



**2022 OPERATORS MANUAL**  
**Above Ground Unit**  
**HMI 7 Console**



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## **Thank you for choosing SubAir.**

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We appreciate your choice in selecting SubAir®, the pioneer and leader in subsurface aeration technology. Your SubAir product was built to the highest standards in the industry, and has been meticulously engineered to provide reliable, trouble free service. However, as with any power equipment product, customer safety and satisfaction largely depend upon understanding the product's intended use and operation. Negligence or being unfamiliar with the equipment, or how to use it properly, can result in personal injury or damage to the equipment. This in turn could lead to a false impression of quality or performance of the equipment. We urge you to read this manual before installing or operating your new equipment, and always follow the operating instructions, and safety precautions herein.

Please consider this owner's manual a permanent part of your SubAir® product, and always keep it available for reference.

SubAir® products are always backed by the SubAir® customer support team which is here to offer you fast, courteous service. For more information visit our website at [www.SubAirSystems.com](http://www.SubAirSystems.com) , or call 1-866-641-6663. If you would prefer to write to us, direct your letter to:

**SubAir Systems, LLC  
Customer Service  
1164 Industrial Avenue  
Graniteville, SC, 29829 USA.**

### **Notice**

This document is intended to aid in the proper installation and use of SubAir® equipment. It is intended to provide general guidance based on our experience and should not replace any industry standards or other pertinent regulations.

### **Precautions**

Federal regulations covering safety for construction are published in the Safety and Health Regulations for Construction under the Department of Labor, Occupational Safety and Health Administration (OSHA). All electrical installations must be made by licensed electricians and must conform to all applicable federal and local electrical codes.

### **Warranty**

SubAir® Systems LLC warranties are contingent upon proper design and installation of not only the materials and equipment provided by SubAir®, but also the connecting electrical systems that become part of the complete system. See the warranty section of the operating manual for full details.

SubAir® is not responsible for injury or damage resulting from improper installation, any noncompliance with the guidelines in this document, or from any use outside of the application for which it was sold.

# Safety

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All electrical work including installation and routine maintenance should be performed only by a trained and/or licensed electrician or SubAir® field service personnel. All electrical work is to conform to both local and National Electric Code specifications.

There is a lockable disconnect located on the SubAir® control panel. This disconnect should be locked in the "OFF" position before the control panel or SubAir® unit is accessed. Appropriate "Lockout/Tagout" procedures consistent with all local and national (including, but not limit to OSHA and National Electric Code) specifications shall be followed during maintenance.

Each SubAir® unit is designed to provide protection to the equipment and any persons not familiar with the system. In addition to the disconnect, the blower motor is equipped with a variable speed drive with internal safety features. Fault signals present on the control panel notify the operator of potentially problematic equipment. The control panel is fused and all components within the control panel are finger safe components.

Your safety is important! We urge all operators of your SubAir® Above Ground system to read this manual thoroughly before operation. For your protection, it is essential that you take special notice of all safety precautions and follow the safety instructions provided precisely. Safety precautions throughout this manual and on the decals affixed to the SubAir® Above Ground components are preceded by the labels DANGER, WARNING, or CAUTION. These labels indicate the severity of safety risk and it is essential that you understand them:

➤ DANGER

- A DANGER indicates an immediate hazard that will result in severe personal injury or death.

➤ WARNING

- A WARNING indicates an immediate hazard that could result in severe personal injury or death.

➤ CAUTION

- A CAUTION with the safety alert symbol indicates a hazard or unsafe practice that could result in minor personal injury.

➤ CAUTION

- A CAUTION without the safety alert symbol indicates a potentially hazardous situation or practice that could result in property damage or personal injury.

## **General Safety Precautions**

Read the following WARNING statements before operating the SubAir® System.

### ➤ WARNING

- This owner's manual should be read completely before attempting to operate the system. Failure to follow the instructions and safety precautions in this manual could result in property damage, severe personal injury, or death
- If any High Voltage Warning sticker on labels have been damaged, removed, or cannot be easily read, they should be replaced immediately to avoid possible property damage, personal injury, or death.
- Any unauthorized modifications or alterations to this equipment may present safety hazards that are not presented in this manual. All warranties are void and SubAir® Systems, LLC is released from any liability for resulting injury and/or damage if equipment is used with unauthorized modifications or alterations. The safety precautions listed below must be followed whenever the system is being operated, inspected, or repaired. Other specific safety precautions appear throughout this manual and on the system.

### ➤ DANGER

- Prior to servicing the system, make sure the main disconnect switch on the control panel is in the "OFF" position and locked out.
- Do not by-pass or alter any safety switches or features associated with the SubAir® System. These include (but are not limited to) all proximity switches, disconnects, safety relays, and float switches.
- Do not tamper with system components, electrical wiring, or connections. All electrical components, wiring and connections must be serviced by a qualified electrician.

### ➤ WARNING

- Only trained technicians should repair or service the system. Anyone performing even basic repairs or service should follow the procedures exactly as stated in this manual and follow all DANGER, WARNING, and CAUTION procedures listed in this manual.
- Shut down the system immediately if there is any sudden increase in blower vibration or other unusual change in operational characteristics.
- Wear safety glasses or approved eye protection when servicing.
- Improper use of product or failure to properly maintain it could result in decreased system performance or severe personal injury.
- Any modification or change to the system could result in severe personal injury or death.
- Use insulated tools when working on or around electrical connections.
- Do not attempt to service moving parts in the system while it is in operation.
- Stay clear of the intake/exhaust port while the system is in operation. Materials can be drawn into the blower intake and can become high-velocity projectiles if ejected at the exhaust port.

## **Manual Limitations**

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This manual has been prepared by SubAir® Systems, LLC. Information contained in this manual has been procured from numerous sources and is believed to be accurate. SubAir® Systems, LLC, reserves the right to change any information contained herein without prior notice. The user is responsible for determining whether this product is appropriate for their application. Should the user identify inaccuracies or inconsistencies within this manual the user is encouraged to contact a SubAir® representative for clarification.

This manual contains proprietary information that is protected by copyright. All rights are reserved. No part of this manual may be photocopied, reproduced, or translated to another language without the written consent of SubAir®.

Although the information contained in this manual was current at the time of printing, subsequent product design changes may vary slightly from the presentation in this manual.

# SubAir<sup>®</sup> Above Ground Installation

## SubAir Above Ground Unit, Distributed Separator, and Isolation Dual Valve Installation

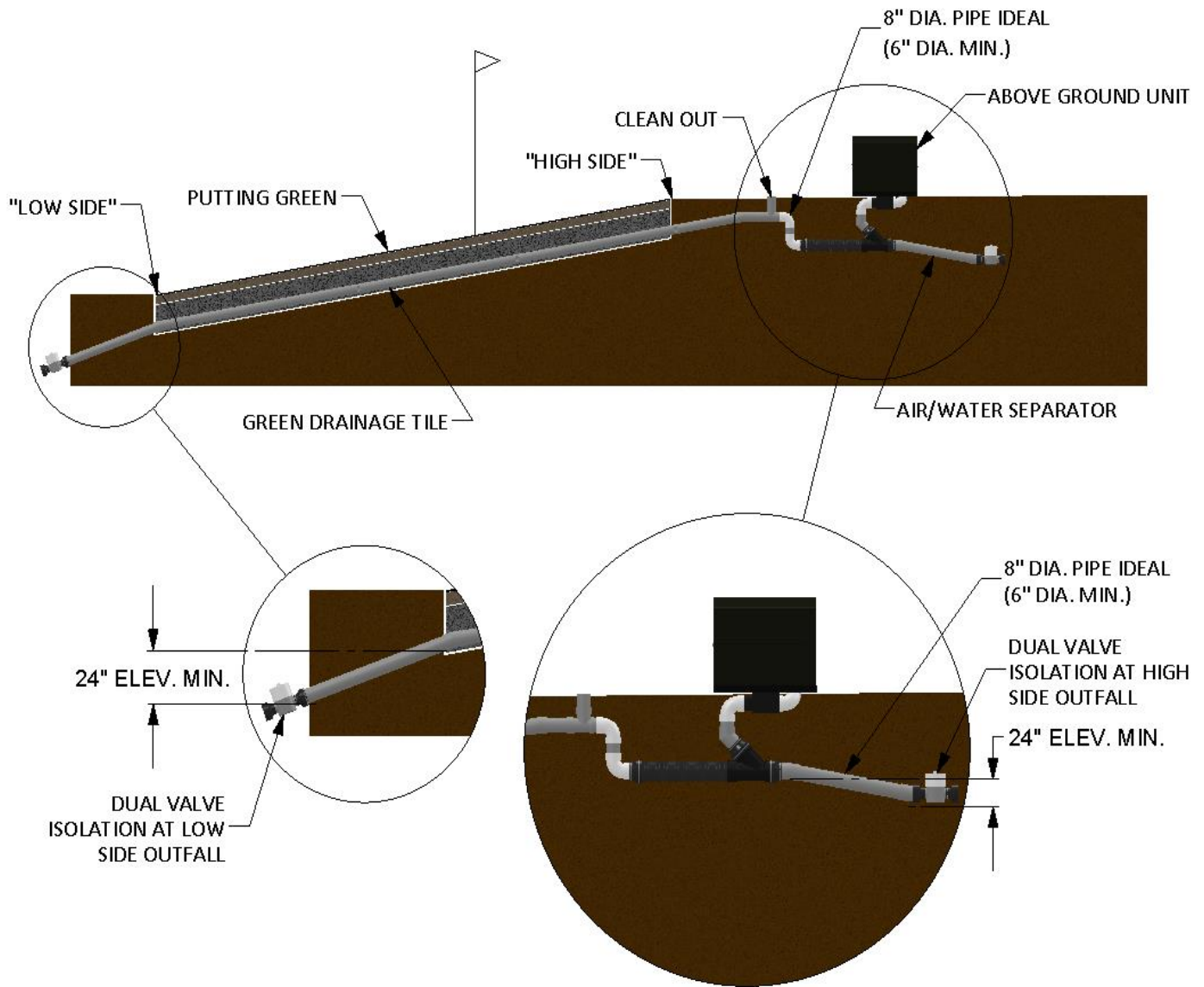


Figure 1: Above Ground Unit Separator and Dual Valve Installation

### Above Ground Unit, Separator, and Dual Valve Installation Notes

- Dual valves should be installed 15-30 degree angle towards outfall, and may not operate correctly if installed at too steep an incline. Use angled fittings if necessary to achieve acceptable installation angle.
- A minimum of 24" of vertical elevation is required between dual valve location and the edge of the green, or water separator. This will prevent water from reaching the green or water separator before it has enough weight to open the valve.
- All pipe junctions and connections should be thoroughly taped to prevent leakage. Failure to do so can result in water ingestion and soil erosion at the point of the leak.



## Control Panel Installation

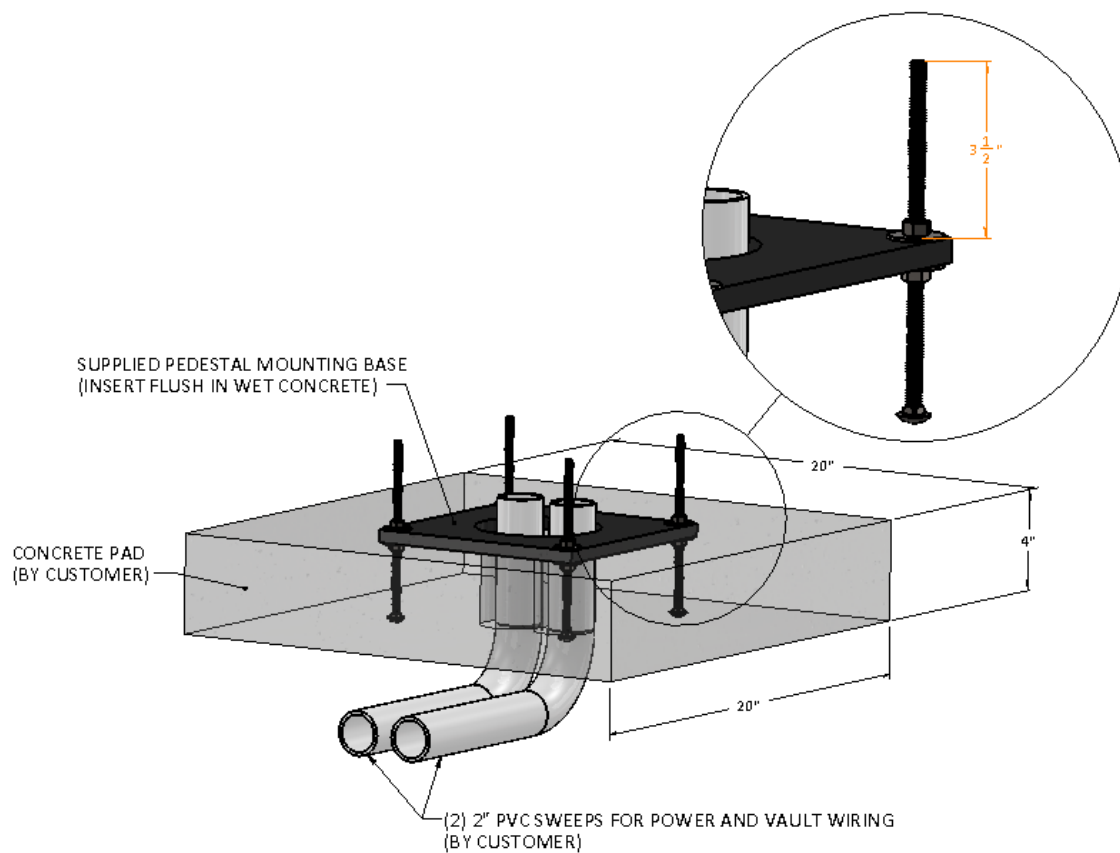


Figure 2: Control Panel Pad Detail

### Installation Notes

- Panels to be located within 150 ft. from the SubAir® unit. Installation at a distance greater than 150 ft. site will require an extended wiring package option, separate output filter, and larger concrete pad. For these installations extend the pad width to the right of the panel by 16 in. (36 in. total width). Control panel location on pad should remain to left.

## Equipment Overview

### Drainage Piping Components

#### Air/Water Separator

The air/water separator is located between the SubAir® unit and the airline connection to the subsurface drainage matrix. The air/water separator effectively uses gravity and inertia to separate any airborne water from the air before it reaches the SubAir® unit.



Figure 3: Air/Water Separator Assembly (SubAir® Part Number 50040A for 4" or 50060A for 6")

#### Dual Valve Assembly

The dual valve is a patented valve that automatically engages during SubAir® operation and isolates the green drainage from the storm sewer system. The valve uses air flow in either direction to seat the check-ball against the face of the inlet or outlet pipe, effectively stopping flow through the valve. In vacuum mode water, will accumulate on top of the ball until the weight of the vertical column of water exerts more pressure downward on the face of the ball than the SubAir® unit is applying upward holding the boll against the face of the pipe. When this occurs, the ball is forced away from the pipe face and up in the overhead chamber where it is trapped until the water has finished draining. After this the ball then falls back down into the air stream and is pulled back up against the seat. Valve operation in pressure mode is very similar; however, it is the buoyancy force of the ball surrounding by water that lifts it from the outlet pipe allowing the water to pass. A dual valve must be located on every drainage outfall.

