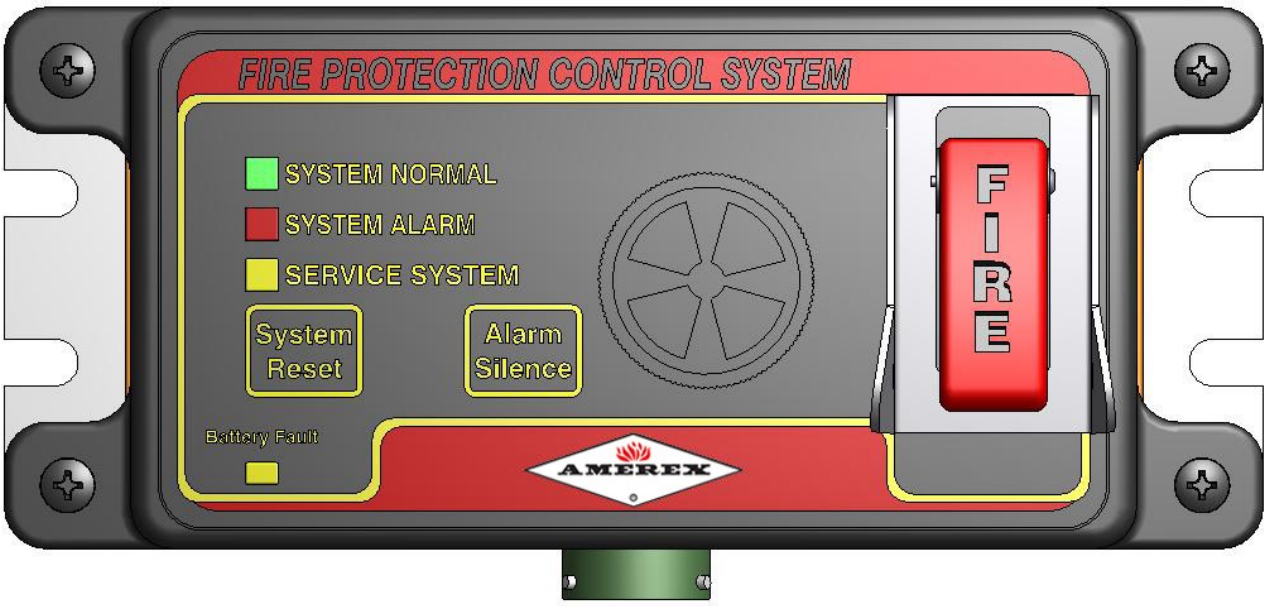
Fire Suppression Systems

Stand Alone 2 Zone System (SA2Z)

Installation, Operation, and Maintenance Manual

P/N 23576 – February, 2015

Revision -



Vehicle Fire Suppression System

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Table of Contents:

Chapter 1: General Information

This document must be used in conjunction with the following standards:

1. All applicable NFPA standards.
2. All other standards or laws deemed applicable to an installation by local authorities having jurisdiction.

⚠ **AMEREX ELECTRONIC PANELS ARE TO BE USED ONLY WITH AMEREX SYSTEM COMPONENTS AND CABLES. THE USE OF UNAPPROVED COMPONENTS WILL VOID AMEREX WARRANTY ON ALL SYSTEM COMPONENTS AND THE FACTORY MUTUAL LISTING. IT IS THE RESPONSIBILITY OF INDIVIDUALS WHO INSTALL, OPERATE, INSPECT, RECHARGE AND /OR MAINTAIN THESE SYSTEMS TO READ THIS ENTIRE MANUAL.**

Updated Installation, Operation, and Maintenance Manuals and Technical Bulletins will be available online at www.amerex-fire.com. It is important that these updates and additions be added to this manual according to the instructions that will accompany them.

The applications and use of the Amerex Stand Alone 2 Zone System (SA2Z) are limited to the applications and uses described in this manual. Technical data contained herein is based on controlled laboratory testing deemed appropriate by Factory Mutual Research Corp. and other listing agencies, and is intended for informational purposes only. The data presented is accurate for the testing performed, but is published with no guarantee relative to a given hazard where factors are different from those encountered during actual tests. Amerex disclaims any liability for any use of the data and information contained herein by any and all other parties. Please direct questions concerning information in this manual to:

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1.1 Introduction

Amerex Stand Alone 2 Zone (SA2Z) is a pre-engineered, FM Approved electronic system that is designed specifically for automatic fire detection and actuation for vehicle equipment hazard areas. These electronics are suitable for use with only Amerex fire suppression systems. The SA2Z electronics were designed for the most rugged environments and heavy duty vehicle use. The SA2Z electronics includes circuits for 2 zones of detection and circuits for 2 zones of actuation. The detection circuits are Class B categorized circuits and are supervised by the Operator Panel. The Operator Panel is mounted with a Master Harness that connects to the bottom of panel. The SA2Z package offers flexible options to meet the needs of Vehicle System fire suppression and overheat detection opportunities.

The original Amerex modular wiring approach is continued as a feature of the SA2Z System. The SA2Z system operates using default sensor alarm and actuator settings. For the advanced user needing additional system flexibility, the SA2Z system may be programmed via a laptop computer or PC. Once accessed, easy to use Windows based pull-down menu screens allow for application specific programming and configuration. The Amerex SA2Z system has been tested to FM, SAE, and CE standards.

Benefits and Features of the SA2Z System:

- Internal extended life lithium battery power source requires no external power connections
- Provides continuous, uninterrupted fire detection and fire suppression
- Manual release switch for system actuation located on Operator Panel
- System status indication and troubleshooting via discrete LEDs or Monitor Mode
- Event Data Recording with time and date stamp for up to 100 events
- Provides Fire Suppression capability for a temperature rating from –40° F to +158° F
- Simple programming features allow for design installation flexibility
- Multiple Class B detection input types:
  - Spot Heat Sensors (SHD)
  - Linear Heat Detection (LHD)
- Allows for multiple cylinder actuation and second shot actuation
- Flexible dual detection and releasing zones
- Audible Alarm with Silence
- Trouble ring back feature
- Low Battery Warning
- Output Signal for Alarm and Fault (Trouble) conditions
- System Reset/Output Signal Override Button
- IP67 rated Operator Panel

1.2 What Can Be Protected

A complete hazard analysis must be performed for each piece of equipment being protected to determine the machine components that would require fire suppression. Protection may include but is not limited to:

- Earth Moving Equipment - Dozers, Haul Trucks, Cranes, Excavators, Drill Trucks, Conveyers, Draglines
- Forestry / Land Clearing - Brush Cutters, Skidders, Feller Bunchers, Grinders
- Landfill / Refuse - Garbage Trucks, Compactors, Track Dozers
- Farming Equipment - Tractors, Harvesters, Mowers, Spreaders
- Transit - Rail, Bus
- Mobile Equipment - Pumps, Generators, Compressors

1.3 Agency Approval Standards

- Factory Mutual
- SAE
- CE

Chapter 2: Component Description

This chapter describes the various components available for use with the Amerex Stand Alone 2 Zone System (SA2Z). These include the electronics panel, detection sensors, cables and other components that comprise a complete system. A simple SA2Z schematic is shown below, which gives the basic system layout and available circuits (See Figure 2). All available components, including additional components not shown in this schematic are detailed in the following sections. For fire suppression systems and components, reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual. Item numbers shown in brackets in the following section titles (**[ITEM X]**) correspond to the item numbers from the Parts List (See Section 2.9).

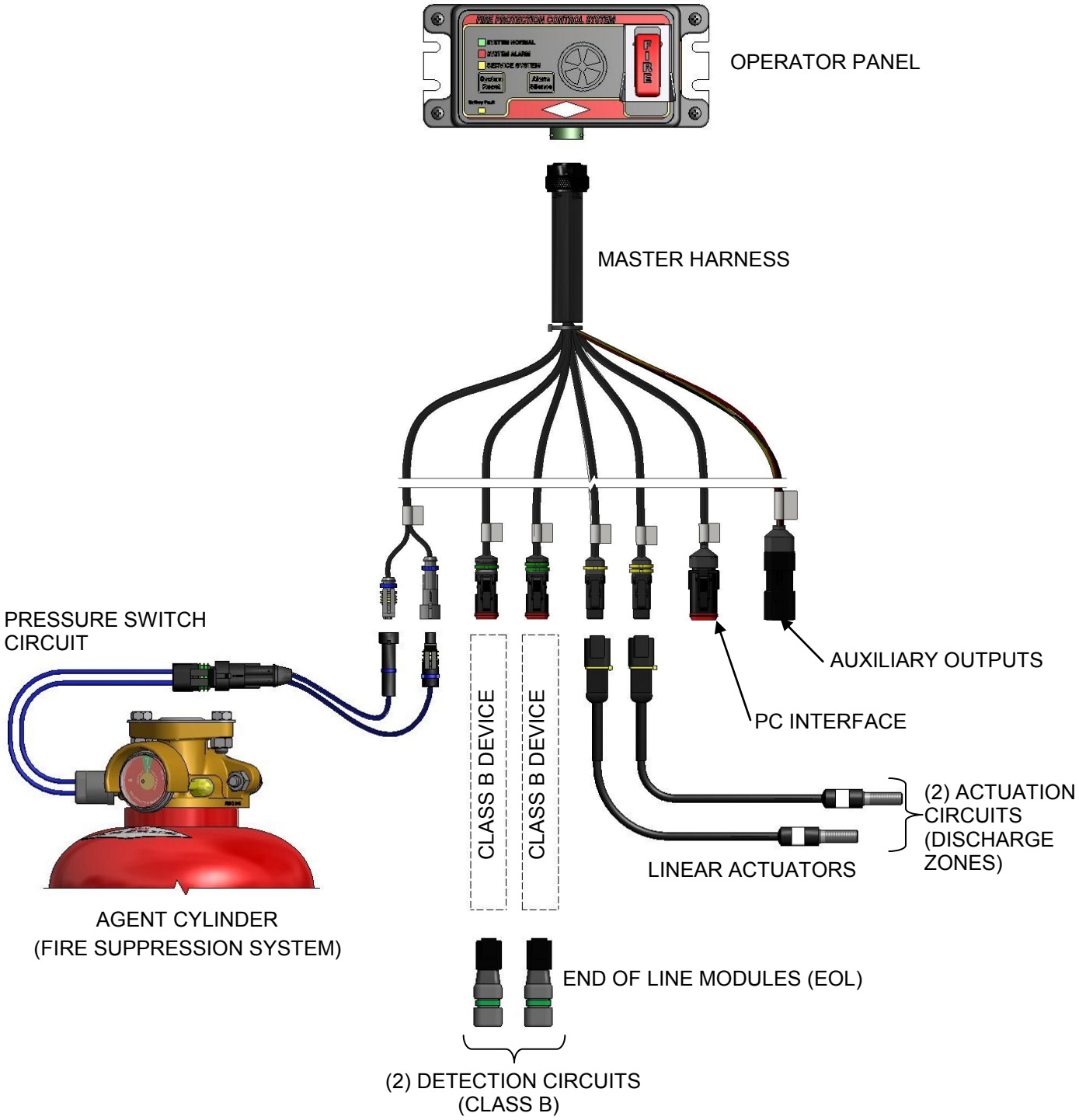


Figure 2

2.1 Operator Panel (P/N 22822) [ITEM 1]

The Amerex Stand Alone 2 Zone (SA2Z) Operator Panel is designed to function without input power from the vehicle being protected. The SA2Z utilizes a non-rechargeable battery as main power supply that will sustain itself for up to one year. The Operator Panel is designed to be surface mounted with the Master Harness cable connector located on the bottom of the panel. Operator Panel front face features are shown below (See Figure/Table 2.1a). Dimensions and specifications are also shown below (See Figure/Table 2.1b). All dimensions are in inches [mm].

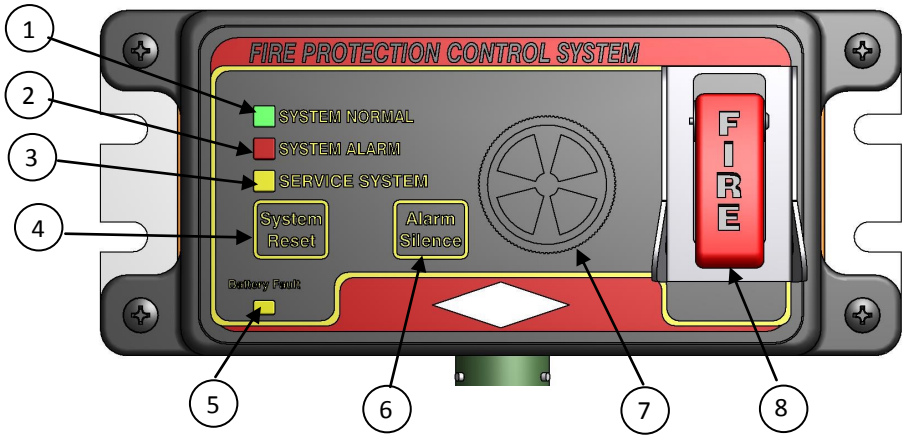


Figure 2.1a

OPERATOR PANEL FEATURES	
1	System Normal LED
2	System Alarm LED
3	Service System LED
4	System Reset Button
5	Battery Fault LED
6	Alarm Silence Button
7	Alarm Sounder
8	Manual Release Switch

Table 2.1a

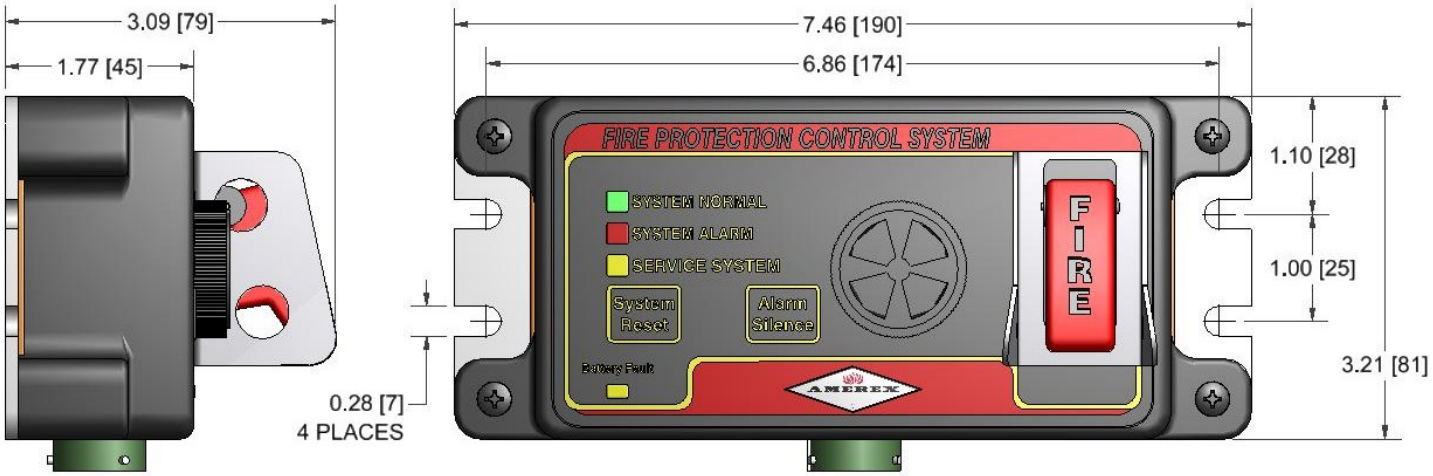


Figure 2.1b

Table 2.1b

Operator Panel Features	Feature Notes
Power Input	Internal Lithium Battery
(2) Class B Detection Circuits	Terminated with 470k ohm End of Line Device (EOL)
(2) Actuation Circuits	Can be mapped to individual or both detection circuits
(1) Pressure Switch Circuit	Terminated with NC pressure switch (closed under pressure)
(1) PC Interface Circuit	Used for Operator Panel programming
(1) Fire Output, Normally Open	Rated for ½ Amp max continuous @ 50 VDC 0 second delay (default); Programmable delay 0 – 30 seconds
(1) Fault (Trouble) Output, Normally Open	Rated for ½ Amp max continuous @ 50 VDC 5 second delay (default); Programmable delay 0 – 30 seconds

2.2 Detection Devices

Amerex offers a variety of Class B heat detection sensors for detecting fire and overheat conditions. These include Spot Heat Detectors (SHD) and Linear Heat Detectors (LHD). A hazard analysis must be performed to identify proper selection of heat detection sensors.

2.2.1 Spot Heat Detectors (SHD), Bracket Mount (P/N 23848/23460); Bulkhead Mount (P/N 23462) [ITEM 2]

A Spot Heat Detector (SHD) is a normally open, self resetting contact closure device. The device is configured with four wires allowing supervision of series connected circuitry. The internal contacts of the device will close upon reaching designed temperature set point parameters. Color coding (green) can be found on each connector. Three versions of the device are available with various temperature set points and mounting styles (See Table 2.2.1).

