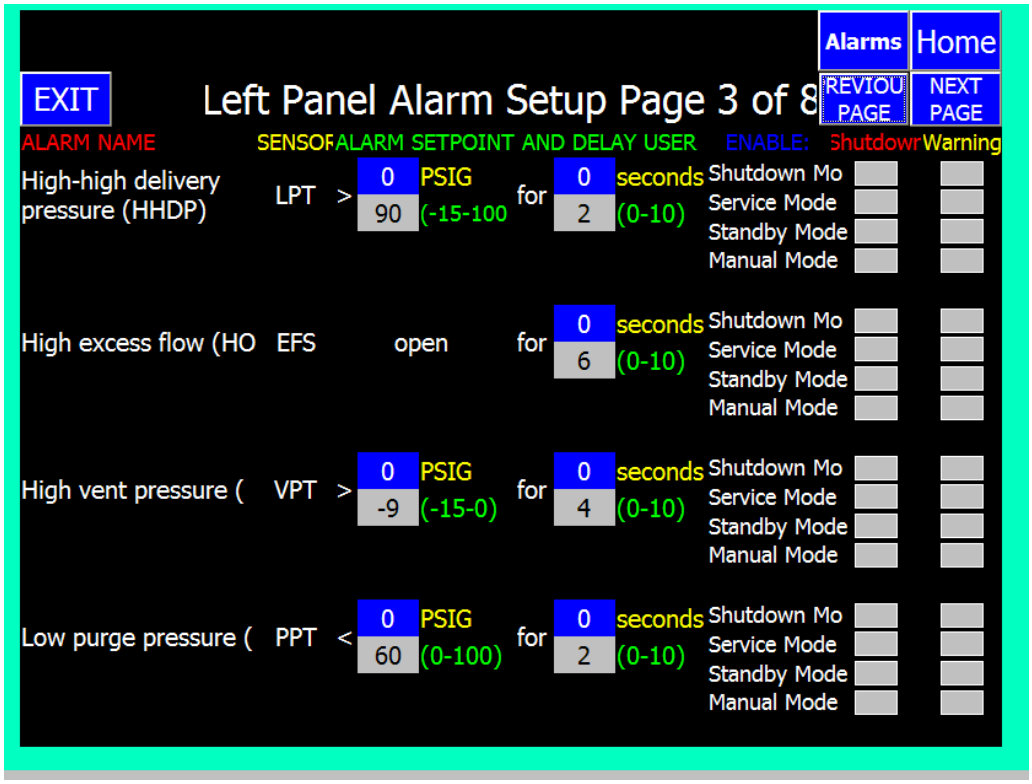
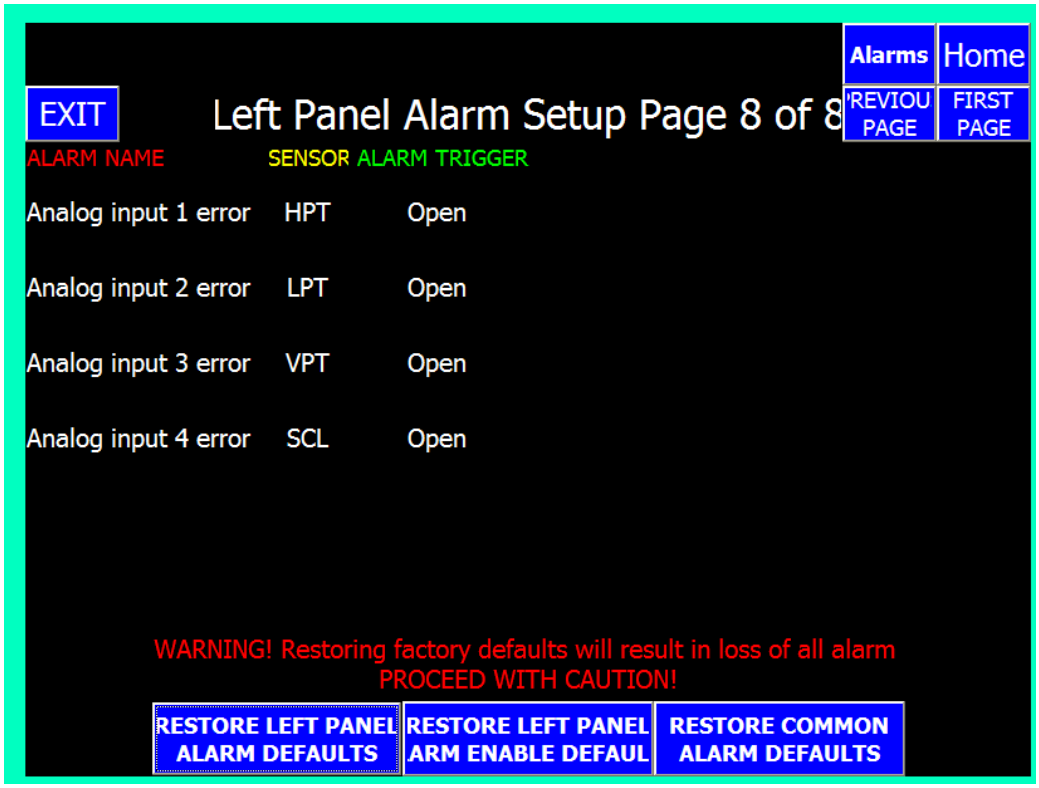


Figure 17. Alarm Setup Display Page 8



6.5 CALIBRATING ANALOG SIGNALS

The zero of an analog transducer typically changes over time (or drifts) due to the deterioration of construction materials. The *Auto-Calibrate* display allows authorized users to automatically adjust the offset for analog inputs in software to compensate for transducer output drift. It also tracks the total offset of a sensor from its previous manual calibration.

***NOTE**: An input can be adjusted only if the maximum drift is less than 1% of the scaled range, which equates to:*

- ± 0.20 mA on a 4-20 mA transducer.
- ± 3 lbs. on a 300 lb. scale.
- ± 1.0 psi on a 100 psi transducer.
- ± 2.5 psi on a 250 psi transducer.
- ± 30 psi on a 3000 psi transducer.

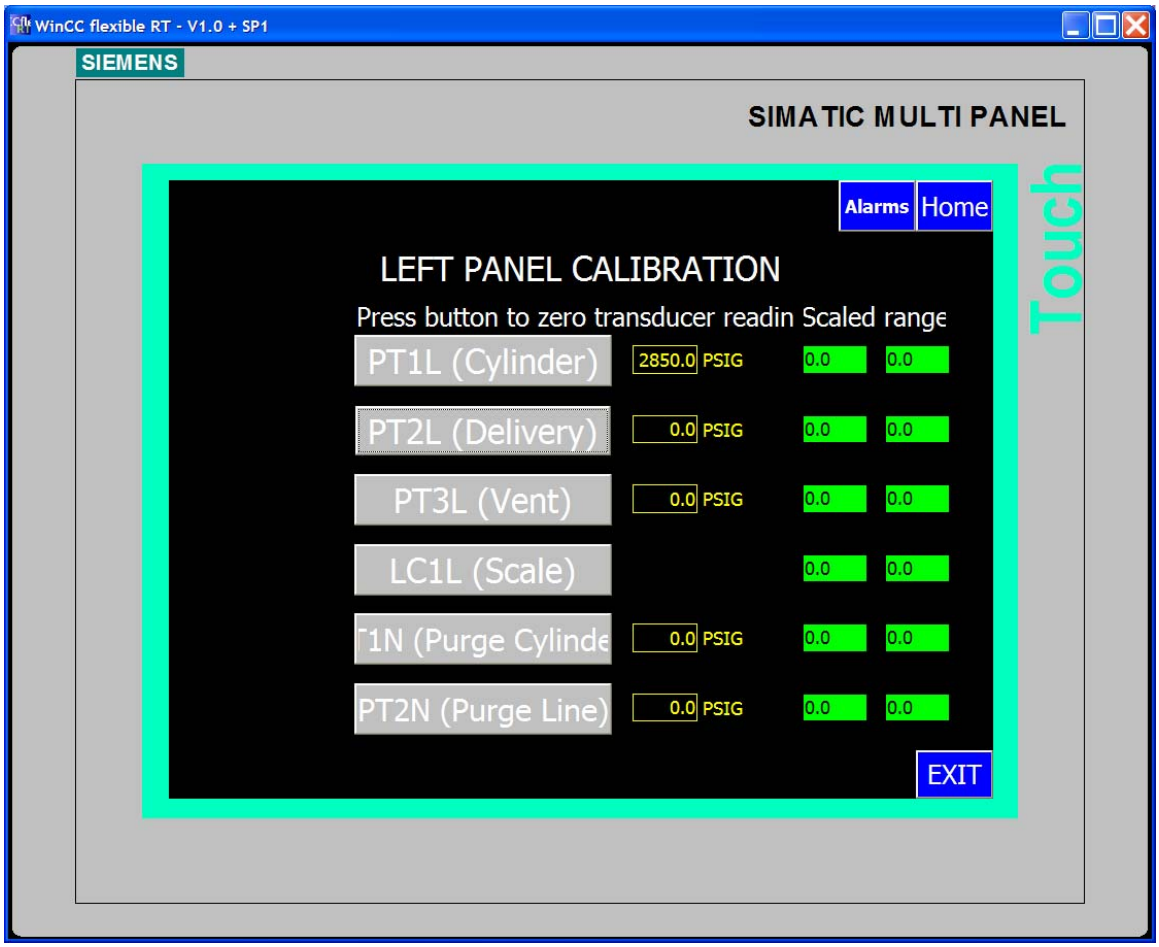
If this condition is not met (the drift is too large), or a sensor has been replaced, the sensor must be calibrated manually. Before doing this, the default calibration should be set. This can be done in one of two ways on the Electrical Troubleshooting screen, see Section 8.3.

To perform an offset adjustment on an analog input:

1. If the transducer to be calibrated is not at atmospheric pressure, manually vent the region of the manifold that contains the transducer until it reaches atmospheric pressure.
2. Press the **CALIBRATION** button on the *Setup* display for the manifold.
3. Press the button for the desired input (Figure 18). Choices may include:
   - HPT (Cylinder Pressure)
   - LPT (Delivery Pressure)
   - VPT (Vent Pressure)
   - SCL (Cylinder Scale)
   - PPT (Purge Line Pressure)

   The system will recalculate the range for the transducer based on the offset.
4. Press the **EXIT** button to return to the manifold *Setup* display.

Figure 18. Panel Calibration Display



6.6 CUSTOMIZING PURGE PROCEDURES

The *Purge Sequence Setup* displays allow authorized users to customize purge sequences. You can optimize the time and number of evacuation, pressurization, and venting cycles that occur, thereby customizing the purge procedure to accommodate a specific application. Acceptable input ranges are listed in Table 7.

Table 7. Acceptable Input Ranges for Purge Sequence Setup

	Cylinder Change	Manifold Maintenance	Process Line Purge
Process Gas Removal			
Evacuation	1-60 seconds	1-60 seconds	10-60 seconds
Pressurization	1-60 seconds	1-60 seconds	1-60 seconds
Venting	1-60 seconds	1-60 seconds	1-60 seconds
Cylinder Shutoff Test			
Evacuation	252-900 seconds	252-900 seconds	252-900 seconds
Flow Purge			
Time	1-60 seconds		
Prepurge			
Cycles	40-120	40-120	40-120
Evacuation	1-60 seconds	1-60 seconds	10-900 seconds
Pressurization	1-60 seconds	1-60 seconds	10-900 seconds
Atmospheric Removal			
Cycles	5-60	5-60	5-60
Evacuation	1-60 seconds	1-60 seconds	10-900 seconds
Pressurization	1-60 seconds	1-60 seconds	10-900 seconds
Leak Test			
Evacuation	60-300 seconds	60-300 seconds	60-300 seconds
Postpurge			
Cycles	40-120	40-120	40-120
Evacuation	1-60 seconds	1-60 seconds	10-900 seconds
Pressurization	1-60 seconds	1-60 seconds	10-900 seconds

Note that the *Purge Sequence Setup* displays are common to both manifolds. To customize a purge procedure:

1. Press the **PURGE SEQUENCE** button for the desired purge procedure from the *Setup* display for either manifold. Choices include:
   - Cylinder Change

- Manifold Maintenance
- Process Line

2. Enter the number of evacuation/pressurization cycles and the number of seconds of evacuation, pressurization and venting for each step in the purge procedure (see Figures 19-21). Note that each entry contains 2 numbers: the top number is the user-configured value, while the bottom number is the factory default.

   - ***Process Gas Removal Evacuation (sec)***: number of seconds that the equipment is evacuated during the process gas removal operation.
   - ***Process Gas Removal Pressurization (sec)***: number of seconds that the equipment is pressurized with purge gas during the process gas removal operation.
   - ***Process Gas Removal Venting (sec)***: number of seconds that the equipment is vented to the atmosphere during the process gas removal operation.
   - ***Cylinder Shutoff Test Evacuation (sec)***: number of seconds that the equipment is evacuated during the cylinder shutoff test.
   - ***Flow Purge (sec)***: number of seconds that purge gas flows through the regulator and exits the vent system during the flow purge step; the default is 30 seconds.
   - ***Prepurge*** / ***Postpurge*** / ***Atmosphere Removal Cycles***: number of evacuation/pressurization cycles applied during each step of the prepurge, postpurge, or atmosphere removal operation.
   - ***Prepurge*** or ***Postpurge Evacuation (sec)***: number of seconds that the equipment is connected to the vacuum port of the vacuum generator during each cycle of the prepurge or postpurge operation.
   - ***Prepurge*** or ***Postpurge Pressurization (sec)***: number of seconds that the equipment is pressurized with purge gas during each cycle of the prepurge or postpurge operation.
   - ***Atmosphere Removal Evacuation (sec)***: number of seconds that the equipment is evacuated after the auto-leak test.
   - ***Atmosphere Removal Pressurization (sec)***: number of seconds that the equipment is pressurized with purge gas after the auto-leak test.
   - ***Leak Test Evacuation (sec)***: number of seconds that the equipment is evacuated during the leak test.

   Press the **DEFAULT** button to restore factory settings for all values.

3. Press the **EXIT** button to enter the information into the system and return to the manifold *Setup* display. Press the **EXIT** button to return to the *Main Menu* display.

