



# NetSure™

-48V DC Power System

User Manual (Section 6026), Revision N

Specification Number: 582136800

Model Number: 502NGFB

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## ADMONISHMENTS USED IN THIS DOCUMENT



**DANGER!** Warns of a hazard the reader **will** be exposed to that will **likely** result in death or serious injury if not avoided. (ANSI, OSHA)



**WARNING!** Warns of a potential hazard the reader **may** be exposed to that **could** result in death or serious injury if not avoided. This admonition is not used for situations that pose a risk only to equipment, software, data, or service. (ANSI)



**CAUTION!** Warns of a potential hazard the reader **may** be exposed to that **could** result in minor or moderate injury if not avoided. (ANSI, OSHA) This admonition is not used for situations that pose a risk only to equipment, data, or service, even if such use appears to be permitted in some of the applicable standards. (OSHA)



**ALERT!** Alerts the reader to an action that **must be avoided** in order to protect equipment, software, data, or service. (ISO)



**ALERT!** Alerts the reader to an action that **must be performed** in order to prevent equipment damage, software corruption, data loss, or service interruption. (ISO)



**FIRE SAFETY!** Informs the reader of fire safety information, reminders, precautions, or policies, or of the locations of fire-fighting and fire-safety equipment. (ISO)



**SAFETY!** Informs the reader of general safety information, reminders, precautions, or policies not related to a particular source of hazard or to fire safety. (ISO, ANSI, OSHA)

# IMPORTANT SAFETY INSTRUCTIONS

## General Safety



**DANGER!** YOU MUST FOLLOW APPROVED SAFETY PROCEDURES.

Performing the following procedures may expose you to hazards. These procedures should be performed by qualified technicians familiar with the hazards associated with this type of equipment. These hazards may include shock, energy, and/or burns. To avoid these hazards:

- a) The tasks should be performed in the order indicated.
- b) Remove watches, rings, and other metal objects.
- c) Prior to contacting any uninsulated surface or termination, use a voltmeter to verify that no voltage or the expected voltage is present. Check for voltage with both AC and DC voltmeters prior to making contact.
- d) Wear eye protection.
- e) Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed.

## Voltages

### AC Input Voltages



**DANGER!** This system operates from AC input voltage capable of producing fatal electrical shock. AC input power must be completely disconnected from the branch circuits wiring used to provide power to the system before any AC electrical connections are made. Follow local lockout/tagout procedures to ensure upstream branch circuit breakers remain de-energized during installation. DO NOT apply AC input power to the system until all electrical connections have been completed and checked.

### DC Output and Battery Voltages



**DANGER!** This system produces DC power and may have a battery source connected to it. Although the DC voltage is not hazardously high, the rectifiers and/or battery can deliver large amounts of current. Exercise extreme caution not to inadvertently contact or have any tool inadvertently contact an output terminal or battery terminal or exposed wire connected to an output terminal or battery terminal. NEVER allow a metal object, such as a tool, to contact more than one termination or battery terminal at a time, or to simultaneously contact a termination or battery terminal and a grounded object. Even a momentary short circuit can cause sparking, explosion, and injury.



**DANGER!** Follow local lockout/tagout procedures to ensure DC branch circuit protection devices remain de-energized during installation at loads, as required.

## Battery

Refer to the battery manufacturer documentation for specific battery safety instructions. The following are general guidelines.



**WARNING!** Correct polarity must be observed when connecting battery leads.



**WARNING!** Special safety precautions are required for procedures involving handling, installing, and servicing batteries. Observe all battery safety precautions in this manual and in the battery instruction manual. These precautions should be followed implicitly at all times.



**WARNING!** A battery can present a risk of electrical shock and high short circuit current. Servicing of batteries should be performed or supervised only by properly trained and qualified personnel knowledgeable about batteries and the required precautions.

