

Sigma 4+



Sigma 4+ is a miniature 4-channel version of the [DAQlink4](#) seismic station. Excellent metrological characteristics, continuous recording capability, high-frequency ADC, built-in or external GNSS receiver, remote access, optional built-in battery and 3C geophone, work with external low-frequency receivers, plug-in anemometer and much, much more, make this station the best choice for the widest range of tasks.

The VSP with the [GStreamer-E](#) 3C probe or the [WellStreamer](#) hydrophone streamer

The Sigma 4+ is the optimal seismic station for different methods of VSP, both for seismic waves velocity estimation along the borehole and for dynamic section plotting. Four recording channels allow performing observations with a 3C probe or a 3-channel hydrophone streamer and a reference geophone receiver, which provides the possibility of accuracy evaluation and correction of source-seismic station synchronization error.

Parallel CST according to ASTM D4428 / D4428M

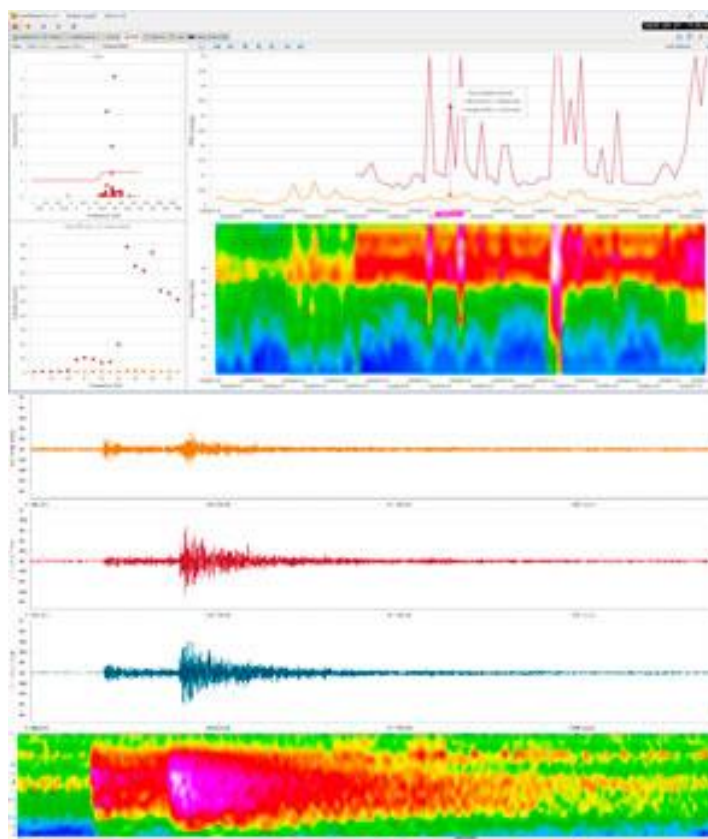
The method allows to reconstruct the velocity profile of P-waves and S-waves of rocks in situ with horizontal direction of waves propagation along the layer, i.e. without taking into account the velocity anisotropy related to thin layering (macroanisotropy) or geological formations consisting of small elements of two different substances (microanisotropy). Observations are performed in two parallel boreholes with a distance of 3 to 6 m between them. Generation of pressure (P) and shear (S) waves is executed using a borehole sparker [Pulse](#) and electrodynamic sources [SHock](#) and [GeoSV](#). Signal receiving is provided by the [GStreamer-E](#) 3C probe and the [WellStreamer](#) hydrophone array. A description of CST technology can be found in ASTM D4428 / D4428M or in our [publications](#).

Pile Length Testing, Base plate and Tunnel lining quality inspection

With its high-frequency ADC, the Sigma 4+ is perfect for almost any geotechnical task. For pile length testing (Pile Integrity Testing) and inspection of the footings (impact method), special high-frequency sensors GTSensor are connected to the station. On foundation slabs, it is more convenient to use 4-channel [LandStreamer](#) towed seismic sensors as a receiver. The data can be processed in the [GeoTechControl](#) software.

Monitoring of microseisms, earthquakes, explosions, hydraulic fracturing and any other events

The station allows continuous long-term data recording to built-in and external data storage devices with hot swapping capability without data loss. Timing is provided by a built-in or external GNSS receiver, a wired or wireless synchronization link between stations or by the station's internal high-stability clock. The Sigma 4+ can be optionally equipped with a built-in or external 2 Hz 3C seismic receiver, an internal battery and a detachable external low-frequency geophone. The station case is equipped with a bubble level and has the possibility of screwing pins directly into its base. The Sigma 4+ is a perfect solution to perform any type of seismic monitoring, thanks to its dedicated software, multiple networking options, remote configuration and data download, continuous or auto-start recording based on a trigger signal or LTA (Long Term Average)/STA (Short Term Average) events with email notification capability.



