

Raspberry Shake Technical Specifications



The Raspberry Shake 3D Personal Seismograph is an all-in-one, IoT plug-and-go solution for personal seismology that 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 China using cutting-edge 3D printing and laser-cutting technology.

Warranty: 1 year from ship date

Parameter	Value
Raspberry Shake 3D Version	All versions
Dimensions (estimated)	<i>Standard enclosure: 140x135x60 mm</i> <i>IP67 enclosure: 160x90x90 mm</i>
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>

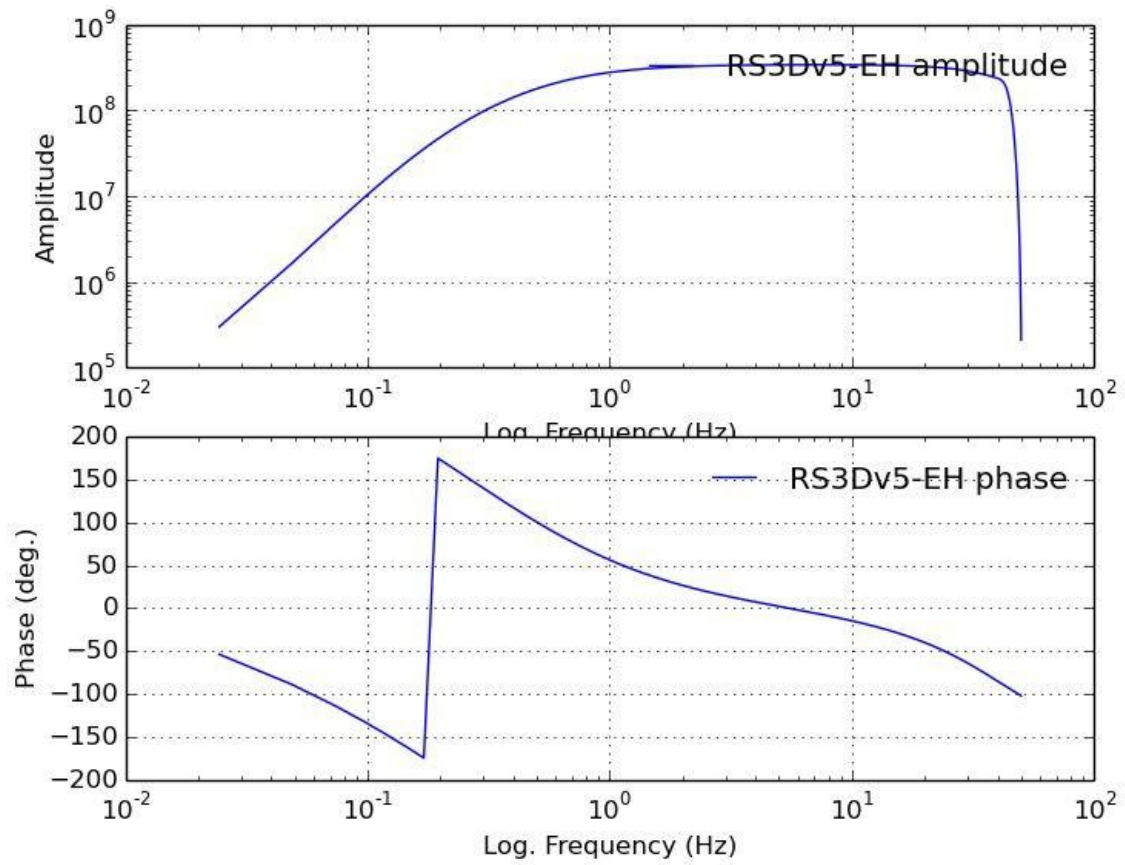
	<i>IP 67 enclosure: Ethernet (RJ45), Power. Note: the supported standard for the IP67 LAN connector is 100 Mbit/s (4-wired LAN cable).</i>
Installation Considerations	Designed for plug-and-go installation
Operating Temperature	0 to 60 C (limited by RPi, the Raspberry Shake itself can go to -20C)
On Board Computer	<p>Raspberry Pi 3 Model B</p> <p><i>The Raspberry Shake board/ Software is also compatible with:</i></p> <p>00[10,13],900032: Model B+</p> <p>a[01040,01041,21041,22042]: 2 Model B</p> <p>a[02082,22082,32082,52082]: 3 Model B</p> <p>a020d3: 3 Model B+</p> <p>4 Model B</p>
Storage Device	<p>8 Gb micro SD card</p> <p><u>Est. # days of disk space:</u></p> <p>OS/ software: ~4 Gb</p> <p>Remaining space for data: ~3 Gb</p> <p># days (15 Mb/ day/ channel [x3]): ~68</p>
Timing	<p>Network Timing Protocol, NTP (default)</p> <p>GPS timing supported</p>
Timing Quality	NTP timing quality remains within 1 sample of accuracy versus startup accuracy: +/- 10 ms or better @ 100 sps

