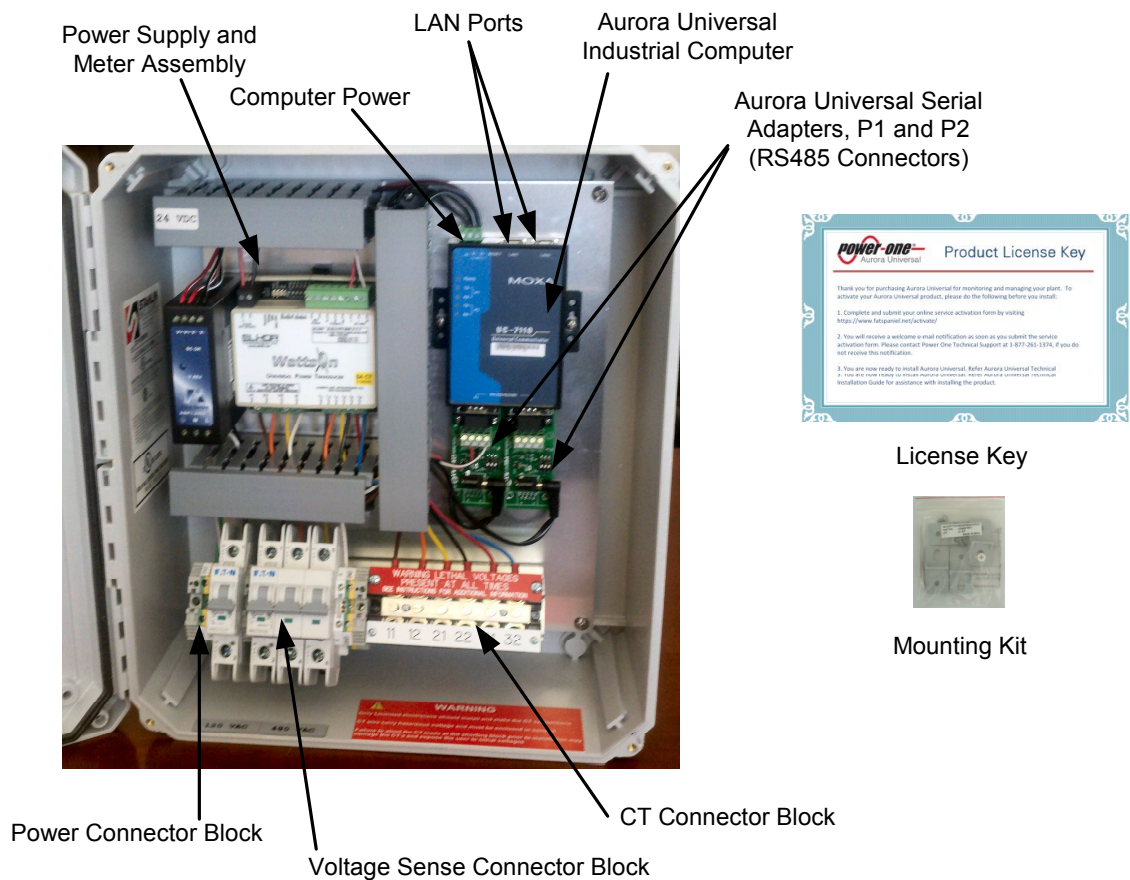


Aurora Universal Revenue Grade Installation Guide

This installation document covers the details for installing the Aurora Universal Revenue Grade hardware to work directly with inverters and other balance-of-system equipment. Through Aurora Universal Revenue Grade, the Management System (for example, Aurora Vision or Fat Spaniel Prime Edition) collects and analyzes energy generation and usage data for your inverters and other equipment. Once the hardware is installed, you will need to login to the Management System website to verify the Internet is connected properly and verify that the data is being received.

Aurora Universal Revenue Grade Installation Overview



Installation Steps

- 1 Select Location and Mount the Aurora Universal Enclosure
- 2 Make Power and Instrument Connections to the Connector Blocks
- 3 Make Connections to Devices to be Monitored and the Internet
- 4 Verify and Validate the Installation via the Management System

Equipment and Supplies

We supply:	You supply:
Aurora Universal System, which includes: Aurora Universal Industrial Computer with two Aurora Universal Serial Adapters attached Power Supply/Meter Assembly Connector Blocks Product License Key Mounting Adapter Kit	Power-One Aurora Inverter(s) Mounting Hardware, including cable ties and conduit 120V wall outlet or 120/230/208/240 circuit power Twisted Pair RS485 signal cable from inverter to Aurora Universal Industrial Computer Straight-through CAT-5 Network cable to LAN port or a Cellular Router

Site Selection and Mounting

Site Location Planning

Site selection depends on how many inverters you are connecting to the Aurora Universal Revenue Grade (AU Revenue Grade) and if other devices are being connected to the system. For multiple inverters, inverters are “daisy-chained” together using twisted pair signal cable with the first inverter in the chain connected to the Aurora Universal Serial Adapter #2 (on the right). Balance-of-system devices are likewise daisy-chained — with the first device connected to AU Serial Adapter #1. The AU Revenue Grade is connected to the Internet using Ethernet compatible cabling.