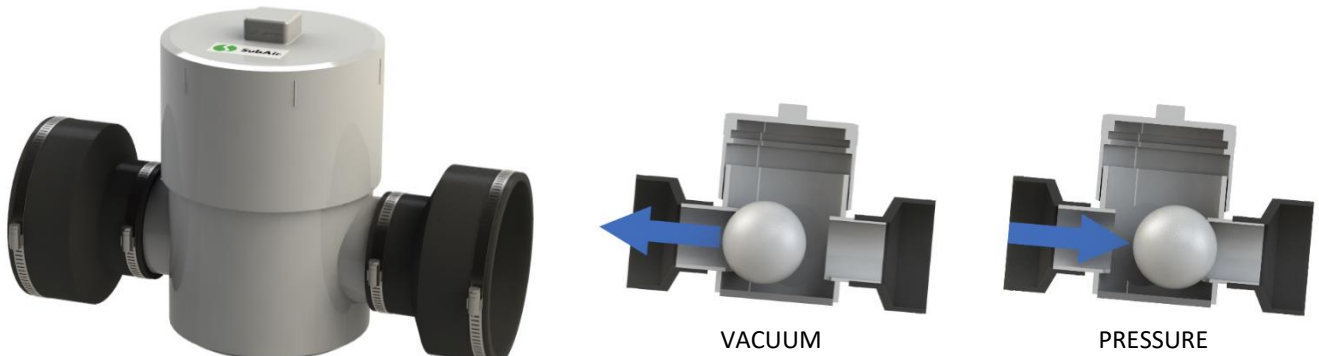


Figure 4: Dual Valve Assembly (SubAir® Part Number: 51040D for 4", 5160D for 6" or 51046D for 4" to 6")

### ***Above Ground Assembly Components***

#### **Aeration Fan Assembly (Motor and Blower)**

The aeration fan is a centrifugal blower located within the above-ground unit. This assembly consists of a motor mounted directly to a pressure blower. The fan motor is controlled by a variable frequency drive (VFD) to provide fan speed control for optimized performance and motor protection.

#### **Air-Flow Reversing Valve (Diverter Valve)**

The air-flow reversing valve is an automated valve that allows the system to operate in "Pressure" or "Vacuum" mode. This valve is a four (4) port air-flow reversing valve with a paddle-shaped diversion component located within the valve body.

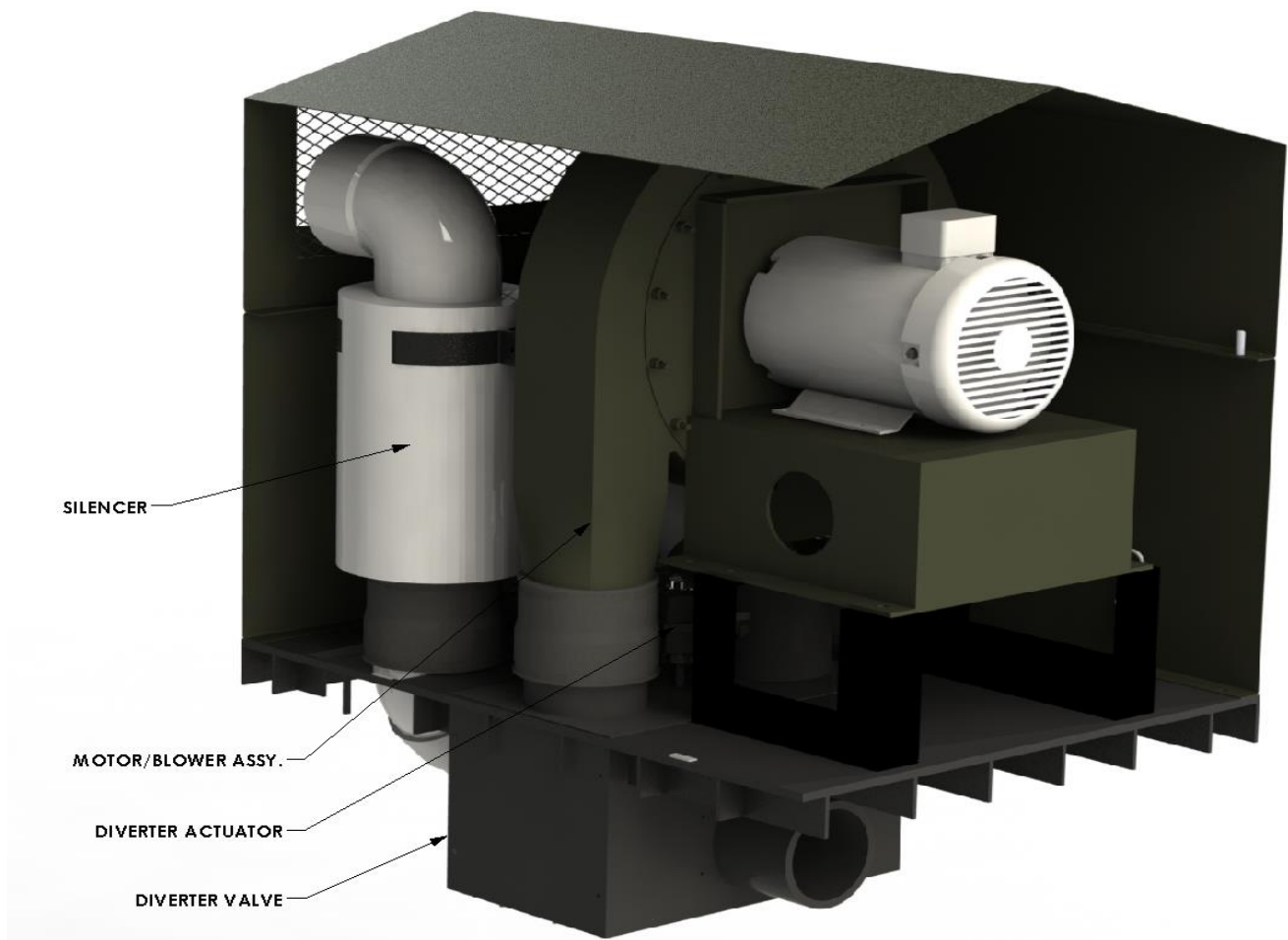
#### **Diverter Valve Actuator**

The diverter valve actuator is a two-way fail-safe electric actuator that controls the position of the air-flow reversing valve.

#### **Silencer Assembly**

The silencer assembly is located on the intake/exhaust port. This device is used to attenuate air noise traveling through the intake/exhaust port.

**Figure 1: SubAir<sup>®</sup> Above Ground Assembly Component Diagram**



**Table 1: SubAir<sup>®</sup> Above Ground Parts List**

| Item | SubAir <sup>®</sup> Part Number | Description           | Qty |
|------|---------------------------------|-----------------------|-----|
| 1    | 67000B                          | Silencer              | 1   |
| 4    | 86040A                          | Motor/Blower Assembly | 1   |
| 7    | 83170C                          | Diverter Actuator     | 1   |

## SubAir Control Panels

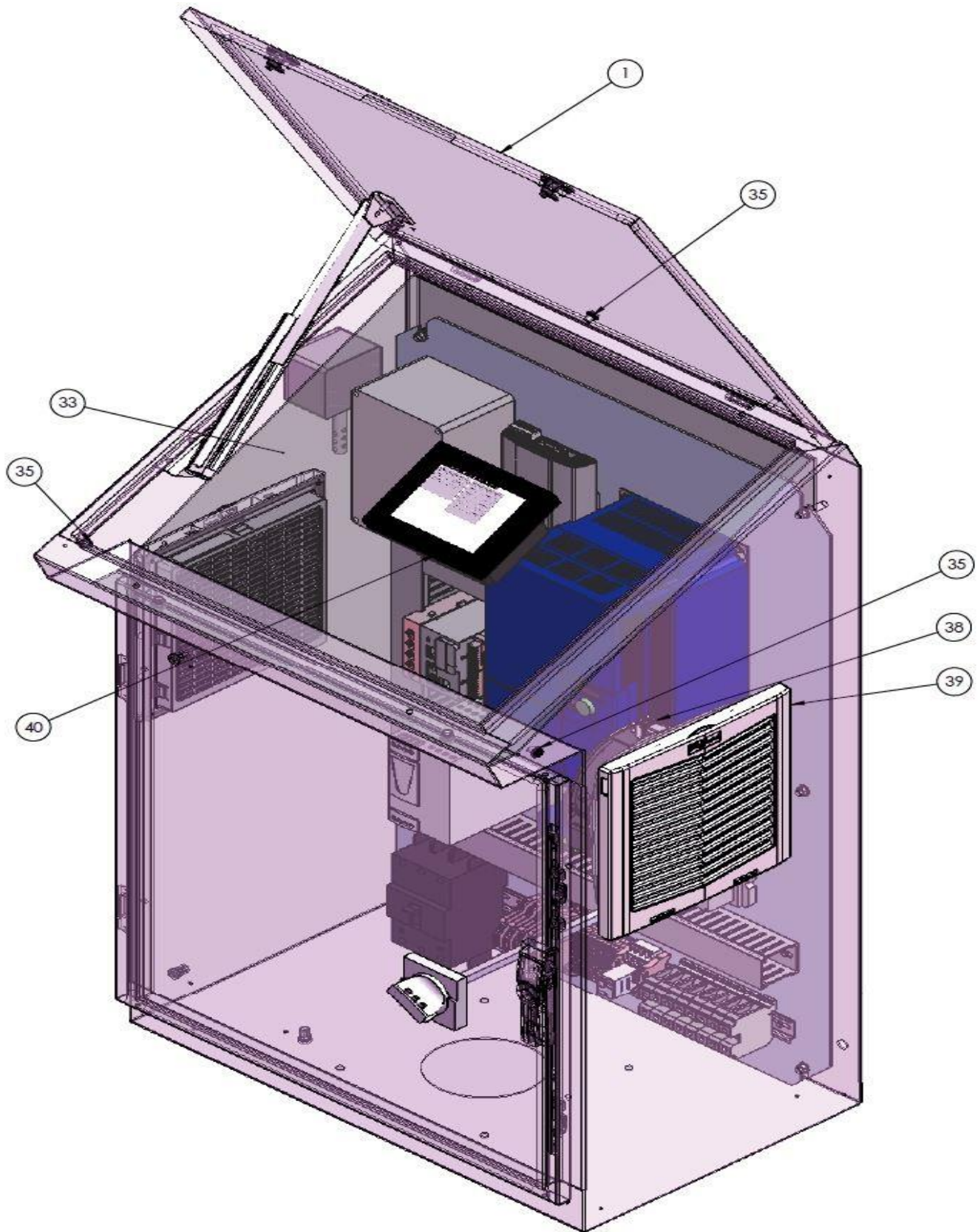
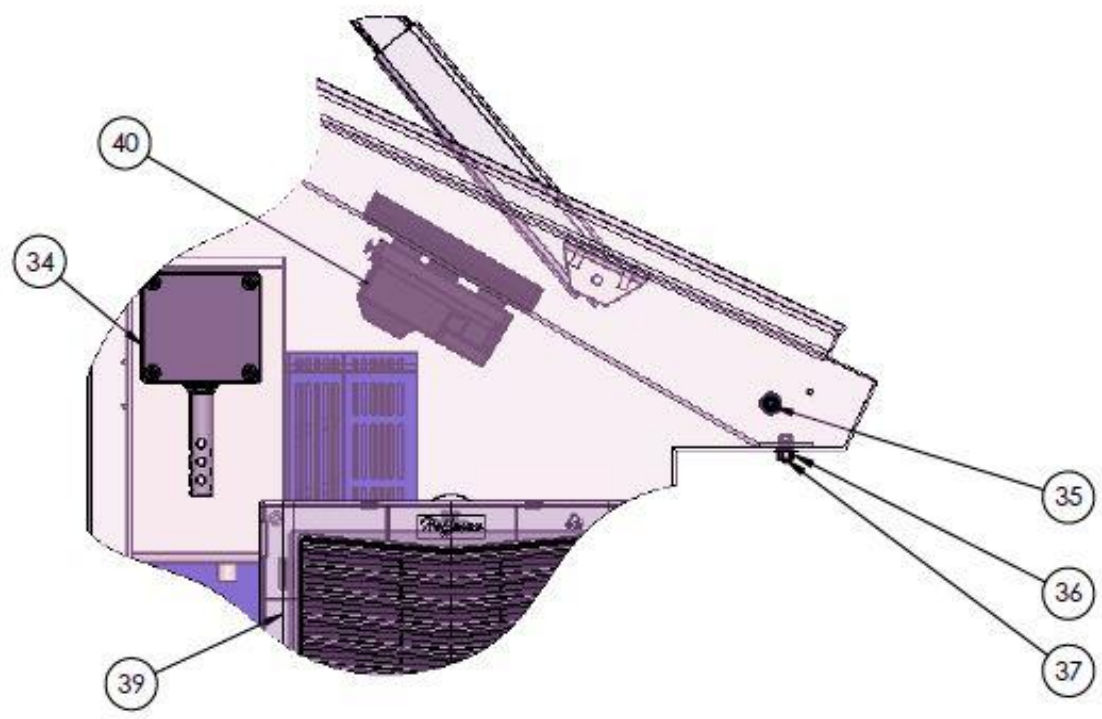


Figure 2: Control Panel Component Diagram 1

**Control Panel Component Diagram**



*Figure 3: Control Panel Component Diagram 2*



## Control Panel Electrical Back Plate

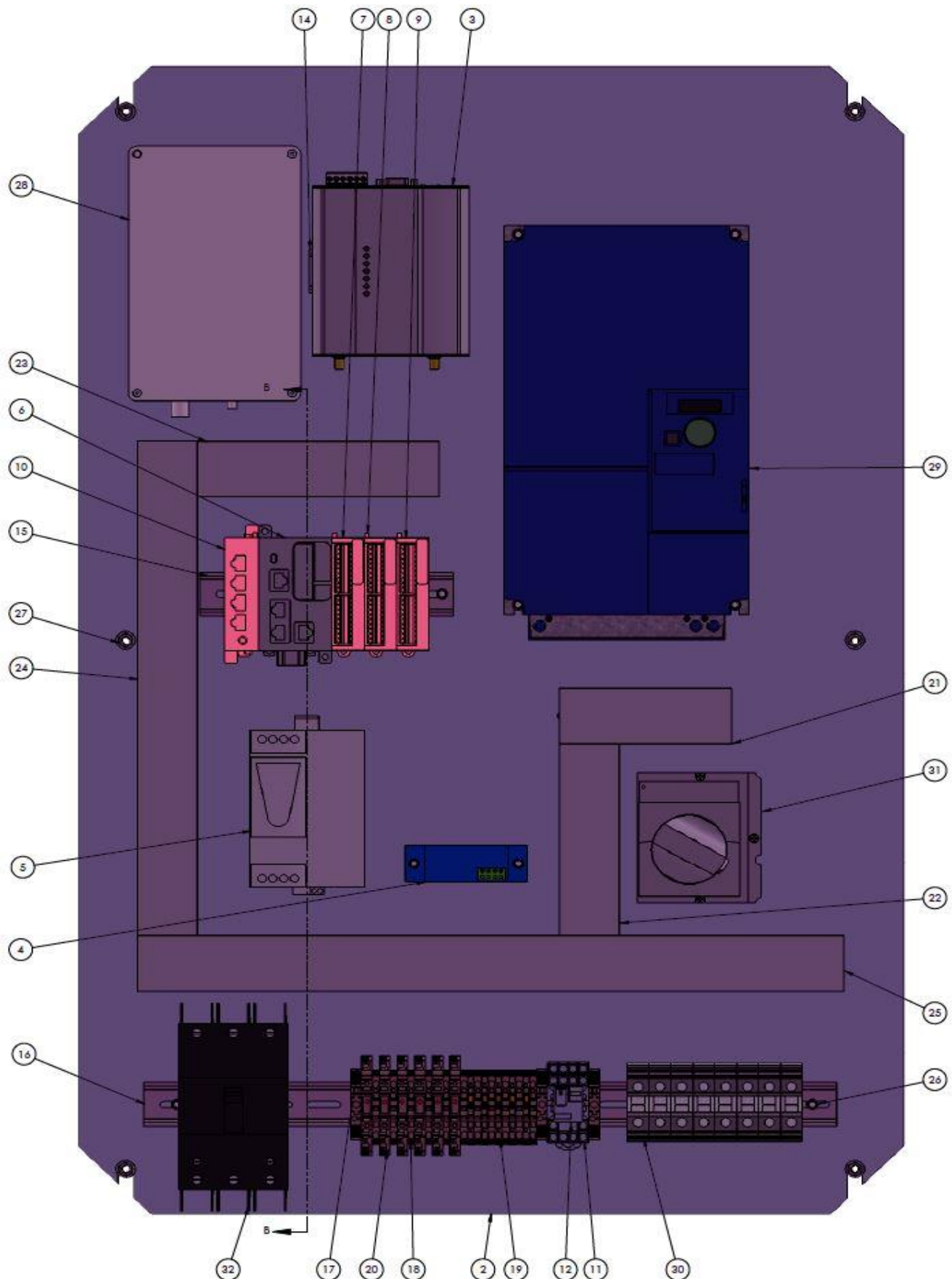
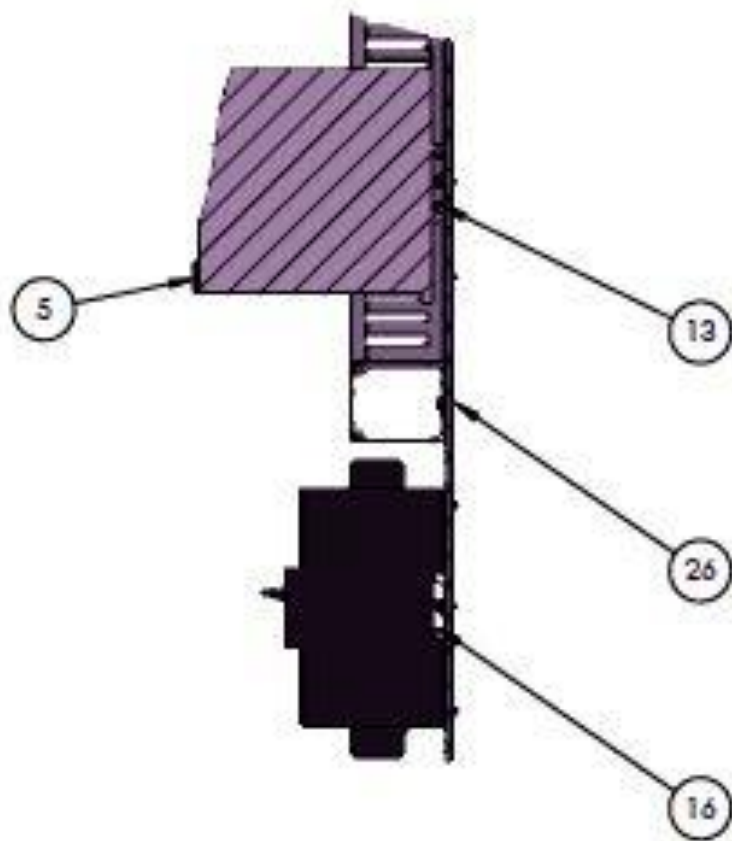


