

Seismic Switch, Inc.

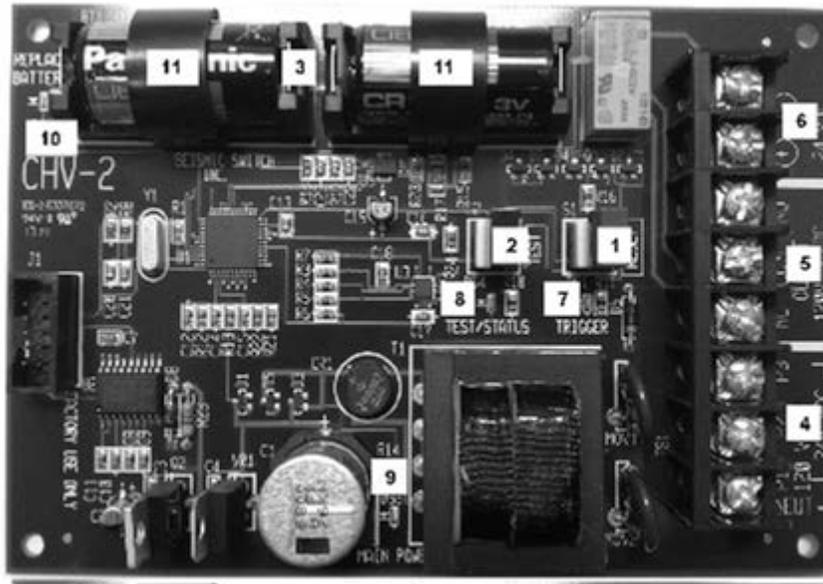


MODEL CHV-2 Earthquake Detector Owner's Manual

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CHV-2 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 8.)
3. Red Mylar insulating shipment tab. **DO NOT REMOVE UNTIL UNIT IS CONNECTED TO "ALWAYS-ON" MAIN POWER.** (See page 6.)
4. Main AC Input terminals.
5. Output relay signal contacts.
6. Main DC Input terminals.
7. **TRIGGER** LED (RED). Indicates CHV-2 has triggered.
8. **TEST/STATUS** LED (ORANGE). Indicates test activities and results.
9. **MAIN POWER** LED (YELLOW). Indicates CHV-2 is operating from external AC and/or DC.
10. **REPLACE BATTERY** LED (ORANGE). Blinking indicates 100 hours TOTAL of battery life has been used; replace batteries at first opportunity.
11. Batteries and clips. **Use only approved battery type.** (See page 14.)

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 proven mechanical unit, the CHV-1, which has performed with outstanding reliability in the field for decades, the CHV-2 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 50/60 Hz Mains power or external 12-32 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

INSTALLATION INSTRUCTIONS

DO NOT REMOVE THE MYLAR BATTERY INSULATING SHIPPING TAB UNTIL STEP 5 BELOW. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN SIGNIFICANT DISCHARGE OF THE BATTERIES AND REDUCED BATTERY LIFE.

THE CHV-2 OPERATES FROM EXTERNAL POWER THAT MUST ALWAYS BE "ON" EXCEPT DURING A POWER FAILURE. IF EXTERNAL POWER IS SWITCHED OFF FOR AN EXTENDED PERIOD, THE BATTERIES WILL RUN DOWN AND THE UNIT WILL TRIGGER.

1) Mount the CHV-2 in its case to a **load-bearing wall, ceiling, floor, 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 an isolated 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 ("**ALWAYS ON**") power (AC or DC or both) 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. An earth ground (“green wire”) terminal is provided in the case.
- b) DC main voltage of 12 to 32 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.

5) **NOW remove the red Mylar battery-insulating tab.** It should be left in the case for future use.

NOTE

6) SAFETY WARNING: Replace the transparent case cover. The cover, with pushbutton standoffs mounted, shall be in place at all times when AC line voltage is applied to the unit. (UL requirement)

7) 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.

8) 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 8). 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.