Seismograph

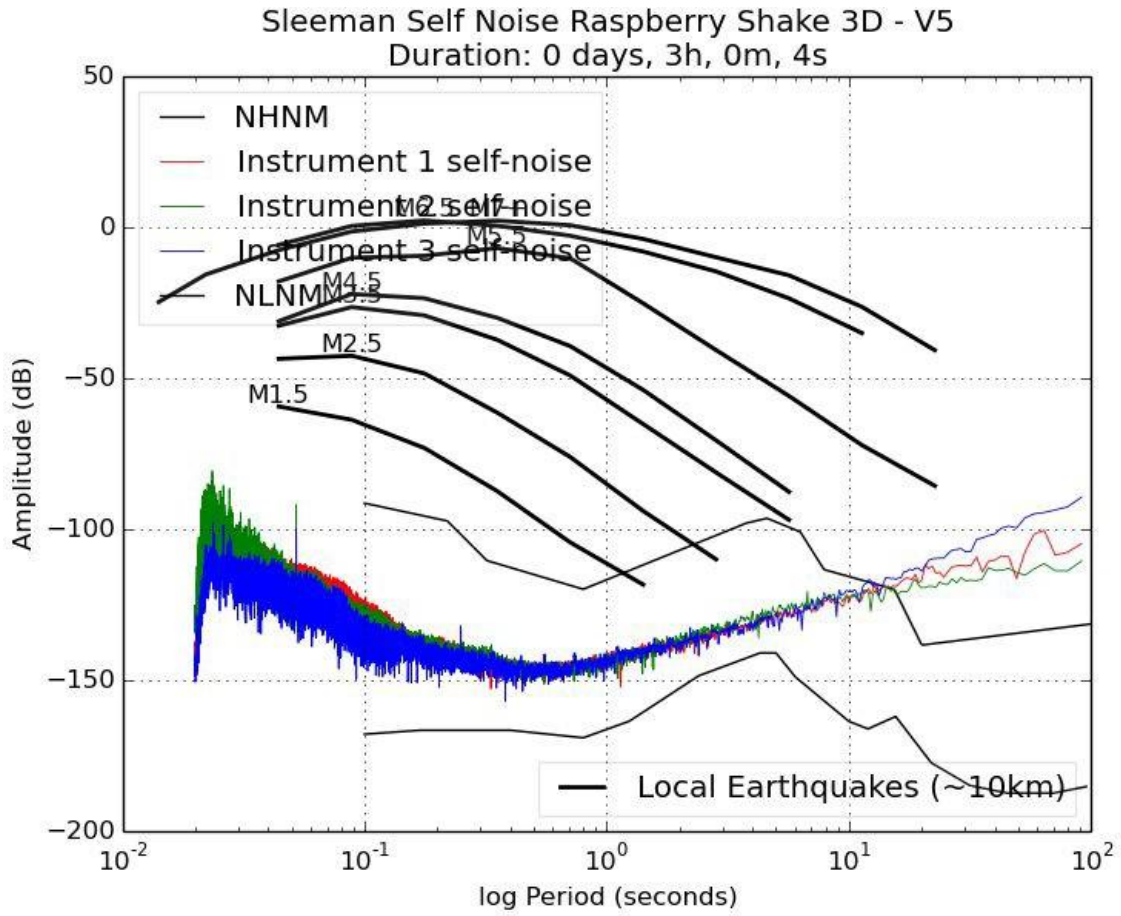
Parameter	Value
Type	<p>3-component, orthogonally placed 4.5 Hz (electronically extended down to 2 seconds) Sunfull PS-4.5B geophones, 375 Ohm</p> <p><i>Note: These are not the same geophones used in the 1D and 4D versions of Raspberry Shake</i></p>
Samples per second	100
<p><i>Earthquake Early Warning (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>V5+: -3dB points at 0.7 to 39 Hz</p> <p>V3: -3dB points at 0.6 to 34 Hz</p>
Poles (estimate, radians/ second)	<p>V5+:</p> <p style="padding-left: 40px;">-1 (0.16 Hz, single pole high pass filter)</p> <p style="padding-left: 40px;">-3.03 x2 (0.48 Hz, double pole high pass filter)</p> <p style="padding-left: 40px;">-666.67 (106 Hz, single pole low pass filter)</p> <p>V3: 2.23E+02 +/- 2.95E+02; 3.76E-01; 0</p>
Zeros (estimate, radians/ second)	<p>V5+: 0, 0, 0</p> <p>V3: -1.96E+02 +/- 1.55E+02; 2.65 +/- 6.83E-01</p>
Sensitivity (estimate)	<p>V5+: 3.60E+08 counts/ meter/ second +/- 10% precision</p> <p>V3: 3.53E+08 counts/ meter/ second +/- 10% precision</p>