Table 2.2.1

P/N	Set Point	Temp. Set Point Color Identification	Mounting Style	Figure
23848	280ºF (137ºC)	Yellow	Bracket	2.2.1a
23460	350ºF (176ºC)	Red	Bracket	2.2.1b
23462	450ºF (232ºC)	Blue	Bulkhead	2.2.1c

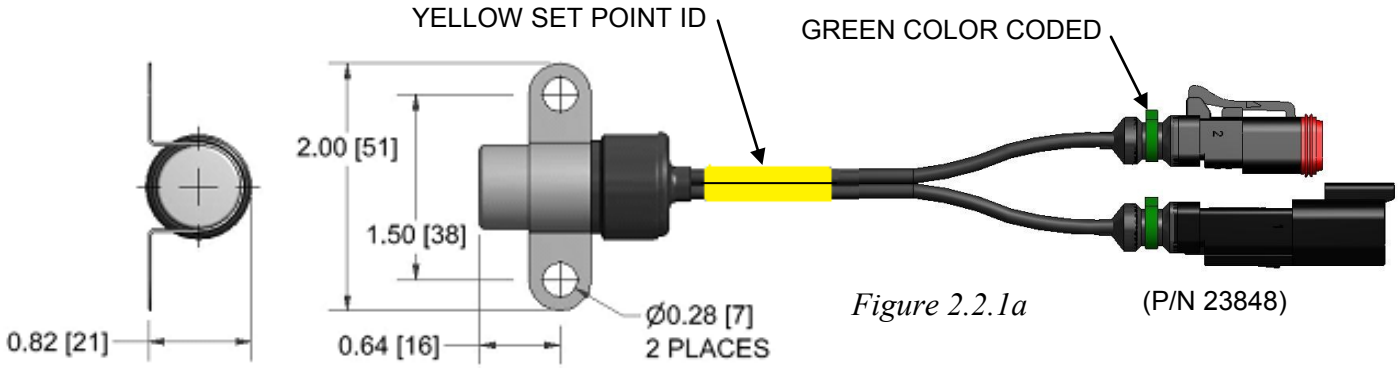


Figure 2.2.1a (P/N 23848)

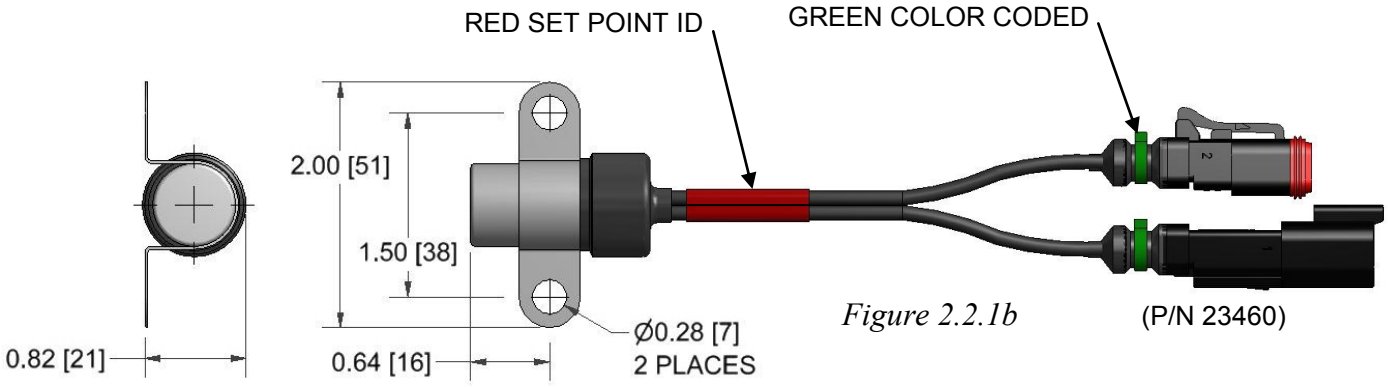


Figure 2.2.1b (P/N 23460)

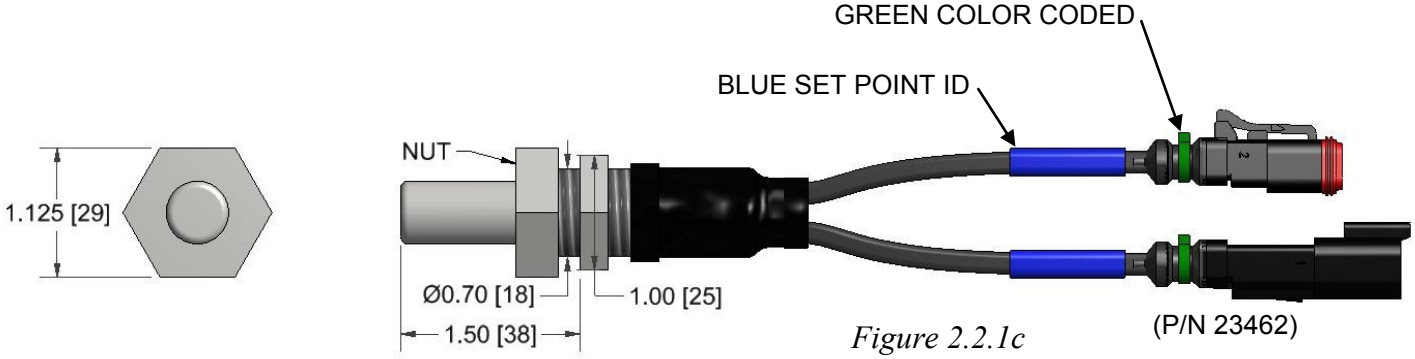


Figure 2.2.1c (P/N 23462)

2.2.2 Linear Heat Detector (LHD) with Protective Spring (P/N 23463); without Protective Spring (P/N 23464) [ITEM 3]

A Linear Heat Detector (LHD) is a normally open device that closes when subjected to heat. The device is comprised of two internal coiled spring loaded conductors that make contact in the event of an overheat condition. A basic LHD (P/N 23464) is a available (See Figure 2.2.2a). A more robust LHD with a protective stainless steel spring along its length (P/N 23463) is also available and can be used to help prevent potential damage to the LHD (See Figure 2.2.2b). Both LHDs are green in color and have a temperature set point of 356°F (180ºC). LHDs must be replaced once they detect an overheat condition. Various lengths of both LHDs are available and shown in the Parts List (See Section 2.9).

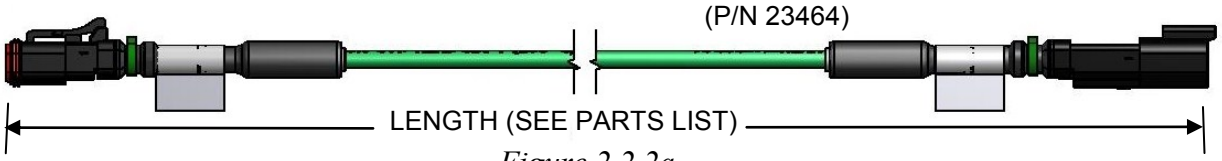


Figure 2.2.2a

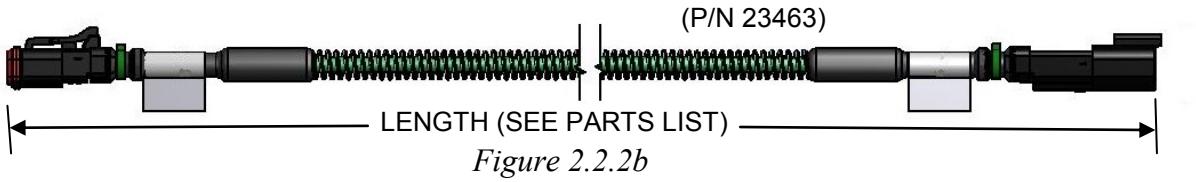


Figure 2.2.2b

2.3 Cables

Amerex offers pre-assembled modular cables for use with the SA2Z system. All are terminated with connectors and color coded to allow easy troubleshooting and installation.

2.3.1 Master Harness (P/N 22940) [ITEM 4]

The Master Harness utilizes a 19 pin circular connector that connects to the Operator Panel and diverges into seven cable assemblies with dedicated connections to other system features (See Figure/Table 2.3.1). Various lengths of this cable are available and shown in the Parts List (See Section 2.9).

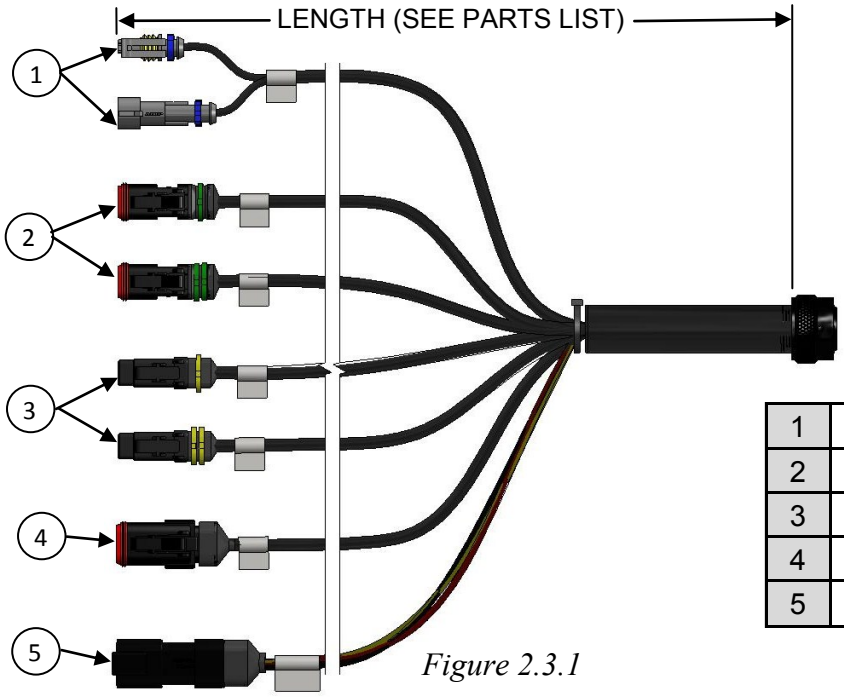


Figure 2.3.1

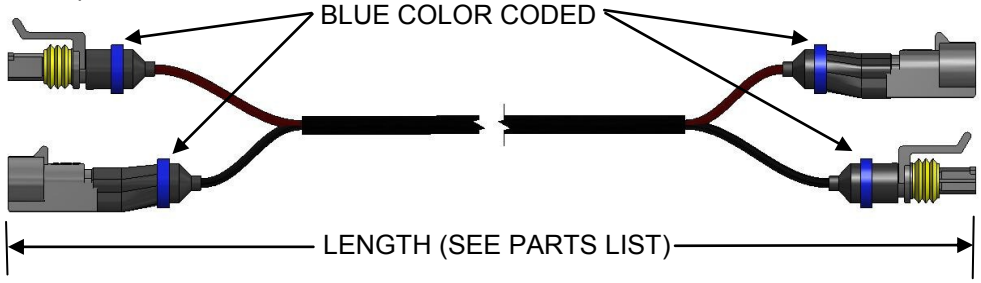
1	PRESSURE SWITCH
2	DETECTION 1 & 2
3	ACTUATION 1 & 2
4	PC INTERFACE
5	OUTPUT SIGNALS

Table 2.3.1

2.3.2 Pressure Switch Cable (P/N 21539) [ITEM 5]

The Pressure Switch Cable is used to connect the Master Harness to a Pressure Switch located on an Agent Cylinder Valve. Additional cables can also be used to connect multiple Agent Cylinders to the same pressure switch circuit. Each is terminated with sealed connectors and color coding (blue) can be found on each connector. Various lengths of this cable are available and shown in the Parts List (See Section 2.9).

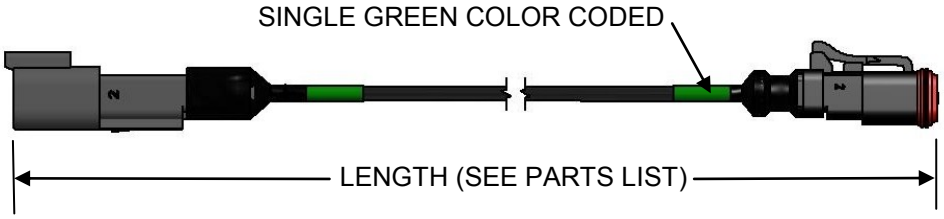
Figure 2.3.2



2.3.3 Class B Detection Hazard Cable (P/N 23091) [ITEM 6]

The Class B Detection Hazard Cable is used as an extension to connect a Class B device (LHD, SHD, or 100 PSI Switch) to the Master Harness in the Class B detection circuit only. This Cable can also be used as an extension between individual Class B devices connected in series. "Hazard" cables contain a protective solid loom and may be carefully routed in a hazard area if desired. Color coding (single green) can be found on each connector. Various lengths of this cable are available and shown in the Parts List (See Section 2.9).

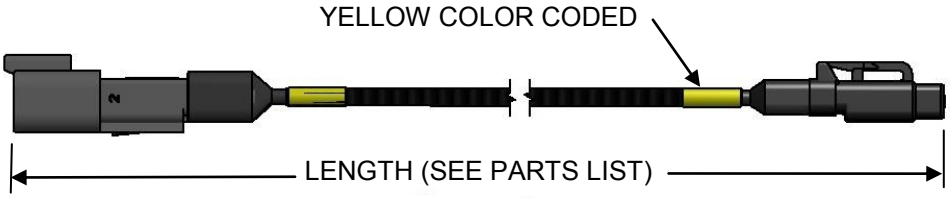
Figure 2.3.3



2.3.4 Actuation Cable (P/N 23110) [ITEM 7]

The Actuation Cable is used as an extension to connect the Master Harness to a Linear Actuator in the actuation circuit only. Color coding (yellow) can be found on each connector. Various lengths of this cable are available and shown in the Parts List (See Section 2.9).

Figure 2.3.4



2.3.5 Output Cable (P/N 23211) [ITEM 8]

The Output Cable is used on the Output Signals circuit of the Master Harness. This cable contains colored, blunt cut leads that can be wired to optional devices. Various lengths of this cable are available and shown in the Parts List (See Section 2.9).

Figure 2.3.5

2.3.6 PC Interface Cable (P/N 24106) [ITEM 9]

The PC Interface Cable is used to program the SA2Z system. The cable connects the PC Interface plug of the Master Harness to the USB port of a laptop computer or PC.

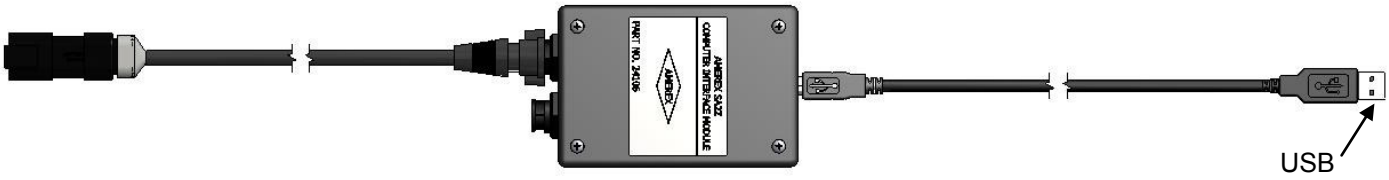


Figure 2.3.6

2.4 Pressure Switch

Pressure switches can be connected directly to the SA2Z system and are used to monitor pressure within a system. These switches can indicate a system discharge has occurred by monitoring the Agent Cylinder directly or by monitoring a Pneumatic Actuation Network indicating a manual actuation has occurred.

2.4.1 Agent Cylinder Pressure Switch (P/N 17609) [ITEM 10]

The Agent Cylinder Pressure Switch is supplied with and connected directly to the Agent Cylinder. This switch is designed to monitor Agent Cylinder pressure. The switch is closed in a pressurized Agent Cylinder and opens when Agent Cylinder pressure drops below 270 psi indicating a discharged or leaking Agent Cylinder. Reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual for selection of Agent Cylinders with Pressure Switches.

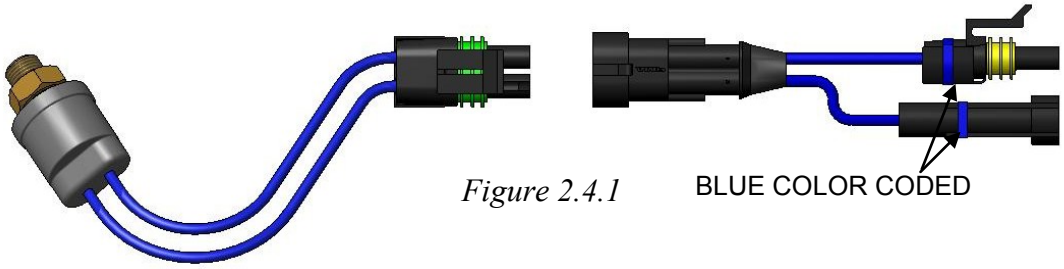


Figure 2.4.1

2.4.2 100 PSI Pressure Switch (P/N 23850) [ITEM 11]

The 100 PSI Pressure Switch is designed to be used in the Pneumatic Actuation Network of a system. The switch connects to the Class B detection circuit. This switch is normally open and closes when subjected to nitrogen pressure in excess of 100 psi indicating that a manual actuation has occurred from a Nitrogen Cylinder. Reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual for 100 PSI Pressure Switch installation instructions.

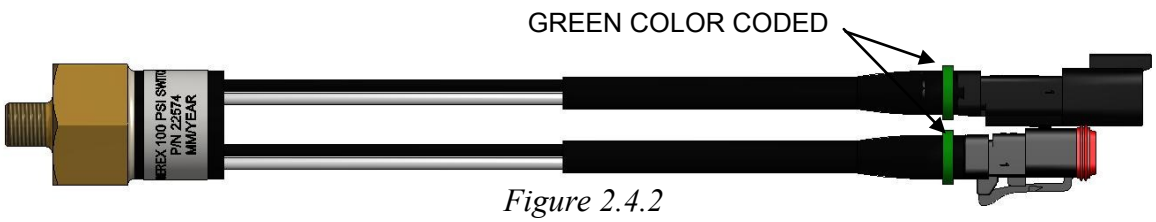


Figure 2.4.2

2.5 Linear Actuator (P/N 20500) [ITEM 12]

The Linear Actuator is a device when electrically activated extends a metal shaft which mechanically opens an Agent Cylinder Valve when used in a control head or opens a Nitrogen Cylinder when used in an Electric Nitrogen Actuator. The Linear Actuator connects to the actuation circuit Master Harness. Once activated, a Linear Actuator cannot be reused and must be replaced. Service life of the Linear Actuator is 6 years after which it must be replaced. Total life of the Linear Actuator is 10 years after which it must be replaced whether it has been placed in service or not. Each Linear Actuator is supplied with a Mylar style label for identifying date of manufacture. An O-ring (P/N 17137) is provided with each Linear Actuator and must be used. Reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual for Linear Actuator installation instructions.

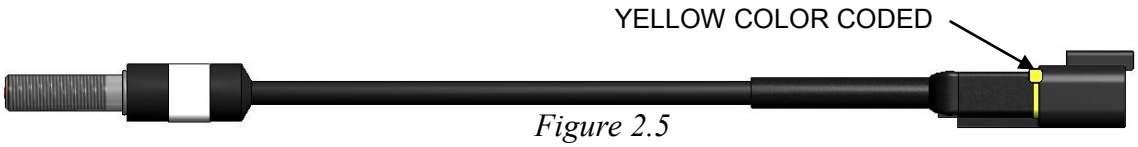


Figure 2.5

2.6 End Of Line Module (P/N 23474) [ITEM 13]

The End Of Line Module (EOL) is utilized to supervise circuitry on the Class B detection circuits. The EOL is color coded green. The device provides a continuous electrical circuit allowing for supervision of the normally open detection network. A total of two EOL modules are supplied with each SA2Z Control Panel.

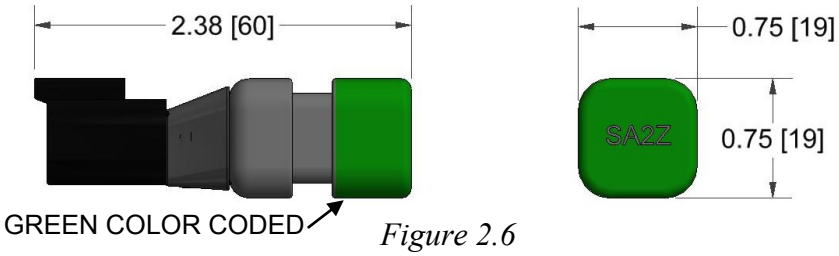


Figure 2.6

2.7 Replacement Battery (P/N 23720) [ITEM 14]

The SA2Z is equipped with a battery that is capable of sustaining a normal operating condition of the electronics for up to one year (specific battery replacement instructions are found in Section 5.5). The battery pack is UN/DOT compliant for shipping purposes. Operating temperature range is –40°F to +185°F (-40°C to +85°C). The Replacement Battery is supplied with a battery identification label located on the battery (see Figure 2.7a) which shows the Amerex part number, serial number, and battery description. An additional Battery Replacement Label is supplied with the Replacement Battery (See Figure 2.7b). Directions for installing this external label are described in Section 5.5.

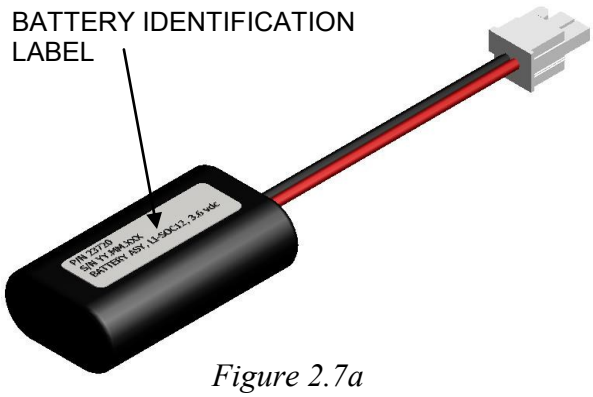


Figure 2.7a

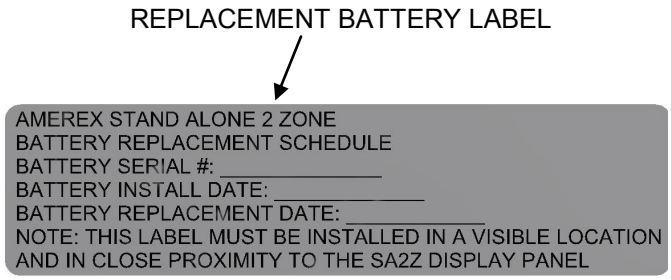


Figure 2.7b

2.8 Dust Plugs, Actuation (P/N 24139); Communication (P/N 24138) [ITEM 16]

A Communication Dust Plug must be installed on the PC Interface connector of the Master Harness at all times. An Actuation Dust Plug must be installed on the actuation connector of the Master Harness on any unused and disabled actuation circuits (See Section 4.6.5). These plugs are sealed to protect the circuit connectors from moisture, dirt or debris. Plugs are included with the Operator Panel as shown in the Parts List (See Section 2.9).

