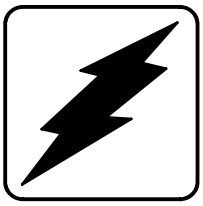
Operation

Wireless Monitoring System



Models:

PowerScan™ Wireless Monitor
GM29535
GM29536

ISO 9001
KOHLER POWER SYSTEMS
NATIONALLY REGISTERED

KOHLER®
POWER SYSTEMS

TP-6223 10/05a

Product Identification Information

Record the product identification information in the spaces below immediately after unpacking the products so that the numbers are readily available for future reference. This information is required to set up and activate the wireless monitoring service.

Wireless Monitor Information

Record the product identification numbers from the wireless monitor label.

Model Designation _____

Device ID Number _____

Monitored Equipment Information

Record the following information for the equipment being monitored.

Equipment Name _____

Address _____

City _____

State _____

Zip Code _____

Manufacturer _____

Model _____

Serial Number _____

Local Contact Person:

Name _____

Phone _____

Table of Contents

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IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Hazardous Voltage/ Electrical Shock

DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Notes

Introduction

This manual provides installation, setup, and operation instructions for the Kohler® PowerScan™ wireless monitoring system. This device must be installed in accordance with the National Electrical Code (NFPA 70), local codes, and the authorities having jurisdiction.

Information in this publication represents data available at the time of print. Kohler Co. reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

Service Assistance

For wireless monitor device activation in the US and Canada, visit the Kohler Power Systems website at KohlerPowerSystems.com.

For professional advice on generator power requirements and conscientious service, please contact your nearest Kohler distributor or dealer.

- Consult the Yellow Pages under the heading Generators—Electric
- Visit the Kohler Power Systems website at KohlerPowerSystems.com
- Look at the labels and stickers on your Kohler product or review the appropriate literature or documents included with the product
- Call toll free in the US and Canada 1-800-544-2444

Notes

1.1 System Description

The wireless monitor system has two components: a wireless monitor device, shown in Figure 1-1, and a messaging center with a website. The monitor device transmits messages in response to inputs received from the equipment controller. The messaging center monitors and delivers these messages to the assigned recipients through selected delivery methods.

Figure 1-1 Wireless Monitor

The user logs on to the messaging center website to activate each wireless monitor, assign recipients for each message type and the delivery method for each recipient, review the status and message history for each device, and start or stop the equipment remotely, if desired.

Note: Disconnect power to connected equipment before servicing or maintenance to prevent starting of the equipment by a remote device. Refer to the equipment manufacturer's instructions.

If a monitoring device is removed from service, log onto the messaging center website to deactivate the device. Devices not deactivated will continue to be billed. See Section 4.4 for instructions to deactivate a device.

1.2 Messages

At the website, the user assigns recipients for each message type and the delivery method for each recipient. Single or multiple messages regarding various operating conditions can be sent to each recipient. Delivery methods include pagers (alphanumeric, numeric), fax, XML, e-mail, PCS, or telephone (voice delivery). More than one delivery method can be selected for each recipient. Each message sent will describe the condition that generated the transmission and also the make, model, and location of the equipment. Up to 40 messages each day can be delivered.

The wireless monitor constantly monitors the inputs. When an input is triggered, the wireless monitor sends the condition over the North American AMPS (advanced mobile phone system). An operations center server receives the transmission and forwards the message to the selected recipients according to the configured delivery method.

Every 24 hours, the wireless monitor sends information about itself and the system it is monitoring. This *heartbeat* transmission tells the message center that the wireless monitor is properly functioning, powered, and able to generate messages. If a device fails to report a nightly heartbeat for more than a day, the system sends a *Unit Failed to Report Heartbeat* alarm message to the website.

Equipment run times are reported daily. Models using hardwire inputs accumulate run times over a 24-hour period and report the run times with the heartbeat message. Models using Modbus® communication report the total accumulated run time and the total number of starts with the heartbeat message. Run times for these models are also totaled using the Control Panel function and can be updated upon request.

Modbus® is a registered trademark of Schneider Electric

1.3 Models

There are two monitor models: GM29535 for use with hardwire inputs, and GM29536 for use with Modbus® communication. Models GM29535 and GM29536 can be powered by either AC voltage or a 12 or 24 VDC battery.

Figure 1-2 lists and describes the models.

Model	Description
GM29535	Includes 7 hardwire inputs: 4 dry contact inputs and 3 voltage inputs.
GM29536	Uses Modbus® communication. Also includes 8 hardwire inputs (4 dry contact and 4 voltage inputs).

Figure 1-2 Wireless Monitor Models

1.4 Specifications

Figure 1-3 lists the wireless monitor specifications.

Description	Specification
Power supply	Selectable: 85–120 VAC, 50/60 Hz; 12 VDC or 24 VDC
Power consumption	15 VA
Battery backup	12 VDC, gel cell
Operating temperature	–40 to 60°C (–40 to 140°F)
Storage temperature	–40 to 70°C (–40 to 160°F)
Enclosure type	Approved for outdoor mounting
Enclosure dimensions, W x H x D	180 x 245 x 89 mm (7.13 x 9.63 x 3.5 in.)
Enclosure material	UV resistant ABS gray
Enclosure knockouts	3 bottom, 3 rear (1/2 in., 3/4 in. concentric)
Radio transmit	824.01–848.97 MHz
Radio receive	869.01–893.97 MHz
Radio output	3 watts
Radio antenna	50 ohms
Vibration	5–10 Hz at 0.2 in. displacement and 10–200 Hz at 2 Gs in 3 planes
Shock	20 Gs for 11 milliseconds in 3 planes

Figure 1-3 Wireless Monitor Specifications

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1.5 Indicators and Panel Buttons

Figure 1-5 shows the wireless monitor with the cover removed to show the components described in the following sections. Refer to Section 2, Installation, for information about DIP switches and other components not listed below.

1.5.1 LED Indicators

The red LED above each input illuminates when the input is on. The LEDs are not visible when the cover panel is in place.

The numerical LED displays the following codes:

- *0–9* to indicate the cell signal strength during normal operation
- *F* when the device is in service mode
- A decimal point (.) if the power has been disconnected
- A code *(— 1 —)* to indicate Modbus® communication when the alarm silence button is pressed three times; see Section 1.5.3 (Modbus® models only).

1.5.2 Status Lights

The yellow status light flashes once per second during normal operation to indicate that the wireless monitor registers service, is available, and is ready to send. See Figure 1-4. The yellow light flashes rapidly when the device is holding a message.

The green status light flashes several times and then flashes quickly for approximately 2 seconds when the monitor sends a message to the message center. If green light flashes only twice, the message did not leave the device. The device will hold the message and retry every 10–15 seconds.

Status Light		
Yellow	**Green**	**Indicates**
Off	Off	Service not available
Flashing once/sec.	Off	Service available, ready to transmit
Flashing rapidly	Off	Holding message
On	Flashes once or twice	Transmitting message
On	Flashes rapidly for 2 sec.	Successful transmission

Figure 1-4 Status Lights

1.5.3 Alarm Silence Button

The alarm silence button silences the audible alarm on the monitor device. The audible alarm occurs when the equipment controller signals a fault/alarm. Select fault assignments on the website (See Section 4). The alarm sounds again five minutes after the button is pressed if the fault is not corrected. The audible alarm can be disabled by a DIP switch selection. The audible alarm is not available for any alarms received via Modbus® connection.

On models equipped with Modbus® communication, press the alarm silence button three times to to check for successful communication. The LED will display the sequence *dash one dash (— 1 —)* to indicate that the monitor is communicating with the equipment controller. A series of dashes without a number *(— — —)* indicates a loss of communication with the equipment controller.

1.5.4 Service Button

Pressing the service button sends a message to the website that a technician has arrived on-site. An *F* on the monitor LED display indicates the service mode. The web screen displays *Service Button*. To minimize nuisance alarm messages, the monitor does not accept alarms from the equipment during servicing.

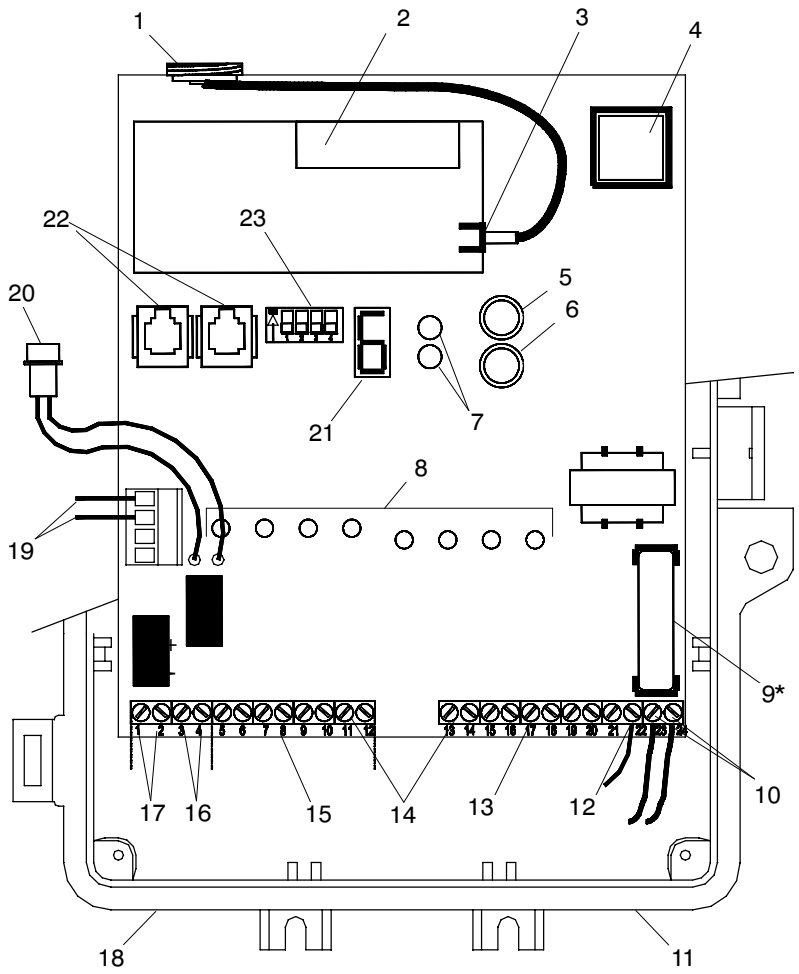
The technician must press the service button again after service to reset the monitor to receive alarms. The monitor automatically resets 120 minutes after the service button is pressed. A signal strength number *(0–9)* on the monitor LED display indicates that the device has returned to normal operation.

1.6 Battery Pack

A rechargeable battery supplies power to AC-powered devices if AC power is lost. The monitor continues to transmit messages for 15 minutes, then transmits a loss of power signal and enters the *sleep* mode. The sleep mode can last up to 18 hours, until the battery completely discharges or power is restored. The wireless monitor continues to send scheduled heartbeat messages during the sleep mode until the battery discharges completely. The sleep mode is disabled if the DC power mode is selected (DIP switch 4).

For DC-powered monitor devices, the rechargeable battery pack can be used during the location and signal strength checks in Section 2. Do not use the rechargeable battery pack as a permanent power source for the monitor.

1.7 Components and Connections



1. Antenna connection
2. Radio module
3. Antenna cable connection
4. Processor module (internal)
5. Option button (alarm silence)
6. Service button
7. Status lights
8. Input indication lights
9. Fuse, 1 amp, 250 volt, fast blow, 3 AG *
10. AC Power supply 23, 24 (85–120 VAC, 60 Hz) ‡
11. Use this knockout for Class I leads †
12. Device wiring 22 (earth ground)
13. Voltage inputs 13-20 (24–120 VAC or 5–48 VDC)
14. Terminal blocks (use 12–18 AWG for connections)
15. Dry contact inputs 5-12 (do not apply voltage)
16. Relay inputs 3, 4 (not used)
17. Relay inputs 1, 2 start/stop relay
18. Use this knockout for Class II leads †
19. DC power supply connection (12 or 24 VDC)
20. Battery pack connector (not connected in DC-powered installations)
21. Signal strength (LED) indicator (0–9=signal strength, F=service mode)
22. Modbus® RS-485 RJ11 communication ports or factory test ports
23. DIP switches; see Section 2.10

* A blown fuse usually indicates a problem that needs to be corrected. Do not replace the fuse without identifying and correcting the problem.

† Never mix Class I and Class II leads. Install signal leads and AC or DC power conductors in separate raceways, cables, or conduit. Always follow the National Electrical Code (NEC) and applicable local codes.

Figure 1-5 Wireless Monitor Components and Connections (shown with cover removed)

Modbus® is a registered trademark of Schneider Electric

2.1 Introduction

This section covers the installation and test of the wireless monitor. Install this device in accordance with the National Electrical Code (NFPA 70), local codes, and the authorities having jurisdiction. Perform the test after the installation, account setup, and message configuration are complete.

Sections 3 and 4 explain account setup and message configuration, which must be done on the Internet at the Kohler website (KohlerPowerSystems.com). Either configure the wireless monitor by completing the account setup and message configuration before installation (installation details can be filled in later) or arrange to have someone available at the equipment site to help test the monitor after completing the Internet setup.

2.2 Required Tools

- One wireless monitor device
- One 85–120 VAC or 12/24 VDC power supply
- Watertight fittings to seal enclosure penetrations
- Screws to surface-mount the enclosure
- Screwdriver, wire for power supply connection, and 12–18 AWG wire for input connections

2.3 Check Cell Service

There are some regions where cell coverage is available but Kohler service is not. A coverage map is available at the website, KohlerPowerSystems.com, under Coverage Maps (see Figure 3-3). Simply enter the zip code where you wish to install the wireless monitor to see if monitoring service is available.

2.4 Connect Antenna

The antenna connections on the enclosure are factory-installed to prevent water from entering the enclosure. DO NOT change any of these existing connections. Simply screw the antenna to the connector on the top of the wireless monitor enclosure. See Figure 1-5 for the connector location.

2.5 Check Location

Take the wireless monitor to the area where the equipment to be monitored is located. The wireless monitor can be located either indoors or outside. Mount the wireless monitor in a location where the ambient temperature range does not exceed –40° C to 60° C (–40° F to 140° F).

Locate the wireless monitor no more than 12 m (40 ft.) from the monitored equipment but at least 0.8 m (2.5 ft.) from electronic components to avoid signal interference. Check locations where the antenna rises at least 50 mm (2 in.) above or is directed away from the equipment. Avoid mounting the monitor on vibrating equipment.

The wireless monitor will be able to send messages in locations where analog cell phones will work. If the equipment is in an area where an analog cell phone cannot get a signal, it is likely the wireless monitor will not be able to get a signal either.

