

Seismic Switch, Inc.

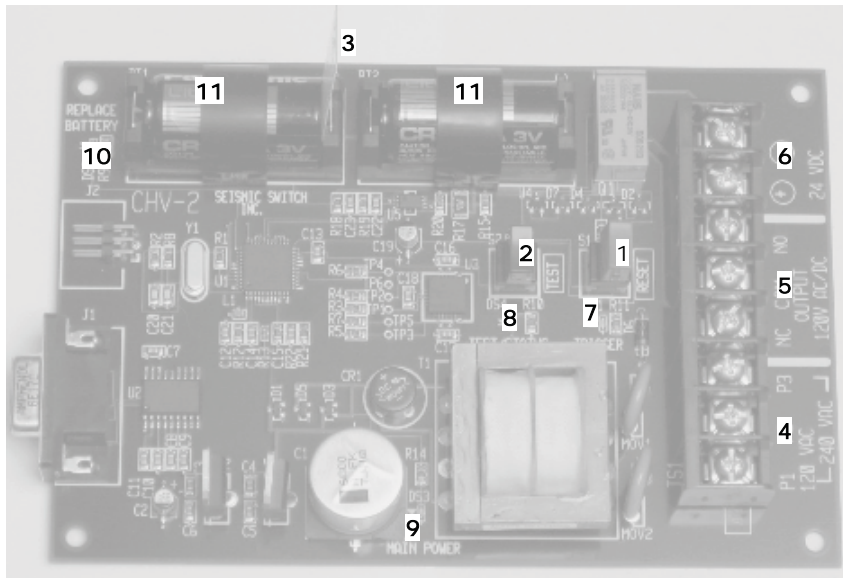


MODEL CHV-2 Earthquake Detector Owner's Manual

Seismic Switch, Inc. Model CHV-2



CHV-1 OPERATING CONTROLS, INDICATORS AND TERMINALS



1. **RESET** button (RED). Press to initialize or reset CHV-2.
2. **TEST** button (BLACK). Press or press and hold to perform diagnostic confidence tests. (See page 6.)
3. Mylar insulating shipment tab. **DO NOT REMOVE UNTIL INSTRUCTED TO DO SO.** (See page 4.)
4. AC Input terminals.
5. Output relay signal contacts.
6. DC Input terminals.
7. **TRIGGER** LED (RED). Indicates CHV-1 has triggered.
8. **TEST/STATUS** LED (ORANGE). Indicates test activities and results.
9. **MAIN POWER** LED (YELLOW). Indicates CHV-1 is operating from external AC or DC.
10. **REPLACE BATTERY** LED (ORANGE). Indicates 100 hours TOTAL of battery life has been used; replace batteries at first opportunity.
11. Batteries and clips. Use only recommended battery types. (See page 11.)

Seismic Switch, Inc. Model CHV-2



INTRODUCTION AND FEATURES

The Seismic Switch, Inc. Model CHV-2 Earthquake/Ground Motion Detector is a self-contained electronic unit which can disable or deactivate electrical devices, such as elevators, which may become life endangering or self destructive during an earthquake. Based upon our patented mechanical unit, the CHV-1, which has performed with outstanding reliability in the field for over 30 years, it is designed to reliably respond to only earthquake motions and to reject interference or false triggering from man made and non-earthquake motions.

The unit provides a Form C (Normally Open/Normally Closed) isolated relay contact operation that is triggered by earthquake motions. Once triggered, the contact remains in this state until manually reset by appropriate authorities.

Features:

- Operates from 120/240 VAC 50/50 Hz Mains power or external 12-35 VDC
- Includes built in battery backup system for up to 100 hours total operation during power outages
- Latching (nonvolatile) electromechanical earthquake memory
- Built-in automatic confidence self test every 10 minutes
- User can initiate complete triggering or non-triggering confidence self tests
- Fail-safe operation – any malfunction initiates trigger; no "dead detector" problems
- Meets all applicable codes
- Simple, quick and easy installation
- No special wire or cables needed
- No calibration ever required
- Customized trigger thresholds available for special needs such as for hospitals
- Customized response characteristics available for other countries
- RS-232 data output available (special order)

Seismic Switch, Inc. Model CHV-2



INSTALLATION INSTRUCTIONS (1)

WARNING

DO NOT REMOVE THE MYLAR BATTERY INSULATING TAB UNTIL EXTERNAL AC OR DC POWERS THE UNIT AND THE MAIN POWER LED IS ILLUMINATED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN SIGNIFICANT DISCHARGE OF THE BATTERIES AND REDUCED BATTERY LIFE.