For sites with multiple inverters or long distances between interconnections, it may be useful to draw a map of site installation, so you are sure the selected site is appropriate.

The Internet connection is only limited by the typical restraints and conditions that apply to any data network, as long as the router connected to the Aurora Universal Industrial Computer (AU Computer) is reachable over a public network. The Internet connection point may be a router or switch that is connected to a public network. It may also be a cellular router affixed within the AU Revenue Grade enclosure or a cellular router shared by multiple Aurora Universal systems.

If connecting balance-of-system Modbus devices to the AU Revenue Grade such as an environmental measurement system, these devices are connected through the AU Serial Adapter #1. The AU Serial Adapter #1 always uses the Modbus protocol.

Cabling Requirements

Below are the rules regarding cable lengths:

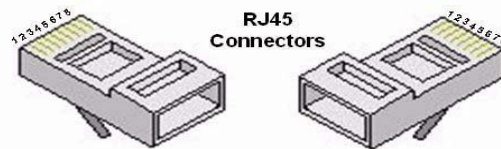
- Maximum 100 m (300 ft) between Aurora Universal and the internet connection point (LAN)
- Maximum 1200 m (4,000 ft) overall length of daisy-chained inverters or Modbus devices

Power plants are “electrically noisy” environments so shielded cable is advised. RS485 signal wiring between inverters is low-voltage wiring and should be shielded from electrical interference, such as high voltage wires or fluorescent light ballasts. If outdoor exposure or proximity to a noise source is a concern, we recommend Belden 9842 shielded wiring or equivalent.

For connection between the AU Revenue Grade and the Internet, ordinary straight through CAT-5 cable works for most applications. However, ordinary CAT-5 is low-voltage wiring and should be shielded from electrical interference. If outdoor exposure or proximity to a noise source is a concern, Cat-5e or equivalent cabling should be used.

It may be necessary for your application to string CAT-5 wire through conduit. It may not be possible to string the wire without cutting off and re-attaching one of the RJ45 connectors. The wiring diagram for RJ45 connectors on CAT-5 cable is provided as a convenience if you are required to re-attach an RJ45 connector.

Pin #	Color
1	Orange/white
2	Orange
3	Green/white
4	Blue
5	Blue/white
6	Green
7	Brown/white
8	Brown



Device Mounting

The exact method of mounting the Aurora Universal enclosure is left to the installer. The back of the enclosure has a female-threaded fastener embedded in the body of the enclosure. Here are some tips and best practices:

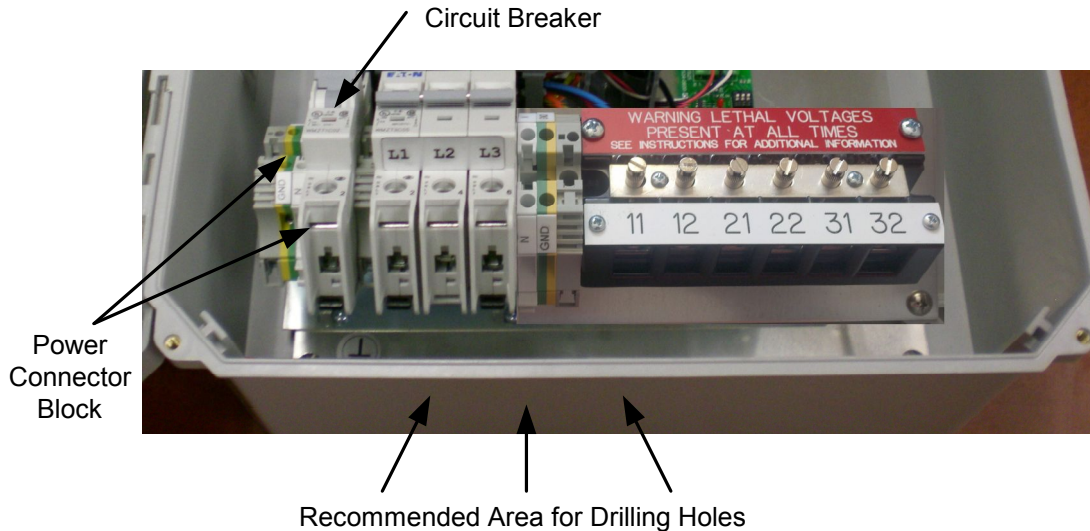
- The mounting kit included in the box transposes the female-threaded fasteners for forward facing bolts or lags (depending on the material to which the enclosure is being fastened). Typically, the boxes are attached to a metal plate that is setup by the installer.
- Ambient temperature around the box should remain between -10°C and 40°C
- If possible, install the enclosure where the enclosure is shaded from direct summer sunlight.
- Keep in mind that clearance between components in the enclosure and the enclosure wall is at least 2 inches, except on back wall of enclosure.
- Enclosure weighs between 5 and 10 lbs. Bracket mounts supporting up to 50 lbs are recommended.
- Enclosure must be mounted off the ground according to standard electrical codes.
- Enclosure door swings out to the left. Make sure you leave enough room to open the enclosure.
- If mounting outside, drill holes for conduit through the bottom of the enclosure and use conduit or glands to protect the integrity of the enclosure. Aurora Universal is a NEMA 3R rated enclosure. You *must* use appropriate conduit fittings to preserve the NEMA rating and your warranty.
- Wall-mounting or pole-mounting kits are available.