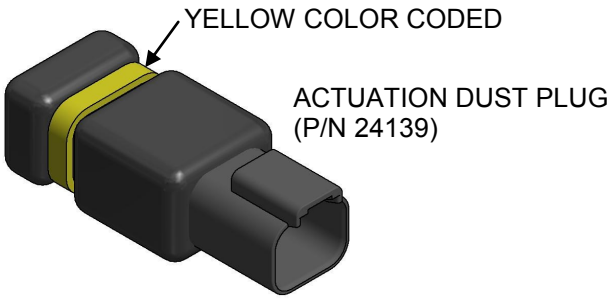


Figure 2.8a

Figure 2.8b

2.9 Parts List

Parts List			
Item Number	**Part Number**	**Description**	**Qty. per System**
1	22822	Operator Panel, SA2Z	1
2	23848	Spot Heat Detector 280°F (Bracket Mount)	Optional
	23460	Spot Heat Detector 350°F (Bracket Mount)	
	23462	Spot Heat Detector 450°F (Bulkhead Mount)	
3	23463-05	Linear Heat Detector (With Protective Spring), 5 Foot Length	Optional, Max 100 Feet Total Per Detection Zone
	23463-10	Linear Heat Detector (With Protective Spring), 10 Foot Length	
	23463-16	Linear Heat Detector (With Protective Spring), 16 Foot Length	
	23463-20	Linear Heat Detector (With Protective Spring), 20 Foot Length	
	23463-25	Linear Heat Detector (With Protective Spring), 25 Foot Length	
	23464-05	Linear Heat Detector (Without Protective Spring), 5 Foot Length	
	23464-10	Linear Heat Detector (Without Protective Spring), 10 Foot Length	
	23464-16	Linear Heat Detector (Without Protective Spring), 16 Foot Length	
	23464-20	Linear Heat Detector (Without Protective Spring), 20 Foot Length	
	23464-25	Linear Heat Detector (Without Protective Spring), 25 Foot Length	
4	22940-03	Master Harness, 3 Foot Length	1*
5	21539-10	Pressure Switch Cable, 10 Foot Length	Optional
	21539-20	Pressure Switch Cable, 20 Foot Length	
	21539-30	Pressure Switch Cable, 30 Foot Length	
	21539-40	Pressure Switch Cable, 40 Foot Length	
	21539-50	Pressure Switch Cable, 50 Foot Length	
	21539-55	Pressure Switch Cable, 55 Foot Length	
6	23091-03	Class B Detection Hazard Cable, 3 Foot Length	Optional
	23091-06	Class B Detection Hazard Cable, 6 Foot Length	
	23091-10	Class B Detection Hazard Cable, 10 Foot Length	
	23091-16	Class B Detection Hazard Cable, 16 Foot Length	
	23091-20	Class B Detection Hazard Cable, 20 Foot Length	
	23091-25	Class B Detection Hazard Cable, 25 Foot Length	
	23091-30	Class B Detection Hazard Cable, 30 Foot Length	
	23091-40	Class B Detection Hazard Cable, 40 Foot Length	
	23091-50	Class B Detection Hazard Cable, 50 Foot Length	

* included with Operator Panel, P/N 22822 (ITEM 1)

Parts List (continued)			
Item Number	**Part Number**	**Description**	**Qty. per System**
7	23110-03	Actuation Cable, 3 Foot Length	Optional
	23110-06	Actuation Cable, 6 Foot Length	
	23110-10	Actuation Cable, 10 Foot Length	
	23110-16	Actuation Cable, 16 Foot Length	
	23110-20	Actuation Cable, 20 Foot Length	
	23110-25	Actuation Cable, 25 Foot Length	
	23110-30	Actuation Cable, 30 Foot Length	
	23110-40	Actuation Cable, 40 Foot Length	
	23110-50	Actuation Cable, 50 Foot Length	
8	23211-05	Output Cable, 5 Foot Length	Optional
	23211-10	Output Cable, 10 Foot Length	
	23211-25	Output Cable, 25 Foot Length	
	23211-50	Output Cable, 50 Foot Length	
9	24106	PC Interface Cable	Optional
10	17609	Agent Cylinder Pressure Switch	REF
11	23850	100 PSI Pressure Switch	REF
12	20500	Linear Actuator	REF
13	23474	End of Line Module (EOL)	2*
14	23720	Replacement Battery	Optional
15	01387	Tamper Seal (not shown)	1*
16	24139	Dust Plug, Actuation	Optional (1*)
	24138	Dust Plug, Communication	1*

* included with Operator Panel, P/N 22822 (ITEM 1)

Chapter 3: Hazard Analysis

3.1 Introduction

Before any component of the Amerex fire suppression system is installed, including electronics, the hazards to be protected must be identified. These hazards determine where and type of detection that is required along with the type of and quantity of fire suppression agent necessary for protection. When performing a hazard analysis, some helpful tools that can be useful are:

- Flashlights – for those hard to see places.
- Cameras and note pads – for helping with documenting the construction of the vehicle fire suppression system and creating a bill of materials. Installers must document and retain all system designs.
- Temperature measuring devices – Thermocouples work well in helping to identify vehicle operating temperatures. Knowing the vehicle operating temperature details is crucial in selecting appropriate hardware when doing a hazard analysis and system layout.
- Access to all Amerex Installation, Operation, & Maintenance Literature – System may require hardware not located in this manual.

NOTE: On all installations, consult the vehicle manufacturer and property owner before making any modifications to equipment.

3.2 Hazard Analysis

A hazard analysis is used as the first step in a process used to assess risk of fire. The result of a hazard analysis is the identification of fire risks. The National Fire Protection Association (NFPA) offers a series of standards with guidelines for a particular product or system being installed. When conducting a hazard analysis, all applicable standards must be observed. Examples of such standards include, but are limited to: NFPA 17, 17A, 52, 120, and 122. Below are some additional considerations to be evaluated when doing a hazard analysis.

3.2.1 Identify the Ignition Source(s)

The potential for hot surfaces such as exhaust manifolds, muffler compartments, hydraulic pumps, and turbochargers can be ignition sources. Other hot surface ignition sources can be friction buildup from bearings, brakes, and gears. Electrical shorts from vehicle electronics and batteries can also be ignition sources.

3.2.2 Identify the Fuel Source(s)

Fuels can be found in many different forms including, but not limited to:

- Class A Material - Wood, paper, coal dust, rags, hoses, tires, combustible refuse buildup.
- Class B Material - Flammable and combustible liquids such as gasoline, diesel fuel, cleaning fluids, hydraulic fluids, brake fluids, transmission fluids.
- Class C Material - Class C items describe sources of electrical current that can energize an area where a fire is present.

3.2.3 Consulting Vehicle Owner and/or Original Equipment Manufacturer

Previous experience with machinery may indicate where special hazards exist. Knowing the history about a particular model of vehicle/machine may help with decisions in protection.

3.2.4 Potential Workplace Hazards for the Equipment

Refuse vehicles frequently work in landfills. Some landfills carry substantial class A fuel sources. Machines working in steel refineries can be exposed to external ignition sources. These types of external hazards will have to be considered when determining the right protection required for the particular machine.

3.2.5 Considerations to be Evaluated

- Is the hazard in an open area or closed compartment? In an open area, each hazard must be treated as a local application with careful considerations for selecting appropriate detection. Open area hazards can present challenges with heat transfer to the detector if the detector is not properly located for identifying the overheat condition.
- Are there many obstructions? Obstructions can limit the exposure of heat to the heat detector. It may be necessary to use additional quantity of heat detection to compensate for obstructions.
- How much air flows through the hazard? Airflow can adversely affect of nozzles and dispersion of Dry Chemical Agents. It may be necessary to use additional Nozzles to compensate for air flow.
- What are the dimensions of the hazard? Determining hazard dimensions allows for Agent Cylinder size(s) and Nozzle quantities to be calculated.
- What is the potential for the hazard to spread to other areas of the vehicle/machine? Additional protection may be required for those areas as well.
- Does the vehicle/machine have additional hand portable extinguishers? Hand portable fire extinguishers are necessary to be used as a backup to an automatic fire suppression system. Appropriate type and rating of hand portable fire extinguishers must be considered.

3.2.6 Selecting the Appropriate Agent

After identifying ignition and fuel sources (see Sections 3.2.1 and 3.2.2), the appropriate fire suppression agent must be selected.

- ABC Dry Chemical - Works well on all Class A, B, and C fires. See the latest version of the Modular Dry Chemical System Manual (P/N 13980) located on the Amerex website at www.amerex-fire.com.
- Purple K Dry Chemical - Works well on Class B fires. See the latest version of the Modular Dry Chemical System Manual (P/N 13980) located on the Amerex website at www.amerex-fire.com.
- ICE Liquid Agent - Works well on Class A and B fires and is good for cooling hot surfaces (turbochargers, exhaust manifolds), but must not be used on electrically energized equipment (batteries, alternators, starters). See the latest version of the ICE System Manual (P/N 22012) located on the Amerex website at www.amerex-fire.com.

3.2.7 Selecting the Appropriate Method of Detection

After identifying vehicle hazard areas, it is necessary to select the appropriate form of detection for those areas. See the applicable electronics manual located on the Amerex website at www.amerex-fire.com.

- Spot Heat Detectors - Localized area devices that react to “set point” temperatures of 280ºF (138ºC), 350ºF (177ºC) or 450ºF (232ºC).

- Linear Heat Detectors (LHD) - Broad area “linear wire” devices of various lengths, that have large surface area for heat detection with a temperature “set point” of 356ºF (180ºC).

3.2.8 Selecting Methods of Actuation

If automatic actuation of any Agent Cylinders in the Amerex Fire Suppression System is selected, a manual means of actuation is also required. At least one manual means of actuation must be located within reach of the vehicle operator during normal vehicle operation. Additional manual means of actuation should be located conveniently in accessible areas along paths of egress. Such manual actuation devices include:

- Manual or Manual/Electric Actuator (P/N 10210 or 23600) - Pneumatic actuation device located in the drivers area or other locations accessible in the event of a fire. Reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual.

Chapter 4: System Design & Installation

This chapter describes design and installation of the Amerex Stand Alone 2 Zone (SA2Z) system. For the addition of mechanical components as part of a fire suppression system such as Nozzles, Agent Cylinders and Pneumatic Actuation Networks, reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual.

4.1 Steps to System Design

- The appropriate quantity and selection of agent cylinders, nozzles and heat detection devices should be made after a hazard analysis has been completed. Selection of the appropriate electrical panels should be made.
- The Operator Panel must be properly located and installed (See Section 4.2).
- The appropriate heat detection devices and manual means of system activation must be located and installed. (See Section 4.3)
- Appropriate lengths and selection of wiring harnesses must be made to accommodate detection zone circuit(s) including the particular style of heat detection device used. Appropriate wiring paths must be made from the heat detection device to the Operator Panel. (See Section 4.3).
- Appropriate lengths and selection of wiring cables must be made to accommodate the actuation circuit(s) (discharge zones). Appropriate wiring paths must be made from any Linear Actuators to the Operator Panel. (See Section 4.4).
- Any auxiliary input/output devices shall be selected and located/installed. Wiring for such devices must be installed. Proper termination of the wiring harness must be performed (See Section 4.5).
- Once all wiring connections are made, Operator Panel programming can be performed (See Section 4.6).
- Component Testing and Initial Commissioning must be performed (See Section 4.7).

4.2 Operator Panel Installation

The Operator Panel (P/N 22822) must be mounted in a convenient location permitting periodic maintenance and inspection along with minimal wiring and cable lengths. Proper routing of all wiring and cables to each system component is required and should be considered when choosing an appropriate location. Any obstacles, moving parts, hazard areas, or bulkheads that may inhibit complete connection of all system components or cause damage to components must be avoided.

The Operator Panel must be mounted in a location where the audio and visual indicators on the face of the panel may be seen and heard from the operator's seat. The Operator Panel should be mounted in a dry location safe from any potential weather, moisture and excessive vibration and must me mounted to a surface capable of supporting the weight of the panel and any additional mounting components. The Operator Panel is typically surface mounted (See Figure 4.2). Consider the most convenient routing path of the mating Master Harness (P/N 22940) to determine the best mounting location for the particular application.

Operator Panel Surface Mounting: For surface mount applications, use the dimensions shown in Figure 2.1b or match drill four holes in the selected mounting surface for mounting screws. Assemble the Control Panel to the mounting surface using the appropriate hardware (See Figure 4.2). **Do not plug the Master Harness into the Operator Panel until directed to do so in Section 4.6.**

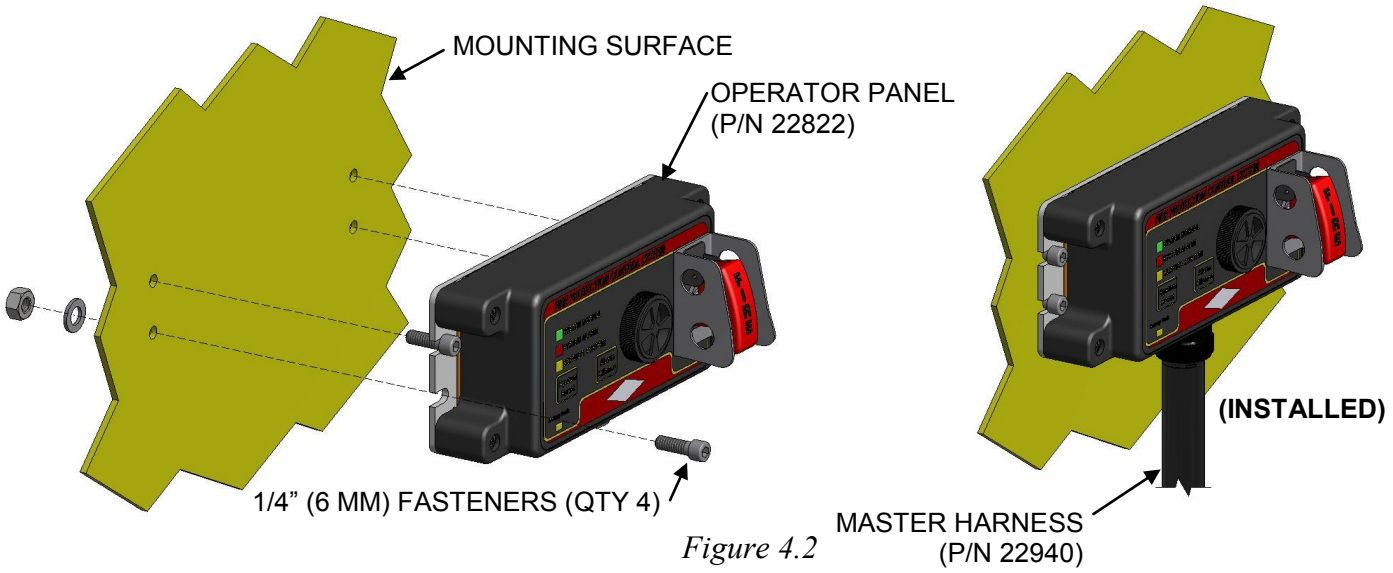


Figure 4.2

4.3 Detection Component Installation

Amerex offers two types of heat detection devices that can be utilized in the SA2Z system. These devices include Linear Heat Detectors (LHDs) and Spot Heat Detectors (SHDs). Each device must be installed as specified in the following sections.

4.3.1 Linear Heat Detector (LHD) (P/N 23463/23464)

The Linear Heat Detector (LHD) is a preset (356ºF/180ºC) heat sensing device capable of sensing an overheat condition at any point along its routed path. All LHDs must be installed in accordance with the following instructions:

- The LHD must be installed in a hazard area where the potential for fire or overheat conditions exist.
- The LHD must be installed in areas where potential damage resulting from normal vehicle operation will NOT occur. The LHD must NOT be chafed, cut, bent or crushed. The LHD with protective spring (P/N 23463) should be used when extra protection of the LHD is needed.
- The LHD wire must not be installed within any hazard area that exceeds 256°F (124ºC) during normal operating conditions. Physical contact with any high heat surfaces exceeding 256°F (124ºC) is not permitted.
- Selection of the LHD length should be such that it adequately covers the hazard area but is not excessively long, reducing the potential of damage. The LHD must not interfere with routine vehicle maintenance.
- The LHD must be installed in the Class B detection circuit. Multiple LHDs can be connected in series or used in the same circuit, but combined length of all LHDs used in a single circuit must not exceed 100 feet (30 m).
- The LHD should be mounted high in the hazard compartment where higher temperatures are prevalent in overheat conditions.
- The LHD must not be installed taught without strain relief. The LHD must not be crimped, pinched or bent beyond it's minimum bend radius of 2 1/2".

- Each LHD must be installed using padded p-clamps (See Figure 4.3.1a) or the p-clamps can be substituted with cable ties and rubber sleeves (See Figure 4.3.1b). If p-clamps are used, LHDs without the stainless steel spring wire (P/N 23464) will use a 3/16" padded p-clamp (P/N 18720), while LHDs with the protective stainless steel spring wire (P/N 23463) will use a 3/8" padded p-clamp (P/N 23038). The LHD must be secured a minimum of every 18" (0.46 m).

