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PureWave® SMS-250 Storage Management System

Power Conversion System 263 kW/263 kVA, 380 V

RED PureWave® SMS-250 Storage Management System
Power Conversion System
263 kW/263 kVA, 380 V

Operation and Maintenance

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Qualified Persons

⚠ WARNING

The equipment covered by this publication must be installed, operated, and maintained by qualified persons who are knowledgeable in the installation, operation, and maintenance of energy storage equipment along with the associated hazards. A qualified person is one who is trained and competent in:

- The skills and techniques necessary to distinguish exposed live parts from nonlive parts of electrical equipment
- The skills and techniques necessary to determine the proper approach distances corresponding to the voltages and arc-flash levels to which the qualified person will be exposed
- The proper use of the special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electrical equipment

These instructions are intended only for such qualified persons. They are not intended to be a substitute for adequate training and experience in safety procedures for this type of equipment.

Read this Instruction Sheet

NOTICE

Thoroughly and carefully read this entire instruction sheet before operating and maintaining the PureWave® SMS-250 Storage Management System and power conversion system (PCS). Familiarize yourself with the Safety Information and Safety Precautions on pages 3 through 5. The latest version of this instruction sheet is available online in PDF format at **sandc.com/Support/Product-Literature.asp**

Retain this Instruction Sheet

This instruction sheet is a permanent part of your PCS. It does not include instruction sheets from the original battery manufacturer. Information sheets such as this one can be placed inside a compartment in the PCS enclosure, where they can be easily retrieved for future use.

Proper Application

⚠ WARNING

The equipment in this publication must be selected for a specific application. The application must be within the ratings furnished for the equipment. Refer to RED General Brochure 659-G358 for the RED PureWave SMS-250 Storage Management System. Failure to do so may result in damage of the equipment.

Warranty

The warranty and/or obligations described in RED's standard conditions of sale, as set forth in Price Sheet 150, plus any special warranty provisions, as set forth in the applicable product-line specification bulletin, are exclusive. The remedies provided in the former for breach of these warranties shall constitute the immediate purchaser's or end user's exclusive remedy and a fulfillment of all seller's liability. In no event shall the seller's liability to the immediate purchaser or end user exceed the price of the specific product that gives rise to the immediate purchaser's or end user's claim. All other warranties, whether express or implied or arising by operation of law, course of dealing, usage of trade or otherwise, are excluded. The only warranties are those stated in Price Sheet 150, and THERE ARE NO EXPRESS OR IMPLIED WARRANTIES OF MERCHANT-ABILITY OR FITNESS FOR A PARTICULAR PURPOSE. ANY EXPRESS WARRANTY OR OTHER OBLIGATION PROVIDED IN PRICE SHEET 150 IS GRANTED ONLY TO THE IMMEDIATE PURCHASER AND END USER, AS DEFINED THEREIN. OTHER THAN AN END USER, NO REMOTE PURCHASER MAY RELY ON ANY AFFIRMATION OF FACT OR PROMISE THAT RELATES TO THE GOODS DESCRIBED HEREIN, ANY DESCRIPTION THAT RELATES TO THE GOODS, OR ANY REMEDIAL PROMISE INCLUDED IN PRICE SHEET 150.

Warranty Qualifications

The seller's warranties are contingent upon the installation and adjustment of the RED PureWave SMS-250 Storage Management System in accordance with RED's applicable instruction sheets, data sheets, and/or data bulletins.

Understanding Safety-Alert Messages

Several types of safety-alert messages may appear throughout this instruction sheet and on labels attached to the PureWave SMS-250 unit. Familiarize yourself with these types of messages and the importance of these various signal words:

DANGER

"DANGER" identifies the most serious and immediate hazards that *will likely* result in serious personal injury or death if instructions, including recommended precautions, are not followed.

WARNING

"WARNING" identifies hazards or unsafe practices that *can* result in serious personal injury or death if instructions, including recommended precautions, are not followed.

CAUTION

"CAUTION" identifies hazards or unsafe practices that *can* result in minor personal injury if instructions, including recommended precautions, are not followed.

NOTICE

"NOTICE" identifies important procedures or requirements that *can* result in product or property damage if instructions are not followed.

Following Safety Instructions

If you do not understand any portion of this instruction sheet and need assistance, contact your nearest RED Sales Office or RED Authorized Distributor. Their telephone numbers are listed on RED's website **renewableenergyanddrives.com**. Or call RED Headquarters on T. 0116 279 6131

NOTICE

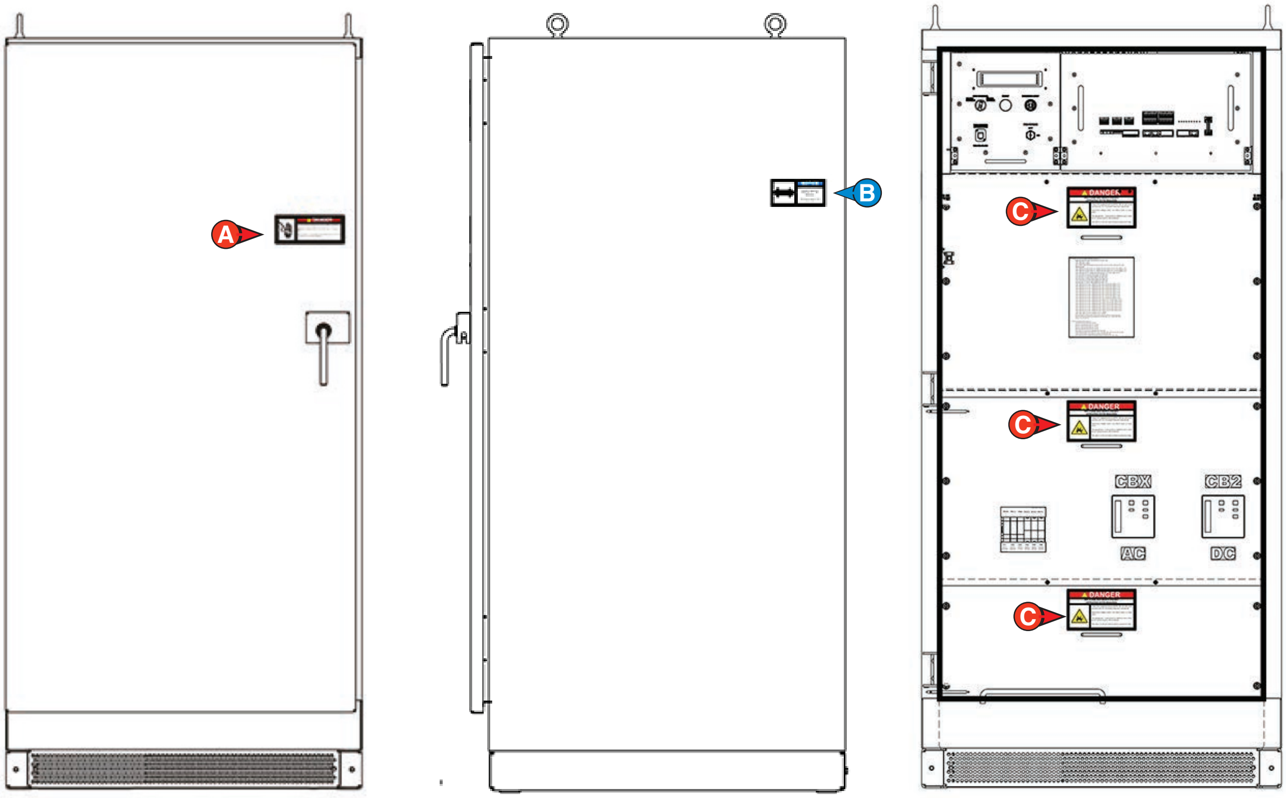
Read this instruction sheet thoroughly and carefully before installing or operating your RED PureWave SMS-250 Storage Management System.

Replacement Instructions and Labels

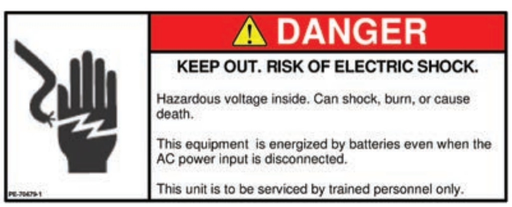
If you need additional copies of this instruction sheet, contact your nearest RED Sales Office, RED Authorized Distributor, RED Headquarters, or RED Electric.

It is important that any missing, damaged, or faded labels on the equipment be replaced immediately. Replacement labels are available by contacting your nearest RED Sales Office, RED Authorized Distributor or RED Headquarters.

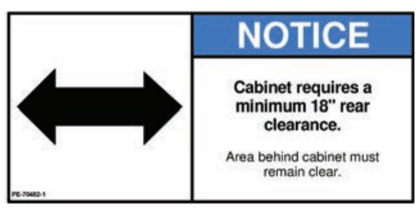
Location of Safety Labels



A



B



C

Reorder Information for Safety Labels

Location	Safety Alert Message	Description	Part Number
A	⚠ DANGER	KEEP OUT. RISK OF ELECTRICAL SHOCK …	PE-70479-1
B★	*NOTICE*	REAR CLEARANCE …	PE-70482-1
C	⚠ DANGER	ARC FLASH AND SHOCK …	PE-70483-1

★ Label is on the left and right sides of the PCS enclosure.

Symbols and Terminal Markings

I	The "I" symbol represents the POWER ON button. When the "I" button with the symbol is pressed, the breaker places the equipment into a fully-powered state.
⏚	Equipment grounding conductor.
O	The "O" symbol represents the POWER OFF button. When the button with the "O" symbol is pressed, the breaker disconnects the load side from the power source. The dc breaker disconnects the PureWave SMS-250 system from the battery. The ac breaker disconnects the ac output to the load.
⎓	Direct current, also indicated as dc.
∿	Alternating current, also indicated as ac.

⚠ DANGER

The PureWave SMS-250 system operates at hazardous voltage. Failure to observe the precautions below will result in serious personal injury or death.

Some of these precautions may differ from your company's operating procedures and rules. Where a discrepancy exists, follow your company's operating procedures and rules.

1. **QUALIFIED PERSONS.** Access to the PureWave SMS-250 system must be restricted only to qualified persons. See "Qualified Persons" on page 2.
2. **SAFETY PROCEDURES.** Always follow safe operating procedures and rules.
3. **PERSONAL PROTECTIVE EQUIPMENT.** Always use suitable protective equipment, such as rubber gloves, rubber mats, hard hats, safety glasses, and flame-retardant clothing, in accordance with safe operating procedures and rules.
4. **SAFETY LABELS.** Do not remove or obscure any of the "DANGER," "WARNING," "CAUTION," or "*NOTICE*" labels.
5. **ENCLOSURE.** Do not open access doors unless the system is offline or otherwise authorized by RED Electric Company.
6. **MAINTAINING PROPER CLEARANCE.** Always maintain proper clearance from energized components, ensuring the dead-front access panels are in place after maintenance and before operation.
7. **HAZARDOUS VOLTAGES.** High-voltage dc is present even without utility power connected. Hazardous voltages should also be expected in all interconnecting components and lines.

   To maintain safety, the user should use a padlock on the door of the PCS. The door and the use of the padlock provide protection to inadvertent contact with hazardous voltages.
8. **GROUNDING.**
   For grounding purposes, the proceeding must be followed:
   - The PCS ground bar in the cable-termination area must be connected to a suitable earth ground for testing before energizing the unit and at all times when energized.
   - The overall ground system should be sufficient to limit the Ground Potential Rise, step voltage, and touch voltage to acceptable limits as determined by the utility's practices and the National Electric Safety Code.
9. **ENERGIZED COMPONENTS.** Always consider all parts live until de-energized, locked open, and tested.
10. **ADDITIONAL CONNECTIONS.** The user should not attempt to connect any additional logic controls or power connections to the PureWave SMS-250 system (beyond the connections shown on the interconnect drawing) without having received written approval from RED Electric Company.
11. **INSULATED HAND TOOLS.** To use insulated hand tools, the proceeding must be followed:
    - Insulated hand tools are required when working on or around any energized equipment. Use only properly rated tools for the energy present.
    - Tool inventories should be kept to ensure that all tools that enter the system enclosure are removed before energizing the system.
12. **EMERGENCY PROCEDURES AND EQUIPMENT.** For emergency procedures:
    - The owner should develop policies and procedures for handling emergency situations.
    - It is the responsibility of the owner to develop site-specific emergency action plans for response to such situations.
13. **ADDITIONAL SAFETY INSTRUCTIONS.** Consult the battery supplier for additional safety instructions and procedures regarding the battery used for the PureWave SMS-250 system.

Enclosure

The enclosure houses the PCS. The weatherproof, tamper-resistant NEMA 4 enclosure helps protect the system from environmental factors and unauthorized interference. Access to the system components shall be by means of a door at the front of the enclosure. Vents for air flow are located on the back. See Figure 1.

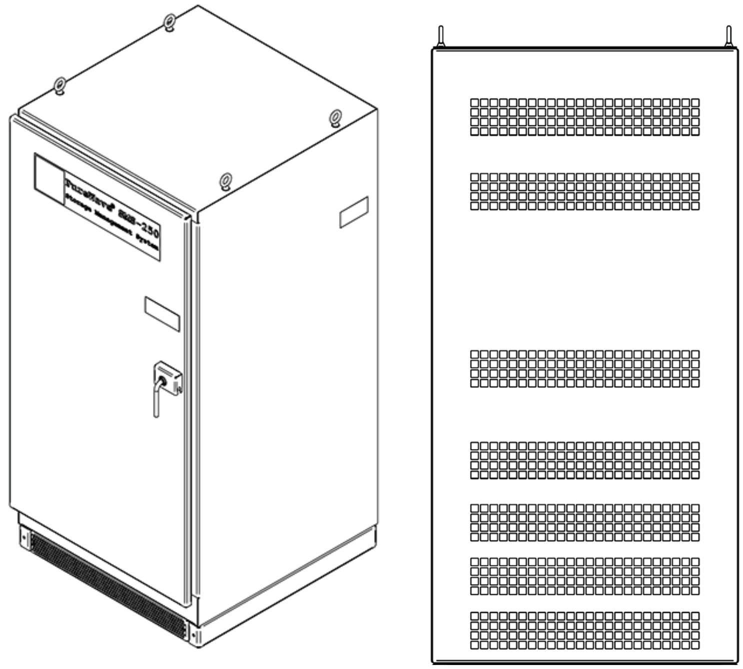


Figure 1. Front and rear view of the PCS enclosure.

LCD Screen

A four-line, 40 character liquid-crystal display is mounted on the control panel, protected by a clear plastic window. The display indicates status information such as voltages (ac), currents (ac), power (ac), vars (ac), battery voltage (dc), inverter state, operating mode, and active alarms. See Figure 2.

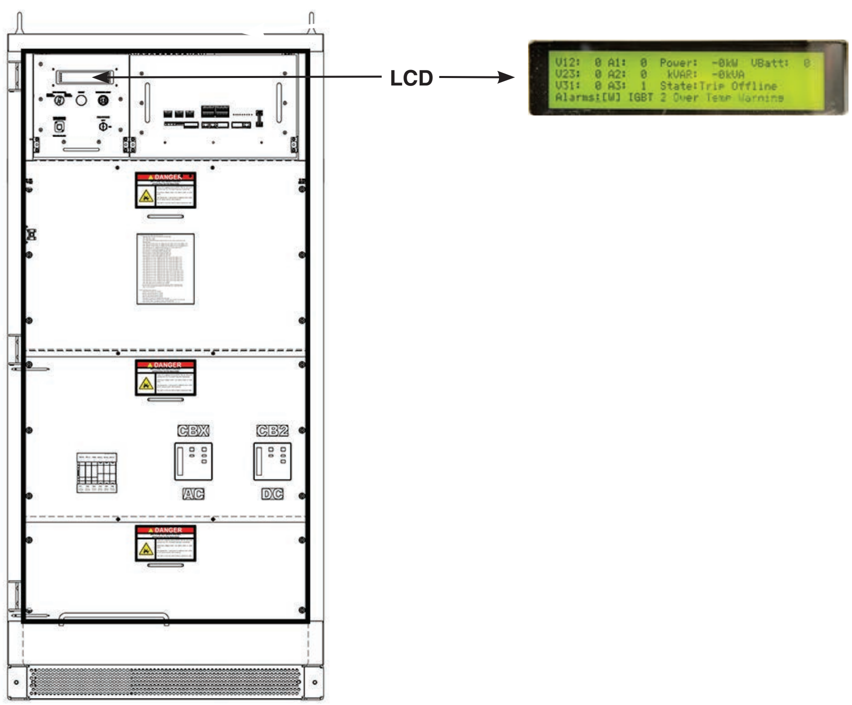


Figure 2. Location of the LCD screen.

Dead-Front Access Panels

⚠ WARNING

Do not remove the dead-front access panels unless qualified to do so. Potentially lethal voltages are present beyond the dead-front access panels. High-voltage dc may be present even without the utility power connected.

After opening the PCS enclosure door, the three dead-front access panels are shown. The panels protect the user from the energized components of the PCS. See Figure 3.

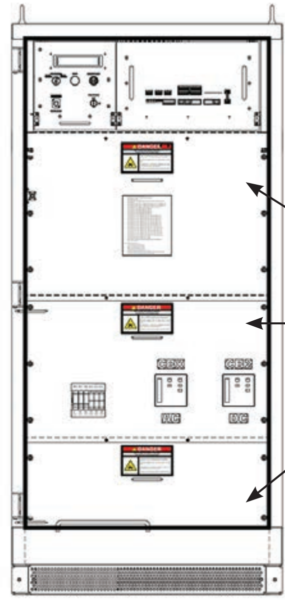


Figure 3. Dead-front access panels.

The panels may be removed starting from the top panel to the bottom panel. Use a #2 Phillips screwdriver for the two screws at the top of each panel and a 13-mm socket wrench for the side flange nuts. Refer to Figure 34 on page 59 for an illustration of the dead-front access panel removal procedure.

Inner Components

⚠ DANGER

Before removing the dead-front access panels, make sure that the PCS is de-energized to avoid serious injury. When removing the three dead-front access panels, remove them from top to bottom to avoid injury or equipment damage.

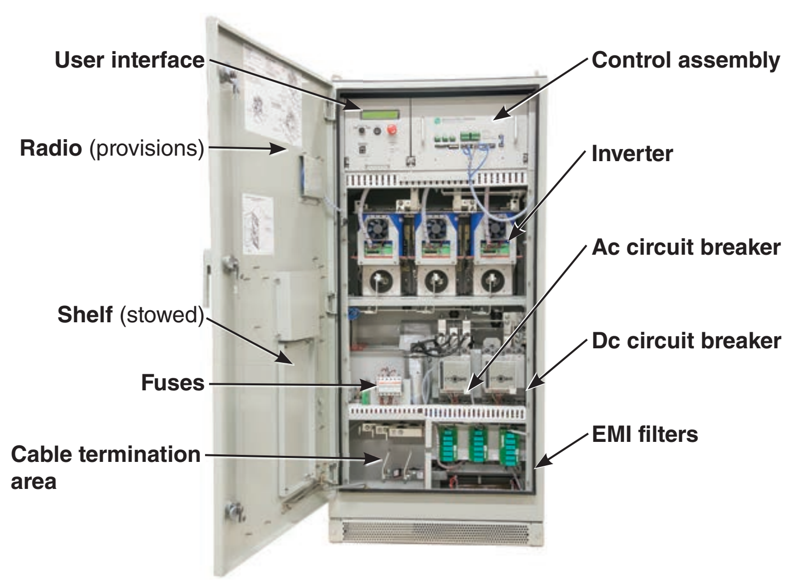


Figure 4. Components inside the PCS enclosure.

User Interface

The PureWave SMS-250 system can be controlled through the user interface located at the top-left side of the unit. Figure 5 shows the controls available on the user interface.

Figure 5. User interface.

The controls on the user interface are as follows:

SMS CONTROL–This switch enables the user to switch control from **SCADA** mode (SCADA ENABLE) to Human Machine Interface (**HMI**) mode (SCADA DISABLE), and vice versa.

RESET–This black pushbutton, when pressed, enables the user to administer a manual reset.

INVERTER STOP– This red pushbutton, when pressed, enables the user to stop any running operation. Pushing this button will open the ac and dc circuit breakers.

WEB SERVER CONNECTION–The user can use this connection port to connect locally to the system via **HMI** mode.

PRE-CHARGE–This key-lock is used when any work or maintenance requires the inverter to be de-energized. When the inverter stop pushbutton is pressed and the pre-charge key is turned to the **Off** position (ac and dc circuit breakers are open), the inverter bridge will discharge to a safe level in 5 minutes.

⚠ WARNING

Capacitors in the PCS may have residual charge after the pre-charge key has been turned off. If there is no load connected to the unit, wait 5 minutes for the capacitors to discharge before proceeding with work or maintenance.

When the pre-charge key-lock is in the **Off** position, the key can be removed. The inverter bridge will remain de-energized until the key is placed back in and turned to the **On** position (and source power is restored). Once the key-lock is in the **On** position, the key cannot be removed unless it is turned back to the **Off** position.

Control Assembly

The control assembly inputs and indicators are located on the front of the control assembly pull-out drawer located at the top-right side of the unit. See Figure 6. This assembly contains all the necessary digital signal processing (DNP), microcontroller, application, and scale boards for operation. The inputs and indicators on the assembly are for service and maintenance personnel use.

NOTICE
Access and use of the control assembly should be done by authorized personnel who are trained in servicing the PCS.

Figure 6. Control assembly inputs and indicators.

Inverter

The inverter assembly consists of a three-phase, four-quadrant inverter that converts the dc power to ac power. It creates the three-phase output from the dc battery bus. Insulated-gate bipolar transistors (IGBTs) are used for switching, and pulse-width modulation is used to control the real and reactive power produced and absorbed by the PCS. See Figure 7.

Figure 7. Inverter assembly.

Ac and Dc Circuit Breakers

The PCS has two circuit breakers located in the lower-middle section of the unit. See Figure 8 for the location of the circuit breakers. The two circuit breakers are:

Ac Circuit Breaker (CB1)–The ac circuit breaker can automatically isolate the PCS from the utility feeder in the event of a **Trip Offline** alarm. The circuit breaker is rated at 400 A. See Figure 8 for the location of the ac circuit breaker.

Dc Circuit Breaker (CB2)–The dc circuit breaker can automatically isolate the PCS from the battery in the event of a **Trip Offline** alarm or inverter stop. The circuit breaker is rated at 400 A. See Figure 8 for the location of the dc circuit breaker.

NOTICE

A few operating controls on the ac and dc circuit breakers are located inside the PCS. However, unless otherwise specified, these controls should only be operated by authorized personnel. Indicators for circuit-breaker status are present not only on the circuit breakers, but also on the HMI.

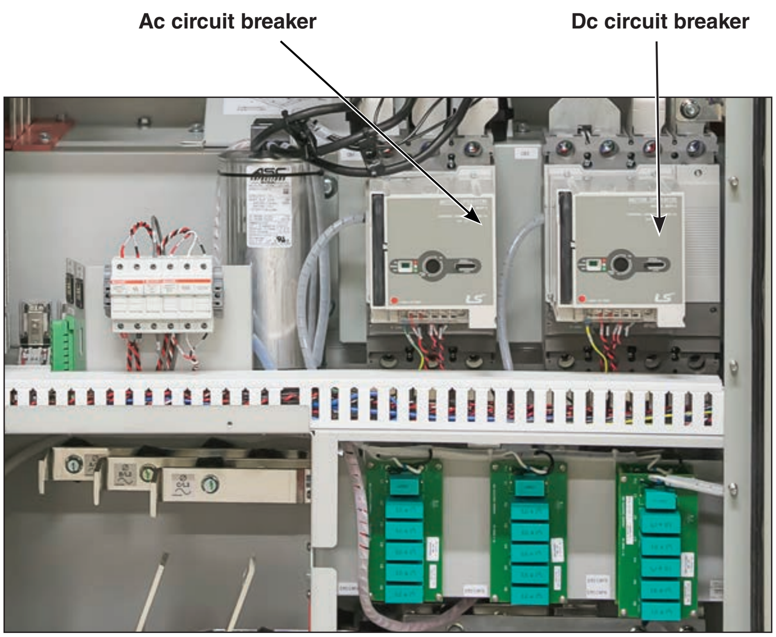


Figure 8. Ac and dc circuit breakers.

EMI Filters

Located below the circuit breakers are ac and dc electromagnetic interference (EMI) filters. These filters are designed to prevent any IGBT interference by shunting the high frequency. See Figure 9 for the location of the EMI filters.

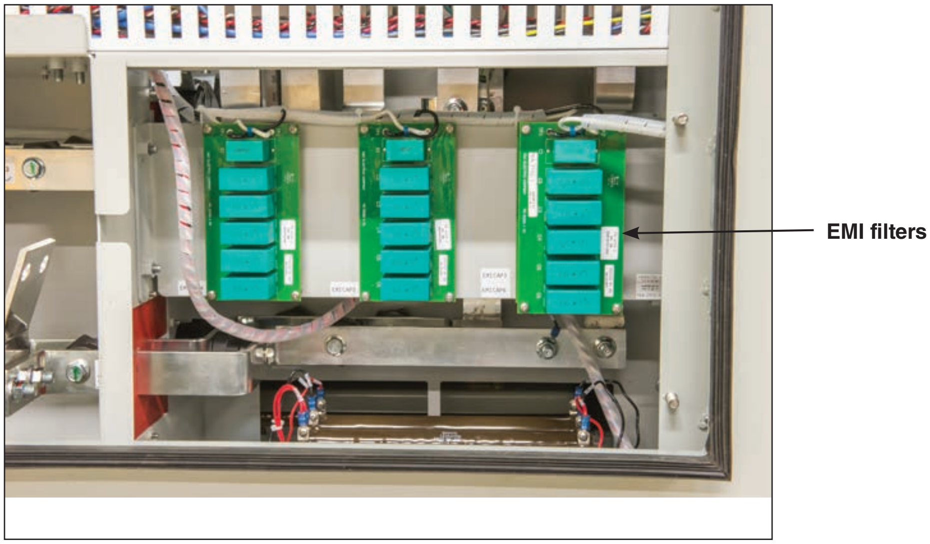


Figure 9. Location of EMI filters.

Cable-Termination Area

The ac and dc cable-termination area is located inside the enclosure at the bottom-left corner. This user-accessible termination area shall include terminals for connecting the utility-source cables and the dc terminals for connecting the battery pack cables. See Figure 10 for the location of the cable-termination area.