Figure 19. Cylinder Change Purge Sequence Setup Display

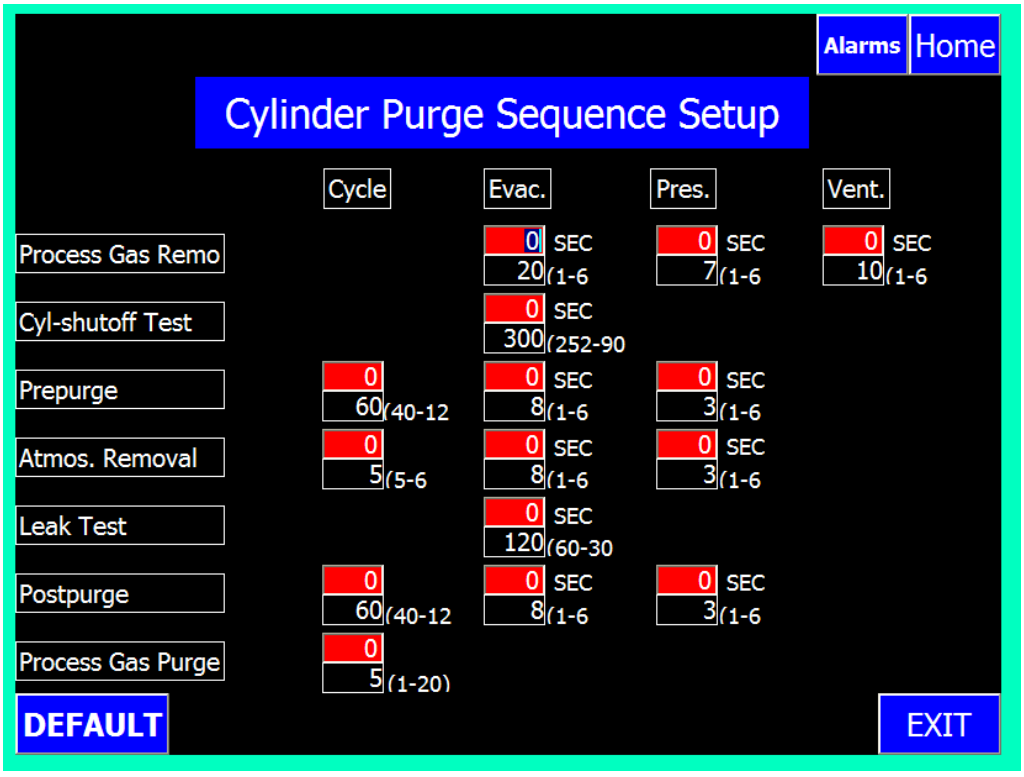


Figure 20. Manifold Maintenance Purge Sequence Setup Display

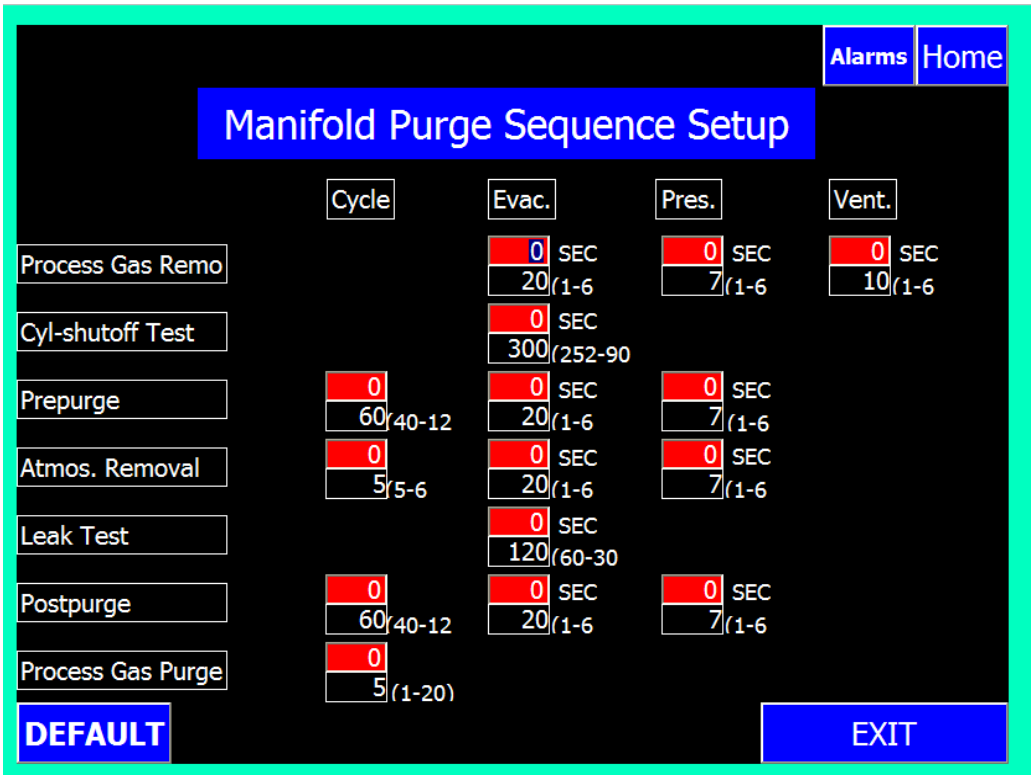
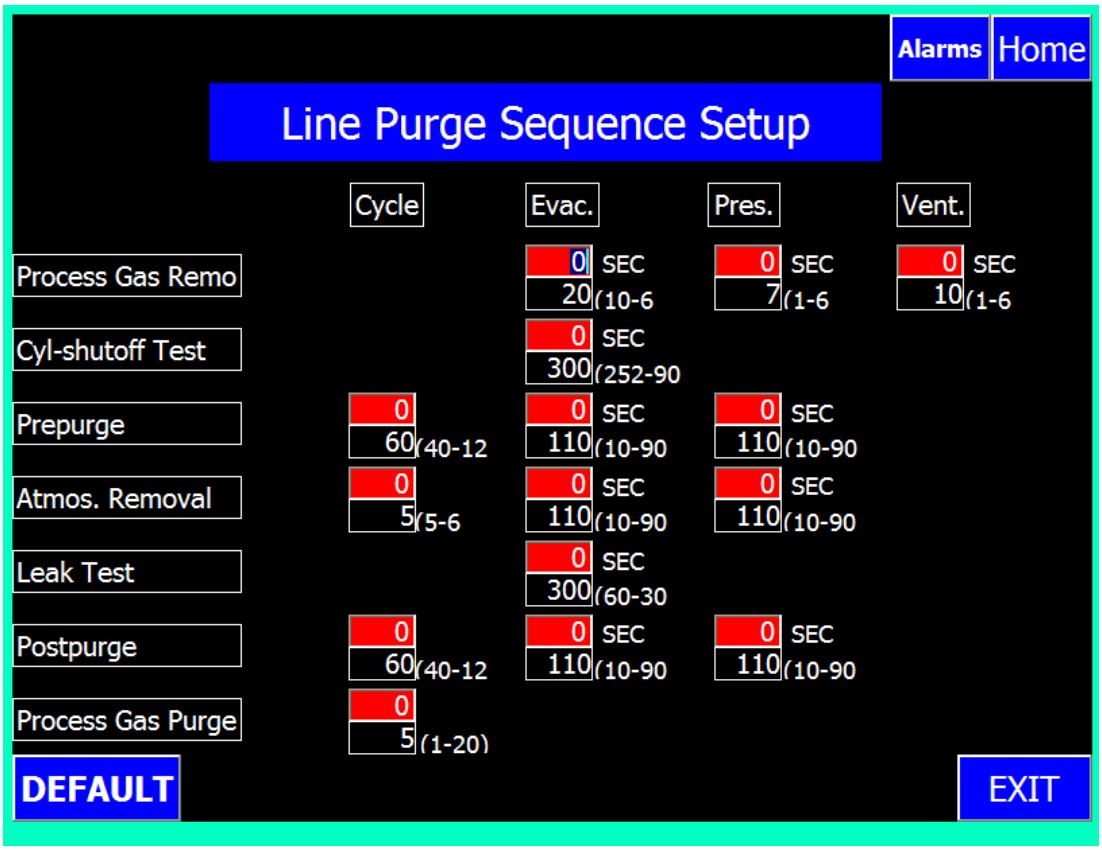


Figure 21. Process Line Purge Sequence Setup Display

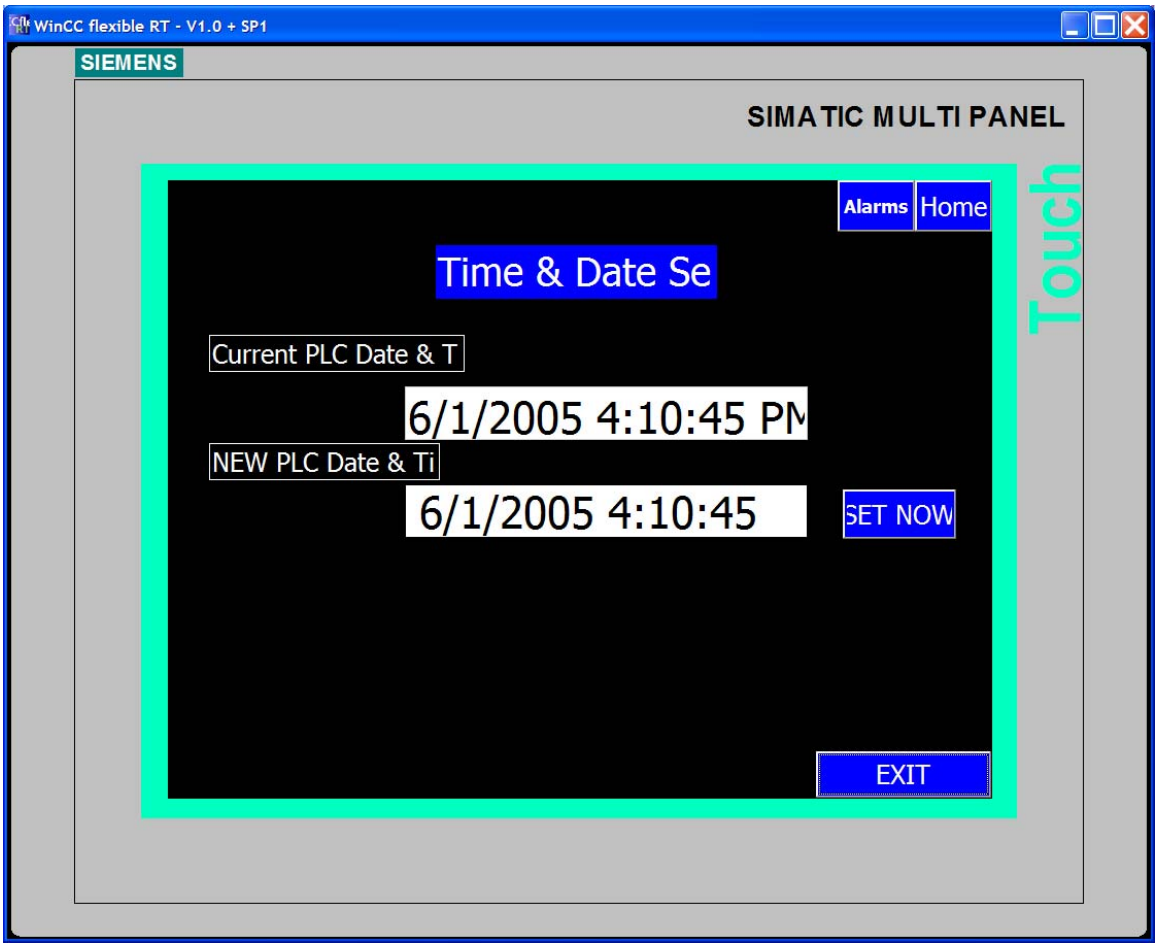


6.7 SETTING THE DATE & TIME

The date and time are used for the alarm and event logs, trends, and cylinder setup. The *Time & Date Setup* display is common to both manifolds. To synchronize the PLC and screen date and time:

1. Press the **SET DATE / TIME** button from the *System* display. The current PLC date and time are displayed (see Figure 22).
2. Select the *New Date & Time* box to display the numeric keypad.
3. Enter a new date and time, then press the **SET NOW** button.
4. Press the **EXIT** button to return to the *System* display.

Figure 22. Time and Date Setup Screen

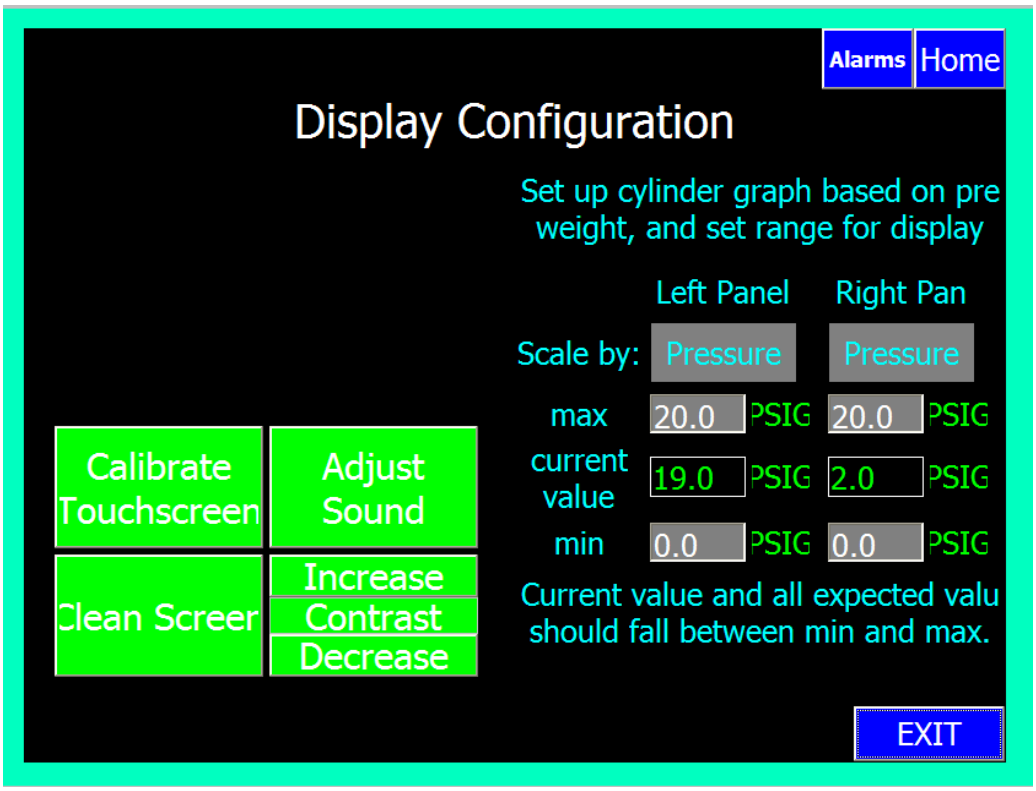


6.8 SETTING DISPLAY PARAMETERS

Display Configuration

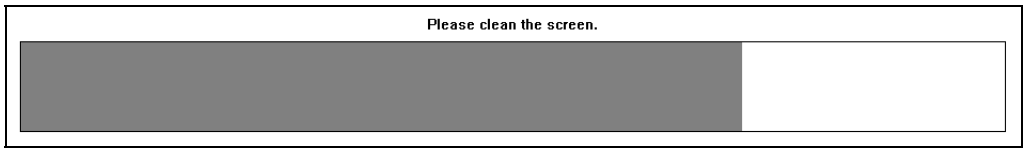
Several display parameters are available from the *Display Configuration* display. The *Display Configuration* display is common to both manifolds.

Figure 23. Display Configuration Screen



1. Press the **DISPLAY CONFIGURATION** button from the *System* display.
2. Adjust any of the following features (see Figure 23):
   - ***Setting up the cylinder bar graph***: Select the button to choose between displaying pressure or weight on the cylinder bar graph (this button is a toggle). Enter the minimum and maximum values for this graph.
   - ***Adjusting the touchscreen sensitivity***: Press the **Calibrate Touchscreen** button to adjust the touchscreen sensitivity. A test will be run where you have to tap the cursor at various positions on the screen. You will then tap the screen to save the new configuration, or wait the designated time to cancel.
   - ***Adjusting the sound***: Press the **Adjust Sound** button to cycle through the 3 choices for the sound volume (Mute, Soft, or Loud).
   - ***Adjusting the screen contrast***: Press the **Increase** button or the **Decrease** button to change the screen brightness.
   - ***Cleaning the screen***: Press the **Clean Screen** button to display the Clean Screen display for approximately 20 seconds. It is safe to clean the screen during this time, without accidentally making selections on the touchscreen. (See Figure 24.)

Figure 24. Clean Screen Display



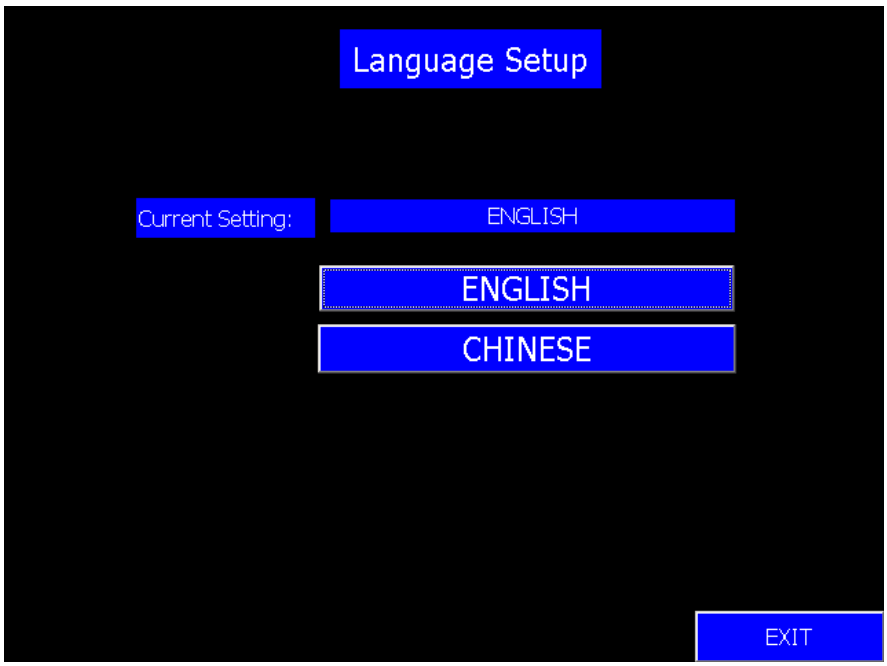
3. Press the **EXIT** button to return to the *System* display.

Language Setup Display

The *Language Setup* display is common to both manifolds. To access the *Language Setup* display:

1. Press the **LANGUAGE** button on the *System* display.
2. Select the button for the desired language, **English** or **Chinese** (see Figure 25). English is the default language. *NOTE:* If you accidentally select the wrong language, you may have difficulty navigating through the buttons to make another language choice.

Figure 25. Language Setup Display



6.9 ARCHIVING PROCESS DATA

Process data can be saved to a CompactFlash card. Typically, data is sampled every 200 seconds, so the archive file stores a minimum of 24 hours of data for each variable. The *Archive Management* display is common to both manifolds. To enable this feature:

1. Press the **ARCHIVING** button on the *System* display.
2. Press the **Start Archiving** button to enable archiving. Press the **Stop Archiving** button to disable this feature. (See Figure 26.)
3. Press the **EXIT** button to return to the *System* display.

The CompactFlash card stores the data in a CSV file. To view the archived data, this file can be imported into a program, such as Microsoft Excel.

Figure 26. Archive Management Display

7. MANIFOLD OPERATION

This section describes how to accomplish the following tasks:

- **Monitor Manifold Status**: to monitor manifold operation.
- **Start the Manifold**: to start manifold operation and perform switchover service between the manifolds.
- **Monitor Alarms**: to view, acknowledge, and reset alarms.
- **Stop the Manifold**: to manually stop manifold service and reset the system after an automatic shutdown.
- **Purge the System**: to start and monitor the various automatic purge procedures.
- **Manually Operate the Manifold**: to manually control the state of the pneumatically actuated valves for maintenance, troubleshooting, testing, and other special purposes.

7.1 MONITORING MANIFOLD STATUS

The manifolds can be in one of six main states: Service, Manual, Standby, Purge, Shutdown, and Stop (see Table 8). The manifold status and operating parameters are shown on several displays.

Table 8. Manifold Status

Status	Description
Service	This is normal operation where process gas is available at the destination and the software controls pneumatically actuated valve positions. Alarm operation is fully enabled. The system must be in Stop or Shutdown mode before you select Service, or it is accessed upon completion of a purge sequence.
Manual	Manual disables automatic control of pneumatically actuated valves and enables user control. Process gas may or may not be available at the destination. Many alarms prompt only warning messages. The system must be in Stop or Shutdown mode before you select Manual. The local EMO button continues to function normally.
Standby	The manifold is ready to deliver process gas to the destination upon switchover. The software controls pneumatically actuated valve positions.
Purge	The system is being purged via an automatic purge procedure, so process gas may or may not be available at the destination, depending upon the state of the other manifold. The software controls pneumatically actuated valve positions. The system must be in Stop or Shutdown mode before you select Purge.
Shutdown	The Local Shutdown switch has been latched, *or* the controller has triggered an Automatic Shutdown in response to an alarm, *or* a Remote Shutdown has been triggered. All valves are closed and process gas is not available at the corresponding destination.
Stop	The Stop button has been pressed on a display, *or* a transition to Service has been cancelled. All valves are closed and process gas is not available at the corresponding destination.

Main Menu Display

The *Main Menu* display is at the top of the display hierarchy, since it allows access to all other displays. All users have access to this display. This display is also known as the Home screen. Pressing the **HOME** button, which is available on most screens, takes you to the *Main Menu* display.

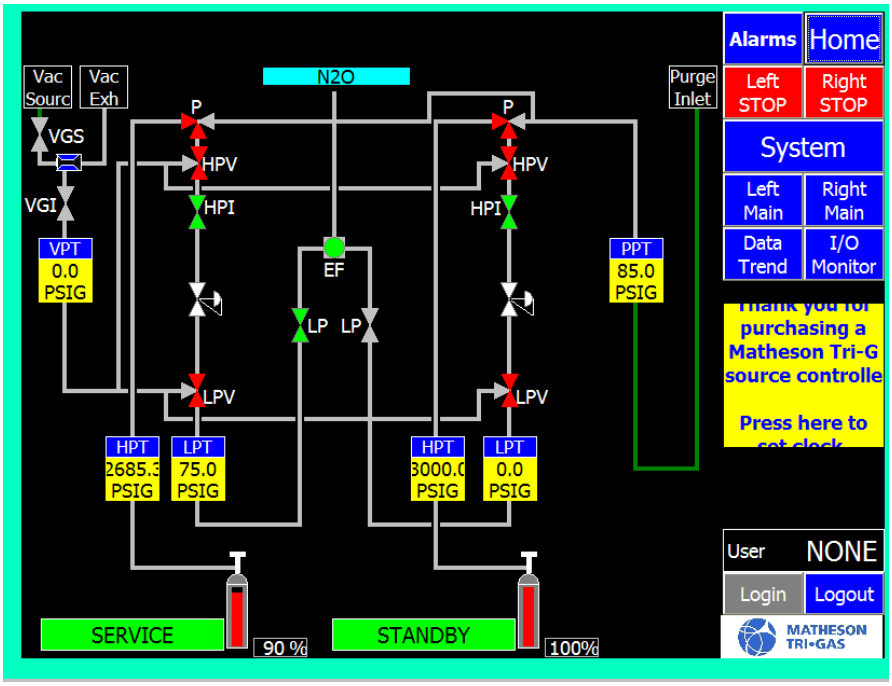
This display contains the following information (see Figure 27):

- The status of both manifolds. The box where the status is displayed uses the following conventions:
  - *Red* indicates that the manifold is shutdown or stopped.
  - *Yellow* indicates that the manifold is being purged.
  - *Green* indicates that the manifold is in service or standby.
  - *White* indicates that the manifold is being controlled manually.
- A continuously updated flow schematic diagram with:
  - All pneumatically actuated valves, their abbreviations (defined in the Glossary), and their state. The color of the valve symbol indicates its state: green means open and red means closed. ***NOTE:*** for some custom applications this color scheme may be reversed.
  - Cylinder, delivery, purge, and vent pressures, and product weight if scales are used.
- The logged-in user's name appears in a box near the bottom lower right corner of the display.

