Patent Number 8067851

DB1™ Differential Pressure Battery Charger

Installation, Operation, & Maintenance (I.O.M.) Manual

ZEUS POWER SYSTEMS

Parker PGI

ENGINEERING YOUR SUCCESS.

Notes

The information contained in this manual may be revised without notice. Refer to the Parker PGI website for current revision.

Parker Hannifin Corporation
Instrumentation Group
PGI Division
16101 Vallen Drive
Houston, Texas 77041

 WARNING — USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker Hannifin Corporation, its subsidiaries and authorized distributors provides product or system options for further investigation by users having technical expertise.

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.

To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Table of Contents

List of Figures

List of Tables

1 Product Overview

1.1 Introduction to the DB1 Differential Pressure Battery Charger

The DB1 Differential Pressure Battery Charger from Parker PGI is an efficient and reliable alternative to solar panel systems that are used to power electronic instruments on gas pipelines. The DB1 continuously monitors the battery's temperature and charge level and can produce up to 50 watts to keep the battery charged. In applications where a lead acid battery is used to provide high peak power for short burst requirements (such as for wireless communications at remote monitoring sites), the DB1 can produce a 12 or 24 volt power output to keep the battery fully charged.

Unlike solar panels, the DB1 can be installed in almost any location where adequate differential pressure exists, and it is not affected by environmental factors such as shade, snow, freezing rain, ice, dust buildup, or birds.

Figure 1-1. DB1 differential pressure battery charger

1.1.1 System Components

The DB1 system consists of three main components: the generator, the controller, and the battery interface module (Figure 1-2 below).

Figure 1-2. DB1 components

The battery charger system uses the differential pressure developed across a pressure reducing device on natural gas pipelines to run a small turbine-powered generator. The generator output can be used to charge a lead acid battery, similar to the thermo-electric chargers (TECs) from Parker PGI. Unlike the TECs, the DB1 does not consume any natural gas. Power is produced by allowing a small portion of the gas to flow through a turbine, bypassing the pressure reducing device. In relation to the total line flow, the amount of gas flow through the DB1 turbine is low. The amount of gas flow is also stable, keeping the DB1 transparent to the pressure. The pressure reducing device automatically adjusts for the slight decrease in flow resulting when the DB1 runs. Controlled by a microprocessor, the power generated provides the ideal temperature compensated battery charging current and voltage to the battery.

The controller provides the ON / DISABLE switch, connectors for field wiring, status and alarm LEDs, and the connection for the diagnostic cable to the PC for system setup and monitoring via the DB Monitor software.

The battery interface module contains the battery temperature sensor, over-current protection, and the battery interface wiring terminal.

The generator and the controller each have a microprocessor. By using separate microprocessors, the generator can monitor itself and the communications link to the controller and shut the control valve using power from the generator (until the turbine stops) if necessary. The generator will monitor the RPM, the charge current, the control valve position, and the input voltage while controlling the valve motor and the optional flow restrictor. All other parameters (battery voltage, battery temperature, remote shutdown (RSD) input, alarm output, status LEDs) are monitored and managed by the controller microprocessor.

1.1.2 Features

- Powered by natural gas to 1,440 psig system pressures.
- Start-up and diagnostics controlled by microprocessor.
- Integrated temperature compensated charger with remote battery temperature sensor.
- User-configurable operating parameters.
- Status output for remote monitoring.
- Generator can be mounted directly on the pipeline or via optional 2” pipe mount. Controller can be wall mounted.
- 10, 20, or 50 watts of charging power.
- Charge either 12 volt or 24 volt batteries (detected and set by the controller).
- Input to allow a switch or remote shutdown device (RSD) to disable the system. Signal may need to go through a barrier if connected to an intrinsically safe device in the hazardous location (the RSD is a failsafe feature that allows for remote activation / deactivation of the DB1).
- Status and alarm LEDs. Reference “LEDs” (page 19) for detailed descriptions.
- ON / DISABLE switch.
- RUN command regardless of battery voltage.
- Two configurable open collector alarm outputs. Reference “Alarm Contacts” (page 19) for a detailed description.
- Event log with battery voltage, date, and time stamp (1,000 events).
- Turbine maintenance log and maintenance timer to track service due.
- Safely shut down the turbine if any wires between the generator and controller are cut or disconnected or if the battery is disconnected.

- RS-485 Serial / Ethernet MODBUS communication protocol. (COM option)
- Can handle up to 8% H2S and 8% CO2 in gas stream. (SVR option)

1.1.3 Models

- DB1-10: 10 watts maximum
- DB1-20: 20 watts maximum
- DB1-50: 50 watts maximum

1.1.4 Options

- VCH: Carbon steel remote mount kit for mounting to 2” Pipe Stand
- VSH: Stainless steel remote mount kit for mounting to 2” Pipe Stand
- COM: RS-485 Serial / Ethernet MODBUS communication protocol
- SVR: Severe Service package for up to 8% H2S and 8% CO2 in gas stream

1.1.5 Accessories

- SK-DB1-003: Diagnostics cable
- P8-214-A0: 3/4” NPT pipe union
- P8-215-C0: 1/2” 316 ss ball valve
- SS-C9E-500-CL: 0 – 2,000 psi gauge
- SS-C9E-516-CL: 0 – 300 psi gauge
- SS-C9E-517-CL: 0 – 600 psi gauge
- SS-C9E-518-CL: 0 – 1,000 psi gauge

Note: All gauges are 316 ss, liquid-filled, 1/4” MNPT center back mount with a 2-1/2” dial.

1.2 Requirements for Start-Up

The requirements for DB1 start-up are listed below. Failure to meet any of the requirements will result in failure to start or improper operation. Repeated attempts at start-up may drain the battery voltage to a level below the start-up requirement (10 V for a 12 V system and 20 V for a 24 V system).

1. **An adequate pressure differential.**

   A minimum pressure differential of 65 psig is required to operate the DB1 at 10 watts (85 psig to operate at 20 watts or 125 psig to operate at 50 watts). The power output will drop as the differential pressure is reduced. The maximum inlet pressure is 1,440 psig.

2. **A properly sized battery.**

   A properly sized battery is necessary for optimum performance of the DB1. If the battery is too small, it will drain and charge very quickly, leading to short cycling of the DB1 and reduced battery life.

3. **A properly charged battery.**

   A drained battery may not provide enough voltage to allow communication between the controller and the generator. If the battery voltage is less than 10 volts for a 12 volt system or less than 20 volts for a 24 volt system, charge or replace the battery, and then restart the DB1.

1.3 DB1 Performance

The DB1 battery charger uses the differential pressure developed across a pressure reducing device on natural gas pipelines to run a small turbine-powered generator. DB1 performance is based on two factors:

(1) There must be a differential pressure in excess of 65 psig between the inlet side and the outlet side of the DB1 to operate at 10 watts (85 psig for 20 watts or 125 psig for 50 watts).

(2) The amount of current generated is directly proportional to the wattage of the DB1 (10, 20, or 50 watts).

Following is a list of conditions that affect these two factors.

1. **The differential pressure available to activate the turbine.**

   The inlet tubing must have a minimum inside diameter of 3/8", and the outlet tubing must have a minimum inside diameter of 1/2". Improperly sized tubing can cause flow restrictions that could affect the differential pressure.

2. **The angle of installation.**

   It is recommended that the DB1 generator be installed in an upright position.

3. **A change in differential pressure.**

   Changes in differential pressure could affect the output power of the generator.

4. **A high supply gas pressure.**

   Supply gas higher than 1,440 psig will exceed the rated pressure capability of the generator, causing the DB1 to fail.

5. **Exposure to wet and cold gas.**

   Moisture in the gas supply, along with a low gas temperature, can cause icing / freezing of the gas that will affect the spinning of the turbine.

1.4 Specifications

Table 1-1. DB1 specifications

Hazardous Location Classification	Class I, Division 1, Group D certified
Charger output	12 / 24 V (temperature compensated) for lead acid batteries
Output power when charging	10 / 20 / 50 W continuous at 68°F (20°C) ambient
Remote battery temperature sensor	Silicone diode
Alarm status and notification	LED and (2) NPN open collectors 30 V, 200 mA maximum
Transient protection	Bi-directional TVS 1,500 watts peak pulse power
Battery short circuit protection	10 amp PTC over-current protection
Electrical connections	(2) 1/2” rigid conduit openings, explosion proof
Wire connections	Terminal strip with screw clamp 14 AWG maximum
Communication	RS-485 Serial / Ethernet MODBUS protocol
Inlet gas supply pressure	1,440 psig maximum
Gas flow during charge cycle	30 scfm at 10 W / 40 scfm at 20 W / 65 scfm at 50 W
Gas supply connections	Inlet: 3/8” OD stainless steel tubing Outlet: 3/4” FNPT
Operating temperature range	-40°F to 140°F (-40°C to 60°C)
Enclosure	Cast Alum A356-T6, 316 SS NEMA 4X
Mounting configurations of generator	Direct mount or optional 2” pipe mount
Weight	15 lbs.

2 Installation

2.1 Notes for Optimal Performance

WARNING!

The electrical connections between the generator and the controller / battery interface must be through conduit with an explosion proof wire seal fitting at the generator end.

WARNING!

Connections between the generator and controller must be through conduit with an explosion proof wire seal fitting at the generator end.

WARNING!

The generator shall be installed on or near the pipeline, typically in a Division 1 or 2 hazardous location. The controller and battery interface module will be mounted near the battery in a safe non-hazardous location.

WARNING!

Failure to comply could result in serious injury and even death!

IMPORTANT!

The inlet and outlet valves should be closed during installation.

Following are installation guidelines to be followed that will ensure optimal performance of the DB1 system. The recommended system installation is shown in Figure 2-1 (page 16).

1. The DB1 generator must be installed across a pressure reducing device that will result in a minimum pressure differential of 65 psig between the inlet side and the outlet side for a 10 W unit (85 psig for 20 W or 125 psig for 50 W).
2. In order to achieve the necessary flow through the generator, it is very important that full opening ball valves be installed at the inlet and outlet.
3. Install the generator in an upright position. If constraints exist, however, the generator may be installed on an angle not to exceed 45° off vertical.
4. Blow out any existing ball valves prior to connecting the tubing.
5. A new run of tubing may contain small metal shavings that could jam the turbine. Blow out the tubing prior to connecting it to the battery generator.
6. The inlet should be located on the pipeline before any gate valves to prevent interruption of the pressure source (which would disable the DB1 system).
7. Use 3/8” minimum tubing on the inlet side.
8. Use 1/2” minimum tubing or pipe on the outlet side.
9. To visually verify that the unit is “seeing” the required input pressure, it is recommended that a pressure gauge adequate for operating conditions be installed as close to the inlet side of the generator as possible. A recommended pressure gauge is listed in “Accessories” (page 11).

10. For direct mount systems, it is recommended that a pipe union be installed between the generator and the full opening gate valve. This will facilitate removal and mounting.
11. The controller should be mounted near the battery in a safe area location.
12. The battery interface module should be mounted directly on or as close as possible to the battery.

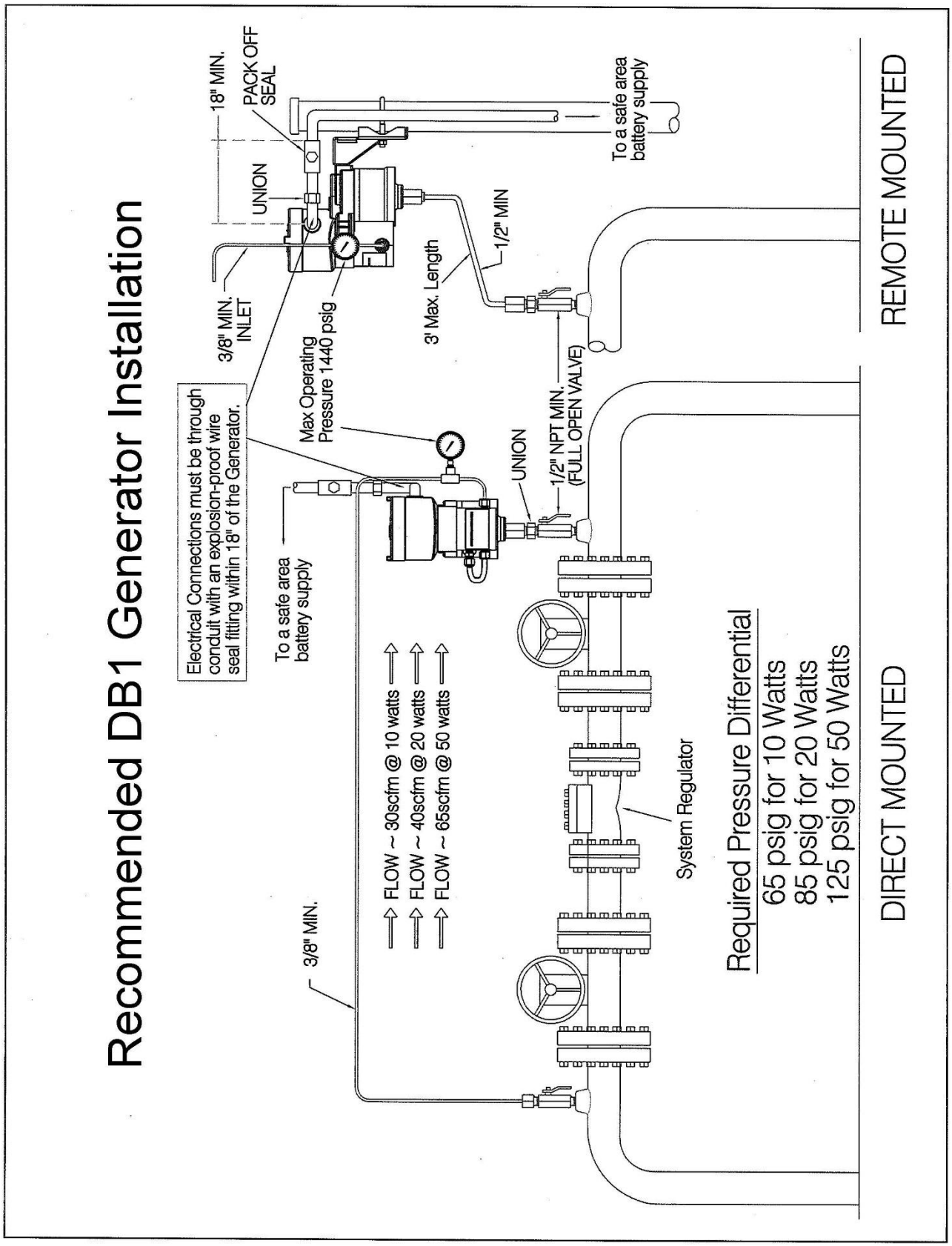

Figure 2-1. Recommended system installation

2.2 Field Wiring Connections

To interface the DB1 generator with the external battery it will keep charged, a 30’ cable and a battery interface module is provided. The 30’ cable will be used to connect the generator to the controller. Cut off any excess and use it to connect the controller to battery interface module. Connections are shown in Figure 2-2 (page 18).

The generator will not start with a dead battery. In order for the generator to start, the battery to be charged must measure greater than 10 V for a 12 V system and greater than 20 V for a 24 V system.

The battery interface module contains a temperature sensor and over-current protection and should be attached directly onto or as close as possible to the battery being charged.

The components listed in Table 2-1 below may be purchased separately.

Table 2-1. Additional components for field wiring

Component	**Part Number**	**Cable Specification**
Battery interface cable, 30’	SS-C85-1553	2 conductor: 14 AWG unshielded Alpha Wire 1891C SL005 or equivalent
Generator to controller interface cable, 30’	SS-C85-1468	3 conductor: 20 AWG shielded Alpha Wire 2413C SL005 or equivalent

⚠ WARNING! ⚠

Ensure the DB1 power switch is in the DISABLE position and the battery (+) lead is disconnected prior to making field connections!

⚠ WARNING! ⚠

Connect the DB1 side first. Then connect the remote battery.

Note: Refer to Section A.2.2 (page 45) for field wiring of the COM communication option.

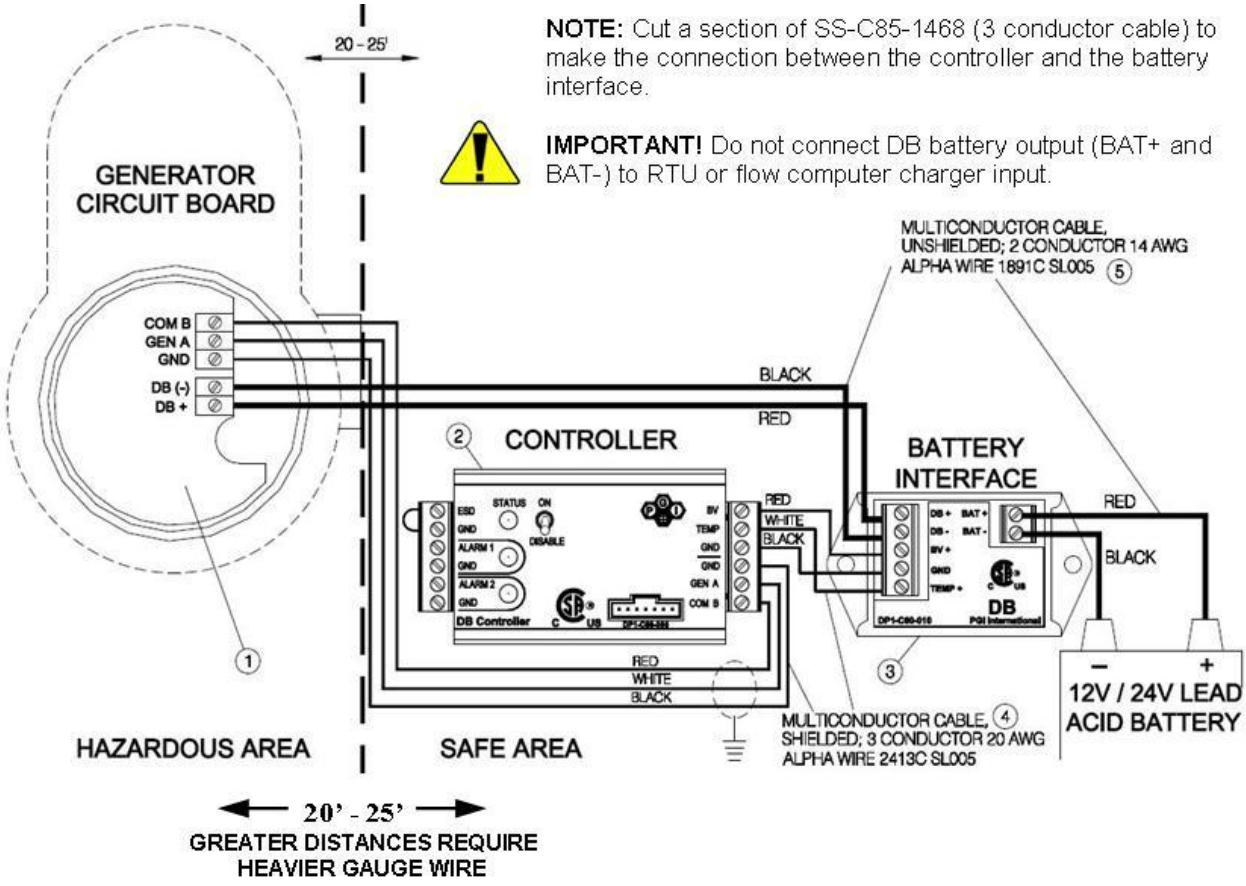

Figure 2-2. Field wiring connections

3 Operating Instructions

3.1 Overview

The DB1 controller provides the operator with visual indicators of system status and alarm conditions via the LEDs. The operator can access this and other information by connecting the diagnostics cable from the communication port on the controller to a PC that has the DB Monitor software installed.