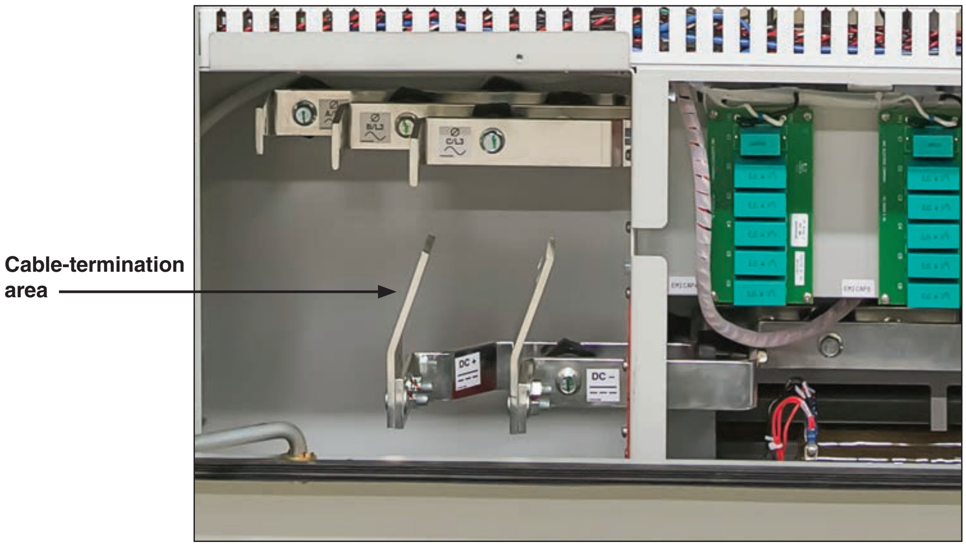


Figure 10. Cable-termination area.

Fuses

Six fuses are located to the left of the circuit breakers. See Figure 11. Some are rated differently from others because the ratings pertain to their application.

Figure 11. Location of fuses.

To replace a fuse, no hardware is necessary. Pulling the fuse latch forward will open the holder. The fuse will then be exposed for replacement.

Service Shelf

The PCS enclosure is supplied with a shelf assembly to assist personnel in servicing or monitoring the unit. The shelf-top and brackets are bolted on the inside of the enclosure door. See Figure 12.

Figure 12. Location of stowed shelf-top and brackets.

Shelf Assembly

STEP 1. Using a 13-mm hexagonal wrench, unbolt the four flange nuts located at the corners of the shelf-top.

(a) Unbolt the nuts holding the brackets. The nuts will be used to assemble the shelf.

(b) Remove the shelf-top and brackets from the door.

⚠ CAUTION

Removal and placement of the shelf-top require careful attention so that mishandling, which can lead to damage or personal injury, does not occur.

STEP 2. Bolt the brackets in the location specified in Figure 13.

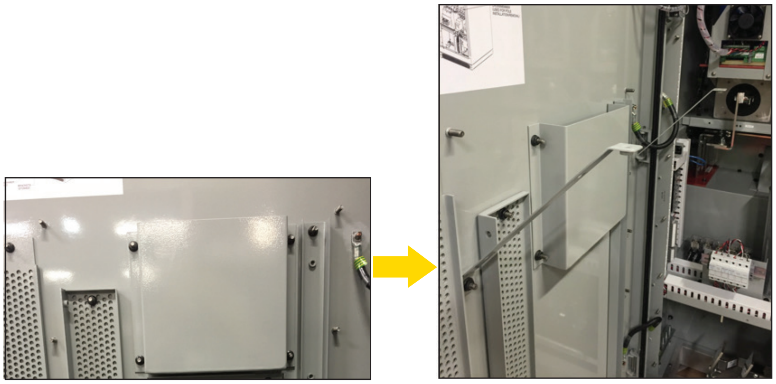


Figure 13. Location of brackets installation.

STEP 3. Place the shelf-top on top of the brackets and through the bolts as seen in Figure 14.

Figure 14. Location of shelf attachment to the enclosure door.

STEP 4. Bolt the flange nuts to secure the shelf-top to the door. The shelf is now ready for use. See Figure 15.

Figure 15. Shelf installed.

NOTICE
Do not close the enclosure door when the shelf is installed. The shelf will need to be disassembled after servicing is complete. Failure to do this can result in damage to the equipment.

The service shelf can also be used for removing and replacing the IGBT inverter pole assemblies inside the PCS. Refer to Figure 36 on page 61 for an illustration of installing the shelf inside the PCS to service these assemblies.

Radio Provisions

The PCS enclosure is supplied with provisions for radio communication. A removable panel to mount the radio and 24-Vdc power are located next to the LCD circuitry on the inside of the enclosure door. See Figure 16.

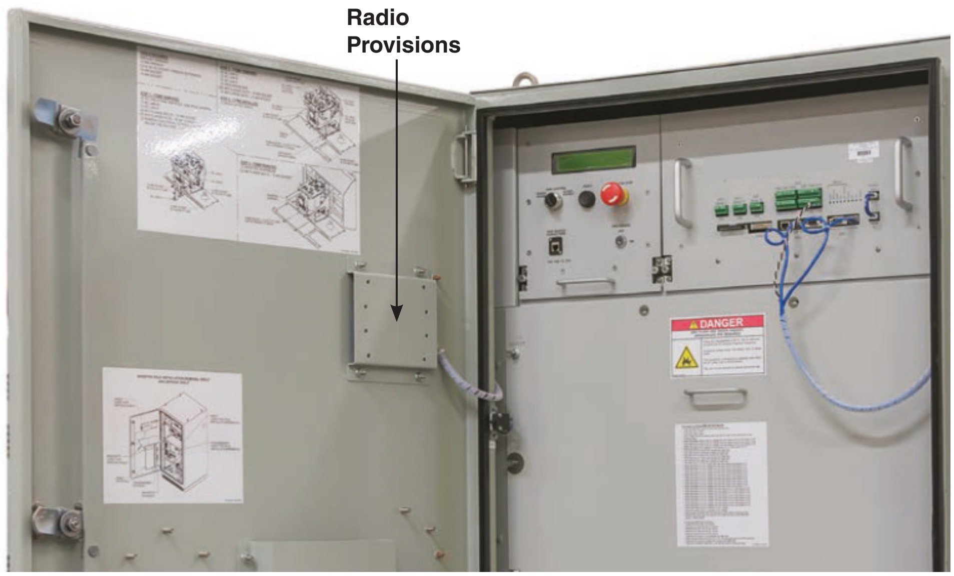


Figure 16. Provisions for radio communication.

Human Machine Interface

The HMI computer is used to control and monitor the PureWave SMS-250 system. A laptop computer can be used. Before connecting to the PureWave SMS-250 system, the user computer network settings need to be configured to the following:

- Set an IP address of 192.168.10.n, where n is a number greater than 0 and less than 100.
- Set the subnet mask to 255.255.255.0.
- The default gateway can be the same as the IP address.
- Domain Name System (DNS) is not needed.

After the user computer network settings are configured, the user can attempt to connect to the HMI control by doing the following:

- Using an Ethernet cable, connect the computer to the WEB SERVER CONNECTION port on the user interface.
- Open the Firefox Web browser.
- When prompted, provide the username and password (username: operator; password: pass123).
- Enter the URL http://192.168.10.100 into the address bar to access the HMI screens.

The user is now ready to navigate through the HMI screens.

NOTICE
The HMI has two levels of access credentials. The Level 1 access enables the user to observe the system's functions. The Level 2 access gives the user credentials to control the system. Contact the system administrator if there are any issues with HMI accessibility.

HMI Program

The HMI program contains the following screens that, when selected, show the status of the PureWave SMS-250 system and its different components. The screens are as follows:

PureWave SMS-250 System Oneline

The **PureWave SMS-250 System Oneline** tab displays an overview of the PureWave SMS-250 system that includes the status of the island and ac and dc circuit breakers. If the circuit breaker is red in color, this indicates that the circuit breaker is closed. If the circuit breaker is green, this indicates that the circuit breaker is open.

The oneline screen also shows the inverter, utility, and battery information. The green box to the left shows the alarm and communication status, system state, and current real and reactive power output values. If the alarm types and/or communication items are green, there are no alarms present and/or the communications are good. If the alarms and/or communication items are red, an alarm is present and/or the communication item(s) is not working. See Figure 17.

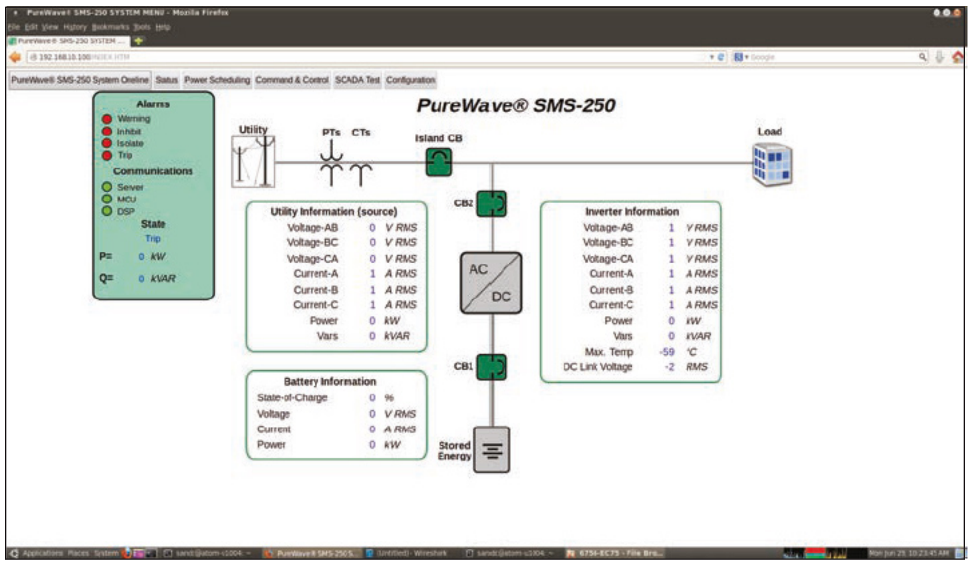


Figure 17. PureWave SMS-250 System Oneline.

Status

The **Status** tab displays the alarm, analog, and digital status for the PureWave SMS-250 system. Figure 18 shows where the user can find these screens by placing the mouse over the **Status** tab to display these status drop-down menu items: **Alarm Status**, **Analogs**, and **Digitals**.

Figure 19 is the **Alarm Status** menu screen, which displays the status of the alarms. In addition, the user can place the mouse over the listed alarm to display a tool-tip pop-up window that provides a description of what the alarm is and the suggested troubleshooting actions to clear it.

Figures 20 and 21 on page 17 show the **Analogs** and **Digitals** status menu screens respectively.

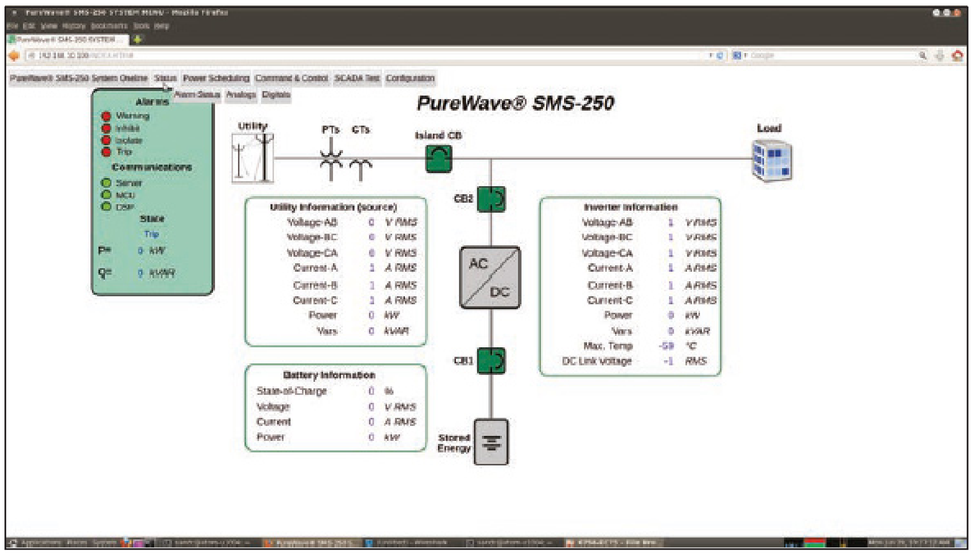


Figure 18. The Status drop down menu.

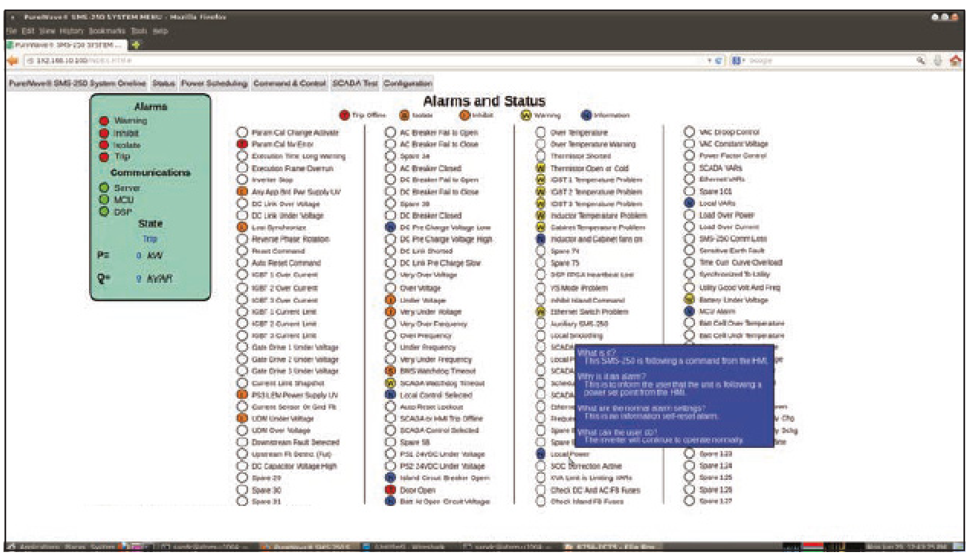


Figure 19. The Alarm and Status window.

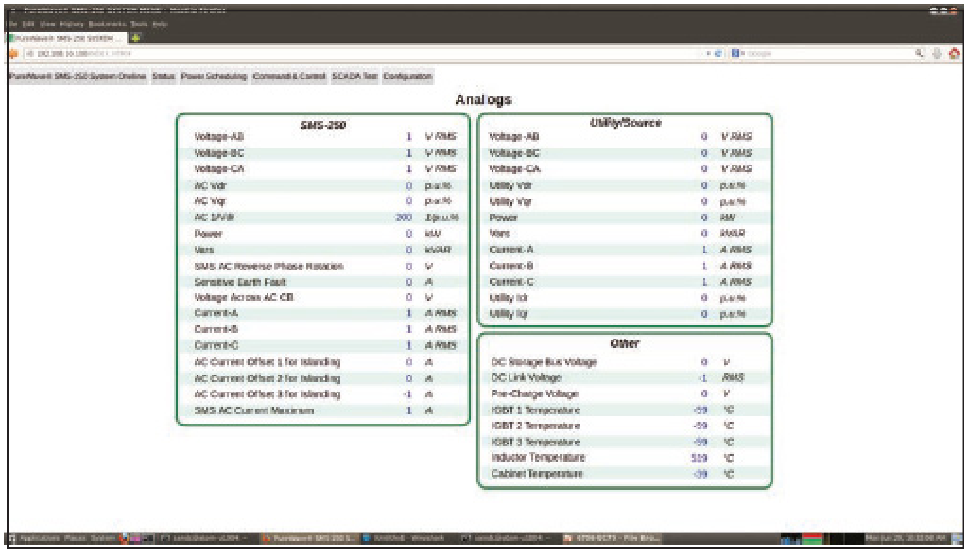


Figure 20. The Analog statuses window.

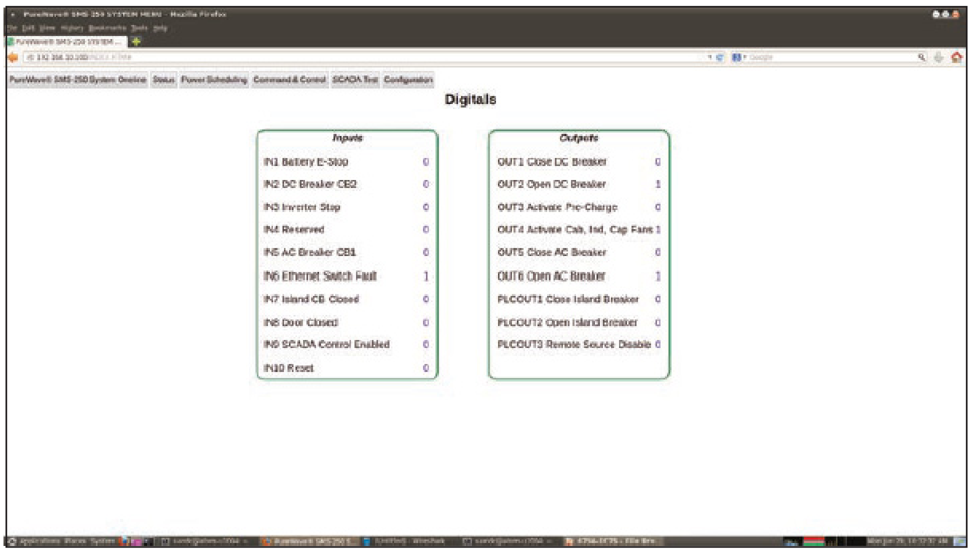


Figure 21. The Digital statuses window.

Power Scheduling

The **Power Scheduling** tab enables the user to charge and discharge the PureWave SMS-250 system at desired time durations and power levels during any time of the week. As seen in Figure 22, the user can place the mouse over the **Power Scheduling** tab to display the power scheduling drop-down menu items, **Profile Setup** and **Week Setup**. Figures 23 and 24 (on page 19) show the screen of these menu items, respectively.

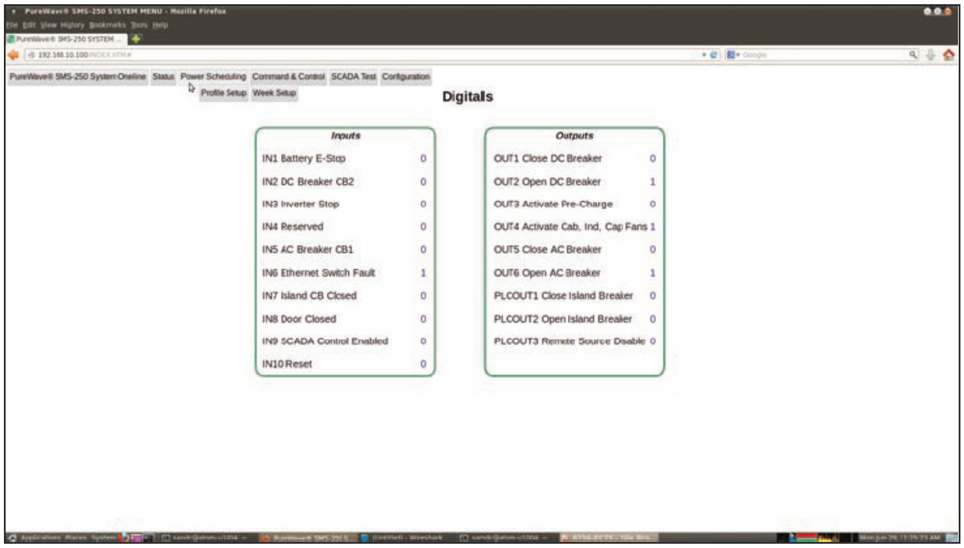


Figure 22. The Power Scheduling drop-down menu.

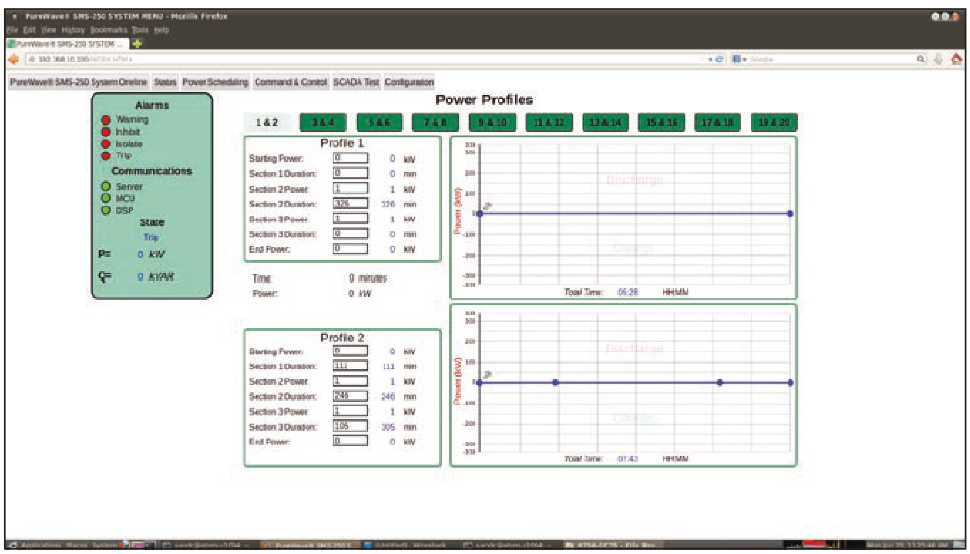


Figure 23. The Profile Setup window.

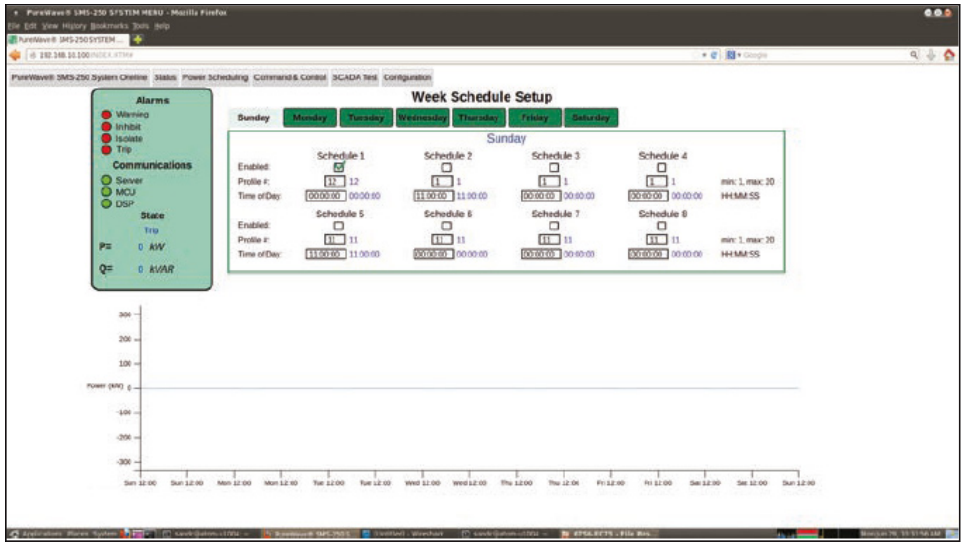


Figure 24. The Week Schedule Setup window.

Command and Control

The **Command and Control** tab enables the user to command real or reactive power to the load. It also allows the user to choose different modes of operation, such as peak shaving, renewable smoothing, schedule follow, or islanding. See Figure 25.

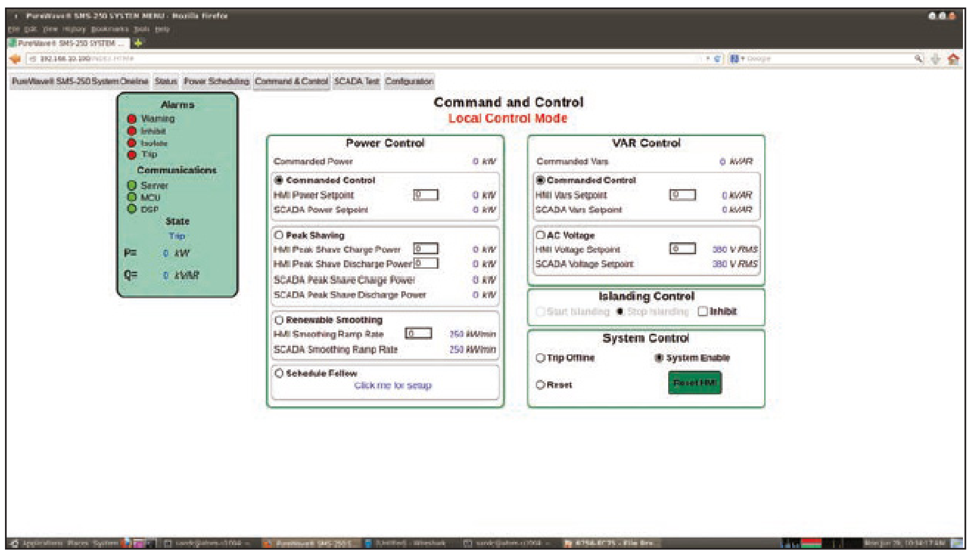


Figure 25. The Command and Control window.

SCADA Test

The **SCADA Test** tab enables the user to change SCADA inputs and outputs (analog and digital) for a desired time to verify that the SCADA system is functioning properly. As seen on Figure 26, the user can place the mouse over the **SCADA Test** tab to display the **SCADA Test** drop-down menu items, **AI** (Analog Inputs), **AO** (Analog Outputs), **DI** (Digital Inputs), and **DO** (Digital Outputs). Figures 27, 28 and 29 (on page 21), and 30 (on page 22) show the respective screens of these menu items.

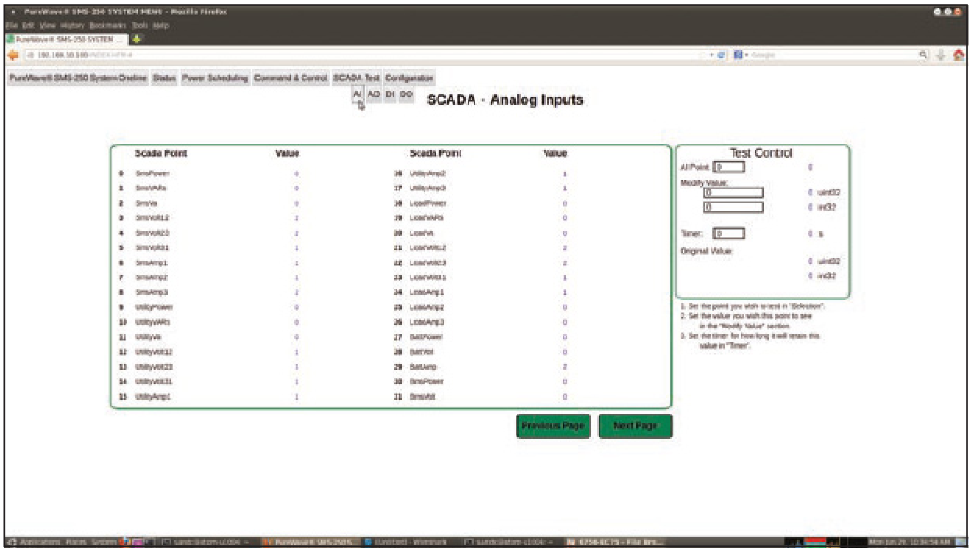


Figure 26. The SCADA TEST drop-down menu.

