Installation and Operation of the Reynolds & Reynolds UV2 Powervator®

by Sally E. Wilk

Learning Objectives

After reading this article, you should have learned about:

- ASME A17.1-2004 code requirements for elevator battery-backup emergency rescue systems
- The principle behind the UV2 Powervator
- The components and basic operation of the Powervator
- Proper mounting, installation and operation of the Powervator
- Testing and maintenance procedures for the Powervator.

UV2 Powervator, photo courtesy of Reynolds & Reynolds

History

The UV2 Powervator from Reynolds & Reynolds Electronics, Inc. is a commonly used battery-backup system for hydraulic elevators. It enables the emergency rescue of passengers who might otherwise be trapped in elevators during power outages. Most elevator mechanics should expect to install and/or maintain the UV2 as a part of their responsibilities.

The UV1, which provided single-phase AC and/or DC power to hydraulic passenger elevators when normal power was lost, was launched in 1989. In 2000, an improved UV1 was released and labeled the UV2, a more compact and less-expensive version. This article concentrates on operation, installation and testing of the UV2.

Code Requirements

Section 3.26.10 of ASME A17.1-2004, "Auxiliary power lowering operation," reads as follows.

3.26.10.1

"Auxiliary lowering shall be permitted to be initiated, provided that all operating and control devices, including door open and close buttons, function as with the normal power supply except that the following devices shall be permitted to be bypassed or made inoperative:

(a) landing and car floor registration devices (or call buttons)

(b) devices enabling operation by designated attendant (hospital service, attendant operation)

(c) devices indicating emergency recall operation to the recall level, unless otherwise specified in 3.27

(d) 'FIRE OPERATION' switch, unless otherwise specified in 3.27."

3.26.10.2

"When the auxiliary lowering operation has been initiated, the car shall descend directly to the lowest landing, except that the operating system shall be permitted to allow one or more intermediate stops, and then after a predetermined interval, the car shall proceed to the lowest landing, provided the auxiliary power supply is of sufficient capacity to open and close doors at each intermediate stop."

Continued

Value: 1 contact hour

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3.26.10.3

"If the car and landing doors are power operated, and if the auxiliary power supply is of adequate capacity, the doors shall open when the car stops at the lowest landing and shall close after a predetermined interval."

Why Battery Backup?

Building owners and managers may choose battery backup for a number of reasons, including but not limited to the following:

- To ensure the safety of elevator passengers
- To greatly decrease the cost of auxiliary power associated with motor generators
- To forestall damage to elevator doors that may occur when first-response teams help trapped passengers to safely exit an elevator
- To ensure the contentment and peace of mind of building residents and visitors
- To respect the time of building tenants and their clients

Definitions

For the purposes of this article, "normal power" is defined as the power that is supplied by the local power company to the building and the elevator system. "Emergency power" is defined as the power that is generated by the Powervator and supplied to the elevator system during a power outage.

Powervator Overview

The UV2 consists of several components, including two batteries, two transformers, an inverter board with an on/off switch and an optional battery-disconnect switch (Figure 1). The batteries are 12-VDC, 12-AHr sealed lead acid cells that are connected in series to provide a 24-VDC nominal output. The main transformer, in conjunction with the inverter board, uses 24 VDC from the batteries to create the appropriate AC voltage supply (120, 208, 240 or 480) for the elevator controller and door operator. The inverter board is hinged on its left side and opens easily to provide access to the internal cabinet for battery replacement and wiring.

The charger transformer is used to trickle charge the batteries when there is normal power present. The optional battery-disconnect switch isolates the battery power source from the power-conversion system in order to prevent inadvertent operation of the Powervator and provide an additional level of security during maintenance operations. It can be padlocked and tagged in the off position. This safety feature is required by some states, such as California and Minnesota.

Theory of Operation

When power is lost, the UV2 activates until power returns. (Figure 2). Under normal power conditions, the UV2 is "transparent" to the elevator system; normal power simply passes through its circuitry. The UV2 monitors incoming power for signs of a power loss and activates when a power loss is detected. Before generating emergency power, the UV2 isolates normal power from the load in order to avoid the potential for two power sources to simultaneously supply the elevator system.

