

# Peace of Mind



## CELLGUARD SYSTEM

### Battery Monitoring Solution with Patented Wireless Communications Architecture

Critical power-backup systems must be ready to go when they're needed. Deploying the **CELLGUARD™ SYSTEM** Battery Monitoring Solution ensures that they will be.

The Midtronics **CELLGUARD SYSTEM** combines the latest wireless communications technology with patented, field-proven battery conductance testing. The **CELLGUARD SYSTEM** provides an economical total cost of ownership package with the most thorough stationary battery health analysis the industry has to offer.

#### Features:

- Continuous 24/7 on-line monitoring for system status indication
- Full conductance, battery temperature and voltage monitoring for comprehensive battery state of health analysis of each cell/monoblock
- Wireless communication architecture ensures proper installation, efficient, hassle-free operation, and reduced maintenance costs
- Intercell connection integrity monitoring ensures system effectiveness
- Economical total cost of ownership includes: reduced installation cost, reasonable hardware price and simple system maintenance
- Multiple communication tools, including MODBUS and alarm contacts
- Applies test signal to an individual cell or monoblock for high resolution of system state of health
- Web enabled communications for remote surveillance
- Full monitoring of string charge and discharge current, and discharge performance recording
- Advanced notification of battery problems via email or text message
- Conductance advantages: safe, simple, accurate battery prognostics
- Industry choice conductance testing is the accepted standard for battery analysis
- Fully scalable and expandable system - simply add components as batteries are deployed



**Stationary Power Products**  
Division of Midtronics, Inc.



**Advancing  
Battery Management**



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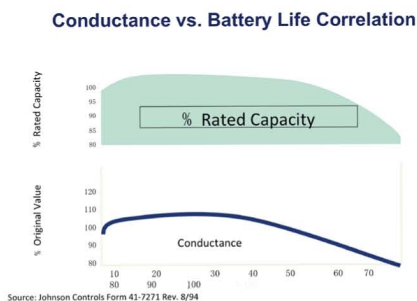
## Battery Monitoring Solution

### The Technology: Conductance

Battery Conductance was originally researched in the 1970s at the University of Minnesota as a variable to be used in the prediction of battery health. The Conductance measurement is an indication of the ability of a battery to produce more electrical current. Years of laboratory and field test data have proven that linear conductance provides a reliable indication of battery state of health and a correlation to battery capacity.

As a battery ages, the plate surface can sulfate or shed active material, which adversely affects its ability to perform. Conductance can be used to detect cell defects, shorts, and open circuits which can cause the battery to fail.

The following diagrams illustrate the high correlation between battery Conductance and capacity:



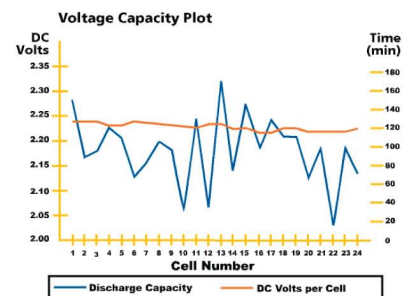
### Conductance vs. Impedance or Resistance Monitoring

Some battery monitoring and testing systems available today utilize internal resistance or impedance to make assessments of battery state of health. While these methods can be effective, the use of conductance has clear advantages:

- Conductance is a more passive method of battery assessment, requiring 1 amp or less removed from the battery for most systems, up to 5 amps in cases where system ripple current is the most extreme. Other methods can require as much as 75 amps, impeding battery readiness and reducing life.
- The unique conductance frequency used by Midtronics has been optimized to detect battery degradation based upon 20+ years of laboratory and field testing. It is not a "one size fits all" measurement, and extensive research has been conducted to ensure effectiveness on a wide range of stationary power batteries in numerous applications.
- Conductance declines as the battery capacity degrades, forming an intuitive correlation between the two parameters.
- Conductance is an accepted standard at global telecommunications service providers, power generation operators (including nuclear facilities), and battery manufacturers worldwide.