Connect Power and Instruments

Connect the Power Source

The AU Revenue Grade comes without holes for electrical connections to the enclosure.

1. Drill a hole in the enclosure to string the power supply wire. The power connection point in the Aurora Universal is at the lower left of the enclosure. This may also require conduit to house the wire if required for your installation.



2. Make sure power is OFF to the power wires coming into the Aurora Universal enclosure. Attach incoming power wires to the Power Connector Block (connectors farthest to the left) of the Aurora Universal enclosure.
3. Make sure the circuit breaker switch on Power Connector Block is OFF. Connect the power supply wire to 120, 208, 230, or 240VAC.

Connect Voltage Sensors

Voltage sense instruments are attached to the AU Revenue Grade at the Voltage Sense Connector Block, which is connected to the revenue grade meter within your system. The AU Revenue Grade comes without holes for electrical connections to the enclosure.

Connection of voltage sensors depends on the type of power used by your inverter: 3-phase, 120V, or 240V. Connectors are labeled L1, L2, L3, and neutral. You must match the L1-L2-L3 voltage sense connectors with the corresponding CT that measures current for the same wire. For example, L1 is paired with CT 11/12 and the two sensors must measure the same wire.

1. Use the same hole/conduit for the power source, or, drill a second hole if appropriate for your installation. The instrument connection points in the Aurora Universal are at the lower portion of the enclosure. This may also require conduit to house the wires if required for your installation.

2. Attach incoming Voltage wires to the Voltage Sense Connector Block of the AU Revenue Grade (connectors in the middle).
3. Install a circuit breaker in the load panel and run voltage taps in conduit to the AU Revenue Grade.
4. Determine the type of power being connected to the Voltage Sense Connector Block and perform the correct procedure below:

3-Phase Power (3-wire or 4-wire)

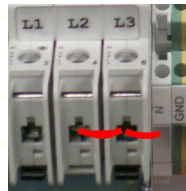
Connect each wire of the 3-phase connector to one of the Voltage Sense connectors—L1, L2, and L3. If you have a fourth neutral wire, connect it to neutral on the Voltage Sense Connector Block. For more information, see the schematic on the inside lid of the AU Revenue Grade enclosure.

120V Power

Connect the hot wire to L1 and the neutral wire to neutral. You must short L2 and L3 to neutral by connecting them using a small, shielded wire. For a full schematic, see Appendix A.

240V Power

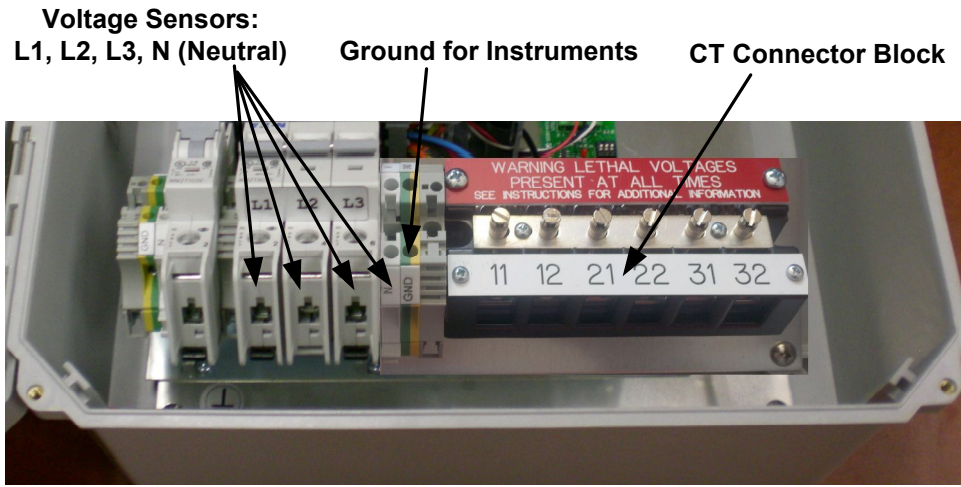
Connect one hot wire to L1 and the other hot wire to L2. You must short neutral and L3 to L2 using a small, shielded wire. For a full schematic, see Appendix A.