The following precautions should be observed when working on batteries:

- Remove watches, rings, and other metal objects.
- Eye protection should be worn to prevent injury from accidental electrical arcs.
- Use certified and well maintained insulated tools. Use double insulated tools appropriately rated for the work to be performed. Ensure that wrenches with more than one working end have only one end exposed.
- Do not lay tools or metal parts on top of batteries.
- Disconnect charging source prior to connecting or disconnecting battery terminals.
- Risk of explosion if battery is replaced with an incorrect type or if polarity is reversed. Recommended to replace batteries with the same manufacturer and type, or equivalent.
- Dispose of used batteries according to the instructions provided with the batteries. Do not dispose of batteries in a fire. They may explode.
- ALWAYS FOLLOW THE BATTERY MANUFACTURER'S RECOMMENDATIONS AND SAFETY INSTRUCTIONS.



**DANGER!** This equipment may be used in conjunction with lead-acid batteries. Working near lead-acid batteries is dangerous!

In addition to the hazard of electric shock, gas produced by batteries can be explosive and sulfuric acid can cause severe burns.

- Do not open or mutilate batteries. Released electrolyte is harmful to the skin and eyes, and is toxic.
- Batteries contain sulfuric acid.
- Batteries generate explosive gases during normal operation. Systems containing batteries should never be installed in an airtight room or space. Only install in a ventilated environment.
- Batteries are an energy source that can produce high amounts of electrical current.

FOR THESE REASONS, IT IS OF CRITICAL IMPORTANCE THAT YOU READ THESE INSTRUCTIONS AND FOLLOW THEM EXACTLY.

WHEN WORKING WITH LEAD-ACID BATTERIES:

- Follow the recommended PPE requirements per the SDS for the battery to be used.
- If battery acid enters your eye, immediately flush your eye with running cold water for at least 15 minutes. Get medical attention immediately.
- If battery acid contacts skin or clothing, wash immediately with soap and water.



**ALERT!** Performing maintenance and/or troubleshooting procedures may interrupt power to the loads, if battery reserve is not sufficient.

### Personal Protective Equipment (PPE)



**DANGER!** ARC FLASH AND SHOCK HAZARD.

Appropriate PPE and tools required when working on this equipment. An appropriate flash protection boundary analysis should be done determine the “hazard/risk” category, and to select proper PPE.



This product is intended only for installation in a Restricted Access Location.

Only authorized and properly trained personnel should be allowed to install, inspect, operate, or maintain the equipment.

Do not work on LIVE parts. If required to work or operate live parts, obtain appropriate Energized Work Permits as required by the local authority, per NFPA 70E “Standard for Electrical Safety in the Workplace”.

### Hazardous Voltage



**DANGER!** HAZARD OF ELECTRICAL SHOCK.

More than one disconnect may be required to de-energize the system before servicing.

### Handling Equipment Containing Static Sensitive Components



**ALERT!** Installation or removal of equipment containing static sensitive components requires careful handling. Before handling any equipment containing static sensitive components, read and follow the instructions contained on the Static Warning Page.

### Maintenance and Replacement Procedures



**CAUTION!** When performing any step in procedures that requires removal or installation of hardware, use caution to ensure no hardware is dropped and left inside the unit; otherwise service interruption or equipment damage may occur.



**NOTE!** When performing any step in procedures that requires removal of existing hardware, retain all hardware for use in subsequent steps, unless otherwise directed.

## STATIC WARNING



This equipment contains static sensitive components. The warnings listed below must be observed to prevent damage to these components. Disregarding any of these warnings may result in personal injury or damage to the equipment.

1. Strictly adhere to the procedures provided in this document.
2. Before touching any equipment containing static sensitive components, discharge all static electricity from yourself by wearing a wrist strap grounded through a one megohm resistor. Some wrist straps have a built-in one megohm resistor; no external resistor is necessary. Read and follow wrist strap manufacturer's instructions outlining use of a specific wrist strap.
3. Do not touch traces or components on equipment containing static sensitive components. Handle equipment containing static sensitive components only by the edges that do not have connector pads.
4. After removing equipment containing static sensitive components, place the equipment only on conductive or anti-static material such as conductive foam, conductive plastic, or aluminum foil. Do not use ordinary Styrofoam™ or ordinary plastic.
5. Store and ship equipment containing static sensitive components only in static shielding containers.
6. If necessary to repair equipment containing static sensitive components, wear an appropriately grounded wrist strap, work on a conductive surface, use a grounded soldering iron, and use grounded test equipment.

