

Specifications for: [OSOP Raspberry Shake 4D](#)

- Your 4D Personal Seismograph & Accelerograph -

An IoT home-automation device

Born on: February, 2017

<http://shop.raspberrysshake.org/>

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Unit

The “Raspberry Shake 4D” Personal Seismograph & Accelerograph is an all-in-one, IoT plug-and-go solution for personal seismology- [OSOP, S.A.](#) integrates a single vertical velocity sensors with a 2G orthogonal MEMS accelerometer, the digitizers, the hyper dampers, and the computer into *a single box*. The Raspberry Shake 4D is manufactured in Volcán, Panamá using cutting-edge 3D printing and laser-cutting technology.

Warranty: 1 year from ship date

Specifications subject to change without notice.

Parameter	Value
Raspberry Shake 4D Version	V5, V4 (Current version: V5)
Dimensions (estimated)	100x120x50 mm
Weight (estimated)	0.35 kg
Immersion rating	<i>Standard enclosure: IP10</i> <i>IP67 enclosure available upon request at additional cost</i>
Connectors	<i>Standard enclosure: Ethernet (RJ45), Power Micro USB (5V, 2.5 Amps), USB 2 ports x4, HDMI, Micro SD, CSI Camera port, Composite video and audio output jack</i>

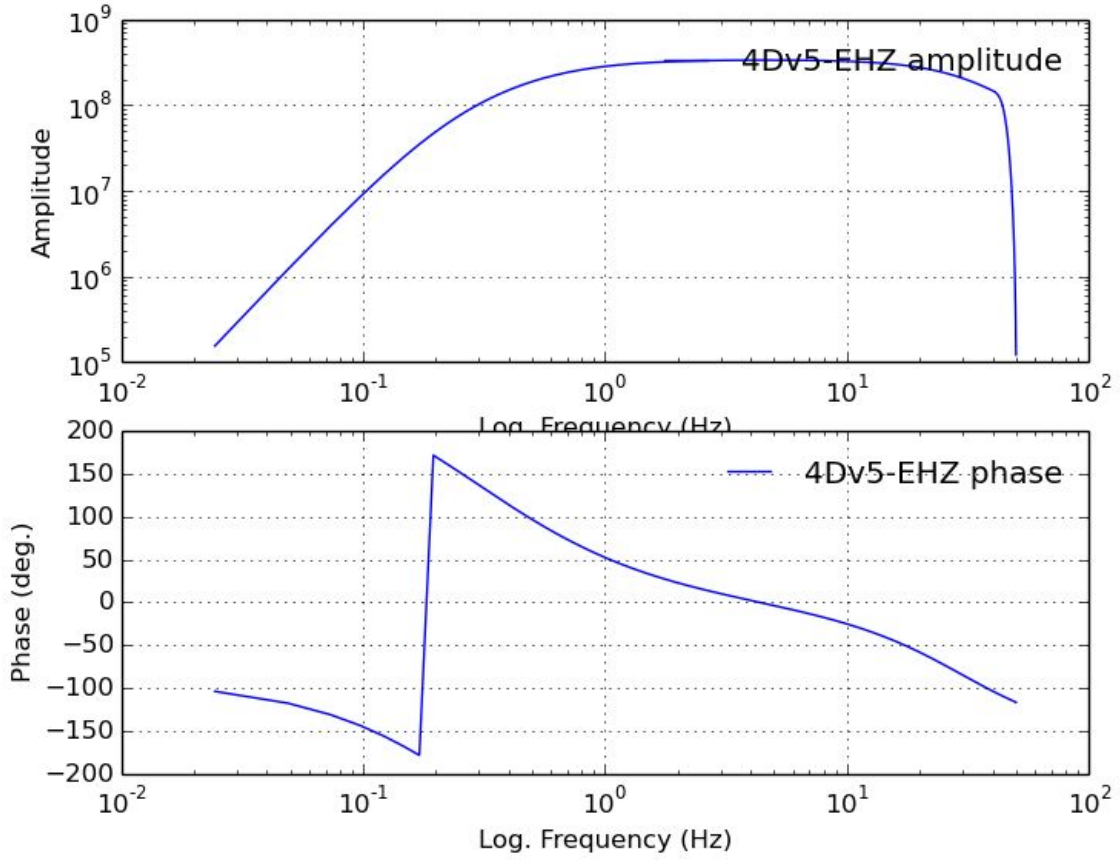
	<i>IP67 enclosure</i> : Ethernet (RJ45), Power
Installation Considerations	<p>Designed for plug-and-go installation</p> <p>Mounting screw anchor slot provided</p> <p>Alignment: with axis of building or magnetic. North arrow provided.</p>
Operating Temperature	0 to 60 C (limited by RPi, the Raspberry Shake itself can go to -40C)
On Board Computer	Wifi-enabled Raspberry Pi 3 Model B
Storage Device	<p>8 Gb or + micro SD card</p> <p><u><i>Est. # days of disk space:</i></u></p> <p>OS/ software: ~3 Gb</p> <p>Remaining space for data: ~5 Gb</p> <p># days (15 Mb/ day/ channel [x4]): ~80, more if you use a bigger SD</p>
Timing	Network Timing Protocol, NTP
Timing Quality	NTP timing quality remains within 1 sample of accuracy versus startup accuracy: +/- 10 ms or better @ 100 sps