Shorting Wires for Connecting Voltage Sensors for 120V or 240V

5. Connect your voltage taps to the fused voltage blocks in your assembly. These are for instrument power, which you may take from the monitored circuit or from a separate circuit of 120, 208, 230, or 240VAC.

6. Be sure to attach a ground to the labeled spring clip terminal. The system must be grounded for both accuracy and safety.



Voltage/Current Sensor Pairings
Line L1 Paired with CT 11, 12
Line L2 Paired with CT 21, 22
Line L3 Paired with CT 31, 32

Connect Current Transducers

Current Transducers (CTs) are attached to the Aurora Universal Revenue Grade at the CT Connector Block, which is connected to the revenue grade meter within your system. The Aurora Universal System comes without holes for electrical connections to the enclosure. The meter is used in conjunction with the CT shorting block assembly, which is designed to short the current from the CTs while you are working with the assembly.



Example 5 Amp Current Transducer used with Aurora Universal Revenue Grade

WARNING!



5 Amp CT wires carry hazardous voltage and must be enclosed in conduit. Failure to short the CT leads through the shorting block prior to installation may expose the user to lethal voltage or damage the CTs. Power must be OFF to the inverter when installing CTs on wires.

1. The CT Connector Block (connectors farthest to the right) comes from the factory with the block shorted. Make sure the shorting screws are in place and fully engaged for all 6 positions.
2. Attach incoming Current Transducer (CT) wires to the CT connector block. Remove the plate with the CT connector numbers (11, 12, 21, 22, 31, 32) to access the screws for attaching CT wires.



CT Connector Block with Number Plate Removed (Ready for Connection)

3. Wire the CT leads to the block, matching the wire number to the corresponding number on the shorting block. Once again, prior to installing the CTs, make sure leads are shorted through the shorting block. *Failure to do so may cause damage to the CTs and expose the user to lethal voltages.* If you need to extend the wires attached to the CT, you must use a 16 AWG or larger wire.



CAUTION!

Voltage/Current sensor connections are paired. The CT attached to the first CT connector must monitor the same wire connected to the first voltage sensor. For example, the CT connected through 11 and 12 must monitor the same line connected to L1. Failure to match the two sensors will result in faulty sensor readings.

4. *After the CT leads are wired to the shorting block and shorted and the inverter is OFF,* install the CTs around the output line of the inverter taking into account the polarity indicator. On each CT you will see a polarity indicator. Depending on the type of CT used, a polarity indicator may be a white dot attached to the CT, or the terminal indicator embossed onto the CT housing, or it may be a label on the face of a square CT.

Install the CT between the inverter and the isolation transformer (PV type installation). Make sure the indicator faces the inverter.

5. After the CTs are installed, reattach the number plate. Remove the shorting screws for all CT positions that have been used to connect CTs. Failure to do so will prevent the meter from sensing current.



CT Connector Block with Shorting Screws Removed (Ready for Sensing)

Connect Monitored Devices and Connect to the Internet

Preparing Inverters for Connection to Aurora Universal

Inverters must be connected to each other in a daisy chain before being connected to Aurora Universal. The RS485 terminal block connects with three individual wires or a three-wire cable. Two wires are for signals and a third one for a ground connection.

1. Install all inverters as per the documentation for the inverter model you are working with. Adhere to all cautions and safety instructions in the Inverter manual and use the proper tools to remove the access panel.
2. **Make sure that all inverters have a unique address.** For detailed information on configuring addresses, refer to the section on “address selection” in the inverter installation manual. Some inverters have special address requirements. For example, for Power-One inverters, the address of the first inverter in the chain must be set to 2 (the default).