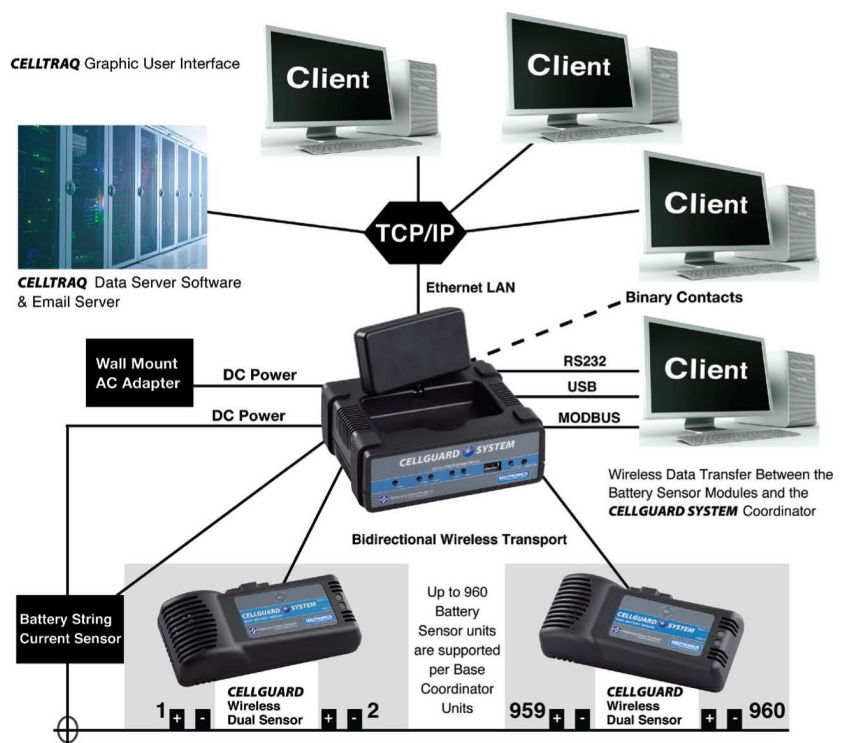
### Conductance vs. Voltage Monitoring

Conductance has been proven to correlate with battery capacity and has been demonstrated in a variety of forms (testing programs, monitors) to provide predictive battery management benefits. Conversely, voltage has proven unrelated to battery capacity. Therefore, when used in place of a predictive variable, such as conductance, it has demonstrated little value. Voltage is effective as a measurement of battery charge levels, although it does not correlate directly with battery state of charge.



The above diagram illustrates the lack of relationship between voltage and battery capacity

### CELLGUARD SYSTEM Architecture



The **CELLGUARD SYSTEM** has been designed for simple expansion and worldwide accessibility

## System Architecture

The **CELLGUARD SYSTEM** is comprised of three base components, simplifying installation and long-term serviceability. At the heart of the system is the sensor module. Attached at the posts of two adjoining battery blocks and intercell connectors, the sensor module contains the proprietary Conductance test circuit, voltage and temperature measuring electronics and advanced wireless communications components. The module communicates with the Base Coordinator unit, designed to capture data from the module and transfer collected and processed data via Ethernet connection, USB, MODBUS, or serial output. Lastly, proprietary server level software allows for the effective management and reporting on system state of health via a web browser interface.

### Sensor Module

- Modules compatible with 2 through 16 volt batteries
- Testing circuitry utilizes advanced Conductance technology, similar in measurement capability to **CELLTRON® MAX** and **CELLTRON® ULTRA** battery analyzers
- Passive test signal does not discharge the battery
- Compatible with low-noise telecom DC power plants, UPS and other systems producing 25-50 Amps RMS of electrical interference
- Measures battery conductance, voltage and temperature, and intercell integrity (resistance) of every block/jar/cell
- Connects only to battery posts with simple Kelvin wiring connection harness (no extraneous wiring)
- Two-way communication to receiver module via IEEE standard radio frequency
- Powered by the battery being monitored (no external power required), with very low power consumption
- Automated timed interval test actuation

### String Voltage, Temperature and Current Module

- Captures system level voltage (up to 600 volts), ambient/cabinet temperature and charge (float)/discharge current
- Ensures proper charging of system by providing system warnings if threshold levels are exceeded
- Ambient/cabinet temperature measurement enables comparison to individual battery temperature for threshold alarms, also indicates if room heating or cooling system is in working order
- Captures discharge currents and string voltages for advanced battery performance measurement

### Base Coordinator Unit

- RS-232 and USB output module for direct serial connection to **CELLTRAQ** RF PC software
- MODBUS connection for interface to facility management systems
- TCP/IP Ethernet output module (for connection to Ethernet connection for communication via internet)
- Receiver module captures data from all test and transmit modules
- Binary contact input & output for alarm interface

## Base Specifications

Element	Range
Battery conductance range	100 S < G < 15,000 S (cell mhos)
Battery voltage range	1.4 V < V < 2.5 V (per cell)
Battery temp measurement range	-10° C < T < 65° C
Electronics temperature range	-10° C < T < 65° C

## User Interface/Remote Software Options

Two primary options are available. The first is a full client server web based system that communicates by a standard Ethernet link. This allows quick and easy access to system data anywhere in the world. The second option is a standalone proprietary PC application that can collect data also by Ethernet connection or by serial connection to the PC from the Base Coordinator unit.