Clip Level (estimate)	<p>+/- 8,388,608 counts (24-bits)</p> <p>V5+/ V3: 24 mm/s peak-to-peak from 0.1 to 10 Hz</p>
Minimum Detection Threshold (estimate)	<p>V5+: 0.03 $\mu\text{m/s}$ RMS from 1 to 20 Hz @ 100 sps</p> <p>V3: 0.06 $\mu\text{m/s}$ 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>
Digitizer Dynamic range	<p>24-bit ADC Sigma-Delta $\Sigma\Delta$</p> <p>144 dB (24 bits)</p>
Effective bits (estimate)	<p>V5+: 21 bits (124 dB) from 1 to 20 Hz @ 100 sps (for the entire analog to digital hardware chain).</p> <p>V3: 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"; "RMS to RMS noise"; or "noise free bits".</p>

Velocity Channel Instrument Response:



Sleeman Self-noise:



Software

Software installed on Raspberry Shake's RPi computer
100% SeisComP compatible Also: AQMS, Antelope, Earthworm, Hydra, ObsPy, SEISAN, ...
Native SeedLink Server (source: GEOFON) with Raspberry Shake's 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 (Linux)

Communications

Parameter	Value
Digital bandwidth consumption at 100 Hz, per channel	Average: 820 bytes/ second 71 megabytes/ day Max: 1420 bytes/ second 123 megabytes/ day
TCP/IP compatible	
Compatible with Ethernet, Cell, GPRS, Satellite modems, StarLink. The supported standard for the IP67 LAN connector is 100 Mbit/s (4-wired LAN cable).	

Power

Parameter	Value
Power Supply Voltage	5.1 Volts DC (2.5+ Amp Supply)
Power Consumption (RPi + Raspberry Shake, estimated)	Startup: 5 Volts x 0.550 A = 2.8 Watts Run-time: 5 Volts x 0.320 A = 1.6 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).