Figure 8: Control Panel Electrical Back Plate Diagram 1

## **New Control Panel Electrical Back Plate**



*Figure 9: Control Panel Electrical Back Plate Diagram 2*

**Table 2: Control Panel Parts List**

| ITEM NO. | QTY. | DESCRIPTION  | PART NUMBER                               |
|----------|------|--|---|
| 1        | 1    | PROLINE GOLD SERIES DESK CONSOLE   | HOFFMAN-PENTAIR PGLD1074DC                |
| 2        | 1    | ELECTRICAL BACK MOUNTING PANEL   | BACK PANEL                                |
| 3        | 1    | ELPRO 245U-E WIRELESS ETHERNET MODEM   | EATON 245U-E                              |
| 4        | 1    | DC CURRENT TRANSDUCER  | FLEX-CORE DT0-420-24U-U-SP                |
| 5        | 1    | 10A POWER SUPPLY   | SCHNEIDER ELECTRIC ABL8RPS24100           |
| 6        | 1    | LOGIC CONTROLLER, MODICON M251   | SCHNEIDER ELECTRIC TM251MESE              |
| 7        | 1    | 4 ANALOG INPUT, 12 BITS, TM3 MODULE  | SCHNEIDER ELECTRIC TM3AI4G                |
| 8        | 1    | 24VDC, 16 DIGITAL INPUT, TM3 MODULE  | SCHNEIDER ELECTRIC TM3DI16G               |
| 9        | 1    | 16 DIGITAL OUTPUT RELAY, TM3 MODULE  | SCHNEIDER ELECTRIC TM3DQ16RG              |
| 10       | 1    | NETWORK MODULE   | SCHNEIDER ELECTRIC TM4ES4                 |
| 11       | 1    | RELAY SOCKET, 10A/300V, 14 BLADE   | SCHNEIDER ELECTRIC 70-461-1               |
| 12       | 1    | RELAY, E-MECH, 4 PDT, 24VDC  | SCHNEIDER ELECTRIC 792XDXM4L-24D          |
| 13       | 1    | 35mm DIN RAIL, 7.5mm TALL x 78.5mm Long  | WEIDMULLER # 0514500000                   |
| 14       | 1    | 35mm DIN RAIL, 7.5mm TALL x 114.5mm Long   | WEIDMULLER # 0514500000                   |
| 15       | 1    | 35mm DIN RAIL, 15mm TALL, x 186.5mm Long   | WEIDMULLER # 1071680000                   |
| 16       | 1    | 35mm DIN RAIL, 7.5mm TALL x 510.5mm Long   | WEIDMULLER # 0514500000                   |
| 17       | 3    | W-SERIES END BRACKET   | WEIDMUELLER # WEW 35/2 1061200000         |
| 18       | 11   | FEED THROUGH TERMINAL, SPRING CLAMP CONNECTION   | WEIDMULLER ZDU 2.5 # 1608510000           |
| 19       | 5    | TEST-DISCONNECT TERMINAL, SPRING CLAMP CONNECTION  | WEIDMULLER ZTR 2.5 # 1608680000           |
| 20       | 6    | Z-SERIES, FUSE TERMINAL, SPRING CLAMP CONNECTION   | WEIDMUELLER ZSI 2.5/LD 120AC # 1616420000 |
| 21       | 1    | 1 1/2" x 2" WIRE WAY, LIGHT GRAY VINYL, NARROW SLOTTED DUCT, WITH COVERS, PANDUIT CAT. No. C1.5LG6 | 5" Long, PANDUIT # F1.5x2LG6              |
| 22       | 1    | 1 1/2" x 2" WIRE WAY, LIGHT GRAY VINYL, NARROW SLOTTED DUCT, WITH COVERS, PANDUIT CAT. No. C1.5LG6 | 6" Long, PANDUIT # F1.5x2LG6              |
| 23       | 1    | 1 1/2" x 2" WIRE WAY, LIGHT GRAY VINYL, NARROW SLOTTED DUCT, WITH COVERS, PANDUIT CAT. No. C1.5LG6 | 7" Long, PANDUIT # F1.5x2LG6              |
| 24       | 1    | 1 1/2" x 2" WIRE WAY, LIGHT GRAY VINYL, NARROW SLOTTED DUCT, WITH COVERS, PANDUIT CAT. No. C1.5LG6 | 15.5" Long, PANDUIT # F1.5x2LG6           |
| 25       | 1    | 1 1/2" x 2" WIRE WAY, LIGHT GRAY VINYL, NARROW SLOTTED DUCT, WITH COVERS, PANDUIT CAT. No. C1.5LG6 | 20.5" Long, PANDUIT # F1.5x2LG6           |
| 26       | 29   | ZINC PLATED, EXTERNAL HEX HEAD DRILLING SCREW, #6, 3/8" LONG                                       | McMASTER CARR #90064A146                  |
| 27       | 5    | M6x1 SERRATED FLANGE LOCKNUT   | McMASTER CARR #96194A101                  |
| 28       | 1    | SOIL SCOUT BASE STATION  | SOIL SCOUT BASE STATION                   |
| 29       | 1    | ATV320 200V 3ph VARIABLE SPEED DRIVE   | ATV320D11M3C                              |
| 30       | 8    | GROUND MODULAR TERMINAL BLOCK - UT 35-PE   | PHOENIX CONTACT 3044241                   |
| 31       | 1    | CB DOOR MOUNTED ROTARY HANDLE  | Schneider S29340                          |
| 32       | 1    | CIRCUIT BREAKER 3P 600V 80A  | SHNEIDER HDL36080                         |
| 33       | 1    | GOLF ELITE TOP HMI PANEL PLATE   | Golf Elite Top HMI Panel Plate            |
| 34       | 1    | AIR TEMPERATURE SENSOR   | OMEGA EWSE-PT100                          |
| 35       | 3    | PANEL MOUNT INDICATOR LIGHT, WATER TIGHT, BLUE   | SLOAN LED #253-286                        |
| 36       | 2    | 18-8 STAINLESS STEEL SERRATED FLANGE LOCKNUT, #10-32   | McMASTER CARR #93776A401                  |
| 37       | 2    | 18-8 STAINLESS STEEL SERRATED-FLANGE HEX HEAD SCREW, #10 x 1/2" LONG.                              | McMASTER CARR # 97646A241                 |
| 38       | 1    | COOLING FAN  | HOFF HF1024414                            |
| 39       | 1    | HF10 SIDE-MOUNT FILTER   | HOFF HG1000404                            |
| 40       | 1    | HMI 5.7" TOUCH SCREEN  | SCHNEIDER HMISTU855                       |



# SubAir® Operation

## Basic Operating Modes

### Vacuum

During vacuum operation air is pulled from the atmosphere down through the soil profile and into the drainage system. Vacuum operation should always be used when ambient air temperatures are in a favorable range for the turf and will generate a complete soil gas exchange much faster than is possible with pressure mode. Vacuum mode will also release uneven pockets of moisture from the soil profile resulting in more even treatment.

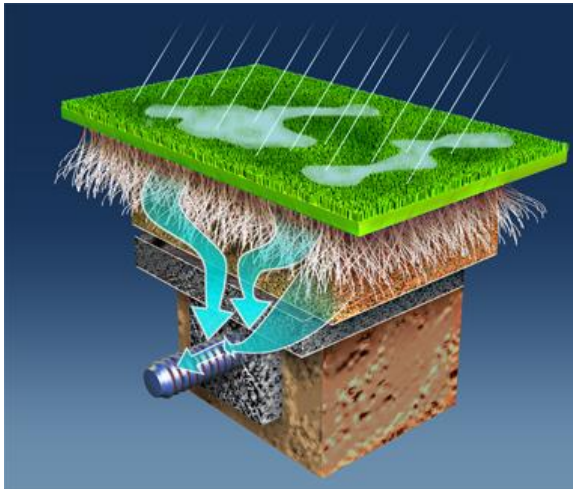


Figure 10: Vacuum Mode Air-Flow Illustration and Console



### Pressure

When the system is in pressure mode, air is forced into the drainage and up through the soil profile. Pressure mode is ideal whenever soil temperatures are more favorable to the turf than ambient air temperatures. Since excessive pressure beneath the surface of the green can lift poorly rooted areas of turf, pressure mode operates a reduced fan speed to limit the pressure applied to the soil profile.

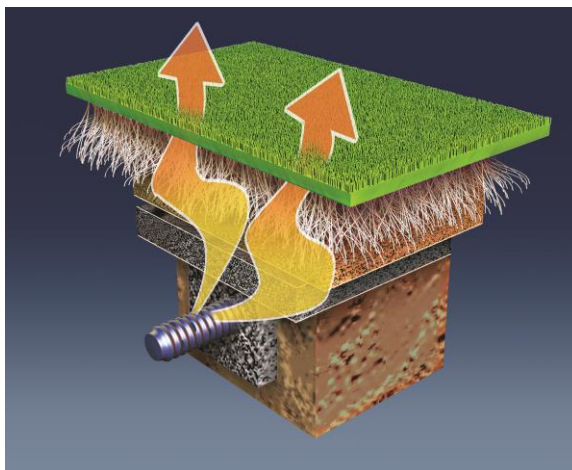


Figure 11: Pressure Mode Air-Flow Illustration and Console



## Intermittent Mode

The intermittent mode is designed to automatically displace toxic gases and excess moisture as they accumulate and maintain optimum respiration pore space and soil gas compositions 24 hours a day, every day. Proper configuration and diligent utilization of the intermittent feature is the only way to reap the full benefits of the SubAir® system. The intermittent mode also provides maximum effectiveness with minimal energy consumption for overall reduced operating costs (see Figure 10).

The intermittent mode uses an asymmetric timer relay and two stage thermostat to control execution intervals and operation modes. The asymmetric timer allows different values to be assigned to the on-times and off-times. To properly configure your timer set the on-time value to 2 times the number of minutes it takes to move air from the surface to the gravel layer in vacuum mode. This can be estimated by dividing the green's square footage by 1000. The off-time value will vary throughout the year and is based on your specific soil respiration rates, CO<sub>2</sub> production, soil moisture, temperature, etc. However, university research and field testing indicate that 2 hours is generally a good starting point during high growth periods. Ideal settings will provide just enough on-time to generate a complete soil gas exchange and have an off-time that initiates operation just prior to soil gases reaching toxic compositions.

The thermostat dictates the mode of operation (Pressure or Vacuum) based on the ambient air temperature, and the general "ideal" root zone temperature ranges for cool or warm season grasses. The standard thermostat settings for cool and warm season grasses, and decision matrix are given in Figure 11 below.

