Engineered Corrosion Solutions

INSTALLATION & OPERATIONS MANUAL

AdvancedIQ VENT CONTROLLER

AVC-2 | AVC-6

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Safety Guidelines

The manual contains safety information that is important to know and understand. The information is provided for the safety of the installers, operators and users of the nitrogen generation systems, as well as the nitrogen generation equipment.

The Installation and Operations Manual that is supplied with each nitrogen generation system must be read thoroughly and be completely understood prior to installing and operating nitrogen generation system. All appropriate safety standards for the handling of gases as determined by local, state or national laws and regulations are to be followed at all times.

General Safety Information

IMPORTANT: Read all of the safety information in the manual prior to operating the equipment. Use of the equipment in a manner not specified within the manual could impair the protection provided by the nitrogen generation system and could result in an unintended release of pressure which could cause serious injury or damage. Only qualified personnel can perform commissioning, inspection, testing and maintenance of the nitrogen generation equipment.

When handling, installing, or operating the nitrogen generation equipment, the personnel must employ safe engineering practices and observe all related local, state and national regulations, health, and safety procedures, and legal requirements for safety.

Ensure the nitrogen generation equipment is depressurized and electrically isolated, before performing any maintenance or troubleshooting instructions specified in this manual.

The warnings covered in this manual are the most known potential hazards, but by definition cannot be all-inclusive. If the user employs an operating procedure, item of equipment, or method of working that is not specifically recommended by Engineered Corrosion Solutions, LLC, the user must ensure that the equipment will not be damaged or become hazardous to any persons or property.

Cautions and Warnings

CAUTION: Do not install the Nitrogen Generation Systems in an area where ammonia, sulfur dioxide, hydrogen sulfide, mercaptans, chlorides, chlorine, oxides of nitrogen, acid fumes, solvent vent vapors, and ozone vapors or similar contaminates exist. The equipment can be damaged by ammonia and other vapors shortening life.

WARNING: Do not operate the Nitrogen Generation System if damaged during shipment, handling or use. Damage could result in injury or property damage.

WARNING: Specific procedures must be developed for maintenance and servicing of the equipment where the nitrogen equipment is located. Appropriate labels must be continuously displayed in all areas where personnel might be exposed to a nitrogen atmosphere under normal and abnormal conditions.

WARNING: Nitrogen is nontoxic and largely inert. Rapid release of nitrogen gas into an enclosed space displaces the oxygen and can cause an asphyxiation hazard.

Maintenance and Troubleshooting Warnings

Advanced**IQ** Vent Controller includes 100-240 VAC, 50-60 Hz voltage inside cabinet. Exercise caution and do not touch any wiring connections when power is applied to the unit.

SYSTEM and PRODUCT INFORMATION

Dry Pipe Nitrogen Inerting (DPNI)

Dry Pipe Nitrogen Inerting technology was developed by Engineered Corrosion Solutions, LLC (ECS) and is used to control oxygen corrosion in dry pipe and/or preaction fire sprinkler systems. DPNI is executed by employing a "fill and purge" differential pressure cycle (breathing) within the sprinkler pipe network. The "fill and purge" pressure cycle consists of venting the system pressure by 3-5 psi (.2-.3 bar), followed by replacing the vented pressure back into the system. This breathing process uses a nitrogen rich gas stream, typically 98% or greater, for a specific length of time (typically fourteen (14) days or less), until a nitrogen rich atmosphere exists within the sprinkler pipe network. By changing the atmosphere inside the pipe network to 98% or higher nitrogen content, the available oxygen content is reduced to a level that will not allow appreciable corrosion of the fire sprinkler pipe. With the level of oxygen corrosion reduced to near zero the effective life of the fire sprinkler system is greatly extended. Systems that implement a DPNI corrosion control strategy should never develop leaks when maintained properly.

Dry Pipe Nitrogen Inerting Equipment

AdvancedIQ Vent Controller (AVC)

The Advanced**IQ** Vent Controller provides automatic oxygen venting, monitoring of nitrogen/oxygen concentration levels, and monitoring of the sprinkler system pressure within each dry pipe/preaction fire sprinkler system. As a fire sprinkler system is filled with a continuous supply of nitrogen gas from the nitrogen generator system, the vent, installed on the sprinkler system riser, allows oxygen rich gas to be vented from the fire sprinkler system.

The AVC samples the discharge gas from each vent connected to the controller. Over a fourteen (14) day period, the vent will dilute the oxygen concentration in the entire fire sprinkler system to less than 2% oxygen. The gas flows out of the restricted orifice on the vent through pressure-rated tubing to provide slow, controlled flow to the Advanced**IQ** Controller. Once the desired system gas composition is reached the controller will automatically close and stop the venting process thereby preventing continuous venting. The AVC is equipped with a programmable logic controller (PLC) and a human-machine interface (HMI) with an LCD display to control the venting process and continuously monitor the nitrogen purity levels in the sprinkler systems.

AdvancedIQ Vent Controller Features

The Advanced**IQ** Vent Controller, in conjunction with oxygen removal vents, along with the ECS-patented "fill and purge" breathing technology, includes the following features:

- All equipment is installed in the sprinkler riser room for easier installation and servicing
- Individual pressure & purity monitoring for up to six (6) sprinkler systems
- Datalogging & historical trends for each sprinkler system
- Leak rate checks for each sprinkler system
- Internet connectivity and remote monitoring capability
- Removeable datalog (flash drive)
- Form-C dry contact supervisory

Oxygen Removal Vent

To completely remove the oxygen in a dry pipe and preaction fire sprinkler system, it is necessary to install a vent on the main riser of each fire sprinkler system. Vents allow for a system to breathe, which requires a 3-5 psig (.2-.3 bar) pressure range to facilitate removal of oxygen gas from the system. Supervisory nitrogen gas is supplied to the system until the air maintenance device reaches the high-end pressure. The vent slowly releases the gas mixture inside the sprinkler system through the restricted orifice until the system reaches the low-end pressure at which point supervisory nitrogen is supplied to the system again. This process is repeated numerous times until the atmosphere inside the piping network reaches at least 98% nitrogen. The vent is crucial for expedient mixing of the gas and elimination of oxygen inside the system within the specified timeframe.

ECS offers two (2) DPNI vents to operate with the AVC, the PAV-DQ vent and the PAV-D vent. The PAV-DQ is configured to operate with the AVC, while PAV-D can be used but requires a minor field modification to operate with the AVC. The PSV-D SMART vent can be used with the AVC but requires field reconfiguration and the SMART vent controller will not be used.

Oxygen Removal Vent Features

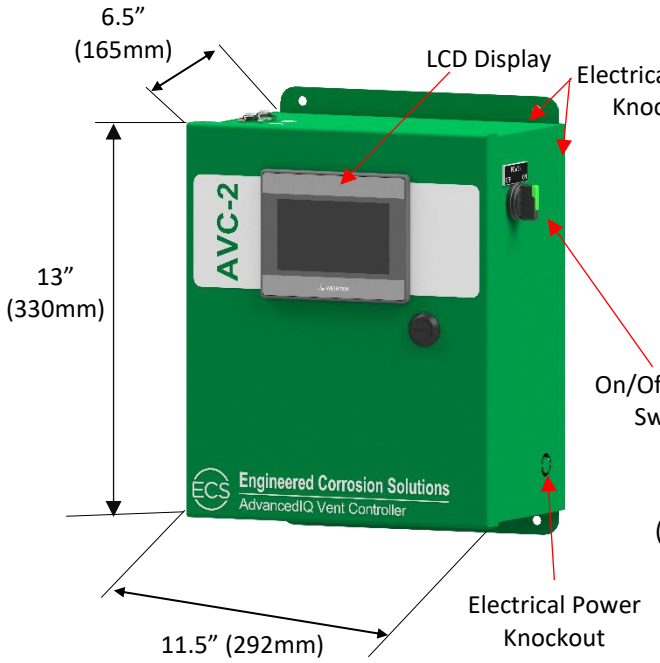
The oxygen removal vents with the ECS-patented “fill and purge” breathing technology include the following features:

- Removal of corrosive oxygen from the entire sprinkler system in fourteen (14) days or less
- All equipment is installed in the sprinkler riser room for easier installation and servicing
- No support hanger required
- Backpressure regulator preventing system depressurization from vent
- In-line filter to protect restricted venting orifice from contamination

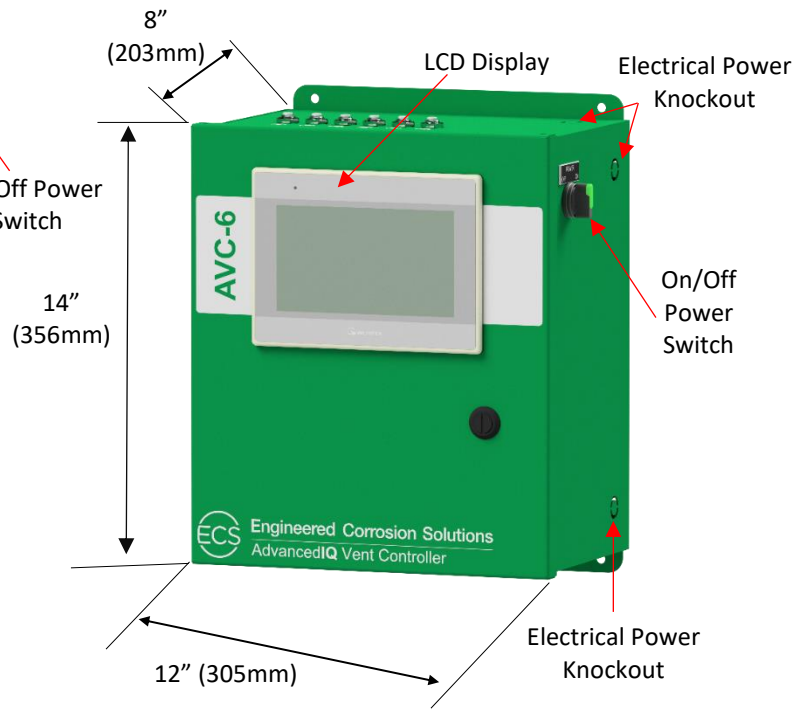
TECHNICAL SPECIFICATIONS

AVC-2 Dimensions	11.5"(292mm) W x 13"(330mm) H x 6.5"(165mm) D
AVC-6 Dimensions	12"(305mm) W x 14"(356mm) H x 8"(203mm) D
AVC-2 Weight	18 lbs (8 kg)
AVC-6 Weight	26 lbs (12 kg)
Location	Dry Indoor Use
Altitude	Up to 6,560 ft (2,000m)
Temperature Range	32°F - 122°F (0°C - 50°C)
Cabinet Power Supply	100-240 VAC, 50-60 Hz, 1 ph
Power Consumption	0.5 Amps
AVC-2 Sample Inputs	Two (2)
AVC-6 Sample Inputs	Six (6)
Internet Connectivity	Ethernet Connection
Signal Output	Common Trouble (*Form-C Contact*)
Output Display	Full Function LCD
Sample Port Connection	5/32” plastic tubing quick connect

AVC-2 Dimensions



AVC-6 Dimensions



Start Up and Operation Procedures

INSTALLATION

Installation Instructions

Installation of the Advanced**IQ** Vent (AVC) requires five (5) steps:

1. Mount the cabinet in the appropriate location.
2. Connect the dedicated power supply to the cabinet (can be connected to the nitrogen generator power supply).
3. Plumb 5/32" tubing between Controller and each oxygen removal vent.
4. Connect the AVC to the internet via ethernet cable connection, where applicable.
5. Connect Supervisory signal output to Building Management System or Building Alarm System, where applicable.

Wire Gauge Chart

1. Ensure an appropriately rated disconnect switch and circuit breaker (minimum 15 Amps and a Short-Circuit Current Rating (SCCR) of 5 kVA) are installed in a suitable and accessible location in accordance with the applicable national and/or local codes (i.e., NFPA 70).
2. The circuit breaker and disconnect are to be easily identifiable as associated with the equipment.
3. Ensure the ground wire is properly connected to the ground terminal(s) of the equipment using appropriately sized ground wire.