Seismograph

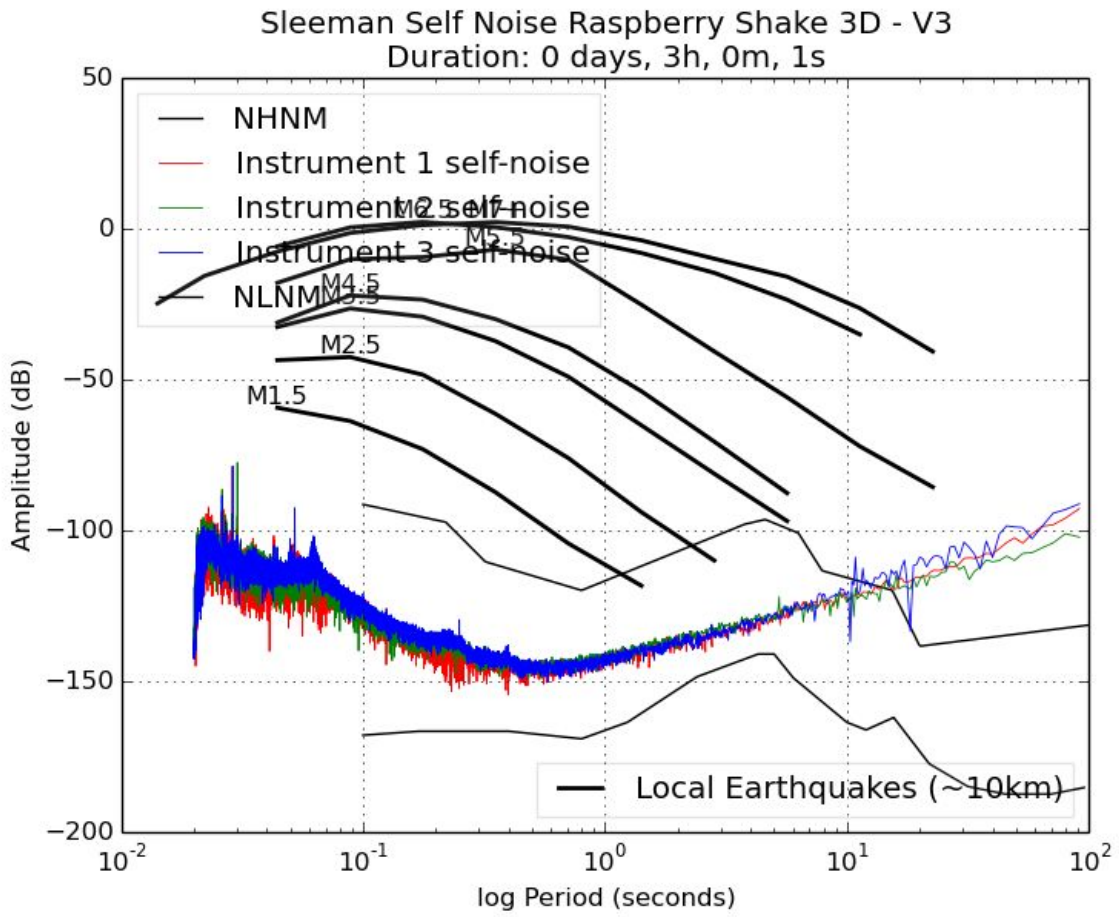
Parameter	Value
Type	Single-component 4.5 Hz 395 Ohm vertical Racotech RGI-20DX geophone with electronic extension to lower frequencies (<1 Hz)
Samples per second	100
<p><i>Earthquake Early Warning (EEW) compatible</i></p> <p><i>data packets shipped across serial port at a rate of 4 packets/ second (250 ms/ packet)</i></p>	
Bandwidth (estimate)	V5: -3dB points at 0.7 to 26 Hz, possibly higher V4: -3dB points at 0.7 to 40 Hz
Poles (estimate)	V5: -1.63E+02 +/- 1.02E+02; -3.61; -1.41 +/- 4.11E-01 V4: 1.82E+02 +/- 3.43E+02; 4.56E-01; 0
Zeros (estimate)	V5: -5.78E+03; 0; 0; 0 V4: -3.60E+02 +/- 8.29E+02; -3.04 +/- 8.48E-01
Sensitivity (estimate)	V5: 3.36E+08 counts/ meter/ second +/- 10% precision V4: 4.05E+08 counts/ meter/ second +/- 10% precision
Clip Level (estimate)	+/- 8,388,608 counts (24-bits) V5: 25 mm/s peak-to-peak from 0.1 to 10 Hz V4: 21 mm/s peak-to-peak from 0.1 to 10 Hz

