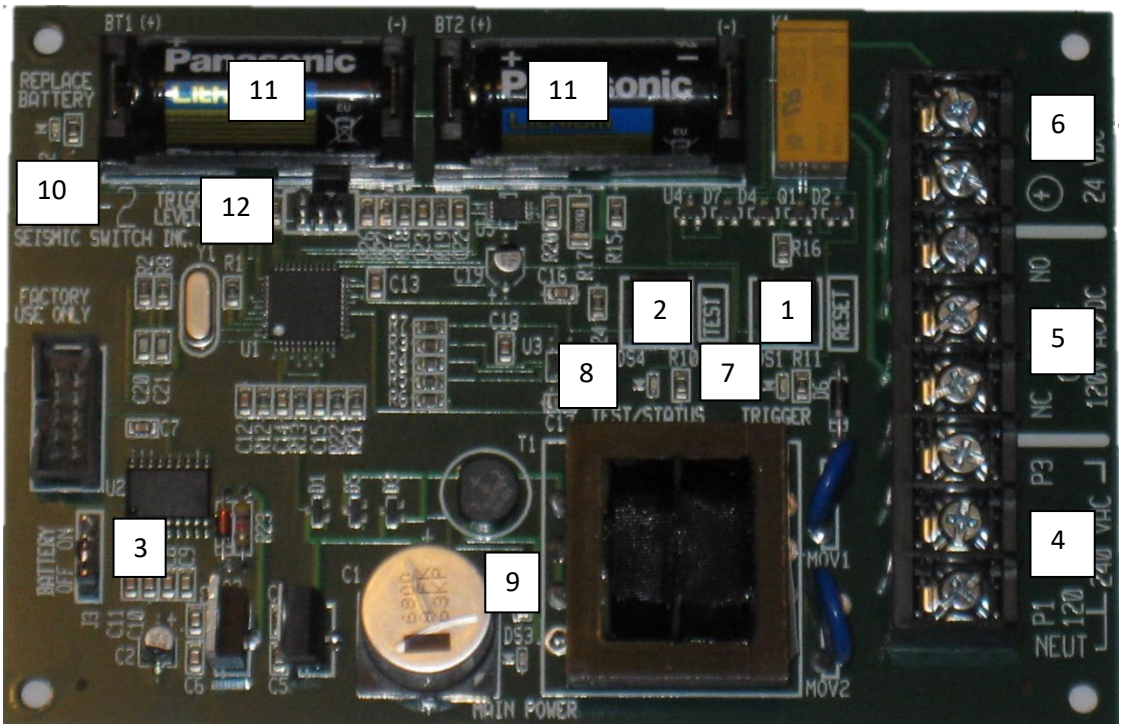
Seismic Switch, Inc.

MODEL CHV-2

Earthquake Detector

Technical Manual

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 self tests. (See page 8.)

3. Battery ON-OFF jumper (J3). DO NOT MOVE to “ON” UNTIL UNIT IS CONNECTED TO “ALWAYS-ON” MAIN POWER. (See page 5.)

4. Main AC Input terminals (P1, P2, P3). Used when unit is powered from 110 or 220 VAC.

5. Output relay signal contacts (NC, COM, NO).

6. Main DC Input terminals. Used when unit is powered from DC.(+,- 24 VDC)

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 UL-approved battery type**. (See page 10.)

12. Sensitivity jumper. Selects trigger level. (See page 12.)

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)

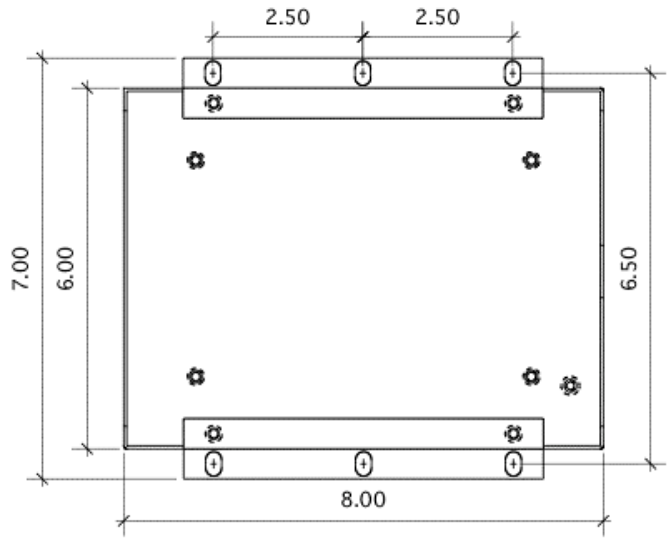
Contact ratings: (See label on unit)

UL 508 Industrial Control Equipment Listed (File E350668):

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

Operating Temperature Range: 0 to 70° C

Overall and Mounting Dimensions:



INSTALLATION INSTRUCTIONS

DO NOT MOVE THE BATTERY JUMPER (J3) TO "ON" 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 the unit 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 move the BATTERY jumper (J3) to the "ON" position**.

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 self test (see Self 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 self test (see SELF TESTS, page 7). 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 self tests (see SELF TESTS, Page 7). In addition, the REPLACE BATTERY LED may remain on (i.e.,flashing) 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.

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 self 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 self test is performed or *any* self 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

SELF TESTS

What is a Self Test?

A self 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 Self Tests run?

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

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

2. Once it successfully completes its power up/reset self 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 self test (tests a through “j”, page 7). 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 self test sequence. Momentarily pushing the **TEST** button will initiate a self test sequence immediately.