This chapter provides information on the operating features of the DB1 controller and instructions for software configuration and starting up the DB1 system.

3.2 DB1 Controller

The DB1 controller provides the ON / DISABLE switch, status and alarm LEDs, and the communication port for connecting the diagnostics cable.

The controller toggle switch does not remove power from the DB1 system. The controller will continue to function when the switch is in the DISABLE position, but the generator will not be allowed to run or open the control valve. If the switch is moved to the DISABLE position while the unit is charging, the control valve will be closed and disable charging.

3.2.1 LEDs

The controller has three LEDs: the status LED (STATUS) and two alarm output LEDs (OUT1, OUT2). See Figure 3-1 below.

Figure 3-1. Controller LEDs

Table 3-1 below lists the conditions indicated by the status LED.

Table 3-1. Conditions indicated by status LED

Condition	**Indicated by**
Standby: The toggle switch is in the ON position, but the generator is not running.	Flashing green.
Charging: The generator is running.	Solid green.
Shutdown: The system has been disabled.	Flashing red.
Waiting to Retry: No generator output detected. System waiting to retry.	Flashing yellow.

Table 3-2 below lists the conditions indicated by the two alarm output LEDs.

Table 3-2. Conditions indicated by alarm output LEDs

Condition	**Indicated by**
No alarms.	OFF.
Minor alarm: A warning. The DB1 generator may continue to function.	Flashing yellow.
Major alarm: The DB1 generator will be disabled (shut down).	Flashing red.
Minor and major alarm conditions exist simultaneously.	Flashing red and yellow alternately.

3.2.2 Alarm Contacts

The open collector alarm output can be used to remotely monitor DB1 health. When the output is “shorted,” the DB1 generator is healthy. If the alarm circuit is “opened,” the generator has either been disabled or has shut down and is no longer charging the battery. There are several tests performed on the generator to detect malfunctions and to safely shut down the system. If the generator shuts down, the battery will continue to power the connected device for a period of time determined by the battery size and device power requirements.

The alarm outputs are configurable and can be used to indicate major and minor alarms. In the event of a major alarm, the system will be disabled. A minor alarm serves as a warning of undesirable conditions. The DB1 system will continue to function during a minor alarm condition. Table 3-3 (page 21) lists the major and minor alarms.

Table 3-3. Alarm conditions indicated by alarm outputs

Condition	**Alarm Type**
Lost generator communication.	Major, non-latched.
Control valve is full open but no RPM detected.	Major, latched.
Control valve failed.	Major, latched.
Generator RPM or voltage output too high.	Major, latched.
Turbine RPM sensor failed.	Major, latched.
Control valve position sensor failed.	Major, latched.
ON / DISABLE switch in DISABLE position.	Minor, non-latched.
Unable to generate maximum power with control valve full open.	Minor, latched.
Generator run time service due.	Minor, latched.
RSD input detected.	Minor, non-latched.
Temperature sensor failed.	Minor, non-latched.
Unable to reach full charge.	Minor, non-latched.
MODBUS shutdown.	Minor, latched.

3.3 The DB Monitor Software

3.3.1 Diagnostics Cable

A diagnostics cable (SK-DB1-003) is provided to enable communication between the DB1 and the DB Monitor software. Connect one end of the cable to a USB port on the PC that will be used and the other end to the communication port on the controller. Figure 3-2 below shows the diagnostics cable.

Note: For information on the COM communication option, refer to Appendix A (page 41).

Figure 3-2. Diagnostics cable

3.3.2 Installing the Software

1. Install the DB Monitor software from the CD provided or the Parker PGI web site (www.pgiint.com).
2. Connect the USB end of the diagnostics cable (SK-DB1-003) to a USB port on the PC. Connect the other end of the cable to the communication port on the DB1 controller, shown below in Figure 3-3.

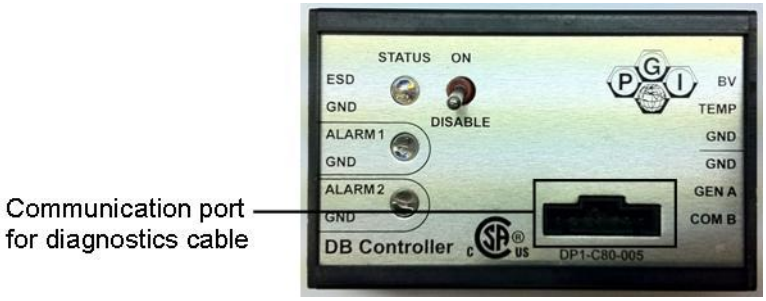

Figure 3-3. Communication port

3. Double-click the **DB Monitor** icon to start the program. The I.D. screen will be displayed. See Figure 3-4 (page 23).

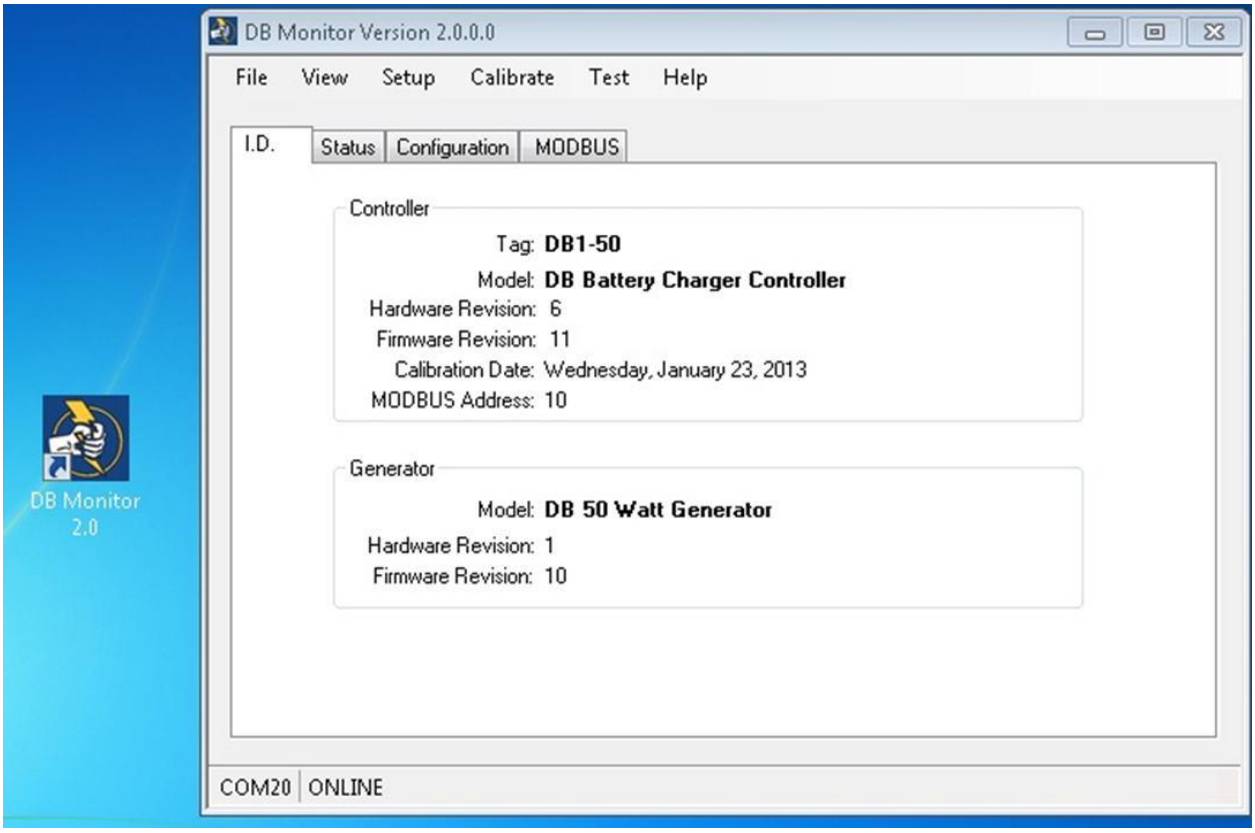

Figure 3-4. DB Monitor icon and I.D. screen

3.3.3 The Start-Up Screen

When you open the DB Monitor software, the start-up screen appears. Four tabs are displayed:

- I.D.: The I.D. tab displays controller and generator information. See Figure 3-4 above for an example.
- Status: The Status tab displays the present state of the generator and battery. The Status tab is discussed later in "Preparing for Start-Up" (page 27).
- Configuration: The Configuration tab allows you to edit system configuration and alarms. The Configuration tab is discussed later in "Preparing for Start-Up" (page 27).
- MODBUS: Refer to Appendix A (page 41) for information on the COM communication option.

3.3.3.1 The Menu Bar

The menu bar consists of the following main menus: File, View, Setup, Calibrate, Test, and Help.

File

Access the File menu to connect to the DB1 or exit the software. See Figure 3-5 below.

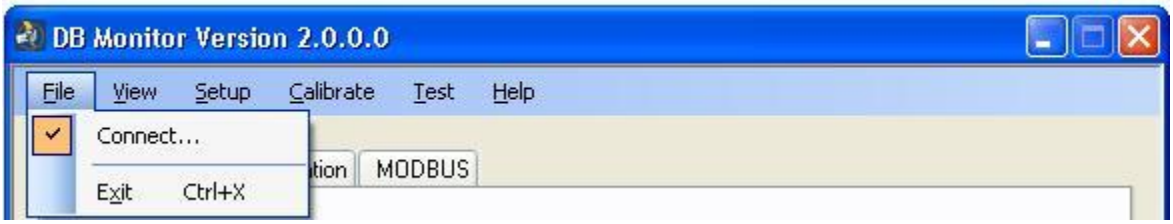

Figure 3-5. File menu

View

Access the View menu (Figure 3-6 below) to view the DB Gauges screen and event log.

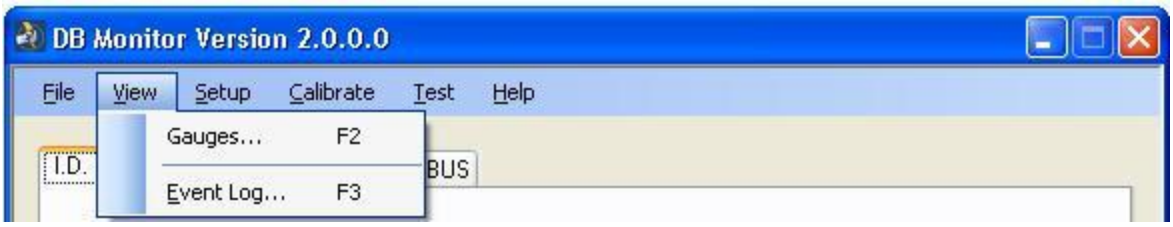

Figure 3-6. View menu

DB Gauges screen

The DB Gauges screen graphically displays the status of the battery and charger. An example is shown below in Figure 3-7.

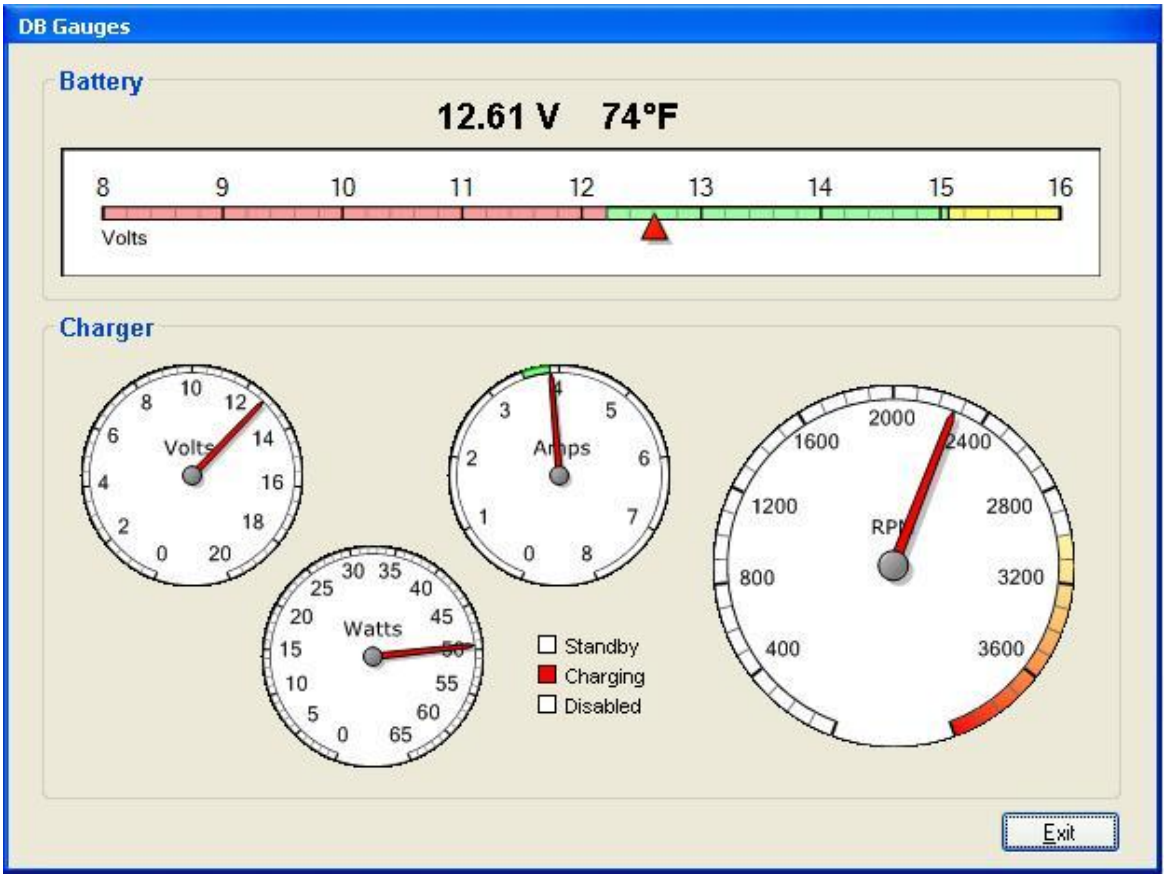

Figure 3-7. DB Gauges screen

Event Log screen

The Event Log screen can display up to 1,000 events. The date, time, and battery volts for each event are also displayed. See Figure 3-8 below for an example. The following events can be logged:

- Start time
- Stop time
- Alarms
- Remote shutdown
- ON/DISABLE switch was switched
- Run or disable commands were turned on and off
- The cable was cut or interface malfunction shutdown. Lost communication link.

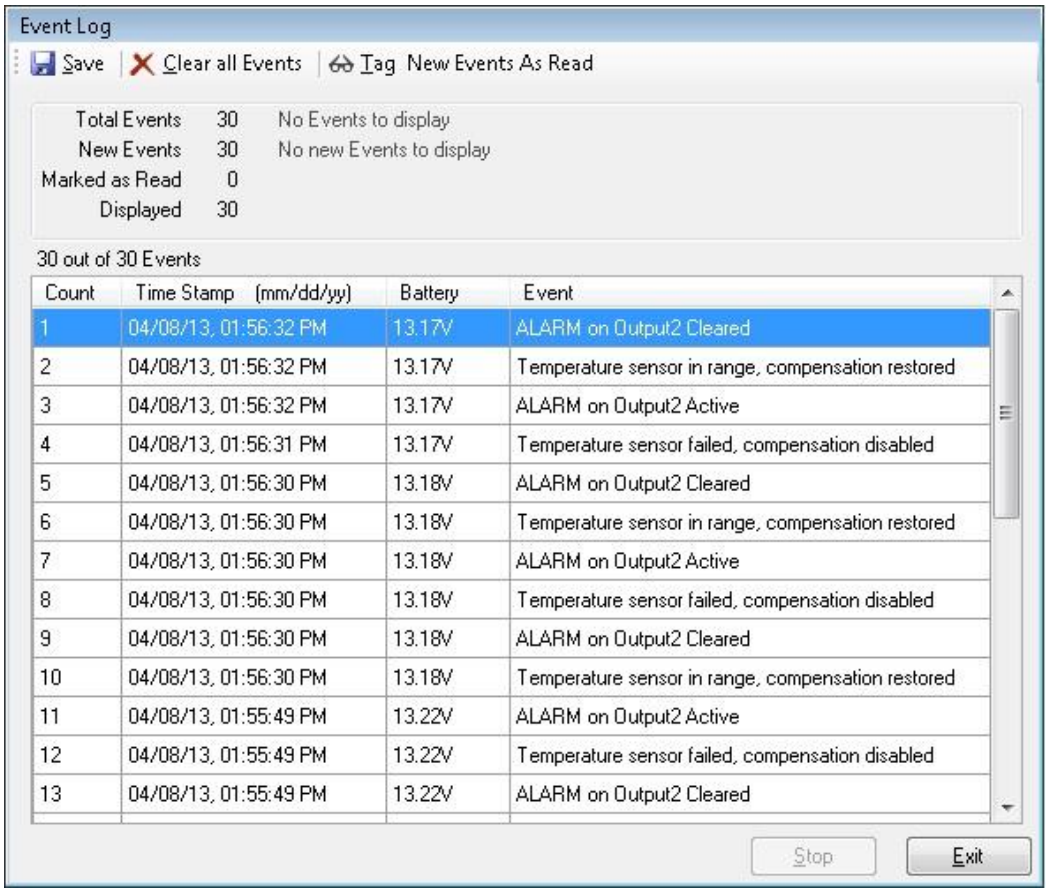

Figure 3-8. Event Log screen

Setup

System setup is discussed later in “Preparing for Start-Up” (page 27).

Calibrate

Calibration is discussed later in “Preparing for Start-Up” (page 27).

Test

Testing is addressed later in “System Tests” (page 35).

Help

The Help menu provides access to the About screen, which displays software information. See Figure 3-9 and Figure 3-10 below.