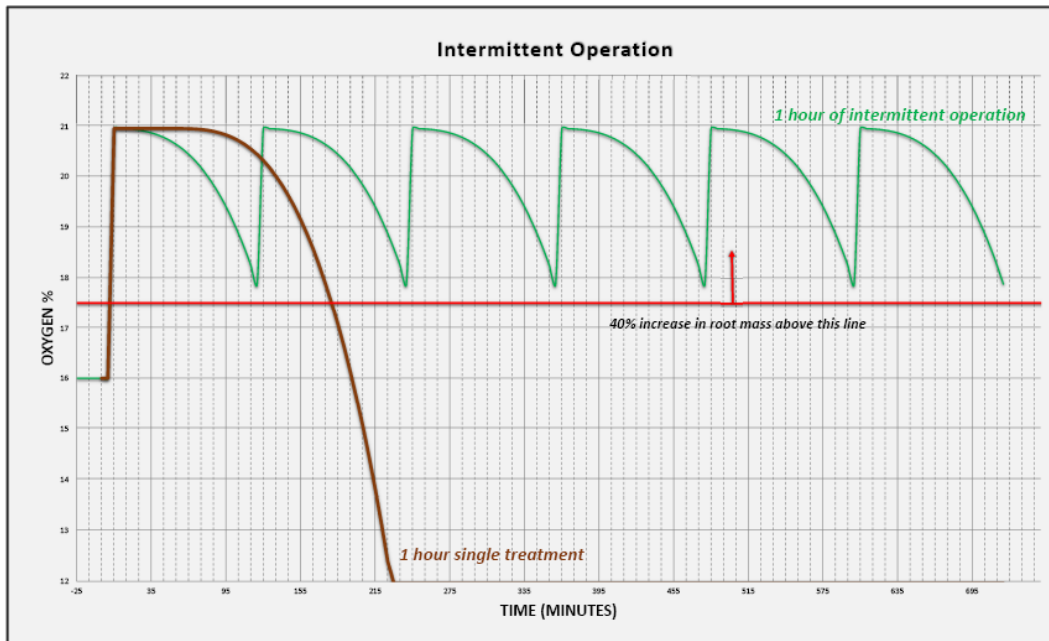


Figure 10: Intermittent Operation

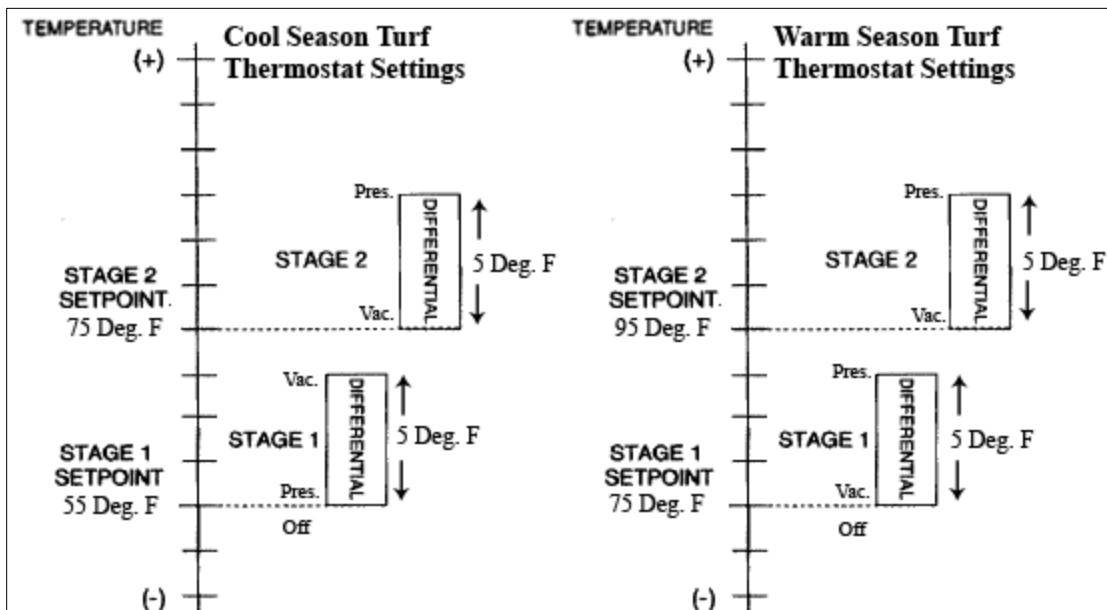


Figure 11: Intermittent Thermostat Settings

# Detailed Theory of Operation

## **General Moisture Control**

Contrary to popular belief, subsurface aeration technology is not simply a “water removal” tool, but rather is an extremely effective pore space management tool. One of the major benefits of SubAir® is the ability to clear excess water from the soil profile. The amount of water the SubAir® unit is capable of removing is directly proportional to the amount of vacuum that can be applied to the gravel layer. Moisture removal with a SubAir® units is comprised of two phases – the desaturation phases, and the evaporation phase. When vacuum operation is initially started the pressure differential across the soil profile quickly dislodges moisture from the pore space where the capillary forces are not stronger than the pressure gradient generated by the blower. This is considered the desaturation phase. The SubAir® will clear whatever percentage of the pore space it can clear after the first 5-15 minutes of operation, effectively “de-saturating” the profile. After this initial operation period the pressure differential is not strong enough to break the capillary forces holding the remaining water in the profile, and evaporation becomes the primary the mechanism driving moisture reduction. This is the “evaporation stage”. During the evaporation phase moisture removal is still accelerated above that of a non-SubAir® green, however the rate is drastically slower than the initial desaturation phase. A good analogy would be considering the amount of time required to drain a 5-gallon bucket with a small pump (de-saturation stage), vs a fan blowing air across the surface of the water (evaporation stage), vs evaporation with no fan (no SubAir®). Thus, when using the SubAir® for moisture removal expect a large initial drop in soil moisture, followed by a much, much slower and more gradual reduction. This makes it much more difficult to “dry out” a green than most initially think.

## **Rain/Irrigation Cycles**

After a rain or irrigation event the turf is often saturated with moisture. Despite the obvious moisture requirements of the plant, extended periods of saturation prevent proper root and soil respiration, and foster disease. The SubAir® System should be run in vacuum to de-saturate the profile as soon as the plants have had time to make proper use of the available moisture.

The SubAir® unit is capable of removing water from a saturated putting green 36 times faster than gravity draining alone (6,000 sqft. green). Running the units in advance, and during a rain event will result in significant reductions in the time required to return to playing conditions, as well as return the profile to aerobic conditions.

## **Flushing**

By utilizing the SubAir® System in conjunction with flushing events, water usage, and the time necessary to thoroughly flush the green can be greatly reduced. Begin watering the green just as you normally would for a flush; however, as soon puddling begins to form on large portions of the green start the SubAir® in vacuum. You should see the puddles vanish within seconds if the profile was properly saturated. If the puddles linger, which indicates air is still able to move unobstructed in some portion of the green, then stop the SubAir®, wait a few more minutes (irrigation still running), and repeat the process. Once you see the puddles vanish quickly stop the irrigation and let the SubAir® continue to run in vacuum for 5-15 minutes to insure all excess moisture is removed from the profile, and the soil has returned to healthy aerobic conditions.

## **Chemical Applications**

By pulling liquids down into the surface on contact, vacuum operation drastically reduces run-off, and surface evaporation during chemical applications and irrigation cycles.

## **Syringing**

Using the pressure mode in conjunction with syringing will provide increased cooling effect as well as reduce infiltration and inadvertent soil wetting. To do this, turn on the SubAir® in pressure 2-3 minutes before starting the syringe and turn it off 2-3 minutes after the syringe is finished.

## **Aeration and Gas Exchange**

Oxygen in the root zone is critical for plant growth and root functionality. Over time oxygen is consumed, and gases such as carbon dioxide, methane and hydrogen sulfide gradually accumulate in the root zone as aerobic and anaerobic microorganisms metabolize organic matter. These gases can develop in concentrations high enough to inhibit root growth and affect overall plant health in a matter of hours during high growth rate periods.

Traditional surface aeration methods are very effective for replacing a relatively small percentage of the total profile volume with clean mix but have little effect on the soil gases outside the actual hole made by a mechanical aerator. This is because no mechanism

other than diffusion exists to drive air laterally through the undisturbed soil around each hole. The SubAir® System forces air through the root zone under vacuum and/or pressure. This quickly purges all soil gases and replaces them with fresh air. The infusion of oxygen rich air will boost microbial activity through the entire soil profile maintaining maximum permeability and extending the service life of the green's mix.

For a typical USGA or California style green, running the SubAir® system is an efficient method to affect change of gas levels in the root zone. Research has shown that a typical green experiences a 50% reduction in soil gases in the first 3-5 minutes of operation. However longer run times may be required depending on soil composition, age of the green, environmental conditions, and frequency of system operation. The root zone can return to its non-aerated gas composition in as little as three to four hours or as long as one to three days after last operating the SubAir® system. The rate depends on the amount of organic material, soil temperature, soil permeability, microorganisms, etc. in the root zone. When the SubAir® system is operated routinely, such as in the intermittent mode, the root mass is often as dense at depth as it is at the surface. With this deeper, denser and healthier root system, the turf-grass is better equipped to survive general environmental stress and disease. All this can be accomplished without any disturbance to the playing surface.

SubAir® **does not claim** to eliminate the need for surface aeration; it is still needed to remove organic material from the surface that can effectively "seal off" the green. However, SubAir® can reduce the number of times that surface aeration needs to be performed and can reduce the size of the tines used so that the process is less disruptive to the surface and subsequently less disruptive to play.

### ***Temperature Moderation***

SubAir® systems can provide some limited temperature moderation in the root zone during periods of extreme heat or cold. The SubAir® Systems take advantage of the thermal mass of soil profile during these periods and use it to condition the hot or cold ambient air before it reaches the root zone. Typically, the soil and gravel layer are cooler in the summer and warmer in the winter than ambient air temperatures. Consequently, when run in the pressure mode, the air is heated or cooled to the same temperature of the gravel and soil before reaching the root zone. Due to the extremely small thermal mass of the air relative to the soil, near continuous operation is required to achieve measurable results. Both field and laboratory tests have shown that with continuous operation the SubAir® units alone are capable of 2-4 deg. F. changes in temperature during the hottest/coolest times of the day.

Although the sub-soils can provide a significant source of heating and cooling, to get maximum effectiveness it must be utilized properly. During hot weather if the nighttime air temperature ever drops below the average soil temperature then it is recommended to operate vacuum during this coolest part of the night. As soon as ambient air temperature rises above that of the soil, switch operation over to pressure and the system will begin pushing the cooler subsurface air back up through profile to cool not only the soil but the surface canopy as well.

Similarly, during cold weather operating in the vacuum mode during the warmest part of the day will pull the warm air into the soil. This will help keep the soil microbes active and increase the cool season health of the turf. During the coolest part of the day, running the system in pressure will push the air through the warmer soil profile back up to the surface region, thus transferring the maximum amount of available heat to the root zone. Pressure operation will also help reduce the severity and frequency of freezing.

# SubAir® Operation

## Programming the Basic Operating Modes

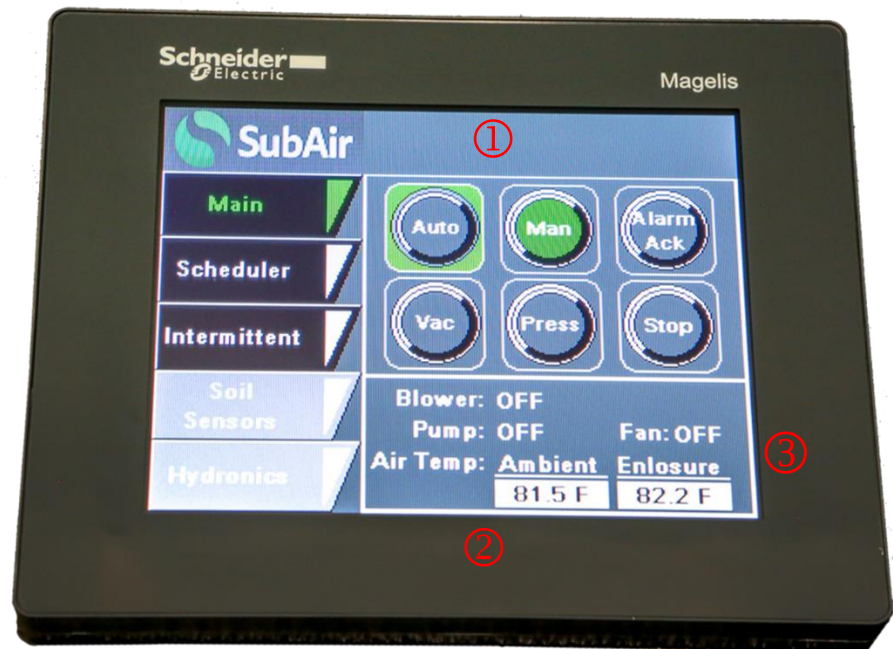


### Operations shown:

Current Operation Mode ①

Ambient Air Temp ②

Enclosure Air Temp ③





## Setting Manual Operations

Select the Manual button to set onetime operation.

Select **Vacuum** or Pressure for operation.



Select **Vacuum** and a Vacuum Mode and Time Setpoint window will appear.

\*Note that 0 minutes will run the operation indefinitely.

\*All time is set in minutes (2 hours are 120 minutes)



Press **"Mins"** button and a Key pad will appear to set Run Time.

Enter the number of minutes for the system to run and press ENTER.



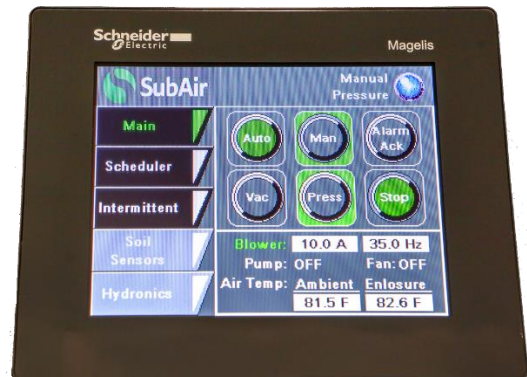
The Vacuum and Time Setpoint window will show the time set. Press Start to run equipment.

Home screen will return and show remaining operation time. Manual settings run one time and scheduled operations will resume once complete.



Select the Manual button to set one-time operation.

Select Vacuum or **Pressure** for operation.



Select **Pressure** and **Pressure Mode Time Setpoint window** will appear.

\*Note that 0 minutes will run the operation indefinitely.

\*All time is set in minutes (2 hours are 120 minutes)



Press “Mins” button and a Key pad will appear to set Run Time.

Enter the number of minutes for the system to run and press ENTER.



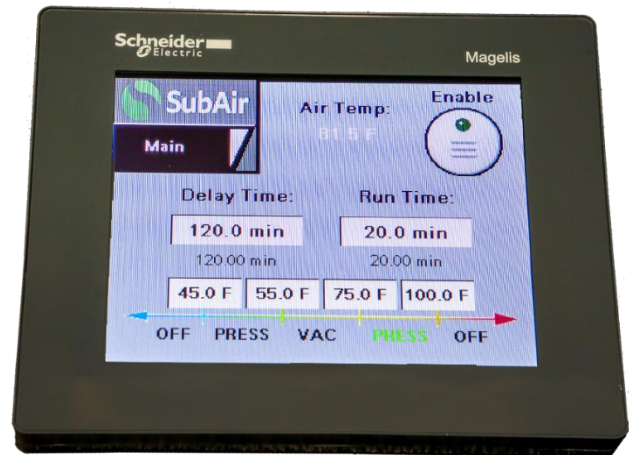
The Pressure and Time Setpoint window will show the time set. Press Start to run equipment.

Home screen will return and show remaining operation time. Manual settings run one time and scheduled operations will resume once complete.



## Setting Intermittent Operations

Select the Intermittent Tab on the Main Screen display. The Intermittent Setting window will appear.



Approved Intermittent Run \Times and Temperature settings will be set when unit is commissioned.

Temperature settings and mode selection will be set when unit is commissioned.

Delay Time – Time between system run times

Run Time: time unit will run programmed operation.

### To Adjust Delay Time:

Press box of minutes shown. A keyboard will appear. Enter in number and Press Enter.

### To Adjust Run Time:

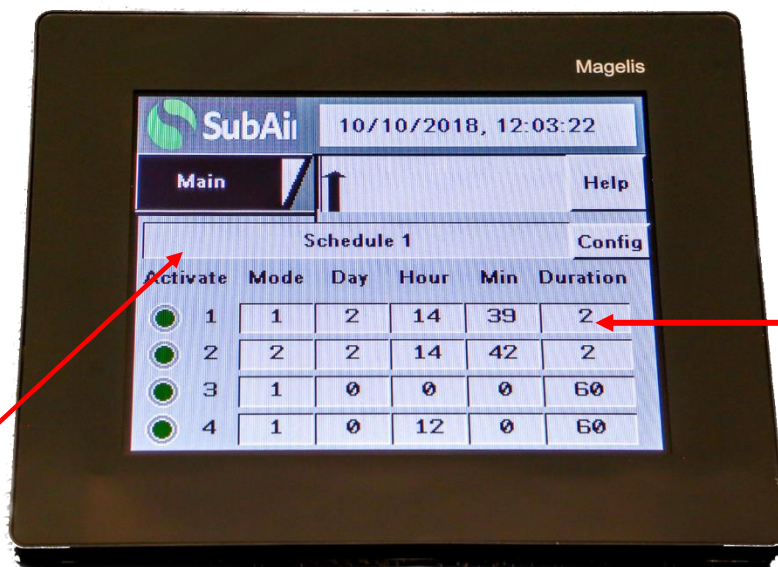
Press box of minutes shown. A keyboard will appear. Enter in number and Press Enter.

When all new settings are entered – **Press the Enable Button to save changes and activate.**



## Setting Schedule Names and Operations

Select the Scheduler Tab on the Main Screen. A Schedule screen appear.



Specific Schedule Names can be created for easy reference. Daily, Tournament, Spring, etc.

Actions and Run Times will appear in the Schedule Setting box.