Wire Gauge Chart							
Size	**Amperage**			**Diameter**		**Resistance**	
(AWG)	60°C (140°F)	75°C (167°F)	90°C (194°F)	(Inches)	(mm)	(Ohms/1,000 ft)	(Ohms/km)
18				.0403	1.024	6.385	20.95
16				.0508	1.291	4.016	13.17
14	15	15	15	.0641	1.628	2.525	8.282
12	20	20	20	.0808	2.053	1.588	5.211
10	30	30	30	.1019	2.588	.9989	3.277
8	36	43	48	.1285	3.264	.6282	2.061

Step 1: Mount the Vent Controller Cabinet

The Vent Controller is designed to be mounted directly to the wall at the appropriate location. Several factors should be considered in choosing the proper mounting location for the controller cabinet:

1. Access to required power supply (dedicated circuit).
2. Access to oxygen removal vents (installed on sprinkler risers) being controlled by AVC.
3. Access to building monitoring connections and internet connection (where applicable).
4. Clearance in front of the unit to open the cabinet door and for servicing the equipment.
5. Cleanliness of the environment.

The cabinet includes pre-punched holes using standard anchors.

NOTE: Ensure the wall is structurally sound and the cabinet is firmly anchored to a wall to support the controller cabinet

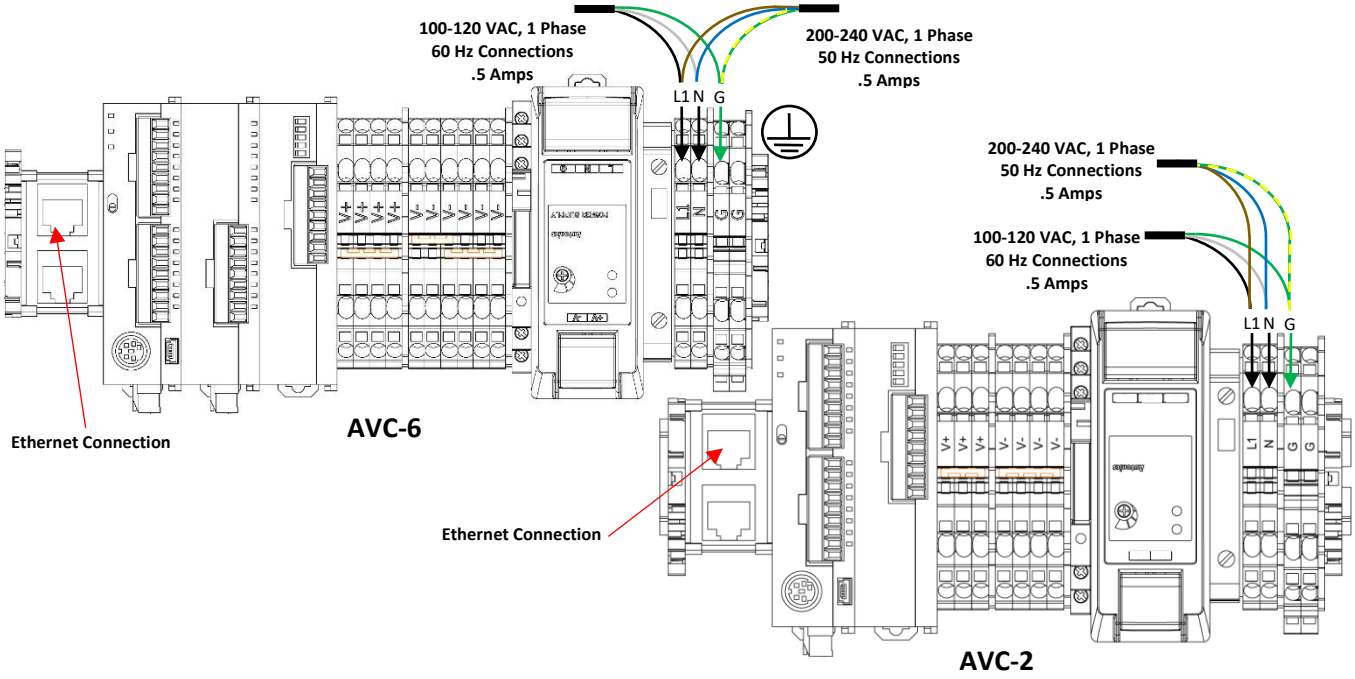
RCOMMENDED: The AVC-2 controller kit includes 100 feet of 5/32" flexible tubing. The AVC-6 controller kit includes 200 feet of 5/32" flexible tubing. Install the AVC controller within 40 feet from the furthest sprinkler system riser, or additional flexible tubing may be required.

Step 2: Connect the Vent Controller Power Supply

The Vent Controller requires a dedicated power supply to prevent interaction with other equipment. The AVC can be connected to the same power supply as the nitrogen generator or additional AVC's, provided the total circuit load does not exceed the circuit limitation. The incoming power supply line is connected to the top of the terminal blocks inside the vent controller cabinet. The terminal connections are labeled L1, N, and G.

NOTE: The AVC cabinet includes combination ½" and ¾" knockout in the right side of the top of the cabinet, and on the upper and lower portion of the right side the cabinet.

Required power supply: 100-240 VAC, 50-60 Hz, 1 phase dedicated circuit.



Step 3: Connect the Nitrogen/Air Vent Discharge to AVC

The Vent Controller can control up to six (6) oxygen removal vents. The nitrogen/air discharge from the oxygen removal vent is connected to the appropriate connection in the AVC using 5/32" flexible tubing. The PAV-DQ, PAV-D or PSV-D vents can be used with the AVC. The PAV-D and PSV-D require field reconfiguration for use with the AVC. Contact ECS for assistance.

NOTE: Maximum distance between AVC and each Vent is 350 feet.

1. Connecting the PAV-DQ to the AVC.
    a. Connect the 5/32" tubing to the push-connect fitting on the oxygen removal vent.
    b. Connect the opposite end of the 5/32" tubing to the appropriate push-connect fitting on the top of the AVC.
    c. Repeat the steps for each additional oxygen removal vent connected to the AVC.
2. Connecting the PAV-D to the AVC.
    a. Remove the muffler from the restricted orifice on the oxygen removal vent and install a 5/32" push-connect fitting.
    b. Connect the 5/32" tubing to the push-connect fitting on the oxygen removal vent.

c. Connect the opposite end of the 5/32” tubing to the appropriate push-connect fitting on the top of the AVC.
d. Repeat the steps for each additional oxygen removal vent connected to the AVC.

3. Connecting the PSV-D to the AVC.
   a. Shutoff power to PSV-D SMART Vent controller. The PSV-D SMART Vent controller will no longer be needed in this application.
   b. Remove power connections to solenoid on PSV-D vent.
   c. Remove the muffler and restricted orifice on the oxygen removal vent.
   d. Remove solenoid and hex nipple on PSV-D vent.
   e. Reinstall the restricted orifice and install a 5/32” push-connect fitting.
   f. Connect the 5/32” tubing to the push-connect fitting on the oxygen removal vent.
   g. Connect the opposite end of the 5/32” tubing to the appropriate push-connect fitting on the top of the AVC.
   h. Repeat the steps for each additional oxygen removal vent connected to the AVC.

Step 4: Connect the Vent Controller: Internet Connection (where applicable)

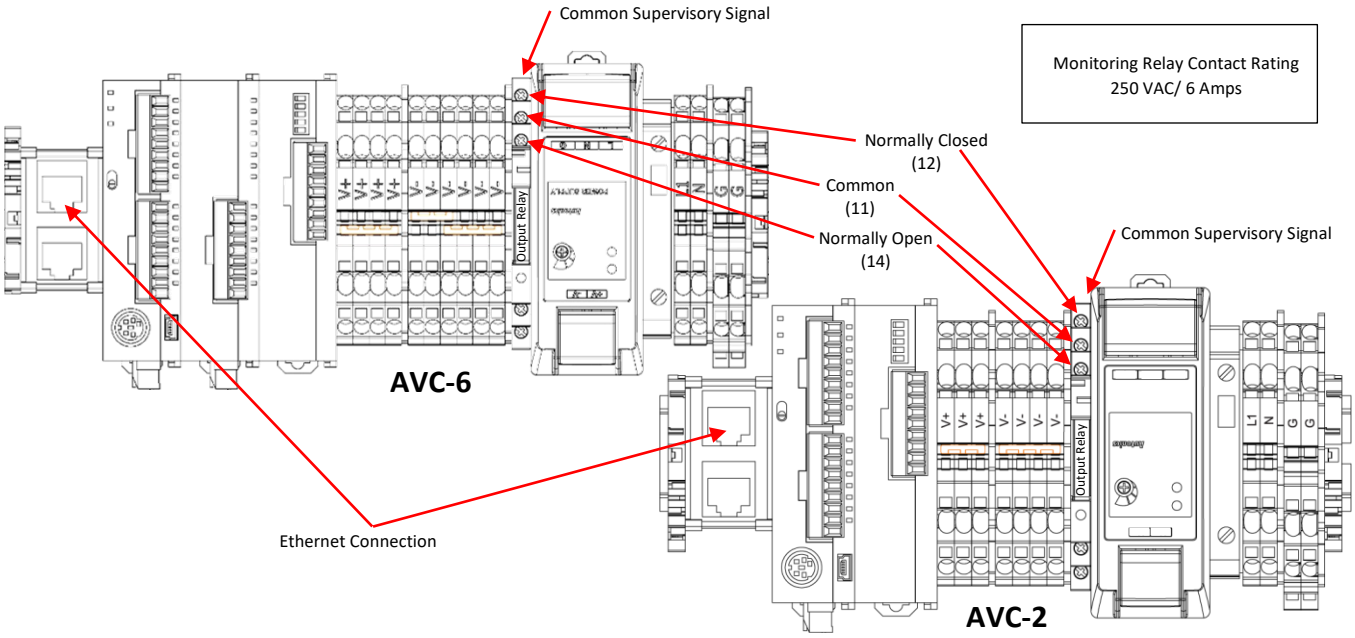
The Vent Controller has ethernet cable connection to the internet through a local area network (LAN). Connect the ethernet cable from the LAN to the ethernet connector in the AVC.

Step 5: Connect the Vent Controller: Output Signals (where applicable)

The Vent Controller has a common supervisory signal that can be monitored by the facility’s Building Management System or Building Alarm System. The common supervisory signal is a Form-C contact with Common (C) and Normally Open (N.O.) or Normally Closed (N.C.) connections.

Common supervisory Signal activates upon the following conditions:

1. ***Excess Vent Duration:*** Any Zone does not obtain 98% purity with fourteen (14) days
2. ***Low Purity:*** Any Zone the nitrogen purity falls below 98% purity after venting process is complete
3. ***Low Air Pressure:*** Any Zone where the pressure falls below the Low Air Alarm Pressure



COMMISSIONING and START UP PROCEDURE

Only qualified personnel should commission the new equipment into service once it is installed. **Once the nitrogen generation equipment has been configured, there should be no reason to adjust the nitrogen generation system.**

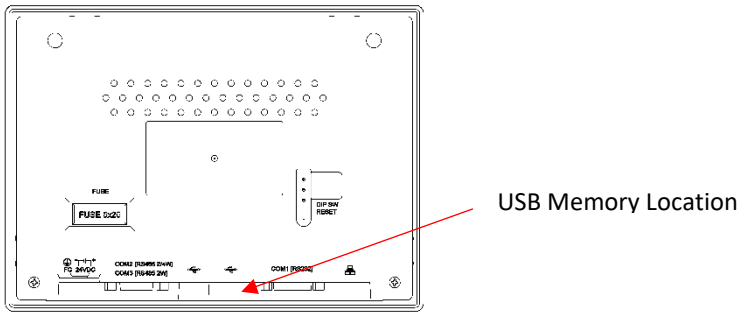
Safety Warning

Prior to any system commissioning on the nitrogen generator, ensure that the nitrogen generator is isolated from all system risers. Failure to do so can result in system damage and/or personal injury.

Pre-Commissioning

Prior to starting up the AVC install the USB memory storage drive into the USB memory location on the back side of the LCD Display.

LCD Display



Oxygen Removal Vent Setup and Pressure Regulator Adjustment Instructions

Once the nitrogen generator has been commissioned, the oxygen removal vents can be commissioned.

1. Verify the appropriate restricted venting orifice is installed in the oxygen removal vent. Restricted venting orifice is typically installed during manufacturing.
    a. If not installed, removing the vent muffler or push connect fitting downstream of the backpressure regulator, installing the restricted venting orifice and re-installing the vent push fitting.
2. The restricted venting orifice size is determined by the sprinkler system capacity (gallons).
3. Consult with ECS to ensure the appropriate restricted venting orifice is installed in the appropriate oxygen removal vent.

Based on the nitrogen generator turn-on pressure and the sprinkler system low alarm pressure, adjust the pressure setting for the backpressure regulator.