# SYSTEM OVERVIEW

## Preface

This document (Section 6026) provides User Instructions for NetSure™ Power System Model 502NGFB, Spec. No. 582136800.

The complete Customer Documentation Package consists of...

### System Installation Manual

- Power System Installation Instructions: Section 6025

### System User Manual

- Power System User Instructions: Section 6026
- Rectifier Instructions: UM1R482000e
- Power System “System Application Guide”: SAG582136800
- Engineering Drawings

### Controller User Manual

- NCU Controller User Instructions: UM1M830BNA
- ACU+ Controller User Instructions: UM1M820BNA
- SCU+ Controller User Instructions: UM1M521BNA

For factory settings of all configurable Controller parameters, refer to the Configuration Drawing (C-drawing) supplied with your Power System.

## System Description

The NetSure™ 502NGFB DC Power System is a complete integrated power system containing rectifiers, intelligent control, metering, and monitoring. This power system is available in configurations for 19” and 23” relay rack mounting, as shown in **Table 1** through **Table 4**. System capacities for the various configurations are shown in **Table 5**.

### 2000W Rectifier Modules

The Rectifier Modules provide load power, battery float current, and battery recharge current during normal operating conditions. The Rectifier Modules are designed to provide constant power. They are designed with the latest patented switch-mode technology using DSP (Digital Signal Processing) functionality for efficient operation. This means that, within the normal operating ambient temperature range and input voltage range, the maximum available output power is a constant 2000W. Within these ranges, the Rectifier Modules operate in one of three modes, depending upon load demands. Transition between modes is completely automatic. If ambient temperature rises above or input voltage falls below acceptable values, Rectifier Modules continue to operate but at derated output power levels.

- a) **Constant Voltage Mode:** For any initial output voltage setting from 48 to 58 volts, output voltage remains constant regardless of load. This is the normal operating condition, in which loads are being supplied and batteries are float charged. Rectifier Modules operate in the Constant Voltage Mode unless load increases to the point where the product of load current and output voltage is approximately 2000W.

- b) **Constant Power Mode:** As load increases above approximately 2000W (non-adjustable), output current continues to increase, but output voltage decreases as required to maintain constant output power. Rectifier Modules operate in the Constant Power Mode unless load continues to increase to the point where the current limit setting is reached.
- c) **Constant Current Mode:** If load increases above the current limit setting, output voltage decreases as required to maintain output current at current limit.

## **Controller**

The controller controls the operation of the rectifier modules. The controller also provides power system control, metering, monitoring, and alarm functions.

NCU (NetSure Control Unit): The controller provides power system control (including optional low voltage battery disconnect (LVBD) and low voltage load disconnect (LVLD) control), rectifier control (including a charge control function), metering functions, monitoring functions, local/remote alarm functions, and connections for binary inputs and programmable relay outputs. The controller also supports rectifier temperature compensation if the system is equipped with a temperature probe(s). Temperature probe(s) may also be designated to monitor ambient temperature and/or battery temperature. The controller also provides data acquisition, system alarm management, and advanced battery and energy management. The controller contains a color TFT display and keypad for local access. The controller provides an Ethernet port and comes with comprehensive webpages for remote access. The controller has SNMP V3 capability for remote system management. The controller supports software upgrade via its USB port. Refer to the NCU Controller Instructions (UM1M830BNA) for more information.

ACU+ (Advanced Control Unit Plus): The controller provides power system control (including optional low voltage battery disconnect (LVBD) and low voltage load disconnect (LVLD) control), rectifier control (including a charge control function), metering functions, monitoring functions, and local/remote alarm functions. The controller also supports rectifier temperature compensation if the system is equipped with a temperature probe(s). Temperature probe(s) may also be designated to monitor ambient temperature and/or battery temperature. The controller also provides data acquisition, system alarm management, and advanced battery and energy management. The controller contains an LCD display and keypad for local access. The controller provides an Ethernet port and comes with comprehensive webpages for remote access. The controller has SNMP capability for remote system management. The controller supports software upgrade via its USB port. Refer to the ACU+ Controller Instructions (UM1M820BNA) for more information.

