



QuakeGuard

Earthquake Early Warning System

System Description

QuakeGuard detects and warns of the imminent arrival of shock waves from an earthquake, providing time to protect people and equipment from injury or damage.

QuakeGuard can trigger audible alarms, control equipment, and initiate other protective measures to reduce the effects of earthquakes.

QuakeGuard has been designed for commercial, residential, school, hospital, emergency services, industrial, municipal, and government installations.

Alarms and Alerts

QuakeGuard™ generates a variety of alarms:

- Produces customizable audio alert.
- Connects to external alarms and sirens.
- Triggers visual alerts and lights.
- Sends alerts email and SMS.

Automated System Controls

QuakeGuard™ generates a variety of output signals, controlling automated devices to protect people and assets.

- Isolate hazards.
- Protect mission-critical systems.
- Avoid disruption of service.

Features

Detects the earliest onset of an earthquake before the damaging shock waves arrive.

Provides 1 second of warning for every 5 miles distance from the epicenter.

Eliminates false positives from man-made vibrations and ignores small, non-damaging earthquakes.

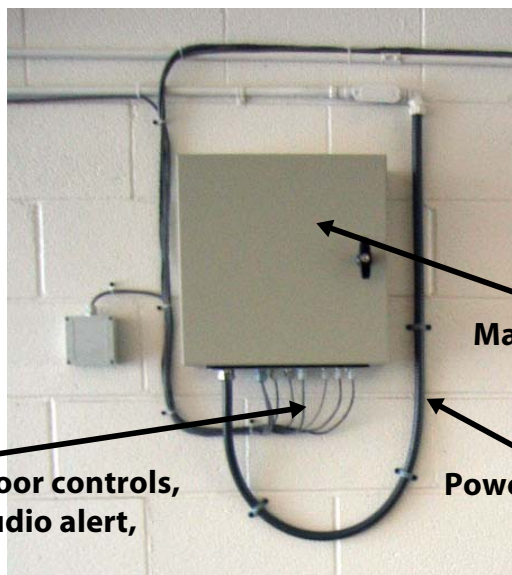
Produces an audible alert to warn people to "drop, cover, and hold".

Automatically sends control signals to equipment using relay contacts and serial or Ethernet based protocols.

Automatically resets after the earthquake is over to be ready to detect aftershocks.

Supports remote monitoring, diagnostics, and configuration over the Internet.

Interfaces with building and factory automation systems.



Main Controller Unit

Interface (door controls, Ethernet, audio alert, lights)

Power (110-240VAC)



QuakeGuard Systems and Options

Dual Sensors

- 2 accelerometers; used to prevent false positives

Main CPU

- Includes controller, memory, and sensor interface in an industrial enclosure
- Embedded O/S, patented DSP software, network interface, calibration & diagnostics

Ethernet Interface

- Communication via TCP/IP to SWS servers
- Browser access for monitoring and control
- Remote management and configuration. Diagnostics monitor the operation of the units and verify performance. Software updates and new features are downloaded remotely from SWS servers

Alarms and Alerts

- Audible alert plays a warning sound and spoken message.
- Customizable using WAV files.
- Optional visible flashers and speakers

Automated Control Outputs

- Protective measures initiated when earthquake is detected
- Relay contacts to interface directly to systems and devices
- Serial protocols over RS-232/RS-422/RS-485
- Ethernet protocols such as Modbus/TCP

Reset & Test Switches

- System resets automatically when earthquake shaking stops
- Button is provided to manually reset alerts
- Test switch to manually trigger the system for testing and training

Battery Backup

- Automatic switch-over when power fails
- Low battery detection causes system to shut down automatically
- System can operate on battery for more than 24 hours

Diagnostics

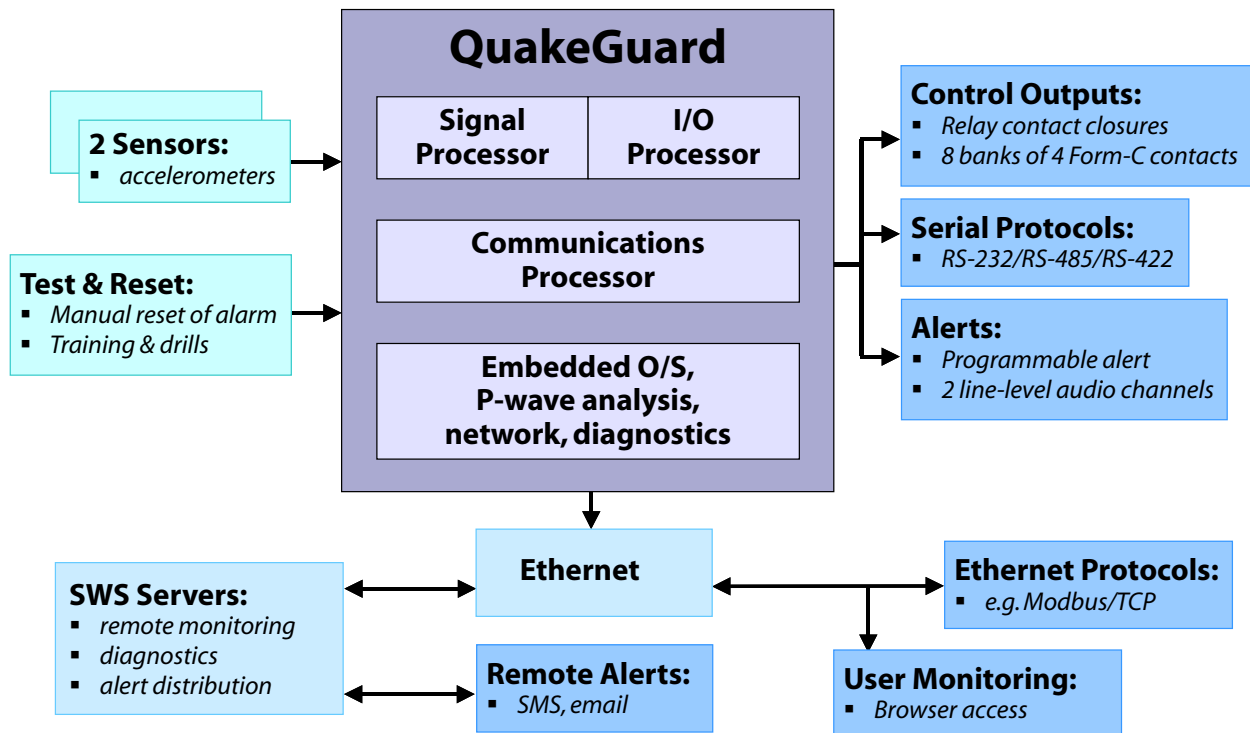
- Continuous diagnostics are run covering all aspects of system operation
- SWS servers are informed when any fault is detected