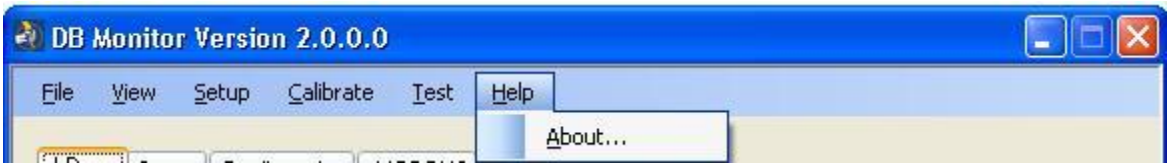

Figure 3-9. Help menu

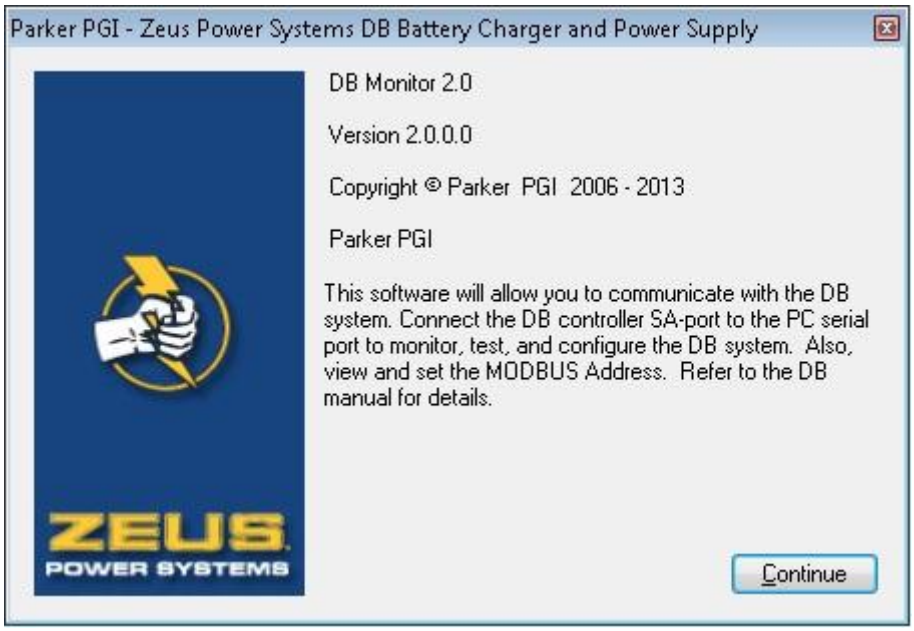

Figure 3-10. About DB Monitor screen

3.4 Preparing for Start-Up

Prior to starting up the DB1 system, follow the procedure below to set up the DB Monitor software.

1. From the menu bar, click **Setup > Tag Name** (or press the **F9** key). See Figure 3-11 below.

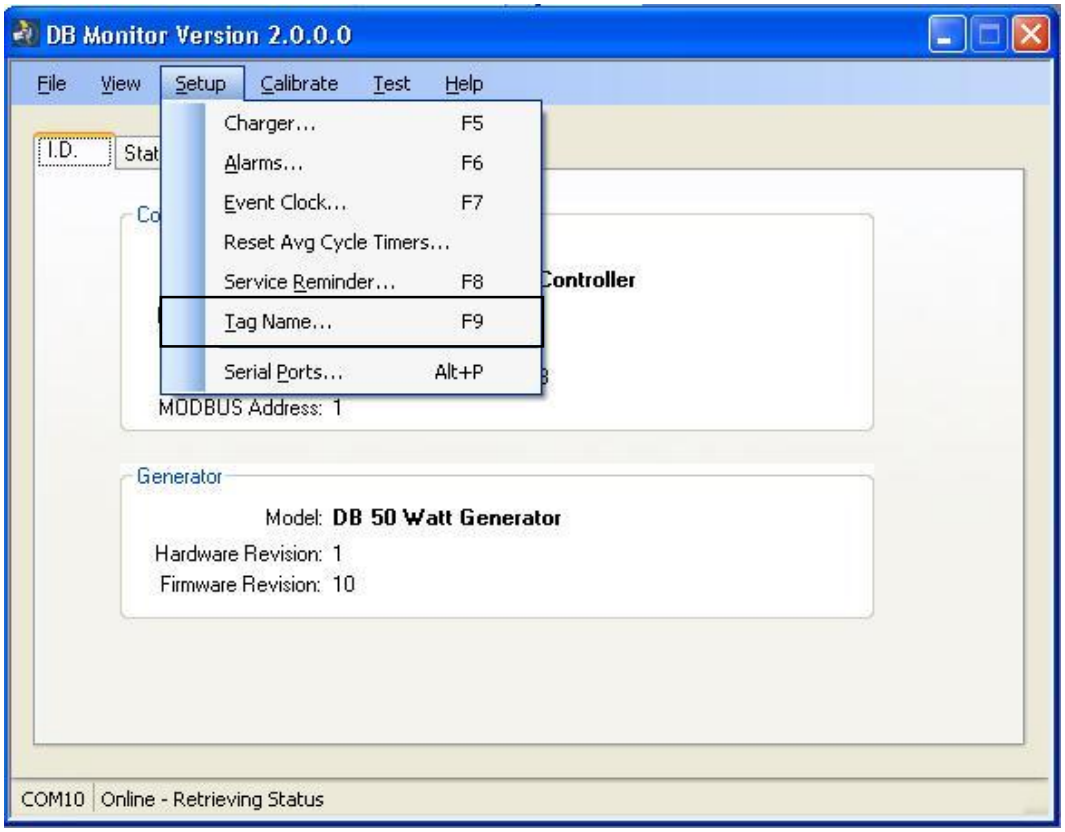

Figure 3-11. Select Tag Name from DB Monitor Setup menu

2. In the text box type in a unique description of the DB unit (i.e. location, number, etc.). Click **DB Save**. See Figure 3-12 below.

Figure 3-12. Edit DB Controller Tag Name text box

3. Click **Setup > Charger** (or press **F5**). On the Setup Charger screen (Figure 3-13 below), set up the following:
   - Battery type: Select **12 Volt Lead Acid** or **24 Volt Lead Acid**.
   - Temperature scale: Select **Fahrenheit** or **Celsius**.
   - Remote shutdown: If a remote shutdown device will be used, click the **Enable RSD Input** checkbox.

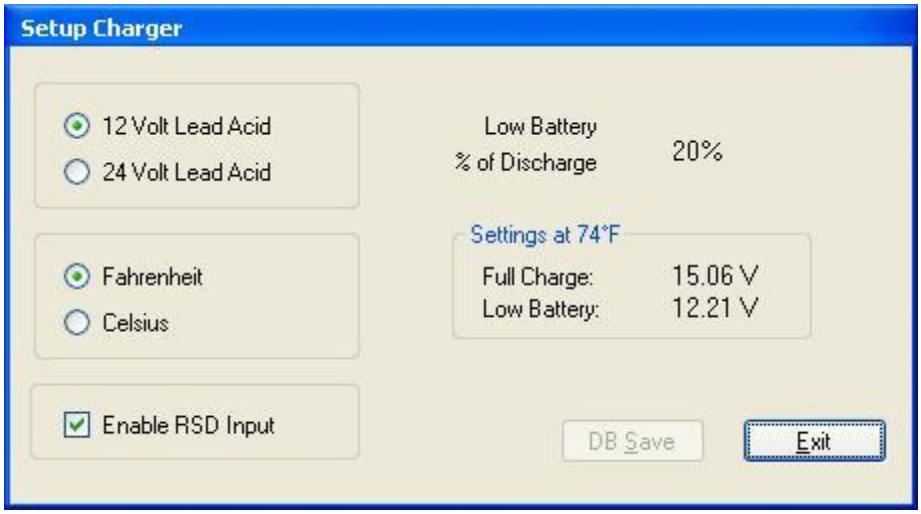

Figure 3-13. Setup Charger screen

4. Click **DB Save** to save the changes or **Exit** to discard them.
5. Click **Setup > Alarms** (or press **F6**). The Setup Alarms screen will be displayed. This screen displays the list of alarms that notify the technician of undesirable conditions. The recommended settings are shown in Figure 3-14 (page 29).

   Note the following:
   - A major alarm will disable the charger.
   - The alarm LED will flash red to indicate a major alarm or yellow to indicate a minor alarm. For more on the alarm LEDs, refer to "Alarm Contacts" (page 20).
   - Latched alarms require the technician to make repairs and reset the charger to clear the alarm. Non-latched alarms will be cleared automatically after the condition is removed.

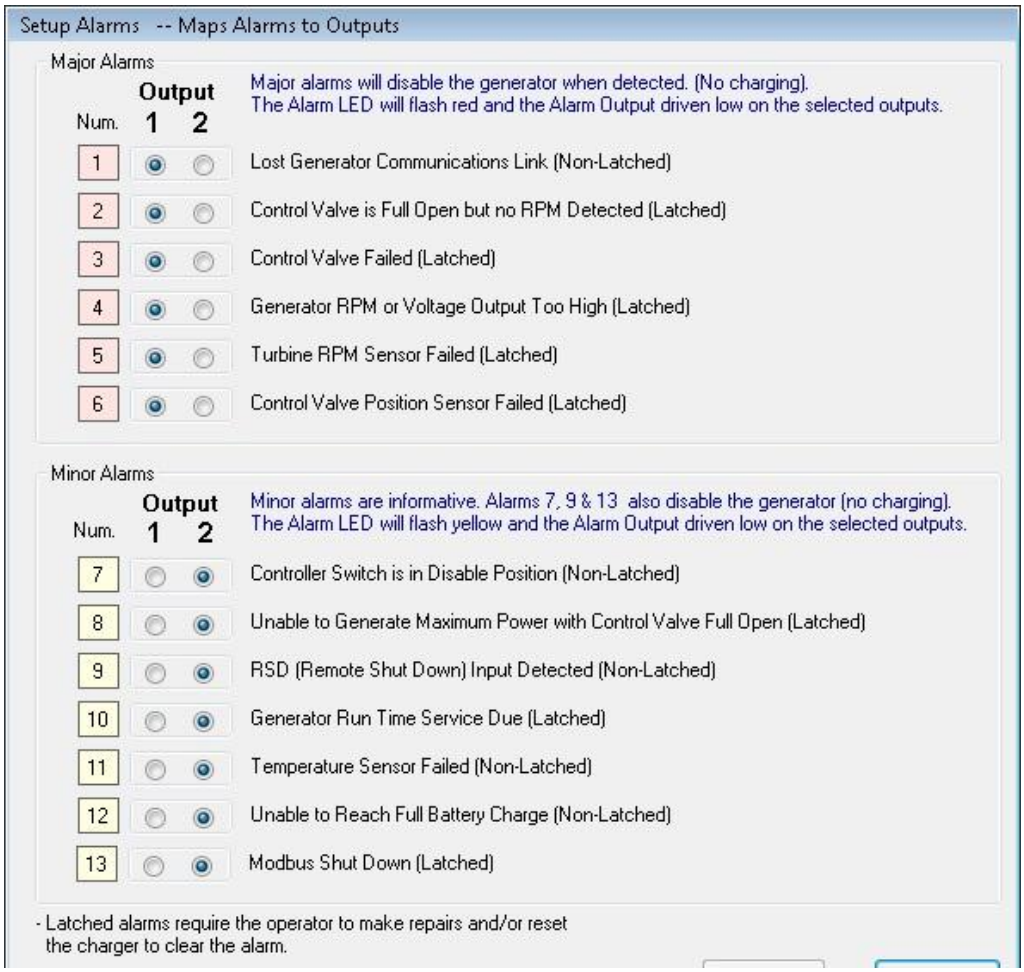

Figure 3-14. Setup Alarms screen

6. From the menu bar, click **Setup > Event Clock** (or press **F7**). The Set Event Clock box (Figure 3-15 below) will display the time and date on the PC. Click **DB Save** to set the event clock.

Figure 3-15. Set Event Clock screen

7. Click **Setup > Service Reminder** (or press **F8**). The Setup Service Reminder box will appear (Figure 3-16 below). It is recommended that the service reminder be set at 5000 hours. Click **DB Save** to save the change.

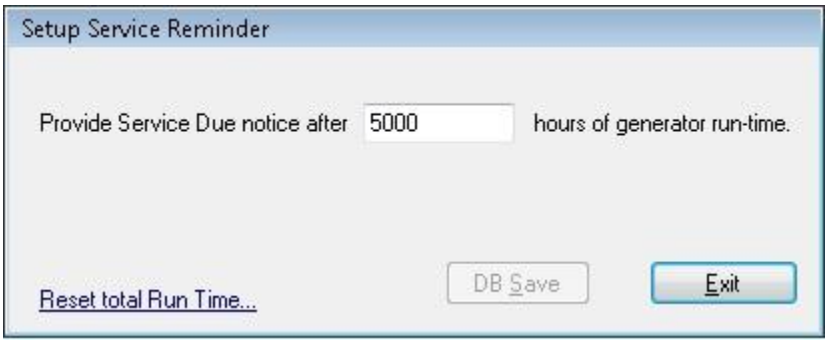

Figure 3-16. Setup Service Reminder screen

8. From the menu bar, click **Calibrate > Battery Volts** (Figure 3-17 below).

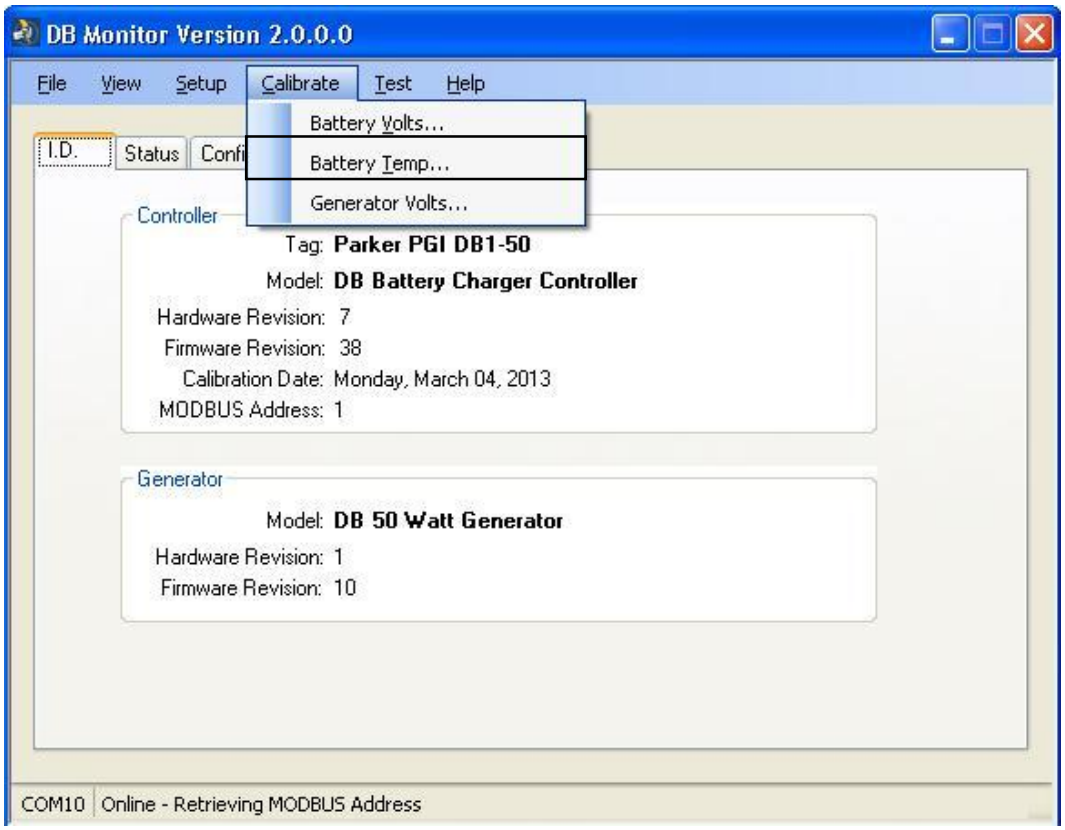

Figure 3-17. Select Battery Volts from Calibrate menu

9. Use a voltmeter to measure the actual battery voltage. Enter that value into the text box on the Calibrate Battery Monitor screen (Figure 3-18 below). Click **Update** to save.

IMPORTANT!

If the initial value in the text box matches the voltmeter reading, enter the value again and click DB Save. This will capture and save all the data values. Otherwise, the default values will reappear if the controller is disabled.

Note: When the Battery Volts value is changed, the calibration date will also change.

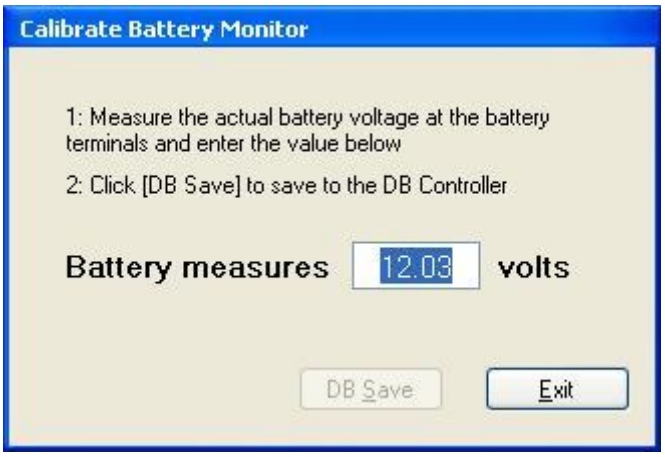

Figure 3-18. Calibrate Battery Monitor screen

10. From the menu bar, click **Calibrate > Battery Temp** (Figure 3-19 below). Measure the temperature near the battery, and enter the value in the text box provided. Click **DB Save** to save the value.

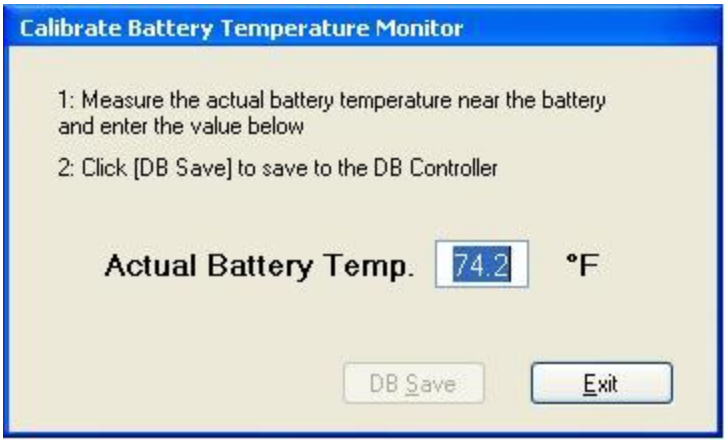

Figure 3-19. Calibrate Battery Temperature screen

11. Click **Calibrate > Generator Volts** (Figure 3-20 below). With the generator in standby (controller switch set to DISABLE), measure the battery voltage and enter the value in the text box provided. Click **DB Save** to save the value.

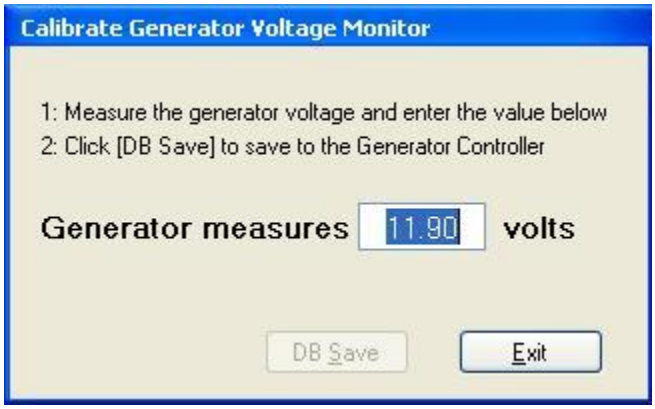

Figure 3-20. Calibrate Generator Voltage Monitor screen

12. Click the **Status tab** to view the present state of the generator and battery. An example of the information displayed is shown in Figure 3-21 (page 33).