The UV2 then provides power to the elevator door and controller. This auxiliary power enables the elevator controller to bring the elevator car down to the appropriate floor and open the elevator doors, allowing passengers to safely exit the cab. After the doors have opened, the system remains active and continues to function until power returns or the combined battery voltage drops below the 21-VDC cutoff voltage. When normal power returns, the UV2 reverts to its original state and recharges its batteries.

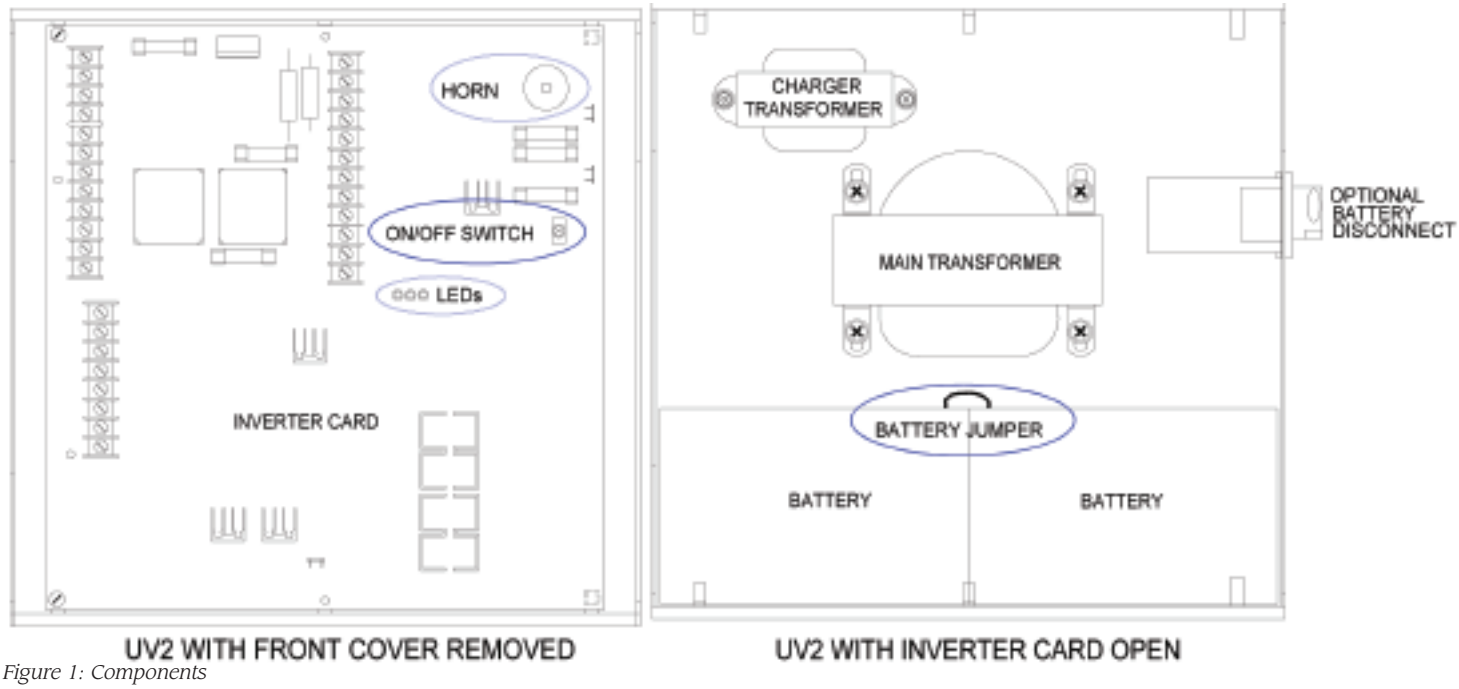

Figure 1: Components

Status Indicators

The UV2 is equipped with four status indicators (Figure 1) that are located on the inverter board. These are:

- The yellow "CHG" (charge) LED, which indicates that the batteries are being charged
- The green "EPS" (emergency power supply) LED, which indicates that emergency power is being provided to the elevator system
- The red "LOB" (low battery) LED, which indicates that battery power to the inverter board is low
- The horn, which indicates that normal power is present, but that the system has been turned off and will not be able to provide emergency power when normal power is lost