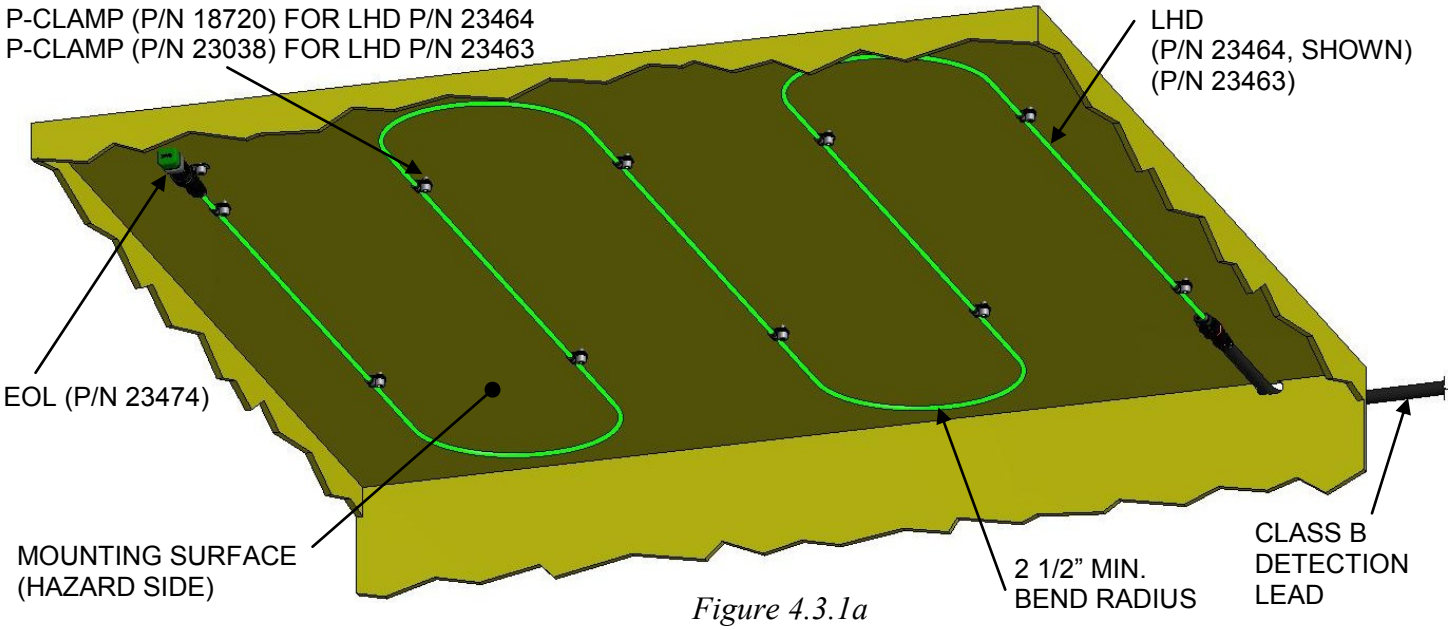


Figure 4.3.1a

Use of cable ties and rubber sleeve material is permitted only when using Amerex kits (P/N 23005 or P/N 23006). If using LHDs without the protective spring (P/N 23464), the 3/16" LHD Clamp Kit (P/N 23005) must be used, while LHDs with the protective spring (P/N 23463) will require the 3/8" LHD Clamp Kit (P/N 23006). The LHD must be secured to supporting structure by cinching the cable tie over hose, LHD, and structure (See Figure 4.3.1b). The LHD must be secured a minimum of every 18" (0.46 m).

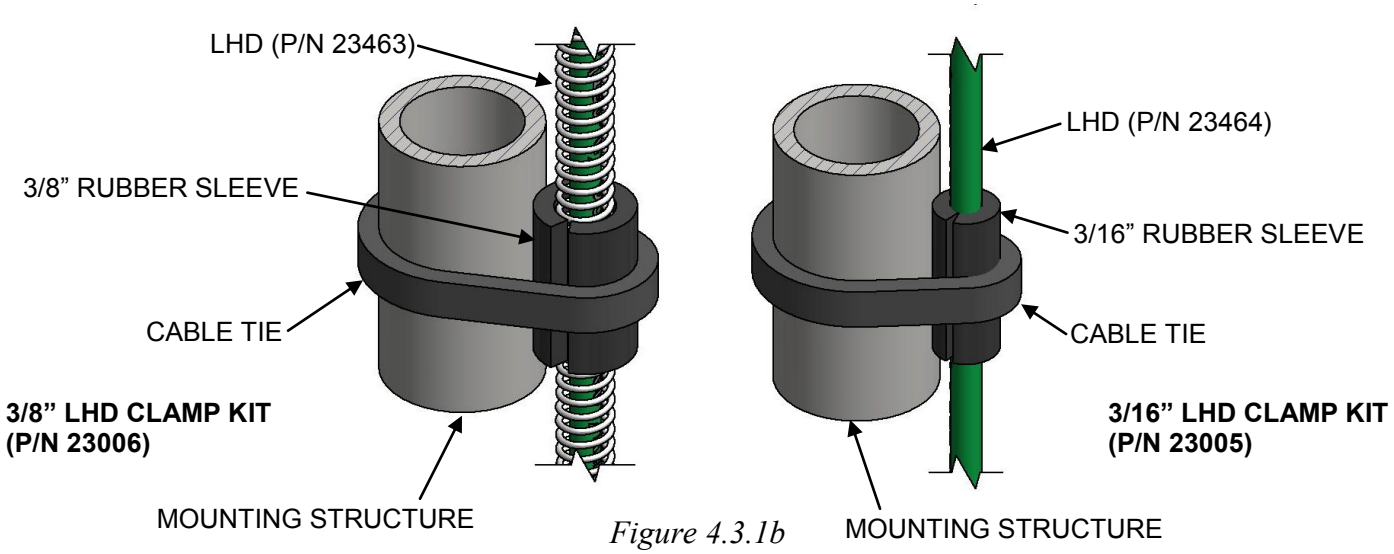


Figure 4.3.1b

4.3.2 Spot Heat Detector (SHD) (P/N 23848/23460/23462)

The Spot Heat Detector (SHD) is a preset heat sensing device designed to detect heat in localized areas of the hazard compartment. Three SHDs are available with preset temperature set points and mounting styles. All SHDs must be installed in accordance with the following instructions:

- The SHD must be installed in a hazard area where the potential for fire or overheat conditions exist. Ambient operating temperature range for a SHD is 100ºF less than the set point, but maximum temperature for the wiring portion of the SHD must not exceed 300ºF (149ºC) for extended periods of time.
- The SHD can be mounted in any orientation as long as the metallic sensor tip is subjected to the hazard area that is to be protected. Locate the SHD where mud, oil or foreign debris do not interfere with the sensor tip. Locations subject to environmental extremes should also be avoided.
- The SHD and its wiring must be installed in a location allowing access for testing and maintenance.
- The SHD sensor is vibration resistant. However, do not install the sensor and wiring in locations with different vibration characteristics. For example, the sensor should not be mounted on an engine and the wiring fixed to the chassis unless proper cable routing and support are provided.
- Secure the SHD sensor wiring using a padded p-clamp located on or within 4” (0.1 m) of each connector (See Figure 4.3.2a).
- The bracket style SHDs (P/N 23848/23460) must be mounted using their standard bracket and the appropriate hardware (See Figure 4.3.2a). The bulkhead style SHD (P/N 23462) must be mounted in a bulkhead configuration (See Figure 4.3.2b) by drilling a single 25/32” to 7/8” hole through the bulkhead (3/16” MAX thickness) and inserting the SHD. Secure by threading the 1 1/8” jam nut to the threaded portion of the SHD using a medium grade thread locking compound. Tighten to a maximum of 10 inch-lbs.

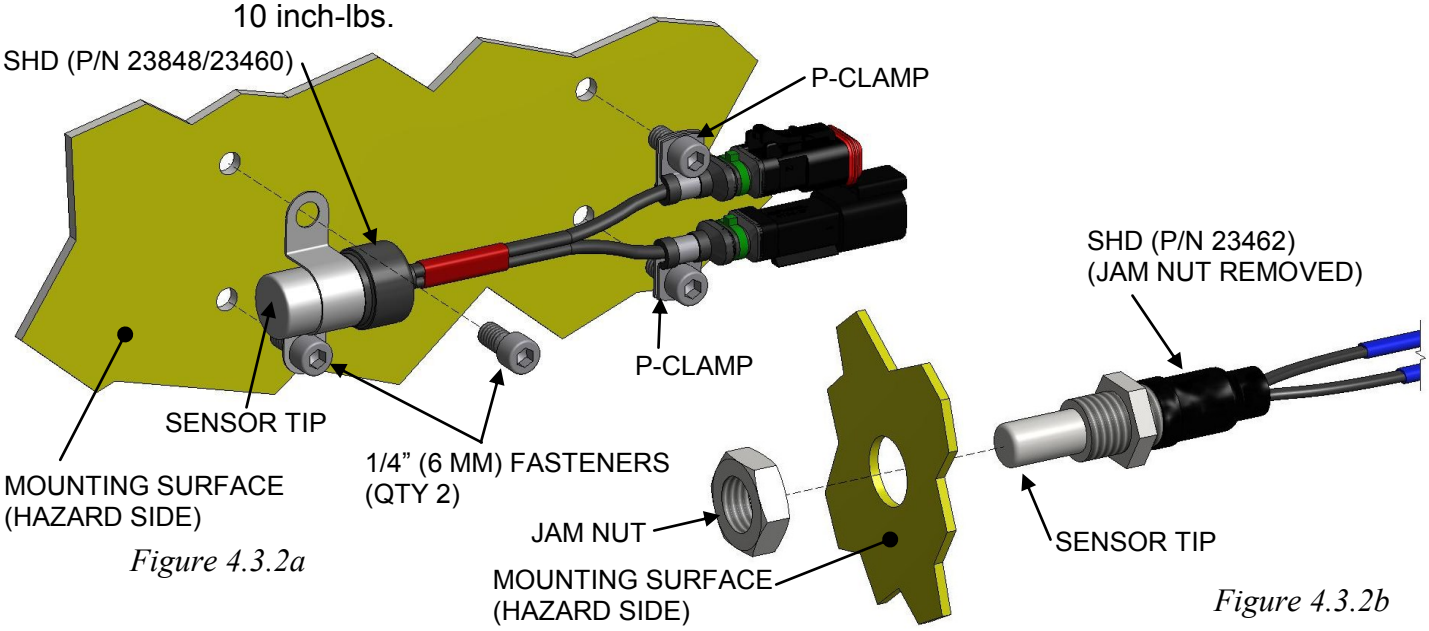


Figure 4.3.2a

Figure 4.3.2b

4.3.3 100 PSI Pressure Switch (P/N 23850)

The 100 PSI Pressure Switch is a normally open switch used to indicate that a system actuation has occurred by means of manual actuation via a Pneumatic Actuation Network. Reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual for switch and Pneumatic Actuation Network installation instructions. The switch is connected to a Class B detection circuit of the SA2Z system.

4.3.4 Detection Circuits

The SA2Z system can support up to two dedicated Class B detection circuits. Each Class B detection circuit supports the use of Spot Heat Detectors (SHD), Linear Heat Detectors (LHD), and 100 PSI Switches. These Class B devices are optional and can be used in any combination by connecting in series. An End of Line Module or EOL (P/N 23474) is always required at the end of the Class B detection circuit. An example schematic is shown, which includes all available cables and devices, some of which are optional (See Figure 4.4). All detection components/cables are color coded green. All cables must be secured to vehicle structure a minimum of every 18" (0.46 m).

4.4 Actuation Circuits (Discharge Zones)

Actuation circuits (discharge zones) connect to a Linear Actuator (P/N 20500) for actuation of the Amerex Fire Suppression System. The SA2Z system supports up to two actuation circuits and therefore two Linear Actuators (See Figure 4.4). Each actuation circuit can be programmed for a delay (0-15 seconds) if desired, after detection of an overheat condition. Additionally, each actuation circuit (discharge zone) can be programmed or mapped to only actuate with an associated heat detection circuit/zone. See Section 4.6 for mapping discharge zones with detection zones. An example schematic is shown, which includes available cables and Linear Actuators (See Figure 4.4). All actuation components/cables are color coded yellow. **The installer must avoid routing any cable or component associated with an actuation circuit through any hazard areas.** All cables should be secured to vehicle structure a minimum of every 18" (0.46 m). Reference the appropriate Amerex Fire Suppression Installation, Operation and Maintenance Manual for Linear Actuator installation instructions. Install an Actuation Dust Plug (P/N 24139) on any unused actuation circuits (discharge zones).

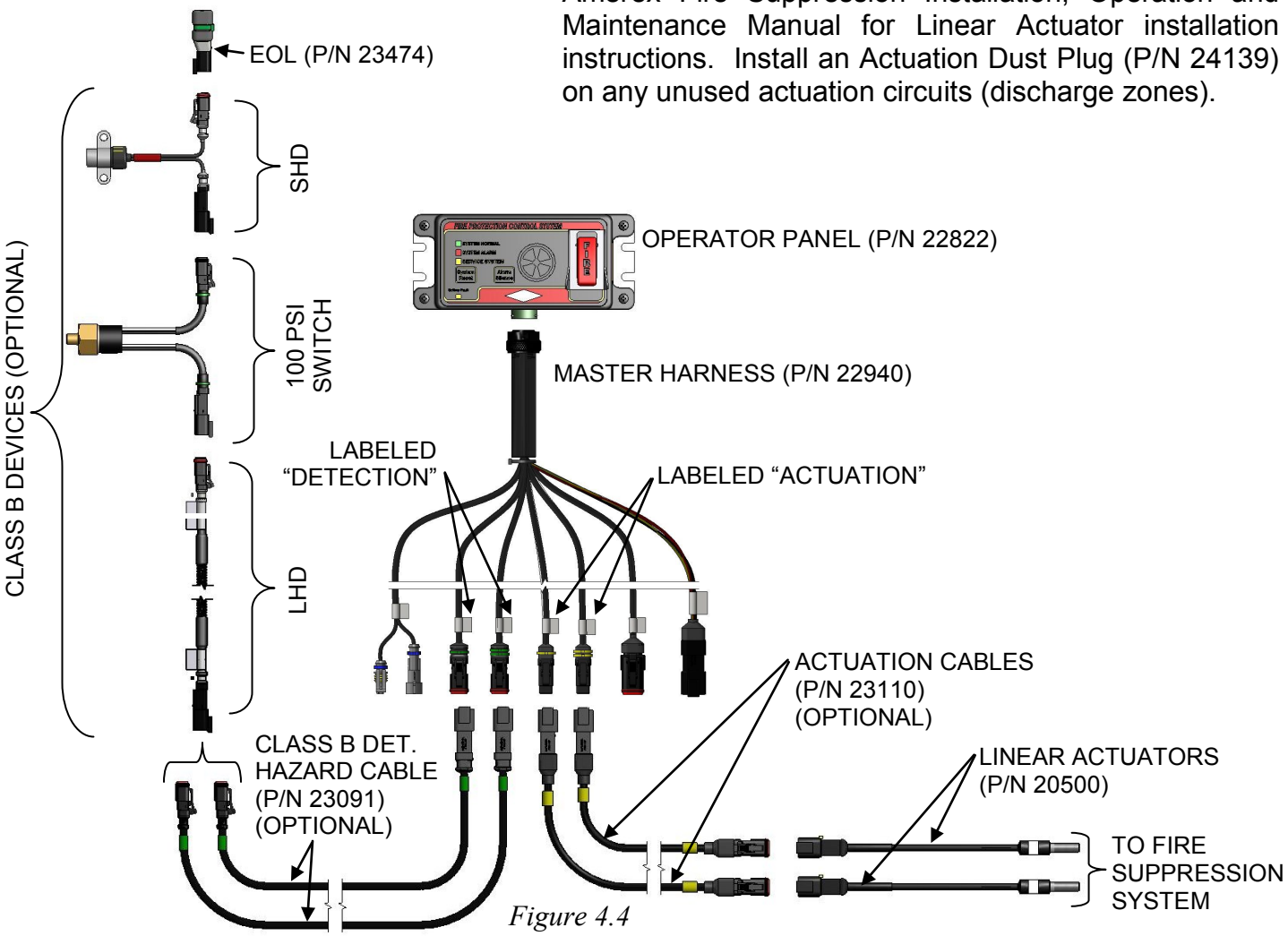


Figure 4.4

4.5 Input / Output Devices

All cables and wiring should be secured to vehicle structure a minimum of every 18" (0.46m).

4.5.1 Agent Cylinder Pressure Switch Input

The Pressure Switch (P/N 17609) located on a fire suppression agent cylinder is connected to the SA2Z system through a pressure switch circuit on the Master Harness. This normally closed circuit monitors the pressure within an Agent Cylinder and indicates a fault (trouble) condition if pressure is lost. If more than one Agent Cylinder is used, the additional Pressure Switch(es) will be connected in series using a Pressure Switch Cable (P/N 21539), forming a circuit loop as shown (See Figure 4.5). If no Pressure Switch is used, connect the two pressure switch connectors on the Master Harness to each other, closing the circuit loop.

4.5.2 Auxiliary Outputs, Fire & Fault (Trouble) Conditions

The auxiliary outputs are provided as a connection on the Master Harness. The Output Cable (P/N 23211) contains individual, colored, blunt cut wires for connecting any external devices to these outputs. Or, the 'Output Signals' connector on the Master Harness can be cut off if blunt cut wires are needed without the use of the Output Cable. These normally open outputs are used to send signals to external devices or alarms when an alarm or fault (trouble) condition occurs. The external devices can be used to power down the vehicle or components on the vehicle to enhance fire fighting measures. During a hazard analysis, the external components that may impede the abilities or dispersion of the fire suppression system must be evaluated and accounted for by using these output signals. Output signals are rated for a max of 1/2 Amp each @ 50 VDC and are delay programmable. Figure/Table 4.5 show the available output circuits and colors. Note: In addition to the fire output, the fault (trouble) output will also close during an alarm condition.

Auxiliary Outputs		
Wire Color	**Function**	**Condition**
Red	Common	-
Yellow	Alarm Condition	Normally Open
White	Fault Condition	Normally Open
Black	NOT USED (located on 23211 only)	

Table 4.5

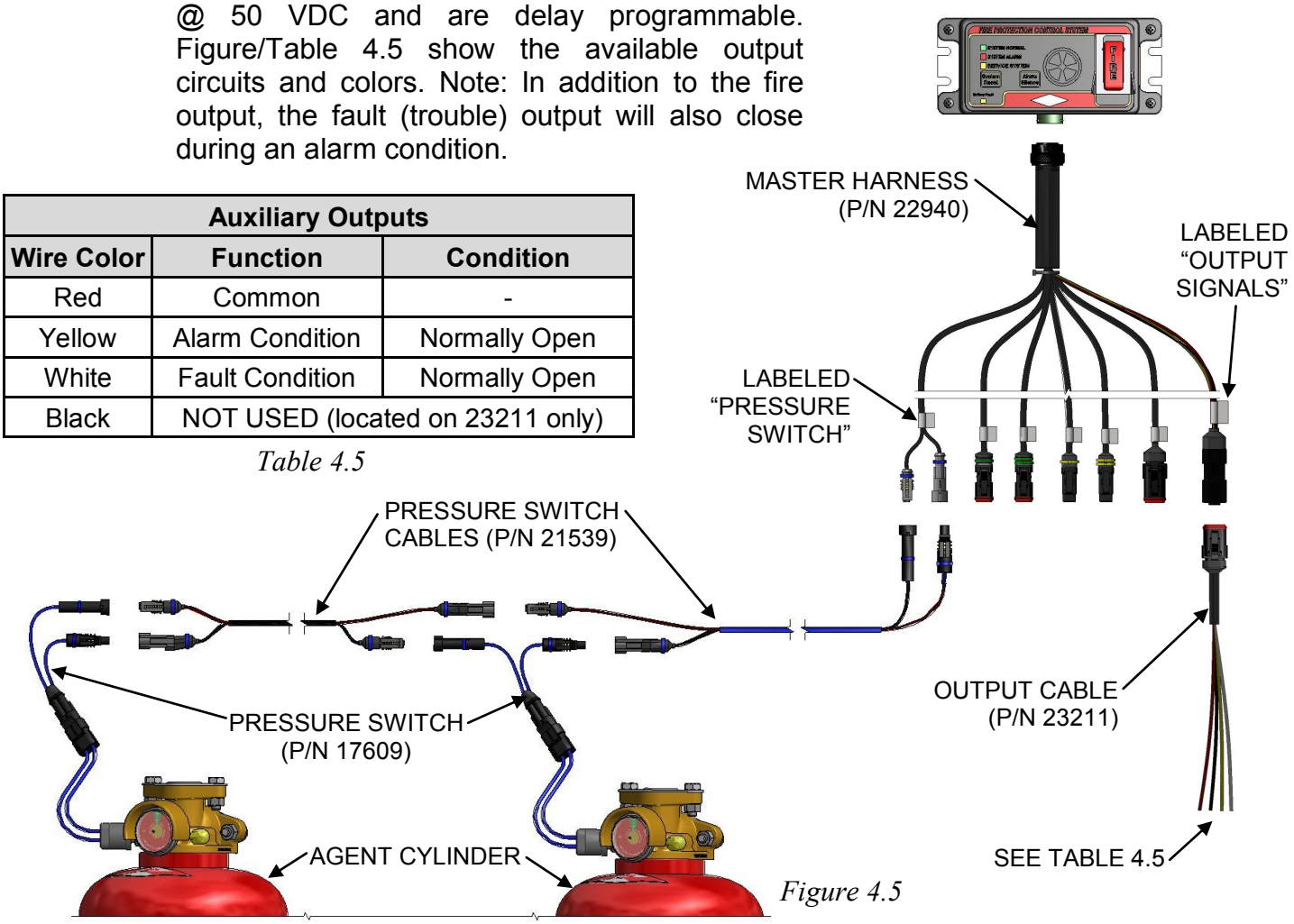


Figure 4.5

4.6 Operator Panel Programming

Once the complete SA2Z system including Operator Panel, all detection devices, any outputs, and all associated cables are installed and connected to the Master Harness, Operator Panel programming can begin. **Do not connect the Master Harness to the Operator Panel until directed to do so in Section 4.6.1.** The SA2Z system is pre-programmed to require all available circuits (all heat sensors, pressure switches, actuators, etc.) be connected to the system. Default programmed settings and default mapping between detection and discharge zones are shown in Table 4.6.3. However, a trained technician can program a system for any desired configuration as detailed in the following sections. **In order to preserve battery power, it is necessary to temporarily replace the Operator Panel battery pack with a spare Replacement Battery (P/N 23720) to perform any programming.** The original battery will be reinstalled after initial commissioning, just prior to placing the system into service as described in Section 4.7.