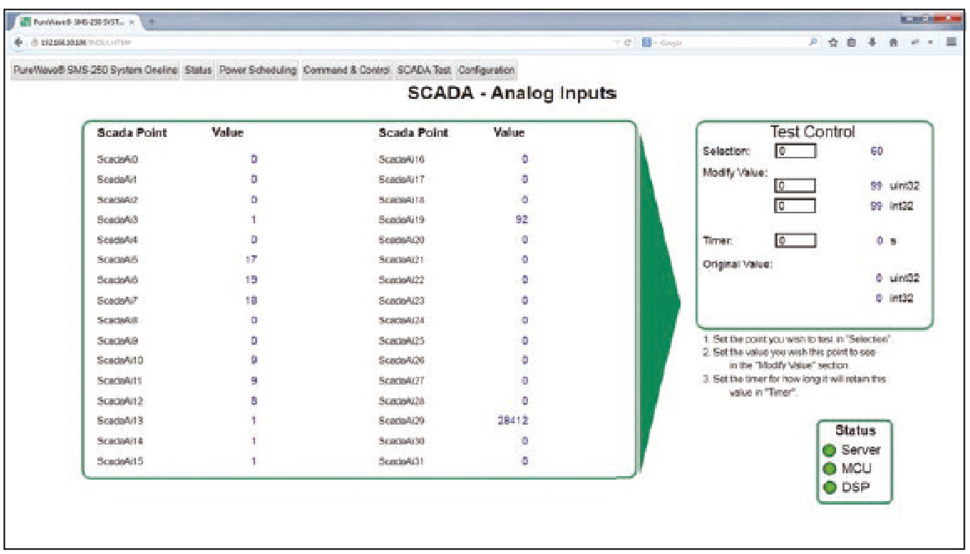


Figure 27. The Analog Inputs window.

Figure 28. The Analog Outputs window.

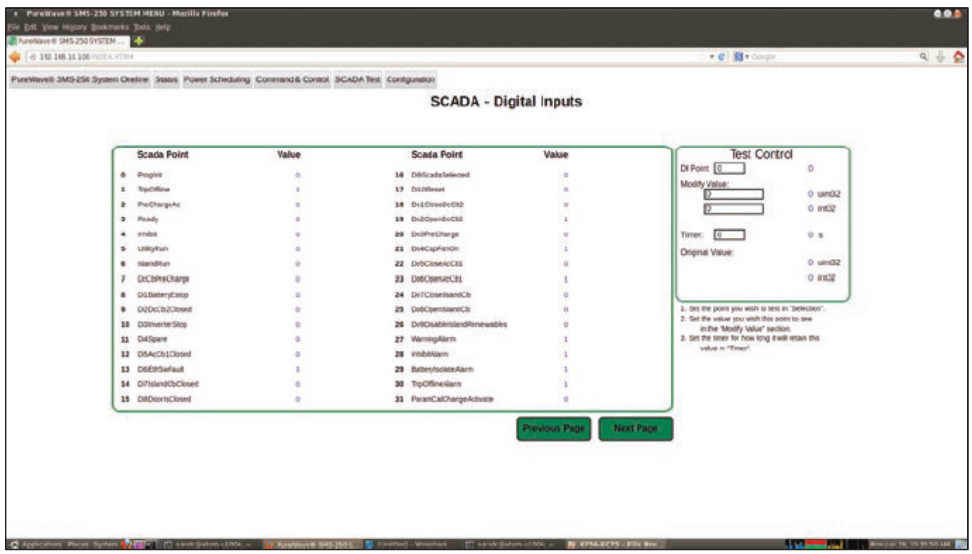


Figure 29. The Digital Inputs window.

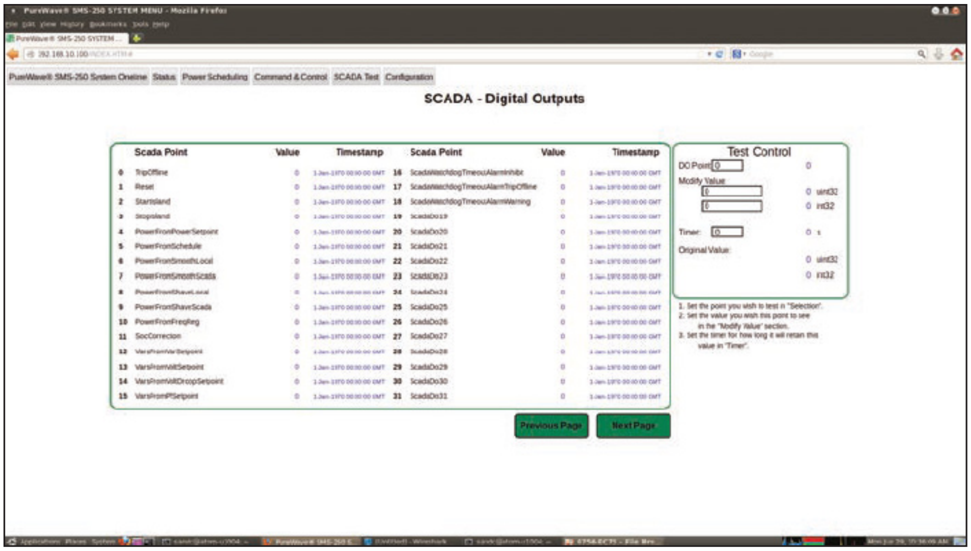


Figure 30. The Digital Outputs widow.

Configuration

The **Configuration** tab enables the user to change communications and field settings. As seen in Figure 31, the user can place the mouse over the **Configuration** tab to display the configuration **Field Parameters** and **Communication** drop-down menu items. Figures 32 and 33 on page 23 show the screens of these menu items, respectively. Placing the mouse over each parameter in these figures reveal a tool-tip pop-up window that describes what the parameter means.

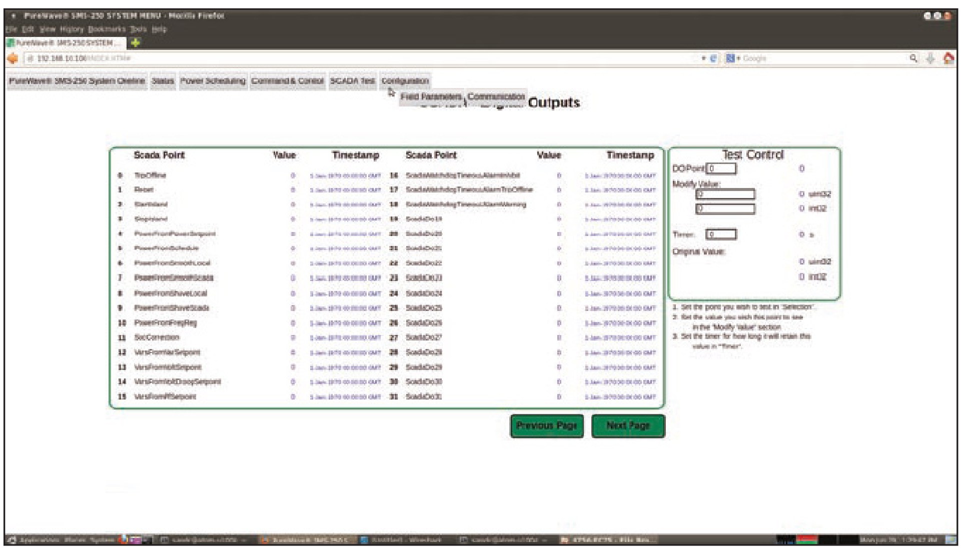


Figure 31. The Configuration drop-down menu.

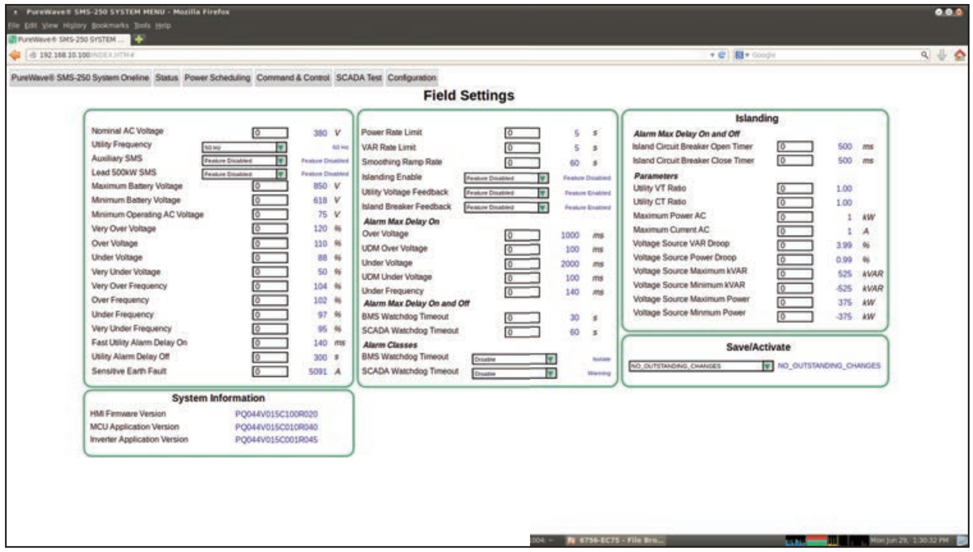


Figure 32. The Field Settings window.

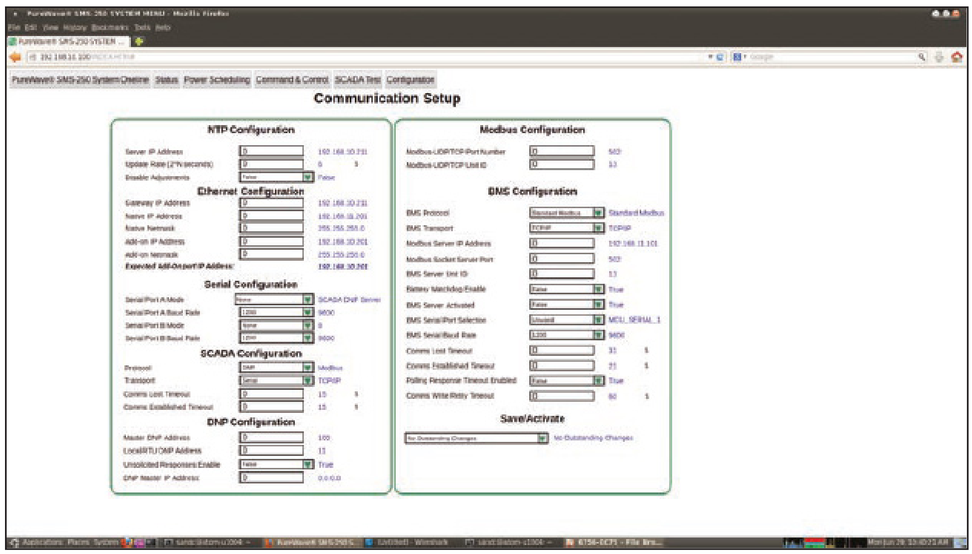


Figure 33. The Communication Setup window.

System Design

The PureWave SMS-250 Storage Management System can be connected to 380 Vac directly (or to 400, 415, or 480 Vac using an auto transformer), 50/60-Hz three-phase utility feeder.

The storage-management system consists of a 263-kW/263-kVA PCS housed in a weatherproof enclosure suitable for outdoor or indoor mounting on a concrete or equivalent pad applied with a user-furnished 618- to 850-Vdc lithium-ion battery pack.

The PCS can use a modular design capable of parallel operation to double the rating.

System Operation

The PCS converts ac power to dc power to charge the energy storage system (batteries). The PureWave SMS-250 system is capable of performing several customizable functions through a SCADA interface or the HMI computer. Discharging of the battery into the electrical system is controlled by the power mode selected. Table 1 describes the modes of system operation.

Table 1. Modes of Operation for the PureWave SMS-250 System

Modes	Description
Commanded Control	Enables the user to command real or reactive power to the load
Frequency Regulation	Follows the commands from an external frequency regulation or spinning reserve signal
Islanding	Fully supports the load using battery power when the utility source is not available
Peak Shaving	Enables the system to absorb real power during off-peak times and to supply real power during peak demand times
Power Scheduling	Dispatches power at a given time for a certain duration on any day of the week
Renewable Smoothing	Limits the rate of change in power from the renewable source by charging/discharging the battery
Voltage Regulation	Mitigates voltage fluctuations by generating leading/lagging reactive power (vars)

States

Listed in Table 2 are the five operating states of the PureWave SMS-250 system. Depending on the alarm condition, the system can be in any of these states. The LCD inside the unit door and in Human Machine Interface (HMI) computer can both inform the user of the system's present state. Table 2 describes each state.

Table 2. Operating States of the PureWave SMS-250 System

States	Description
Ready	The inverter is ready to run. The ac circuit breaker is closed. If the battery is available, the dc circuit breaker is also closed. The IGBTs are not switching.
CS Run	CS Run stands for current source state. In this state, the inverter is running. The ac circuit breaker is closed. If the battery is available, the dc circuit breaker is also closed. For var output, the ac circuit breaker is only required to be closed. For real power output, the ac and dc circuit breakers are required to be closed.
VS Run	VS Run stands for **Voltage Source** state. In this state, the utility feeder source is not available and the inverter is running, powering the local load. The ac and the dc circuit breakers are closed.
Inhibit	A problem with the inverter is inhibiting the proper operation of the PCS. The inverter will not operate until the alarm is cleared. The ac and dc circuit breakers are closed.
Trip Offline	An alarm is active that requires the ac and dc circuit breakers to be open. The inverter will not operate until the alarm is cleared.

Resets

Alarm conditions can be cleared in any of three ways. Table 3 describes the three resets available for the PureWave SMS-250 system: Auto, Manual, and Self.

Table 3. Reset Types for the PureWave SMS-250 System

Resets	Description
Auto	This type of reset is automatically performed until a predetermined reset count has been reached.
Manual	This type of reset will require a person to use the HMI or a SCADA connection, or to push the RESET button on the user interface of the PCS, to reset the system.
Self	This type of reset will automatically clear an alarm when it is no longer active.

Alarm Types

The alarms of the PureWave SMS-250 system are categorized into five alarm types: **Information Status**, **Warning**, **Inhibit**, **Battery Isolate**, and **Trip Offline**. Table 4 describes each alarm type.

Table 4. Alarm Types for the PureWave SMS-250 System

Alarm Type	Description
Information Status	Indicates the status of the PureWave SMS-250 system and will not affect the proper operation of the system
Warning	Indicates a problem that may need attention but will not affect the proper operation of the system (The system will continue to operate.)
Inhibit	Indicates a problem that needs attention and will affect the proper operation of the system (The inverter will stop operating and the ac and dc circuit breakers will remain closed.)
Battery Isolate	Indicates a problem that needs attention and will affect the proper operation of the system (The dc circuit breaker will open, and the ac circuit breaker will remain closed. This will cause the inverter to lose the ability to produce/consume real power, but reactive-power operation will remain unaffected,)
Trip Offline	Indicates a problem that needs attention and will affect the proper operation of the system (The system will not operate and the ac and dc circuit breakers will open.)

Basic Operation

The following describes how the user can operate the PureWave SMS-250 system using HMI (**SCADA Disable**) and SCADA (**SCADA Enable**) modes. Toggle the SMS CONTROL switch on the user interface to select the desired mode.

To Trip the PureWave SMS-250 System Offline

To stop the storage-management system, the user can push the INVERTER STOP button located on the user interface. The **Trip Offline** state can also be activated as follows:

- HMI: On the PCS user interface, toggle the SMS CONTROL switch to the **SCADA DISABLE** setting. Then, on the **Command-Control** HMI screen under the **System Control** menu, click on the **Trip Offline** radio button for the PureWave SMS-250 to go to the **Trip Offline** state.
- SCADA: The user can select the DNP Point 0 (Trip Offline) to pulse on a request for the PureWave SMS-250 to go to the **Trip Offline** state.

Starting the PureWave SMS-250 System

To start the storage management system, if the INVERTER STOP button on the user interface was pressed, the button will need to be twisted and released to its not-pressed position for the system to go to the **Ready** state (barring any other **Trip Offline** or **Inhibit** alarms). If the INVERTER STOP button was not pressed, then either of the following actions can be taken:

- HMI: On the PCS user interface, make sure the SMS CONTROL switch is in the **SCADA DISABLE** postion. Then, on the **Command-Control** HMI screen under the **System Control** menu, click on the **Online** radio button for the system to go to the **Ready** state.
- SCADA: If the SCADA **Trip Offline c**ommand is set, the user can clear the bit at DNP Point 0 (Trip Offline) to latch off the **Trip Offline** request for the PureWave SMS-250 system to go to the **Ready** state.

Resetting the PureWave SMS-250 System

To manually reset the storage-management system, the user can press the RESET button on the user interface. In addition, either of the following can be administered to reset the PureWave SMS-250 system:

- HMI: On the PCS user interface, toggle the SMS CONTROL switch to the **SCADA DISABLE** setting. Then, on the **Command-Control** HMI screen under the **System Control** menu, click on the **Reset** radio button for the PureWave SMS-250 system to reset.
- SCADA: The user can select the DNP Point 1 (Reset) to pulse on a request for the PureWave SMS-250 system to reset.

Ready ➔ CS Run

- HMI: On the user interface, toggle the SMS CONTROL switch to the **SCADA DISABLE setting**. On the **Command-Control** HMI screen, choose the desired control mode and enter the power or vars value. This allows the PureWave SMS-250 system to go to the **CS Run** state.
- SCADA: Select the desired power or vars control mode and pulse on its DNP Point for the PureWave SMS-250 system to go the **CS Run** state.

Island Modes

The **VS Run** mode can be configured in three ways: automatic islanding, utility-commanded islanding with closed transition return, and utility-commanded islanding with open transition return. In addition, the **VS Run** mode can be tested through the HMI or SCADA as described further below.

NOTICE

To run the **Island** mode, the islanding panel must be installed.

Automatic Islanding with the PureWave SMS-250 Unit Controlling the Breaker: In this mode, the PureWave SMS-250 system will command the island circuit breaker open by closing the island circuit breaker open contact when it sees a Utility Disturbance Monitor (UDM) overvoltage or a UDM undervoltage event, or an overfrequency or underfrequency event for the time specified on the **Configuration—Field Parameters** HMI screen. When the island circuit breaker feedback voltage (24 V) goes away, indicating the island circuit breaker is open, the PureWave SMS-250 system will run in the island mode providing power to the islanded load. When the utility power returns and is at a normal voltage and frequency for 300 seconds (configurable on the **Configuration—Field Parameters** HMI screen), the PureWave SMS-250 system will synchronize with the utility and command the island circuit breaker closed. When the island circuit breaker feedback voltage (24 V) returns, indicating that the island circuit breaker is closed, the PureWave SMS-250 system will stop islanding.

NOTICE

The PureWave SMS-250 system open contact must be wired to open the island circuit breaker.

The PureWave SMS-250 system close contact must be wired to close the island circuit breaker.

Islanding circuit-breaker feedback must be configured so that, when the island circuit breaker is closed, there is voltage (24 Vdc), and when it is open, the voltage (24 Vdc) is zero.

For this mode, the user must use the **Configuration—Field Parameters** HMI screen and configure the following:

- Islanding
- Utility Voltage
- Island Breaker

Automatic Islanding with the Utility Controlling the Breaker: In this mode, the utility has control of opening and closing the island circuit breaker. When an island state is necessary, the utility commands the island circuit breaker to open. When the PureWave SMS-250 system sees a UDM overvoltage or a UDM undervoltage, or an overfrequency or underfrequency, and the island circuit-breaker feedback voltage is zero volts, the PureWave SMS-250 system will move to the **VS** mode. After the utility voltage returns, the PureWave SMS-250 system will turn on the **Synchronized to Utility** alarm and set the SCADA status point. When the utility sees that the ac voltage is good and the PureWave SMS-250 system is synchronized, it can close the island circuit breaker. The PureWave SMS-250 system will stay in **VS Run** mode (islanding) until the utility voltage has been within tolerance for 300 seconds. After this condition is met and the islanding circuit-breaker feedback voltage (24 V) returns, indicating the island circuit breaker is closed, the PureWave SMS-250 system switches to **CS Run** mode, stopping the **Island** state. The 300-seconds setting is configurable on the **Configuration—Field Parameters** HMI screen.

NOTICE
Islanding Breaker Feedback must be configured so there is voltage (24 Vdc) when the island circuit breaker is closed and no voltage when it is open.

For this mode, the user must use the **Configuration—Field Parameters** HMI screen and configure the following:

- Islanding Enable
- Utility Voltage Feedback
- Island Breaker Feedback

Utility Commanded Islanding: In this mode, the utility has control of the opening and closing of the island circuit breaker. When the **Start Island SCADA** control point is set, the PureWave SMS-250 system will move to the **Island** mode. When the utility voltage and frequency return to normal, the utility issues the **Stop Island SCADA** control point. When the SCADA status point for the **Island Run** state is clear, the utility can command the island circuit breaker to close.

For this mode, the user must use the **Configuration—Field Parameters** HMI screen and configure the following:

- Islanding Enable
- Utility Voltage Feedback
- Island Breaker Feedback

Island Test Modes

The following modes can be used to test the automatic-islanding capability of the PureWave SMS-250 system without disturbance:

HMI Commanded Islanding: In this mode, with the PureWave SMS-250 system controlling the islanding breaker, the PureWave SMS-250 system is in **Local** mode and will receive a **Start Island** command. When the island circuit breaker feedback voltage is zero, indicating the island circuit breaker is open, the PureWave SMS-250 system will run in the **Island** mode providing power to the islanded load. When the **Stop Island** command is received and the utility is providing power at a normal voltage and frequency, the PureWave SMS-250 system will synchronize to the utility and command the island circuit breaker to close. When the island circuit breaker feedback voltage (24 V) returns, indicating that the island circuit breaker is closed, the PureWave SMS-250 system will stop islanding.

NOTICE

The PureWave SMS-250 system open contact must be wired to open the island circuit breaker.

The PureWave SMS-250 system close contact must be wired to close the island circuit breaker.

The **Islanding Breaker Feedback** mode must be configured so there is voltage (24 Vdc) when the island circuit breaker is closed and the voltage (24 Vdc) is removed when it is open.

For this mode, the user must toggle the SMS CONTROL switch to the **SCADA Disable** setting. The manual controls are radio buttons located on the **Command and Control** HMI screen in the **Island Control** window.

In addition, the user must use the **Configuration—Field Parameters** HMI screen and configure the following to command islanding via the HMI:

- Islanding Enable
- Utility Voltage Feedback
- Island Breaker Feedback—Feature Enable

SCADA Commanded Islanding: In this mode, with the PureWave SMS-250 system controlling the islanding breaker, the PureWave SMS-250 system is in **Remote** mode and will receive a **Start Island** command. When the island circuit breaker feedback voltage (24 V) goes to zero, indicating the island circuit breaker is open, the PureWave SMS-250 system will run in the **Island** mode providing power to the islanded load. When the **Stop Island** command is received and the utility is providing power at a normal voltage and frequency, the PureWave SMS-250 system will synchronize to the utility and command the island circuit breaker to close. When the island circuit-breaker feedback voltage (24V) returns, indicating that the island circuit breaker is closed, the PureWave SMS-250 system will stop islanding.

NOTICE

The PureWave SMS-250 system open contact must be wired to open the island circuit breaker.

The PureWave SMS-250 system close contact must be wired to close the island circuit breaker.

Islanding Breaker Feedback must be configured so there is voltage (24 Vdc) when the island circuit breaker is closed and no voltage when it is open.

For this mode, the user must toggle the SMS CONTROL switch to the **SCADA Enable** setting. Then, the user can select DNP Point 2 (StartIsland) to pulse on a request for the PureWave SMS-250 system to go to the **VS Run** state.

CS Run ➔ Ready

- HMI: On the PCS user interface, toggle the SMS CONTROL switch to the **SCADA DISABLE** setting. Then, on the **Command-Control** HMI screen, change the values of the control mode so there are no power or vars required. This allows the PureWave SMS-250 system to go to the **Ready** state.
- SCADA: Change the values of the control mode so there are no power or vars required so the PureWave SMS-250 system can go to the **Ready** state.

VS Run ➔ Ready (for Island Test Modes)

The PureWave SMS-250 system automatically moves to the **Ready** state when the utility source has been restored. However, the storage-management system can also be manually commanded to the **Ready** state as follows:

- HMI: On the PCS user interface, toggle the SMS CONTROL switch to the **SCADA DISABLE** setting. Then, on the **Command-Control** HMI screen under the **Islanding Control** menu, click on the **Stop Island** radio button for the PureWave SMS-250 system to go to the **Ready** state.
- SCADA: The user can select the DNP Point 3 (Stop Island) to pulse on a request for the PureWave SMS-250 system to go to the **Ready** state.

Alarm List and Troubleshooting Tips

The PureWave SMS-250 system contains an extensive self-diagnosis system. If any abnormal condition occurs, the system will activate an alarm. Following is a list of alarms categorized by alarm type in order of: **Information Status**, **Warning**, **Inhibit**, **Battery Isolate**, and **Trip Offline**.

NOTICE

The alarms in the following tables are listed according to alarm type at the time of shipment. Alarms may be reconfigured during operation and should be documented accordingly.

The troubleshooting tips listed in the following tables are for guidance purposes. Please contact RED Electric Company if more troubleshooting assistance is required or if there are any doubts about how to handle an alarm event.