### Reference Codes

**Mode:** 1 = Vacuum, 2 = Pressure

**Day of Week:** 0 = Sunday, 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday, 7 = All Days

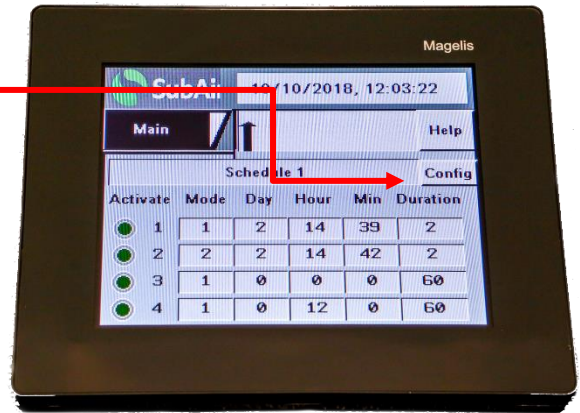
**Start Hour:** Hour of the day, 0-23 (military time 9:00 PM = 21)

## Setting Schedule Names and Operations – cont'd

Multiple schedules can be saved to provide immediate changes in system operations.

Each schedule can be named and configured to specific operations.

To name schedules, press the Configure Schedule Name rectangle.



A Schedule Naming panel will appear with five (5) options.



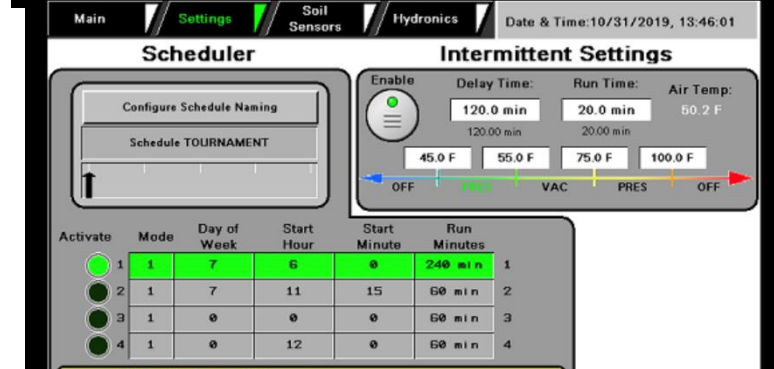
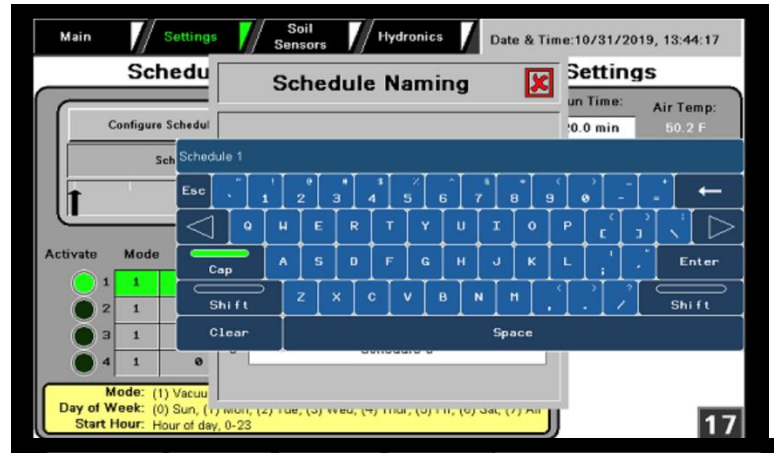
Press Schedule 1 to name schedules and a keyboard will appear.

To enter a schedule name, type in your selection (ex: Tournament) and press Enter.



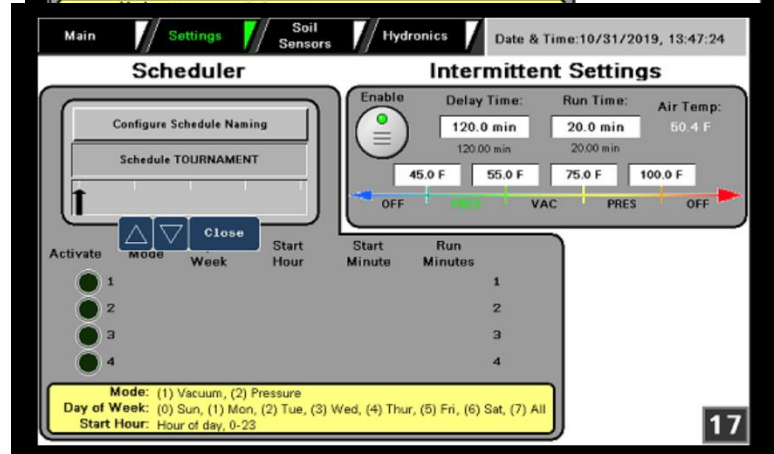
## Setting Schedule Names and Operations – cont'd

New name will appear in Naming box.



To select among multiple saved schedules,

Press the arrow in the Configure Schedule Naming box. Arrow keys will appear to move down the list of Schedule Names. Press Close when specific Schedule name appears.



## Setting A Scheduled Program

Once a Schedule has been named continue with entering Mode, Day of Week, Start Hour and Run Minutes

### Column 1 is Mode – Vacuum or Pressure

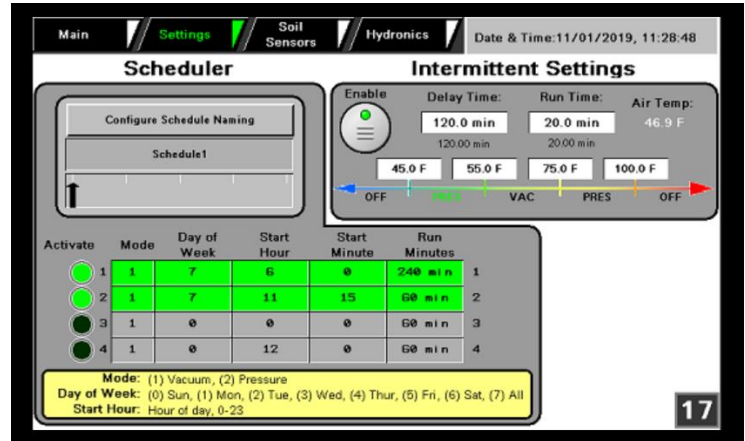
Press the button/rectangle in the first Row under Mode column.

A Key pad window will appear.

Enter the Mode # and or specific day of week to operate and press Enter.

*Reference codes are at bottom of screen.*

*Select 1 for Vacuum or 2 for Pressure*



### Column 2 is Day of Week.

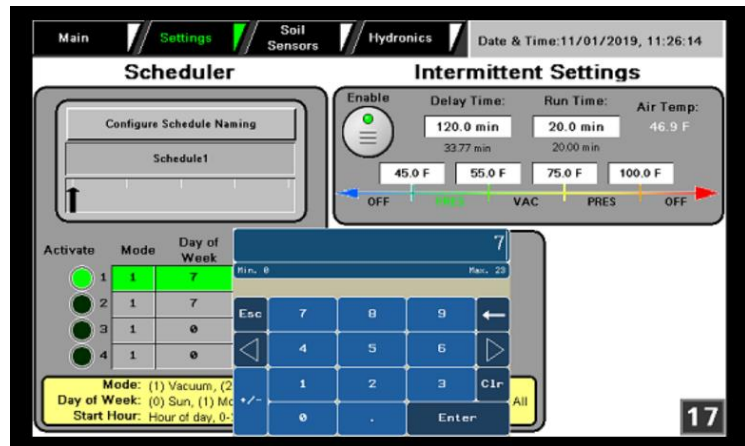
Press the button/rectangle in the first Row under the Day of the Week.

A Key pad window will appear.

Enter number for specific day of week to operate and press Enter.

*Reference codes are at bottom of screen.*

*Select 0 = Sunday, 1 = Monday, 2 = Tuesday, 3 = Wednesday, 4 = Thursday, 5 = Friday, 6 = Saturday, 7 = All Days*



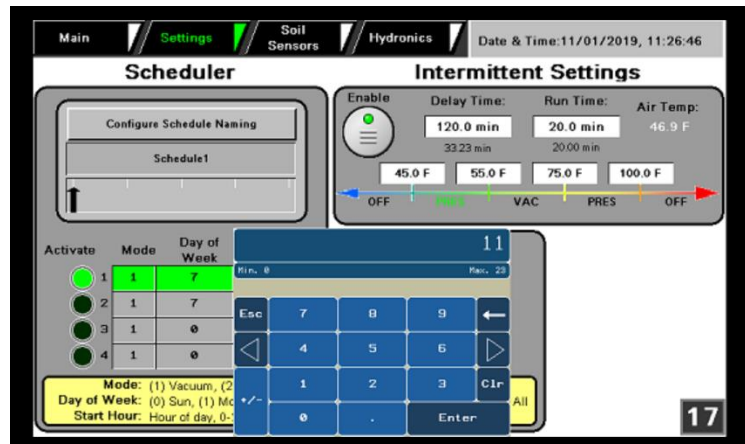
### Column 3 is Start Hour.

Press the button/rectangle in the first Row under the Start Hour.

A Key pad window will appear.

Enter number for Hour of Day to start operating and press Enter.

**Start Hour:** Hour of the day, 0-23 (military time) example: 9:00PM = 21





## Setting a Scheduled Program cont'd

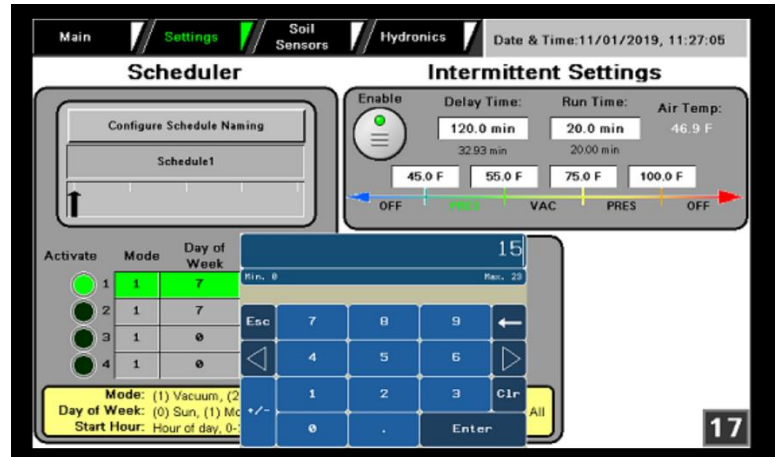
### Column 4 is Start Minutes

Press the button/rectangle in the first Row under the Start Minutes.

A Key pad window will appear.

Enter minute within the hour for operation to begin.

Example: Run time to begin at 11:15 AM  
Start Minutes will be 15.

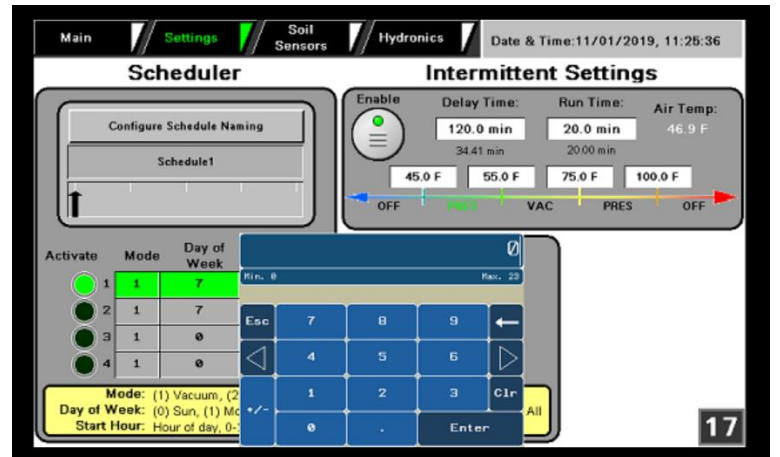


### Column 5 is Run Minutes - the length of time for system to run.

Press the button/rectangle in the first Row under the Run Minutes.

A Key pad window will appear.

Enter number of minutes for how long operation will run and press Enter.



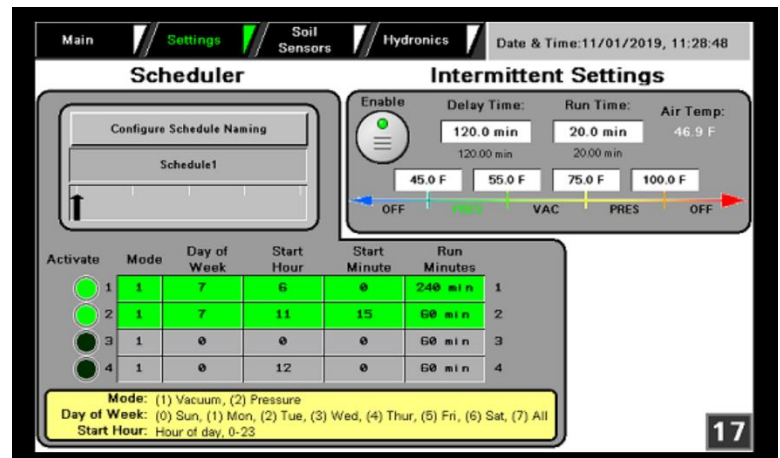
Press the ACTIVATE Button to save all entries.

Each row sets one run time, additional run times are entered in the next row.

Row 1 – Vacuum Mode, All Days,  
Starts at 6 AM, Runs 240 minutes

Row 2 – Vacuum Mode, All Days,  
Starts at 11 AM, Runs 60 minutes

The screen shown indicates Row 1&2 are active and will run programmed mode (vacuum) will run each day at designated time and duration.