This display also has buttons that allow access to the following displays and functions:

- *Login* and *Logout* functions.
- All users have access to *Tool Information*, *Active Alarms*, *Alarm History*, and *Event Log* displays.
- All authorized users have access to the *Main Menu* displays for both manifolds.
- All users have access to the *System* display, and authorized users have access to configuration of the system parameters and user access levels.

Figure 27. Main Menu Display



Manifold Main Menu Displays

The *Manifold Main Menu* displays allow access to operation and configuration displays for a specific manifold. Authorized users have access to these displays.

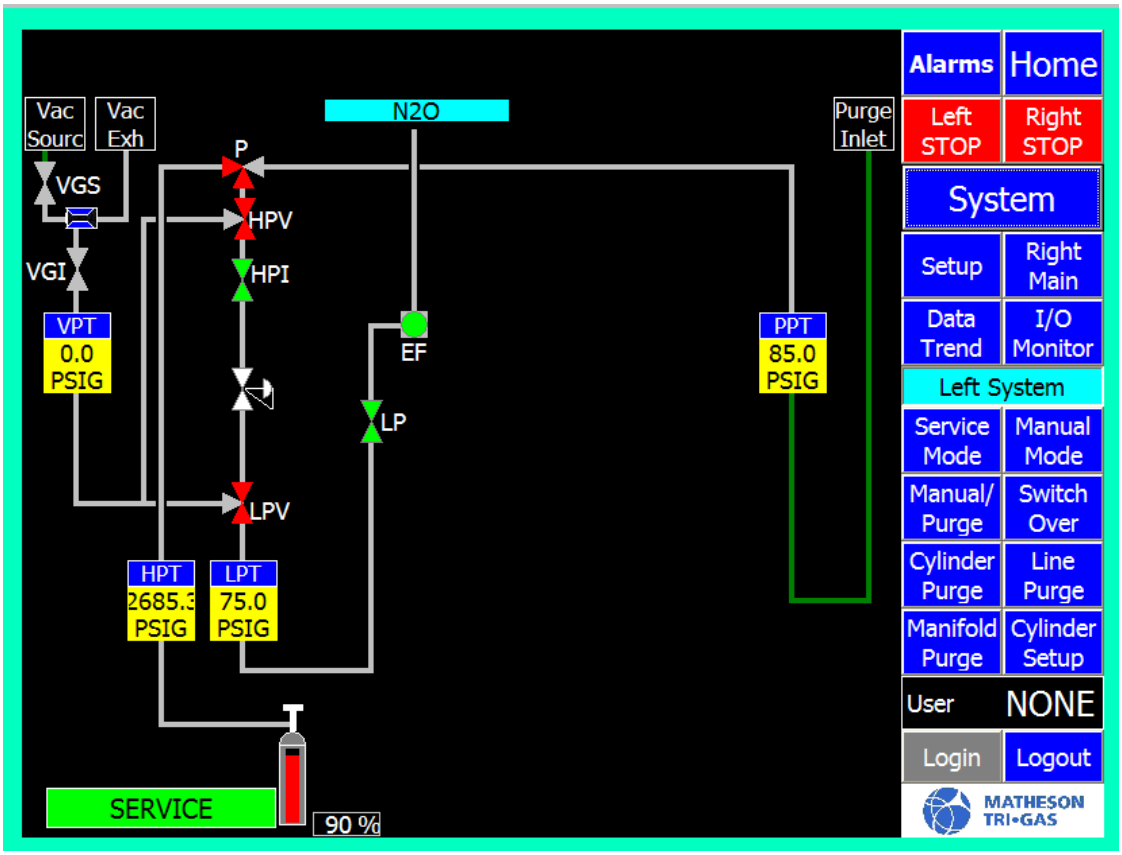
To view these displays:

1. Go to the *Main Menu* display.
2. Press either the **LEFT MAIN** button or the **RIGHT MAIN** button, depending on which manifold you want to view.
3. The *Manifold Main Menu* displays the following information (see Figure 28):
   - The manifold status, using the same color conventions as on the *Main Menu* display.
   - A continuously updated flow schematic diagram containing the same information as on the *Main Menu* display.

The *Manifold Main Menu* has buttons that allow access to the following displays:

- Press the **SETUP** button to access the selected manifold *Setup* display.
- Press the **Left/Right Main** button to access the *Manifold Main Menu* display for the other manifold.
- Press the **HOME** button to return to the *Main Menu* display.

Figure 28. Left Manifold Main Menu Display



Data Trend Display

The *Data Trend* display graphs analog inputs (see Figure 29). Data is sampled approximately every 30 seconds, and the system stores 500 samples for every analog input. Authorized users have access to this display. To view this display:

1. From either the *Main Menu* display or *Manifold Main Menu* display, press the **Data Trend** button.
2. Select the button for the desired analog input, or press the **Left/Right Side** button to display inputs for the other manifold.
3. Adjust the graph using the buttons below the graph as follows:
   - Stop recording data; this button toggles with the button to start recording data.
   - Jump to the most recently stored data.
   - Scroll forward or backward.
   - Zoom in or out.

NOTE: If a CompactFlash card is not in the system, then the trend feature is disabled.

Figure 29. Sample Data Trend Screen

7.2 CHANGING MANIFOLD OPERATION

The *Manifold Main Menu* display allows access to operation of the manifold. Access privileges can be restricted for certain operations within this screen (see Section 6.1). To change the status of a manifold:

1. Go to the *Main Menu* display.
2. Press either the **LEFT MAIN** or the **RIGHT MAIN** button, depending on which manifold you want to view.
3. Select the button for the desired manifold operation (see Figure 28):

   NOTE: The user must have the proper authorization level to access some modes.

   - **Left STOP** OR **Right STOP:** Stops the selected manifold (closes all pneumatically actuated valves), even if it is not the manifold currently displayed. Press **YES** on the confirmation display to stop service, or press **NO** to continue service. These buttons are also available on the *Main Menu*. (See *7.4 Stopping or Shutting Down the System.*)
   - **SERVICE MODE**: Starts process gas delivery to process equipment. ***NOTE:*** The system must be in Stop or Shutdown mode to access Service mode.
     - If the manifold has not completed a purge and your user settings allow Service without a purge, you may press **OVERRIDE** to enter Standby mode to be followed by the next situation or **CANCEL** to remain in Stop or Shutdown modes. ***NOTE:*** You must have service without purge privileges.
     - If there are no interlocks remaining before entering Service, you will be prompted to press **CONFIRM** to enter Service and begin gas delivery or **CANCEL** to return to Stop or Shutdown. If the other manifold is already in Service, this manifold will enter Standby.
   - **CYLINDER PURGE / MANIFOLD PURGE / LINE PURGE**: Allows you to select the type of purge procedure. (See *7.5 Purging the System.*) ***NOTE:*** The system must be in Stop or Shutdown mode to access Purge mode. You will be prompted to press **CONFIRM** to enter Purge mode. Otherwise, press **CANCEL** to cancel the initiation of the purge procedure.
   - **MANUAL MODE**: Allows you to manually toggle all pneumatically actuated valves on the selected manifold. In other words, this button activates Manual mode. You need to confirm that you want to enter Manual mode by pressing the **CONFIRM** button when prompted. Otherwise, press **CANCEL** to cancel the initiation of manual operation. ***NOTE:*** The system may be in Stop, Shutdown, or Purge mode to access Manual mode. (See *7.6 Manual Operation.*)
   - **MANUAL / PURGE**: Toggles into and out of manual mode when the panel is undergoing a purge sequence. You need to confirm that you want to enter Manual mode by pressing the **CONFIRM** button. Otherwise, press **CANCEL** to cancel the initiation of manual operation.
   - **SWITCH OVER:** Switches operation from the Manifold currently in Service to the manifold currently in Standby status. This operation is available only when one manifold is in service and the other manifold is in standby. You need to confirm that you want to switch operation to the manifold in standby mode by pressing the **CONFIRM** button. Otherwise, press **CANCEL** to cancel the initiation of a switchover.

   Typically, messages are displayed at the top of the display, while **CONFIRM** and **CANCEL** buttons are located at the bottom of the display.
4. Press the **HOME** button to return to the *Main Menu* display.

7.3 MONITORING ALARMS

Alarms exist for each manifold and the entire enclosure. Some alarms are permanently enabled for triggering. For some process and purge alarms, you can configure the alarm setpoint and delay time (see *6.4 Setting Alarm Limits*).

ALARM TRIGGERING

The outputs of sensors are monitored and evaluated (some at all times, others only during a purge sequence) and their associated alarms are triggered when:

- An analog or digital sensor's output signal exceeds its setpoint (see Table 9).
- A switch-type sensor's state changes from its configured normally open or normally closed state. ***Note:*** Excess flow switch setpoints are fixed and cannot be modified; instead the switch must be changed.
- The Local Shutdown switch is latched.
- A Remote Shutdown is triggered.

When an alarm is triggered, the software performs some or all of the following actions:

- Activates the horn.
- Displays a flashing **ALARMS** button, which is present on most screens.
- Triggers an automatic shutdown, which interrupts manifold operation by closing all pneumatically actuated manifold valves. The corresponding manifold's front-panel red (shutdown) LED indicator flashes. When an enclosure alarm (such as Fire Detection) is triggered, automatic shutdown occurs for both manifolds and both manifolds' front-panel red (shutdown) LED indicators flash.
- Flashes the corresponding manifold's front-panel yellow (warning) LED indicator. Warnings do not cause any operational changes, but you should perform preventive action to avoid a shutdown.
- Adds an alarm record to the alarm history log.

Table 9. List of Alarms

Alarm	Device	Factory Set Point	Alarm Action						
			Cylinder Change	Manifold Maint.	Line Purge	Service	Standby	Manual	Shut-down
Manifold Alarms (L/R)									
High-high delivery pressure (HHDP)	LPT	90 psig[a]	SD[b]			SD	SD[c]	WN	WN
Excess flow (HOF)	EFS1	Open	SD[c]			SD	SD[c]	WN	WN
Vacuum generator failure (HVP)	VPT	-9 psig[a]	SD[b]			IG	IG	IG	IG
Low N2 pressure (LPP)	PPT	60 psig[a]	SD[b]			WN	WN	WN	WN
Vacuum failure (HMP)	HPT	15 psig[a]	SD[b]			IG	IG	IG	IG
High pressure gas is abnormal (LMP)	HPT	15 psig[a]	SD[b]			IG	IG	IG	IG
Low-low gas weight (LLGW)	SCL	6 lbs[a]	SD[b]			WN	WN	IG	IG
Low-low cylinder pressure (LLCP)	HPT	180 psig[a]	SD[b]			WN	WN	IG	IG
Low-low delivery pressure (LLDP)	LPT	25 psig[a]	SD[b]			WN	WN	IG	IG
Low-low-low pressure (LLLCP)	HPT	150 psig[a]	SD[b]			SD	SD	WN	IG
High-high vent pressure (HHVP)	VPT	10 psig[a]	SD[b]			SD	SD	IG	IG
Low-low-low gas weight (LLLGW)	SCL	5 lbs[a]	SD[b]			SD	SD	WN	IG
High purge pressure (HPP)	PPT	95 psig[a]	SD[b]			SD[d]	SD[d]	WN[d]	WN[d]
Leak test fail (MDP)	HPT	4.0 psi Δ[a]	SD[b]			IG	IG	IG	IG
High delivery pressure (HDP)	LPT	95 psig[a]	WN[e]						
Low gas weight (LGW)	SCL	8 lbs[a]	WN[e]						
Low cylinder pressure (LCP)	HPT	200 psig[a]	WN[e]						
Low delivery pressure (LDP)	PPT	30 psig[a]	WN[e]						
Controller Alarms									
Flame is detected	Flame sensor	Open	SD						
Z-purge failure	DPS2	Open	WN						
E.M.O. shut down	EMO	Open	SD						
Exhaust failure (LME)	DPS1	Open	SD						
Remote E.M.O.-1 shut down	Input 0.0	Open	SD						
Low pneumatic pressure	N2 pres. switch	Open	SD						
PLC low battery	PLC register	N/A	IG						
Power reset	PLC register	Power up	WN						
Shutdown occurred while L/R panel in Service	N/A	N/A	WN[e]						
Shutdown occurred while L/R panel in Standby	N/A	N/A	WN[e]						
Analog input errors	Any PT or SCL	Low reading	WN[e]						

Key: SD = Shutdown; WN = Warning; SWO = Switchover; IG = Ignored

[a] Configurable setpoint.

[b] Triggered only during certain steps of purge sequence.

[c] Triggers a Shutdown on *the other manifold* in the above mode (e.g. Excess flow triggered on Left Manifold causes Shutdown on Right Manifold if it is in Cylinder Change mode).

[d] Only active when other manifold is not in purge or manual mode.

[e] Action is not user-settable.

VIEWING, ACKNOWLEDGING, & RESETTING ALARMS

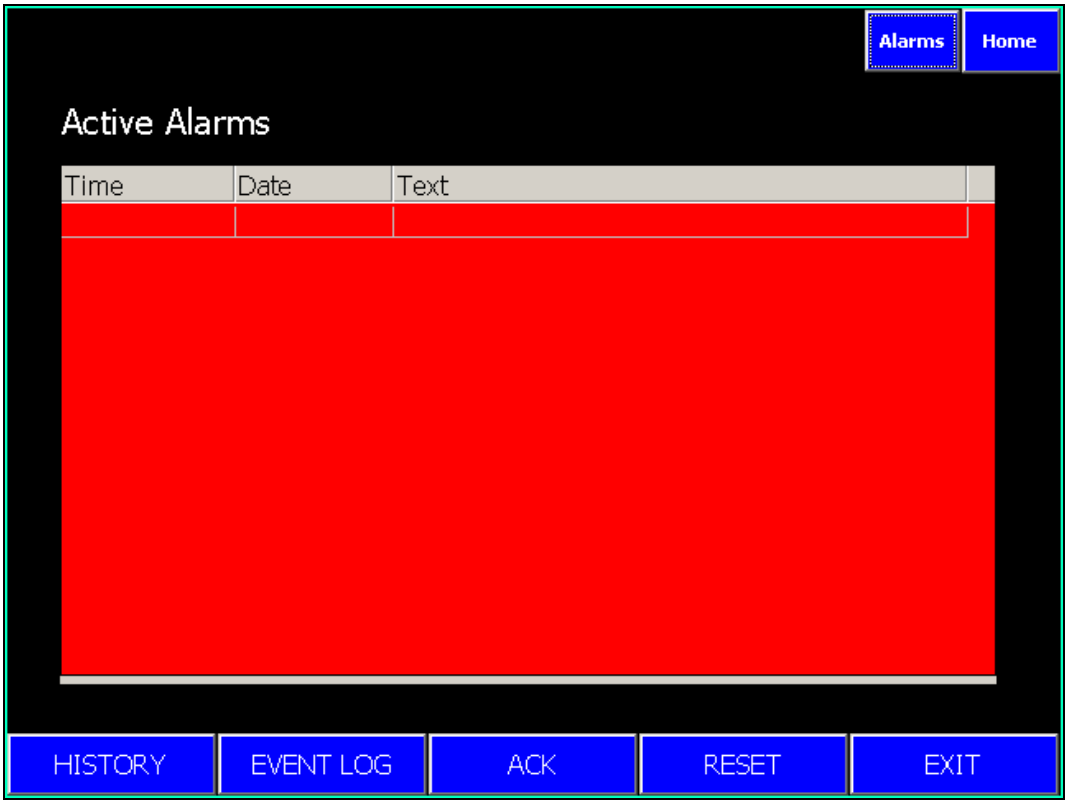
Active Alarm Display

The *Active Alarm* display lists all existing *triggered* alarms. All users have access to this display.

To view this display:

1. Go to the *Main Menu* display.
2. Press the **ALARMS** button to view the current alarms (see Figure 30). This button is available on every display. Alarms are listed chronologically, with the most recent alarm at the top of the list. Each alarm shows:
   - The time and date the alarm was triggered.
   - The location (manifold number or enclosure) and the sensor that generated the alarm.
3. Press the following buttons to acknowledge the alarms:
   - **ACK**: Silences the horn, without otherwise affecting operation.
   - **RESET**: Clears the alarm when the alarm-triggering physical condition has been corrected. The alarm must be located and corrected before you can reset the alarm. If the physical cause of the alarm persists, the alarm cannot be cleared. (Refer to *Section 8. Troubleshooting* for possible causes of alarms.)
4. Press the **EXIT** button to return to the previous display, or press the **HOME** button to return to the *Main Menu* display.

Figure 30. Active Alarm Display



Returning to Previous Operation

After an alarm that triggers a shutdown has been corrected and reset, the manifold where the alarm occurred remains in Shutdown mode. In the case of an enclosure alarm, both manifolds remain in Shutdown mode.

Returning to Service Mode or Manual Mode

- To place a manifold into Service, follow the instructions in *Section 7.2, Changing Manifold Operation*.
- To place a manifold into Manual mode, follow the instructions is *Section 7.6, Manual Operation.*

Note that if the manifold was engaged in a purge procedure when shutdown occurred, the manifold must be manually shutdown again by selecting the **Left/Right STOP** button from the *Main Menu* or *Manifold Main Menu* display after the alarm is cleared in order to access Service mode or Manual mode. See the next section for more details.

Returning to Purge Mode

If a manifold was engaged in a purge procedure when shutdown occurred, the status box located at the top of various displays shows what purge sequence was running when the alarm occurred:

- *SD/CYLINDER* indicates that the manifold was in Cylinder Purge mode when the alarm occurred.
- *SD/MANIFOLD* indicates that the manifold was in Manifold Purge mode when the alarm occurred.
- *SD/LINE* indicates that the manifold was in Line Purge mode when the alarm occurred.

To return to the purge procedure that was being run prior to alarm occurrence, follow the instructions in *Section 7.5, Purging the System*. The purge procedure will continue at the beginning of an appropriate operation as determined by the software.

If a manifold was engaged in a purge procedure when shutdown occurred, and a different operation is to be run (a different purge procedure, Service, or Manual mode), first perform a shutdown by selecting the **Left/Right STOP** button from the *Main Menu* or *Manifold Main Menu* display. The manifold can then be placed in any operating mode.