Passive MASW and the Nakamura method

The task of recording surface waves from stochastic or industrial sources as well as recording microseisms for subsequent calculation of H/V spectral ratios is successfully performed by the Sigma 4+ seismic station with an integrated or external mid-frequency (2 Hz) 3C sensor, connected external geophones (from 4.5 Hz) and low-frequency seismometers, accelerometers or torsional transducers.

Seismic survey in mines or dense urban building

It is not always possible to realize synchronization between the source and the seismic station. It can be extremely problematic or impossible to deploy a wired synchronization line between the mines or from the tunnel to the surface while testing, and using a radio channel in these cases is simply not feasible. Seismic surveys in the city often impose similar restrictions. [DAQlink4](#) and Sigma 4+ seismic stations can keep long-term records on the built-in and external storage with time reference from the GNSS signal and an autonomous high-stability clock. One seismic station can be connected to the receiving array and the other to the source for shooting log formation - this allows performing synchronization in post-processing, i.e. to slice standard seismograms from the data array.

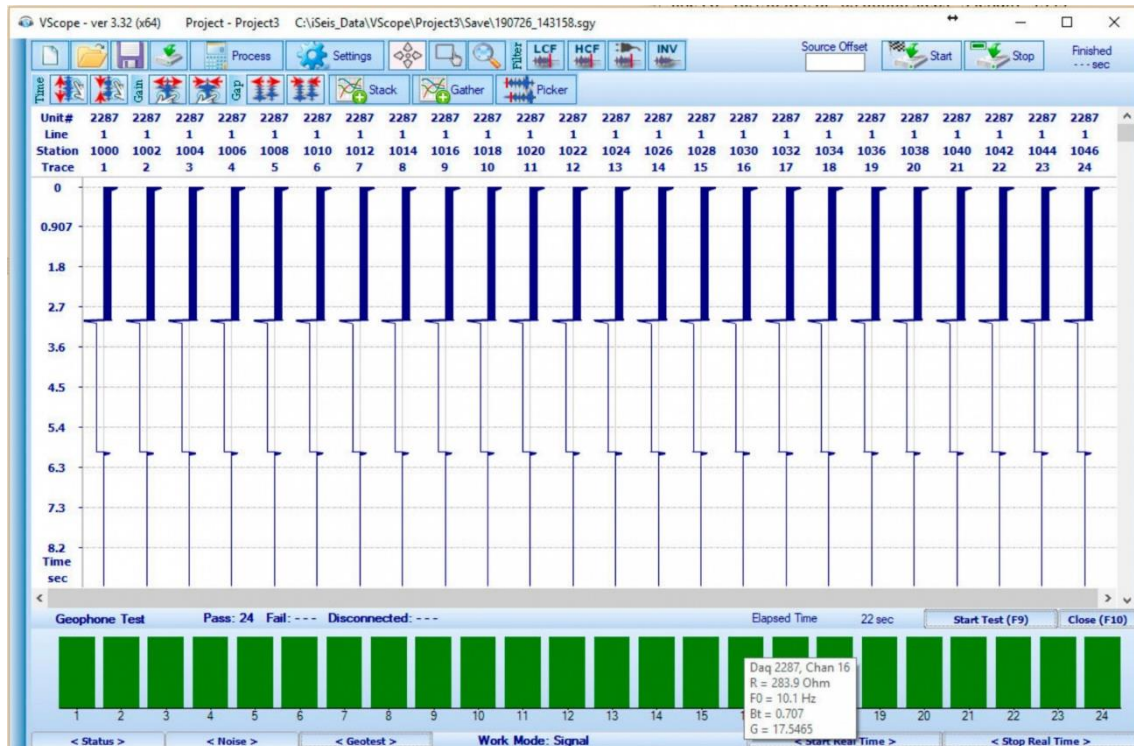
High Resolution Marine Seismic

The fast and reliable Sigma 4+ and [DAQlink4](#) high-frequency seismic stations are excellent for 2D or 3D high-resolution marine seismic acquisition with the [HRStreamer-1](#) towed streamer with a unique adjustable hydrophone array or the advanced 48-channel [HRStreamer-48](#). A more complete description of the capabilities of the stations, towed water sources, and other necessary equipment can be found in a [dedicated section](#). We also provide high-resolution marine data processing services.