## Setting A Schedule Program - cont'd

## Home Screen View of SubAir System During Operation

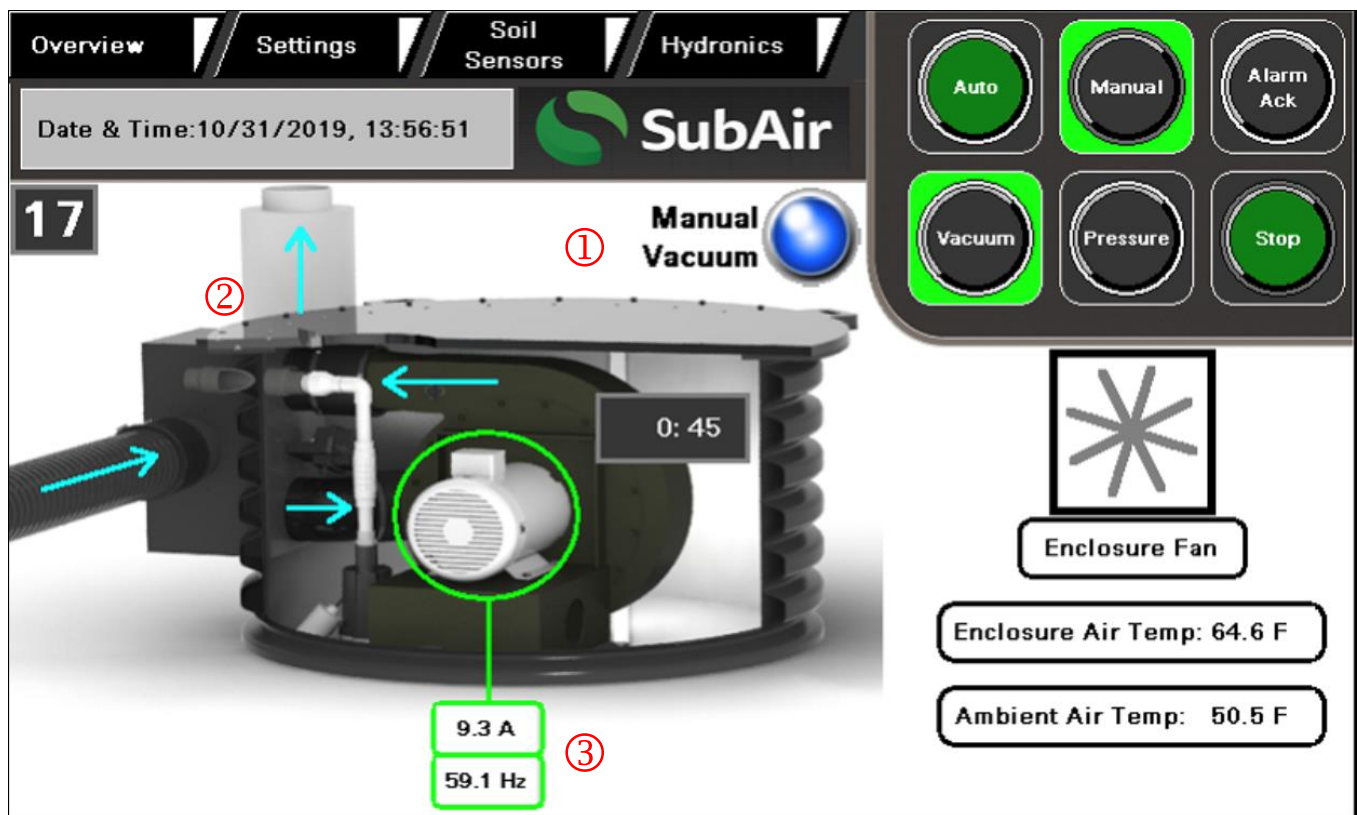
## Operation ①

Mode ①

### Air Flow Direction ②

Amperage③

Hertz③



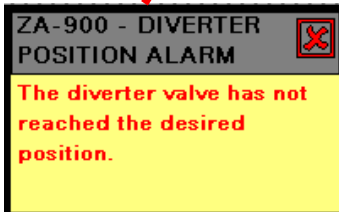
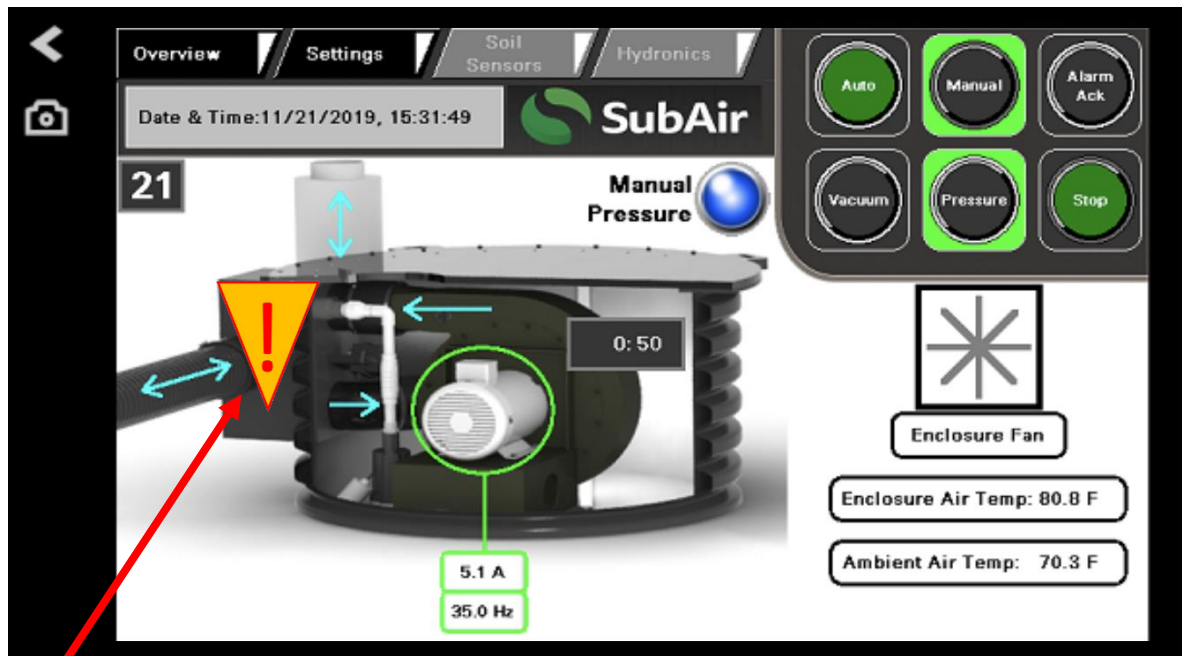
## Fault and Protection Features

### Maintenance Cycle Operation

It is imperative that the control panel be left fully powered at all times after installation. Power should be removed only when performing maintenance inside the unit or control panel. Likewise, the maintenance cycle, which periodically runs the blower in reverse at 16% speed to lubricate the bearings and cycle the diverter actuator, will cease to function. If power is removed for any reason other than during maintenance, it will prevent these protective features from operating and will void the equipment warranty.

### Over-Current Protection

The SubAir® control panel is equipped with primary (line) circuit breakers on the incoming power leads, as well as secondary circuit breakers on the low voltage circuits. The VFD serves as the protective device for the motor leads and will detect any issues related to both the incoming power and motor circuit and provide fault information if a problem arises.



## Periodic Inspection

| PERIODIC INSPECTION SCHEDULE |                |  |
|------------------------------|----------------|--|
| INSPECTION FREQUENCY         | COMPONENT      | INSPECTION PROCESS   |
| Every Use, by Owner/Operator | General System | Listen for unusual noise or vibration. If excessive noise or vibration is detected, take the system out of service and call SubAir® Systems.   |
|                              |                | Assure that air is flowing in/out of the air intake port.  |
|                              |                | Assure that air is flowing in the proper direction at the air intake/exhaust port (i.e., being pushed out of the port when operated in the vacuum mode, and being pulled into the port when in pressure mode). |
|                              |                | Observe control panel fault light and monitor if illuminated.  |
| Monthly, by Owner/Operator   | Control Panel  | Run the system in all modes, assuring all electrical and, if available, radio signals communicate properly   |
|                              | Fan/Motor      | Allow the unit to operate a minimal of four (4) hours per month  |
| Quarterly, by Owner/Operator | Dual Valve     | Inspect the valve; remove lid and visually inspect to ensure no debris is present. Turn SubAir® to both pressure and vacuum mode to ensure air effectively flows to valve location.                            |
|                              | Clean out      | Inspect this location; remove cap visually inspect to ensure no debris is present. Turn SubAir® to both pressure and vacuum mode to ensure air effectively flows to valve location.                            |

### ➤ DANGER

- Prior to servicing the system, make sure the system is off and the main disconnect on the control panel is turned to "OFF" and locked out. Confirm that there is no power to the above ground system before providing maintenance to the unit.
- Do not tamper with system components, electrical wiring or connections. All electrical components, wiring and connections must be serviced by a qualified electrician or electrical technician.

### ➤ WARNING

- Only trained technicians should repair or service the system. Anyone doing even simple repairs or service should follow the procedures exactly as stated in this manual, and follow all DANGER, WARNING and CAUTION procedures listed in this manual.
- Shut down the system immediately if there are any sudden increases in blower vibrations, or other unusual change in operational characteristics.
- Wear safety glasses or approved eye protection when servicing.
- Do not wear loose clothing or jewelry when servicing system.
- Use insulated tools when working on or around electrical connections.
- Improper use of product or failure to properly maintain it could result in decreased system performance or severe personal injury.
- Any modification or change to the system could result in severe personal injury or death.
- If any problems are found during scheduled inspection, do not operate the system until repairs are made.
- Failure to make necessary repairs could result in fire, property damage, severe personal injury, or death.
- To ensure trouble-free product performance, it is very important to follow a periodic inspection program.
- Regular and consistent system inspection and maintenance can prevent down-time and expensive repairs that result from neglect. Any system not functioning correctly should be removed from use until it is repaired. This will prevent further damage to the system and avoid the possibility of operator injury.

## LUBRICATION

The SubAir® blower motor bearings are fully lubricated from the factory. Motor bearings should receive 2.5 grease gun strokes (0.16 ounces of grease) after every 5500 hours of operation. Use hand-operated grease gun, not a pneumatic grease gun. Pump grease slowly, taking 10 to 12 seconds to complete each stroke. Take care to apply the correct amount of grease. Over-greasing the bearing is just as damaging as have no grease.



# Troubleshooting, System Faults, and Fault Indicator Illuminations

## General Problems

| Problem   | Probable Cause of Problem/Fault   | Remedy   |
|---|---|--|
| Motor will not start  | No power supply to system.  | Supply power to system.  |
|   | Disconnect(s) in "OFF" position.  | Turn to "ON" position.   |
|   | Tripped circuit breaker in control-panel box.                                 | Check primary and secondary circuit breakers.  |
|   | Defective wiring or loose connections in circuit.                             | Check VFD for fault code. Locate and correct defects or poor connections   |
|   | AirWave Communication Failure   | Check communication link light in AirWave System Monitor Page  |
|   | Diverter Valve Unable to Reach Desired Position                               | Check for obstructions, loose shaft coupling, bad actuator feedback wiring connections   |
| System does not operate in selected mode (Vacuum or Pressure) | Defective electrical connection between air-reversing actuator and controller | Check conductor continuity and replace as required. Check electrical connections and tighten as required   |
|   | Air-reversing valve actuator failure.   | Test actuator and replace actuator as required.  |
|   | Air-reversing valve jam   | Loosen actuator and ensure air-reversing paddle rotates from pressure position to vacuum position freely. Remove any obstructions. With actuator loosened, ensure full paddle actuation. |
| Low or no air flow  | Blockage in turf drainage system.   | Clear blockage.  |
|   | Turf is saturated with water.   | Operate system in vacuum mode for an extended period.  |
|   | Intake/exhaust port blocked.  | Find and clear blockage.   |
|   | Air-reversing valve malfunction   | Ensure air flow diverter paddle is fully seated in the selected mode of operation  |
|   | Blower impeller is loose.   | Call SubAir® Systems for assistance.   |
| Excessive vibration   | Loose mounting bolts, set screws, bearings, or couplings.                     | Tighten as required. If disassembly of motor/blower unit is required, have SubAir® Systems or authorized representative make repair.   |
|   | Misaligned or unbalanced motor.   | Check and adjust.  |
|   | Bent shaft or impeller due to foreign matter impact.                          | Replace bent component. Have SubAir® Systems or authorized representative make repair.   |
|   | Excessive wear or corrosion of impeller.                                      | Replace impeller. Have SubAir® Systems or authorized representative make repair.   |
| Excessive noise.  | Foreign object hitting impeller.  | Remove foreign object.   |
|   | Drainage system resonance or pulsation.                                       | Look for broken pipe or loose joint.   |
|   | Loose accessories or components on system.                                    | Locate and tighten.  |
| Premature component failure.                                  | Prolonged or intense vibration.   | Locate and correct source of vibration. Repair/replace components as required.   |
|   | Abrasive or corrosive elements in the airstream or surrounding environment.   | Look for breaks in piping and repair.  |
|   | Misalignment or physical damage to rotating components or bearings.           | Repair, replace, or adjust components as required. Have SubAir® Systems or authorized representative make repair.  |
|   | Chronic problem of water slugs stalling blower and overloading motor.         | Repair system leaks; assure proper operation of air/water separation and dual valve components   |

## Fault Indicator Illuminations

| Problem/Fault                  | Probable Cause of Problem/Fault                          | Remedy   |
|--------------------------------|--|--|
| Fault Illumination Illuminated | An error or fault is detected by the safety circuit.     | Identify core problem. Common causes include magnetic safety switch, float switch, temperature switch, or drive fault. See below for remedy to each. |
| Drive Fault                    | Variable Frequency Drive (VFD) senses an internal fault. | Refer to Altivar 312 manual for troubleshooting steps, and code definitions.   |

## **SubAir® Systems Limited Warranty**

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SubAir® Systems LLC (SubAir® Systems) warrants, in accordance with the provisions below, to the original purchaser for the period of twelve (12) months from the date of commissioning that the system is free from any defects in material or workmanship. SubAir® Systems' obligation under warranty is to repair or replace, at SubAir® Systems' election, without charge, any part or parts of the system which, in the judgment of SubAir® Systems, prove to be defective.

This warranty and SubAir® System's obligation hereunder is in lieu of all other warranties, expressed or implied, including, without limitation, the implied warranty of merchantability or implied warranty of fitness for particular purpose, and all other obligations or liabilities of SubAir® Systems for incidental and consequential damages resulting from the design, manufacture, sale or use of the system. No person is authorized to make any warranty or assume for SubAir® Systems any liability not strictly in accordance with this warranty.

SubAir® Systems LLC warranties are contingent upon proper installation of not only the materials and equipment provided by SubAir®, but also the connecting drain pipe that becomes part of the complete system. Documentation of the installation is needed for warranty issues as well as for potential modifications and repairs in the future. Photos showing the exposed, in-place components (pipe, water separators, and traps), and as-built drawings with key elevation measurements as defined in the installation guide are required.

SubAir® is not responsible for injury or damage resulting from improper installation of this equipment, noncompliance with the Installation Guide, or from use outside the application for which it was sold. This warranty shall not apply to any system or system part, which in the judgment of SubAir® Systems, has been improperly installed, altered or tampered with in any way or has been subjected to misuse, neglect or accident, or has had the serial numbers altered, effaced or removed. This warranty does not apply to component parts not manufactured by SubAir® Systems (motor, blower, actuator) except to the extent of their individual manufacturer guarantees.

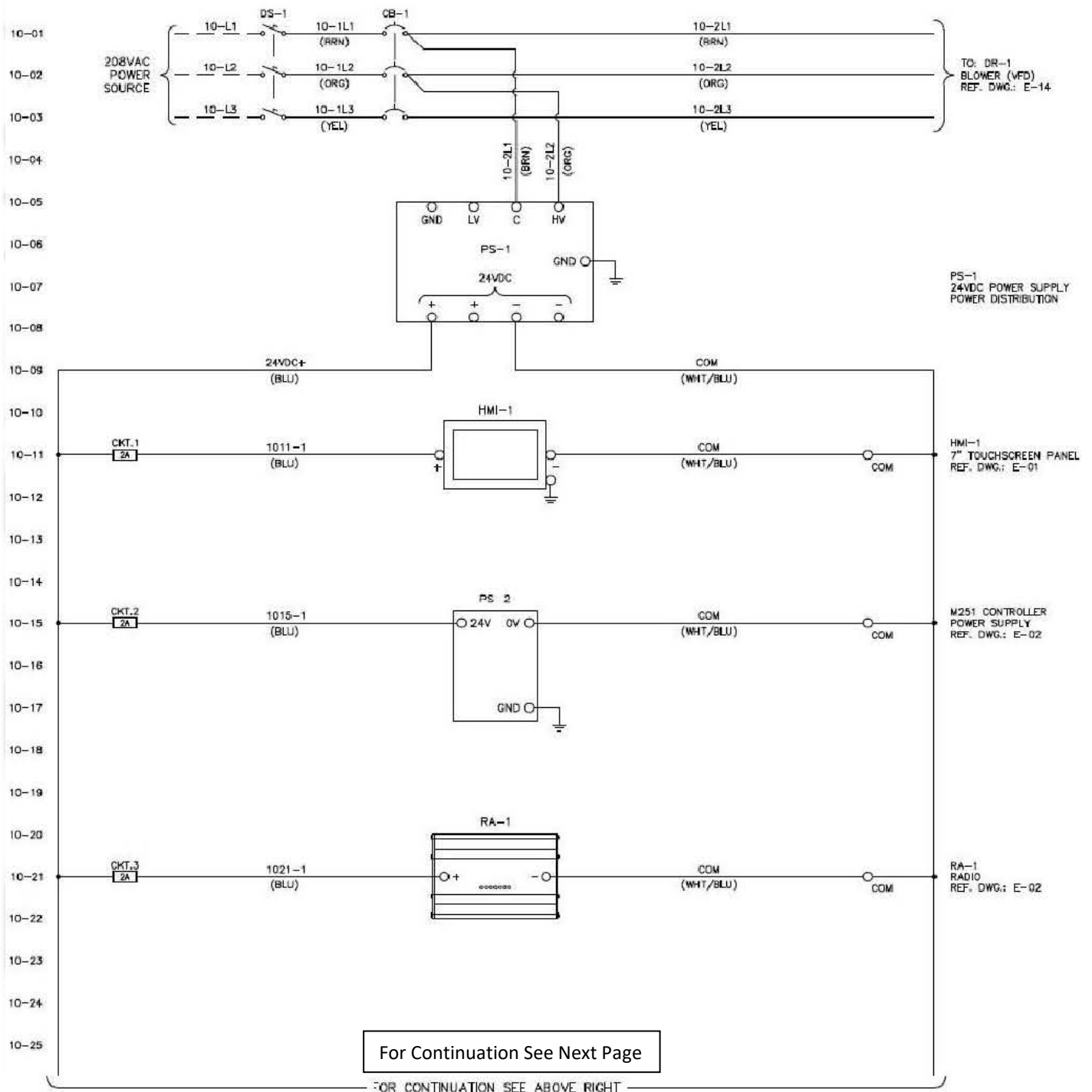
➤ **WARNING**

- Any unauthorized modification, alteration, or use of non-approved attachments may present safety hazards that are not present in this manual. If any such modifications, alterations, or attachments are used, all warranties are void and SubAir® Systems, LLC is released from any liability for injury and/or damage arising from subsequent use of this equipment.