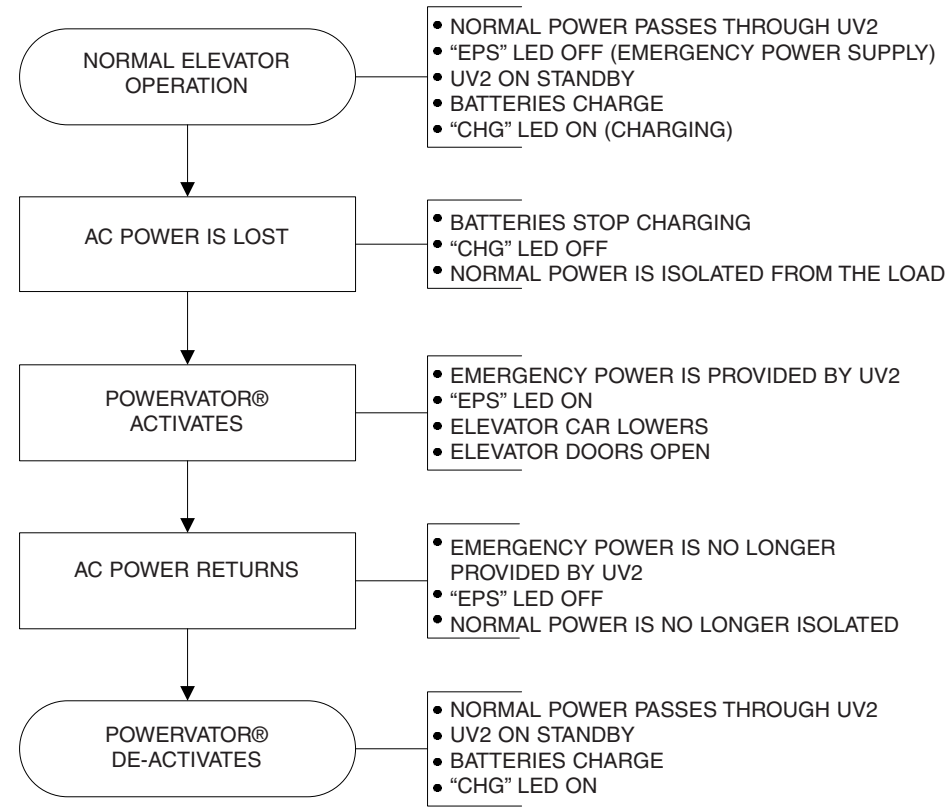

Figure 2: Theory of Operation

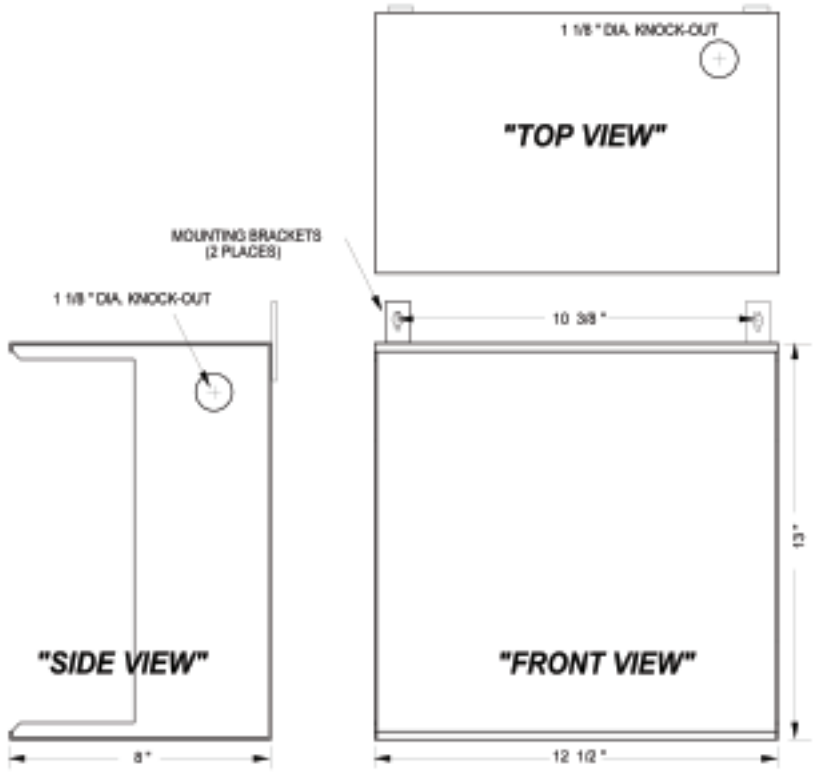

Figure 3: Mounting

Proper Mounting

Remove the two mounting brackets and four flathead screws from the back of the cabinet. Rotate the brackets 180° from their original position and reattach them to the cabinet (Figure 3). Select a suitable location on the wall for mounting, taking into consideration the following:

- The UV2, with batteries, weighs approximately 50 pounds.
- It is necessary to maintain approximately 5 inches of clearance around the cabinet for ease of maintenance.
- Electrical knockouts for conduit are located on the top and sides of the case.

Select the appropriate anchoring hardware for the application. Use the UV2 cabinet as a template by which to mark the locations of the mounting-bracket holes. Set the unit aside and install the anchoring hardware in the wall. Secure the unit to the wall.

Safety Precautions

Safeguard the area so that no one is hurt. Inform building personnel that the elevator system will be out of service during installation or maintenance of the Powervator. **High AC and DC voltages will flow through the unit!** When installing the unit or during major maintenance work, turn off both the building's main disconnect and the inverter board on/off switch.

A battery can present a risk of electrical shock and burn from high short-circuit current. If the optional battery-disconnect switch is

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installed, this switch should be locked out and tagged out during maintenance operations on the elevator. If the unit does not have a battery-disconnect switch, disable battery functions by removing the jumper between the two batteries. (Figure 1). After the batteries have been disconnected, be careful not to short them together inadvertently.

Wiring