Startup and Signal Check Procedure

1. Plug the battery pack into the battery pack connector provided on the monitor. See Figure 1-5, item 20.

2. The wireless monitor will begin a startup routine. The startup time will vary but may last up to several minutes as the wireless monitor establishes a connection to a cell site and registers a message.

3. During the startup routines, the *Signal Strength Indicator* display segments will rotate. Initially, the middle display segment will not be lit. When the middle segment comes on, the wireless monitor has successfully completed the first half of the startup routines.

4. Check the yellow status light. The yellow status light (see Figure 1-4) flashes once per second and the signal strength is displayed when service is available. See Section 2.6, Cell Coverage Check.

5. Walk around the equipment or the equipment room with the wireless monitor powered by the battery pack.

Note: On battery power, the monitor will display the signal strength for 15 minutes before it goes into a sleep mode and displays a decimal point. Simply unplug the battery pack and then reconnect to continue on battery power to determine final location.

6. Place the wireless monitor in several sample mounting locations and check the signal strength by observing the signal strength indicator. Check locations where the antenna rises at least 50 mm (2 in.) above or is directed away from the equipment. The cell signal strength can range from 0 to 9. The higher the signal strength number, the better the signal. See Section 2.6, Check Signal Strength.

   Note: A signal strength less than 2 will not provide reliable message transmission. A high-gain antenna may be required.

7. When the mounting location with the strongest (highest number) signal strength is found, disconnect the battery pack connection until the final installation has been completed.

Nuisance alarms are sometimes triggered when the equipment is being tested or serviced. To avoid nuisance alarms, do not connect the power supply or reconnect the battery to the wireless monitor until instructed to do so in Section 2.11.

2.6 Check Signal Strength

After the initial startup routine, the LED numerical display shows the cell signal strength at the wireless monitor location. The cell signal strength can range from 0 to 9. The higher the signal strength number, the better the signal.

The wireless monitor sends out a sample message and then waits for a return signal to determine if Kohler service is available at this site. The yellow status light (see Figure 1-4) will flash once a second and the signal strength will be displayed when service is available. Telemetry system delays may occur in cell coverage areas due to high traffic volume that may result in message delays.

A signal strength less than 2 will not provide reliable message transmission. A high-gain antenna may be required.

2.7 Mount Wireless Monitor

Choose a surface that is flat and strong enough to hold the wireless monitor. Avoid mounting the device on vibrating equipment. Locate the wireless monitor no more than 12 m (40 ft.) from the monitored equipment but at least 0.8 m (2.5 ft.) from electronic components to avoid signal interference. The antenna must clear the top of the equipment by 50 mm (2 in.) minimum.

The enclosure has one keyhole mounting tab extending from the top of it and two mounting tabs extending underneath. Use all three tabs to secure the device.

Note: This enclosure is UL approved for outdoor use. **DO NOT** drill any holes into or through the enclosure. Use watertight fittings in the precast holes at the bottom of the enclosure for wire entrances.

2.8 Prevent Accidental Starting

Before proceeding to wire the power supply and input connections, disconnect power to the monitored equipment to prevent accidental starting. Refer to the equipment manufacturer's documentation for instructions.

2.9 Connect Field Wiring

Open the monitor enclosure and remove the four screws securing the black panel cover to gain access to the input terminals and LEDs (see Figure 1-5).

The enclosure is equipped with six knockouts. **DO NOT** make any other holes in the enclosure. Bring all Class 1 and Class 2 wiring into the enclosure through separate knockouts. See NFPA 70, National Electric Code, Article 725 for definitions of Class 1 and Class 2 circuits. Install signal leads and AC or DC power conductors in separate raceways, cables, or conduit.

After removing a knockout, seal it with a watertight fitting (not supplied) if the wireless monitor is being mounted outdoors.

Note: Watertight fittings at the knockout openings are *required* in order to maintain the enclosure's UL outdoor approved rating.

Route all field wiring away from sharp projections, corners, and internal components.

Refer to the equipment manufacturer's wiring diagrams for connection diagrams.

2.9.1 Hardwire Input Connections

Each wireless monitor model has different functions for the four sets of dry contact inputs and the four sets of voltage inputs (see Figure 1-5).

Select up to four available dry contact outputs and up to four DC voltage outputs to connect to the wireless monitor. Use 12–18 AWG wire for field connections to the wireless monitor inputs. Refer to the equipment manufacturer's wiring diagrams to connect the equipment outputs to the wireless monitor input terminals. Note the polarity of the connections and the maximum voltage indicated in Figure 1-5. Follow the equipment wiring diagrams carefully.

Note: *Reversed polarity causes a fault.*

Set DIP switch 3 for the dry contact inputs as shown in Figure 2-1.

2.9.2 Modbus Communication Connections

Model GM29536 supports Modbus® network communications. A 14 ft. communication cable is supplied with these models. Connect the RJ11 connector to the Modbus® port on the monitor device. Refer to the equipment manufacturer's instructions to wire the other end of the communication cable to the Modbus communication terminal on the connected equipment.

The monitor device communicates at 9600 baud. Refer to the manufacturer's instructions to set the connected equipment to communicate at 9600 baud.

2.9.3 Remote Start/Stop Connections

To allow remote starting and stopping of the monitored equipment through the message center website, connect the equipment's remote start/stop circuit to monitor terminals 1 and 2. The monitor's remote start/stop DIP switch must also be enabled for remote starting and stopping; see Section 2.10.

Note: Disable monitored equipment during maintenance or service to prevent accidental starting. See the equipment Operation or Service Manual for instructions.

2.10 Set DIP Switches

The four DIP switches on the wireless monitor are assigned to the functions shown in Figure 2-1. Set the DIP switches to the appropriate positions for the application. DIP switch positions with the monitor oriented as shown in Figure 1-5 are: up = on, down = off.

Note: The wireless monitor is shipped with all DIP switches in the down (off) position.

DIP Switch	Models	Function	Notes *
1	All	Remote start/stop enable/disable	Set in conjunction with relay input terminals 1 and 2 for remote start/stop operation. On = Enable remote start/stop † Off = Disable remote start/stop
2	All	Audible alarm enable/disable	Audible alarm can also be silenced by pushbutton. On = Enable audible alarm Off = Disable audible alarm
3	GM29535	Input 4 active on contact open or closed	Applies to dry contact input #4 *only*. On = Active on open Off = Active on closed
	GM29536	Inputs 1–4 active on contact open or closed	Applies to all dry contact inputs. On = Active on open Off = Active on closed
4	GM29535 GM29536	AC/DC power supply selection	On = DC power supply Off = AC power supply

* DIP switch positions: on = up, off = down. The wireless monitor is shipped with all DIP switches in the down (off) position.

† Disable monitored equipment during maintenance or service to prevent accidental starting.

Figure 2-1 DIP Switches

2.11 Connect Monitor Power

DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before servicing. Install the barrier after adjustments, maintenance, or servicing.

Wireless monitor models GM29535 and GM29536 operate with either AC (85–120 VAC, 50/60 Hz) or DC (12 or 24 VDC) power.

Note: The battery pack mounted inside the monitor enclosure does not function as a permanent DC power supply for the device. The battery pack is intended for temporary power during equipment setup or AC power loss and connects to a different connector than the DC power supply.

2.11.1 AC-Powered Installations

Refer to Figure 1-5. Connect the monitor device battery pack before wiring main power. The battery pack connection is on the left side of the monitor.

For AC-powered installations, provide an AC power supply with a voltage within the range 85–120 VAC. Provide a stepdown transformer for power supply voltages over 120 VAC. Connect the monitor to a receptacle or circuit that is powered by backup power so that the monitor continues to function if the utility power fails. Connect the AC power supply to terminals 22 – 24 (see Figure 1-5).

2.11.2 DC-Powered Installations

Models GM29535 and GM29536 can be powered by 12 or 24 VDC from a battery or other DC power supply. Use a battery charger to maintain the battery.

For battery-powered (DC) installations, do not connect the battery pack mounted inside the monitor enclosure. Move DIP switch 4 to the DC position (DIP switch in the ON [up] position). See Figure 2-1. Connect the external battery harness (provided) to the battery. See Figure 1-5 for connections. Then plug the harness connector into the battery connection on the wireless monitor.

The monitor does not enter the sleep mode when battery-powered with DIP switch 4 in the DC position.

Fuse. The battery harness contains a 5-amp, 250-volt fast-acting ceramic fuse, Kohler part number 233298. If the fuse blows, determine and correct the cause of the blown fuse. Replace a blown fuse with an identical part.

2.12 Record Important Information

Record the following information to use for account setup and message configuration.

- The Device ID number, located on the label inside the monitor. See Figure 2-2 for the location of the Device ID number on the label.

Note: DO NOT leave the site without recording the Device ID number. Without this number, the device cannot be configured at the website.

- The location name for the piece of equipment being monitored, and the exact street address, city, state, and zip code where the wireless monitor is located.
- The local contact phone and name. These should be the phone number and name of the person(s) who would need to be contacted in order to gain access to this wireless monitor.
- The equipment name for the piece of equipment being monitored. Try to be as specific as possible, especially if there are multiple pieces of equipment that will have wireless monitors installed at a single site.
- The equipment manufacturer, model, and serial number. This information should be sufficient to identify repair or replacement parts before a service person is dispatched to the site.

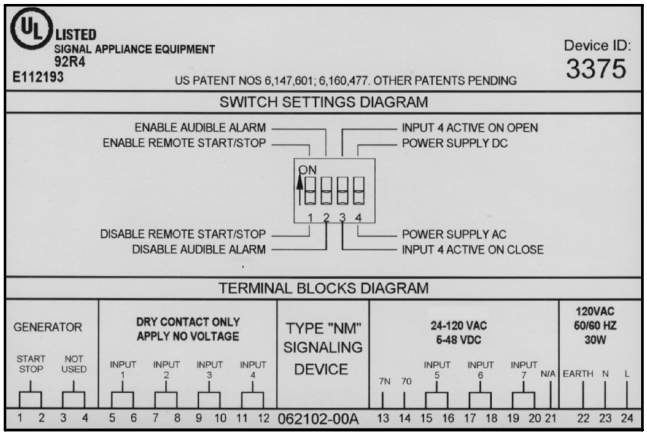


Figure 2-2 Label with Device ID in Upper Right Corner

2.13 Connect Equipment Power

Refer to the equipment manufacturer's instructions to reconnect power to the equipment and return it to normal operation.

2.14 Set Up an Account

Use the information collected in Section 2.12 to set up an account. Connect to the Internet and access www.KohlerPowerSystems.com. The steps to set up a Kohler account are explained in Section 3.

2.15 Test Monitor

Perform the test in this section after configuring the wireless monitor at the Kohler website as instructed in Sections 3 and 4. Testing requires a person at the equipment site and someone with access to the web page.

Note that while the following test is recommended, a properly functioning wireless monitor will send out a *Heartbeat* message every night. Therefore, it is possible to check the system operation by simply waiting until the next morning and then checking the website to determine if the wireless monitor sent out a message.

Equipment Site Test Procedure

1. Verify that the yellow status light is flashing once per second (see Figure 1-4). This indicates the wireless monitor registers service, is available, and is ready to send. The green status light should be off.

2. Press and release the *Service Button.* The yellow light flashes rapidly to indicate that it is waiting to send a message. The green light flashes several times and then flashes quickly for approximately 2 seconds to indicate that the message has been sent.

   Note: If green light flashes only twice, the message did not leave the monitor. The monitor will hold the message and retry every 10–15 seconds.

3. After the message has been successfully sent, check that the green light turns off and the yellow light flashes every second, showing that the wireless monitor is ready to send another message.

Cell tower traffic can cause occasional delays in message transmission. If the message does not go through after the first few attempts, the yellow light flashes rapidly to indicate that the monitor is holding a message. After about 5 minutes, the monitor will attempt to transmit the message again. The yellow light will light steadily and the green light will again begin to flash, indicating an attempt to transmit. This cycle will continue until the message is sent.

Website Test Procedure

1. Access the Kohler website and log in to the PowerScan™ site. See Section 4 for instructions to log onto and navigate the website.

2. Confirm that the equipment information is correct including the name, model, make, and address. Confirm the contact information is correct. The correct information is the name and telephone number of the individual(s) who can provide access to the equipment.

3. Verify that the *Device Information* screen shows the message that the service button has been pressed.

4. Check that all the other appropriate messages were received. Make sure the appropriate individuals were paged, that the appropriate faxes were sent, and the appropriate telephone calls were made.

Notes

A Kohler account is required to configure the wireless monitor. The account will contain billing information for the wireless monitor service. Use the Internet to set up a Kohler account and configure the wireless monitor.

The following sections explain how to set up an account. You must provide your Kohler customer number to set up and access your account. Select a password for website access. Once you complete and submit the billing information and password, you will receive a member ID. Use your member ID and password to set up and access devices on a password-secure website. The member ID determines the address used for invoicing.

Important: **Record your member ID and password** and place them in a safe location. You will need this information each time you access your account.

If you already have a member ID and password, skip this section and proceed to Section 4.

3.1 Account Setup

3.1.1 Access the Website

To set up an account, connect to the Internet and go to the Kohler web page at KohlerPowerSystems.com.

Click on On-Site Power Systems on the Kohler Power Systems home page. The On-Site Power systems page is shown in Figure 3-2. Click on Wireless Monitoring to access the login screen shown in Figure 3-3. Select *Set Up A PowerScan ™ Account.*

The login screen also contains a link to the coverage map. Click on the Coverage Map link to check cell phone coverage in your area, if desired.