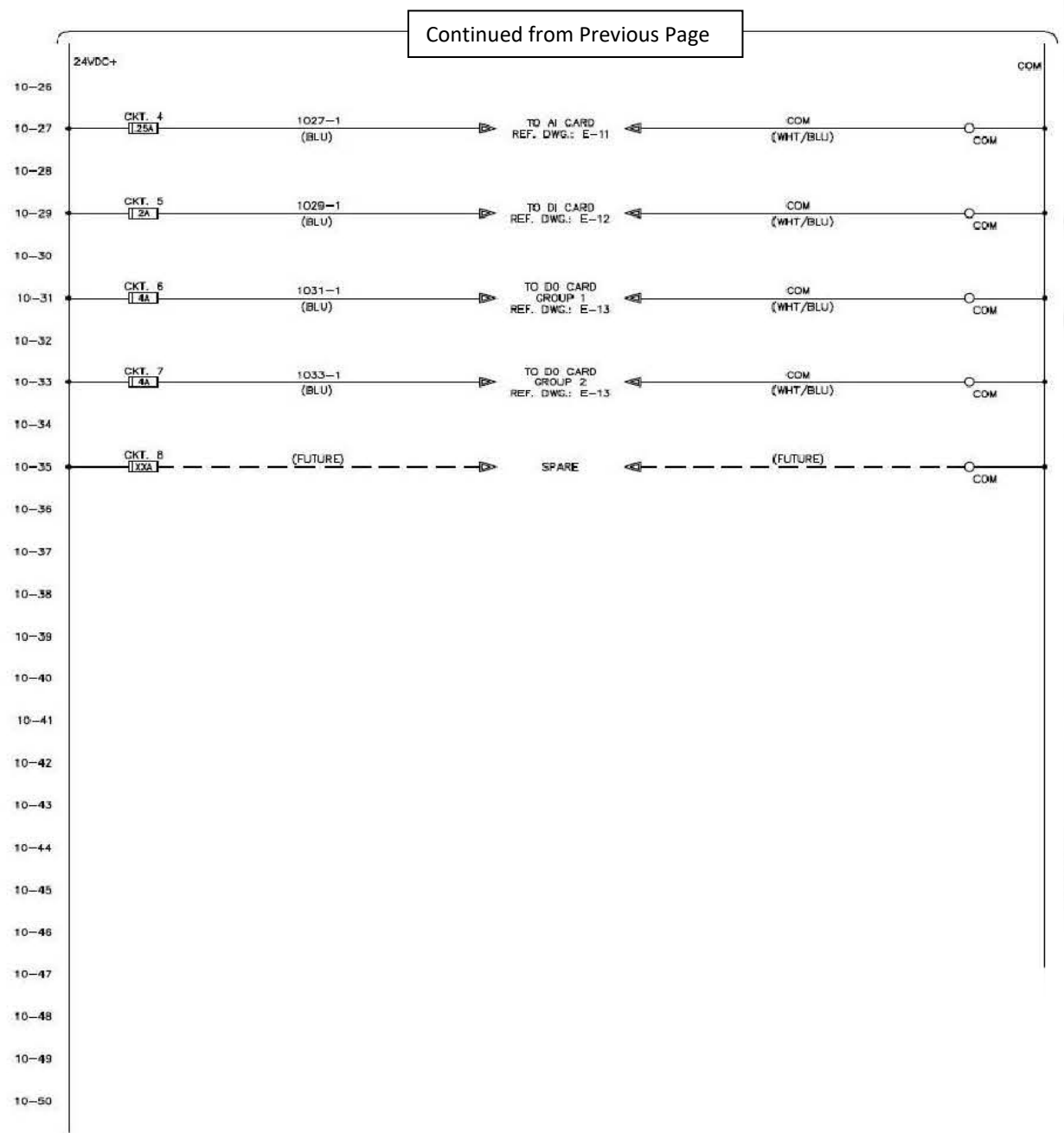
ALL WARRANTY REPAIR AND SERVICE MUST BE HANDLED THROUGH AN AUTHORIZED SUBAIR® SYSTEMS REPRESENTATIVE OR DIRECTLY WITH SUBAIR® SYSTEMS, LLC.

# Electrical Schematics

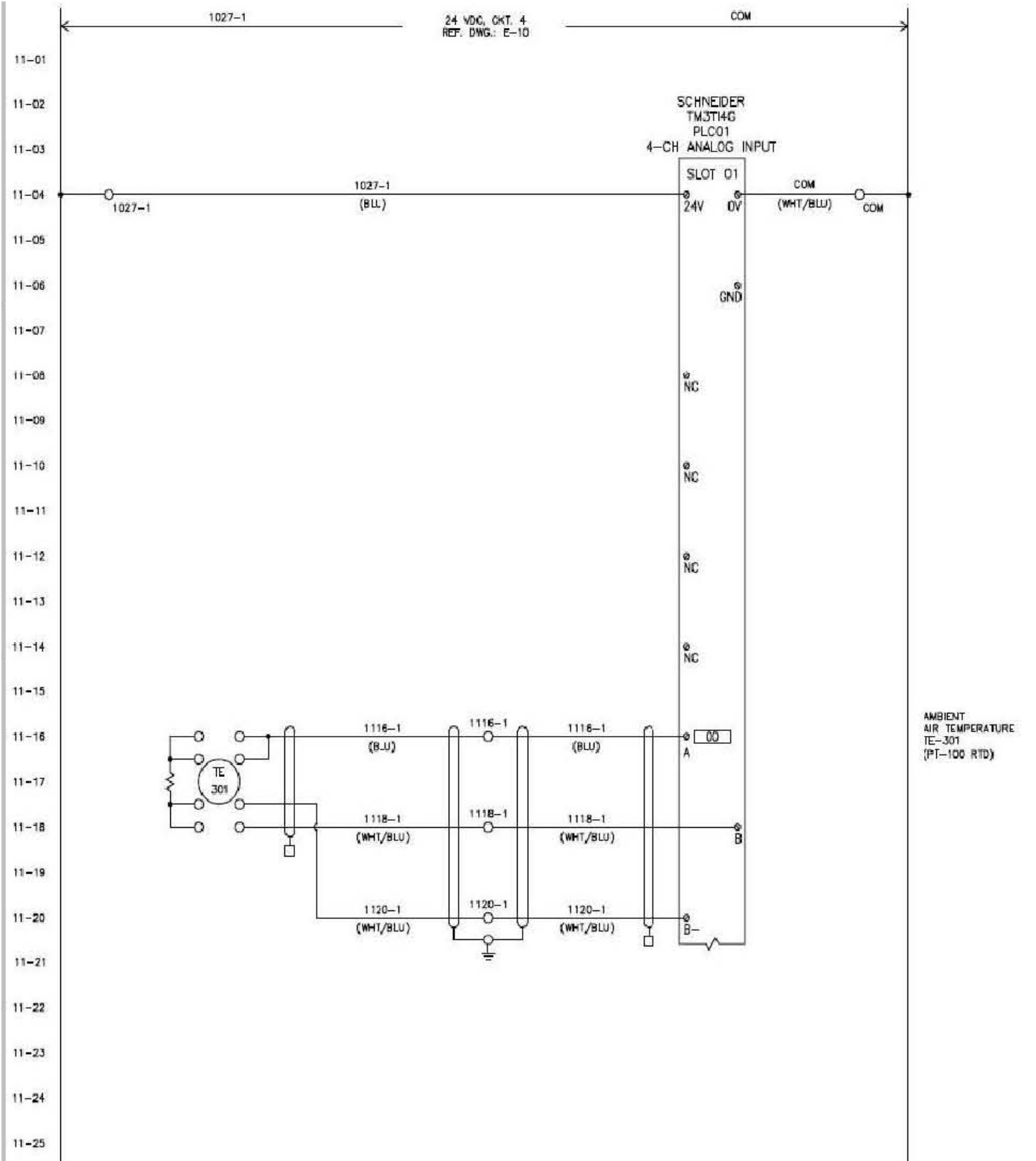
## Standard Electrical Schematic – Wiring Diagram Power Distribution



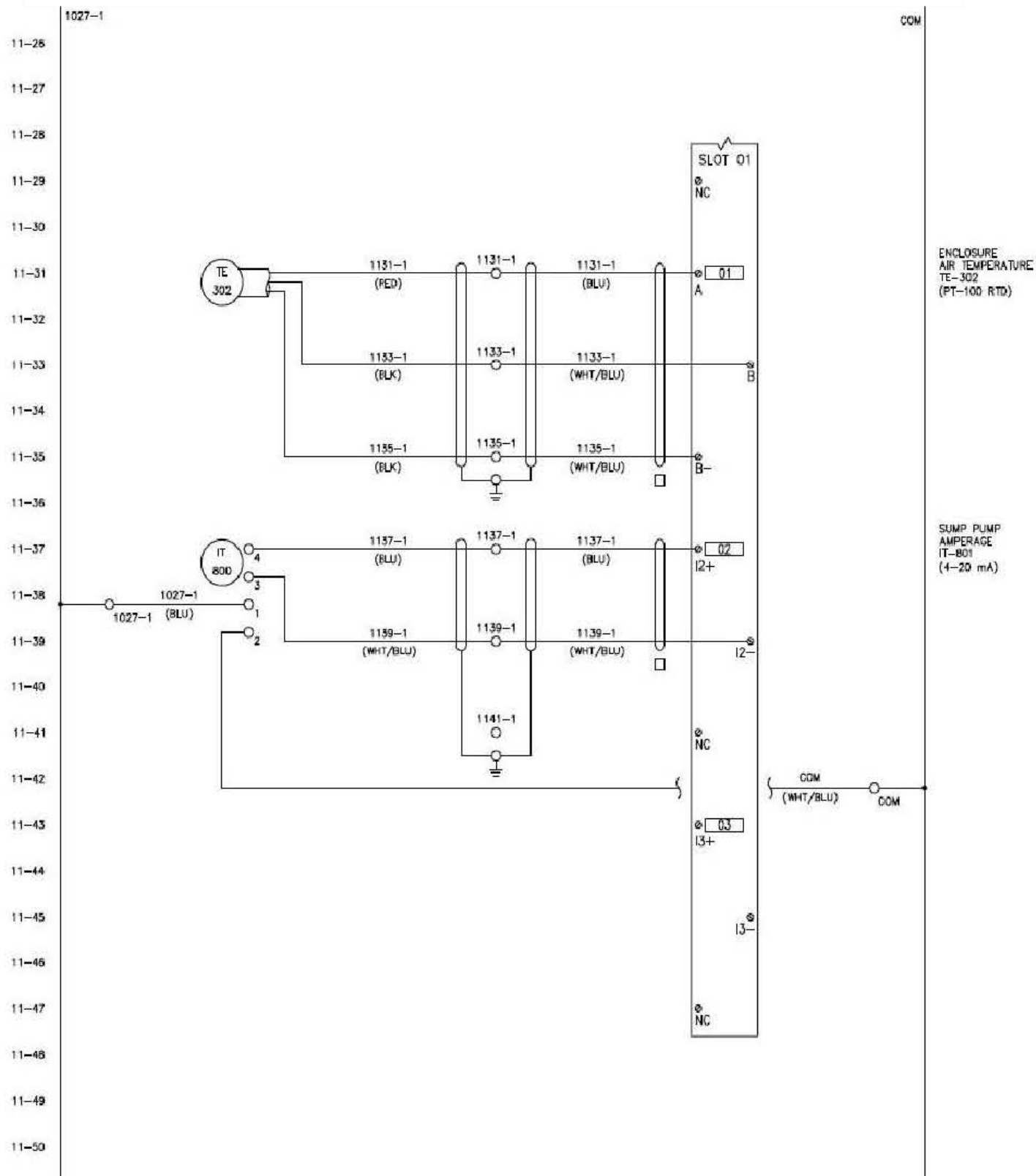
Standard Electrical Schematic – Wiring Diagram Power Distribution



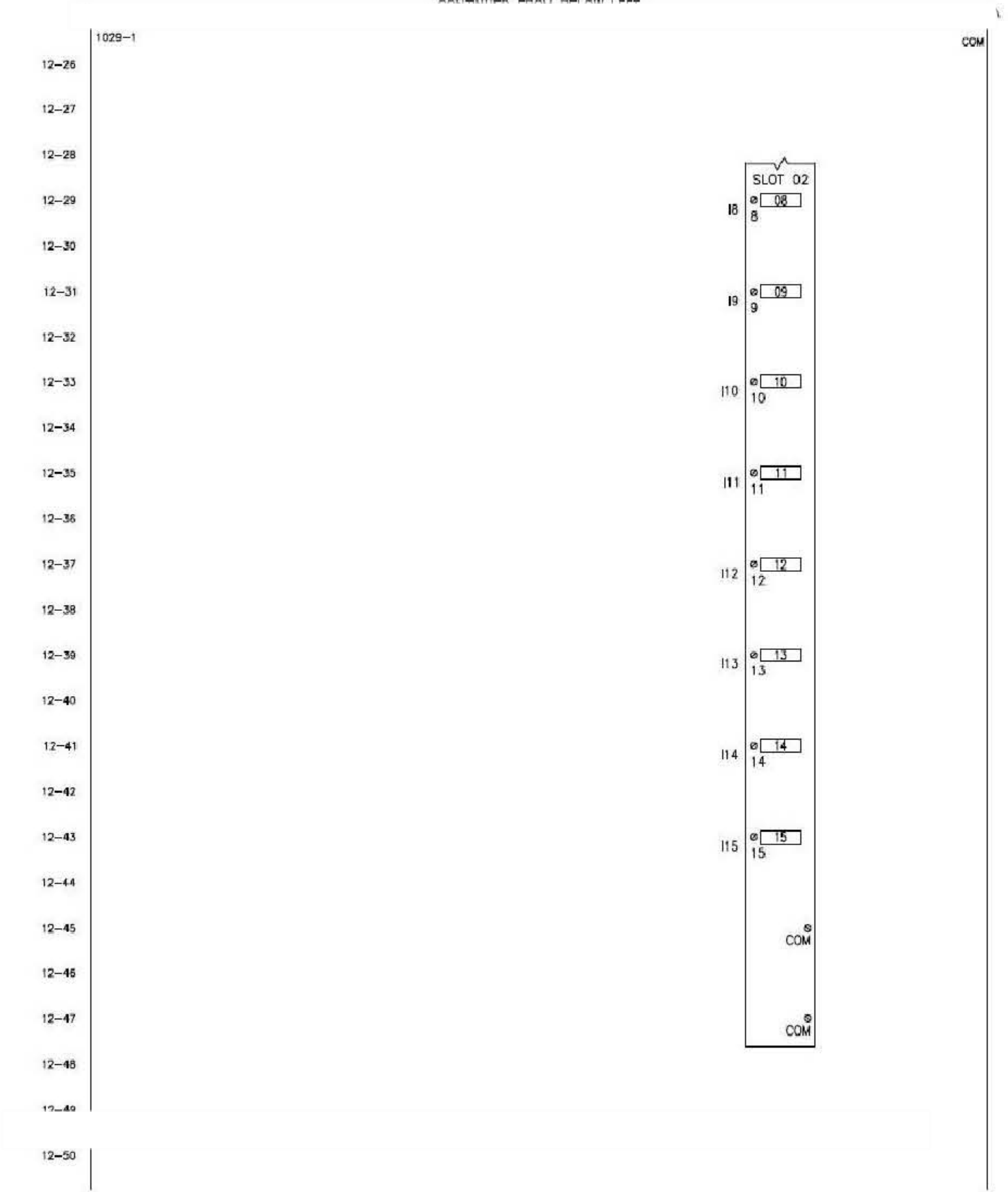
Standard Electrical Schematic – Wiring Diagram Power Distribution