1) Mount the CHV-2 in its case to a **load-bearing wall, stud or joist** with at least two screws through the case mounting flanges. Any convenient mounting attitude is acceptable. (The CHV-2 will automatically orient itself.) The location chosen must be relatively free from man-made or machine-made vibration. (Excessive vibration will cause false triggering and reduced battery life.)

2) Remove the transparent case cover by loosening the four (4) captive screws until the cover comes free.

All wiring to the CHV-2 passes through the conduit hole near the terminal strip.

3) Connect the **OUTPUT** terminals to the elevator control system. The output is a Form C contact so that systems requiring a contact closure (**NO**) or break (**NC**) to the **COM**mon terminal can be used. **NO** means that the path from **COM**mon to **NO** is OPEN until a triggering event occurs. **NC** means that the path from **COM**mon to **NC** is CLOSED until a triggering event occurs.

4) Wire the main power to the unit:

a) AC mains voltages of 80 to 135 VAC (terminals **P1** to **P2**) or 160 to 270 VAC (terminals **P1** to **P3**) may be used. The unit can operate on either 50 or 60 Hz current.

b) DC main voltage of 12 to 35 VDC may be used by connecting to the **(+)** and **(-)** terminals. Be sure to observe proper polarity. There is a reverse-polarity protection diode in the CHV-2; if the unit is connected incorrectly it won't function.

c) BOTH AC and DC may simultaneously be connected to the unit. In this case the DC input can serve as a backup voltage. The priority of main voltage source used by the CHV-2 is (1)AC, (2)external DC, (3)internal battery.

Seismic Switch, Inc. Model CHV-2



INSTALLATION INSTRUCTIONS (2)

5) Apply main power (AC or DC or both) to the unit. The unit will fail its power-up confidence test (see Confidence Tests) and trigger. The red **TRIGGER** LED will light up and the latching relay will click. The **MAIN POWER** LED (Yellow) should illuminate. If it does not, check the main power source(s) and wiring.

Do not proceed further unless the **MAIN POWER** LED is lit.

6) **NOW remove the Mylar battery-insulating tab.** It may be disposed of or left in the case.

7) Press the **RESET** button. The **TRIGGER** LED should go off (and stay off). The CHV-2 will perform its initial power-up confidence test (see CONFIDENCE TESTS, page 6). The **TEST/STATUS** LED coming on for approximately one second and then turning off visually indicates this. The **REPLACE BATTERY** LED coming on for approximately one second and then turning off follows this. This repeats (twice). Shortly after this sequence, the CHV-2 begins its normal monitoring function. The unit should NOT trigger unless an earthquake event occurs.

8) Replace the transparent cover using the four captive screws. If the unit is properly (securely) mounted this activity should not cause the unit to trigger.

NOTE

In external AC or DC powered operation, it is normal for the **TEST/STATUS** and **REPLACE BATTERY** LEDs to come on for one second every 10 minutes as the unit performs its automatic confidence tests (See CONFIDENCE TESTS, Page 6). In addition, the **REPLACE BATTERY** LED may remain on if it is time to replace the batteries (see BATTERY SYSTEM, Page 9), and the **MAIN POWER** LED will be lit.

However, *in battery-powered* mode, no LEDs should be on. If the **TEST/STATUS** LED comes on and the unit is *NOT* triggering, the CHV-2 is mounted in a location with too much man-made vibration. This will cause the unit to be constantly "awakened" from its low-power stand-by mode and will *prematurely* run down the batteries. If this occurs, select another location for the unit that is free from excessive vibration.

Seismic Switch, Inc. Model CHV-2



CONFIDENCE TESTS (1)

What is a confidence test?