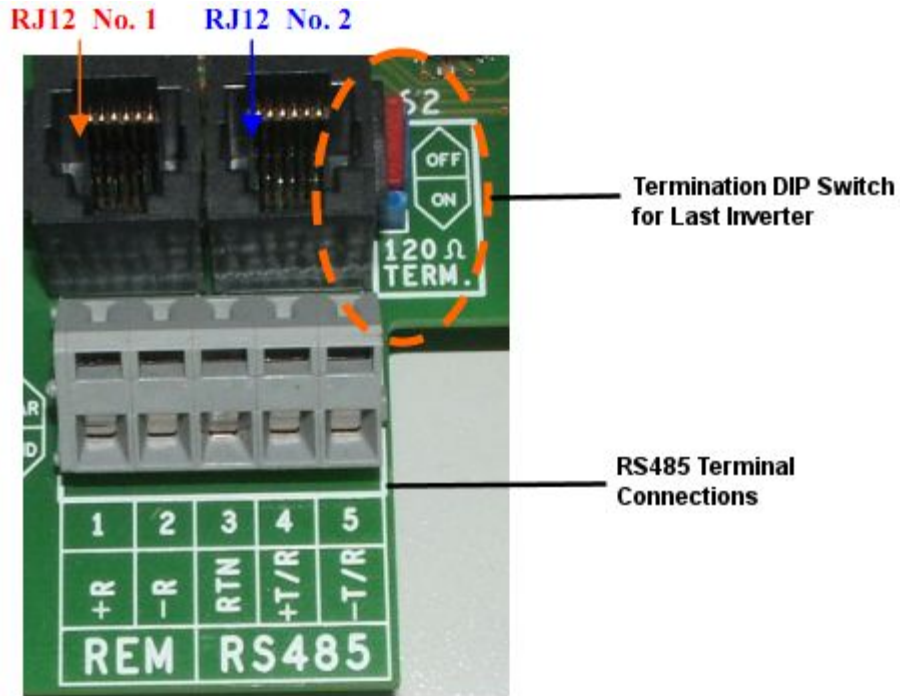
CAUTION!

Power-One uses the inverter address to track data for each inverter and to establish the Web site view. Once the inverter is connected to the monitoring equipment and is reporting data to the management server, the address cannot be changed without requiring changes to the management system configuration.

If the address must be changed at a later time or an inverter is replaced, please contact Power-One Technical Support *before the change is made.*

If for some reason the inverters cannot be configured as specified, please contact Power-One Technical Support *before service is started.*

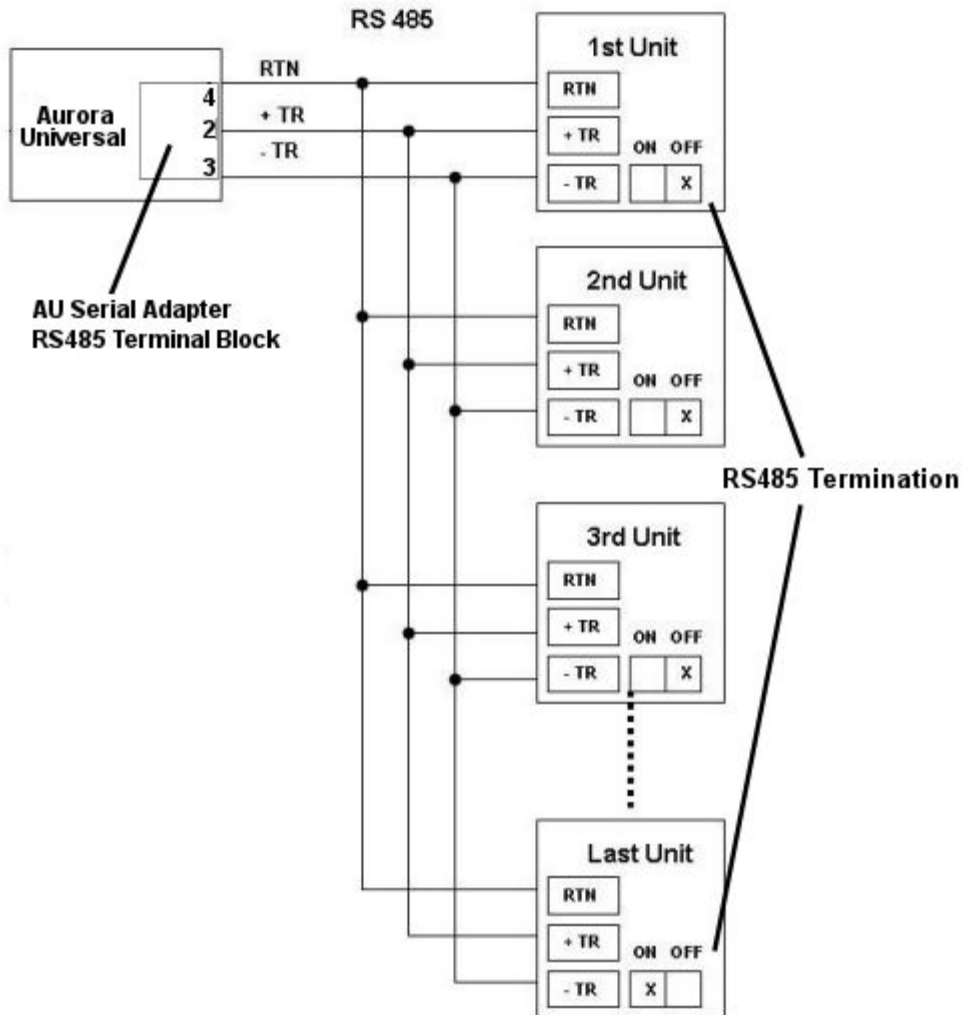
3. **Connect all inverters in the chain** (make a serial link between inverters). You need to locate the RS485 terminal block for each inverter in the chain. Inverters are connected by twisted pair signal cable from one RS485 terminal block in the inverter to the next inverter in the chain. The RS485 connectors may be a screw terminal block or cage-clamp connector. An example terminal block from an inverter is shown in the next figure.



