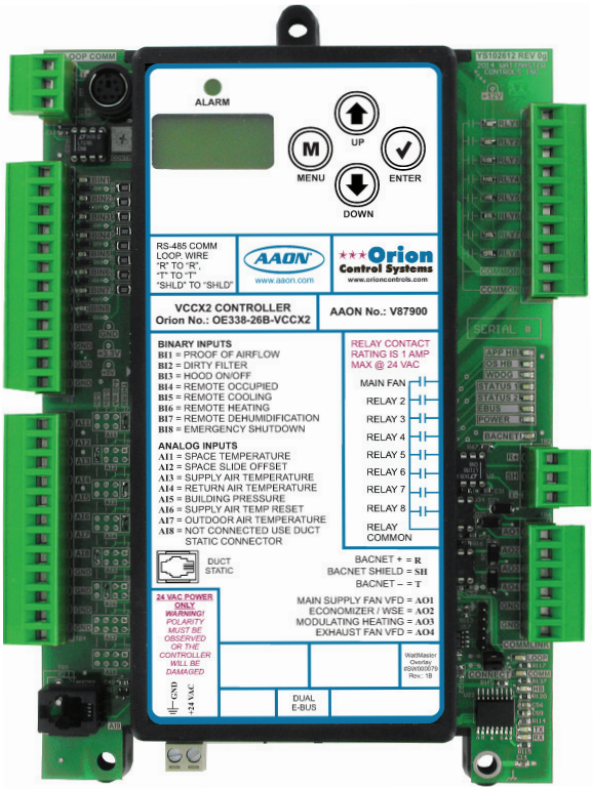
Orion Control Systems

www.orioncontrols.com

VCCX2 Component & System Wiring Technical Guide

VCCX2 Controller Code: SS1088 version 1.0 and up
VCC-X Controller Code: SS1079
VAV/Zone Controller Code: SS8011



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System Types

Overview

The Orion system components can be configured into several types of systems. It is a good idea to become familiar with the different types of systems and their architecture by reading the information in this section and looking at the configuration diagrams in the System Configurations section of this manual. The information below is designed to help you understand how the system components integrate with each other and the available configuration options.

System Types

Four different system configurations are available depending on the type and number of controllers that you have on your system.

1. **Stand Alone**
   (See **Figure 1**, **page 16** for Connection Diagram)
2. **Interconnected**
   (See **Figure 2**, **page 17** for Connection Diagram)
3. **Networked Single Loop**
   (See **Figures 3-5**, **pages 18-20** for Connection Diagrams)
4. **Networked Multiple Loop**
   (See **Figure 6**, **page 21** for Connection Diagrams)
5. **System Managers, Service Tool, Computer, CommLink 5, IP Module, USB-Link 2**
   (See **Figures** starting on **page 66**)

System Type Definitions

Stand Alone

This system consists of a single VCCX2 Controller. Configuration and status monitoring are accomplished by one or more of the following methods.

1. By using an operator interface. This can be a Modular Service Tool, a Modular System Manager, a System Manager TS-L (Limited Access), or all 3 devices.
2. A computer interface can also be used in conjunction with the other operator interfaces listed above, or by itself. This requires a CommLink 5 or USB-Link 2 and a personal computer with the Prism 2 computer front-end software installed.

Interconnected

This system consists of multiple VCCX2 Controllers interconnected with communication cable to allow configuration and monitoring from one central location. Broadcasting between controllers is not available. Configuration and status monitoring are accomplished by one or more of the following methods.

1. By using an operator interface. This can be a Modular Service Tool, a Modular System Manager, a System Manager TS-L (Limited Access), or all 3 devices.
2. A computer interface can also be used in conjunction with the other operator interfaces listed above, or by itself. This requires a CommLink 5 or USB-Link 2 and a personal computer with the Prism 2 computer front-end software installed.

Networked Single Loop

The Networked Single Loop system, as its name implies, consists of a single communications loop. This loop utilizes a network device to share information that is broadcast from one controller to all controllers on the loop. The system can consist of the following devices.

1. Multiple VCCX2 Controllers that utilize a network device to broadcast information between controllers on the loop.
2. A single VCCX2 Controller and a series VAV/Zone Controllers that utilize a network device to broadcast information between controllers on the loop.

These systems require a network device in the form of either a CommLink 5 communications interface or a MiniLink Polling Device 5 (MLPD5). Both network devices may also be used together. Configuration and status monitoring are accomplished by the following methods:

1. By using an operator interface. This can be a Modular Service Tool, a Modular System Manager, a System Manager TS-L (Limited Access), or all 3 devices.
2. A computer interface can also be used in conjunction with the other operator interfaces listed above, or by itself. This requires a CommLink 5 or USB-Link 2 and a personal computer with the Prism 2 computer front-end software installed.

When using the MLPD5 alone, only the System Manager, System Manager TS-L, and Modular Service Tool can be used to configure and monitor the system. With the addition of the CommLink 5, the Prism 2 computer front-end software and a PC can be used to configure and monitor the system in addition to the Modular System Manager, and the System Manager TS-L (Limited Access).

Networked Multiple Loop

The Networked Multiple Loop System consists of two or more loops, each being called a "Local Loop", with one "Network Loop" that ties the "Local Loops" together. Each of these loops can consist of one of the following groups of controllers:

1. Multiple VCCX2 Controllers.
2. A single VCCX2 Controller and a series of VAV/Zone Controllers that utilize a network device to broadcast information between all controllers on the local loop.

To form the Networked Multiple Loop System, the following network devices are required:

1. A MiniLink Polling Device 5 (MLPD5) is required per loop (Local Loop). The MLPD5 broadcasts information from one controller to all controllers on the local loop.
2. One CommLink 5 is required for the entire system. It resides on the Network Loop and allows for communications between all the local loops and provides for global broadcasts to all controllers on the entire system.

Configuration and status monitoring are accomplished by one or more of the following methods:

1. By using an operator interface. This can be a Modular Service Tool, a Modular System Manager, a System Manager TS-L (Limited Access), or all 3 devices. The Modular System Manager, System Manager TS-L, or Modular Service Tool connect to any "Local Loop" on the system.
2. A computer interface can also be used in conjunction with the other operator interfaces listed above, or by itself. This requires a personal computer with the Prism 2 computer front-end software installed connected to the CommLink 5.

Network Communications Devices

MiniLink Polling Device 5 (MLPD5)

The MLPD5 is used in the following applications:

1. This device is required on all Zoning applications and is typically required on single loop VAV systems.
2. This device is required on each local loop of all Networked Multiple Loop systems.
3. This device is responsible for local loop broadcasts only. It always resides on the local loop, but on multiple loop systems, the MLPD5s are daisy-chained together back to the CommLink 5 to form the Network loop.

For a Networked Single Loop VCCX2 system, this device can be used for tenant logging and alarm reporting to a Modular System Manager or System Manager TS-L. It can be used to broadcast information such as outside air temperature or outside air humidity to all devices on the local loop. It can also be used to broadcast certain sensor values from a GPC-XP Controller to any controllers on this loop that do not have their own sensors.

For a Networked Single Loop VAV system, the MLPD5 can be used for tenant logging and alarm reporting to a Modular System Manager or System Manager TS-L. It must be used to broadcast information such as, internal schedule, supply air temperature, fan and heat status, unoccupied calls for heating and cooling from the VAV/Zone Controllers, and forced modes of operation.

For a Networked Single Loop Zoning system, this device must be used for zone voting, because it calculates the heating and cooling totals on the loop and broadcasts cooling, venting, and heating modes to the VCCX2 Controller. It can also be used for tenant logging and alarm reporting to the Modular System Manager or System Manager TS-L.

CommLink 5

The CommLink 5 device is used in the following applications.

1. A CommLink 5 is required on all Networked Multiple Loop Systems.
2. A CommLink 5 is optional on all Networked Single Loop Systems.
3. A CommLink 5 is required on any system when a permanent computer interface is desired. The USB-Link 2 can be used for temporary computer connection at an RTU for setting up or servicing the system, but does not have the complete functionality that the CommLink 5 provides.

The CommLink 5 is responsible for local loop broadcasts on a Networked Single Loop system, and on this type of system, the Loop switch on the back of the CommLink must be set to "Single." This device is responsible for network broadcasts on Networked Multiple Loop systems. On this type of system, the Loop switch on the back of the CommLink must be set to "Multiple."

For a Networked Single Loop VCCX2 system, this device can be used for tenant logging and alarm reporting to a Modular System Manager or System Manager TS-L. It can also be used to broadcast information like outside air temperature or outside air humidity to all local loops on the entire networked system. It may also be used to broadcast space temperature from a GPC-XP Controller to any controllers on the local loop that do not contain their own Space Temperature Sensor.

On a Networked Single Loop VAV/Zone system, the CommLink 5 can be used to broadcast information such as internal schedule, supply air temperature, fan and heat status, unoccupied calls for heating and cooling, and forced modes of operation to and from the VAV/Zone Controllers.

Wiring Considerations

Before beginning installation, please study the wiring diagrams for the controllers you are using with your particular application. These diagrams appear in this manual and can also be found in the technical guides supplied with your specific controllers. Wire and transformer sizing instructions and examples are found in **Figure 7, page 22** of this manual.

Installation Procedures

The installation procedures that follow are based on recommended methods of wiring connections and controller installation. Installation procedures vary depending on the type of system you are installing. The system you are installing could be a Stand Alone, Interconnected, Networked Single Loop, or Networked Multiple Loop system. The Networked System also has installation variations based on the type of components you are installing for that system. The following information explains the procedures for all of these systems. Please find the system and components that closely match your system and follow the outlined procedures.

Stand Alone Systems

See **Figure 1, page 16** of this manual for a detailed Stand Alone System wiring diagram. Also see **page 22** for wire and transformer sizing information. You should review these diagrams before attempting connections or powering up the controller or interface devices.

1. Install a 24 VAC, 15 VA minimum, transformer for the VCCX2 Controller and wire from transformer to the controller using 18 gauge minimum, 2 conductor cable for power. Observe polarity on all power wiring.
2. The Modular Service Tool SD connects to the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Stand Alone.
3. The Modular System Manager SD comes supplied with a 12 foot modular cable with a modular connector on one end and stripped wires on the other. If the Modular System Manager is to be mounted in a remote location, run 18 gauge, 2 conductor shielded cable for communications from the controller's 3 wire communications terminal to a junction box. Run 18 gauge minimum, 2-wire, power wires from a separate 24 VAC, 6 VA minimum transformer into the junction box. Splice the modular cable to the communications and power wire inside of the junction box by making solid connections, using wire nuts or butt splice connectors. The Communications setting must be set to Hi Speed Stand Alone.
4. The System Manager TS-L utilizes a 3-wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2-wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum 2 conductor wire. In the Settings Menu, *enter* **<0>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.
5. If a CommLink 5 is used for a computer interface, connect communications using 18 gauge, 2 conductor with shield cable. Connect from the controller's 3-wire communications connector to the CommLink's 3-wire communications connector. For this type of system, the Loop switch located on the back of the CommLink 5 must be set to "Single" and the Baud rate switch set to "High".
6. Use 18 gauge minimum, 2-wire cable for all 24 VAC power wiring. Be sure to maintain polarity on all boards. If a CommLink is connected, use the 110 VAC/24 VAC power supply furnished with the CommLink for its power source.
7. Before powering up the controller, set the desired board address on the controller (usually 1).

Interconnected Systems

See **Figure 2, page 17** for a detailed Interconnected System wiring diagram. Also see **page 22** for wire and transformer sizing information. You should review these diagrams before attempting connections or powering up the controller or interface devices.

1. Connect all VCCX2 Controllers in a daisy chain format using 18 gauge, 2 conductor shielded cable for communications. Install a separate 24 VAC, 15 VA minimum transformer for each controller and wire the transformers to each controller using 18 gauge minimum, 2 conductor cable. Observe polarity on all boards.
2. The Modular Service Tool SD will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Stand Alone.
3. The Modular System Manager SD connects to any controller using 18 gauge, 2 conductor shielded cable. If the Modular System Manager is to be mounted in a remote location, run 18 gauge, 2 conductor shielded cable for communications from the controller's 3-wire communications terminal to a junction box. Run 18 gauge minimum, 2-wire power wires from a separate 24 VAC, 6 VA minimum transformer into the junction box. The Communications setting must be set to Hi Speed Stand Alone.
4. The System Manager TS-L utilizes a 3-wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2-wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum 2 conductor wire. In the Settings Menu, *enter* **<0>** for the System Manager Address and make sure

One to One Unit Connection is not selected. OPT1 Dipswitch should be set to ON for high speed.

5. If a CommLink 5 is used to provide for connection to a computer interface, connect communications using 18 gauge, 2 conductor shielded cable. Connect from one of the controller's 3-wire communications connectors to the CommLink's 3-wire communications connector. For this type of system, the Loop switch on the back of the CommLink needs to be set to "Single" and the Baud rate switch set to "High."

6. Use 18 gauge minimum, 2-wire cable for all 24 VAC power wiring. Be sure to maintain polarity on all boards. If a CommLink 5 is installed, use the 110 VAC/24 VAC power supply furnished with the CommLink for its power source.

7. Before powering up the controllers, set each controller's board address to a unique number from 1 through 60.

Networked Single Loop Systems

See **Figures 3-5, pages 18-20** for detailed Networked Single Loop System wiring diagrams. Also see **page 22** for wire and transformer sizing information. You should review these diagrams before attempting connections or powering up the controller or interface devices.

Loop Containing VCCX2 Controllers Only (Using CommLink 5)

1. Connect all VCCX2 Controllers on the loop in a daisy chain format using 18 gauge, 2 conductor shielded cable wiring from each controller's communication terminals to the next controller's communication terminals. Install a separate 24 VAC, 15 VA minimum transformer for each controller and wire from controllers to the transformers using 18 gauge minimum, 2 wire cable. Be sure to observe polarity on all boards.

2. Connect 18 gauge minimum 2 conductor shielded cable from one of the VCCX2 Controller's 3 wire communication terminals to the CommLink5's 3 wire communications terminal. The Loop switch on the back of the CommLink must be set to "Single" and the Baud rate switch set to "High" for this installation. Use the 110 VAC/24 VAC power supply furnished with the CommLink for its power source.

3. The Modular Service Tool SD will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

4. The Modular System Manager SD connects to any controller using 18 gauge, 2 conductor shielded cable. If the Modular System Manager is to be mounted in a remote location, run 18 gauge, 2 conductor shielded cable for communications from the controller's 3-wire communications terminal to a junction box. Run 18 gauge minimum, 2-wire power wires from a separate 24 VAC, 6 VA minimum transformer into the junction box. The Communications setting must be set to Hi Speed Stand Alone. The Modular System Manager **MUST** always be connected on the "Local Loop", never the "Network Loop". The Communications setting must be set to Hi Speed Network Mode.

5. The System Manager TS-L utilizes a 3 wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2 wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum, 2 conductor wire. In the Settings Menu, *enter* **<63>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.

6. Before powering up the controllers, set each controller's board address to a unique number from 1 through 59.

Loop Containing VCCX2 Controller with VAV/Zone Controllers and MiniLink PD Only

1. Connect 2 conductor shielded cable from the VCCX2 Controller's 3 wire communications connector to the MiniLink PD's 3 wire communications connector marked "Local Loop". Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 15 VA minimum, transformer for the VCCX2 Controller and wire from the transformer to the controller. Also connect a 24 VAC 6 VA minimum transformer to the MiniLink PD power terminals using 18 gauge minimum, 2 wire cable. Then wire from the VCCX2 Controller's 3 wire communications connector or the MiniLink PD's 3 wire communications connector marked "Local Loop" to the first VAV/Zone Controller's 3 wire communications terminals. Using 18 gauge minimum, 2 wire cable, connect all of the associated VAV/Zone Controllers in a daisy chain format using 18 gauge, 2 conductor shielded cable for communications. Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 6 VA minimum, transformer for each VAV/Zone Controller and wire from each transformer to its VAV/Zone Controller. WattMaster recommends you use a separate transformer for each VAV/Zone Controller as stated. As an alternative, it is allowable to have several VAV/Zone Controllers share one properly sized transformer (6 VA per VAV/Zone Controller). **Warning:** *Polarity must be observed on all of the VAV/Zone Controllers or damage to the controllers will result.* Use 18 gauge minimum, 2 wire cable for all power wiring and be sure to maintain polarity on all boards.

Networked Single Loop

2. The Modular System Manager can connect to any VAV/Zone Controller or to the VCCX2 Controller using 18 gauge, 2 conductor shielded cable. A separate transformer is required for the Modular System Manager. Connect the 2 power wires from the pigtail connector to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power. The Communications setting must be set to Hi Speed Network Mode.

3. The Modular Service Tool SD will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

4. The System Manager TS-L utilizes a 3 wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2 wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum wire. In the Settings Menu, *enter* **<63>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.

5. Before powering up the controllers, set each VAV/Zone Controller's board address to a unique number from 1 through 58. Address the VCCX2 Controller at 59. Set MiniLink PD's address at 1.

Loop Containing VCCX2 Controller with VAV/Zone Controllers and CommLink 5 Only

1. Connect 2 conductor shielded cable from the VCCX2 Controller's 3 wire communications connector to the CommLink 5's 3 wire communications connector. Use the 110 VAC/24 VAC power supply furnished with the CommLink for its power source. Be sure to maintain polarity on all boards. The Loop switch on the back of the CommLink 5 should be set to "Single" and the Baud rate switch set to "High."

2. Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 15 VA minimum, transformer for the VCCX2 Controller and wire from the transformer to the VCCX2 Controller. Then wire from the controller's 3 wire communications connector or the CommLink 5's 3 wire communications connector to the first VAV/Zone Controller's 3 wire communications terminal. Connect all of the associated VAV/Zone Controllers in a daisy chain format using 18 gauge, 2 conductor shielded cable for communications. Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 6 VA minimum, transformer for each VAV/Zone Controller and wire from each transformer to its VAV/Zone Controller. WattMaster recommends you use a separate transformer for each VAV/Zone Controller as stated. As an alternative, it is allowable to have several VAV/Zone Controllers share one properly sized transformer (6 VA per VAV/Zone Controller). **Warning:** *Polarity must be observed on all of the VAV/Zone Controllers or damage to the controllers will result.* Use 18 gauge minimum, 2 wire cable for all 24 VAC power wiring. Be sure to maintain polarity on all boards.

3. The Modular System Manager can connect to any VAV/Zone Controller or to the VCCX2 Controller using 18 gauge, 2 conductor shielded cable. A separate transformer is required for the Modular System Manager. Connect the 2 power wires from the pigtail connector to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power. The Communications setting must be set to Hi Speed Network Mode.

4. The Modular Service Tool SD will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

5. The System Manager TS-L utilizes a 3 wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2 wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum wire. In the Settings Menu, *enter* **<63>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.

6. Before powering up the controllers, set each VAV/Zone Controller's board address to a unique number from 1 through 58. Address the VCCX2 Controller at 59.

Loop Containing VCCX2 Controller with VAV/Zone Controllers, MiniLink PD, and CommLink 5

1. Connect the CommLink 5 to the MiniLink PD by using 2 conductor shielded cable to connect from the CommLink's 3 wire communications connector to the MiniLink PD's 3 wire communications connector marked "Network Loop". Use the 110 VAC/24 VAC power supply furnished with the CommLink for its power source. Be sure to maintain polarity on all boards. The Loop switch on the back of the CommLink 5 should be set to "Multiple" and the Baud rate switch set to "High." Also connect a 24 VAC 6 VA minimum transformer to the MiniLink PD power terminal using 18 gauge minimum, 2 wire cable.

2. Connect all controllers in a daisy chain format using 2 conductor shielded cable to connect from the controller's 3 wire communications connector to the MiniLink PD's 3 wire communications connector marked "Local Loop". Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 15 VA minimum, transformer for the VCCX2 Controller and wire from the transformer to the VCCX2 Controller. Then wire from the VCCX2 Controller's 3 wire communications connector to the MiniLink PD's 3 wire communications con-

nector marked "Local Loop". From either the MiniLink PD connector marked "Local Loop" or the VCCX2 Controller's 3 wire communications connector, wire to the first VAV/Zone Controller's 3 wire communications terminal. Using 18 gauge minimum, 2 wire cable, connect all of the associated VAV/Zone Controllers in a daisy chain format using 18 gauge, 2 conductor shielded cable for communications.

3. Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 6 VA minimum, transformer for each VAV/Zone Controller and wire from each transformer to its VAV/Zone Controller. WattMaster recommends you use a separate transformer for each VAV/Zone Controller as stated. As an alternative, it is allowable to have several VAV/Zone Controllers share one properly sized transformer (6 VA per VAV/Zone Controller). **Warning:** *Polarity must be observed on all of the VAV/Zone Controllers or damage to the controllers will result.* Use 18 gauge minimum, 2 wire cable for all power wiring and be sure to maintain polarity on all boards.

4. The Modular System Manager can connect to any VAV/Zone Controller or to the VCCX2 Controller using 18 gauge, 2 conductor shielded cable. A separate transformer is required for the Modular System Manager. Connect the 2 power wires from the pigtail connector to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power. The Communications setting must be set to Hi Speed Network Mode.

5. The System Manager TS-L utilizes a 3 wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2 wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum wire. In the Settings Menu, *enter* **<63>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.

6. The Modular Service Tool SD will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

7. Before powering up the controllers, set each VAV/Zone Controller's board address to a unique number from 1 through 58. Address the VCCX2 Controller at 59. Set MiniLink PD's address at 1.

Networked Multiple Loop Systems

See **Figure 6, page 21** of this manual for detailed Networked Multiple Loop System wiring diagrams. Also see **page 22** for wire and transformer sizing information. You should review these diagrams before attempting connections or powering up the controller or interface devices.

Local Loops containing VCCX2 Controllers with VAV/Zone Controllers

1. Using 18 gauge minimum, 2 wire cable for power, install a 24 VAC, 15 VA minimum, transformer for the VCCX2 Controller and wire from the transformer to the controller.

2. Using 2 conductor shielded cable, connect from the VCCX2 Controller's 3 wire communications connector to the MiniLink PD's 3 wire communications connector marked "Local Loop". Use 18 gauge minimum wire for power and observe polarity on all boards.

3. Using 2 conductor shielded cable, connect from the VCCX2 Controller's 3 wire communications connector to the VAV/Zone Controllers. Using 18 gauge minimum, 2 wire cable, connect all of the associated VAV/Zone Controllers in a daisy chain format using 18 gauge, 2 conductor shielded cable for communications.

4. Repeat the above steps for each local loop containing VCCX2 Controllers with VAV/Zone Controllers.

5. The Modular System Manager can connect to any VAV/Zone Controller on the entire system. The Modular Service Tool will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controllers is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

6. The System Manager TS-L utilizes a 3 wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2 wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum wire. In the Settings Menu, *enter* **<63>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.

7. The Modular Service Tool SD will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controller is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

8. Using 2 conductor shielded cable, connect from the CommLink 5's 3 wire communications connector to one of the MiniLink PD's 3 wire communications connector marked "Network Loop". The Loop switch on the back of the CommLink 5 must be set to "Multiple" and the Baud rate switch must be set to "High." The CommLink only needs to be connected to one of the MiniLink PDs on the system.

9. Connect all the remaining MiniLink PD's in the same manner using a daisy chain format.

10. Before powering up the controllers, set each VAV/Zone Controller's board address to a unique number from 1 through 58. Address the VCCX2 Controller at 59. Set MiniLink PD's address from 1 to 60.

Loops Containing VCCX2 Controllers without VAV/Zone Controllers

1. Connect all VCCX2 Controllers on the loop in a daisy chain format using 18 gauge minimum, 2 conductor shielded cable for communications. Install a separate 24 VAC, 15 VA minimum, transformer for each controller and wire to its transformer using 18 gauge minimum, 2 wire cable for power. Observe polarity on all boards.

2. Connect 2 conductor shielded cable from one of the controller's 3 wire communications connector to the MiniLink PD's 3 wire communications connector marked "Local Loop". Use 18 gauge wire for power and observe polarity on all boards.

3. Connect 2 wire shielded cable from the CommLink 5's 3 wire communications connector to the MiniLink PD's 3 wire communications connector marked "Network Loop". The Loop switch on the back of the CommLink 5 must be set to "Multiple" and the Baud rate switch set to "High". Use the 110 VAC/24 VAC power supply furnished with the CommLink for its power source.

4. Only one MiniLink PD on the system should connect to the CommLink. Install a separate 24 VAC, 8 VA minimum, transformer for each MiniLink PD and wire to transformer using 18 gauge minimum, 2 wire cable for power. Observe polarity on all boards. Each MiniLink PD's address switch should be set with a unique address between 1 and 60.

5. Using 18 gauge, 2 conductor shielded cable, connect from the each MiniLink PD's terminal connector marked "Network Loop" to the next MiniLink PD's "Network Loop" terminal connector. Connect all the remaining MiniLink PD's in the same manner using a daisy chain format.

6. The Modular Service Tool will connect to any of the controllers using the supplied cable with DIN connectors on both ends. The connection point on the controllers is located near the communications connector. The Communications setting must be set to Hi Speed Network Mode.

7. If the Modular System Manager is to be mounted in remote location, run 18 gauge, 2 conductor shielded cable for communications from one controller's 3 wire terminal connector to one of the MiniLink PD's in the same manner using a daisy chain format. The Communications setting must be set to Hi Speed Network Mode.

8. The System Manager TS-L utilizes a 3 wire communication terminal block for connection to any controller on the communications local loop that has communication wire terminals. A separate transformer is required for the System Manager TS-L. It has a 2 wire 24 VAC terminal block for connection to a 24 VAC transformer. The transformer should be sized to provide 6 VA minimum power and should be connected using 18 gauge minimum wire. In the Settings Menu, *enter* **<63>** for the System Manager Address. The OPT1 Dipswitch should be set to ON for high speed.

9. Address the VCCX2 Controllers from 1 to 59.

The following information is a brief overview of the procedures required to commission a typical Orion System. Select the type of system that you have and follow the procedures listed for that system.

Stand Alone System

1. Be sure that the controller is set at address 1.
2. Apply power to the controller.
3. Verify diagnostics LED indicator for proper operation. See the technical guide for the specific controller in order to locate the diagnostic LED and controller start-up sequence.
4. Connect an operator's interface device to the controller for configuration the controller.

Interconnected System

1. Be sure that the controllers are addressed from 1 to 60.
2. Apply power to the controllers.
3. Verify diagnostics LED indicator for proper operation of all controllers. See the technical guide for the specific controller in order to locate the diagnostic LED and controller start-up sequence.
4. Connect an operator's interface to one of the controllers for configuration all of the controllers.

Networked Systems

1. Address each MiniLink PD from 1 to 60.
2. On a loop of VCCX2 Controllers, address the controllers from 1 to 59.
3. On a VAV or Zoning system, address VAV/Zone Controllers from 1 to 58. Address the VCCX2 Controller at 59.
4. On a VAV or Zoning system, apply power in the following order:
    a. VCCX2 Controller
    b. MiniLink Polling Device
    c. CommLink 5
5. Verify diagnostics LED indicator for proper operation of all controllers. See the technical guide for the specific controller in order to locate the diagnostic LED and controller start-up sequence.
6. If a computer is used, connect it to the CommLink 5 to access all of the controllers on the entire system for configuration.
7. If a computer is not used, and if a Modular System Manager is not already connected on the local loop, connect a Modular Service Tool or System Manager TS-L to one of the controllers to perform configuration of all controllers on the entire system.

SYSTEM COMMISSIONING

System Configurations

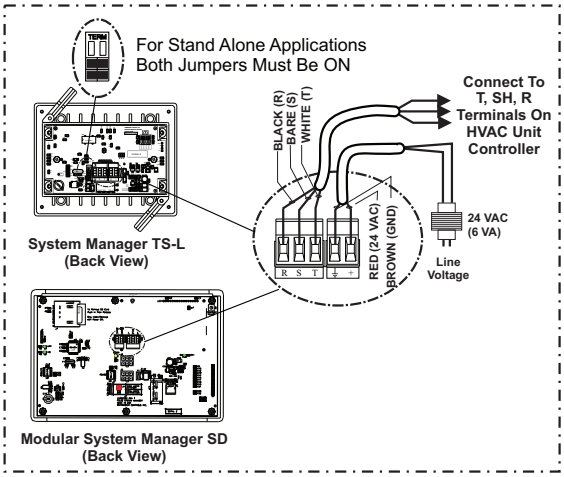
Typical Stand Alone System

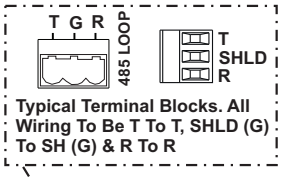
Note: Either A Modular System Manager SD, Modular Service Tool SD, Or Computer With Prism 2 Software Installed Can Be Used To Program And Configure The Orion System. For Computer Connection Information, See The Computer And Remote Connection Section Of This Manual.

Note: The SMTS-L Is An End-User Interface Only. It Cannot Be Used To Configure The Controllers.

System Manager Touch Screen-L

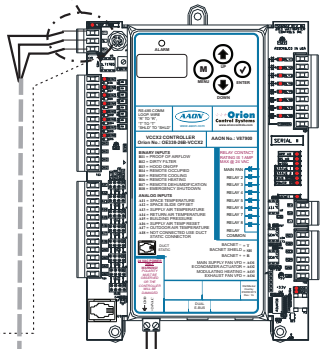
Modular System Manager SD





Typical Terminal Blocks. All Wiring To Be T To T, SHLD (G) To SH (G) & R To R

VCCX2 Controller



24 VAC (15 VA)

Line Voltage

Modular Service Tool SD

Connect MIni Din Connector Cable Ends To Female Connectors on Modular Service Tool And VCCX2 Controller

Note: A Modular System Manager SD, A Modular Service Tool SD Or A PC With Prism 2 Software Installed Can Be Used To Configure AndMaintain The Orion Controls System.

Note:

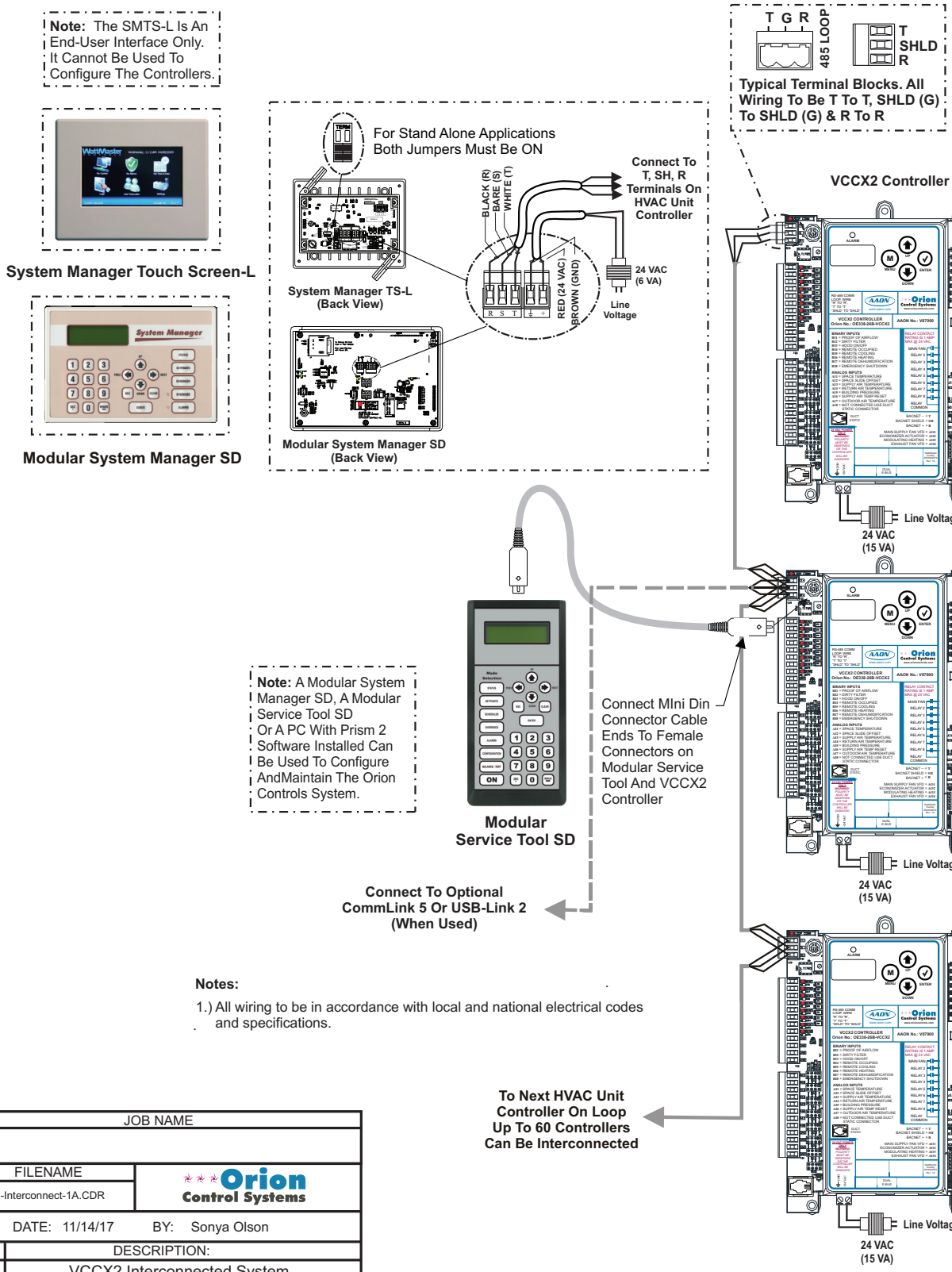
1.) All wiring to be in accordance with local and national electrical codes and specifications.

Connect To Optional CommLink 5 Or USB-Link 2 (When Used)

JOB NAME	
FILENAME	Orion Control Systems
VCCX2-Stand-Alone-1A.CDR	
DATE: 11/14/17 BY: Sonya Olson	
PAGE	DESCRIPTION:
1 of 1	VCCX2 Stand Alone System
	Wiring & Connection Diagram

Figure 1: Stand Alone System Wiring

Typical Interconnected System



JOB NAME	
FILENAME	Orion Control Systems
VCCX2-Interconnect-1A.CDR	
DATE: 11/14/17 BY: Sonya Olson	
PAGE	DESCRIPTION:
1 of 1	VCCX2 Interconnected System
	Wiring & Connection Diagram

Figure 2: Interconnected System Wiring

NETWORKED SINGLE LOOP SYSTEM

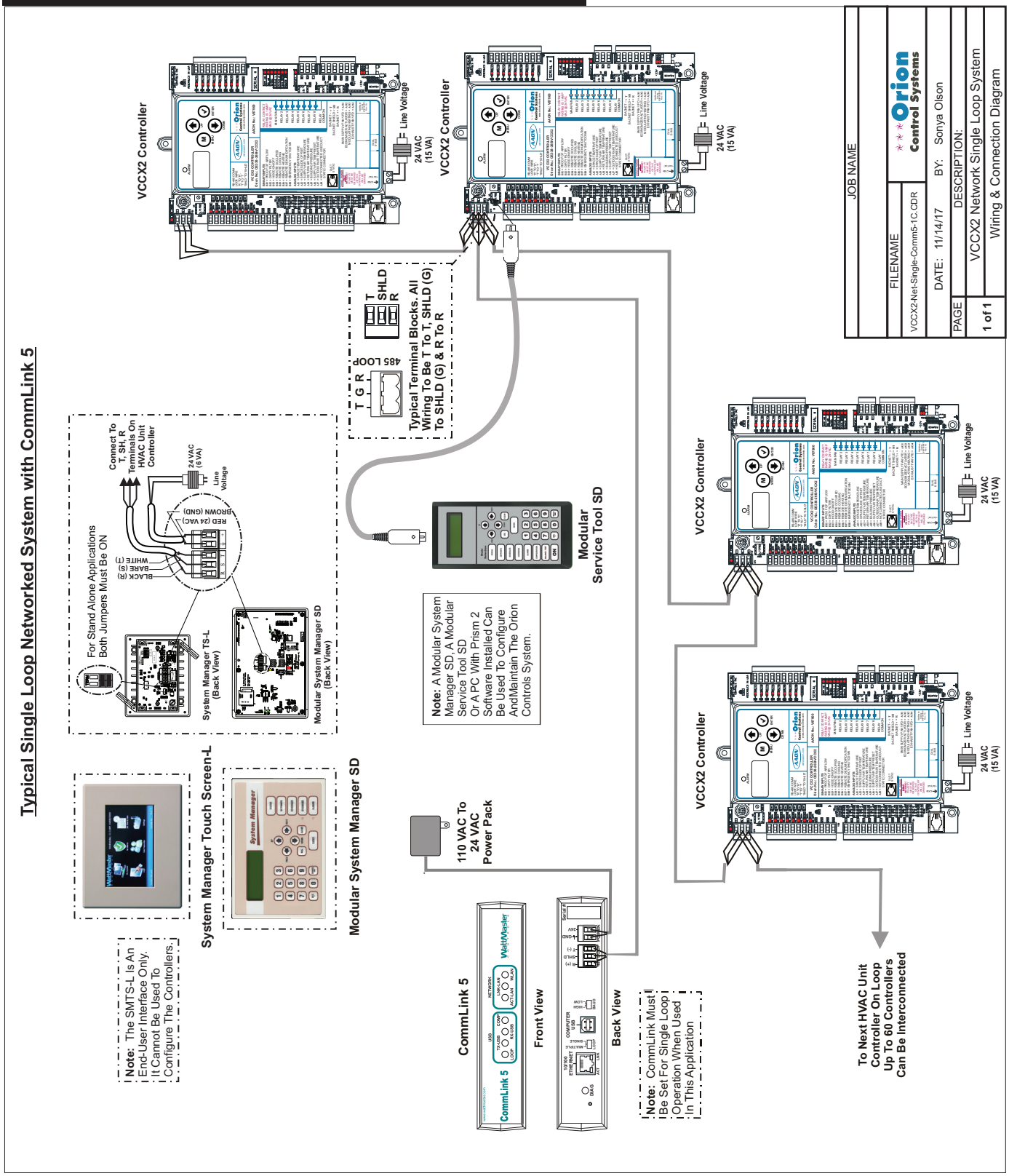


Figure 3: Networked Single Loop System With CommLink Only Wiring

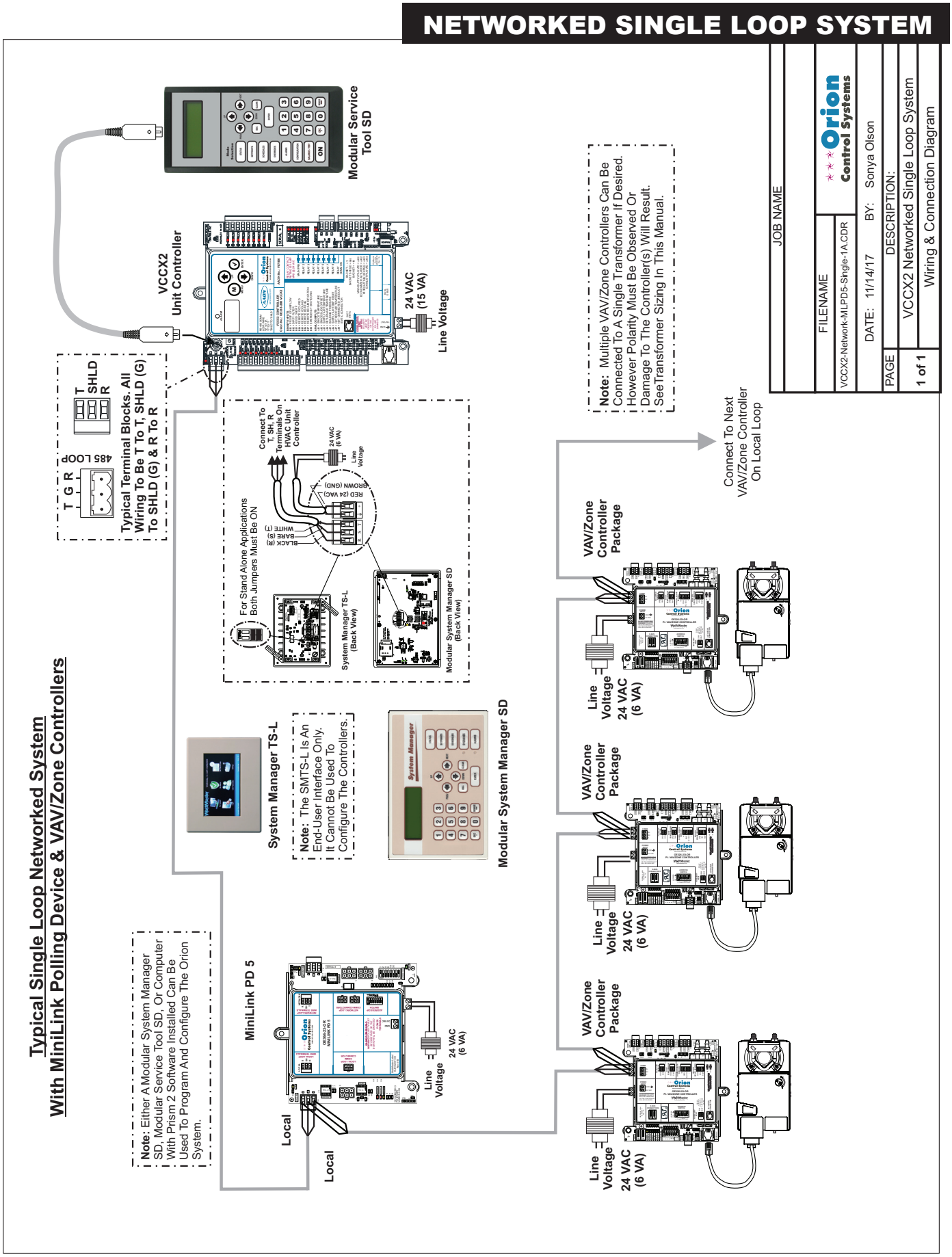


Figure 4: Networked Single Loop System With MiniLink PD and VAV/Zone Controllers Wiring