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 8). In addition, the REPLACE BATTERY LED may remain on (flashing if it is time to replace the batteries (see BATTERY SYSTEM, Page 12), 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.

CONFIDENCE TESTS

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 and can be read properly.
- h) The accelerometer is reconfigured to perform an internal functional self-test in which actual acceleration forces are applied to the internal 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 system 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.

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.

If batteries are not installed in place the unit will NOT pass its confidence tests. See Battery Replacement, page 14.

2. Once it successfully completes its power up/reset confidence test, the CHV-2 begins normal operation, sampling motions via its accelerometer system 50 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 9). 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 9) 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 9). 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.*

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 performing 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 17.
- 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

BATTERY SYSTEM

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 in 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, not external main power).

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 flash/blink 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 14.)

BATTERY SYSTEM

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. *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!

APPROVED BATTERIES: The CHV-2 is shipped with Panasonic CR-123A batteries. *This is the only UL-approved battery for this unit.*

CAUTION

The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100°C (212°F) or dispose of in fire. Replace battery with Panasonic Part No. CR-123A only. Use of another battery may present a risk of fire or explosion.

Dispose of used battery promptly. Keep away from children. Do not disassemble and do not dispose of in fire.

Resetting the REPLACE BATTERY LED is part of the battery replacement procedure. (See BATTERY REPLACEMENT, Page 14.)

BATTERY REPLACEMENT

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 (charge used) 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 flash. 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) Remove AC power from the CHV unit.
- 3) Remove the transparent cover. (See **Safety Warning** on Page 6.)
- 4) Remove the old batteries and insert the new batteries. Carefully observe the correct battery polarity.
- 5) Replace the transparent cover before re-applying AC power to the unit. Make certain that the unit is operating from main power (main power LED is lit).
- 6) 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:

- 7) Simultaneously press and hold down BOTH the **RESET** and **TEST** buttons.
- 8) Release the **RESET** button but continue to hold down the **TEST** button until the **TEST/STATUS** LED lights. (The **REPLACE BATTERY** LED will flash on and off 10 times.) If the **TEST** button is released before the **TEST/STATUS** LED lights, no battery charge reset will occur. If the **TEST** button is held down until after the **TEST/STATUS** LED lights (approximately 10 seconds), the accumulated battery charge consumption will be reset to zero.
- 9) 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.

10) If desired, perform a complete triggering or non-triggering confidence test by pressing the **TEST** button. (See page 8, Confidence Tests).

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

12) Dispose of the used batteries in accordance with the **CAUTION** notice on Page 12. The batteries are *not* rechargeable.

MISCELLANEOUS

NOTE

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

It may require 30 seconds to one minute for the internal signal processors 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.

TRIGGERING

The CHV-2 utilizes a precision 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 50 measurements per second.

The signals from the accelerometer are passed to digital signal processing (DSP) computations which make the response independent of the mounting position of the unit (automatic leveling).

The CHV-2 is based upon the Seismic Switch, Inc. proven Model CHV-1 mechanical earthquake sensor that has provided unparalleled reliability in thousands of elevator installations for more than 46 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. 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. This is not a valid way to characterize an earthquake sensor and this number is included only for comparison purposes.