Inverters typically features two holes so that input and output cables can be separated when multiple units are connected in a daisy chain. Cable is routed through the holes located at the inverter bottom. Holes are sometimes blanked with waterproof plugs, and the inverter manufacturer may supply cable glands for the holes to protect the inverter. After passing through the cable glands, cables are connected inside of the unit to the RS485 terminal blocks. Terminal blocks are protected by a door or covering. Remove the protective cover to access the RS485 terminal block.

Some inverters allow connections between inverters using RJ12 connectors and cabling. Refer to the inverter manual for information on using these ports to daisy chain inverters. However, note that the connection between the first inverter in the chain and the AU Revenue Grade must be made through the RS485 connectors.

4. **Terminate the last inverter.** Make sure the RS485 connection to the last inverter is terminated as per the inverter documentation. See the figure in the step above for an example of a DIP switch that needs to set to ON to terminate the last inverter. If you have a single inverter, that inverter must be terminated. For detailed information, refer to the section on communications in the inverter installation manual.



Connect Inverter and Ethernet

The Aurora Universal System comes without holes for electrical connections to the enclosure.

String CAT-5 or CAT-5e compatible cable between the AU Computer and an Ethernet switch or router to complete the physical connection to Ethernet. Connecting the AU Computer to a cellular router can also be used. If using a cellular router, it may be useful to attach the cellular router to the inside right wall of the Aurora Universal enclosure.

1. Drill a separate hole in the enclosure for the low voltage wires. The connection points in the Aurora Universal are on the AU Computer in the right side of the enclosure. This may require conduit to house the wires if required for your installation.
2. Connect the RS485 data wires from the RS485 terminal block on the AU Serial Adapter on the right (P2) to the RS485 terminal block in the first inverter in the chain using the pin callouts in the table below. Refer to the diagram and table below to make the proper connections. Refer to the Inverter installation documentation for details on the RS485 terminal block location. Make sure to use twisted pair wire to pins 2 and 3 on the Aurora Universal Terminal Block.