4.6.1 Temporary Spare Battery Installation

Before connecting the Master Harness to the Operator Panel, the Operator Panel battery must be replaced with a spare Replacement Battery (P/N 23720). Since programming operations and potential fault (trouble) conditions consume battery power, this process ensures that the original battery remains at full power. To replace the battery, remove the cover of the Operator Panel by loosening the four cover screws as shown. Take care not to damage any electronic components. Disconnect the original battery connector from the back of the Operator Panel cover on the circuit board (See Figure 4.6.1). Then, connect the spare Replacement Battery in its place. The Master Harness can now be connected to the Operator Panel. The Operator Panel will then power up, illuminate, and indicate system status. If all available circuits are not desired and therefore not connected, a fault (trouble) condition will be generated until the configuration is programmed to match the desired system design.

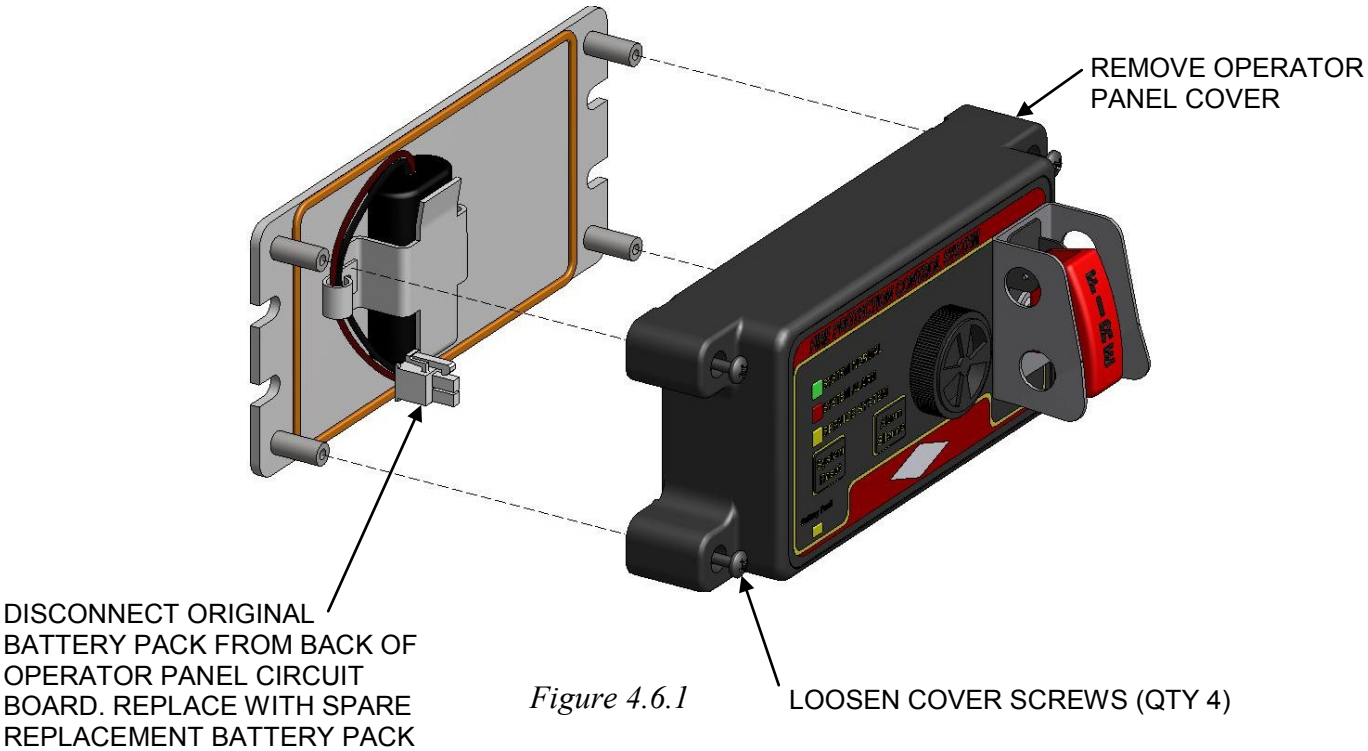


Figure 4.6.1

4.6.2 PC Interface Installation & Connection

The Amerex SA2Z PC software, included with the PC Interface Cable (P/N 24106), may be installed on any PC operating with Microsoft Windows 8 or earlier version via an included CD ROM or other electronic transfer media. The executable file and drivers are installed in the Users 'Programs' or 'Program Files' folder in a sub-folder named 'Amerex'. The software also creates a folder in the users 'Documents' folder named 'My Amerex Files'. In the 'My Amerex Files' folder, an 'SA2Z Panel' folder is created with subfolders including 'Config', 'EventLog', and 'Update'. After installation is complete, an executable icon is placed on the user's Desktop.

Connect the PC interface Cable from the PC Interface connector on the Master Harness to a USB slot on the PC (See Figure 4.6.2). Double clicking on the Amerex SA2Z Utility icon opens and displays the SA2Z Panel Utility window. This window uses the common Microsoft Windows menu structure. The latest version of SA2Z PC software is also available on and can be downloaded from the www.amerex-fire.biz website.

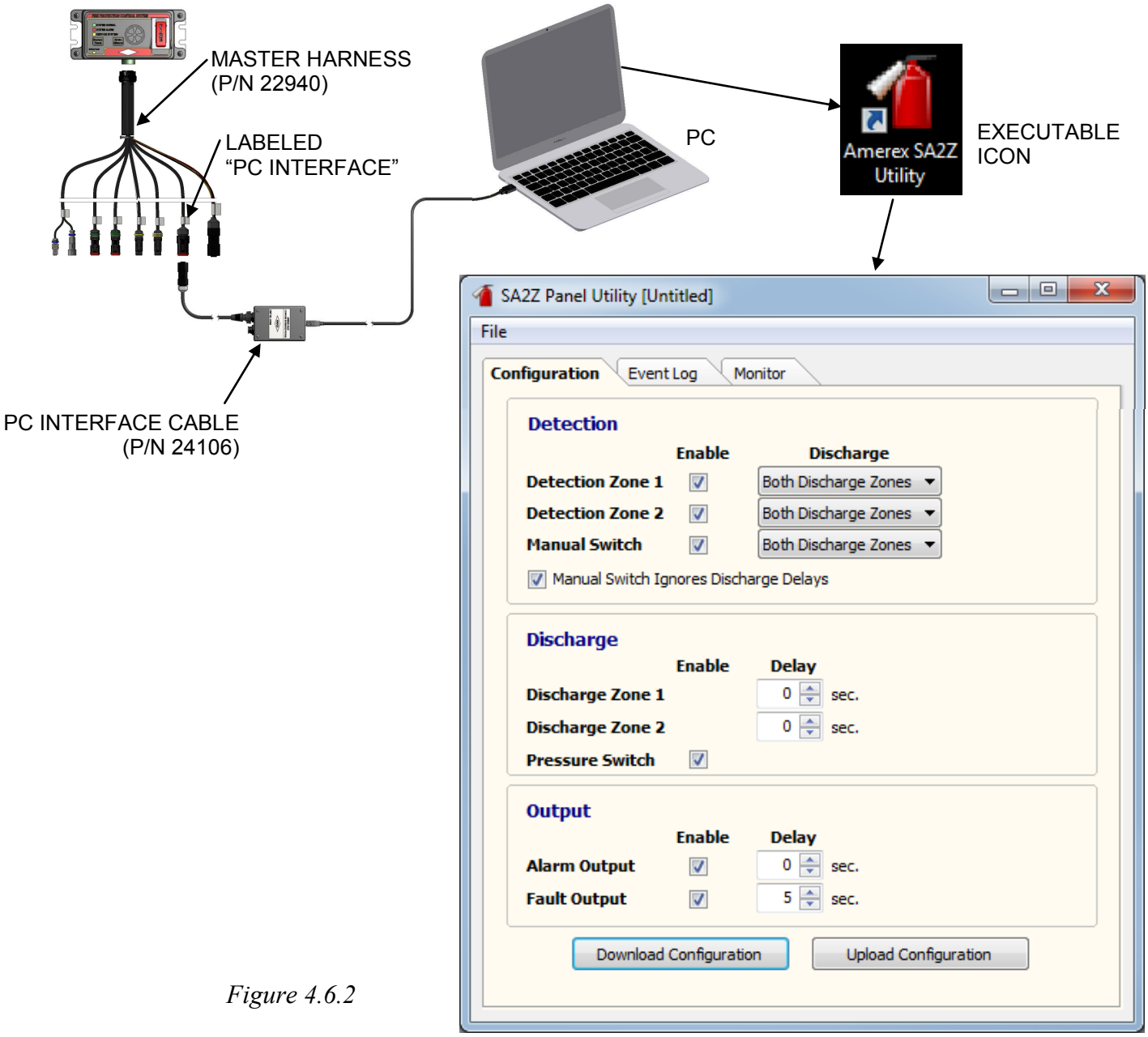


Figure 4.6.2

4.6.3 Programming a System Configuration (Basic)

The Amerex SA2Z system is pre-programmed to require all supervised inputs (all heat sensors, pressure switch, actuators, etc.) to be connected to the system. If a system design does not require all inputs be connected or if a custom configuration is desired, a trained technician can modify the system configuration using “basic” programming options. The Operator Panel must be in programming mode for any configuration changes. Also, verify the latest version of SA2Z software is installed on the PC.

Enter Programming Mode - The Operator Panel programming mode is started by pressing and holding the ‘System Reset’ button and ‘Alarm Silence’ button for a period of 5 seconds (See Figure 4.6.3a). Programming mode is indicated by two LED flashes and two audible alarm beeps. The Operator Panel will automatically exit programming mode and return to normal after one minute, if no programming functions are performed, as indicated by a single LED flash and audible alarm beep. NOTE: The Operator Panel is disabled while in programming mode.

PRESS AND HOLD ‘System Reset’ AND ‘Alarm Silence’ BUTTONS TO ENTER PROGRAMMING MODE

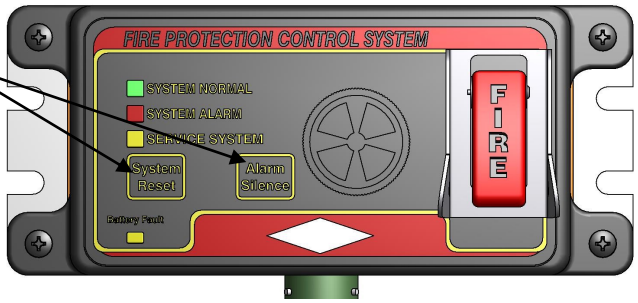
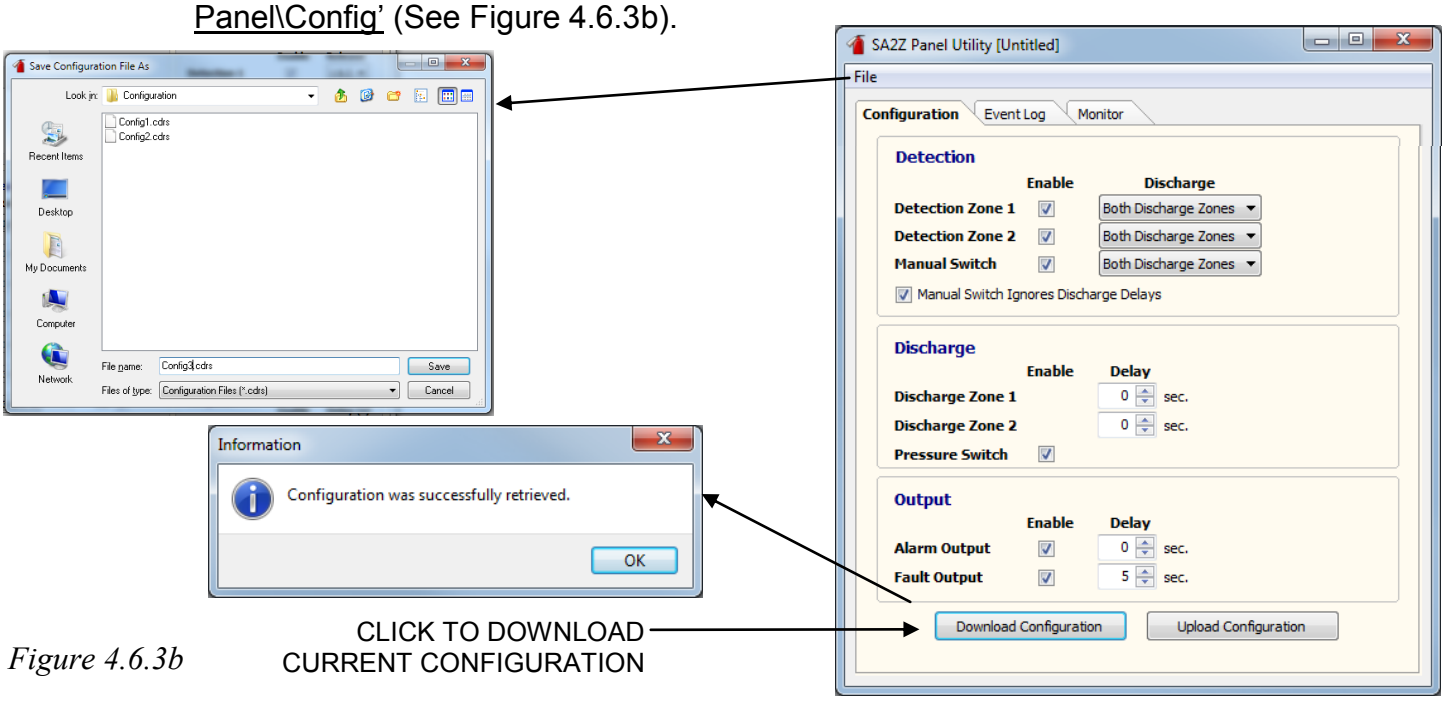


Figure 4.6.3a

Downloading A System Configuration - Prior to making any changes to the system configuration, common practice is to download the configuration that currently exists on the SA2Z system. Ensure the PC Interface Cable is connected and the Operator Panel is in programming mode. Open the Amerex SA2Z Utility on the PC. The current configuration can be downloaded to the PC by clicking the ’Download’ Configuration’ button in the lower left corner of the SA2Z Panel Utility window. A successful download is indicated by an Information window. The downloaded configuration may then be saved on the PC for future use by selecting the ‘File” tab and “Save As”. The default folder in the user’s ‘Documents’ folder is ‘My Amerex Files\SA2Z Panel\Config’ (See Figure 4.6.3b).



CLICK TO DOWNLOAD CURRENT CONFIGURATION

Figure 4.6.3b

Modifying a System Configuration - The trained technician is now able to adjust the various settings available with the SA2Z system. Two Class B detection zones and manual release switch are available, up to two actuation circuits may be mapped, and a variety of time delays and outputs may be programmed. A complete list of programming options and default settings is shown in Table 4.6.3.

Table 4.6.3

Programming Feature	Programming Range	Default Setting
Class B Detection Zones (Detection Circuits)	Zone 1 and Zone 2 Enabled/Disabled	Both Zones Enabled
	Discharge Zone Mapping: None, 1, 2, Both	Both Zones Mapped to: Both Discharge Zones (1 & 2)
Manual Release Switch (Switch on Op. Panel Face)	Enabled\Disabled	Enabled
	Discharge Zone Mapping: None, 1, 2, Both	Both Discharge Zones (1 & 2)
	Obey\Ignore Discharge Zone Delays	Ignore
Discharge Zones (Actuation Circuits)	Zone 1 and Zone 2 Enabled/Disabled	Both Zones Enabled
	Delay: 0-15 seconds in 5 second increments	Both Zones: 0 second delay
Pressure Switch Input	Enabled\Disabled	Enabled
Alarm Output	Enabled\Disabled	Enabled
	Delay: 0-30 seconds in 5 second increments	0 second delay
Fault Output (Trouble)	Enabled\Disabled	Enabled
	Delay: 5-30 seconds in 5 second increments	5 second delay

Enable/Disable Detection Zones - Both detection zones are enabled as a default setting. However, unused detection zones can be disabled if desired. In the SA2Z Panel Utility window, disable an unused detection zone by unchecking the 'Enable' box next to that detection zone.

Programming Detection Zones with Discharge Zones - The SA2Z system has two zones of detection with two discharge zones (actuation circuits). Each detection zone can be mapped to the desired discharge zone(s) as a means of actuating a fire suppression system. In the SA2Z Panel Utility window, select the desired discharge zone(s) by choosing from the drop menu next to each detection zone. A single discharge zone, both zones, or no zones may be selected. If a detection zone is to be used as a warning device only for an overheat condition, select 'None' for the discharge zone (See Figure 4.6.3c).

Programming a Manual Switch - The manual release switch, located on the face of the Operator Panel, is enabled as a default setting since a manual means of system actuation is almost always required. Like detection zones, the associated discharge zone(s) for the manual switch may be selected from the pull down menu next to it in the SA2Z Panel Utility window. However, in the rare case that this switch will be unused, it may be disabled by unchecking the 'Enable' box next to it. As an additional feature, an enabled switch can use or ignore any programmed discharge zone time delay by checking/unchecking the box under the manual switch (See Figure 4.10.3c).

Discharge Zone Time Delay - Each discharge zone may be programmed with an optional actuation delay from 0-15 seconds between system detection and discharge. This discharge delay must only be used in applications where external devices or components must be powered down or changed from one state to another (such as powering a fan down or reducing the speed of a machine to minimize air flow) to enhance fire suppression system capability and dispersion (See Figure 4.6.3c).

Pressure Switch - The pressure switch circuit is default enabled. If the pressure switch circuit will not be used, uncheck the 'Enable' box next to it (See Figure 4.6.3c). See Section 4.5 if no pressure switches are used in a system configuration.