SCU+ (Standard Control Unit Plus): The SCU+ provides Rectifier Module and optional Low Voltage Battery Disconnect (LVBD) or Low Voltage Load Disconnect (LVLD) control, metering functions, monitoring functions, and local/remote alarms. The SCU+ contains an LCD display and keypad for local access. It provides connection for binary inputs, programmable relay outputs, and a charge control function. The controller also supports rectifier temperature compensation if the system is equipped with a temperature probe (or multiple temperature probes connected via a Temperature Concentrator (SM TEMP), and ambient temperature monitoring if equipped with a second temperature probe. The SCU+ also provides Ethernet connection and SNMP capability.

### Individual Shelves with Bulk Output Rear Busbars

**Table 1:**

System	19" or 23" Relay Rack Mounting	Number of Power Shelves	Number of Rectifier Mounting Positions	Output Capacity (Amperes)
58213680001	19"	1 (Main)	4	See <b>Table 5</b>
58213680002	19"	1 (Expansion)	5	
58213680003	23"	1 (Main)	5	
58213680004	23"	1 (Expansion)	6	

### Assembled Shelves with Top AC Input / DC Output Termination Panel Systems

**Table 2:**

System	19" or 23" Relay Rack Mounting	Number of Power Shelves	Number of Rectifier Mounting Positions	Output Capacity (Amperes)
58213680005	19"	1 (Main)	4	See <b>Table 5</b>
58213680006	19"	2 (Main and Expansion)	9	
58213680007	23"	1 (Main)	5	
58213680008	23"	2 (Main and Expansion)	11	

### Assembled Shelves with Rear AC Input / Top DC Distribution Cabinet

**Table 3:**

System	19" or 23" Relay Rack Mounting	Number of Power Shelves	Number of Rectifier Mounting Positions	Output Capacity (Amperes)
58213680010	19"	1 (Main)	4	See <b>Table 5</b>
58213680011	19"	2 (Main and Expansion)	9	
58213680012	23"	1 (Main)	5	
58213680013	23"	2 (Main and Expansion)	11	
58213680014	19"	1 (Expansion Field)	5	
58213680015	23"	1 (Expansion Field)	6	
58213680016	19"	3 (1 Main, 2 Expansion)	14	
58213680017	23"	3 (1 Main, 2 Expansion)	17	

### Assembled Shelves with GMT Distribution Panel and Rear AC Input / Top DC Distribution Cabinet

**Table 4:**

System	19" or 23" Relay Rack Mounting	Number of Power Shelves	Number of Rectifier Mounting Positions	Output Capacity (Amperes)
58213680020	19"	1 (Main)	4	See <b>Table 5</b>
58213680021	19"	2 (Main and Expansion)	9	
58213680022	23"	1 (Main)	5	
58213680023	23"	2 (Main and Expansion)	11	
58213680026	19"	3 (1 Main, 2 Expansion)	14	
58213680027	23"	3 (1 Main, 2 Expansion)	17	

### System Output Capacities

**Table 5:**

System	208/240VAC Input		120VAC Input	
	+40°C	+65°C	+40°C	+65°C
58213680001	166A	133A	105A	84A
58213680002	208A	166A	131A	105A
58213680003	208A	166A	131A	105A
58213680004	250A	200A	157A	126A
58213680005	166A	133A	105A	84A
58213680006	374A	299A	236A	189A
58213680007	208A	166A	131A	105A
58213680008	400A	365A	290A	230A
58213680010	166A	133A	105A	84A
58213680011	374A	299A	236A	189A
58213680012	208A	166A	131A	105A
58213680013	458A	366A	288A	231A
58213680014	208A	166A	131A	105A
58213680015	250A	200A	157A	126A
58213680016	582A	400A	367A	294A
58213680017	600A	400A	445A	357A
58213680020	166A	133A	105A	84A
58213680021	374A	299A	236A	189A
58213680022	208A	166A	131A	105A
58213680023	458A	366A	288A	231A
58213680026	582A	400A	367A	294A
58213680027	600A	400A	445A	357A

# OPERATING PROCEDURES

## Controller and Rectifier

For operation instructions on these units, refer to the following documents.

