

DSI Dipole Shear Sonic Imager

APPLICATIONS

- Geophysics
 - Velocity calibration, time/depth conversion
 - Synthetic seismograms
 - Amplitude variation with offset (AVO) calibration
 - Shear seismic interpretation
- Anisotropy
- Petrophysics
 - Porosity estimation (also in cased hole)
 - Lithology and clay identification
 - Gas identification
- Stoneley wave measurement
 - Fracture evaluation
 - Permeability (mobility)
- Geomechanics
 - Pore pressure
 - Wellbore stability
 - Hydrofracture design
 - Sand strength
- Sonic imaging
- Sonic imaging with borehole acoustic reflection survey (BARS)
 - Very long spacing tool (using spacers)
 - Reflection analysis
 - Highly dipping beds
 - Horizontal wells (apparent dip > 45°)
 - Well placement with respect to cap rock

The DSI* dipole shear sonic imager combines monopole and dipole sonic acquisition capabilities. The transmitter section contains a piezoelectric monopole transmitter and two electrodynamic dipole transmitters perpendicular to each other. An electric pulse at sonic frequencies is applied to the monopole transmitter to excite compressional- and shear-wave propagation in the formation. For Stoneley wave acquisition a specific low-frequency pulse is used. The dipole transmitters are also driven at low frequency to excite the flexural wave around the borehole.

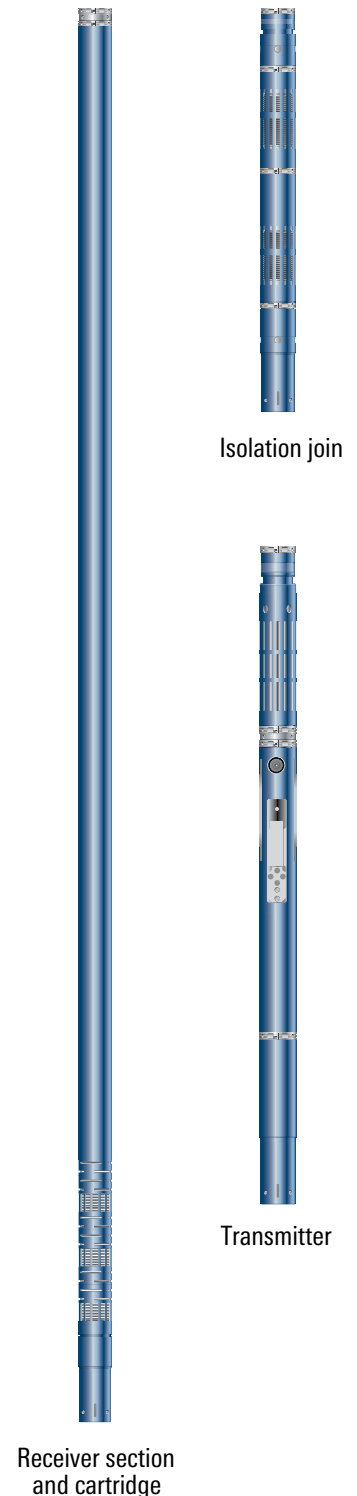
The imager is made up of three sections—acquisition cartridge, receiver section, and transmitter section. An isolation joint is placed between the transmitter and receiver sections to prevent direct flexural wave transmission through the tool body.

The receiver section has an array of eight receiver stations spaced 6 in. [15.24 cm] apart and 9 ft [2.74 m] from the monopole transmitter, 11 ft [3.35 m] from the upper dipole transmitter, and 11.5 ft [3.50 m] from the lower dipole transmitter. Each receiver station consists of two pairs of wideband piezoelectric hydrophones aligned with the dipole transmitters. Summing the signals recorded by one pair of hydrophones provides the monopole waveform, whereas differentiating them cancels the monopole signal and provides the dipole waveform. When a dipole transmitter is fired, the hydrophone pair diagonally in line with the transmitter is used. Four sets of eight waveforms can be acquired from the four basic operating modes fired in sequence.

A special dipole mode enables recording both the inline and crossline (perpendicular) waveforms for each dipole mode. This mode, called both cross receivers (BCR), is used for anisotropy evaluation.

The optional S-DSI modification to the DSI imager uses a special slow sleeve to extend the slowness measurement to 1,200 us/ft [3,937 us/m] from the standard 700 us/ft [2,296 us/m].

As part of the suite of ABC* analysis behind casing services, the DSI imager can also provide a measurement of slowness behind the casing by using recently developed acquisition strategies and BestDT* automated sonic waveform processing.



Receiver section and cartridge

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Measurement Specifications

	DSI Imager
Output	Compressional and shear Δt , waveforms, Variable Density* waveforms
Logging speed [†]	Max.: 3,600 ft/h [1,097 m/h]
Range of measurement	Standard shear slowness: 700 us/ft [2,297 us/m] S-DSI max. slowness: 1,200 us/ft [3,937 us/m]
Vertical resolution	3.5-ft [1.07-m] processing resolution for 6-in [15.24-cm] sampling rate
Accuracy	Δt : 2 us/ft [6.56 us/m]
Depth of investigation	9 in [22.86 cm]
Mud type or weight limitations	None
Combinability	Fully combinable with other tools

[†] Actual acquisition speed depends on the number of acquisition modes used and the data sampling rate.

Measurement Specifications

	DSI Imager
Temperature rating	350 degF [177 degC]
Pressure rating	20,000 psi [138 MPa]
Borehole size—min.	4 $\frac{3}{4}$ in [12.07 cm]
Borehole size—max.	21 in [53.34 cm]
Outer diameter	3.625 in [9.21 cm]
Length	51 ft [15.54 m] (including isolation joint)
Weight	900 lbm [408 kg]
Tension	5,000 lbf [22,240 N] S-DSI: 3,500 lbf [15,570 N]
Compression	1,550 lbf [6,890 N] S-DSI: 1,000 lbf [4,450 N]

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