Alarm and Fault Output Time Delay - The Alarm Output can be used to switch external devices on or off in the event of a fire or overheat condition. The Fault Output can be used to indicate a trouble condition or fault within the system. Both outputs are default enabled and may be programmed with an optional delay from 0-30 seconds (alarm) or 5-30 seconds (fault) between alarm or fault detection and output switching (See Figure 4.6.3c). If either output will not be used, disable that output by unchecking the 'Enable' box next to each.

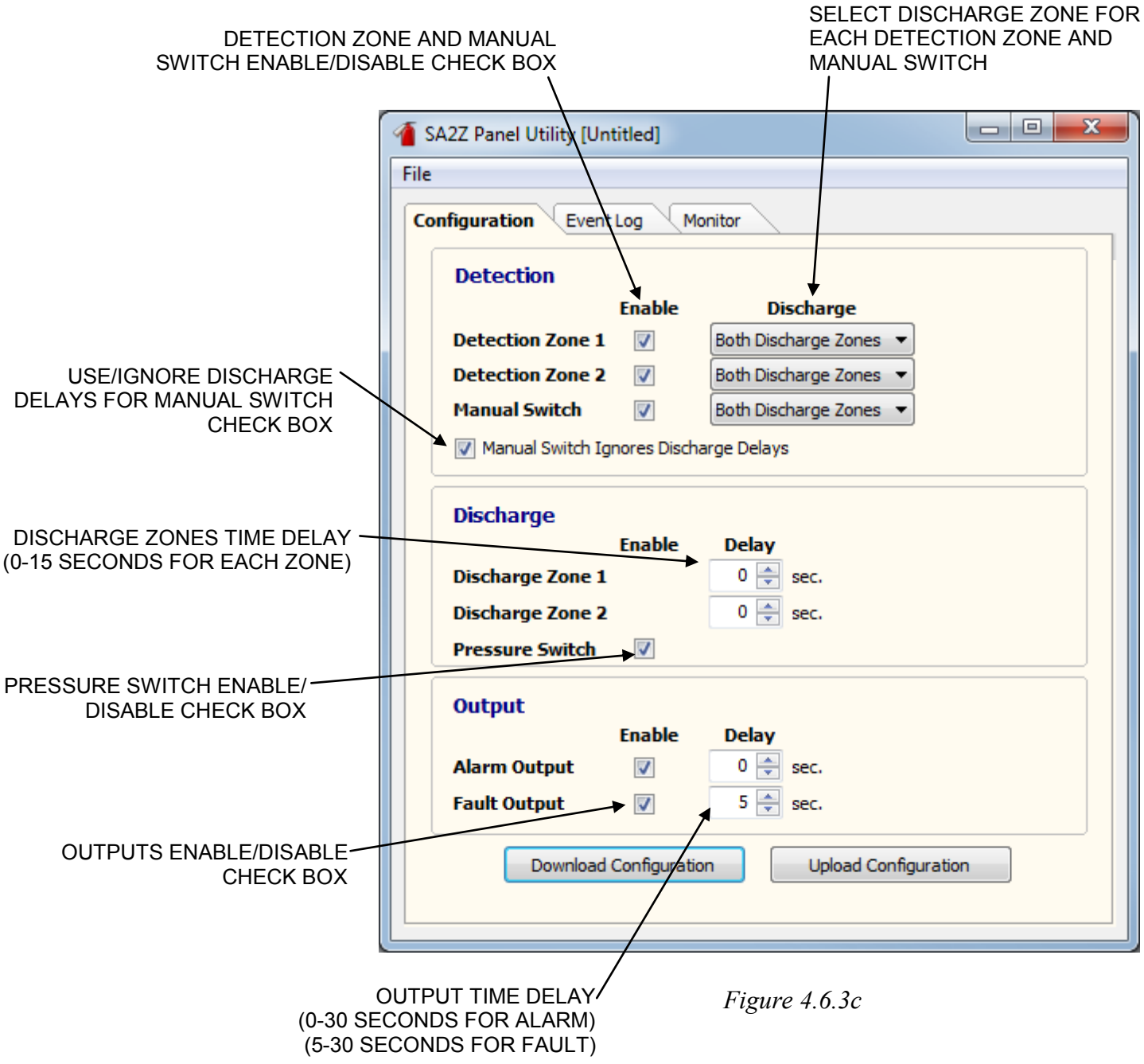


Figure 4.6.3c

Uploading A System Configuration - After all desired changes have been made and system configuration is complete, the configuration should be saved to the PC clicking the 'File' tab and clicking 'Save'. Ensure the PC Interface Cable is connected and the Operator Panel is in programming mode. Next, the configuration should be uploaded to the SA2Z Operator Panel by clicking the 'Upload Configuration' button at the bottom right of the SA2Z Panel Utility window. Enter the password in the password prompt, after which an Information window should appear indicating that the upload was successful (See Figure 4.6.3d). The SA2Z system is now configured as shown in the SA2Z Panel Utility window. An error will be generated if the PC interface Cable is disconnected or the Operator Panel is not in programming mode. Once the Operator Panel exits programming mode, verify the green "SYSTEM NORMAL" LED is flashing once every 5 seconds. If not, verify the system is programmed to match the system design or refer to the fault condition section (See Section 6.2). Monitor Mode can also be helpful for viewing system status (See Section 4.6.4).

Once the SA2Z system is functioning properly with the green "SYSTEM NORMAL" LED flashing, disconnect the PC Interface Cable and install the Communication Dust Plug (P/N 24138) in its place on the Master Harness.

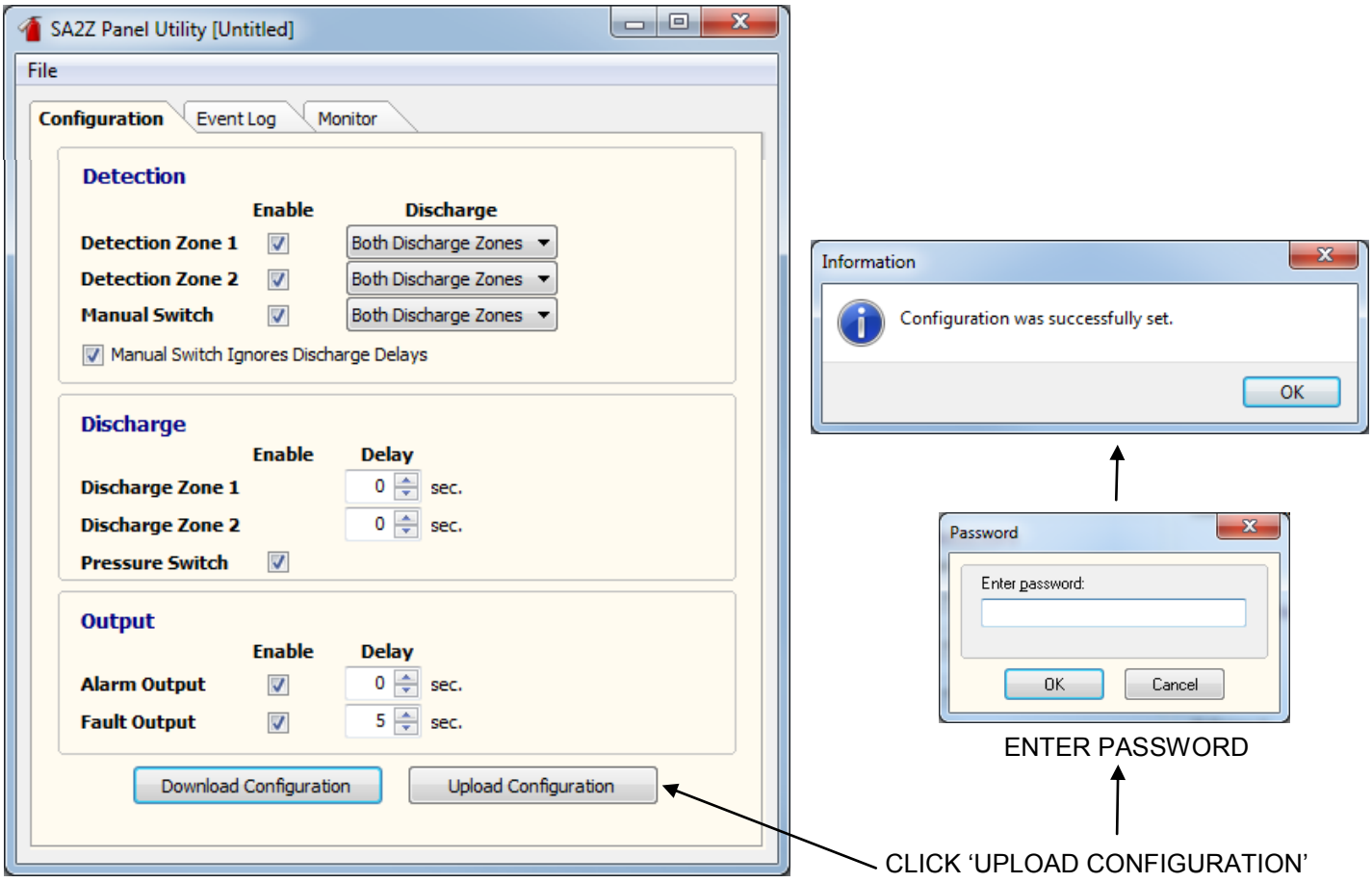


Figure 4.6.3d

4.6.4 Monitor Mode

When using the SA2Z PC software, a Monitor Mode is available on the SA2Z Panel Utility window. Monitor Mode allows the user to view complete system status. This feature can be useful when programming a system configuration by indicating which sensors and circuits are enabled and if a fault or alarm condition currently exists. Also, battery voltage is displayed in Monitor Mode.

To access Monitor Mode, the Operator Panel must be connected to a PC and in programming mode with the SA2Z Panel Utility window open and running on the PC. Click on the 'Monitor' tab (See Figure 4.6.4). Click the 'Get Status' button after which Monitor Mode displays current status for all enabled circuits and devices, indicated by a colored box next to each. A green box indicates a working enabled circuit/device, while a grey box indicates a disabled circuit (from Section 4.6.3). Fault conditions are displayed as yellow boxes, while alarm conditions appear as red boxes. The 'Get Status' button must be clicked again to refresh the Monitor Mode display when any changes are made. An example of a system configuration and Monitor Mode, both displaying disabled and fault circuits, is shown below (See Figure 4.6.4).

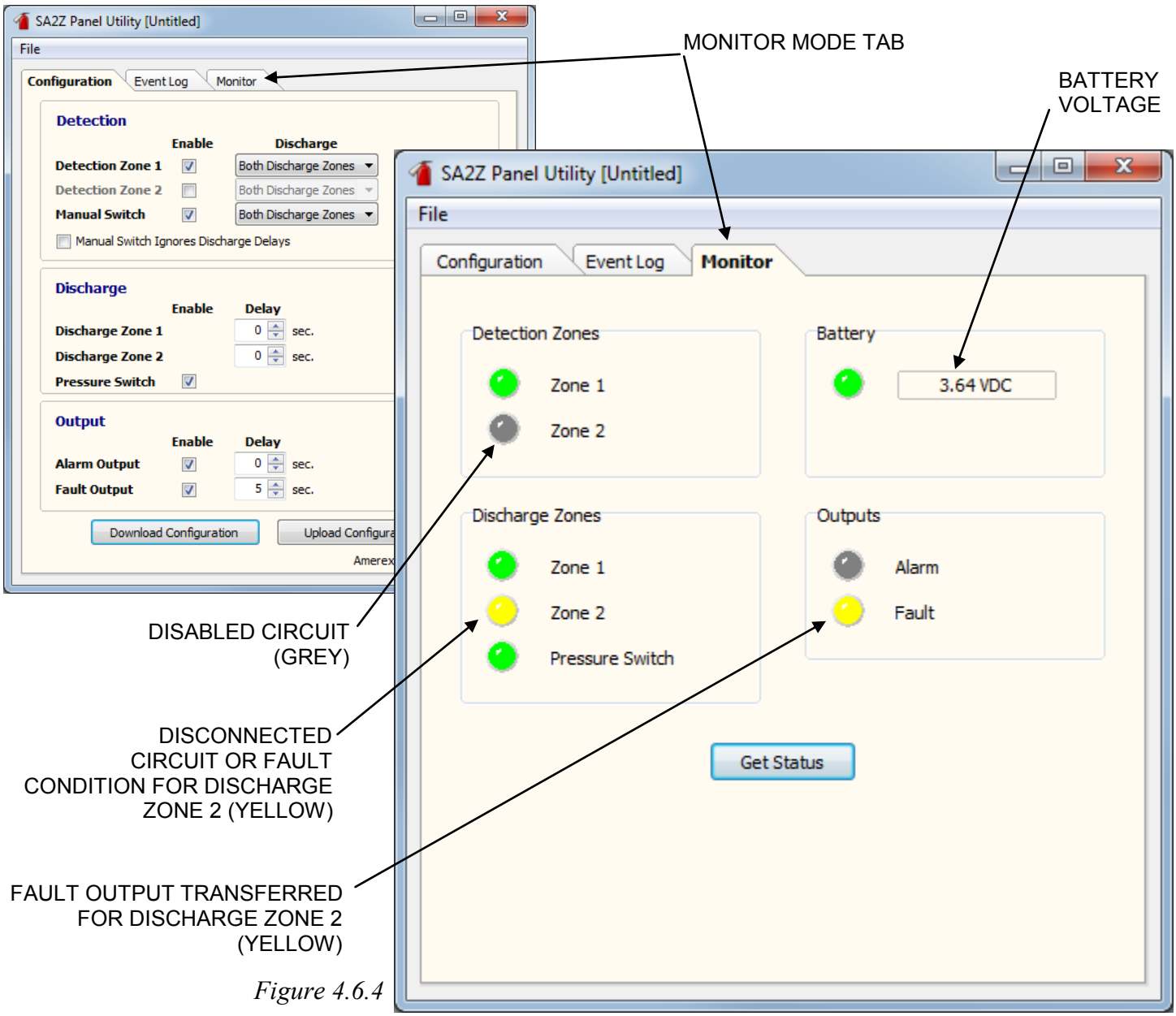


Figure 4.6.4

4.6.5 Programming a System Configuration (Advanced)

The Amerex SA2Z system has an “advanced” programming option in addition to “basic” programming. Advanced programming allows the trained technician to perform all programming options previously described in Section 4.6.3, but also allows undesired actuation circuits (discharge zones) to be disabled. The advanced configuration utility window contains an ‘Enable’ box next to each discharge zone, which may be checked or unchecked (See Figure 4.6.5). Any undesired or unused discharge zones may be disabled by unchecking the ‘Enable’ box next to the associated zone. As an added precaution, if any detection zone, or manual release switch is assigned to a particular discharge zone, the configuration utility window will not allow that discharge zone to be disabled and an error message will be generated. Always install an Actuation Dust Plug (P/N 24139) on the Master Harness for any disabled and unused actuation circuits (discharge zones).

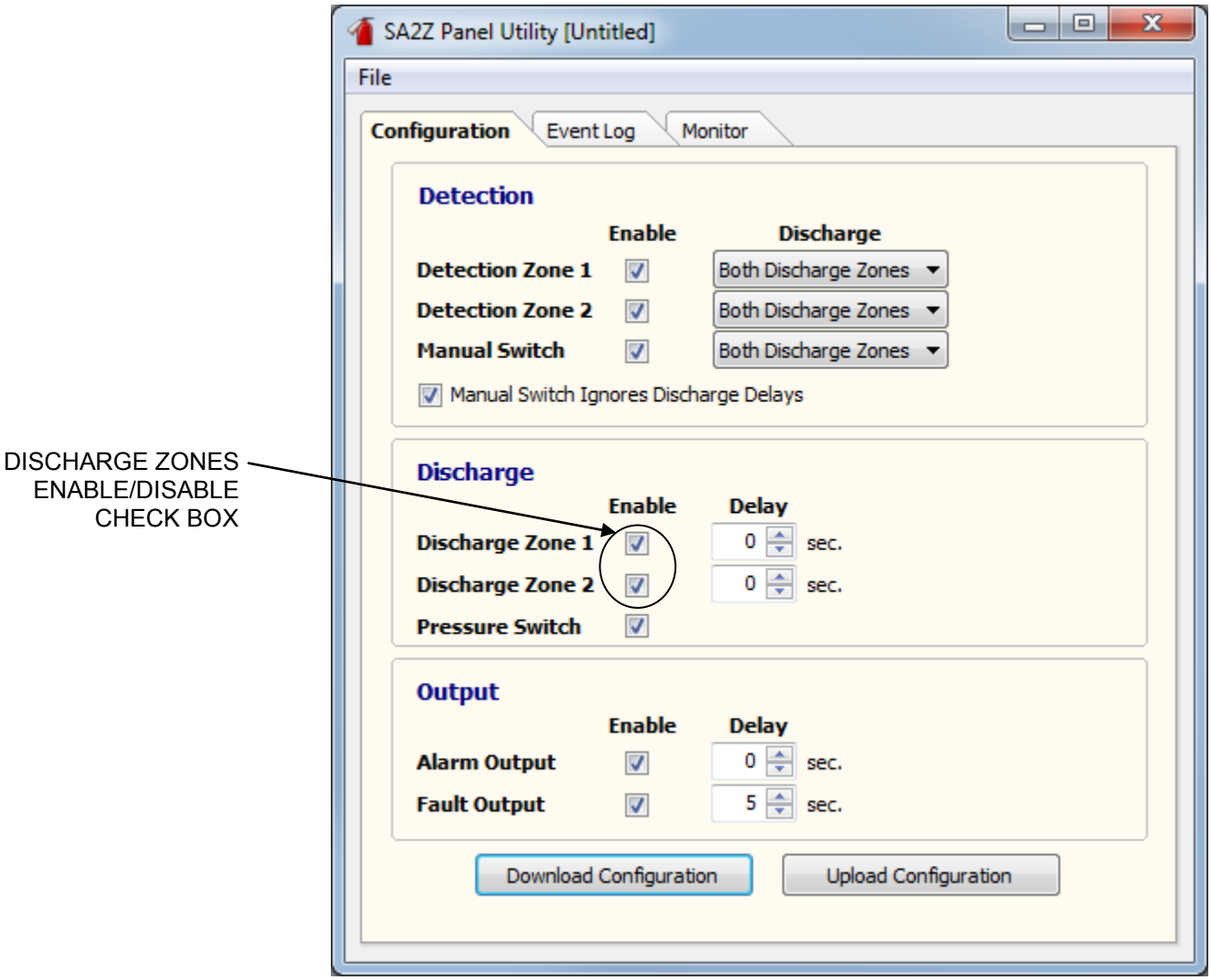


Figure 4.6.5

4.7 SA2Z Function Testing & Initial Commissioning

After any desired configuration has been uploaded from a PC, the SA2Z system and components must be functionally tested as part of the initial commissioning, just prior to placing the system into service. These tests include Operator Panel display, manual release switch and actuation circuit, detection sensor, and circuit fault testing as shown in the following steps. All detection devices, any outputs, and all associated cables must be installed and connected to the Master Harness. **If not already connected from Section 4.6, do not connect the Master Harness to the Operator Panel until directed to do so in step 1. In order to preserve battery power, it is necessary to temporarily replace the Operator Panel battery pack with a spare Replacement Battery (P/N 23720) to perform initial commissioning of a system. A Fire Alarm Module (P/N 23651) is necessary and must be installed for each Linear Actuator used in the system.** Perform the following steps.