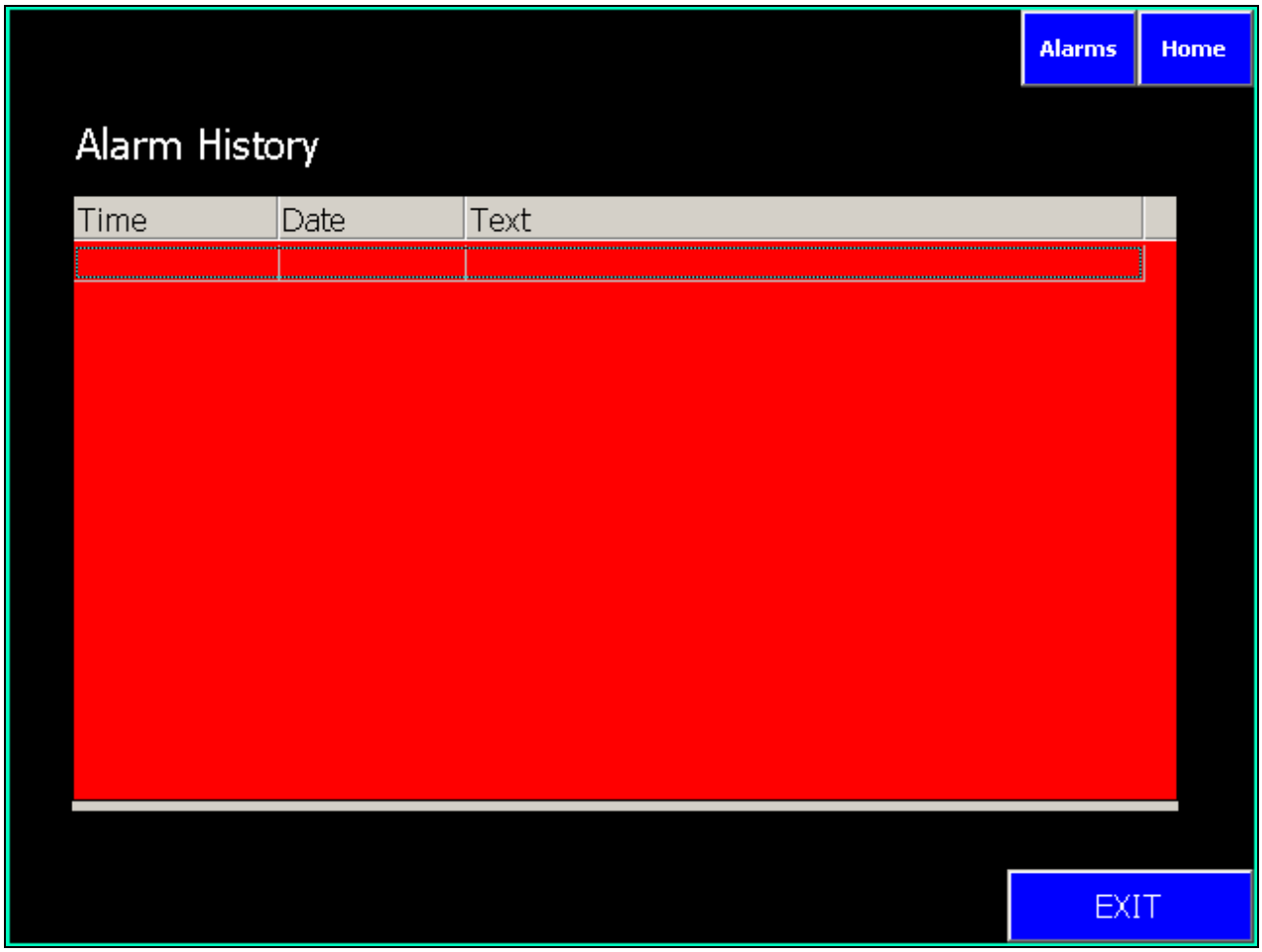
Alarm History Display

The *Alarm History* display lists the last 250 alarms that have been triggered. All users have access to this display.

To view this display:

1. Go to the *Active Alarms* display.
2. Press the **HISTORY** button to view a historical list of alarms (see Figure 31). Select one of the archived alarms to scroll through the list of alarms. Alarms are listed in reverse chronological order. Each alarm shows:
   - The time and date the alarm was triggered.
   - The location (manifold number or enclosure) and sensor that generated the alarm.
3. Press the **EXIT** button to return to the *Active Alarms* display.

Figure 31. Alarm History Display



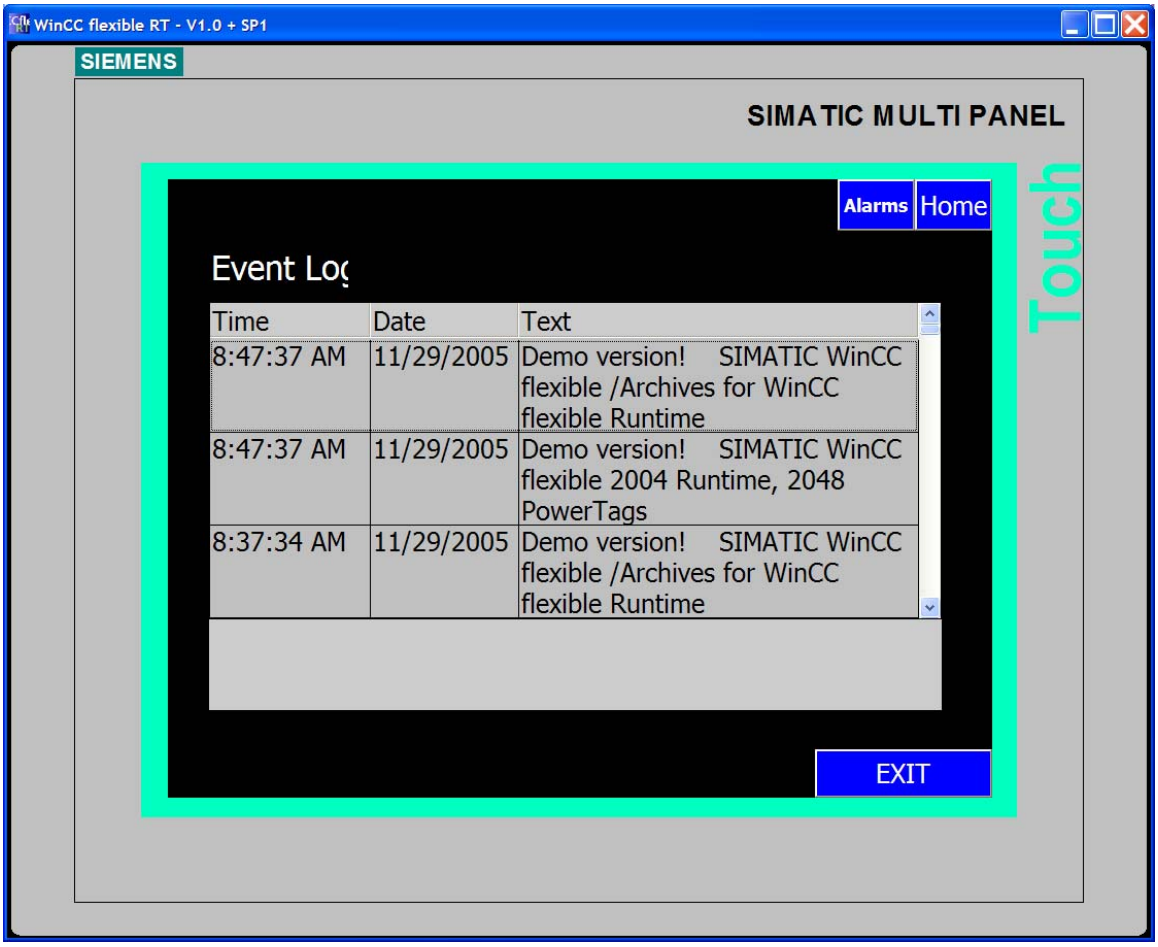
Event Log Display

The *Event Log* display lists the last 250 user events. These events include selected button presses, screen navigation, and operating system events. All users have access to this display.

To view this display:

1. Go to the *Active Alarms* display.
2. Press the **EVENT LOG** button to view a historical list of user events (see Figure 32). Events are listed in reverse chronological order. Each alarm shows:
   - The time and date of the event.
   - A description of the event.
3. Press the **EXIT** button to return to the *Main Menu* display.

Figure 32. Event Log Display



7.4 STOPPING OR SHUTTING DOWN THE SYSTEM

A shutdown interrupts manifold operation by closing all pneumatically actuated manifold valves. There are several ways to shutdown the system:

- The operator manually latches the Local Shutdown Switch on the controller front panel.
- The operator selects the **Left STOP** or **Right STOP** button from the *Main Menu* or *Manifold Main Menu* display.
- The controller triggers an automatic shutdown in response to an alarm.
- Facilities system triggers a Remote Shutdown.

All authorized users can shutdown the system via the software (STOP button), and anyone (including observers) can shutdown the system via the Local Shutdown switch.

Resetting Shutdowns

To make the system operational, you must determine how the shutdown was triggered. If a front-panel Local Shutdown Switch has *not* been latched or a STOP button has not been pressed, the shutdown was automatically triggered as part of an alarm response or it was triggered remotely. If an automatic shutdown occurs, the physical error condition that triggered the shutdown must be cleared before manifold operation resumes.

To restore equipment operation after a shutdown:

1. On the *Active Alarms* display, press **ACK**.
2. On the controller front panel, note which manifold is in shutdown state (its red LED indicator will be illuminated). It will be flashing for an automatic shutdown or a shutdown activated by the Local Shutdown Switch. Both LEDs will be flashing for an enclosure alarm (e.g. fire or low pneumatic supply).
3. On the *Active Alarms* display, read the active alarms to learn the physical condition that caused the sensor(s) to trigger the alarm.
4. Correct the physical condition. For a local shutdown, rotate the affected switch clockwise until the switch unlatches.
5. On the *Active Alarms* display, press **RESET**. If the shutdown doesn't clear, check for another alarm condition.

7.5 PURGING THE SYSTEM

Purge procedures exhaustively dilute contaminant gas in a manifold space with purge gas. Purging typically is required to remove hazardous production gas in a manifold prior to performing maintenance, and to remove atmospheric contaminants in a manifold prior to introducing process gas. Purging is accomplished by cycling through repeatedly pressurizing the manifold with purge gas, then evacuating the manifold to a vent system.

Each purge procedure is actually several purge operations. These operations, in turn, consist of many purge steps involving evacuate/pressurize cycles that are executed automatically according to the purge procedure sequences that have been programmed into the controller. Operators may not be able to perform a purge procedure depending on their access rights and the status of the manifold.

Types of Purge Procedures

There are 3 standard purge procedures:

- *Cylinder Change Purge*: Evacuates from the cylinder valve to the low-pressure isolation valve (LPI). It is used to replace a depleted cylinder.
- *Manifold Purge*: Evacuates from the cylinder valve to the process line isolation valve (PLI).
- *Line Purge*: Evacuates from the cylinder valve to the process gas destination.

These procedures are summarized in Tables 10-12. Additional custom purge procedures for specialized applications can be purchased as options. Also, authorized users can customize a purge using the *Purge Sequence Setup* displays (refer to *Customizing Purge Procedures* in the previous chapter).

Starting a Purge Procedure

A purge procedure cannot be started if *the other manifold* is in Purge mode.

1. On the *Main Menu* display, press the **MAIN** button for the manifold that you want to purge.
2. On the *Manifold Main Menu* display, press the **PURGE** button for the purge procedure to be initiated.
3. Press the **CONFIRM** button to start, or press **CANCEL**.
4. If the purge procedure is started, the *Manifold Main Menu* display shows:
    - **Current Mode/Sequence**: The manifold status, using the same color conventions as on the *Main Menu* display.
    - **Flow Schematic**: A continuously updated flow schematic diagram containing the same information as on the *Main Menu* display.
    - **Step Name and Message**: Additional information about the current mode, such as the specific step of the purge procedure or instructions to the operator (typically shown at the top or bottom of the display). When operator intervention is required, the purge procedure halts until the operator performs the step and presses one of the following buttons. These buttons are displayed only when they can be used.
        - **ACK**: To acknowledge that the operator has completed the step, or to proceed through the normal path to a point where a choice is to be made.

- **RESET**: To choose an alternate path through the purge sequence. For example, Reset is pressed to skip the VAP test or repeat the leak test.

- **Purge Details**: The time remaining until the next halt requiring operator intervention, step number, cycles remaining in this step, and time remaining in this step.

When the purge procedure is finished, the message "*Ready for service; press Ack*" appears in the message field.

5. Press the **Manual/Purge** button to enter manual mode during a purge procedure.
6. To terminate a purge procedure, press the **Left STOP** or **Right STOP** button from the *Main Menu* display.

Adjusting the Cylinder Tare Weight

The *Cylinder Setup* display calculates the cylinder tare weight. This display is only available when a cylinder scale is used to monitor the remaining cylinder contents.

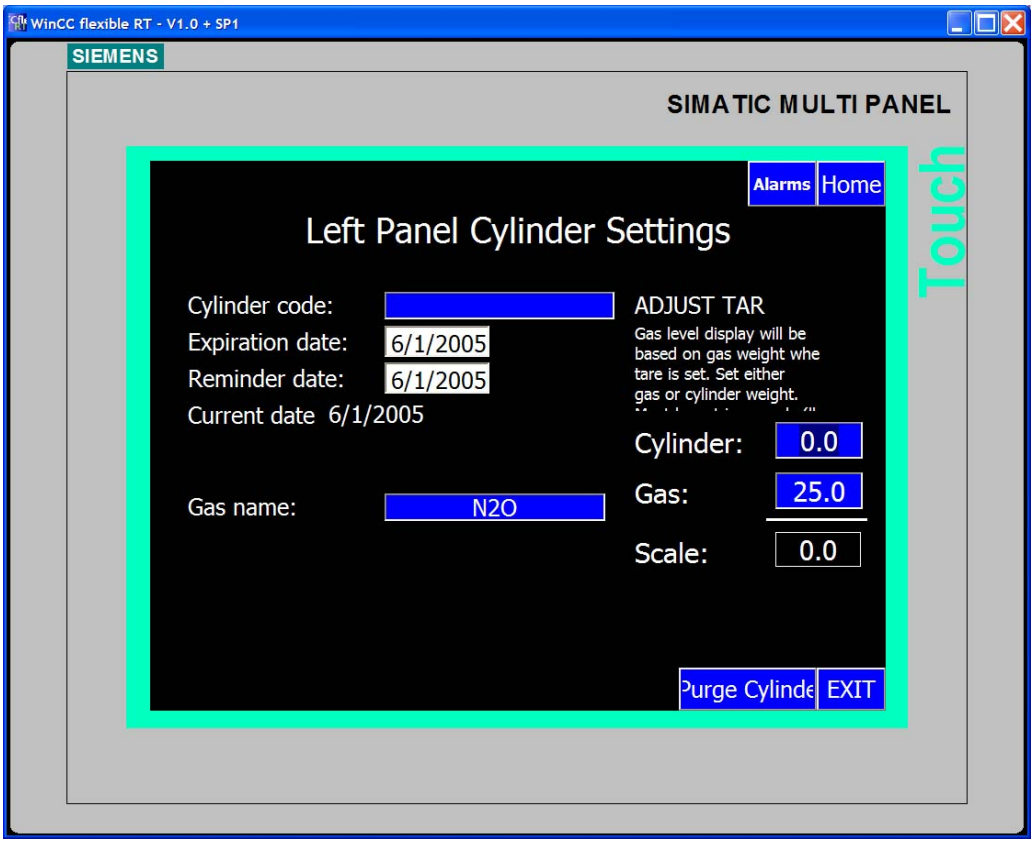
When a cylinder scale is used, the operator is prompted to go to the *Cylinder Setup* display during the Cylinder Change purge sequence after a new cylinder is installed. This display can be accessed at any time. All authorized users have access to this display.

1. On the *Main Menu* display, press the **MAIN** button for the manifold that you want to tare the cylinder weight.
2. On the *Manifold Main* display, press the **CYLINDER SETUP** button.
3. Enter either the actual weight of the gas contents in the cylinder or the weight of the cylinder via the keypad. This information typically is provided on a label or tag attached to the cylinder. If gas weight is entered, the cylinder tare weight is calculated by subtracting the entered gas weight from the cylinder scale total weight. (See Figure 33.)
4. Enter the following additional information for the cylinder:

   - **Cylinder code**: The barcode number on the cylinder.
   - **Expiration date**: The expiration date on the cylinder. If the cylinder is in service past the expiration date, the system can be configured to display an expiration warning.
   - **Reminder date**: The system displays a warning on the reminder date to inform the operator that the expiration date is approaching.
   - **Gas name**: The name of the gas in the cylinder.

   NOTE: If the Current date that is shown on the Cylinder Setup display is incorrect, see *6.7 Setting the Date & Time*.
5. Press the **PURGE CYLINDER** button to enter information for the purge gas (see step #4).
6. Press **EXIT** to return to the *Manifold Main* display.

Figure 33. Cylinder Setup Display



Adjusting Evacuation & Pressurization Times

You should adjust evacuation and pressurization times for a Line Purge, since process line length varies for every application. Perform the following to determine the appropriate evacuation and pressurization times:

CAUTION: *This procedure assumes that process gas has been removed from the manifold and the manifold is pressurized with purge gas. Additional steps may need to be taken before performing this procedure to achieve these conditions.*

1. Place the manifold in Manual mode (see *7.6 Manual Operation*).
2. Ensure that the cylinder valve is fully closed.
3. Open the HPI, the VGS, and any valves that isolate the process gas destination from the low-pressure vent (this may include LPI, PLI, and other valves external to the source manifold, depending on your specific configuration).
4. Open the LPV and record the amount of time it takes for the vacuum in the line to reach –12 psig (-24.4 in. Hg).
5. Close the LPV.
6. Open the PGI for the manifold and record the amount of time it takes for the line pressure to equalize with the purge gas source pressure.
7. Set the evacuation and pressurization times for the Line Purge to be at the values recorded above, or higher. Refer to the procedures described in *Customizing Purge Procedures* in the previous chapter.

Table 10. Cylinder Change Purge Procedure

PLI = Process Line Isolation valve; REG = pressure regulator;
CW = rotate clockwise; CCW = rotate counterclockwise
NOTE: VAP, AutoGuard are optional features.

Step	Purge Operation	Message To User
1	Cylinder Shutoff	Close cylinder valve; then press **Ack**
2	PLI Shutoff	Close PLI when present; then press **Ack**
3	Process Gas Removal	
4	C-Cylinder Shutoff Test	
5	Flow Purge	
6	C-Prepurge	
7	Cylinder Change	Change cylinder; then press **Ack**
8	Auto Leak Test	
9	C-Atmosphere Removal	
10	Auto Leak Test	
11	Exit Auto Leak Test	**Ack** to exit Auto Leak Test
12	Manual Leak Test	Perform outboard leak test; then press **Ack**
13	Leak Test Venting	
14	Skip VAI leak test	**RESET** to skip VAI test; **Ack** to begin
15	Manual Leak Test	Connect to VAI; then press **Ack**
16	Manual Leak Test	Perform inboard leak test; then press **Ack**
17	Manual Leak Test	Disconnect leak detector; then press **Ack**
18	Leak Repair	Repair any leaks; then press **Ack**
19	Repeat Leak Test	**RESET** to repeat leak test; **Ack** to skip
20	C-Postpurge	
21	Postpurge Venting	
22	Regulator Shutoff	Close regulator(CCW); then press **Ack**
23	Regulator Shutoff Test	
24	Open PLI Valve	Open PLI when present; then press **Ack**
25	Purge Gas Removal	
26	Process Gas Introduction	Open cylinder valve; then press **Ack**
27	Cylinder Pressure Test	
28	Regulator Adjustment	Adjust regulator(CW); then press **Ack**
29	Service Ready	Ready for service; press **Ack**

Table 11. Manifold Purge Procedure
PLI = Process Line Isolation valve; REG = pressure regulator;
CW = rotate clockwise; CCW = rotate counterclockwise
NOTE: VAP, AutoGuard are optional features.