Each Powervator is shipped with an application-specific connection diagram. Always refer to the specific connection diagram provided with the system when installing the unit. Figure 4 represents a typical 480-VAC installation, which will be used for the purposes of this article. Be certain to observe all aforementioned safety precautions before proceeding.

Important Considerations

- All output voltages that the Powervator produces must match the voltages of the wires they feed.
- The UV2 is not designed to support the load of the elevator's hydraulic pump motor.
- The UV2 will be damaged if the inputs and outputs are reversed.
- The UV2 AC power connections must be made in series, not in parallel. (Figure 5). If the UV2 is connected in parallel, normal power won't be isolated from emergency power, and the potential exists for two power sources to simultaneously supply the elevator system. Please refer to the "Theory of Operation" section of this article for details.
- Fuse protection should be installed between the Powervator and the mainline.

480-VAC Connections

1. Turn the main disconnect off. Turn off all power to the elevator system.
2. The inverter-board on/off switch should be off.
3. If the optional battery-disconnect switch is installed, it should be turned off, locked out and tagged out. If the unit does not have a battery-disconnect switch, disable battery functions by removing the jumper between the two batteries (Figure 1).
4. Identify the AC power lines to the elevator controller.
5. Disconnect the power from the elevator controller between the fuses that protect the controller and the controller itself.
6. Wire the UV2 into the circuit so that terminals $L1I_{T\text{-}PWR9}$, $L2I_{T\text{-}PWR10}$ and $L3I_{T\text{-}PWR5}$ are connected to the output of the fuses, and $L1O_{T\text{-}PWR11}$ and $L3O_{T\text{-}PWR7}$ are feeding the elevator controller. Refer to Figure 4 for wiring details and to Figure 6 for the location of the T-PWR terminal block on the inverter board.
7. Use $L2O_{T\text{-}PWR12}$ and $L3O_{T\text{-}PWR7}$ to power the door transformer.