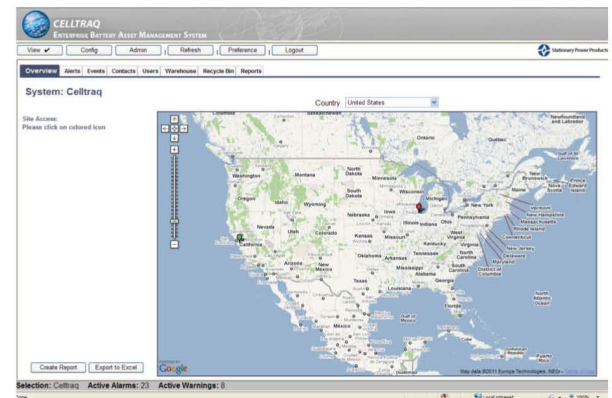


Figure 1. User interface—an organized approach to managing sites/locations

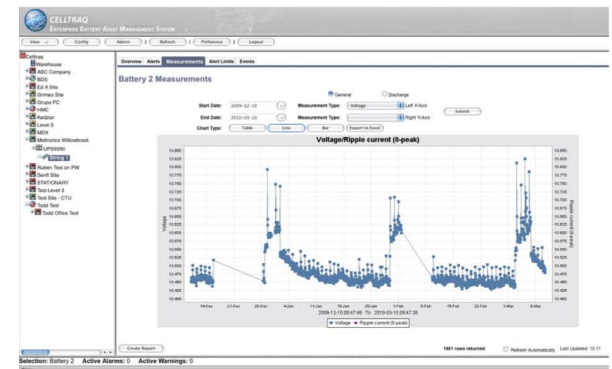


Figure 2. An example of graphical data output



## Test Site II Summary

### Overview

Alert State: Alarm

Active Alarms: 1

Active Warnings: 0

### Battery Information

Battery Plant	String	# of Batteries	Enclosure	Manufacturer	Model	Type
Test Plant II	Test String II	4	NONE	AlphaCell	BSGX	VR1A

### Testing Information

Battery Plant	String	# of Batteries	Test Type	Data Source	Test Interval	Last Timestamp
Test Plant II	Test String II	4	Cellguard	Monitoring	VT-4hours	2010-10-12

Figure 3. Printed report output



# CELLGUARD SYSTEM

## Battery Monitoring Solution

### Specifications

#### Communications Interfaces

Ethernet 10/100 Mbps  
RS232 or serial USB ( @ 57.6 kbps )  
802.15.4 compliant RF transport @ 2.4  
GHz Radio Band  
MODBUS ( 2/4 Wire )  
Binary contact for alarm input  
and output

#### Temperature

**Operating Temperature**  
( 0° C to +65° C )

**Storage Temperature**  
( -10° C to +80° C )

#### Protection

**Sensor ( 2 V, 4V, 6V, 8V, 12V, 16V )**  
Test load and power paths are fused,  
protection for high heat detection

#### Power Requirements

**Base Coordinator Unit Power**  
Powered by 9 V DC wall plug adaptor  
or powered from VTC (optional)

**VTC Unit Power**  
Powered from the battery ( < 60 mA )

**Sensor Power**  
Powered from the battery  
under surveillance

#### Conductance Measurement Range

100 to 15,000 Siemens (cell mhos)

#### Strap Resistance Measurement

2 micro Ohms minimum

#### Test Current

Test current is approximately 5 Amps RMS

#### Voltage Measuring Characteristics

##### Sensor

Voltage range: 1.4 V to 2.5 V per cell  
Resolution: +/- 20 mV

#### Sensor Negative Battery Post Temperature Reading

**Temperature Range**  
( 0° C to +65° C )

**Measurement Accuracy**  
( +/- 2° C )

#### String Voltage Measurement

**Input Range**  
42 to 600 Volts DC

**AC Ripple**  
Peak AC Ripple Detection

#### String Current Measurement

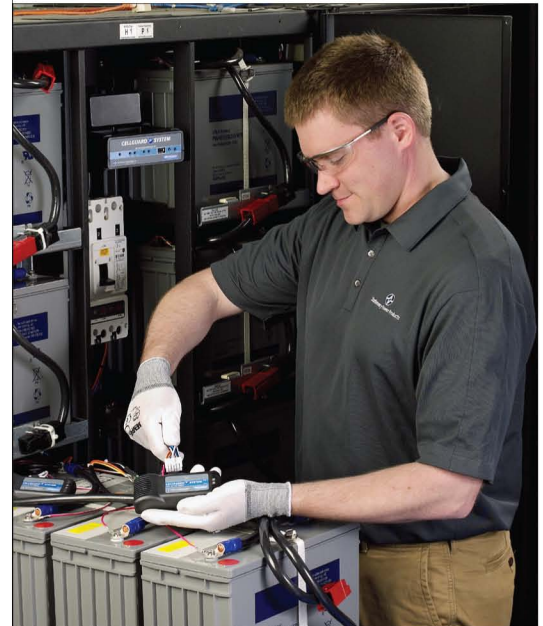
-3000 to 3000 Amps with transducer

#### Physical Dimensions

**Base Coordinator Unit**  
5.3 in x 6.5 in x 2.35 in  
13.5 cm x 16.5 cm x 6 cm

**VTC String Monitor**  
5.08 in x 5.25 in x 2.25 in  
12.9 cm x 13.3 cm x 5.7 cm

**2V to 16V Dual Sensor**  
5.1 in x 2.15 in x 1.2 in  
13 cm x 5.5 cm x 3 cm



*Simple installation process improves reliability and reduces total cost of ownership.*



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