- In the Battery block of the Status screen, the present state of the battery (12.55 volts) and the battery temperature (73°F) are displayed.
- To view a chronological list of events, click **# New Events** (125 new events in the example shown).
- If an alarm condition exists, it will be indicated in the Alarm 1 or Alarm 2 block. To display the alarm descriptions, click the **Configuration tab** (Figure 3-22, page 33).
- The Charger block contains two sections: Setpoints and Generator. Under Setpoints, the Full Charge, Low Battery, and Charge Current values are displayed. When the DB1 controller switch is toggled to the ON position and the battery voltage (displayed in the Battery block) drops below the low battery value, the controller will determine the charge current necessary to reach the full charge value. The generator will attempt to match the calculated charge current. The control valve will open until the turbine reaches the speed at which the milliamps produced by the generator equals the required charge current. The control valve will remain open until the full charge value is achieved.

  Note: (1) The amount of charge delivered to the battery is calculated with consideration to the battery temperature. (2) Conditions may exist that can cause inconsequential fluctuations in the current produced.

  Under the Generator section of the Charger block, the Charging, Avg Charge Time, Avg Discharge Time, Avg Total Cycle Time, and Total Run Time values are displayed. The charging values show the status of the generator as it attempts to match the calculated charge current. The average charge, average discharge, and average total cycle times are used to calculate the total run time since the last configuration update.

  Note: Data must be compiled over a period of time before calculations can be made.

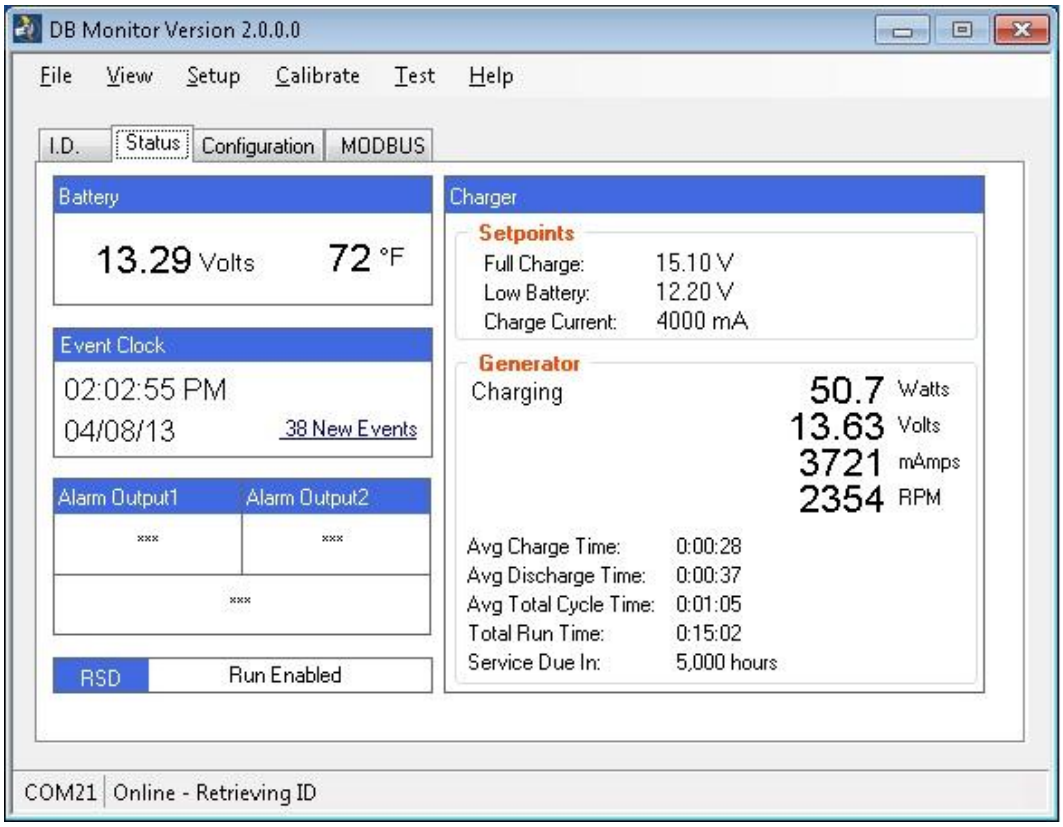

Figure 3-21. Status tab

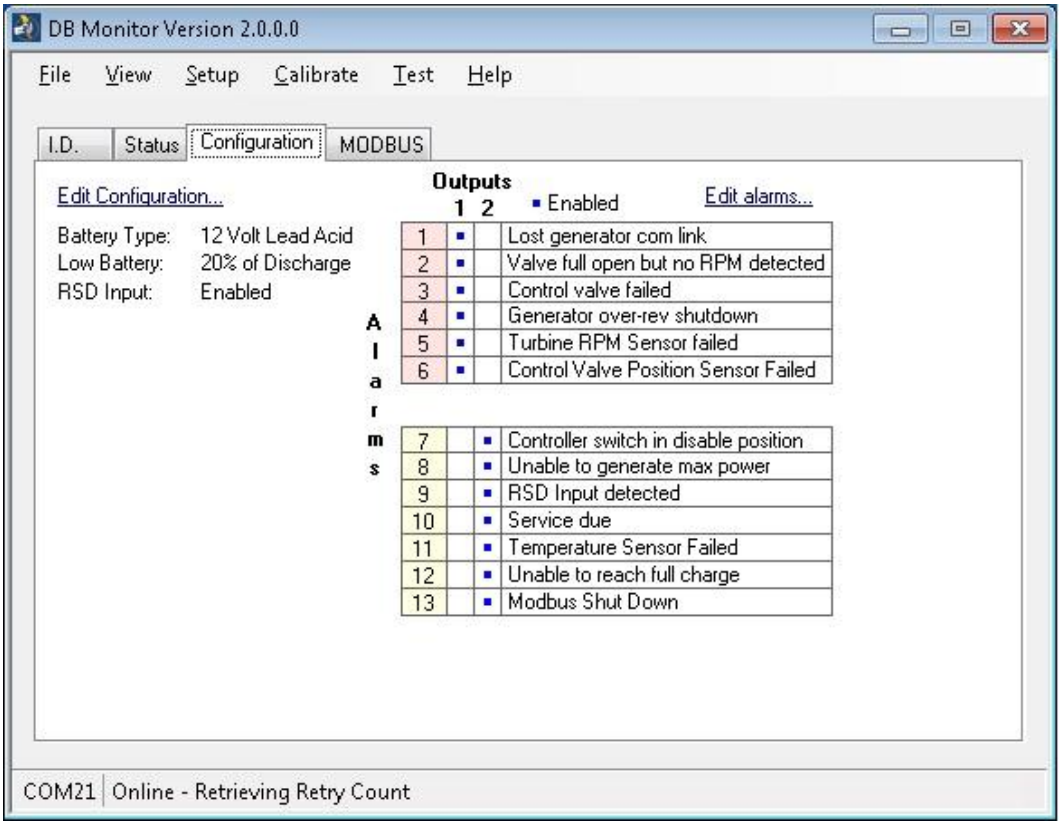

Figure 3-22. Configuration tab

3.5 System Start-Up

⚠ WARNING! ⚠

Check field wiring and all connections before starting up the system.

⚠ WARNING! ⚠

Test all connections for gas leaks.

Follow the steps below to start the DB1 system.

1. Connect the diagnostics cable (SK-DB1-003) from the PC to the controller.
2. Open the main shutoff valve.
3. Toggle the DB1 ON/ DISABLE switch to the ON position (Figure 3-23 below).

Figure 3-23. DB1 ON / DISABLE switch

When the ON / DISABLE switch is toggled ON, the controller will determine if the battery needs to be charged. If a charge is needed, the controller will then determine the charge level required and open the control valve accordingly. The control valve will be held open by the controller until one of the following conditions occurs:

- The ON / DISABLE switch is toggled to the DISABLE position,
- The battery is fully charged, or
- The internal diagnostics detects a problem with the system.

When gas flow is introduced to the DB1, the turbine will begin to spin, generating power. Once the battery has been fully charged, the controller will close the control valve and enter a standby mode.

3.6 System Shutdown

To shut down the DB1 system, toggle the ON / DISABLE switch to the DISABLE position. The controller will close the control valve.

3.7 System Tests

The DB Monitor software provides test functions for alarm outputs, the generator, and the control valve.

3.7.1 Alarm Outputs

To test the alarm outputs and alarm LEDs, select **Test > Alarm Outputs**. Follow the instructions provided on the screen that appears (Figure 3-24 below).

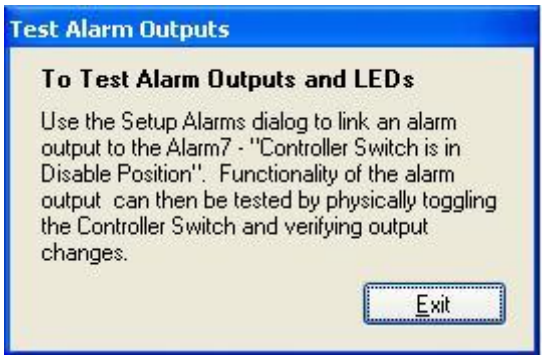

Figure 3-24. Test Alarms screen

3.7.2 The Generator

To test the generator when in Standby mode, select **Test > Charger**. In the screen that appears, click **START** and the generator will start and continue to run until stopped manually by clicking **STOP** or the battery voltage reaches the full charge setpoint. See Figure 3-25 below.

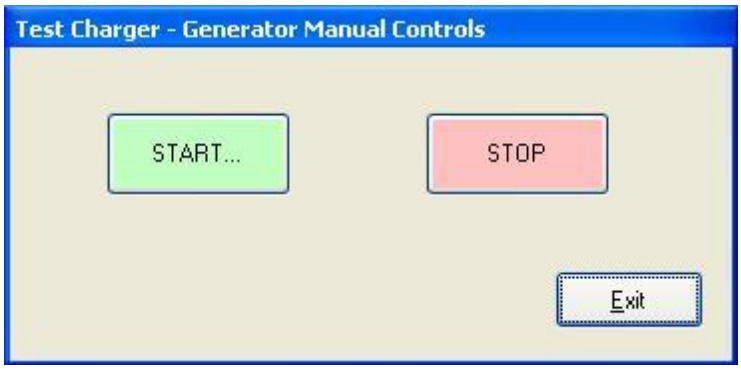

Figure 3-25. Test Charger - Generator Manual Controls screen

3.7.3 Control Valve

To view the operation (CLOSING / STOPPED / OPENING) of the control valve while it adjust for maximum power output, select **Test > Control Valve**. The screen that appears will display, in real time, the movement of the internal control valve as it adjusts the flow of gas through the turbine in order to produce the maximum power output. MAX CLOSED means the valve is completely closed and there should be no gas flowing through the turbine. MAX OPEN means the valve is completely open and the generator is producing the maximum amount of power it can produce with the provided differential pressure.

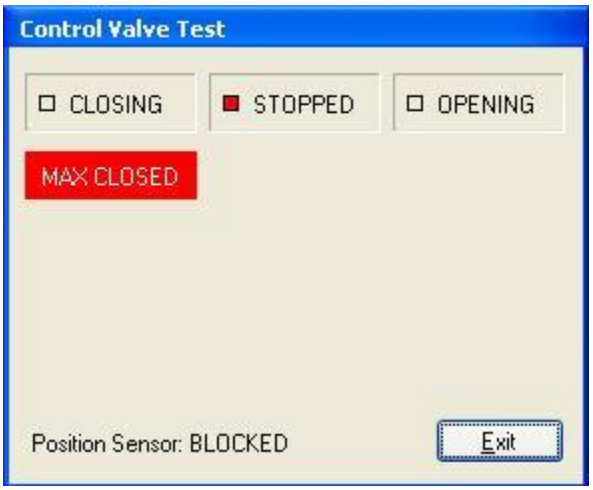

Figure 3-26. Control Valve Test screen

4 Maintenance & Troubleshooting

The DB1's sturdy construction and limited number of moving parts equate to high reliability and low maintenance. However, there are variables that occur during normal operation that may affect the life and operation of the DB1 system.

What follows are potential issues, causes, and possible remedies for various system components.

⚠ WARNING! ⚠

Do not perform any service on the DB1 system unless the area is known to be non-hazardous!

⚠ WARNING! ⚠

Prior to performing any service to the DB1 system, review Figure 4-1 below.

Prior to performing any service to the DB1 system:

- Toggle the ON / DISABLE switch to DISABLE.
- Completely disconnect system from battery.
- Close the supply gas main shutoff valve. (1)
- Close the downstream outlet valve. (2)
- Purge the DB1 by loosening one of the fitting nuts on the transition tube. (3)

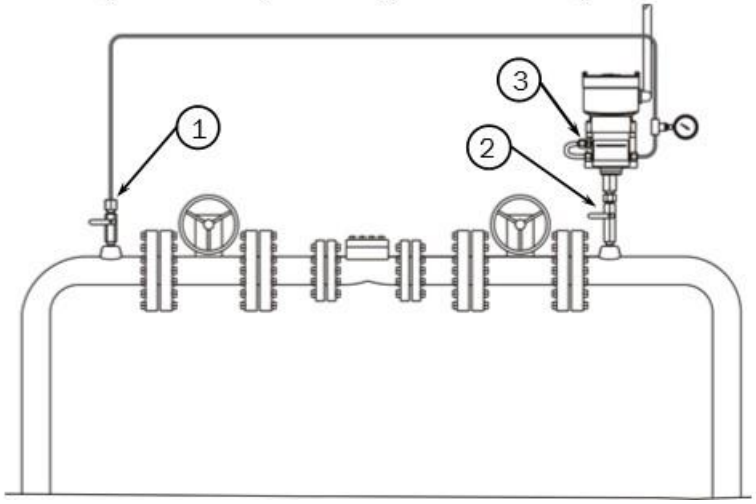

Figure 4-1. Steps required prior to performing service

4.1 DB1 Valve

Problem

There is a leak around the valve stem area.

Possible Cause

- A leak from the stem area indicates the valve stem packing has been depleted or has failed. This type of leak would create a hazardous condition.
- A leak through the valve when fully closed indicates damage to the valve seat. In this case, the generator turbine may continue to run when the valve is fully closed, although not fast enough to produce current.

Solution

Replace the valve: Service kit number SK-DP1-C60-002.

4.2 Valve Motor

Problem

The valve will not open (or close).

Possible Cause

- The gears in the valve motor may become worn.
- The valve motor could be damaged by a lightning strike or other power surge.

Solution

Replace the valve motor: Service kit number SK-DP1-C60-009.

4.3 Bearing

Problem

The generator is noisy and / or vibrating.

Possible Cause

- The bearing may not have sufficient lubrication.
- The bearing may become damaged by dirty supply gas.
- A worn bearing can prevent the generator from turning properly.

Solution

Replace the bearing: Service kit number SK-DP1-C50-015.

4.4 Electronics

Problem

The generator will not start up due to communication loss between the controller and generator.

Possible Cause

An electrical component could be damaged by a lightning strike or other power surge.

Solution

Replace the parts.

- Generator board: Service kit number SK-SS-C85-1522.
- Controller board: Service kit number SK-DP1-C60-005.
- Battery interface board: Service kit number SK-DP1-C60-010.

4.5 Support

Before contacting technical support, please have the following information available:

- Unit model number (DB1-10, DB1-20, or DB1-50)
- Pipeline pressure and flow rate
- Differential pressure
- Power requirements

4.6 Warranty

OFFER OF SALE

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, its subsidiaries and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods, services or work described will be referred to as "Products".

1. **Terms and Conditions.** Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is subject to these Terms and Conditions or any newer version of the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional terms or conditions of Buyer's order or any other document issued by Buyer.
2. **Price Adjustments; Payments.** Prices stated on Seller's quote or other documentation offered by Seller are valid for 30 days, and do not include any sales, use, or other taxes unless specifically stated. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). Payment is subject to credit approval and is due 30 days from the date of invoice or such other term as required by Seller's Credit Department, after which Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.
3. **Delivery Dates; Title and Risk; Shipment.** All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon placement of the products with the shipment carrier at Seller's facility. Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.
4. **Warranty.** Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of twelve months from the date of delivery to Buyer or 2,000 hours of normal use, whichever occurs first. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**
5. **Claims; Commencement of Actions.** Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 30 days after delivery. Buyer shall notify Seller of any alleged breach of warranty within 30 days after the date the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for an amount due on any invoice) must be commenced within 12 months from the date of the breach without regard to the date breach is discovered.
6. **LIMITATION OF LIABILITY.** UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. **IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.**
7. **User Responsibility.** The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.
8. **Loss to Buyer's Property.** Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, will be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer ordering the items manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.
9. **Special Tooling.** A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.
10. **Buyer's Obligation; Rights of Seller.** To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest.
11. **Improper use and Indemnity.** Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.
12. **Cancellations and Changes.** Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.
13. **Limitation on Assignment.** Buyer may not assign its rights or obligations under this agreement without the prior written consent of Seller.
14. **Force Majeure**. Seller does not assume the risk and shall not be liable for delay or failure to perform any of Seller's obligations by reason of circumstances beyond the reasonable control of Seller (hereinafter "Events of Force Majeure"). Events of Force Majeure shall include without limitation: accidents, strikes or labor disputes, acts of any government or government agency, acts of nature, delays or failures in delivery from carriers or suppliers, shortages of materials, or any other cause beyond Seller's reasonable control.
15. **Waiver and Severability.** Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.
16. **Termination.** Seller may terminate this agreement for any reason and at any time by giving Buyer thirty (30) days written notice of termination. Seller may immediately terminate this agreement, in writing, if Buyer: (a) commits a breach of any provision of this agreement (b) appointments a trustee, receiver or custodian for all or any part of Buyer's property (c) files a petition for relief in bankruptcy on its own behalf, or by a third party (d) makes an assignment for the benefit of creditors, or (e) dissolves or liquidates all or a majority of its assets.
17. **Governing Law.** This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement.
18. **Indemnity for Infringement of Intellectual Property Rights.** Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.
19. **Entire Agreement.** This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.
20. **Compliance with Law, U. K. Bribery Act and U.S. Foreign Corrupt Practices Act**. Buyer agrees to comply with all applicable laws and regulations, including both those of the United Kingdom and the United States of America, and of the country or countries of the Territory in which Buyer may operate, including without limitation the U. K. Bribery Act, the U.S. Foreign Corrupt Practices Act ("FCPA") and the U.S. Anti-Kickback Act (the "Anti-Kickback Act"), and agrees to indemnify and hold harmless Seller from the consequences of any violation of such provisions by Buyer, its employees or agents. Buyer acknowledges that they are familiar with the provisions of the U. K. Bribery Act, the FCPA and the Anti-Kickback Act, and certifies that Buyer will adhere to the requirements thereof. In particular, Buyer represents and agrees that Buyer shall not make any payment or give anything of value, directly or indirectly to any governmental official, any foreign political party or official thereof, any candidate for foreign political office, or any commercial entity or person, for the purpose of influencing such person to purchase products or otherwise benefit the business of Seller.