Step	Purge Operation	Message To User
1	Cylinder Shutoff	Close cylinder valve; then press **Ack**
2	Process Gas Removal	
3	PLI Shutoff	Close PLI when present; then press **Ack**
4	M-Cyl Shutoff Test	
5	Open Regulator	Open regulator(CW); then press **Ack**
6	M-Prepurge	
7	Prepurge Venting	
8	Manifold Maintenance	Perform Maintenance; then press **Ack**
9	Auto Leak Test	
10	Open Regulator	Open Regulator; then press **Ack**
11	Leak Check	
12	M-Atmosphere Removal	
13	Auto Leak Test	
14	Exit Auto Leak test	**Ack** to exit Auto Leak Test
15	Manual Leak Test	Perform outboard leak test; then press **Ack**
16	Leak Test Venting	
17	Skip VAI leak test	**RESET** to skip VAI test; **Ack** to begin
18	Manual Leak Test	Connect to VAI; then press **Ack**
19	Manual Leak Test	Perform inboard leak test; then press **Ack**
20	Manual Leak Test	Disconnect leak detector; then press **Ack**
21	Leak Repair	Repair any leaks; then press **Ack**
22	Repeat Leak Test	**RESET** to repeat leak test; **Ack** to skip
23	Skip Postpurge	**Ack** to start postpurge; **RESET** to skip
24	M-Postpurge	
25	Postpurge Venting	
26	Regulator Shutoff	Close regulator(CCW); then press **Ack**
27	Regulator Shutoff Test	
28	Open PLI Valve	Open PLI when present; then press **Ack**
29	Purge Gas Removal	
30	Process Gas Introduction	Open cylinder valve; then press **Ack**
31	Cylinder Pressure Test	
32	Regulator Adjustment	Adjust regulator(CW); then press **Ack**
33	Service Ready	Ready for service; press **Ack**

Table 12. Line Purge Procedure

PLI = Process Line Isolation valve; REG = pressure regulator;
CW = rotate clockwise; CCW = rotate counterclockwise
NOTE: VAP, AutoGuard are optional features.

Step	Purge Operation	Message To User
1	Cylinder Shutoff	Close cylinder valve; then press **Ack**
2	Open PLI Valve	Open PLI when present; then press **Ack**
3	Process Gas Removal	
4	L-Cylinder Shutoff Test	
5	Open Regulator	Open regulator(CW); then press **Ack**
6	L-Prepurge	
7	Prepurge Venting	
8	Line Maintenance	Perform maintenance; then press **Ack**
9	Auto Leak Test	
10	L-Atmosphere Removal	
11	Auto Leak Test	
12	Exit Auto Leak Test	**Ack** to exit Auto Leak Test
13	Manual Leak Test	Perform outboard leak test; then press **Ack**
14	Leak Test Venting	
15	Skip VAI leak test	**RESET** to skip VAI test; **Ack** to begin
16	Manual Leak Test	Connect to VAI; then press **Ack**
17	Manual Leak Test	Perform inboard leak test; then press **Ack**
18	Manual Leak Test	Disconnect leak detector; then press **Ack**
19	Leak Repair	Repair any leaks; then press **Ack**
20	Repeat Leak Test	**RESET** to repeat leak test; **Ack** to skip
21	Skip Postpurge	**Ack** to start postpurge; **RESET** to skip
22	L-Postpurge	
23	Postpurge Venting	
24	Regulator Shutoff	Close regulator(CCW); then press **Ack**
25	Regulator Shutoff Test	
26	Purge Gas Removal	
27	Process Gas Introduction	Open cylinder valve; then press **Ack**
28	Cylinder Pressure Test	
29	Regulator Adjustment	Adjust regulator(CW); then press **Ack**
30	Service Ready	Ready for service; press **Ack**

7.6 MANUAL OPERATION

⚠ WARNING

ONLY TRAINED PERSONNEL
CAN OPERATE THIS EQUIPMENT IN MANUAL MODE

Operation of this equipment in manual mode by untrained personnel is hazardous and can result in injury or equipment damage.

If you have questions about any aspect of operation of this equipment, consult a supervisor or a Matheson Tri-Gas field service technician.

Manual operation allows you to override automatic operation of pneumatically actuated valves on a specific manifold so that you can manually toggle valve states to perform troubleshooting, testing, maintenance or other special tasks. You can select manual operation when the system is in Shutdown mode. Some users may not be able to enter Manual mode due to access restrictions.

During manual operation:

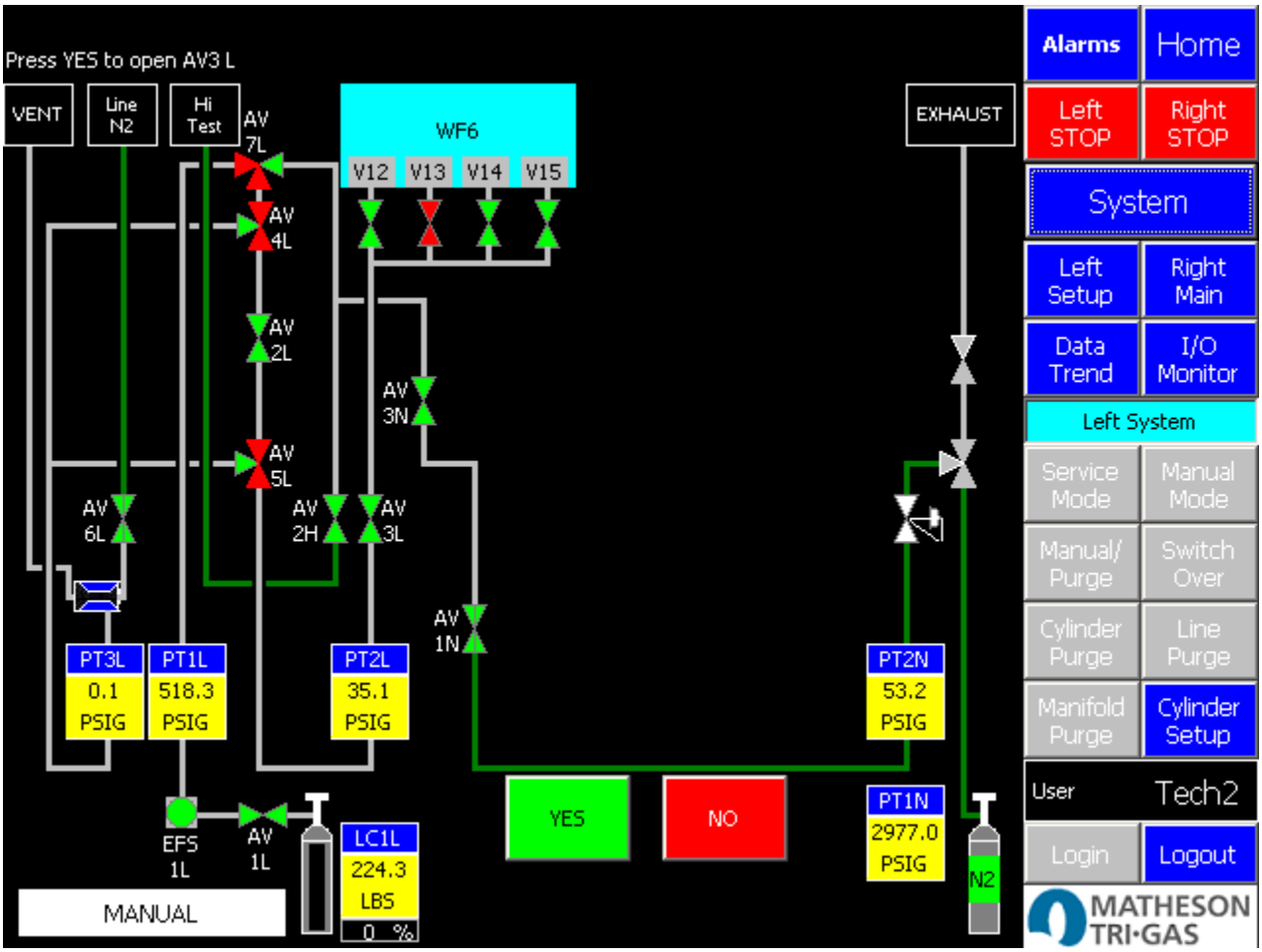
- Alarms are annunciated and alarm messages are shown, but the automatic shutdown of valves does not occur for local alarms.
- The Remote Shutdown switch and all Local Shutdown switches remain enabled.

Entering Manual Mode

Authorized users can select manual operation as follows:

1. From the *Main Menu* display, select the **MAIN** button for the desired manifold.
2. From the *Manifold Main* display, select the **MANUAL MODE** button. Press the **CONFIRM** button to enter manual mode. Press **CANCEL** to cancel initiation of Manual mode.
3. Select valves on the display to change their state (see Figure 34). Press **YES** to confirm changing state, or press **NO**. Some valves have interlocks built into the software that prevent manually toggling the valve when certain conditions exist. When this is the case, an error message is displayed. Also, some valves have interlocks built into the software that require a confirmation from the user when certain conditions exist before you can open them. (For specific interlocks, see Tables 13 & 14.)
4. Select the **LEFT STOP** or **RIGHT STOP** button to stop manual operation.

Figure 34. Manual Mode Display



Safety Interlocks

Safety interlocks are built into the controller software to prevent you from manually opening a valve if certain process conditions exist. If you try to change the state of an interlocked valve, a message stating "GLOBAL INTERLOCK PRESENT/ACCESS DENIED" appears on the touchscreen. Refer to Table 13 for a list of the safety interlocks.

Table 13. Safety Interlocks

Valve	Safety Interlock
HPV: High-Pressure Vent Valve	Cannot open when the cylinder pressure > 200 psig.
HPA / LPA: High-Pressure Access / Low-Pressure Access Valves	Cannot open at the same time.
HPA: High Pressure Access Valve	Cannot open when the opposite manifold is in Purge mode.
LPA: Low Pressure Access Valve	Cannot open when the opposite manifold is in Purge mode.

Some valves have interlocks built into the software that require a confirmation from the user when certain conditions exist. After you confirm that action, you can open the valve. Refer to Table 14 for a list of the safety interlocks that require confirmation from the user.

Table 14. Safety Interlocks Requiring User Confirmation

Action	Explanation
Opening HPV	It is not recommended that you open the HPV when a high-pressure hazardous gas is present in the manifold. The exhaust system and all connected equipment may be compromised by the release of this gas through the high-pressure vent line, especially if the cylinder valve is opened. If a high-pressure hazardous gas needs to be vented from the manifold, it is recommended that you close the cylinder valve and vent the gas through the low-pressure vent by opening the HPI and LPV valves with the venturi generator running.
Opening HPI while high delivery pressure exists	It is not recommended that you open the HPI if high delivery pressure exists, since this may allow the delivery of high-pressure gas from its source. If there is high delivery pressure, first vent excess pressure through the low-pressure vent by opening LPV with the venturi generator running. The regulator should then be checked, since this is the probable cause of the high delivery pressure. The regulator should either be adjusted to deliver a lower pressure, or be replaced if it is defective.
Opening LPV while HPV is opened	It is not recommended that you open the LPV while the HPV is opened, since this may allow contaminants to enter the manifold through the low-pressure vent line. Normally, it is recommended that you vent all manifold gas through the low-pressure vent. If the high-pressure and low-pressure sides both need to be vented (possibly due to a regulator that has failed closed), then vent them separately at different times to prevent potential manifold contamination.
Opening PGI while high manifold pressure or low purge pressure exists	It is not recommended that you open the PGI if there is high manifold pressure or low purge pressure, since this may allow hazardous process gas to enter the purge line. This may compromise the integrity of purge line equipment, including the regulator. If the manifold needs to be purged, it is recommended that you correct the high manifold pressure or low purge pressure first, clear the alarm, then introduce purge gas.
Opening ACV	It is not recommended that you open the ACV in Manual Mode, since this valve is normally opened only when process gas delivery is occurring in Service Mode. Opening this valve during any type of venting or service procedure can result in personal injury or equipment damage. If the ACV needs to be opened to vent the contents of a cylinder, it is recommended that you vent the gas through the low-pressure vent by opening the HPI and LPV with the venturi generator running, ensuring that the HPV is closed. The ACV is also interlocked with the AGC and HPV.
Opening PGI or VGS while the other manifold is in Purge Mode	For autoswitchover configurations, it is not recommended that you open the PGI or VGS while the other manifold is in Purge Mode, since this may compromise the operating conditions of the purge. Opening the VGS on Centurion configurations lower the vacuum on the manifold being purged, since the two manifolds share a common vacuum generator supply header. Opening the PGI potentially lowers the available purge pressure for the manifold being purged. If these valves need to be opened, it is recommended that you wait until the purge sequence is completed or you abort the purge sequence.

8. TROUBLESHOOTING

8.1 ALARM MESSAGES

Alarm messages inform the user of abnormal conditions. Interpretations of these alarm messages and some typical causes for alarm triggering are described in Table 15.

If you are having difficulty with equipment operation, first make sure that all interconnecting cables and pneumatic tubing assemblies are correctly installed, and that all electrical and pneumatic connectors are tight. Also, verify all alarm setpoints on the *Alarm Setup* displays.

Manifold and sensor configurations often are specially configured to meet the requirements of specific installations. For this reason, troubleshooting is difficult to describe in a standard manner. Non-standard equipment may trigger alarm messages for reasons other than those described in this section. If questions arise, contact the Matheson Field Service Department for assistance.

Table 15. Alarm Messages & Operator Actions

Alarm	Interpretation	Possible Causes
Low Pneumatic Supply	Inadequate Nitrogen supply pressure to controller detected by pneumatic supply pressure switch. Causes a manifold Shutdown in Purge mode. Results in a Shutdown in Standby, Service, or Manual mode.	• Inadequate nitrogen supply pressure to controller. • Incorrect, defective, or disconnected pneumatic supply pressure switch.
Low Z-Purge Pressure	Inadequate pressure in controller enclosure. Results in a Warning.	• Leaking or missing gaskets and seals on the controller enclosure. • Low or loss of facility purge gas supply. • Controller not closed and sealed properly. • Improper connection of lines between controller and Z-purge unit. • Malfunctioning pressure switch or pressure gauge on Z-purge unit.
Gas Detection	Gas detection device has detected a process gas leak above the preset alarm level. Causes a manifold Shutdown.	• Inadequate seal at any connection in the system, such as the cylinder (CGA) connection. • Incorrect, defective, or disconnected gas detection sensor device.
"Analog Input" Out of Normal Range (where "Analog Input" is replaced by actual input, i.e. scale or purge xdcr)	Controller is not receiving a signal from the sensor. Results in a Warning.	• Failed sensor. • Disconnected, damaged, or cut wire.

Alarm	Interpretation	Possible Causes
System A/B Local Shutdown Button	Manual activation of the Emergency Stop Button has occurred. Causes a manifold Shutdown.	• Emergency situation required that the manifold be shutdown. • User pressed local shutdown button.
System A/B Fire Detected	Fire detected. Causes a manifold Shutdown.	• Fire exists in gas cabinet. • Incorrect, defective or disconnected fire detector.
System A/B Low & Low/Low Cylinder Pressure	Inadequate process gas pressure detected by the base cylinder pressure transducer/switch. During a Purge operation, results in a Shutdown. During a Service operation, results in a Shutdown or Switchover. During Standby or Manual operation, results in a Warning only.	• Inadequate process gas source pressure. • Blocked process gas manifold between source and manifold assembly. • Defective, obstructed, or maladjusted base cylinder pressure transducer. • Alarm threshold incorrectly adjusted. • Defective analog input.
System A/B Low Cylinder Weight	Process gas weight has dropped below the preset alarm limit. Results in a Warning or Switchover in Service mode. Results in a Warning in Manual or Standby mode. Results in a Shutdown during a Purge procedure.	• Process gas weight has dropped below the preset alarm limit. Change cylinder. • Process gas cylinder weight has been incorrectly tared. • Incorrect or defective cylinder scale.
System A/B Low Low Cylinder Weight	Process gas weight has dropped below the preset alarm limit. Results in a Shutdown or Switchover in Service mode. Results in a Warning in Manual mode. Results in a Shutdown during a Purge procedure or in Standby mode.	• Process gas weight has dropped below the preset alarm limit. Change cylinder. • Process gas cylinder weight has been incorrectly tared. • Incorrect or defective cylinder scale.
System A/B Low Manifold Pressure	Inadequate purge gas pressure detected by delivery pressure transducer during a purge procedure. Results in a Shutdown during a purge.	• Incorrectly adjusted or defective pressure regulator. • Purge gas manifold is obstructed downstream of the purge gas pressure transducer. • Defective, obstructed, or misadjusted delivery pressure transducer. • Defective, failed, or closed PGI or HPI. • Defective, failed, or opened LPV or LPI. • Alarm setpoint incorrectly set. • Defective analog input.

Alarm	Interpretation	Possible Causes
System A/B High Manifold Pressure	High pressure detected by delivery pressure transducer during a venting stage of Purge procedure, evoking a Shutdown in Purge procedure.	• Leaking purge gas inlet valve. • Manifold obstructed downstream of delivery pressure transducer, not allowing vacuum supply to reach transducer. • Defective, obstructed, or maladjusted delivery pressure transducer.
System A/B High Outlet Flow	Excessive process gas flow detected by branch excess flow switch. During standby mode, results in a Shutdown.	• Incorrect, defective, or disconnected manifold excess flow switch. • Broken or disconnected process gas delivery manifold to process equipment.
System A/B High Delivery Pressure	Excessive pressure detected by delivery pressure transducer. Results in a Shutdown.	• Excessive purge gas pressure if Shutdown triggered during a Purge procedure. • Excessive process gas pressure if Shutdown triggered during Service. • Defective, obstructed, or misadjusted delivery pressure transducer. • Obstructed manifold filter or Purifilter™. • Defective LPV or check valve. • Alarm setpoint incorrectly adjusted. • Defective analog input.
System A/B Low Purge Pressure	Inadequate purge gas pressure detected by purge gas pressure transducer. During a purge procedure, results in a Shutdown. During other operations, results in a Warning.	• Inadequate purge gas supply pressure. • Obstructed purge gas conical filter gasket. • Defective purge gas check valve. • Defective, obstructed, or misadjusted purge gas pressure transducer. • Alarm setpoint incorrectly adjusted. • Defective analog input.
System A/B Low Manifold Exhaust	Photohelic device detected inadequate exhaust flow from the gas cabinet. Results in a Warning.	• Exhaust fan turned off or failed. • Main cabinet door opened during operation. • Inadequate exhaust motor power. • Obstruction of cabinet ventilation holes. • Incorrect, defective, or disconnected Photohelic device.