Step 1 - If not already performed from programming (See Section 4.6), it is necessary to temporarily replace the Operator Panel battery pack with a spare Replacement Battery (P/N 23720) before connecting the Master Harness to the Operator Panel. Since commissioning tests consume battery power, this process ensures that the original battery remains at full power. To replace the battery, remove the cover of the Operator Panel by loosening the four cover screws as shown. Take care not to damage any electronic components. Disconnect the original battery connector from the back of the Operator Panel cover on the circuit board (See Figure 4.7a). Then, connect the spare Replacement Battery in its place. The Master Harness can now be connected to the Operator Panel. The Operator Panel will power up, illuminate, and indicate system status. Verify the green "SYSTEM NORMAL" LED is flashing once every 5 seconds before proceeding. If not, verify the system is programmed to match the system design or refer to the fault condition section (See Section 6.2).

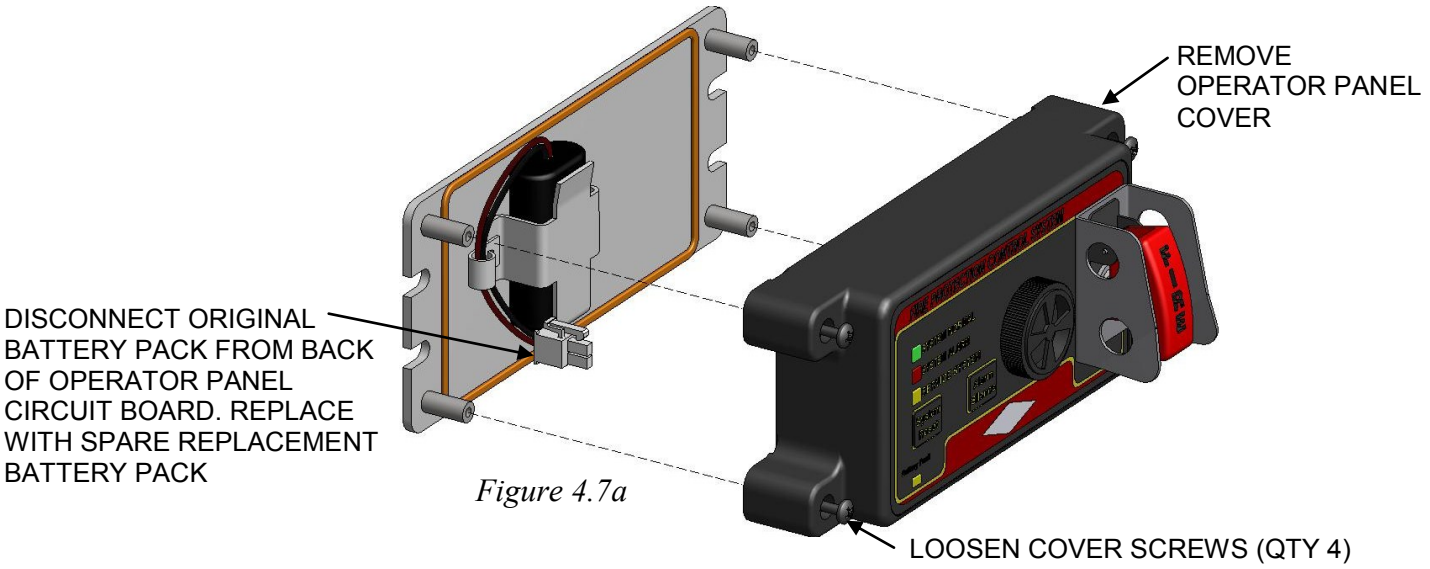


Figure 4.7a

Step 2 - Disconnect all Linear Actuators (P/N 20500) from the discharge zones (actuation circuits) and replace each with a Fire Alarm Module (P/N 23651) as shown (See Figure 4.7b). **Warning: A fire suppression system discharge will occur if all Linear Actuators are not disconnected from the system before proceeding!**

Figure 4.7b

Step 3 - Verify that all Operator Panel LEDs are functioning properly. Press and hold the 'System Reset' and 'Alarm Silence' buttons simultaneously for 5 seconds. Verify that all four Operator Panel LEDs flash twice and the audible alarm beeps twice. The Operator Panel will automatically return to normal after one minute, as indicated by a single LED flash and audible alarm beep.

Step 4 - Test the pressure switch circuit by disconnecting the circuit at the agent cylinder(s) and verify that the Operator Panel indicates a fault condition. Verify the following results have occurred on the Operator Panel (See Table 4.7a). Reconnect the pressure switch circuit and verify the green 'SYSTEM NORMAL' LED is flashing once every 5 seconds.

Indicator	Result After Pressure Switch Circuit Disconnect
Green 'SYSTEM NORMAL' LED	OFF
Yellow 'SERVICE SYSTEM' LED	FLASHES every 5 seconds
Audible Alarm	Single beep every 5 seconds
Auxiliary Fault (Trouble) Output, if enabled	Transfers state (normally open to closed) after programmed delay

Table 4.7a

Step 5 - Test the manual release switch located on the Operator Panel with discharge zones (actuation circuits). **Verify that all Linear Actuators have been replaced with a Fire Alarm Module (P/N 23651).** Flip the "FIRE" toggle switch guard up and activate the toggle switch. Verify that the following results have occurred on the Operator Panel and Fire Alarm Modules (See Figure 4.7c & Table 4.7b).

Indicator	Result After Manual Release Switch
Green 'SYSTEM NORMAL' LED	OFF
Red 'SYSTEM ALARM' LED	FLASHES every 3 seconds
Audible Alarm	Single beep every 3 seconds
Red LED on each Alarm Module (P/N 23651)	ON (for mapped Discharge Zones only) after programmed delay
Auxiliary Alarm Output, if enabled	Transfers state (normally open to closed) after programmed delay
Auxiliary Fault (Trouble) Output, if enabled	Transfers state (normally open to closed) after programmed delay

Table 4.7b

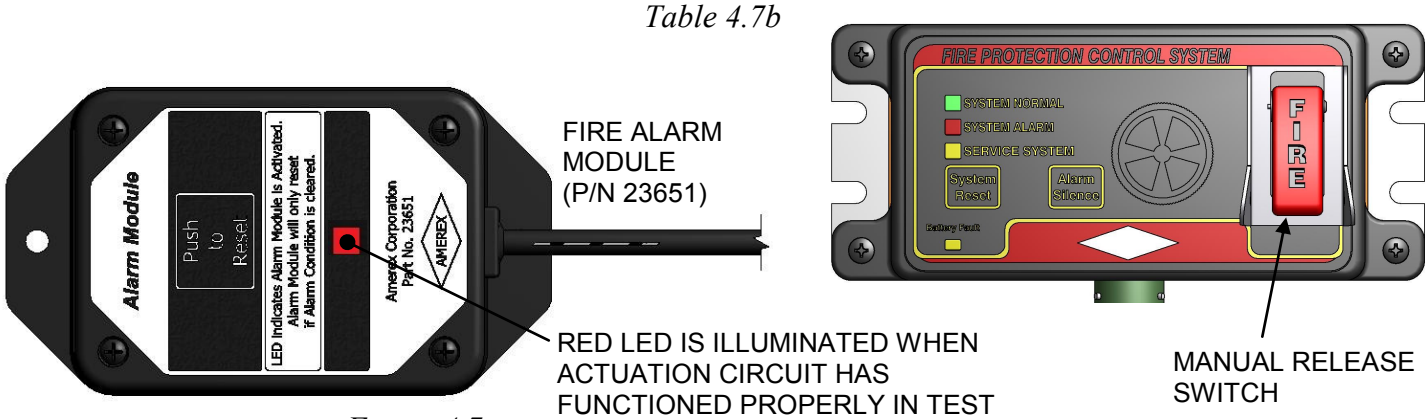


Figure 4.7c

Step 6 - After verifying the manual release switch and discharge zones are functioning properly, flip the toggle switch back down and close the switch guard. The audible alarm can be silenced by pressing and holding the 'Alarm Silence' button for 5 seconds. Press the "Push To Reset" button on each Alarm Module. Next, press and hold the "System Reset" button on the Operator Panel for approximately 10 seconds and verify the green 'SYSTEM NORMAL' LED is flashing once every 5 seconds.

Step 7 - Test any Spot Heat Detector (SHD) detection circuits with discharge zones (actuation circuits). If SHDs are used, each sensor requires testing upon initial commissioning of the SA2Z system. Each SHD must be subjected to its set point temperature to ensure that a system alarm condition and actuation of the associated discharge zone will occur. **Verify that all Linear Actuators (P/N 20500) have been replaced with a Fire Alarm Module (P/N 23651).** SHD sensors must be subjected to their pre-programmed set point temperature. Use an electric heat gun to heat the sensor tip only to this set point. Set point temperatures are:

- Bracket Mount SHD (P/N 23848): 280ºF (138ºC) +/- 14ºF (130 to 146ºC)
- Bracket Mount SHD (P/N 23460): 350ºF (177ºC) +/- 17ºF (167 to 186ºC)
- Bulkhead Mount SHD (P/N 23462): 450ºF (232ºC) +/- 22ºF (220 to 244ºC)

Do not overheat any SHD by more than 100ºF over the set point. Overheating the unit beyond these limitations may cause the unit's set point to change from factory settings. Immediately remove the heat gun once the set point is reached. Verify that the following results have occurred on the Operator Panel and Fire Alarm Modules (See Table 4.7c).

Indicator	Result After SHD Alarm Condition
Green 'SYSTEM NORMAL' LED	OFF
Red 'SYSTEM ALARM' LED	FLASHES every 3 seconds
Audible Alarm	Single beep every 3 seconds
Red LED on each Alarm Module (P/N 23651)	ON (for mapped Discharge Zones only) after programmed delay
Auxiliary Alarm Output, if enabled	Transfers state (normally open to closed) after programmed delay
Auxiliary Fault (Trouble) Output, if enabled	Transfers state (normally open to closed) after programmed delay

Table 4.7c

Step 8 - After verifying each SHD and associated discharge zone is functioning properly, allow each SHD to cool below set point temperature. The audible alarm can be silenced by pressing and holding the 'Alarm Silence' button for 5 seconds. Press the "Push To Reset" button on each Alarm Module. Next, press and hold the "System Reset" button on the Operator Panel for approximately 10 seconds and verify the green 'SYSTEM NORMAL' LED is flashing once every 5 seconds. Repeat step 7 and 8 for each SHD.

Step 9 - Test any Linear Heat Detector (LHD) detection circuits. Disconnect each Linear Heat Detector circuit at the Master Harness connector and verify that the Operator Panel indicates a fault condition. Verify that the following results have occurred on the Operator Panel (See Table 4.7d). Then, reconnect the circuit and verify the green 'SYSTEM NORMAL' LED is illuminated. Repeat this process by disconnecting each connector in the circuit until reaching (and including) the End Of Line Module (P/N 23474). This process is intended to verify the integrity of each detection circuit.

Indicator	Result After LHD Disconnect
Green 'SYSTEM NORMAL' LED	OFF
Yellow 'SERVICE SYSTEM' LED	FLASHES every 5 seconds
Audible Alarm	Single beep every 5 seconds
Auxiliary Fault (Trouble) Output, if enabled	Transfers state (normally open to closed) after programmed delay

Table 4.7d

Step 10 - Each Operator Panel and Replacement Battery (P/N 23720) is supplied with a Battery Replacement Label. Locate the original battery (removed in step 1) and populate a Battery Replacement Label with that battery's serial number, current date of commissioning the system, and battery replacement date (one year from current date of commissioning) as shown (See Figure 4.7d). Disconnect and remove the Replacement Battery from the back of the Operator Panel cover on the circuit board. Then, connect the original battery in its place. Replace the Operator Panel cover using the four cover screws. Verify the green "SYSTEM NORMAL" LED is flashing once every 5 seconds.

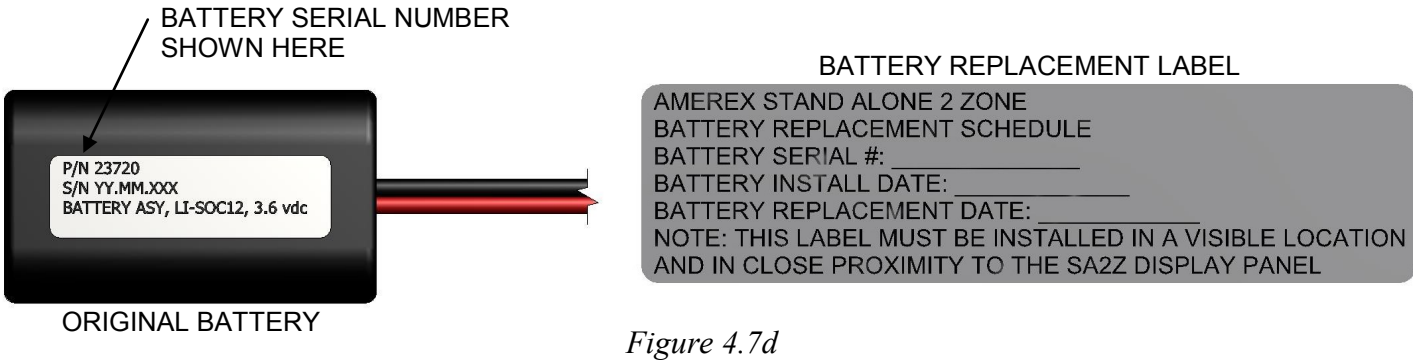


Figure 4.7d

Step 11 - Install the populated Battery Replacement Label on or in close proximity to the Operator Panel. The Battery Replacement Label must be visible during normal service (See Figure 4.7e).

Step 12 - Each Operator Panel is supplied with a Tamper Seal (P/N 01387). Install this seal on the manual release switch in the location shown (See Figure 4.7e).

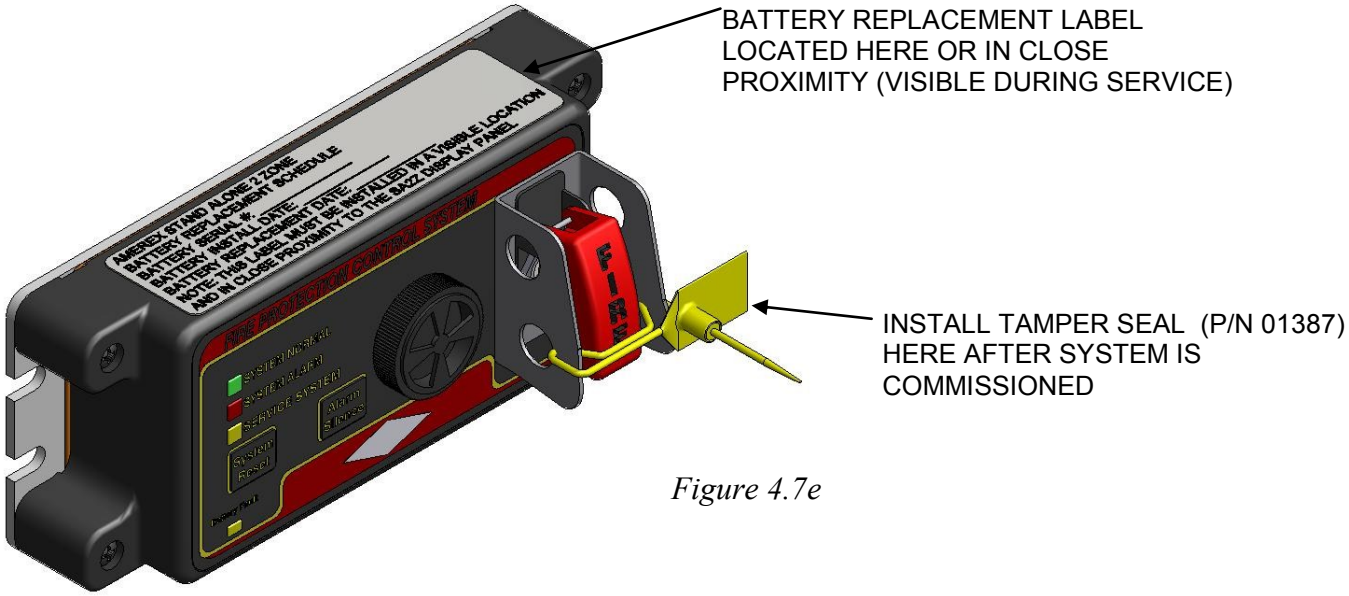


Figure 4.7e

Step 13 - SA2Z initial commissioning is now complete. Verify green "SYSTEM NORMAL" LED is flashing once every 5 seconds. Next, disconnect all Fire Alarm Modules (P/N 23651) on the discharge zones (actuation circuits) and replace each with the original Linear Actuators (P/N 20500).

Chapter 5: Inspection & Maintenance

The Amerex SA2Z System requires periodic care to provide maximum assurance that the system will operate effectively and safely. Inspection frequency should be based on the requirements of the equipment on which the fire suppression system will operate. Inspection and maintenance schedules are shown in this manual and must be followed to ensure reliable system performance. Equipment operating continually and/or in harsh environments will require more frequent inspection and maintenance. The latest revisions of any Amerex Installation, Operation, and Maintenance Manuals referenced in this Chapter can be found at www.amerex-fire.com. Note: All NFPA guidelines that are applicable to the system must be followed for service and maintenance. The following inspections and maintenance requirements are additional Amerex requirements.

5.1 Daily Inspection: OPERATOR / OWNER

- On the Operator Panel, verify that the green "SYSTEM NORMAL" LED is flashing.

5.2 Monthly Inspection: OPERATOR/ OWNER

- Verify that all components are present, in their original location and securely fastened.
- Verify that all mechanical actuation devices are unobstructed by vehicle modifications or clutter.
- Verify that the maintenance tag or certificate is in place and up to date. Record the date of inspection and initials of inspector.
- Verify the physical condition of all components. Inspect for damage or conditions that may prevent operation.
- Verify the date of the battery replacement schedule on the Battery Replacement Label. If battery is scheduled to be replaced, contact an Amerex Certified and Authorized Servicing Technician for scheduling a replacement.
- Verify the tamper seal in installed on the manual release switch on the Operator Panel.

If any service is required as a result of monthly inspections, it should be done only by an Amerex Certified and Authorized Servicing Technician.

5.3 Semi-Annual Maintenance : AUTHORIZED AMEREX TECHNICIAN

The Amerex SA2Z System must be serviced by an Authorized Amerex Technician that is trained and certified on the Amerex SA2Z System and in accordance with NFPA and any federal, state, and/or local code requirements. Service and maintenance shall be done at intervals of six (6) months or more frequent if deemed necessary.

- Perform the monthly inspection procedure.
- Verify that hazards have not changed. Look for changes in vehicle operation or cleaning procedures that may have increased the hazard. Compare with the original vehicle hazard analysis.
- Perform a visual inspection of each detector, detection network and actuation (discharge) network. During the visual inspection, verify no dents, dings, cracks, scorch marks from flames, or any other physical damage has occurred to any detector, component, or cable. Replace any suspect components. If a build-up of grease, dust, or any other foreign matter has accumulated on the detector or circuitry, clean with a vacuum or soft dry cloth.
- Perform a commission test of the system as described in Section 4.7. **Warning: Do not perform these tests on the system until all Linear Actuators (P/N 20500) are replaced with Fire Alarm Modules (P/N 23651). Otherwise, a system discharge will result!** Use a spare Replacement Battery (P/N 23720) to perform these tests.

- Verify battery replacement date shown on Battery Replacement Label located on or in close proximity to the Operator Panel. If the battery is out of date or will be out of date before the next semi-annual (6 month) service, replace the battery and Battery Replacement Label (See Section 5.5).
- Document all work completed during service for record retention. Disclose any anomalies, deficiencies to the property owner for corrective action requirements.

5.4 (6) Six Year Maintenance: AUTHORIZED AMEREX TECHNICIAN

- Perform semi-annual inspection.
- Replace Linear Actuators if in service for 6 years.