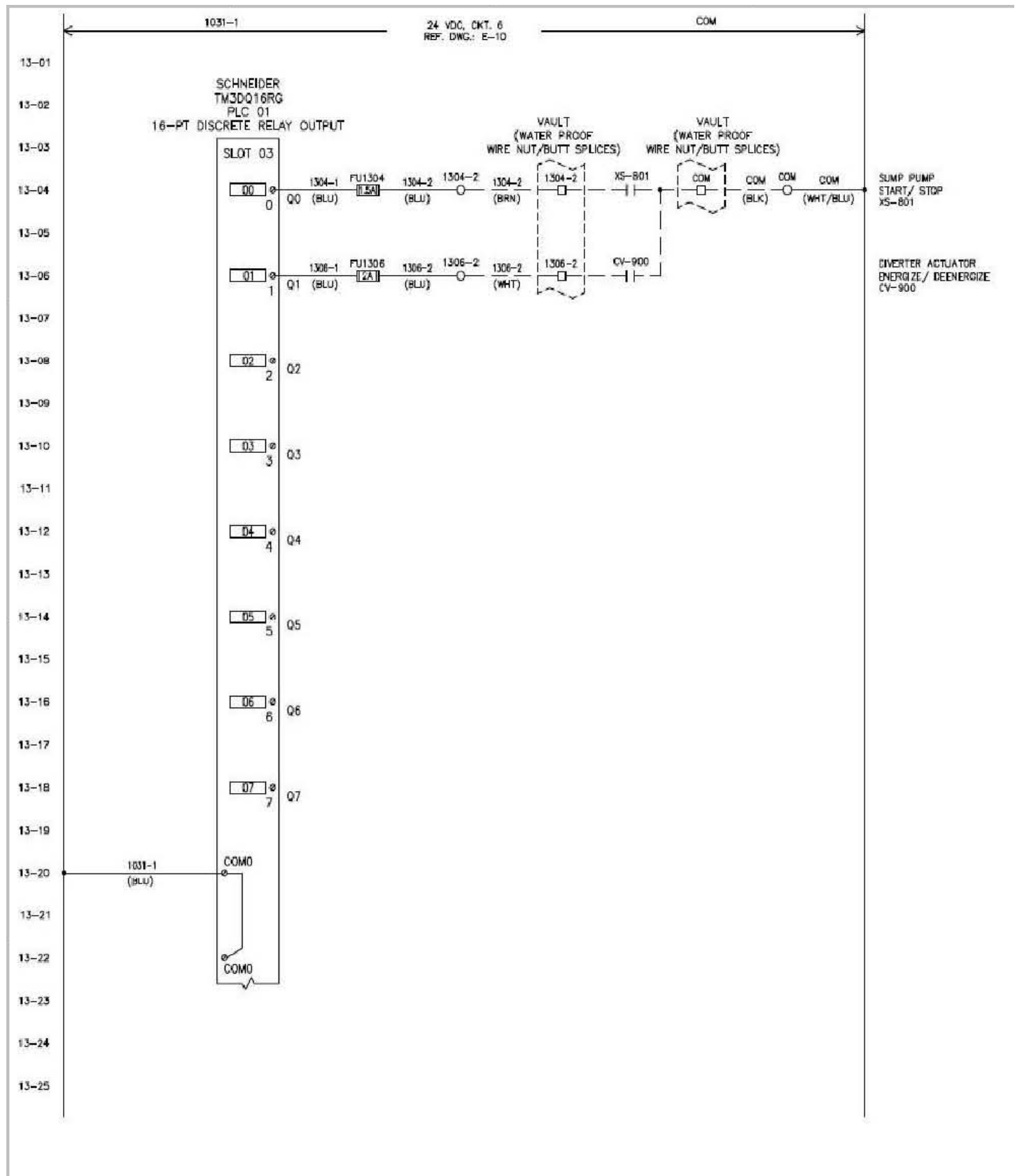
# Standard Electrical Schematic – Wiring Diagram Power Distribution



Standard Electrical Schematic – Wiring Diagram Power Distribution

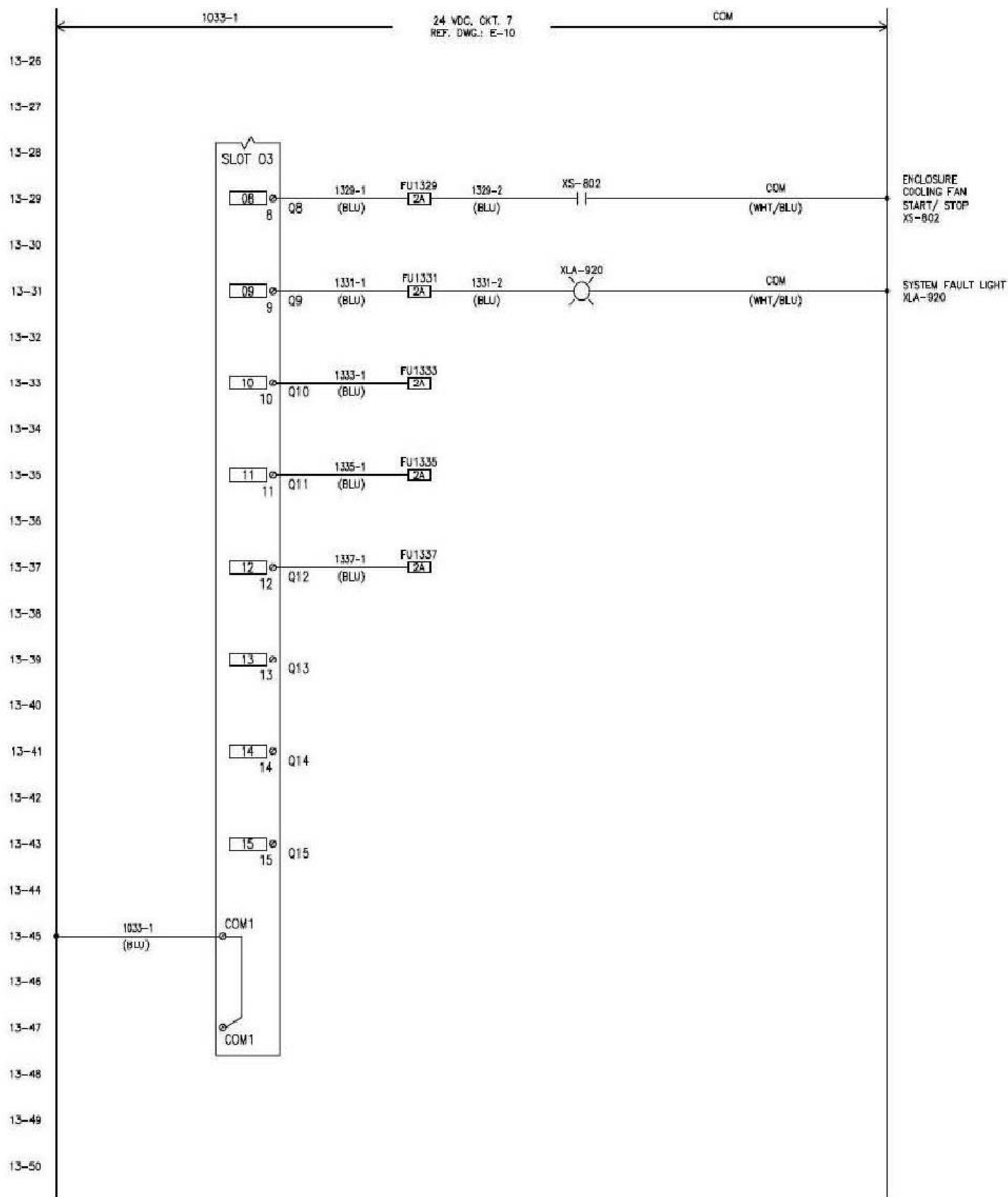


# Standard Electrical Schematic – Wiring Diagram Power Distribution

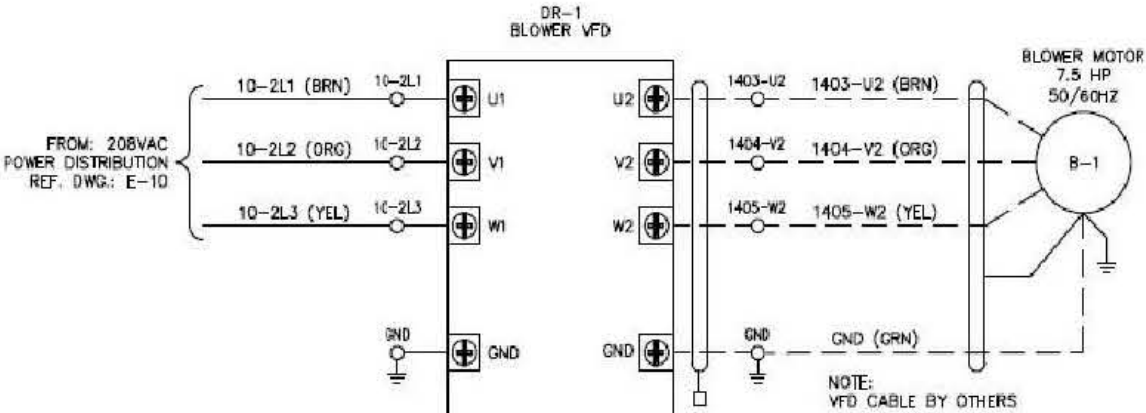




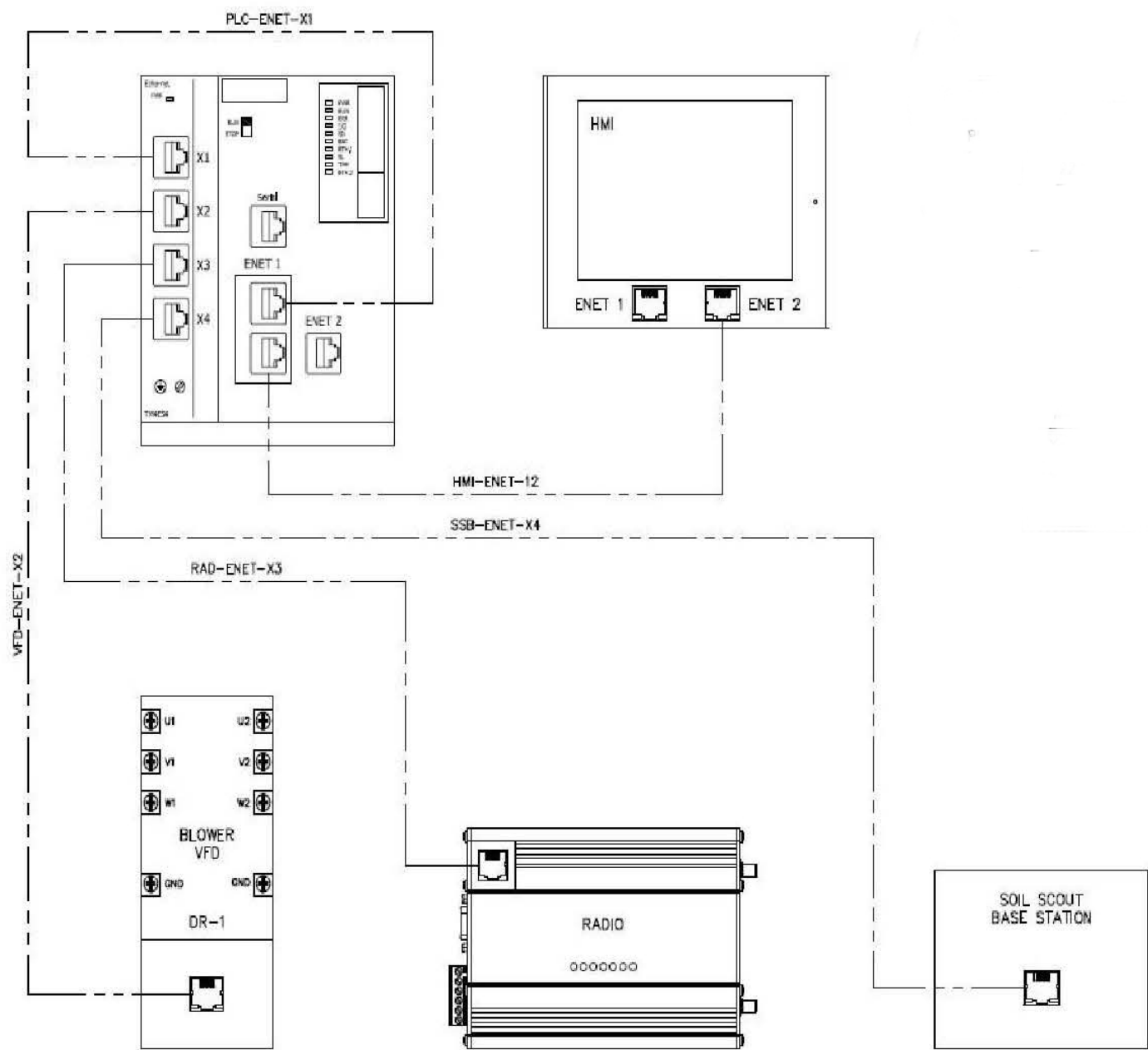
# Standard Electrical Schematic – Wiring Diagram Power Distribution



Standard Electrical Schematic – Wiring Diagram Power Distribution



Standard Electrical Schematic – Wiring Diagram Power Distribution



**Standard Electrical Schematic – Wiring Diagram Power Distribution**

**ROUTER PORT FORWARDING CONFIGURATION**

| DEVICE  | IP ADDRESS   | SUBNET MASK   | GATEWAY      |
|---------|--------------|---------------|--------------|
| PLC     | 192.168.10.V | 255.255.255.0 | 192.168.10.1 |
| HMI     | 192.168.10.W | 255.255.255.0 | 192.168.10.1 |
| RADIO   | 192.168.10.X | 255.255.255.0 | 192.168.10.1 |
| SS BASE | 192.168.10.Y | 255.255.255.0 | 192.168.10.1 |
| VFD     | 192.168.10.Z | 255.255.255.0 | 192.168.10.1 |

| DEVICE                 | PORT NO. |
|------------------------|----------|
| MAGELIS WEB SERVER     | H + 8080 |
| MAGELIS DATA SHARING   | H + 6000 |
| VIJEO DESIGN® AIR      | H + 6050 |
| RADMIN (IF APPLICABLE) | H + 4900 |
| —                      | —        |

| IP ADDRESS LEGEND |
|-------------------|
| V= HOLE NO. +10   |
| W= HOLE NO. +50   |
| X= HOLE NO. +100  |
| Y= HOLE NO. +150  |
| Z= HOLE NO. +200  |

| PORT NO. LEGEND |
|-----------------|
| H = HOLE NO.    |

VAULT WIRING