Information Status Alarms

These notifications provide the status of the PureWave SMS-250 system and will not affect the proper operation of the system. See Table 5 for the listed information statuses

Table 5. PureWave SMS-250 Information Status Alarms

Alarm	Description	Reset Type
Ac Breaker Closed	**What is it?** This alarm indicates that the circuit breaker is closed and has been closed for 300 ms. **Why is it an alarm?** The auxiliary contacts on circuit breakers may not close exactly when the main contacts close. This alarm is used to verify the circuit breaker has been closed for some time before moving to another state that requires a closed circuit breaker. **What are the normal alarm settings?** This is a self-reset information alarm that is used by the main state machine to verify the circuit breaker is closed. **What can the user do?** Because this is an information alarm, it does not change the operation of the PureWave SMS-250 system so no action is required.	SELF
Auto Reset Command	**What is it?** This alarm indicates an **Auto Reset** command has been sent. **Auto Reset** commands allow the inverter to try resetting a problem, but if it returns quickly, the reset commands are locked out. **Why is it an alarm?** This is an alarm for troubleshooting purposes so RED technicians can see when auto resets have been sent and what the results were. **What are the normal alarm settings?** This is an informational alarm that self-resets and causes a snapshot to be taken. **What can the user do?** Because this is for information and is self-resetting, there is no user action necessary.	SELF
Auxiliary SMS-250	**What is it?** This PureWave SMS-250 system is taking commands from a lead PureWave SMS-250 system. **Why is it an alarm?** To inform the user that this is an auxiliary unit. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Battery at Open Circuit Voltage	**What is it?** This alarm is used to know when to keep the battery voltage the same to avoid charging or discharging the battery. When a battery is being charged or discharged, if the battery voltage is held at the voltage that it is at while dc current is flowing, the dc current will slowly go from the existing value to zero while continuing to charge or discharge the battery. **Why is it an alarm?** When the inverter is running vars and no power, we want to hold the power at zero. This can only be done after the battery voltage has relaxed to its open circuit value. **What are the normal alarm settings?** This is an information self-reset alarm with a 10-minute delay to allow the battery to return to its open circuit value. **What can the user do?** This information alarm requires no actions from the user.	SELF
Current Limit Snapshot	**What is it?** This alarm is on when any phase goes into current limit. **Why is it an alarm?** The alarm is used to take a snapshot when a current limit occurs, but it also minimizes the number of snapshots. **What are the normal alarm settings?** This is a warning, self-resetting alarm that takes a snapshot. There is a 10-second delay off, so after there are no current-limit snapshots for 10 seconds, the alarm clears. **What can the user do?** This alarm should clear after 10 seconds. If it doesn't clear, one of the current-limit alarms is probably on or is going on and off. Look at the individual alarms to try and find the phase that is keeping this alarm on.	SELF

TABLE CONTINUED ►

Dc Breaker Closed	**What is it?** This alarm indicates that the circuit breaker is closed and has been closed for 300 ms. **Why is it an alarm?** The auxiliary contacts on circuit breakers may not close exactly when the main contacts close. This alarm is used to verify that the circuit breaker has been closed for some time before moving to another state that requires a closed circuit breaker. **What are the normal alarm settings?** This is a self-reset information alarm that is used by the main state machine to verify that the circuit breaker is closed. **What can the user do?** Because this is an information alarm, it does not change the operation of the PureWave SMS-250 system so no action is required.	SELF
Dc Pre-charge Voltage High	**What is it?** This alarm indicates that the dc pre-charge voltage is above what we expect. This will cause problems with charging the dc link. **Why is it an alarm?** If we have over the expected pre-charge voltage, the DC link will not charge as expected, resulting in a pre-charge alarm. This alarm separates the possible causes to allow better troubleshooting. **What are the normal alarm settings?** This is a self-reset informational alarm. **What can the user do?** This is caused because the voltage for pre-charging the dc link is higher than expected. If this alarm is on, additional troubleshooting by a trained technician is required.	SELF
Dc Pre-charge Voltage Low	**What is it?** This alarm indicates that the dc pre-charge voltage is below what we expect. This will cause problems with charging the dc link. **Why is it an alarm?** If we do not have the expected pre-charge voltage, the dc link will not charge as expected resulting in a pre-charge alarm. This alarm separates the possible causes to allow better troubleshooting. **What are the normal alarm settings?** This is a self-reset informational alarm. **What can the user do?** This is caused because the voltage for pre-charging the DC link is lower than expected. If this alarm is on, additional troubleshooting by a trained technician is required.	SELF
Emergency Frequency Response Active	**What is it?** This indicates the line frequency is no longer within the defined deadband and the PureWave SMS-250 is either providing or consuming real power to bring the line frequency back into the deadband. **Why is it an alarm?** This alarm provides notice that the PureWave SMS-250 is no longer operating in its configured power mode but instead is trying to control the line frequency. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Ethernet Power	**What is it?** This PureWave SMS-250 system is following an Ethernet power command, this is an auxiliary PureWave SMS-250 system following a Lead PureWave SMS-250 system or a master control. The lead or master control is sending the power set point over Ethernet. **Why is it an alarm?** This is to inform the user that the unit is following a power set point from an Ethernet command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF

TABLE CONTINUED ►

Ethernet Vars	**What is it?** The PureWave SMS-250 system is following a var command from the Ethernet connection to the lead PureWave SMS-250 system or a master control. **Why is it an alarm?** This is to inform the user that the unit is following a var command from the Ethernet connection. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Frequency Regulation Power	**What is it?** This PureWave SMS-250 system is following a **Frequency Regulation** signal supplied over the SCADA connection. **Why is it an alarm?** This is to inform the user that the unit is following a power set point from a **Frequency Regulation** signal. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Inductor and Cabinet fans on	**What is it?** When either the cabinet or the inductor winding get too hot, both the fan in the inductor area and the cabinet fan are commanded on. **Why is it an alarm?** This alarm allows the user to see when these fans are commanded on. If the IGBT thermistor is open, we call it an open or broken thermistor. We call the thermistor broken or cold if the temperature is under -25° C (-13° F). This can happen in a very cold ambient temperature. **What are the normal alarm settings?** This is a warning self-reset alarm without a snapshot. **What can the user do?** If the ambient temperature is very low, this alarm can be a normal condition. If it is not cold, it is possible that the IGBT is damaged. If the inverter is running, the IGBTs are fine, but if this alarm occurs with an over current alarm, refer the problem to a trained technician.	SELF
Inhibit Island Command	**What is it?** There has been a customer command to prevent islanding of the system. **Why is it an alarm?** This shows the unit will not island during a utility disturbance or commanded island. **Why are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally. If the unit is required to island, remove the **Inhibit Island** command through SCADA or on the HMI.	SELF
Island Circuit Breaker Open	**What is it?** This alarm indicates the islanding circuit breaker is open. **Why is it an alarm?** This will inform the user the islanding circuit breaker is open. The alarm is used when moving to or from the islanding mode. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** This information alarm requires no actions from the user.	SELF
KVA Limit Is Limiting Vars	**What is it?** The PureWave SMS-250 system is not outputting the commanded amount of vars because of the real power flow occurring at the same time. **Why is it an alarm?** The user will not see the expected amount of vars because of the real power flow occurring at the same time. The unit is limited by its maximum kVA rating. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate at a reduced capacity. To generate the full reactive power expected, the user would have to reduce the real power command.	SELF

TABLE CONTINUED ►

Local Control Selected	**What is it?** This alarm indicates that the control of the system is being done locally, not from SCADA. **Why is it an alarm?** So the state of the SCADA / LOCAL select switch can be seen from the controls, as well as remotely. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** This is for information only, the inverter will continue to operate based on the commands from the HMI.	SELF
Local Peak Shave	**What is it?** ThisPureWave SMS-250 system is peak shaving from a local command. **Why is it an alarm?** This is to inform the user the unit is peak shaving from a local command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Local Power	**What is it?** This PureWave SMS-250 system is following a command from the HMI. **Why is it an alarm?** This is to inform the user that the unit is following a power set point from the HMI. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Local Smoothing	**What is it?** This PureWave SMS-250 system is smoothing from a local command. **Why is it an alarm?** This is to inform the user that the unit is smoothing from a local command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Local Vars	**What is it?** The PureWave SMS-250 system is following a var command from the local control. **Why is it an alarm?** This is to inform the user that the unit is following a var command from the local control. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
MCU Alarm	**What is it?** This alarm can indicate one or more issues originating from the MCU; for example, that there is a problem with the compact flash card used to store snapshots or a communications issue with the HMI device or an external I/O device. **Why is it an alarm?** The compact flash card stores snapshots. The snapshots are used to look at the history of the PureWave SMS-250 system so events can be analyzed after they occur. Without the Compact Flash card, this feature is no longer available. If it's a comms issue with the HMI or I/O device, then servicing may be required. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** Replace the compact flash card with another compact flash card, preferably the wide temperature range high cycle compact flash model that is supplied by RED. For HMI or external I/O device communications, check network cabling and status of network switches. If this does not solve the problem, contact RED service and report the alarm.	SELF

TABLE CONTINUED ►

Motor Start Correction	**What is it?** The PureWave SMS-250 system is maintaining the voltage (droop or constant voltage) by quickly responding to large changes in the load current. **Why is it an alarm?** This is to inform the user that the unit is maintaining the voltage by quickly responding to large changes in the load current. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Power Factor Control	**What is it?** The PureWave SMS-250 system is maintaining a Power Factor. **Why is it an alarm?** This is to inform the user that the unit is maintaining a power factor. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Reset Command	**What is it?** This alarm indicates that a reset has been sent. **Why is it an alarm?** This is an alarm only for troubleshooting purposes so RED technicians can see when resets have been sent and what the results were. **What are the normal alarm settings?** This is an informational alarm that self-resets and causes a snapshot to be taken. **What can the user do?** Because this is for information and is self-resetting, there is no user action necessary.	SELF
SCADA Control Selected	**What is it?** This alarm indicates that the control of the system is being done using SCADA. **Why is it an alarm?** So the state of the SCADA / LOCAL select switch can be seen from the controls. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate based on the SCADA commands.	SELF
SCADA Peak Shave	**What is it?** This PureWave SMS-250 system is peak shaving from a SCADA command. **Why is it an alarm?** This is to inform the user that the unit is peak shaving from a SCADA command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
SCADA Power	**What is it?** This PureWave SMS-250 system is following a SCADA power setpoint. **Why is it an alarm?** This is to inform the user that the unit is following a power setpoint from a SCADA command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
SCADA Smoothing	**What is it?** This PureWave SMS-250 system is smoothing from a SCADA command. **Why is it an alarm?** This is to inform the user that the unit is smoothing from a SCADA command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF

TABLE CONTINUED ►

SCADA Vars	**What is it?** The PureWave SMS-250 system is following a var command from the SCADA control. **Why is it an alarm?** This is to inform the user that the unit is following a var command from the SCADA control. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Scheduled Power	**What is it?** This PureWave SMS-250 system is peak shaving from a SCADA command. **Why is it an alarm?** This is to inform the user that the unit is peak shaving from a SCADA command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
SOC Correction Active	**What is it?** When doing smoothing or frequency regulation, the signal may contain a power offset that is slowly charging or discharging the battery. Turning on the SOC correction will bias the power to move toward the nominal SOC, so if the battery SOC is higher than the desired SOC, it will add a small discharge to the commanded signal to move back toward the nominal SOC. **Why is it an alarm?** This is to inform the user that the unit is doing SOC correction. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Synchronized to Utility	**What is it?** This alarm shows that the PureWave SMS-250 system is synchronized to the utility side of the island circuit breaker. **Why is it an alarm?** This alarm verifies synchronization before transitioning from an island mode to a utility connected mode, so the transition back to the utility will be seamless. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally. If the alarm is not working as expected, contact RED service and report the alarm.	SELF

Utility Good Volt and Freq	**What is it?** This alarm shows the utility voltage is good and the frequency is good. If the PureWave SMS-250 system is islanded, it will not transition back to the utility until the utility has good voltage and frequency. **Why is it an alarm?** This alarm verifies the utility voltage and frequency are good before transitioning from an island mode to a utility connected mode, so the transition back to the utility will be seamless. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally. If the alarm is not working as expected, contact RED service and report the alarm.	SELF
Vac Constant Voltage	**What is it?** The PureWave SMS-250 system is following a constant voltage. **Why is it an alarm?** This is to inform the user the unit is following a constant voltage command. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally.	SELF
Vac Droop Control	**What is it?** The PureWave SMS-250 system is following a Voltage Droop curve. **Why is it an alarm?** This is to inform the user the unit is following a voltage-droop curve. **What are the normal alarm settings?** This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally	SELF

Warning Alarms

These alarms indicate a problem that may need attention but will not affect the proper operation of the system. The system will continue to operate when a **Warning** condition is being displayed. See Table 6 for the listed **Warning** alarms.

Table 6. PureWave SMS-250 Warning Alarms

Alarm	Description	Reset Type
Battery Under Voltage	**What is it?** This alarm shows the battery voltage is below the minimum voltage defined for the battery. **Why is it an alarm?** This shows that we should not connect to the battery or run the battery. **What are the normal alarm settings?** This is a self-reset warning alarm. **What can the user do?** This could be caused because the battery is not connected to the PureWave SMS-250 system. In this case, the alarm can be cleared by connecting the battery to the PureWave SMS-250 system, typically by closing the circuit breaker in the battery container. If this is not the cause, contact RED service and report the alarm.	SELF
BMS Req SOC Recalc	**What is it?** The battery is requesting to charge or discharge so it can recalculate its state of charge. **Why is it an alarm?** The battery is requesting to discharge so it can recalculate its state of charge. **What are the normal alarm settings?** This is a warning self-reset alarm. **What can the user do?** Command a discharge so the battery can reach bottom of charge. If the alarm remains, contact RED to investigate further.	SELF
Cabinet Temperature Problem	**What is it?** The PureWave SMS-250 monitors the temperature of the cabinet thermistor. If there is an **Over-temperature** warning, an over-temperature event occurs, a thermistor has shorted, or a Thermistor Open alarm occurs based on the cabinet temperature, this alarm comes on. **Why is it an alarm?** This alarm allows the user to see whether the cabinet temperature was the cause of the alarm. **What are the normal alarm settings?** This is a warning self-reset alarm with a snapshot. **What can the user do?** See the base alarm description for suggested actions.	SELF

CS Over Load Cool Down	**What is it?** This is a current source alarm indicating the system was over 400 A for too long. Too long is defined by an equation that calculates the junction temperature in a maximum ambient while running at 100% current. This method gives the same response to an overload regardless of the conditions so the user can coordinate protection with other devices. **Why is it an alarm?** The PureWave SMS-250 system can run above rated current for a short period of time. Once this period of time expires, the system can only run at 400 A and under. This allows a 5-minute cool down period before allowing the current to exceed the rating again. **What are the normal alarm settings?** This is a warning self-reset alarm. **What can the user do?** The inverter will continue to operate normally, but overload capability will not be allowed until the alarm clears. Wait five minutes for the alarm to clear.	SELF
Ethernet Switch Problem	**What is it?** The Ethernet switch ETH1 is reporting a problem. **Why is it an alarm?** If ETH1 stops working, the HMI and the web pages cannot communicate with the controls. **What are the normal alarm settings?** This is an informational alarm that is self-reset. No snapshot is taken. **What can the user do?** Verify by looking at ETH1 if the fault light is on. This will come on if an Ethernet cable that normally communicates at all times through the switch is unplugged. Check all the blue Ethernet cable connections.	SELF
Emergency Freq Response Misconfigured	**What is it?** This alarm indicates the Emergency Frequency Response power curves are configured improperly. **Why is it an alarm?** The Emergency Frequency Response will not function if the settings are incorrect. **What are the normal alarm settings?** This is an warning self-reset alarm. **What can the user do?** Connect the settings so the alarm clears and the Emergency Frequency Response can function.	SELF
Execution Time Long Warning	**What is it?** The software for the PureWave SMS-250 system runs in a loop that executes every 208 microseconds. If we take longer than expected to go through the loop, this alarm will turn on. **Why is it an alarm?** This alarm lets RED know the calculation loop is taking longer than expected. **What are the normal alarm settings?** This is a warning alarm with a manual reset so a single loop that runs long will turn on the warning. A snapshot is taken so RED engineers can evaluate the conditions when the alarm occurs. **What can the user do?** All the user can do is reset the alarm. RED would like to know if the alarm turns on, so if the alarm is reset by a user, please let RED Electric Company know the alarm was on and has been reset.	SELF

TABLE CONTINUED ►

IGBT 1 Current Limit	**What is it?** This alarm indicates the current in the indicated phase reached 1080 A peak, or 800 Aac. This can occur in the **Island** mode when the load is first picked up or when a new transient load is added. When we reach current limit, the IGBTs are turned off for the remainder of the 208-microsecond cycle then allowed to turn on again in the next 208-microsecond cycle. **Why is it an alarm?** This alarm is an indication that the inverter is working at its limit. The alarm has a time delay off to keep it from causing too many snapshots. **What are the normal alarm settings?** This is a warning self-reset alarm with no snapshot and a 0.1-second delay off that is used for future troubleshooting. **What can the user do?** If this alarm is continually on, the alarm could be the result of a bad current sensor power supply.	SELF

Table 6. PureWave SMS-250 Warning Alarms—continued

Alarm	Description	Reset Type
IGBT 1 Temperature Problem	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT. The PureWave SMS-250 system monitors the temperature of each thermistor. If there is an over temperature warning, an overtemperature, a thermistor shorted, or a thermistor open alarm on IGBT1, this alarm comes on. **Why is it an alarm?** This alarm allows the user to see if IGBT1 was the cause of the alarm. **What are the normal alarm settings?** This is a warning self-reset alarm with a snapshot. **What can the user do?** See the base alarm description for suggested actions.	SELF
IGBT 2 Current Limit	**What is it?** This alarm indicates the current in the indicated phase reached 1080 A peak, or 800 Aac. This can occur in the **Island** mode when the load is first picked up or when a new transient load is added. When we reach current limit, the IGBTs are turned off for the remainder of the 208-microsecond cycle then allowed to turn on again in the next 208-microsecond cycle. **Why is it an alarm?** This alarm is an indication the inverter is working at its limit. The alarm has a time delay off to keep it from causing too many snapshots. **What are the normal alarm settings?** This is a warning self-reset alarm with no snapshot and a 0.1-second delay off that is used for future troubleshooting. **What can the user do?** If this alarm is continually on, the alarm could be the result of a bad current sensor power supply.	SELF
IGBT 2 Temperature Problem	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT. The PureWave SMS-250 system monitors the temperature of each thermistor. If there is an overtemperature warning, an overtemperature occurred, a thermistor shorted, or there is a thermistor open alarm on IGBT2, this alarm comes on. **Why is it an alarm?** This alarm allows the user to see whether IGBT2 was the cause of the alarm. **What are the normal alarm settings?** This is a warning self-reset alarm with a snapshot. **What can the user do?** See the base alarm description for suggested actions.	SELF

TABLE CONTINUED ►

IGBT 3 Current Limit	**What is it?** This alarm indicates that the current in the indicated phase reached 1080 A peak, or 800 Aac. This can occur in the **Island** mode when the load is first picked up or when a new transient load is added. When we reach current limit, the IGBTs are turned off for the remainder of the 208-microsecond cycle then allowed to turn on again in the next 208-microsecond cycle. **Why is it an alarm?** This alarm is an indication that the inverter is working at its limit. The alarm has a time delay off to keep it from causing too many snapshots. **What are the normal alarm settings?** This is a warning self-reset alarm with no snapshot and a 0.1-second delay off that is used for future troubleshooting. **What can the user do?** If this alarm is continually on, the alarm could be the result of a bad current sensor power supply.	SELF
IGBT 3 Temperature Problem	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT. The PureWave SMS-250 system monitors the temperature of each thermistor. If there is an overtemperature warning, an overtemperature occurred, a thermistor shorted, or there is a thermistor open alarm on IGBT3, this alarm comes on. **Why is it an alarm?** This alarm allows the user to see whether IGBT3 was the cause of the alarm. **What are the normal alarm settings?** This is a warning self-reset alarm with a snapshot. **What can the user do?** See the base alarm description for suggested actions.	SELF
Inductor Temp Problem	**What is it?** The PureWave SMS-250 system monitors the temperature of the inductor winding. If there is an overtemperature warning, an over temperature occurred, a thermistor shorted, or there is a thermistor open alarm based on the inductor winding temperature, this alarm comes on. **Why is it an alarm?** This alarm allows the user to see whether the inductor winding temperature was the cause of the alarm. **What are the normal alarm settings?** This is a warning self-reset alarm with a snapshot. **What can the user do?** See the base alarm description for suggested actions.	SELF
Load Over Current	**What is it?** This alarm shows the current going to the island breaker is greater than the PureWave SMS-250 system can handle. **Why is it an alarm?** It is used to block the transition to **Island** mode whether the PureWave SMS-250 system cannot provide enough current to the island. **What are the normal alarm settings?** The threshold for this alarm is set at the current rating of the PureWave SMS-250 system. This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally but will not transition to **Island** mode in the event of a utility disturbance.	SELF

TABLE CONTINUED ►

Load Over Power	**What is it?** This alarm shows the power going to the island breaker is greater than the PureWave SMS-250 system can handle. **Why is it an alarm?** It is used to block the transition to **Island** mode if the PureWave SMS-250 system cannot provide power to the island. **What are the normal alarm settings?** The threshold for this alarm is set at the power rating of the PureWave SMS-250 system. This is an information self-reset alarm. **What can the user do?** The inverter will continue to operate normally but will not transition to **Island** mode in the event of a utility disturbance.	SELF
Over Temp Warning	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT. The PureWave SMS-250 system monitors the temperature of each thermistor. Additionally, the inductor has an RTD to monitor its temperature. Also, the cabinet has a thermistor to monitor the top of cabinet ambient temperature. Finally, the transformer has a relay to signal overtemperature and, in some cases, liquid level gauge, pressure vacuum gauge (-5PSIG and +7.5PSIG), and pressure relief device alarms. **Why is it an alarm?** If the IGBT, inductor, cabinet, or transformer gets too hot, damage to components could occur. Before damage occurs, this alarm stops inverter operation. **What are the normal alarm settings?** This is an inhibit auto reset alarm with a snapshot. **What can the user do?** One cause of this problem is restricted air flow. The user can look at the outside of the PureWave SMS-250 system to make sure there are no restrictions near the air intakes for the PureWave SMS-250 system. If there are no visible restrictions, the problem should be referred to a trained technician.	SELF
PS1 24-Vdc Under Voltage	**What is it?** There are two 24-Vdc power supplies that serve the PureWave SMS-250 system. One is connected to the ac utility line, where a three-phase bridge rectifier provides the highest of the three line-to-line voltages to the input of the 24-Vdc power supply. The other 24-Vdc power supply input comes from the battery input to the PureWave SMS-250 system. This input provides power to transition to the **Island** mode. This alarm means the power supply feeding off the dc bus is not working. **Why is it an alarm?** If either of the power supplies stops working and there is not a good reason, the system operator needs to know so the problem can be resolved. **What are the normal alarm settings?** This is a warning self-reset alarm that takes a snapshot. **What can the user do?** If there is both ac and dc voltage at the inverter terminals, the problem should be referred to a trained technician.	SELF
PS2 24-Vdc Under Voltage	**What is it?** There are two 24-Vdc power supplies that serve the PureWave SMS-250 system. One is connected to the ac utility line, where a three-phase bridge rectifier provides the highest of the three line-to-line voltages to the input of the 24-Vdc power supply. The other 24-Vdc power supply input comes from the battery input to the PureWave SMS-250 system. This input provides power to transition to the **Island** mode. This alarm means the power supply feeding off the utility is not working. **Why is it an alarm?** If either of the power supplies stops working and there is not a good reason, the system operator needs to know so the problem can be resolved. **What are the normal alarm settings?** This is a warning that is self-reset. A snapshot is taken for future troubleshooting. **What can the user do?** If there is both ac and dc voltage at the inverter terminals, the problem should be referred to a trained technician.	SELF

Reduced Storage Capacity	**What is it?** One or more batteries in the system is either unavailable or has a reduced capacity. **Why is it an alarm?** If the system is an islanding system, the runtime in **Island** mode may be reduced if batteries are unavailable/unusable. In a non-islanding system, the battery may not meet the needs of the load if batteries are unavailable/unusable. **What are the normal alarm settings?** This is a warning self-reset alarm. **What can the user do?** Contact RED to investigate further.	SELF
SCADA Watchdog Timeout	**What is it?** Often the PureWave SMS-250 system is controlled by a SCADA system. When this is the case, the system should follow the SCADA commands to perform the expected functions. **Why is it an alarm?** Loss of communication can result in the PureWave SMS-250 system continuing a function that is no longer desirable. An example would be smoothing, where the SCADA is providing a power signal from a wind turbine to smooth. The PureWave SMS-250 system charges and discharges the battery to smooth out the power from the wind. If SCADA communication is lost, the best action for the PureWave SMS-250 system is to stop operation. **What are the normal alarm settings?** This is an inhibit self-reset alarm. A snapshot is not taken because the state will change resulting in a snapshot of the event. **What can the user do?** The class of the alarm and the time delay are field settings and can be changed to be appropriate for the operating mode. These class changes are available in the field settings or from SCADA. If this alarm is occurring on a regular basis, there could be a problem with the physical connection. A trained technician can troubleshoot this problem.	SELF
SMS-250 Comm Loss	**What is it?** This alarm is only used with two PureWave SMS-250 inverters running as a PureWave SMS-250 system. When the alarm is on, it shows that a lead PureWave SMS-250 system is not communicating with an auxiliary PureWave SMS-250 system or an auxiliary PureWave SMS-250 system is not communicating with a lead PureWave SMS-250 system or master control. **Why is it an alarm?** is used to stop operation of an auxiliary PureWave SMS-250 system, or reduce the power and current available on a lead PureWave SMS-250 system. **What are the normal alarm settings?** The threshold for this alarm is set at a communication loss for 30 seconds. This is a warning self-reset alarm. **What can the user do?** This is the result of a bad Ethernet connection to the DSP Ethernet. Check the Ethernet cable on both ends. If needed, replace the cable. Cables between two PureWave SMS-250 systems are cross over Ethernet cables. Cables between a master control and a PureWave SMS-250 system is a normal Ethernet cable.	SELF

TABLE CONTINUED ►

Thermistor Open or Cold	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT. The PureWave SMS-250 system monitors the temperature of each IGBT and the cabinet thermistor. If a thermistor is open, it looks like a low temperature. The RTD looks like a high temperature if it is open. **Why is it an alarm?** If the IGBT or cabinet thermistor is open, we call it an open or broken thermistor. We call the thermistor broken or cold if the temperature is under -25°C (-13°F). This can happen in a very cold ambient temperature. The RTD is open if the temperature is above 200°C (392°F). **What are the normal alarm settings?** This is a warning self-reset alarm without a snapshot. **What can the user do?** If the ambient temperature is very low, this alarm can be a normal condition. If it is not cold, it is possible that the IGBT is damaged. If the inverter is running, the IGBTs are fine, but if this alarm occurs with an over current alarm refer the problem to a trained technician.	SELF
Transformer Problem	**What is it?** The PureWave SMS-250 system monitors the temperature of the transformer through two relays. If there is an overtemperature warning or an overtemperature, this alarm comes on. If the **Overtemperature** alarm is on, it could be an overtemperature is occurring or one of the following in an oil-filled transformer case: liquid level gauge, pressure vacuum gauge (-5PSIG and +7.5PSIG), and pressure relief device alarm. **Why is it an alarm?** This alarm allows the user to see if the transformer temperature was the cause of the alarm. **What are the normal alarm settings?** This is a warning self-reset alarm with a snapshot. **What can the user do?** See the base alarm description for suggested actions.	SELF
Thermistor Shorted	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT, as does the cabinet. The PureWave SMS-250 monitors the temperature of each thermistor. If a thermistor has shorted, it looks like a high temperature. When shorted, the inductor RTD looks like a low temperature. **Why is it an alarm?** If a thermistor or RTD has shorted, instead of calling the temperature an over-temperature, we call it a shorted thermistor. We call the thermistor shorted if the temperature is over 200°C (392°F), much higher than we ever expect from the IGBT baseplate or cabinet. The RTD is shorted if the temperature is below -25°C (-13°F). **What are the normal alarm settings?** This is a warning self-reset alarm without a snapshot. **What can the user do?** This is probably a wiring problem, either in the inverter or on the IGBT pole. The problem should be referred to a trained technician.	SELF
VsModeProblem	**What is it?** The island breaker is open, and we are not islanding. **Why is it an alarm?** This puts the system in an unexpected state. **What are the normal alarm settings?** This is a warning self-reset alarm. **What can the user do?** The inverter will continue to operate normally. Contact RED service and report the alarm.	SELF

Inhibit Alarms

These alarms indicate a problem that needs attention and will affect the proper operation of the system. The inverter will stop operating when an **Inhibit** condition is being displayed. The ac and dc circuit breakers will remain closed. See Table 7 for the listed **Inhibit** alarms.