Alarm	Interpretation	Possible Causes
System A/B High & High High Vent Pressure	Inadequate vacuum detected by vent pressure sensor. During a purge procedure, causes a Shutdown.	• Defective or misadjusted vent pressure transducer. • Defective LPV, VGI, or VGS. • Inadequate vacuum generator supply source pressure. • Nitrogen flow obstructed through vacuum venturi line. • Defective or obstructed vacuum generator. • Obstructed vacuum generator supply manifold check valve. • Alarm setpoint incorrectly adjusted. • Defective analog input.
High Purge Pressure	Excess pressure at purge gas pressure sensor.	• Excessive purge gas pressure if Shutdown triggered during a Purge procedure. • Defective, obstructed, or misadjusted purge pressure transducer. • Defective or misadjusted purge gas regulator. • Alarm setpoint incorrectly adjusted. • Defective analog input.
Delta Pressure Alarm	Excess difference in pressure measured at cylinder pressure transducer during purge operation.	• Leaking cylinder valve. • Defective or leaking PGI valve. • Defective or leaking HPV valve. • Alarm setpoint incorrectly adjusted. • Defective analog input.

8.2 OTHER PROBLEMS

Electric Power Not Provided

- Verify that electric power is available.
- Verify that all connectors are clean, functional, and properly seated.
- Check internal circuit breaker.

8.3 TROUBLESHOOTING DISPLAYS

Several functions available from the *System* display may help you troubleshoot system problems.

Electrical Troubleshooting Display

The *Electrical Troubleshooting* display shows the analog setup parameters that are used to convert an analog signal to digital (see Figure 35). These values are factory set, but they may need to be adjusted if a transducer must be manually calibrated due to drift or if a replacement transducer is installed. The *Electrical Troubleshooting* display is common to both manifolds. To access this display:

1. Go to the *Main Menu* display or the *Manifold Main* display.
2. Press the **SYSTEM** button.
3. Press the **ELECTRICAL TROUBLESHOOTING** button.
4. Calibrate the transducer in one of the following ways:
   - To auto-calibrate the values for *every* transducer, press the **Calibrate Based on Scaled Range** button. The **Auto calib** values (the zeroes) will be restored based on the equation:

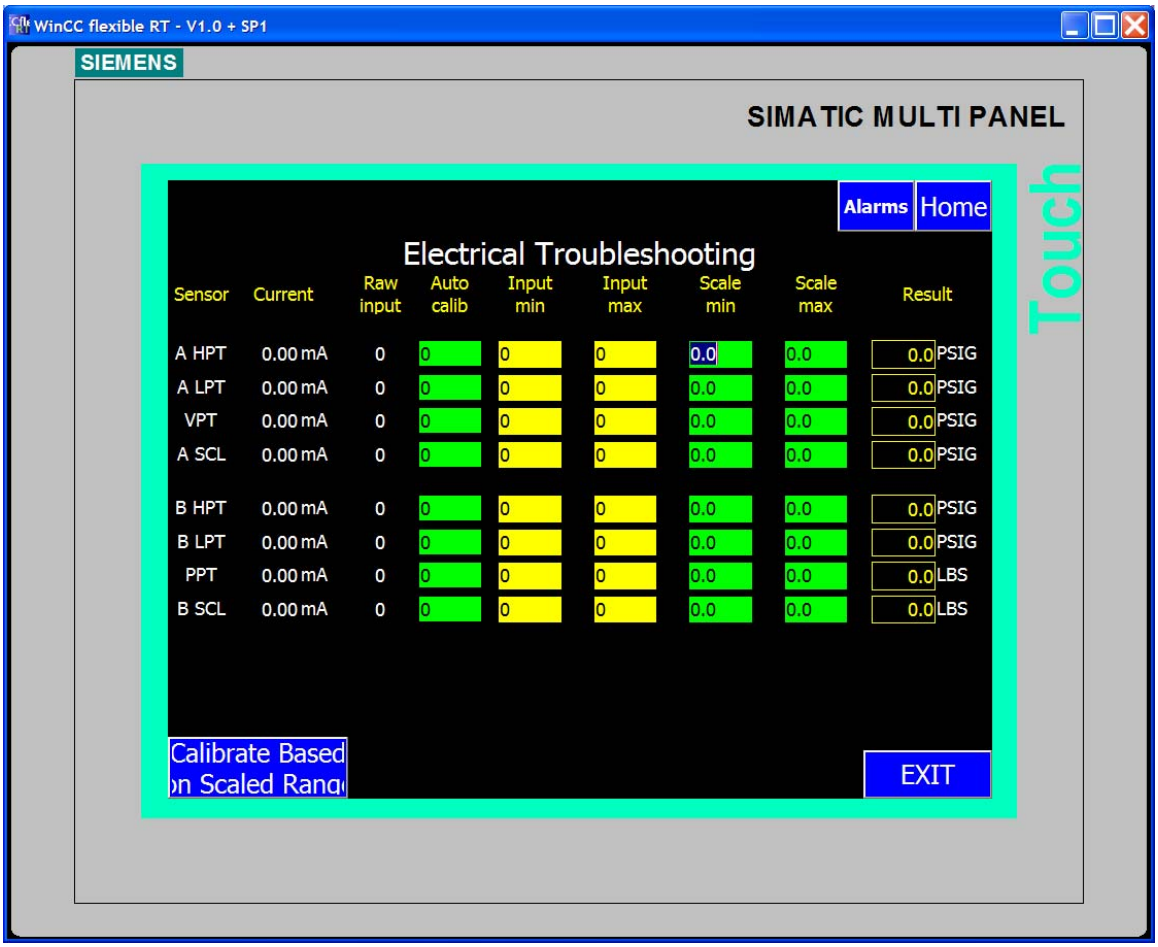
$$\textbf{Auto calib} = \textbf{27648}\frac{\textbf{(0 - Scale min)}}{\textbf{(Scale max - Scale min)}}$$

   - To avoid having to zero-calibrate all transducers when replacing only one, enter into the proper row of the **Auto calib** column the value calculated from the equation:

$$\textbf{Auto calib} = \textbf{(Input max - Input min)} * \frac{\textbf{(0 - Scale min)}}{\textbf{(Scale max - Scale min)}}$$

5. Adjust the **Input min/max** and the **Scale min/max** values according to the following guidelines:
   - The **Input min** and **Input max** values (the x values) should remain at 0 and 27648, so the calculated **Auto calib** values should be the same.
   - If the range of a replacement transducer differs from the one it replaces, the **Scale min** and **Scale max** values (the y values) should be adjusted. Usually only the **Scale max** value changes. For example, when replacing a 100-psia transducer with a 250-psia unit, the **Scale max** values changes from 85.3 to 235.3, while the **Scale min** stays at –14.7 for both transducers.
6. Press the **EXIT** button to return to the *System* display.

Figure 35. Electrical Troubleshooting Screen



I/O Monitor Displays

The *I/O Monitor* displays show the channels to which all digital inputs and outputs and analog inputs are assigned. These displays are for information only. To access these displays:

1. Go to the *Main Menu* display or the *Manifold Main* display.
2. Press the **I/O Monitor** button.
   - Page 1 lists the 24 CPU digital inputs and the 16 CPU digital outputs (see Figure 36).
   - Page 2 lists the 32 possible digital outputs on the EM 322 module and the 8 EM 331 analog inputs (see Figure 37).

Figure 36. I/O Monitor Screen (page 1)

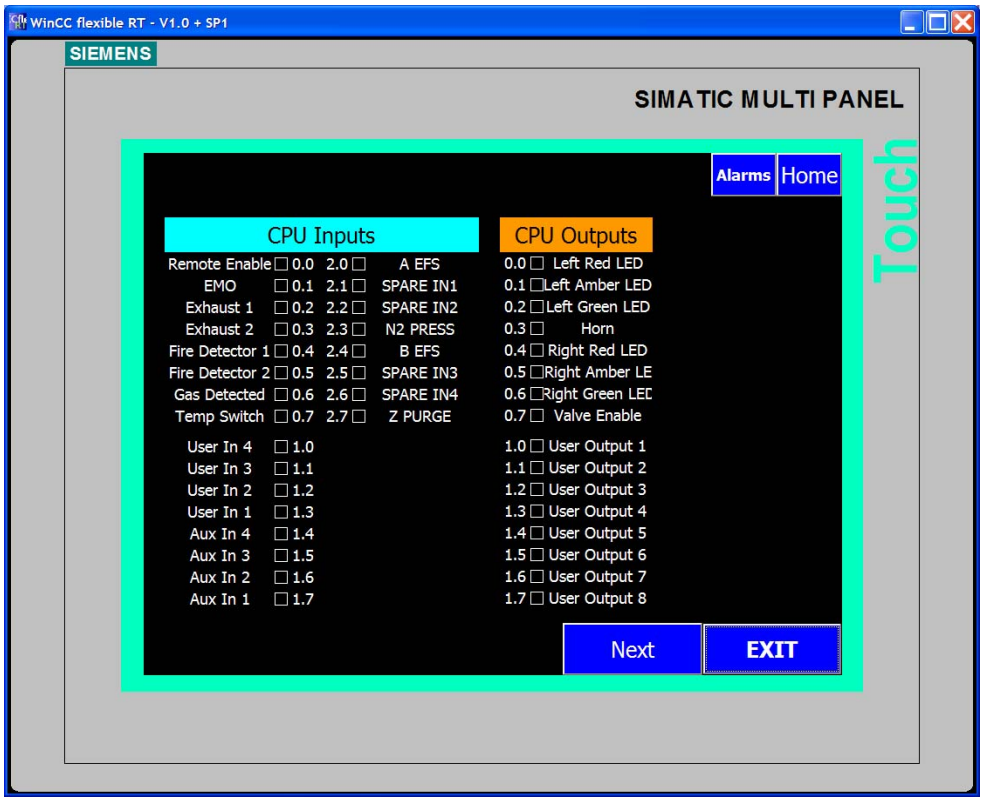
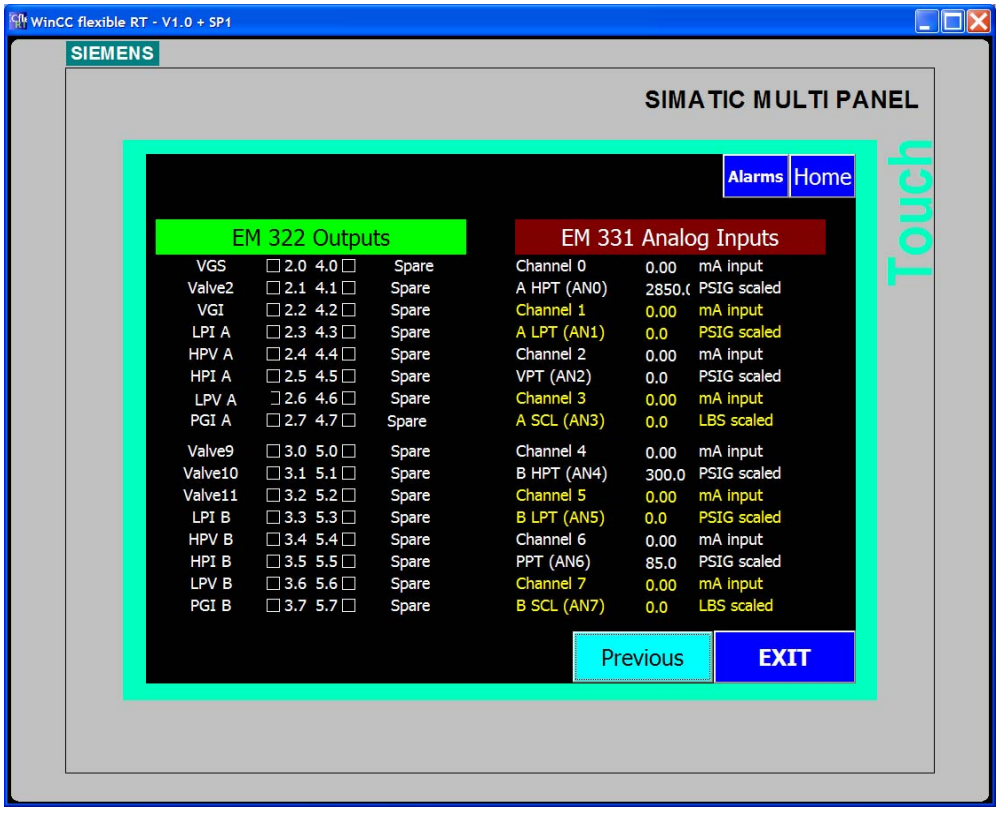


Figure 37. I/O Monitor Screen (page 2)



Exiting the PLC Program

The PLC software is an application that runs in a Windows CE environment. Users with the required authorization may need to exit the HMI application and access the Windows CE console.

1. Go to the *Main Menu* display or the *Manifold Main* display.
2. Press the **SYSTEM** button.
3. Press the **EXIT PROGRAM** button.
4. In the Windows CE environment, a pop-up window displays the following choices:
   - Transfer *(not a field function)*
   - Start
   - Control Panel
   - Taskbar

   Select **Start** to run the HMI application.