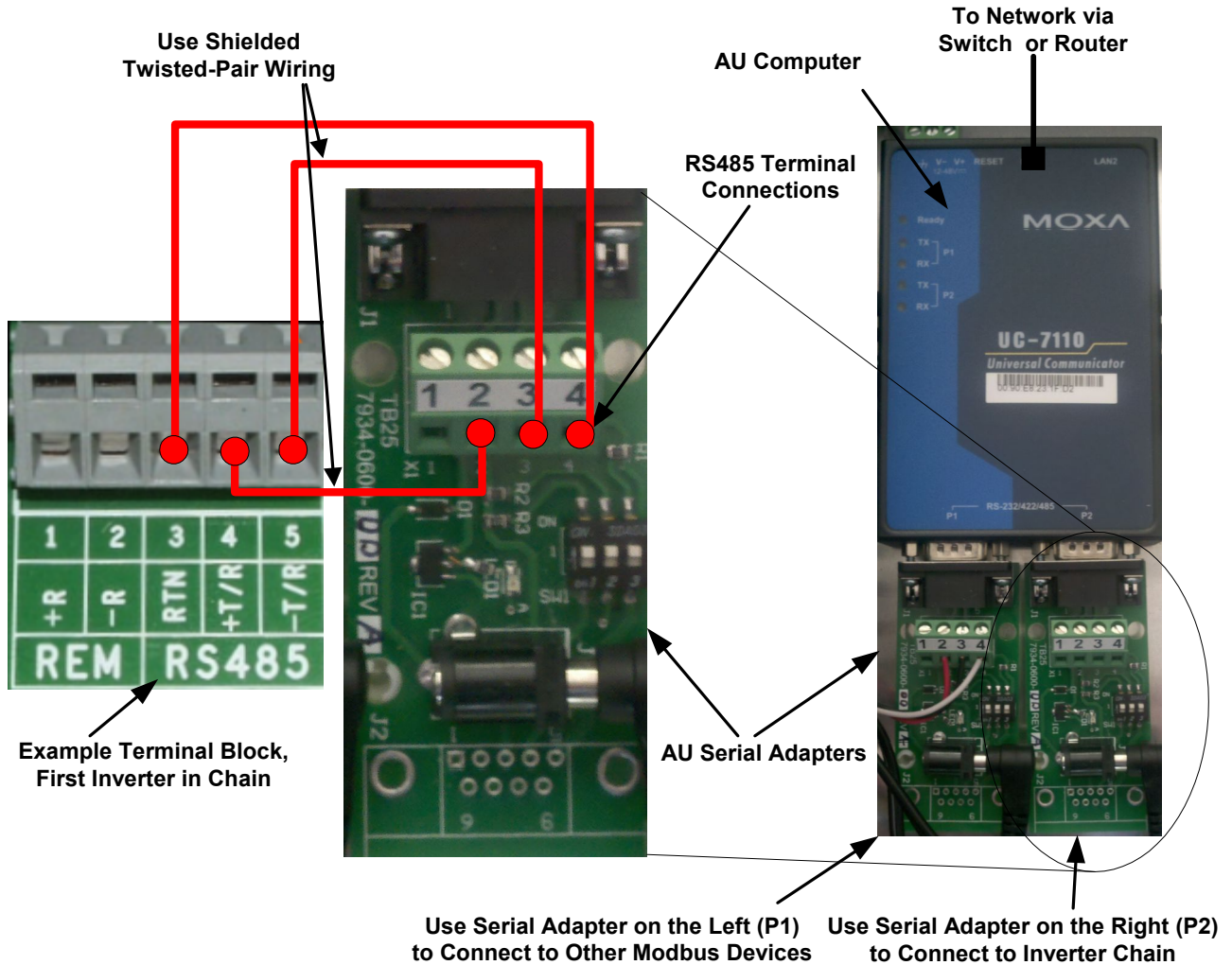
Table 1: RS485 Connections

Inverter RS485 Terminal Block Connection	Aurora Universal RS485 Terminal Block Connection	Aurora Inverter Pin Numbers
RTN	4 (white)	3
+TR	2 (red)	4
-TR	3 (black)	5
	DO NOT USE CONNECTOR 1!!!	



WARNING!

Connector 1 on the Aurora Universal RS485 Terminal Block is 24 VDC for devices that require 24 VDC power, such as certain weather stations. **DO NOT** connect any inverter's RS485 port to connector 1 on the AU RS485 Terminal Block. This may seriously damage the inverter's RS485 terminal block.



3. Connect any additional devices that use the Modbus protocol. Connect the device's RS485 terminal block to the Serial Adapter on the left (P1).¹ The pin callouts are the same for this connection as for the inverter chain (see the pin callouts in Table 1). Make sure to use twisted pair wire to pins 2 and 3 on the AU Serial Adapter Terminal Block.

¹ It is recommended to connect devices/inverters as in the procedures above; however, devices/inverters can be chained together in any order to either AU Serial Adapter, as long as some restrictions are followed:

1. Each device in a chain must have a unique address.
2. Devices attached to the left adapter MUST use the Modbus protocol and no device can have Modbus ID 32.
3. The last device in the chain MUST be terminated.
4. Some inverters require a unique AU Serial Adapter that replaces the AU Serial Adapter on the right (e.g., Fronius, Xantrex).
5. Only one protocol can be used for one AU Serial Adapter. Modbus or proprietary protocols MUST be isolated on a single chain.
6. In addition to Modbus, currently supported protocols are Power-One, Fronius, Solectria, SMA, SMA Webbox, and Kaco.

