AC and AC/UPS Power Systems

Installation, Operation and Maintenance Manual

12, 24, and 48 Volt Systems

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Notice

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Federal Communications Commission (FCC) Notice

The Power System is designed to meet the limits pursuant to Part 15 of the FCC rules.

CE Compliance

The Power System is designed to be CE compliant.

Safety Instructions

Retain all safety information for future reference. The following table defines precautionary safety terms used within this guide. Failure to observe these precautions when installing, using, or servicing this product violates this products intended purpose and may result in personal injury or damage to equipment.

DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.

Safety Symbols

Safety symbols shown on the Power System must be observed when operating, servicing, or repairing the system. Failure to comply with safety precautions shown on the AC and AC/UPS Power System components or in this guide violates the intended use of this product.

The following safety symbols appear on the Power System components and in this guide:

GENERAL HAZARD

This symbol represents a general warning or caution.

Read and Understand all Instructions

To reduce the risk of fire, shock, and injury to personnel or damage to equipment, always follow basic safety precautions when installing, using, or servicing the system for which this guide is written. Ventev shall not be held liable for any damage or injury involving its enclosures, power supplies, or other hardware if used or operated in any manner not consistent with its intended purpose, or is installed or operated in an unapproved manner. Images and photographs contained in this manual are for illustrative purposes only and may not directly apply to your application of the technology. Basic safety precautions include, but are not limited to, the following:

- Use qualified service personnel to service equipment. Servicing is required when the equipment has been damaged and does not operate normally.
- Use insulated tools for electrical connections and do not touch live terminals with bare hands.
- The enclosure should be locked and secured at all times, except when being serviced.
- Remove all conductive personal equipment and jewellery prior to servicing the equipment
- Systems with batteries can be heavy, so use proper lifting techniques where applicable.
- Battery installation, maintenance, service and replacement must only be performed by authorized personnel. Follow guidelines in this manual and utilize battery manufacture's recommended procedures.
- Use caution when manipulating battery cabling as the result may be arcing, fire, or possible explosion.
- Batteries contain harsh chemicals. Follow the Chemical Hazards notes if contact with skin and/or clothing occurs and reference manufacturers MSDS.
- Follow the battery manufacturers approved transportation and storage instructions.
- Do not introduce sparks in the vicinity of a battery.

Local Code and Permits

- Contact local authorities to determine and obtain the necessary permits before installing your solar system.
- Follow requirements of applicable local and national electrical codes.

WARNING

Prior to installation, assure the available site source power is within the recommended input specifications of the enclosure and its equipment. Also, verify that the output voltage(s) from the enclosure will adequately power equipment load.

Quick Start Guide

High-level steps to assemble, install, and commission the Ventev AC and AC/UPS System include:

1. Open the shipping packages and confirm all components and parts are on hand.
2. Mount the enclosure.
3. Disengage the Orange Line voltage knife switch located on the AC terminal power input block to disrupt power feed to the AC circuits.
4. If AC/UPS System, install battery(s) in the enclosure and connect them in the proper configuration. Connect the battery(s) to the DC load terminal blocks.
5. Connect the load to terminal blocks.
6. Engage the Orange Line voltage knife switch located on the line AC terminal power input block.
7. Confirm operation by measuring voltages and by confirming the DC light on the power supply is green.

About this Guide

Purpose and Scope

The purpose of this manual is to introduce the reader to Ventev's AC and AC/UPS Systems and to instruct in the successful installation and use of them. The guide describes the enclosure components and functions, and provides task-based instruction for operating and maintaining the Ventev Power System after installation.

Audience

This guide is intended for first time and experienced users. It is assumed that users have a basic understanding of electrical wiring techniques.

Organization

The following table is a roadmap to using this guide efficiently.

Refer to…	To…
Chapter 1, System Overview	Understand Ventev's Power Systems, its theory of operation, architecture, the AC/UPS battery selection process, and system wiring.
Chapter 2, Installation	Unpacking, position, assemble, mount, and commission the Power System.
Chapter 3, System Troubleshooting Procedures	Verify and validate installation and setup, and troubleshoot problems.
Chapter 4, Maintenance	Maintain the Power System.
Appendix A, Wiring Diagrams and Site Layout	View representative wiring diagrams of the various power systems.
Appendix B. Battery Selection Plots	Select optimum battery capacity for specific geographic sites.

Conventions

The following table describes visual conventions used throughout this guide.

Description	Example
A button or switch you press on a device appears in this **TYPEFACE**.	On the Enclosure, press the **START** button.
An arrow represents a note or a tip to convey related information.	

Contents

List of Figures

Chapter 1: System Overview

This chapter provides an overview of the system and a description of the system architecture and wiring. Experienced users of Ventev's AC and AC/UPS Power Systems will find this section provides a quick start guide and reminder in

assembling the Power System. Those new to this product will find detailed installation, operation and maintenance instructions in subsequent chapters. Topics discussed in this chapter include the following:

Ventev's AC and AC/UPS Power Systems

The Ventev AC and AC/UPS Power systems provide a safe, reliable, weather resistant means to power DC equipment remotely. These systems are typically installed to power systems such as wireless communications networking, SCADA networks, security, and surveillance.

The Ventev AC and AC/UPS Power System offers two different configurations for powering equipment in remote locations. Both systems provide a flexible, scalable power system that is designed to provide power for customer equipment staged in remote locations where utility power is available. On the AC/UPS platform, battery back up standby power is ready in event of loss of utility power at the site. The system is designed to provide continuous power for pre-defined durations as defined by the Ventev battery back up curves.

Theory of Operation

Using the datasheet on this product as a guide, the customer can match required load to the system size needed. The technology is pre-selected by Ventev to offer a robust configuration for outdoor usage/networks.

The AC/UPS Power systems are AC Power systems that include battery(s) for load continuum during utility power outages. The Uninterruptible Power System provides sustained DC current to critical customer equipment load(s) in the event of momentary or extended site utility power loss. While the number of hours of uninterrupted load can be designed into the system, the actual number of hours power will be available depends on equipment off-design load and local weather conditions (battery capacity can be temperature dependent). Refer to Ventev datasheets or more information on uninterrupted power time.

System Description

Figure 1 is a wiring diagram showing the Power System components and connectivity.

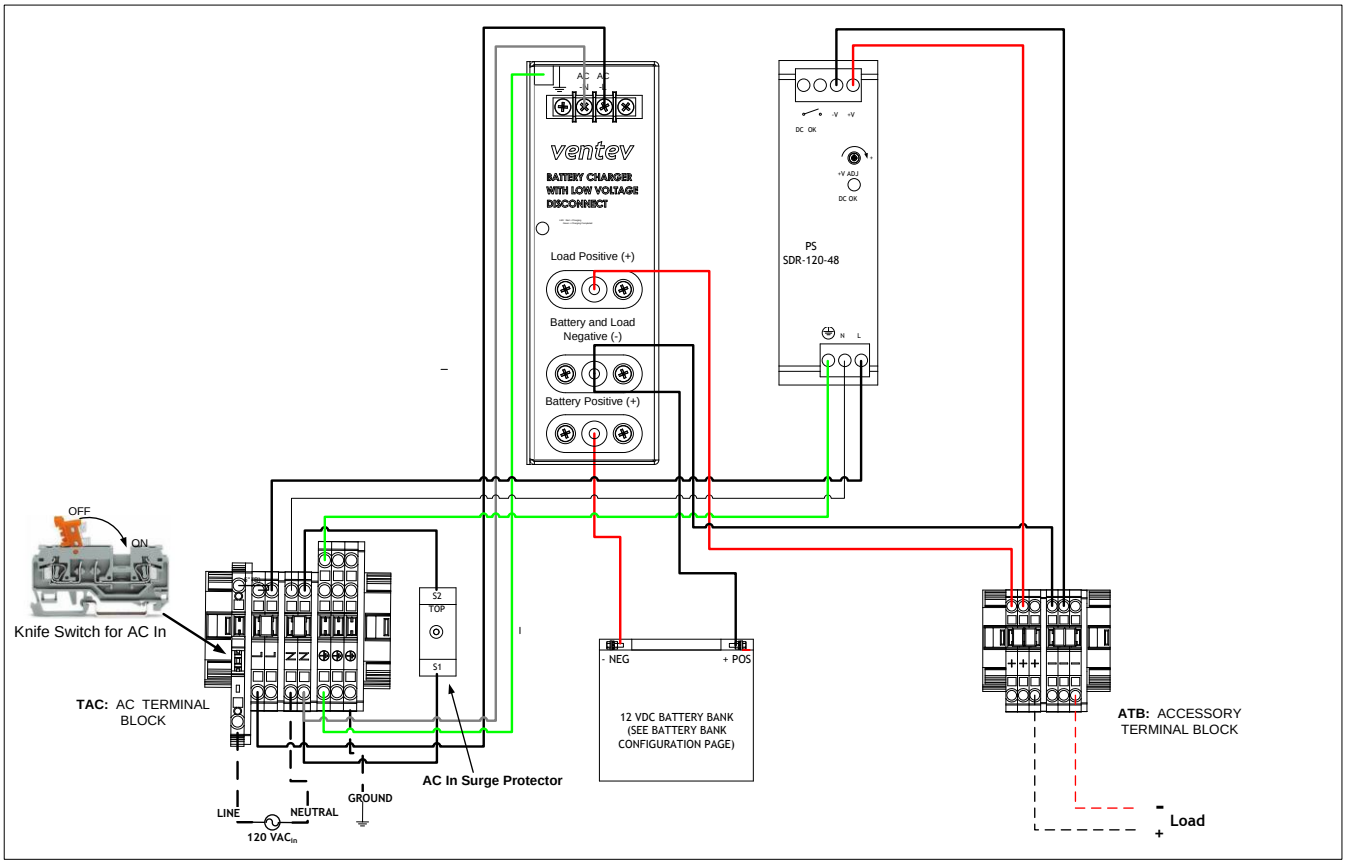

Figure 1. Wiring Diagram of a Large System

As shown in Figure 1, an AC Terminal Block assembly, with a surge protection circuit, passes through AC power to the power supply. The power supply is connected to the battery charger and customer load. The Ventev battery charger is equipped with a low voltage disconnect feature to protect the battery in event of extended utility power interruption (prevents battery over-discharge).

Battery Configurations

Figures 2 through 6 show the various battery configurations provided with the AC/UPS systems.

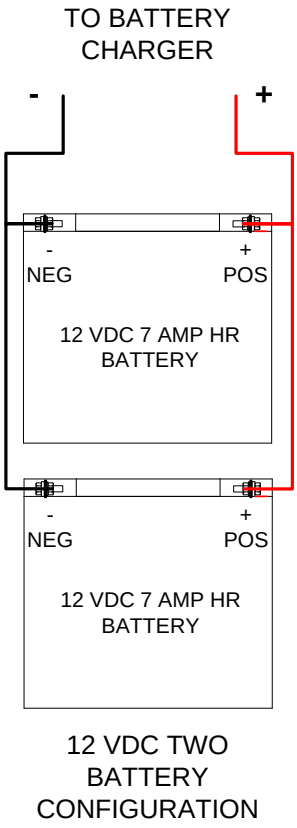

Figure 2. Two Battery 12 Volt Configuration

Figure 2 shows two 12 Volt batteries connected in parallel to provide twice as much capacity at the same 12 volts.

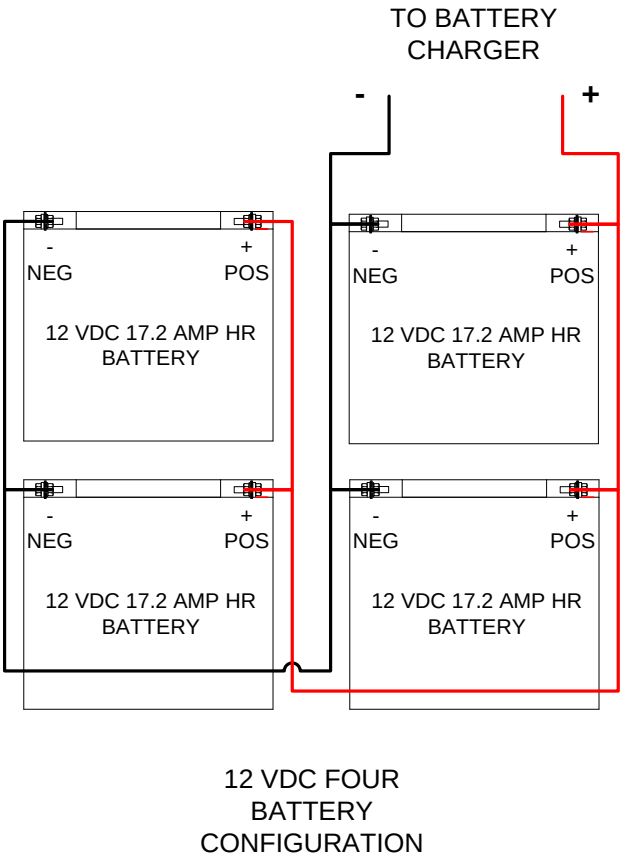

Figure 3. Four Battery 12 Volt Configuration

Figure 3 illustrates four batteries connected in parallel to yield four times each battery's AMP Hr capacity (68.8 AMP HR at 25 DegC).