A confidence test is a functional test of the electronic systems to assure that all elements of the CHV-2 are operating correctly:

- a) The microprocessor interfaces are initialized and tested for correct status.
- b) The **TEST/STATUS** LED is turned on for one second (the system checks to see that the LED is functional in addition to giving a visual indication).
- c) The **REPLACE BATTERY** LED is turned on for one second (the system checks to see that the LED is functional in addition to giving a visual indication).
- d) The unregulated system voltage is measured to make certain that it is within operating limits.
- e) The regulated system voltage is measured to make certain that it is within operating limits.
- f) The three-axis accelerometer interface is initialized and an identification message is read from the accelerometer.
- g) The accelerometer is configured for normal operation, and each configuration register is read back to make certain that it was loaded properly.
- h) The accelerometer is reconfigured to perform an internal functional self-test in which actual acceleration forces are applied to the MEMS accelerometer micro-mechanisms. *Thus the system is tested all the way to its physical input.* After this test the accelerometer is once again re-configured for normal operation.
- i) The battery charge gauge interface is tested and initialized.
- j) The battery charge gauge is sent an *Identify* command, which results in a 64-bit unique identifier being returned. This command result has a Cyclic Redundancy Check (CRC) run on it to assure proper communication integrity with the battery charge gauge unit.
- k) In a triggering self-test the unit is intentionally triggered.

If **any** of the above tests fail the unit is *immediately* triggered.

Seismic Switch, Inc. Model CHV-2



CONFIDENCE TESTS (2)

When are Confidence Tests run?

1. The CHV-2 performs a confidence test sequence after any power up or reset. If any test fails, the unit triggers.

NOTE

If batteries are not installed the unit will NOT pass its confidence tests. See Battery Installation, page 11.

2. Once it successfully completes its power up/reset confidence test, the CHV-2 begins normal operation, sampling motions via its accelerometer system 40 times per second.

Every 10 minutes (approximately) the system takes a several second "break" and runs a non-trigger confidence test (tests a through j, page 6). If the test fails, the unit triggers. Therefore, the CHV-2 continuously monitors itself to assure proper operation of the unit.

3. It is not necessary to wait for up to 10 minutes to perform a confidence test sequence. Momentarily pushing the **TEST** button will initiate a confidence test sequence immediately.

Non-trigger Test sequence:

a) If the **TEST** button is *only pressed momentarily* a non-triggering test (tests a through j, page 6) is run. If the tests pass, the **TEST/STATUS** LED will flash on and off three times (one second each). If *any* test fails the unit will trigger.

Trigger (Complete) Test sequence:

b) If the **TEST** button is *held down for more than 3 seconds* (until the **TEST/STATUS** LED illuminates), the unit will run the test sequence as in a) but, in addition, the unit will trigger (item k, page 6). The relay will actuate and the **TRIGGER** LED will illuminate. This allows a forced operation (and test) of the trigger circuit and latching relay. In addition to the previous tests, the trigger relay status is monitored. If it is correct (not triggered until the trigger command is issued and triggered afterwards) the **TEST/STATUS** LED will flash on and off three times (one second each). The unit must be **RESET** by pressing the **RESET** button after such a trigger test. *This is an end-to-end functional test.*

Seismic Switch, Inc. Model CHV-2



GENERAL OPERATION

Once mounted, the CHV-2 monitors its attachment point to detect seismic (earthquake) motions in all 3 axes. With no seismic activity or power interruptions the unit remains inactive except for its internal confidence test every 10 minutes.

There are various conditions that cause the unit to actuate its latching relay (and switch its **OUTPUT** contacts); this is called "triggering". Once the unit triggers it remains in this state via the magnetic latching relay in the unit until the unit is reset.

What causes the CHV-2 to trigger?

- a) On AC power-up, if the unit has not been running in battery mode, i.e., during any power supply start-up.
- b) An earthquake event greater than the CHV-2 threshold occurs. See TRIGGERING, page 13.
- c) A triggering confidence test is performed or *any* confidence test fails.
- d) With nearly dead batteries and no AC power, the CHV-2 uses its last available amount of charge to trigger (Fail-safe).

What causes the CHV-2 to be reset?

There is only **one** thing that can reset the CHV-2: pressing the **RESET** button.

Seismic Switch, Inc. Model CHV-2



BATTERY SYSTEM (1)

The CHV-2 uses a lithium primary (non-rechargeable) battery system to permit operation when external AC or DC power is absent. This allows the unit to trigger on local earthquake motions that might occur during a power outage caused by, for example, a previous earthquake at a distant upstream location in the power feed chain.