02/12

Appendix A The COM Communication Option

A.1 Introduction

A.1.1 Overview

An option for the DB1 battery charger is available that allows for MODBUS communication using RS485 or Ethernet connection. This appendix provides information specific to this option. It is assumed that the user is knowledgeable of MODBUS, and therefore, discussion on the MODBUS standard is not included. For information on the standard, refer to www.MODBUS.org.

A.1.2 Specifications

Specifications for the DB1 system with the COM communication option are provided in Table A-1 (page 42).

Table A-1. DB1 battery charger with COM communication option specification

Input voltage	11 – 30 Vdc (supplied by controller)
Input current	80 mA at 12.4 V typical (280 mA maximum when Ethernet active)
Operating temperature range	-40°F to 140°F (-40°C to 60°C)
Connections	RS485, Ethernet
Multi-drop	Up to 256 (depending on cabling)
User-selectable RS485 termination jumpers	Load termination Reference to +V and GND Add series resistance to GND signal
Electrical isolation	Certifications for individual components, not as an assembly. Isolated power supply: Up to 3 kV for 1 second CB Test Report: US/14402A/UL IEC 60950-1:2001 1st Ed. UL General Safety Report: E3224736 UL 60950-1 1st Ed. CUL General Safety C22.2 No. 60950-1-03 EN Medical Safety Report: SPC1005061 EN60601-1 EN General Safety Report: SPCLVD1005061 EN60950-1, 2nd Ed. RS485 integrated circuit: Galvanically isolated UL 1577, IEC 60747-5-2 (VDE 0884, Rev 2) IEC 61010-1, IEC 60950-1, and CSA Approved Thermal shutdown protection Low bus capacitance: 16 pF (typical) Typical transient immunity: 50 kV/ms Failsafe receiver for bus open, short, idle Meets or exceeds TIA/EIA RS485

A.1.3 DB1 Controller with Communication Module

With the COM communication option, a communication (COM) module is added to the standard DB1 controller. This COM module adds LEDs for remote communication, RS485 and Ethernet ports, an 8-position connector, and the COM wire harness. See Figure A-1 below.

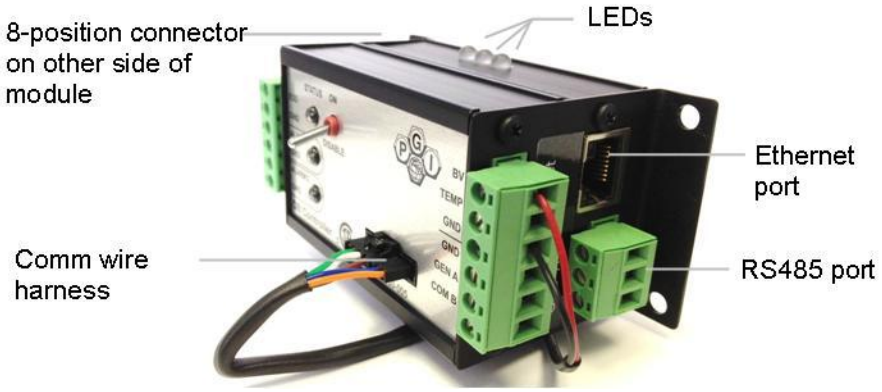

Figure A-1. COM module for COM communication option

A.1.4 LEDs for Remote Communication

Figure A-2 below shows the status LEDs for remote communication.

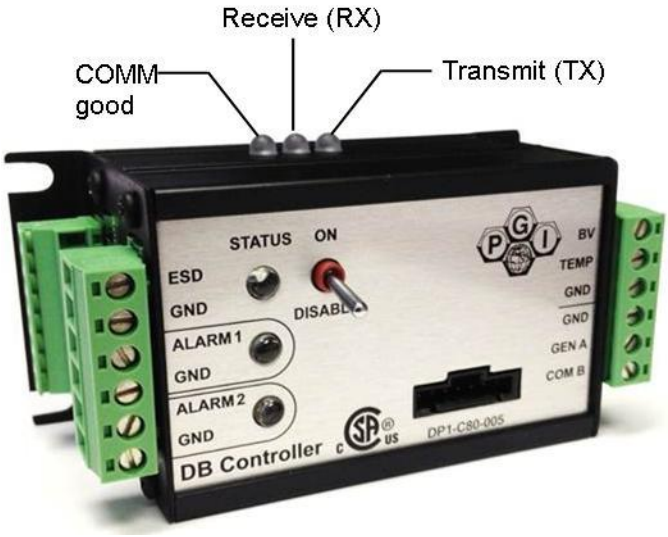

Figure A-2. Status LEDs for remote communication

Table A-2 below describes the status indicated by each LED.

Note: These LEDs have no relevance when the diagnostics cable (SK-DB1-003) is connected to the controller.

Table A-2. Status indicated by remote communication LEDs

LED	Color	Status
COMM good	Green (solid)	Communication has been received and is good.
Receive (RX)	Red (flashing)	Communication on the network is present. Activity does not necessarily mean the battery charger is addressed, but indicates all activity if there are other devices on the same network.
Transmit (TX)	Amber (flashing)	The battery charger is transmitting.

A.1.5 RS485 & Ethernet Communication

The COM module provides one RS485 port and one Ethernet port (Figure A-3 below).

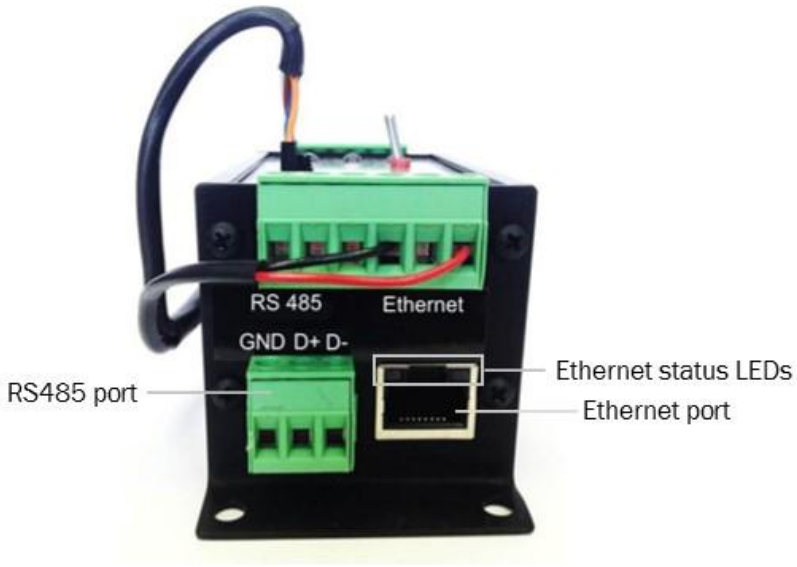

Figure A-3. RS485 and Ethernet ports

The two Ethernet status LEDs are shown above in Figure A-3. The left LED indicates the speed of the network, and the right LED indicates data activity. Unlike the RS485 network, Ethernet can have activity to only this device or it can show activity any time traffic is present on the network, depending on how the Ethernet network is implemented. Therefore, rely on the three communication LEDs on the controller for status.

The COMM Good LED will show if the MODBUS commands are being responded to.

NOTE: If using Ethernet, remember to enable the port using jumper across pins 1 and 2 (see Figure A-16).

A.2 Installation

IMPORTANT!

This section pertains to installation and wiring specific to the COM communication option only. Refer to Chapter 2 (page 14) in conjunction with this appendix. Heed all warnings and cautions provided for the standard installation and wiring.

A.2.1 Mounting the Controller

The only difference in installation between the standard DB1 system and the DB1 system with COM communication is how the controller is mounted. Mounting of the generator and battery interface module is the same.

Figure A-4 below provides a template for the controller mounting holes. Alternatively, use the controller itself to locate and mark holes in the enclosure.

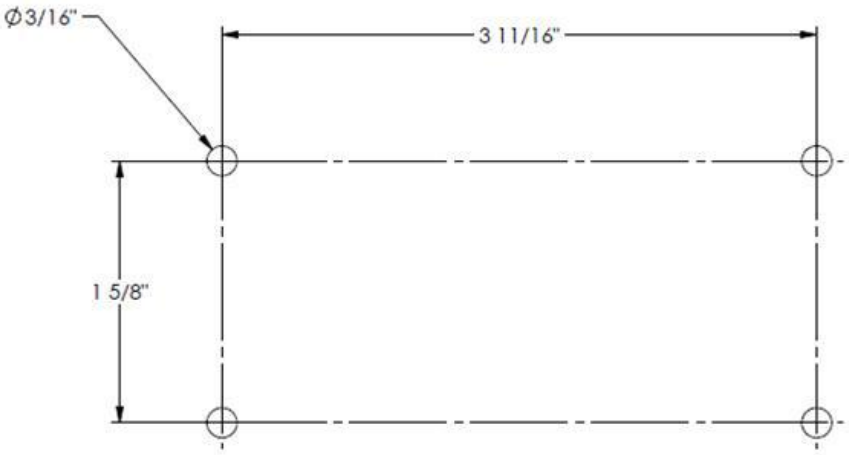

Figure A-4. Drill template for mounting the controller

A.2.2 Field Wiring

In addition to the standard wiring described in Chapter 2, two wires from the COM wire harness need to be connected in parallel with BV and GND on the right side connector of the controller assembly. See Figure A-5 below.

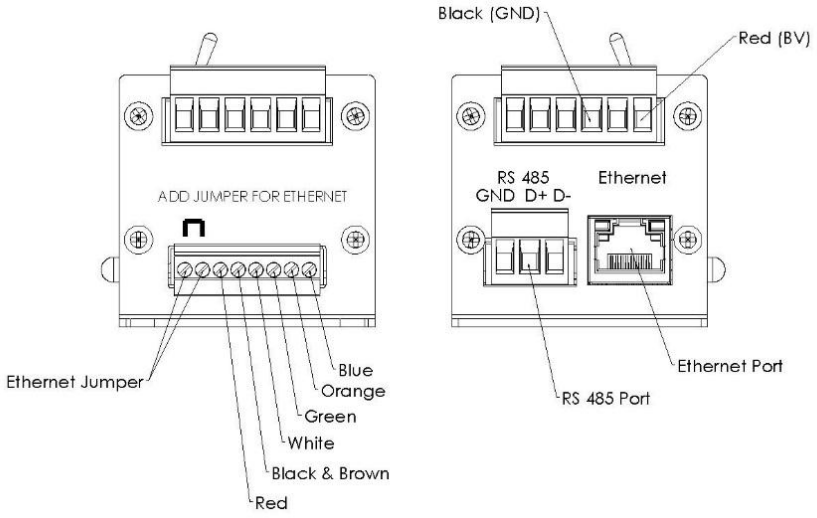

Figure A-5. BV and GND connections (as supplied)

A.3 Communication

A.3.1 COM Wire Harness

With the COM communication option, a COM wire harness provides the communication link between the COM module and the DB1 controller. The COM wire harness should be connected to the communication port on the controller. See Figure A-6 below.

Figure A-6. COM wire harness connected to controller communication port (as supplied)

A.3.2 RS485 Connection

Either RS485 or an Ethernet connection may be used (not both) for MODBUS communication. You will need to provide the wiring RS485 or Ethernet wiring and a sealed penetration in the enclosure.

If using RS485, there should be no connection to the Ethernet port. The RS485 connection is electrically isolated from the DB1 controller electronics. For the RS485 network connection, match the signals from the master to the slave (i.e. D(+) to D(+) and D(-) to D(-)). Additionally, a signal return ground (not Earth ground) is available if needed. See Figure A-7 below.

Note: Supplying power to the Ethernet module does not disable the RS485 port, and the RS485 may still be used if there is not an Ethernet link. However, if the Ethernet option will not be used, you will save power by not adding the Ethernet power jumper (refer to Section A.3.5).

Figure A-7. Connections for RS485

A.3.3 Termination Jumpers

There are four termination jumpers that should only be used if the DB1 controller is the farthest device from the master on the RS485 network. All jumpers supplied by Parker PGI are in the un-jumpered position, except for J5. **Do not change these jumpers unless the following conditions are required:**

- J2 is the termination for the last (most distant) RS485 node on the network. If the DB1 system is the last device, jumper J2. There must be only one termination in the network. Refer to the MODBUS specification at www.MODBUS.org for explanation.
- J1 and J4 are for establishing a center balanced reference between the isolated + volts and ground. Jumper these two only if necessary. Both are needed if either is used.
- J5 is for the ground resistor bypass. Only remove if the cable installation requires it.

If the DB1 controller is the last device on the RS485 bus, jumpers are required. Follow the procedure below to install these jumpers.

⚠ WARNING! ⚠

Do not perform any service on the DB1 system unless the area is known to be non-hazardous!

⚠ WARNING! ⚠

Review Figure 4-1 (page 37) prior to performing any service on the DB1 system.

1. Unplug all connectors from the assembly.
2. Reference Figure A-8 below. Remove the two bottom screws on both ends of the assembly. Loosen (do not remove) the two top screws on the end with the Ethernet port.

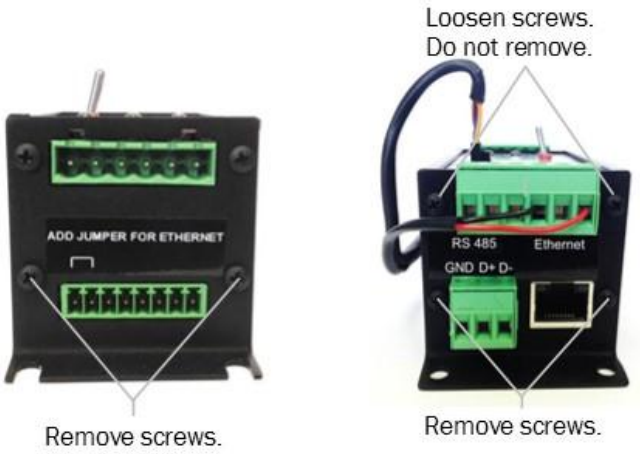

Figure A-8. Assembly screws to remove or loosen

3. Separate the two halves of the assembly as shown below in Figure A-9. Set aside the top portion (controller) with the endplates.

Figure A-9. Separate the assembly

4. Reference Figure A-10 below. With the LEDs facing away from you, slide the aluminum plate off to the right side of the assembly to expose the circuit board.

   Note: Do not remove circuit board from aluminum chassis.

   Note: Do not allow the circuit board to shift in the chassis while removing the plate.

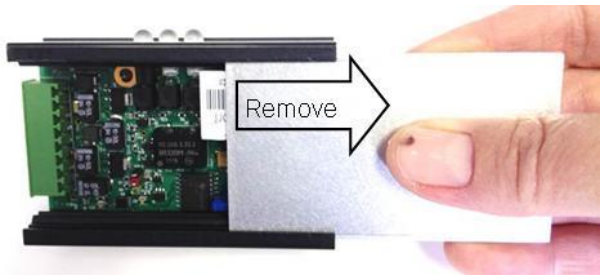

Figure A-10. Remove the aluminum plate

5. Reference Figure A-11 below and Figure A-12 (page 49). Reposition the included jumpers across the required jumper blocks. At a minimum, J2 must be jumpered. If required, the termination can be balanced between +V and GND by installing jumpers at J1 and J4 as well.

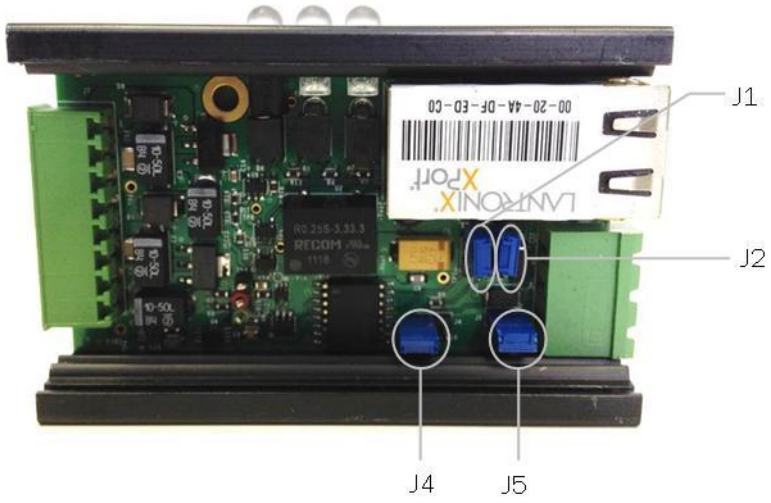

Figure A-11. Locations of termination jumpers

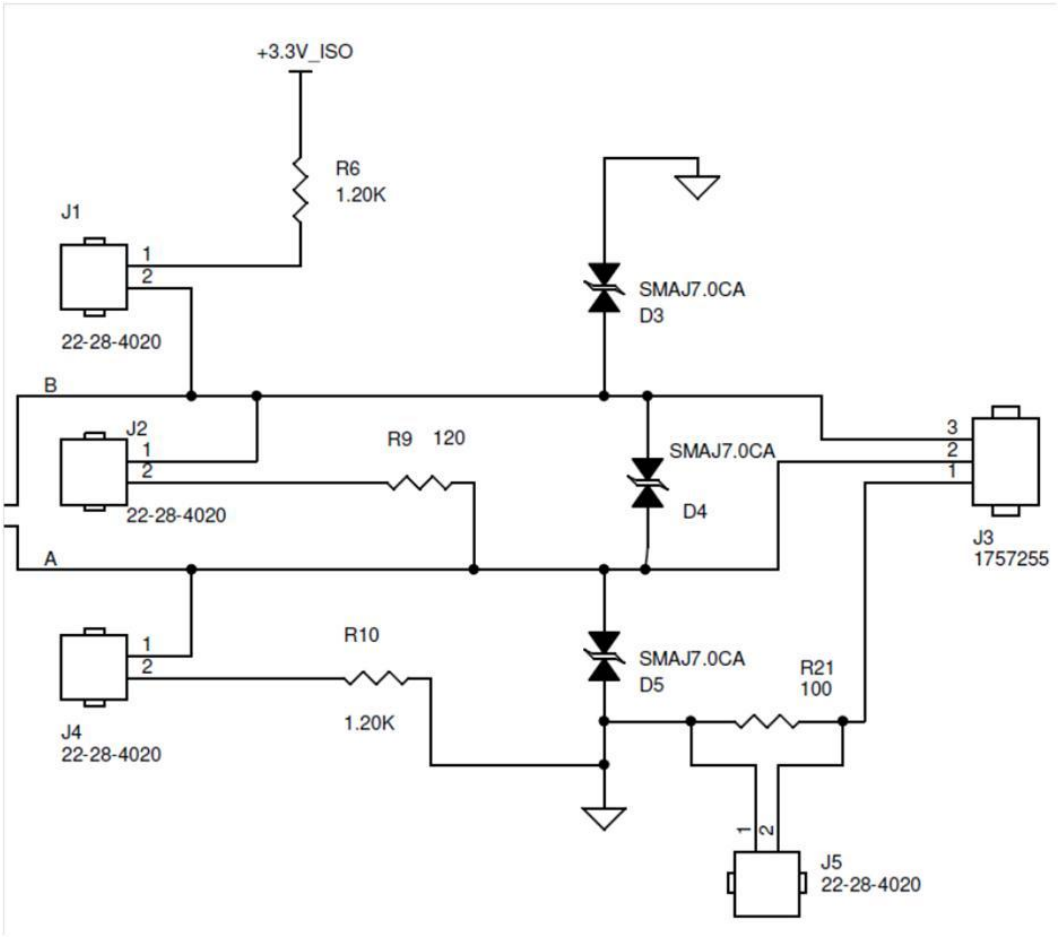

Figure A-12. Termination jumpers schematic

6. Once jumpers are installed, reassemble the unit in reverse order.

   Note: Install the aluminum plate from right to left, as shown below in Figure 44.