1. Choose a pressure setting for the backpressure regulator that is **above** the sprinkler system low air alarm pressure and **below** the turn-on pressure of the nitrogen generator.
2. Pull the knob out from the regulator to adjust pressure setting. Turn the knob clockwise to raise the pressure, counterclockwise to lower the pressure.
3. Close the isolation ball valve and allow the vent to depressurize through the restricted venting orifice to pressure setting. Make adjustment to pressure setting using the knob, then open the isolation ball valve to pressurize the vent and close the isolation ball valve again to check pressure setting. Repeat process until desired pressure setting is achieved.

    NOTE: This process can only be performed when the fire sprinkler system is at normal operating pressure.

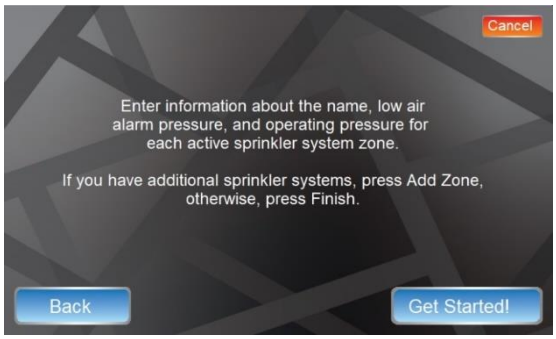
4. Push knob back into regulator until it clicks into place.

5. Repeat this process for each additional oxygen removal vent connected to the AVC.
6. Once the Nitrogen Generator System has been commissioned, open the isolation ball valve on the vent assembly.

COMMISSIONING

Once the vent backpressure regulator pressure has been determined and set, the AVC can be turned on and commissioned. The commissioning is accomplished through the Human Machine Interface (HMI) screen. The HMI screen provides access for setup, monitoring and control functions of the AVC. See Maintenance Section for HMI User Interface Screen information (Section 5B).

1. Allow the AVC to initialize (Initialization is complete when main screen appears on the LCD display)
2. The HMI Home Screen includes a banner that requires the AVC to be commissioned prior to operation. To commission, press the commissioning note banner.
3. The Commissioning Screen provides the information required for each active zone connected to the AVC. Once the information has been obtained, press **Get Started** button.



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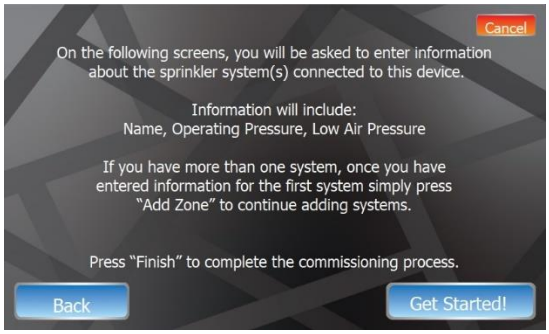


AVC-6

4. Enter the sprinkler zone information in the HMI Screen
    a. Press the appropriate display, which displays a keyboard.
    b. Enter the appropriate information, then press **Enter.**
        i. Set **PSI/Bar** button to the appropriate position, if needed (*Factory set for PSI*).
        ii. Add the custom label for the sprinkler system.
            1) Press the label, which displays a keyboard.
            2) Enter the appropriate information, then press **Enter.**
        iii. Enter the Sprinkler System Low Air Alarm Pressure.
            1) Press the label, which displays a keyboard.
            2) Enter the appropriate information, then press **Enter.**
        iv. Enter the Sprinkler System Operating Pressure.
            1) Press the label, which displays a keyboard.
            2) Enter the appropriate information, then press **Enter.**

5. If additional zones are to be added, press **Add Zone** button and add the information for each additional zone.
6. If no additional zones are to be added, press **Finish** button.
7. Enter the installation location information into the HMI Screen (*Recommended but not required*).
    a. Press the appropriate display, which displays a keyboard.
    b. Enter the appropriate information, then press **Enter**

8. Enter the Owner Contact information (*Recommended but not required*).
    a. Press the appropriate display, which displays a keyboard.
    b. Enter the appropriate information, then press **Enter**.

9. Press **Finish** button.

START UP

The Vent Controller monitors each sprinkler system pressure and nitrogen purity individually along with storing the information into the individual sprinkler system's memory and transmits the information to the remote monitoring site via the internet, where used. To start-up the AVC or to put AVC back in service, follow these steps:

1. Turn the On/Off Power Switch to the **On** position.
2. The AVC will complete the initialization process followed by displaying the **Home** Screen.

AVC-2

AVC-6

3. Press the **Vent Control** button to initiate fourteen (14) day nitrogen inerting process for any or all sprinkler zones.
    a. Pressing the **Vent Control** Button displays the Vent Control Screen
4. The **Vent Control** Screen initiates the venting process for each sprinkler zone individually or for all for the sprinkler zones.
    a. Press the individual **Start Venting** button to initiate zone venting individually.
    b. Press the **Vent All Zones** button to initiate zone venting for all of the zones (at the same time).

AVC-2

AVC-6

NOTE: The **Main Menu** button allows access to all of the settings screens for review or to make any required changes. See section 5B, HMI User Interface Information in Maintenance Section for additional information.

NORMAL OPERATION

The Vent Controller monitors each sprinkler system pressure and nitrogen purity individually. The information is stored into the individual sprinkler system zone's memory. In addition, the information is transmitted to the remote monitoring site via the internet, where used.

FIRE SPRINKLER SYSTEM MAINTENANCE PROCEDURE

In the event the fire sprinkler system requires maintenance or repair, the following procedure ensures the nitrogen inerting process will continue to function properly.

1. Complete the maintenance or repair work on the fire sprinkler system.
2. Refill the sprinkler system with air in compliance with the NFPA 13 30-minute fill requirement.
3. Initiate the fourteen (14) day nitrogen inerting process from the Vent Control Screen for the appropriate fire sprinkler system (See Start Up, Section 2D).

COMMISSIONING CHECKLIST

Fire Sprinkler System: General

Verify and document the quantity of dry/preaction fire sprinkler systems connected to the AVC: ☐ Yes Qty. __

Verify and document the specific names or label of each dry/preaction fire sprinkler systems connected to the AVC: ☐ Yes ☐ No

Sys. #1 _____

Sys. #2 _____

Sys. #3 _____

Sys. #4 _____

Sys. #5 _____

Sys. #6 _____

Nitrogen Generation Equipment

Verify and document the location of the AVC(s): _____

Verify and document the quantity of the AVC(s): _____

Verify and document the serial number of the AVC(s): _____

Verify and document whether the AVC(s) is/are installed correctly: ☐ Yes ☐ No

If No, explain: _____

Verify and document whether the AVC(s) is/are wired correctly: ☐ Yes ☐ No

If No, explain: _____

Oxygen Removal Vents: PAV-D & PAV-DQ

Verify and document the appropriate orifices for each vent are available: ☐ Yes ☐ No

Install the appropriate orifice in the oxygen removal vent.

NOTE: Ensure the appropriate orifice is installed in the appropriate vent for each fire sprinkler system. The restricted venting orifice size is determined by the sprinkler system capacity (gallons). The restricted venting orifice ensures the oxygen removal process is completed in all fire sprinkler systems within the same approximate timeframe and typically within fourteen (14) days.

Verify and document the model and serial number of each oxygen removal vent installed: ☐ Yes ☐ No

Determine the pressure setting of the backpressure regulator of oxygen removal vent.

1. The backpressure regulator setting must be **below** the cut-in or turn-on pressure of the nitrogen generator and **above** the low air alarm pressure of the fire sprinkler system.

Adjust the backpressure regulator setting on the oxygen removal vent:

1. Open and close the isolation ball valve on the oxygen removal vent to determine the pressure setting of the backpressure regulator.
2. Pull the knob out from the regulator to adjust pressure setting. Turn the knob clockwise to raise the pressure, counterclockwise to lower the pressure.
3. Repeat process until desired pressure setting is achieved.

NOTE: This process can only be performed when fire sprinkler system is at normal operating pressure.

4. Once the desired pressure has been obtained on the backpressure regulator, push the knob onto the regulator until it clicks into place.

Verify and document the backpressure regulator set point: _____

Verify and document isolation ball valve left in open position: ☐ Yes ☐ No

Programming of AVC

Turn On/Off Power Switch to the **On** position.

Set PSI/Bar button to the appropriate position, if needed: ☐ Yes ☐ No

Enter the specific names or labels for each sprinkler systems into the AVC: ☐ Yes ☐ No

Enter the Sprinkler System Low Air Alarm Pressure: ☐ Yes ☐ No

Enter the Sprinkler System Operating Pressure: ☐ Yes ☐ No

Enter the installation location information: ☐ Yes ☐ No

Enter the Owner Contact information: ☐ Yes ☐ No

Enter the Service Contractor Contact information: ☐ Yes ☐ No

Determine the AVC is to initiate the venting process: ☐ Yes ☐ No

If venting, determine whether venting all sprinkler systems or specific sprinkler system(s): ☐ Yes ☐ No

Initiate the appropriate function (individual system venting or all systems venting): ☐ Yes ☐ No

Leak check all plumbing between AVC and oxygen removal vents, repair any leaks found.

Verify and document that the no leaks exist between AVC and oxygen removal vents: ☐ Yes ☐ No

NOTE: If unable to perform any functions with the AVC, contact ECS.

Sequence of Operation

Once in service, the Advanced**IQ** Vent Controller (AVC) requires no additional intervention to function properly. AVC settings should not be altered without consulting ECS and the unit should not be powered down or bypassed for any reason other than a service or maintenance procedure as detailed in the Maintenance Section. The AVC operates in two (2) modes: Venting Mode and Monitoring Mode.

Venting Mode

The Venting Mode which initiates the Dry Pipe Nitrogen Inerting (DPNI) protocol to a dry pipe or preaction fire sprinkler system. The DPNI protocol is fundamentally different than the traditional application of compressed air as a supervisory gas. Because the DPNI protocol uses a process called "fill and purge breathing" which requires small (3-5 psig (.2-.3 bar)) supervisory pressure fluctuations in the fire sprinkler system(s) to remove oxygen before it can cause corrosion.

1. The nitrogen generator and compressor will cycle on to increase the pressure in all fire sprinkler systems connected to the nitrogen generator.
    a. Once the high-end pressure of the breathing cycle is reached the air compressor and nitrogen generator will turn off and the fire sprinkler system(s) are allowed to depressurize gradually through the oxygen removal vent(s).
    b. Once the low-end pressure of the breathing cycle is reached, the air compressor and nitrogen generator automatically turn on to repeat the process.
    c. The high-end/turn-off pressure is determined by the pressure setting of the fire sprinkler system(s) air maintenance device (AMD) and the low-end/turn-on pressure is determined by the nitrogen generator's integral pressure transducer.
    d. The air compressor and nitrogen generator are simultaneously cycling the pressure in all fire sprinkler system(s) by 3-5 psig (.2-.3 bar) during each cycle. This will result in longer run times of the air compressor and nitrogen generator than a traditional air compressor configured to supply supervisory gas.
2. The DPNI "fill and purge breathing" protocol is performed for a fourteen (14) day period, during this time the system pressure will fluctuate between the high-end and low-end breathing pressures.
3. Once the fourteen (14) day inerting period is complete and the sprinkler system has obtained 98% nitrogen purity, the AVC will automatically stop the venting process and monitor the sprinkler system pressure and nitrogen purity.
4. All information for the sprinkler system is stored in the Events Log and transmitted to the remote monitoring site via the internet, where used.

Monitoring Mode

In the Monitoring Mode, the AVC will monitor the sprinkler system's pressure and nitrogen purity. All data obtained from each sprinkler system is stored in the Events Log on an individual zone basis and transmitted to the remote monitoring site via the internet, where used.

Restart of the Nitrogen Inerting Process

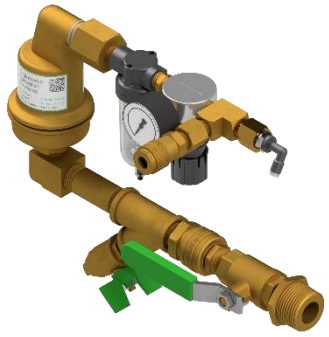
Whenever the fire sprinkler system(s) are serviced and refilled with air, the DPNI protocol using the “fill and purge breathing” process must be reinitialized.

1. Press the **Vent System** button on the Vent Control Screen for the appropriate sprinkler system.
    a. The AVC will automatically monitor and control the venting process until the DPNI process is completed.
    b. The AVC will automatically transition from venting to system monitoring.