APPENDIX: DIAGRAMS

Figure 38. S7-313C PLC System Wiring Overview

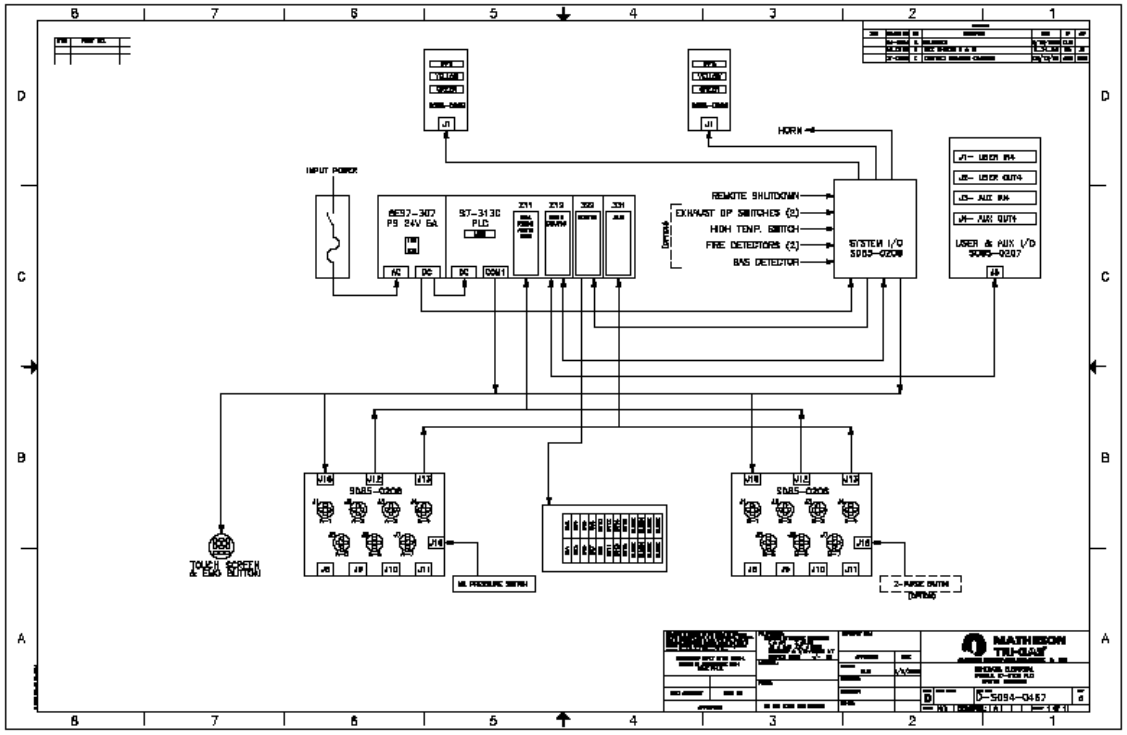


Figure 39. S7-313C PLC System Line Power and Touchscreen Communications

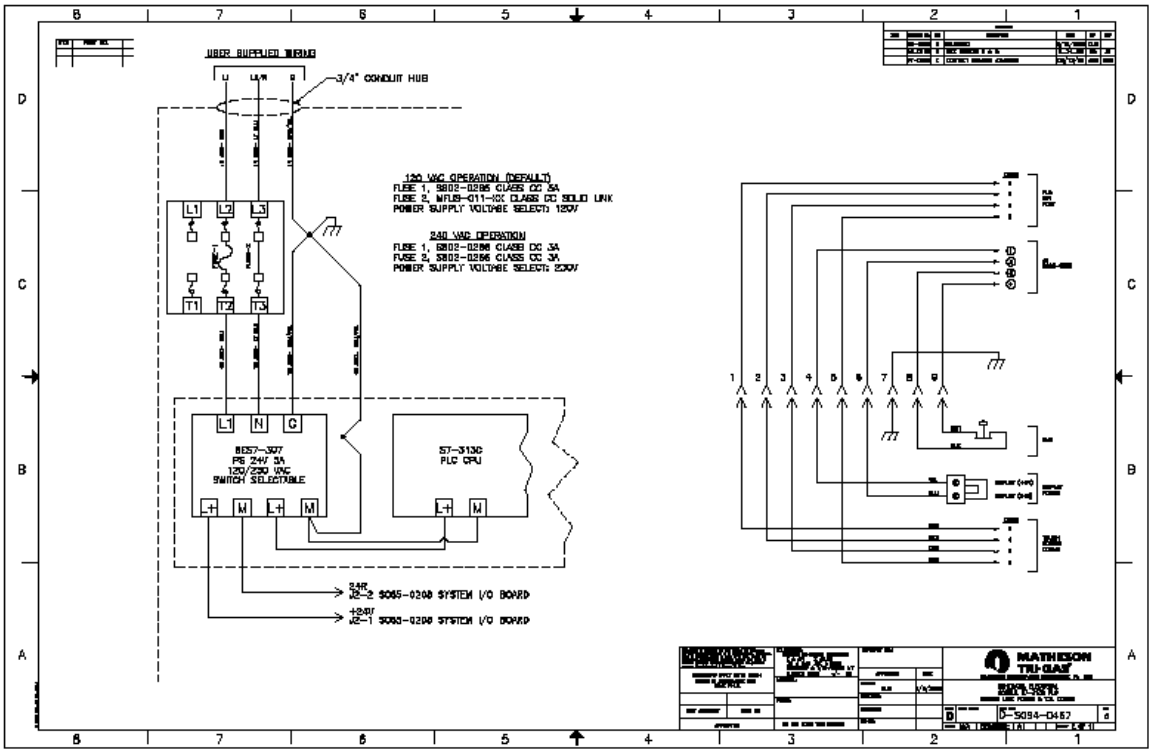


Figure 40. S7-313C PLC Digital Input (0.0-0.7) Wiring, Sheet 1

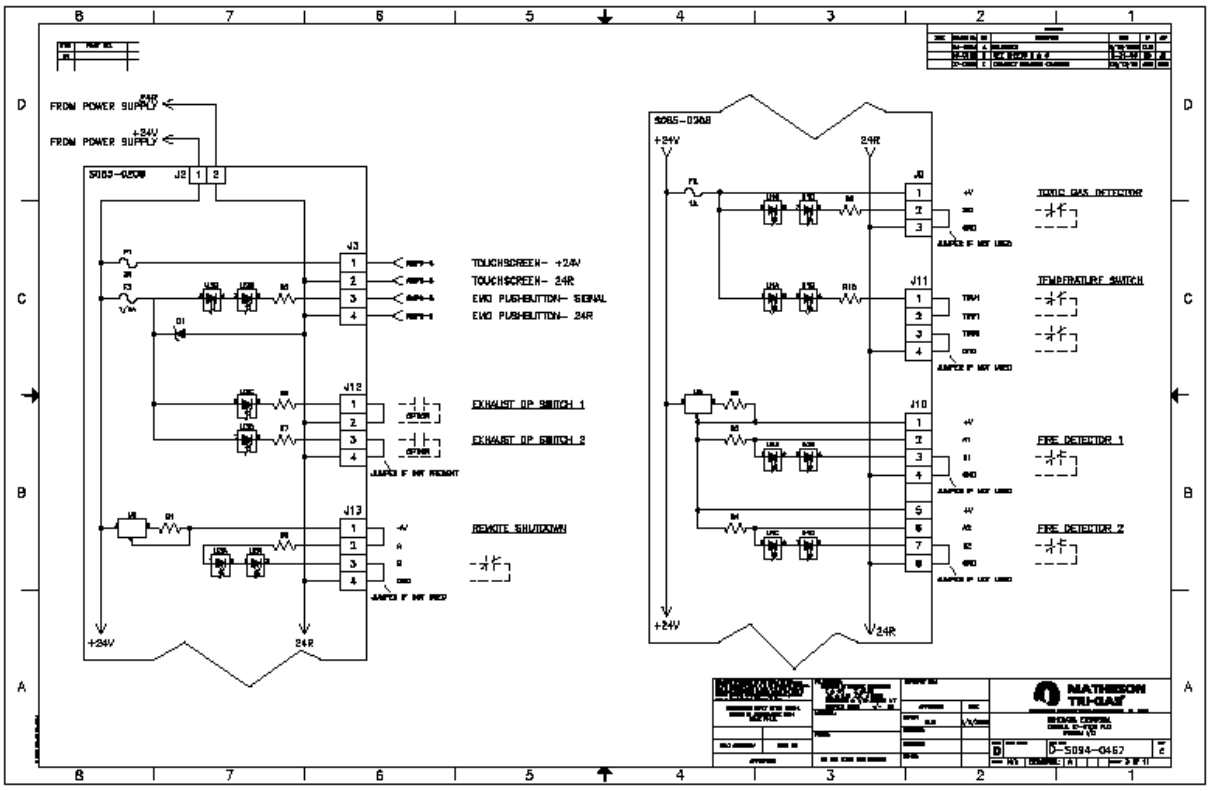


Figure 41. S7-313C PLC Digital Input (0.0-0.7) Wiring, Sheet 2

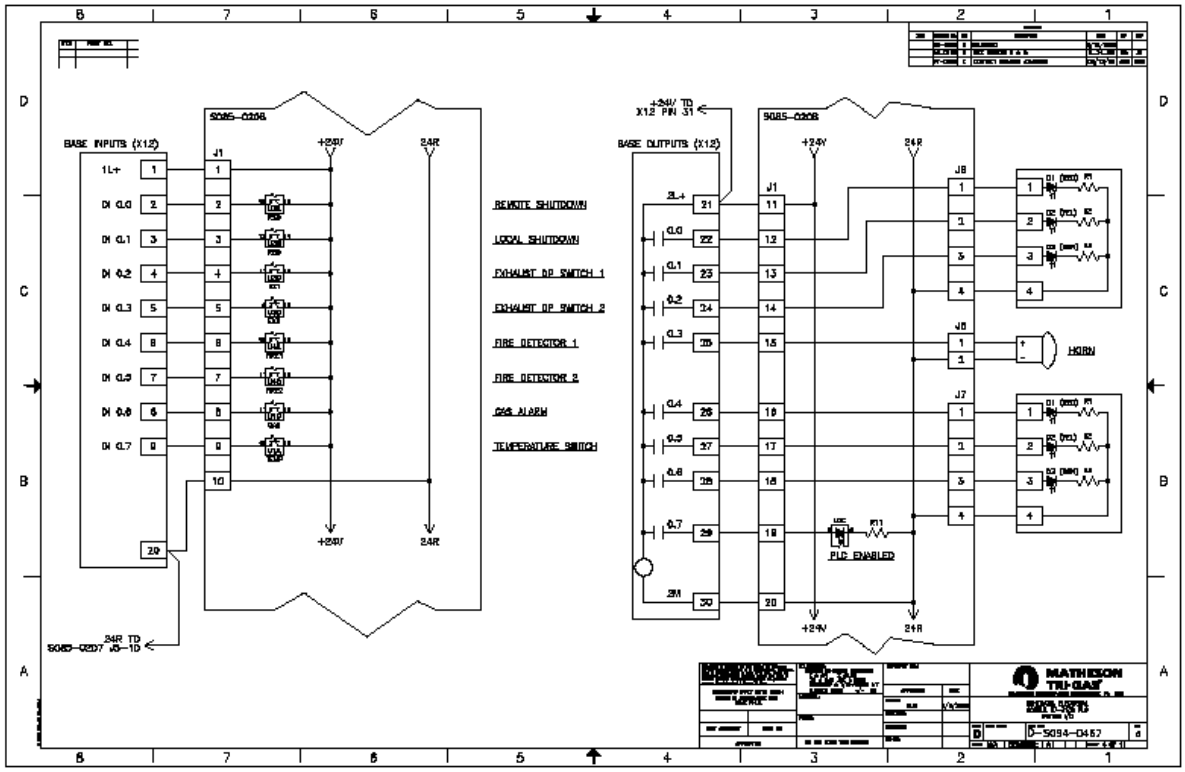


Figure 42. S7-313C PLC User & Auxiliary Input (1.0-1.7) Wiring

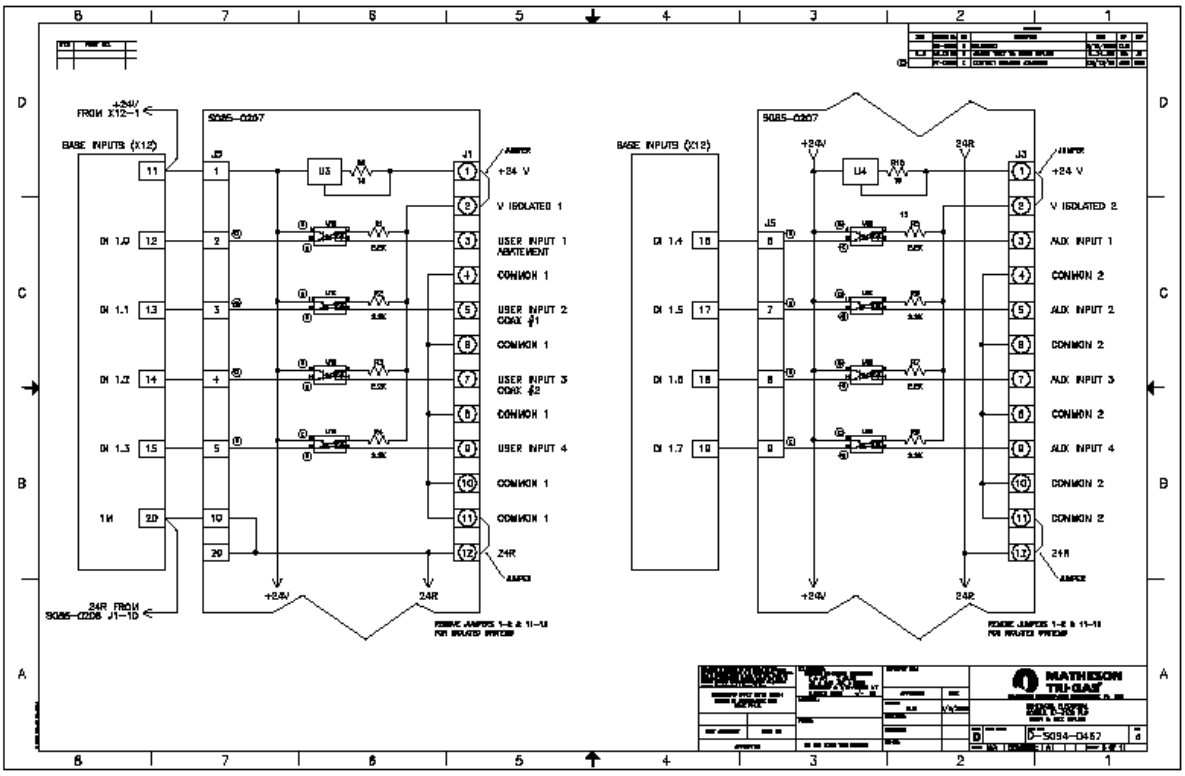


Figure 43. S7-313C PLC User & Auxiliary Relay Output (1.0-1.7) Wiring

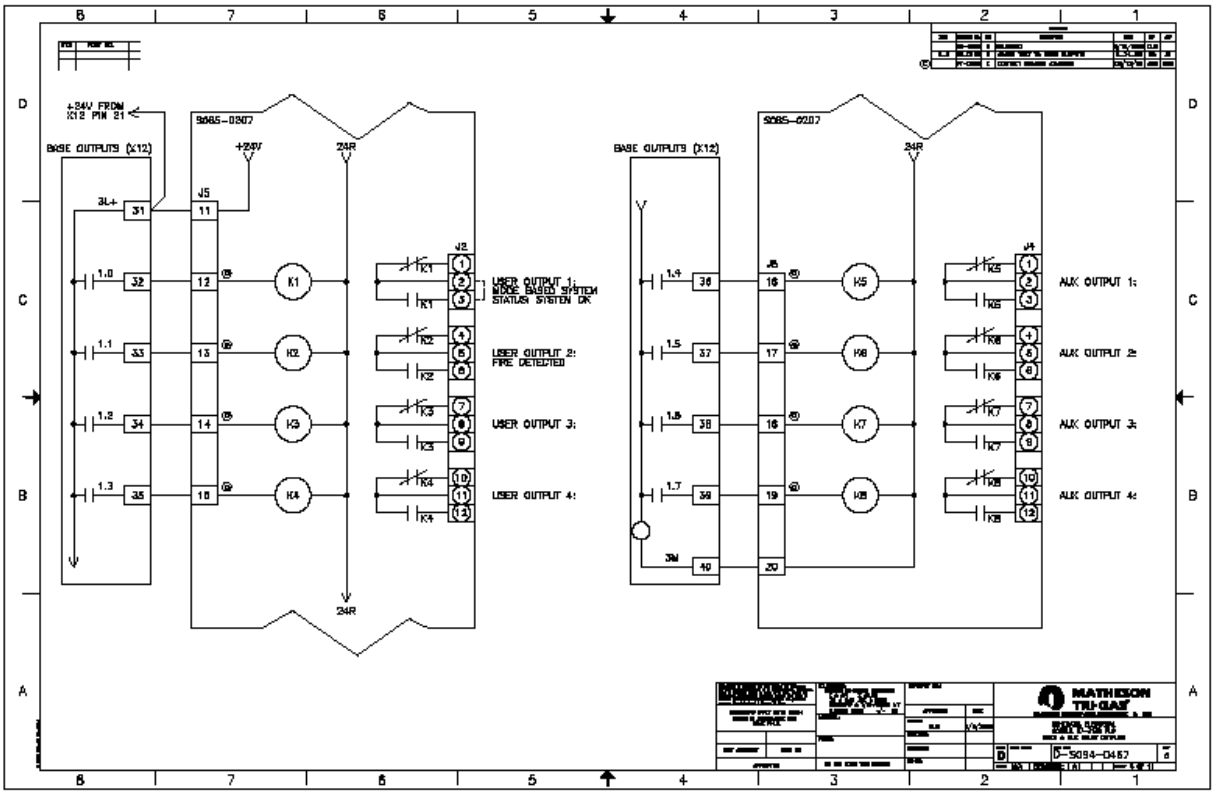


Figure 44. S7-313C PLC Solenoid Valve Output Wiring

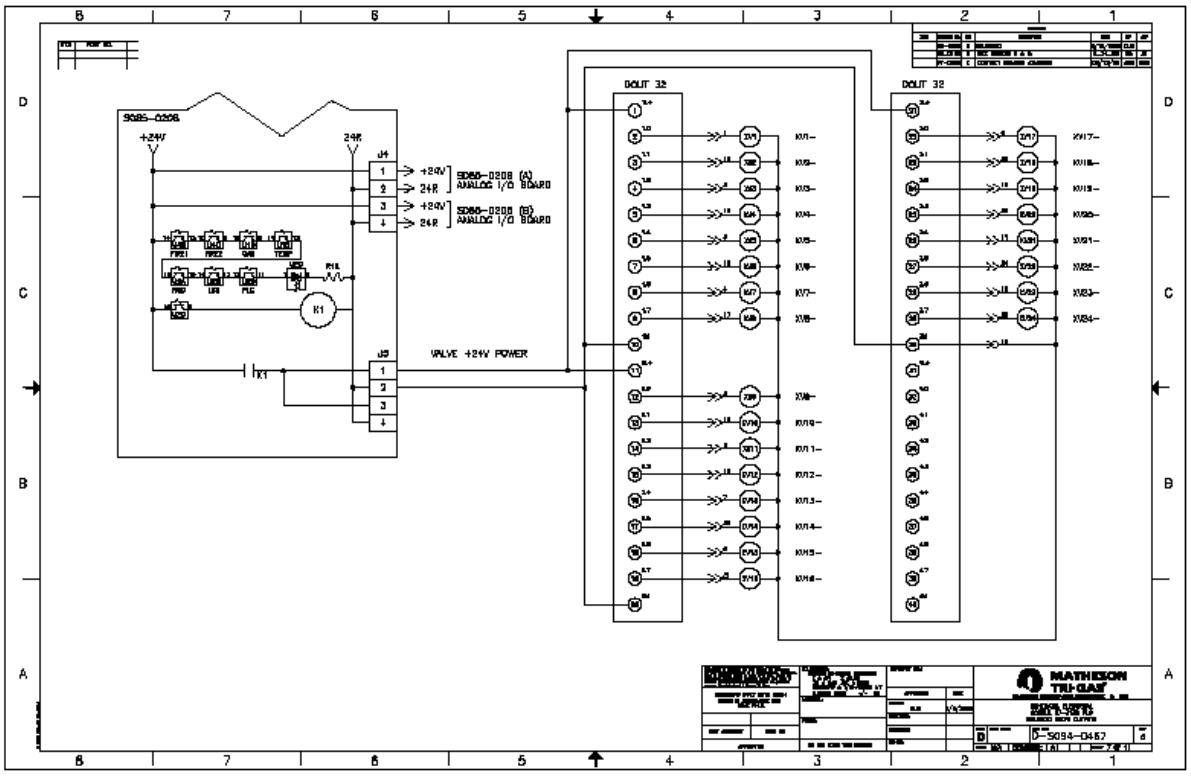


Figure 45. S7-313C PLC Analog Input (A1-A4) Wiring

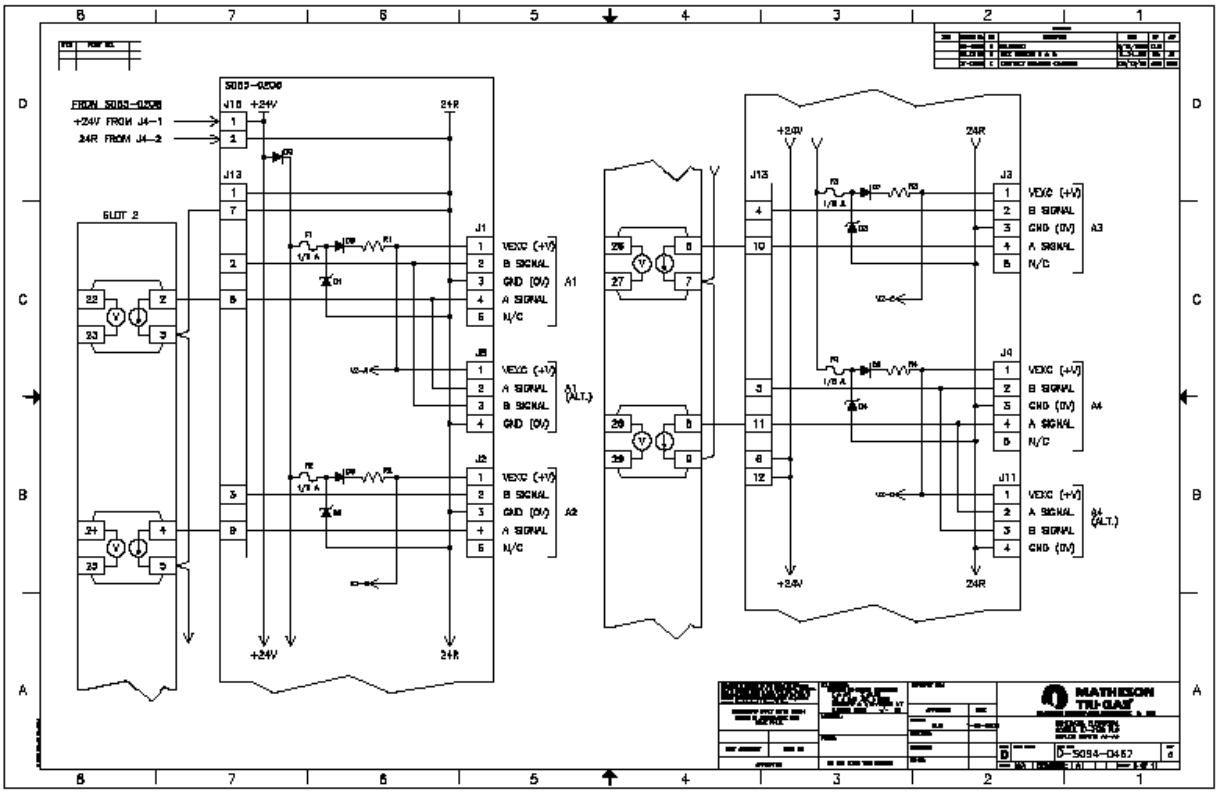


Figure 46. S7-313C PLC Analog / Digital Input (A5-A7) Wiring

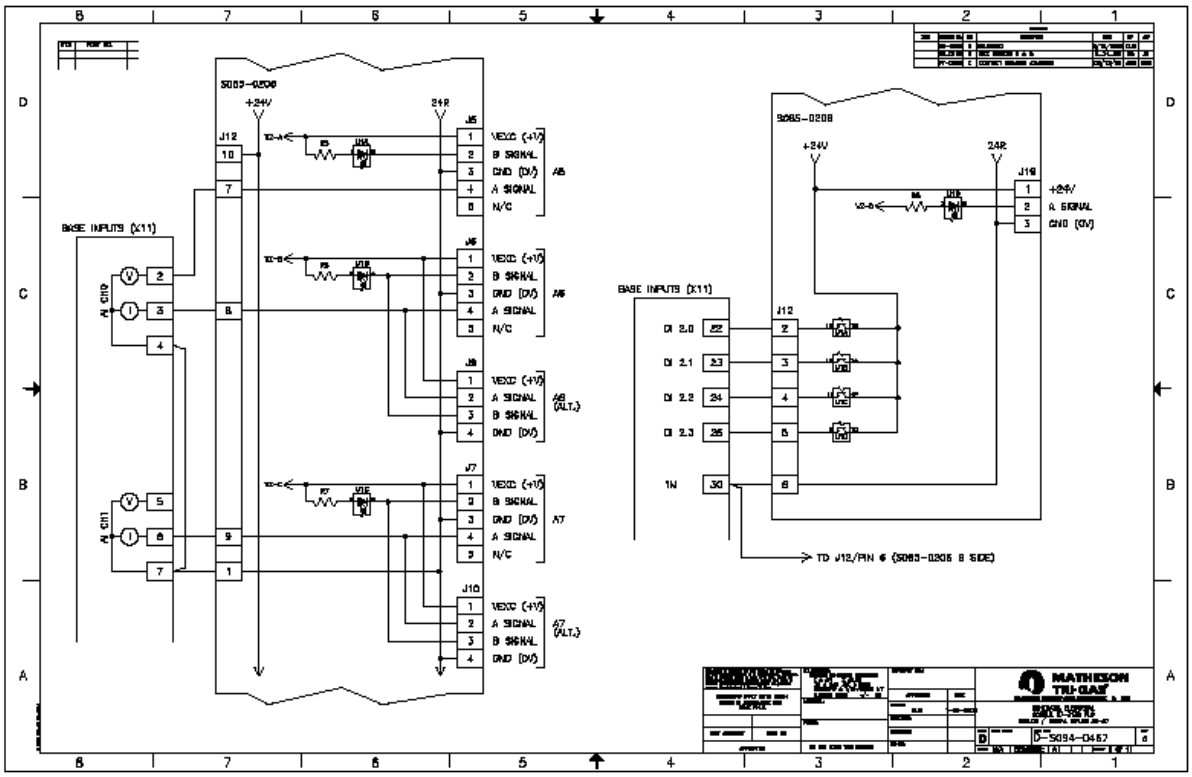


Figure 47. S7-313C PLC Analog Input (B1-B4) Wiring

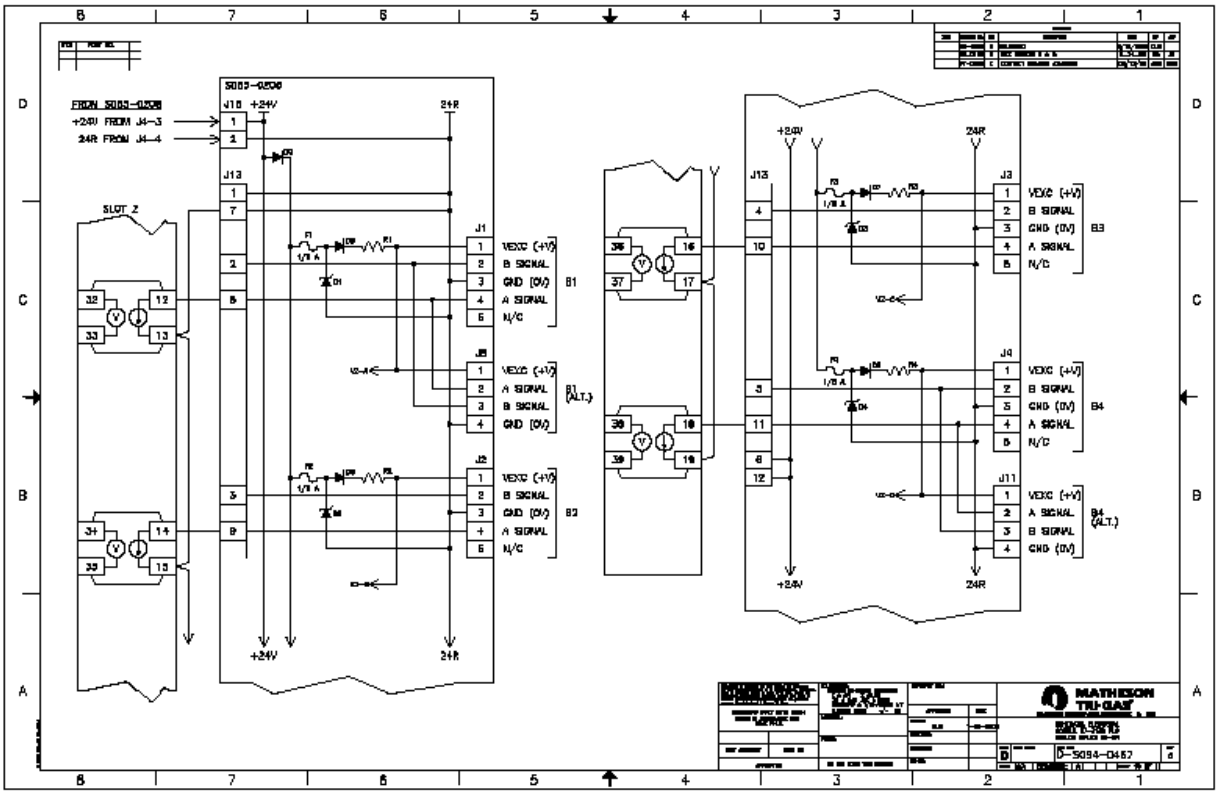
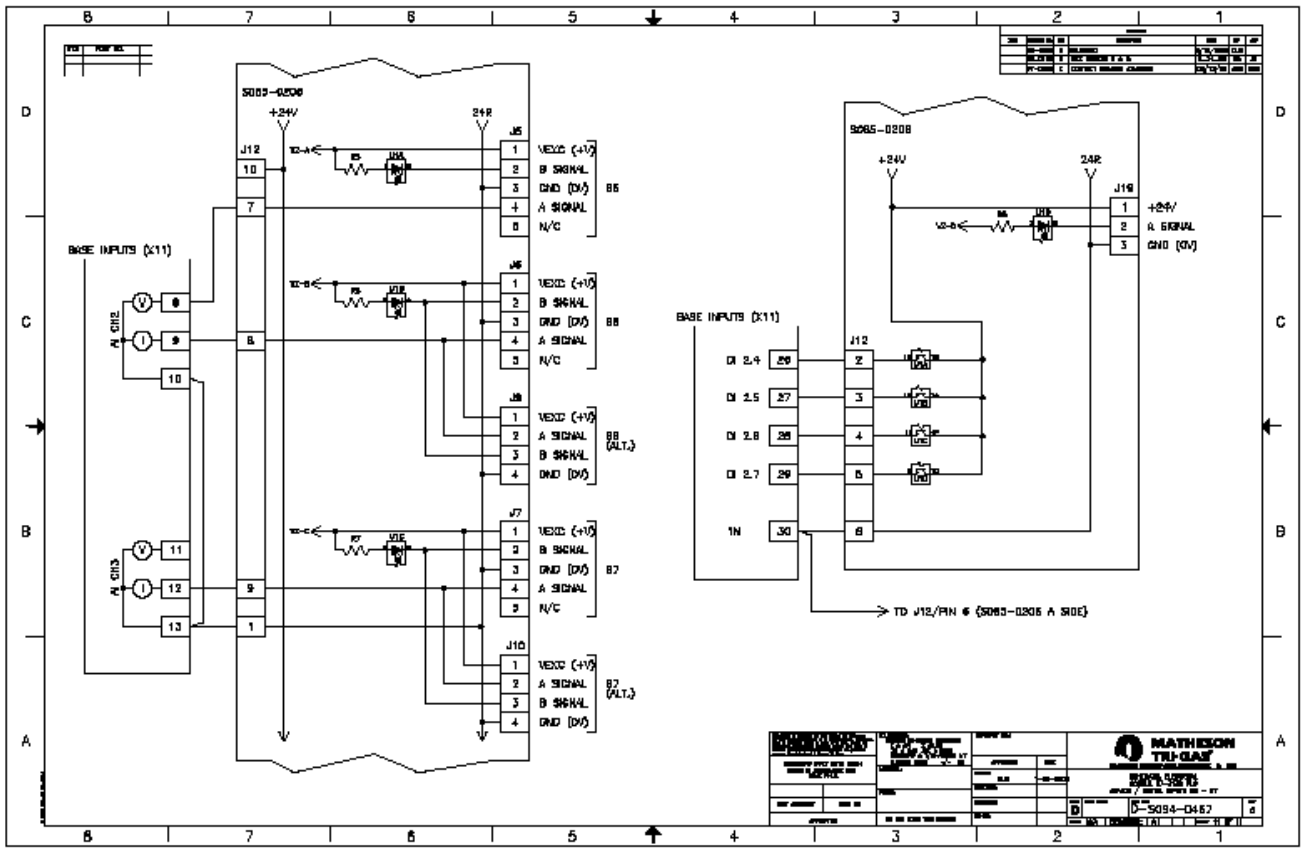


Figure 48. S7-313C PLC Analog / Digital Input (B5-B7) Wiring



LIMITED WARRANTY & SERVICE POLICY

Should a problem develop in operating any MATHESON TRI-GAS SYSTEMS equipment, we respectfully suggest reading the appropriate sections of the Operation Manual. Should the problem persist, please remember that Matheson field service engineers are available during normal business hours (Pacific Time) to answer questions.

The Matheson factory toll-free telephone number is 800-227-7468; the local telephone number is 408-971-6500; the National Service Center toll-free number is 800-850-6231.

Customer suggestions for service and product improvements are encouraged and *always* appreciated.

LIMITED WARRANTY: HARDWARE & SOFTWARE

Matheson warrants its equipment to be free from defects in materials and workmanship for a period of 12 months after installation or 18 months after shipment, whichever period first expires. This warranty, at Matheson's option, is limited to incurred labor and repair or replacement of parts.

Warranty claims may be lodged with either the Matheson Field Service Department or authorized local sales representatives.

Not covered under this warranty are equipment failures caused by (1) misapplication, (2) improper installation or operation, (3) internal or external contamination, (4) abuse, and (5) failure of equipment not purchased from Matheson.

In no event shall Matheson liability include special, incidental, or consequential loss or damage, even though Matheson may have been apprised of the possibility of such potential loss or damage.

This warranty is in lieu of all other warranties of fitness and merchantability. Additional warranties of any kind are neither expressed nor implied.

IN-WARRANTY REPAIRS

Charges are waived; repaired equipment is returned freight prepaid.

OUT-OF-WARRANTY REPAIRS

Charges typically include parts, labor, freight, and insurance. Equipment that cannot be economically restored to satisfactory operating condition will be returned unrepaired freight collect or discarded at the owner's option.

SHIPMENTS TO FACTORY

Please contact your local Matheson field service engineer or the Matheson factory for consultation and advice prior to returning suspected defective goods for inspection and repair. All returns must be shipped with freight prepaid and accompanied by a RETURNED MATERIAL AUTHORIZATION (RMA) NUMBER.

GLOSSARY

Administrator — A user authorized to access *all* PLC displays and functions.

Alarm — An event (e.g., activation of horn, shutdown) that results when equipment operation deviates significantly from a predetermined safe or expected norm, causing an associated sensor value to surpass its associated alarm setpoint.

Manifold alarms refer to error conditions (e.g., high delivery pressure) that exist within one of the 2 manifolds.

Enclosure alarms refer to error conditions (e.g., fire. hazardous gas) that are not associated with a specific manifold, but to error conditions that exist elsewhere (e.g., within the manifold assembly enclosure).

Authorized User — A person who is authorized to access a specific group of PLC displays or evoke specific functions. An administrator must assign a name and password for each authorized user.

Baud Rate — Rate at which a device, such as a terminal, communicates on a network.

Check Valve — An automatic valve that enables fluid flow in one direction only.

Field — An entry on a display or window that contains alphanumeric characters that typically can be changed by authorized users only.

Manifold — One of the 2 manifold assembly divisions that distribute pressure-regulated process gas to a destination.

Manifold Assembly — All piping and associated components (e.g., valves, sensors) of the manifold assembly that are contained within the manifold enclosure.

Network — A communication method that, via Ethernet protocol, enables host communication with other nodes on a network.

Network Address — The unique numerical identifier assigned to each node on a network.

Observer — A user without a user name and password. Observers are restricted to read-only and alarm displays only.

Pressure Switch — An automatic switch that either opens or closes when the applied pressure surpasses a setpoint.

Pressure Regulator — A mechanical device that converts a liquid or gas at an unregulated inlet pressure to an accurately regulated delivery pressure.

Purge Procedure — An automated procedure for exhaustively diluting contaminant gas in a manifold space with purge gas. Purging typically is required to dilute a toxic process gas in a manifold prior to performing maintenance, and to dilute atmospheric contaminants in a manifold prior to introducing process gas. Purging is accomplished by repeatedly pressurizing and exhausting the manifold space with purge gas. Interruptions in the procedure enable maintenance operations, leak testing, etc. to be accomplished. Several types of purge procedures are available for accomplishing diverse tasks.

Sensor — A pressure transducer, flow switch, pressure switch, or similar device that detects a change in physical conditions.

Setpoint — A target value for a process operating parameter. When the actual process value is below or above the setpoint, it triggers a specific action, such as an alarm.

State — With reference to a valve, either opened or closed.

Status Refers to manifold operation:

Service: Process gas is available at process equipment. This is normal operation.