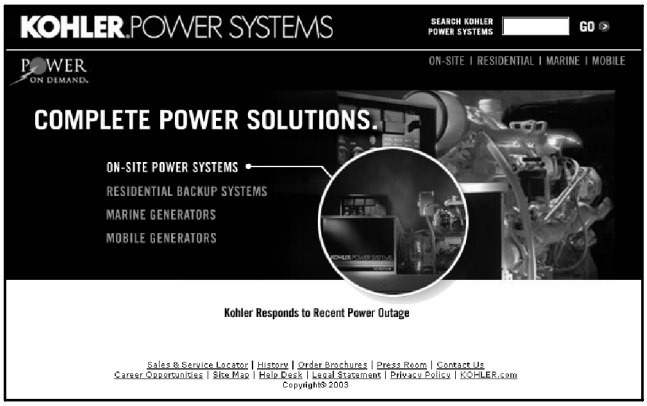
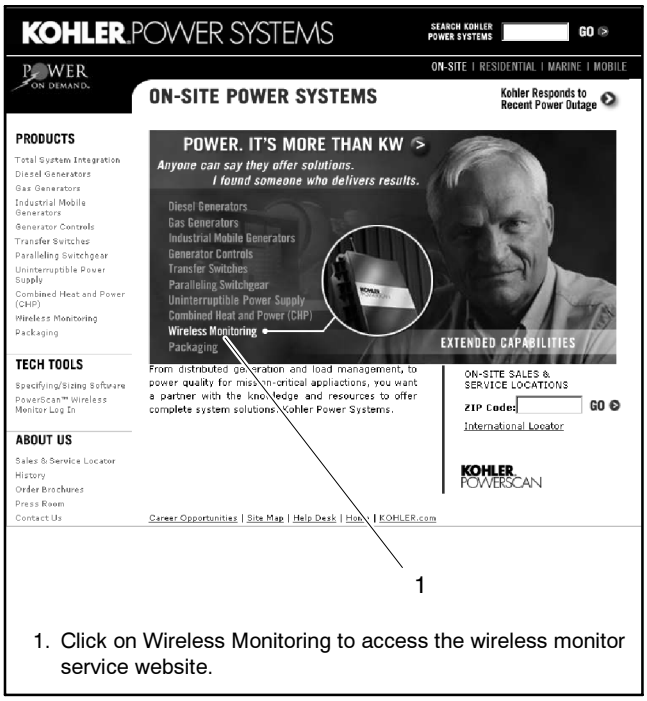
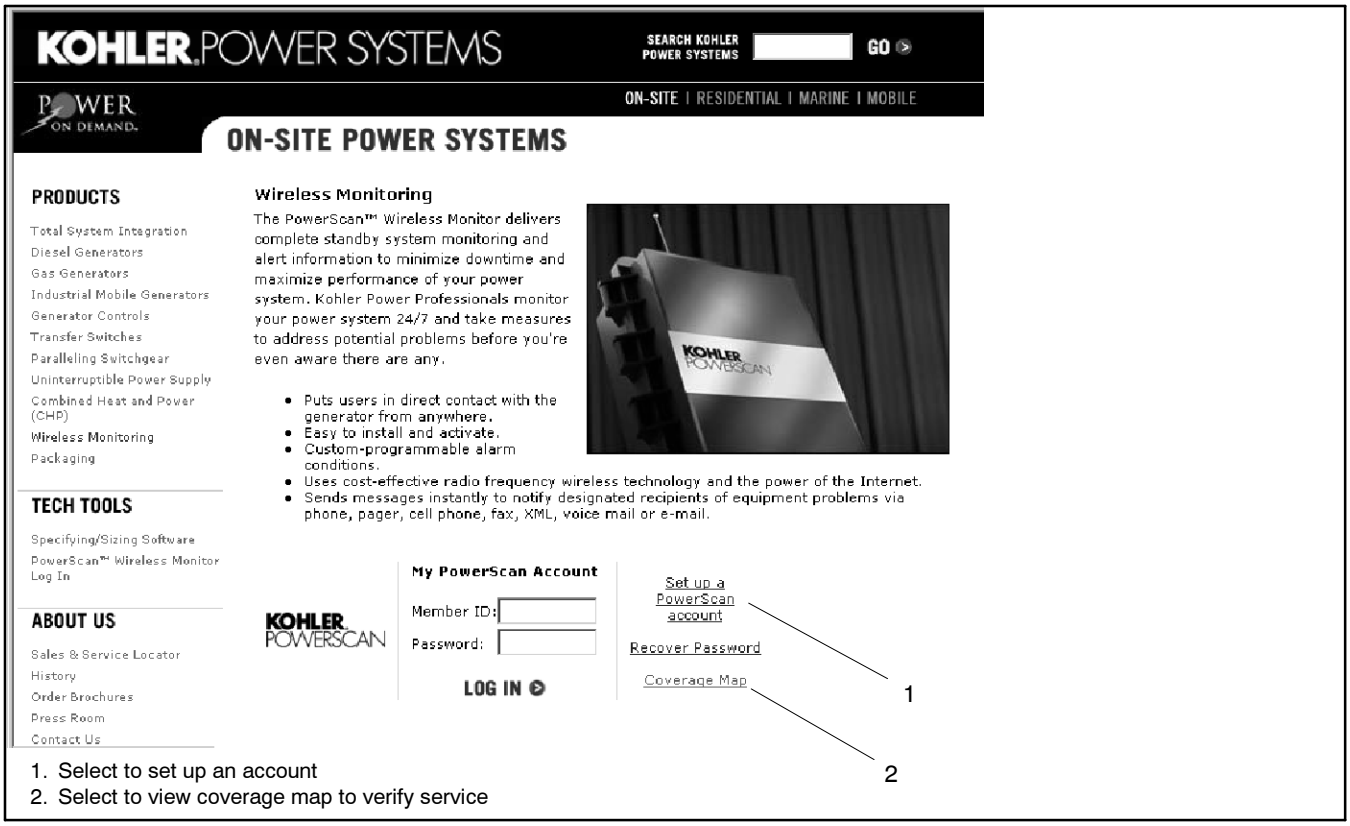


Figure 3-1 KohlerPowerSystems.com Home Page



1. Click on Wireless Monitoring to access the wireless monitor service website.

Figure 3-2 KohlerPowerSystems.com On-Site Power Systems Page



1. Select to set up an account
2. Select to view coverage map to verify service

Figure 3-3 Login Screen

3.1.2 Set up the Account

Fill in the required information in the *Set Up a New Account* screen shown in Figure 3-4. A red check mark indicates required information; other items are optional. Scroll down to fill in the information at the bottom of the screen.

Note: Be sure to insert a Kohler customer number for billing. Using an incorrect customer number may cause deactivation.

Note: The information in this screen refers to the individual(s) who will recieve invoices for the service. Do not use this screen to input location information for the user or the wireless monitor.

When all of the required fields are completed, click on the Submit button at the bottom of the page.

3.1.3 Obtain a Member ID Number

After the account setup is complete, an e-mail message containing the member ID number and password will be sent to the e-mail address entered in the new account information. Save the information in a secure place.

Note: Record the member ID and password and place them in a safe location. You will need this information each time you access your account.

3.1.4 Log On to Your Account

Return to the screen shown in Figure 3-3 and use your member ID number and password to log onto your account. A *Service Agreement* screen appears. Read the agreement before clicking on the Agree button to accept it. Proceed to the next screen to activate your device.

Note: Users are automatically logged out of the website after approximately 10 minutes of inactivity. After automatic logout, the user is returned to the login screen.

Note: Right click on any screen to refresh after a change or command.

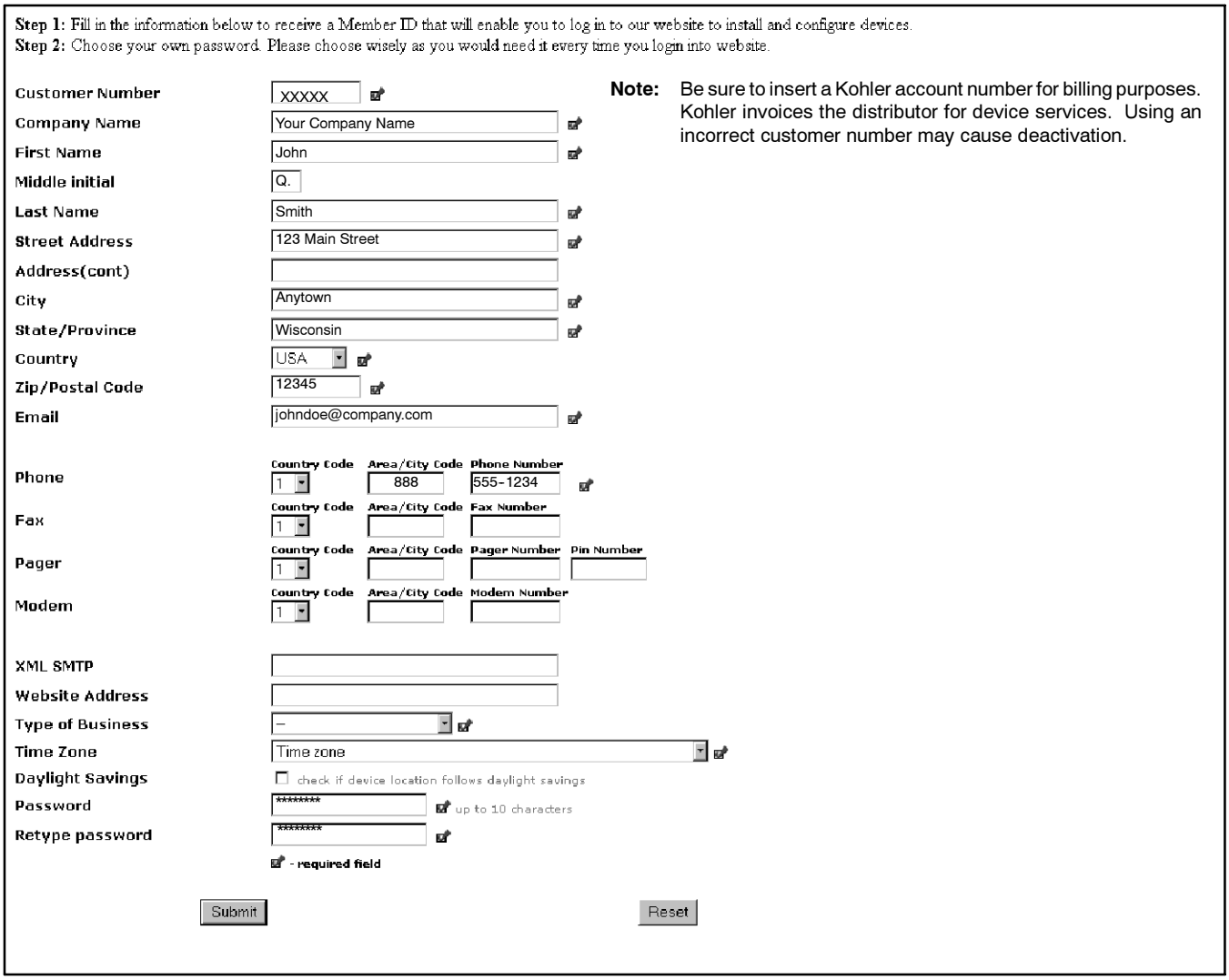


Figure 3-4 Set Up a New Account

3.2 Device Activation

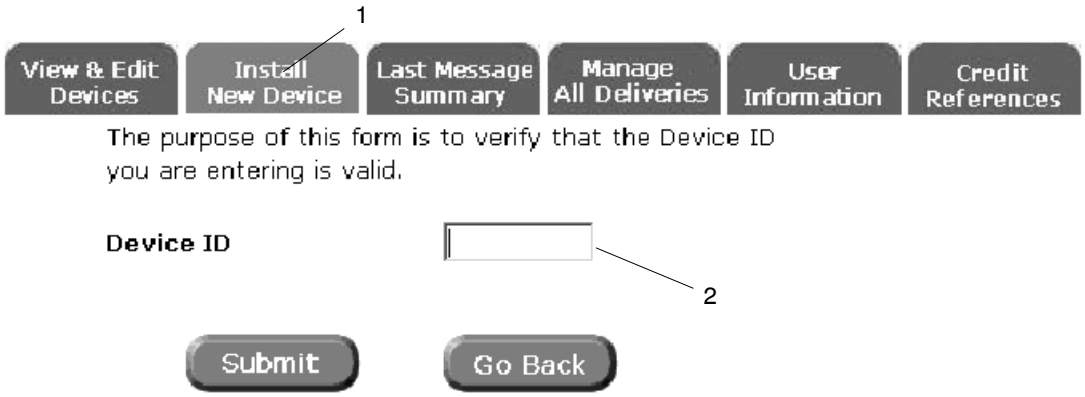
Multiple devices can be installed on a single account. Select the *Install New Device* tab near the top of the screen to begin device setup. See Figure 3-5. Enter the numeric Device ID, shown on the label inside the device. See Section 2.12 for the Device ID number location on the label. Click on the submit button to activate the device at the operations center.

After submitting the Device ID, select the View and Edit Devices tab. See Figure 3-6. Installed devices are listed on the screen. Select the installed device by clicking on the underlined description in the Location column. The Device Information screen shown in Figure 3-7 appears.

Complete and submit the *Device Information* screen to finish the activation. Scroll down to see all of the required fields. The information in this screen refers to the equipment location.

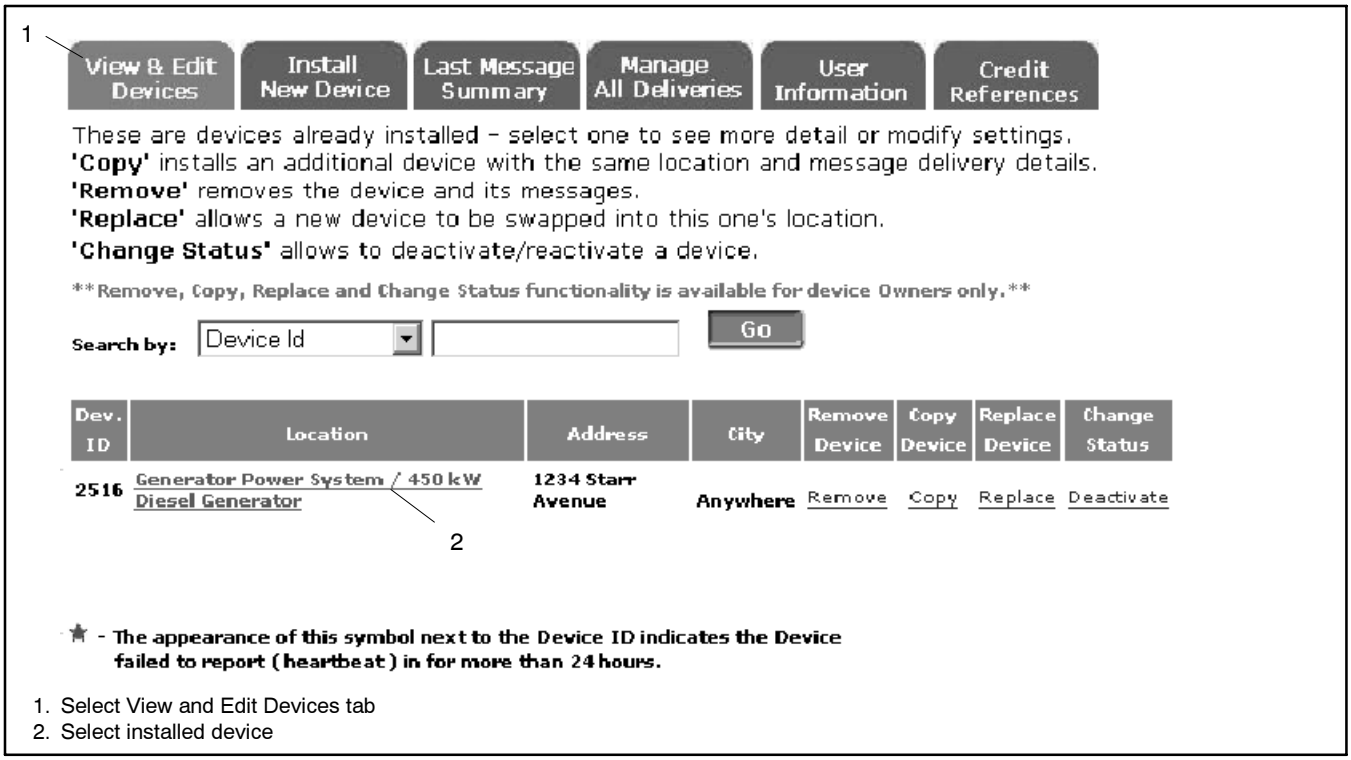
Note: Voice messages include the alarm type, equipment name, location, address, make, and model. Enter concise information into the equipment name, make, and model fields or leave some of those fields blank for short, concise voice messages.