Installation, Warranty, and Service

- Includes 1 year parts and labor warranty
- Professional installation required
- Basic and onsite service contracts are available



QuakeGuard Block Diagram



QuakeGuard Applications

Fire Following Earthquake

Fire following an earthquake is one of the most common causes of serious losses. Some fires can be avoided by shutting off gas mains and electrical power.

Spills

Material spills require cleanup after the earthquake. Spills can be reduced by shutting off feeder valves, or routing materials to holding tanks.

Injuries to Personnel

Prevention of injuries to personnel can reduce the amount of time required for the company to return to normal operations following an earthquake. Drop, cover, and hold alerts with appropriate training and regular drills can reduce injuries.

Data Losses

Transaction processing can be routed to an alternate facility before the earthquake shock waves strike. Data in individual computers can be protected by parking the disks, preventing writes while the computer is shaking.

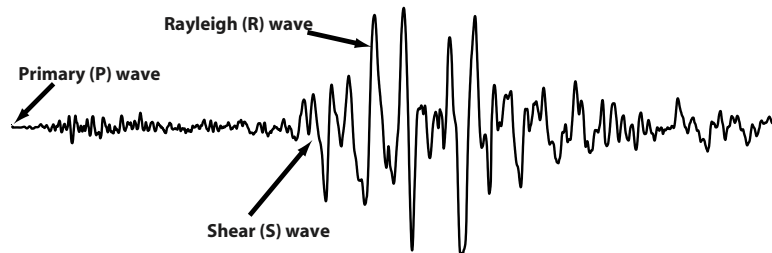
Asset Damage

Damage to assets causes direct losses, through repair or replacement, and indirect costs, through interruption of the operation of the business. Sensitive equipment can be placed into a safe mode or shut down before damaging shaking occurs.



How QuakeGuard Works

Every earthquake, or seismic event, produces a series of different types of shock waves, which travel at different speeds and convey different amounts of energy. The fastest shock waves, called P-waves, are the first to arrive and rarely cause any damage. QuakeGuard™ works by detecting these P-waves and triggering alarms and other protective measures before the damaging waves arrive. The warning time is about 1 second for every 5 miles of distance from the earthquake's hypocenter.



Patented Technology

SWS's P-wave technology is unique in eliminating false positives: filtering both man-made vibrations and small earthquakes (which should be ignored) while triggering on large quakes. Patented DSP algorithms isolate and analyze earthquake shock waves. Dual sensors help eliminate false positives. SWS has received U.S. and international patents covering the use of multiple sensors for eliminating false positives, advanced sensor design, and several digital signal analysis techniques.

Tested in the Lab

QuakeGuard™ has been extensively tested in academia, in the lab, on shake tables, using a variety of recorded earthquake waveforms of both small and large earthquakes.

Proven in the Field

QuakeGuard™ is uniquely reliable, triggering *only* in the event of a damaging earthquake, typically MMI V or greater. The system has been in use at customer sites since 2001 and has experienced dozens of earthquakes, from the 5.1 Anza in October, 2001 to the 7.2 El Major Cucapah earthquake in April, 2010. QuakeGuard's performance has been proven many times in actual use confirming lab testing results. There are also many examples of QuakeGuards ignoring man-made vibrations, such as the partial demolition of the building in which the system was installed. QuakeGuard™ is *not* triggered by smaller, non-damaging earthquakes or other sources of vibration such as machinery, vehicles, and construction equipment.

Specifications

Enclosure

- NEMA 12 and 4 (main unit)
- NEMA 4X (sensors)

Temperature

- Storage -30° to 70° C
- Operating 0° to 50° C

Humidity

- 10% - 90% non-condensing

Power

- 95-235VAC 50-60Hz 150W max (<10W typical)

Line-level Audio Output

- 2 channels
- Transformer-coupled
- +4dBm into 600 ohms

Relay Output

- Form C contacts
- Lifetime: >200,000 operations
- Ratings: resistive load:
 - 30VDC @ 10A
 - 110VDC @ 0.5A
 - 120VAC @ 10A
 - 240VAC @ 7.5A
- Ratings: inductive load:
 - 30VDC @ 7A
 - 110VDC @ 0.3A
 - 120VAC @ 7A
 - 240VAC @ 5A

Ethernet I/O

- 10/100 Base-T
- RJ-45 modular jack

Test/Reset Input

- Contact closure
- 3VDC open-circuit
- 3mA short-circuit
- Diode protected

Battery Configuration

- One 7.2AH battery
- 24 hour min operation on battery
- Built-in charger
- Automatic switch-over
- Low battery detection