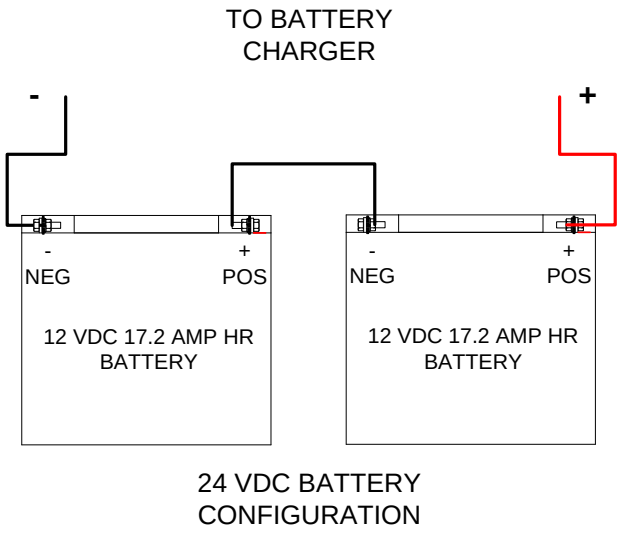

Figure 4. Two Batteries Connected in Series

Figure 4 is a diagram of two batteries connected in series to yield 24 volts with the Amp HR capacity remaining the same as each individual battery, in this case 17.2 AMP HR at 25 DegC.

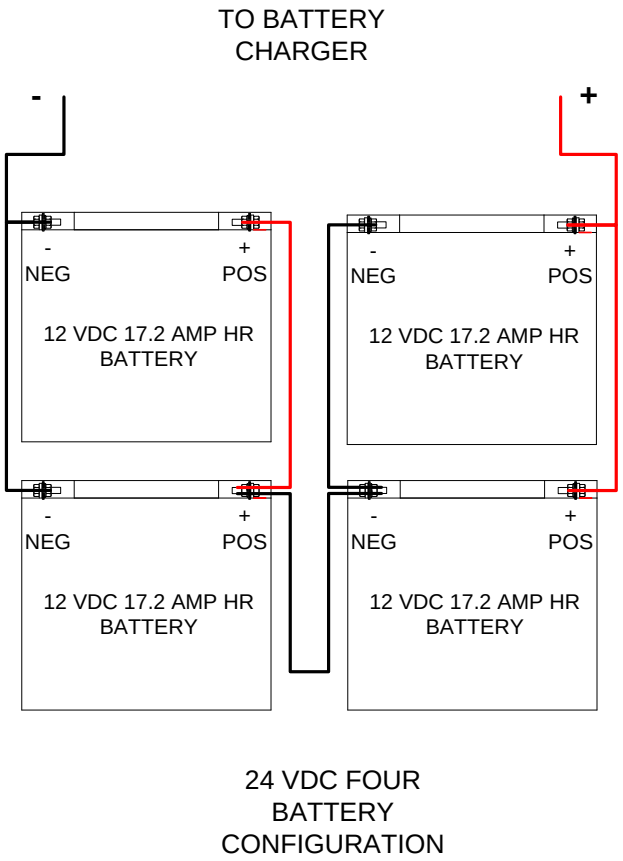

Figure 5. Four Batteries Connected with a Set of Two Connected in Series in Parallel with the Other Two.

Figure 5 diagrams four batteries configured to yield 24 volts. Two pairs are connected in series then each pair connected in parallel. Connected AMP HR capacity is the value of the total of each pair, in this case two times 17.2 AMP HRs or 34.4 AMP HRs at 25 DegC.

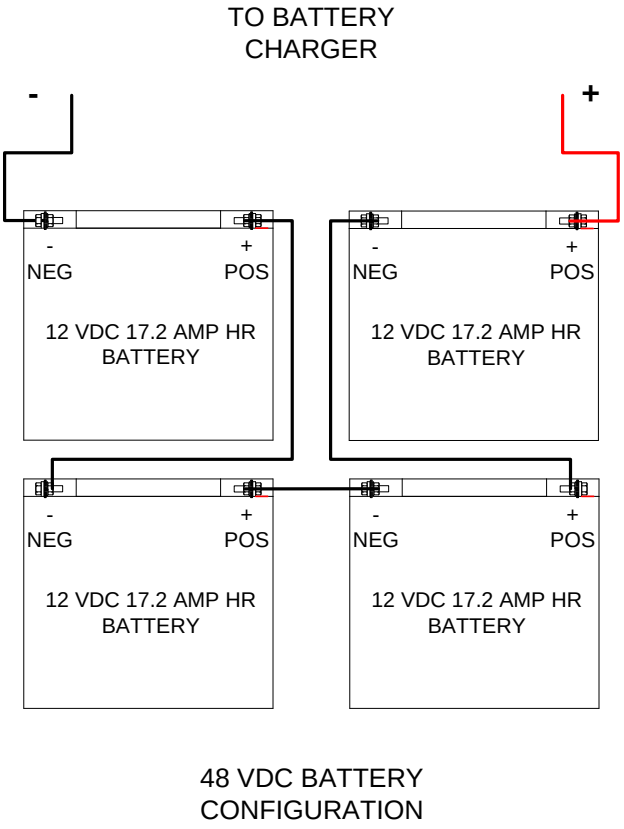

Figure 6. Four 12 Volt Batteries Connected in Series for 48 Volts

In Figure 6, four 12 volt batteries are connected in series resulting 48 Volts. Total capacity is equal to that of one of the batteries (17.2 AMP HR at 25 DegC).

Battery Selection

Because applications, customers and requirements for battery back up time vary greatly, Ventev has developed a series of charts to enable selection of the size in Amp-Hours of the battery bank that will meet the purchaser's needs. These sizing charts are intended to provide an estimated battery backup time based upon the System DC voltage (12, 24, or 48) and the power rail (100 or 500 series).

Batteries must be selected and configured to meet load demand and provide load for the customer's equipment through normal power outages at the site for which they serve. Figures 7 and 8 show the effects of temperature on battery capacity.

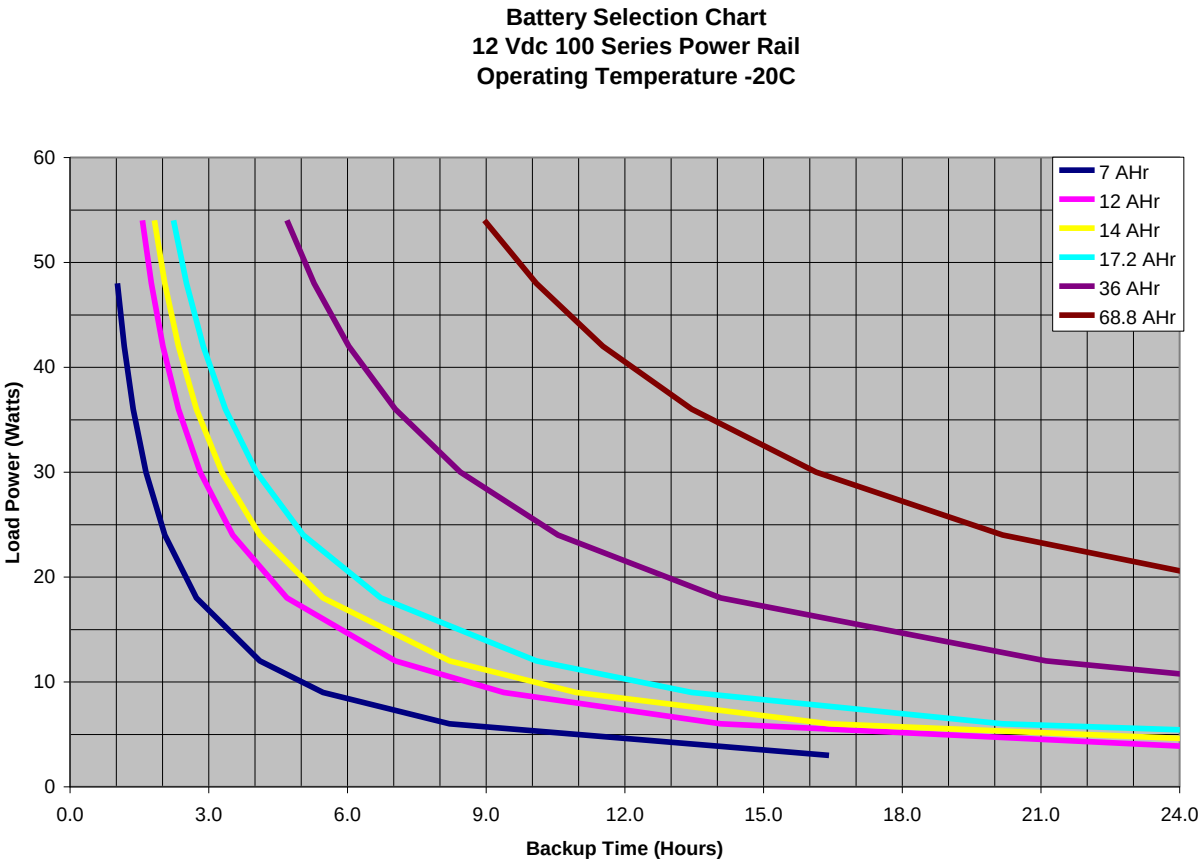

Figure 7. Battery Selection Chart for a 12DC System at -20Deg C.

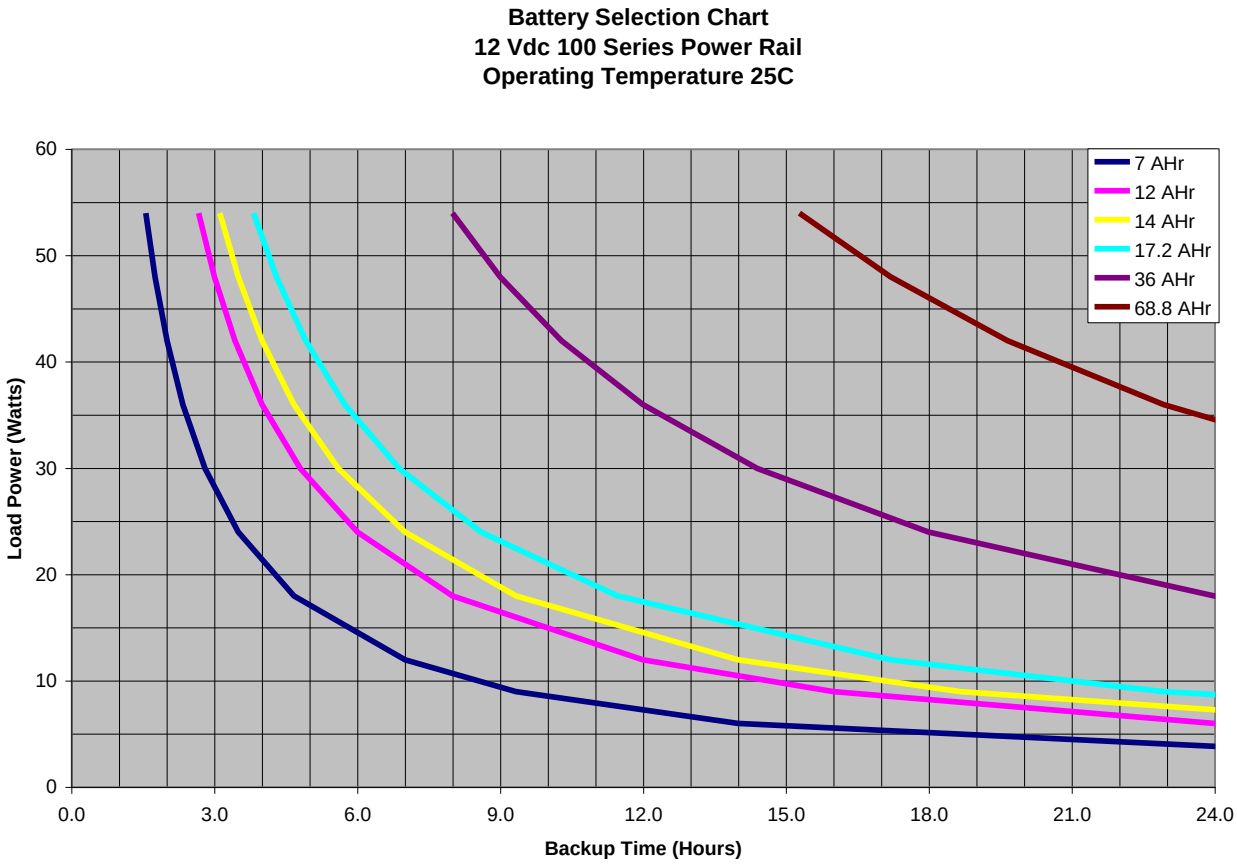

Figure 8. Battery Selection Chart for a 12DC System at +25Deg C.