Table 7. PureWave SMS-250 Inhibit Alarms

Alarm	Description	Reset Type

TABLE CONTINUED ►

Any App Brd Pwr Supply UV	**What is it?** The application board has several on board power supplies that are derived from the 24-V incoming power. If any of these supplies is below the required value, this alarm will indicate the problem. **Why is it an alarm?** These supplies are critical to the proper operation of the PureWave SMS-250 system inverter. **What are the normal alarm settings?** This is an inhibit alarm with an auto reset. It will reset itself a couple of times, then lock out if the event continues. **What can the user do?** This is a problem with the application board. The control box will need to be replaced by a qualified technician.	AUTO
Check Dc and Ac Feedback Fuses	**What is it?** This alarm shows that, with the dc circuit breaker indicating it is closed, the dc battery and dc link voltages are different. Or it indicates that,with the ac breaker indicating closed, there is voltage across the ac circuit breaker. A typical setting is a voltage difference of 20 V when the difference should be 0 V. **Why is it an alarm?** The alarm shows that the voltage is not the expected voltage. **What are the normal alarm settings?** This is an inhibit self-reset alarm. **What can the user do?** Look at the data on the status-analog page to see whether the difference is on the ac or dc side. The ac side looks at the voltage across the ac circuit breaker. Check fuses F4, F5, and F6 if there is voltage across the ac circuit breaker and it is closed. If it is on the dc side, the dc link voltage will not match the storage voltage. If this is the case, check F1 and F2. If the fuses are all good, then the conductivity of the ac or dc circuit breaker could be the problem. If this is the case, contact RED service with the results of the troubleshooting.	SELF
Check Island Feedback Fuses	**What is it?** This alarm shows that, with the island circuit breaker indicating it is closed, the ac-input voltage and island-input voltages are different. A typical setting is a voltage difference of 20 V when the difference should be 0 V. **Why is it an alarm?** The alarm shows that the voltage is not the expected voltage. **What are the normal alarm settings?** This is a warning self-reset alarm. **What can the user do?** Look at the data to see whether the low voltage is on the island or PureWave SMS-250 system side. If it is on the island side, one at a time check the island-feedback fuses (they are external to the PureWave SMS-250 system). If the low voltage is on the PureWave SMS-250 system side, the conductivity of the island circuit breaker could be the problem. If this is the case, contact RED service with the results of the troubleshooting.	SELF
Dc Link Over Voltage	**What is it?** This alarm indicates that the dc link is 5 volts higher than the battery maximum voltage. The battery maximum voltage threshold is configurable and can be as high as 850 Vdc. The threshold can be seen on the web-based browser screen as one of the parameters by users who have the right to view this screen. **Why is it an alarm?** A battery voltage that is higher than the maximum allowed battery voltage can damage the battery. **What are the normal alarm settings?** This is an inhibit alarm with an auto reset. A snapshot is taken for future troubleshooting at the RED factory. **What can the user do?** If the auto reset has locked out, the user can reset the alarm.	AUTO

TABLE CONTINUED ►

Dc Link Under Voltage	**<u>What is it?</u>** This alarm indicates the dc link is at less than 90% of the line-to-line peak voltage. **<u>Why is it an alarm?</u>** A dc link voltage that is lower than the minimum 90% of the peak voltage causes major current distortion. **<u>What are the normal alarm settings?</u>** This is an inhibit alarm with a self-reset. A snapshot is taken for future troubleshooting at the RED factory. **<u>What can the user do?</u>** The alarm will reset itself when the voltage is returned into its normal range.	AUTO
Downstream Fault Detected	**<u>What is it?</u>** This alarm shows there is fault current flowing in the utility connection. **<u>Why is it an alarm?</u>** If there is a downstream fault, the PureWave SMS-250 system should not move to the **Island** mode because the utility is better at restoring the voltage than the PureWave SMS-250 system. In addition, the utility can supply more fault current to cause downstream protection to open clearing the fault. **<u>What are the normal alarm settings?</u>** Current through the island circuit breaker that is over 2 PU (800 A for a single PureWave SMS-250 system). This is an inhibit self-reset alarm. **<u>What can the user do?</u>** The inverter will inhibit for 1 second after the fault clears. If the alarm is continuously active, the PureWave SMS-250 system is seeing currents over 2 PU (800 A for a single PureWave SMS-250 unit). If this is not expected, contact RED service and report the alarm.	SELF
Dsp Fpga Heartbeat Lost	**<u>What is it?</u>** This alarm indicates that the FPGA and the DSP processors are not properly communicating. **<u>Why is it an alarm?</u>** This FPGA is responsible for the modulation and current limiting of the inverter. If it is not properly communicating with the DSP, the inverter may not be able to properly control the current. **<u>What are the normal alarm settings?</u>** This is an inhibit manual reset alarm. **<u>What can the user do?</u>** The user can send a reset. If the alarm clears, the communication has been restored. If the alarm persists after a reset has been sent, contact RED service and report the alarm.	MANUAL
Fpga Hardware Alarm	**<u>What is it?</u>** This alarm indicates the FPGA has detected a voltage or current that exceeds the system limit. This can indicate the LEM currents were too high (also indicated by an IGBT Over Current alarm), the Dc Link voltage was too high (also indicated by a DC Link Over-Voltage alarm), the precharge voltage was too high (also indicated by a DC Pre-Charge Voltage High alarm), the sensitive earth fault voltage was too high (also indicated by a Sensitive Earth Fault alarm), or the filter-capacitor voltages were too high (only indicated by this alarm). **<u>Why is it an alarm?</u>** When a hardware threshold is reached, the IGBTs will shut down to protect the system. **<u>What are the normal alarm settings?</u>** This is an inhibit manual reset alarm. **<u>What can the user do?</u>** Note the other alarms that are present (Dc Link Over Voltage, IGBT Over Current, Dc Pre-Charge Voltage High, Sensitive Earth Fault). Contact RED service and report the alarms.	SELF

TABLE CONTINUED ►

Gate Drive 1 Under Voltage	**What is it?** Each of the IGBTs has a gate drive. The gate drive requires power connected to the IGBT emitter. This connection moves with respect to ground requiring an isolated gate drive power supply. Each of these power supplies is monitored for undervoltage, typically at 13.5 V on the 15-V gate power supply. **Why is it an alarm?** If an IGBT is driven with a low voltage, the IGBT will switch slower. If the voltage gets low enough, the voltage across the IGBT goes up rapidly, resulting in high power loss resulting in a high-temperature IGBT. The power-supply voltage is an early indication of a problem. **What are the normal alarm settings?** This alarm is an auto reset inhibit alarm with a snapshot. **What can the user do?** A reset may clear the problem. If not contact RED.	AUTO
Gate Drive 2 Under Voltage	**What is it?** Each of the IGBTs has a gate drive. The gate drive requires power connected to the IGBT emitter. This connection moves with respect to ground requiring an isolated gate drive power supply. Each of these power supplies is monitored for undervoltage, typically at 13.5 V on the 15-V gate power supply. **Why is it an alarm?** If an IGBT is driven with a low voltage, the IGBT will switch slower. If the voltage gets low enough, the voltage across the IGBT goes up rapidly resulting in high power loss resulting in a high-temperature IGBT. The power-supply voltage is an early indication of a problem. **What are the normal alarm settings?** This alarm is an auto reset inhibit alarm with a snapshot. **What can the user do?** A reset may clear the problem. If not contact RED.	AUTO
Gate Drive 3 Under Voltage	**What is it?** Each of the IGBTs has a gate drive. The gate drive requires power connected to the IGBT emitter. This connection moves with respect to ground requiring an isolated gate drive power supply. Each of these power supplies is monitored for under voltage, typically at 13.5 V on the 15-V gate power supply. **Why is it an alarm?** If an IGBT is driven with a low voltage, the IGBT will switch slower. If the voltage gets low enough, the voltage across the IGBT goes up rapidly, resulting in high power loss resulting in a high-temperature IGBT. The power-supply voltage is an early indication of a problem. **What are the normal alarm settings?** This alarm is an auto reset inhibit alarm with a snapshot. **What can the user do?** A reset may clear the problem. If not contact RED.	AUTO
Lost Synchronize	**What is it?** The PureWave SMS-250 inverter synchronizes to the voltage input at its terminals using a Phase Lock Loop (PLL). The PLL should always be locked to the input voltage. However, it is possible that the PLL could lose its lock. **Why is it an alarm?** The current from the inverter is locked to the inverter angle from the inverter PLL. If the angle is not correct, the power and vars from the inverter will not be correct. **What are the normal alarm settings?** The inverter must be within 10 degrees of the three-phase input voltage. This is an inhibit alarm that is self-resetting and defined as a utility disturbance. A snapshot is taken for future troubleshooting at the RED factory. **What can the user do?** If the user sees this alarm when the utility voltage frequency and phase rotation are good, they should contact the factory for support. If the voltage or frequency or phase rotation is bad, the inverter may not be able to lock to the utility until the voltage and frequency are both within tolerance.	SELF

TABLE CONTINUED ►

Over Frequency	**<u>What is it?</u>** This alarm looks at the line frequency at the inverter ac connection. If this frequency is above the **Over-frequency** threshold, it sets the alarm. **<u>Why is it an alarm?</u>** This alarm is used to comply with IEEE 1547 to inhibit operation in the event of an **Over-frequency** condition. **<u>What are the normal alarm settings?</u>** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **<u>What can the user do?</u>** The inverter will respond based on the over-frequency settings. To change the sensitivity, time delay on can be changed or the frequency threshold as a percent of the base frequency can be changed.	SELF
Over Voltage	**<u>What is it?</u>** This alarm looks at the RMS line-to-line voltage of each of the three phases at the inverter ac connection and, if any are above the **Overvoltage** threshold, it sets the alarm. **<u>Why is it an alarm?</u>** This alarm is used to comply with IEEE 1547 inhibiting operation in the event of an **Overvoltage** condition. **<u>What are the normal alarm settings?</u>** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **<u>What can the user do?</u>** The inverter will respond based on the voltage settings. To change the sensitivity, time delay on can be changed or the voltage threshold as a percent of nominal voltage can be changed.	SELF
Parameter Cal Change Activate	**<u>What is it?</u>** The SMS has what we call parameters. These are variables that help to calibrate and define the operation of the system. An example of calibration is that we calibrate the dc battery voltage. The actual voltage might be 702.5 Vdc. Without calibration, the SMS might read 697.8 Vdc. In the factory, we calibrate the voltage so it is within 0.1% of a high-accuracy calibrated meter. **<u>Why is it an alarm?</u>** This alarm comes on when we change a parameter, and it goes back off after a 0.1-second delay. We use this alarm to stop inverter operation and allow the new parameter(s) to change with the inverter not switching. **<u>What are the normal alarm settings?</u>** This is an inhibit alarm that is self-clearing after 0.1 seconds. A snapshot is taken to show that the inverter inhibited because the parameters had changed. **<u>What can the user do?</u>** This alarm goes off by itself. The user cannot do anything to clear the alarm, but the alarm should never be on for more than the refresh time of the user interface.	SELF

TABLE CONTINUED ►

PS3 LEM Power Supply UV	**What is it?** The PureWave SMS-250 current sensors are Hall Effect current sensors that can sense both ac and dc current. They are actively powered using a dual 15-V power supply. The +15 V and -15 V are both monitored by the controls to make sure that the current sensors have good voltage. **Why is it an alarm?** Current feedback is essential to the PureWave SMS-250 inverter. If we lose a power supply, the current feedback will not follow the primary current. This will cause misoperation of the inverter. **What are the normal alarm settings?** This is an auto reset inhibit alarm that takes a snapshot. The threshold for under voltage is 13.5 V on each of the 15-V supplies. **What can the user do?** The auto reset lockout can be reset, but if the problem persists the inverter will need to be looked at by qualified personnel.	AUTO
Reverse Phase Rotation	**What is it?** This alarm indicates that the PureWave SMS-250 inverter is connected to a voltage that is rotating L1 - L3 - L2 instead of L1 - L2 - L3 with the voltage positive zero crossing occurring on L1 then L2 and finally L3 as expected. **Why is it an alarm?** The inverter controls expect a phase rotation of L1 - L2 - L3 and are configured for this phase rotation. **What are the normal alarm settings?** This is a Trip Offline self-reset alarm. **What can the user do?** If this alarm is on and stays on, the phase rotation should be corrected by swapping the utility connection wires, for instance between L2 and L3.	SELF
Time Current Curve Overload	**What is it?** This is an islanding alarm that indicates we are over 400 A for too long. Too long is defined by an equation that calculates the junction temperature in a maximum ambient temperature when running at 100% current. This method gives us the same response to an overload regardless of the conditions so the user can coordinate protection with other deviSMS-250. **Why is it an alarm?** If the current is too high for too long, the IGBTs could be damaged. **What are the normal alarm settings?** This is a manual reset inhibit alarm that takes a snapshot. **What can the user do?** If this occurs, it is because of a high load or a fault in the load when islanding. To reduce the occurrence of this alarm when the cause is an overload, the Island load should be reduced.	MANUAL
Under Frequency	**What is it?** This alarm looks at the line frequency at the inverter ac connection. If this frequency is below the **Under-frequency** threshold, it sets the alarm. **Why is it an alarm?** This alarm is used to comply with IEEE 1547 to inhibit operation in the event of an **Under-frequency** condition. **What are the normal alarm settings?** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **What can the user do?** The inverter will respond based on the under-frequency settings. To change the sensitivity, time delay on can be changed or the frequency threshold as a percent of the base frequency can be changed.	SELF

TABLE CONTINUED ►

UDM Over Voltage	**What is it?** UDM is an acronym for utility-disturbance monitor. When the utility, as measured on the utility side of the islanding switch, has a disturbance and an island is needed to continue to supply the load, a fast detection of the island is needed. This alarm looks at the RMS line-to-line voltage of each of the three phases at the inverter ac connection and, if any are above the **Overvoltage** threshold, it sets the alarm. This generally takes time as we are looking at the RMS voltage; this voltage is filtered in its calculation. **Why is it an alarm?** This gives us a fast detection of a utility problem so we can island, while the overvoltages and undervoltages in the slow alarms are used to prevent islanding unintentionally. **What are the normal alarm settings?** This is an information self-reset alarm that is also a utility disturbance. **What can the user do?** The inverter will respond based on the voltage settings. To make the system less sensitive, time delay on can be added or the voltage can be increased.	SELF
UDM Under Voltage	**What is it?** UDM is an acronym for utility-disturbance monitor. When the utility, as measured on the utility side of the islanding switch, has a disturbance and an island is needed to continue to supply the load, a fast detection of the island is needed. This alarm looks at the RMS line-to-line voltage of each of the three phases at the inverter ac connection and, if any are below the **Undervoltage** threshold, it sets the alarm. This generally takes time as we are looking at the RMS voltage; this voltage is filtered in its calculation. **Why is it an alarm?** This gives us a fast robust detection of a utility problem so we can island, while the overvoltage and undervoltages in the slow alarms are used to prevent us from islanding unintentionally. **What are the normal alarm settings?** This is an information self-reset alarm that is also a utility disturbance. **What can the user do?** The inverter will respond based on the voltage settings. To make the system less sensitive, the voltage level or time delay on can be added or the voltage can be reduced.	SELF
Under Voltage	**What is it?** This alarm looks at the RMS line-to-line voltage of each of the three phases at the inverter ac connection and, if any are below the **Undervoltage** threshold, it sets the alarm. **Why is it an alarm?** This alarm is used to comply with IEEE 1547 to inhibit operation in the event of an **Undervoltage** condition. **What are the normal alarm settings?** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **What can the user do?** The inverter will respond based on the voltage settings. To change the sensitivity, time delay on can be changed or the voltage threshold as a percent of nominal voltage can be changed.	SELF
Very Over Frequency	**What is it?** This alarm looks at the line frequency at the inverter ac connection. If this frequency is above the **Very Over Frequency** threshold, it sets the alarm. **Why is it an alarm?** This alarm is in addition to IEEE 1547 and inhibits operation in the event of a **Very Over Frequency** condition. **What are the normal alarm settings?** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **What can the user do?** The inverter will respond based on the very over frequency settings. To change the sensitivity, time delay on can be changed or the frequency threshold as a percent of the base frequency can be changed.	SELF

Very Over Voltage	**What is it?** This alarm looks at the RMS line-to-line voltage of each of the three phases at the inverter ac connection and, if any are above the **Very Over Voltage** threshold, it sets the alarm. **Why is it an alarm?** This alarm gives us a faster response than the **Overvoltage** alarm. It is used to comply with IEEE 1547. **What are the normal alarm settings?** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **What can the user do?** The inverter will respond based on the voltage settings. To change the sensitivity, time delay on can be changed or the voltage threshold as a percent of nominal voltage can be changed.	SELF
Very Under Frequency	**What is it?** This alarm looks at the line frequency at the inverter ac connection. If this frequency is below the **Very Under Frequency** threshold, it sets the alarm. **Why is it an alarm?** This alarm is used to comply with IEEE 1547 to inhibit operation in the event of a **Very Under Frequency** condition. **What are the normal alarm settings?** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **What can the user do?** The inverter will respond based on the **Very Under Frequency** settings. To change the sensitivity, time delay on can be changed or the frequency threshold as a percent of the base frequency can be changed.	SELF
Very Under Voltage	**What is it?** This alarm looks at the RMS line-to-line voltage of each of the three phases at the inverter ac connection and, if any are below the **Very Under Voltage** threshold, it sets the alarm. **Why is it an alarm?** This alarm is used to comply with IEEE 1547 to inhibit operation in the event of a **Very Under Voltage** condition. **What are the normal alarm settings?** This is an inhibit self-reset alarm that is also a utility disturbance and takes a snapshot. **What can the user do?** The inverter will respond based on the voltage settings. To change the sensitivity, time delay on can be changed or the voltage threshold as a percent of nominal voltage can be changed.	SELF
Over Temperature	**What is it?** Each IGBT package has a thermistor on the baseplate of the IGBT. The SMS-250 monitors the temperature of each thermistor. Additionally, the Inductor has a RTD to monitor its temperature. Also, the cabinet has a thermistor to monitor the top of cabinet ambient temperature. Finally, the transformer has a relay to signal over temperature and in some cases liquid level gauge, pressure vacuum gauge (-5PSIG and +7.5PSIG), and pressure relief device alarms. **Why is it an alarm?** If the IGBT, inductor, cabinet, or transformer gets too hot, damage to components could occur. Before damage occurs, this alarm stops inverter operation. **What are the normal alarm settings?** This is an inhibit auto reset alarm with a snapshot. **What can the user do?** One cause of this problem is restricted air flow. The user can look at the outside of the SMS-250 and make sure that there are no restrictions near the air intakes for the SMS-250. If there are no visible restrictions, the problem should be referred to a trained technician.	SELF

Battery Isolate Alarms

These alarms indicate a problem that needs attention and will affect the proper operation of the system. The system will operate on a limited basis when a **Battery isolate** condition is being displayed. The dc circuit breaker will open. See Table 8 for the listed **Battery Isolate** alarms.

Table 8. PureWave SMS-250 Battery Isolate Alarms

Alarm	Description	Reset Type

TABLE CONTINUED ►

Table 8. PureWave SMS-250 Battery Isolate Alarms—continued

Battery Cell Over Temperature	**What is it?** A battery cell is reporting that it has gotten too hot. **Why is it an alarm?** A battery cell has overheated, so continued operation of the pack could be dangerous. **What are the normal alarm settings?** This is a battery isolate (DC breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. The cell may cool down over time. If the cell does not cool down and the alarm remains, contact RED to investigate further.	SELF
Battery Cell Under Temperature	**What is it?** A battery cell is reporting that it has gotten too cold. **Why is it an alarm?** A battery cell has cooled down below the operational range, so continued operation of the pack could be detrimental to battery health. **What are the normal alarm settings?** This is a battery isolate (dc breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. The cell may heat up over time. If the cell does not heat up and the alarm remains, contact RED to investigate further.	SELF
Battery Cell Over Voltage	**What is it?** A battery cell is reporting that it has overcharged. **Why is it an alarm?** A battery cell has over charged so continued operation of the pack could be dangerous. **What are the normal alarm settings?** This is a battery isolate (dc breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. The cell may equalize its charge over time. If the cell does not equalize and the alarm remains, contact RED to investigate further.	SELF
Battery Cell Under Voltage	**What is it?** A battery cell is reporting that it has discharged to a very low level. **Why is it an alarm?** A battery cell has discharged beyond normal operating range so continued operation of the pack could be dangerous. **What are the normal alarm settings?** This is a battery isolate (dc breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. The cell may equalize its charge over time. If the cell does not equalize and the alarm remains, contact RED to investigate further.	SELF

Battery Requests Shutdown	**What is it?** The battery is reporting that it would like to shut down. **Why is it an alarm?** The battery is reporting the desire to power down, so continued operation of the pack could be dangerous. **What are the normal alarm settings?** This is a battery isolate (dc breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. If the alarm remains, contact RED to investigate further.	SELF
Battery String Over Current	**What is it?** The battery string has had too much current flow. **Why is it an alarm?** A battery string is reporting that the inverter produced more than the expected current flow. **What are the normal alarm settings?** This is a battery isolate (dc breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. The dc breaker opening should prevent the flow of current. If it does not contact RED to investigate further.	SELF
BMS Watchdog Timeout	**What is it?** Many advanced battery systems have a battery-management system to help protect the battery from running in a way that will damage the battery. This system monitors temperature, current, and voltage on individual cells or on blocks of cells to make sure the conditions for safe operation with long battery life are maintained. **Why is it an alarm?** It is important to make sure the communication link with the Battery Management System (BMS) is working so the battery is properly managed. The watch dog is a timer that makes sure that good communication has occurred within the watchdog time. If not, the PureWave SMS-250 system stops charging and discharging the battery. **What are the normal alarm settings?** This is an inhibit self-reset alarm. A snapshot is not taken because the state will change resulting in a snapshot of the event. **What can the user do?** The class of the alarm and the time delay are field settings and can be changed to be appropriate for the battery. If this alarm is occurring on a regular basis, there could be a problem with the physical connection. A trained technician can troubleshoot this problem.	SELF
Internal Battery Communications Failure	**What is it?** The BMS is reporting that it is having issues communicating internally. **Why is it an alarm?** The battery is reporting potentially incorrect data so continued operation of the pack could be dangerous. **What are the normal alarm settings?** This is a battery isolate (dc breaker will open) self-reset alarm. **What can the user do?** The inverter will not be able to produce real power while this alarm is present. The pack may correct its communication issue over time. If the alarm remains, contact RED to investigate further.	SELF

TABLE CONTINUED ►

Trip Offline Alarms

These alarms indicate a problem that needs attention and will affect the proper operation of the system. The system will not operate when a **Trip Offline** condition is being displayed. The ac and dc circuit breakers will also open. See Table 9 for the listed **Trip Offline** alarms.