Proceed to Section 4 for instuctions to set up the message delivery for each device.



1. Select Install New Device tab
2. Enter the device ID number from the wireless monitor label

Figure 3-5 Install New Device



1. Select View and Edit Devices tab
2. Select installed device

Figure 3-6 View and Edit Devices

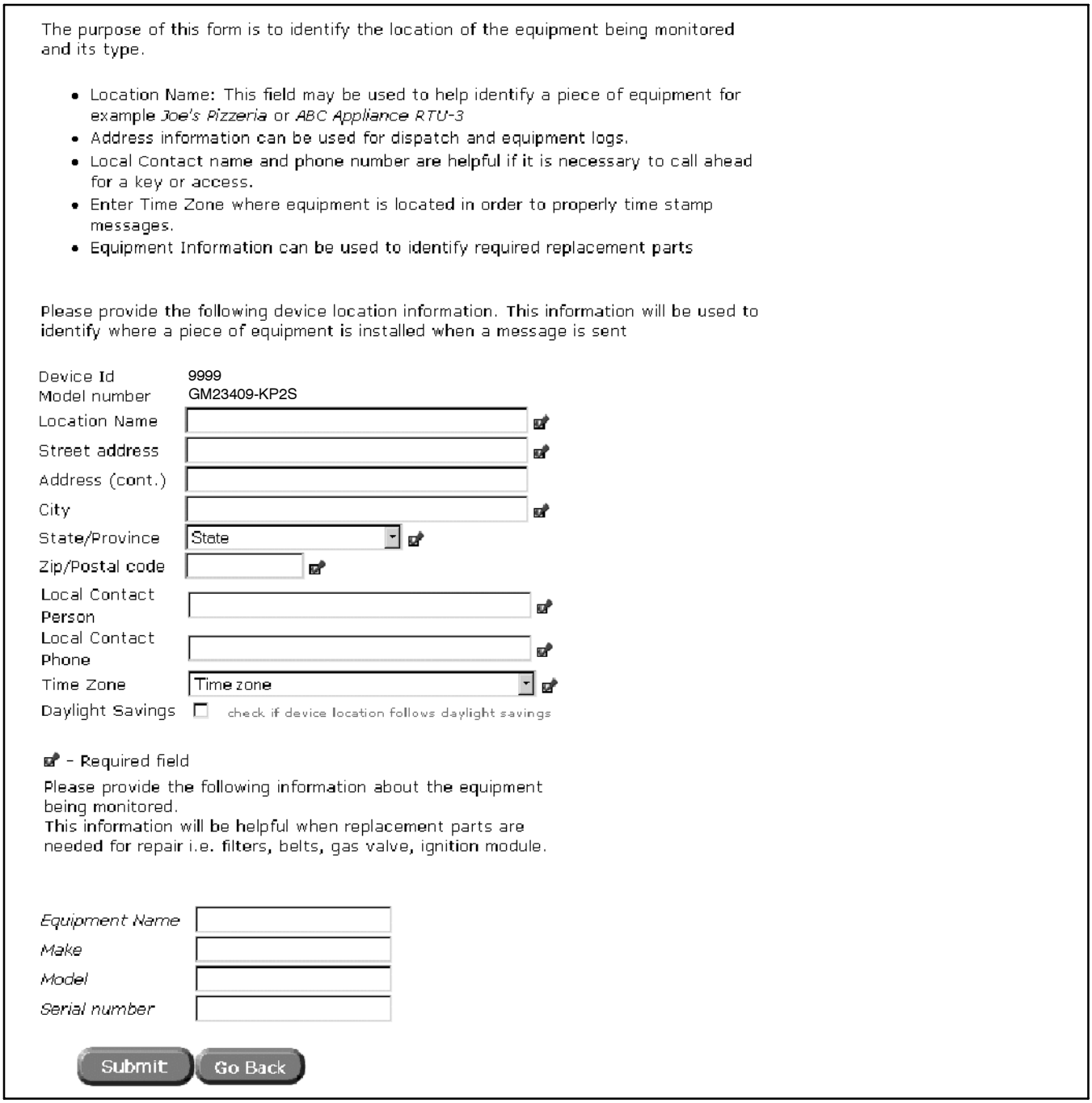


Figure 3-7 Device Information Screen

If you have a Kohler PowerScan member ID and password, proceed with the steps below to configure wireless monitor messages. If you do not have a member ID and password, refer to Section 3 for instructions to set up your account before proceeding.

4.1 Web Page Access

Connect to the Internet and go to the Kohler Power Systems web page at KohlerPowerSystems.com. The home page is shown in Figure 3-1 in Section 3.

Click on On-Site Power Systems on the Kohler Power Systems home page.The On-Site Power systems page is shown in Figure 3-2. Scroll down, if necessary, and click on Wireless Monitoring to access the login screen shown in Figure 4-1.

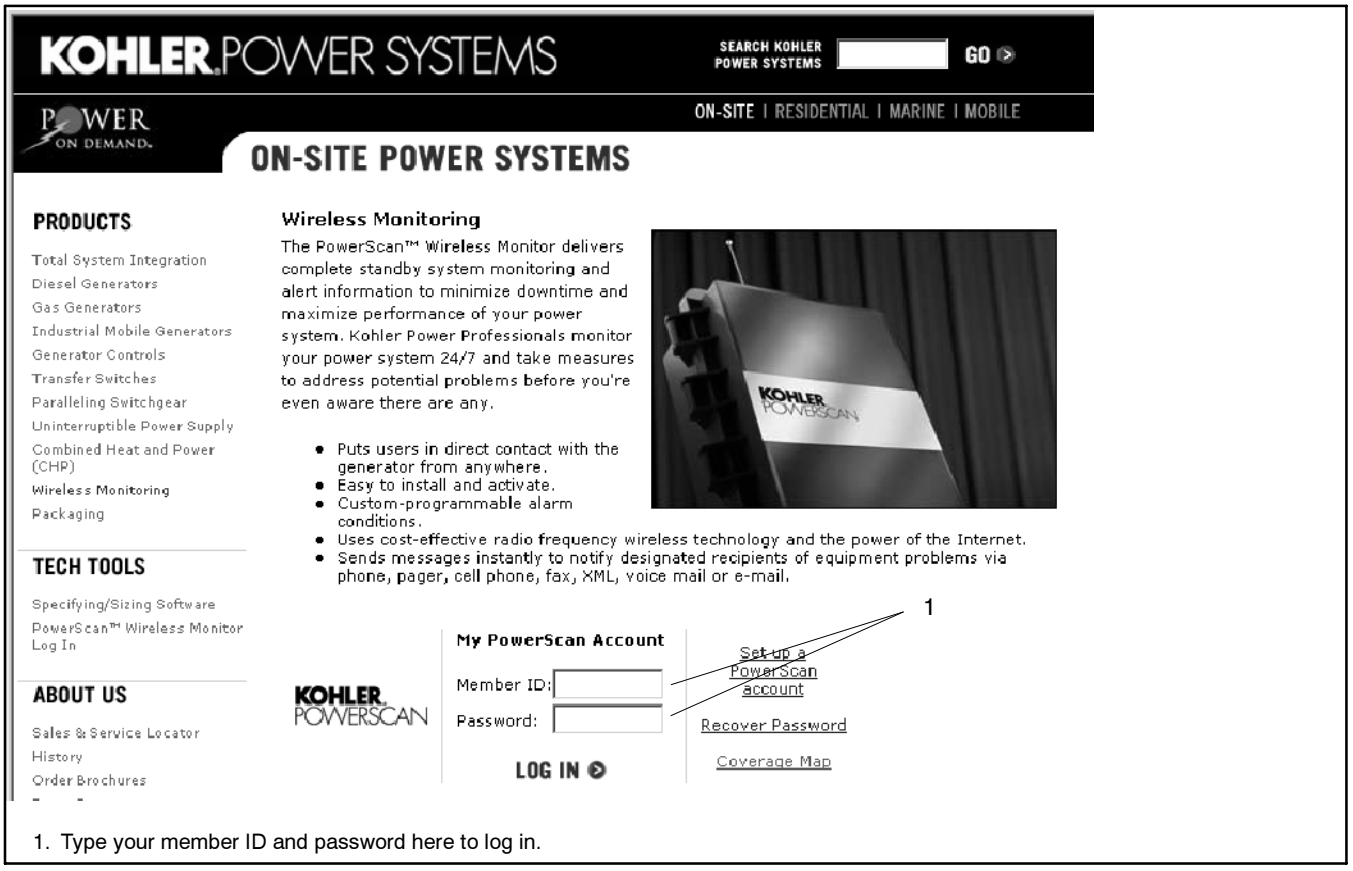
4.2 Logging In

A copy of the login screen is shown in Figure 4-1. Enter your member ID and password and click on *Submit*.

Read and accept the Services Agreement to proceed to the first user screen.

Note: Users are automatically logged out of the website after approximately 10 minutes of inactivity. After automatic logout, the user is returned to the login screen.

The account owner can allow numerous users access to a device by entering their member IDs in the Assign Users screen. The owner assigns each additional user full rights or read-only access to the device and device data. See Section 4.14, Assign Users Screen. If you are not the account owner, your member ID allows you to access only the devices assigned to your member ID by the account owner.



1. Type your member ID and password here to log in.

Figure 4-1 Login Screen

4.3 Menus and Submenus

Figure 4-2 shows the location of the main menu and submenu selection tabs.

The following main menus show information for all devices on the website:

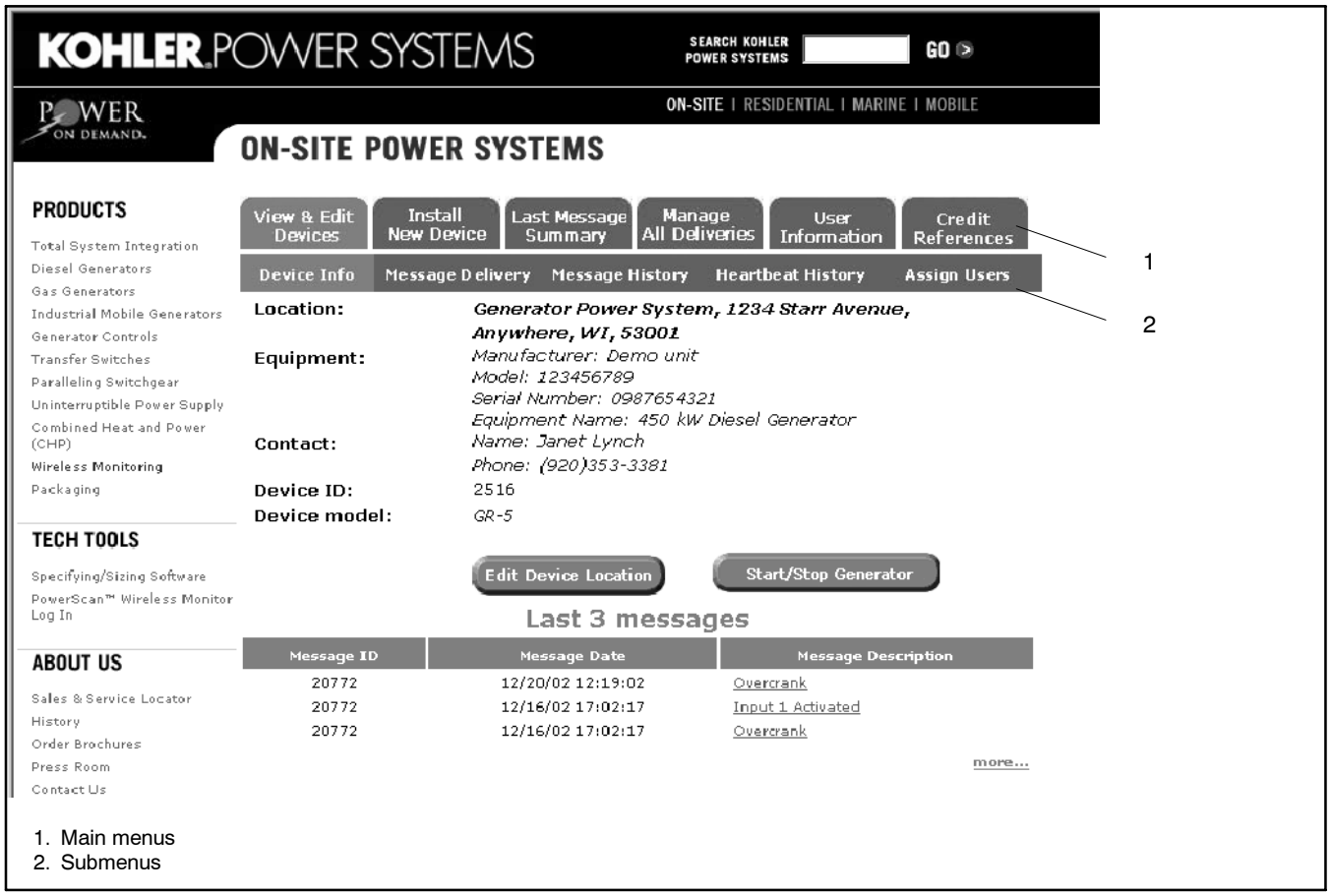
- View & Edit Device
- Install New Device
- Last Message Summary
- Manage All Deliveries
- User Information
- Credit References (not used)

The following submenus show information for a selected device:

- Device Info
- Message Delivery
- Message History
- Heartbeat History
- Assign Users

Access submenus by first selecting *View and Edit Device* and then selecting an individual device from the *Location* column. (See Figure 4-3.)

Note: Right click on any screen to refresh after a change or command.



1. Main menus
2. Submenus

Figure 4-2 Menu and Submenu Locations in a Typical Device Info Screen

4.4 View and Edit Devices Screen (*View All Devices and Select a Single Device)*

Logging in and accepting the Services agreement brings you to the *View & Edit Device* screen shown in Figure 4-3. All wireless monitors installed on the account appear in a list. To add a new device, click on the *Install New Device* main menu tab. To change an existing device, click on the device (underlined text) in the Location column.

The *View and Edit Devices* screen provides a list of all monitor devices (by Device ID) and the associated equipment location. Clicking on the underlined text on this screen reveals additional choices. The user can edit and deactivate each device at this screen.