Figures 7 and 8 show a family of curves for 7, 12, 14, 17.5, 38, and 68.5 AmpHr showing load as a function of backup time. Figure 7 plots the curves at -20 Deg C and Figure 8 shows the same curves at +25 Deg C. Notice the upward shift in back up time as temperature increases. Expected temperature at the operating site must be taken into account to assure reliable year-round operation.

Appendix B contains the same set of curves as shown in Figures 7 and 8 for all Ventev AC/UPS systems. These curves can be used to select new battery banks or check existing system battery capacities.

To determine the battery bank that provides the amount of backup time required:

1. Identify the system voltage (12V, 24V, 48V)

2. Determine system power requirements using the charts y-axis

3. Determine the backup time required using the charts x-axis

4. Identify the corresponding battery curve that will provide the amount of uninterrupted service needed..

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Chapter 2: Installation

This chapter provides detailed instructions on the installation of the AC Power and AC/UPS system. Topics include:

Installation Overview

This section describes the installation of a basic system.

Required Tools

The following tools may be needed to assemble the Power System:

- Screw driver
- Voltage meter
- Pliers

Before you Begin

The system must be installed as described in this manual to ensure reliable operation.

Use extreme care in selecting the site and mounting. Do not connect loads requiring more power than the system was designed for because it will cause system damage. In addition, if this is an AC/UPS system, battery standby power will be drastically reduced.

To help ensure optimal, reliable performance of your system based on the original specified design parameters, follow the instructions presented herein.

Unpacking the system

Ventev systems are delivered to customers in a variety ways depending upon the volume. Efforts are made to closely pack the components to minimize shipping and handling fees. Upon receipt of the order,

1. Remove the enclosure from the shipping carton.
2. Inspect the external sides of the system for any shipping damage. Open the enclosure to remove all packaging materials.
3. Cable ties may be used to ensure DIN rail mounted components remain mounted properly.
4. Remove the zip lock bag typically containing the following items:
   - AC & cable entry/feed-thru x 2 (one for .24"-.47", one for .20"-.35")
   - Hole plug kit
   - Battery series jumper cable (14 AWG) for 24V configurations or
   - Battery parallel jumper cable (14 AWG) x 2 for 12V configurations
   - Wall Mount Feet with screws

   Note: These items may differ depending upon the system purchased

Mounting the Enclosure to a Pole

Most codes require the base of the enclosure to be located a minimum height from the ground. Always verify height restrictions at installation site before proceeding.

For AC/UPS Systems: Mounting the Battery in the Enclosure

The physical size and weight of the batteries varies depending on storage capacity dictated by design requirements. The system is designed such that the batteries are to be placed in the bottom of the enclosure after it is attached to the pole.

Mounting Enclosure to Pole

1 Take the two clamps/U-bolts from the hardware bag for the appropriate pole size, hex nuts, bolts and washers.

2 Position the battery box against the pole and install the clamps/U-bolts loosely using hardware described above.

3 Position the enclosure against the north side of the pole to take advantage of any shading available for reduced heat on the battery(s) and electronics in the enclosure and tighten the bolts (Check for level before tightening).

TIP:

To improve battery life, position the battery enclosure such that it will be shaded from direct sunlight during the summer months if possible.

System Setup and Wiring

CAUTION:
If an AC system is not properly grounded, there is a risk of electrical shock or severe burns. Always follow local and national electrical code grounding techniques during installation.

Grounding

1. Ground the support rails in accordance with local code.
2. Ground the enclosure in accordance with local code.

Load Wiring

1. Open the AC knife switch located on the AC terminal block.
2. Locate the wiring diagram on the door. Refer to the wiring diagram and wire the load equipment to the terminal blocks; be careful to always observe correct polarity.

Wiring and Installing the Battery(s) in AC/UPS Systems

(Battery supplied separately with AC/UPS Power Systems)

When working with batteries, observe the following guidelines:

CAUTION: Electrical Burn Hazard
Take extreme care when working and installing batteries and interconnect wiring. A short-circuited battery can produce thousands of amperes and is capable of melting hand tools and causing severe burns.

CAUTION:
Always wear eye protection and gloves. Be sure to remove all metal jewellery that can come in contact with battery terminals.

CAUTION:
Use extreme care in placing the battery(s) into the enclosure, being careful not to short battery terminals to the enclosure casing.

To Install and Wire the Battery

1. Indicate the battery installation date. On the battery label, remove the appropriate punch-outs to indicate the month and year, for example, 6 ,2008 = June 2008. When tracking battery performance and warranty information, this data is very important.
2. Loosen the retaining screw on the battery retaining bracket and move the bracket clear of the battery shelf.
3. Install the battery into the enclosure.
4. Replace the battery retaining bracket and secure.
5. Verify that the battery terminals are completely covered by the insulating boots (if included in the installation kit).
6. Close and lock the enclosure the cabinet

CAUTION:
Observe proper polarity. Re-check battery wiring for inadvertent reverse polarity battery connection. Next, energize the AC circuit feeding the AC or AC/UPS cabinet.

System Commissioning

After completing the mechanical and electrical installation, conduct a system inspection to verify the integrity of all mechanical fasteners and electrical terminations:

1. Verify AC power with a volt meter.
2. Verify DC power voltage is within design specifications on the door diagram.
3. Turn on the load to verify the system is operating properly
4. For AC/UPS Systems only, check the battery voltage.
5. Do a final re-check of all electrical connections.
6. Once the system checkout and commissioning is complete; close and secure the enclosure.

CAUTION:
Incorrect site AC voltage can damage the unit and void the warranty. Verify the input voltage matches applied AC input power on the enclosure door diagram. Never apply 480VAC to a unit with the input voltage limit of 240VAC.

Chapter 3: System Troubleshooting Procedures

This section describes system troubleshooting procedures. Topics discussed in this chapter include the following:

System Verification

If a system fails to operate within design parameters, it is usually due to one or more of the following reasons:

1. Excessive load operation.
    a. AC/Power System Failure may result if the load is greater than design specifications.
    b. AC/UPS Power system failure may result if the load is greater than design specifications or is operated on a the uninterruptable battery source daily or more hours than the original design specifications.
2. System component damage/malfunction. This may be a result of one of the following symptoms:
    a. Severe voltage drop/power loss. Loose or damaged wiring or an open circuit of the battery or load can cause loss of power.
    b. Operating this power system in a hut or location where the ambient temperature is higher than the design specifications.
    c. On AC/UPS systems only, low or no battery power. Excessive load operation can cause permanent battery damage (e.g. deep discharge).
3. Battery Capacity Performance Degradation. Battery life can be impacted by environmental temperatures, high system loads and the frequency and duration of power outages.

Battery Capacity

The temperature in which batteries operate have a direct affect on their capacity. This must be taken into account when choosing batteries.
Figure 9 is a plot of temperature affects on battery capacity.

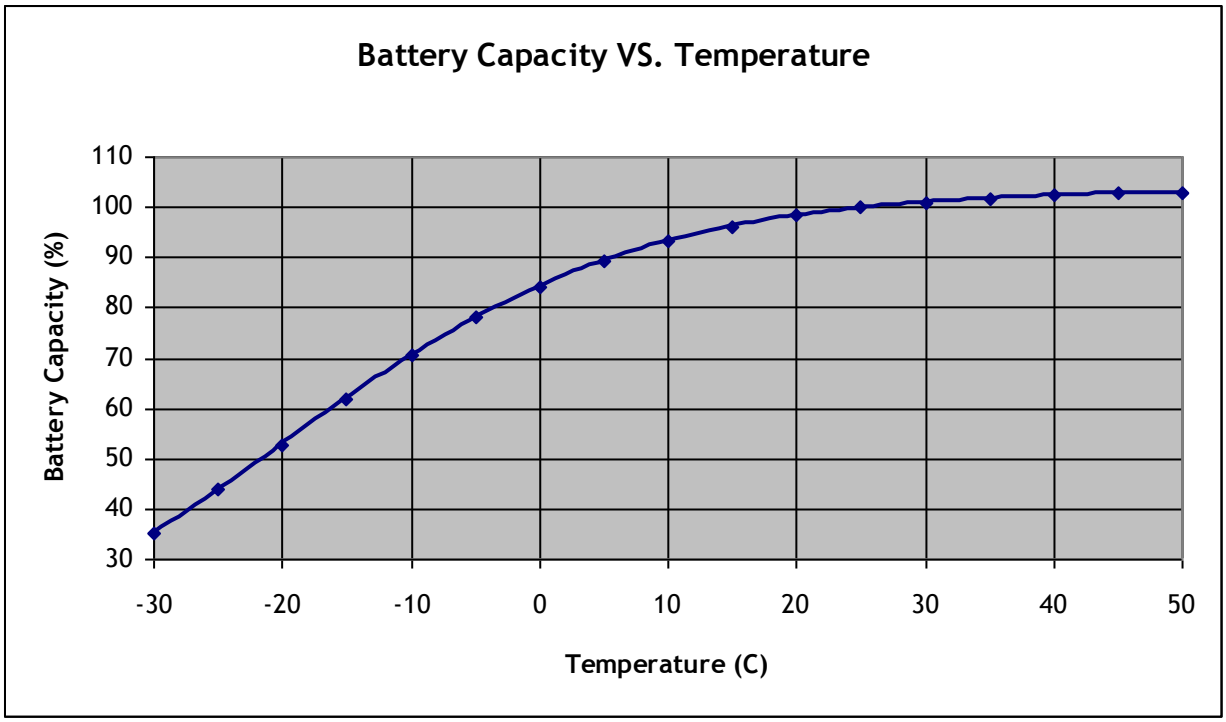

Figure 9. Battery Capacity Plotted Against Temperature Drop

The X-axis in Figure 9 shows the temperature range from -30 to 50 DegC. The Y axis is percent of capacity over the temperature range. At -30 Deg C, capacity is just below 40 percent and at 0 DegC capacity is just above 80 percent. This indicates the importance of factoring in average ambient temperatures of the coldest month for the site where the system will be installed.

Troubleshooting

AC Power System

Verify AC Terminal Block voltage and DC Accessory Terminal Block voltage.

1. AC Terminal Block voltage is LOW and DC Accessory Terminal Block Voltage LOW

    a. Open input AC Terminal Block power knife switch to disconnect power from the system

    b. Restore input AC power

    c. Close knife switch when power is restored

    d. Verify output voltages

2. AC Terminal Block voltage is GOOD and DC Accessory Terminal Block Voltage is LOW

a. Verify that the system load wires are not shorted together

b. Tighten the wiring screws on the power supply

c. If system does not work, there are no serviceable components in the system, call TESSCO Technologies for replacement power supply

AC/UPS Power System

Verify AC Terminal Block voltage, DC Accessory Terminal Block voltage, and Battery voltage

1. AC Terminal Block voltage is LOW, and DC Accessory Terminal Block Voltage is LOW, and Battery Voltage is BELOW 10.5 VDC

a. Open input AC Terminal Block power knife switch to disconnect power from the system

b. Restore input AC power

c. Close knife switch when power is restored

d. Verify output voltages

2. AC Terminal Block Voltage is GOOD and DC Accessory Terminal Block voltage is GOOD and Battery Voltage is LOW

a. Battery may is either recharging from a recent power outage

b. Tighten the wiring screws on the power supply, battery charging terminals, and battery

c. Battery may need replaced, call TESSCO Technologies for further instruction

3. AC Terminal Block Voltage is GOOD and DC Accessory Terminal Block voltage is LOW and Battery Voltage is NORMAL

a. Tighten the wiring screws on the power supply, battery charging terminals, and battery

b. Contact TESSCO Technologies for further assistance, Power Supply/Charger may be defective

Technical Support

If you are unable to resolve issues after referring to this manual, please contact technical support for additional help:

Ventev Innovations (A division of TESSCO Technologies)
10999 McCormick Rd
Hunt Valley, MD 21031
Phone +1 (800) 759-9996

Chapter 4: Maintenance

This chapter describes how to maintain the Power System. The AC system has no serviceable parts, therefore this section focuses mainly on the AC/UPS system. If you have problems with the AC system, refer to troubleshooting guidelines in Chapter 3.