<p>Minimum Detection Threshold (estimate)</p>	<p>V5: 0.03 $\mu\text{m/ s}$ RMS from 1 to 20 Hz @ 100 sps V4: 0.16 $\mu\text{m/ s}$ RMS from 1 to 20 Hz @ 100 sps</p> <p><i>Note: The minimum detectable level is considered to be 10 dB above the noise RMS. Dynamic range is the full scale sinusoid RMS over the noise RMS in dB.</i></p>
<p>Digitizer Dynamic range</p>	<p>24-bit ADC Sigma-Delta $\Sigma\Delta$ 144 dB (24 bits)</p>
<p>Effective bits (estimate)</p>	<p>V5: 21 bits (126 dB) from 1 to 20 Hz @ 100 sps (for the entire analog to digital hardware chain). V4: 18 bits (109 dB) from 1 to 20 Hz @ 100 sps (for the entire analog to digital hardware chain).</p> <p><i>Note: Whereas most manufacturers report this for their digitizer only, we are reporting it for the entire sensor + ADC hardware chain. The effective bits of the digitizer itself are necessarily better.</i></p> <p>This parameter is also commonly known as “Dynamic Range” or “RMS to RMS noise”.</p>

Velocity Channel Instrument Response:



Sleeman Self-Noise:

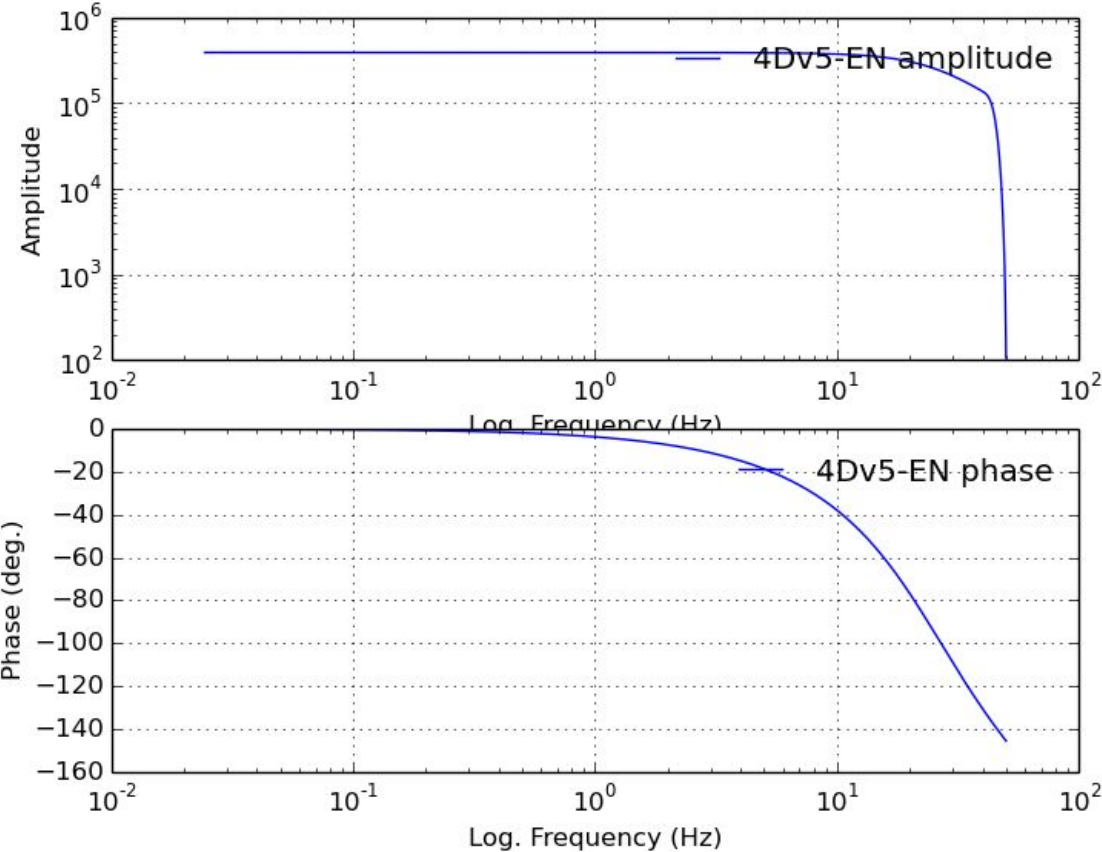


Accelerograph: MEMs

Parameter	Value
Sensor	3-component, orthogonally placed +/- 2g MEMs sensor (Class C)
Samples per second	100
<p><i>Earthquake Early Warning (EEW) compatible</i></p> <p><i>data packets shipped across serial port at a rate of 5 packets/ second (200 ms/ packet)</i></p>	
Flat Frequency Range (estimate, -3dB points)	V5: DC to 23 Hz, possibly higher V4: DC to 29 Hz, possibly higher
Poles (estimate)	V5: 6.57E+02 +/- 1.20E+03; 0 V4: 5.06E+01 +/- 2.86E+02; 0
Zeros (estimate)	V5: -1.26E+02 +/- 1.02E+-02; -6.24E-05 V4: -4.33E+02; -1.45E+02 +/- 2.78E+02; 3.94E-02
Sensitivity (estimate)	V5: 3.87E+05 counts/ meter/ second squared +/- 10% precision V4: 3.96E+05 counts/ meter/ second squared +/- 10% precision
Clip Level (estimate)	V5/ V4: +/-2G (21 m/s ² peak-to-peak from 0.1 to 10 Hz)
Digitizer Dynamic range	24-bit ADC Sigma-Delta $\Sigma\Delta$ 144 dB (24 bits)