To deactivate a device, select *Deactivate* under the *Change Status* heading for the device to be deactivated. Do not simply remove the device.

Note: Devices that are not deactivated continue to be billed.

Note: An activation fee is required to reactivate a deactivated device.

Select a device in the *Location* column to access the submenus. Clicking on the equipment in the *Location* column also brings up a *Device Info* screen specific to the equipment and the associated PowerScan™ device. See Section 4.8 for information about the *Device Info* screen.

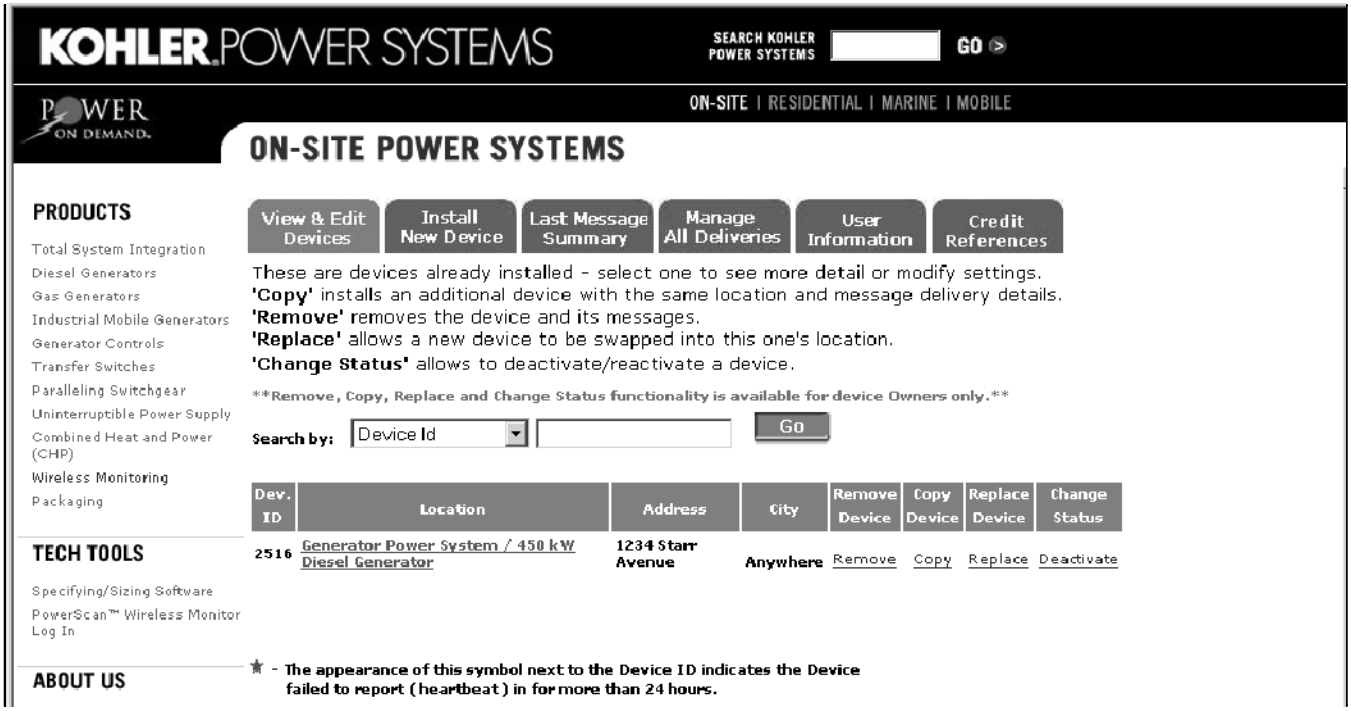


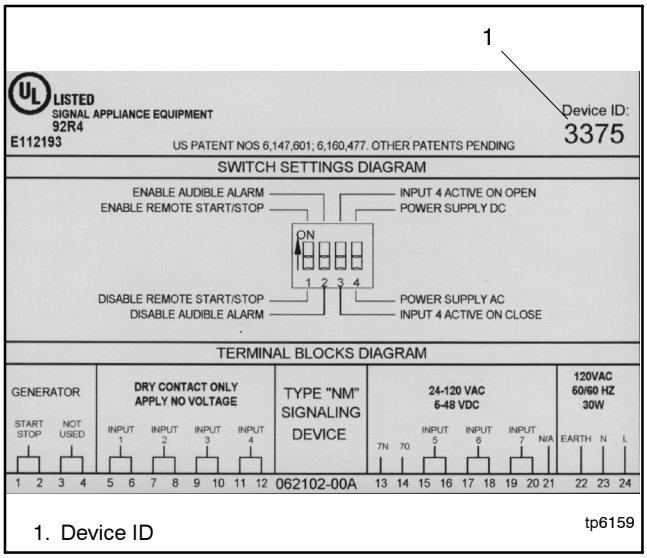
Figure 4-3 View and Edit Devices

4.5 Install New Device Screen

Figure 4-5 shows the *Install New Device* screen. Enter the numeric Device ID, found on the label inside the device. See Figure 4-4. Click on the submit button to activate the device at the operations center. Then complete and submit the *User Information* screen and the *Device Information* screen to finish the activation. Following successful activation, the new device number appears on the *View & Edit Devices* screen.

A valid customer number is required to activate a device.

A service subscription will initiate upon activation. Device deactivation is required to terminate service. See Section 4.4 for instructions to deactivate a device.



1. Device ID

Figure 4-4 Device ID Location on Label

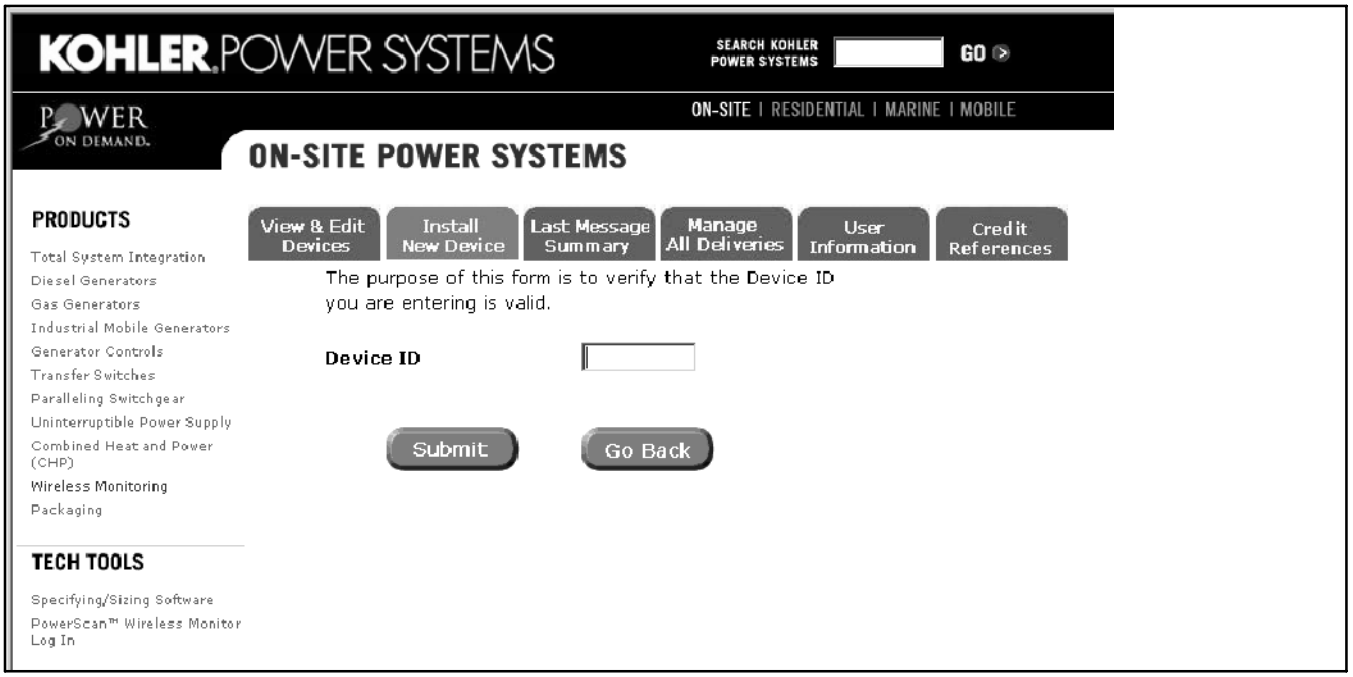


Figure 4-5 Install New Device

4.6 User Information Screen *(Website Manager)*

Select the *User Information* tab at the top of any screen after logging in to bring up the *User Information* screen shown in Figure 4-6.

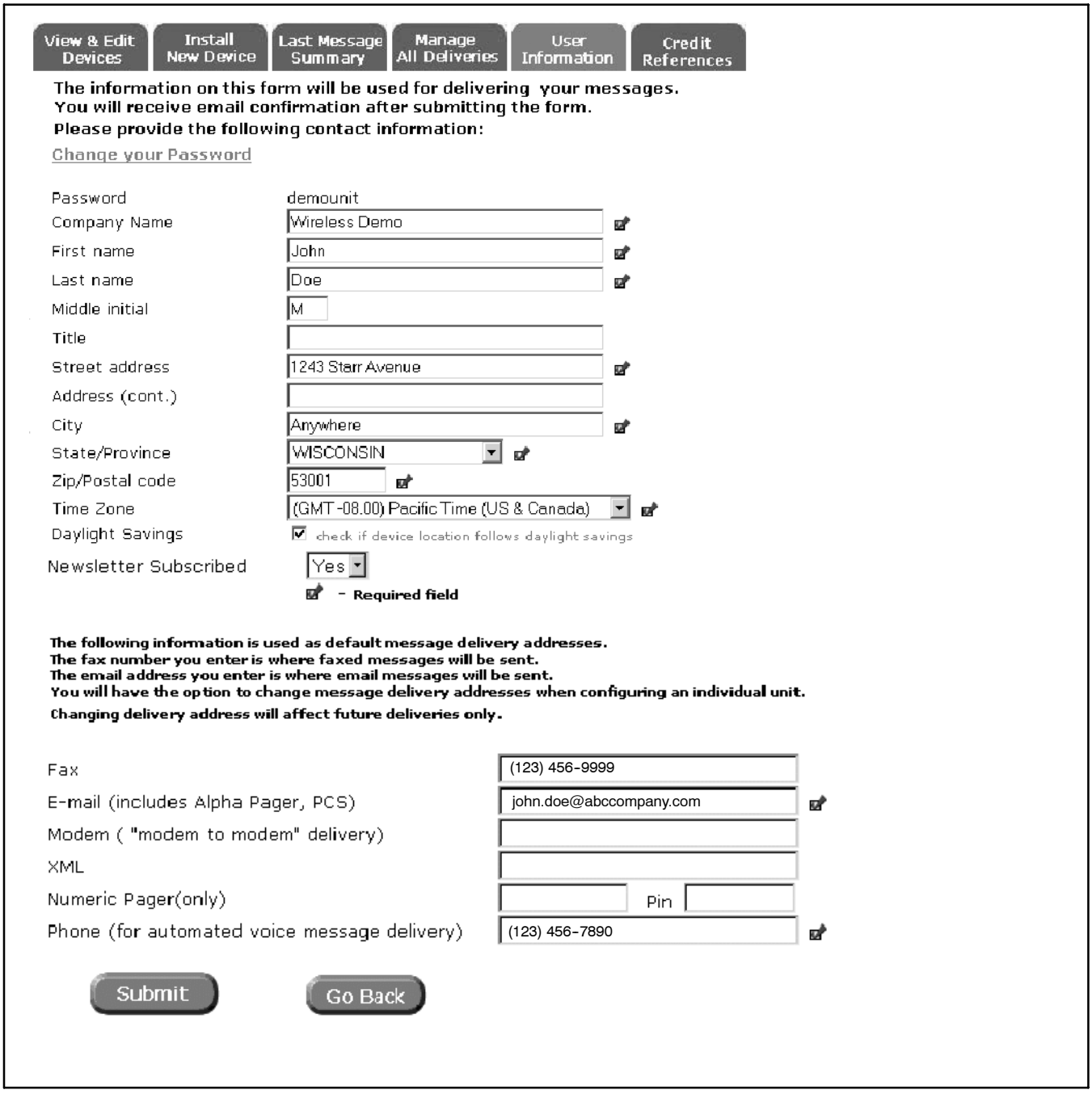


Figure 4-6 User Information

The user information in this screen is *not* the device location information. Do not use this screen to input wireless monitor location information. The *user* address, phone, fax, and time zone information on this screen applies to:

- The individual who obtains the website member ID and password.
- The owner or manager of the website who has full rights.
- The person who is invoiced for the monitoring service of all devices on this website.
- The person who has access to data for all monitor devices on the website.

Note: The user and the device contact (set up under the submenu *Device Information* screen) may be the same individual.

Select the method of message delivery for the user at this screen. The four fields marked *telephone, fax, e-mail,* and *pager* are the default locations where messages will be delivered. All fields with check boxes must be filled in. When setting up a particular device, the values you input automatically appear in the delivery fields (make sure the required information is entered). This makes configuring new devices fast and easy. However, each device must be configured separately, and the message delivery can be modified as required.

Once you have completed the form, click on the *Submit* button.

4.7 Credit References Screen

The *Credit References* screen is not used.

4.8 Device Info Screen *(Selecting the Device Contact and Configuring Equipment)*

The *Device Information (Device Info)* screen is a submenu selection located under the *View & Edit Devices* menu. To view submenus, click on a device in the Location column on the *View & Edit Devices* screen. See Section 4.3.

Figure 4-7 shows the *Device Info* screen for a device using dry contact inputs. Figure 4-8 shows the *Device Info* screen for a device using Modbus® communication. This device-specific screen has a summary of the last three messages received from the wireless monitor, the last heartbeats received, an *Edit Location* selection, and a *Start/Stop Generator* selection. For a wireless monitor connected to a device using Modbus® communication, there will also be a *Control Panel* selection.

Click on the *Edit Device Location* button to access the data input screen. Complete the information for each monitor device and associated equipment. All the fields marked with check boxes are required. The address fields are intended for the device location, not the billing or contact location. **Provide contact information for the individual (technician or service person) that can access the equipment connected to the monitor device.**

Note: For voice message delivery, note that the voice synthesizer only annunciates words. Do not use abbreviations such as St. for street or Rd. for road. Do not use uppercase letters for words. Uppercase letters will cause the voice synthesizer to annunciate each letter instead of the word.

The last fields identify the equipment served by the monitor device. The information is intended to help a service person prepare for maintenance or repair of the equipment before arriving at the site. You may need to scroll down to see the information at the bottom of the screen.