Highlights of Sigma 4+ and DAQlink4 seismic stations:

- Possibility to combine seismic stations in a single array using twisted pair (length up to 3 km), Ethernet, Wi-Fi or GSM modems
- Any recording duration up to continuous recording
- Wide bandwidth of the recorded signal: 0 to 20,000 Hz
- Capability of remote control, setup, recording and data downloading via Wi-Fi, Gigabit Ethernet or cellular connection. Built-in FTP server
- Geophone test: frequency, impedance, attenuation and other features
- VHF / UHF radio or twisted pair wired synchronization (up to 3km) for use in mines
- Continuous logging with GNSS time synchronization
- Built-in 99.9 Wh battery

- Multiple triggering options: source sensor trigger, LTA (Long Term Average) and STA (Short Term Average) event, TTL pulse, and more. Even email notification is possible if an expected LTA or STA event is detected



- Register data from any type of source. Supports Force 3 controllers
- Built-in 16 GB memory for independent data recording and flash drive connection for data backup and transfer
- Built-in tools for seismic station test (distortion factor, mutual interference between the channels, common mode rejection, inherent noise level) and geophones test (impedance, frequency, attenuation, sensitivity)
- Data can be saved in the formats SEG-2, SEG-D, SEG-Y, ASCII or MiniSEED

Delivery set:

- Sigma 4+ seismic station
- Cable set
- Software

Additional options and peripheral accessories:

- 2 Hz 3C built-in or external low-frequency receiver
- Low-frequency seismometers, accelerometers and torsional transducers
- Wi-Fi option
- Mesh Radio Network module

- GSM modem
- High-frequency sensor GTSensor
- LandStreamer 4-channel array
- Pile Length Testing kit
- External USB data storage device
- Built-in or external GNSS receiver
- Built-in rechargeable battery (99.9 Wh)
- Solar panel
- Anemometer
- Marine and downhole seismic acquisition equipment

Software for Sigma 4+:

- Event monitor and Tremor cloud for microseismic surveys, seismic monitoring, earthquake recording, hydraulic fracture and injection monitoring
- Vscope and Bgr to collect data from different types of seismic sources
- DataCollection for data acquisition with track visualization
- Visualiser for data visualization and conversion to other formats
- Earthquake Locator for locating the epicenter
- Harvest for stacking

Specification:

Number of channels in one station	4 ch.
ADC capacity	24, Σ - Δ bits
Dynamic range	127 dB (@ 500 Hz)
Preamplifier gain	$\times 1$ (0 dB), $\times 4$ (12 dB), $\times 16$ (24 dB)
Sample rate	125; 250; 500; 1000; 2000; 4000; 8000; 16000; 32000; 64000 Hz
Maximum record length	unlimited
Frequency range	0 ÷ 20 000 Hz
Anti-aliasing filter	80% of Nyquist frequency
High Pass Filter	0.001 ÷ 120 Hz, digital
Filter type	linear-phase
Trigger accuracy	± 1 (@ 500 Hz) μ s
Maximum input signal with minimum gain	± 3 V
The level of inherent noise of the registering channel	< 0.15 μ V (@ 500 Hz)
Non-linear distortion coefficient	0.0001 % (@ 500 Hz)
Mutual interference between channels	125 dB

Common mode suppression factor	100 dB (@ 500 Hz)
Power consumption	0.4 W/channel
Input impedance	100 kOhm
Time synchronization	GNSS receiver or VHF
Data storage capacity (16 Gb CF internal memory)	720 hours (4 channels @ 500 Hz, 16 Gb)
Maximum capacity of external USB flash drive	up to 2TB
Hot swap external USB drive without data loss	yes
Data format	SEG-2, SEG-D, SEG-Y, ASCII, MiniSEED, SEEDlink
LEDs	2 LEDs for displaying battery status and operating mode
Power	10 – 28 V DC
Temperature range	-40 ÷ +80 °C
Operating humidity	0 ÷ 100 %
Dimensions	360×150×75 mm
Weight without additional extensions	1.5 kg
Possibility of optional installation of devices and sensors	<ul style="list-style-type: none"> - GNSS receiver - 2 Hz 3C geophone - rechargeable battery 99.9Wh - single-board computer with Linux for real-time data processing, acquisition or transmission via radio channel (Linux option) - solar panel
External devices connectivity	external USB storage device, radio access point, Wi-Fi module, GSM modem, GNSS receiver, anemometer
Connectors	<ul style="list-style-type: none"> - 26 pins for geophones, ADC calibration and built-in sensors - 4 pins for external GNSS receiver - 10 pins for Ethernet connection - 3 pins external power supply - 19 pins for external USB drive or trigger line <p>Optional:</p> <ul style="list-style-type: none"> - USB for cloud storage connection (Linux option)