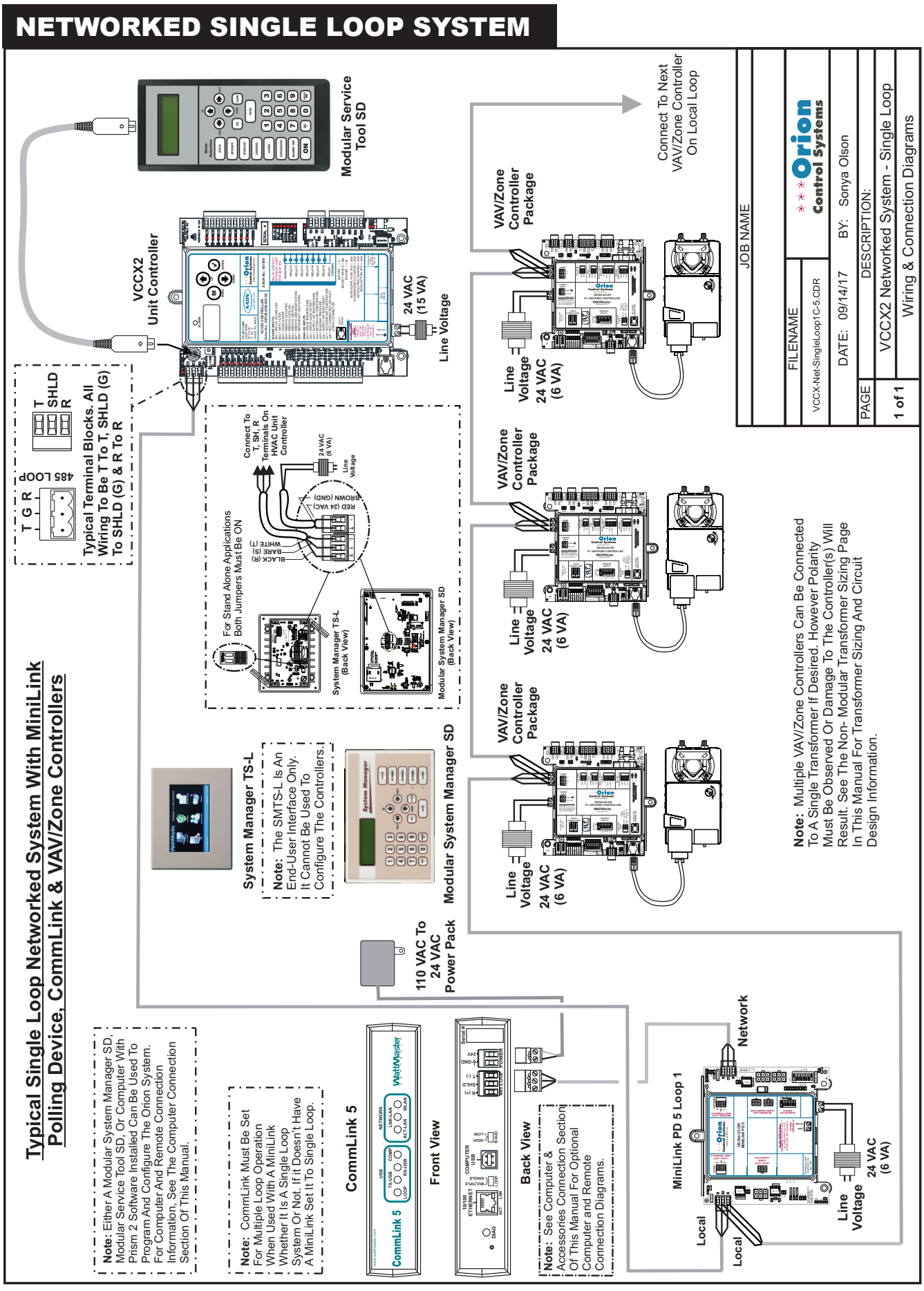


Figure 5: Networked Single Loop System With CommLink & MLPD - VAV/Zone Controllers

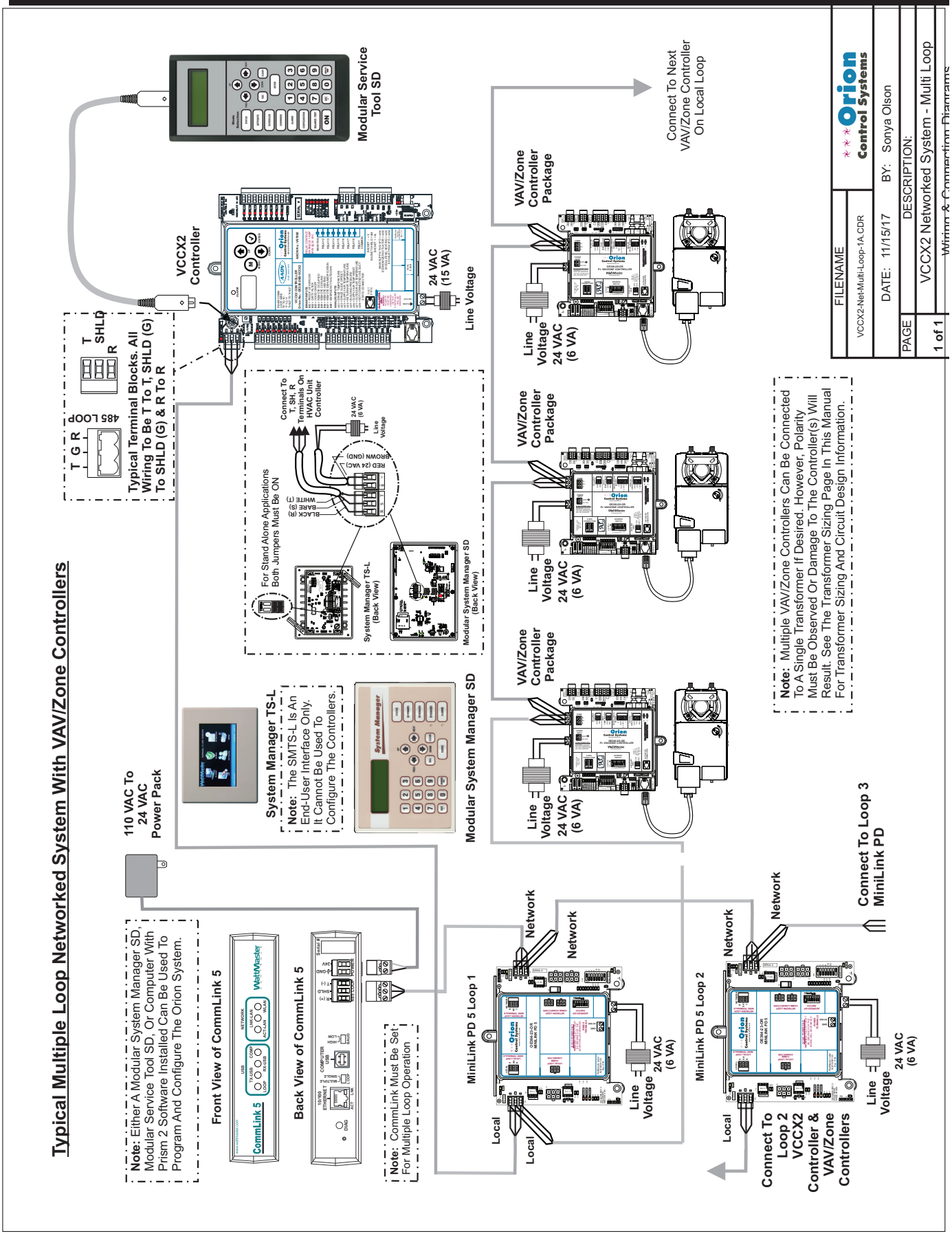


Figure 6: Networked Multiple Loop System Wiring With VAV/Zone Controllers

Transformer Sizing & Wiring

24 VAC Power - Transformer & Wire Sizing Considerations for Devices Without Modular Connectors

Some installers like to use one large 24 VAC transformer to power several devices. This is allowable as long as polarity is maintained to each device on the transformer circuit. **Warning: If polarity is not maintained, severe damage to the devices may result. WattMaster Controls recommends using a separate transformer for each device in order to eliminate the potential for damaging controllers due to incorrect polarity.** Using separate transformers also allows redundancy in case of a transformer failure. Instead of having 8 controllers inoperative because of a malfunctioning transformer you have only 1 controller off line. If the installer does decide to use a large transformer to supply power to several devices, the following transformer and wire sizing information is presented to help the installer correctly supply 24 VAC power to the devices.

Following is a typical example to help the installer to correctly evaluate transformer and wiring designs.

Each GPC-XP Controller requires 8 VA @ 24VAC power. In the examples below we have a total of 8 GPC-XP Controllers.

8 GPC-XP Controllers @ 8 VA each..... 8 x 8 VA = 64 VA.

The above calculation determines that our transformer will need to be sized for a minimum of 64 VA if we are to use one transformer to power all the controllers.

Next we must determine the maximum length of run allowable for the wire gauge we wish to use in the installation. Each wire gauge below has a voltage drop per foot value we use to calculate total voltage drop.

18ga wire.....0.00054 = voltage drop per 1' length of wire
16ga wire.....0.00034 = voltage drop per 1' length of wire
14ga wire.....0.00021 = voltage drop per 1' length of wire

For our example we will use 18 gauge wire. WattMaster recommends 18 gauge as a minimum wire size for all power wiring.

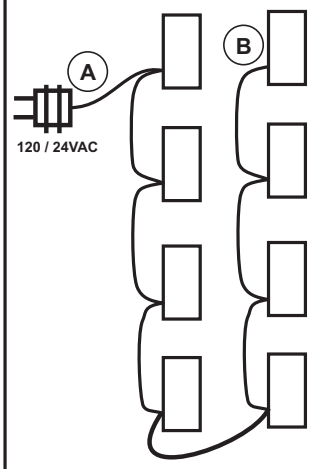
Next use the voltage drop per foot value for 18 gauge wire from the list above and multiply by the total VA load of the 8 controllers to be installed.

0.00054 (Voltage drop per foot for 18 gauge wire) x 64VA controller load = **0.0346** Volts/Ft.

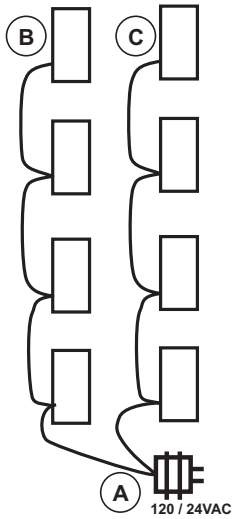
WattMaster controllers will operate efficiently with a voltage drop no greater than 2 Volts. Divide the total allowable voltage drop of 2 Volts by the number you arrived at above and you have the maximum number of feet you can run the 18 gauge wire with an 75 VA transformer with no more than a 2 Volt drop at the farthest controller from the transformer..

$$\frac{\text{2 (Volts total allowable voltage drop)}}{\text{0.0346 (Voltage drop per 1 ft. @ 64VA load)}} = 57.80 \text{ feet}$$

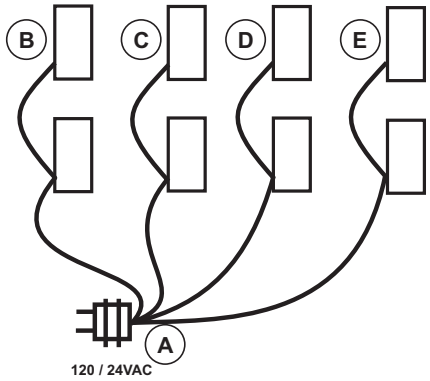
Parallel circuiting of the wiring instead of wiring all 8 controllers in series allows for longer wire runs to be used with the same size wire (as shown in our examples below). It is often necessary for the installer to calculate and weigh the cost and installation advantages and disadvantages of wire size, transformer size, multiple transformers, circuiting, etc., when laying out an installation. No matter what layout scheme is decided upon, it is mandatory that the farthest controller on the circuit is supplied with a minimum of 22 Volts.



Distance A to B cannot exceed 57.80 Ft.



Distance from A to B cannot exceed 115.60 Ft.
Distance from A to C cannot exceed 115.60 Ft.



Distance from A to B cannot exceed 230.40 Ft.
Distance from A to C cannot exceed 230.40 Ft.
Distance from A to D cannot exceed 230.40 Ft.
Distance from A to E cannot exceed 230.40 Ft.

Component Power Requirements

VCCX2 Controller	15 VA	GPC-XP Controller	8 VA
VAV/Zone Controller	6 VA	MiniLink Polling Device	6 VA

JOB NAME	
FILENAME	Orion Control Systems
WIRESIZE1-1A.CDR	
DATE: 11/15/17	
PAGE	DESCRIPTION:
1 of 1	Orion VCCX2 System
	Wire & Transformer Sizing - Non-Modular

Figure 7: Transformer & Wire Sizing

VCCX2 Controller Wiring

Main Controller Wiring

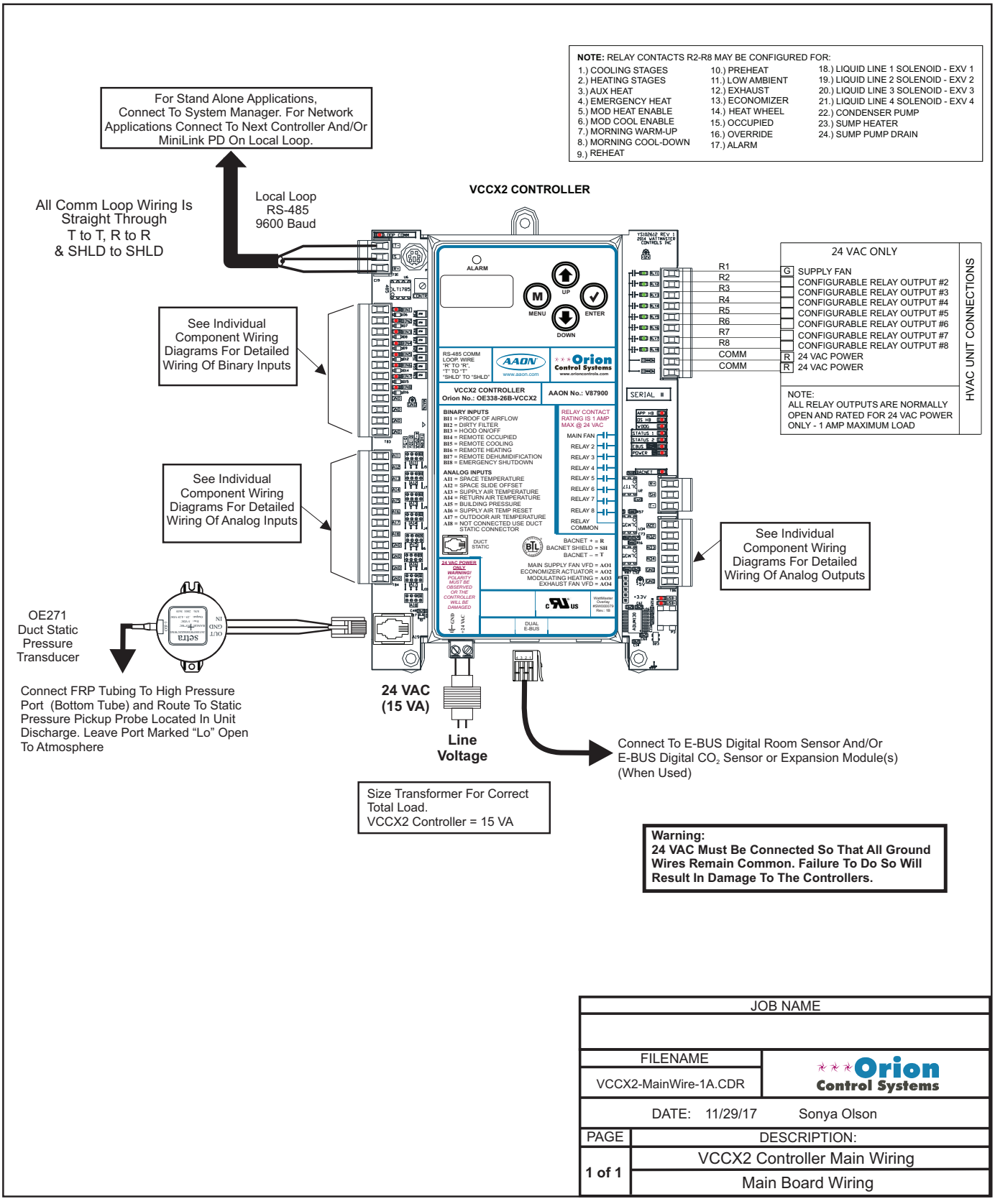
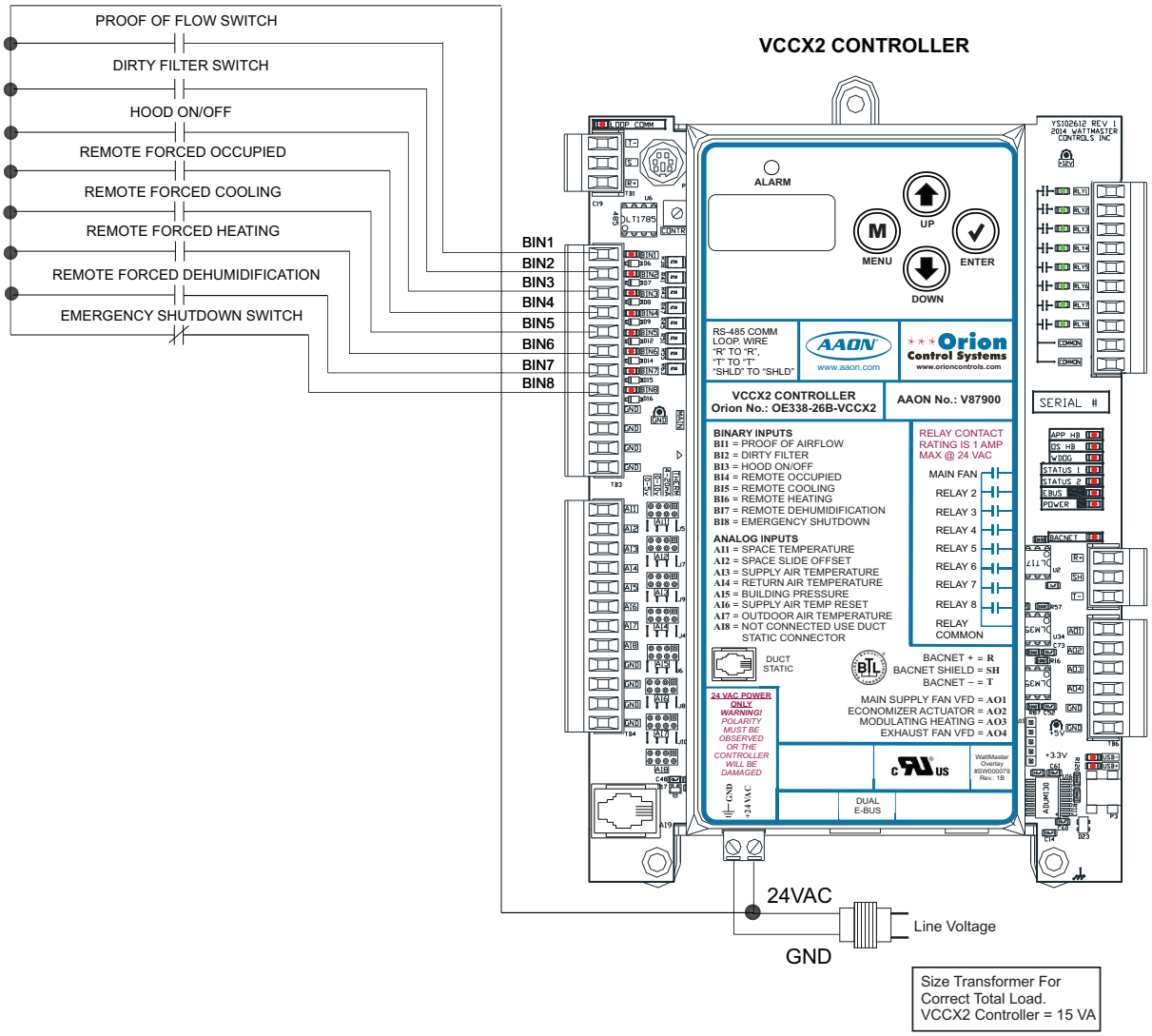


Figure 8: OE338-26B-VCCX2 - VCCX2 Controller Wiring



JOB NAME	
FILENAME	Orion Control Systems
VCCX2-Binary-Inputs-1A.CDR	
DATE: 11/28/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Binary Inputs Wiring & Connection Diagram