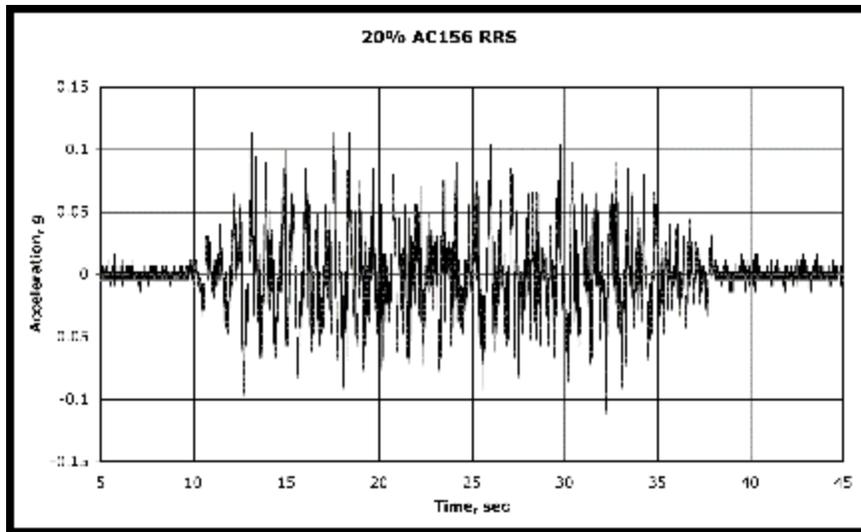


Figure 1. CHV-2 Triggering Standard

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

Instructions for Trigger Level Selection

Should your application require a selectable level, you may choose from one of four levels using a simple shunt—included in the unit in a small plastic bag.

	<p>NO J2 JUMPER - ORIGINAL CHV-2 RESPONSE This selection sets the response and trigger level of the CHV-2 to the original trigger threshold and frequency sensitivity and is compliant with the ASME A17.1 elevator code safety requirements. Recommended for all units installed in substantially-built buildings.</p>
	<p>J2 JUMPER POSITION ONE (FAR RIGHT AS SHOWN) - MAXIMUM ALLOWABLE A17.1 CODE TRIGGER LEVEL Maximum allowable level in conformance with ASME A 17.1 elevator code safety requirements. Provides slightly greater immunity to vibrations in buildings where the mounting is less than optimal or there is greater than normal vibration from machinery, etc.</p>
	<p>J2 JUMPER POSITION TWO (MIDDLE POSITION) - ASCE 25–97 NOMINAL TRIGGER THRESHOLD This standard is intended for piping systems and other applications where there is hammering of valves, etc. The standard states that it is intended for structures no higher than four stories.</p>
	<p>J2 JUMPER POSITION THREE (FAR LEFT) - ASCE 25–97 MAXIMUM (MUST TRIGGER) TRIGGER THRESHOLD This standard is intended for applications where there is severe hammering of valves, etc. The standard states that it is intended for structures no higher than four stories.</p>

SPECIFICATIONS

External Input Power: (See label on unit)

AC: 120 VAC or 240 VAC

DC: 12 to 32 VDC (Isolated low voltage, limited energy power supply, 24VDC; 100VA maximum)

Internal Battery Power: 2 x Panasonic CR123A Lithium Battery

Minimum total operating time on internal batteries: 100 Hours

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

Contact ratings: (See label on unit)

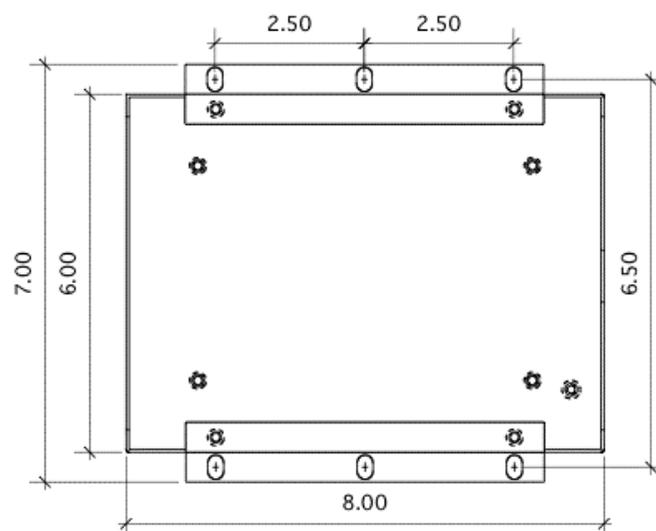
UL 508 Industrial Control Equipment Listed (File E350668):

Industrial Control Switch evaluated for Risk of Fire and Risk of Shock Hazards Only

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.)

Operating Temperature Range: 0 to 70° C

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.

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