   Note: Do not allow the circuit board to shift in the chassis while installing the plate.

Figure A-13. Install the aluminum plate

A.3.4 RS485 2-Wire System

The RS485 port uses a 2-wire half duplex system. Figure A-14 below illustrates a typical 2-wire topology. If you are using a 4-wire full duplex system, refer to Figure A-15 below to connect a 4-wire system to a 2-wire system.

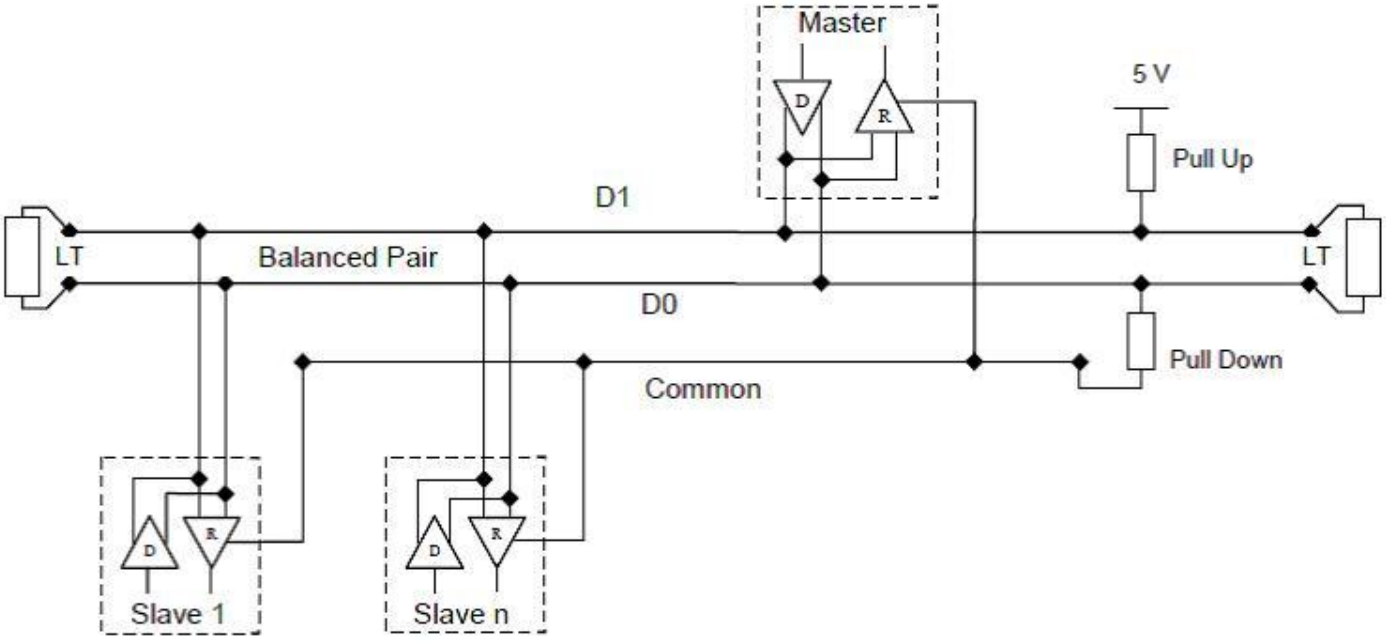

Figure A-14. Typical 2-wire topology

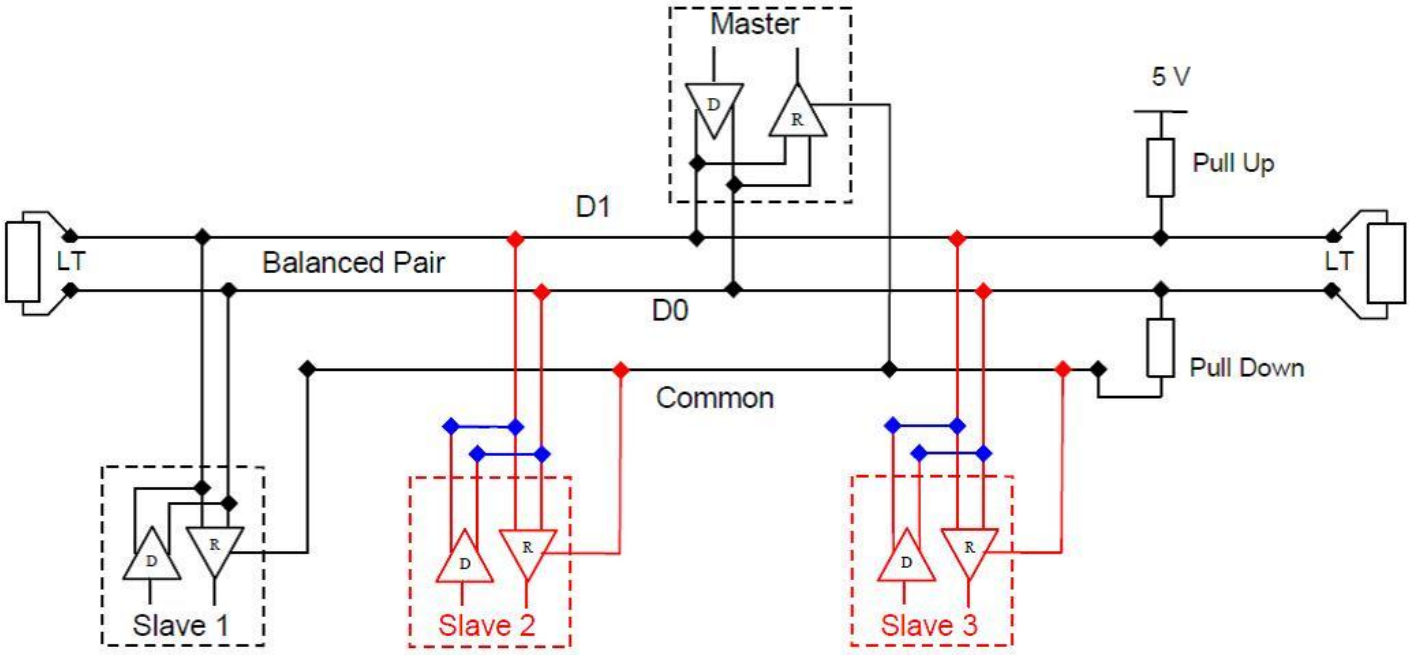

Figure A-15. Connecting a 4-wire system to a 2-wire system

A.3.5 Ethernet Connection

If using Ethernet, there should be no wiring to the RS485 connector. A wire jumper must be installed across pins 1 and 2 of the 8-position connector. This jumper will supply power to the Ethernet module. See Figure A-16 below.

Note: Supplying power to the Ethernet module does not disable the RS485 port, and the RS485 may still be used if there is not an Ethernet link. Both ports may not be used simultaneously.

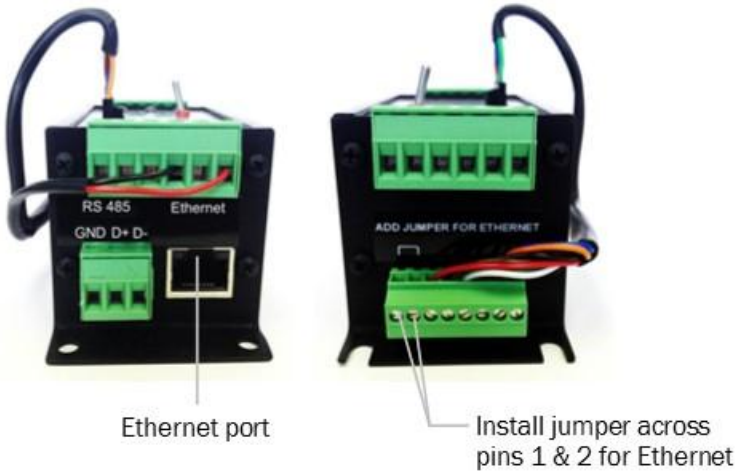

Figure A-16. Ethernet port and pins 1 and 2 of 8-position connector

A.4 Retrofitting an Existing DB1 Controller

To retrofit an existing DB1 controller, remove all connections from the existing controller. Then remove the controller itself, and replace it with the new controller. The replacement assembly is specifically designed to occupy the same footprint on the back plate of the enclosure. The unit will be taller; however, this is usually not a problem.

Reference the field wiring sections in Chapter 2 and in this appendix for wiring details.

A.5 Communication Setup

A.5.1 MODBUS

Note: Ensure DB Monitor software version 2.0 or higher is installed on your PC before continuing. The software is available from the Parker PGI website. Refer to "The DB Monitor Software" (page 22) for software installation instructions.

Note: Disconnect the COM wire harness from the controller communication port and connect the diagnostics cable to establish communication with the software.

The default configuration for the software is described below. When setup is complete, the DB1 controller will reload the stored MODBUS settings each time the ON /DISABLE switch is moved to the ON position and the diagnostics cable is connected.

MODBUS parameters are set using the DB Monitor software version 2.0 or higher. The settings are configured under the MODBUS tab (Figure A-17 below).

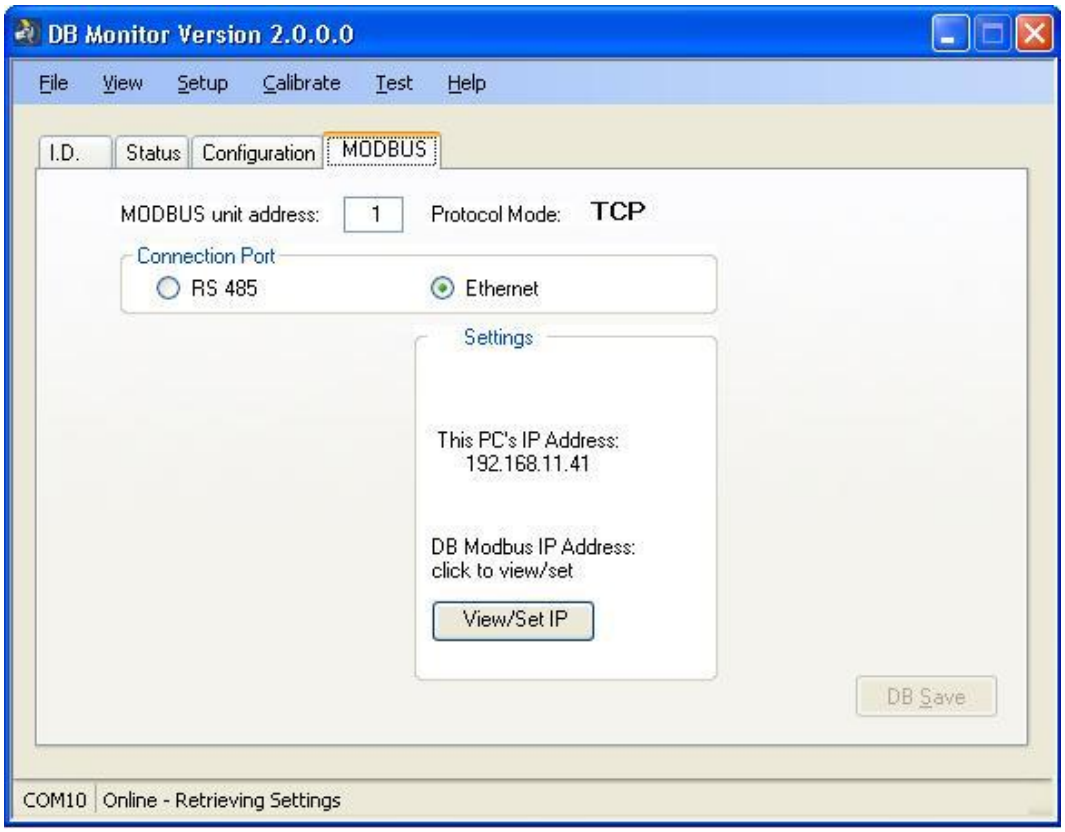

Figure A-17. MODBUS tab

To start the DB Monitor software, follow the procedure below.

1. After connecting the diagnostics cable to the controller communication port, toggle the ON / DISABLE switch to the ON position.
2. Double-click the DB Monitor program icon. The software will attempt to connect to the DB1 controller via the last serial port used. If it cannot find that serial port, the software will ask for a new serial port. When prompted, select the appropriate communication port for your PC.
3. Data fields will begin to fill in. See Figure A-18 below.

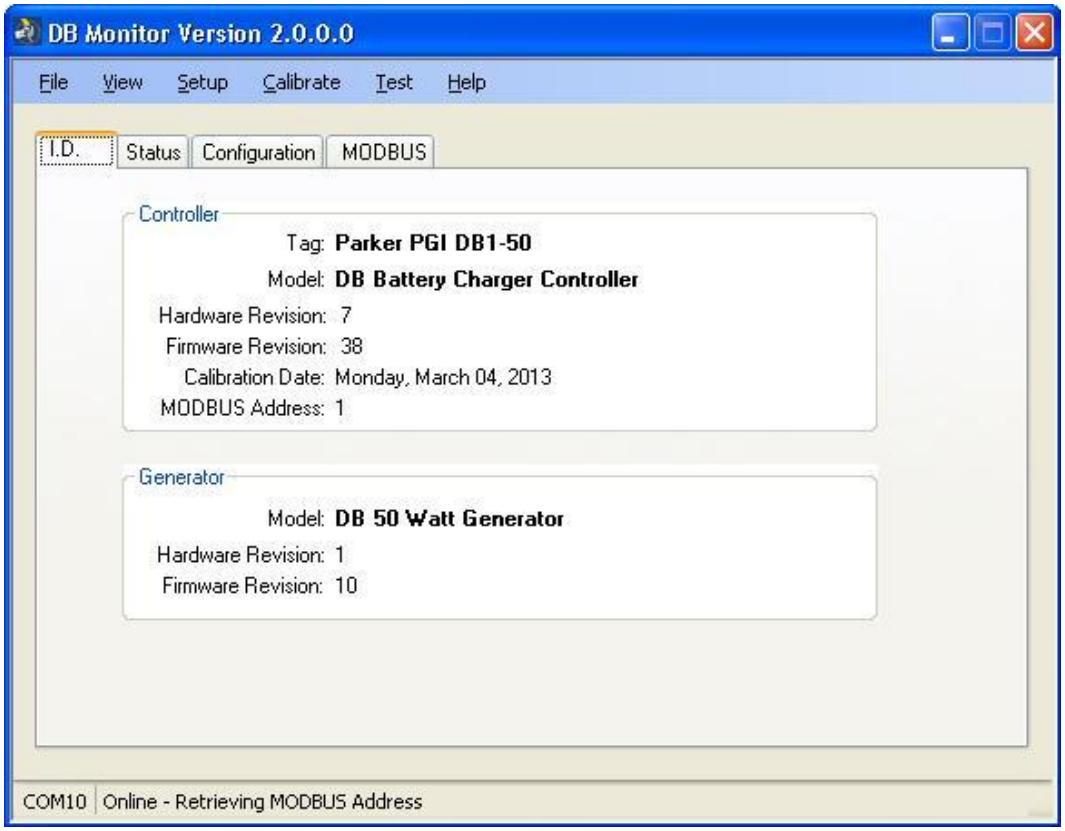

Figure A-18. Unit information

4. In order to use MODBUS, an address must be saved in the DB1 controller. This address should be supplied by whomever operates the MODBUS master or SCADA system. If necessary, change the address by entering the correct address in the MODBUS unit address field on the MODBUS screen.
5. If using RS485, click the **RS485** button and verify the communication settings. The RS485 serial port is able to operate from 1,200 to 38,400 baud. Default serial port parameters are:
   - Baud: 9600
   - Bits: 8
   - Parity: None
   - Stop Bits: 1

   Change any settings as required and then click the **Save to DB** button to save the new settings.

Note: If using an Ethernet connection, continue to the next section to set the IP address.

A.5.2 IP Address Setup

If using an Ethernet connection, the IP address needs to match the device installer. To setup the IP address, follow the procedure below.

1. Using an Ethernet cable, connect your computer to the Ethernet port on the COM module. Ensure that the Ethernet jumper on the 8-position connector is installed across pins 1 and 2. Refer to Figure A-16 (page 51).
2. Launch the DB Monitor software and click the **MODBUS** tab and select the **Ethernet** radio button. See Figure A-19 below.

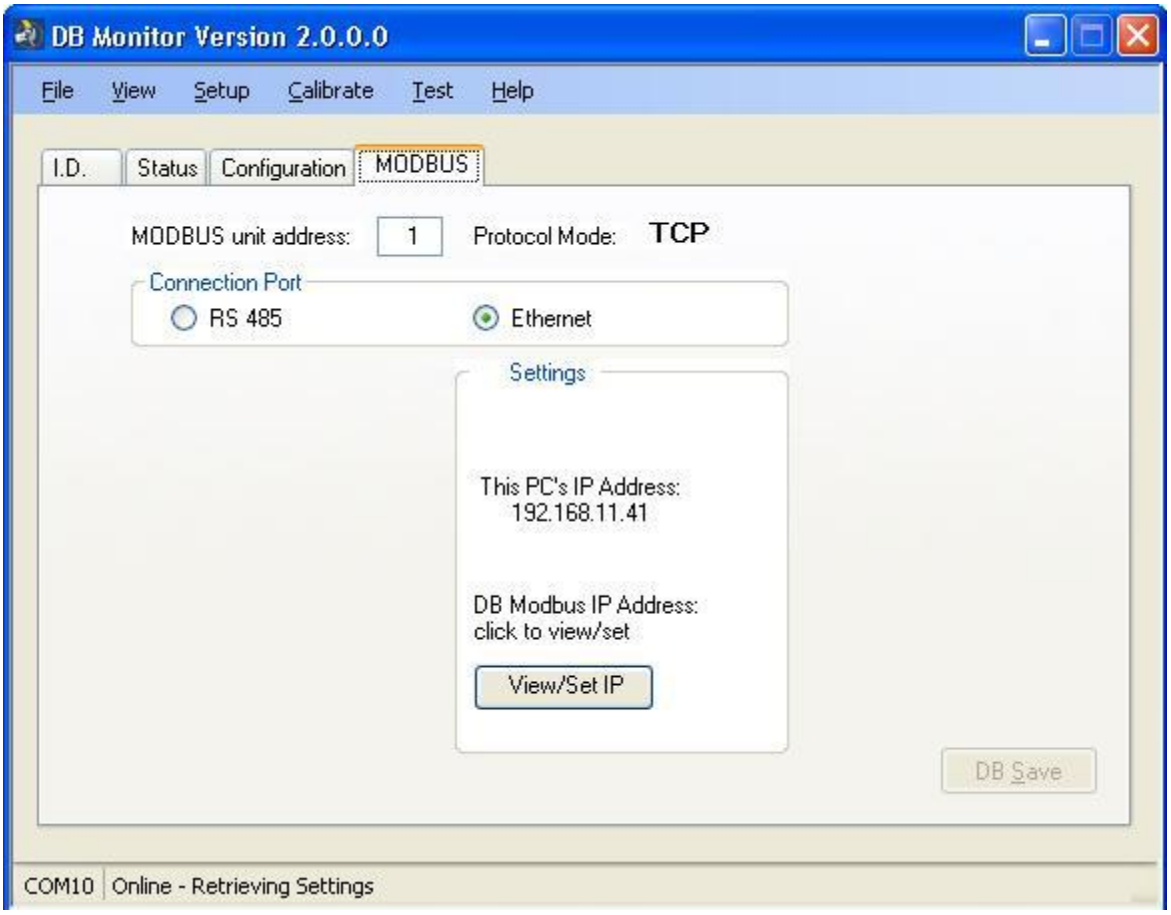

Figure A-19. Select Ethernet connection on MODBUS screen

3. Click the **View/Set IP** button to launch the Device Installer software, which is included in the install package of the DB Monitor software.
4. Click the **+** sign next to the **XPort** folder on the left side pane to expand it. See Figure A-20 below.