Figure 9: VCCX2 Binary Inputs Wiring

Space Temperature Sensor & E-BUS Digital Room Sensor

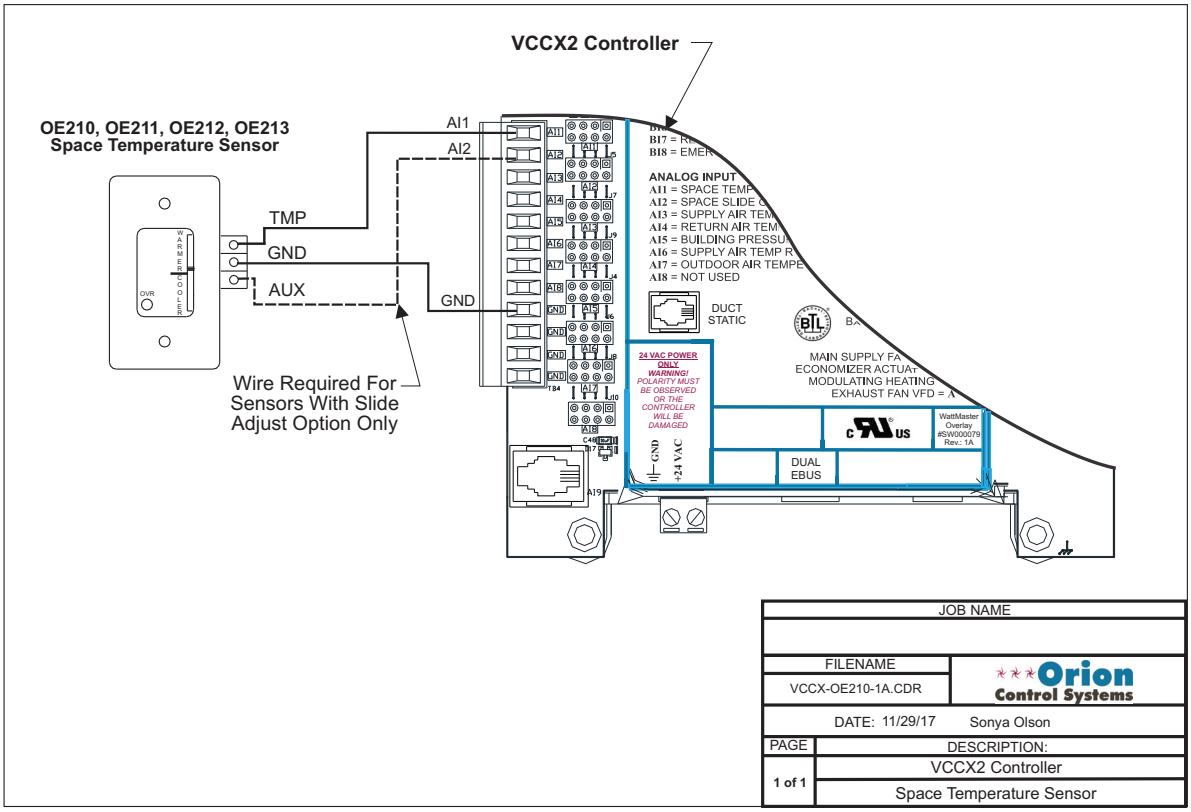


Figure 10: OE210, OE211, OE212, OE213 Space Temperature Sensor Wiring

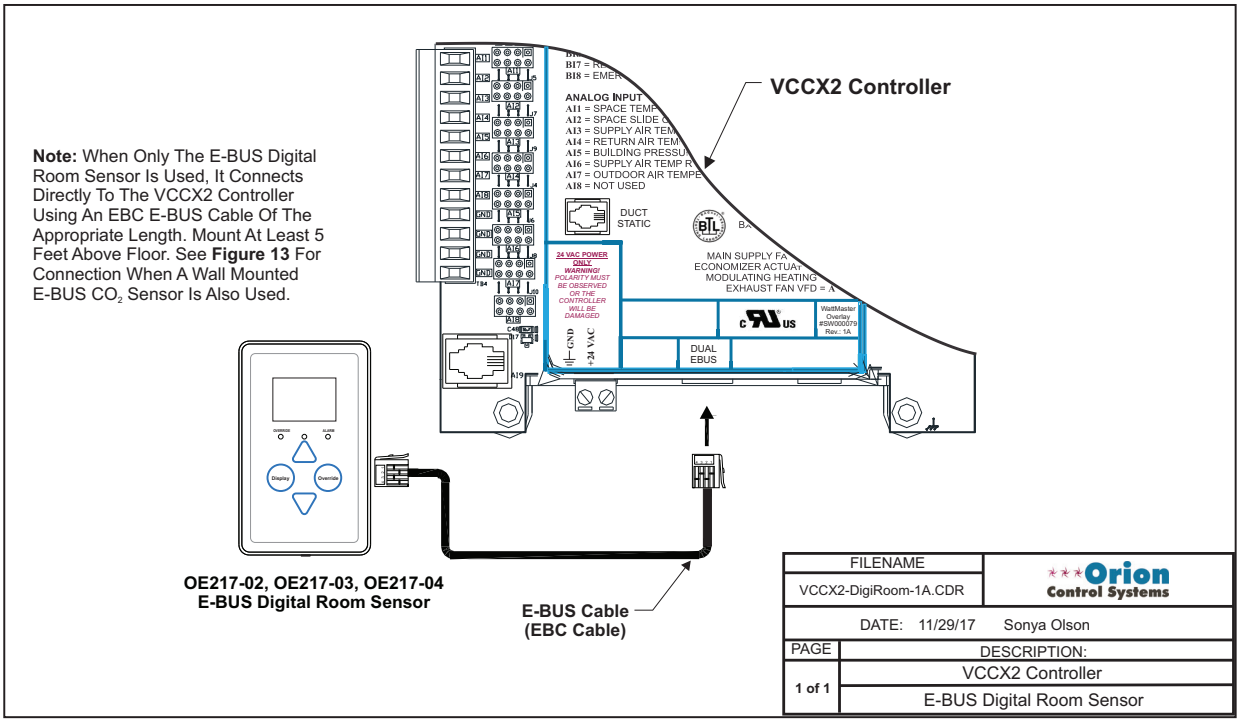


Figure 11: OE217-02 / OE217-03 / OE217-04 E-BUS Digital Room Sensor

Wall-Mounted & Duct-Mounted E-BUS CO_2 Sensor

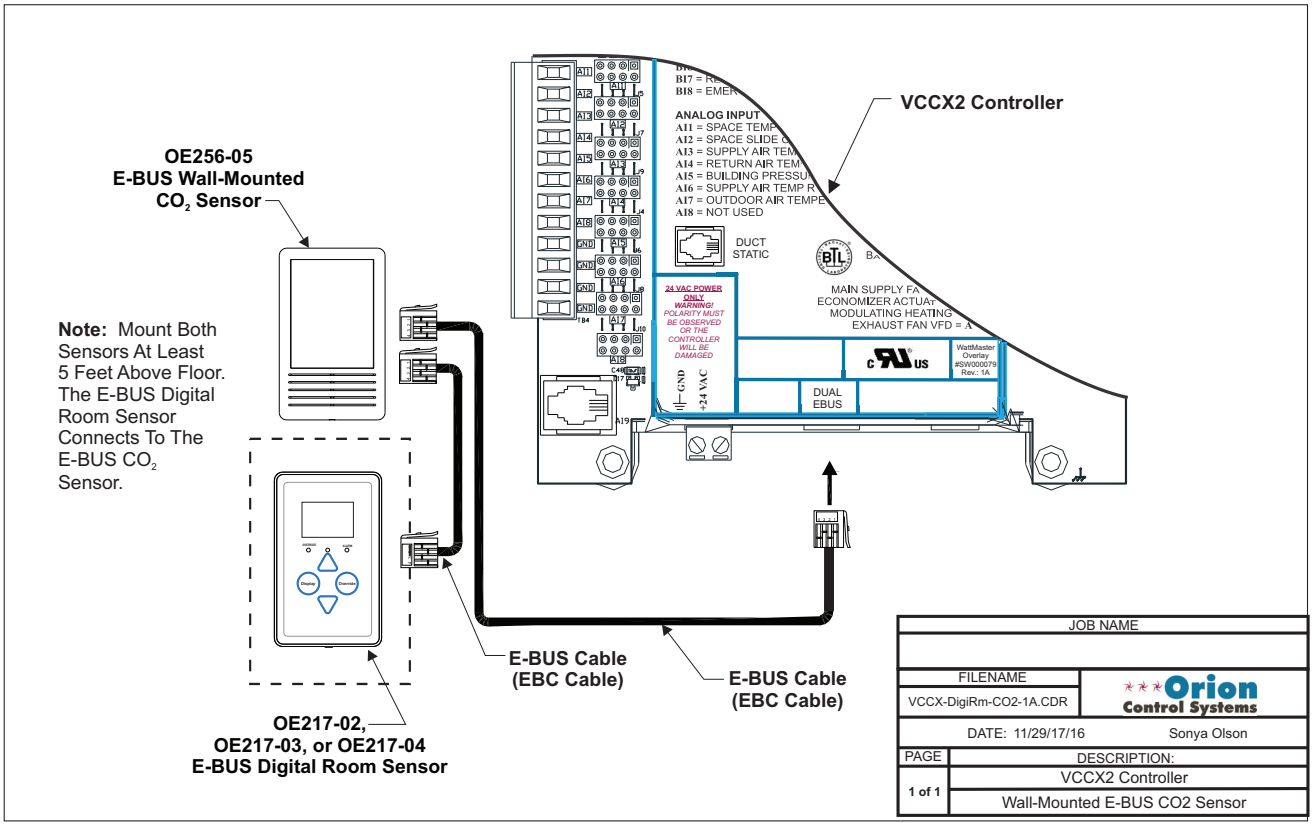


Figure 12: OE256-05 Wall-Mounted E-BUS CO_2 Sensor

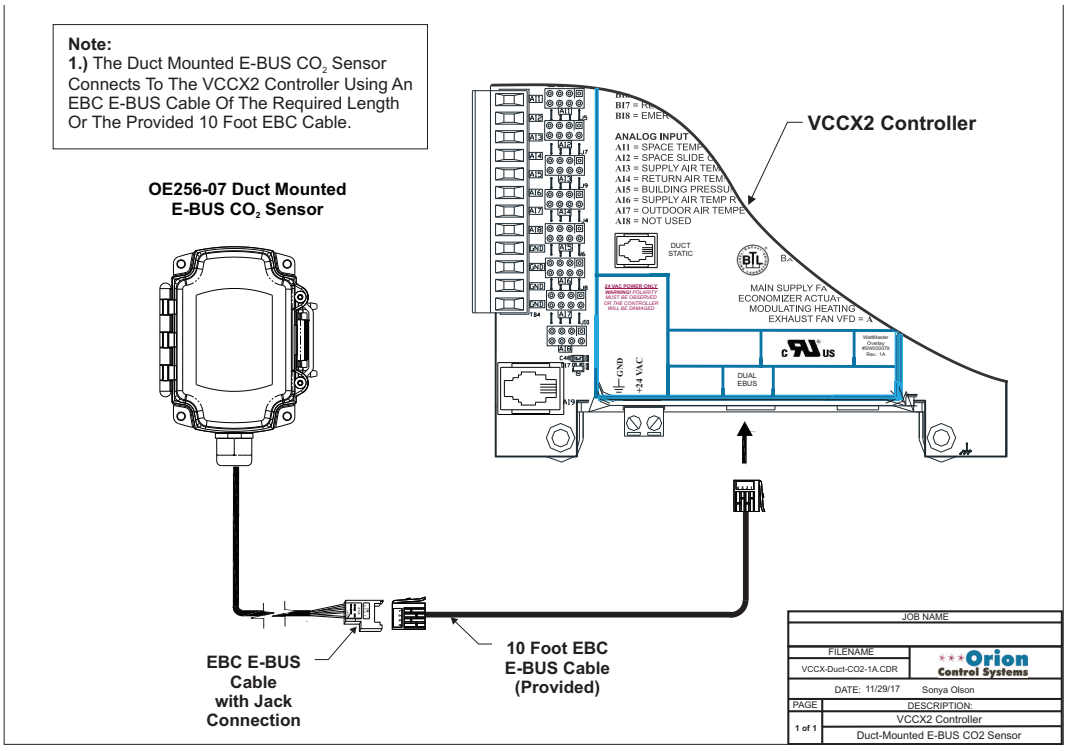


Figure 13: OE256-07 Duct-Mounted E-BUS CO_2 Sensor

Supply Air & Return Air Temperature Sensor Wiring

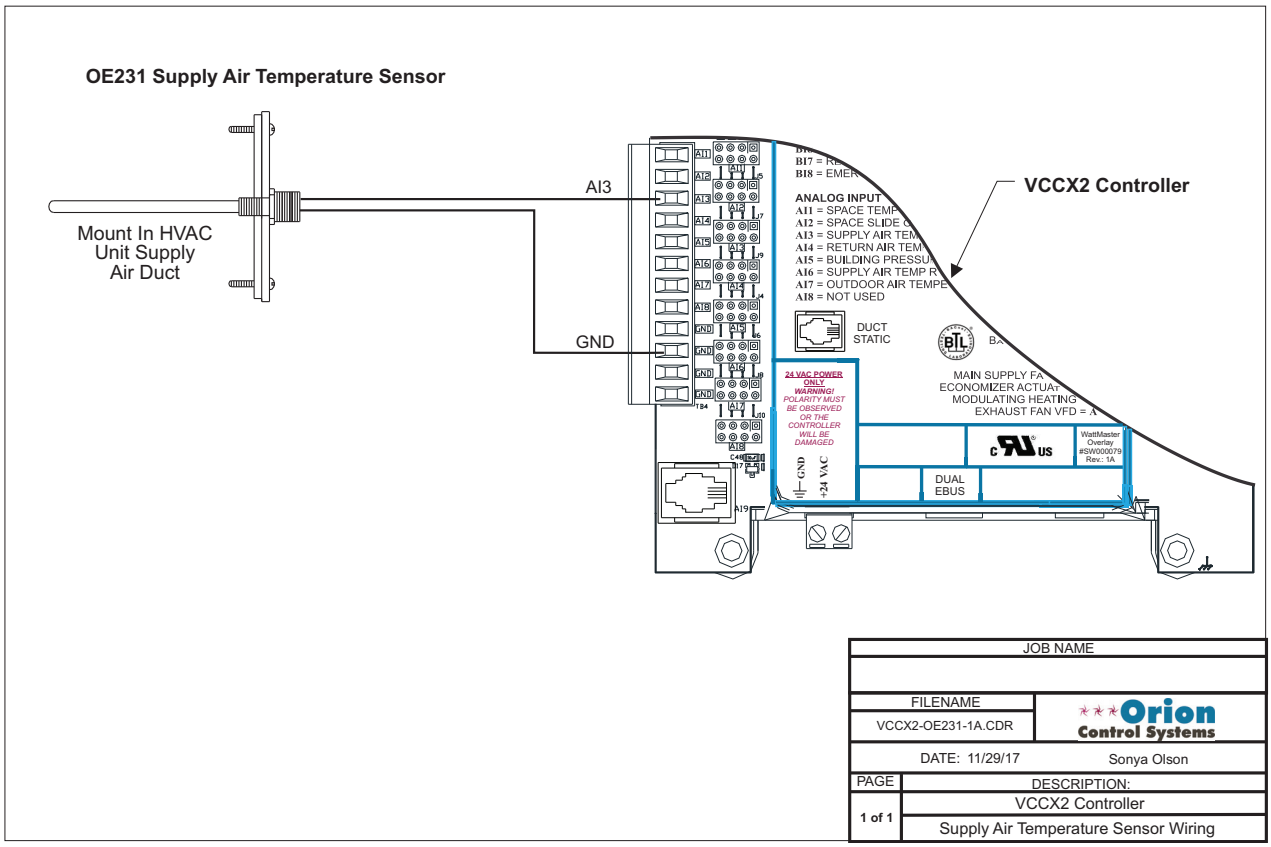


Figure 14: OE231 Supply Air Temperature Sensor Wiring

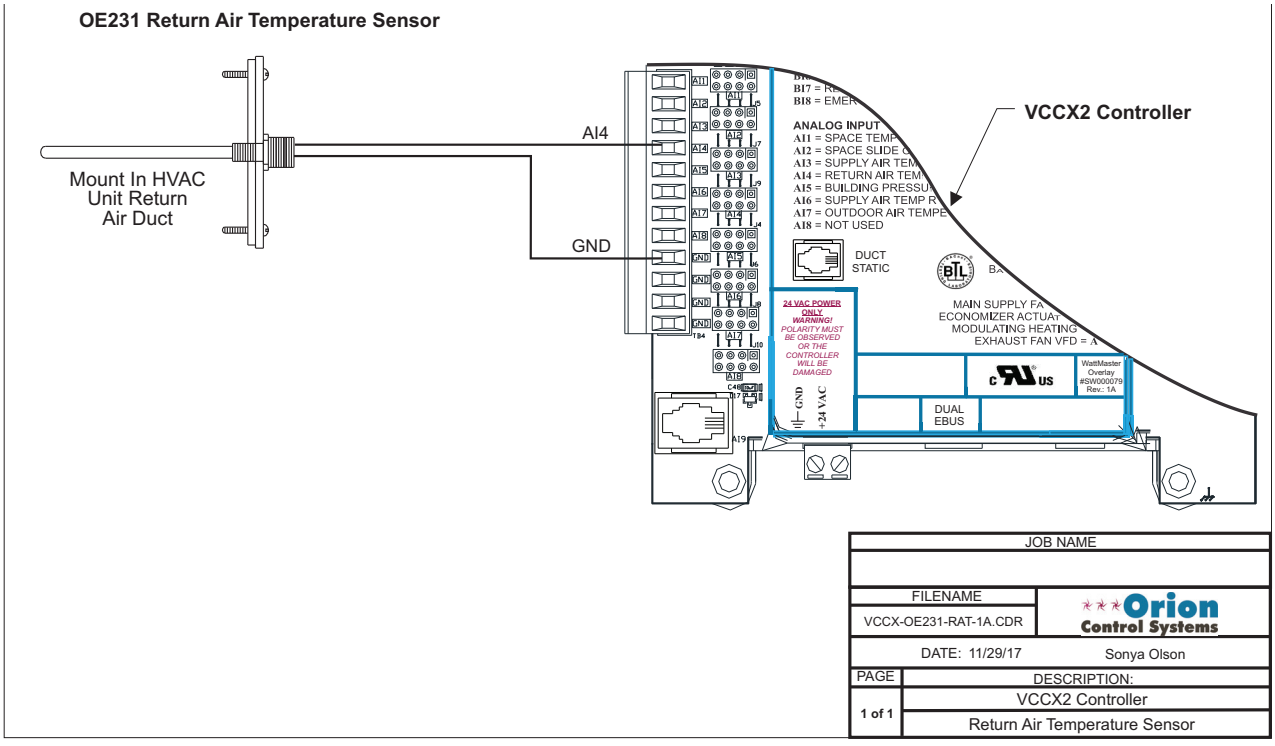


Figure 15: OE231 Return Air Temperature Sensor Wiring

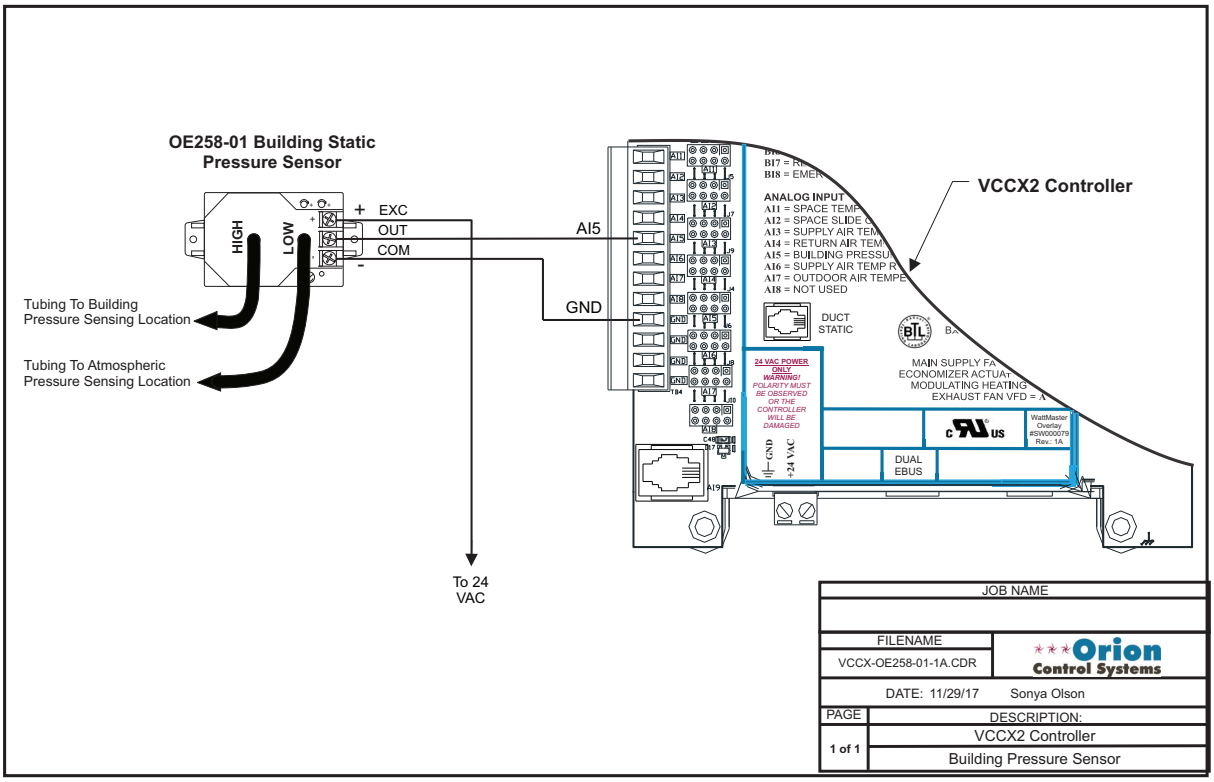


Figure 16: OE258-01 Building Pressure Sensor Wiring

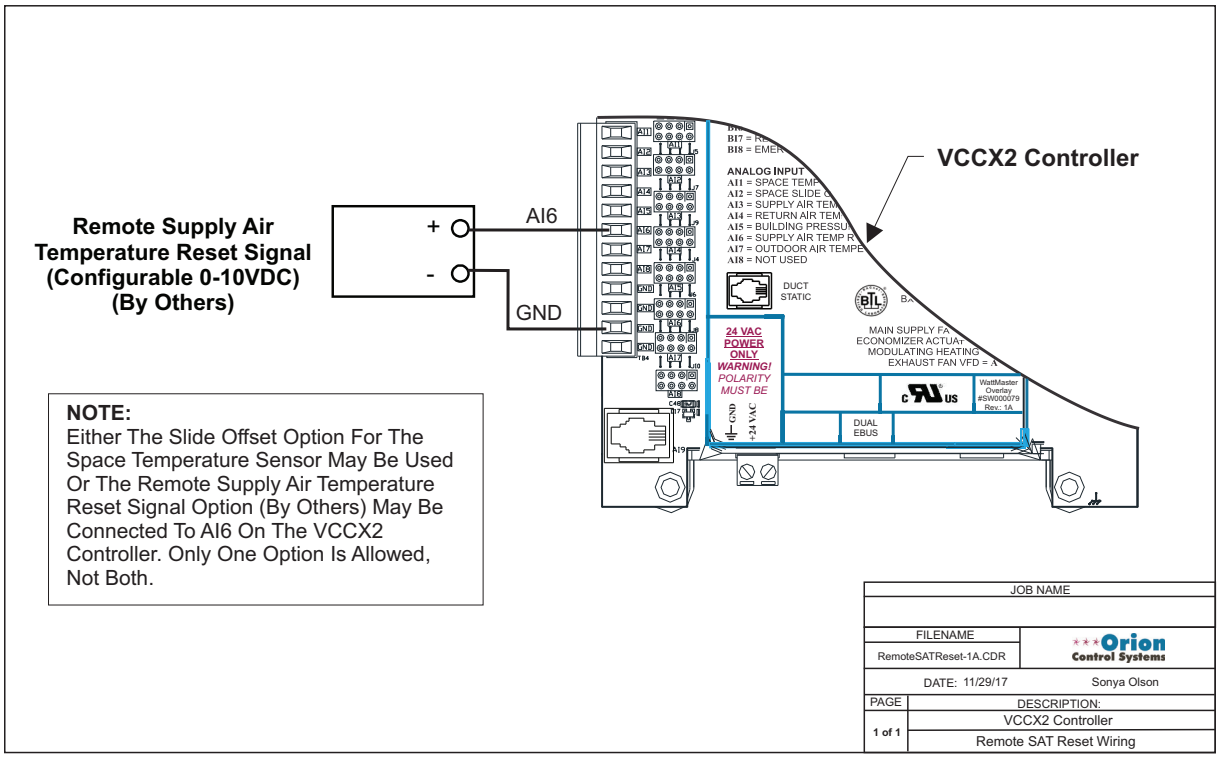


Figure 17: Remote Supply Air Temperature Reset Wiring

OAT Sensor & E-BUS OAT & RH Sensor Wiring

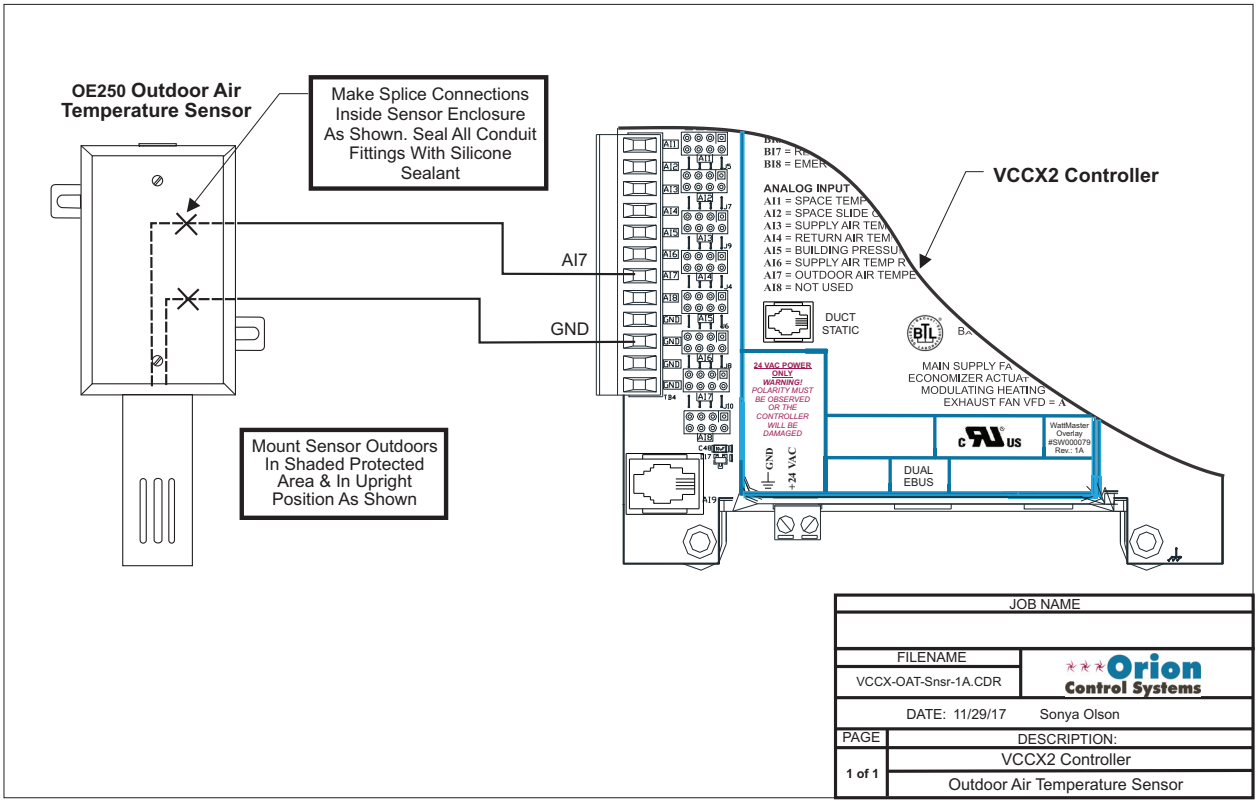


Figure 18: OE250 Outdoor Air Temperature Wiring

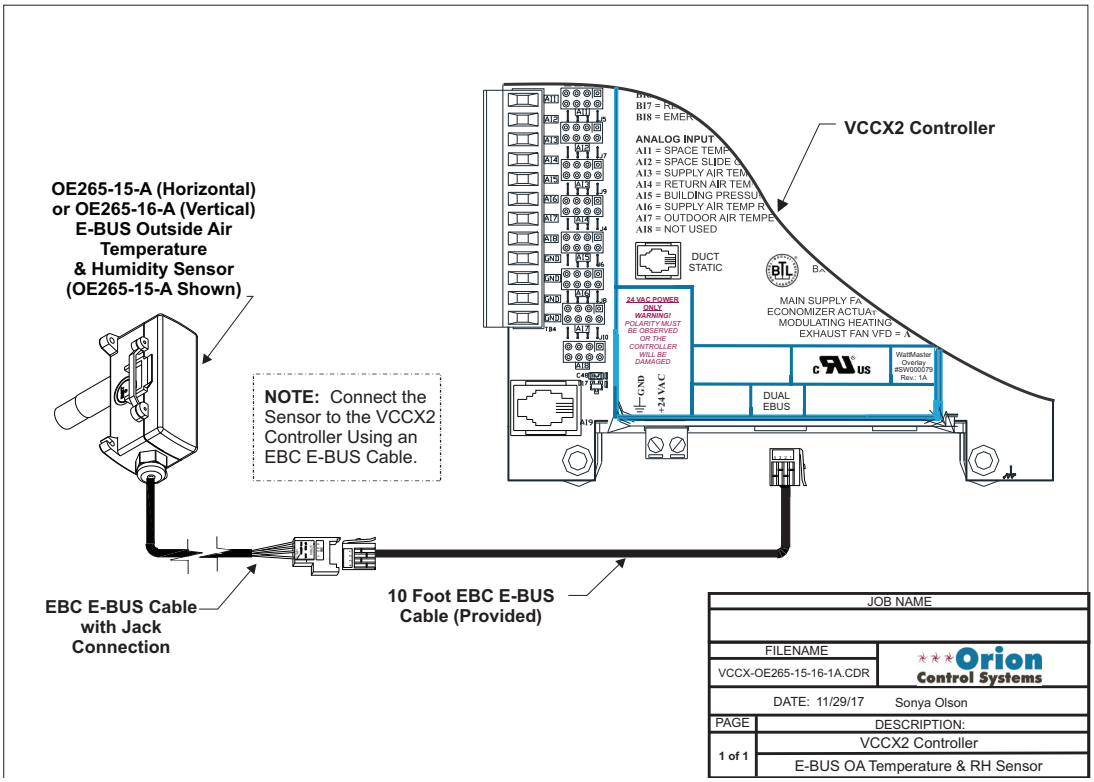


Figure 19: OE265-15-A or OE265-16-A – E-BUS Outdoor Air Temperature & Humidity Sensor Wiring

E-BUS RAT & RH Sensor & Static Pressure Transducer Wiring

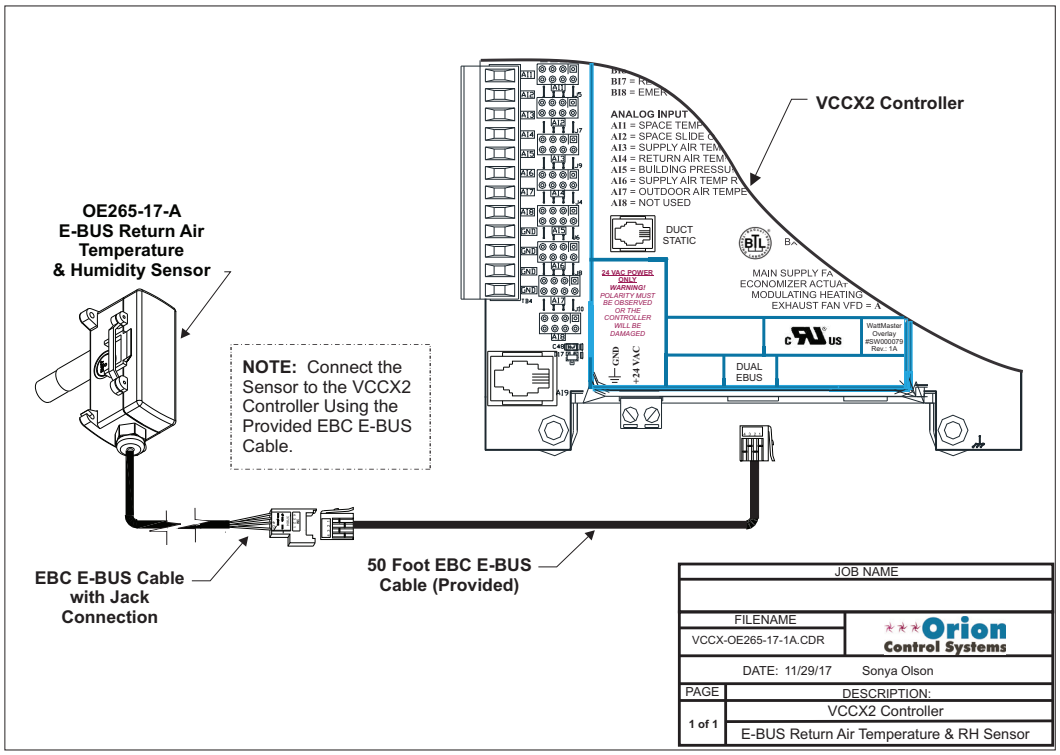


Figure 20: OE265-17-A – E-BUS Return Air Temperature & Humidity Sensor Wiring

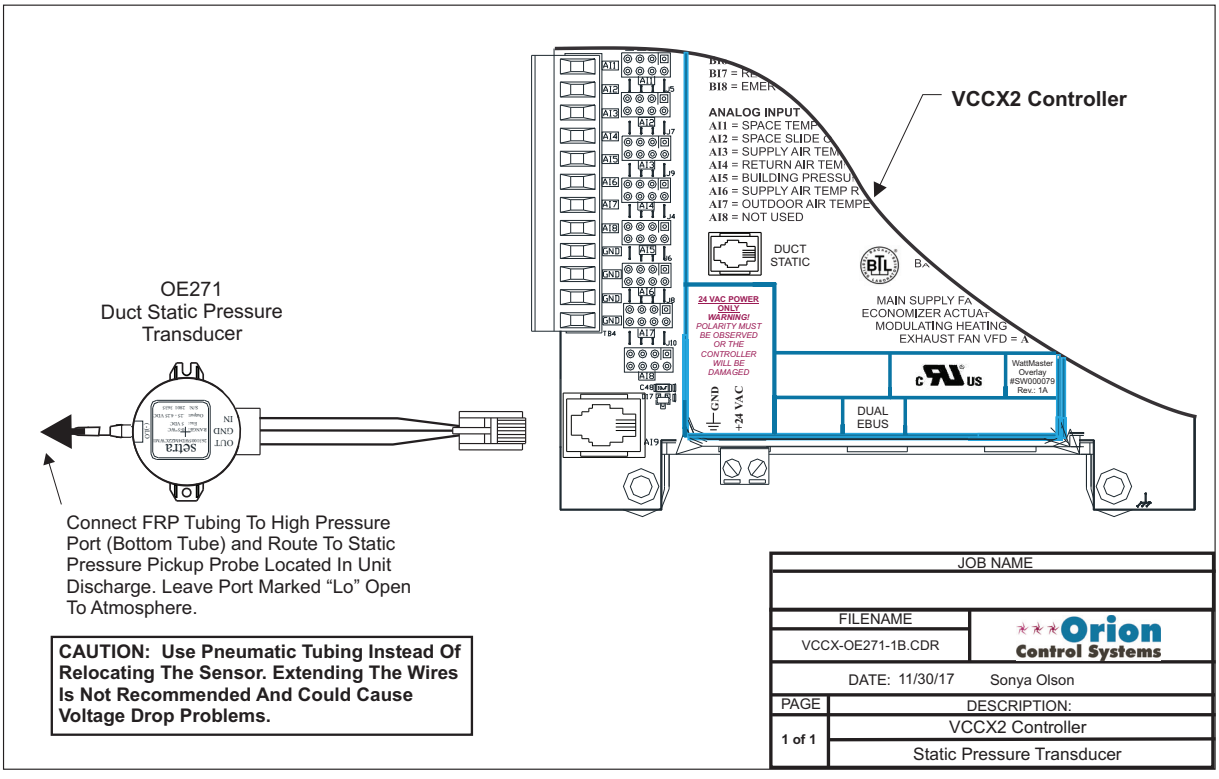


Figure 21: OE271 Static Pressure Transducer Wiring

Supply Fan VFD & Bypass Damper Actuator Wiring

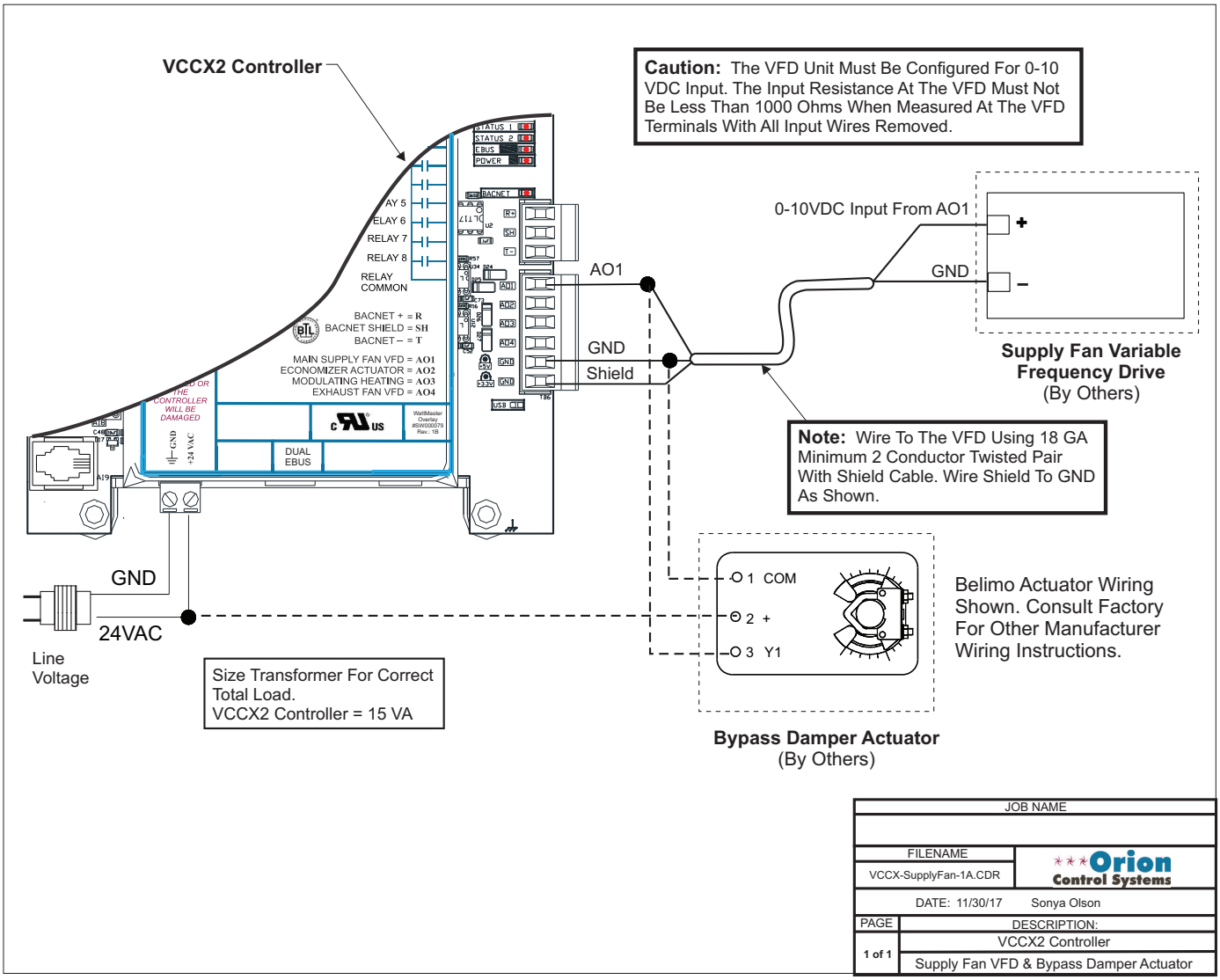


Figure 22: Supply Fan VFD & Bypass Damper Actuator Wiring

Economizer Damper Actuator or Water-Side Economizer Wiring

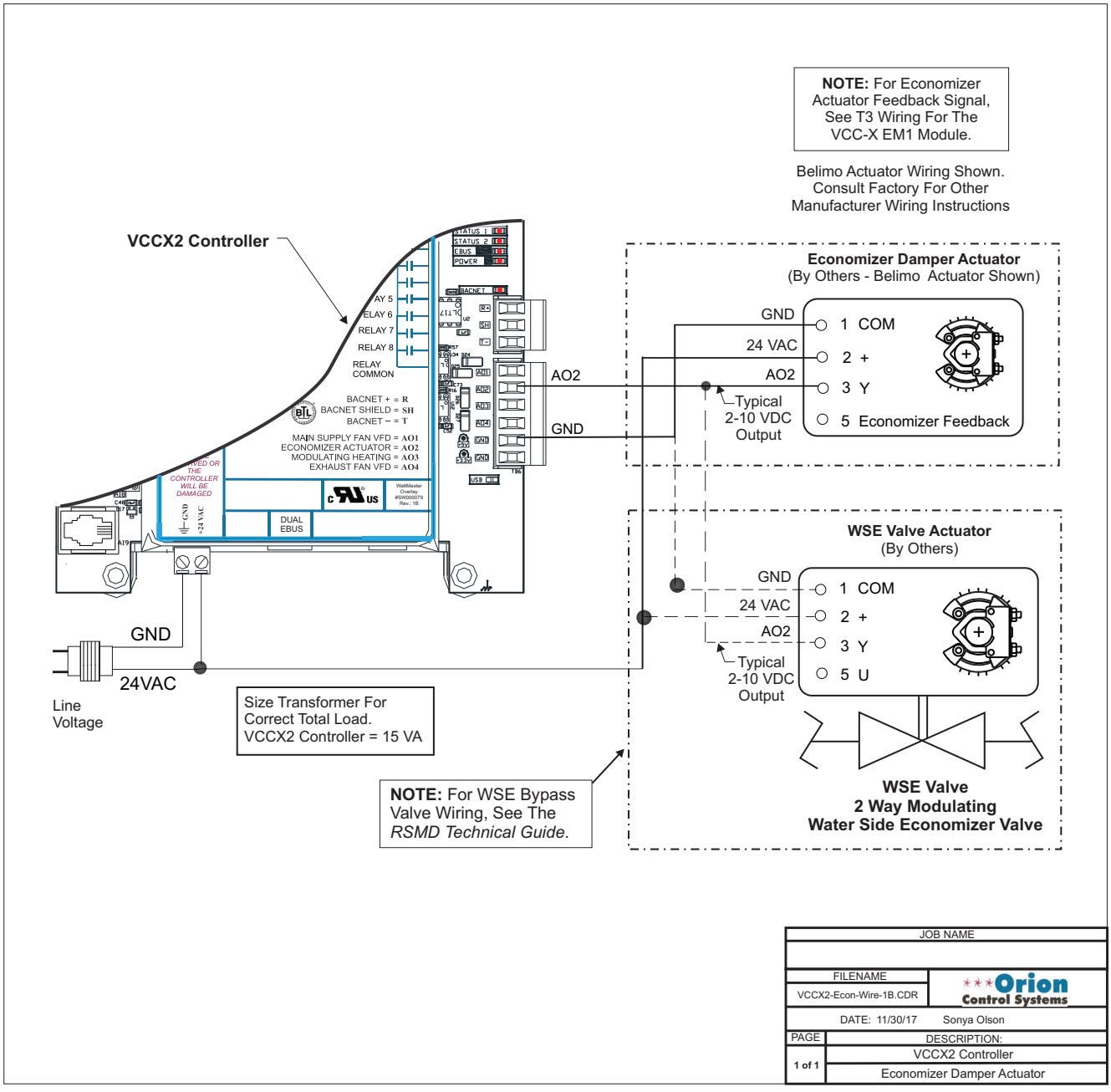


Figure 23: Economizer Damper Actuator or Water-Side Economizer Actuator Wiring

Modulating Heating Wiring

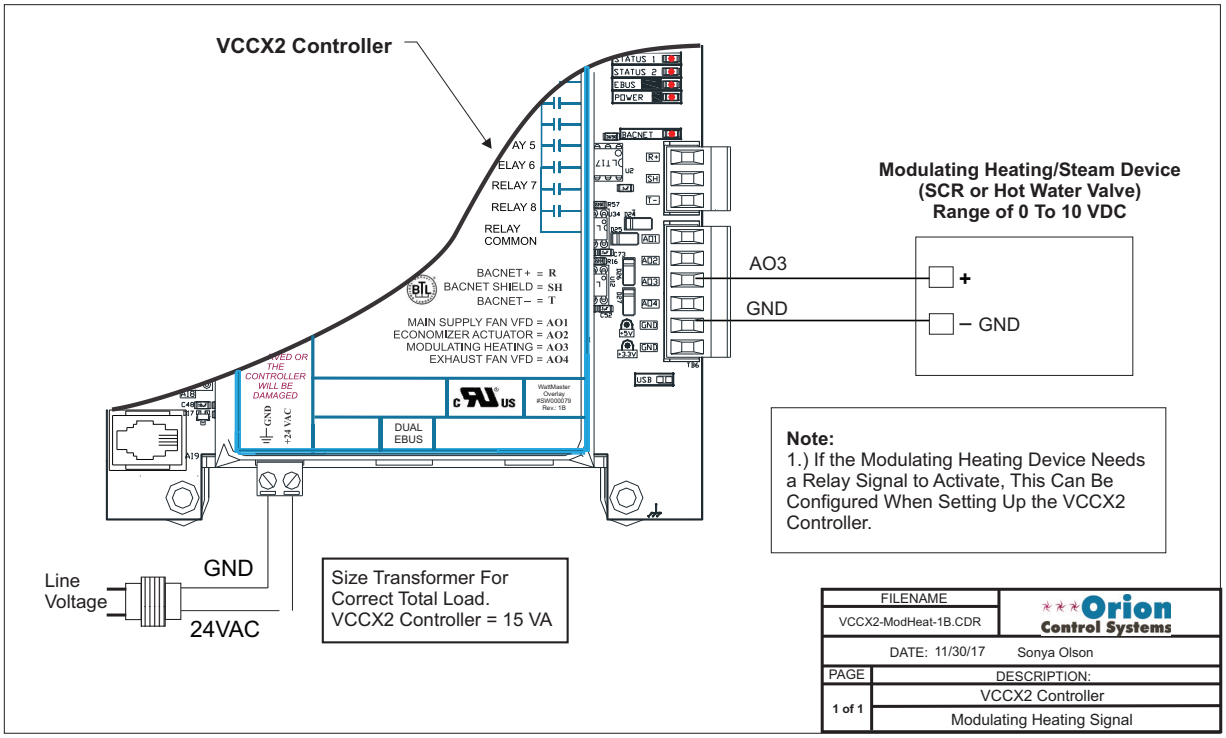


Figure 24: Modulating Heating Device Wiring

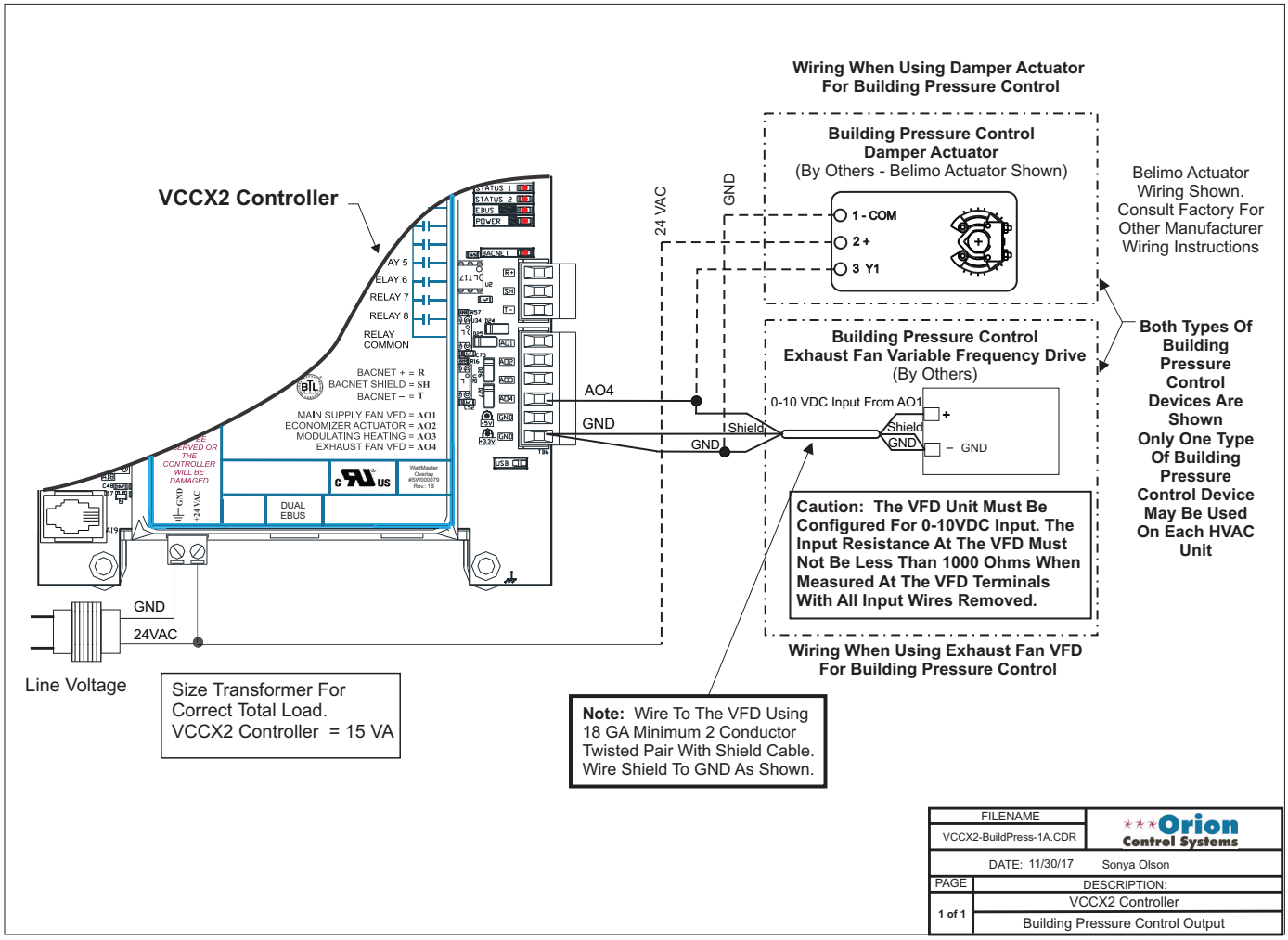


Figure 25: Building Pressure Control Output Wiring Diagram

Airflow Monitoring

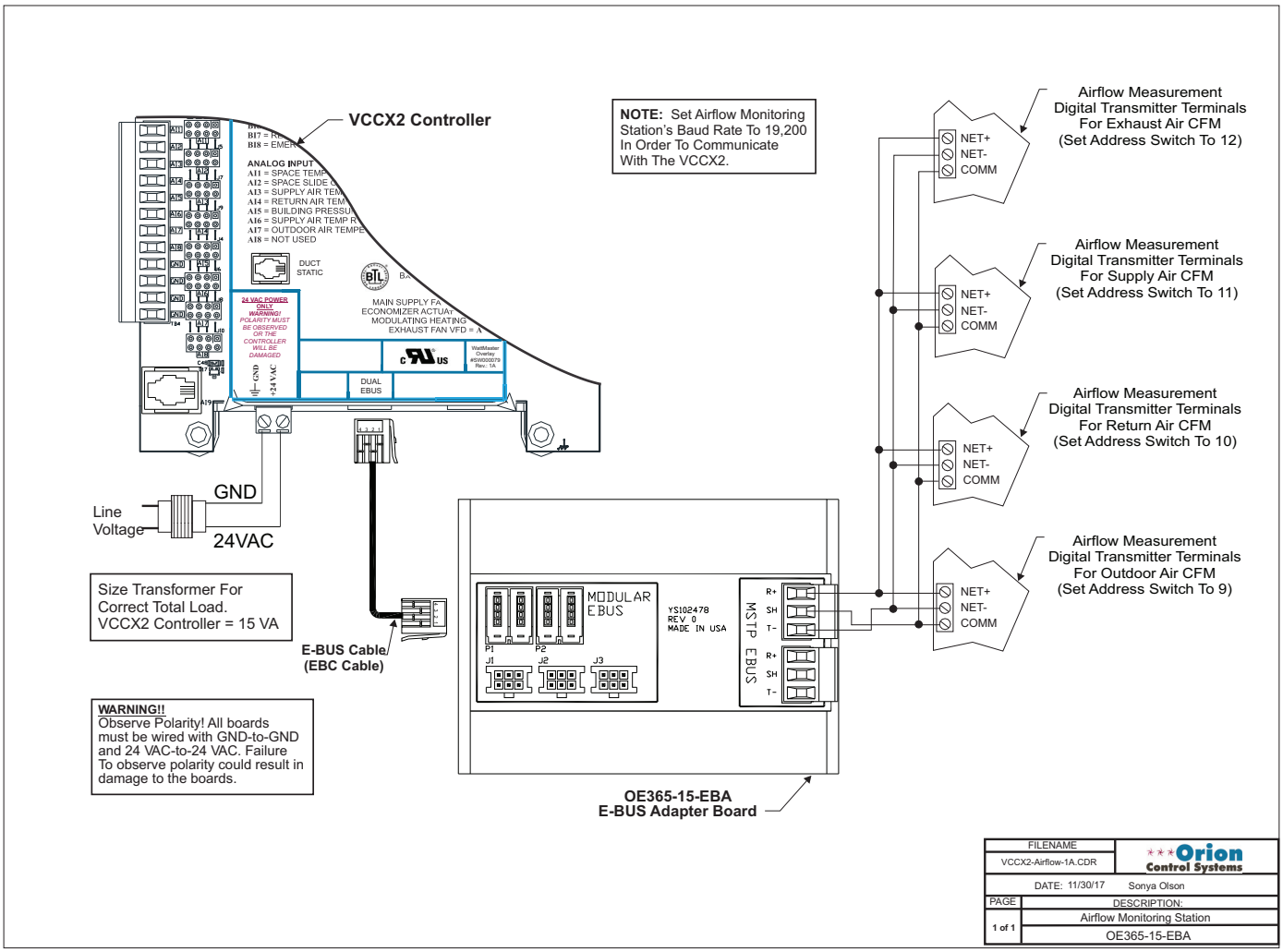
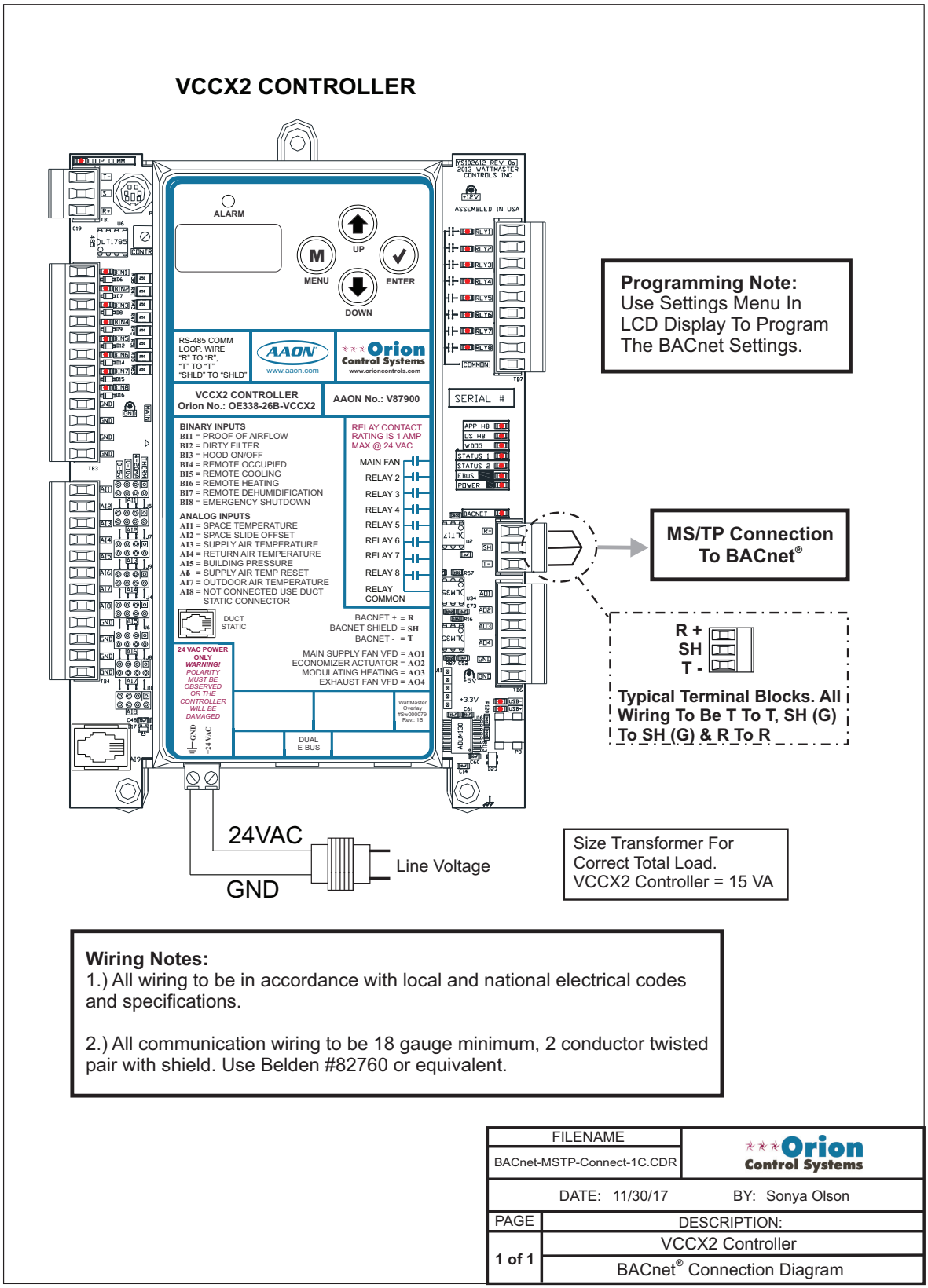


Figure 26: OE365-15-EBA - EBTRON® GTC116 & HTN104 Series, GreenTrol™ GA-200-N Series, and Paragon MicroTrans^{EQ} Series Air Flow Measurement Digital Transmitter Wiring

VCCX2 BACnet® Connection To MS/TP Network



Wiring Notes:
1.) All wiring to be in accordance with local and national electrical codes and specifications.

2.) All communication wiring to be 18 gauge minimum, 2 conductor twisted pair with shield. Use Belden #82760 or equivalent.

FILENAME	Orion Control Systems
BACnet-MSTP-Connect-1C.CDR	
DATE: 11/30/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Controller BACnet® Connection Diagram

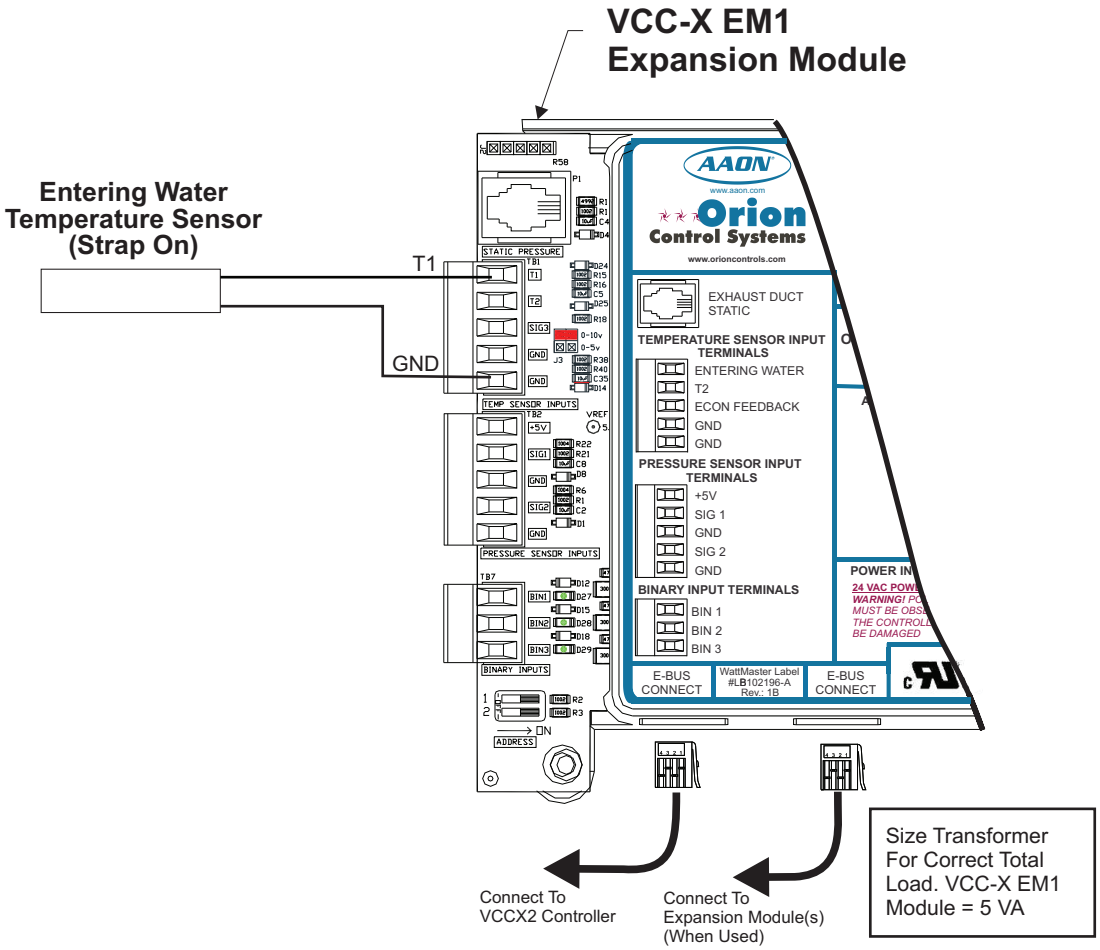
Figure 27: VCCX2 BACnet® Connection to MS/TP Network

VCCX2 CONTROLLER WIRING

VCC-X EM1 & 12-Relay E-BUS Expansion Module Wiring

VCC-X EM1 & Entering Water Temperature Sensor Wiring

WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.