Topics discussed include the following:

Battery and Battery Maintenance Guidelines

Important Battery Facts

- Most battery manufacturers specify battery capacity in amp-hours. Many factors can affect battery capacity, including rate of discharge (from the load), depth of discharge, temperature, age, and recharging characteristics.
- Replacement battery(s) are designed such that the integrity of system performance and safety of system users is protected. Follow the guidelines herein for installation, operation and maintenance. In general, the battery (or battery bank) should be away from the main flow of people and animal traffic.
- Use special caution when connecting or adjusting battery cabling. Carelessness can result in a situation where the battery(s) terminals make contact with an unintended surface resulting in arcing, fire, or possible even an explosion.
- If a battery showing signs of cracking, leaking, or swelling it should be replaced immediately by authorized personnel with a battery of identical type and rating.
- Batteries should be Inspected every 6-12 months for cracking, leaking or swelling.
- The Power System's are sized to meet specific expected performance criteria. Departure from use of a battery(s) with identical specifications will result in undesired system performance.
- Used batteries are environmentally unsafe and should be recycled or disposed of in accordance with all federal, state and local regulations.

Life Expectancy

While there is a tendency to think of battery life expectancy in terms of years, battery manufacturers specify life expectancy in terms of the number and depth of charge/discharge cycles. Batteries loose capacity over time and are considered to be at the end of their life when they can no longer maintain more than 80% of their original capacity.

Depth of discharge (DOD) of a battery is the percentage of the original rated amp-hour capacity that has been used. A battery operating in a system with shallow cycling of only 25% DOD would be expected to last 4000 cycles at 25°C (77°F). The same battery cycled to 80% DOD would last 1500 cycles. If the system in which the battery operated required one cycle per day, the shallowly cycled battery would last approximately eleven (11) years while the deeply cycled battery would last for about four (4) years.

It is recommended that the battery voltage be routinely monitored to assure operation is within original design expectations. Consistent downward trending of the float voltage can be an early indicator that the battery is approaching end of life. Routinely measuring battery voltage can assure the system voltage is trending flat and not downward.

Environmental Conditions

Batteries are sensitive to the environment and are operation is particularly affected by the temperature of that environment. As the temperature trends downward, voltage to maintain the same charge will need to trend upward. More energy from the battery charger is required as the temperature drops. The opposite is true in warmer temperatures.

Further, battery capacity will decrease with lowering temperatures (than 25°C, 77°F) and increase at higher temperatures. A battery at 32°F may achieve only 65 to 85% of its fully rated room temperature capacity and at -22°F it may achieve only 50%. Therefore, environment considerations, particularly temperature, must be included in the power systems design to assure that the system load on a power system is properly sized. A system undersized in any way may not operate well in colder temperatures.

While battery capacity decreases when the temperature drops below 77°F, battery life increases. Conversely, battery capacity increases with higher temperatures but battery life shortens. Many manufacturers claim a 50% loss in life for every 15°F increase over the standard 77°F cell temperature. For this reason, it is essential, that battery life is monitored more frequently in colder environments than other parts of the country. The battery capacity versus life issue tends to even out in most systems because the site location experiences temperature swings (e.g. night and day, summer and winter), so part of their lives is spent in higher temperatures and part in lower temperatures.

Battery Replacement

While battery maintenance activities are few in number, following the below recommended actions can reduce potential for unplanned power system outages due to battery failure:

1. After installation, record all voltages to benchmark levels.
2. Periodically, at a minimum of 6 to 12 months, check all battery terminal connections for looseness and corrosion. Clean corroded terminals and tighten connections.
3. With a voltmeter, routinely measure and log the battery(s) voltage.
4. If the battery voltage has trended downward over time to near 80% original capacity, initiate actions for battery replacement or contact TESSCO customer support.

Since the battery(s) in the Ventev AC/UPS Power Systems are hot-swappable when following proper precautions, there is no need to power down the power system to replace the batteries.

Battery Replacement Steps

1. Unplug the battery connections.
2. As you disconnect positive battery wire(s), cover them with electrical tape.
3. Loosen the bolts on the battery bracket and move the bracket clear of the enclosure.
4. Remove the battery(s) in need of replacement.
5. Replace the battery(s).
6. Secure the battery(s) retaining bracket.
7. Connect the battery(s) following the included wire diagram placed on the interior of the door.

Appendix A: Wiring Diagrams & Site Layout

This section provides wiring diagrams for system enclosures and a generic site layout. Diagrams included in this section include the following:

AC/UPS 100 Series Power Rail Enclosure Wiring Diagram

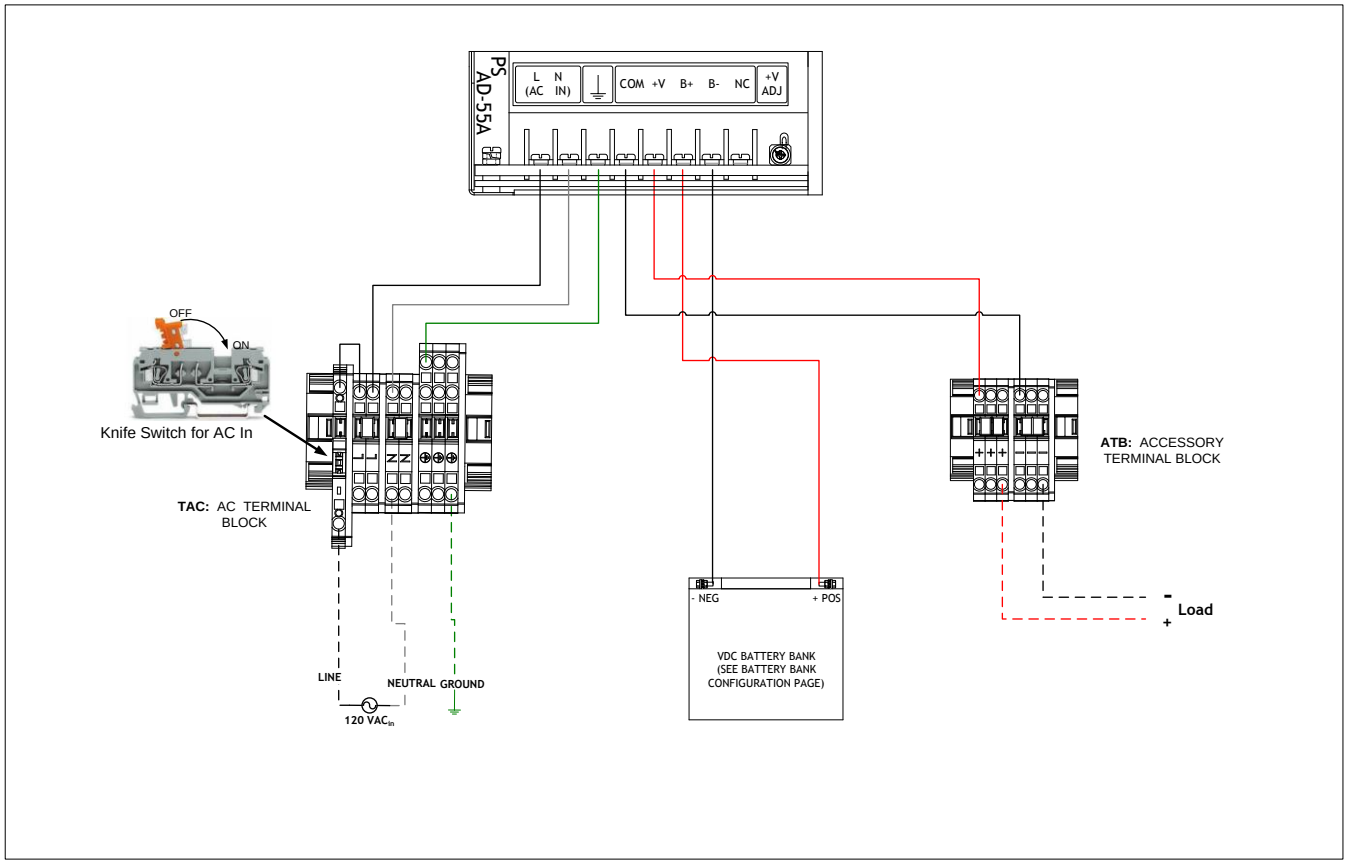

Figure 10: AC/UPS Series 100 Enclosure Single Battery System

AC/UPS 500 Series Power Rail Wiring Diagram

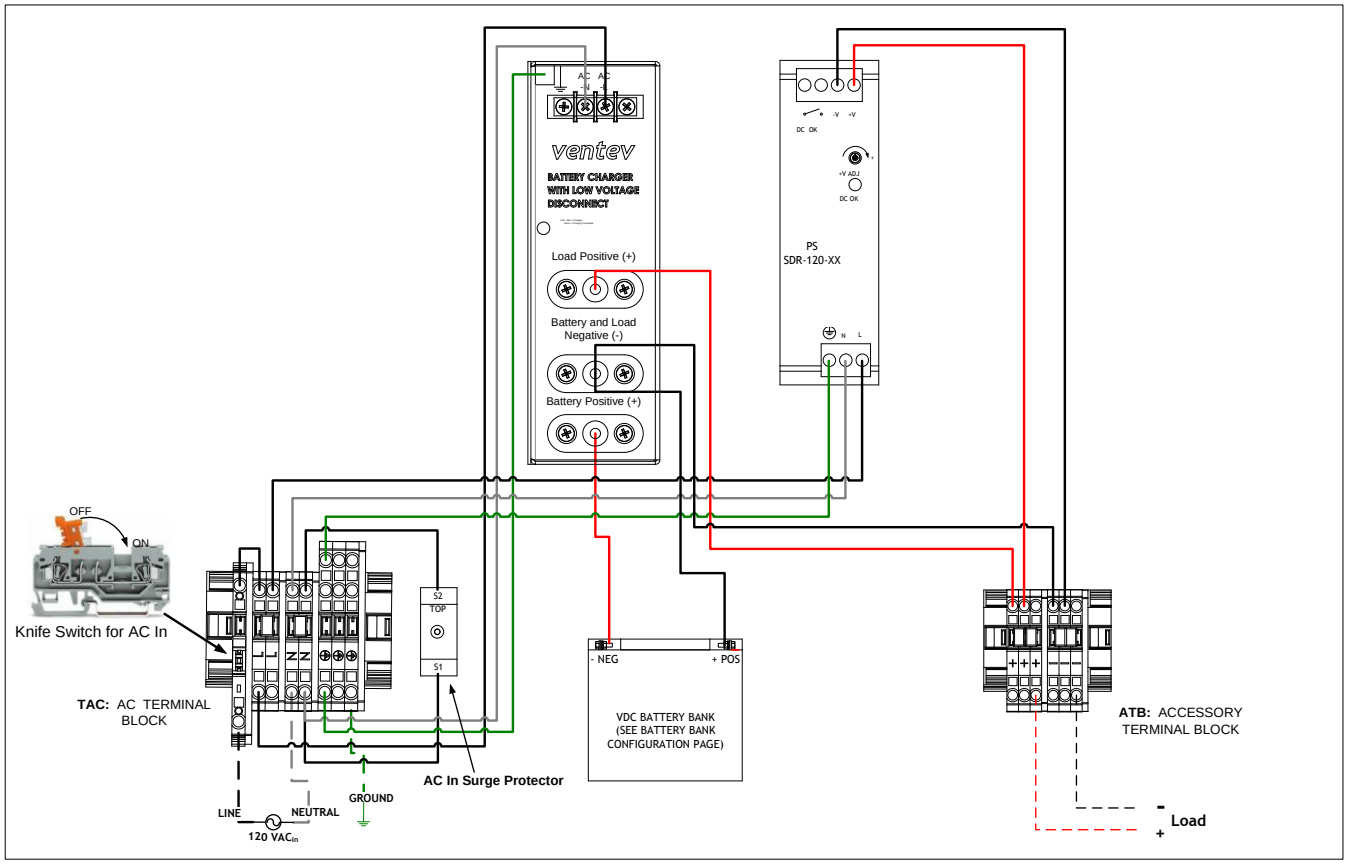

Figure 11: AC/UPS 500 Series Power Rail Wiring Diagram

AC 100 Series Power Rail Wiring Diagram

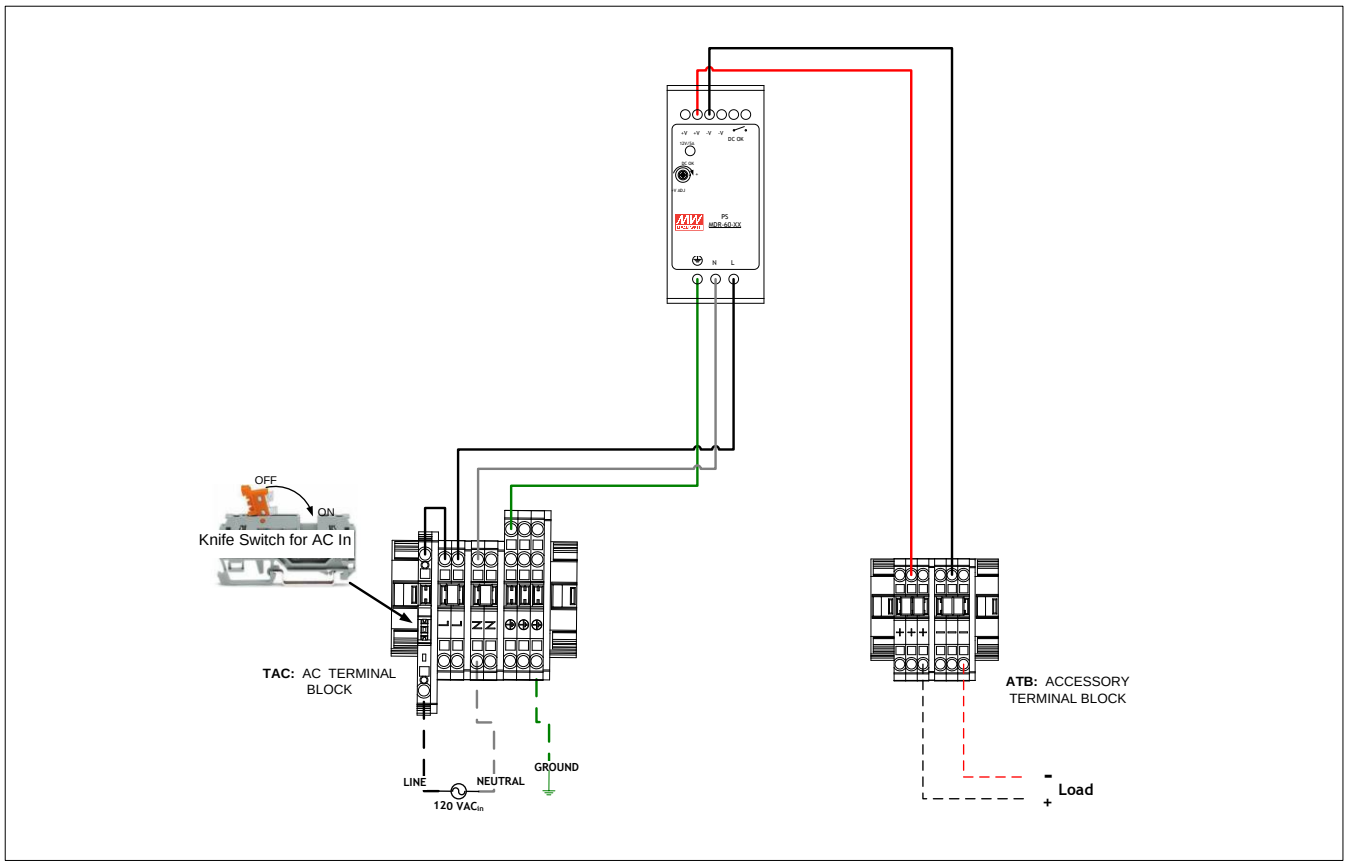

Figure12: AC 100 Series Power Rail Wiring Diagram

AC 500 Series Power Rail Wiring Diagram

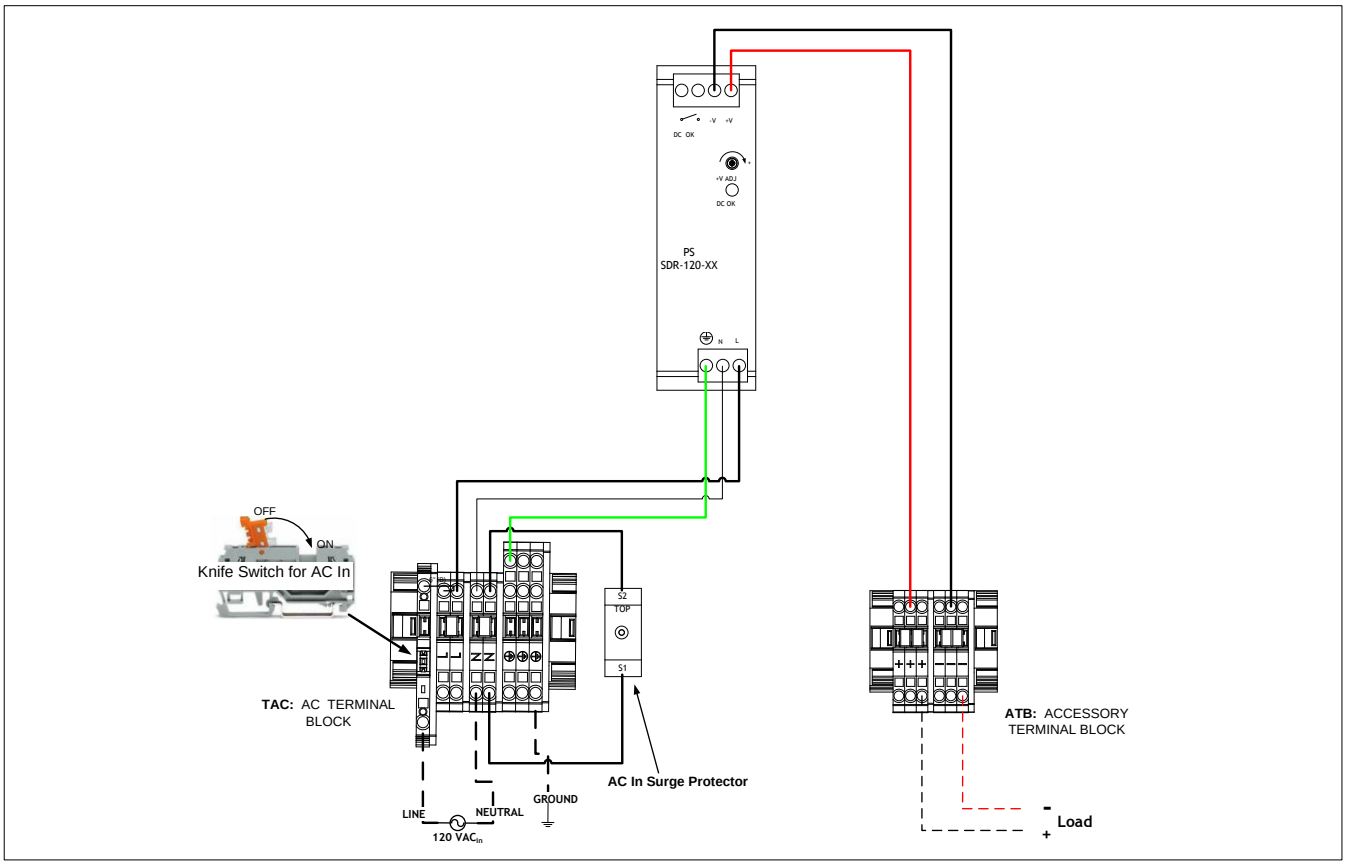

Figure 13. AC 500 Series Power Rail Wiring Diagram

Appendix B: Battery Selection Plots

Because applications, customers and requirements for battery back up time vary greatly, Ventev has developed the charts below to enable selection of the size in Amp-Hours of the battery bank that will meet the purchaser's needs. These sizing charts are intended to provide an estimated battery backup time based upon the System DC voltage (12, 24, or 48) and the power rail (100 or 500 series).