4. If you do not have a cellular router, skip to step 4. If you have a cellular router, connect the cellular router cable (RJ45) to the port labeled **LAN1** on top of the AU Computer. If this is your permanent means of connecting to Ethernet, it is not necessary to run the CAT-5 cable described in step 4. If the cellular router is being used for a temporary connection for installation verification or diagnostics, run the CAT-5 cable as described in step 4. Switch the Cellular router ON.
5. Run the CAT-5 or CAT-5 equivalent cable to an Ethernet access point, usually a switch or router. Refer to the Cabling Requirements section of this document if you need to need to cut and re-attach an RJ45 connector. Connect the CAT-5 cable (RJ45) to the AU Computer port labeled **LAN1**. Leave the cable temporarily disconnected if a cellular router is already connected.
6. You're now ready to test power and the physical connections. A cellular router, LAN switch, or LAN router must be connected through the LAN1 port of the AU Computer. Turn on the power to the Aurora Universal using the breaker on the Power Connector Block.
7. Check the power connection. You should see a green light on the power supply indicating that the power supply is operating properly. If no light is present, make sure the power to the power supply wires is ON, and check your wiring to the Power Connector Block.
8. Check the AU Computer power. There are 4 LED lights on the front of the AU Computer. The Ready LED should be ON.
9. Check the AU Computer Ethernet connection. Look at the top of the AU Computer; you should see a green light above the LAN1 port.

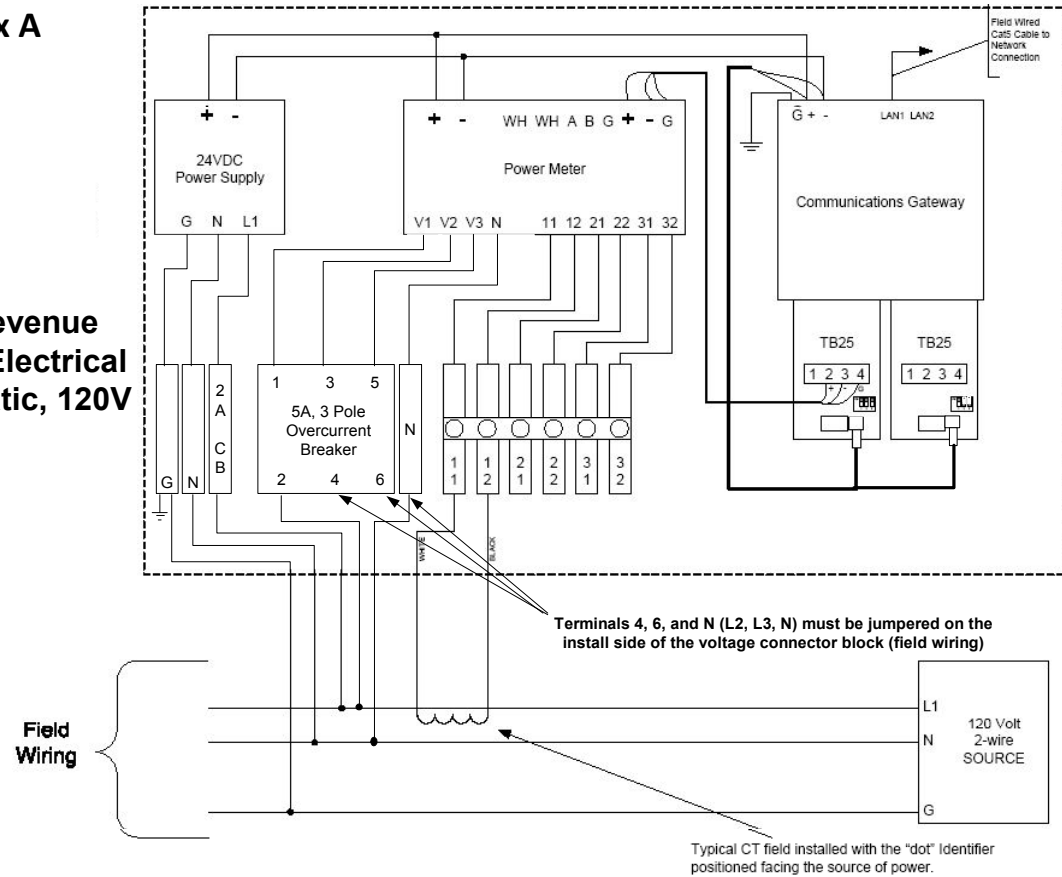
System Activation and Validation

If you acquired the Aurora Universal System as part of an Aurora Universal/Aurora Vision product bundle, please refer to the Product License Key that came with your Aurora Universal package. This License Key provides more information about the next steps for product installation and system validation.

If you are using Aurora Universal in conjunction with Fat Spaniel Prime Edition, go to <https://partnerportal.fatspaniel.net/display/pub/Home> and log in to Fat Spaniel Prime Edition with your account name and password. Using your product license key, set up the connection to Aurora Universal.

Appendix A

AU Revenue Grade Electrical Schematic, 120V



AU Revenue Grade Electrical Schematic, 240V