JOB NAME	
FILENAME	Orion Control Systems
VCCX2-EM1-H20-Sensor-1A.CDR	
DATE: 12/01/17 Sonya Olson	
PAGE	DESCRIPTION:
1 of 1	VCC-X EM1 Entering Water Temperature Sensor

Figure 28: OE233 – Entering Water Temperature Sensor Wiring

VCC-X EM1 Entering Water Temperature Sensor Wiring

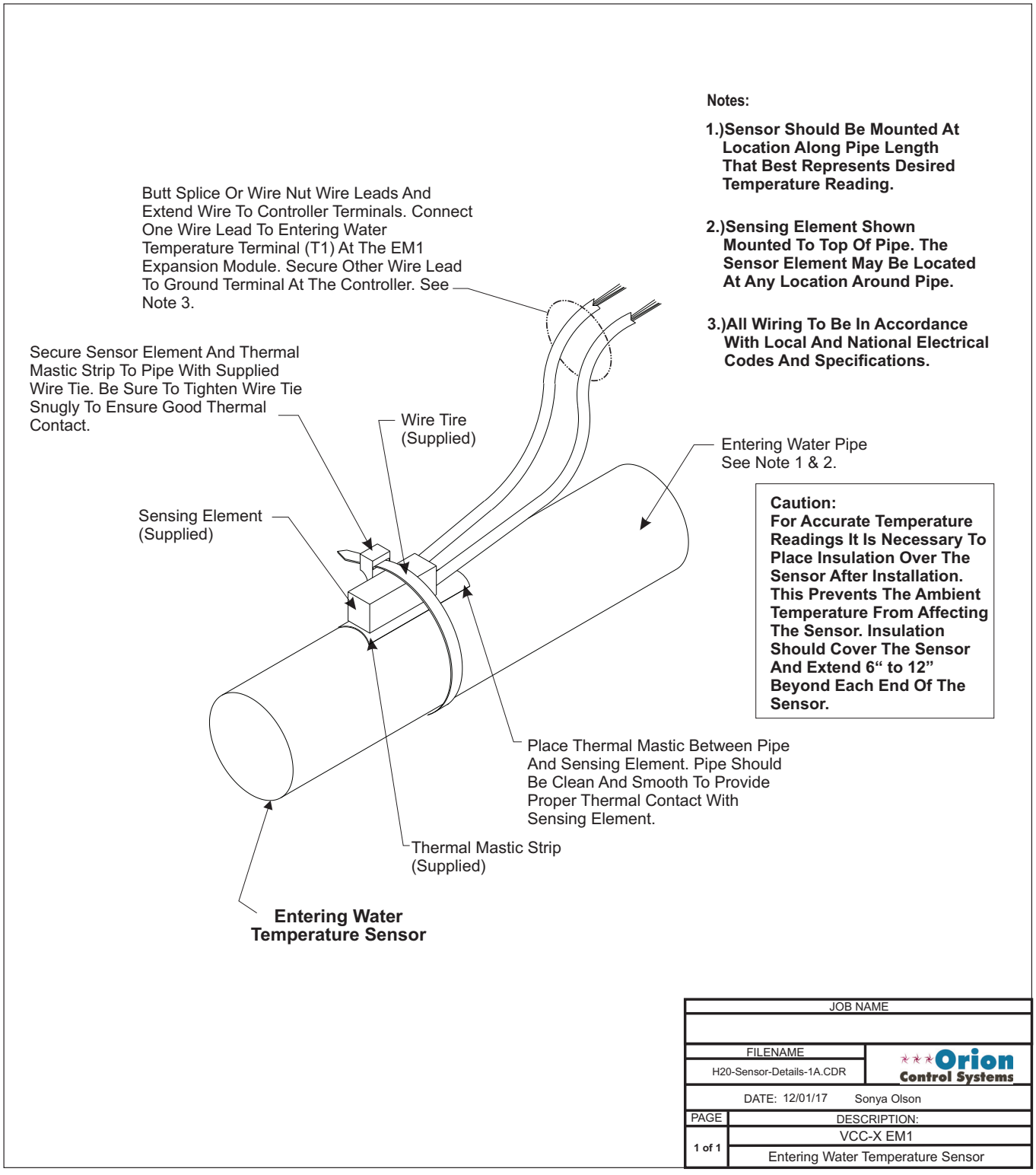


Figure 29: OE233 – Entering Water Temperature Sensor Installation

Exhaust Duct Static Pressure & Economizer Actuator Feedback

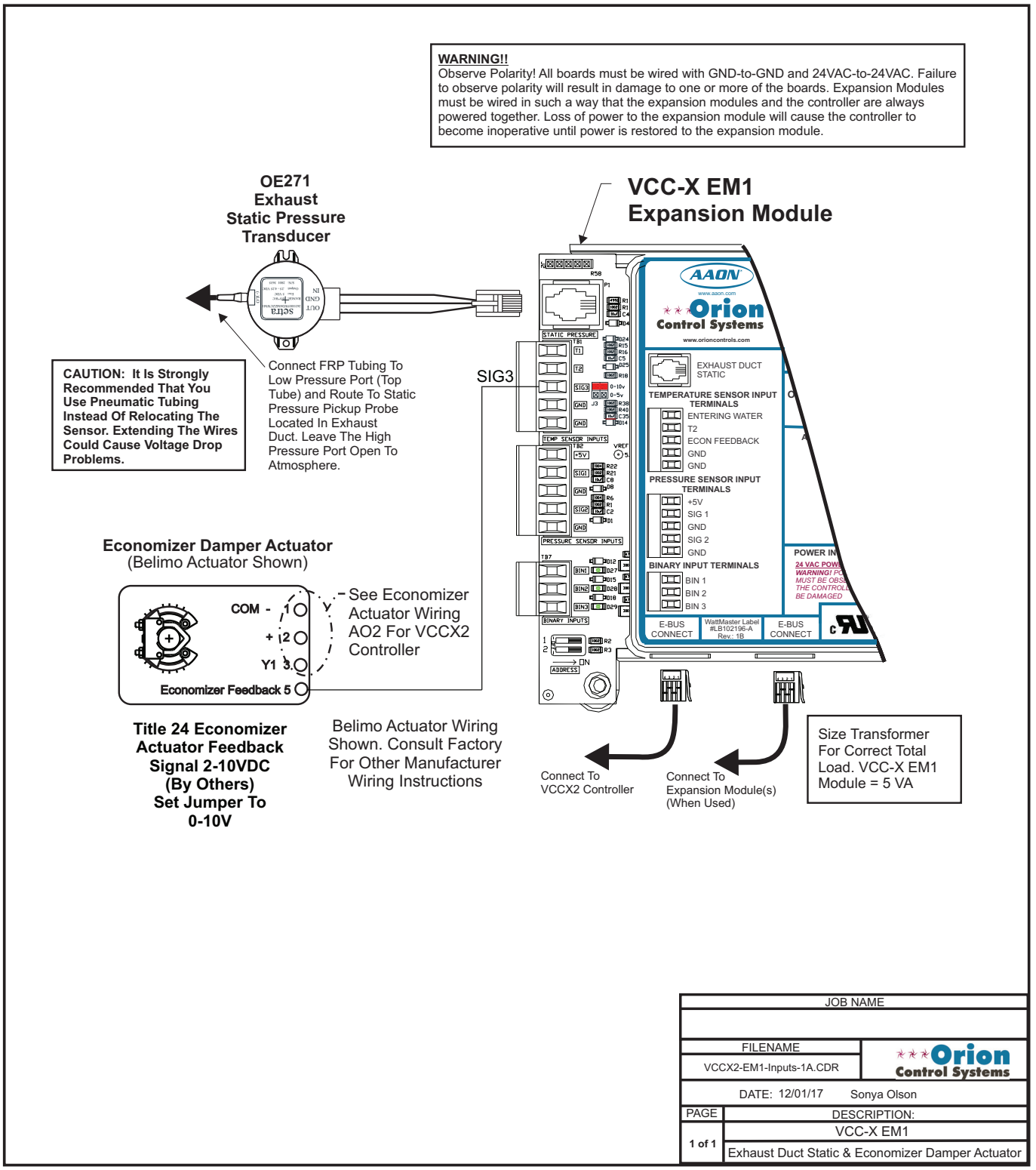


Figure 30: VCC-X EM1 Exhaust Duct Static Pressure & Economizer Actuator Feedback Wiring

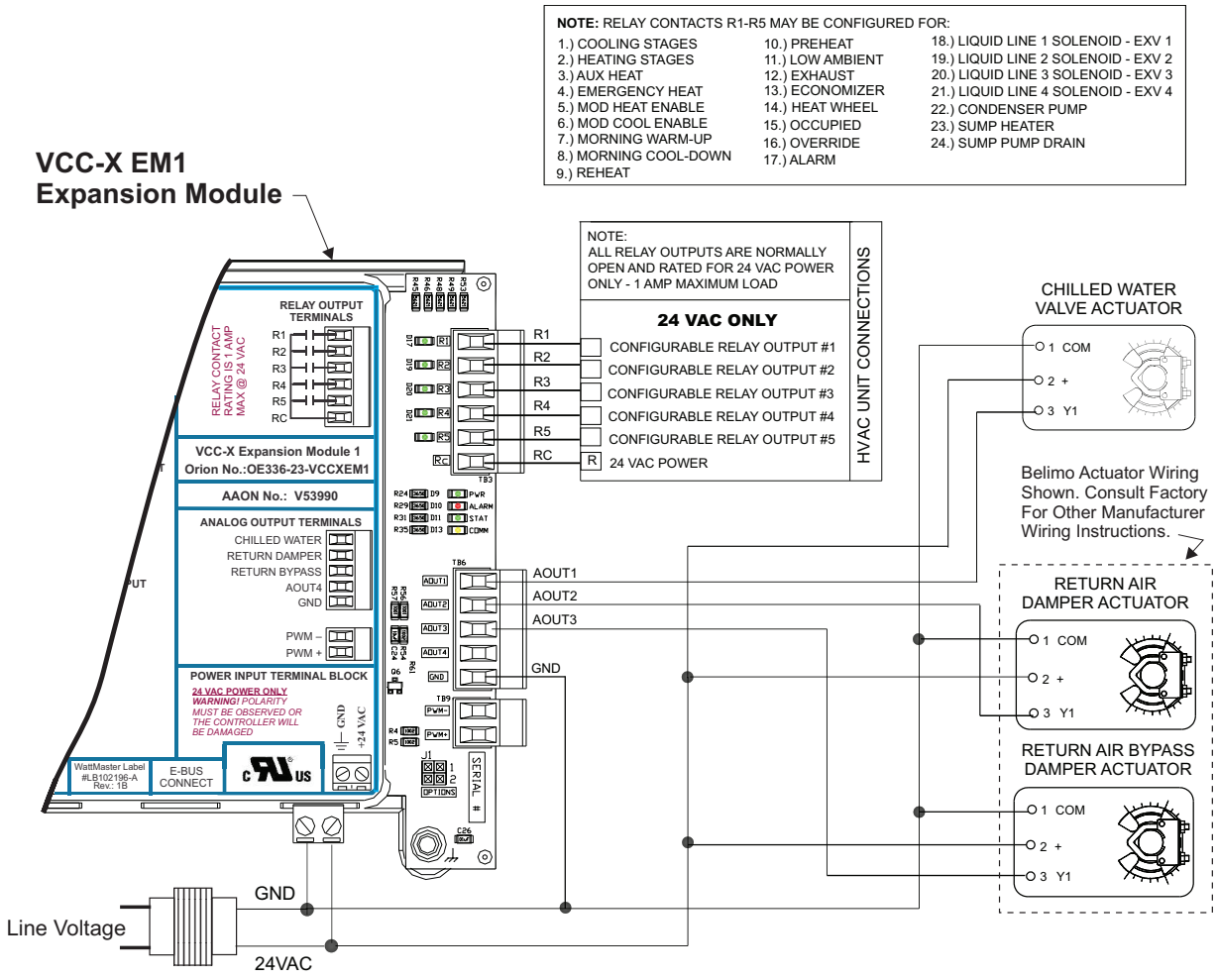
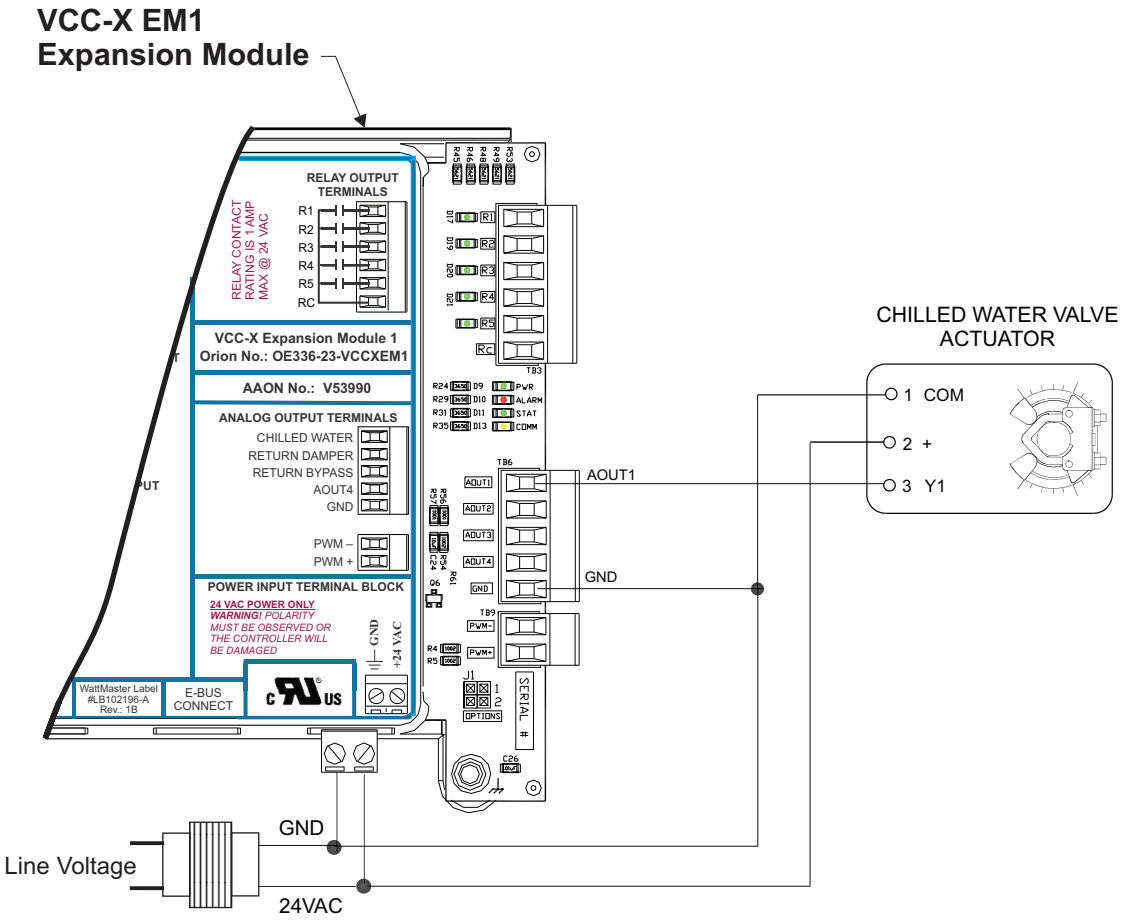


Figure 31: OE336-23-VCCXEM1 - VCCX2 Expansion Module Output Wiring

Chilled Water Valve Actuator Wiring

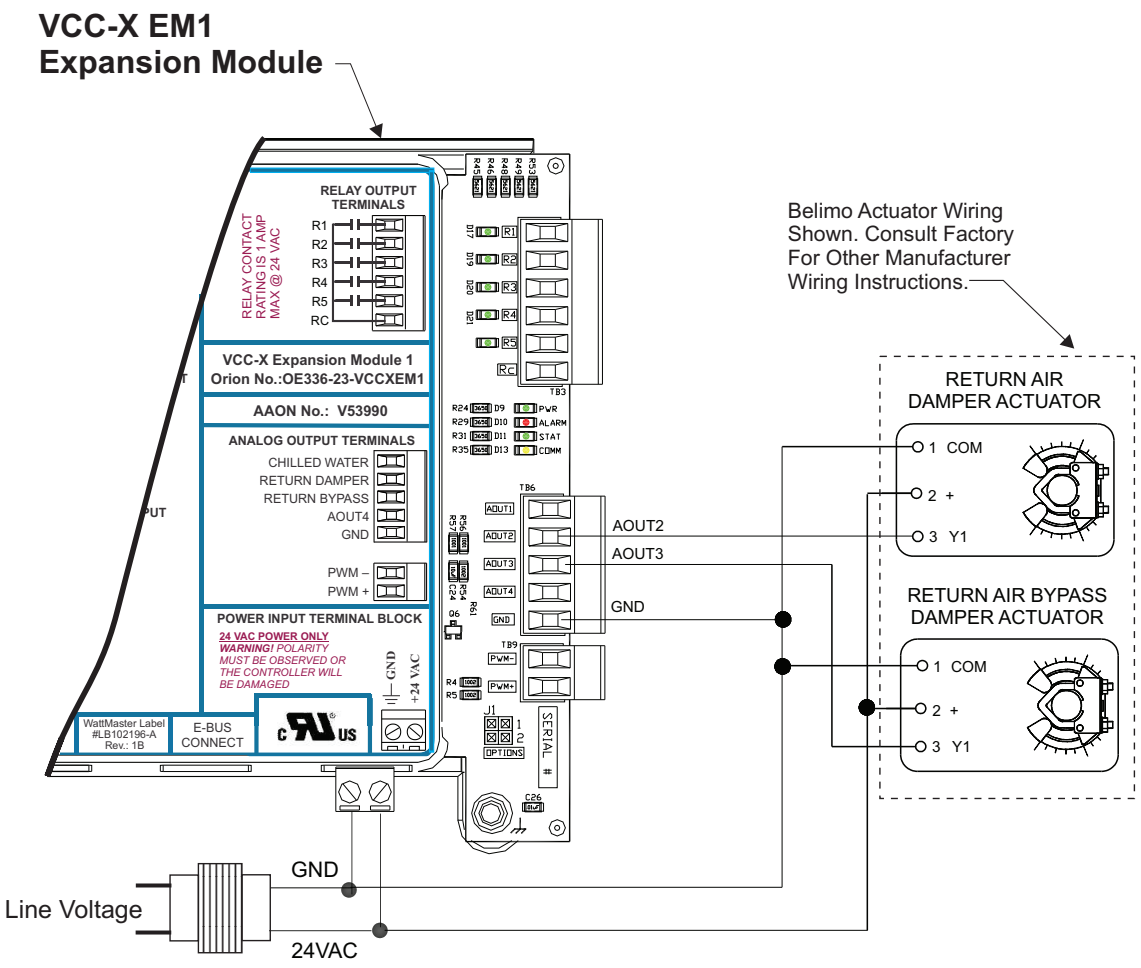


Size Transformer For Correct Total Load.
VCC-X EM1 Module = 5 VA

WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

JOB NAME	
FILENAME	Orion Control Systems
VCCX2-Chilled-Water-1A.CDR	
DATE: 12/01/17 Sonya Olson	
PAGE	DESCRIPTION:
1 of 1	VCC-X EM1
	Chilled Water Valve Wiring

Figure 32: Chilled Water Valve Actuator Wiring Diagram



Size Transformer For Correct Total Load.
VCC-X EM1 Module = 5 VA

WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

JOB NAME	
FILENAME	Orion Control Systems
VCCX2-Return-Bypass-1A.CDR	
DATE: 12/01/17 Sonya Olson	
PAGE	DESCRIPTION:
1 of 1	VCC-X EM1 Return Bypass Wiring

Figure 33: Return Air Bypass Wiring

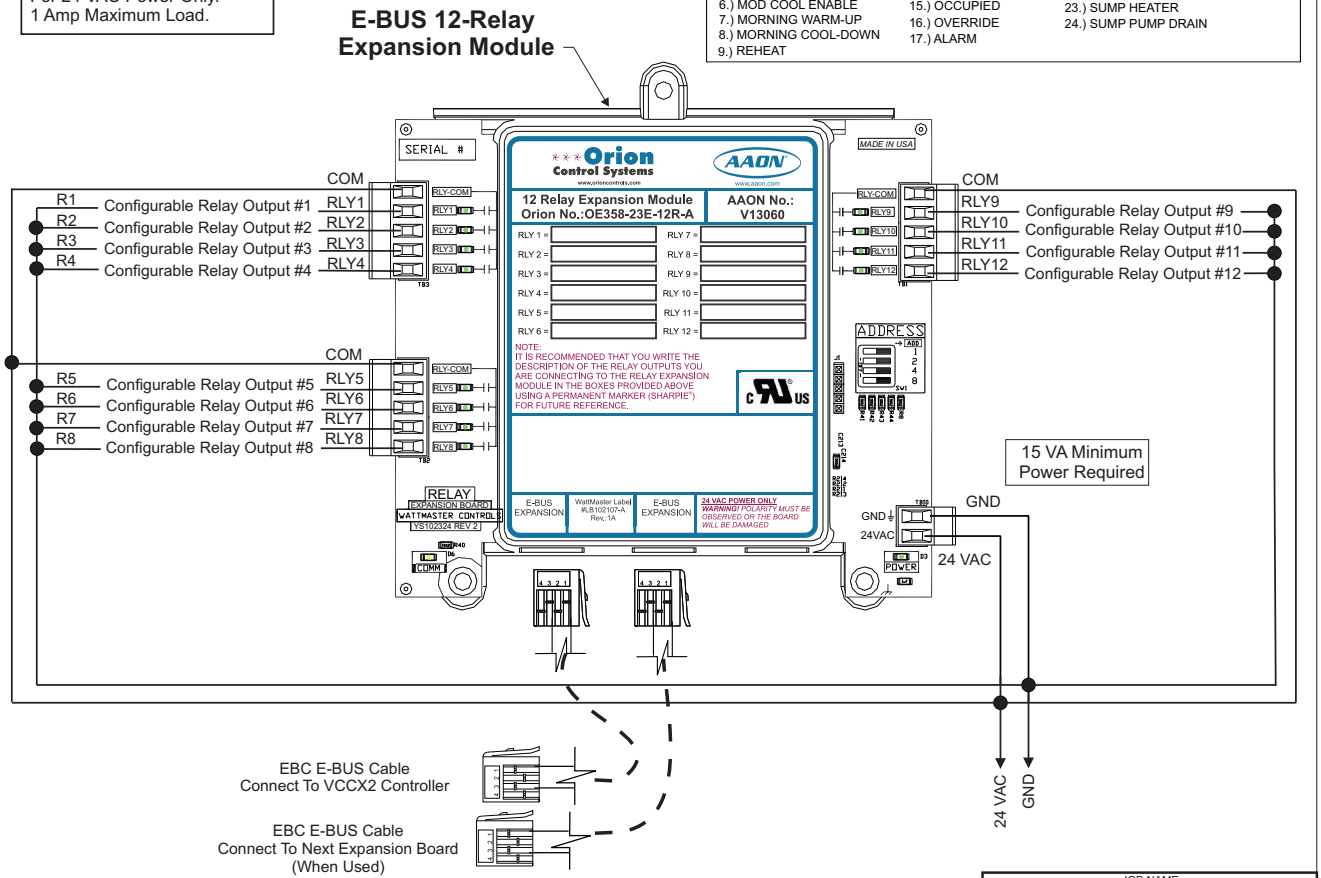
12 Relay E-BUS Expansion Module

WARNING!!
Observe Polarity! All boards must be wired with GND-to-GND and 24VAC-to-24VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion Modules must be wired in such a way that the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

NOTE:
All Relay Outputs Are Normally Open And Rated For 24 VAC Power Only.
1 Amp Maximum Load.

NOTE: RELAY CONTACTS R1-R12 MAY BE CONFIGURED FOR:

1.) COOLING STAGES
2.) HEATING STAGES
3.) AUX HEAT
4.) EMERGENCY HEAT
5.) MOD HEAT ENABLE
6.) MOD COOL ENABLE
7.) MORNING WARM-UP
8.) MORNING COOL-DOWN
9.) REHEAT
10.) PREHEAT
11.) LOW AMBIENT
12.) EXHAUST
13.) ECONOMIZER
14.) HEAT WHEEL
15.) OCCUPIED
16.) OVERRIDE
17.) ALARM
18.) LIQUID LINE 1 SOLENOID - EXV 1
19.) LIQUID LINE 2 SOLENOID - EXV 2
20.) LIQUID LINE 3 SOLENOID - EXV 3
21.) LIQUID LINE 4 SOLENOID - EXV 4
22.) CONDENSER PUMP
23.) SUMP HEATER
24.) SUMP PUMP DRAIN

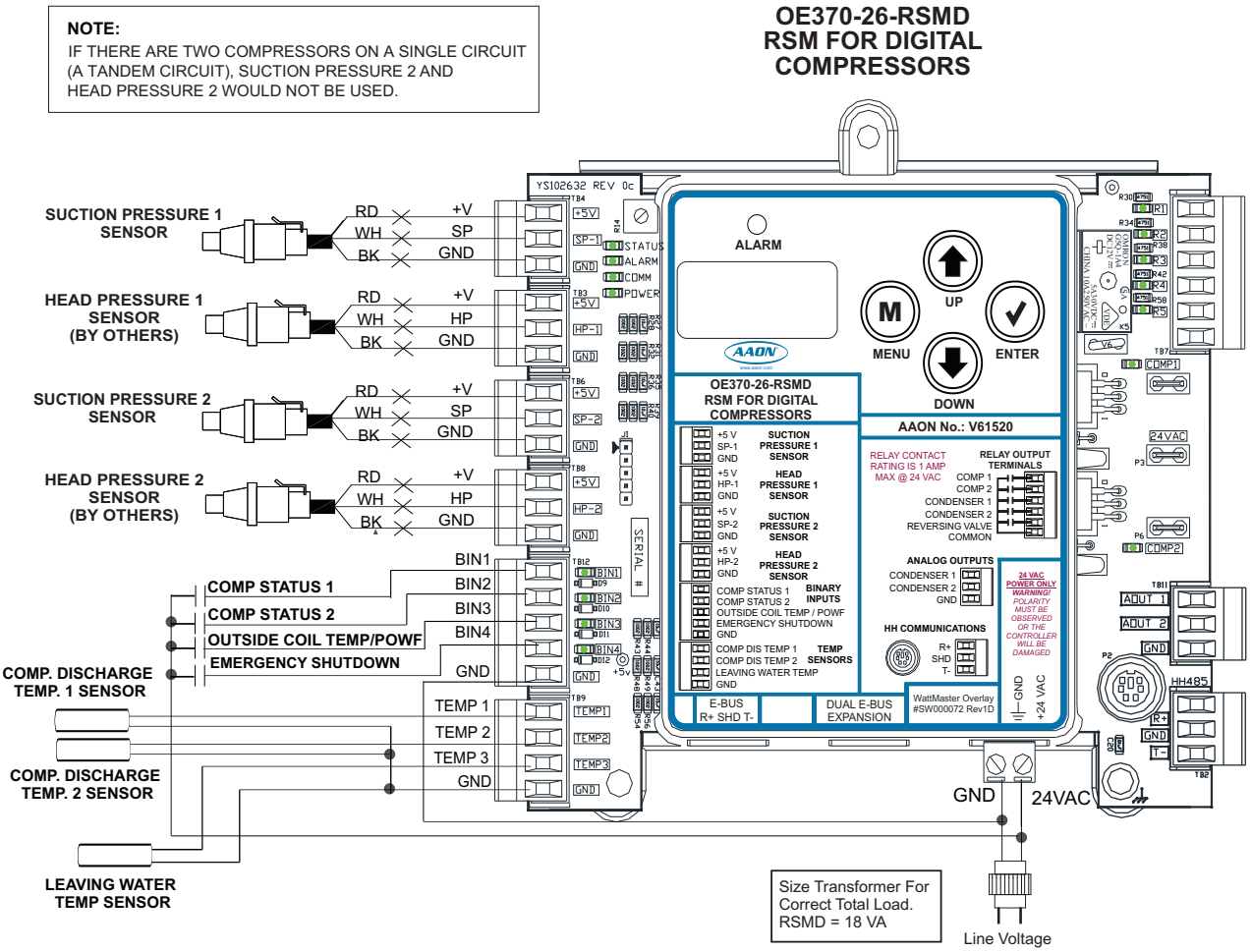


JOB NAME	
FILENAME	Orion Control Systems
VCCX2-12-Relay-1B.CDR	
DATE: 12/01/17 Sonya Olson	
PAGE	DESCRIPTION:
1 of 1	12 Relay E-BUS
	12 Relay E-BUS Expansion Module

Figure 34: OE358-23E-12R - 12 Relay E-BUS Expansion Module Wiring

Refrigeration System Module Wiring

RSMD Module Input Wiring



FILENAME	Orion Control Systems
RSMD-INPUTS-01B.CDR	
DATE: 12/04/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Controller
	RSMD Inputs Wiring

Figure 35: RSMD Inputs Wiring

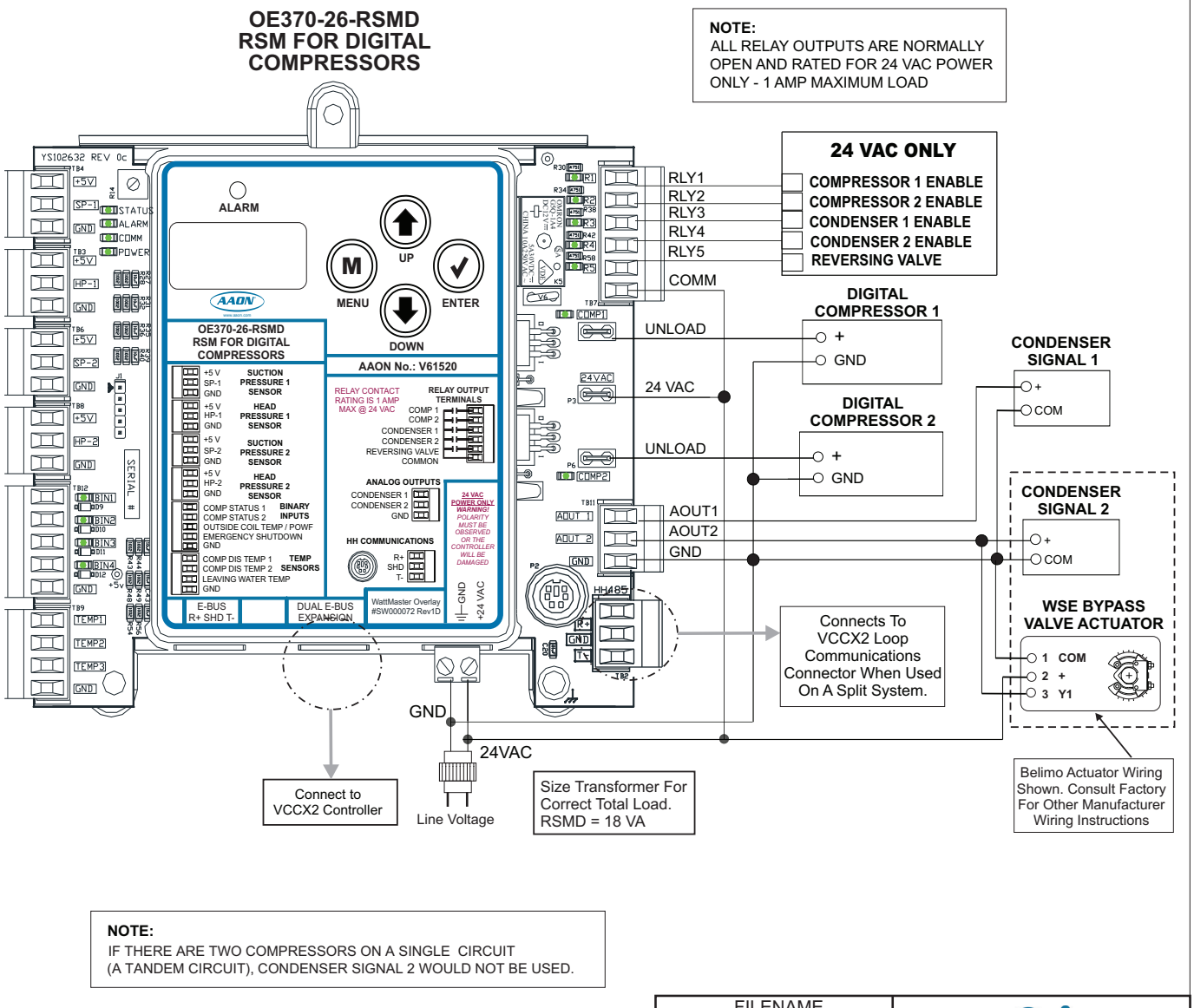
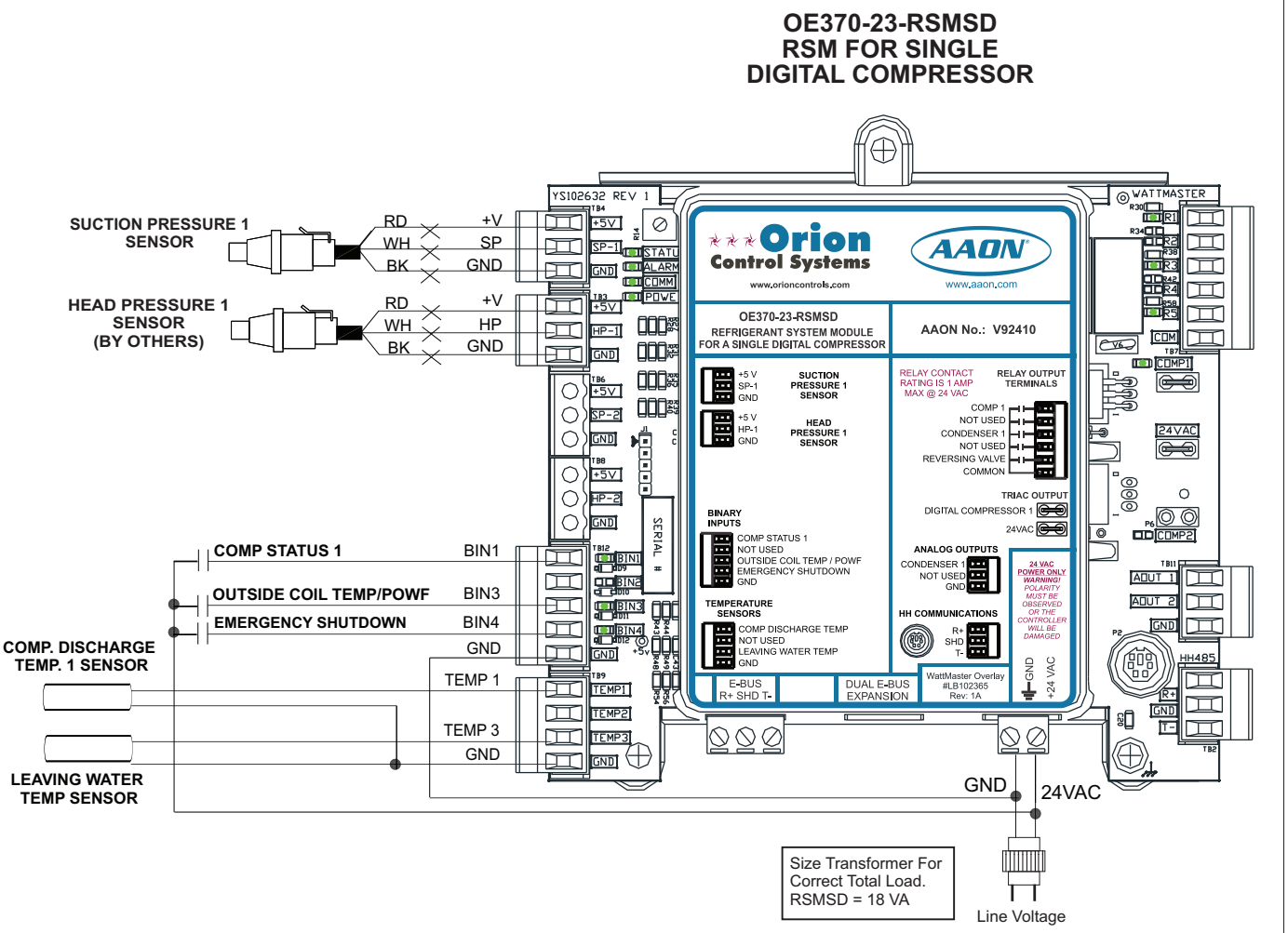


Figure 36: RSMD Outputs Wiring

RSMSD Module Input Wiring



FILENAME	Orion Control Systems
RSMSD-INPUTS-1A.CDR	
DATE: 09/19/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Controller
	RSMSD Input Wiring

Figure 37: RSMSD Inputs Wiring

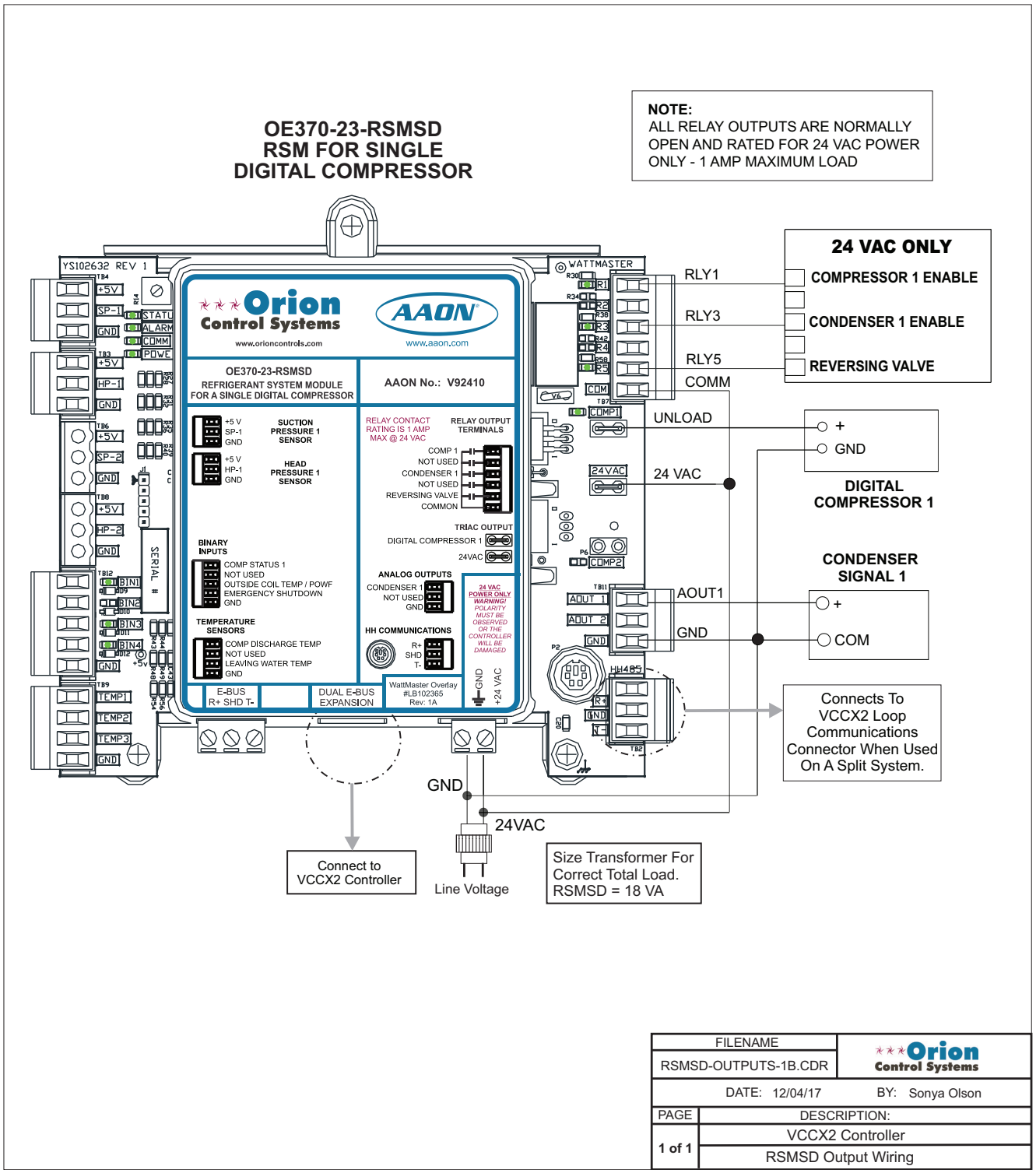
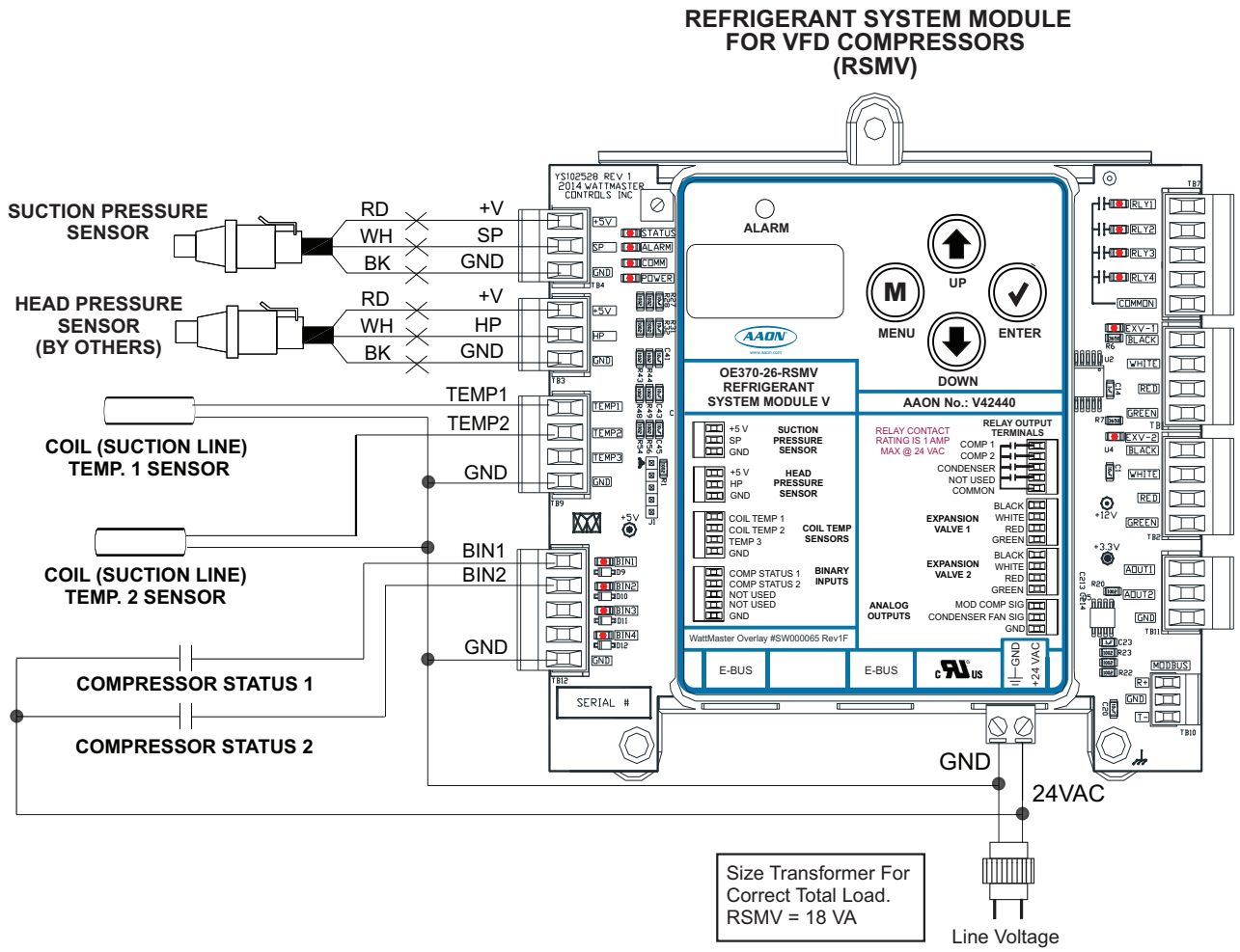


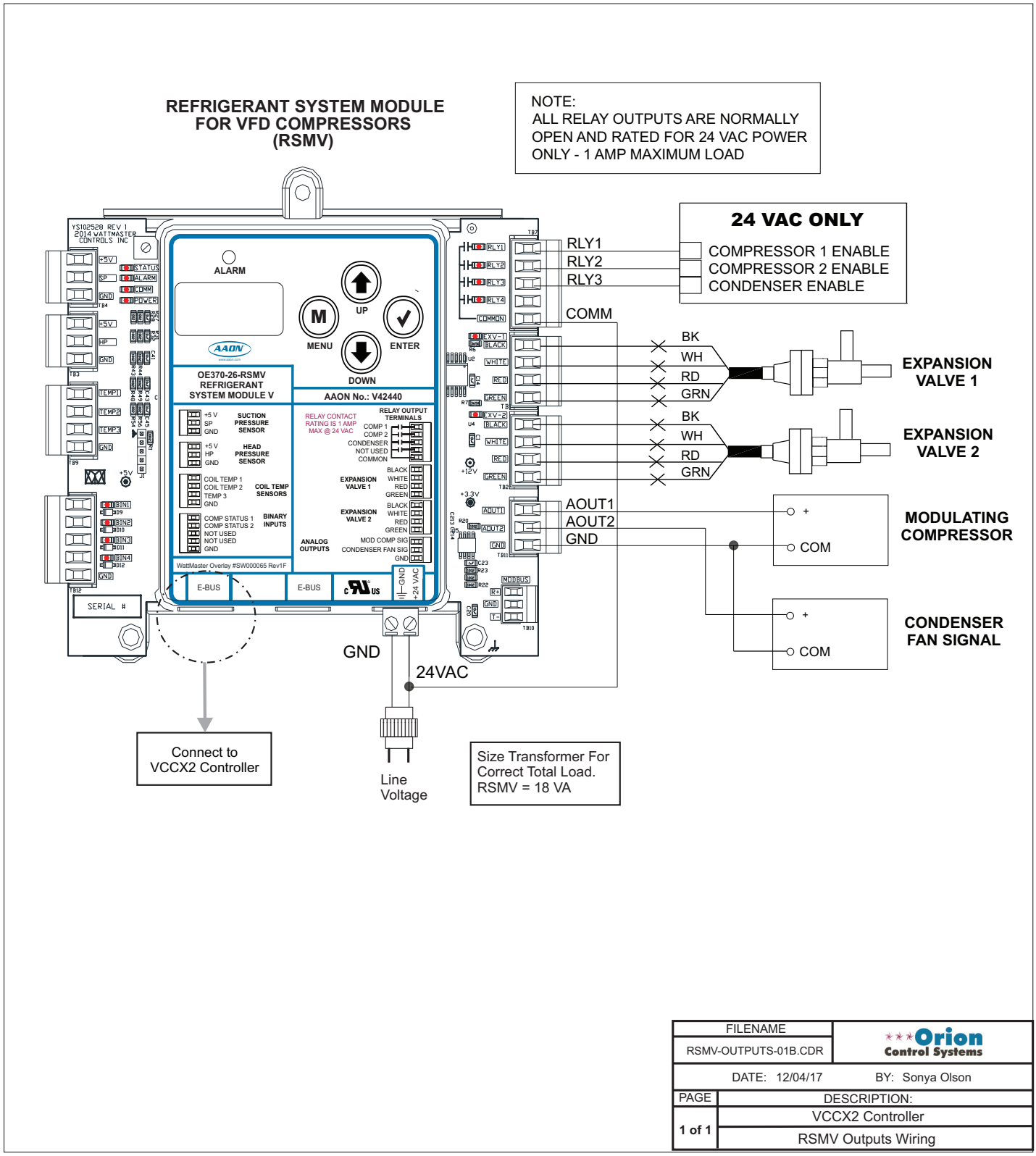
Figure 38: RSMSD Outputs Wiring

RSMV Module Input Wiring



FILENAME	Orion Control Systems
RSMV-INPUTS-01B.CDR	
DATE: 09/18/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Controller RSMV Input Wiring