- NCU Controller Instructions (UM1M830BNA)
- ACU+ Controller Instructions (UM1M820BNA)
- SCU+ Controller Instructions (UM1M521BNA)
- Rectifier Instructions (UM1R482000e)

## List KG GMT Load Distribution Fuse Panel

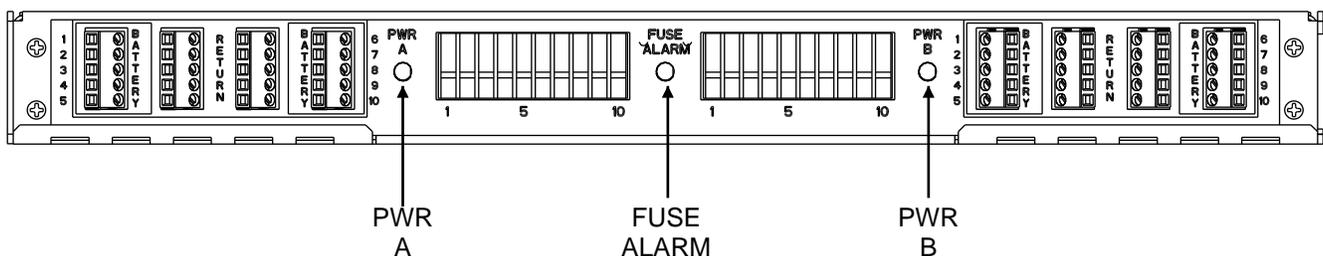
### Controls and Indicators

Refer to **Figure 1** for indicator locations.

**PWR A and PWR B indicators:** When illuminated (green), indicate power is supplied to the A and B sides, respectively.

**FUSE ALARM indicator:** When illuminated (red), indicates a load distribution fuse is open. The open fuse provides a mechanical indicator visible through the fuse safety cover.

**Figure 1:** Indicator Locations (List KG)



# MAINTENANCE

## Important Safety Instructions



**DANGER!** Adhere to the “Important Safety Instructions” presented at the front of this document.

## System Maintenance Procedures

The maintenance procedures listed in **Table 6** should be performed and recorded at the recommended interval to ensure continual system operation.

The table references specific sections in the **User Instructions (Section 6026)** or the separate **Installation Instructions (Section 6025)** that help in performing these procedures.

**Table 6:** Maintenance Procedures to be performed at 6-Month Intervals

PROCEDURE	REFERENCED IN
Check ventilation openings for obstructions such as dust, papers, manuals, etc.	--
Inspect and tighten all installer's connections.	Section 6025, Making Electrical Connections section.

## TROUBLESHOOTING AND REPAIR

### Contact Information

Refer to Section 4154 (provided with your customer documentation) for support contact information.

### Controller and Rectifiers

For troubleshooting and repair instructions on these units, refer to the following documents.

- NCU Controller Instructions (UM1M830BNA)
- ACU+ Controller Instructions (UM1M820BNA)
- SCU+ Controller Instructions (UM1M521BNA)
- Rectifier Instructions (UM1R482000e)

### Controller Configuration

For factory settings of all configurable controller parameters, refer to the Configuration Drawing (C-drawing) supplied with your Power System.

### System Troubleshooting Information

#### General

This system is designed for ease in troubleshooting and repair. The various indicators as described in the "Operating Procedures" section and the separate Controller and Rectifier User Manuals, are designed to isolate failure to a specific element. Once the faulty element has been identified, refer to the next sections, "REPLACEMENT INFORMATION" and "REPLACEMENT PROCEDURES".