Table 9. PureWave SMS-250 Trip Offline Alarms

Alarm	Description	Reset Type
Ac Breaker Fail to Close	**What is it?** This alarm indicates the circuit breaker is open when it is being commanded closed. **Why is it an alarm?** The circuit breakers should follow their commands. **What are the normal alarm settings?** This is a manual reset trip offline alarm that takes a snapshot. There is a 15-second delay to allow the circuit breaker to close after the command is given. **What can the user do?** Verify that there is not a circuit breaker. **Overcurrent** alarm. If there is, reset this alarm. Verify that the inverter stop is not active by pulling it out. Check the spring status. If the circuit breaker has a Discharged Spring message, the motor operator is not charged. The breaker can still be closed by charging the spring by manually pulling down on the charging handle several times. Reset the system and see if the circuit breaker closes.	MANUAL
Ac Breaker Fail to Open	**What is it?** This alarm indicates the circuit breaker is closed when it is being commanded open. **Why is it an alarm?** The circuit breakers should follow their commands, especially the open commands. **What are the normal alarm settings?** This is a manual reset trip offline alarm that takes a snapshot. There is a 1-second delay to allow the circuit breaker to open after the command is given. **What can the user do?** If the circuit breaker is closed, try pressing the inverter stop. This should open the circuit breaker. If this causes the circuit breaker to open, the output block on the inverter controls has been damaged, replace the output block or the inverter controls.	MANUAL
Auto Reset Lockout	**What is it?** An auto reset causes several resets to occur to try and clear an auto reset alarm. After the resets are complete, the system will go to the **Trip Offline** state. **Why is it an alarm?** This is the alarm that takes the system to the **Trip Offline** state and informs the user of the reason for being in the **Trip Offline** state. **What are the normal alarm settings?** This is a **Trip Offline** manual reset alarm without a snapshot. A state change should accompany the change from an inhibit to a **Trip Offline** alarm. **What can the user do?** The user can issue a reset to clear this alarm. The system should then be watched to see if the original alarm comes back. If it does come back, troubleshoot the alarm that is causing this alarm, not this alarm.	MANUAL
BMS Requested Trip Offline	**What is it?** This alarm shows that the BMS has opened a contact to stop the inverter from charging or discharging the battery. **Why is it an alarm?** If the Battery sends a **Trip Offline Command**, the inverter will trip offline. This shows the reason for the trip offline. **What are the normal alarm settings?** This is a **Trip Offline** self-reset alarm. **What can the user do?** This alarm comes from the battery system. Check F8; this is used to protect the 24-Vdc used to power the external dry contact. If F8 is OK, refer to the battery owner's manual to troubleshoot the alarm.	SELF
Current Sensor or Ground Fault	**What is it?** The output of our PureWave SMS-250 inverter is a three-phase delta. In a three-phase delta output, the three phase currents must add to zero. This alarm looks at the sum of the three phase currents. If it gets too high or low, this alarm is activated. This could be caused by a ground fault that results in current flowing in the ground as well as the three phases. **Why is it an alarm?** Current feedback is essential to the PureWave SMS-250 inverter. If we lose a current sensor, the current feedback will not follow the primary current. This will cause misoperation of the controls. If there is a ground fault, we would like to stop operation. **What are the normal alarm settings?** This is a manual reset **Trip Offline** alarm that takes a snapshot. The threshold for tripping the inverter is 20 A. **What can the user do?** If the cause of the alarm is a ground fault, the system should not be re-started without first looking for ground faults. This will take a qualified technician.	MANUAL

TABLE CONTINUED ▶

Dc Breaker Fail to Close	**<u>What is it?</u>** This alarm indicates that the circuit breaker is open when it is being commanded closed. **<u>Why is it an alarm?</u>** The circuit breakers should follow their commands. **<u>What are the normal alarm settings?</u>** This is a manual reset **Trip Offline** alarm that takes a snapshot. There is a 15-second delay to allow the circuit breaker to close after the command is given. **<u>What can the user do?</u>** Verify that there is not a circuit breaker **Overcurrent** alarm. If there is, reset this alarm. Verify that the inverter stop is not active by pulling it out. Check the spring status. If the circuit breaker has a Discharged Spring message, the motor operator is not charged. The breaker can still be closed by charging the spring by manually pulling down on the charging handle several times. Reset the system and see if the circuit breaker closes.	MANUAL
Dc Breaker Fail to Open	**<u>What is it?</u>** This alarm indicates that the circuit breaker is closed when it is being commanded open. **<u>Why is it an alarm?</u>** The circuit breakers should follow their commands, especially the open commands. **<u>What are the normal alarm settings?</u>** This is a manual reset **Trip Offline** alarm that takes a snapshot. There is a 1-second delay to allow the circuit breaker to open after the command is given. **<u>What can the user do?</u>** If the circuit breaker is closed, try pressing the inverter stop. This should open the circuit breaker. If this causes the circuit breaker to open, the output block on the inverter controls has been damaged. Replace the output block or the inverter controls.	MANUAL
Dc Link Pre Charge Slow	**<u>What is it?</u>** We wait 3-time constants to get to 90% of the ideal voltage on the dc link when charging from the ac or dc side. **<u>Why is it an alarm?</u>** If we cannot reach the expected voltage, something is wrong with the pre-charge circuit. **<u>What are the normal alarm settings?</u>** This is an auto reset warning alarm. **<u>What can the user do?</u>** The system can be reset, but there is a 2-minute delay to allow the pre-charge resistors to cool. One cause of this is a bad precharge resistor, or there is a high-impedance fault across the dc link. If this alarm cannot be overcome, additional troubleshooting by a trained technician is required.	AUTO
Dc Link Shorted	**<u>What is it?</u>** This alarm indicates that the dc link voltage is coming up very slowly. **<u>Why is it an alarm?</u>** The dc link precharge resistors can overheat and get damaged if they dissipate too much power for too long. **<u>What are the normal alarm settings?</u>** This is a manual reset **Trip Offline** alarm that takes a snapshot. **<u>What can the user do?</u>** This may be caused by the PRECHARGE KEY switch in the **Off** position. If so, turn the PRECHARGE KEY switch on and reset the system. It will take 2 minutes to clear the alarm before precharge is attempted again. If the key switch is on and this alarm is on, additional troubleshooting by a trained technician is required.	MANUAL
Dc Capacitor Voltage High	**<u>What is it?</u>** This alarm shows that the dc voltage is getting close to the rated voltage of the capacitor. **<u>Why is it an alarm?</u>** The alarm shows the voltage on a capacitor is higher than expected. **<u>What are the normal alarm settings?</u>** This is a **Trip Offline** manual-reset alarm that takes a snapshot. **<u>What can the user do?</u>** A reset can be used to see if the alarm was caused by a temporary condition. If the alarm continues to BE set, the inverter needs service. Contact RED service and report the alarm.	MANUAL
Cabinet Door Open	**<u>What is it?</u>** This alarm indicates the PureWave SMS-250 door is open. **<u>Why is it an alarm?</u>** This will inform the user the door is open and the system cannot run because of this. **<u>What are the normal alarm settings?</u>** This is **Trip Offline** self-reset alarm. **<u>What can the user do?</u>** Close the door. If it is desirable for other reasons to run the system with the door open, the standard door switch can be defeated by pulling out the plunger. The plunger is reset when the door is closed.	SELF

TABLE CONTINUED ►

Execution Frame Overrun	**<u>What is it?</u>** The software for the PureWave SMS-250 system runs in a loop that executes every 208 microseconds. If we enter a second loop while the first loop is still running, this alarm will turn on. **<u>Why is it an alarm?</u>** If we re-enter the execution loop the calculations for turning on and off, the IGBTs can have a problem resulting in unexpected current. Before that happens, the inverter is turned off. **<u>What are the normal alarm settings?</u>** This is a **Trip Offline** alarm with a manual reset that takes a snapshot of the conditions when the alarm occurs. **<u>What can the user do?</u>** All the user can do is to reset the alarm. RED would like to know if the alarm turns on, so if the alarm is reset by a user, please let RED know that the alarm was on and has been reset.	MANUAL
IGBT 1 Over Current	**<u>What is it?</u>** This alarm indicates the current in the indicated phase went beyond 1190-A peak, the peak of a current limited 880-Aac waveform. This should not occur because the current limit for the phase should turn off the IGBTs in the phase leg reducing the current. **<u>Why is it an alarm?</u>** This is an alarm that is in place to protect the IGBT from excessive current. **<u>What are the normal alarm settings?</u>** This is a **Trip Offline** manual reset alarm with a snapshot for future troubleshooting. **<u>What can the user do?</u>** It is possible that a utility transient caused the alarm. Check the broken thermistor alarm and the IGBT1, IGBT2 and IGBT3 **Temperature Problem** alarms. If the broken thermistor is clear or if it is set and the IGBT1-3 temperature alarms are clear, the system can be reset. If the broken thermistor alarms are present, do not reset the alarm and call RED for service.	MANUAL
IGBT 2 Over Current	**<u>What is it?</u>** This alarm indicates the current in the indicated phase went beyond 1190-A peak, the peak of a current limited 880-Aac waveform. This should not occur because the current limit for the phase should turn off the IGBTs in the phase leg reducing the current. **<u>Why is it an alarm?</u>** This is an alarm that is in place to protect the IGBT from excessive current. **<u>What are the normal alarm settings?</u>** This is a **Trip Offline** manual reset alarm with a snapshot for future troubleshooting. **<u>What can the user do?</u>** It is possible that a utility transient caused the alarm. Check the broken thermistor alarm and the IGBT1, IGBT2 and IGBT3 **Temperature Problem** alarms. If the broken thermistor is clear or if it is set and the IGBT1-3 temperature alarms are clear, the system can be reset. If the broken thermistor alarms are present, do not reset the alarm and call RED for service.	MANUAL
IGBT 3 Over Current	**<u>What is it?</u>** This alarm indicates the current in the indicated phase went beyond 1190-A peak, the peak of a current limited 880-Aac waveform. This should not occur because the current limit for the phase should turn off the IGBTs in the phase leg reducing the current. **<u>Why is it an alarm?</u>** This is an alarm that is in place to protect the IGBT from excessive current. **<u>What are the normal alarm settings?</u>** This is a **Trip Offline** manual reset alarm with a snapshot for future troubleshooting. **<u>What can the user do?</u>** It is possible that a utility transient caused the alarm. Check the broken thermistor alarm and the IGBT1, IGBT2 and IGBT3 **Temperature Problem** alarms. If the broken thermistor is clear or if it is set and the IGBT1-3 temperature alarms are clear, the system can be reset. If the broken thermistor alarms are present, do not reset the alarm and call RED for service.	MANUAL
Inverter Stop	**<u>What is it?</u>** There is a red mushroom pushbutton on the inverter. When this is depressed, it will cause the inverter to stop operating and will open the ac and dc circuit breakers. The opening of the ac and dc circuit breakers is a combination of hardware and software, either of which will cause the breakers to open. **<u>Why is it an alarm?</u>** This **Trip Offline** alarm causes the inverter to stop operation and move to a state where the battery and utility are disconnected. This is the function of the STOP button. **<u>What are the normal alarm settings?</u>** This is a **Trip Offline** alarm that is reset when the mushroom switch is twisted clockwise to release the inverter stop. **<u>What can the user do?</u>** This alarm should clear when the mushroom switch is twisted clockwise. A snapshot will be taken when this alarm is asserted.	SELF

TABLE CONTINUED ►

Parameter Cal Nv Error	**What is it?** This alarm indicates that, when the main processor read the nonvolatile memory where the parameters and calibration values are stored, it found some corrupt data. This is done by checking the memory using a cyclical redundancy check or CRC. **Why is it an alarm?** Corrupt memory in the inverter settings or calibration can cause a malfunction in the inverter. **What are the normal alarm settings?** Nonvolatile memory is checked when the system is powered up or when the nonvolatile memory is changed. A single bit error will cause the alarm. This is set to a **Trip Offline** alarm with a manual reset and no snapshot. **What can the user do?** This is a problem that the user cannot fix with a reset. It is possible, but very unlikely, that a power cycle will clear the error. The system will need to be reprogrammed or replaced--probably replaced if the cause is a hardware problem.	MANUAL
SCADA or HMI Trip Offline	**What is it?** The SCADA system and/or the local HMI can do a **Trip Offline** command to take the PureWave SMS-250 system offline. **Why is it an alarm?** If the SCADA system or the local HMI commands the system offline, it is good to understand why the system is not running. This alarm provides that information. **What are the normal alarm settings?** This is a **Trip Offline** manual reset alarm that takes a snapshot. **What can the user do?** To clear this alarm, the SCADA must send a 0 to the SCADA **Trip Offline** bit register or the local HMI must toggle off the HMI **Trip Offline** bit register.	MANUAL
Sensitive Earth Fault	**What is it?** Sensitive Earth Fault is an alarm that indicates the three-phase input current does not sum to zero. **Why is it an alarm?** When operating properly, the PureWave SMS-250 three-phase currents sum to zero. **What are the normal alarm settings?** This is a **Trip Offline** manual-reset alarm. **What can the user do?** The alarm can be reset to bring the inverter back to an operating mode. However if the fault continues to occur, the ground fault should be discovered and eliminated.	MANUAL

Specifications

NOTICE

The PureWave SMS-250 system is capable of servicing the distributed power generation needs of its users when operated within its design limitations and specifications. Nonproprietary operation specifications for the PureWave SMS-250 system beyond those identified in this instruction sheet may be obtained from RED Electric Company.

Table 10. System Specifications

Description	Value or Range
Real/Reactive Power	263 kW/263 kVA
Secondary Voltage	380 Vac directly 400, 415, or 480 Vac using an auto transformer
Frequency	50 or 60 Hz
Dimensions (single enclosure)	36 W × 36 L × 80 H inches (914 × 914 × 2032 mm)
Weight	2,000 lbs (907.2 kg)

Table 11. Environmental Specifications

Description	Value or Range
Ambient Operating Temperature	-40°F to 104°F (-40°C to 40°C) without de-rating
Storage Ambient Temperature	-49°F to 140°F (-45°C to 60°C)
Humidity	0% to 100% condensing
Altitude	Sea level to 1,000 meters without de-rating
Seismic	Uniform Building Code Zone 4
Audible Noise	< 55 dBA at 3 meters when inverter is not running; < 65 dBA at 3 meters when inverter is running

Annual Inspections

After the PureWave SMS-250 system is commissioned and the unit is online, inspection and maintenance should be scheduled for the PCS on an annual basis to ensure the proper operation of the system. Schedules for maintenance should be reviewed by the customer based upon the given site conditions and, if required, the frequency of the recommended maintenance should increase to ensure the reliability of their PureWave SMS-250 system.

Maintenance Checklist

The following checklist provides the PureWave SMS-250 PCS inspection activities that are to be performed on an annual basis. The amount of dust and dirt accumulated in the units varies from site to site. Therefore, the customer should review schedules for maintenance based on the given site conditions and, if required, the frequency of the recommended maintenance may increase to ensure the reliability of the PureWave SMS-250 system.

RED Electric Company has extended service agreements and spare parts kits available for the PCS. Please contact RED Electric Company–Global Support Monitoring Center at (888) 762-1100.

Annual Maintenance Checklist

The PCS requires a minimal amount of maintenance to help ensure high system reliability and efficiency. The following checklist can be used as a reference to assist in properly maintaining the unit(s):

⚠ DANGER

Make sure the PCS is de-energized before performing maintenance on the equipment. Taking this necessary step will minimize serious injury or even death. Proper personal protective equipment (PPE) must be used.

Preparation

- ☐ Review the steps in this checklist to prepare the proper tools that will be needed to complete these maintenance tasks.
- ☐ Communicate with RED Electric Company to identify any additional tasks that are expected to be accomplished during the annual maintenance visit.
- ☐ Coordinate with the site facilitator to obtain keys for the padlocks (if applicable) to unlock the door to the PCS enclosure(s).

Required Tools

- ☐ Shop vacuum
- ☐ Rags or paper towels
- ☐ General purpose cleaner (e.g. Simple Green)
- ☐ New compact flash card for replacement (old card should be returned to RED Electric Company)
- ☐ Ratchet wrench
- ☐ 11-mm socket
- ☐ 15-mm socket
- ☐ .5-M (20-inch) socket wrench extension
- ☐ 13-mm socket
- ☐ 7-mm socket
- ☐ 5.5-mm socket
- ☐ 3/8-inch socket
- ☐ Slot driver
- ☐ #1 Phillips
- ☐ #2 Phillips
- ☐ 3-mm hex wrench
- ☐ 8-mm hex wrench
- ☐ White lithium grease (door grease)

Arrival

- ☐ Discuss maintenance plan with site facilitator (if applicable).
- ☐ Record the following information:

Site Name: ____________________________

Serial Number: _______________

Control Mode (SCADA - Enabled or Disabled): ____________________

Current System State (from LCD): ____________________

Safety Checks

⚠ DANGER

Use lockout-tagout procedures before working on the PCS. Conduct the following checks to avoid damaging the equipment, personal injury, or even death.

- ☐ Open the PCS enclosure door and press the INVERTER STOP button located on the user interface panel.
- ☐ Verify the ac circuit breaker CB1 is open.
- ☐ Verify the dc circuit breaker CB2 is open.
- ☐ Use a meter with insulated leads that will not short to the dead front for the following steps:
  - Verify there is line-to-line ac voltage from the bottom of F4 (ac fuse) to the bottom of F5 (ac fuse).
  - Verify there is line-to-line ac voltage from the bottom of F5 to the bottom of F6 (ac fuse).
  - Verify there is line-to-line ac voltage from the bottom of F6 to the bottom of F4.
  - Verify there is dc voltage from the bottom of F1 (dc fuse) to the bottom of F2 (dc fuse).
- ☐ Disconnect the ac power that supplies the PureWave SMS-250 system.
- ☐ Lock open the ac power that supplies the PureWave SMS-250 system.
- ☐ Tag open the ac power that supplies the PureWave SMS-250 system.
- ☐ Disconnect the dc power that supplies the PureWave SMS-250 system.
- ☐ Lock open the dc power that supplies the PureWave SMS-250 system.
- ☐ Tag open the dc power that supplies the PureWave SMS-250 system.

☐ Verification

- Verify there is no ac voltage from the door bond to the bottom of F1.
- Verify there is no dc voltage from the door bond to the bottom of F1.
- Verify there is no ac voltage from the door bond to the bottom of F2.
- Verify there is no dc voltage from the door bond to the bottom of F2.
- Verify there is no ac voltage from the door bond to the bottom of F4.
- Verify there is no dc voltage from the door bond to the bottom of F4.
- Verify there is no ac voltage from the door bond to the bottom of F5.
- Verify there is no dc voltage from the door bond to the bottom of F5.
- Verify there is no ac voltage from the door bond to the bottom of F6.
- Verify there is no dc voltage from the door bond to the bottom of F6.
- Verify there is no ac voltage from the bottom of F1 to the bottom of F2.
- Verify there is no dc voltage from the bottom of F1 to the bottom of F2.
- Verify there is no ac voltage from the bottom of F4 to the bottom of F5.
- Verify there is no dc voltage from the bottom of F4 to the bottom of F5.
- Verify there is no ac voltage from the bottom of F5 to the bottom of F6.
- Verify there is no dc voltage from the bottom of F5 to the bottom of F6.
- Verify there is no ac voltage from the bottom of F6 to the bottom of F4.
- Verify there is no dc voltage from the bottom of F6 to the bottom of F4.

⚠ DANGER

Wait at least 5 minutes after disconnecting power before continuing work. The dc capacitor bus will go from its maximum voltage to a safe voltage in this time period. Waiting this amount of time will prevent equipment damage, personal injury, or even death.

⚠ CAUTION

To inspect the internal components of the PCS enclosure, the dead-front access panels require careful removal to prevent injury or equipment damage.

☐ Remove the three dead-front access panels from inside the PCS enclosure using a #2 Phillips driver for the screws at the top of each panel and a 13-mm socket wrench. See Figure 34.

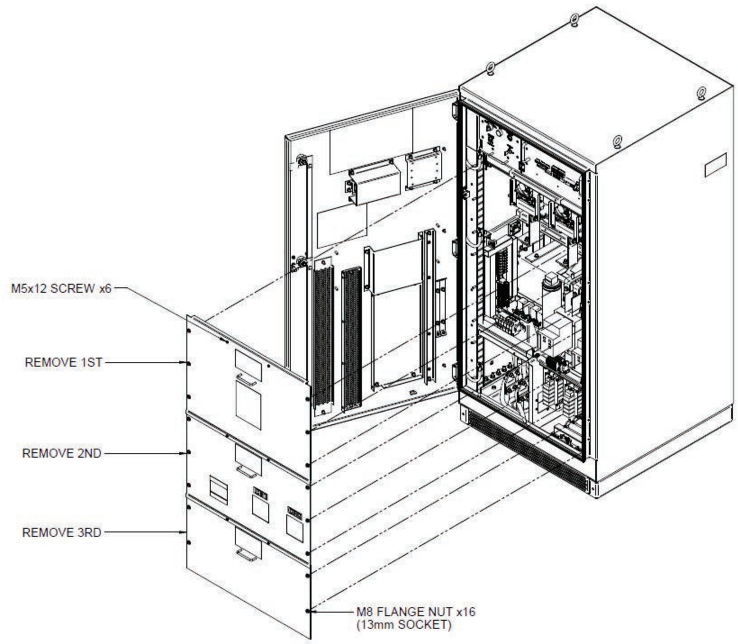


Figure 34. Dead-front access panel removal.

Maintenance Inspection

Enclosure

☐ Check painted surfaces for signs of deterioration or rust.

- Rust found? YES or NO (circle one)
- If yes, clean the rust and paint. Use RED touch-up paint part number ***9999-080*** (ANSI 70 gray) for the PCS.
- If rust was found, but not cleaned and painted,
  Why? ______________________________

☐ Check gaskets and seals around the door and the PCS enclosure opening.

- Are the gaskets and seals in good condition? YES or NO (circle one)
- If no, replace the gasket. Use RED part number ***CD-2340.***
- If gasket is not in good condition, but not replaced,
  Why? ______________________________

Internal Components

☐ Inspect door latching mechanisms. Make sure the mechanism operates easily and holds the door closed. Grease if necessary.

☐ Clean all dirty components inside the PCS enclosure using the shop vacuum or a rag. These include:

- ☐ Enclosure interior
- ☐ Dead-front access panels
- ☐ Intake and outlet vents at the back of the enclosure
- ☐ Fine screen at the bottom of enclosure (requires removal of painted steel screen using a 13-mm wrench/socket)

Clean PCS Enclosure Fans

- ☐ Inductor fan (requires removal of inductor fan cover. See Figure 35.)

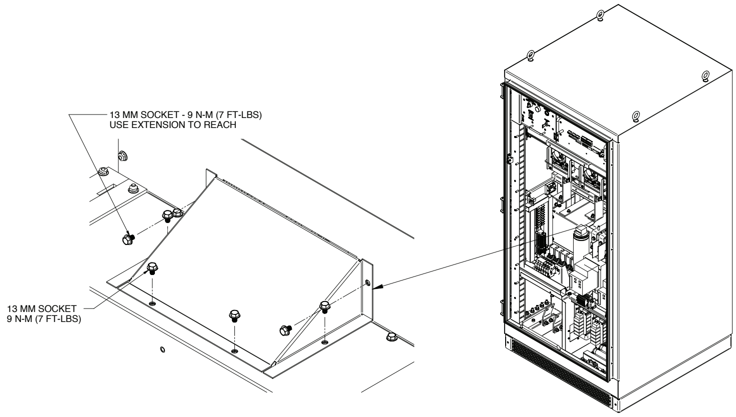


Figure 35. Removal of inductor fan cover.

- ☐ Three fans on the IGBT poles
- ☐ Cabinet fan (located behind the pull-out control assembly at the top of the enclosure)

Fan Functionality Verification

Inductor Fan

- ☐ Verify the fans spin freely.
- ☐ Verify there is no bearing noise when the fan is rotating.
- ☐ Verify there is no rust visible.

IGBT Pole Fan #1

- ☐ Verify the fans spin freely.
- ☐ Verify there is no bearing noise when the fan is rotating.
- ☐ Verify there is no rust visible.

IGBT Pole Fan #2

- ☐ Verify the fans spin freely.
- ☐ Verify there is no bearing noise when the fan is rotating.
- ☐ Verify there is no rust visible.

IGBT Pole Fan #3

- ☐ Verify the fans spin freely.
- ☐ Verify there is no bearing noise when the fan is rotating.
- ☐ Verify there is no rust visible.

Cabinet Fan

- ☐ Verify the fans spin freely.
- ☐ Verify there is no bearing noise when the fan is rotating.
- ☐ Verify there is no rust visible.

NOTICE
If damage, rust, or any other problem is found, replace the fan.

Power electronic assemblies

☐ For IGBT inverter pole assembly servicing, install the service shelf in the PCS as illustrated in Figure 36.

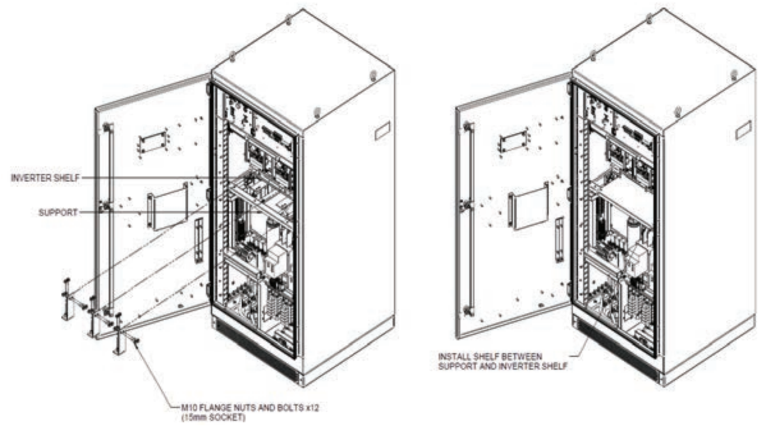


Figure 36. Shelf installation for pole(s) servicing.

☐ Remove the three IGBT inverter assemblies using the procedure located at the top inside of the PCS enclosure door.

For IGBT inverter assembly #1:

☐ Replace any damaged components.

☐ Check for and remove any foreign debris.

☐ Clean the IGBT pole, paying careful attention when cleaning the laminated bus bar.

☐ Check for signs of thermal or electrical stress as well as discolored components.

☐ Check capacitors for any signs of damage.

☐ Clean the large heat sinks.

For IGBT inverter assembly #2:

☐ Replace any damaged components.

☐ Check for and remove any foreign debris.

☐ Clean the IGBT pole, paying careful attention when cleaning the laminated bus bar.

☐ Check for signs of thermal or electrical stress as well as discolored components.

☐ Check capacitors for any signs of damage.

☐ Clean the large heat sinks.

For IGBT inverter assembly #3:

☐ Replace any damaged components.

☐ Check for and remove any foreign debris.

☐ Clean the IGBT pole, paying careful attention when cleaning the laminated bus bar.

☐ Check for signs of thermal or electrical stress as well as discolored components.

☐ Check capacitors for any signs of damage.

☐ Clean the large heat sinks.

☐ Replace the three IGBT assemblies (following the instructions located at the top-inside of the PCS door.

☐ Torque the bus connections and components according to Table 12 on the next page.

Table 12. Torque Requirements

Assembly	Part	Hardware	Tool	Torque [N-M]	Torque [Ft-Lbs]
Inverter Pole	Ground wire	M6 hex nut	11-mm socket	9.5	7
	Ground bus	M6 hex nut	11-mm socket	9.5	7
	Shorting bus	M10 flange nut	15-mm socket	54.2	40
	Typical bus	M10 flange nut/bolt	15-mm socket	54.2	40
	Ac connection	M10 flange bolt	15-mm socket	54.2	40
Typical Bus Connections	N/A	M10 flange nut/bolt	15-mm socket	54.2	40
Inductor/Cabinet Fans	Terminal blocks	M4 terminals	Slot driver	1.7	1.25
Dc Blowers	Terminal blocks	M4x12 screw	3-mm hex	1.1	0.8
Circuit Breaker Terminal Block	Terminal blocks	M3 terminals	Slot driver	0.5	0.4
Circuit Breaker	Bus Tabs	M10 bolt	8-mm hex	27.1	20
EMI Filter Board	Positive leads	M10 flange nut	15-mm socket	13.6	10
	Ground studs	M6 hex nut	11-mm socket	9.5	7
Input Box	CT PCB terminals	10-32 hex nut	3/8-inch socket	3.5	2.6
	Capacitor terminal block	Terminal screws	#2 Phillips	3.9	2.9
	Relay block terminals	8-32 screw	#2 Phillips	2.2	1.6
Islanding Tray	CT terminal block	#10-32 terminals	Slot driver	2	1.5
	Terminal blocks	M4 terminals	Slot driver	1.7	1.25
	PLC	M3 mounting	#1 Phillips	1.1	0.8
Resistor Tray	Contactor - power	M4 studs	7-mm socket	1.4	1
	Contactor - coil	M3 studs	5.5-mm socket	0.5	0.4
	Resistor connections	M5x10 screw	3-mm hex	3.9	2.9
Dc Blower Terminal Block	Terminal blocks	M3 terminals	Slot driver	0.5	0.4

☐ Verify that all accessible electrical control connections are tight (using a screwdriver).