There are two types of self test that can be run: Non-triggering and Triggering

Non-trigger Test sequence:

a) If the **TEST** button is *only pressed momentarily* a non-triggering test (tests “*a”* through “*j”*, page 7) 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 7). 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.*

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 self 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 11.)

BATTERY SYSTEM DESCRIPTION

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 or the sum of the battery voltage is less than 5.0 Volts, the **REPLACE BATTERY** LED will be blink on and off.

When this LED is blinking 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 – SAFETY WARNING

The battery used in this device may present a fire or chemical burn hazard if mistreated. Do not recharge, disassemble, heat above 100ºC (212ºF) 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 11.)

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 continue to blink. 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 10.)

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 self 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 self test and normal operation will resume. The **REPLACE BATTERY** LED should not be illuminated.

10) If desired, perform a complete triggering or non-triggering self test by pressing the **TEST** button. (See page 7, Self 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 10. 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.

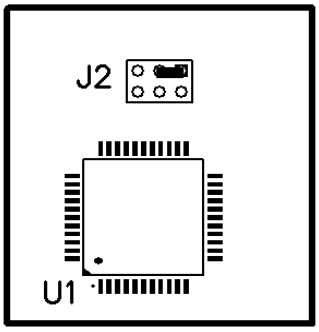
Simply wait for the above time to pass and allow the unit to calculate its non-triggered system values. The unit will then operate normally.

ADJUSTABLE TRIGGER LEVEL

The CHV-2 allows a selection of four sensitivities or trigger levels to accommodate local installation conditions. This sensitivity selection is made by means of a Jumper plug situated above U1 and is labeled J2. See item 12 on page 2 for the location of this jumper plug. The possible locations for this jumper plug are detailed below.

The Jumper plug is shipped from Seismic Switch Inc. in the most sensitive setting, and it is recommended that this setting be used if possible, since it gives the greatest degree of protection in the event of earthquakes. However, if vibration levels are too high, the unit will be triggered when there is no earthquake occurring; this is known as “false triggering”.

If this false triggering becomes a nuisance or problem, the Jumper plug should be removed from its factory-installed location, and one of the alternate positions should be selected. It is recommended that the Jumper plug be installed in the lowest position that eliminates the false triggering. It should be noted that the two highest settings (bottom two selections below) are not A 17.1 compliant over part or all of the 1-10 Hz range of the device. If it is necessary to use either of these settings it is recommended that an effort be made to improve the mounting conditions of the CHV-2 unit.



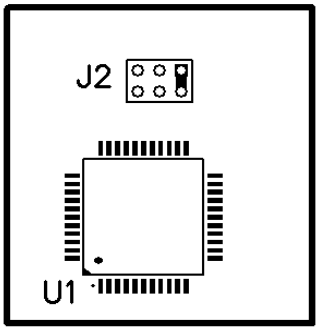
JUMPER OPTIONS

HORIZONTAL Jumper (as shipped):

Response of 1994 Northridge Quake X 0.2

Most sensitive

(LOWEST trigger threshold)



FAR RIGHT, Vertical:

Less sensitive (0.15 g)

Maximum level (0.15g, 1-10 Hz) allowed

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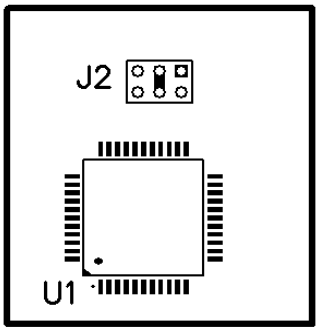
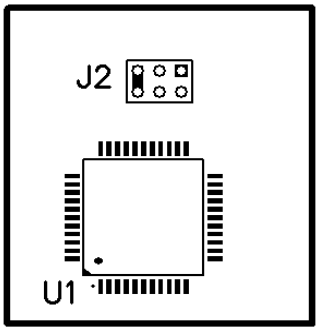


MIDDLE, Vertical: Even less sensitive

ASCE 25–97 NOMINAL TRIGGER THRESHOLD

Inserting the jumper in this position sets the response and trigger level of the CHV-2 to the nominal (median) spectrum as specified in standard ASCE 25–97. 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, and it is not compliant with the ASME A17.1 code above 2 Hz. It provides a rising trigger threshold with increasing frequency (up to 0.6 g) over the range of 1 to 10 Hz, with sharp roll-off above 10 Hz



FAR LEFT, Vertical: Least sensitive

ASCE 25–97 MAXIMUM (MUST TRIGGER) THRESHOLD

Inserting the jumper in this position sets the response and trigger level of the CHV-2 to the maximum (MUST TRIGGER) spectrum as specified in standard ASCE 25–97. 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, and it is not compliant with the ASME A17.1 code at any frequency. It provides a rising trigger threshold with increasing frequency (0.25g up to 0.8 g) over the range of 1 to 10 Hz, with sharp roll-off above 10 Hz.

(HIGHEST trigger threshold)

Limited Warranty

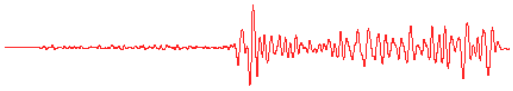
Seismic Switch, Inc. warrants to the original purchaser that the CHV-2 Earthquake Detector shall be free from defects in material and workmanship under normal use and services for a period of two (2) years from the date of purchase.

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.



889 4th Street

San Rafael, CA 94901

Telephone: (415) 492-1200

E-mail: seismic@seismicswitchinc.com

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