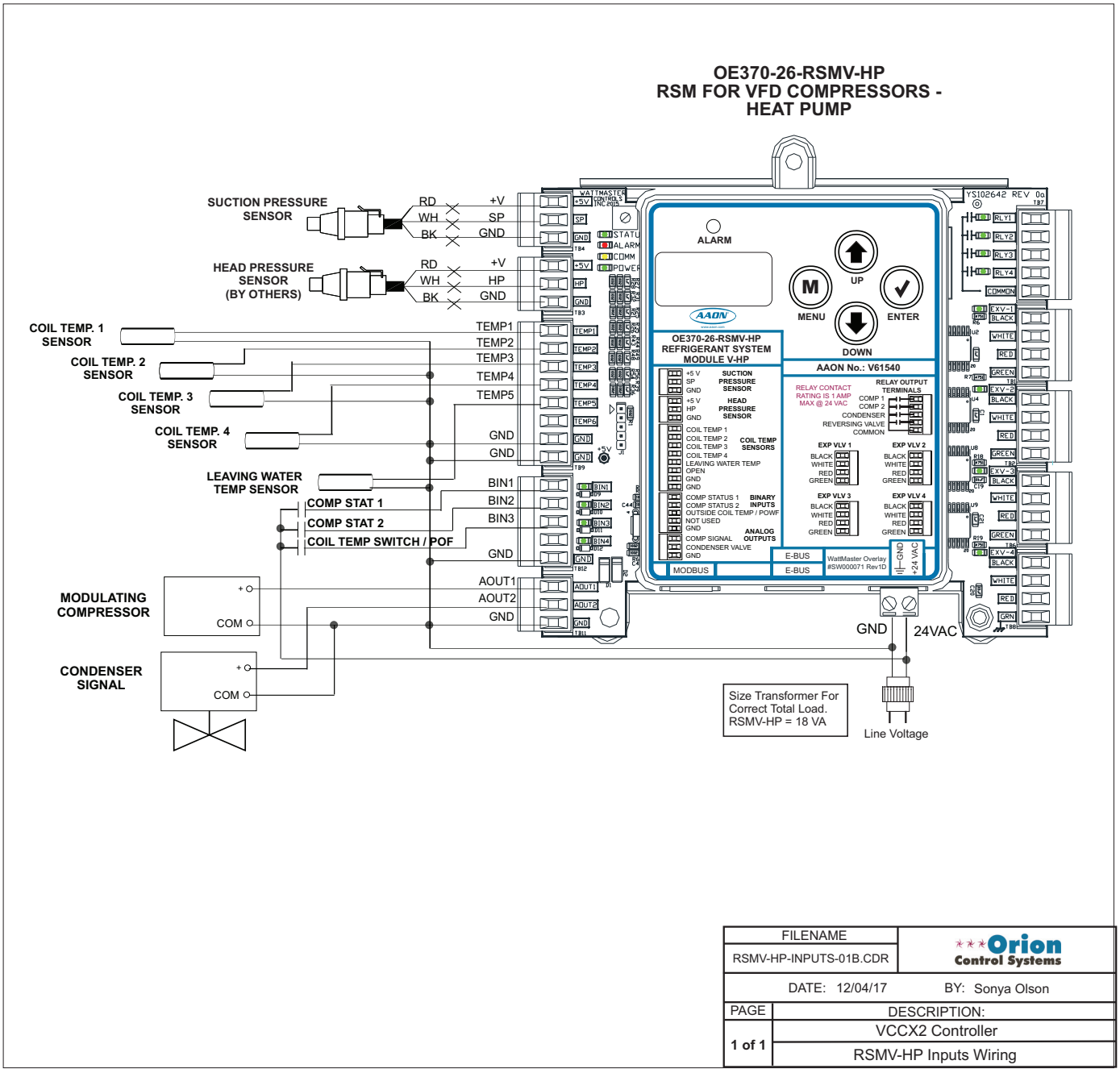
Figure 39: RSMV Inputs Wiring



FILENAME	Orion Control Systems
RSMV-OUTPUTS-01B.CDR	
DATE: 12/04/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Controller
	RSMV Outputs Wiring

Figure 40: RSMV Outputs Wiring

RSMV-HP Module Input Wiring



FILENAME	Orion Control Systems
RSMV-HP-INPUTS-01B.CDR	
DATE: 12/04/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Controller
	RSMV-HP Inputs Wiring

Figure 41: RSMV-HP Inputs Wiring

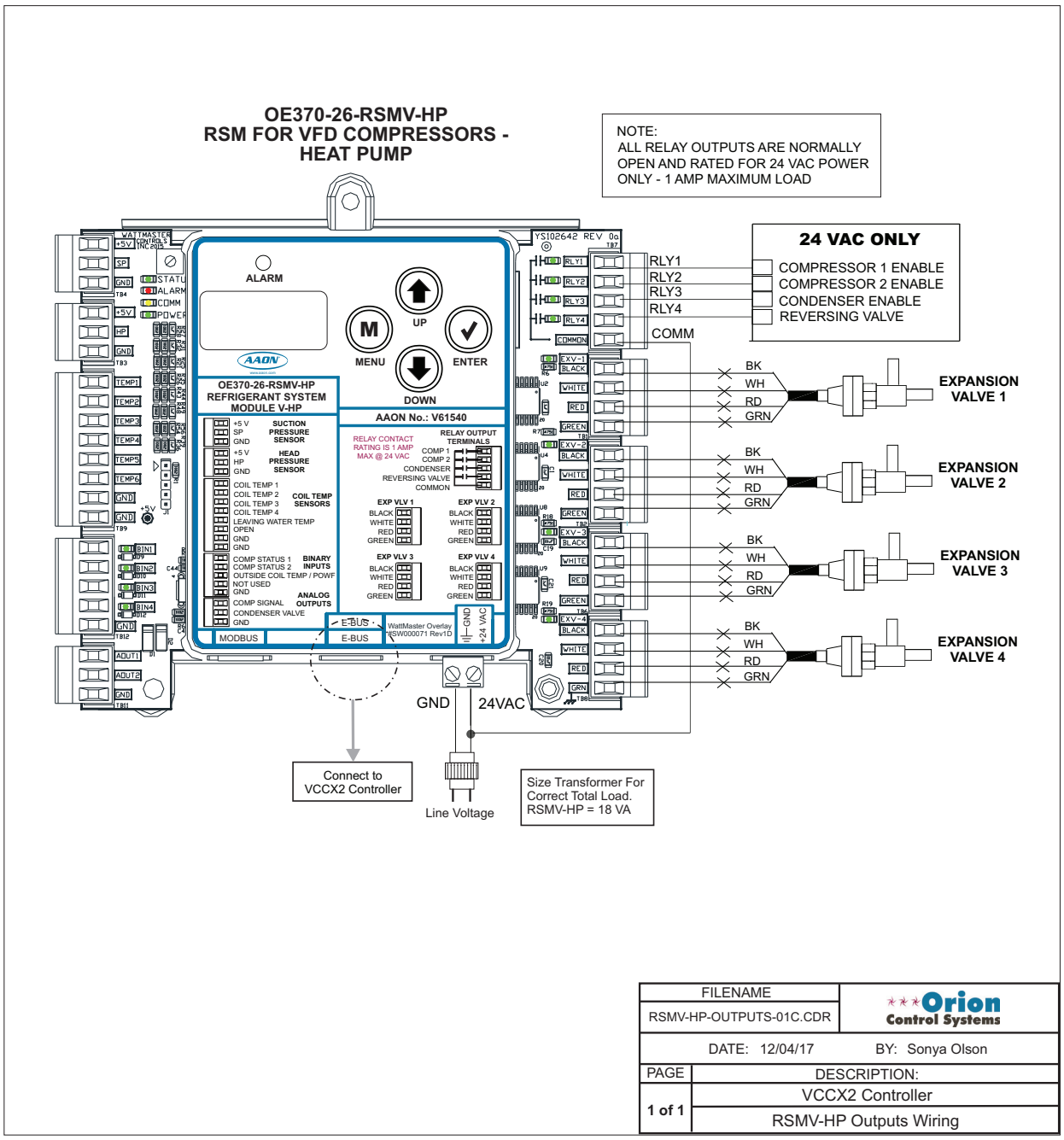


Figure 42: RSMV-HP Outputs Wiring

VAV/Zone Controller Diagrams

VAV/Zone Controller Package Wiring

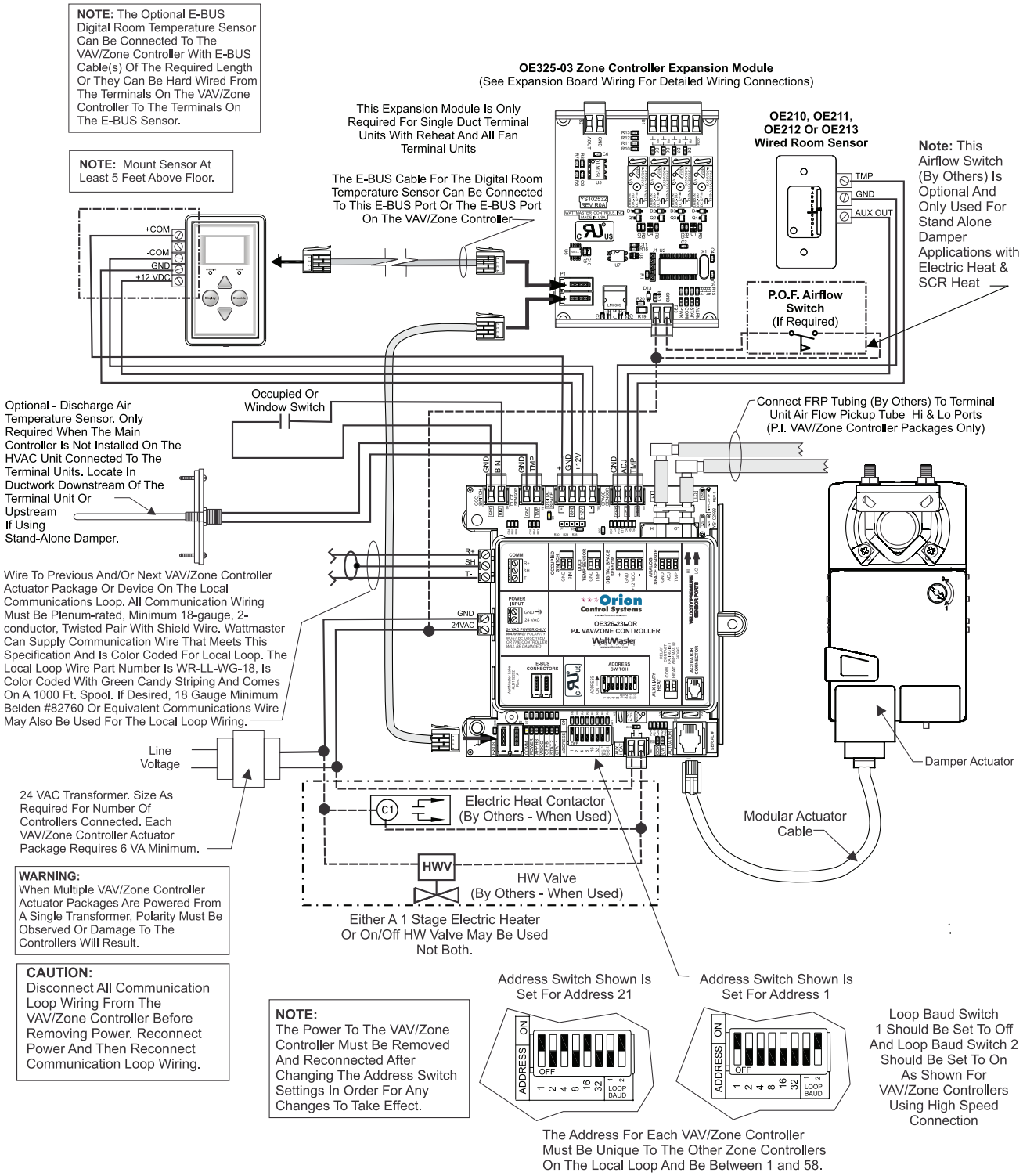


Figure 43: VAV/Zone Controller Package with Terminal Blocks Wiring

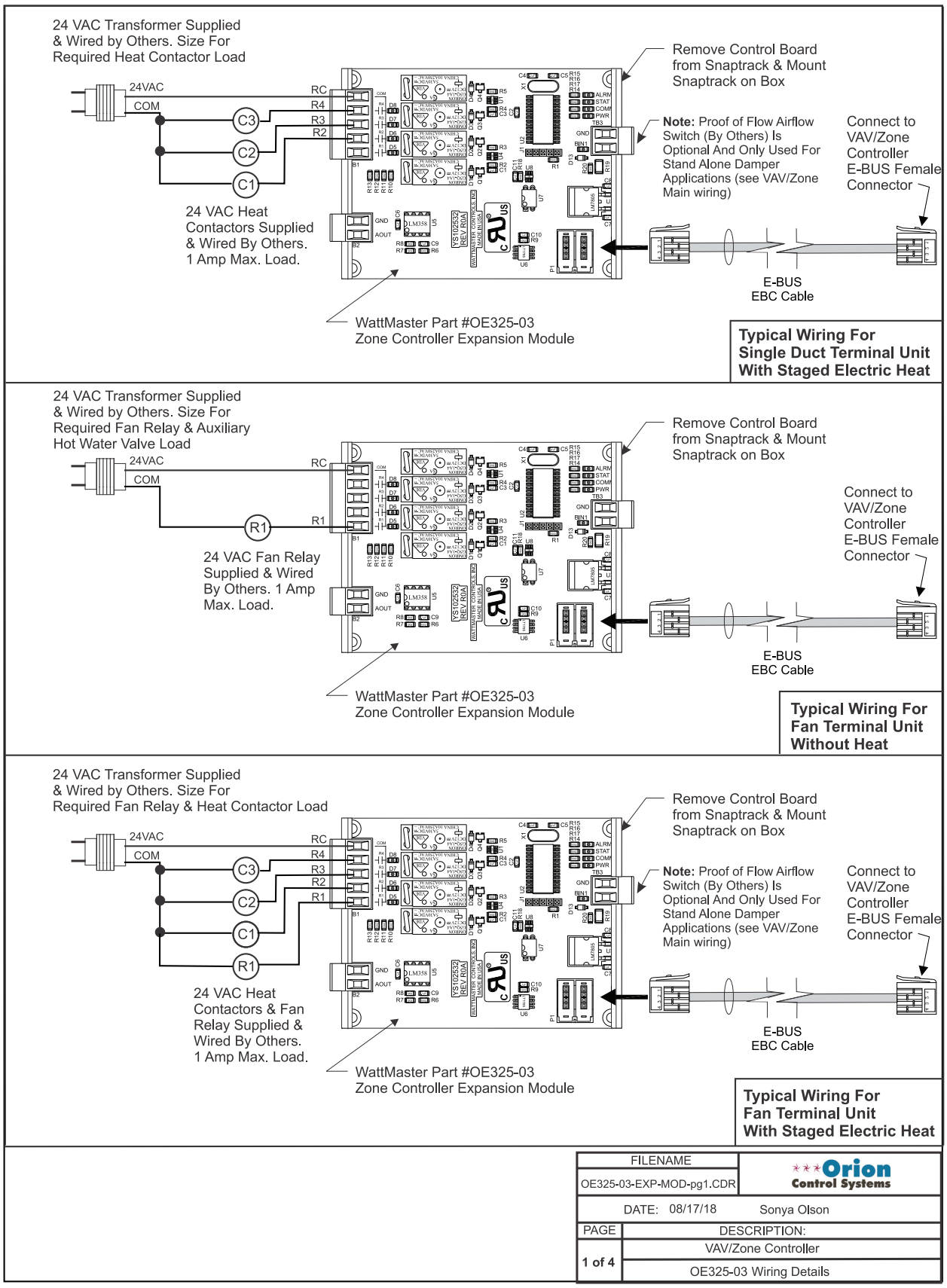
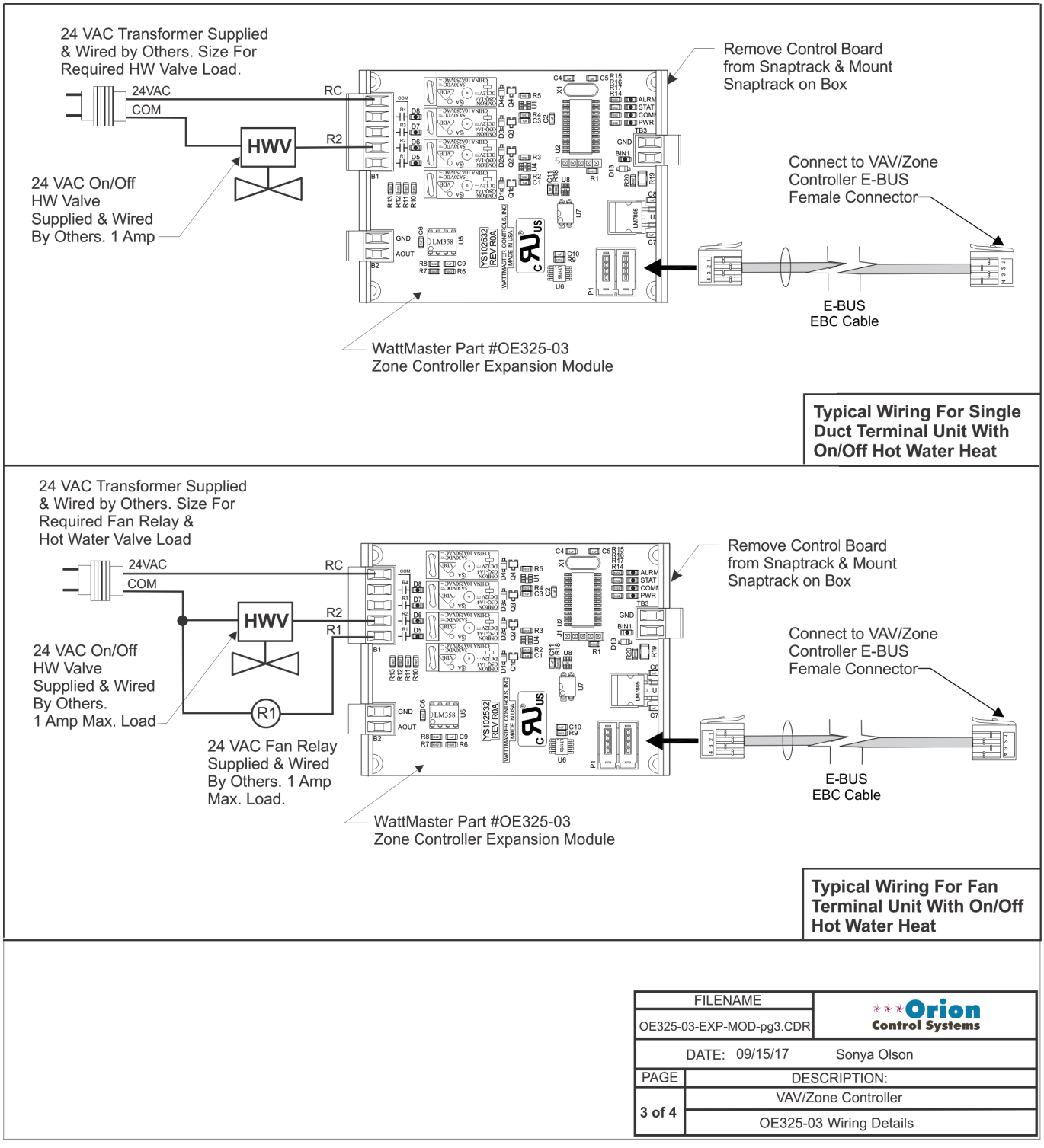


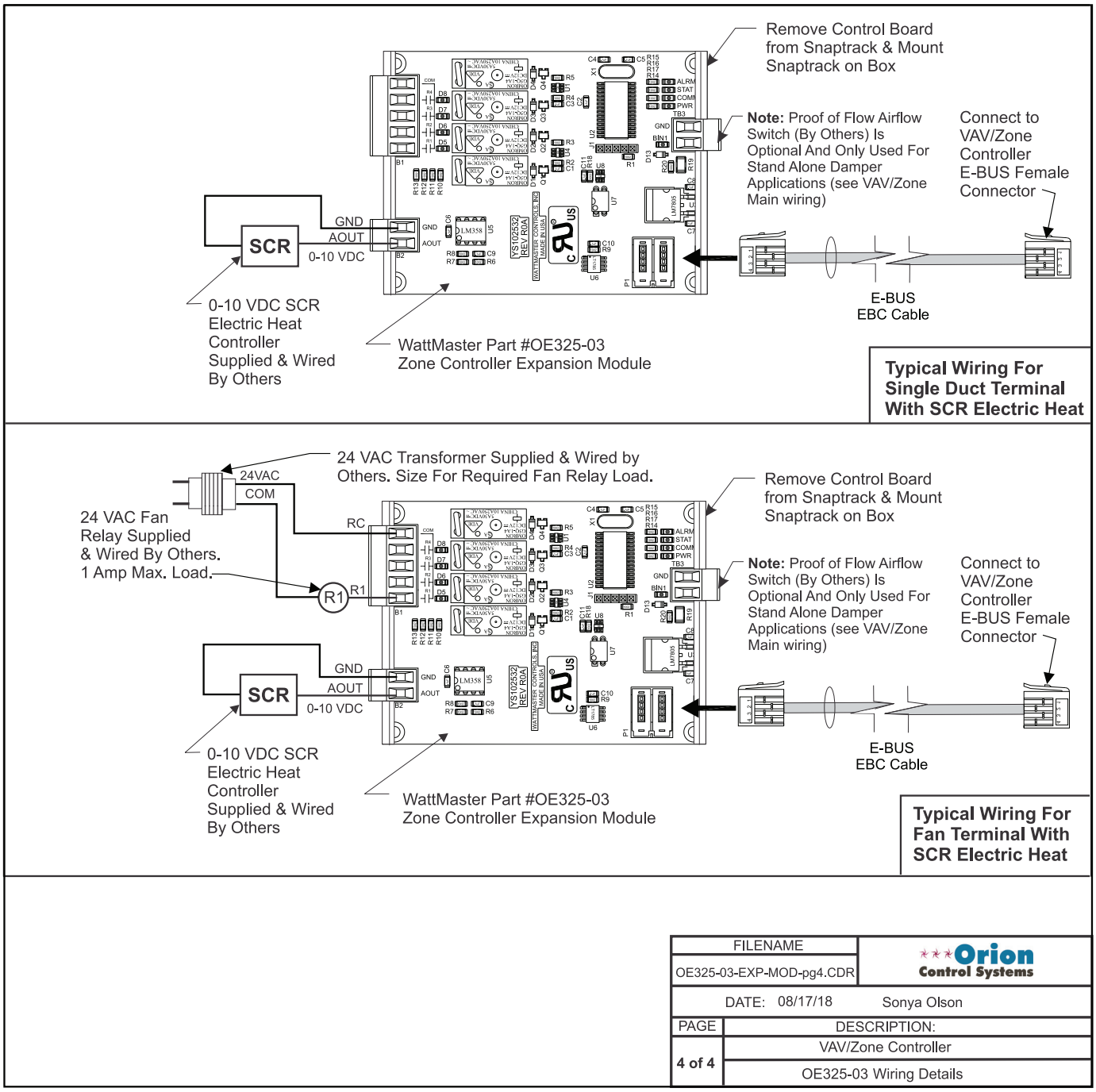
Figure 44: OE325-03 VAV/Zone Expansion Module Wiring

Expansion Module Wiring



FILENAME	Orion Control Systems
OE325-03-EXP-MOD-pg3.CDR	
DATE: 09/15/17 Sonya Olson	
PAGE	DESCRIPTION:
3 of 4	VAV/Zone Controller
	OE325-03 Wiring Details

Figure 45: OE325-01 Expansion Module Wiring



FILENAME	Orion Control Systems
OE325-03-EXP-MOD-pg4.CDR	
DATE: 08/17/18	Sonya Olson
PAGE	DESCRIPTION:
4 of 4	VAV/Zone Controller
	OE325-03 Wiring Details

Figure 46: OE325-01 Expansion Module Wiring

Expansion Module Wiring

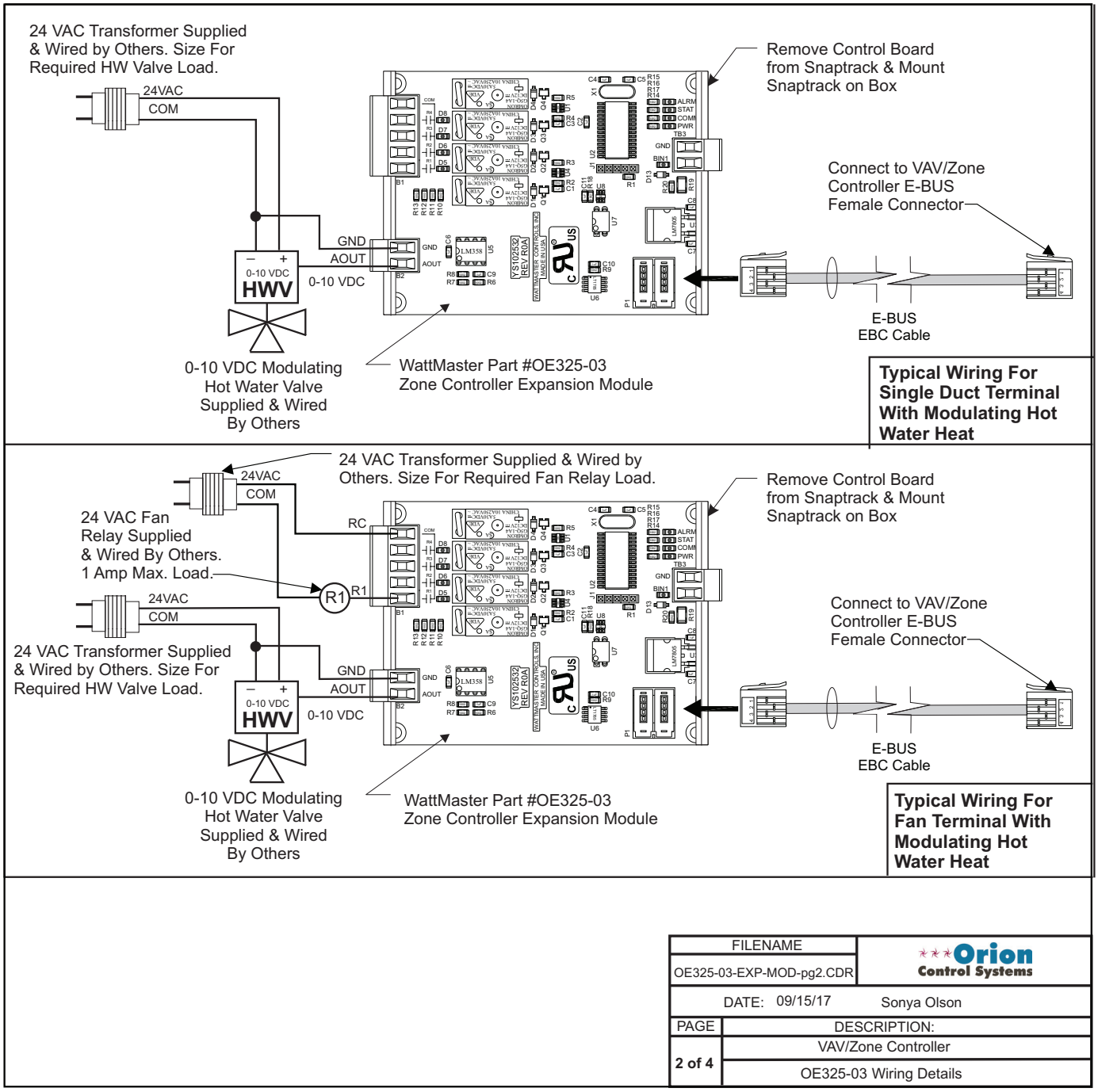


Figure 47: OE325-01 Expansion Module Wiring

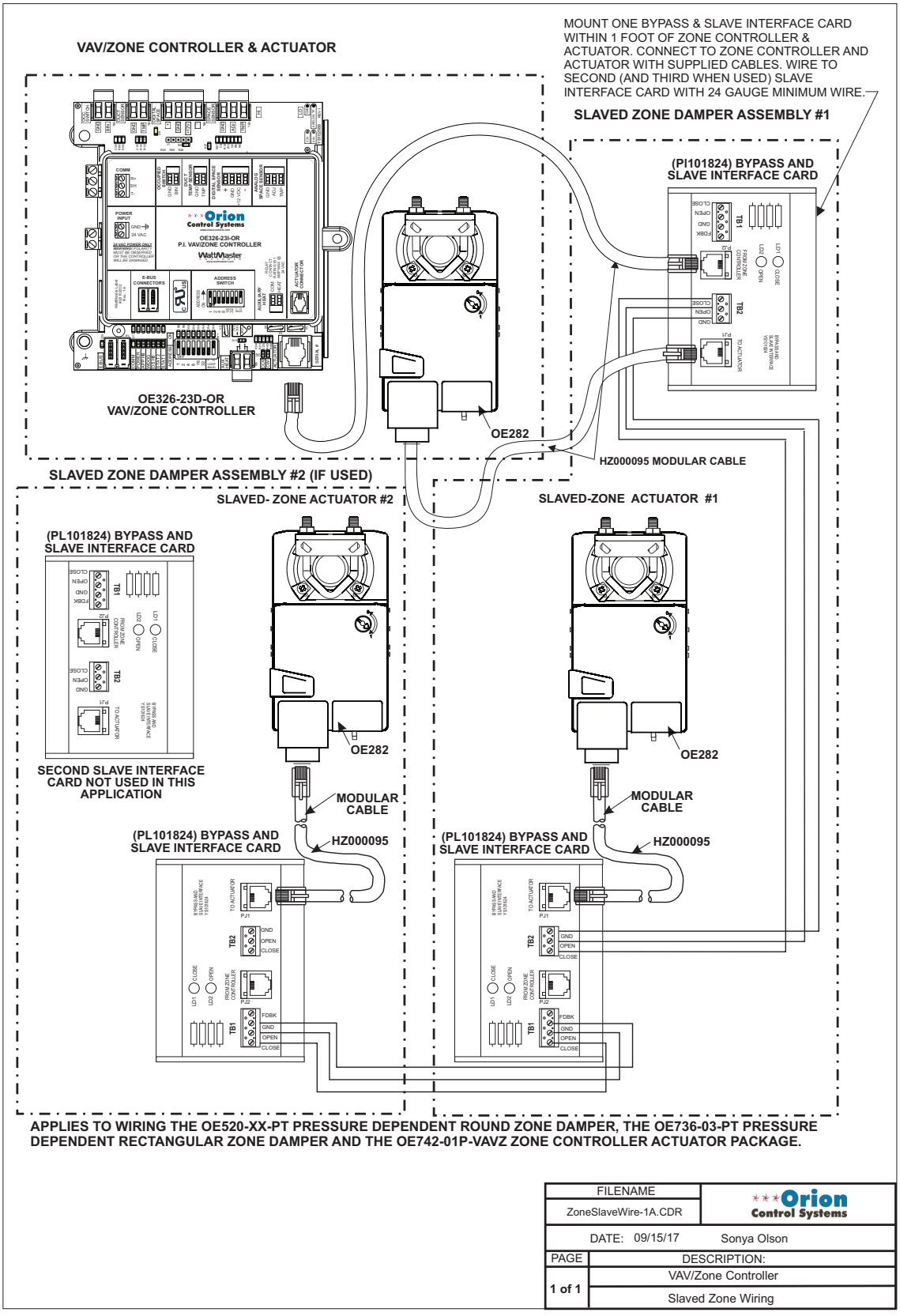
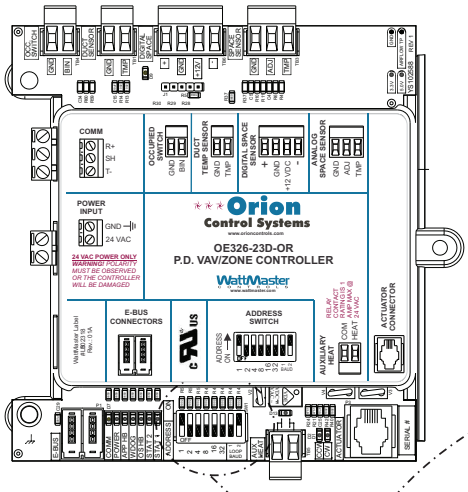


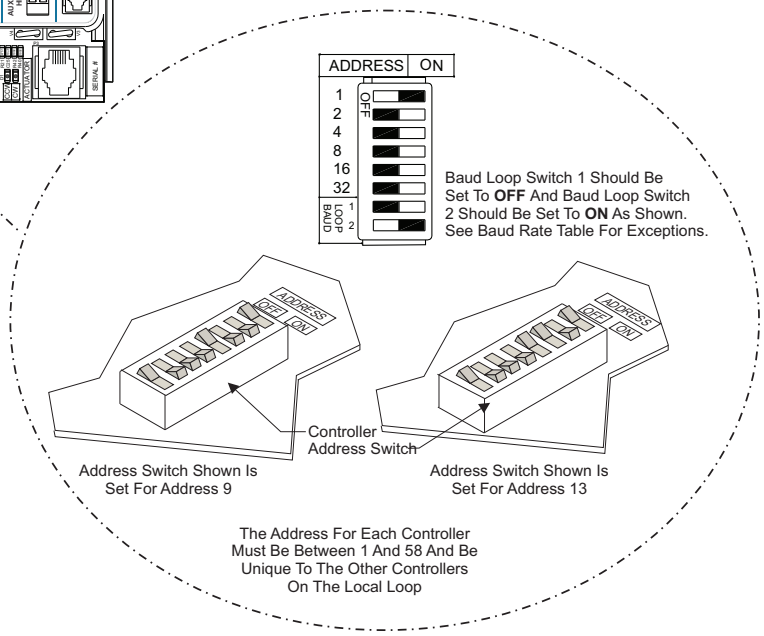
Figure 48: Slaved Zone Wiring

Addressing and Baud Rate



NOTE:
The Power To The Controller Must Be Removed And Reconnected After Changing The Address Switch Settings In Order For Any Changes To Take Effect.

CAUTION:
Disconnect All Communication Loop Wiring From The Controller Before Removing Power From The Controller. Reconnect Power And Then Reconnect Communication Loop Wiring.



BAUD RATE SELECTION

Baud	Switch 1	Switch 2	Communication Setting
9600	OFF	OFF	CommLink IV
9600	OFF	OFF	CommLink 5 Set at Low Speed*
57600	OFF	ON	CommLink 5 Set at High Speed* or VAV/Zone Controller is Stand Alone

* The CommLink 5 must be set to Low Speed if it is being used on a system that includes the VCM-X Controller or older generation of Orion Controllers.
** The CommLink 5 can be set to High Speed if is being used on a system that only includes VCC-X, VCB-X, or GPC-XP Controllers.