Controls

☐ Open the top of the control assembly box and clean the control board with a vacuum, if needed.

☐ Verify there is no unusual particulate or fungal growth. If there is, take pictures and report it to RED Electric Company for further evaluation.

☐ Close and re-fasten the top of the control assembly box.

☐ Remove the compact flash card and replace it with the new one.

Maintenance Completion

- ☐ Verify any damaged or inoperable components have been repaired or replaced.
- ☐ Verify all applicable maintenance tasks are complete.
- ☐ Verify all tools have been removed from the PCS enclosure.
- ☐ Visually inspect the PureWave SMS-250 system to ensure nothing is out of place before re-energization.
- ☐ Replace and secure the dead-front access panels.
- ☐ Address and/or report any concerns the site facilitator may have.

Re-energization of the System

- ☐ Remove your tag from the ac source.
- ☐ Remove the lock from the ac source.
- ☐ Remove your tag from the dc source.
- ☐ Remove the lock from the dc source.
- ☐ Close the ac source to re-energize the PureWave SMS-250 system.
- ☐ Verify the fans start and run for 60 seconds.
  - Top screen on the back is the cabinet fan.
  - Next two screens down are the main IGBT blowers. Verify air flow on all three assemblies.
  - The fourth screen down is the inductor fan. Verify that it is working properly.
- ☐ Close the dc source to supply dc power to the PureWave SMS-250 system.
- ☐ With the site facilitator's approval, run the PureWave SMS-250 system to verify proper functionality:
  - Connect the laptop computer to the Ethernet connection and start the Human Machine Interface (HMI) browser.
  - Verify the browser screens are working.
  - Toggle the SMS CONTROL switch on the user interface panel to the **SCADA DISABLE** position.
  - Set the HMI power control to the **Commanded Control** setting.
  - Set the HMI Power Setpoint to 0.
  - Set the HMI VAR Control to the **Commanded Control** setting.
  - Set the HMI VARs Setpoint to 0.
  - Twist the inverter stop to bring the system to the **Ready** state.
  - Command a discharge of 50 kW.
  - Verify the PureWave SMS-250 system runs at 50 kW.
  - Set the Power Setpoint to 0 to stop the operation.
  - Disconnect the laptop computer.

Departure

Place the PureWave SMS-250 system in the desired control mode and state. Record these below:

Control Mode (SCADA - Enabled or Disabled): ____________________

System State: ____________________

☐ Close and padlock all access doors.

☐ Send the compact flash card to RED Electric Company for analysis.

Annual Maintenance Performed By: ____

Date: ____________________

Table 13. Modbus and DNP Register List: Analog Inputs

DNP Point	Modbus Register	Description	Access	Units	Type	Comments
Product Information						
0	40001	ProductIdentifier	Read	N/A	UINT16	RED product identifier.
1	40002	ScadaVersion	Read	N/A	UINT16	SCADA points list version number (MSB=Major, LSB=Minor).
PureWave SMS-250 Data						
2	40003	SmsPower	Read	kW	INT16	Sum of the three-phase power from the PureWave SMS-250 system + power is discharge.
3	40004	SmsVARs	Read	kvar	INT16	+Vars act like a capacitor; the SMS-250 system is supplying vars.
4	40005	SmsVa	Read	kVA	INT16	Calculated from SmsVa = (SmsPower^2 + SmsVars^2)^0.5.
5	40006	SmsVolt12	Read	Volts RMS	INT16	Line-to-line RMS voltage for Line 1 with respect to Line 2 at the PureWave SMS-250 terminals.
6	40007	SmsVolt23	Read	Volts RMS	INT16	Line-to-line RMS voltage for Line 2 with respect to Line 3 at the PureWave SMS-250 terminals.
7	40008	SmsVolt31	Read	Volts RMS	INT16	Line-to-line RMS voltage for Line 3 with respect to Line 1 at the PureWave SMS-250 terminals.
8	40009	SmsAmp1	Read	Amps RMS	INT16	Phase 1 RMS current at the PureWave SMS-250 ac connection.
9	40010	SmsAmp2	Read	Amps RMS	INT16	Phase 2 RMS current at the PureWave SMS-250 ac connection.
10	40011	SmsAmp3	Read	Amps RMS	INT16	Phase 3 RMS current at the PureWave SMS-250 ac connection.
Utility Data						
11	40012	UtilityPower	Read	kW	INT16	Sum of the three-phase power from the 250-kW utility; + power is providing power to a load.
12	40013	UtilityVARs	Read	kvar	INT16	+Vars act like a capacitor; the utility is supplying vars.
13	40014	UtilityVa	Read	kVA	INT16	Calculated from UtilityVa=(UtilityPower^2 + UtilityVars^2)^0.5.
14	40015	UtilityVolt12	Read	Volts RMS	INT16	Line-to-line RMS voltage for line 1 with respect to line 2 at the utility terminals.
15	40016	UtilityVolt23	Read	Volts RMS	INT16	Line-to-line RMS voltage for line 2 with respect to line 3 at the utility terminals.
16	40017	UtilityVolt31	Read	Volts RMS	INT16	Line-to-line RMS voltage for line 3 with respect to line 1 at the utility terminals.
17	40018	UtilityAmp1	Read	Amps RMS	INT16	Phase 1 RMS current at the utility ac connection.
18	40019	UtilityAmp2	Read	Amps RMS	INT16	Phase 2 RMS current at the utility ac connection.
19	40020	UtilityAmp3	Read	Amps RMS	INT16	Phase 3 RMS current at the utility ac connection.
Load Data						
20	40021	LoadPower	Read	kW	INT16	Sum of the three-phase power to the 250-kW load; + power is providing power to a load.
21	40022	LoadVARs	Read	kvar	INT16	+Vars act like an inductor; the load is consuming vars.
22	40023	LoadVa	Read	kVA	INT16	Calculated from LoadVa = (LoadPower^2 + LoadVars^2)^0.5.
23	40024	LoadVolt12	Read	Volts RMS	INT16	Line-to-line RMS voltage for Line 1 with respect to Line 2 at the load terminals
24	40025	LoadVolt23	Read	Volts RMS	INT16	Line-to-line RMS voltage for Line 2 with respect to Line 3 at the load terminals.
25	40026	LoadVolt31	Read	Volts RMS	INT16	Line-to-line RMS voltage for Line 3 with respect to Line 1 at the load terminals.
26	40027	LoadAmp1	Read	Amps RMS	INT16	Phase 1 RMS current at the load ac connection.
27	40028	LoadAmp2	Read	Amps RMS	INT16	Phase 2 RMS current at the load ac connection.
28	40029	LoadAmp3	Read	Amps RMS	INT16	Phase 3 RMS current at the load ac connection.

Table 13. Modbus and DNP Register List: Analog Inputs—continued.

DNP Point	Modbus Register	Description	Access	Units	Type	Comments
Battery Data - Only Applicable For Systems with Batteries						
29	40030	BattPower	Read	kW dc	INT16	Battery power, calculated from BattVolt x BattAmp.
30	40031	BattVolt	Read	Volts dc	INT16	Battery voltage, measured using a sliding window filter of one cycle.
31	40032	BattAmp	Read	Amps dc	INT16	Battery current measured using a sliding window filter of one cycle.
32	40033	BmsPower	Read	kW dc	INT16	BMS power, reported by the battery-management system.
33	40034	BmsVolt	Read	Volts dc	INT16	BMS voltage, reported by the battery-management system.
34	40035	BmsAmp	Read	Amps dc	INT16	BMS current, reported by the battery-management system.
35	40036	BmsSoc	Read	% times 10	INT16	SOC is BMS reported state of charge. A 70% SOC battery will have a number of 700 in this register.
36	40037	BmsMaxDischargePower	Read	kW	INT16	This is the BMS reported battery-charge limit. The charge power limit is negative.
37	40038	BmsMaxChargeCurrent	Read	kW	INT16	This is a battery limit. Discharge power is adjusted to provide ac power after accounting for losses in the CES. Discharge power is positive.
38	40039	BmsMaxChargeCurrent	Read	Amps	INT16	This is the BMS reported battery-charge limit. The Charge current limit is negative.
39	40040	BmsMaxDischargeCurrent	Read	Amps	INT16	This is a battery limit. Discharge power is adjusted to provide ac power after accounting for losses in the PureWave SMS-250 system. Discharge current is positive.
40	40041	BmsMaxBattTemp	Read	°C	INT16	Maximum battery temperature.
41	40042	BmsMinBattTemp	Read	°C	INT16	Maximum battery temperature.
Other Analog Data						
42	40043	SmsVdr	Read	Volts	INT16	PureWave SMS-250 system ac voltage two-phase, dr (in phase) voltage vector.
43	40044	SmsVqr	Read	Volts	INT16	PureWave SMS-250 system ac voltage two-phase, qr (90° out of phase) voltage vector.
44	40045	SmsIdr	Read	Amps	INT16	PureWave SMS-250 system ac current two-phase, dr (in phase) voltage vector.
45	40046	SmsIqr	Read	Amps	INT16	PureWave SMS-250 system ac current two-phase, qr (90° out of phase) voltage vector.
46	40047	SmsReversePhaseRotationVoltage	Read	Volts	INT16	PureWave SMS-250 ripple on Vdr; used to determine reverse phase rotation.
47	40048	SensitiveEarthFault	Read	Amps	INT16	Sensitive earth fault current reading.
48	40049	SmsVoltageAcrossCB	Read	Volts	INT16	Average voltage across the ac circuit breaker.
49	40050	SmsAcCurrentOffset1	Read	Volts	INT16	Dc current measured on inverter ac current sensor when in Island mode. This is used to keep the transformer from saturating.
50	40051	SmsAcCurrentOffset2	Read	Volts	INT16	Dc current measured on inverter ac current sensor when in Island mode. This is used to keep the transformer from saturating.
51	40052	SmsAcCurrentOffset3	Read	Volts	INT16	Dc current measured on inverter ac current sensor when in Island mode. This is used to keep the transformer from saturating.
52	40053	UtilityVdr	Read	Volts	INT16	Utility ac voltage two phase, dr (in phase) voltage vector.
53	40054	UtilityVqr	Read	Volts	INT16	Utility ac voltage two phase, qr (90° out of phase) voltage vector.
54	40055	UtilityIdr	Read	Amps	INT16	Utility ac current two phase, dr (in phase) voltage vector.
55	40056	UtilityIqr	Read	Amps	INT16	Utility ac current two phase, qr (90° out of phase) voltage vector.
56	40057	DcLinkVoltage	Read	Volts	INT16	Voltage of the dc link; this is the same as the battery voltage when the dc circuit breaker is closed.
57	40058	PreChargeVoltage	Read	Volts	INT16	This is the voltage the dc link is charged with when the pre-charge contactor is closed.
58	40059	Spare58	Read	TBD	INT16	Reserved for future implementation.
59	40060	Spare59	Read	TBD	INT16	Reserved for future implementation.
60	40061	TemperatureIgbtPhase1	Read	°C	INT16	Temperature measured by the IGBT package thermistor.

Table 13. Modbus and DNP Register List— Analog Inputs continued.

DNP Point	Modbus Register	Description	Access	Units	Type	Comments
61	40062	TemperatureIgbtPhase2	Read	°C	INT16	Temperature measured by the IGBT package thermistor.
62	40063	TemperatureIgbtPhase3	Read	°C	INT16	Temperature measured by the IGBT package thermistor.
63	40064	TemperatureInductorCoil	Read	°C	INT16	Temperature measured by the inductor coil RTD.
64	40065	TemperatureCabinet	Read	°C	INT16	Cabinet temperature measured by the cabinet thermistor.
65	40066	WdtSms	Read	Count	INT16	Value from the PureWave SMS-250 system that changes every second to act as a watchdog timer showing that the PCS control is working.
66	40067	PeakShaveResultPower	Read	kW	INT16	This is the sum of the power to be peak-shaved and the PureWave SMS-250 power.
67	40068	SmoothingResultPower	Read	kW	INT16	This is the sum of the power to be smoothed and the PureWave SMS-250 power.
Power Setpoints - Active Values - Only Applicable For Systems with Batteries						
68	40069	PowerSetpoint	Read	kW	INT16	This is the real power setpoint of the power from the battery system where +power is discharge.
69	40070	DgPower	Read	kW	INT16	This is the power from a distributed resource (generation) that is remote from PureWave SMS-250 system used as feedback.
70	40071	SmoothingRampRate	Read	kW / Minute	INT16	This is the smoothing ramp rate.
71	40072	TargetSocSetpoint	Read	% times 10	INT16	This is the desired SOC when smoothing.
72	40073	KpSoc	Read	kW	INT16	1 pu = Put out 1 pu power if there is a 1-pu difference between target and actual SOC.
73	40074	PeakShavePower	Read	kW	INT16	Power to be peak-shaved where the power (load) is remote from the PureWave SMS-250 used as feedback.
74	40075	PeakShaveChargeSetpoint	Read	kW	INT16	This is the setpoint below which the PureWave SMS-250 system will charge.
75	40076	PeakShaveDischargeSetpoint	Read	kW	INT16	The setpoint above which the PureWave SMS-250 system will discharge.
76	40077	FrequencyRegulationPowerSetpoint	Read	kW	INT16	This is the frequency regulation power setpoint of the power from the battery system where +power is discharge.
77	40078	ScheduledPower	Read	kW	INT16	This is the present real power setpoint as calculated by the PureWave SMS-250 power scheduling algorithm (+power is discharge).
VAR Setpoints - Active Values						
78	40079	VarSetpoint	Read	kvar	INT16	This is the reactive power setpoint for the PureWave SMS-250 system where +vars is supplying vars (looking like a capacitor) limited to 400 amps ac.
79	40080	VoltSetpoint	Read	% times 10	INT16	This is the setpoint voltage percentage for the voltage at the output terminals of the PureWave SMS-250 system.
80	40081	Droop	Read	% times 10	INT16	This is the setpoint droop for the voltage at the output terminals of the PureWave SMS-250 system when in ac voltage regulation droop control.
81	40082	PowerFactorSetpoint	Read	PF*100	INT16	PF*100.
Battery Setpoints - Active Values - Only Applicable For Systems with Batteries						
82	40083	MaxSoc	Read	% SOC times 10	INT16	This is the current setpoint of maximum SOC for the system.
83	40084	MinSoc	Read	% SOC times 10	INT16	This is the current setpoint of minimum SOC for the system when in CS mode.
Snapshot Data						
84-85	40085-40086	LastSnapshotRequestStatus	Read	Data	UINT32	This is the result of the last snapshot request operation.
85-87	40087-40088	LastSnapshotTaken	Read	Data	UINT32	This is the ID number of the last snapshot taken.

Table 14. Modbus and DNP Register List—Analog Outputs

DNP Point	Modbus Register	Description	Access	Units	Type	Comments
88-215	40089-40216	Snapshot data words	Read	Data	Array of UINT16's	This is one snapshot's worth of data; maximum is 256 bytes, or 128 words.
85	40086	ContainerTemperature1	Read	Temp in degrees C x 10	INT16	-50°C to 110°C (-58°F to 230°F)
86	40087	ContainerTemperature2	Read	Temp in degrees C x 10	INT16	-50°C to 110°C (-58°F to 230°F)
87	40088	ContainerHumidity	Read	RH in %	INT16	0-100%

DNP Point	Modbus Register	Description	Access	Units	Type	Comments	Limits
Power Setpoints							
0	41001	PowerSetpoint	R/W	kW	INT16	This is the real power setpoint of the power from the battery system where +power is discharge.	± 115% of VA rating (± 303 kW at 380 V)
1	41002	DgPower	R/W	kW	INT16	This is the power from a distributed resource (generation) that is remote from PureWave SMS-250 system used as feedback.	0 to 5000 kW
2	41003	SmoothingRampRate	R/W	kW/ minute	INT16	This is the smoothing ramp rate.	1 to 251 kW per minute
3	41004	TargetSocSetpoint	R/W	% times 10	INT16	This is the desired SOC when smoothing.	0%-100%
4	41005	KpSoc	R/W	kW	INT16	1.0 pu = Put out 1 pu power if there is a 1-pu difference between target and actual SOC.	0 to 250 kW
5	41006	PeakShavePower	R/W	kW	INT16	Power to be peak-shaved where the power (load) is remote from the PureWave SMS-250 system used as feedback.	0 to 5000 kW
6	41007	PeakShaveChargeSetpoint	R/W	kW	INT16	This is the setpoint below which the PureWave SMS-250 system will charge.	0 to 5000 kW
7	41008	PeakShaveDischargeSetpoint	R/W	kW	INT16	This is the setpoint above which the PureWave SMS-250 system will discharge.	0 to 5000 kW and below high setpoint
8	41009	FrequencyRegulationPowerSetpoint	R/W	kW	INT16	This is the frequency regulation power setpoint of the power from the battery system where +power is discharge.	± 115% of VA rating (± 303 kW at 380 V)
Var Setpoints							
9		VsModeFrequency	Read	Hz x 100	INT16	This is the present operating frequency setpoint (Applies to VS Mode only).	
10		VarSetpoint	R/W	kvar	INT16	This is the reactive power setpoint for the PureWave SMS-250 system where +vars is supplying vars (looking like a capacitor) limited to 400 amps ac.	± 115% of VA rating (± 303 kvar at 380 V)
11		VoltSetpoint	R/W	% x 10	INT16	Setpoint voltage percentage for the voltage at the output terminals of the PureWave SMS-250 system.	90% - 105%
12		Droop	R/W	% x 10	INT16	Setpoint droop for the voltage at the output terminals of the PureWave SMS-250 system when in ac voltage regulation droop control.	10%

Table 14. Modbus and DNP Register List—Analog Outputs—continued.

DNP Point	Modbus Register	Description	Access	Units	Type	Comments	Limits
13		PfSetpoint	R/W	Power factor x 100	INT16	Positive values result in a lagging power factor for the PureWave SMS-250 system and downstream load; negative values result in leading power factor.	-50 to -100 or 50 to 100
Battery and BMS Setpoints							
14		MaxSoc	R/W	% SOC x 10	INT16	This is the maximum SOC for the system.	0%-100%
15		MinSoc	R/W	% SOC x 10	INT16	This is the minimum SOC for the system when in CS mode.	0%-100%

DNP Point	Modbus Register	Description	Access	Units	Type	Comments	Limits
Communications Setpoints							
16		WdtScada	R/W	None	INT16	SCADA writes to this every 1 to 10 seconds with a new value so the PCS can detect loss of communications from the SCADA controller.	Any value that changes
Snapshot Request							
17-18		SnapshotNumber	R/W	Data	UINT32	This is the ID number of the snapshot you wish to read.	0 - (2^32 - 1)
19-20		SnapshotOpRequest	R/W	Data	UINT32	This is the snapshot request operation.	TBD

Table 15. Modbus and DNP Register List—Status Points

DNP Point	Modbus Register	Description	Access	Format	Comments
SMS-250 State machine state					
0	10001	ProgInit	Read	Bit	PureWave SMS-250 system is in **Program Initialize** state.
1	10002	TripOffline	Read	Bit	PureWave SMS-250 system is in **Trip Offline** state.
2	10003	PreChargeAc	Read	Bit	PureWave SMS-250 system is in the **Pre-Charge for the Ac Breaker to Close** state.
3	10004	Ready	Read	Bit	PureWave SMS-250 system is in the **Ready** state.
4	10005	Inhibit	Read	Bit	PureWave SMS-250 system is in the **Inhibit** state.
5	10006	UtilityRun	Read	Bit	PureWave SMS-250 system is in the **Utility Run** state.
6	10007	IslandRun	Read	Bit	PureWave SMS-250 system is in the **Island Run** state.
7	10008	DcCbPreCharge	Read	Bit	PureWave SMS-250 system is in the **Commanding the Precharge for Dc** state.
SMS-250 Digital Inputs					
8	10009	Di1BatteryEstop	Read	Bit	BMS has sent a battery ESTOP hard contact.
9	10010	Di2DcCb2Closed	Read	Bit	The dc circuit breaker CB2 is closed.
10	10011	Di3InverterStop	Read	Bit	Inverter stop is active.
11	10012	Di4AutoTransformerOverTempWarning	Read	Bit	Auto transformer over temperature warning.
12	10013	Di5AcCb1Closed	Read	Bit	The ac circuit breaker CB1 is closed.
13	10014	Di6EthSwFault	Read	Bit	Ethernet switch has a fault.
14	10015	Di7AutoTransformerOverTemp	Read	Bit	Auto transformer is over specified temperature.
15	10016	Di8DoorIsClosed	Read	Bit	The main door of the PureWave SMS-250 system is closed.
16	10017	Di9ScadaSelected	Read	Bit	The Local-SCADA switch is in the **SCADA** position.
17	10018	Di10Reset	Read	Bit	The RESET button is depressed.
18	10019	Di11IslandCbClosed	Read	Bit	The island CB is closed.
19	10020	Di12Reserved	Read	Bit	Reserved for future use.

TABLE CONTINUED ►

Table 15. Modbus and DNP Register List—Status Points—continued.

DNP Point	Modbus Register	Description	Access	Format	Comments
20	10021	Di13Reserved	Read	Bit	Reserved for future use.
21	10022	Di14Reserved	Read	Bit	Reserved for future use.
22	10023	Di15Reserved	Read	Bit	Reserved for future use.
23	10024	Di16Reserved	Read	Bit	Reserved for future use.
24	10025	Di17Reserved	Read	Bit	Reserved for future use.
25	10026	Di18Reserved	Read	Bit	Reserved for future use.
SMS-250 Digital Outputs					
26	10027	Do1CloseDcCb2	Read	Bit	Close the dc circuit breaker CB2.
27	10028	Do2OpenDcCb2	Read	Bit	Open the dc circuit breaker CB2.
28	10029	Do3PreCharge	Read	Bit	Close the precharge contactors.
29	10030	Do4CapFanOn	Read	Bit	Turn on the capacitor fan.
30	10031	Do5CloseAcCb1	Read	Bit	Close the ac circuit breaker CB1.
31	10032	Do6OpenAcCb1	Read	Bit	Open the ac circuit breaker CB1.
32	10033	Do7CloseIlsandCb	Read	Bit	Close the island circuit breaker.
33	10034	Do8OpenIslandCb	Read	Bit	Open the island circuit breaker.
34	10035	Do9DisableIslandRenewables	Read	Bit	Disable any renewable resources on the island so the battery doesn't overcharge.
35	10036	Do10IslandedNeutralCurrentEnable	Read	Bit	Enable islanded neutral current.
36	10037	Do11Reserved	Read	Bit	Reserved for future use.
37	10038	Do12Reserved	Read	Bit	Reserved for future use.
38	10039	Do13Reserved	Read	Bit	Reserved for future use.
39	10040	Do14Reserved	Read	Bit	Reserved for future use.
40	10041	Do15Reserved	Read	Bit	Reserved for future use.
41	10042	Do16Reserved	Read	Bit	Reserved for future use.
42	10043	Do17Reserved	Read	Bit	Reserved for future use.
SMS-250 Summary Alarms					
43	10044	WarningAlarm	Read	Bit	**Warning** alarm is on.
44	10045	InhibitAlarm	Read	Bit	**Inhibit** alarm is on.
45	10046	BatteryIsolateAlarm	Read	Bit	**Battery Isolate** alarm is on.
46	10047	TripOfflineAlarm	Read	Bit	**Trip Offline** alarm is on.
SMS-250 Individual Alarms					
47	10048	ParamCalChangeActivate	Read	Bit	
48	10049	ParamCalNvError	Read	Bit	
49	10050	ExecutionTimeLongWarn	Read	Bit	
50	10051	ExecutionFrameOverrun	Read	Bit	
51	10052	InverterStop	Read	Bit	
52	10053	AnyAppBrdPwrSupplyUV	Read	Bit	
53	10054	DCLinkOverVoltage	Read	Bit	
54	10055	DCLinkUnderVoltage	Read	Bit	
55	10056	LostSynchronize	Read	Bit	
56	10057	ReversePhaseRotation	Read	Bit	
57	10058	ResetCommand	Read	Bit	
58	10059	AutoResetCommand	Read	Bit	
59	10060	IGBT1OverCurrent	Read	Bit	
60	10061	IGBT2OverCurrent	Read	Bit	
61	10062	IGBT3OverCurrent	Read	Bit	
62	10063	IGBT1CurrentLimit	Read	Bit	
63	10064	IGBT2CurrentLimit	Read	Bit	
64	10065	IGBT3CurrentLimit	Read	Bit	
65	10066	GateDrive1UnderVoltage	Read	Bit	
66	10067	GateDrive2UnderVoltage	Read	Bit	

Table 15. Modbus and DNP Register List—Status Points—continued.

DNP Point	Modbus Register	Description	Access	Format	Comments
67	10068	GateDrive3UnderVoltage	Read	Bit	
68	10069	CurrentLimitShapshot	Read	Bit	
69	10070	PS3LEMPowerSupplyUV	Read	Bit	
70	10071	CurrentSensorOrGndFlt	Read	Bit	
71	10072	UDMUnderVoltage	Read	Bit	
72	10073	UDMOverVoltage	Read	Bit	
73	10074	DownstreamFaultDetected	Read	Bit	
74	10075	UpstreamFltDetect(Fut)	Read	Bit	
75	10076	DcCapacitorVoltageHigh	Read	Bit	
76	10077	Spare29	Read	Bit	
77	10078	Spare30	Read	Bit	

DNP Point	Modbus Register	Description	Access	Format	Comments
78	10079	Spare31	Read	Bit	
79	10080	ACBreakerFailtoOpen	Read	Bit	
80	10081	ACBreakerFailtoClose	Read	Bit	
81	10082	Spare34	Read	Bit	
82	10083	ACBreakerClosed	Read	Bit	
83	10084	DCBreakerFailtoOpen	Read	Bit	
84	10085	DCBreakerFailtoClose	Read	Bit	
85	10086	Spare38	Read	Bit	
86	10087	DCBreakerClosed	Read	Bit	
87	10088	DCPreChargeVoltageLow	Read	Bit	
88	10089	DCPreChargeVoltageHigh	Read	Bit	
89	10090	DCLinkShorted	Read	Bit	
90	10091	DCLinkPreChargeSlow	Read	Bit	
91	10092	VeryOverVoltage	Read	Bit	
92	10093	OverVoltage	Read	Bit	
93	10094	UnderVoltage	Read	Bit	
94	10095	VeryUnderVoltage	Read	Bit	
95	10096	VeryOverFrequency	Read	Bit	
96	10097	OverFrequency	Read	Bit	
97	10098	UnderFrequency	Read	Bit	
98	10099	VeryUnderFrequency	Read	Bit	
99	10100	BMSWatchdogTimeout	Read	Bit	
100	10101	SCADAWatchdogTimeout	Read	Bit	
101	10102	LocalControlSelected	Read	Bit	
102	10103	AutoResetLockout	Read	Bit	
103	10104	SCADAorHMITripOffline	Read	Bit	
104	10105	SCADAControlSelected	Read	Bit	
105	10106	FpgaHardwareAlarm	Read	Bit	
106	10107	PS124VDCUnderVoltage	Read	Bit	
107	10108	PS224VDCUnderVoltage	Read	Bit	
108	10109	IslandCircuitBreakerOpen	Read	Bit	
109	10110	DoorOpen	Read	Bit	
110	10111	BattAtOpenCircuitVolt	Read	Bit	
111	10112	OverTemperature	Read	Bit	
112	10113	OverTemperatureWarning	Read	Bit	
113	10114	ThermistorShorted	Read	Bit	
114	10115	ThermistorOpenCold	Read	Bit	

TABLE CONTINUED ►

Table 15. Modbus and DNP Register List—Status Points—continued.