For an activated device, the *Device Information* screen lists the *Last 3 Messages* sent by the PowerScan™ device. To view the message delivery method and address, click on the message delivery link.

To view all of the messages sent by the PowerScan™ device, click on *more*. View all the *Last Heartbeat* messages by clicking on *more*. A 90-day history of all messages is retained.

Pending Problem. "Yes" in the *Pending Problem* column under Last Heartbeat indicates that one or more inputs from the monitored equipment were active at the time of the heartbeat signal. "No" in this column indicates no active inputs detected.

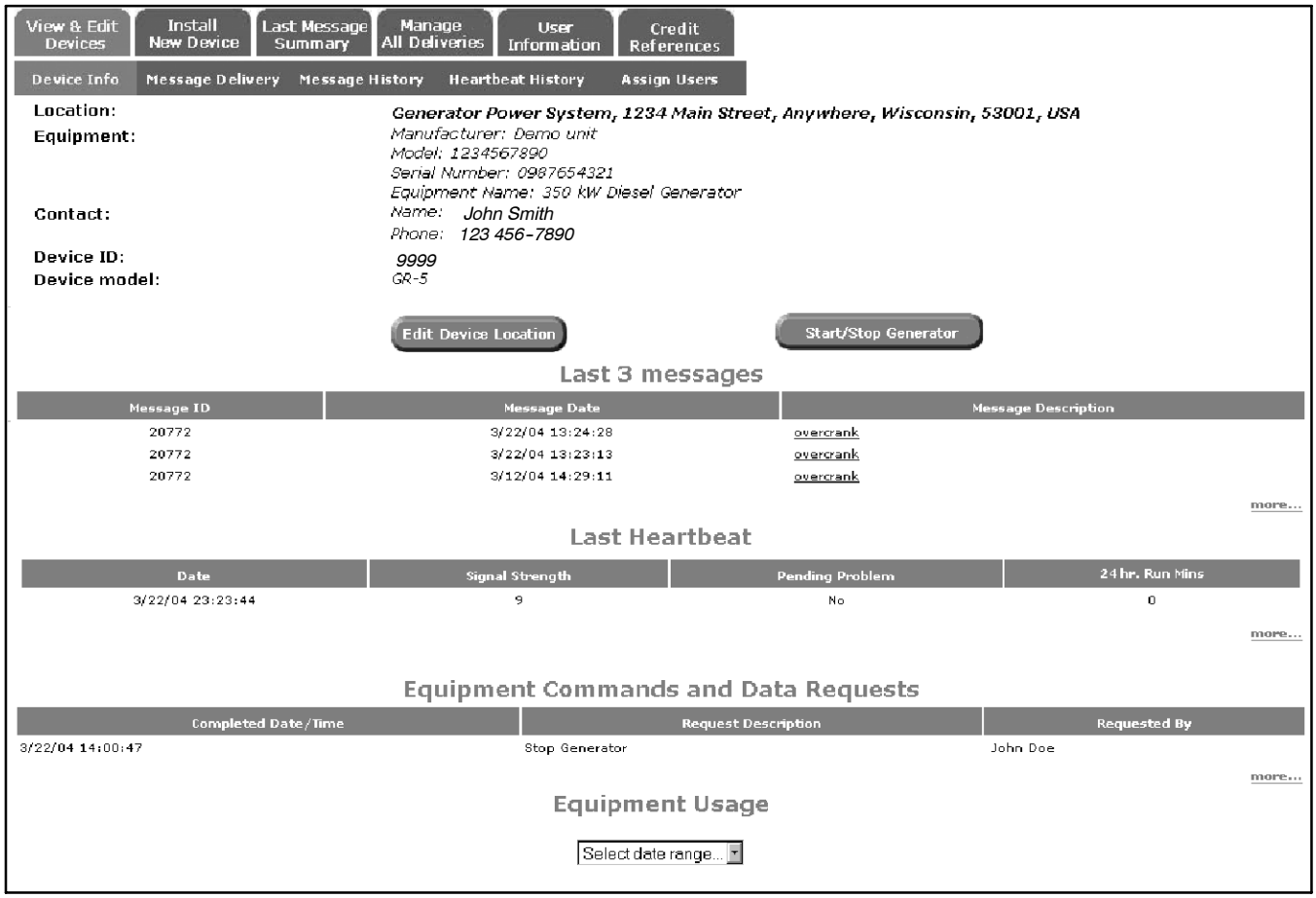


Figure 4-7 Device Information, Dry Contact Input Models

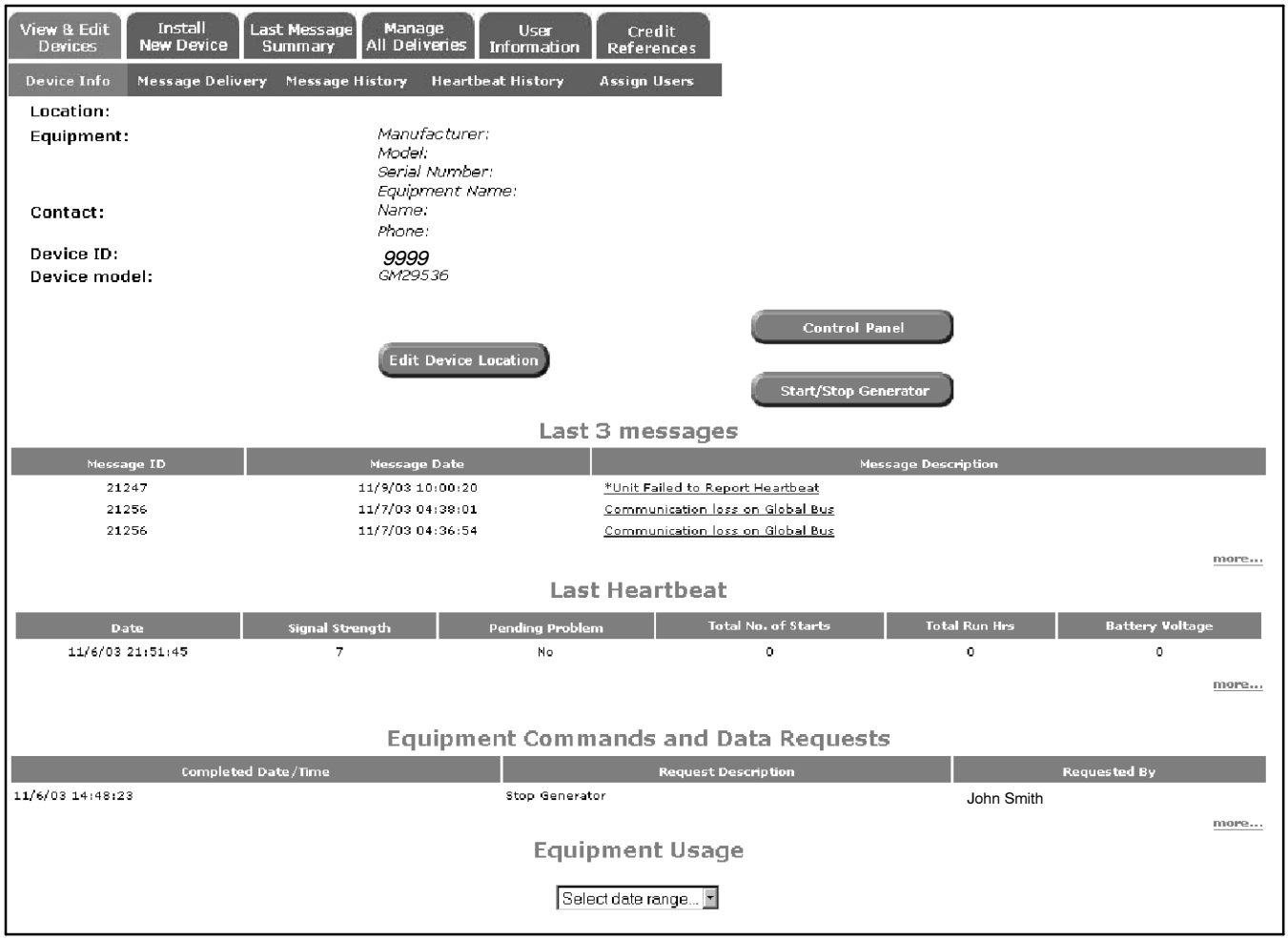


Figure 4-8 Device Information, Modbus® Communication Models

4.8.1 Control Panel

The *Control Panel* screen is available for monitor devices connected to equipment using the Modbus® communication port. Select the *Control Panel* button in the *Device Info* screen to bring up the *Control Panel* screen shown in Figure 4-9.

The first time you select the *Control Panel* for each device, you will be prompted to select metric or non-metric units for displayed data. Select metric or non-metric units to match the system used by the equipment. Temperature will be displayed in degrees C or F and pressure will be displayed in kPa or PSI accordingly. The system of units can be changed later, if necessary, by selecting *Edit Device Location* in the *Device Information* screen.

Note: The units selected for the wireless monitoring system must match the units used by the monitored equipment. The monitoring system does not recalculate numerical values to convert between metric and non-metric units.

The *Control Panel* screen lists data groups (controller outputs) that can be selected for monitoring. Select the *Get* button for each data group to obtain updated information for that group. The information is displayed in snapshot format and is updated each time the corresponding *Get* button is selected. Information is displayed in metric or non-metric values as selected (next to the Control Panel selection).

Note: There is an additional charge to update each data group using the corresponding *Get* button. (A *Get* button selection is referred to as a Data Request in the monitoring service fees.) Use caution to select and update only information that is relevant to site operation.

Once a data group is selected (by clicking the corresponding Get button), that group continues to be displayed in the upper part of the control panel screen. A data group cannot be “deselected,” but additional charges are assessed only when the corresponding Get button is selected.

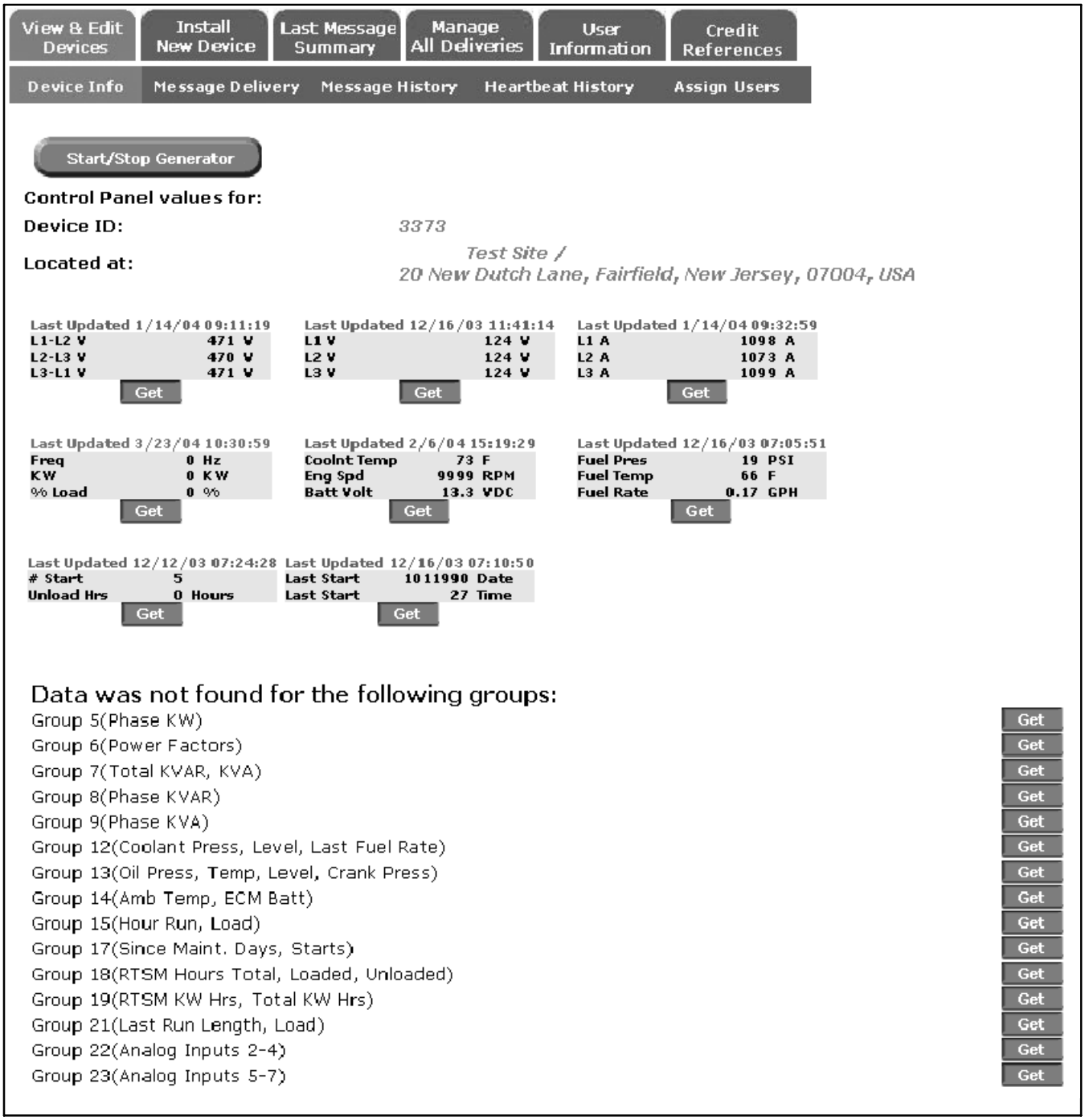


Figure 4-9 Control Panel, Modbus® Models

Modbus® is a registered trademark of Schneider Electric

4.8.2 Remote Start/Stop

Note: Disconnect power sources and disable equipment during maintenance or service to prevent starting by a remote switch or command. Refer to the equipment manufacturer's documentation for instructions to disconnect power and prevent starting.

Set the remote start/stop DIP switch on the monitor device to Enable (see Section 2.10) and connect terminals 1 and 2 on the monitor to the equipment's remote start/stop circuit to allow the *Start/Stop Generator* button to function. Refer to the equipment wiring diagrams provided by the manufacturer.

Selecting the *Start/Stop Generator* button in the *Device Information* or *Control Panel* screens brings up the screen shown in Figure 4-10. The start/stop generator button allows remote starting or stopping of the equipment from the website.

Each activation of the remote start or remote stop command is shown on the Device Info screen under Equipment Commands and Data Requests. Right click to refresh the screen if the command does not appear immediately.

Press the service button on the wireless monitor to disable the remote start/stop function during monitor or equipment maintenance or service. Disable the equipment during service to prevent it from starting.

Figure 4-10 Start/Stop Generator

4.9 Last Message Summary Screen *(Alarm History for all Website Devices)*

The *Last Message Summary* screen, shown in Figure 4-11, provides a listing of the last message received from each device assigned to the account. Click on the underlined text in the Description column to see who successfully received the alarm message.