System Power Loss

In the event of a system power loss, all programmed information in the AVC is stored in the controller and the AVC will automatically resume at the sequence prior to the loss of power once system power is restored.

Oxygen Removal Vent: PAV-D & PAV-DQ



For use under U.S. Patents
8,720,591, 9,144,700, 9,186,533 and 9,610466 B2

Specifications

Stock Number:	PAV-D PAV-DQ
Service Pressure:	Up to 175 PSIG (12 Bar)
System Connection:	1” NPT Male
Temperature Range:	40°F to 125°F (4.5°C to 51°C)
Dimensions:	13.5” (W) X 7.5” (H) X 4.25” (D) (343mm (W) X 191mm (H) X 108mm (D))

Support Hanger Not Required

General Description

The PAV-D/DQ Vent provides oxygen venting in dry pipe and preaction fire sprinkler systems. As a fire sprinkler system is filled with a continuous supply of nitrogen gas from the nitrogen generator system, the PAV-D/DQ allows oxygen rich gas to be vented from the fire sprinkler system. Over a short period of time the vent will almost completely remove oxygen from the fire sprinkler system (less than 2% oxygen). The vent is equipped with a levered float valve that prevents water from passing through the restricted venting orifice when water enters the fire sprinkler system. The in-line filter protects the restricted venting orifice from contaminants from the sprinkler system. A backpressure regulator is included to prevent total system depressurization from the vent assembly during the venting process. The restricted venting orifice allows oxygen to be vented from the fire sprinkler system at a controlled rate to achieve a minimum of 98% nitrogen concentration. A special push fitting is provided to receive 5/32” tubing when the vent is connected to the Advanced**IQ** Controller.

Installation Instructions

1. The vent is equipped with a ball valve to be connected to the fire sprinkler riser. The contractor must install a 1” outlet (welded or mechanical) to connect the vent assembly to the sprinkler system on the system side of the main control valve. The ball valve must remain in the closed position until the nitrogen generator system has been commissioned.

   NOTE: The vent assembly does not require a support hanger.

2. Install the vent assembly in a level position. Recommended mounting height is 5’-10’ (2-3m) above the finished floor, but a minimum of 2’ (.6m) above the dry pipe or preaction valve.

   NOTE: Piping to the vent assembly cannot be installed in a configuration that would trap water and prevent drainage to the sprinkler system; a water trap impedes the ability of the vent assembly to vent oxygen from the fire sprinkler system.

3. Connect the 5/32” flexible tubing into the push fitting on the vent and connect the opposite end of the 5/32” flexible tubing to the appropriate push fitting on the AVC.
4. Inspection of the vent assembly should be performed after installation and hydrostatic testing of the fire sprinkler system. Inspection should be performed periodically thereafter in accordance with the applicable national codes, NFPA codes and standards, and/or the authority having jurisdiction.

NOTE: Inspection must include the condition of the in-line filter and checking for blockage in the Y-Strainer and the restricted venting orifice.

Operating Instructions

1. Verify the vent assembly has been equipped with a restricted venting orifice downstream of the backpressure regulator.

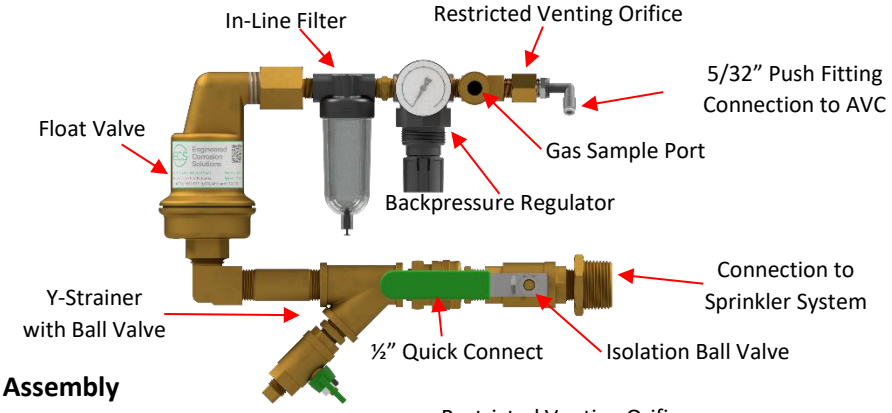
   NOTE: If the vent assembly is not equipped with a restricted venting orifice, one will be provided by ECS during system commissioning. The restricted venting orifice must be installed before proceeding with the steps below.

2. Determine the low air alarm pressure and the turn-on pressure of the nitrogen generator.
3. Choose a pressure setting for the backpressure regulator that is above the low air alarm pressure but below the turn-on pressure of the nitrogen generator.
4. Pull the knob out from the regulator to adjust pressure setting. Turn the knob clockwise to raise the pressure, counterclockwise to lower the pressure.
5. Close the ball valve and allow the vent to depressurize through restricted venting orifice to pressure setting. Make adjustment to pressure setting using the knob, then open ball valve to pressurize the vent and close ball valve again to check pressure setting. Repeat process until desired pressure setting is achieved.

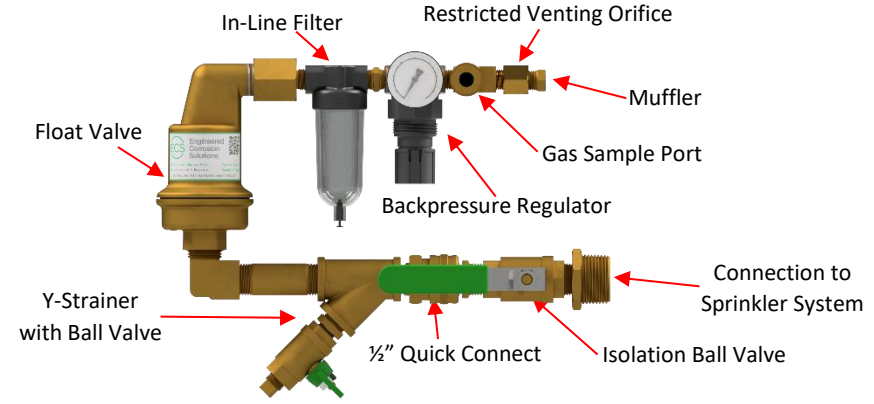
   NOTE: This process can only be performed when fire sprinkler system is at normal operating pressure.

6. Push knob back into regulator until it clicks into place.
7. Once the nitrogen generator system has been commissioned, open the isolation ball valve on the vent assembly. The vent is now open and actively venting oxygen from the fire sprinkler system.

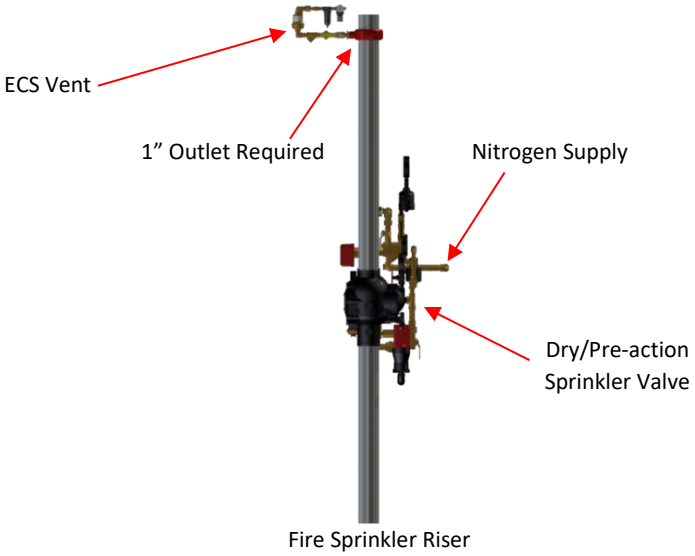
PAV-DQ Vent Assembly



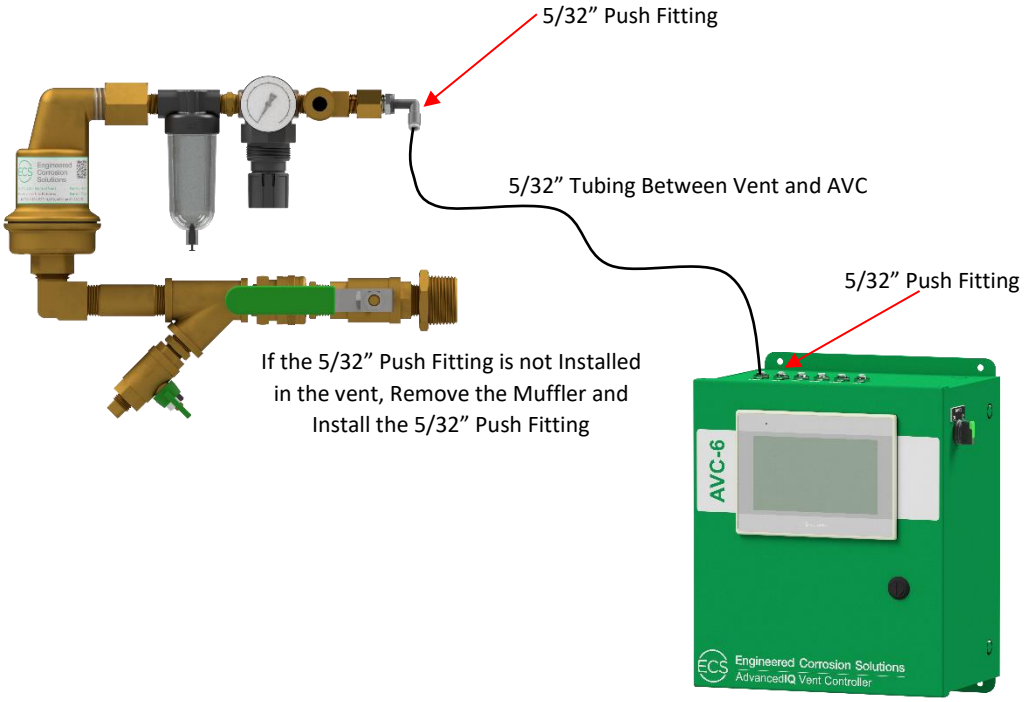
PAV-D Vent Assembly



Vent Installation Schematic



Vent/AVC Installation Schematic



Maintenance

Safety Warning

Only qualified personnel can perform inspection, testing and maintenance of the nitrogen generation equipment. Prior to any system maintenance on the nitrogen generation system, ensure that the nitrogen generator is isolated from the compressed air supply and all system risers. Ensure that the nitrogen generation system and the associated piping that is to be manipulated is completely depressurized prior to performing any maintenance. Failure to do so can result in system damage and/or personal injury.

Maintenance And Troubleshooting Warnings

1. Advanced**IQ** Vent Controller (AVC) includes 100-240 VAC, 50-60 Hz voltage inside cabinet. Exercise caution and do not touch any wiring connections when power is applied to the unit.
2. AVC has hot surfaces inside cabinet when operating. Exercise caution when working on AVC. (***Wear Hand Protection, where needed***)

ROUTINE CHECKS

The AVC requires limited maintenance; however, it is advisable to routinely check the AVC to ensure functionality. The following is a checklist and schedule for routine inspection.

Check	Occurrence
Verify the AVC is powered on and is operating	Quarterly
Verify nitrogen purity maintains at or above 98%	Quarterly
Verify the sprinkler system pressures displayed are in alignment with sprinkler system gauges	Quarterly
Verify there are no noticeable leaks on unit or oxygen removal vent	Quarterly
Verify Oxygen Removal Vent In-Line Filter and Y-Strainer are clean	Annually

HMI USER INTERFACE INFORMATION

The Advanced**IQ** Controller operation is accomplished through the Human-Machine Interface (HMI) screen. The HMI screen provides access for setup, monitoring and control functions of the AVC. All of the screens on the HMI are accessible from the Home Screen.

