

# Specifications for: OSOP Raspberry Shake 3D

- Your 3D Personal Seismograph -

*An IoT home-automation device*

*Born on: February, 2017*

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## Unit

The Raspberry Shake 3D Personal Seismograph is an all-in-one, IoT plug-and-go solution for personal seismology- OSOP, S.A. integrates a 3 orthogonal velocity sensors, the digitizers, the hyper dampers, and the computer into *a single box*. The Raspberry Shake 3D Personal Seismograph 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 3D Version	V3
Dimensions (estimated)	140x130x60 mm
Weight (estimated)	0.6 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>

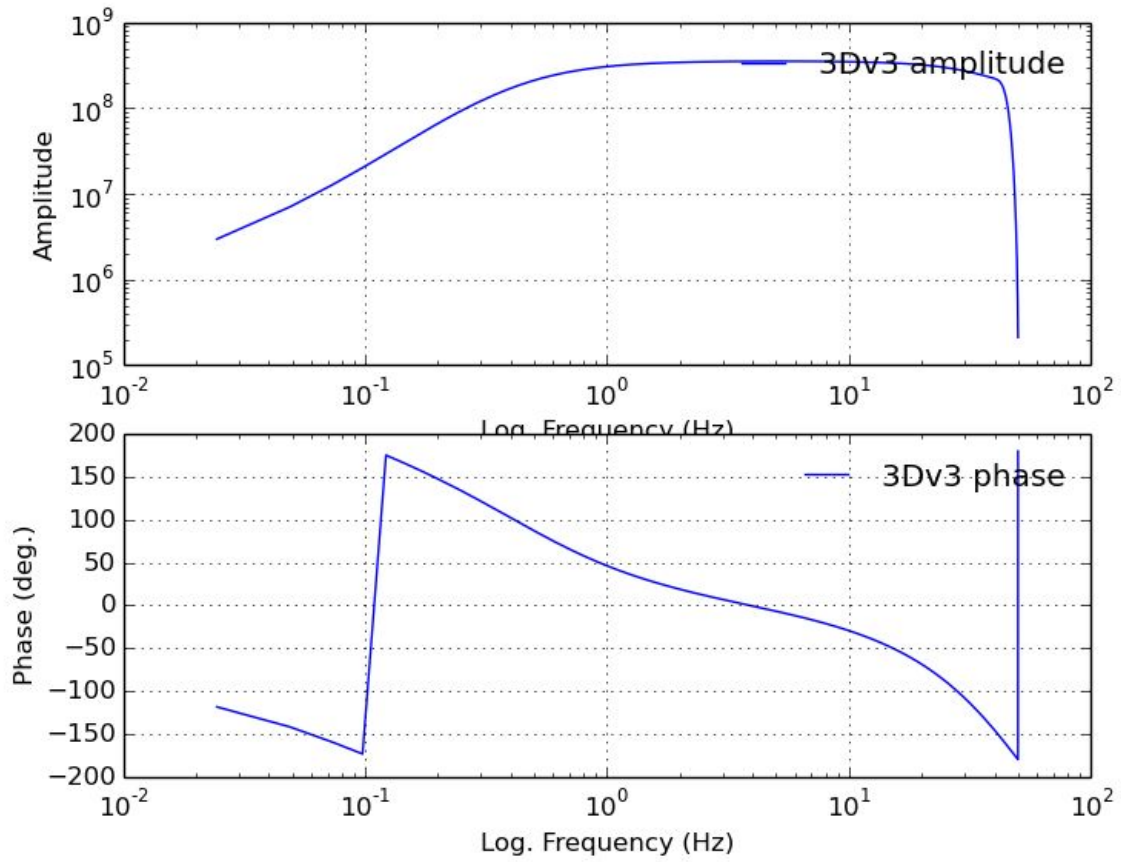
	<i>IP67 enclosure: Ethernet (RJ45), Power</i>
Installation Considerations	Designed for plug-and-go installation
Operating Temperature	0 to 60 C (limited by RPi, the Raspberry Shake itself can go to -40C)
On Board Computer	Wifi-enabled Raspberry Pi 3 Model B
Storage Device	<p>8 Gb or + micro SD card</p> <p><u>Est. # days of disk space:</u></p> <p>OS/ software: ~3 Gb</p> <p>Remaining space for data: ~5 Gb</p> <p># days (15 Mb/ day/ channel [x3]): ~110, 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	<p>3-component, orthogonally placed 4.5 Hz (electronically extended down to 2 seconds) Sunfull PS-4.5B geophones, 375 Ohm</p> <p><i>Note: These are not the same geophones used in the 1D and 4D versions of Raspberry Shake</i></p>
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)	<p>-3dB points at 0.6 to 34 Hz</p> <p><i>Note: We hope to extend this out to 40 Hz (or 80% of Nyquist) before shipping the first round of Raspberry Shakes</i></p>
Poles (estimate)	2.23E+02 +/- 2.95E+02; 3.76E-01; 0
Zeros (estimate)	-1.96E+02 +/- 1.55E+02; 2.65 +/- 6.83E-01
Sensitivity (estimate)	3.53E+08 counts/ meter/ second +/- 10% precision
Clip Level (estimate)	<p>+/- 8,388,608 counts (24-bits)</p> <p>24 mm/s peak-to-peak from 0.1 to 10 Hz</p>
Minimum Detection Threshold (estimate)	<p>0.06 <math>\mu</math>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>

Digitizer Dynamic range	24-bit ADC Sigma-Delta $\Sigma\Delta$ 144 dB (24 bits)
Effective bits (estimate)	<p>20 bits (120 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:



# Software

<b>Software installed on Raspberry Shake's RPi computer</b>
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, 3 channels (estimated)	Incoming rates RX: ~72.0 kbits/s  Outgoing rates TX: ~282.0 kbits/s  TCP Flow rate: 25.2 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).