FILENAME	Orion Control Systems
Addressing-1A.CDR	
DATE: 09/15/17	Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VAV/Zone Controller
	Addressing and Baud Rate Setting

Figure 49: Address and Baud Rate Switch Setting

Communication Devices Diagrams

System Manager SD Wiring & Jumper Setting

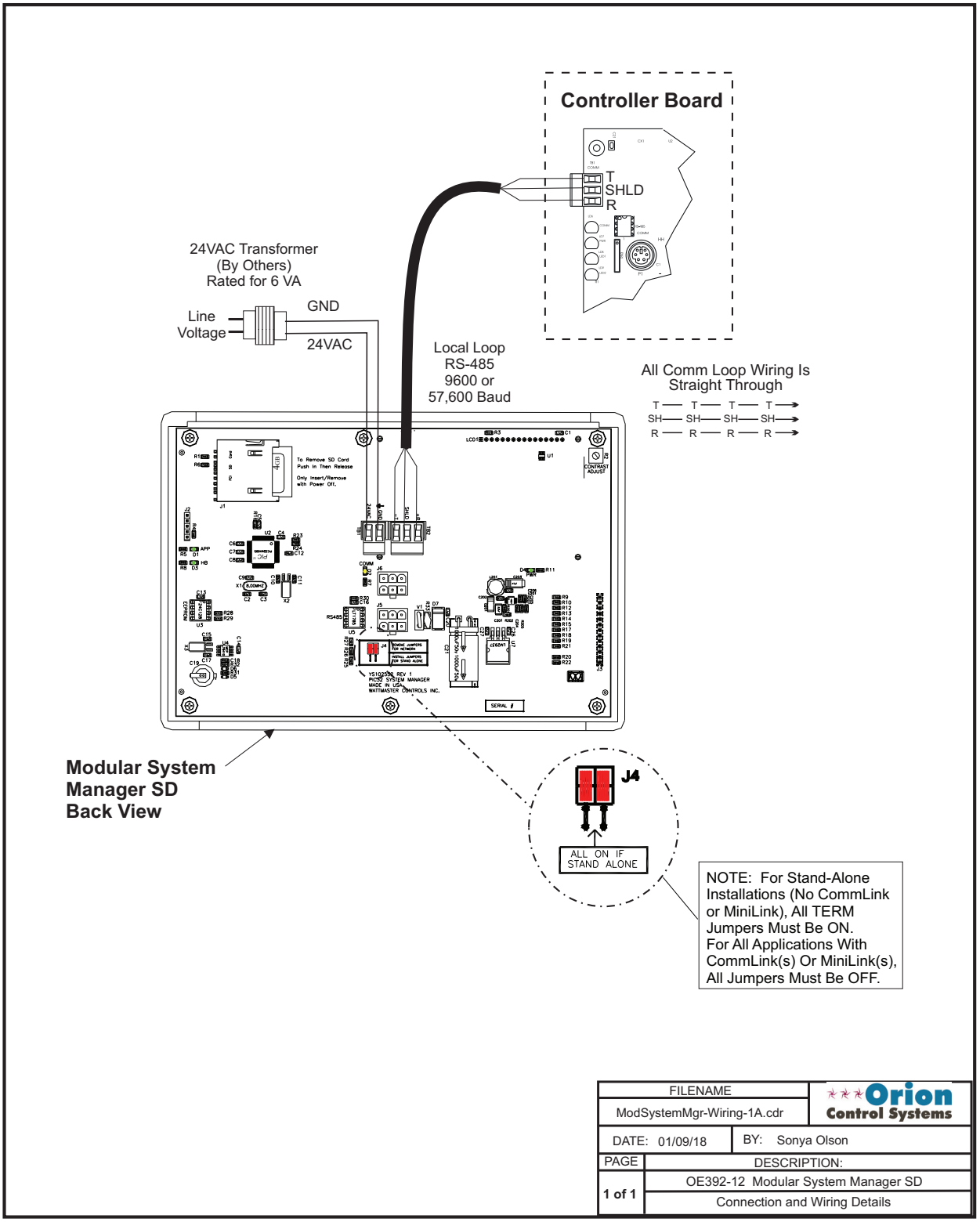
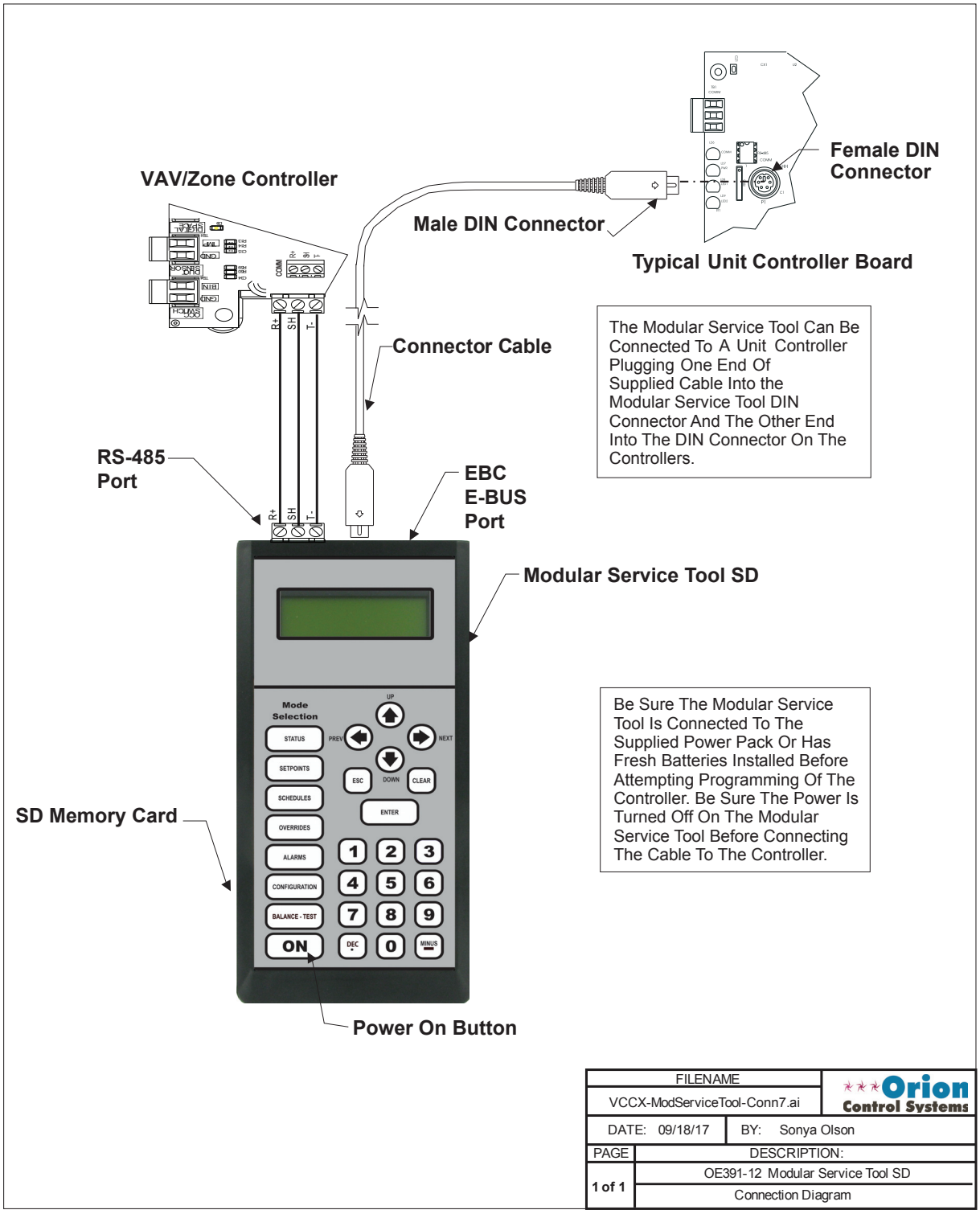


Figure 50: OE392-12 Modular System Manager SD Wiring & Jumper Setting



FILENAME	Orion Control Systems
VCCX-ModServiceTool-Conn7.ai	
DATE: 09/18/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	OE391-12 Modular Service Tool SD Connection Diagram

Figure 51: OE391-12 - Modular Service Tool SD Connections

System Manager TS-L to VCCX2 Controller Wiring

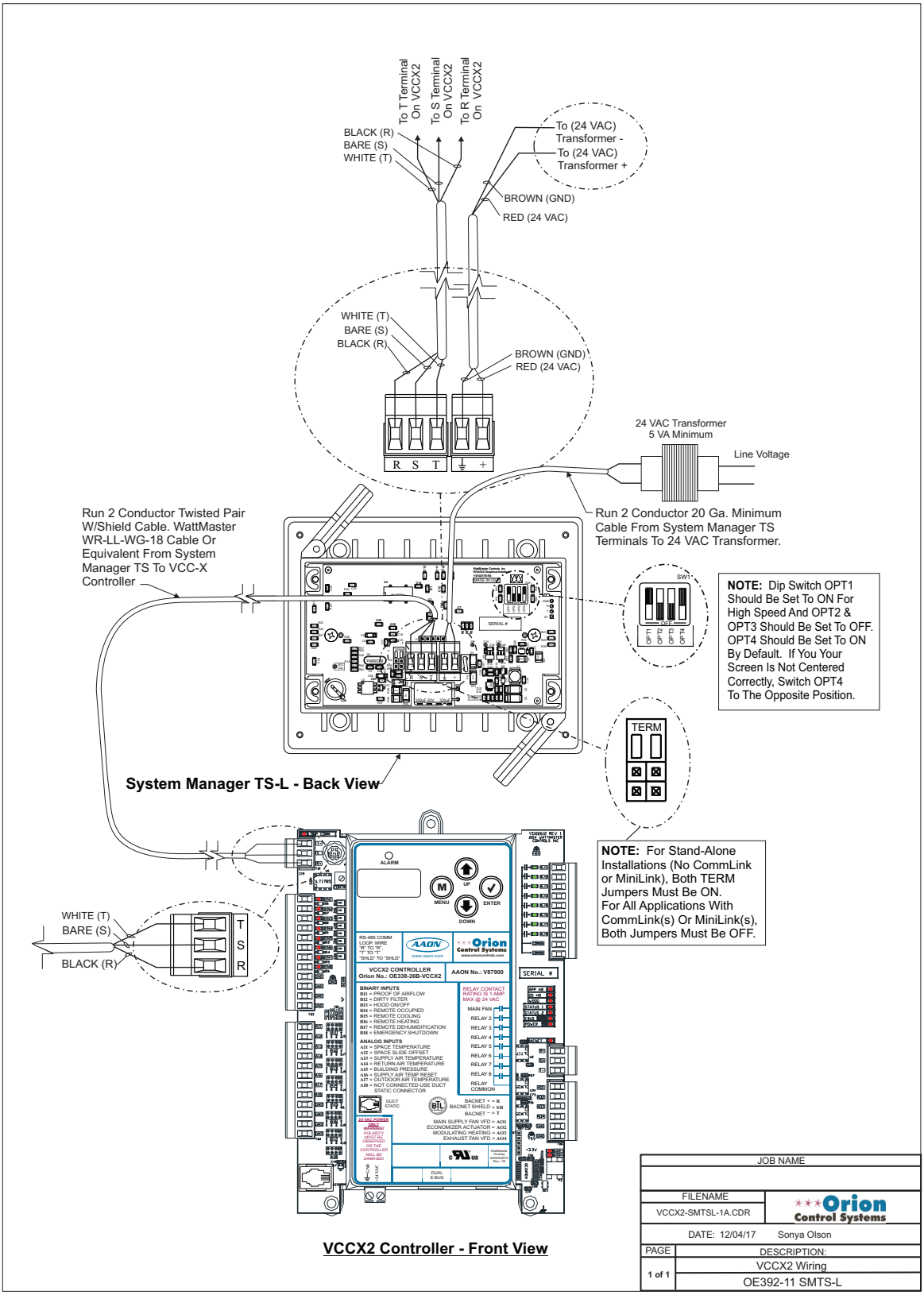


Figure 52: OE392-11 System Manager TS-L to VCCX2 Controller Wiring

System Manager TS-L to VAV/Zone Controller Wiring

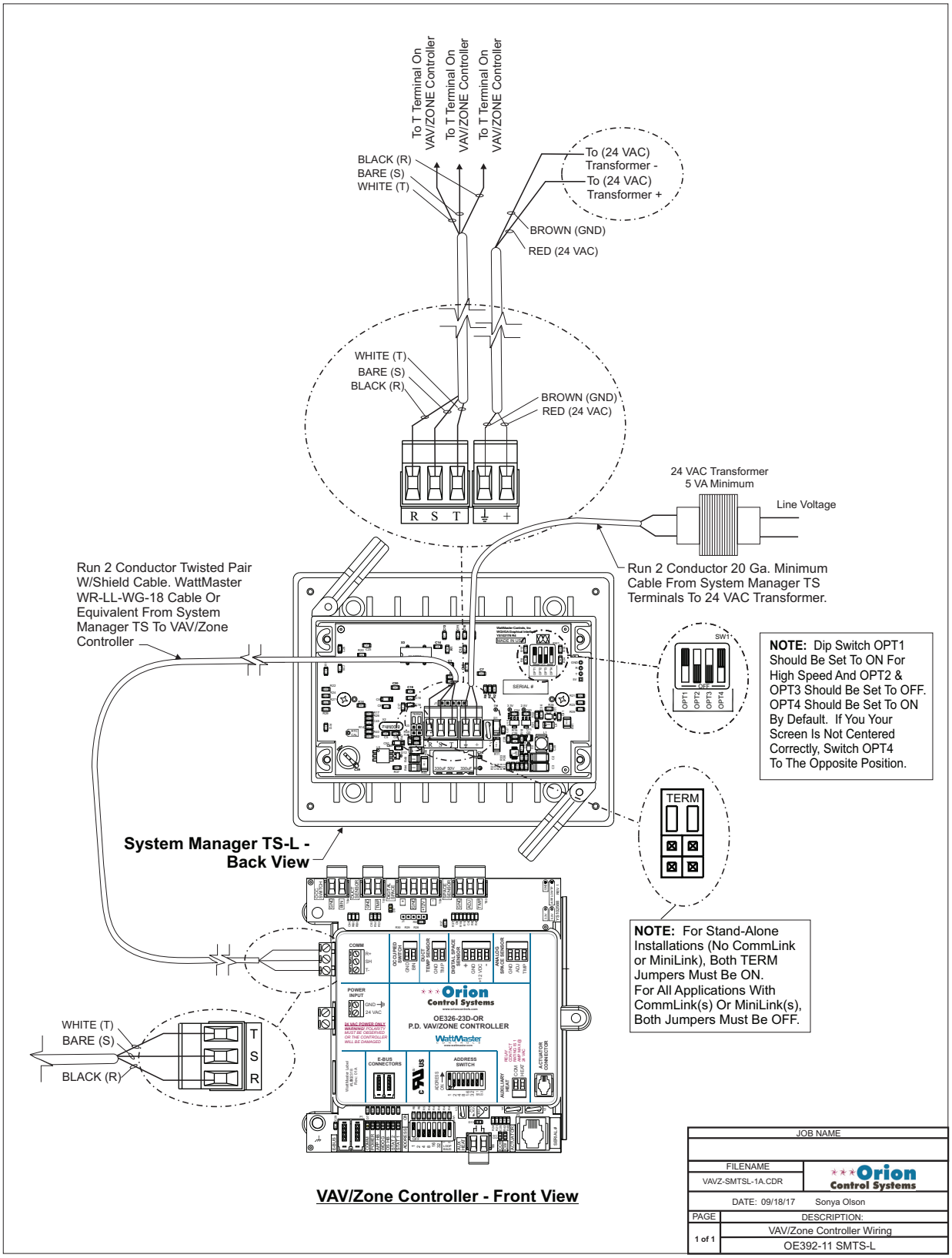
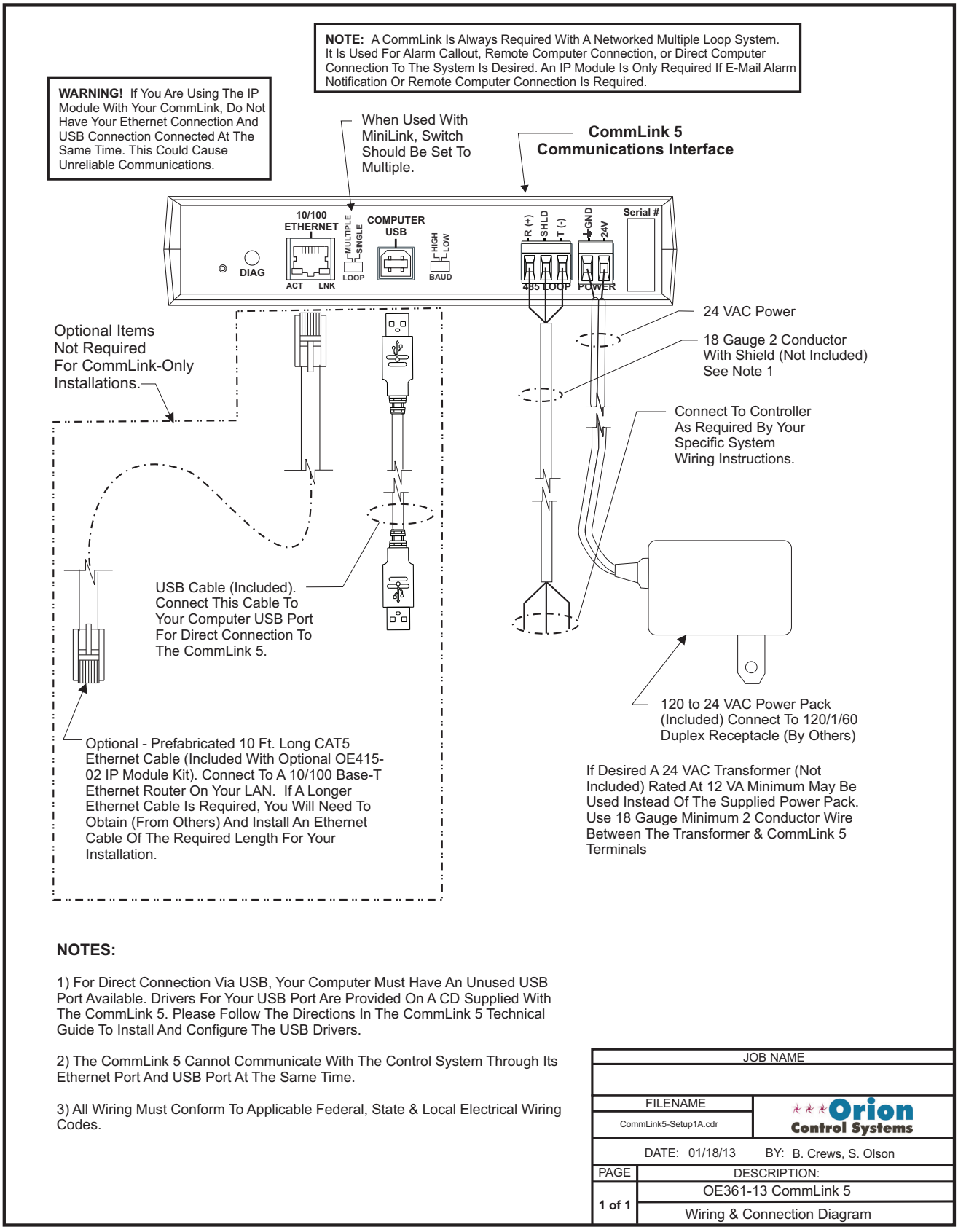


Figure 53: OE392-11 System Manager TS-L to VAV/Zone Controller Wiring

CommLink 5 Connections & Wiring



NOTES:

1) For Direct Connection Via USB, Your Computer Must Have An Unused USB Port Available. Drivers For Your USB Port Are Provided On A CD Supplied With The CommLink 5. Please Follow The Directions In The CommLink 5 Technical Guide To Install And Configure The USB Drivers.

2) The CommLink 5 Cannot Communicate With The Control System Through Its Ethernet Port And USB Port At The Same Time.

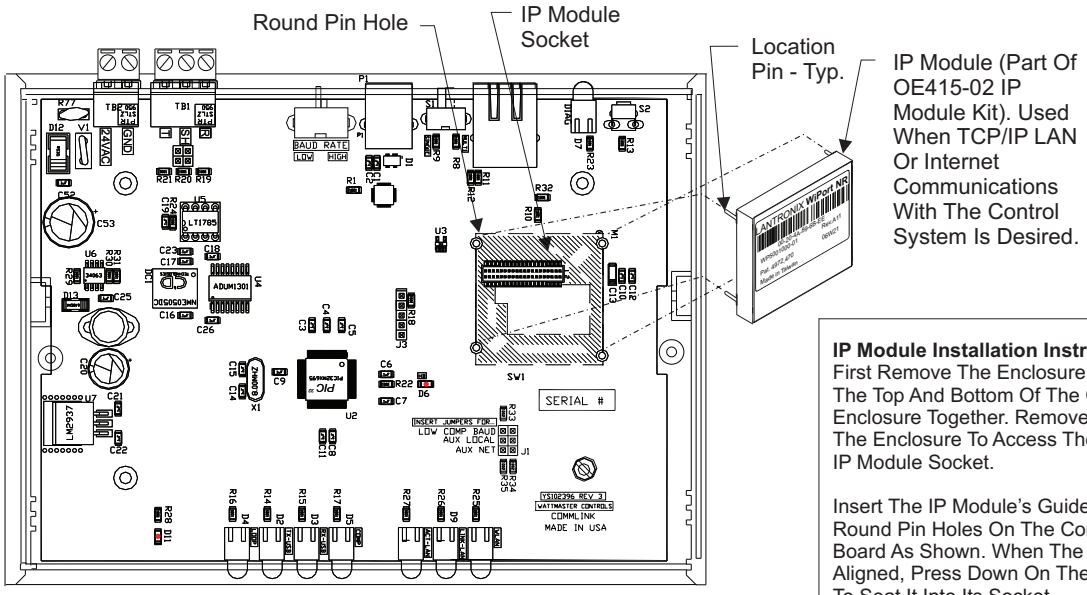
3) All Wiring Must Conform To Applicable Federal, State & Local Electrical Wiring Codes.

JOB NAME	
FILENAME	Orion Control Systems
CommLink5-Setup1A.cdr	
DATE: 01/18/13 BY: B. Crews, S. Olson	
PAGE	DESCRIPTION:
1 of 1	OE361-13 CommLink 5 Wiring & Connection Diagram

Figure 54: OE361-13 CommLink 5 Computer Connection and Wiring

IP-Module General Installation Instructions

Installing the OE415-02 IP Module into the CommLink 5



IP Module Installation Instructions:
First Remove The Enclosure Screws That Hold The Top And Bottom Of The CommLink Enclosure Together. Remove The Top Half Of The Enclosure To Access The Circuit Board And IP Module Socket.

Insert The IP Module's Guide Pins Into The Round Pin Holes On The CommLink Circuit Board As Shown. When The Pins Are Properly Aligned, Press Down On The IP Module Firmly To Seat It Into Its Socket.

After Making Sure The IP Module Is Firmly Seated, Replace The CommLink Cover And Secure The Enclosure Halves Back Together With The Enclosure Screws That Were Previously Removed.

Follow The Instructions In This Guide For Installing The IP Module Software And Configuring The IP Module For Your Control System.

JOB NAME	
FILENAME	Orion Control Systems
IP-ModInstall1A.CDR	
DATE: 01/18/13 BY: S. Olson	
PAGE	DESCRIPTION:
1 of 1	CommLink 5 IP Module Installation Wiring & Connection Diagram

Figure 55: OE415-02 IP Module Installation Instructions

On-Site Computer Connections & Wiring

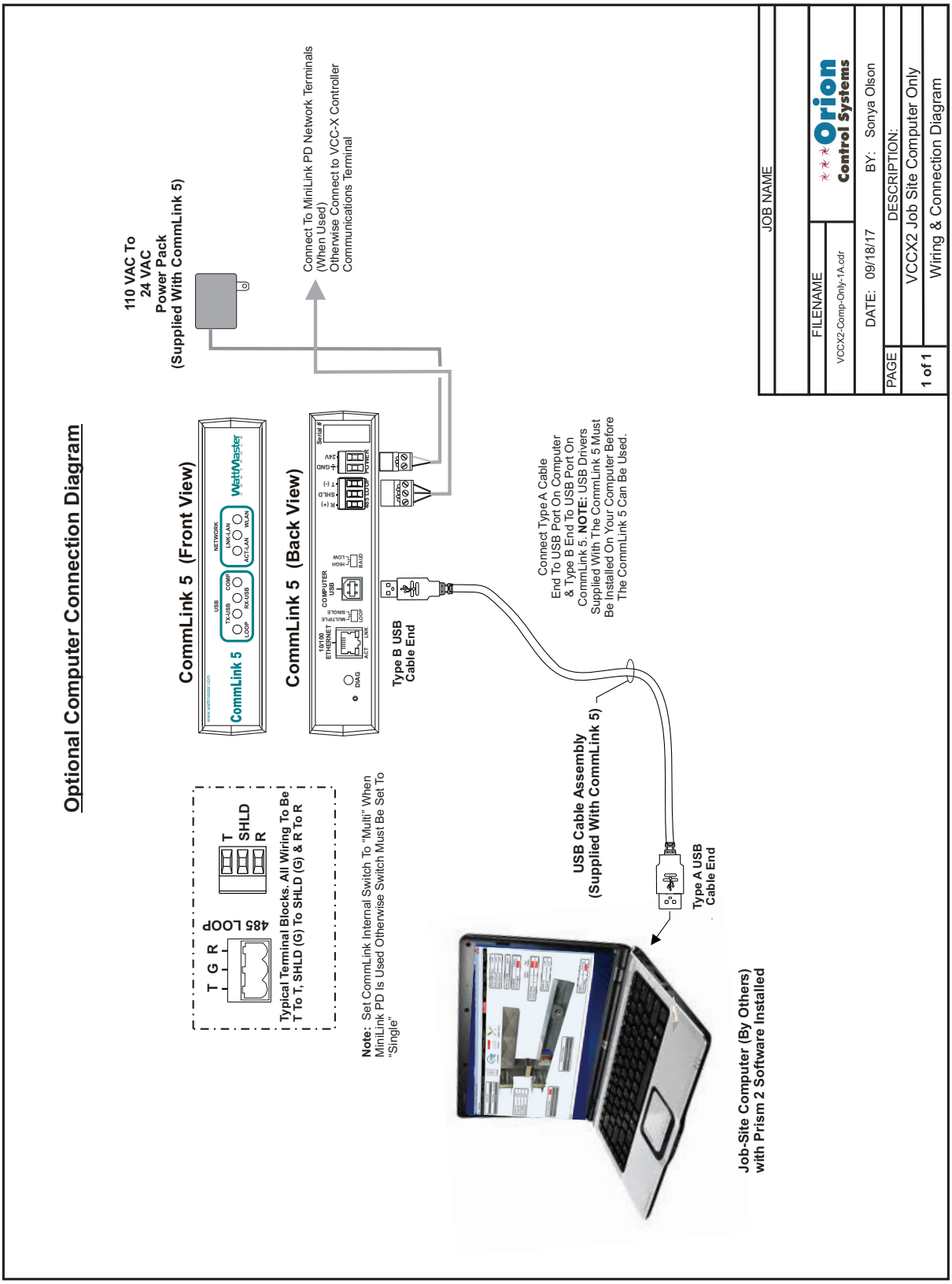


Figure 56: On-Site Computer Connection

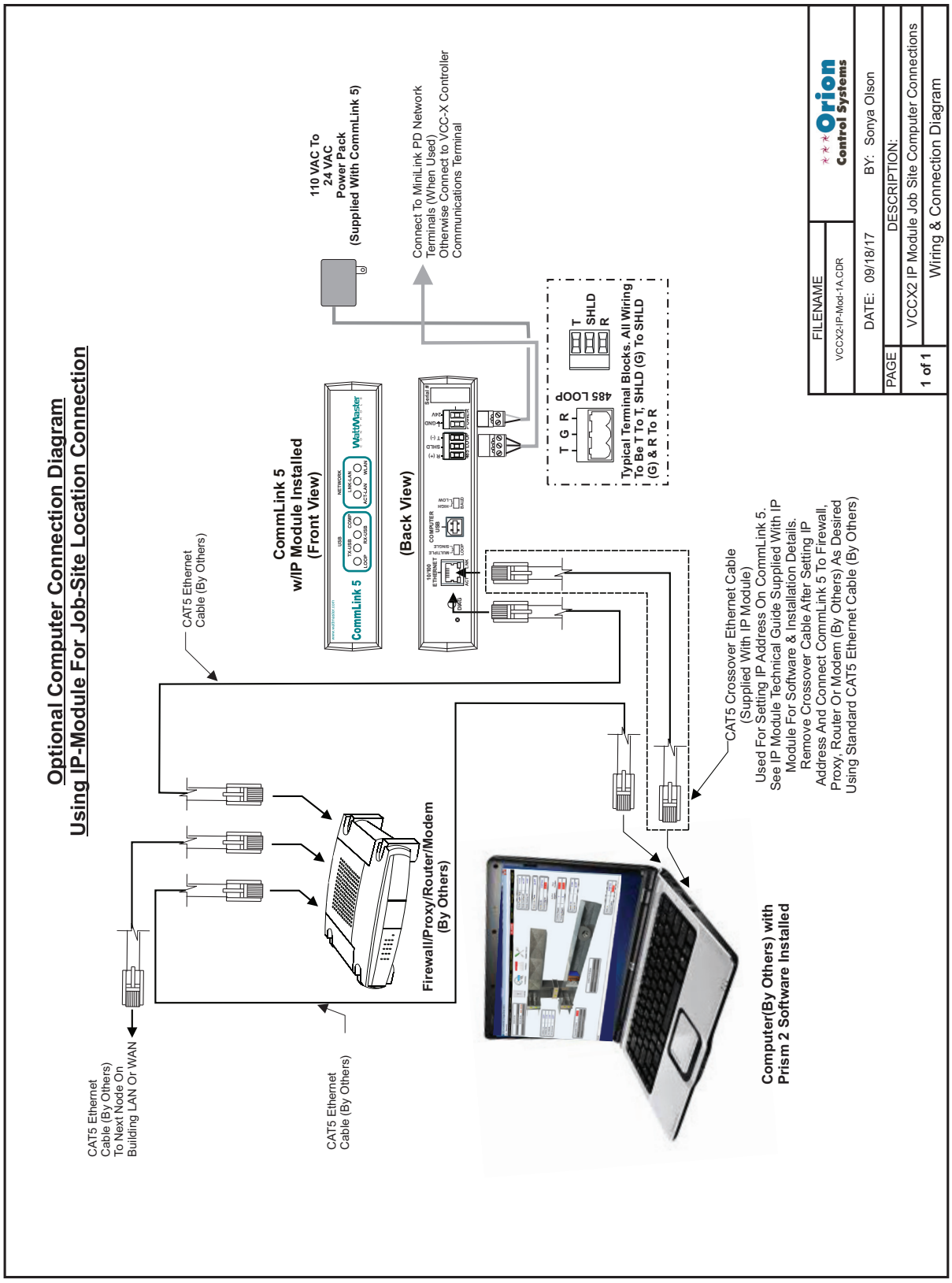


Figure 57: Remote Job-Site Computer Connection

USB-Link 2 Computer Connections & Wiring

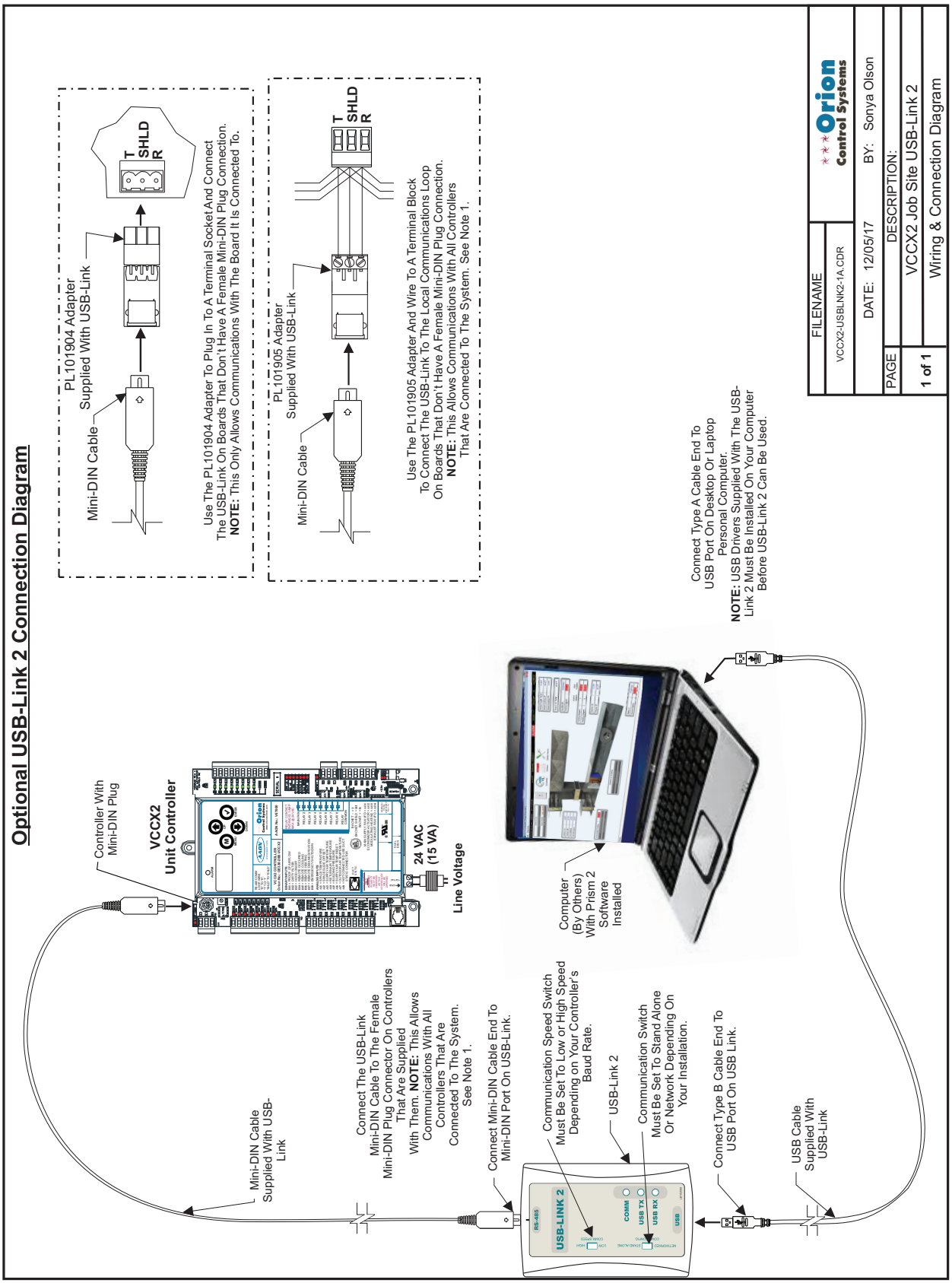
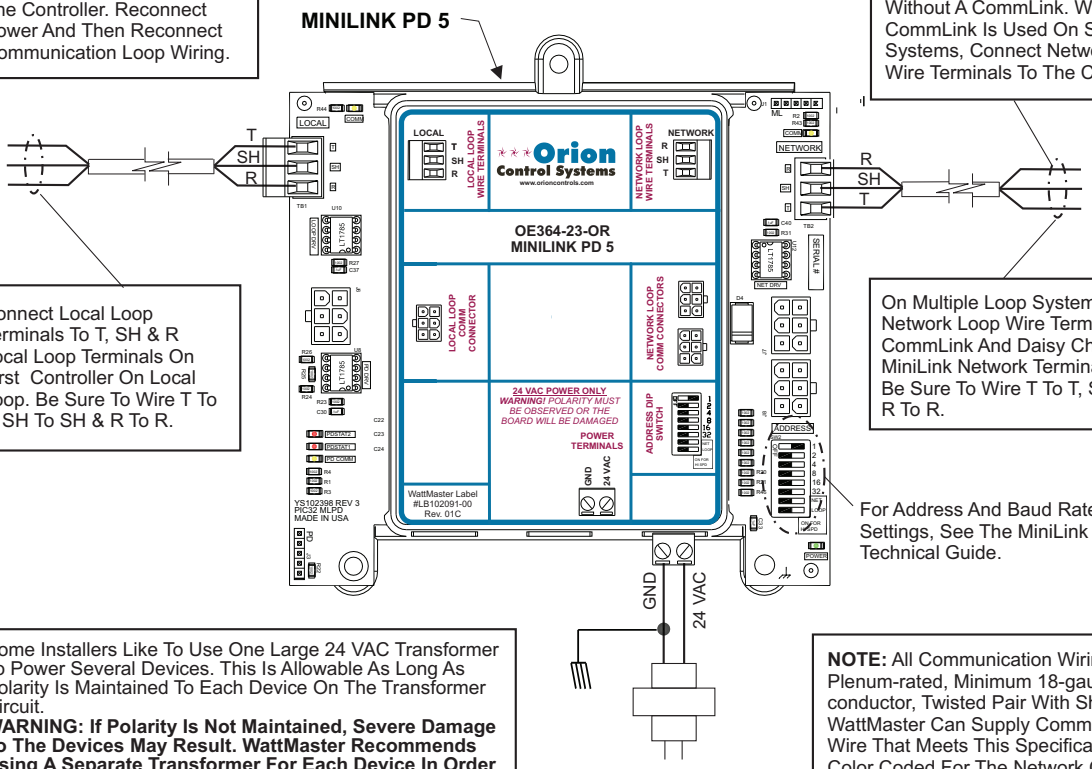


Figure 58: Computer Connections Using USB-Link 2

MLPD 5 Connections & Wiring

CAUTION:
Disconnect All Communication Loop Wiring From The MiniLink Before Removing Power From The Controller. Reconnect Power And Then Reconnect Communication Loop Wiring.



Connect Local Loop Terminals To T, SH & R Local Loop Terminals On First Controller On Local Loop. Be Sure To Wire T To T, SH To SH & R To R.

NOTE: This Network Wiring Is Not Required On Single Loop Systems Without A CommLink. When A CommLink Is Used On Single Loop Systems, Connect Network Loop Wire Terminals To The CommLink.

On Multiple Loop Systems, Connect Network Loop Wire Terminals To CommLink And Daisy Chain All MiniLink Network Terminals Together. Be Sure To Wire T To T, SH To SH & R To R.

For Address And Baud Rate Settings, See The MiniLink PD 5 Technical Guide.

Some Installers Like To Use One Large 24 VAC Transformer To Power Several Devices. This Is Allowable As Long As Polarity Is Maintained To Each Device On The Transformer Circuit.
WARNING: If Polarity Is Not Maintained, Severe Damage To The Devices May Result. WattMaster Recommends Using A Separate Transformer For Each Device In Order To Eliminate The Potential For Damaging Devices Due To Incorrect Polarity.
Using Separate Transformers Also Allows Redundancy In Case Of A Transformer Failure. Instead Of Having 8 Devices Inoperative Because Of A Malfunctioning Transformer, You Have Only 1 Device Off Line.

24 VAC Transformer
Size For 6 VA Min. Load

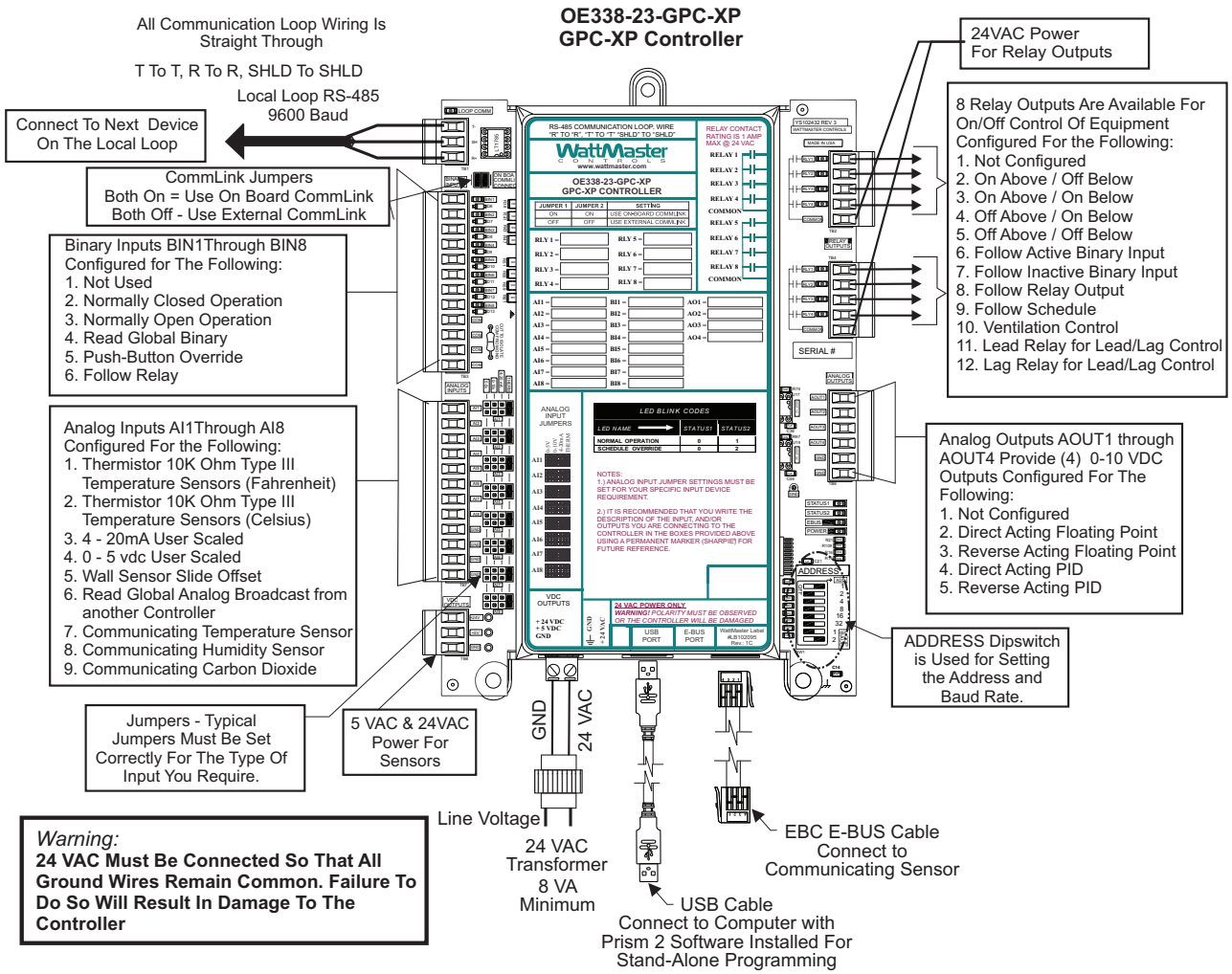
NOTE: All Communication Wiring Must Be Plenum-rated, Minimum 18-gauge, 2-conductor, Twisted Pair With Shield Wire. WattMaster Can Supply Communication Wire That Meets This Specification And Is Color Coded For The Network Or Local Loop. The Local Loop Wire Part Number Is WR-LL-WG-18, Is Color Coded With Green Candy Striping And Comes On A 1000 Ft. Spool. The Network Loop Wire Part Number Is WR-NL-WR-18, Is Color Coded With Red Candy Striping And Comes On A 500 Ft. Spool. If Desired, 18 Gauge Minimum Belden #82760 Or Equivalent Communications Wire May Also Be Used For Network Or Local Loop Wiring.

JOB NAME	
FILENAME	Orion Control Systems
VCCX2-MLPD5-1A.CDR	
DATE: 12/05/17	BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	VCCX2 Job Site MLPD5 Wiring & Connection Diagram

Figure 59: OE364-23 MiniLink Polling Device 5 Wiring

Add-On Devices Diagrams

GPC-XP Controller Wiring



NOTES:

1.)24 VAC Must Be Connected So That All Ground Wires Remain Common.

2.)All Wiring To Be In Accordance With Local And National Electrical Codes and Specifications.

3.)All Communication Wiring To Be 18 Ga. Minimum, 2 Conductor Twisted Pair With Shield. Belden #82760 Or Equivalent.

4.)It Is Recommended That The Address Switch Is Set Before Installation.

JOB NAME	
FILENAME	Orion Control Systems
GPCXP-Wire-1A.CDR	
DATE: 01/05/17	DRAWN BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	OE332-23-GPCXP GPC-XP Controller

Figure 60: OE332-23-GPCXP GPC-XP Controller Wiring

GPC-XP Controller On-Board CommLink Setting

Caution:
Disconnect All Communication Loop Wiring From The Controller Before Removing Power From The Controller. Reconnect Power And Then Reconnect Communication Loop Wiring.

Note:
The Power To The Controller Must Be Removed And Reconnected After Changing The Address Switch Settings In Order For Any Changes To Take Effect.

ON-BOARD COMMLINK SETTING

Jumper 1	Jumper 2	Setting
ON	ON	Use On-Board CommLink
OFF	OFF	Use External CommLink

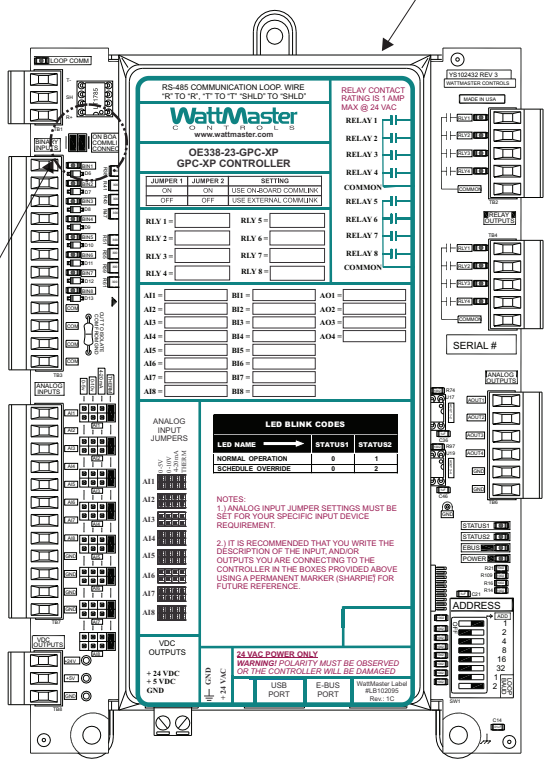
Both Jumpers ON

USE ON-BOARD COMMLINK

Both Jumpers OFF

USE EXTERNAL COMMLINK

GPC-XP Controller



JOB NAME	
FILENAME	Orion Control Systems
GPCXP-CommLink-1A.CDR	
DATE: 01/05/17	DRAWN BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	OE332-23-GPCXP GPC-XP Controller

Figure 61: OE332-23-GPCXP GPC-XP Controller On-Board CommLink Setting

GPC-XP Controller Addressing & Baud Rate Selection

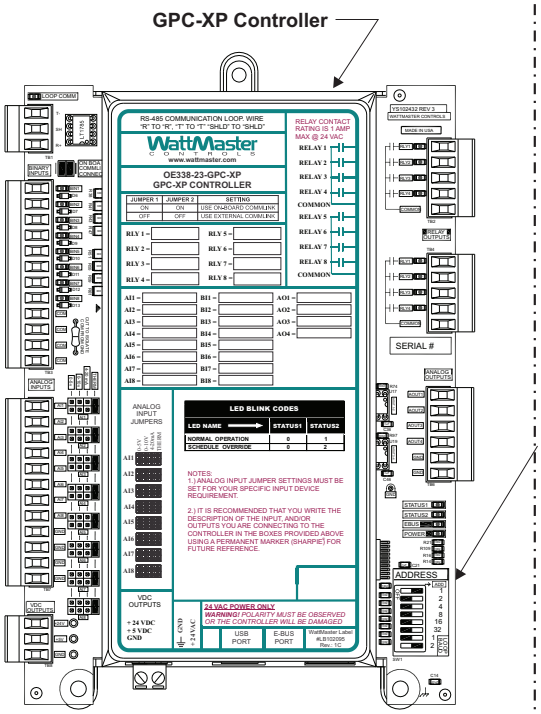
Caution:
Disconnect All Communication Loop Wiring From The Controller Before Removing Power From The Controller. Reconnect Power And Then Reconnect Communication Loop Wiring.

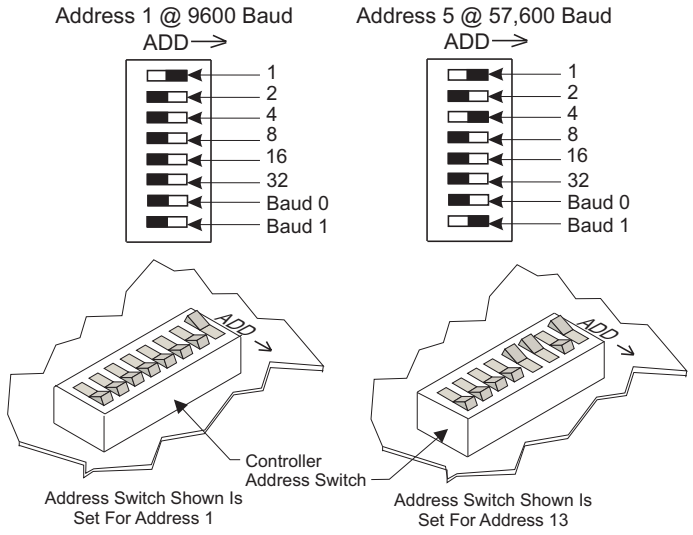
Note:
The Power To The Controller Must Be Removed And Reconnected After Changing The Address Switch Settings In Order For Any Changes To Take Effect.