HOME SCREEN

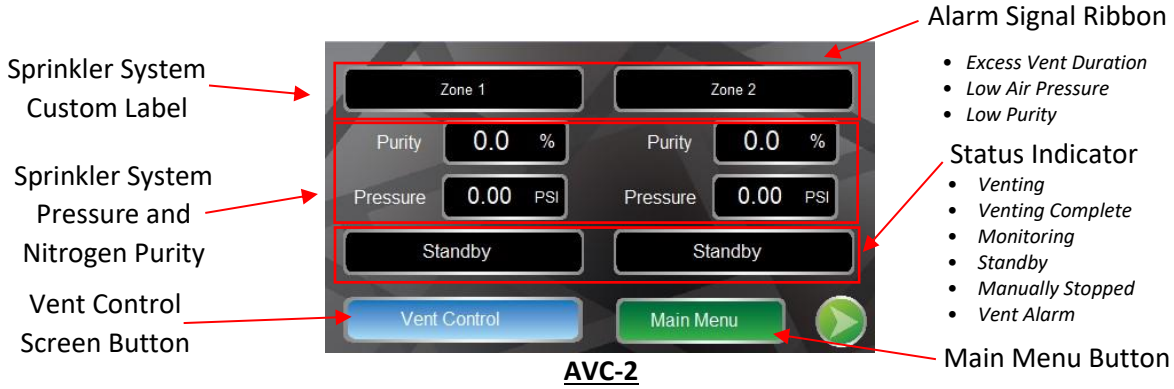
The Home Screen displays nitrogen pressure, nitrogen purity and whether the sprinkler zone is in the fourteen (14) day nitrogen inerting venting process. The Home Screen also provides access to **Main Menu** Screen. The Home Screen displays any alarm signals developed in the nitrogen generator across the top of the screen.

NOTE: The **Home** Screen displays the status of each sprinkler zone:

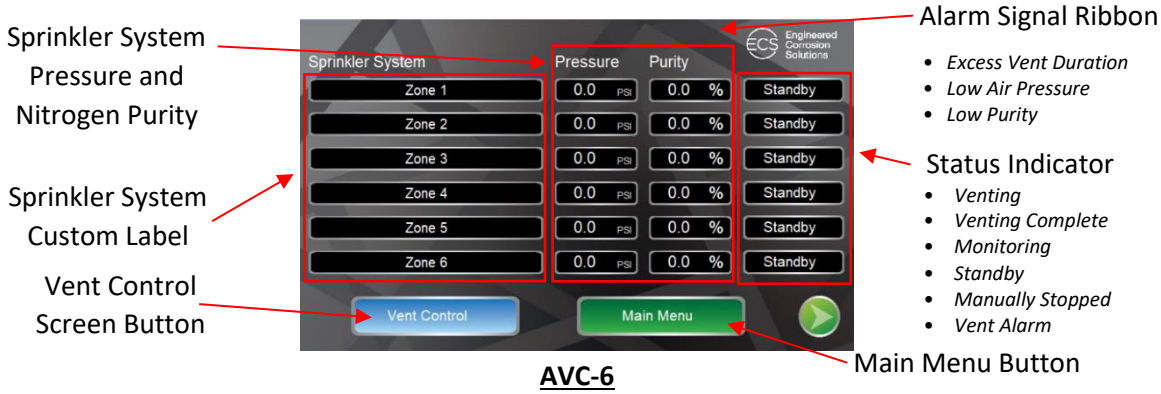
1. *Venting:* Sprinkler system is in the fourteen (14) day nitrogen inerting mode.
2. *Venting Complete:* Achieved 98% nitrogen purity within a Fourteen (14) day period.
3. *Monitoring:* Nitrogen purity and system pressure monitored, not venting.
4. *Standby:* The sprinkler system is not venting or monitoring.
5. *Manually Stopped:* The venting process was manually stopped.
6. *Vent Alarm:* Does not achieve 98% nitrogen purity within the Fourteen (14) day period.

NOTE: The Alarm Signal Ribbon displays three (3) different messages:

1. *Excessive Vent Duration:* Does not achieve 98% nitrogen purity within the Fourteen (14) day period.
2. *Low Air Pressure:* Pressure is below the programmed Low Air Alarm Pressure.
3. *Low Purity:* Venting process complete and nitrogen purity is below preset level.



AVC-2



AVC-6

NOTE: Home Screen

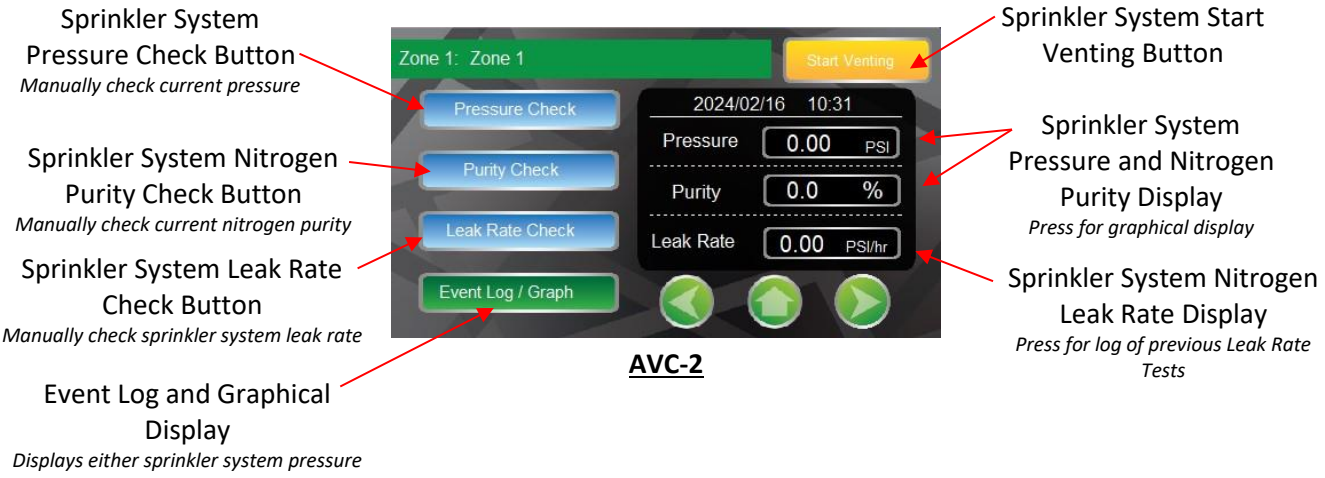
Previous Screen

Next Screen

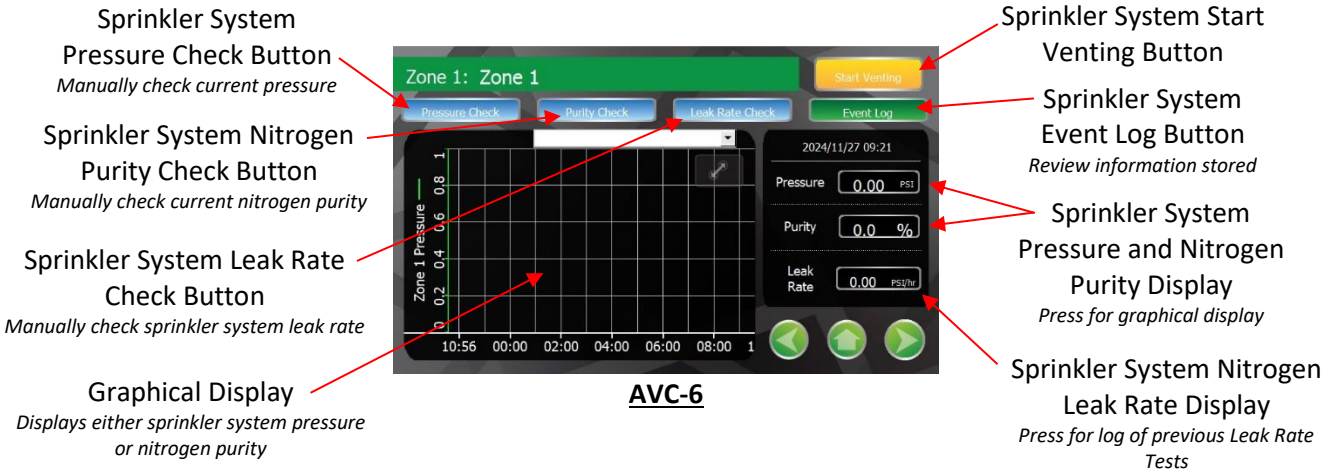
Individual Zone Detail Screen

The sprinkler system zone information is stored in memory for each sprinkler system controlled by the AVC. The Individual Zone Detail Screen provides sprinkler system pressure and nitrogen purity displayed digitally and graphically, Start Venting Button to initiate venting, Leak Rate Check Button to initiate Sprinkler Leak Rate Test and digitally display leak rate. The historical information can be reviewed by pressing the Event Log Button.

Access: **Home** screen→**Sprinkler System Custom Label** area.



AVC-2



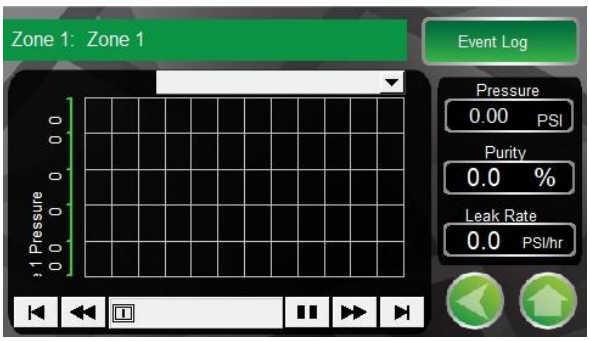
AVC-6

Individual Zone Event Log Information

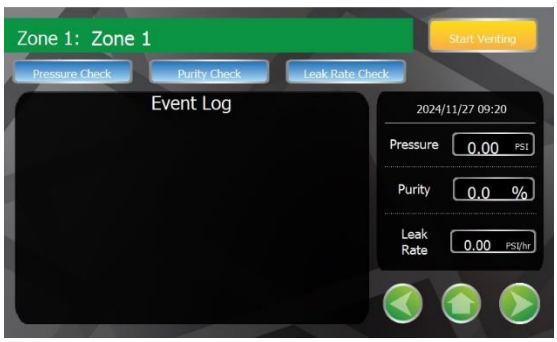
The Individual Zone Event Log information is stored on the USB Storage drive and can be reviewed from the Individual Sprinkler System Zone Screen. To review the Event Log information.

Access: **Home** screen→**Sprinkler System Custom Label** area→ **Event Log** button

NOTE: AVC-2, press the **Event Log/Graph** button displays the Event Log Information.



AVC-2



AVC-6

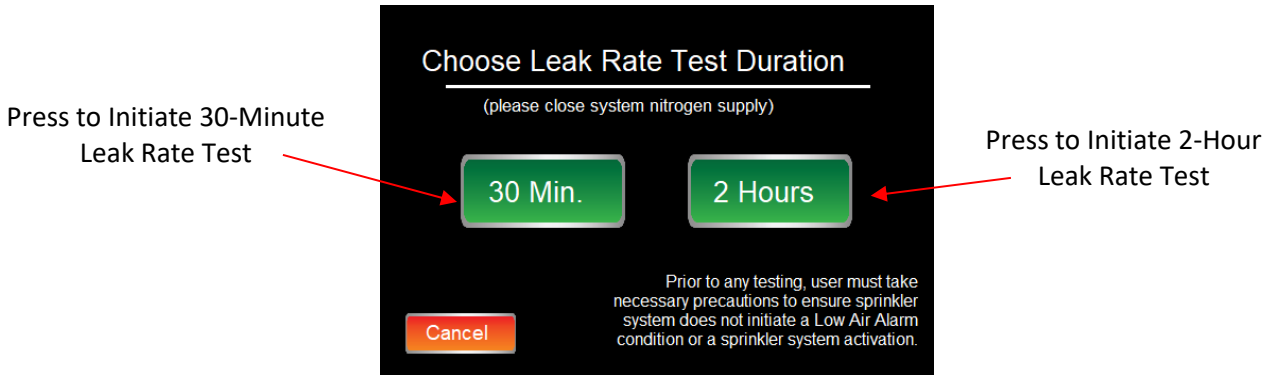
LEAK RATE CHECK

The AVC can perform a leak rate check of the sprinkler system on an individual sprinkler system basis. The leak rate check can be used to determine the leak rate of the sprinkler system for compliance with the NFPA allowable leak rates.