12VDC Battery Selection Chart for 100 Series Power Rail

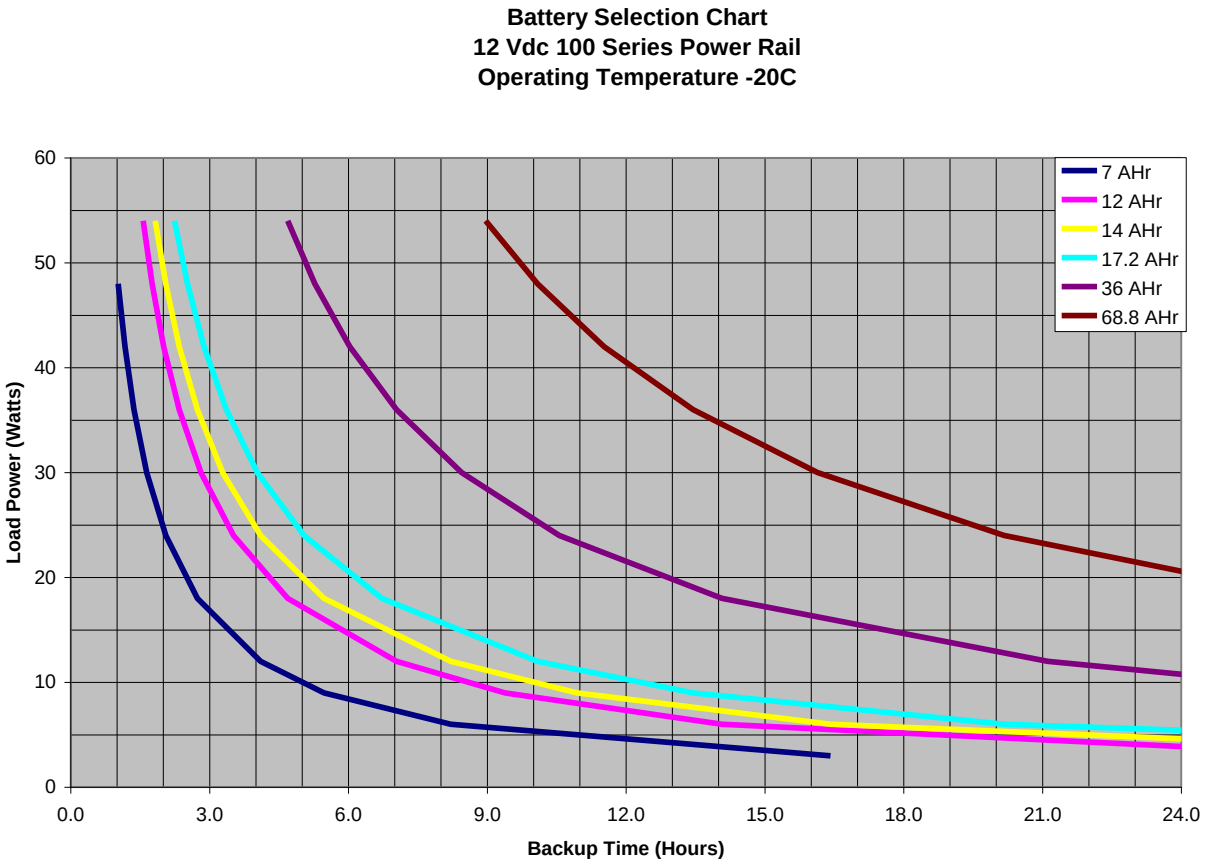

Figure 14. Battery Selection Chart for 12VDC 100 Series Power Rail; -20 DegC

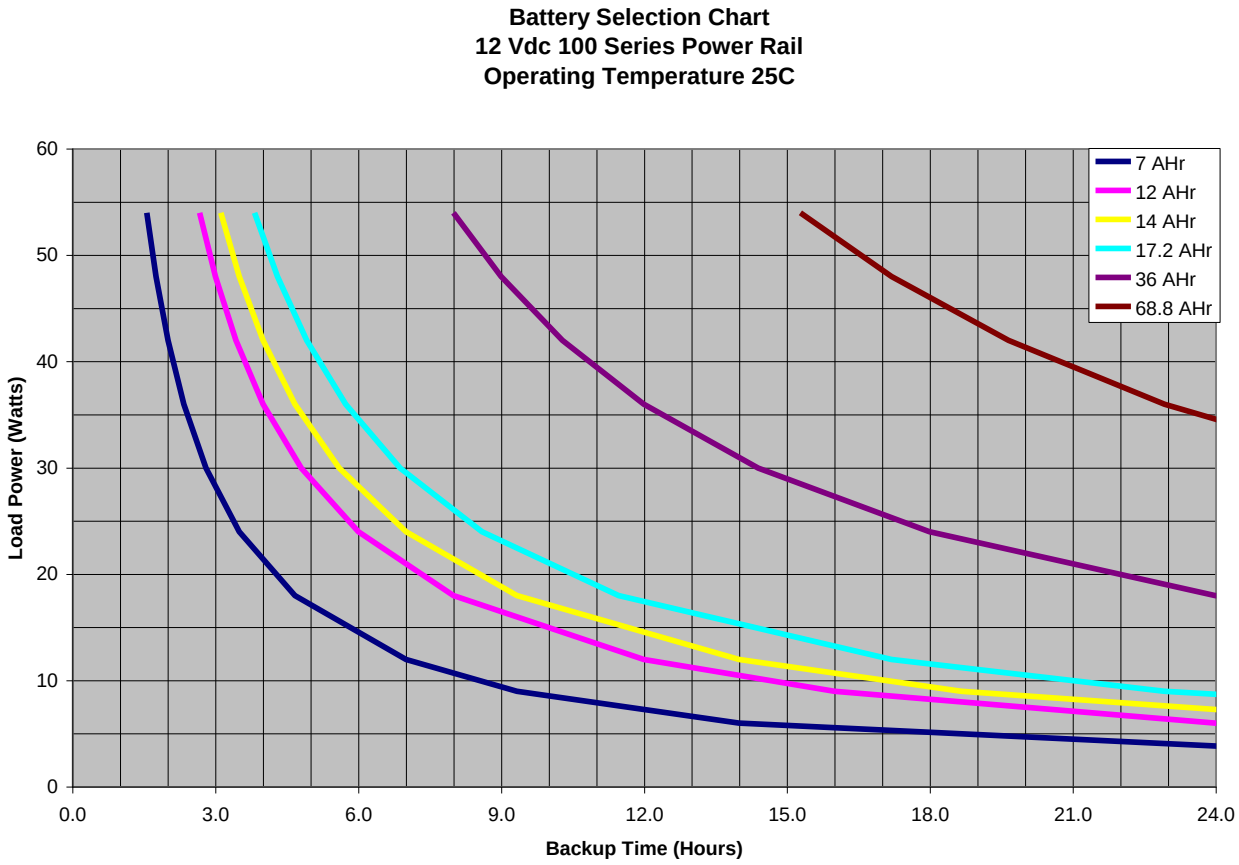

Figure 15. Battery Selection Chart for 12VDC 100 Series Power Rail; +25 DegC

12VDC Battery Selection Chart for 500 Series Power Rail

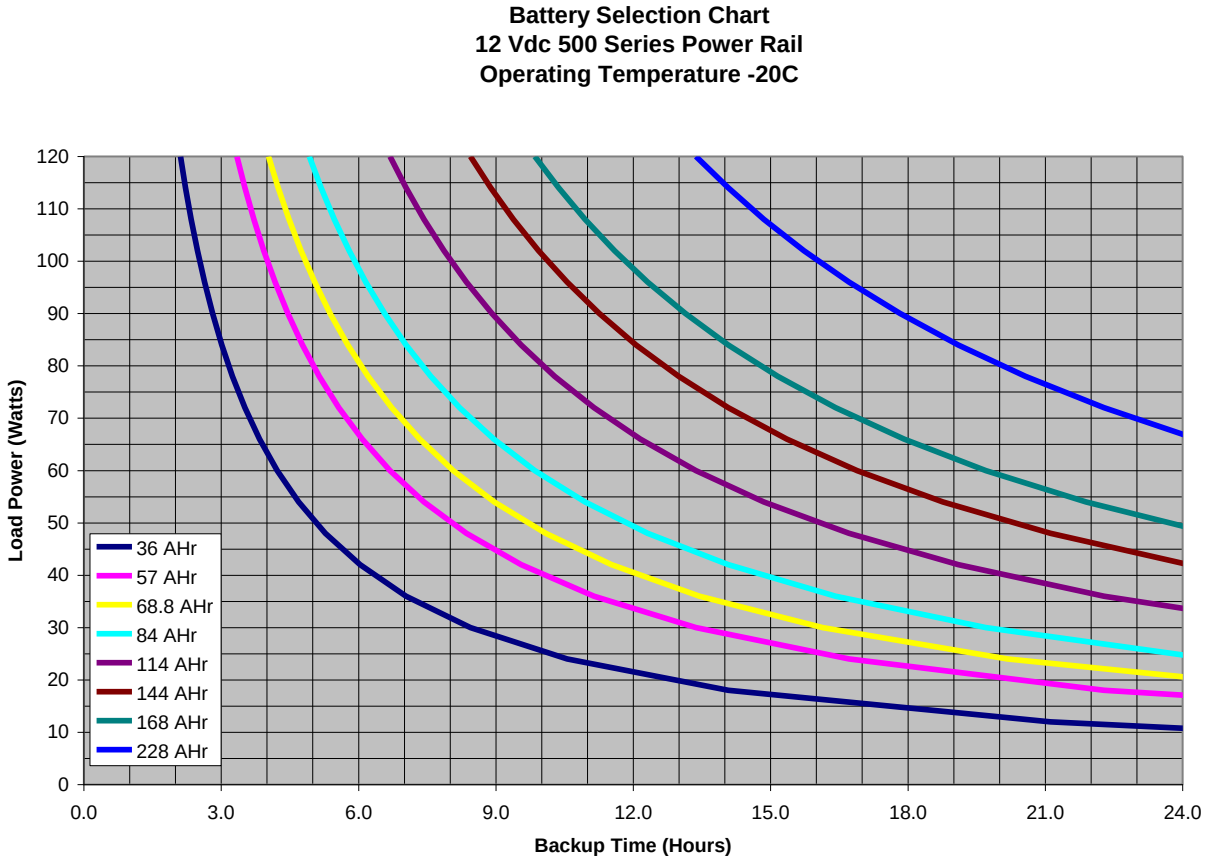

Figure 16. Battery Selection Chart for 12VDC 500 Series Power Rail; -20 DegC.

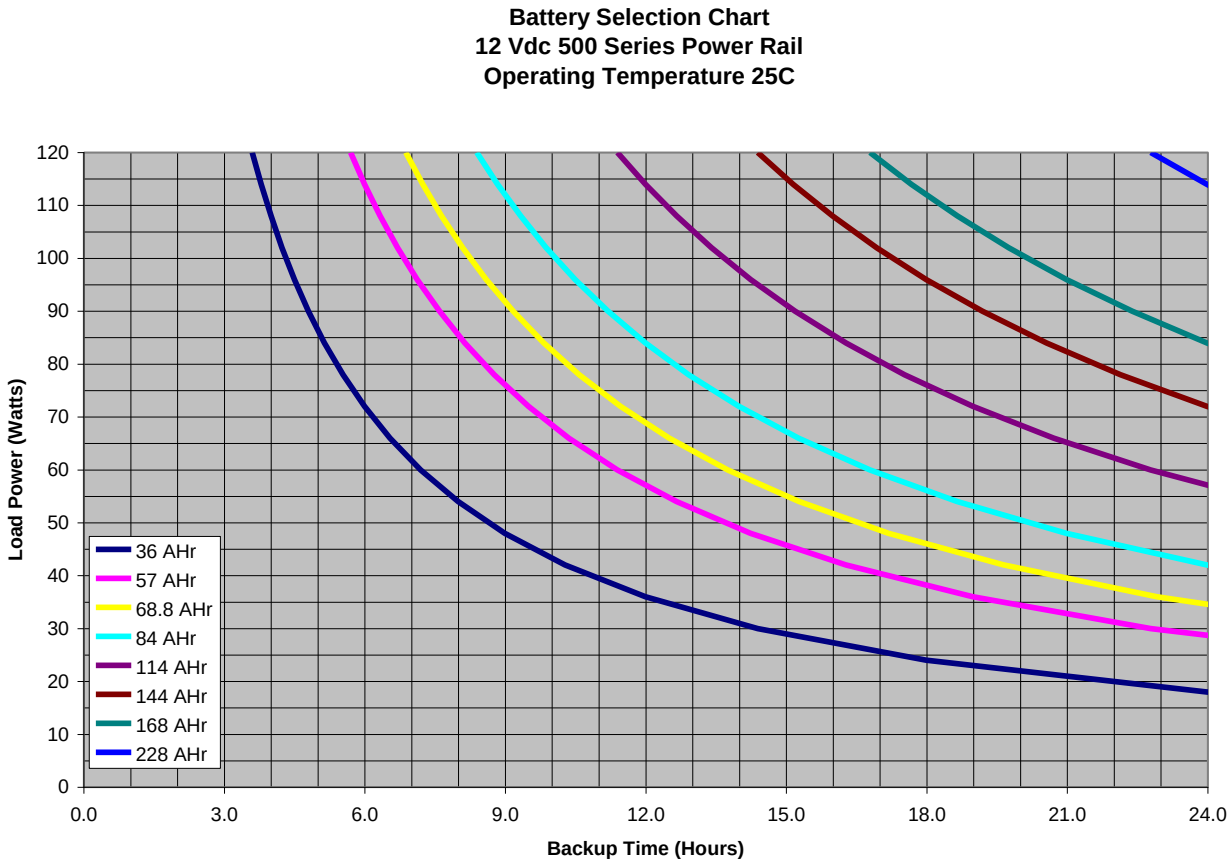

Figure 17. Battery Selection Chart for 12VDC 500 Series Power Rail; +25 DegC.

24VDC Battery Selection Chart for 100 Series Power Rail

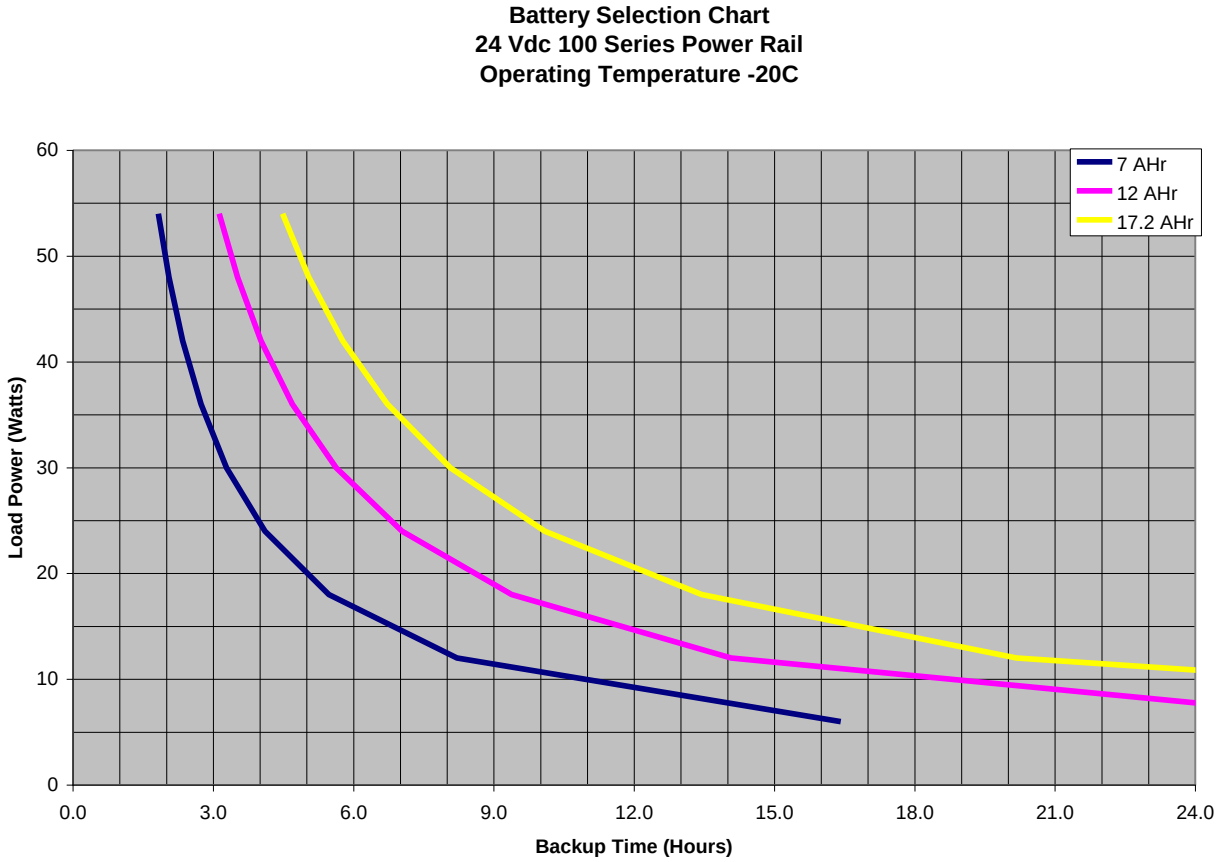

Figure 18. Battery Selection Chart for 24VDC 100 Series Power Rail; -20 DegC.