BAUD RATE SELECTION

Baud	Switch 7	Switch 8	Communication Setting
9600	OFF	OFF	CommLink IV
9600	OFF	OFF	CommLink 5 Set at Low Speed*
57600	OFF	ON	CommLink 5 Set at High Speed* or GPC-XP is Stand Alone

* The CommLink 5 must be set to Low Speed if it is being used on a system that includes the VCM-X Controller or older generation of Orion Controllers.
** The CommLink 5 can be set to High Speed if is being used on a system that only includes VCC-X or VCC-X Controllers that are set to High Speed along with this GPC-XP Controller.





The Address For Each Controller
Must Be Unique To The Other Controllers
On The Local Loop And Be Between 1 and 59

JOB NAME	
FILENAME	Orion Control Systems
GPCXP-Address-1A.CDR	
DATE: 01/05/17	DRAWN BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	OE332-23-GPCXP GPC-XP Controller

Figure 62: OE332-23-GPCXP GPC-XP Controller Addressing & Baud Rate Selection

Additional Module Wiring & Connections

MODGAS-X Controller Wiring When Used With The VCCX2

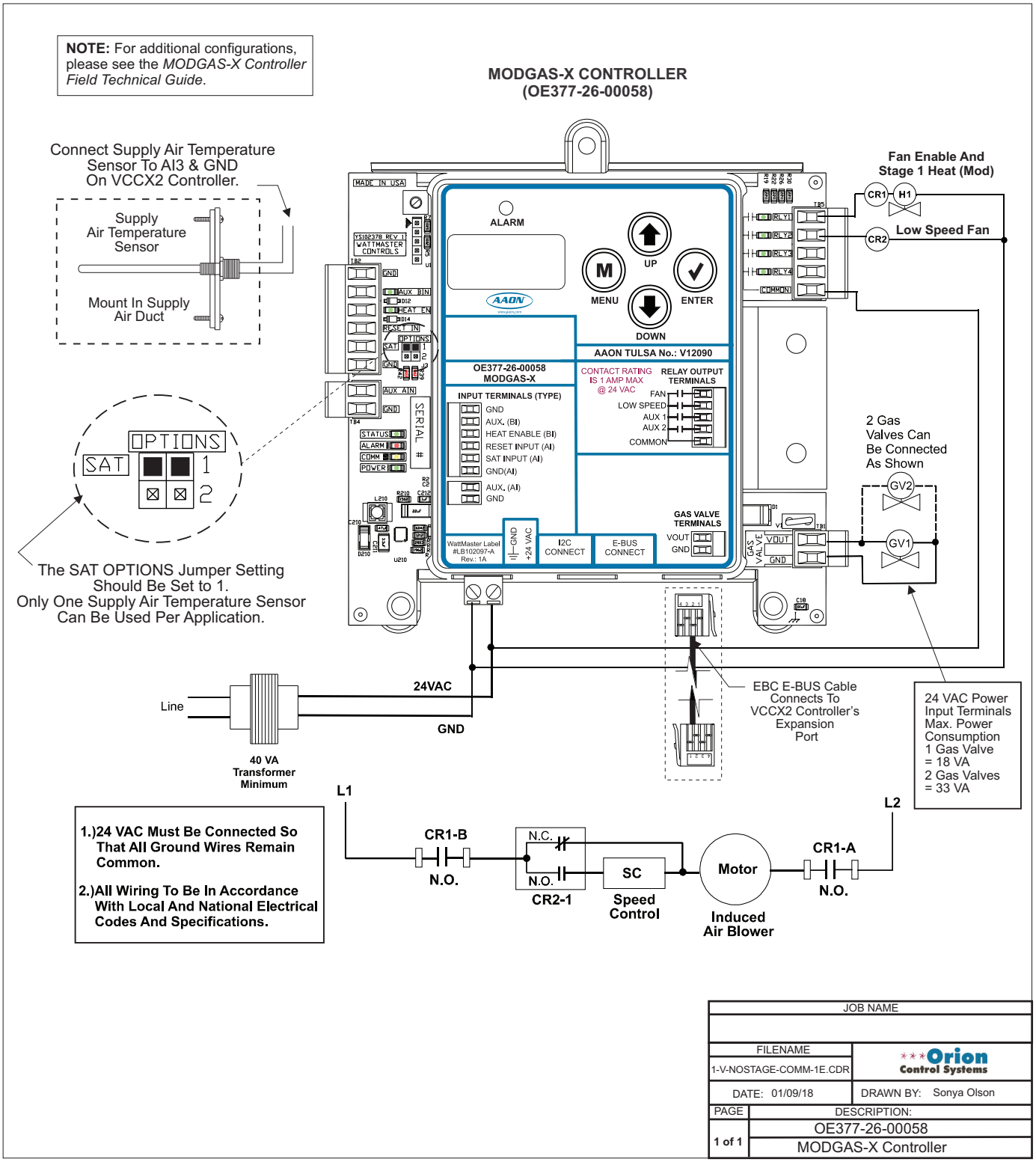
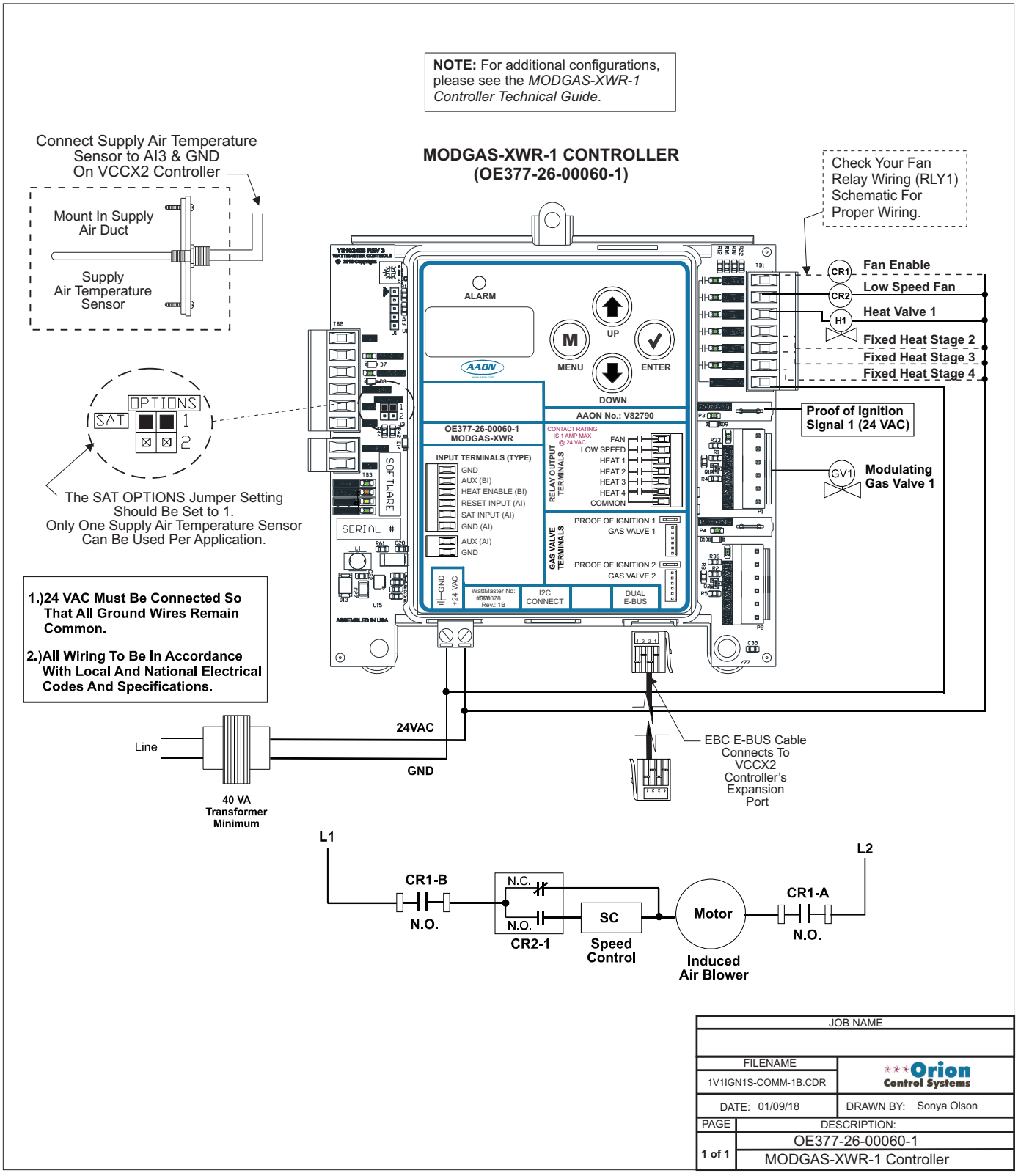


Figure 63: OE377-26-00058 - Single Modulating Valve No Staging Communicating

MODGAS-XWR-1 Controller Wiring When Used With The VCCX2



JOB NAME	
FILENAME	Orion Control Systems
1V1IGN1S-COMM-1B.CDR	
DATE: 01/09/18	DRAWN BY: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	OE377-26-00060-1 MODGAS-XWR-1 Controller

Figure 64: OE377-26-00060-1 One Modulating Valve, One Ignitor, One Stage Communicating Wiring

MHGRV-X Controller Wiring When Used With The VCCX2

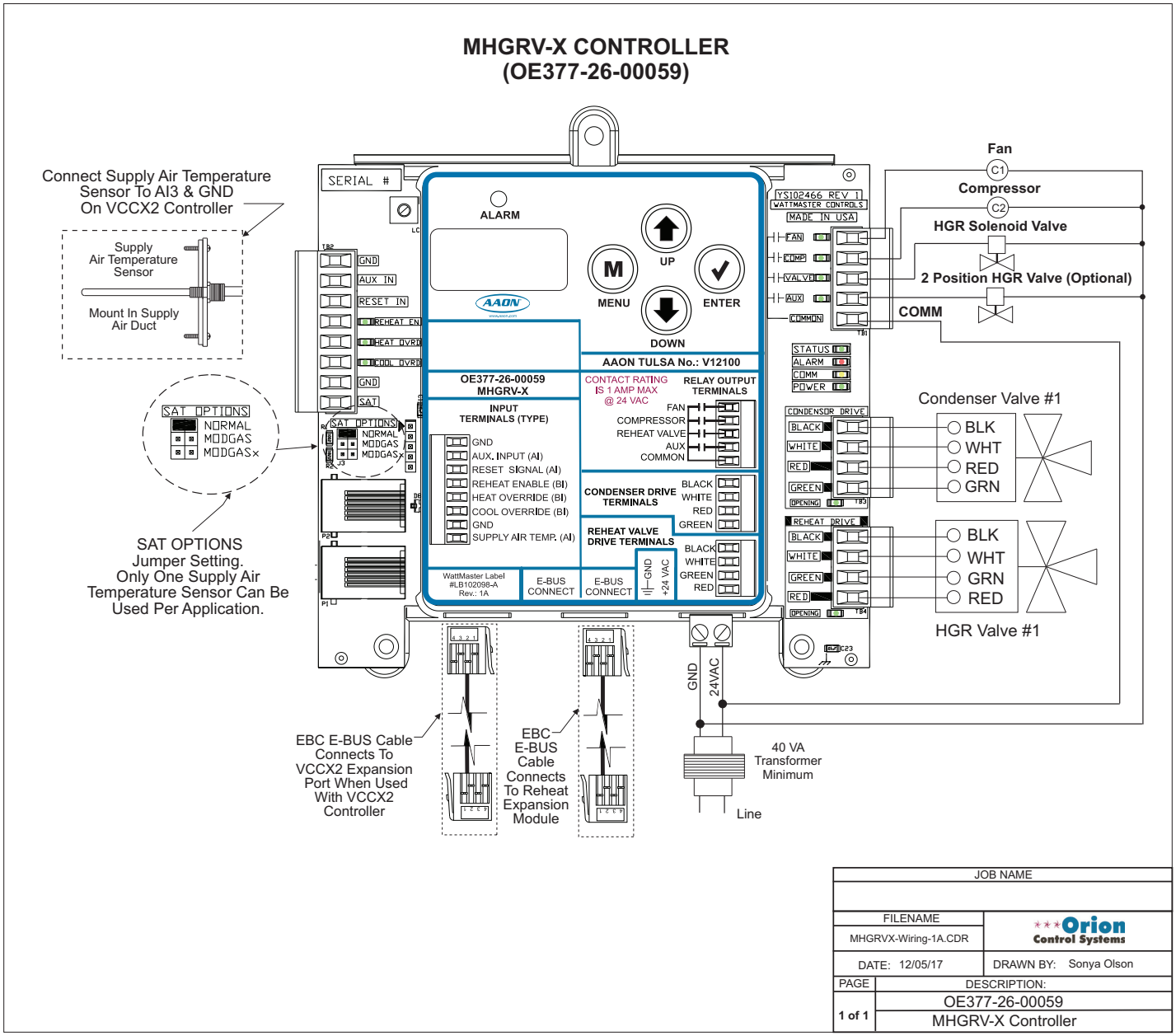
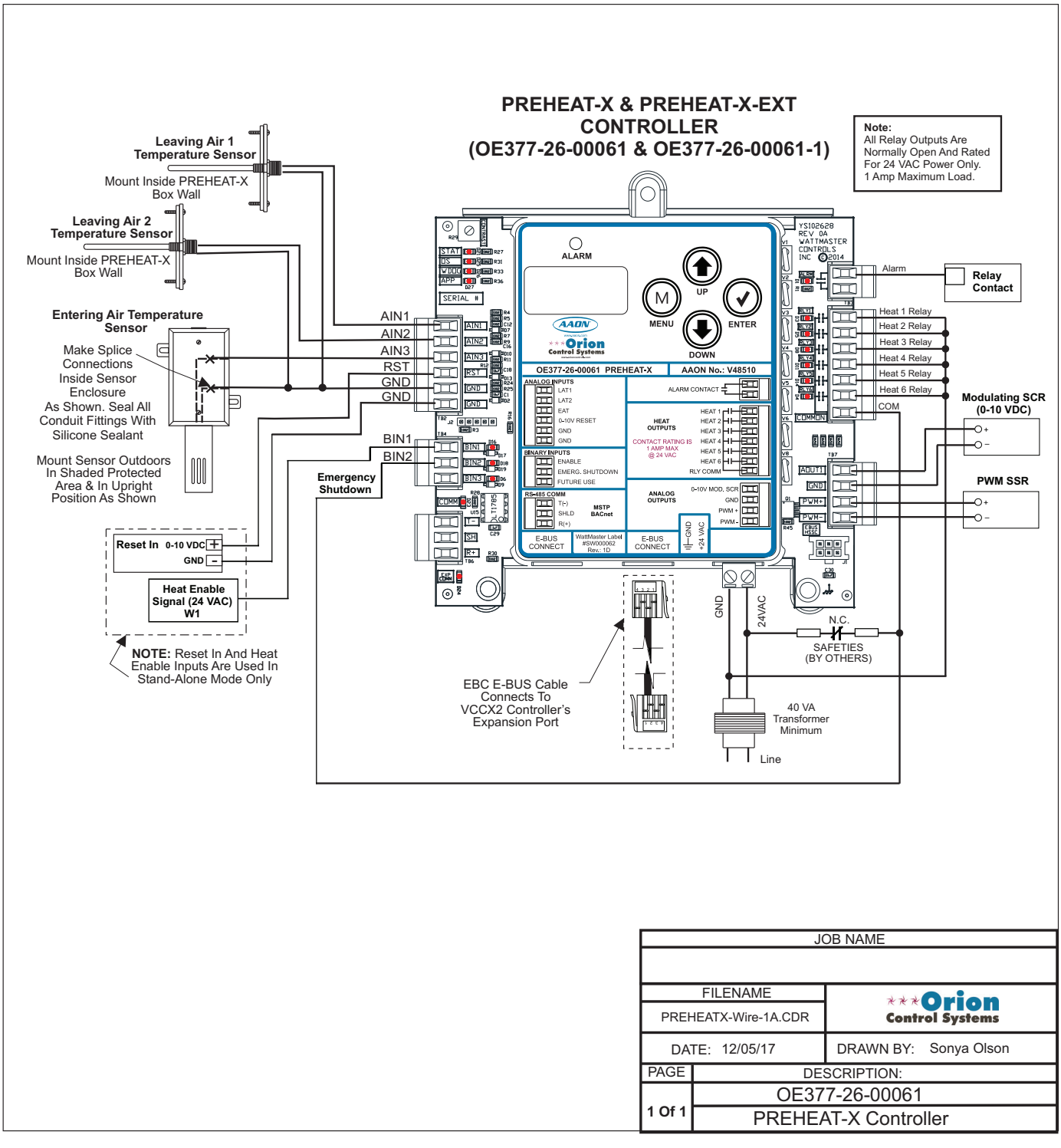


Figure 65: OE377-26-00059 MHGRV-X Controller to VCCX2 Controller Wiring

PREHEAT-X Controller Wiring When Used With The VCCX2

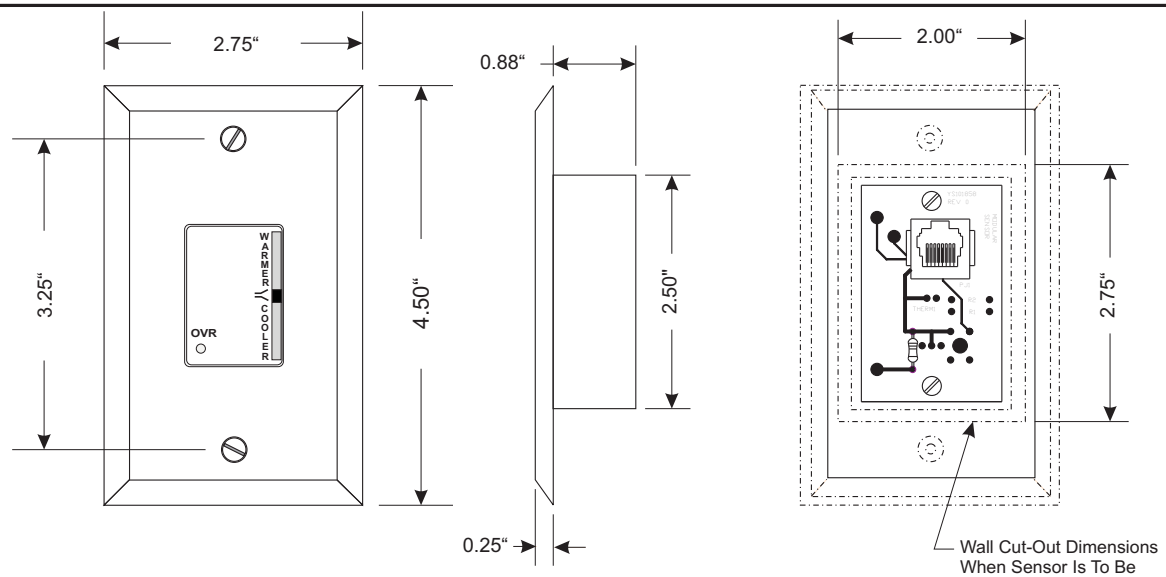


JOB NAME	
FILENAME	Orion Control Systems
PREHEATX-Wire-1A.CDR	
DATE: 12/05/17	DRAWN BY: Sonya Olson
PAGE	DESCRIPTION:
1 Of 1	OE377-26-00061 PREHEAT-X Controller

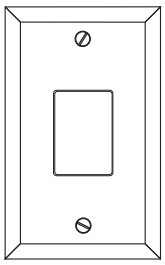
Figure 66: PREHEAT-X & PREHEAT-X-EXT Controller Wiring to VCCX2 Controller

Miscellaneous Technical Information

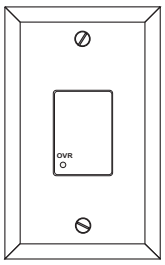
Modular Room Sensor Wiring



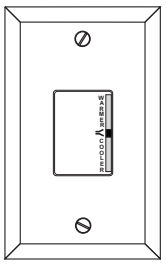
Room Sensor Typical Dimensions



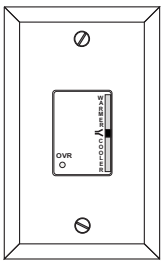
OE210-02
Modular Room Sensor - Plain



OE211-02
Modular Room Sensor With Override



OE212-02
Modular Room Sensor With Setpoint Adjust



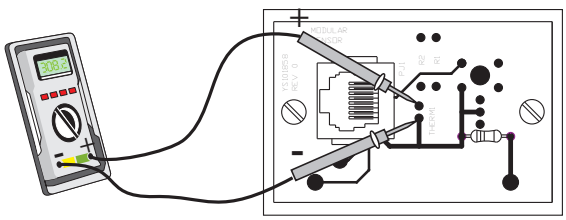
OE213-02
Modular Room Sensor With Setpoint Adjust & Override

Temperature Sensor Resistance/Voltage Chart

Temp ° F	Resistance* Ohms	Voltage @ Input*	Temp ° F	Resistance* Ohms	Voltage @ Input*	Temp ° F	Resistance* Ohms	Voltage @ Input*	Temp ° F	Resistance* Ohms	Voltage @ Input*
-10	93333	4.620	45	21094	3.470	69	11906	2.780	84	8514	2.352
-5	80531	4.550	50	18655	3.330	70	11652	2.752	86	8153	2.297
0	69822	4.474	52	17799	3.275	71	11379	2.722	88	7805	2.242
5	60552	4.390	54	16956	3.217	72	11136	2.695	90	7472	2.187
10	52500	4.297	56	16164	3.160	73	10878	2.665	95	6716	2.055
15	45902	4.200	58	15385	3.100	74	10625	2.635	100	6047	1.927
20	40147	4.095	60	14681	3.042	75	10398	2.607	105	5453	1.805
25	35165	3.982	62	14014	2.985	76	10158	2.570	110	4923	1.687
30	30805	3.862	64	13382	2.927	78	9711	2.520	115	4449	1.575
35	27140	3.737	66	12758	2.867	80	9302	2.465	120	4030	1.469
40	23874	3.605	68	12191	2.810	82	8893	2.407			

***Chart Notes:**

1. Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered). Connect as shown below.
2. Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the sensor leads as shown in the illustration below. If the voltage is above 5.08 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, the sensor or wiring is shorted.



JOB NAME	
FILENAME	Orion Control Systems
O-MODRMSENS1.CDR	
DATE: 10/11/01	DRAWN BY: B. CREWS
PAGE	DESCRIPTION:
1	OE210-02, OE211-02, OE212-02, OE213-02 Modular Room Sensor

Figure 67: OE210-02, OE211-02, OE212-02, OE213-02 Modular Room Sensor Wiring

Updating The SD Memory Card

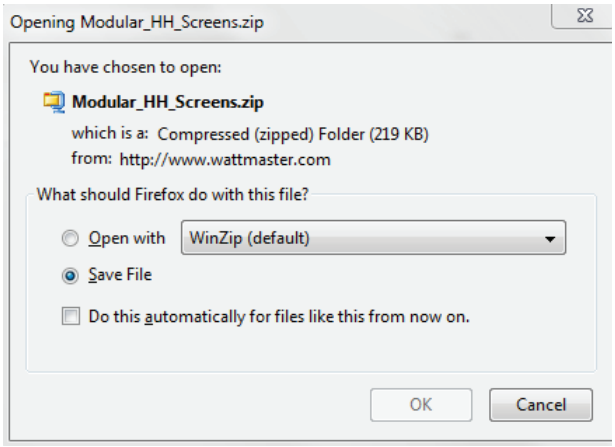
You may need to update the SD memory card from time to time, either for a new release or to add data for another Controller. Follow the instructions below to download the update file from our tech support web page:

1. Insert the SD memory card in your computer's SD drive and open the drive's window.

2. Open your browser and type in the address: http://wattmaster.com/techsupport.

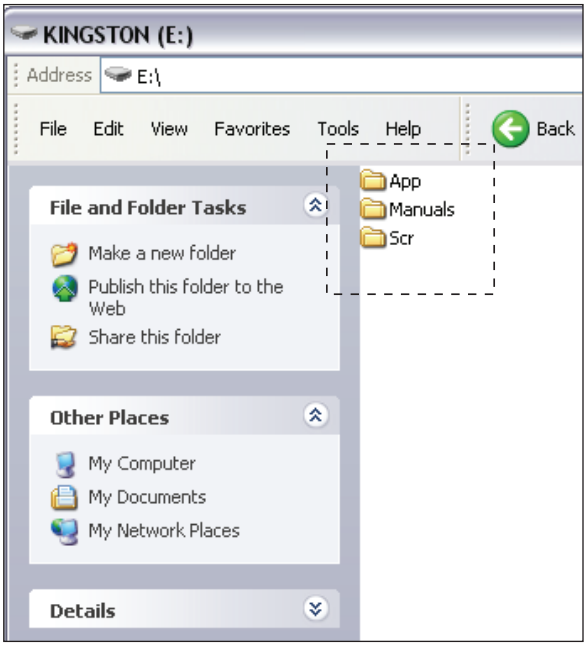
3. On the Tech Support webpage, locate the file Modular_HH_Screens.zip and *double-click* on it.

4. Click **<Save File>** when asked to save or open the file and then *click* **<OK>**. This option will save the file to the "Downloads" folder on your PC.



5. *Open* the "Downloads" folder in Windows Explorer. You will find a folder labeled, "Modular_HH_Screens.zip" *Right-click* on the folder and choose "Extract All" from the options list. **NOTE:** Any compression software can be used to extract the zip folder's contents, for example, Winzip.

6. Once you unzip the file, you will see a window similar to the one below.



7. *Press* **<CTRL> <A>** to highlight the folders in the window—App, Manuals & Scr. Press **<CTRL> <C>** to copy the folders.

8. Paste the folders into the SD memory card drive's window by *pressing* **<CTRL> <V>**.

9. Remove the SD Memory Card from your computer and reinsert it in the Modular Hand Held Service Tool or Modular System Manager.

Updating E-BUS Module Software

Updating Controller & E-BUS Module Software Using the Modular Service Tool SD

To update the software for various WattMaster E-BUS modules, follow these simple steps.

1. Update your SD memory card with the new software file for the controller or module you need to update. Follow the steps on **page 96** for Updating the SD memory card.

2. Connect the Modular Service Tool to the device you wish to update using the mini DIN communication cable or EBC E-BUS cable provided.

3. Power up the controller or E-BUS module you wish to update.

4. Apply power to the Modular Service Tool SD and *press* the **<ON>** button.

5. After initialization of the Modular Service Tool SD, *press* **<NEXT>** *at the first Setup Screen and* **<4>** at the second *Setup Screen* shown below.

```
 1) Set Time & Date
 2) Communications
NEXT) More Options
ESC) Exit Menu
```

```
 3) Energy Saving
 4) Update Software
NEXT) More Options
ESC) Exit Menu
```

6. The *Update Software Screen* will appear as shown below:

```
Select Communication
1) WattMaster Comm
2) E-BUS Module
ESC) Exit Menu
```

7. Follow the instructions for WattMaster E-BUS Modules.

E-BUS Modules

1. *Press* **<2>** to update an E-BUS Module. The following screen will appear:

```
Enter Board Address
         0

Esc) Exit Menu
```

2. *Enter* the address of the E-BUS module you are updating and then *press* **<ENTER>**. The following is the list of Module addresses:

   MHGRV-X - address 132
   MODGAS-X - address 138
   MODGAS-XWR - address 138 & 139 (#2 board)
   PREHEAT-X - address 157
   RSM #1 - address 152
   RSM #2 - address 153
   RSM #3 - address 154
   RSM #4 - address 155

3 The *Software Version Screen* will appear as shown below. *Enter* **<0>** for the latest software version or enter the number of an older version if given to you by Technical Support. Then *press* **<ENTER>**.

```
  Software Version
Enter 0 for Latest
         0
Esc) Exit Menu
```

4. The screen will display the following messages:
   "Resetting Unit"
   "Load Sys Info"

5. If communications are successful, the screen will display, the name of the HEX file on the top line, "Flash Memory Erased" on the second line, and the progress percentage on the third line.

   NOTE: If communications are not successful, the screen will display, "Press Any Key to Continue. Cannot Load Sys Info." Make sure you have the right address and the right software version on your SD card. If these two items are correct and you still experience a problem, contact Technical Support.

6. When updating is complete, the screen will display, "Finish Download."

Space, Supply Air, Outdoor Air or Return Air Temperature Sensor Testing

The following sensor voltage and resistance table is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the tables. Please follow the notes and instructions that appear after the chart when checking sensors.

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.33	93333	4.51
-5	-20.55	80531	4.45
0	-17.77	69822	4.37
5	-15	60552	4.29
10	-12.22	52500	4.2
15	-9.44	45902	4.1
20	-6.66	40147	4.002
25	-3.88	35165	3.891
30	-1.11	30805	3.773
35	1.66	27140	3.651
40	4.44	23874	3.522
45	7.22	21094	3.39
50	10	18655	3.252
52	11.11	17799	3.199
54	12.22	16956	3.143
56	13.33	16164	3.087
58	14.44	15385	3.029
60	15.55	14681	2.972
62	16.66	14014	2.916
64	17.77	13382	2.861
66	18.88	12758	2.802
68	20	12191	2.746
69	20.55	11906	2.717
70	21.11	11652	2.691
71	21.66	11379	2.661
72	22.22	11136	2.635
73	22.77	10878	2.605

Table 1: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
74	23.33	10625	2.576
75	23.88	10398	2.549
76	24.44	10158	2.52
77	25	10000	2.5
78	25.55	9711	2.464
80	26.66	9302	2.41
82	27.77	8893	2.354
84	28.88	8514	2.3
86	30	8153	2.246
88	31.11	7805	2.192
90	32.22	7472	2.139
95	35	6716	2.009
100	37.77	6047	1.884
105	40.55	5453	1.765
110	43.33	4923	1.65
115	46.11	4449	1.54
120	48.88	4030	1.436
125	51.66	3656	1.339
130	54.44	3317	1.246
135	57.22	3015	1.159
140	60	2743	1.077
145	62.77	2502	1.001
150	65.55	2288	0.931

Table 1, cont.: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.88 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, then the sensor or wiring is shorted.

OE271 Duct Static & OE258-01 Building Pressure Sensor Testing

OE271 Pressure Sensor Testing

The table below is used to troubleshoot the OE271 Duct Static Pressure Sensors.

OE271 Duct Static Pressure Sensor			
Pressure @ Sensor (“ W.C.)	Voltage @ Input (VDC)	Pressure @ Sensor (“ W.C.)	Voltage @ Input (VDC)
0.00	0.25	2.60	2.33
0.10	0.33	2.70	2.41
0.20	0.41	2.80	2.49
0.30	0.49	2.90	2.57
0.40	0.57	3.00	2.65
0.50	0.65	3.10	2.73
0.60	0.73	3.20	2.81
0.70	0.81	3.30	2.89
0.80	0.89	3.40	2.97
0.90	0.97	3.50	3.05
1.00	1.05	3.60	3.13
1.10	1.13	3.70	3.21
1.20	1.21	3.80	3.29
1.30	1.29	3.90	3.37
1.40	1.37	4.00	3.45
1.50	1.45	4.10	3.53
1.60	1.53	4.20	3.61
1.70	1.61	4.30	3.69
1.80	1.69	4.40	3.77
1.90	1.77	4.50	3.85
2.00	1.85	4.60	3.93
2.10	1.93	4.70	4.01
2.20	2.01	4.80	4.09
2.30	2.09	4.90	4.17
2.40	2.17	5.00	4.25
2.50	2.25		

Table 2: Duct Static Pressure/Voltage for OE271 Duct Static Pressure Sensors

OE271 Pressure Sensor Testing Instructions

Use the voltage column to check the Duct Static Pressure Sensor while connected to powered controllers. Read voltage with meter set on DC volts. Place the “-” (minus) lead on the GND terminal and the “+” (plus) lead on the right side of the resistor labeled R85. Be sure to replace the jumper after checking.

OE258-01 Pressure Sensor Testing

The table below is used to troubleshoot the OE258-01 Building Pressure Sensors.

OE258-01 Building Pressure Sensor			
Pressure @ Sensor (“ W.C.)	Voltage @ Input (VDC)	Pressure @ Sensor (“ W.C.)	Voltage @ Input (VDC)
-0.25	0.00	0.01	2.60
-0.24	0.10	0.02	2.70
-0.23	0.20	0.03	2.80
-0.22	0.30	0.04	2.90
-0.21	0.40	0.05	3.00
-0.20	0.50	0.06	3.10
-0.19	0.60	0.07	3.20
-0.18	0.70	0.08	3.30
-0.17	0.80	0.09	3.40
-0.16	0.90	0.10	3.50
-0.15	1.00	0.11	3.60
-0.14	1.10	0.12	3.70
-0.13	1.20	0.13	3.80
-0.12	1.30	0.14	3.90
-0.11	1.40	0.15	4.00
-0.10	1.50	0.16	4.10
-0.09	1.60	0.17	4.20
-0.08	1.70	0.18	4.30
-0.07	1.80	0.19	4.40
-0.06	1.90	0.20	4.50
-0.05	2.00	0.21	4.60
-0.04	2.10	0.22	4.70
-0.03	2.20	0.23	4.80
-0.02	2.30	0.24	4.90
-0.01	2.40	0.25	5.00
0.00	2.50		

Table 3: Building Static Pressure/Voltage for OE258-01 Building Pressure Sensors

OE258-01 Building Pressure Sensor Testing Instructions

Use the voltage column to check the Building Static Pressure Sensor while connected to a powered expansion module. Read voltage with meter set on DC volts. Place the “-” (minus) lead on terminal labeled GND and the “+” lead on terminal AI5 on the VCCX2 Controller.

OE275-01 Suction Pressure Transducer Testing for R410A Refrigerant

The Evaporator Coil Temperature is calculated by converting the Suction Pressure to Temperature. The Suction Pressure is obtained by using the OE275-01 Suction Pressure Transducer, which is connected into the Suction Line of the Compressor.

Use the voltage column to check the Suction Pressure Transducer while connected to the RSMV/RSMD Module(s). The VCCX2 and the RSMV/RSMD Module(s) must be powered for this test. Read voltage with a meter set on DC volts. Place the positive lead from the meter on the PR OUT terminal located on the RSMV/RSMD Module(s) terminal block. Place the negative lead from the meter on the ground (GND) terminal located adjacent to the PR OUT terminal on the RSMV/RSMD Module(s) terminal block. Use a refrigerant gauge set and/or an accurate electronic thermometer to measure the temperature or suction line pressure near where the Suction Pressure Transducer is connected to the suction line. Measure the Voltage at the terminals PR OUT and GND terminals and compare it to the appropriate chart depending on the refrigerant you are using. If the temperature/voltage or pressure/voltage readings do not align closely with the chart, your Suction Pressure Transducer is probably defective and will need to be replaced.

The OE275-01 Suction Pressure Transducer, Pressure, Temperature, and Voltage Chart for R410A Refrigerant testing chart shows a temperature range from 20°F to 80°F. For troubleshooting purposes, the DC Voltage readings are also listed with their corresponding temperatures and pressures.

OE275-01 Suction Pressure Transducer Coil Pressure – Temperature – Voltage Chart for R410A Refrigerant					
Temperature °F	Pressure PSI	Signal DC Volts	Temperature °F	Pressure PSI	Signal DC Volts
21.19	80.94	1.8	59.03	168.10	3.2
24.49	87.16	1.9	61.17	174.32	3.3
27.80	93.39	2.0	63.19	180.55	3.4
30.99	99.62	2.1	65.21	186.78	3.5
33.89	105.84	2.2	67.23	193.00	3.6
36.80	112.07	2.3	69.24	199.23	3.7
39.71	118.29	2.4	71.15	205.46	3.8
42.30	124.52	2.5	72.95	211.68	3.9
44.85	130.75	2.6	74.76	217.91	4.0
47.39	136.97	2.7	76.57	224.14	4.1
49.94	143.2	2.8	78.37	230.36	4.2
52.23	149.42	2.9	80.18	236.59	4.3
54.50	155.65	3.0			
56.76	161.88	3.1			

Table 4: Coil Pressure/Voltage/Temp for OE275-01 Suction Pressure Transducers - R410A Refrigerant

Copeland® Discharge Thermistor Temperature Sensor Testing

Copeland® Discharge Thermistor Temperature Sensor Testing

The following sensor voltage and resistance table is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the table. Please follow the notes and instructions the appear after the chart when checking sensors.

Discharge Thermistor Temperature/ Resistance			
Temp (ºF)	Temp (ºC)	Resistance (K Ohms)	Voltage @ Input (VDC)
-40	-40	2889.60	4.98
-31	-35	2087.22	4.97
-22	-30	1522.20	4.96
-13	-25	1121.44	4.95
-4	-20	834.72	4.94
5	-15	627.28	4.92
14	-10	475.74	4.89
23	-5	363.99	4.86
32	0	280.82	4.82
41	5	218.41	4.77
50	10	171.17	4.72
59	15	135.14	4.65
68	20	107.44	4.57
77	25	86.00	4.47
86	30	69.28	4.36
95	35	56.16	4.24
104	40	45.81	4.10
113	45	37.58	3.94
122	50	30.99	3.77
131	55	25.68	3.59
140	60	21.40	3.40
149	65	17.91	3.20
158	70	15.07	3.00
167	75	12.73	2.80
176	80	10.79	2.59
185	85	9.20	2.39

Table 5: Discharge Thermistor Temperature/ Resistance

Discharge Thermistor Temperature/ Resistance			
Temp (ºF)	Temp (ºC)	Resistance (K Ohms)	Voltage @ Input (VDC)
194	90	7.87	2.19
203	95	6.77	2.01
212	100	5.85	1.84
221	105	5.09	1.68
230	110	4.45	1.53
239	115	3.87	1.39
248	120	3.35	1.25
257	125	2.92	1.12
266	130	2.58	1.02
275	135	2.28	0.92
284	140	2.02	0.83
293	145	1.80	0.76
302	150	1.59	0.68
311	155	1.39	0.61
320	160	1.25	0.55
329	165	1.12	0.50
338	170	1.01	0.45
347	175	0.92	0.42
356	180	0.83	0.38

Table 5, cont.: Discharge Thermistor Temperature/ Resistance

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.98 VDC, then the sensor or wiring is "open." If the voltage is less than 0.38 VDC, then the sensor or wiring is shorted.

Leaving Water Temperature Sensor Testing

The following sensor voltage and resistance table is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the tables. Please follow the notes and instructions that appear after the chart when checking sensors.

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.33	93333	4.51
-5	-20.55	80531	4.45
0	-17.77	69822	4.37
5	-15	60552	4.29
10	-12.22	52500	4.2
15	-9.44	45902	4.1
20	-6.66	40147	4.002
25	-3.88	35165	3.891
30	-1.11	30805	3.773
35	1.66	27140	3.651
40	4.44	23874	3.522
45	7.22	21094	3.39
50	10	18655	3.252
52	11.11	17799	3.199
54	12.22	16956	3.143
56	13.33	16164	3.087
58	14.44	15385	3.029
60	15.55	14681	2.972
62	16.66	14014	2.916
64	17.77	13382	2.861
66	18.88	12758	2.802
68	20	12191	2.746
69	20.55	11906	2.717
70	21.11	11652	2.691
71	21.66	11379	2.661
72	22.22	11136	2.635
73	22.77	10878	2.605

Table 6: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
74	23.33	10625	2.576
75	23.88	10398	2.549
76	24.44	10158	2.52
77	25	10000	2.5
78	25.55	9711	2.464
80	26.66	9302	2.41
82	27.77	8893	2.354
84	28.88	8514	2.3
86	30	8153	2.246
88	31.11	7805	2.192
90	32.22	7472	2.139
95	35	6716	2.009
100	37.77	6047	1.884
105	40.55	5453	1.765
110	43.33	4923	1.65
115	46.11	4449	1.54
120	48.88	4030	1.436
125	51.66	3656	1.339
130	54.44	3317	1.246
135	57.22	3015	1.159
140	60	2743	1.077
145	62.77	2502	1.001
150	65.55	2288	0.931

Table 6, cont.: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.88 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, then the sensor or wiring is shorted.

Coil Temperature Sensor Testing

Coil Temperature Sensor Testing

The following sensor voltage and resistance table is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the tables. Please follow the notes and instructions that appear after the chart when checking sensors.

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.33	93333	4.51
-5	-20.55	80531	4.45
0	-17.77	69822	4.37
5	-15	60552	4.29
10	-12.22	52500	4.2
15	-9.44	45902	4.1
20	-6.66	40147	4.002
25	-3.88	35165	3.891
30	-1.11	30805	3.773
35	1.66	27140	3.651
40	4.44	23874	3.522
45	7.22	21094	3.39
50	10	18655	3.252
52	11.11	17799	3.199
54	12.22	16956	3.143
56	13.33	16164	3.087
58	14.44	15385	3.029
60	15.55	14681	2.972
62	16.66	14014	2.916
64	17.77	13382	2.861
66	18.88	12758	2.802
68	20	12191	2.746
69	20.55	11906	2.717
70	21.11	11652	2.691
71	21.66	11379	2.661
72	22.22	11136	2.635
73	22.77	10878	2.605

Table 7: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Temperature – Resistance – Voltage for Type III 10 K Ohm Thermistor Sensors			
Temp (ºF)	Temp (ºC)	Resistance (Ohms)	Voltage @ Input (VDC)
74	23.33	10625	2.576
75	23.88	10398	2.549
76	24.44	10158	2.52
77	25	10000	2.5
78	25.55	9711	2.464
80	26.66	9302	2.41
82	27.77	8893	2.354
84	28.88	8514	2.3
86	30	8153	2.246
88	31.11	7805	2.192
90	32.22	7472	2.139
95	35	6716	2.009
100	37.77	6047	1.884
105	40.55	5453	1.765
110	43.33	4923	1.65
115	46.11	4449	1.54
120	48.88	4030	1.436
125	51.66	3656	1.339
130	54.44	3317	1.246
135	57.22	3015	1.159
140	60	2743	1.077
145	62.77	2502	1.001
150	65.55	2288	0.931

Table 7, cont.: Temperature/Resistance for Type III 10K Ohm Thermistor Sensors

Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the "-" (minus) lead on GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

If the voltage is above 4.88 VDC, then the sensor or wiring is "open." If the voltage is less than 0.05 VDC, then the sensor or wiring is shorted.

Head Pressure Transducer Troubleshooting

If you suspect there is a problem related to head pressure transducer measurements, reference the table, below.