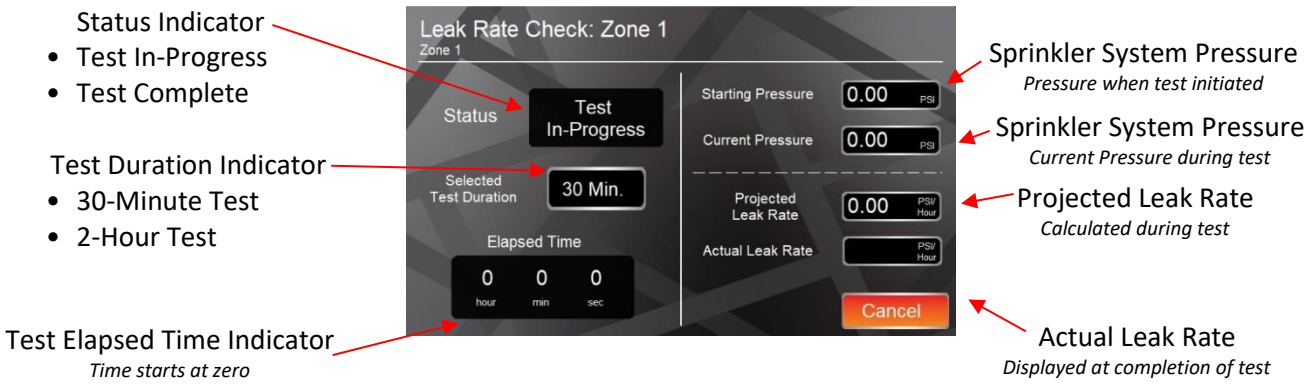
Access: **Home** screen→**Sprinkler System Custom Label** area→ **Leak Rate Check** button

1. Determine the sprinkler system on which the leak rate check is to be performed.
2. Choose the appropriate leak rate duration.

NOTE: Prior to initiating the sprinkler system Leak Rate Test, determine the duration of the test and take the necessary precautions to ensure the sprinkler system pressure does not initiate a Low Air Alarm signal or an activation of the sprinkler system**.**



NOTE: **Cancel** button stops the Leak Rate Test and returns to Individual Sprinkler System Detail Screen.



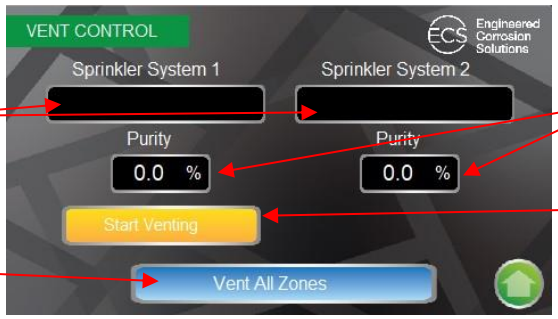
At the completion of the Leak Rate Check:

1. The status display will indicate Test Complete.
2. **Done** Button will be displayed.
3. The actual leak rate will be displayed.
4. The leak rate is logged in the Events Log.
5. Press the **Done** button returns to the Individual Sprinkler System Detail Screen.

NOTE: **Cancel** button stops the Leak R_ate Test and returns to Individual Sprinkler System Detail Screen.

VENT CONTROL SCREEN

The Vent Control Screen allows access to initiate the venting process either on an individual zone basis or vent all of the zones at the same time.



Zone Custom Label
Press Display to edit

Zone Nitrogen Purity Level

Individual Zone Venting Button
Vents zones individually

Vent All Zones Button
Vents all zones at the same time

NOTE: Additional Individual Zone Vent Buttons will be displayed for each system connected to AVC

AVC-2

Zone Custom Label
Press Display to edit

Individual Zone Venting Button
Vents zones individually

NOTE: Additional Individual Zone Vent Buttons will be displayed for each system connected to AVC

Vent All Zones Button
Vents all zones at the same time

Zone Nitrogen Purity Level

AVC-6

MAIN MENU SCREEN

The Main Menu Screen provides access to the Zone Settings Screen, Alarms Screen, Communication Screen, Datalogging Screen, Admin Settings Screen and the Information Screen.

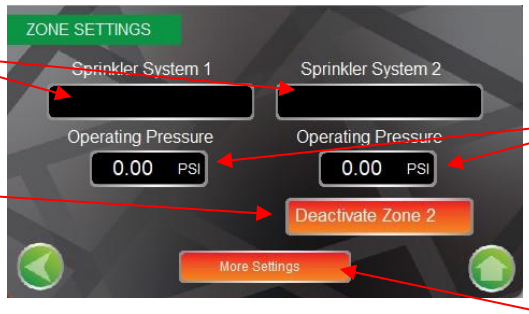
Access: **Home** screen→ **Main Menu** button.

Press the appropriate button to set or to change the appropriate function.

Zone Settings Screens

The Zone Settings Screen provides access to change sprinkler zone name(s), change the sprinkler system operating pressure, and add or delete additional sprinkler zones to the AVC.

Access: **Home** screen→ **Main Menu** button→ **Zone Settings** button.



Zone Custom Label
Press Display to edit

Press Button to Add or Delete Sprinkler Zone

Sprinkler System Operating Pressure
Press Display to edit

Press More Settings Button to access additional information

AVC-2

Zone Custom Label
Press Display to edit

Press Button to Add Sprinkler Zones

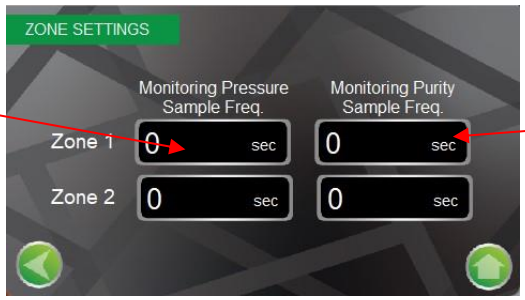
Press Button to Delete Sprinkler Zones

Press More Button to access additional information

AVC-6

AVC-2 More Settings Button

The More Zone Settings Screen provides access to pressure sampling frequency and purity sampling frequency.

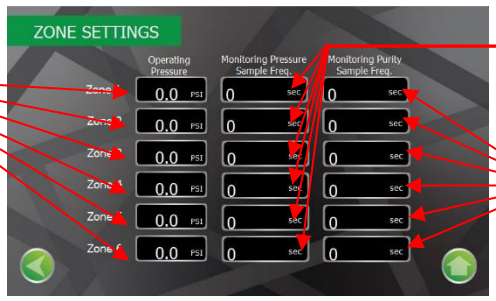


Pressure Sampling Frequency
Press Display to edit

Purity Sampling Frequency
Press Display to edit

AVC-6 More Button

The More Zone Settings Screen provides access to change sprinkler zone operating pressure, pressure sampling frequency and purity sampling frequency.



Zone Operating Pressure
Press Display to edit

Zone Pressure Sampling Frequency
Press Display to edit

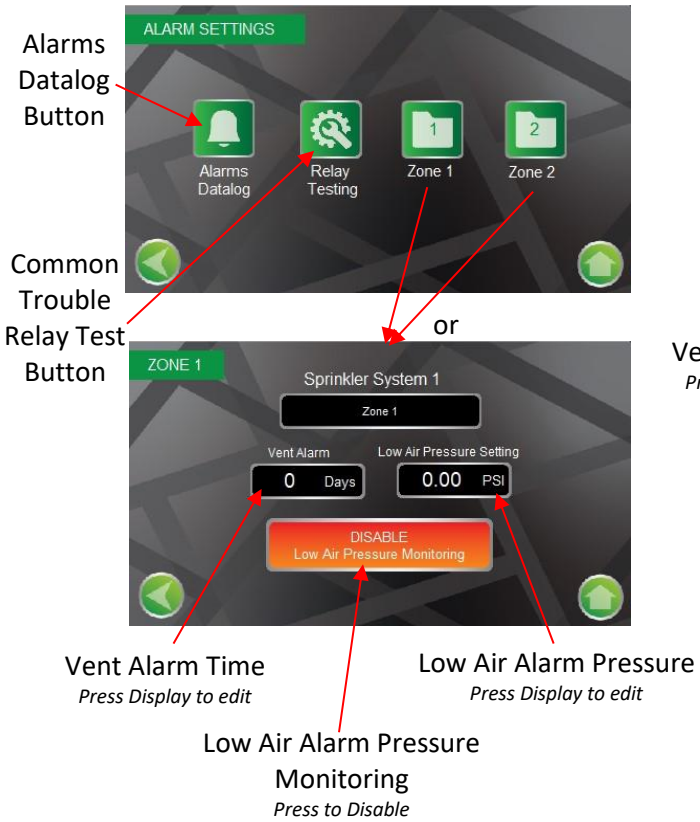
Zone Purity Sampling Frequency
Press Display to edit

Alarm Settings Screen

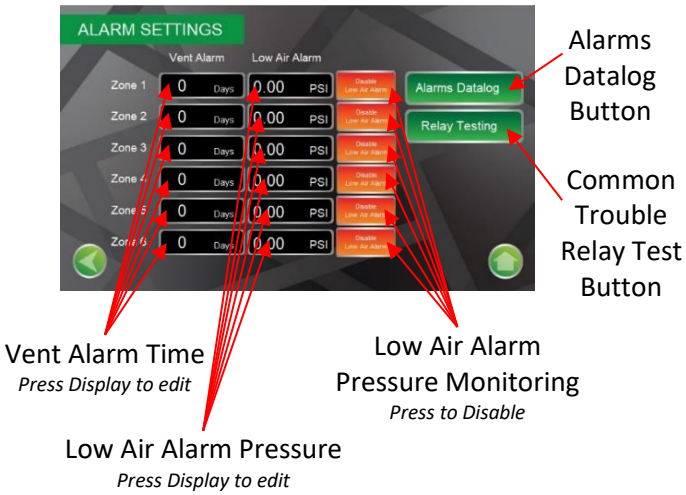
The Alarm Settings Screen displays any alarms provides access to adjust the Venting Alarm Time (default fourteen 14 days) and the Low Air Alarm Pressure.

Access: **Home** screen→**Main Menu** button→**Alarm Settings** button.

AVC-2



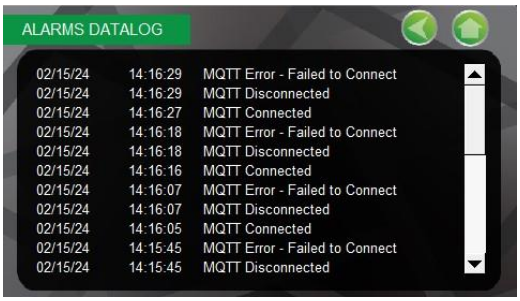
AVC-6



Alarm Datalog Screen

The Alarm Datalog Screen displays any alarms associated with Venting Alarm Time and the Low Air Alarm Pressure.

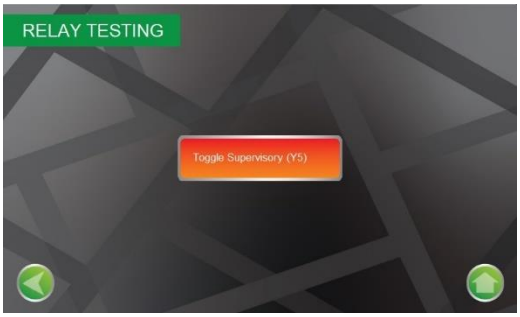
Access: **Home** screen→**Main Menu** button→**Alarms** Settings button→**Alarms Datalog** button.



Relay Testing Screen

The Relay Testing Screen provides a functional test of the Common Trouble supervisory relay.

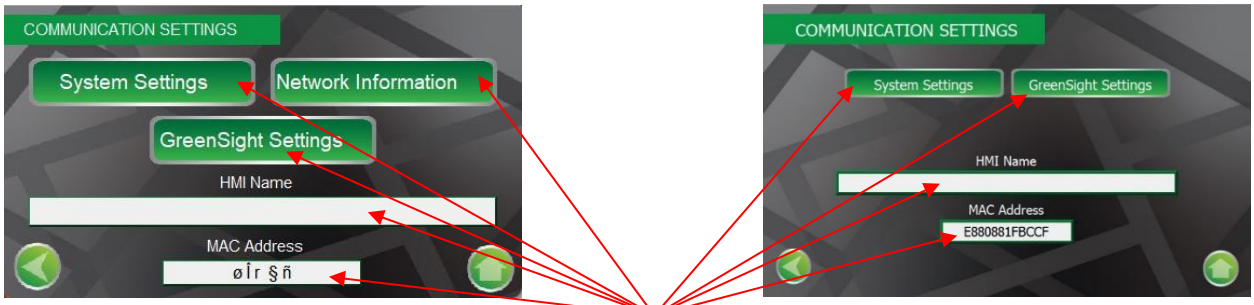
Access: **Home** screen→**Main Menu** button→**Alarms** Settings button→**Relay Testing** button.



Communication Settings Screen

The Communication Settings Screen provides access to configure the remote communications to the AVC.

Access: **Home** screen→**Main Menu** button→**Communication** button.