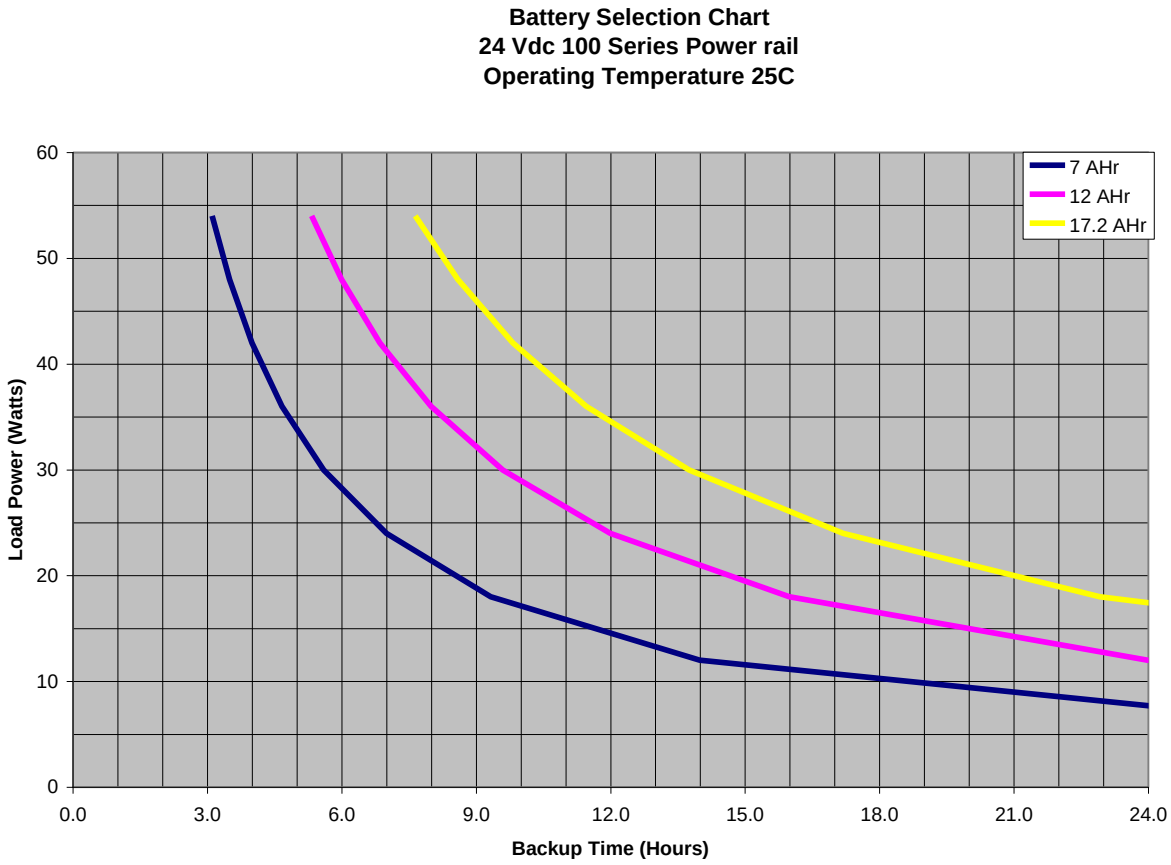

Figure 19. Battery Selection Chart for 24VDC 100 Series Power Rail; +25 DegC.

24VDC Battery Selection Chart for 500 Series Power Rail

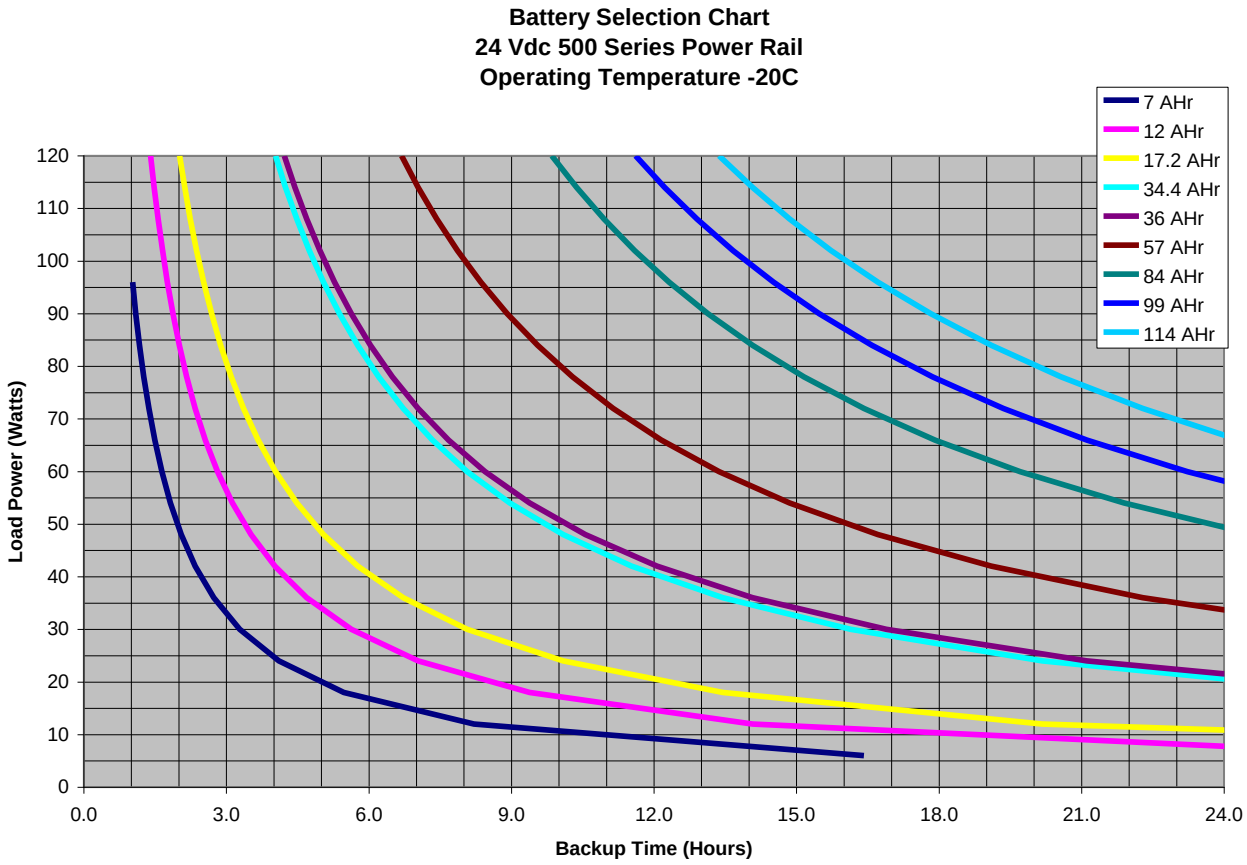

Figure 20. Battery Selection Chart for 24VDC 500 Series Power Rail; -20 DegC.

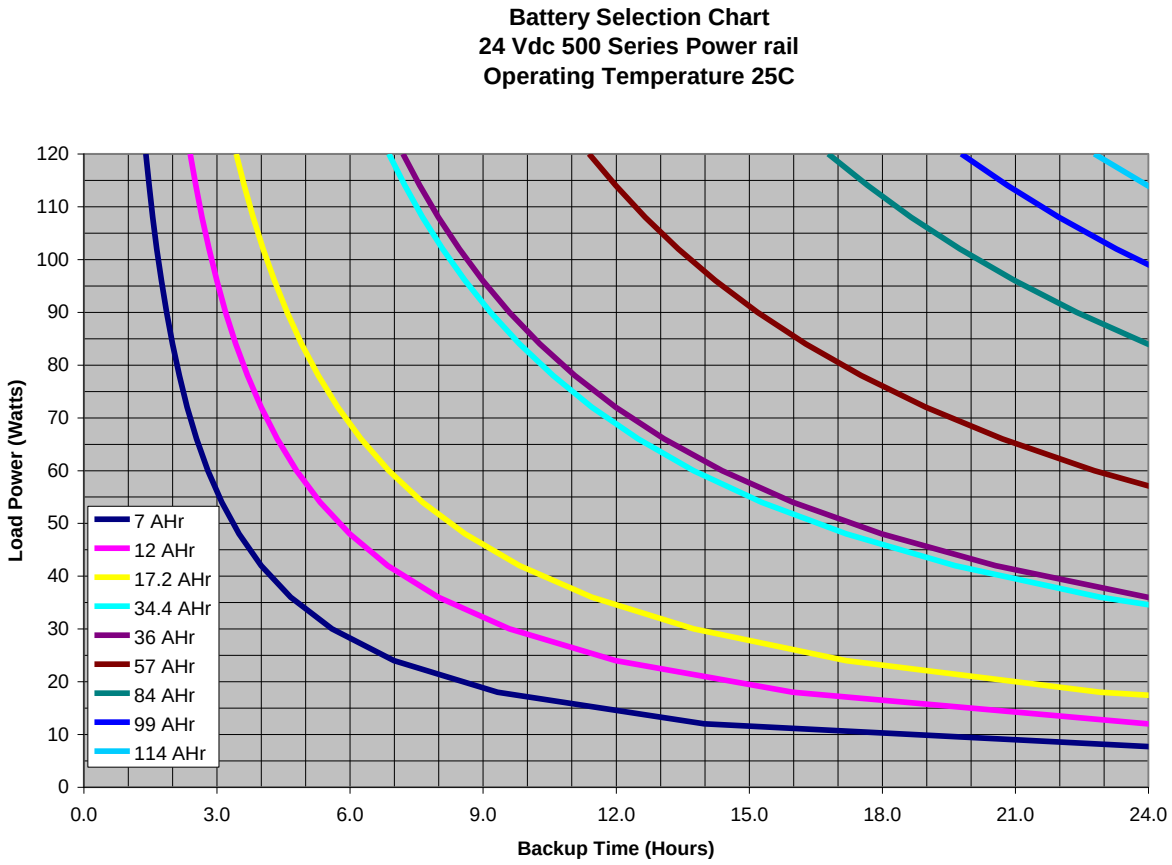

Figure 21. Battery Selection Chart for 24VDC 500 Series Power Rail; +25DegC.

