

# hDVS Distributed Acoustic Sensing System

Seismic surveys and in-well flow profiling enabled by efficient vibration data acquisition using fiber-optic logging cables or installed fibers

## APPLICATIONS

- Checkshots for seismic calibration
- Vertical seismic profile (VSP) imaging
- Time-lapse seismic monitoring
- Microseismic monitoring
- Injection or production evaluation
- Leak detection
- Flow behind tubing and crossflow diagnosis
- Cement evaluation
- Gas lift optimization

The heterodyne distributed vibration sensing (hDVS) system brings new high-performance capabilities to distributed acoustic sensing (DAS) for efficiently conducting borehole seismic and flow profiling applications. The hDVS DAS system's optical interrogator unit at surface is connected to any optical-fiber cable deployed in a well, from hybrid wireline logging cable to fiber attached to production tubing or optical fiber permanently cemented behind casing. The interrogator unit measures the Rayleigh backscattered light to provide a local measurement of the dynamic strain, which is converted into seismic waveforms or vibration logs.

Because the hDVS DAS system makes every logging run or fiber installation an opportunity for seismic data acquisition, it significantly improves the efficiency of borehole seismic operations while lowering the cost. No longer is time required for rigging up and down and dedicated-run deployment of conventional borehole seismic tools because the system is simply connected to the fiber at surface and records seismic data in conjunction with other stationary logging services or on its own. A full well profile is recorded for each shot in only minutes, rather than hours for a conventional tool survey. The full-aperture measurements acquired are suitable for checkshots for seismic calibration or time-lapse imaging over the life of the field.

For well completion or in older wells, the hDVS DAS measurement along the entire well at high spatial resolution delivers a game-changing efficient evaluation of stimulation and production enhancement and well integrity diagnostics. The system provides fluid movement visualization and detection: into or out of reservoir; evaluation of flow behind pipe, crossflow, and tubing leaks; flow pattern recognition; stimulation fluid monitoring (acid and scale inhibitor); fracture monitoring; and gas lift optimization.



Interrogator unit of the hDVS DAS system.

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## Measurement Specifications

	<b>hDVS DAS</b>
Output	Full-aperture seismic waveforms or vibration logs
Source	Laser Class 1 certified IEC/EN 60825-1:2014 Electromagnetic Compatibility Directive 2004/108/EC Low Voltage Directive 2006/95/EC
Logging speed	Speed of light [ $3 \times 10^8$ m/s]
Measurement parameters	Native measurement type: Strain Operating principle: Coherent phase measurement Operating wavelength: 1,550 nm Range: 10 km <sup>†</sup> Output spatial interval: 2, 5, and 10 m Gauge length: 5, 10, 20, 30, and 40 m Output time interval: 0.1, 0.25 0.5, 1, and 2 ms Low-frequency limit: 5 Hz <sup>†</sup>
Mud type or weight limitations	None
Combinability	Fully combinable with any optical-fiber cable, including hybrid wireline logging cable, fiber-installed production tubing, and fiber permanently cemented behind casing Fiber type: Preferred single mode, with multimode compatibility evaluated for the application
Special applications	Real-time stacking and correlation of seismic shot data for wellsite QC with interfacing to common source controllers Real-time output of frequency band energy (FBE) logs for immediate flow profiling evaluation in the Techlog* wellbore software platform and Petrel* E&P software platform Data exchange architecture to output acquired data in numerous industry standard and proprietary formats, including SEG Y, LDF, WITSML™, and PRODML™ Data mirroring support to both primary and secondary external mirror devices

<sup>†</sup> Typical value, depending on application and conditions

## Mechanical Specifications

	<b>hDVS DAS</b>
Temperature rating	Operating: 0 to 45 degC Storage: -20 to 70 degC
Dimensions	Server rack: 955 mm (L) × 574 mm (W) × 333 mm (D) Instrument rack: 955 mm (L) × 559 mm (W) × 244 mm (D)
Power	Maximum: 600 W Typical: 400 W
Weight	Server rack: 60 kg Instrument rack: 30 kg
Supply voltage	110 or 230 V

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