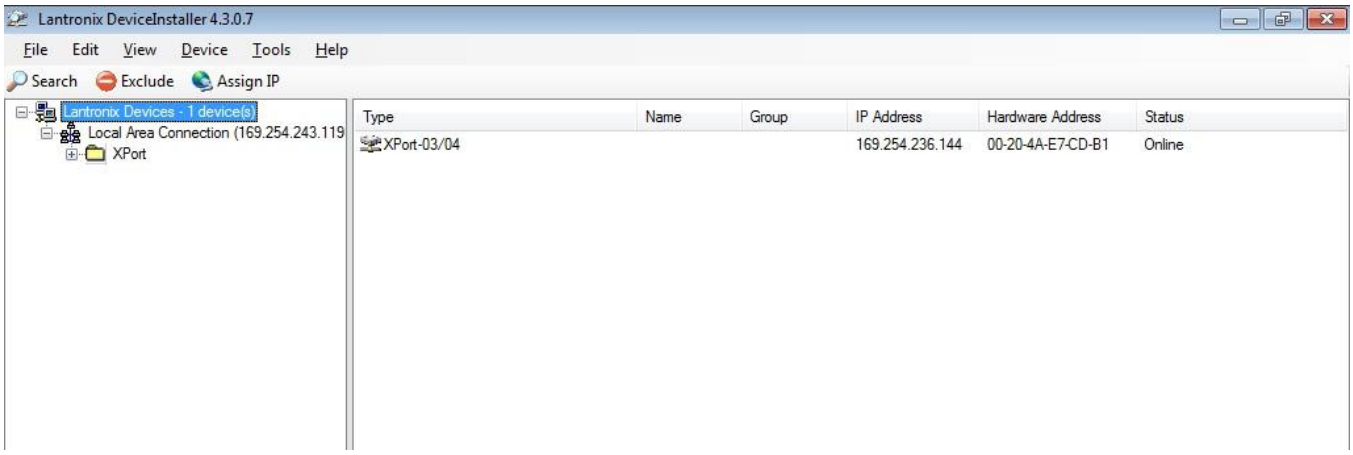

Figure A-20. Set up IP address – Expand the XPort folder

5. Click the **+** sign next to **XPort-03/04-firmware** to expand it.
6. Once the IP address of the module is visible, single-click it to select it. In the example below, the IP address is 169.254.236.144. Then click **Assign IP** button in the menu. See Figure A-21 below.

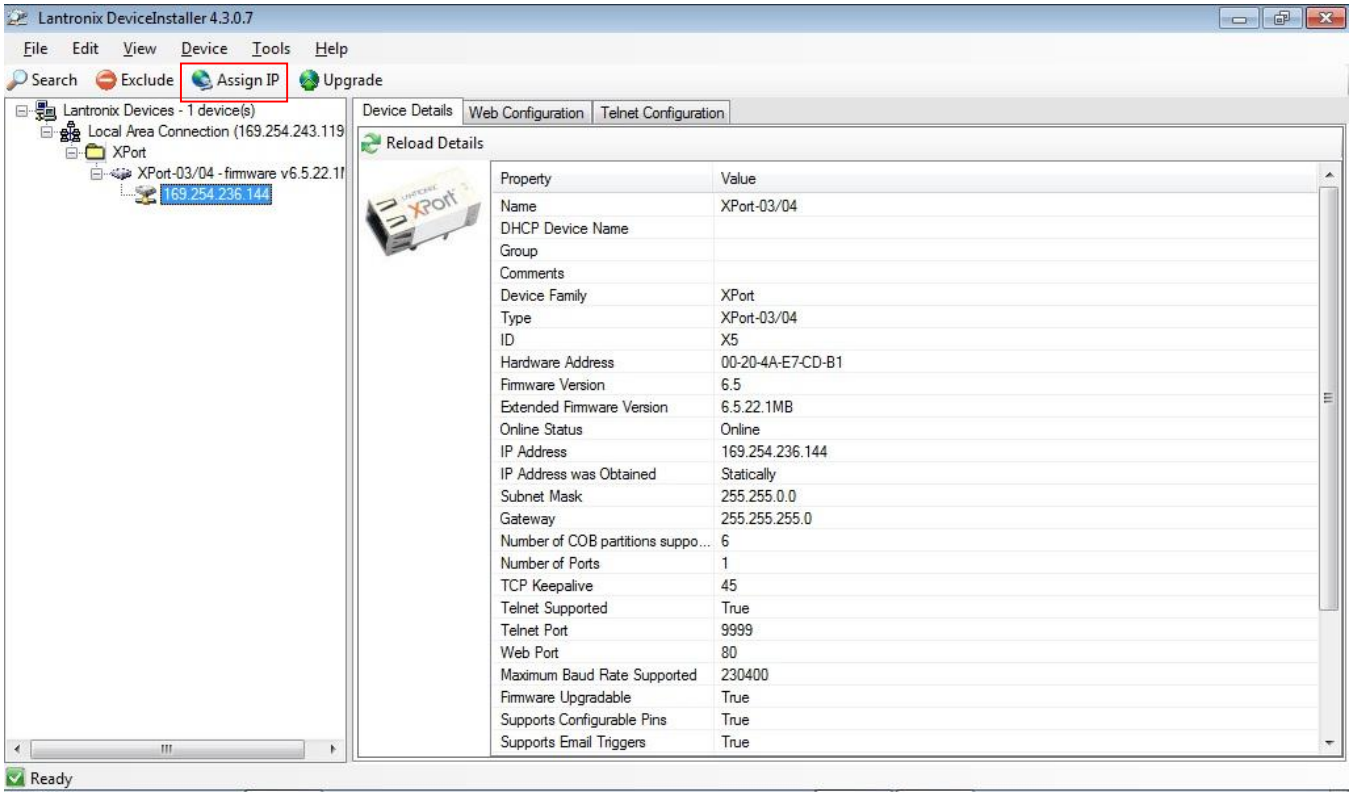

Figure A-21. Set up IP address – Select IP address

7. In the screen that appears, select **Assign a specific IP address** and click **Next**. See Figure A-22 below.

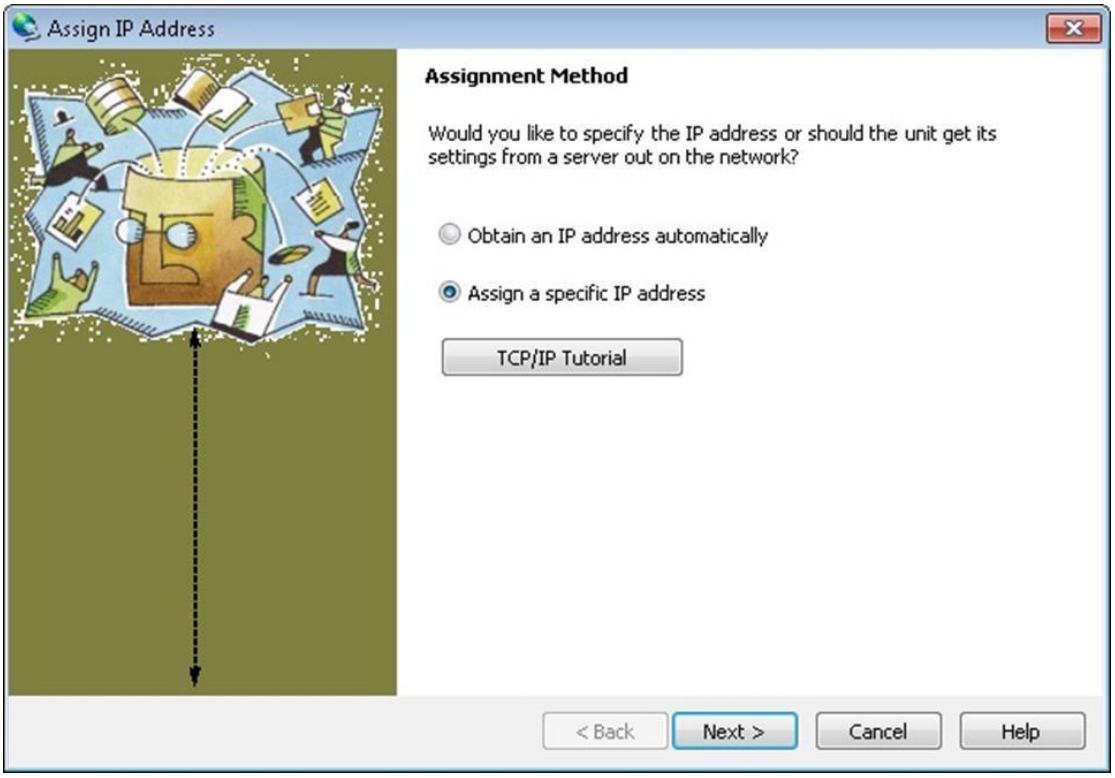

Figure A-22. Set up IP address – Assign specific IP address

8. In the next screen, enter the IP address and gateway settings in the **IP address** and **Default** gateway fields respectively. Click **Next**. See Figure A-23 below.

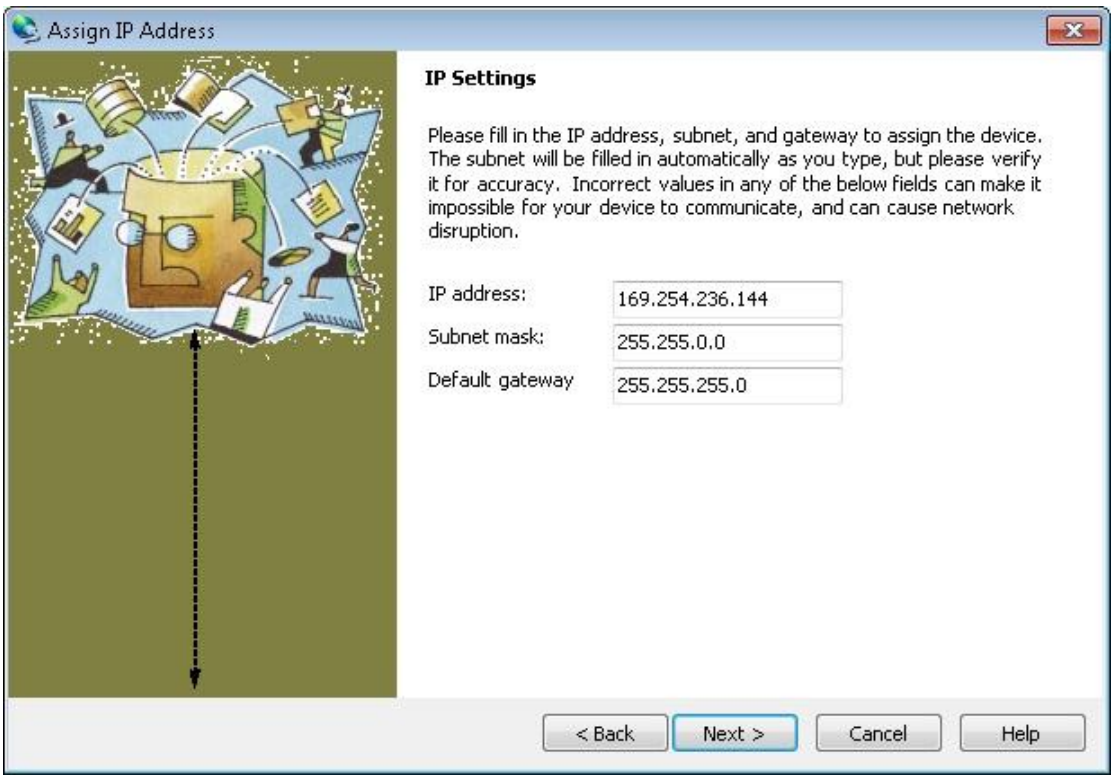

Figure A-23. Set up IP address – Enter IP address and gateway

9. At the next screen, click **Assign** to assign the IP address. See Figure A-24 below.

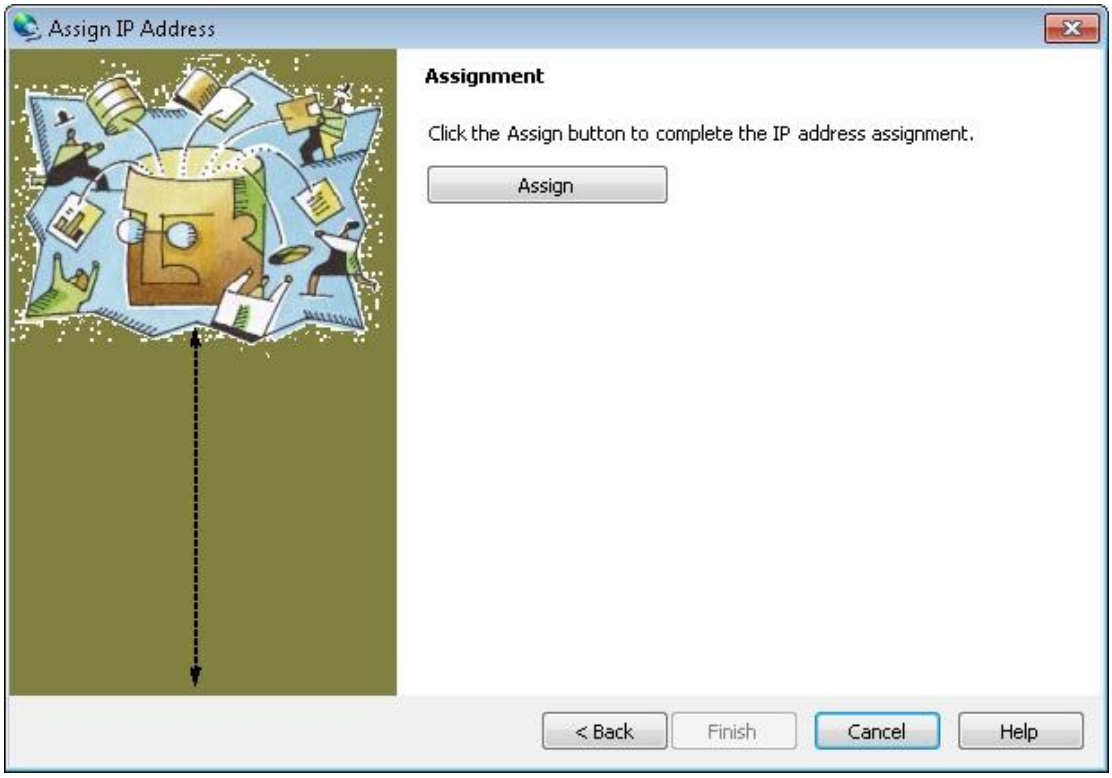

Figure A-24. Set up IP address – Complete IP address assignment

10. Once the progress bar is full and “Completed successfully” appears, click **Finish**. See Figure A-25 below.

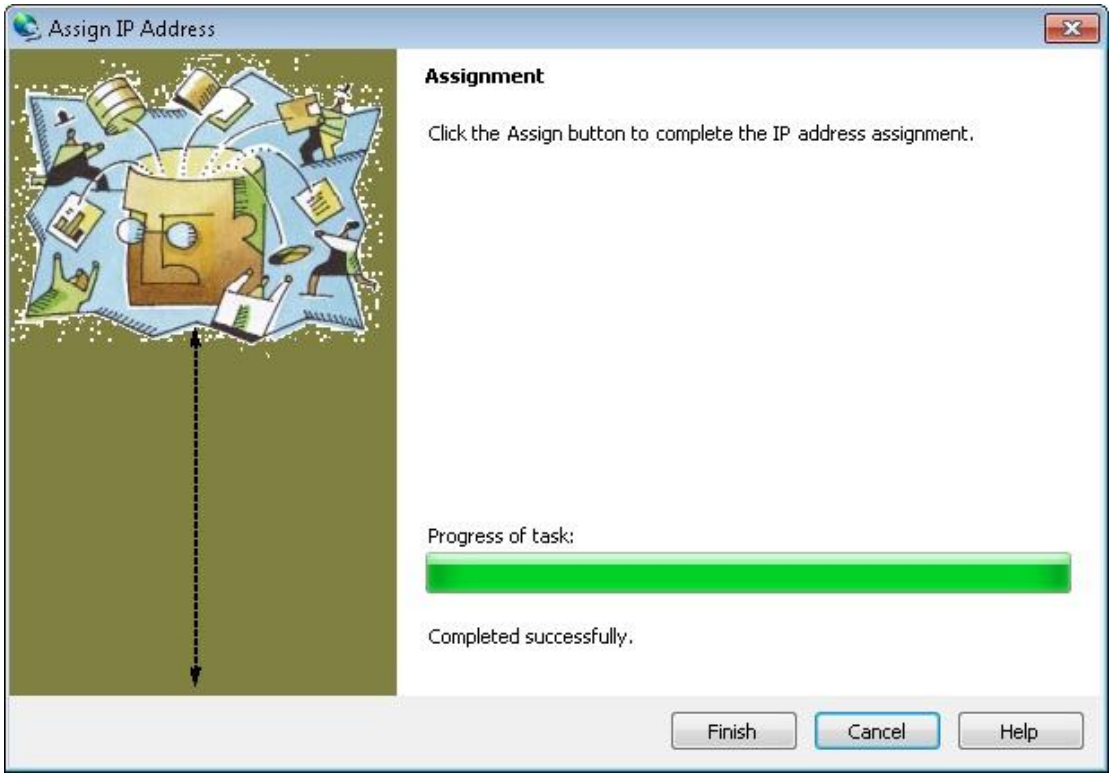

Figure A-25. Set up IP address – IP address assignment complete

11. Close the Device Installer software to return to DB Monitor.

A.6 Operating Instructions

General operating instructions for the DB1 controller and the DB Monitor software are provided in Chapter 3 (page 19). This section provides operating information specific to operating the DB1 battery charger with the COM communication option.

Check field wiring and all connections before starting up the system.

Test all connections for gas leaks.

Follow the steps below to start the DB1 system.

1. Connect the diagnostics cable (SK-DB1-003) from the PC to the controller.
2. Open the main shutoff valve.
3. Toggle the DB1 ON/ DISABLE switch to the ON position.