Head Pressure Transducer Chart			
Voltage	**Pressure**	**Voltage**	**Pressure**
0.5	0	2.6	350
0.6	17	2.7	367
0.7	33	2.8	384
0.8	50	2.9	400
0.9	67	3.0	417
1.0	83	3.1	434
1.1	100	3.2	450
1.2	117	3.3	467
1.3	133	3.4	484
1.4	150	3.5	500
1.5	167	3.6	517
1.6	183	3.7	534
1.7	200	3.8	550
1.8	217	3.9	567
1.9	233	4.0	584
2.0	250	4.1	600
2.1	267	4.2	617
2.2	283	4.3	634
2.3	300	4.4	650
2.4	317	4.5	667
2.5	334		

Table 8: Head Pressure Transducer Chart

APPENDIX A: MISCELLANEOUS TECHNICAL INFORMATION

Modular Wiring

Modular Wiring Considerations

Wiring Considerations

Before beginning installation, please study the wiring diagrams for the controllers you are using with your particular application. These diagrams appear in this manual and can also be found in the technical guides supplied with your specific controllers.

The VAV/Zone Controllers can have a modular adapter installed that provides modular connections. See **Figure 69, page 102** for adapter installation instructions. The Power/Comm board is supplied with both terminals and a modular connector on the input side. All of the Power/Comm board outputs use modular connectors. The MinLink Polling Device is equipped with both modular and wiring terminal blocks.

Power/Comm Board Requirements

Standard Connection Configurations and Use

Power/Comm boards are typically used on Networked Single and Multiple Loop systems to transfer 24 VAC power and "Local Loop" communications to Modular VAV/Zone Controllers, Modular System Managers, or other Power/Comm boards.

The Power/Comm board must always be powered by its own dedicated 24 VAC transformer connected to its 2-wire, 24 VAC input terminals (TB1).

Local Loop communications can be transferred to the Power/Comm Board via a modular cable connected to its "Comm In" modular connector input terminal (P2). This modular cable connection can originate from the "Local Loop" modular connector of the MiniLink PD for this loop, another Power/Comm board output on the same loop, or a Modular VAV/Zone Controller or Modular System Manager output on the same loop. A Power/Comm board can also be connected if desired to the "Local Loop" by hard wiring a 2-wire shielded cable connected between its 3-wire communications input terminal (TB1) and a Power/Comm board, or the MiniLink PD "Local Loop" 3-wire communications terminal.

Alternative Connection Configuration and Use

If desired, the Power/Comm board can also be used to transfer both 24 VAC power and "Network Loop" communications to multiple MiniLink PDs. Connection between the MiniLink PD(s) and Power/Comm board(s) is accomplished by using modular cables between the Power/Comm board's modular output connectors and the MiniLink PD(s)'s "Network Loop" modular input connectors. When a Power/Comm board is used to connect power and communications to MiniLink PDs in this manner, that particular Power/Comm board cannot also be used to share communications and/or power with Modular VAV/Zone Controllers or Modular System Manager(s).

Warning: Do not ground the 24 VAC transformer that is to be used with the Power/Comm board. Grounding of the transformer will damage the Power/Comm board and all boards connected to it. A separate transformer must be used for each Power/Comm board. No exceptions. Do not connect any other devices to the transformer used for the Power/Comm board!

MiniLink Polling Device (MiniLink PD)

Standard Connection Configurations and Use

The MiniLink PD is used on Networked Single and Multiple Loop systems to provide two-way communication between all devices on its "Local Loop" and to all the other "Network Loop" devices on the entire system. The MiniLink PD is equipped with terminal blocks for connection of 24 VAC power, "Local Loop" and "Network Loop" communications.

Each MiniLink PD is normally hard wired to a 24 VAC power source connected to its 24 VAC input terminal (TB1). "Network Loop" communications are transferred between multiple MiniLink PDs by modular cables connected to their "Network Loop" modular connectors (P3 and P5). A CommLink 5 must be connected to one of the MiniLink PDs on the system by using a 2-wire shielded cable connected between its 3-wire "Network Loop" communications terminal block (TB4) and to the CommLink's "485 Loop" terminal block. Transfer of "Local Loop" communication from the MiniLink PD to a Power/Comm board is made by using a modular cable connected between the MiniLink PD "Local Loop" modular connector (P4) and the Power/Comm board modular "Comm In" connector (P2). If desired as an alternative, transfer of "Local Loop" communication from the MiniLink PD to a Power/Comm board can be made by hard wiring a 2-wire shielded cable connected between the MiniLink PD's 3-wire communications terminal (TB1) and the 3-wire communications input (TB1) on the Power/Comm board.

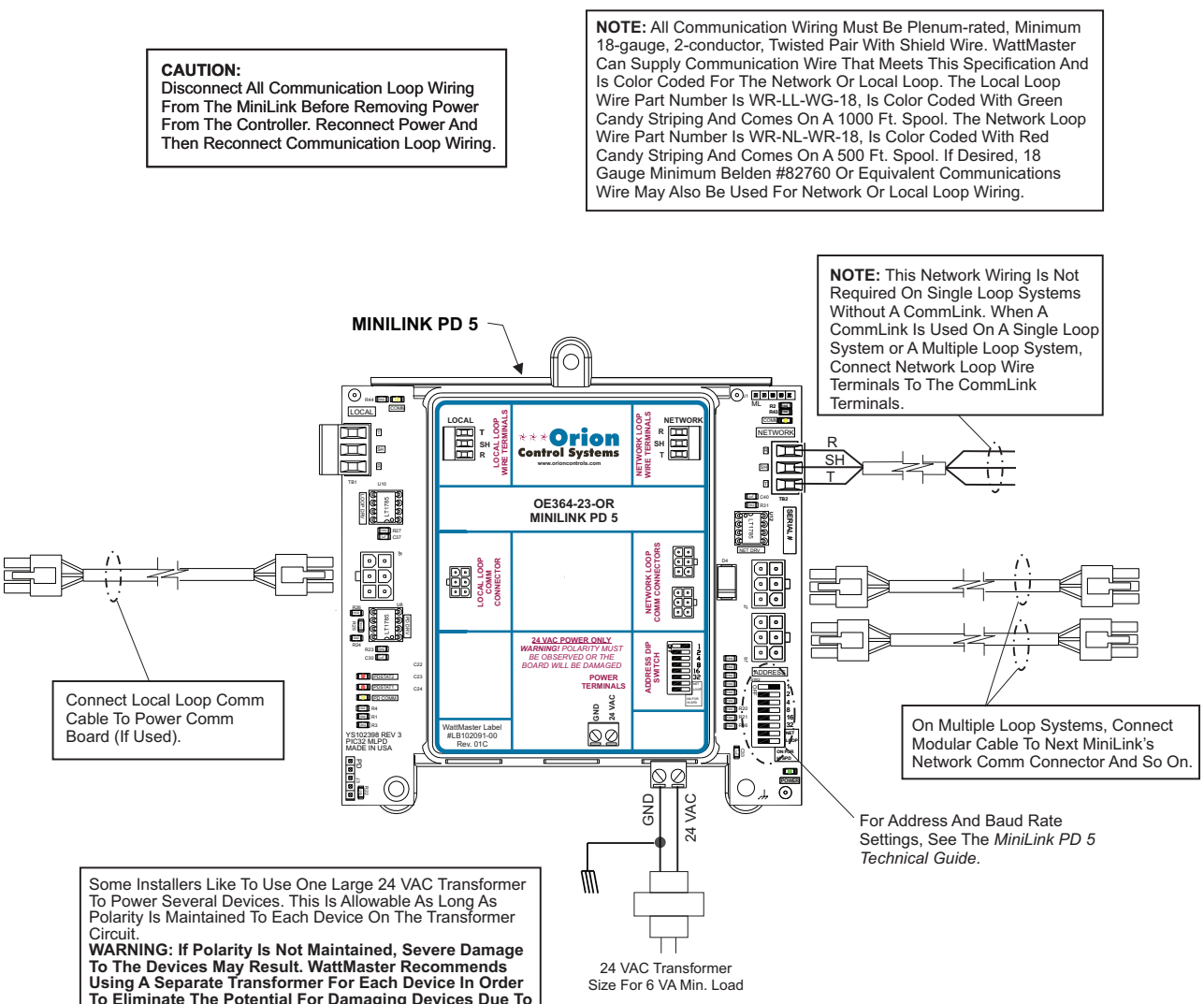
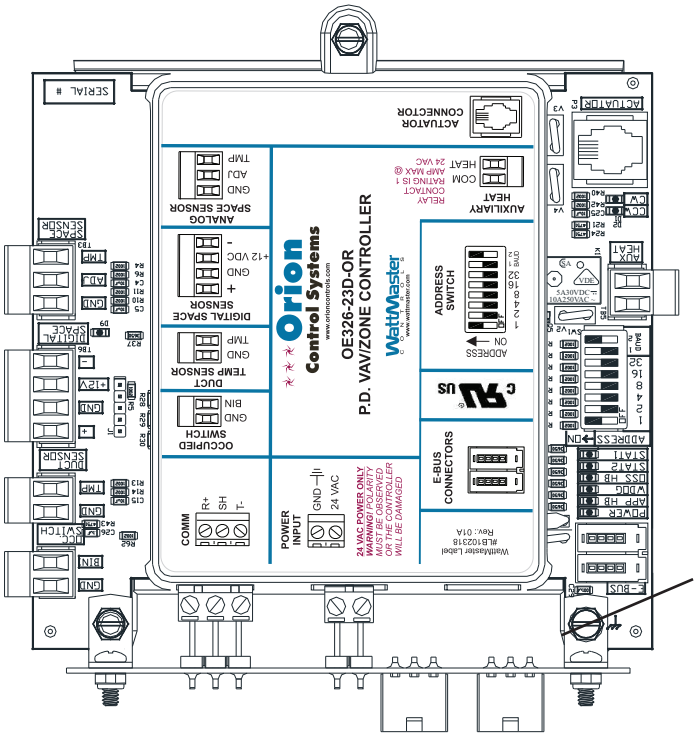


Figure 68: OE364-23 MiniLink Polling Device 5 Modular Wiring

VAV/Zone Controller With Modular Adapter

VAV/Zone Controller



The PL102681 VAV/Zone Controller Modular Adapter provides two Modular PCC (Power and Comm) connections to the OE326-23I-OR and OE326-23D-OR VAV/Zone Controllers. It plugs into the 3 pin Comm connector and the 2 pin 24VAC power connector on the VAV/Zone Controller. The PCC modular cabling is not included.

Installation Instructions

1. Insert the two terminal pin headers of the VAV/Zone Controller Modular Adapter into the 24VAC and Comm terminal blocks that are located on the VAV/Zone Controller.

2. Tighten the two right angle brackets on the VAV/Zone Modular Adapter down to secure the mounting of the VAV/Zone Controller Modular Adapter circuit board with two of the three screws that were originally provided with the VAV/Zone Controller.

3. Tighten the terminal block screws on the 3 pin - Comm and 2 pin - 24VAC power connectors that are on the VAV/Zone Controller.

4 Plug in the power and comm cables to the VAV/Zone Controller Modular Adapter Board.

FILENAME	Orion Control Systems
PL102681-INSTL-1A	
DATE: 09/20/17	BY: Sonya Olson
PAGE	DESCRIPTION
1 of 1	VAV/Zone Controller Modular Adapter Installation

Figure 69: VAV/Zone Controller with Modular Adapter PL102681 Installed - OE326-23D-OR Shown

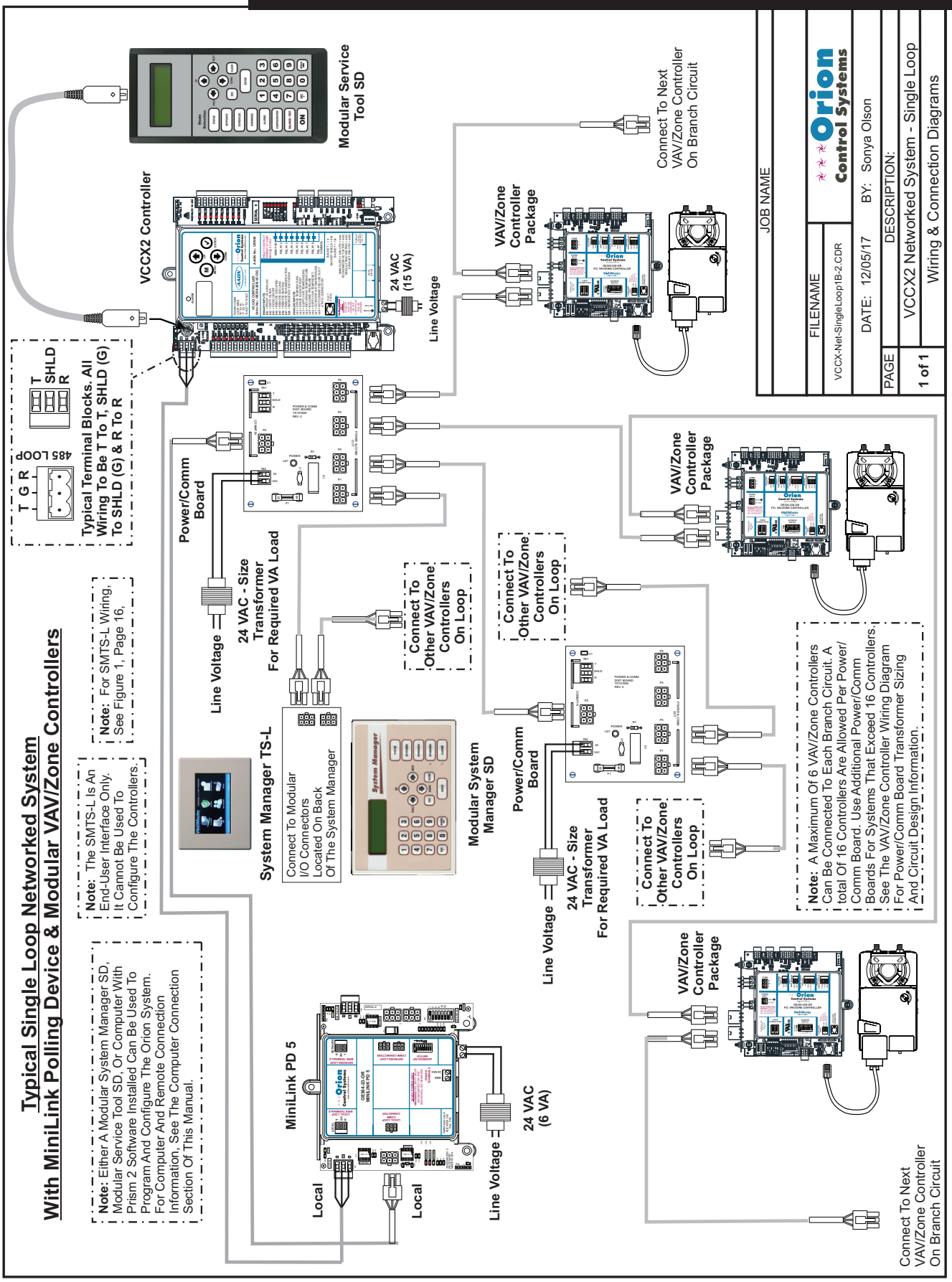


Figure 70: Networked Single Loop System With MiniLink PD And Modular VAV/Zone Controllers Wiring

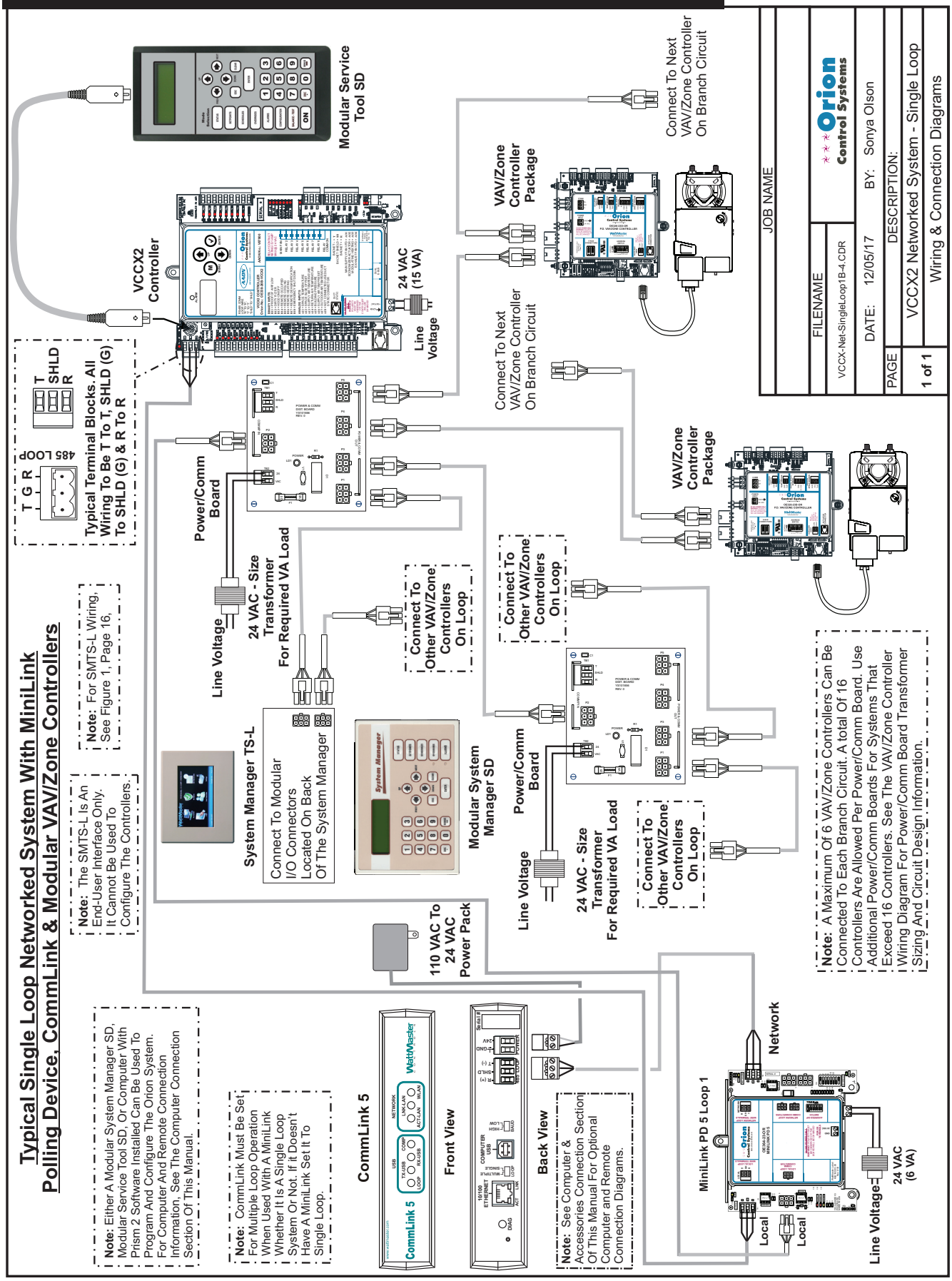


Figure 71: Networked Single Loop System With CommLink & MiniLink PD - Modular VAV/Zone Controllers

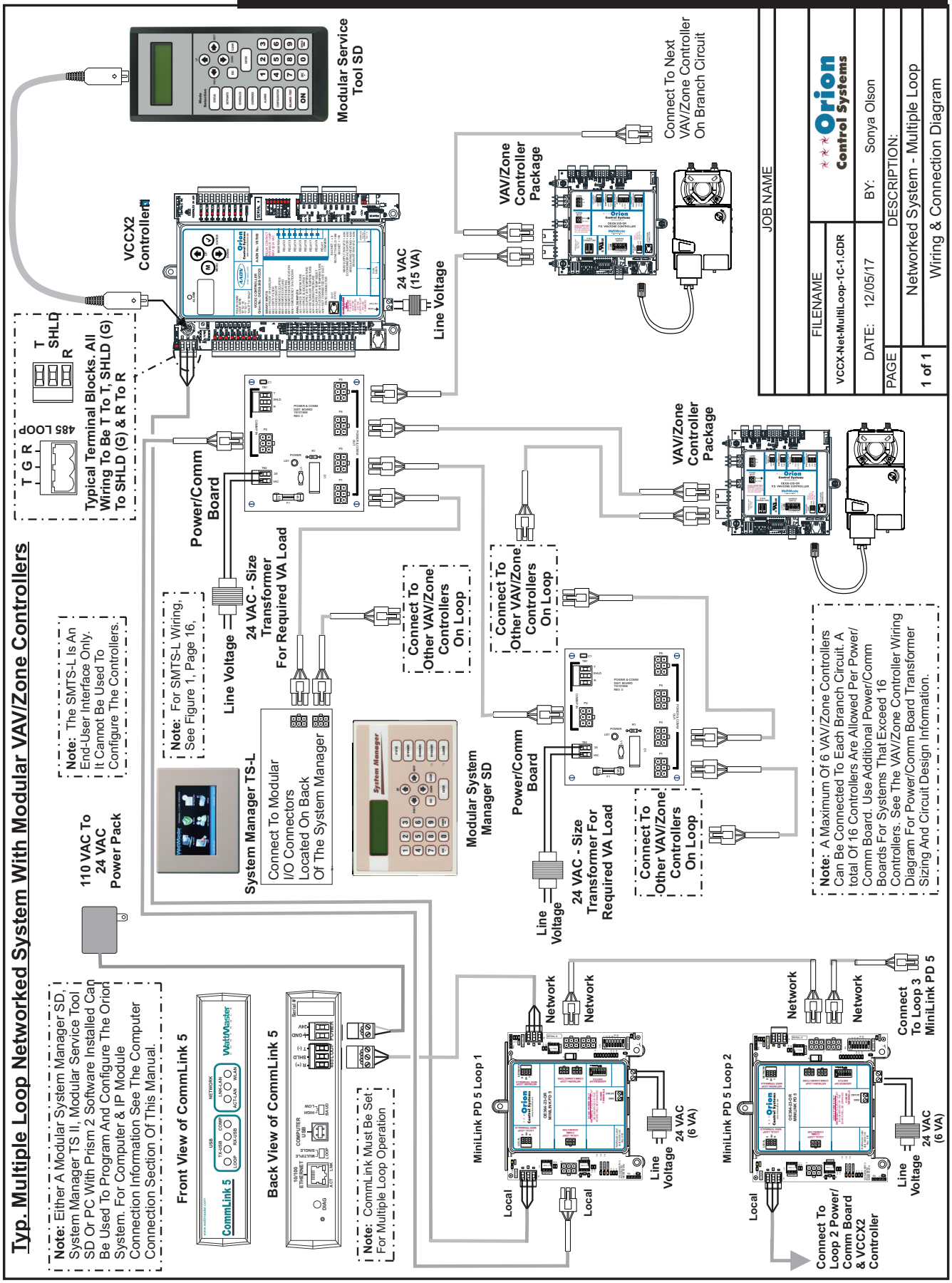


Figure 72: Networked Multiple Loop System Wiring With Modular VAV/Zone Controllers

System Manager SD Pigtail Cable Wiring

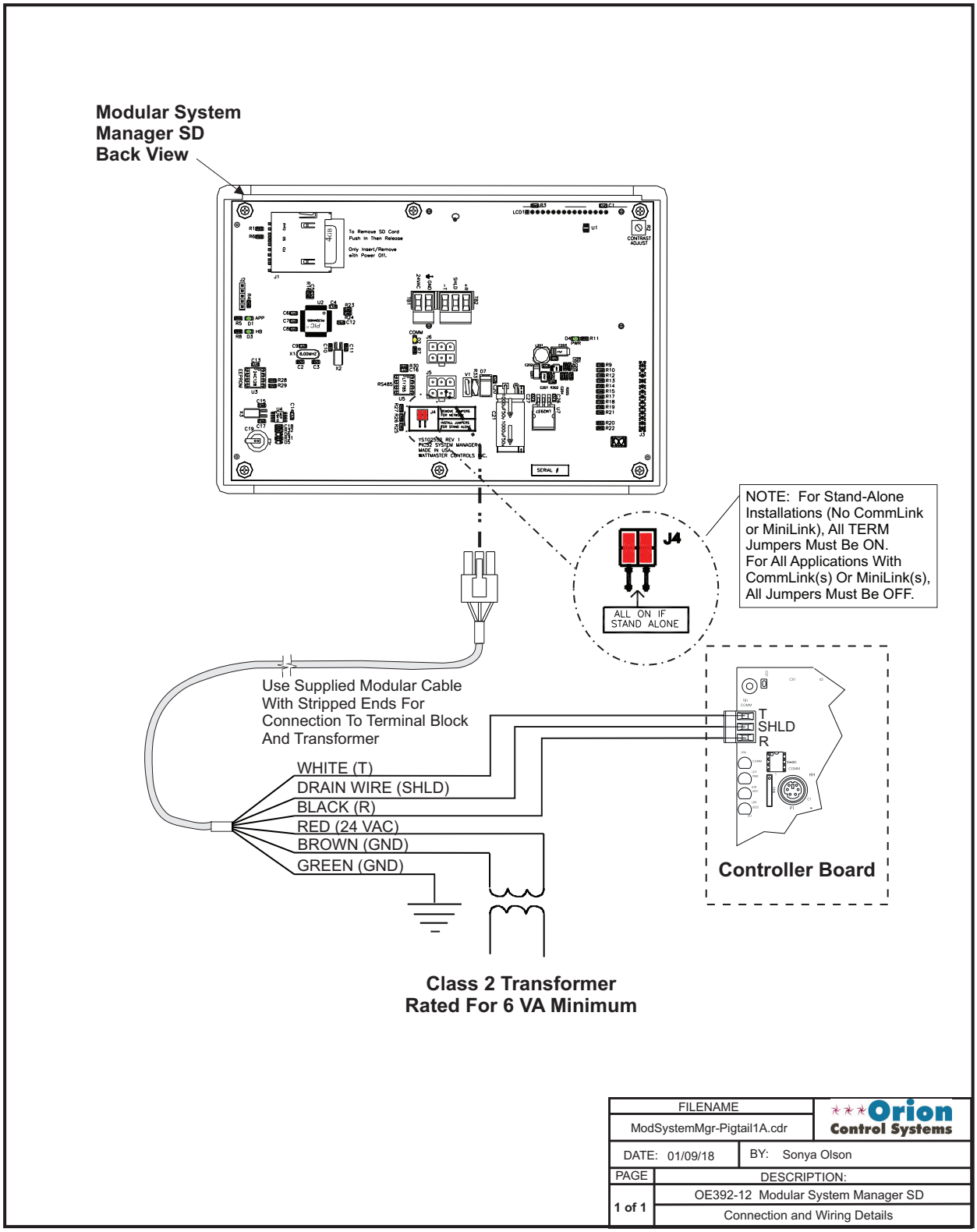
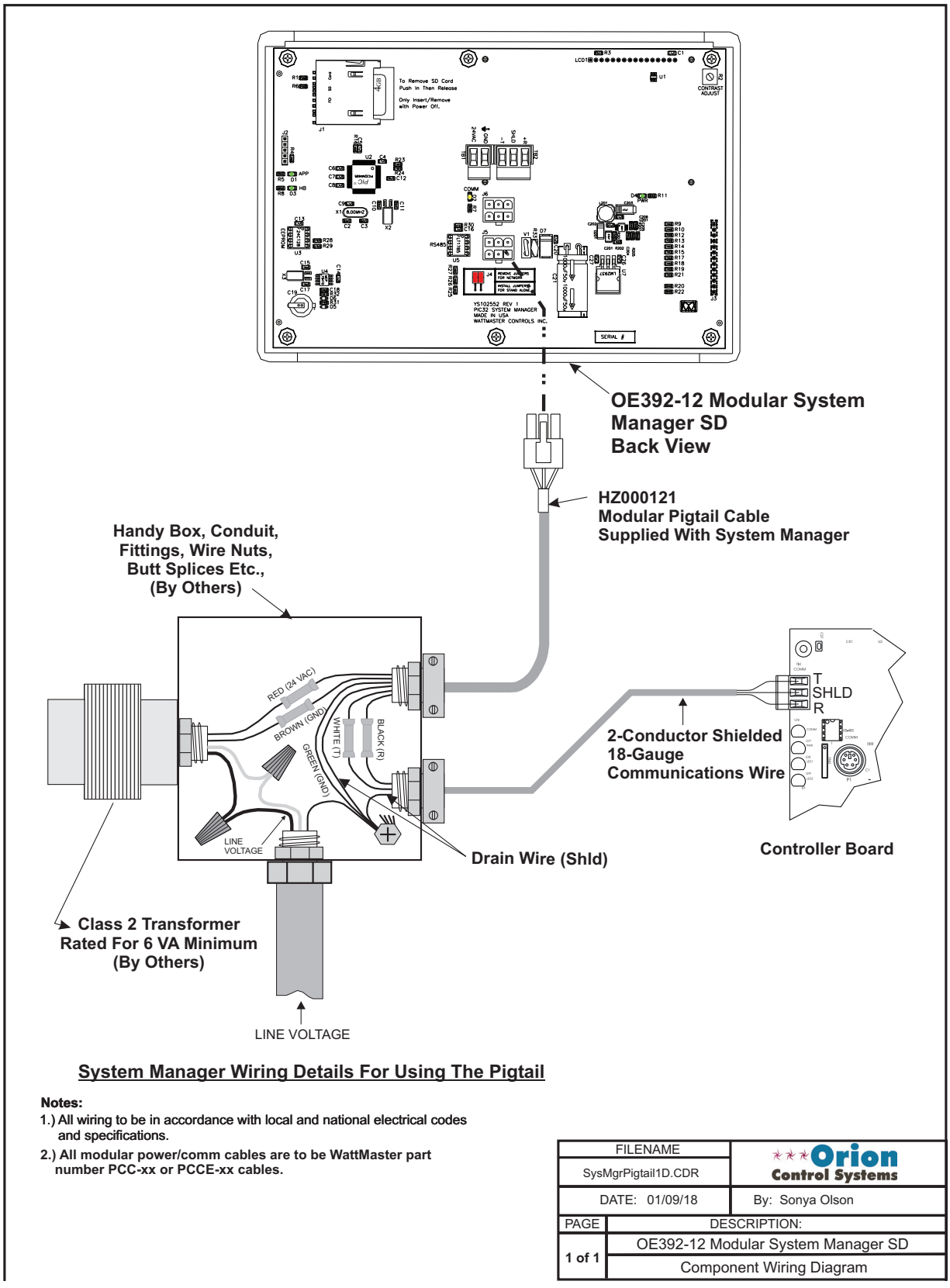


Figure 73: OE392-12 Modular System Manager SD Pigtail Cable Wiring

System Manager Modular Cable Pigtail Wiring Detail



System Manager Wiring Details For Using The Pigtail

Notes:

1.) All wiring to be in accordance with local and national electrical codes and specifications.

2.) All modular power/comm cables are to be WattMaster part number PCC-xx or PCCE-xx cables.

FILENAME	Orion Control Systems
SysMgrPigtail1D.CDR	
DATE: 01/09/18	By: Sonya Olson
PAGE	DESCRIPTION:
1 of 1	OE392-12 Modular System Manager SD Component Wiring Diagram

Figure 74: OE392-12 Modular System Manager SD Cable Pigtail - Wiring Detail

Power/Comm Board Wiring For Local Loops

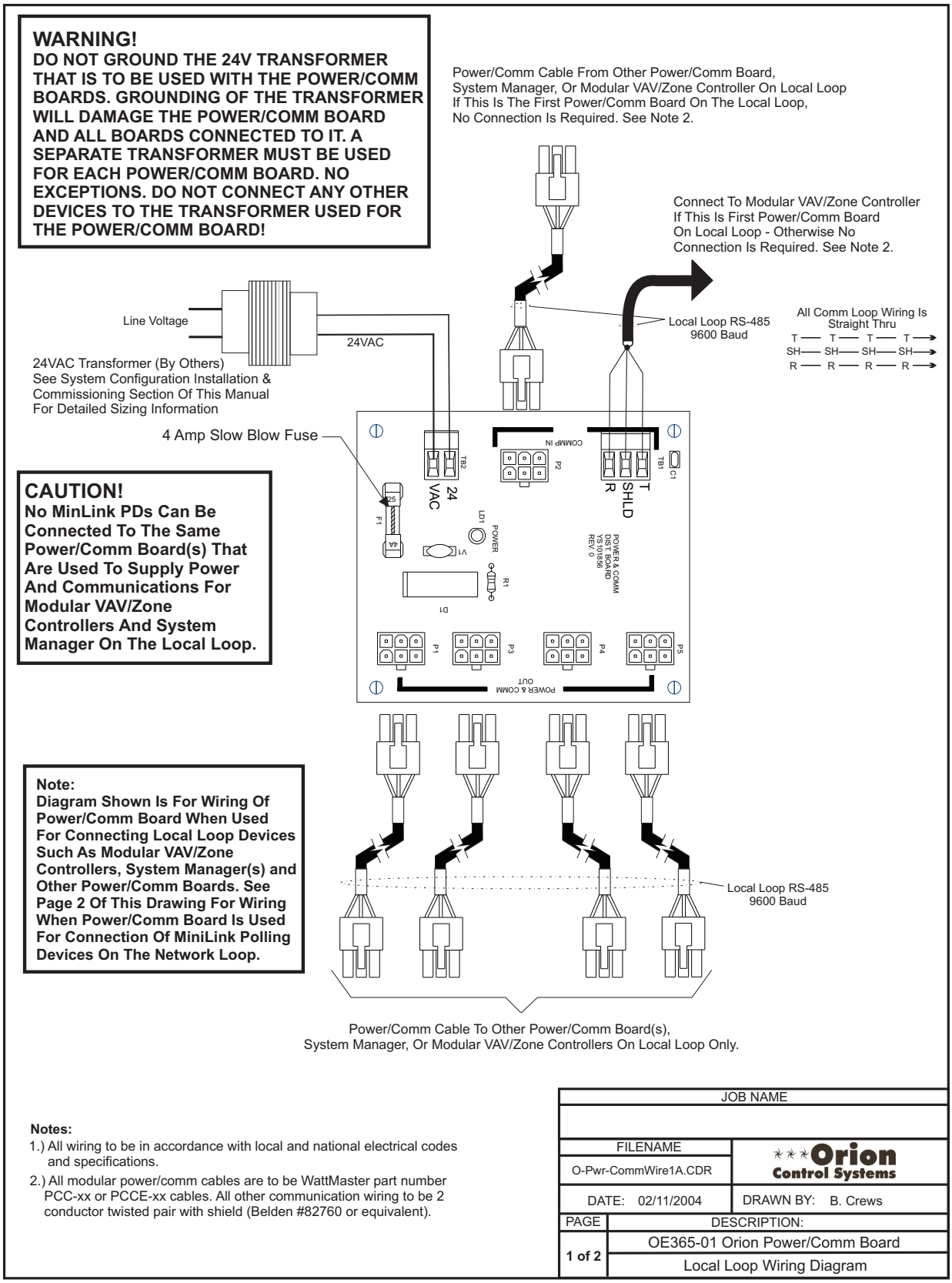


Figure 75: OE365-01 Power/Comm Board Wiring When Used For Local Loop Devices

Power/Comm Board Wiring - When Used For Network Loop Devices

WARNING!
DO NOT GROUND THE 24V TRANSFORMER THAT IS TO BE USED WITH THE POWER/COMM BOARDS. GROUNDING OF THE TRANSFORMER WILL DAMAGE THE POWER/COMM BOARD AND ALL BOARDS CONNECTED TO IT. A SEPARATE TRANSFORMER MUST BE USED FOR EACH POWER/COMM BOARD. NO EXCEPTIONS. DO NOT CONNECT ANY OTHER DEVICES TO THE TRANSFORMER USED FOR THE POWER/COMM BOARD!

Comm/Power Cable From Other Power/Comm Board Used For Connecting MiniLink PDs Or Previous MiniLink PD On Network Loop. If This Is The First Power/Comm Board On The Network Loop, This Power/Comm Cable Connection Is Not Required. Instead Use The 3 Pole Terminal Block Communication Connection As Shown Below And Connect To The CommLink. See Note 2.

Use To Connect CommLink When This Is the First Power/Comm Board On The Network Loop. Otherwise No Connection Is Required. See Note 2.

Line Voltage

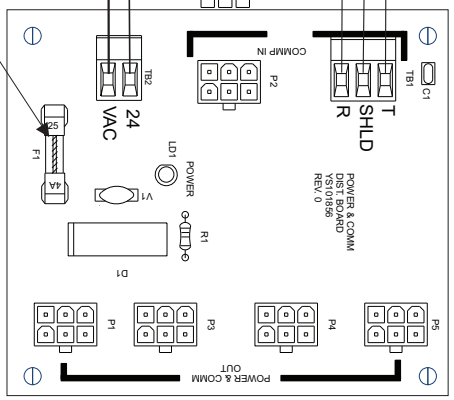
24VAC

24VAC Transformer (By Others)
See System Configuration Installation & Commissioning Section Of This Manual For Detailed Sizing Information

Network Loop RS-485
192000 Baud

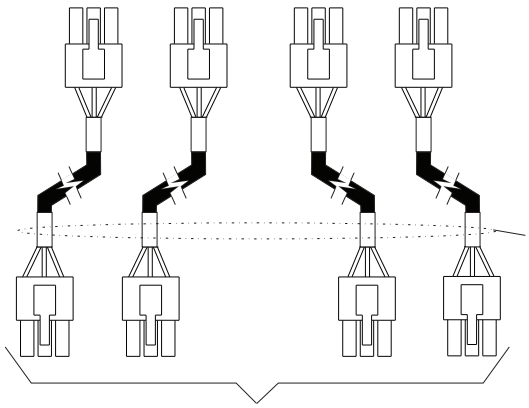
All Comm Loop Wiring Is Straight Thru
T — T — T — T →
SH — SH — SH — SH →
R — R — R — R →

4 Amp Slow Blow Fuse



CAUTION!
No Local Loop Devices (Modular VAV/Zone Controllers, System Manager(s) Etc.) Can Be Connected To The Same Power/Comm Board(s) That Are Used To Supply Power And Communications For MinLink PDs On The Network Loop.

Note:
Diagram Shown Is For Wiring When Power/Comm Board Is Used For Connection Of MiniLink Polling Devices On The Network Loop. For Wiring Of Local Loop Devices Such As Modular VAV/Zone Controllers, System Manager(s) and Other Power/Comm Boards On The Local Loop See Page 1 Of This Drawing For Wiring .



Network Loop RS-485
19200 Baud

Connect Power/Comm Cables To Other Power/Comm Distribution Board Or MiniLink PDs On The Network Loop Only.

Notes:
1.) All wiring to be in accordance with local and national electrical codes and specifications.
2.) All modular power/comm cables are to be WattMaster part number PCC-xx or PCCE-xx cables. All other communication wiring to be 2 conductor twisted pair with shield (Belden #82760 or equivalent).

JOB NAME	
FILENAME	Orion Control Systems
O-Pwr-CommWire1A.CDR	
DATE: 02/11/2004	DRAWN BY: B. Crews
PAGE	DESCRIPTION:
2 of 2	OE365-01 Orion Power/Comm Board Network Wiring Diagram

Figure 76: OE365-01 Power/Comm Board Wiring When Used For Network Loop Devices

Transformer Sizing & Cabling For Devices With Modular Connectors

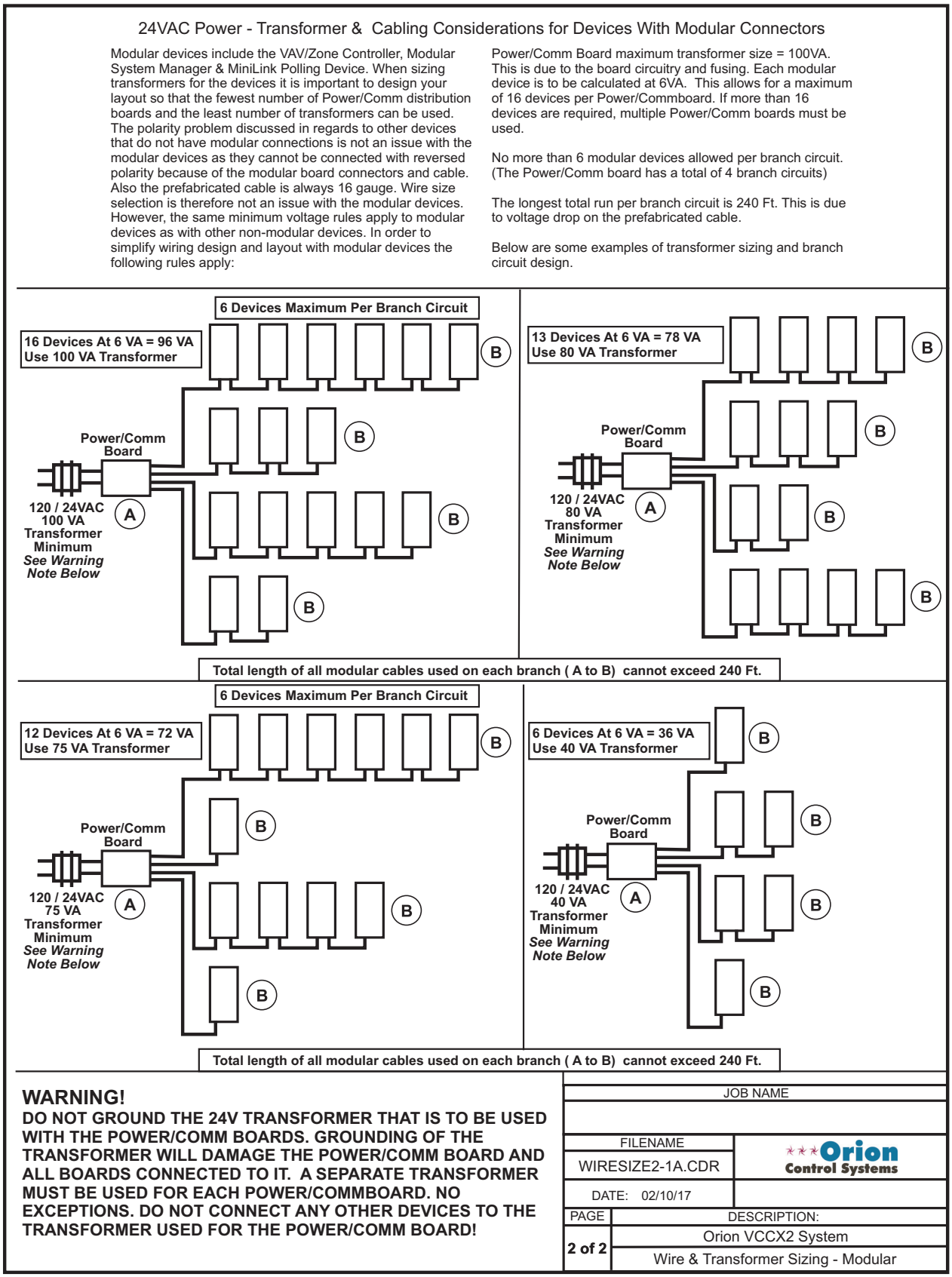


Figure 77: Transformer & Wire Sizing - Devices with Modular Connectors

APPENDIX B: MODULAR WIRING

Orion Control Systems

Form: OR-VCCX2WIRE-TGD-01B Printed in the USA August 2018

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