DNP Point	Modbus Register	Description	Access	Format	Comments
115	10116	IGBT1TemperatureProblem	Read	Bit	
116	10117	IGBT2TemperatureProblem	Read	Bit	
117	10118	IGBT3TemperatureProblem	Read	Bit	
118	10119	InductorTemperatureProblem	Read	Bit	
119	10120	CabinetTemperatureProblem	Read	Bit	
120	10121	InductorAndCabinetFansOn	Read	Bit	
121	10122	TransformerProblem	Read	Bit	
122	10123	CsOverloadCoolDown	Read	Bit	
123	10124	DspFpgaHeartbeatLost	Read	Bit	
124	10125	VsModeProblem	Read	Bit	
125	10126	InhibitIslandCommand	Read	Bit	
126	10127	EthernetSwitchProblem	Read	Bit	
127	10128	AuxiliarySMS-250	Read	Bit	
128	10129	LocalSmoothing	Read	Bit	
129	10130	SCADASmoothing	Read	Bit	
130	10131	LocalPeakShave	Read	Bit	
131	10132	SCADAPeakShave	Read	Bit	
132	10133	ScheduledPower	Read	Bit	
133	10134	SCADAPower	Read	Bit	
134	10135	EthernetPower	Read	Bit	
135	10136	FrequencyRegulationPower	Read	Bit	
136	10137	EmergencyFrequencyResponseActive, Read, Bit	Read	Bit	
137	10138	EmergencyFreqResponseMisconfigured, Read, Bit	Read	Bit	
138	10139	LocalPower	Read	Bit	
139	10140	SOCCorrectionActive	Read	Bit	
140	10141	KVALimitisLimitingVARs	Read	Bit	
141	10142	CheckDCAndACFBFuses	Read	Bit	
142	10143	CheckIslandFBFuses	Read	Bit	
143	10144	VACDroopControl	Read	Bit	
144	10145	VACConstantVoltage	Read	Bit	
145	10146	PowerFactorControl	Read	Bit	
146	10147	SCADAVARs	Read	Bit	
147	10148	EthernetVARs	Read	Bit	
148	10149	MotorStartCorrection	Read	Bit	
149	10150	LocalVARs	Read	Bit	
150	10151	LoadOverPower	Read	Bit	
151	10152	LoadOverCurrent	Read	Bit	
152	10153	SMS-250CommLoss	Read	Bit	
153	10154	SensitiveEarthFault	Read	Bit	
154	10155	TimeCurrCurveOverload	Read	Bit	
155	10156	SynchronizedToUtility	Read	Bit	
156	10157	UtilityGoodVoltAndFreq	Read	Bit	
157	10158	BatteryUnderVoltage	Read	Bit	
158	10159	McuAlarm	Read	Bit	
159	10160	BattCellOverTemperature	Read	Bit	
160	10161	BattCellUndrTemperature	Read	Bit	
161	10162	BatteryCellOverVoltage	Read	Bit	
162	10163	BatteryCellUnderVoltage	Read	Bit	

TABLE CONTINUED ▶

Table 15. Modbus and DNP Register List—Status Points—continued

DNP Point	Modbus Register	Description	Access	Format	Comments
163	10164	BatteryStringOverCurr	Read	Bit	
164	10165	InternalBattCommsFail	Read	Bit	
165	10166	Spare118	Read	Bit	
166	10167	BatteryRequestsShutdown	Read	Bit	
167	10168	BMSReqSOCRecalcByChg	Read	Bit	
168	10169	BMSReqSOCRecalcByDchg	Read	Bit	
169	10170	BMSRequestedTripOffline	Read	Bit	
170	10171	Spare123	Read	Bit	
171	10172	Spare124	Read	Bit	
172	10173	Spare125	Read	Bit	
173	10174	Spare126	Read	Bit	
174	10175	Spare127	Read	Bit	
DNP Point	**Modbus Register**	**Description**	**Access**	**Format**	**Comments**
Controls Parameters					
175	10176	ScadaWatchdogTimeoutAlarmInhibit	Read	Bit	If this bit is set, then the **SCADA Communications Watchdog Timeout** alarm class action is set to inhibit the inverter.
176	10177	ScadaWatchdogTimeoutAlarmTripOffline	Read	Bit	If this bit is set, then the **SCADA Communications Watchdog Timeout** alarm class action is set to trip the system offline.
177	10178	ScadaWatchdogTimeoutAlarmWarning	Read	Bits	If this bit is set, then the **SCADA Communications Watchdog Timeout** alarm class action is set to just a warning and no other action will be taken when the SCADA communications alarm is asserted.
Advanced Status Points					
178	10179	AuxSmsTripOffline	Read	Bits	If this bit is set, an auxiliary PureWave SMS-250 unit has a **Trip Offline** alarm.
179	10180	AuxSmsInhibit	Read	Bits	If this bit is set, an auxiliary PureWave SMS-250 unit has an **Inhibit** alarm.
180	10181	AuxSmsIsolate	Read	Bits	If this bit is set, an auxiliary PureWave SMS-250 unit has an **Isolate** alarm.
181	10182	AuxSmsWarning	Read	Bits	If this bit is set, an auxiliary PureWave SMS-250 unit has a **Warning** alarm.
182	10183	AuxSmsAvailableForVs	Read	Bits	If this bit is set, an auxiliary PureWave SMS-250 unit is available to island.
183	10184	SetpointRejected	Read	Bits	If this bit is set, the controls reject one or more analog setpoints. Verify the current setpoint values are within system specifications.
184	10185	ControlPointRejected	Read	Bits	If this bit is set, the controls reject one or more digital control points. Verify the current control point settings are valid for current system conditions and system specifications.
Container I/O					
185	10186	IslandBreakerStatusSource	Read	Bit	Readback for the source for the Island Breaker Status. 0 = Discrete I/O, 1 = SCADA
186	10187	IslandBreakerStatus	Read	Bit	Readback of the status of the Island Breaker. 0 = Open, 1 = Closed
187	10188	EmergencyFrequencyResponseEnabled	Read	Bit	The SMS will compensate for frequency deviation.
188	10189	EmergencyFrequencyResponseDisabled	Read	Bit	The SMS will compensate not for frequency deviation.
189	10190	DoorContactOpen	Read	Bit	State of the Door contact. 0 = Closed, 1 = Open
190	10191	FireAlarmNormal	Read	Bit	0 = Alarm, 1 = Normal
191	10192	FireTroubleNormal	Read	Bit	0 = Alarm, 1 = Normal
192	10193	HVACLockoutNormal	Read	Bit	0 = Lockout, 1 = Normal
193	10194	DcDisconnectClosed	Read	Bit	0 = Open, 1 = Closed
194	10195	ContainerVoltageProblem	Read	Bit	24 VDC and 380 VAC, 0 = Normal, 1 = Problem
195	10196	BatteryVoltageProblem	Read	Bit	24 VDC for the Battery, 0 = Normal, 1 = Problem

TABLE CONTINUED ►

Table 16. Modbus and DNP Register List—Control Points—continued.

DNP Point	Modbus Register	Description	Access	Format	Comments	DNP Action
System Control						
0	11001	TripOffline	W	Bit	Set to trip the PureWave SMS-250 system offline. Clear the bit to remove the SCADA trip offline.	Latch On/Off
1	11002	Reset	W	Bit	Set/pulse to reset the system. This bit self clears after the reset.	Pulse On
2	11003	StartIsland	W	Bit	Set/pulse to turn on the **Island** mode if it is able to do so. Power and vars are determined by the load.	Pulse On
3	11004	StopIsland	W	Bit	Set/pulse to turn off the **Island** mode if it is able to do so. This resumes the **Utility Connected** operation.	Pulse On
4	11005	InhibitIsland	W	Bit	Set to inhibit **Island** mode operation regardless of island reason. Clear to allow **Island** mode.	Latch On/Off
Power Control Mode Selection						
5	11006	PowerFromPowerSetpoint	W	Bit	Set/pulse to enable power is controlled by the ScadaPower setpoint. This clears other power control modes.	Pulse On
6	11007	PowerFromSchedule	W	Bit	Set/pulse to enable power from schedule; this clears other power control modes.	Pulse On
7	11008	PowerFromSmoothLocal	W	Bit	Set/pulse to enable power to smooth a locally measured (using island breaker voltage and current sensors to measure the combined PureWave SMS-250 system and load or source) variable source or load. Parameters are used to allow load smoothing or SCADA-supplied power smoothing. This clears other power control modes.	Pulse On
8	11009	PowerFromSmoothScada	W	Bit	Set/pulse to enable power to smooth a variable source or load where the load or source is reported as the analog output DgPowerScada. Parameters are used to allow load smoothing or SCADA -supplied power smoothing. This clears other power control modes.	Pulse On
9	11010	PowerFromShaveLocal	W	Bit	Set/pulse to enable power that will peak-shave a locally measured (using island breaker voltage and current sensors to measure the combined PureWave SMS-250 system and load or source) load; this clears other power control modes. Parameters are used to allow load peak-shaving or SCADA-supplied power peak-shaving. This clears other power control modes.	Pulse On
10	11011	PowerFromShaveScada	W	Bit	Set/pulse to enable power that will peak shave a SCADA measured load. The load is reported by the analog output ShavePowerScada. This clears other power control modes. Parameters are used to allow load peak-shaving or SCADA-supplied power peak-shaving. This clears other power control modes.	Pulse On
11	11012	PowerFromFreqReg	W	Bit	Set/pulse when frequency regulation power mode; this keeps the PureWave SMS-250 system running even with a zero power command.	Pulse On
12	11013	SocCorrection	W	Bit	Set to turn on **SoC Correction** mode. Clear the bit to turn off **SoC Correction** mode.	Latch On/Off

TABLE CONTINUED ►

Table 16. Modbus and DNP Register List—Control Points—continued.

DNP Point	Modbus Register	Description	Access	Format	Comments	DNP Action
VAR Control Mode Selection						
13	11014	VarsFromVarSetpoint	W	Bit	Set/pulse to use the three-phase var command VarSet.	Pulse On
14	11015	VarsFromVoltSetpoint	W	Bit	Set/pulse to control the ac voltage to a setpoint.	Pulse On
15	11016	VarsFromVoltDroopSetpoint	W	Bit	Set/pulse to control the ac voltage using a droop control.	Pulse On
16	11017	VarsFromPfSetpoint	W	Bit	Set/pulse to do (average) power factor control at the interconnection point of the utility where vars on each phase are the same; power factors on a phase basis may be different.	Pulse On
17	11018	MotorStartCorrection	W	Bit	Set to turn on fast current control to maintain voltage during motor-starting applications. Clear the bit to turn off **Motor Start Correction** mode.	Latch On/Off
Controls Parameters						
18	11019	ScadaWatchdogTimeoutAlarmInhibit	W	Bit	Set/pulse to set the **SCADA Communications Watchdog Timeout** alarm class action to inhibit the inverter upon assertion of the alarm. Note: This setting is mutually exclusive with the other two (2) SCADA Communications Watchdog Timeout alarms' class actions control points. Setting this bit will momentarily inhibit the system as the setting is applied.	Pulse On
19	11020	ScadaWatchdogTimeoutAlarmTripOffline	W	Bit	Set/pulse to set the SCADA Communications Watchdog Timeout alarm class action to trip the system offline upon assertion of the alarm. Note: This setting is mutually exclusive with the other two (2) SCADA Communications Watchdog Timeout alarms' class actions control points. Setting this bit will momentarily inhibit the system as the setting is applied.	Pulse On
20	11021	ScadaWatchdogTimeoutAlarmWarning	W	Bit	Set/pulse to set the **SCADA Communications Watchdog Timeout** alarm class action to create a warning upon assertion of the alarm. Note: This setting is mutually exclusive with the other two (2) **SCADA Communications Watchdog Timeout** alarms' class actions control points. Setting this bit will momentarily inhibit the system as the setting is applied.	Pulse On
21	11022	IslandBreakerStatusSource	W	Bit	Defines the source of the island breaker status. 0 = Discrete I/O. 1 = SCADA.	Latch On/Off
22	11023	IslandBreakerStatus	W	Bit	Specifies the state of the island breaker - 0 is open, 1 is closed	Latch On/Off
23	11024	StartEmergencyFrequencyResponse	W	Bit	Pulse to turn on Emergency Frequency Response; this will use real power to compensate for frequency deviations	Pulse On
24	11025	StopEmergencyFrequencyResponse	W	Bit	Pulse to turn off Emergency Frequency Response.	Pulse On

DNP Implementation

This implementation of DNP and this section of documentation conform to the document "DNP V3.00 Subset Definitions," Version 2.00, available from the DNP Users Group.

1. **Device Profile Description**

   This section describes the compatibility of RED's implementation of DNP with other devices.

Table 17. Device Profile

DNP V3.00 DEVICE PROFILE DOCUMENT	
Vendor Name: RED Electric Company	
Device Name: RED Universal Interface	
Highest DNP Level Supported: For Requests - Level 2 For Responses - Level 2	Device Function: __ Master X Slave
Notable objects, functions, and/or qualifiers supported in addition to the Highest DNP Levels Supported (the complete list is described in the attached table): 8-Bit Unsigned Integers____ ____ ____ ____ ____	
Maximum Data Link Frame Size (bytes) Transmitted - 292 Received - 292	Max Application Fragment Size (bytes) Transmitted - 2048 Received - 2048
Maximum Data link Re-tries: X None __ Fixed at _________ __ Configurable, range 1 to 25	Maximum Application Layer Re-tries __ None __ Fixed at _________ X Configurable, range 0 to 10

Table 17. Device Profile—continued

```
Requires Data Link Layer Confirmation:
    X  Never
    __ Always
    __ Sometimes     If 'Sometimes', when?
    __ Configurable  If 'Configurable', how?
```

```
Requires Application Layer Confirmation:
    __ Never
    __ Always (not recommended)
    X  When reporting Event Data (Slave devices only)
    __ When sending multi-fragment responses (Slave devices only)
    __ Sometimes     If 'Sometimes', when?
    __ Configurable  If 'Configurable', how?
```

```
Timeouts while waiting for:
    Data Link Confirm        X  None  __ Fixed  __ Variable  __ Config
    Complete Appl. Fragment  __ None  X  Fixed  __ Variable  __ Config
    Application Confirm      __ None  __ Fixed  __ Variable  X  Config
    Complete Appl. Response  X  None  __ Fixed  __ Variable  __ Config
    Others ___________________________________________________________
    Attach explanation if 'Variable' or 'Configurable' was checked
    (see Note 1 below for explanation)
```

```
Sends/Executes Control Operations:
    WRITE Binary Outputs     X  Never  __ Always  __ Sometimes  __ Config
    SELECT/OPERATE           X  Never  __ Always  __ Sometimes  __ Config
    DIRECT OPERATE           X  Never  __ Always  __ Sometimes  __ Config
    DIRECT OPERATE - NO ACK  X  Never  __ Always  __ Sometimes  __ Config

    Count > 1                X  Never  __ Always  __ Sometimes  __ Config
    Pulse On                 X  Never  __ Always  __ Sometimes  __ Config
    Pulse Off                X  Never  __ Always  __ Sometimes  __ Config
    Latch On                 X  Never  __ Always  __ Sometimes  __ Config
    Latch Off                X  Never  __ Always  __ Sometimes  __ Config

    Queue                    X  Never  __ Always  __ Sometimes  __ Config
    Clear Queue              X  Never  __ Always  __ Sometimes  __ Config

    Attach explanation if 'Sometimes' or 'Configurable' was checked
    (see Note 2 below for explanation)
```

TABLE CONTINUED ►

Table 17. Device Profile—continued

<table>
<tr><td colspan="2">FILL OUT THE FOLLOWING ITEM FOR MASTER DEVICES ONLY:</td></tr>
<tr><td colspan="2">Master Expects Binary Input Change Events:
__ Either time-tagged or non-time-tagged for a single event
__ Both time-tagged and non-time-tagged for a single event
__ Configurable (attach explanation)</td></tr>
<tr><td colspan="2">FILL OUT THE FOLLOWING ITEMS FOR SLAVE DEVICES ONLY:</td></tr>
<tr><td>Reports Binary Input Change Events when no specific variation requested:
__ Never
X Only time-tagged
__ Only non-time-tagged
__ Configurable to send both</td><td>Reports time-tagged Binary Input Change Events when no specific variation requested:
__ Never
X Binary Input Change with Time
__ Bin In Change Relative Time
__ Configurable (explain)</td></tr>
<tr><td>Sends Unsolicited Responses:
__ Never
X Configurable (explain)
__ Only certain objects
__ Sometimes (explain)

__ ENABLE/DISABLE UNSOLICITED Function codes supported
(see Note 3 below)</td><td>Sends Static Data in Unsolicited Responses:
__ Never
__ When Device Restarts
X When Status Flags Change

No other options are permitted.

(see Note 3 below)</td></tr>
<tr><td>Default Counter Object/Variation:
__ No Counters Reported
__ Configurable (explain)
X Default Object - 20
Default Variation - 5
__ Point-by-point list attached</td><td>Counters Roll Over at:
__ No Counters Reported
__ Configurable (explain)
__ 16 Bits
X 32 Bits
__ Other Value __________
__ Point-by-point list attached</td></tr>
<tr><td colspan="2">Sends Multi-Fragment Responses (Slave Only): X Yes __ No</td></tr>
</table>

TABLE CONTINUED ►

(a) **NOTE 1: Timeouts While Waiting for Confirmations**

When an application layer response confirmation is requested, the Interface Module waits before either sending another response/confirmation attempt (if the retry number has not been reached) or stopping the confirmation process. The **Time Delay Between Retries** setting may be adjusted using the HMI.

(b) **NOTE 2: Control Operations Executed**

For all **Binary Output Relay** operations and **Analog Output** operations, the allowed control functions are:

- Select/Operate
- Direct Operate
- Direct Operate No Ack

The master station can choose which of these three functions to use at any given time.

The controls ignore the **On Time** and **Off Time** values and the **Queue** and **Clear** flags in the control code.

For more details, see the Control Relay Output Block section of the document object library in the DNP V3.00 Basic 4 Document Set, available from the DNP Users Group.

(c) **NOTE 3: Unsolicited Responses**

The controls return unsolicited responses to the configured master station address when a change occurs in any mapped status point configured for event reporting. The unsolicited responses are returned when the configured deadband is exceeded for any mapped analog input point configured for event reporting or when the configured deadband is exceeded for any mapped counter point configured for event reporting.

The delivery of unsolicited response messages may be controlled by adjusting the **Unsolicited Transmit Delay Event Count** setting and the **Unsolicited Transmit Delay Time** setting using the HMI.

Unsolicited responses may be enabled and disabled using the HMI; use function code 20 to enable and function code 21 to disable

Implementation Table

The following section describes the objects and requests accepted by this DNP implementation and the responses that are returned. Object, variation, and qualifier codes in the request must match exactly the tabulated codes. All application layer responses use the standard response function code 129.

Unsolicited responses, if configured, will always use function code 130. Included in the table is the default variation returned if no specific variation is requested. The default variation also applies to class data and unsolicited reports, where applicable.

Table 18. Implementation Table

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
1	0	Binary Input - All Variations	1	06	01
1	1	Binary Input	1	06	
1	2	Binary Input with Status	1	06	
2	0	Binary Input Change - All Variations	1	06,07,08	02
2	1	Binary Input Change without Time	1	06,07,08	
2	2	Binary Input Change with Time	1	06,07,08	
2	3	Binary Input Change with Relative Time (object parsed but no data to return)	1	06,07,08	
10	0	Binary Output - All Variations	1	06	02
10	1	Binary Output (object parsed but WRITE not used)			
10	2	Binary Output Status (only the on-line bit is used)	1	06	
12	0	Control Block - All Variations			
12	1	Control Relay Output Block	3,4, 5,6	17, 28	echo of request
12	2	Pattern Control Block			
12	3	Pattern Mask			

TABLE CONTINUED ▶

Table 18. Implementation Table—continued.

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
20	0	Binary Counter - All Variations	1,7,8 9,10	06	05
20	1	32-Bit Binary Counter	1	06	
20	2	16-Bit Binary Counter	1	06	
20	3	32-Bit Delta Counter			
20	4	16-Bit Delta Counter			
20	5	32-Bit Binary Counter without Flag	1	06	
20	6	16-Bit Binary Counter without Flag	1	06	
20	7	32-Bit Delta Counter without Flag			
20	8	16-Bit Delta Counter without Flag			
21	0	Frozen Counter - All Variations	1	06	09
21	1	32-Bit Frozen Counter	1	06	
21	2	16-Bit Frozen Counter	1	06	
21	3	32-Bit Frozen Delta Counter			
21	4	16-Bit Frozen Delta Counter			
21	5	32-Bit Frozen Counter w/ Time of Freeze			
21	6	16-Bit Frozen Counter w/ Time of Freeze			
21	7	32-Bit Frozen Delta Counter with Time of Freeze			
21	8	16-Bit Frozen Delta Counter with Time of Freeze			
21	9	32-Bit Frozen Counter without Flag	1	06	
21	10	16-Bit Frozen Counter without Flag	1	06	
21	11	32-Bit Frozen Delta Counter w/o Flag			
21	12	16-Bit Frozen Delta Counter w/o Flag			

TABLE CONTINUED ►

Table 18. Implementation Table—continued.

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
22	0	Counter Change Event - All Variations	1	06,07,08	05
22	1	32-Bit Counter Change Event w/o Time	1	06,07,08	
22	2	16-Bit Counter Change Event w/o Time	1	06,07,08	
22	3	32-Bit Delta Counter Chg Event w/o Time			
22	4	16-Bit Delta Counter Chg Event w/o Time			
22	5	32-Bit Counter Change Event with Time	1	06,07,08	
22	6	16-Bit Counter Change Event with Time	1	06,07,08	
22	7	32-Bit Delta Counter Chg Event w/ Time			
22	8	16-Bit Delta Counter Chg Event w/ Time			
23	0	Frozen Counter Event - All Variations			
23	1	32-Bit Frozen Counter Event w/o Time			
23	2	16-Bit Frozen Counter Event w/o Time			
23	3	32-Bit Frozen Delta Count Evt w/o Time			
23	4	16-Bit Frozen Delta Count Evt w/o Time			
23	5	32-Bit Frozen Counter Event w/ Time			
23	6	16-Bit Frozen Counter Event w/ Time			
23	7	32-Bit Frozen Delta Count Event w/ Time			
23	8	16-Bit Frozen Delta Count Event w/ Time			
30	0	Analog Input - All Variations	1	06	04
30	1	32-Bit Analog Input	1	06	
30	2	16-Bit Analog Input	1	06	
30	3	32-Bit Analog Input without Flag	1	06	
30	4	16-Bit Analog Input without Flag	1	06	

TABLE CONTINUED ▶

Table 18. Implementation Table—continued.

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
31	0	Frozen Analog Input - All Variations			
31	1	32-Bit Frozen Analog Input			
31	2	16-Bit Frozen Analog Input			
31	3	32-Bit Frozen Analog Input with Time of Freeze			
31	4	16-Bit Frozen Analog Input with Time of Freeze			
31	5	32-Bit Frozen Analog Input without Flag			
31	6	16-Bit Frozen Analog Input without Flag			
32	0	Analog Change Event - All Variations	1	06,07,08	04
32	1	32-Bit Analog Change Event without Time	1	06,07,08	
32	2	16-Bit Analog Change Event without Time	1	06,07,08	
32	3	32-Bit Analog Change Event with Time	1	06,07,08	
32	4	16-Bit Analog Change Event with Time	1	06,07,08	
33	0	Frozen Analog Event - All Variations			
33	1	32-Bit Frozen Analog Event without Time			
33	2	16-Bit Frozen Analog Event without Time			
33	3	32-Bit Frozen Analog Event with Time			
33	4	16-Bit Frozen Analog Event with Time			
40	0	Analog Output Status - All Variations	1	06	02
40	1	32-Bit Analog Output Status	1	06	
40	2	16-Bit Analog Output Status	1	06	
41	0	Analog Output Block - All Variations			
41	1	32-Bit Analog Output Block	3,4, 5,6	17, 28	echo of request
41	2	16-Bit Analog Output Block	3,4, 5,6	17, 28	echo of request

TABLE CONTINUED ▶

Table 18. Implementation Table—continued.

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
50	0	Time and Date - All Variations			
50	1	Time and Date	2	07 where quantity=1	
50	2	Time and Date with Interval			
51	0	Time and Date CTO - All Variations			
51	1	Time and Date CTO			
51	2	Unsynchronized Time and Date CTO			
52	0	Time Delay - All Variations			
52	1	Time Delay Coarse (response for a restart request)	13		
52	2	Time Delay Fine (response for a delay measure request)	23		
60	1	Class 0 Data	1	06	
60	2	Class 1 Data	1	06,07,08	
60	3	Class 2 Data	1	06,07,08	
60	4	Class 3 Data	1	06,07,08	
80	1	Internal Indications	2	00 index=7	
81	1	Storage Object			
82	1	Device Profile			
83	1	Private Registration Object			
83	2	Private Registration Object Descriptor			
90	1	Application Identifier			

TABLE CONTINUED ▶

Table 18. Implementation Table—continued.

OBJECT			REQUEST		RESPONSE
Obj	Var	Description	Func Code (dec)	Qualifier Codes (hex)	Default Var. (hex)
100	1	Short Floating Point			
100	2	Long Floating Point			
100	3	Extended Floating Point			
101	1	Small Packed Binary-Coded Decimal			
101	2	Medium Packed Binary-Coded Decimal			
101	3	Large Packed Binary-Coded Decimal			
102	0	8-Bit Unsigned Integer			
102	1	8-Bit Unsigned Integer	1,2	04	
		No Object	13		
		No Object	23		

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