5.5 Battery Replacement: AUTHORIZED AMEREX TECHNICIAN

The internal Lithium-Thionyl Chloride (LI-SOC12) battery (P/N 23720) installed in the SA2Z Operator Panel will require periodic replacement. Before replacing the battery or performing system maintenance, it is a safe practice to disconnect the discharge zones (actuation circuits). The internal battery shall also be replaced following these events:

* Battery is over a year old
* Battery Replacement Label is missing
* A fault (trouble) event occurs
* A fire event occurs
* Low battery indicator on front of panel is illuminated.
* Label information is not legible

The battery may be accessed by loosening the four cover screws and removing the Operator Panel cover. Take care not to damage any electronic components when maintaining the battery. Unplug the out of date battery from the back of the Operator Panel on the circuit board and place it to the side. Install a new Replacement Battery (P/N 23720), routing the connector wiring through the wiring clip and such that it will not be pinched when replacing the cover. Replace the battery, plug the battery into the circuit board, organize the wiring and replace the Operator Panel cover. Tighten the cover screws diagonally to snug, approximately 5 inch-pounds. Replace and populate the Battery Replacement Label. This label must be visible and on or in close proximity to the Operator Panel (See Figure 5.5). Dispose of the out of date battery properly and in accordance with local regulations.

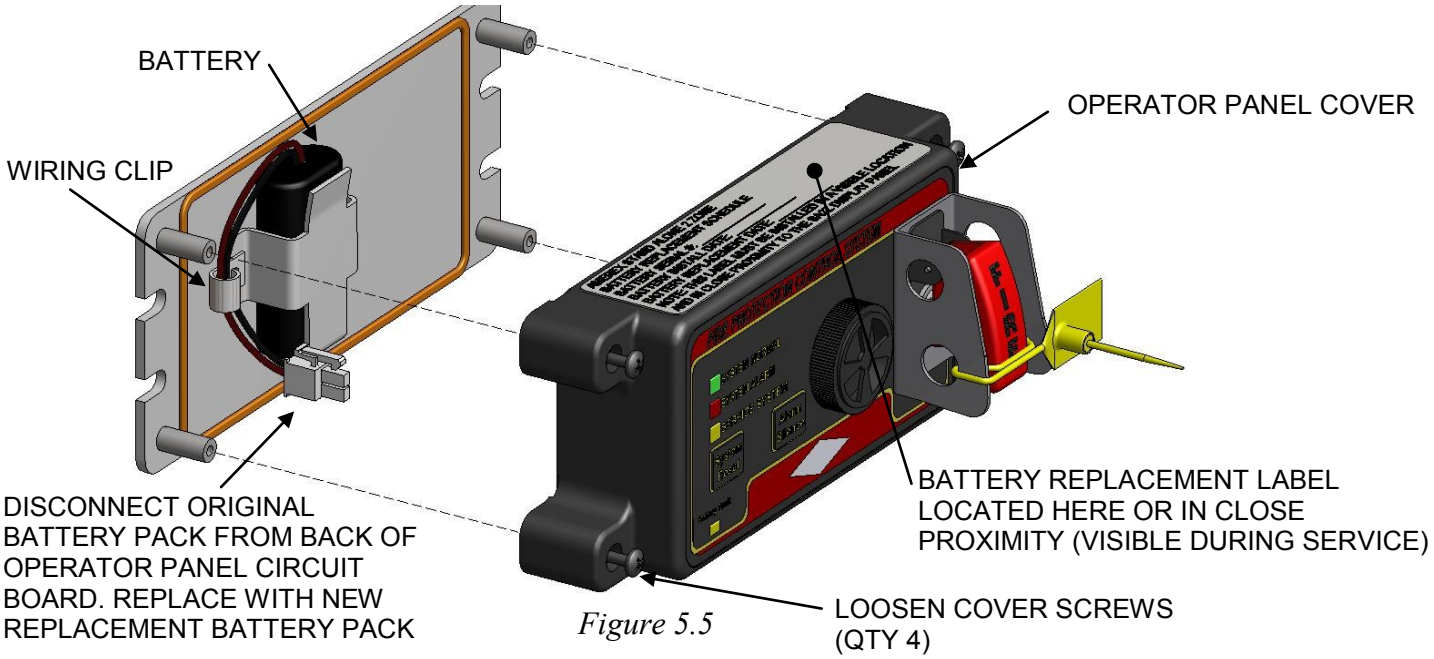


Figure 5.5

Chapter 6: System Alarms & Troubleshooting

Under normal working conditions, the green “SYSTEM NORMAL” LED on the Operator Panel will flash once approximately every 5 seconds. If the green “SYSTEM NORMAL” LED is not flashing, an alarm or fault (trouble) condition exists with the system. Any alarm or fault event shown on the Operator Panel mandates having the internal battery be replaced with a new one (See Section 5.5).

6.1 System Alarm Condition

A system alarm condition is a latching alarm condition indicating an overheat/fire event. If the SA2Z Operator Panel is experiencing a system alarm condition, the following indications will occur on the Operator Panel (See Table 6.1).

Indicator	Result After Alarm Condition
Green ‘SYSTEM NORMAL’ LED	OFF
Red ‘SYSTEM ALARM’ LED	FLASHES every 3 seconds
Audible Alarm	Single beep every 3 seconds
Auxiliary Alarm Output, if enabled	Transfers state (normally open to closed) after programmed delay
Auxiliary Fault (Trouble) Output, if enabled	Transfers state (normally open to closed) after programmed delay

Table 6.1

The system will remain in alarm until the cause of the alarm has been identified and corrected and the system manually reset. Reset the Operator Panel by pressing and hold the “System Reset” button for approximately 10 seconds and verify the green ’SYSTEM NORMAL’ LED is flashing once every 5 seconds. Inspection or use of the Event Log feature (See Section 6.5) or Monitor Mode feature (See Section 4.6.4) can be used to identify the affected circuit or cause of an alarm. Any used or damaged components must be replaced. If an alarm condition resulted in the actuation of any programmed discharge zones, replace any spent Linear Actuators (P/N 20500). An alarm condition most often results from the following:

Manual release switch activated - The technician must inspect the manual release switch on the Operator Panel to see if the tamper seal is broken or missing.

Detection device initiated - If a detection device is initiated from an overheat/fire condition, the source of the alarm condition must be identified somewhere in the detection circuit(s), and the cause must be corrected by the Amerex servicing technician.

- SHD - Spot Heat Detectors are self resetting devices. The technician must identify the overheat/fire condition by evaluating the surrounding environment for indications such as smoke or fire damage in close proximity. SHDs are normally open devices when not exposed to set point parameters from overheat/fire conditions. If no smoke or fire damage exists, the SHD could potentially be damaged from some other means. Check for dents on the SHD housing.
- LHD - Linear Heat Detectors are one time use, normally open devices when not exposed to set point parameters from overheat/fire conditions. The LHD will have permanent damage such as melting, burns or cuts resulting from overheat/fire or damage from some other means. Locate any used or damaged LHDs and replace.
- 100 PSI Pressure Switch - An alarm condition can be initiated by a 100 PSI Pressure Switch (P/N 23850) used in a detection circuit. This alarm condition would indicate that a manual actuation of a fire suppression system has occurred, by use of a nitrogen cylinder in a pneumatic actuation network.

6.2 System Fault (Trouble) Condition

The SA2Z system is designed to supervise and monitor all detection, discharge, and pressure switch connections and circuits. If the SA2Z system detects a problem, a fault (trouble) condition will result, indicated by the yellow "SERVICE SYSTEM" LED and the following indications will be displayed on the Operator Panel (See Table 6.2).

Indicator	Result After Fault (Trouble) Condition
Green 'SYSTEM NORMAL' LED	OFF
Yellow 'SERVICE SYSTEM' LED	FLASHES every 5 seconds
Audible Alarm	Single beep every 5 seconds
Auxiliary Fault (Trouble) Output, if enabled	Transfers state (normally open to closed) after programmed delay

Table 6.2

The Operator Panel will return to a 'SYSTEM NORMAL' status automatically once the fault condition is corrected. Inspection or use of the Event Log feature (See Section 6.5) or Monitor Mode feature (See Section 4.6.4) can be used to identify the affected circuit or cause of a fault. Fault conditions most often result from the following:

Pressure Switch Circuit Fault - The pressure switch circuit is a normally closed circuit. Any agent cylinder pressure switch (P/N 17609) connected to this circuit is also closed while pressurized. If an agent cylinder loses pressure, the circuit will open and indicate a fault condition. Verify that any connected agent cylinders are pressurized if a pressure switch circuit fault is suspected. Also, if any pressure switch cables or components are disconnected or damaged, the circuit could may open resulting in a fault condition. Inspect the circuit for disconnected connectors, broken or cut wiring, or damaged components. Another method for identifying damaged or faulty segments of the pressure switch circuit is to disconnect the two pressure switch connectors of the Master Harness and connect them together to each other, closing the circuit. If the fault condition no longer exists, the cause most likely lies downstream in the circuit. Repeat this process at each connection point of the circuit until the faulty cable or device is found.

Detection Circuit Fault - If any detection circuit cables or components are disconnected or damaged, a fault condition will result. Inspect each circuit for disconnected connectors, broken or cut wiring, or damaged components. The End Of Line Modules or EOLs (P/N 23474), located at the end of each detection circuit, can be used as tools for identifying damaged or faulty segments of the detection circuit. To do so, disconnect each EOL from the end of the detection circuit and reconnect to the Master Harness detection connector in that circuit. If the fault condition no longer exists, the cause most likely lies downstream in that detection circuit. Repeat the process at each connector of that detection circuit until the faulty cable or device is found.

Discharge (Actuation) Circuit Fault - If any discharge circuit cables or components are disconnected or damaged, a fault condition will result. Inspect each circuit for disconnected connectors, broken or cut wiring, or damaged components. If an alarm condition has occurred resulting in the actuation of any programmed discharge zones, a fault condition will occur until all spent Linear Actuators (P/N 20500) are replaced from those zones. Fire Alarm Modules (P/N 23651), can be used as tools for identifying damaged or faulty segments of the discharge circuit. To do so, disconnect the circuit at the Master Harness discharge connector and connect a Fire Alarm Module at that location. If the fault no longer exists, the cause most likely lies downstream in that discharge circuit. Repeat this process at each connector of that discharge circuit until the faulty cable or device is found.

6.3 Low Battery Power

Low battery power is indicated on the Operator Panel by the yellow 'Battery Fault" LED flashing on approximately every 4 seconds (See Figure 6.3). The battery must be replaced if a "Battery Fault" condition exists (See Section 5.5).

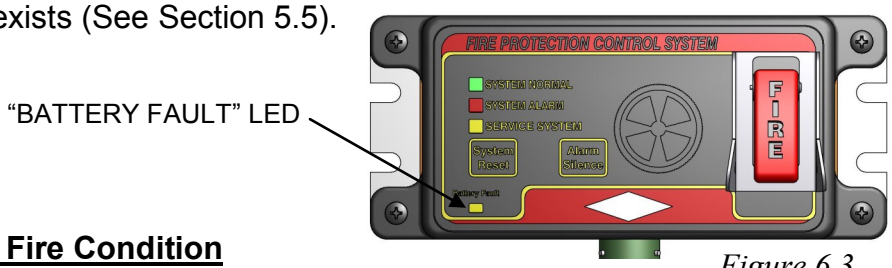


Figure 6.3

6.4 Actions to Take During a Fire Condition

- Bring the vehicle to a safe and controlled stop.
- Set the parking brakes on the vehicle.
- Actuate the SA2Z system by breaking the tamper seal and switching the manual release switch.
- Evacuate all passengers from the vehicle to a safe distance away from the vehicle.
- Notify local fire department.
- Stand by with portable fire extinguisher and watch for sources of re-ignition.

6.5 Event Log

The Event Log allows the user or servicing distributor to access a history of events that have occurred on the system. The system clock (date and time) are preset within the Operator Panel. The Event Log can be used to identify intermittent issues that may not always be seen by the servicing technician. The Event Log can also be used to determine the most recent maintenance that has been performed on the vehicle. To access the Event Log, the SA2Z system must be in programming mode and be connected to a PC with the SA2Z Panel Utility window open and running. Click the 'Event Log' tab (See Figure 6.5). Once the 'Event Log' tab is selected, the SA2Z system allows the user to select the last 20 or all events by clicking the 'View Events' button on the bottom left. Each event is time and date stamped and provides a history of all events or actions performed on the system, including any alarm and fault (trouble) conditions and which circuit caused the condition. Alarm and fault system resets are displayed, as well as timestamps for new configuration uploads. These events are stored in "non-volatile" memory in the SA2Z. The Event Log can be used for system troubleshooting and analysis of past SA2Z history. The Event Log may be saved on the PC by clicking the 'Save' button in the lower center of the window (See Figure 6.5). The default folder in the user's 'Documents' folder is 'My Amerex Files/SA2Z Panel/EventLog'. The file format is *.csv which can be opened and viewed using Microsoft Excel. It is recommended that the title of the saved file include the vehicle identification number and date.

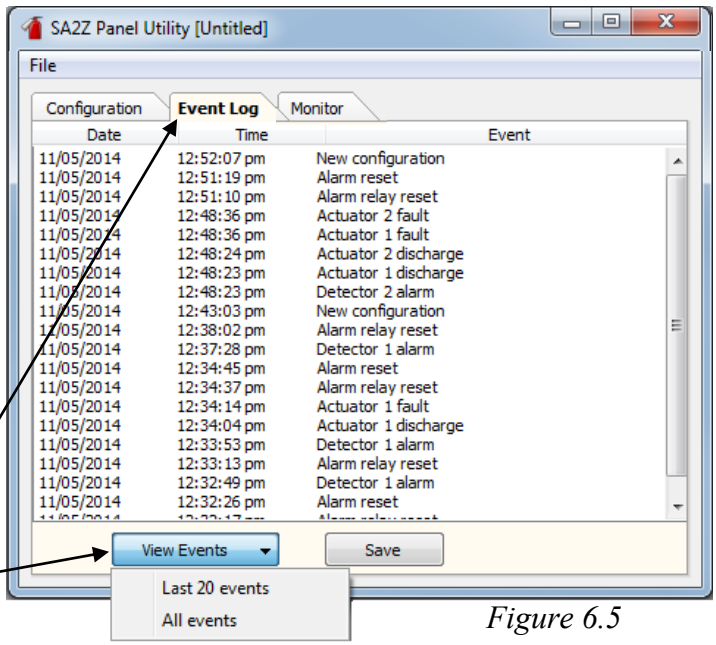


Figure 6.5

Chapter 7: Warranty

Warranty Statement:

Warranty and Limitation of Liabilities, Buyers Remedies, and Indemnification

Amerex Corporation (Seller) warrants that Vehicle Fire Suppression System components (Goods) delivered are free from defects in material and workmanship under conditions of normal use for a period of three (3) years from the date of purchase except Small Vehicle Fire Suppression System components, batteries, and AMGADS gas sensors which are warranted for a period of one (1) year. Non-standard products manufactured by Seller to customer specifications are warranted for a period of one (1) year. Contact Amerex Corporation for warranty statements for other Amerex Corporation products. Seller reserves the right to make any modifications required by production conditions to the information set forth in the Seller's catalogues and advertising literature. Seller shall not be liable or responsible, however, for (A) any defects attributed to normal wear and tear, erosion or corrosion or improper storage, use or maintenance, or (B) defects in any portion or part of the Goods manufactured by others. If (B) above is applicable, Seller will, as an accommodation to Buyer, assign to Buyer any warranties given to it by any such other manufacturers. Any claim by Buyer with reference to the Goods for any cause shall be deemed waived by Buyer unless submitted to Seller in writing within ten (10) days from the date Buyer discovered, or should have discovered, any claimed breach. Buyer shall give Seller an opportunity to investigate.

Provided that Seller is furnished prompt notice by Buyer of any defect and an opportunity to inspect the alleged defect as provided herein, Seller shall, at its option and in its sole discretion either: (i) repair the defective or non-conforming Goods, (ii) replace the nonconforming Goods, or part thereof, which are sent to Seller by Buyer within sixty days after receipt of the Goods at Buyer's plant or storage facilities, or (iii) if Seller is unable or chooses not to repair or replace, return the purchase price that has been paid and cancel any obligation to pay unpaid portions of the purchase price of nonconforming Goods. In no event shall any obligation to pay or refund exceed the purchase price actually paid. This warranty does not cover defects resulting from modification, alteration, misuse, exposure to corrosive conditions or improper installation or maintenance. Repair and/or replacement as provided above shall be at Seller's plant and shipped F.O.B. Plant unless otherwise agreed to by Seller. Transportation charges for the return of the Goods or part thereof to Seller shall be prepaid by Buyer, unless otherwise agreed to in writing by Seller. Seller shall, in no event, be responsible for any labor, removal or installation charges that may result from the above-described repair and/or replacement of any Goods. The foregoing warranty does not cover failure of any part or parts manufactured by others, the failure of any part or parts from external forces, including but not limited to earthquake, installation, vandalism, vehicular or other impact, application of excessive torque to the operating mechanism or frost heave. The exclusive remedy of Buyer and the sole liability of Seller, for any loss, damage, injury or expense of any kind arising from the manufacture, delivery, sale, installation, use or shipment of the Goods and whether based on contract, warranty, tort or any other basis of recovery whatsoever, shall be, at the election of Seller, the remedies described above.

The foregoing is intended as a complete allocation of the risks between the parties and Buyer understands that it will not be able to recover consequential damages even though it may suffer such damages in substantial amounts. Because this Agreement and the price paid reflect such allocation, this limitation will not have failed of its essential purpose even if it operates to bar recovery for such consequential damages.

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES WHETHER EXPRESS OR IMPLIED BY LAW. THERE IS NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. IN NO EVENT, WHETHER AS A RESULT OF BREACH OF CONTRACT, WARRANTY, TORT (INCLUDING NEGLIGENCE) OR STRICT LIABILITY, SHALL SELLER BE LIABLE FOR ANY PUNITIVE, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF PROFIT, LOSS OF USE OF THE GOODS OR OTHER PROPERTY EQUIPMENT, DAMAGE TO OTHER PROPERTY, COST OF CAPITAL, COST OF SUBSTITUTE GOODS, DOWNTIME, OR THE CLAIMS OF BUYER'S CUSTOMERS FOR ANY OF THE AFORESAID DAMAGES. SELLER SHALL NOT BE LIABLE FOR AND BUYER AGREES TO DEFEND AND INDEMNIFY SELLER AGAINST ALL CLAIMS OR LOSSES (INCLUDING ATTORNEYS' FEES), INCLUDING PERSONAL INJURY, PROPERTY DAMAGE OR OTHER LIABILITY, RESULTING IN WHOLE OR IN PART FROM (1) THE NEGLIGENCE OF BUYER OR ITS CUSTOMERS; (2) BUYER'S OR ITS CUSTOMER'S MISUSE , damage, alteration or modification of Seller's Goods; (3) Buyer's OR ITS CUSTOMER'S use of the Goods in any product or system designed, manufactured or sold by Buyer OR ITS CUSTOMERS; OR (4) ANY BREACH OF THIS AGREEMENT; provided, however, that Buyer shall have no obligation to indemnify Seller for claims or losses that arise solely from the negligence or misconduct of Seller.

In any contract by Buyer for resale of the Goods, Buyer shall effectively disclaim, as against Seller, any implied warranty of merchantability and all liability for property damage or personal injury resulting from the handling, possession or use of the Goods, and shall exclude, as against Seller, any liability for special or consequential damages.