Safety-Switch Connections

The safety-switch circuit ensures that the Powervator will not activate when the mainline power is purposely turned off. It should be used in conjunction with a disconnect switch that has a fourth pole. The safety switch will be wired as shown in Figure 4. Refer to Figure 6 for the location of the T-CTL terminal block on the inverter board. Connect terminal $A_{T\text{-}CTL10}$ to one side of the fourth pole and terminal $D_{T\text{-}CTL9}$ to the other side of the fourth pole. Verify that A and D are shorted when the disconnect switch is closed (on) and that there is no connection

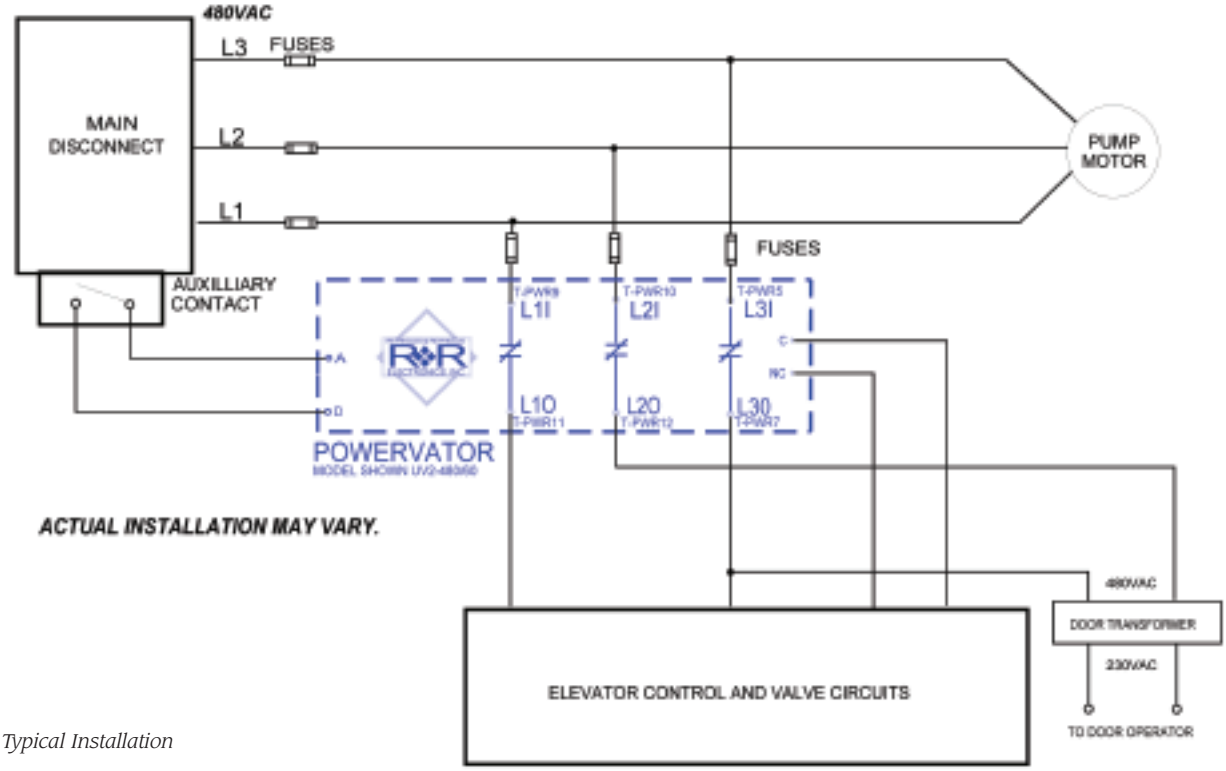

Figure 4: Typical Installation

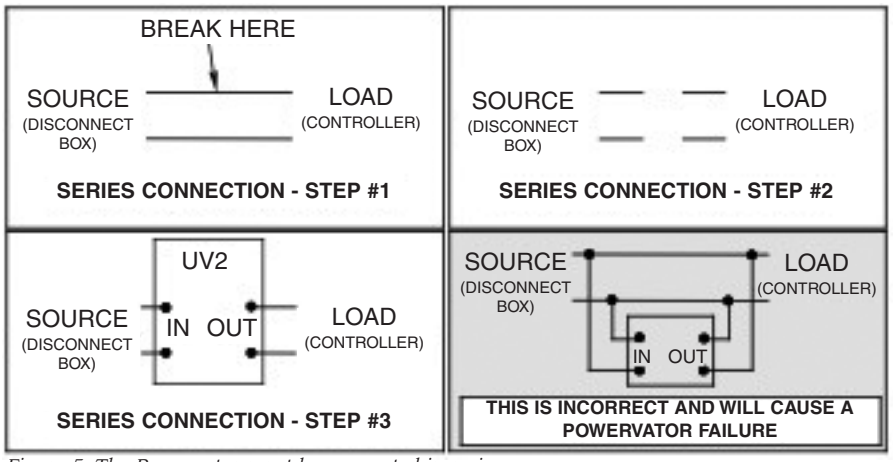

Figure 5: The Powervator must be connected in series

(open circuit) between A and D when the disconnect switch is open (off).

Relay Terminal Connections

A set of dry relay contacts is provided at terminals $NC_{T\text{-}CTL7}$, $NO_{T\text{-}CTL5}$ and $C_{T\text{-}CTL6}$. These terminals can be used:

- To send a signal to the elevator controller, informing it that the elevator is now on emergency power and that it may only go in the down direction
- As a pilot relay to initiate an emergency-power situation.

Contact the elevator-controller manufacturer to determine how to connect the relay contacts to the controller. Observe all local and national codes that pertain to an emergency recall.

Battery Connections

Observing all aforementioned safety precautions, remove the two battery brackets from the cabinet. Position each battery in the cabinet according to Figure 7. Reinstall the battery brackets. Connect the batteries together using the jumper with which they are provided. The voltage across the battery terminals should read approximately 24 VDC. Connect the free black lead in the unit to the available negative battery terminal. Connect the free red lead in the unit to the available positive battery terminal.

Testing

Functional Test, Part A

This test will cause the elevator to move. Safeguard the area so that no one is hurt. The purpose of this test is to demonstrate the following:

- That the A to D connection to the main disconnect is correctly wired.
- That the UV2 will power the elevator and controller during a loss of power, and the controller will "rescue."

The following steps are to be performed in order:

1. The inverter board on/off switch should be off.
2. If the unit does not have a battery-disconnect switch, disable battery functions by removing the jumper between the two batteries (Figure 1).
3. Turn the main disconnect off. Turn off all power to the elevator system.
4. Remove the wires from the A to D circuit that connect the circuit to the main disconnect.
5. Connect terminals A to D together (direct short) with 22-AWG or larger wire.
6. Turn on all power to the elevator system. Turn the main disconnect on.
7. If there is an optional battery-disconnect switch, turn it on. If the unit does not have a battery-disconnect switch, install the jumper between the two batteries (Figure 1).
8. Turn the inverter board on/off switch on.
9. Remove AC input power by turning the main disconnect off. The Powervator will detect the loss of power and activate. The elevator will move to the appropriate floor and open its doors.
10. The test is complete. Establish a safe environment for continued testing by performing the following:

- Turn the inverter board on/off switch off.