During battery operation the circuit greatly reduces its power consumption in order to obtain the greatest possible battery life. This means that certain features normally available when operating from external AC or DC power are disabled in battery operation. The most notable of these are:

- a) The system confidence tests (triggering and non-triggering, both automatic and TEST button initiated) are disabled.
- b) All LED activity for the **TEST/STATUS** and **REPLACE BATTERY** indicators is suspended. However, the **TRIGGER** LED will light on an earthquake event as long as there is sufficient battery power. The **MAIN POWER** LED is not lit (indicating that the unit is operating from its batteries).

GENERAL OPERATION OF THE BATTERY SYSTEM

During normal operation of the CHV-2 on external AC or DC power, practically no battery current is used and the battery life is essentially its shelf life, which should be up to 5 years or more if no trigger events or power outages occur.

During battery operation with no earthquake triggering events occurring, the battery can supply at least 100 hours of continuous operation.

Therefore, the battery life can vary from at least 100 hours (continuous battery operation) to the shelf life of the battery (no external power interruptions).

The CHV-2 keeps track of how much of the available battery charge (life) has been used. When approximately 100 hours (total) of internal battery operation has elapsed, the **REPLACE BATTERY** LED will come on whenever external AC or DC power is available. When this is observed, the batteries should be replaced as soon as possible (See BATTERY REPLACEMENT, Page 11.)

Seismic Switch, Inc. Model CHV-2



BATTERY SYSTEM (2)

It is characteristic of lithium batteries to have a no-load terminal voltage that is quite temperature sensitive. In addition, this type of battery has a high internal resistance, so the battery voltage varies considerably depending on instantaneous load and the amount of remaining capacity. *It is therefore not possible to determine how much battery capacity remains by simply measuring the battery voltage. By the time the no-load battery voltage drops significantly there is essentially no useful battery charge left.*

To overcome these limitations and take advantage of the fact that lithium batteries have a very long shelf life and low self-discharge compared to other battery types, the CHV-2 incorporates a sophisticated "battery charge gauge" controller and monitor system.

This charge gauge system continuously monitors both the amount of current drawn from the battery and the length of time that the current is drawn. It therefore monitors the total amount of charge taken from the battery, independent of the battery terminal voltage. This accumulated charge quantity is reported back to the microprocessor at all times.

*When the CHV-2 is running on normal AC/DC power, if the accumulated battery charge usage has exceeded 100 hours the **REPLACE BATTERY** LED will be illuminated.*

When this LED is illuminated the batteries should be replaced at the first opportunity!

The CHV-2 is shipped with approved batteries. Acceptable substitutes are
Panasonic CR-123A
Duracell DL-123A
Energizer EL123A

Other manufacturers may also be used. To see which battery types are approved please visit the Seismic Switch, Inc. Web site:

www.seismicswitchinc.com

Resetting the REPLACE BATTERY LED is part of the battery replacement procedure. (See BATTERY REPLACEMENT, Page 11.)

Seismic Switch, Inc. Model CHV-2



BATTERY REPLACEMENT (1)

Eventually the batteries will have to be replaced. In most cases, where there are infrequent power outages and few or no earthquake triggers, this will be a long interval, essentially the shelf life of the batteries.

When the batteries are replaced it is necessary to reset the accumulated battery charge quantity in the charge gauge system. If this reset is not done, the unit will continue to accumulate charge from its last reading and the **REPLACE BATTERY LED** will remain illuminated. This would defeat the visual battery monitoring function.

To replace the batteries perform the following steps:

- 1) Choose a time when trigger outputs from the CHV-2 will not be a nuisance. If necessary, bypass or disable the CHV-2 output to accomplish this.
- 2) Make certain that the CHV-2 is running on external AC/DC power (the **MAIN POWER LED** will be lit). *Failure to do this will result in the unit triggering and drawing a comparatively large amount of charge from the new batteries; this will reduce their useful life.*
- 3) Remove the old batteries. If an automatic confidence test happens to occur with the batteries out, the test will fail and the unit will trigger.
- 4) Insert the new batteries. Carefully observe the correct battery polarity.
- 5) Press the **RESET** button and allow the CHV-2 to perform its normal reset confidence test. The **TEST/STATUS LED** will go on and off and the **REPLACE BATTERY LED** will remain illuminated.

Now reset the accumulated charge in the monitor system:

- 6) Simultaneously press and hold down BOTH the **RESET** and **TEST** buttons.
- 7) Release the **RESET** button but continue to hold down the **TEST** button. The **REPLACE BATTERY LED** will flash on and off 10 times. If the **TEST** button is released before the 10 flashes have completed, no battery charge reset will occur. If the **TEST** button is held down until after the **REPLACE BATTERY LED** stops flashing (approximately 10 seconds), the accumulated battery charge consumption will be reset.