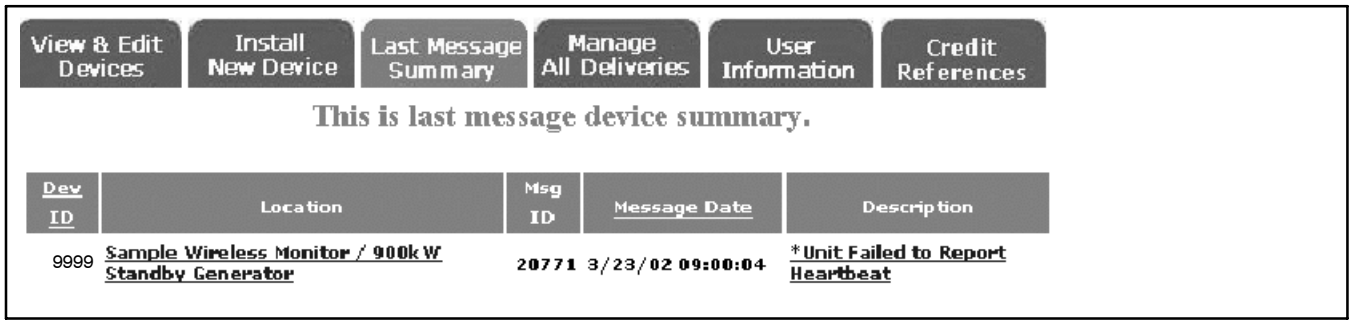


Figure 4-11 Last Message Summary

4.10 Manage All Deliveries Screen *(Assign and Revise Message Delivery)*

The *Manage All Deliveries* screen, shown in Figure 4-12, lists all the message recipients and delivery methods for all the devices on the website. Use this screen to change or add message recipients and delivery methods. Click on *Add New Delivery* to add a new individual or delivery method, selecting the number of delivery attempts and the retry interval (minutes between retries). To revise an existing entry, select the *Add New Delivery* option and enter the new data, submit, and then return to the previous screen and delete the delivery address with the incorrect information.

Figure 4-12 Manage All Deliveries

4.11 Message Delivery Screen *(Selecting Messages for Device Inputs)*

The *Message Delivery* screen is a submenu selection. To bring up the submenus, click on a device in the Location column on the *View & Edit Devices screen*. See Section 4.3.

The *Message Delivery* screen, shown in Figure 4-13, lists all messages defined for the selected device and shows the target address (recipient) for each message.

The message delivery method can be changed on the *Message Delivery* screen. Use the last column, *Edit Delivery Detail,* to change the following items.

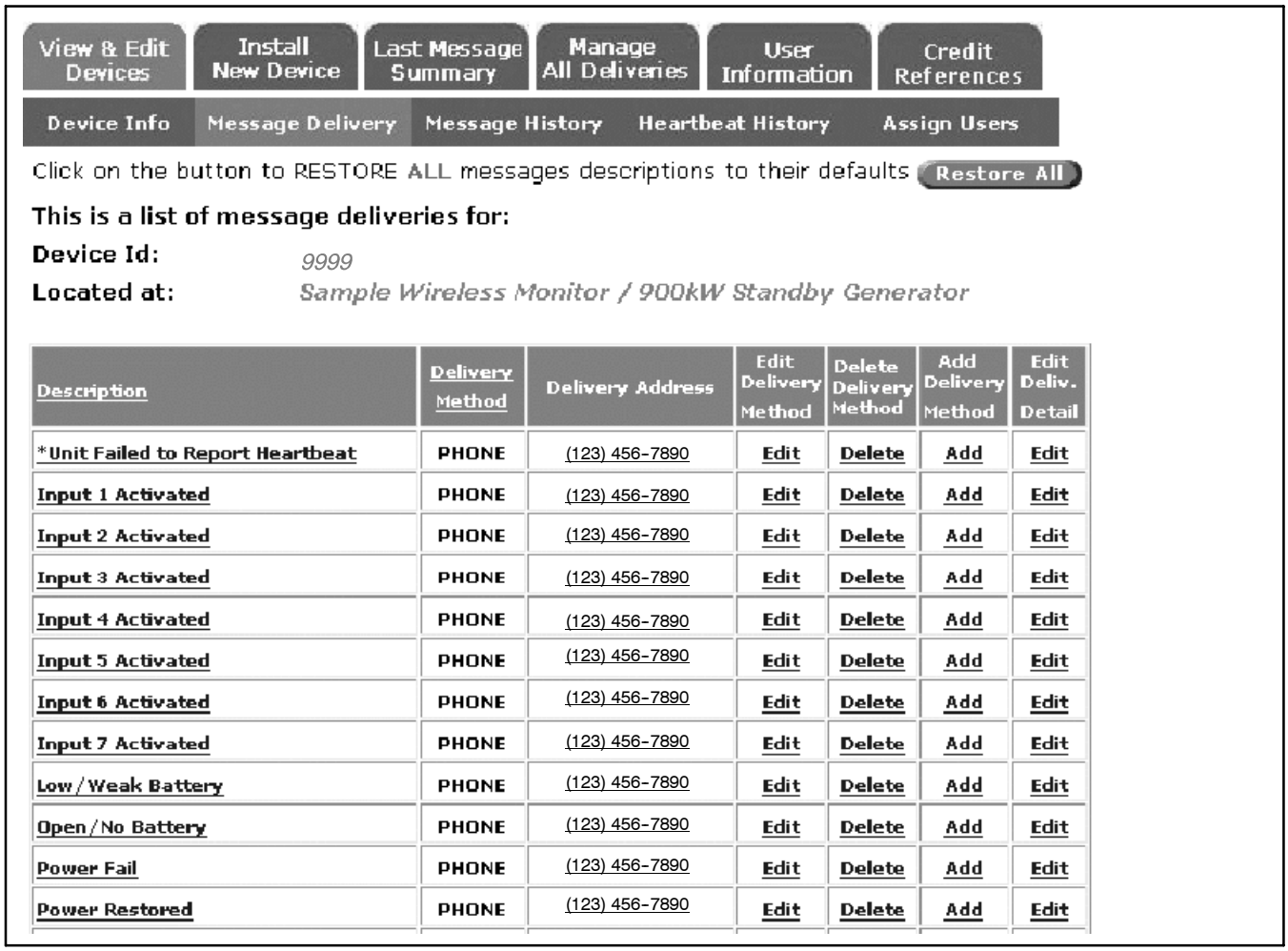
The *Delivery Attempts* field determines how many times Kohler will attempt to deliver a message if a message is not successfully received. The number of attempts can also be selected on the *Manage All Deliveries* screen using *Add New Device.* When the message is delivered successfully, no more attempts will be made.

If the message is not successfully delivered after the specified number of delivery attempts, an e-mail will be sent to the account holder that the user information may need to be changed or updated.

The *Retry Interval* is the time period between attempts to deliver the message. It is also located on the *Manage All Deliveries* screen.

Phone delivery messages are interactive. The message (alarm) will not be delivered unless the the user presses #1 on the phone during the greeting. Attempts to direct the message to voice mail will fail. Undelivered messages appear as failed deliveries in the message description details of the Message History screen. See Section 4.12.

Note: At this time, it is not possible to deliver a message to a phone extension.



Description	Delivery Method	Delivery Address	Edit Delivery Method	Delete Delivery Method	Add Delivery Method	Edit Deliv. Detail
*Unit Failed to Report Heartbeat	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 1 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 2 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 3 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 4 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 5 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 6 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Input 7 Activated	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Low/Weak Battery	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Open/No Battery	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Power Fail	PHONE	(123) 456-7890	Edit	Delete	Add	Edit
Power Restored	PHONE	(123) 456-7890	Edit	Delete	Add	Edit

Figure 4-13 Message Delivery

Message Descriptions

Figure 4-13 shows default descriptions for various messages. The descriptions can be changed, if desired. For example, *Input 1 Activated* could be changed to describe the output or condition that triggers Input 1. To modify the text of a message, click on an individual message listed in the *Description* column to bring up the *Customize Alarms* screen shown in Figure 4-14. Type in the desired message and click on the *Submit* button.

The battery and power messages shown in Figure 4-13 apply to the power supply for the wireless monitor device. Low/Weak Battery indicates that the wireless monitor battery voltage has dropped below 11.5 volts. The Power Fail and Power Restored messages will only appear for AC-powered units. See Section 2.11 for more information about wireless monitor power.

The *Restore All* button on the message delivery screen restores all message descriptions to the default values. See Figure 4-13.

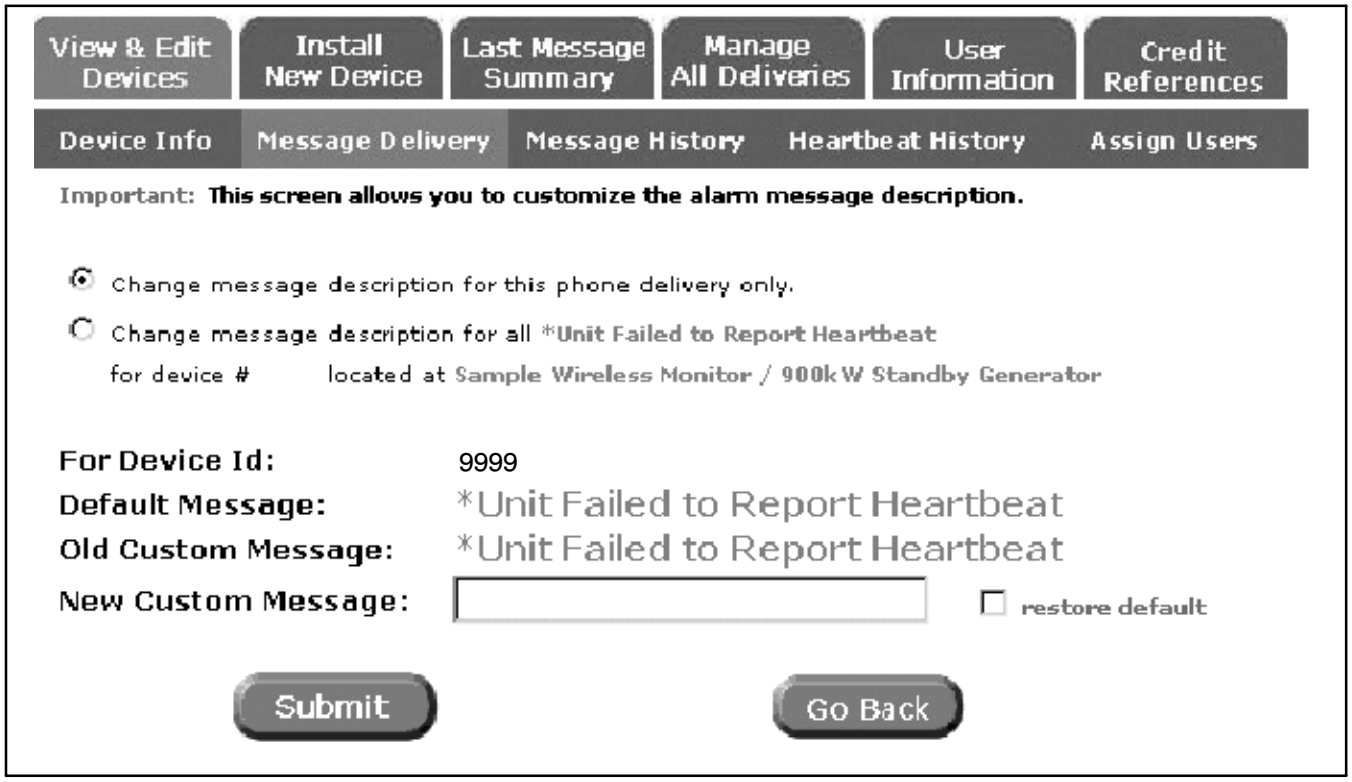


Figure 4-14 Customize Alarms Screen

4.12 Message History Screen *(Reviewing Message History for Single Inputs)*

The *Message History* screen is a submenu selection. Click on a device in the *Location* column on the *View & Edit Devices* screen to bring up the submenus. See Section 4.3.

All messages that have been generated by the outputs of a single monitor device are listed on this screen. Click on an item in the *Message Description* column to view detailed information on all messages for this output, the delivery address, and the result of the delivery.

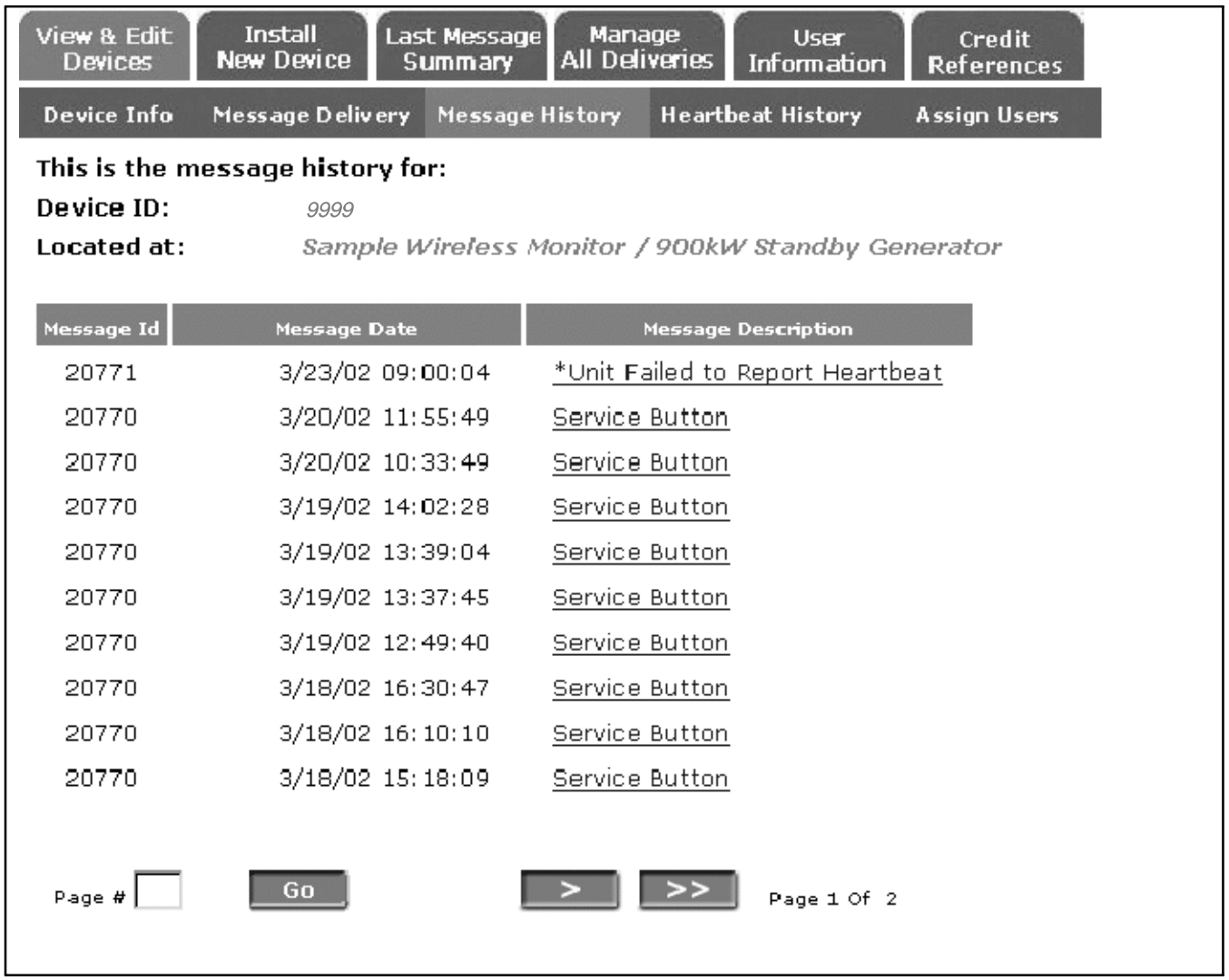


Figure 4-15 Message History

4.13 Heartbeat History Screen

The *Heartbeat History* screen is a submenu selection. Click on a device in the *Location* column on the *View & Edit Devices* screen to bring up the submenus. See Section 4.3.