48VDC Battery Selection Chart for 100 Series Power Rail

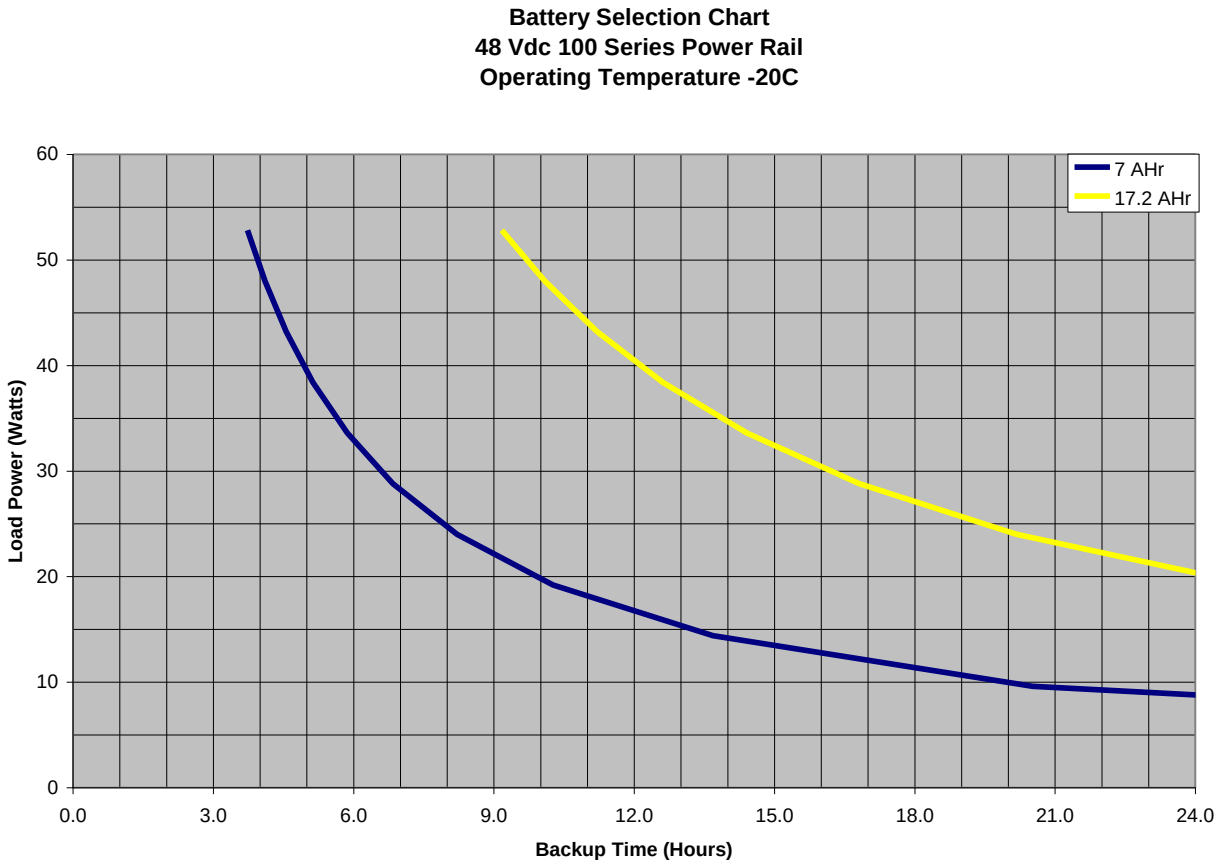

Figure 22. Battery Selection Chart for 48VDC 100 Series Power Rail; -20 DegC.

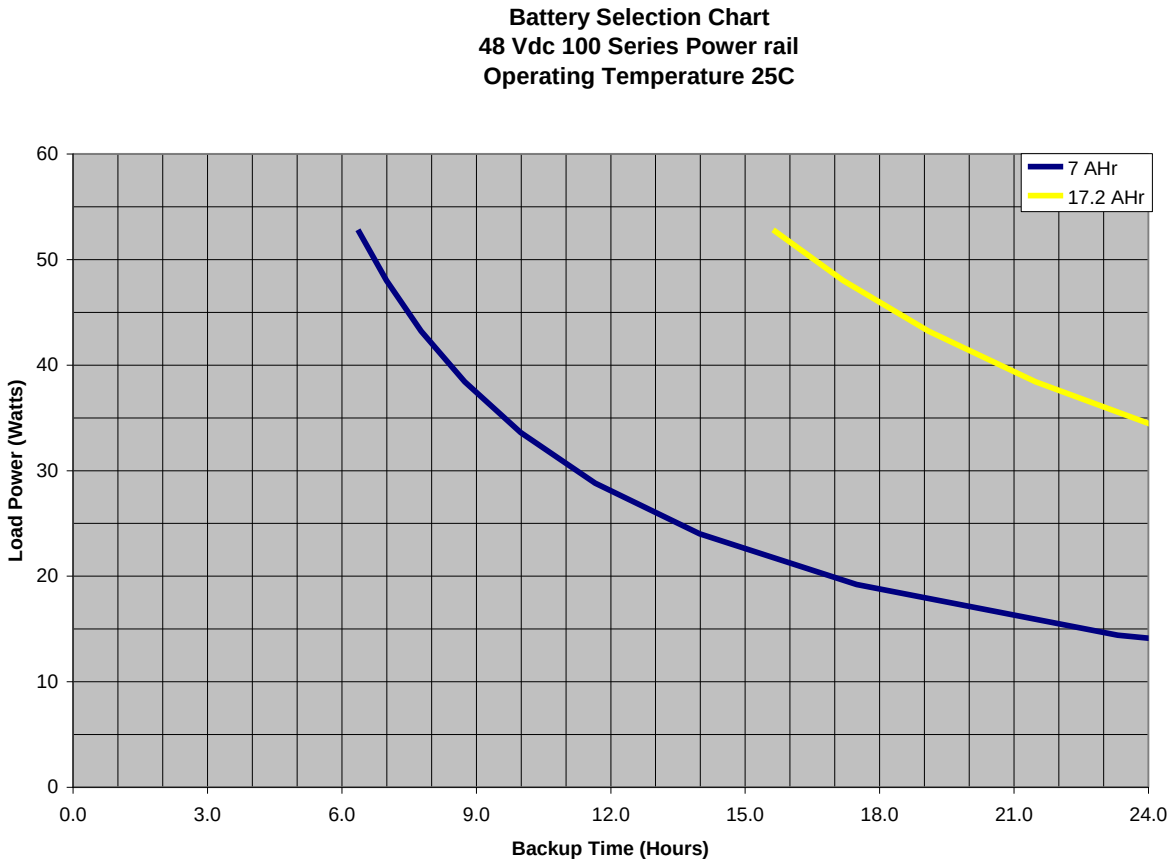

Figure 23. Battery Selection Chart for 48VDC 100 Series Power Rail; +25 DegC.

48VDC Battery Selection Chart for 500 Series Power Rail

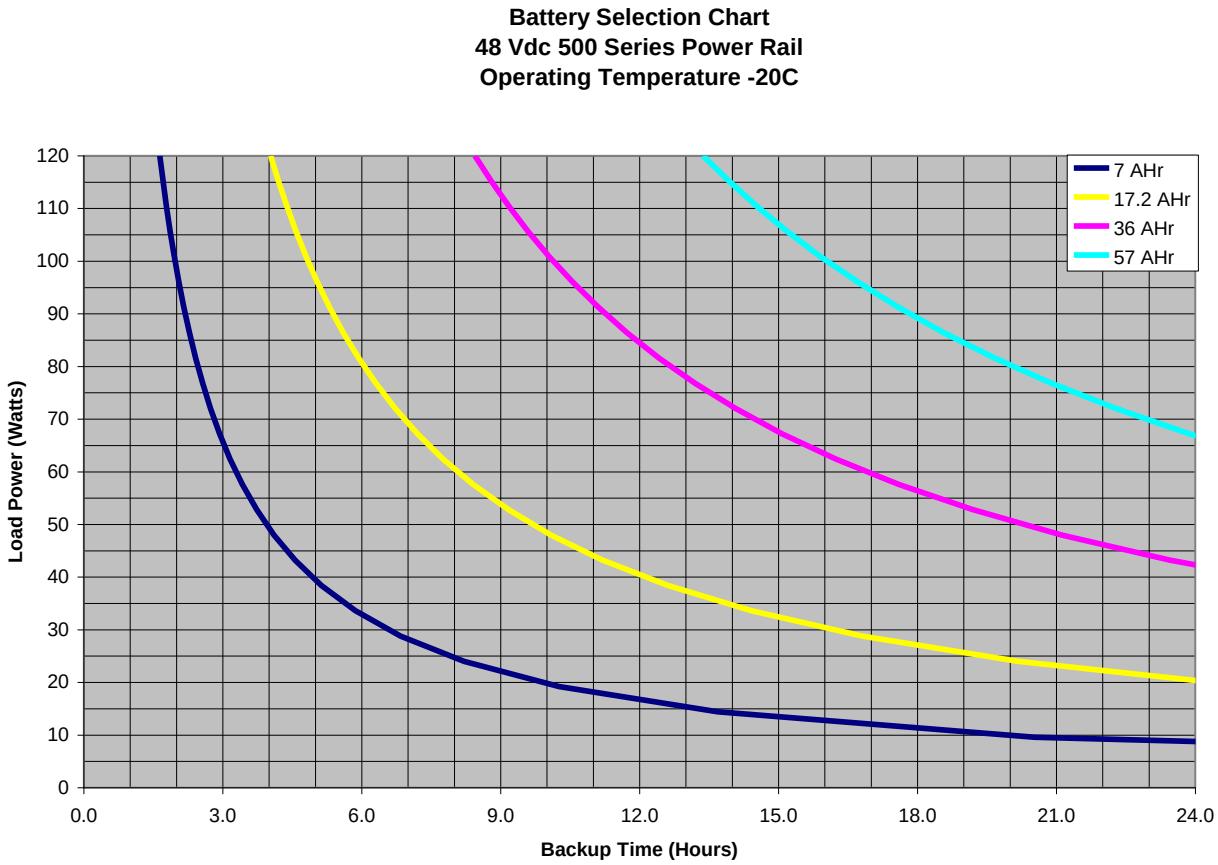

Figure 24. Battery Selection Chart for 48VDC 500 Series Power Rail; -20 DegC.

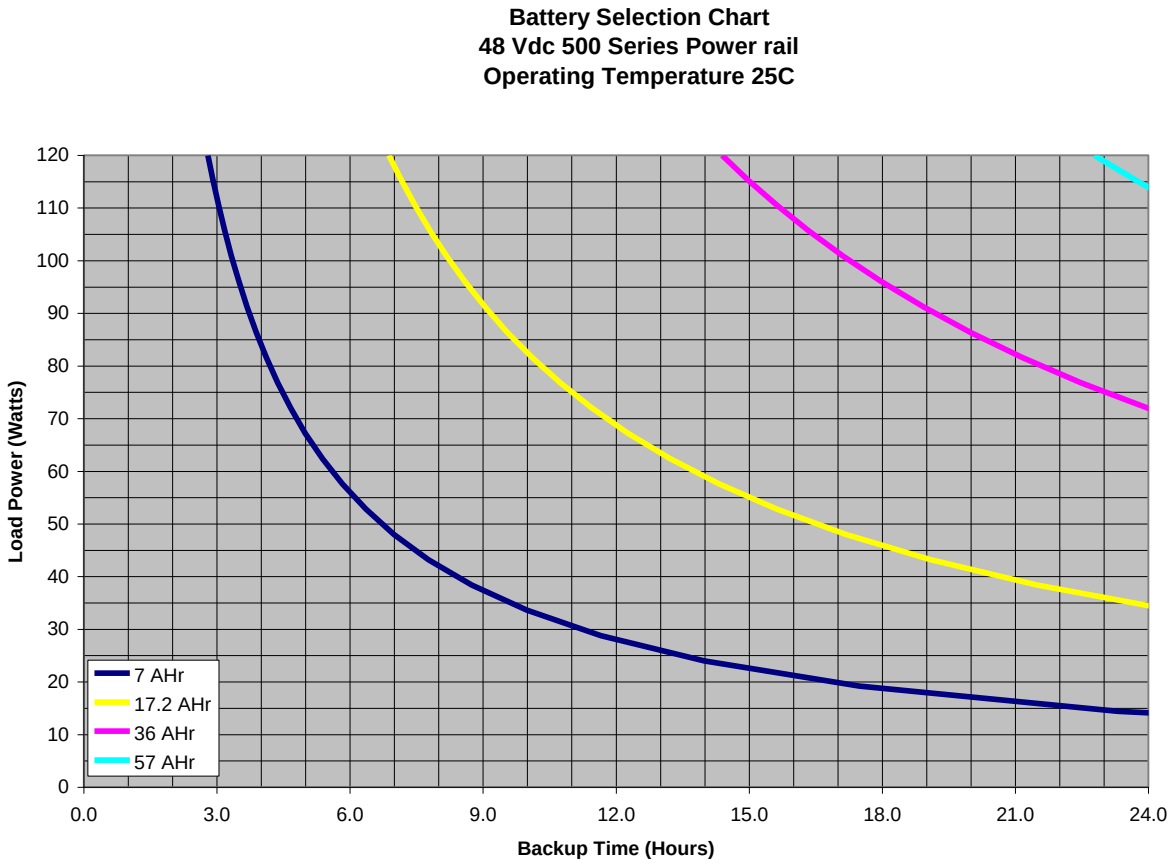

Figure 25. Battery Selection Chart for 48VDC 500 Series Power Rail; +25 DegC

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