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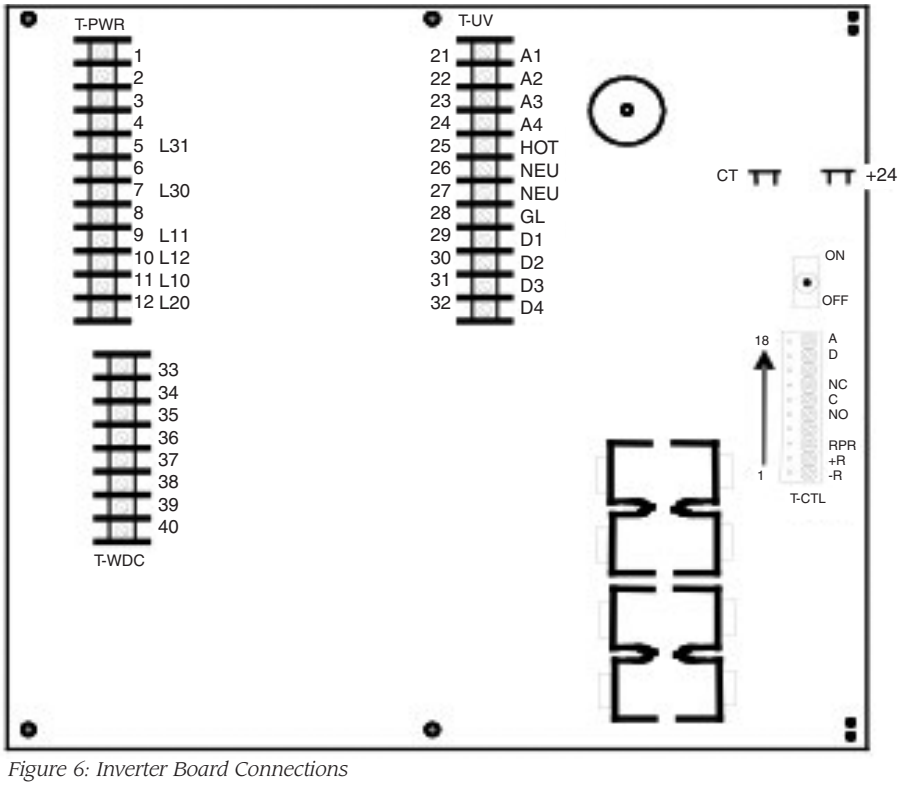

Figure 6: Inverter Board Connections

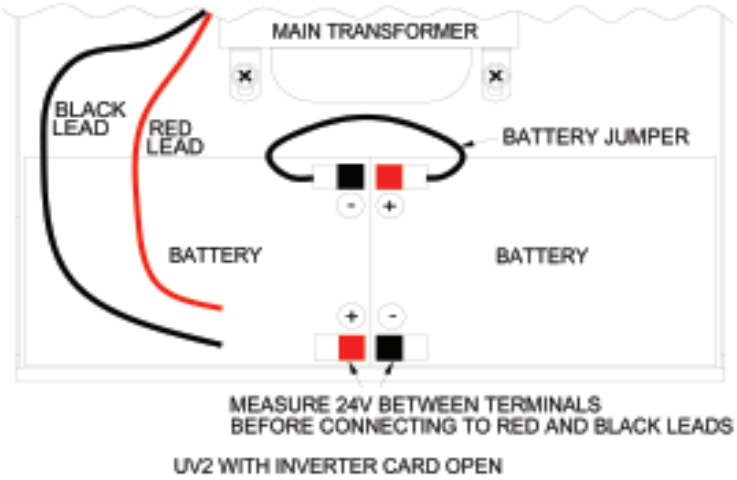

Figure 7: Battery connections

- Turn the optional battery-disconnect switch off or remove the jumper between the batteries.
- Turn the main disconnect off and turn off all power to the elevator system.
- Rewire the A to D safety circuit so that it is connected to the main disconnect according to the "Safety-Switch Connections" section of this article.

11. In order to establish the correct operating state for the Powervator, please complete the next test as well.

Functional Test, Part B

This test may cause the elevator to move, as the elevator controller is exercised. Safeguard the area so that no one is hurt.

1. Turn on all power to the elevator system. Turn the main disconnect on.
2. The inverter board on/off switch should be off. The horn will sound.
3. If there is an optional battery-disconnect switch, turn it on. If the unit does not have a battery-disconnect switch, install the jumper between the two batteries (Figure 1).
4. The "LOB" LED should be on. This indicates that the batteries do not yet power the logic circuits.
5. Ensure that the A to D circuit is intact. Measure the battery voltage across both batteries. If it is less than 26 VDC, let the Powervator charge the batteries until the battery voltage reaches 26 VDC. (In order to charge the batteries, the mainline power to the Powervator must be on. This requires AC voltage to be present at terminals L1I and L2I. The voltage on L1I and L2I will also be present on L10 and L20. The yellow "CHG" LED should light.
6. When the batteries are fully charged and the CHG LED is on, turn the on/off switch on the inverter board on. The LOB LED should go out and the inverter should be ready to supply power to the controller.
7. Remove AC input power by turning off the main disconnect. The Powervator will detect a power loss but won't activate because of the A to D safety circuit, which recognized that the main disconnect was intentionally turned off. The CHG LED will be off.
8. Run any pertinent tests on the controller.
9. Apply normal AC input power to the installation by turning the main disconnect on. The Powervator will detect the return of AC power, begin to charge and release the isolation relays, which will restore normal power to the controller.
10. Run any pertinent tests on the controller.