Heartbeat messages are delivered every 24 hours to indicate that the monitor device is active and communicating. All heartbeat messages during the past 90 days are listed on the screen. See Figure 4-16. A missing heartbeat message could indicate that the monitor device has lost power or a web server error has occurred. Failure to receive a heartbeat message for a 24-hour period will be noted by a red star next to the device on the *View & Edit Devices* screen. Even though each heartbeat message has an associated time, the actual message may not be displayed on the website for several hours after reporting.

There is other information displayed on this screen (see Figure 4-16):

- *Signal Strength*. The strength of the signal via the cell tower is (0–9) displayed. A signal strength of 2 or less indicates an unreliable signal and a different device location should be considered. Consider using an optional high-gain antenna if a signal strength greater than 2 cannot be obtained at the site with the standard antenna.

  An *F* in the Signal Strength column indicates the monitor device is in the service mode and cannot transmit messages. A monitor device in the service mode also does not allow the *Start/Stop* function to be activated via the website.

- *Pending Problem*. "Yes" in the *Pending Problem* column indicates that one or more inputs from the monitored equipment were active at the time of the heartbeat signal. "No" in this column indicates no active inputs detected.

- *Runtime.* Models using hardwire inputs display the accumulated generator set runtime for a 24-hr. period in tha cloumn labeled *24 hr. Run Mins*. Runtimes are collected through voltage inputs 13 and 14 on the PowerScan™ device.

  On models using Modbus® communication, runtime is collected through the Modbus® communication connection and accumulated from startup. The runtime is displayed in a column labeled *Total Run Hrs.* These models also display the total number of starts in a separate column.

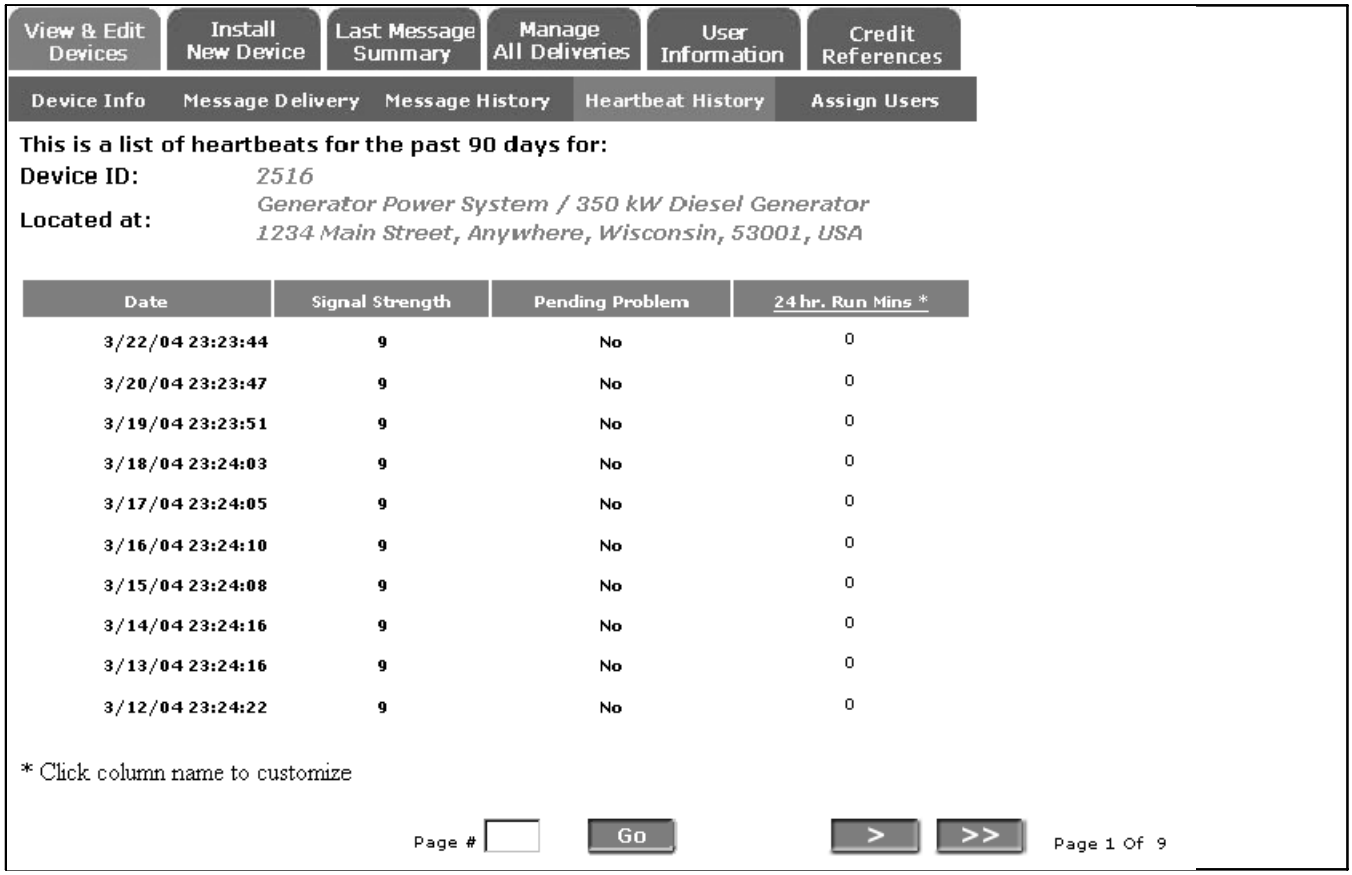


Figure 4-16 Heartbeat History

Modbus® is a registered trademark of Schneider Electric

4.14 Assign Users Screen *(User Rights)*

The *Assign Users* screen is a submenu selection. Click on a device in the *Location* column on the *View & Edit Devices* screen to bring up the submenus. See Section 4.3.

Use the *Assign Users* screen to add users and define their user rights: full rights or read-only access to devices and device data. See Figure 4-17.

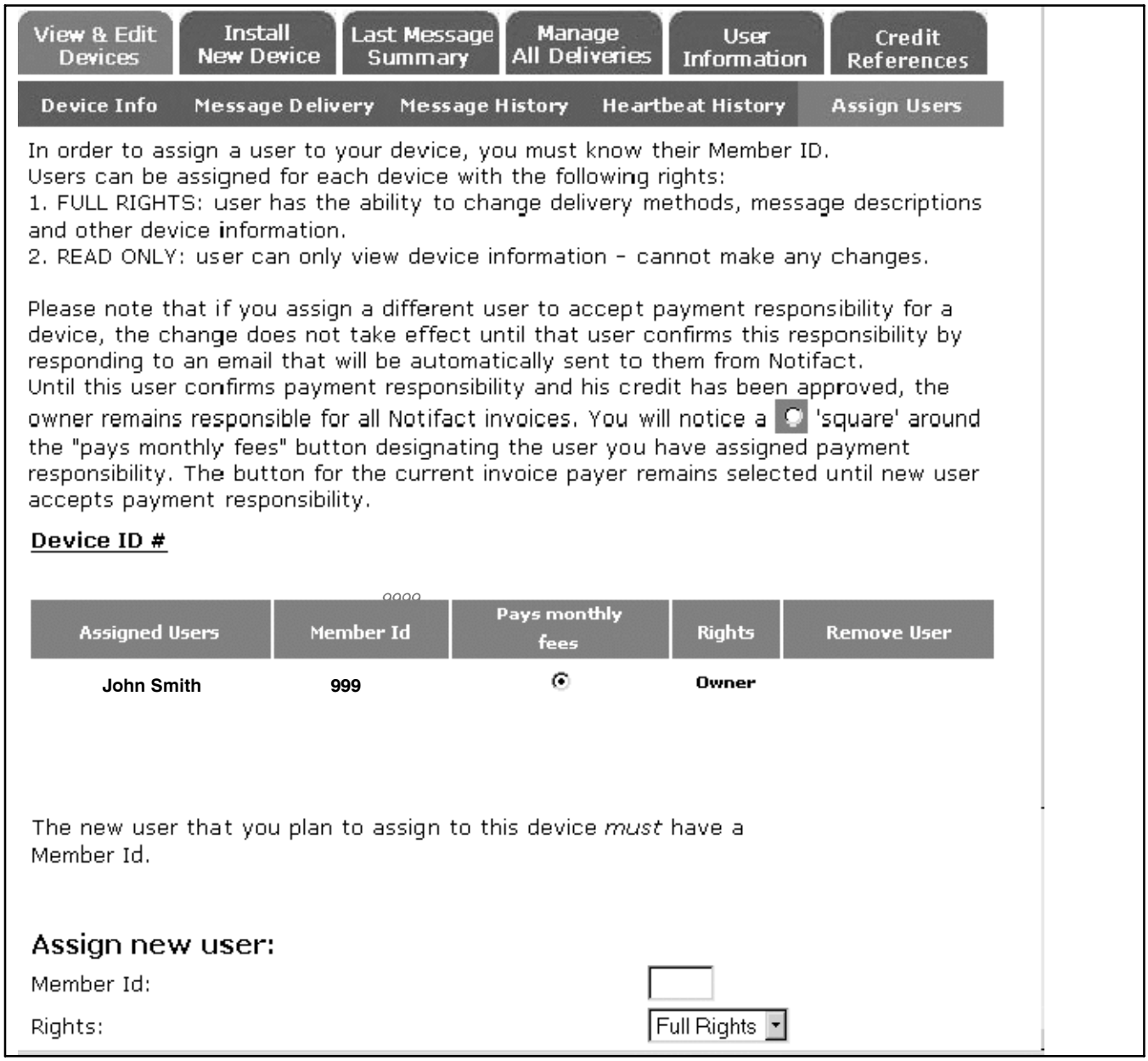


Figure 4-17 Assign Users

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
API	American Petroleum Institute
approx.	approximate, approximately
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
A/V	audiovisual
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example (*exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temperature, high engine temperature
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard
k	kilo (1000)
K	kelvin

kA	kiloampere
KB	kilobyte (2^{10} bytes)
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCM	one thousand circular mils
MCCB	molded-case circuit breaker
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips head crimptite (screw)
PHH	Phillips hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent-magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec, specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

Appendix B Noise and Wiring Practices

Electrical noise is an unwanted electrical signal that can cause errors in measurement, loss of control, malfunctions in microprocessor-based control systems, errors in data transfer between systems over communication links, or reductions in system performance.

Good system design and wiring practices can minimize noise levels and the effects of noise.

Noise, because of its random nature, is typically characterized by frequency distribution. Many noise sources are broad-spectrum, that is, they produce many frequencies distributed over a wide range. Broad-spectrum noise is particularly troublesome because it cannot be removed easily by filtering, and because it can affect a variety of systems in unpredictable ways. One common source of broad-spectrum noise is a switch, which can produce voltage and current changes when an electrical circuit is connected and disconnected.

Coupling is the transfer of signals between separate circuits. Signals from one circuit become noise in another. The amount of coupling is cumulative and is a function of the proximity of the circuits, their orientation, exposed area, and length of run. Minimize coupling by the following:

- Isolating circuits from each other by using separate raceways or conduit
- Separating circuits from each other by locating them as far apart as possible
- Enclosing circuits with a grounded metallic shield such as an enclosure, metallic conduit, or cable shield
- Running conductors perpendicular, rather than parallel, to each other
- Running wires loosely and randomly rather than bundling them tightly together
- Twisting a circuit's wires together in pairs

In an industrial environment, there are typically five types of circuits with different noise emission and rejection capabilities. The five types of circuits are as follows:

- **High-Power Distribution.** Circuits to high-power loads such as large electric motors and heaters can emit transient high levels of broad-spectrum noise. Loads on high-power distribution circuits are nearly immune to noise.
- **General Purpose Power Distribution.** Circuits to medium-power loads such as lighting, offices, light-duty equipment, and small motors such as fans and pumps can emit transient, medium levels of broad-spectrum noise. Some electronic equipment, such as computers, emits constant levels of broad-spectrum noise in addition to transient broad-spectrum noise. Loads on general-purpose circuits, except for sensitive electronic equipment, are nearly immune to noise.
- **Control.** Control circuits include DC circuits and 120 VAC maximum AC circuits that operate at a low power level (less than 1 W). Typical circuits include circuits to switches, actuators, and dry-contact relays, including the generator engine-start circuit. Control circuits emit transient low levels of broad-spectrum noise and are fairly immune to noise.
- **Analog.** Analog circuits are low-voltage DC circuits that convey measurement information as relatively small changes in current or voltage. Typical circuits include those connected to the controller's analog inputs. Analog circuits create the lowest noise levels and are the most sensitive to noise.
- **Communication and Signaling.** Communication and signaling circuits are low-voltage circuits that convey information. Typical circuits include RS-232 and RS-485 serial communication lines, telephone lines, and computer network lines. These circuits create noise with frequencies related to the communication signaling rate. These circuits have some level of built-in noise immunity. Typical systems will detect or correct errors caused by noise below certain levels, but with a corresponding reduction in the data transfer rate.

When planning an installation, separate all of these types of circuits as much as possible to minimize the hazards of insulation failure, accidental miswiring, and noise coupling. For best results, install control circuits, analog circuits, and communication and signaling circuits separately. Combining circuit types is unavoidable in the controller's enclosure and some other areas.

Note: It is very important to isolate high- and medium-power circuits in raceways or conduit separate from the other types of circuits.

Notes

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