AVC-2 **AVC-6**

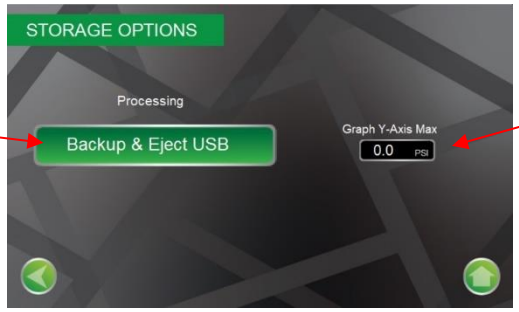
Network Connectivity Information
Contact ECS for Use

Storage Options Screen

The Datalogging Settings Screen provides access to back up the Historical Data or remove the USB drive in the AVC.

Access: **Home** screen→**Main Menu** button→**Storage Options** button.

Press Button to Convert Data to Useable Format
(Excel File)



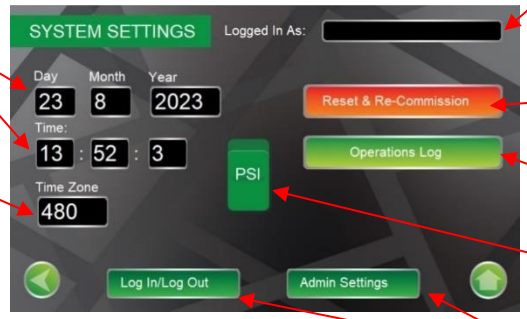
Graphic Display Maximum Pressure
Adjust to align with sprinkler system pressure, if desired
(Default setting - 100 psi)

System Settings Screen

The System Settings Screen provides access to clock and calendar settings.

NOTE: If the AVC needs to be recommissioned, **Reset & Re-Commission** button can be pressed which will reset the AVC to the default settings.

Access: **Home** screen→**Main Menu** button→**System Settings**.



Time and Date
Adjust as needed
Press Display to edit

Time (minutes) between local time and Greenwich Mean Time (GMT)
Adjust as needed
Press display to edit

ECS Internal Use Only

Press Button to Reset AVC to Default Settings and Re-Commission

Press Button to View All Operations Events

Press Button to change pressure from PSI to Bar

ECS Internal Use Only

Operations Events Screen

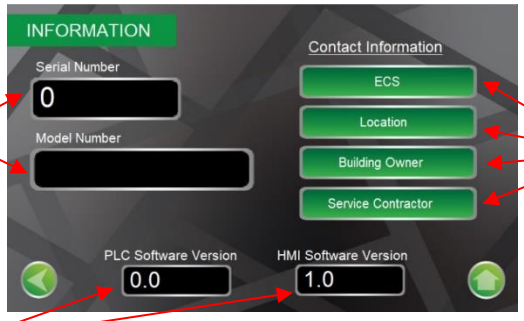
The Operations Events Screen displays all events associated with functions of the AVC.

Access: **Home** screen→**Main Menu** button→**System Settings** button→**Operations Log** button.

Information Screen

The Information Screen displays the nitrogen generator's model number, serial number, PLC and HMI software version numbers. The Information Screen provides access for the ECS Contact Information, Site Location Information, Building Owner's Contact Information, and Service Contractor Contact Information.

Access: **Home** screen→ **Main Menu** button→ **Information** button.



Model and Serial Number
Factory installed

Press Button for Information Screen to Appear

Press Display on Specific Screen for Keyboard to edit

Software Version Number
Factory installed

OXYGEN REMOVAL VENT MAINTENANCE

1. Vents Assembly must be inspected Annually at a minimum.
2. Vent Assembly is pressurized when isolation ball valve is open.
3. Open isolation ball valve (if not open), check for air/water leaks and ensure the pressure gauge is displaying normal system pressure.
4. Close isolation ball valve.
5. Depressurized vent by pressing pressure relief valve on the bottom of the in-line filter housing until no air is exhausted.
6. Inspection y-strainer for debris in screen.
    a. Remove the y-strainer cap by turning counterclockwise until it can be removed.
    b. Remove the screen for inspection.
        i. Clean as necessary.
    c. Reinstall screen.
    d. Reinstall y-strainer cap by turning clock
    e. wise until wrench tight
7. Inspection of in-line filter.
    a. Remove the lower section filter housing by turning counterclockwise until it can be removed.
        i. Filter housing should only be finger/hand tight

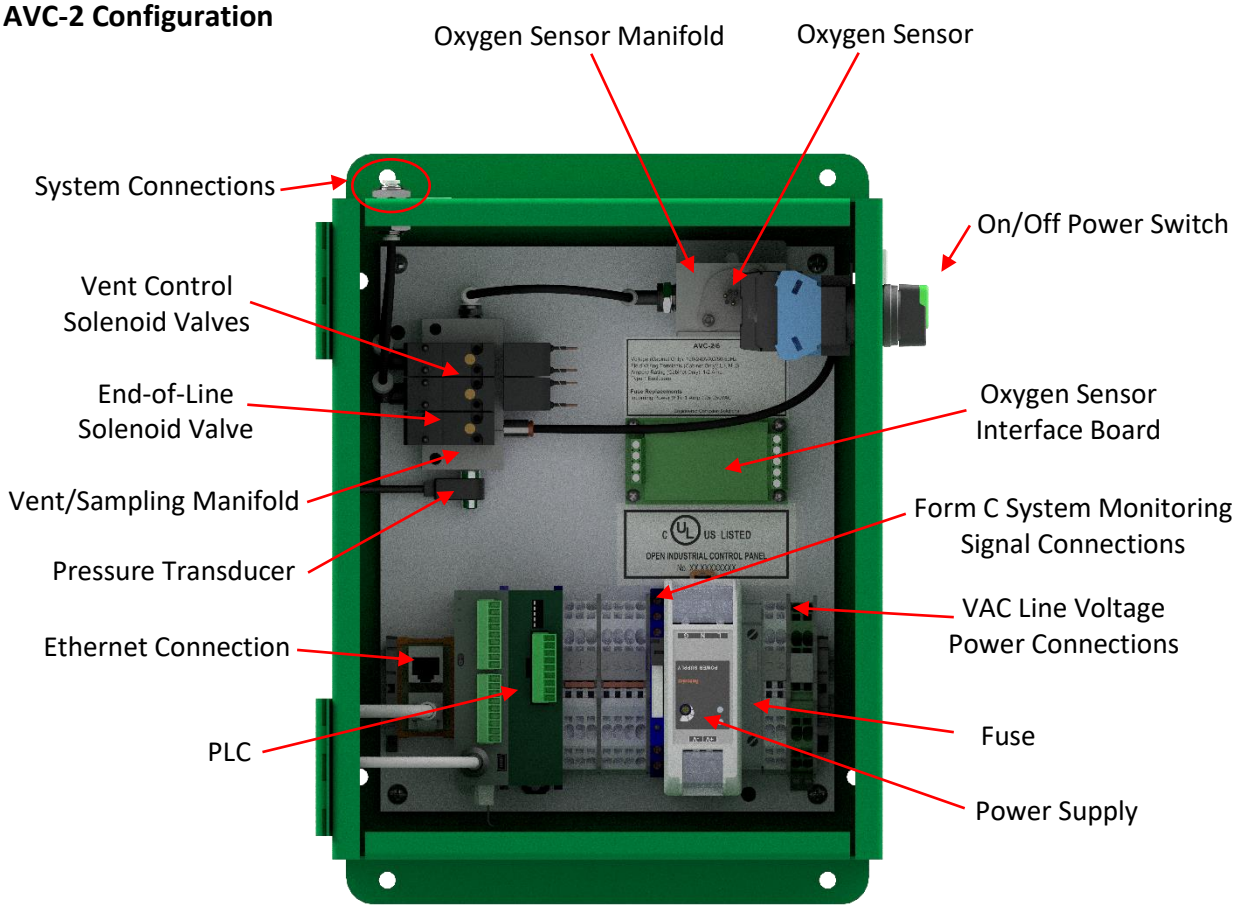
        NOTE: A rubber o-ring/seal is located between the upper and lower sections of the filter housing.
    b. Remove the filter by turning the filter counterclockwise.
        i. Inspect and clean as necessary
        ii. Replace filter, if deteriorated.
    c. Reinstall filter by turning clockwise.

        NOTE: Ensure the filter is secured only finger/hand tight.
    d. Install the rubber o-ring/seal on the lower section of the filter housing.
    e. Reinstall the filter housing by turning the filter housing clockwise.

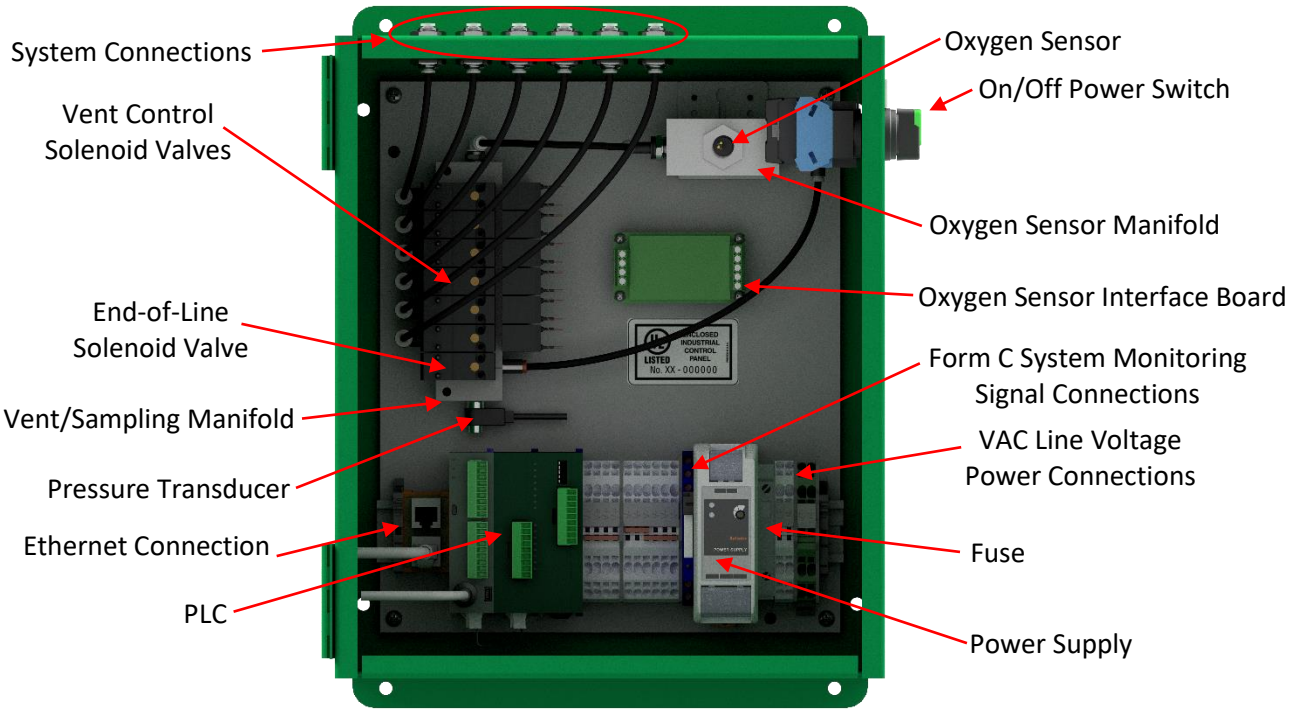
        NOTE: Ensure the filter is secured only finger/hand tight.
    f. Open the isolation ball valve.
8. Verify operation of vent regulator.
    a. PAV-D: Follow the Vent Testing Procedure.
    b. PSV-D/DE Vents: Push ***Vent*** button, follow the Vent Testing Procedure.
    c. PAV-DQ Vents: Remove 5/32” tubing from push fitting, follow the Vent Testing Procedure.
    d. ***Vent Testing Procedure***:
        i. Open isolation valve then close isolation valve.
        ii. Regulator gauge pressure should increase to system pressure (valve open).
        iii. Regulator gauge pressure should decrease and stop at desired pressure (valve closed).
9. Reset vent for normal operation.
    a. PAV-D: Isolation valve remains closed unless starting 14-day nitrogen inerting process.
    b. PSV-D/DE: Open Isolation valve and reset Control Cabinet (turn power ***Off*** then ***On***).
    c. PAV-DQ: Open Isolation valve and reinstall 5/32” tubing into PAV-DQ push fitting.