Effective bits (estimate)	<p>V5/ V4: 14 bits (84 dB) from 1 to 10 Hz @ 100 sps (for the entire analog to digital hardware chain).</p> <p><i>Note: Whereas most manufacturers report this for their digitizer only, we are reporting it for the entire sensor + ADC hardware chain. The effective bits of the digitizer itself are necessarily better.</i></p> <p>This parameter is also commonly known as “Dynamic Range” or “RMS to RMS noise”.</p>
Noise Level	<p>V5/ V4: 3000 $\mu\text{m/ s}$ (0.3 Gal, 0.0003 g) RMS from 1 to 10 Hz @ 100 sps</p>

Acceleration Channel Instrument Response:



Software

Software installed on Raspberry Shake's RPi computer
100% SeisComP3 compatible Also: AQMS, Antelope, Earlybird, Earthworm, Hydra, ObsPy, SEISAN, ...
Native SeedLink Server (source: GEOFON) with OSOP Data Flow Message Router
Tight and automatic integration with SeisComP
Web-interface (HTML) for easy configuration
Software to store continuous seismic data in miniSEED format
Web-based helicorder plot generator (source: USGS)
Swarm (source: USGS)
Software distributed with Docker
Automatic updates
Operating System: Debian 8 (Linux)

Communications

Parameter	Value
Digital bandwidth consumption at 100 Hz, 4 channels (estimated)	Incoming rates RX: ~96.0 kbits/s Outgoing rates TX: ~376.0 kbits/s TCP Flow rate: 33.6 kbits/s
TCP/IP compatible	
Compatible with Wifi, Ethernet, Cell modem, GPRS, Satellite	

Power

Parameter	Value
Power Supply Voltage	5 Volts DC (2.5 Amp supply)
Power Consumption (RPi + Raspberry Shake, estimated)	$5.14 \text{ Volts} \times 0.270 \text{ A} = 1.4 \text{ Watts}$

Calibration Mechanism: Calibration not required over time but can be verified using the [OSOP Calibration Table](#). All seismographs are verified prior to shipping to ensure that their gain is within 10% of the nominal instrument response (up to 10% variation attributable to geophones and capacitors).

Questions?

Email us at sales@raspberrysake.org