#### Troubleshooting Alarm Conditions on the Controller

The controller displays alarm conditions as listed in the Available Alarms section of the separate Controller User Manual. Programmable external alarm relays are also available. The separate Power System Installation Manual (Section 6009) lists the factory default alarm relay configurations. Your system may have different

configurations then those listed. Refer to the Configuration Drawing (C-drawing) supplied with your Power System for your alarm relay configurations.

The controller's **Active Alarm** and **Alarm History** submenus allow the user to view alarm details. Refer to the separate Controller User Manual to access these menus.

### **Checking the NCU or ACU+ Controller's Current Limit Point after Adding or Removing a Rectifier**

If a rectifier is added to the power system, the system current limit point will automatically increase by the percentage each existing rectifier was set to provide prior to the addition.

If a rectifier is removed from the system (and the Rect Comm Fail alarm is reset), the current limit point will remain unchanged unless the capacity of the remaining rectifiers is not sufficient to maintain the present current limit point. If that happens, the current limit point will automatically increase to the maximum (121% of the remaining rectifiers).

It is recommended that the current limit point be checked whenever a rectifier is added to or removed from the power system.

When setting total rectifier current limit, the set point to each unit is the total set point divided by the number of units. For example, if the system contains five rectifiers and the current limit is set to 150 amps then each rectifier has a current limit set point of 30 amps. If one or more rectifiers are removed or fail it will take several seconds for the individual set points to the remaining rectifiers to be reset. In the example given, if one rectifier is removed the current limit set point will drop to 120 amps (30 amps times four remaining rectifiers) until the controller can send updated set points to the remaining rectifiers. This takes a couple communication cycles (several seconds) after which each rectifier would have a new set point of 37.5 amps for a total of 150 amps. The total current limit of the rectifiers should not be set such that the loss of the redundant rectifiers will cause this temporary set point to drop below the actual maximum expected load. If batteries are used on the rectifier output, the batteries should support the load until the current limit set points can be re-established due to loss of a rectifier.

Refer to the ACU+ Instructions (UM1M820BNA) or NCU Instructions (UM1M830BNA) for a procedure.

### **Clearing a Rectifier Communications Fail Alarm after Removing a Rectifier**

If a rectifier module is removed from the system, a rectifier communications failure alarm is generated. If the rectifier module will not be replaced, the alarm should be cleared.

Refer to the controller instructions for a procedure.

### **Clearing a Rectifier Lost Alarm**

If the controller resets while a rectifier communications fail alarm is active, the rectifier communications fail alarm is replaced with a rectifier lost alarm. The alarm should be cleared.

Refer to the controller instructions for a procedure.

## **Replacement Information**

### **Replacement Assemblies**

When a trouble symptom is localized to a faulty Rectifier Module or Controller, that particular device should be replaced in its entirety. Other than a Rectifier Module fan replacement, no attempt should be made to troubleshoot or repair individual components on any Rectifier Module or Controller. Refer to the separate Controller or Rectifier Module User Manuals for replacement procedures.

Refer to SAG582136800 for replacement part numbers.

## Replacement Procedures

### Important Safety Instructions



**DANGER!** Adhere to the “Important Safety Instructions” presented at the front of this document.

### Replacing a Rectifier Module

Refer to the separate Rectifier Module User Manual for a rectifier replacement procedure. Before replacing any Rectifier Modules, note the following:

In a Power System equipped with an NCU or ACU+ controller, the rectifier module being replaced is assigned by the controller the lowest available identification number. If desired, you can change the identification number. Refer to the ACU+ Instructions (UM1M820BNA) or NCU Instructions (UM1M830BNA) for a procedure.

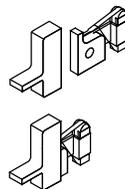
### Replacing the Controller

Refer to the controller instructions for a procedure.

### Replacing a GMT Distribution Fuse (List KG GMT Fuse Load Distribution Panel)

Load distribution fuses are located on the front panel of List KG. If replacement of a distribution fuse becomes necessary, replace only with Bussmann GMT type of the correct rating. Ensure a safety cover is installed on the replacement fuse, as shown in **Figure 2**.

**Figure 2:** Safety Fuse Cover, Part No. 102774 (Bussmann GMT-Y)



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