When the ON / DISABLE switch is toggled to the ON position, the controller will determine if the MODBUS interface is present and if the battery needs to be charged. At all times during this operation, the software will communicate with the controller and return data from the generator.

In order to view MODBUS data via the RS485 or Ethernet port:

1. Disconnect the diagnostics cable.
2. Connect the COM wire harness to the controller communication port.
3. Toggle the ON / DISABLE switch.

A.7 DB1 Register Map

Category	Name - SYSTEM INFO	Modbus Register 5-digit	Register Address	R/W
User Tag	20 byte ASCII text string - TAG (same as in DB Monitor)	40 001	0	R/W
	User can assign TAG to identify unit	---	---	
	Default "PARKER DB1 + MODBUS!"	40 010	9	
	20 byte ASCII text string - additional user Tag	40 011	10	R/W
	User can assign additional 20 characters	---	---	
	Default "LINE 2 NAME "	40 020	19	
System Info	20 byte ASCII text string - System Model "DB1-10W" or "DB1-20W" or "DB1-50W"	40 021	20	R
		---	---	
		40 030	29	
	Serial Number (16-bit integer)	40 031	30	R
	Generator Hardware Revision (16-bit integer)	40 032	31	R
	Generator Firmware Revision (16-bit integer)	40 033	32	R
	Controller Hardware Revision (16-bit integer)	40 034	33	R
	Controller Firmware Revision (16-bit integer)	40 035	34	R
	Reserved for Future Expansion	40 036	35	R
	and additional System Components	---	---	
	(ie, stacked generator #2, etc)	40 250	249	

Category	Name - **OPERATIONAL**	Modbus Register 5-digit	Register Address	R/W
Time Clock and Date	Year - 2000 to 2099	40 251	250	**R/W**
	Month - 1 to 12	40 252	251	
	Day - 1 to 31	40 253	252	
	Hour (24Hr) - 0 to 23	40 254	253	
	Minute - 0 to 59	40 255	254	
	Second - 0 to 59	40 256	255	
	Clock is Good 1 = Good, 0 = Failed clock HW, date/time not valid	40 257	256	**R**
	Reserved = 0	40 258	257	**R**
	Reserved = 0	40 259	258	**R**
	Reserved = 0	40 260	259	**R**
Generator #1	Generator Volts x100 (16-bit integer) 0 to 655.35 V (after divide by 100)	40 261	260	**R**
	Generator Amps x100 (16-bit integer) 0 to 655.35 A (after divide by 100)	40 262	261	**R**
	Generator RPM (16-bit integer) 0 to 65,535	40 263	262	**R**
	Reserved = 0	40 264	263	**R**
	Generator Auto-Restart Retry Attempts Allowed (Requires system reset to take effect) 0 to 10 Default = 3	40 265	264	**R/W**
	Generator Time between Auto- Restart Attempts (Requires system reset to take effect) 1 to 24 Hrs Default = 24 Hrs	40 266	265	**R/W**
	Generator is Good 4 = Good normal operation 3 = Warning, operational but service required 2 = Good but in Wait to Auto-Retry 1 = Good, but in manual shut down due to RSD, ON/Disable in Disable or Modbus Shut Down 0 = Failed HW and requires service	40 267	266	**R**
	Generator Diagnostic Info	40 268	267	**R**
	Reserved = 0	40 269	268	**R**
	Generator Maximum Watts	40 270	269	**R**

Category	Name - OPERATIONAL (cont.)	Modbus Register 5-digit	Register Address	R/W
Battery	Battery Voltage x100 (16-bit integer) 0 to 655.35Volts (after divide by 100)	40 271	270	R
	Battery Reserved = 0	40 272	271	R
	Battery Reserved = 0	40 273	272	R
	Battery Temperature C x100 (signed 16-bit integer) -327.68 to 327.67 (after divide by 100) -45.55C = not installed or non functional sensor	40 274	273	R
	Battery Temperature F x100 (signed 16-bit integer) -327.68 to 327.67 (after divide by 100) -50F = not installed or non functional sensor	40 275	274	R
	Installed Battery Voltage (16-bit integer) 12=12V, 24= 24V Default = 12	40 276	275	R
	Battery Reserved = 0	40 277	276	R
	Battery Reserved = 0	40 278	277	R
	Battery Reserved = 0	40 279	278	R
	Battery Reserved = 0	40 280	279	R
Battery Charger	Charger Stage 2 - 2nd stage of charge cycle, 1 - 1st stage of charge cycle, 0 - not charging	40 281	280	R
	Charger Type 0=cyclic	40 282	281	R
	Maximum Cyclic Charge Timeout (16-bit integer) Alarm12 parameter - this is the time allowed before Alarm12 will be actived. Since this is a minor alarm the battery will continue to be charged as needed. Expressed in Hours. 1 to 1000 Default 120 Hrs	40 283	282	R/W
	Charger Reserved = 0	40 284	283	R
	Charger Reserved = 0	40 285	284	R
	Average Cyclic Charge Time (16-bit interger) in Hours X 100 i.e 5.5Hrs = 550	40 286	285	R
	Average Cyclic Discharge Time (16-bit interger) in Hours X 100	40 287	286	R
	Charger Reserved = 0	40 288	287	R
	Charger Reserved = 0	40 289	288	R
	Charger Reserved = 0	40 290	289	R

Category	Name - SERVICE & ALARMS	Modbus Register 5-digit	Register Address	R/W
Service	On Time Hours (16-bit integer) Default 0 Total accumulated on time of the controller	40 291	290	R
	Generator Run Time Hours (16-bit integer) Default 0 Total accumulated run time of the generator.	40 292	291	R
	Service Due in Hours (16-bit integer) Default 5000 hours Generator suggested service interval.	40 293	292	R
	Reserved = 0	40 294	293	R
Alarms	Alarm Output1 1 - output being driven due to mapped alarm 0 - no alarm	40 295	294	R
	Alarm Output2 1 - output being driven due to mapped alarm 0 - no alarm	40 296	295	R
	Alarm1 - Lost Generator Communications (if does not clear by itself requies system reset to clear. Possible service issue. Alarm1 is not latched.) 2 - in alarm, major -- diagnostic shutdown 0 - no alarm	40 297	296	R

Category	SERVICE & ALARMS(cont.)	Modbus Register 5-digit	Register Address	R/W
ALARMS (Cont.)	Alarm2 - Generator Valve full open but no RPM (Requires system reset to clear. May be due to lost of differential pressure. Prior to the Alarm the system will attempt auto-restart(s). Upon failure to auto- restart(s) the Alarm is set and the system is in diagnostic shutdown until service . Alarm2 is latched.) 3 - in alarm, major --diagnostic shutdown 0 - no alarm	40 298	297	R
	Alarm3 - Generator Valve Fail RPMs when full closed or timeout when driving open/close (Requires system reset to clear. Possible service issue due to leaky valve, or position sensor. System is in diagnostic shutdown until service. Alarm3 is latched.) 3 - in alarm, major -- diagnostic shutdown 0 - no alarm	40 299	298	R
	Alarm4 - Generator Over Rev/Voltage (Requires system reset to clear. Possible Service issue. System is in diagnostic shutdown until service. Alarm4 is latched.) 3 - in alarm, major -- diagnostic shutdown 0 - no alarm	40 300	299	R
	Alarm5 - Generator RPM Sensor Failure (Requires system reset to clear. Possible service issue. System is in diagnostic shutdown until service.) 3 - in alarm, major -- diagnostic shutdown 0 - no alarm	40 301	300	R
	Alarm6 - Generator Valve Position Sensor Failure (Requires system reset to clear. Possible service issue. Alarm6 is latched.) 3 - in alarm, major -- diagnostic shutdown 0 - no alarm	40 302	301	R
	Alarm7 - Controller Switch is in Disable Position (Reqires switch to be moved to ON to clear.) 1 - in alarm -- diagnostic shutdown 0 - no alarm	40 303	302	R

Category	SERVICE & ALARMS(cont.)	Modbus Register 5-digit	Register Address	R/W
	Alarm8 - Unable to generate Max Power (Requires system reset to clear. Possible low differential pressure. Will contnue to run the generator and charge if possible. Possible service issue.) 1 - in alarm 0 - no alarm	40 304	303	R
	Alarm9 - RSD (Remote Shut Down) (Requires active RSD input to be negated to clear) 1 - in alarm -- diagnostic shutdown 0 - no alarm	40 305	304	R
	Alarm10 - Generator Run Time Service Due (Requires service. Will continue to run generator and charge if possible.) 1 - in alarm 0 - no alarm	40 306	305	R
	Alarm11 - Battery Temperature Sensor Failure (If does not clear by itself requires system reset to clear. Will contnue to run the generator but use 68F as the battery temperature. Possible service issue) 1 - in alarm 0 - no alarm	40 307	306	R
	Alarm12 - Battery unable to reach full charge (If does not clear by itself requires system reset to clear. Will run generator in Stage1 full charge. Possible service issue) 1 - in alarm 0 - no alarm	40 308	307	R
	Alarm13 - Modbus Shut Down (Requires Modbus device to negate to clear.) 1 - in alarm -- diagnostic shutdown 0 - no alarm	40 309	308	R
FUTURE	Reserved = 0	40310 --- 40 350	309 --- 349	R

Category	Name - COMMUNICATIONS	Modbus Register 5-digit	Register Address	R/W
COMM	Modbus ID (16-bit integer) 1 to 247 Default = 1	40 351	350	R/W
	Modbus Reserved = 0	40 352	351	R
	ModbusSerial Protocol Mode (16-bit integer) 2=TCP/IP,1=RTU, 0=ASCII Default = 1 (Requires reset to take effect)	40 353	352	R/W
	Modbus Serial RS-485 Baud (16-bit integer) 1200,2400,4800,9600,14400,19200,38400 Default = 9600 (Requires reset to take effect)	40 354	353	R/W
	Modbus Parity (16-bit integer) 2=EVEN, 1=ODD, 0=NONE Default = 0 (Requires reset to take effect)	40 355	354	R/W
	Modbus Reserved	40 356	355	R
	Modbus ASCII Protocol Timeout (16-bit integer) 1 to 65,535 seconds Default = 1	40 357	356	R/W
	Modbus Error Count (16-bt Integer)	40 358	357	R/W
	Reboot Info (16-bit integer) 15=from disable switch, 12=From power being off, 0=forced reset from Modbus coil command	40 359	358	R
	Modbus Reserved = 0	40 360	359	R
	Modbus Reserved = 0	40 361	360	R
	Modbus Reserved = 0	40 362	361	R
	Modbus Reserved = 0	40 363	362	R
	Modbus Reserved = 0	40 364	363	R
	Modbus Reserved = 0	40 365	364	R
	Reserved = 0	40 366	365	R
		---	---	
		40 375	374	

Category	Name - **EVENT LOG**	Modbus Register 5-digit	Register Address	R/W
Logger	Reserved = 0	40 376	375	R
		---	---	
		40 398	397	
	New Events in Event Log (16 bit integer)	40 399	398	R/W
	Total Events in Event Log (16 bit integer)	40 400	399	R
	Event Record #1 - 10 Registers	40 401	400	R
	most current entry	---	---	
		40 410	409	
	Event Record #2 - 10 Registers	40 411	410	R
	next entry	---	---	
	only valid if <= Total number of Events	40 420	419	
	Event Record #3 to #999 - 10 Registers each	40 421	420	R
	next entries	---	---	
	only valid if <= Total number of Events	50 390	10 389	
	Event Record #1000 - 10 Registers	50 391	10 390	R
	last entry	---	---	
	only valid if <= Total number of Events	50 400	10 399	

Event Record - Structure	Modbus Register Offset
Year - 2000 to 2099	xx xx1
Month - 1 to 12	xx xx2
Day - 1 to 31	xx xx3
Hour (24Hr) - 0 to 23	xx xx4
Minute - 0 to 59	xx xx5
Second - 0 to 59	xx xx6
Event Code (see list for details)	xx xx7
Reserved = 0	xx xx8
Battery Volts x100 (16-bit integer) 0 to 655.35 V (after divide by 100)	xx xx9
Record Number 1 to 1000	xx x10

Event Code	Description
0	* reserved event code (0)
1	Power ON
2	ON/Disable switch in DISABLE position
3	Event Table Cleared
4	New Events Tagged as Read
5	Generator Started
6	Generator Stopped
7	Temperature sensor failed, compensation disabled
8	Temperature sensor in range, compensation restored
9	code 9
10	RSD detected
11	RSD cleared
12	Lost communications link to Generator
13	Valve is full open but no RPM detected
14	Unable to generate max power with control valve full open
15	Unable to maintain full charge with max charging power
16	Unstable RPM detected
17	RPM detected with control valve full closed
18	Generator over-rev shutdown
19	Generator efficiency loss detected
20	Generator Disable - Diagnostics Shutdown
21	Service Due Timer Updated by Operator
22	Total Run-Time Updated by Operator
23	Generator Service Due
24	code 24
25	Control Valve Failed to Initialize
26	code 26
27	code 27
28	Unknown Generator Size or Type
29	Using Test Power Value
30	ALARM on Out1 Active
31	ALARM on Out2 Active
32	ALARM on Out1 Cleared
33	ALARM on Out2 Cleared
34	code 34
35	code 35
36	Battery voltage monitor calibrated
37	Battery temperature monitor calibrated
38	Charge current zero calibrated
39	Charge current gain calibrated

Event Code	Description (Cont.)
40	Generator voltage monitor calibrated
41	Event clock time and date set
42	Charger mode set to 12 volt battery
43	Charger mode set to 24 volt battery
44	Alarms 1 & 2 - Settings Updated
45	code 45
46	Calibration Date Updated
47	Tag Name Updated
48	Test charge current set
49	Configuration Updated
50	Generator Packet Timeout
51	Generator received packet checksum error
52	Generator received packet size error
53	MODBUS commanded 'Disable'
54	MODBUS commanded 'ON'
55	code 55
56	code 56
57	code 57
58	code 58
59	Generator received invalid command
60	Gen control - Max RPM delta adjusted
61	Gen control - Minimum motor PWM adjusted
62	Gen control - Valve open StopPoint adjusted
63	Gen control - Valve close DropPoint adjusted
64	Gen control - Setpoint deadband upper adjusted
65	Gen control - Setpoint deadband lower adjusted
66	Gen control - Defaults Restored
67	Turbine RPM sensor failed
68	Control valve position sensor failed
69	Unable to Reach Full Charge
70	Adjusted Timeout - for Unable to reach Full Charge
71	Full Open, No RPM Detected - Waiting to Retry
72	Full Open, No RPM Detected - Retrying Now
73	Full Open, No RPM Detected - Auto Count Reset
74	Adjusted Retry Delay - for Full Open, No RPM Alarm
75	Adjusted # Retry Limit - for Full Open, No RPM Alarm
76	Wait To Retry Overridden by Manual Charge Control
77	Wait To Retry Overridden by Diagnostic Shutdown
78	Wait To Retry Overridden by ON/Disable Switch
79	Control valve driving open timeout
80	Control valve driving close timeout
all others	Unknown Event

Event Code	Description (Cont.)
40	Generator voltage monitor calibrated
41	Event clock time and date set
42	Charger mode set to 12 volt battery
43	Charger mode set to 24 volt battery
44	Alarms 1 & 2 - Settings Updated
45	code 45
46	Calibration Date Updated
47	Tag Name Updated
48	Test charge current set
49	Configuration Updated
50	Generator Packet Timeout
51	Generator received packet checksum error
52	Generator received packet size error
53	MODBUS commanded 'Disable'
54	MODBUS commanded 'ON'
55	code 55
56	code 56
57	code 57
58	code 58
59	Generator received invalid command
60	Gen control - Max RPM delta adjusted
61	Gen control - Minimum motor PWM adjusted
62	Gen control - Valve open StopPoint adjusted
63	Gen control - Valve close DropPoint adjusted
64	Gen control - Setpoint deadband upper adjusted
65	Gen control - Setpoint deadband lower adjusted
66	Gen control - Defaults Restored
67	Turbine RPM sensor failed
68	Control valve position sensor failed
69	Unable to Reach Full Charge
70	Adjusted Timeout - for Unable to reach Full Charge
71	Full Open, No RPM Detected - Waiting to Retry
72	Full Open, No RPM Detected - Retrying Now
73	Full Open, No RPM Detected - Auto Count Reset
74	Adjusted Retry Delay - for Full Open, No RPM Alarm
75	Adjusted # Retry Limit - for Full Open, No RPM Alarm
76	Wait To Retry Overridden by Manual Charge Control
77	Wait To Retry Overridden by Diagnostic Shutdown
78	Wait To Retry Overridden by ON/Disable Switch
79	Control valve driving open timeout
80	Control valve driving close timeout
all others	Unknown Event

Category	Name - **RESETS**	Modbus Coil 5-digit	Data Address	R/W
ON/Disable	Remote ON/Disable Disable value = 0x0000 - force shut down (simulate ON/Disable switch in DISABLE position) ON value=0xFF00 - turn ON and force a reset (simulate ON/Disable switch in the ON position)	00 001	0	**W**
EVENT LOG clear	Event Log Clear OFF value = 0x0000 - no change ON value=0xFF00 force clear Event log 40 399 - New Events = 0 40 400 - Total Events = 0 one shot, after clearing will operate and start logging including log of this clearing command (Logs Event 3)	00 002	1	**W**
Counter reset	Counters Reset to zero OFF value = 0x0000 - no change ON value=0xFF00 - reset to zero the following: 40 286 - Average Cyclic Charge Time 40 287 - Average Cyclic Discharge Time 40 291 - Total Controller On Time 40 292 - Total Generator Run Time And Reloads Default : 40 293 - Service Due Hours, Default 5000 Hours one shot, after clearing will operate normal. (Logs Event 22, Event 21)	00 003	2	**W**
Generator Start/Stop	Remote Generator Start/Stop Stopvalue = 0x0000 - force genertor into stop state. Note: When battery requires charging the generator will restart normally. Start value=0xFF00 - turn on the generator Note: When battery is fully charged the generator will stop normally.	00 004	3	**W**

A.8 Troubleshooting

Problem

RS485 - Failure to communicate

Possible Solutions

- Ensure that the connecting cable is properly installed and that, if applicable, the 2-wire to 4-wire connection is correct. (See Section A.3.4.)
- Ensure that no Ethernet connection attempt is being made and that the jumper is removed from pins 1 and 2 of the 8-position connector. (See Section A.3.5.)
- Using the DB Monitor software, verify that the RS485 port settings saved to the controller match those at the remote connection.
- If there are multiple devices in the network, verify the termination jumpers in the communication module have been properly set and adjust if necessary. (See Section A.3.3.)

Problem

Ethernet - Failure to communicate

Possible Solutions

- Ensure a standard Ethernet cable is being used. A cross-over cable is not required.
- Verify that no RS485 connection attempt is being made and that a jumper is installed between pins 1 and 2 of the 8-position connector. (See Section A.3.5.)
- Using the instructions provided, verify that the IP address saved to the communication module has been properly set to work with the remote device network. (See Section A.5.2.)

Parker Hannifin Corporation
Instrumentation Group

PGI Division
16101 Vallen Drive
Houston, TX 77041 USA
Phone 713 466 0056
pgi_sales@parker.com
www.parker.com/pgi