Manual: An operator is manually controlling valves to allow process gas to be available at process equipment.

Shutdown: Process gas has been interrupted by HPI closure.

Stop: Process gas has been interrupted by the user pressing the Stop button on a display.

Standby: The manifold is ready to deliver process gas to process equipment. It will begin service upon a switchover.

Purge: A purge procedure has been started.

Manual/Purge: A purge procedure was started, then interrupted by the user so the user can manually control all pneumatically actuated valves.

Vacuum Generator A no-moving-parts venturi device for producing a vacuum.

Vacuum Generator Bleed A bypass flow feature that allows a small flow of vacuum generator supply gas through the vacuum generator venturi at all times, thereby discouraging occlusion of the venturi by deposits or corrosion.

ACRONYMS

ACV Automatic Cylinder Valve. A pneumatically actuated version of the conventional cylinder valve.

AGC Auto-Guard Cover (4-port).

AS Automatic Switchover.

CCW Counter-clockwise.

CFG Conical Filter Gasket.

CGA Cylinder gas connection.

CW Clockwise.

EFS Excess Flow Switch.

EMO Emergency Machine Off switch, also known as the local shutdown switch.

FD Fire Detected by the fire sensor in the enclosure. When open, it shuts down the manifold.

GAG Pressure Gauge.

GD Gas Detected by the sensor in the enclosure. When the switch is open, it shuts down the manifold.

GDMC Gas Distribution Manifold Controller.

GSMC Gas Source Manifold Controller.

HDP High Delivery Pressure alarm. This alarm causes a warning.

HDPT High Delta Pressure Test alarm. This alarm causes the manifold to shutdown.

HHDP High-High Delivery Pressure alarm. This alarm can be configured as a shutdown or warning.

HHVP High-High Vent Pressure alarm. This alarm can be configured as a shutdown or warning.

HMI Human Machine Interface.

HMP High Manifold Pressure alarm. This alarm can be configured as a shutdown or warning.

HOF High Outlet Flow alarm. This alarm can be configured as a shutdown or warning.

HPA High-Pressure Access.

HPI High-Pressure Isolation Valve. When closed, it isolates the regulator and downstream components from the process gas source.

HPLT High-Pressure Leak Test.

HPP High Purge Pressure alarm. This alarm can be configured as a shutdown or warning.

HPT High-Pressure Transducer. The cylinder pressure.

HPV High-Pressure Vent Valve. When open, it vents high-pressure purge gas or high-pressure process gas via the vacuum generator. The check valve prevents backflow of vacuum generator supply gas or high-pressure process gas into the manifold assembly.

HVP High Vent Pressure alarm. This alarm can be configured as a shutdown or warning.

I/O Inputs/Outputs.

LCP Low Cylinder Pressure alarm. This alarm causes a warning.

LCW Low Cylinder Weight alarm. This alarm causes a warning.

LDP Low Delivery Pressure alarm. This alarm causes a warning.

LLCP Low-Low Cylinder Pressure alarm. This alarm can be configured as a shutdown or warning.

LLCW Low-Low Cylinder Weight alarm. This alarm can be configured as a shutdown or warning.

LLDP Low-Low Delivery Pressure alarm. This alarm can be configured as a shutdown or warning.

LLLCP Low-Low-Low Cylinder Pressure alarm. This alarm can be configured as a shutdown or warning.

LLLCW Low-Low-Low Cylinder Weight alarm. This alarm can be configured as a shutdown or warning.

LME Low Manifold Exhaust switch on the manifold enclosure. When open, it generates a warning.

LMP Low Manifold Pressure alarm. This alarm can be configured as a shutdown or warning.

LOTO Lockout / Tagout procedures for maintenance and installation.

LPA Low-Pressure Access.

LPI Low-Pressure Isolation Valve. When closed, it isolates the manifold from the process gas delivery line to process equipment.

LPP Low Purge Pressure. This alarm causes the manifold to shutdown during a purge, and it results in a warning during normal service.

LPS Low Pneumatic Supply by the pneumatic pressure switch. When open, it shuts down the manifold.

LPT Low-Pressure Transducer. The delivery pressure.

LPV Low-Pressure Vent Valve. When open, it vents low-pressure purge gas or low-pressure process gas via the vacuum generator. The check valve prevents reflux of vacuum generator supply gas or high-pressure process gas into the manifold assembly.

LZP Low Z-Purge Pressure switch. When open, it generates a warning.

MDP High Manifold Delta Pressure alarm. This alarm can be configured as a shutdown or warning.

MSDS Material Safety Data Sheet, containing information for chemicals.

PAC Password Access Controlled. Specific manifold functions that can be accessed, altered, or triggered by authorized users only.

PBV Purifier Bypass Valve.

PFI Purifier Inlet Valve.

PFO Purifier Outlet Valve.

PGB Purge Gas Bleed Valve. It allows full flow of purge gas when open, and it allows a small flow of purge gas when closed. It extends equipment life by allowing a small flow of purge gas at all times, thereby lessening the chance of corrosive obstruction.

PGI Purge Gas Inlet Valve. When closed, it isolates the regulator and downstream components from the purge gas source.

PGO Purge Gas Orifice.

PLC Programmable Logic Controller.

PLI Process (Gas Delivery) Line (to Manifold) Isolation Valve. When closed, it isolates the manifold from the process gas delivery line.

PPT Purge Pressure Transducer. The low purge pressure alarm can be configured as a shutdown or warning.

REG Pressure regulator.

REL Relief Valve.

RS Remote Shutdown alarm. Customer controlled dry contact which will shutdown the cabinet.

SCL Scale Transducer for the cylinder.

SD Shutdown.

SWO Switchover.

VAI Vacuum Access Isolation Valve. When closed, it isolates the low-pressure vent manifold from the leak test equipment vacuum source. The inlet port of this valve is connected to leak test equipment during leak testing only; the inlet port is closed with a protective cap during typical operation of the manifold assembly.

VAP Vacuum Access Port. An optional feature that includes VAI and VGI valves.

VGI Vacuum Generator Isolation Valve. When closed, it isolates the low-pressure vent manifold from the vacuum generator.

VGS Vacuum Generator Supply Valve. When open, it allows vacuum generator supply gas to enter the vacuum generator venturi, producing a vacuum.

VPT Vent Pressure Transducer. The high vent pressure alarm can be configured as a shutdown or warning.

VV Vacuum Venturi Generator.

WN Warning.

XDCR Transducer.

Z Z-Purge alarm. Triggered when a Z-Purge equipped controller loses purge gas pressure.