CONFIGURATION DIAGRAMS

AVC-2 Configuration



AVC-6 Configuration



TROUBLESHOOTING

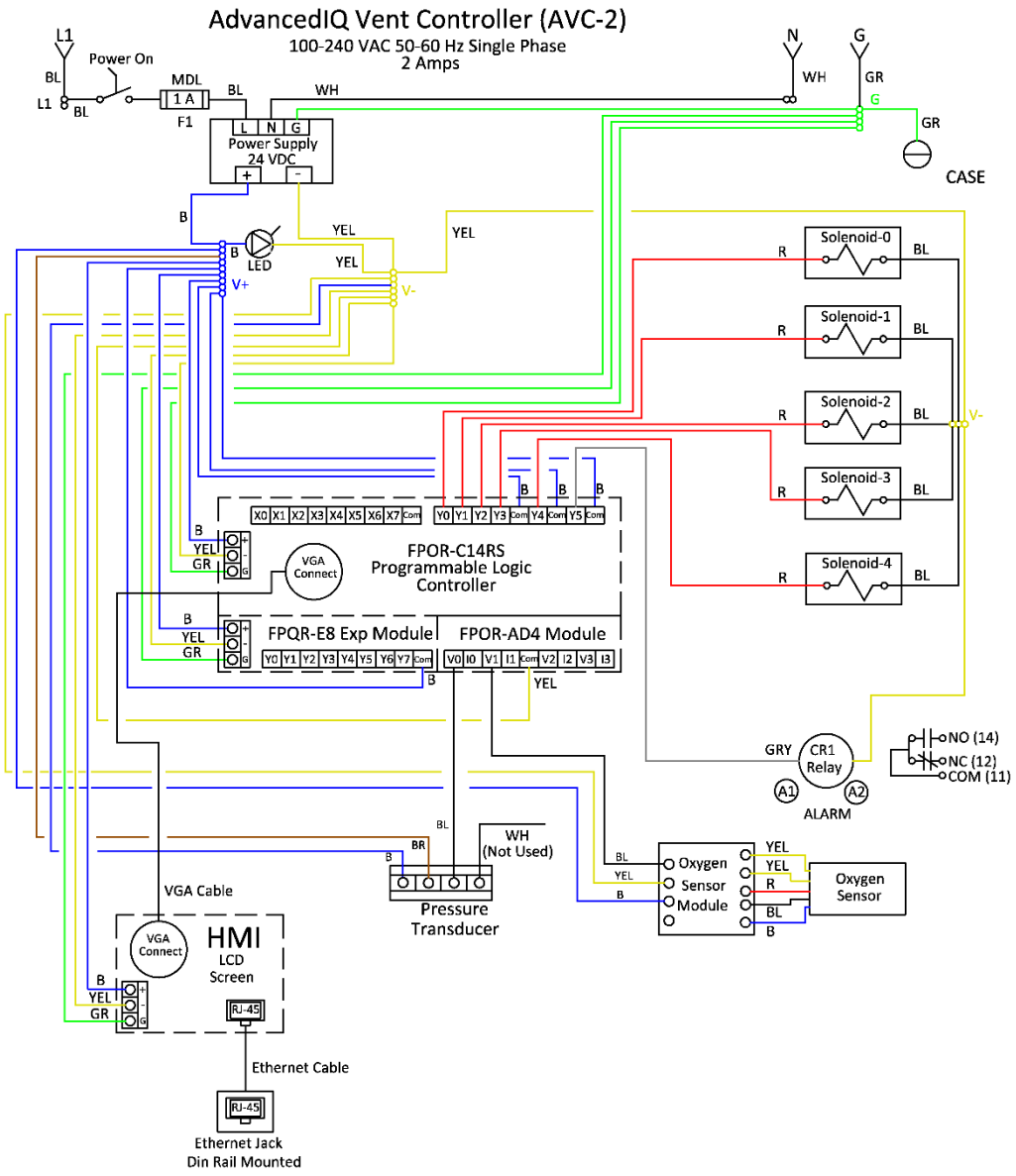
Safety Warning

Only qualified personnel can perform inspection, testing and maintenance of the nitrogen generation equipment. Prior to any system troubleshooting on the nitrogen generation system, ensure that the nitrogen generator and the AdvancedIQ Controller are isolated from the compressed air supply and all system risers. Be aware of pressurized system components as some of the troubleshooting procedures require system components to be pressurized. Failure to do so can result in system damage and/or personal injury.

SYMPTOM	PROBLEM	RESOLUTION
HMI Display: Storage Space Insufficient *Error Message*	The flash drive in the back of the HMI is improperly seated or missing	Unplug and reseat the Flash drive or install a flash drive in the HMI
HMI Display: Device No Response *Error Message*	PLC is switched to PRG or is not receiving power	• Verify PLC is switched to RUN • Verify PLC power wires are connected to V+ and V- and PLC is receiving power
	Communications cable between PLC and HMI not properly seated or defective	Reseat communications cable in PLC and HMI or replace communications cable
AVC not running	Lights, HMI Screen or indicators on AVC are <u>off</u>	• Check On/Off Power Switch on AVC • Check incoming power to AVC • Check fuses in AVC • Check input and output of power supply in AVC • Repair or replace as necessary
Low Pressure on a single or multiple zones *Recommended maximum tubing length is 40' between AVC and Vent* *Longer distances are supported with a change to software settings*		• Verify the Vent regulator set point is below generator turn-on pressure o Gas is exhausting from vent push fitting o Gas is entering the AVC inlet push fitting • Check for leaks in push fittings o Vent push fitting and tubing connection o AVC bulkhead push fitting and tubing connection (both sides) o Manifold push fitting and tubing connection • Repair or replace as necessary (See Commissioning and Start Up Procedure, oxygen removal vent setup)
	Tubing length is more than 40'	Contact ECS: Sampling duration settings may need to be adjusted
Low Nitrogen Purity on a single or multiple zones		• Verify nitrogen generator has not been recently placed into bypass • Verify the Vent regulator set point is below generator turn-on pressure o Gas is exhausting from vent push fitting o Gas is entering the AVC inlet push fitting • Repair or replace as necessary (See Commissioning and Start Up Procedure, oxygen removal vent setup)
Low Nitrogen Purity on all zones		• Verify the Vent regulator set point is below generator turn-on pressure o Gas is exhausting from vent push fitting o Gas is entering the AVC inlet push fitting • Check for leaks in internal AVC push fittings o Bottom of solenoid manifold push fitting to pressure transducer assembly *Revision 1* o Pressure Transducer to oxygen sensor assembly *Revision 1* o Bottom of solenoid manifold push fitting to oxygen sensor assembly *Revision 2* o Oxygen sensor assembly to top of solenoid manifold *All* • Carefully verify oxygen sensor has properly heated to operating temperature: DO NOT TOUCH • If cold: Verify oxygen sensor interface board is properly connected to V+ and V- and is receiving power

Wiring Diagrams

AVC-2 Wiring Diagram



WIRING NOTES:

AC WIRING 14 AWG. AFTER FUSE
DC WIRING 16 AWG. BLUE (+) Yellow (-)
GROUND GREEN
USE COPPER CONDUCTORS ONLY
FIELD WIRING TEMPERATURE RATING: 60°C (140°F)
USE TERMINAL BLOCKS AS REQUIRED
REQUIRED FIELD WIRING TERMINAL TIGHTENING TORQUE: 14 IN. LBS.
100-240 VAC, 15 AMP CIRCUIT BREAKER TO BE PROVIDED BY INSTALLER
AS MEANS OF BRANCH CIRCUIT PROTECTION
BOND DOORS

WIRING COLOR LEGEND:

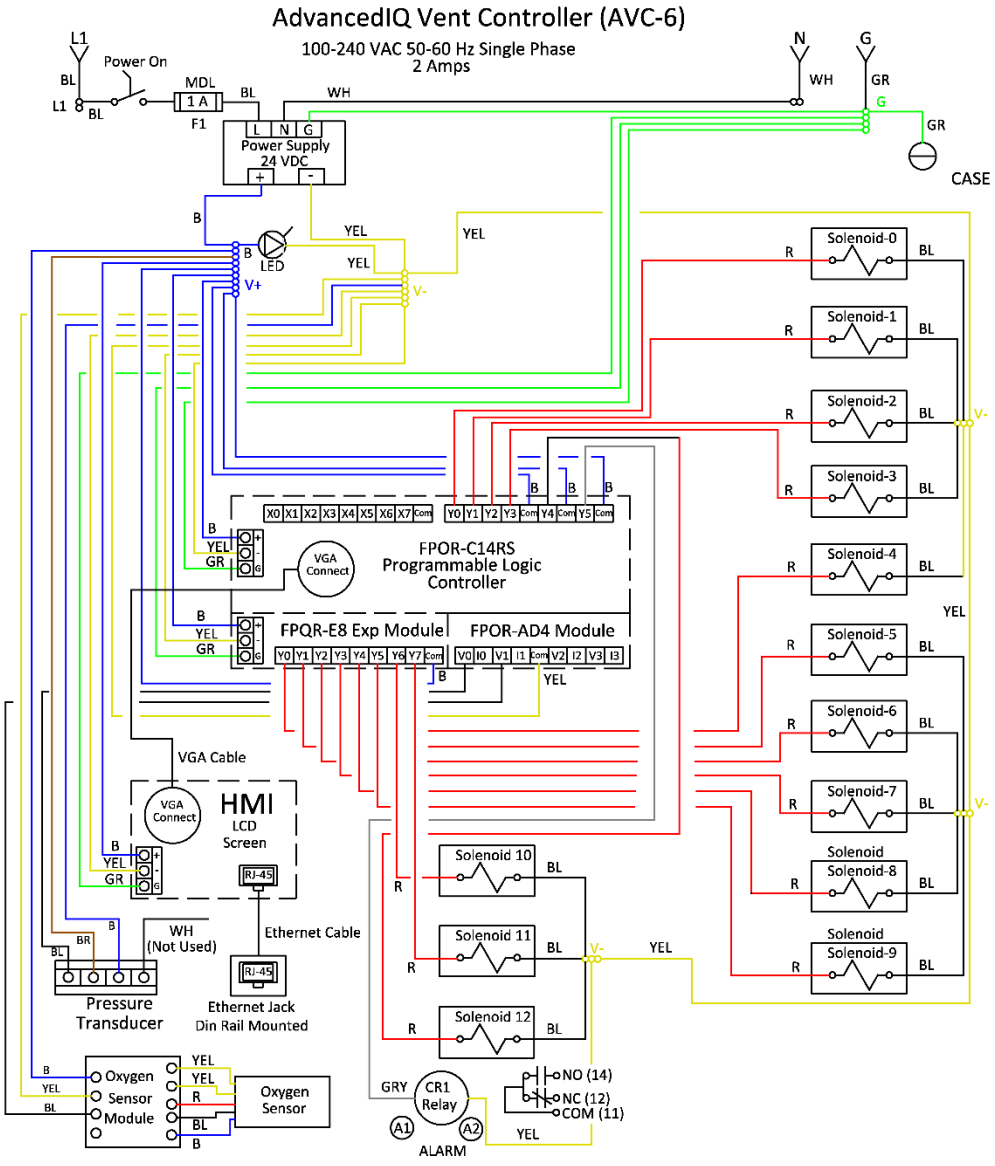
BL	BLACK
WH	WHITE
GR	GREEN
B	BLUE
R	RED
O	ORANGE
YEL	YELLOW
Y/GR	YELLOW/GREEN
BR	BROWN
GRY	GREY

MONITORING NOTES:

1 ALARM OUTPUT ACTIVATES ON ANY CHANGE IN STATUS IN THE AVC

Rev. 1.00

AVC-6 Wiring Diagram



WIRING COLOR LEGEND:

BL	BLACK
WH	WHITE
GR	GREEN
B	BLUE
R	RED
O	ORANGE
YEL	YELLOW
Y/GR	YELLOW/GREEN
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MONITORING NOTES:

1 ALARM OUTPUT ACTIVATES ON ANY CHANGE IN STATUS IN THE AVC

WIRING NOTES:

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GROUND GREEN
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100-240 VAC, 15 AMP CIRCUIT BREAKER TO BE PROVIDED BY INSTALLER
AS MEANS OF BRANCH CIRCUIT PROTECTION
BOND DOORS

Rev. 1.00

Miscellaneous

SYSTEM SUMMARY

AdvancedIQ Vent Controller		Operating Pressure	Low Air Alarm Pressure
Model Number	Serial Number		

Oxygen Removal Vent	Vent	Location	Orifice
Model Number	Serial Number		
Vent Pressure Regulator: psig (bar)			

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