Seismic Switch, Inc. Model CHV-2



BATTERY REPLACEMENT (2)

8) Release the **TEST** button. The CHV-2 will complete its normal reset confidence test and normal operation will resume. The **REPLACE BATTERY** LED should not be illuminated.

9) If desired, perform a complete triggering or non-triggering confidence test by pressing the **TEST** button. (See page 6, Confidence Tests).

10) If the CHV-2 was bypassed or otherwise disabled, re-connect it for normal operation.

11) Dispose of the used batteries in an environmentally responsible way (this varies with locale). The batteries are *not* rechargeable.

MISCELLANEOUS (1)

NOTE

If the CHV-2 is suddenly flipped or rotated while powered up it will trigger.

It may require 30 seconds to one minute for the internal filters and calculations to re-orient the unit. During this time the unit will not stay reset when the **RESET** button is pushed.

Simply wait for the above time to pass and allow the unit to calculate its non-triggered system values. The unit will then operate normally.

Seismic Switch, Inc. Model CHV-2



TRIGGERING (1)

The CHV-2 utilizes a 3-axis electronic MEMS (micro-electro-mechanical system) nano-scale integrated circuit accelerometer to measure and monitor motions of the unit. This accelerometer provides a high quality measurement of all three axes (x, y and z) at a rate of 40 measurements per second.

The signals from the accelerometer are passed to digital signal processing (DSP) filters and computations which limit the range of frequencies in the signal to the desired earthquake motion frequency range and also make the response independent of the mounting position of the unit (automatic leveling).

The CHV-2 is based upon the Seismic Switch, Inc. patented Model CHV-1 mechanical earthquake sensor that has provided unparalleled reliability in thousands of elevator installations for more than 30 years. The CHV-1 was initially qualified by the California Division of Industrial Safety after extensive seismic testing and certification, and has been tested and approved by many other agencies since initial qualification.

The CHV-1 is a mechanical device. The CHV-2 duplicates the dynamic behavior of the CHV-1 by means of modeling and computation in the unit's microprocessor. Both the CHV-1 and CHV-2 have been mounted side by side and subjected to shaker table seismic tests to assure that the two units perform *in the same manner*.

The triggering specification for the CHV-2 is:

The unit shall trigger within 5 seconds in any direction when subjected to onset of seismic motion in accordance with the horizontal Required Response Spectrum (RRS) of ICC-ES AC156 (2007) with all instantaneous amplitudes multiplied by 0.2.

This motion is shown in Figure 1 on Page 14. The peak acceleration is approximately 0.1g, and the onset begins at 10 seconds. The CHV-2 must trigger between 10 seconds and 15 seconds on the graph.

The corresponding steady-state sensitivity is 0.05g in the frequency range of 2 to 3 Hz.

Seismic Switch, Inc. Model CHV-2



TRIGGERING (2)

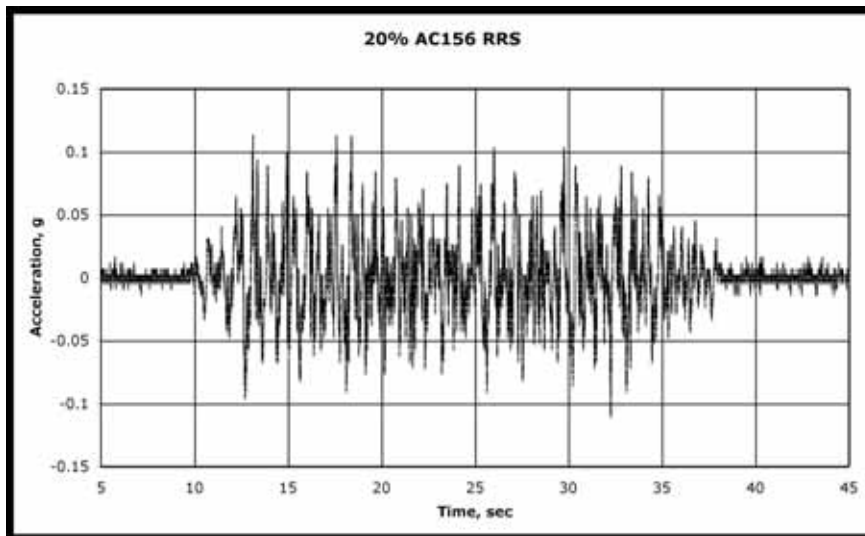


Figure 1. CHV-2 Triggering Standard

AC156 is a modern, robust standard adopted by the Uniform Building Codes, the BOCA National Codes, and the SBCCI Standard Codes. Details of the specification are at

www.icc-es.org

Seismic Switch, Inc. Model CHV-2



SPECIFICATIONS

External Input Power:

AC: 120 VAC or 240 VAC +/- 20%, 1.1 VA max, 50-60 Hz

Agency Certifications

- UL 1446 (E66312)
- UL recognized to UL 506 / UL 5085-2, File # E63829
- CSA certified to C22.2 #66.1, File # 221070

DC: 12 to 35 VDC, 60 mA max

Internal Battery Power: 2 x CR123a Lithium Battery from approved vendors

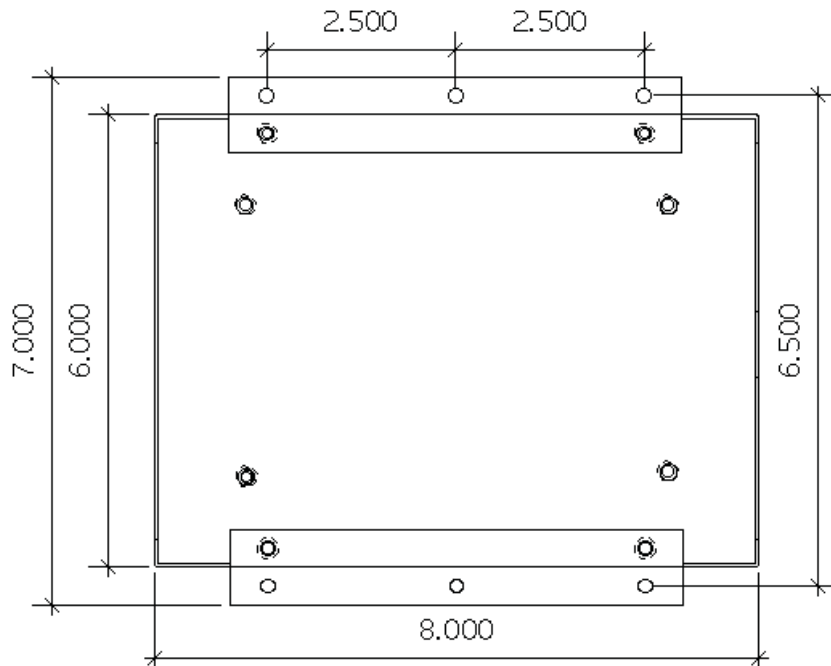
Minimum total operating time on internal batteries: 100 Hours

Outputs: Isolated Form C Latching Relay Contact (NC or NO)

Contact rating: 125 V, 1A AC or DC

Triggering: Within 5 seconds in any direction when subjected to onset of seismic motion in accordance with the horizontal Required Response Spectrum (RRS) of ICC-ES AC156 (2007) with all instantaneous amplitudes multiplied by 0.2. (Corresponding steady-state sensitivity of 0.05g in the frequency range of 2 to 3 Hz.)

Overall and Mounting Dimensions:



Limited Warranty

Seismic Switch, Inc. warrants to the original purchaser that the CHV-2 Earthquake Detector shall be free from defects in material and workmanship under normal use and services for a period of two (2) years from the date of purchase.

Liability of Seismic Switch, Inc. is limited to replacement of the CHV-2, provided that proof of purchase date is presented to Seismic Switch, Inc.

This warranty is void if the CHV-2 has been damaged by accident, tampering, misuse, abuse, lack of reasonable care for the product, improper installation or used in applications not in accordance with this Owner's Manual.

This warranty is in lieu of all other warranties, express or implied, and any other obligations or liabilities. Seismic Switch, Inc. shall have no liability for any personal injury, property damage or any special incidental, contingent or consequential damage of any kind.

Seismic Switch, Inc.



**2125 Magnolia Ave.
Petaluma, CA 94952**

Telephone: (707) 763-9993
Fax: (707) 763-9994
E-mail: seiswtch@pacbell.net
Web Site: www.seismicswitchinc.com