Maintenance

The Powervator is self-contained, operates automatically and requires very little maintenance.

1. Keep the unit free of dirt, moisture and excessive humidity by keeping the cabinet closed at all times.
2. Test the unit once every six months by performing the tests as described in this article.
3. Under normal conditions, battery life is three to five years. Undercharging, overcharging and heat are the most common causes of premature battery failure. Batteries should be replaced at least once every five years, even if they hold a charge.

This article was approved by W. John Reinarts, president and CEO of Reynolds & Reynolds Electronics, Inc.

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Learning-Reinforcement Questions

Use the below learning-reinforcement questions to study for the Continuing Education Assessment Exam available online at www.elevator-books.com or on page 123 of this issue.

- What is the purpose of the UV2 Powervator?
- List three reasons why a building owner might choose auxiliary power.
- What is the operation theory of the UV2?
- What parts of the elevator system does the UV2 power? What part of the elevator system isn't powered by the UV2?
- Name the key components of the UV2.
- What do the "LOB," "CHG" and "EPS" LEDs indicate?

ELEVATOR WORLD Continuing Education Assessment Examination Questions

Instructions:

- Read the article **"Installation and Operation of the Reynolds & Reynolds UV2 Powervator®."** (page 79) and study the learning-reinforcement questions.
- To receive **one hour** of continuing-education credit, answer the assessment examination questions found below online at www.elevatorbooks.com or fill out the ELEVATOR WORLD Continuing Education Reporting Form found overleaf and submit by mail with payment.
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1. The UV2 Powervator:
   a. Is a battery-backup system.
   b. Is a motor-generator system.
   c. Enables passengers to safely exit an elevator during a power outage.
   d. A and C.
   e. B and C.

2. The UV2 Powervator was introduced in:
   a. 1898.
   b. 1989.
   c. 2000.
   d. 2006.

3. The UV2 Powervator is used with:
   a. Traction elevator systems.
   b. Hydraulic elevator systems.
   c. Both A and B.
   d. None of the above.

4. According to ASME A17.1-2004 Section 3.26.10.2, an elevator operating under emergency power:
   a. Must stop at every floor and open its doors.
   b. Must stop at every other floor and open its doors.
   c. Must proceed directly to the lowest landing and open its doors without making any intermediate stops.
   d. Must proceed to the lowest landing and can stop at floors in between, provided that there is enough power to open and close the elevator doors at each intermediate stop.

5. How many 12-VDC batteries does the UV2 require in order to generate 480 VAC?
   a. 40.
   b. 4.
   c. 20.
   d. 2.

6. At least how often should UV2 batteries be replaced?
   a. Every 2 years.
   b. Every 3 years.
   c. Every 4 years.
   d. Every 5 years.

7. What part(s) of the elevator system do(es) the UV2 power?
   a. Elevator door only.
   b. Elevator controller, valves and door.
   c. Elevator controller and valves, and hydraulic pump.
   d. Hydraulic pump only.

8. The UV2 is equipped with three LED indicators. These are:
   a. CHG, EPS, NPO.
   b. CHG, EPS, LOB.
   c. NPO, EPS, LOB.
   d. LOB, CHG, NPO.

9. Which of the following best describes the normal sequence of events associated with the UV2 Powervator?
   a. UV2 activates, loss of normal power, UV2 deactivates, normal power returns.
   b. UV2 activates, loss of normal power, normal power returns, UV2 deactivates.
   c. Loss of normal power, UV2 activates, normal power returns, UV2 deactivates.
   d. Loss of normal power, UV2 activates, UV2 deactivates, normal power returns.

10. How often should the UV2 be tested in order to ensure continued functionality?
    a. Once every three months.
    b. Once every four months.
    c. Once every six months.
    d. Once every five years.

ELEVATOR WORLD Continuing Education Reporting Form

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Continuing-education credit: This article will earn you **one contact hour** of elevator-industry continuing-education credit.

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