



ODiSI 6000 Series

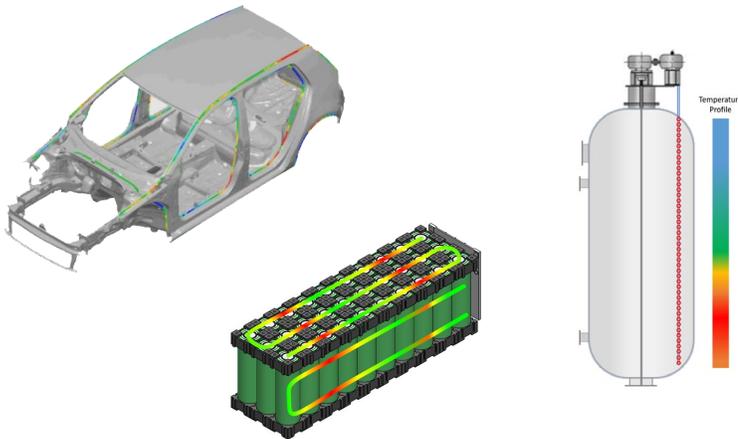
Optical Distributed Sensor Interrogators



The ODiSI 6000 Series is an innovative measurement system specifically designed to address the test challenges of 21st century advanced materials and systems.

The ODiSI 6000 Series provides thousands of strain or temperature measurements per meter of a single high-definition fiber sensor. The ultra-high resolution data can fully map the contour of strain for a structure under test or the continuous temperature profile of a process in real time.

The sensor is flexible, low profile, requires no electrical source and can be bonded to sharply curved surfaces, embedded within structures or mounted directly to electrical surfaces.



Instrumenting an automotive frame, battery pack or distillation column with high-definition strain or temperature sensors yields comprehensive data and increased insight for model verification, testing and monitoring.

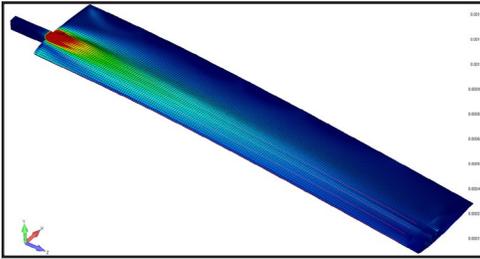
Acquire thousands of strain or temperature measurements per meter of optical fiber.

KEY FEATURES

- **High-definition distributed sensing** — thousands of measurements with sub-millimeter gage pitch
- **Real-time multichannel system** with each channel supporting up to 100 m of high-def sensing fiber
- **Flexible, lightweight** and easy-to-install sensors reduce time to first measurement
- **Passive, corrosion resistant, dielectric sensors go where other sensors can't** — in bends, corners, embedded inside materials
- **Long sensor life** — no drift or recalibration, cycle counts $>10^7$

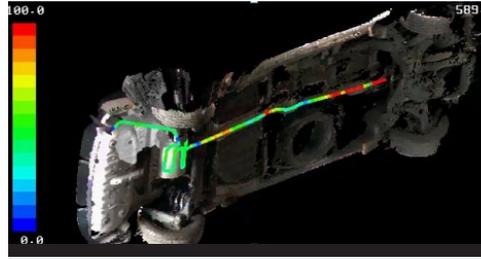
APPLICATIONS

- Characterize strain in new materials and complex structures
- Profile temperature in-situ to maximize the efficiency of critical processes
- Measure two- and three-dimensional strain fields to validate FE models
- Evaluate multi-material joining
- Detect small cracks and defects in critical structures
- Embed sensors within materials to create “smart parts”



Transform Structural Testing

ODiSI is ideal for strain measurements on and in composite materials, including materials characterization, FE model verification and full scale test.



Accelerate Design

With continuous, high resolution mapping of strain and temperature, "hot spots" and large strain gradients are easily identified, located and accurately characterized.



Ensure Quality

With no "line of sight" issues and the ability to bond to curved and difficult-to-gage locations, ODiSI sensors go where no other sensors can and deliver more comprehensive data.

HIGH-DEFINITION DISTRIBUTED FIBER OPTIC SENS-

The ODiSI system captures strain and temperature data with unmatched spatial resolution and precision, delivering valuable benefits for measurement and control applications:

- Capture details not available with conventional point sensors or other fiber optic sensing technologies
- Real-time data from demanding environments and difficult-to-instrument locations

HD Rayleigh Sensors for Maximum Spatial Resolution

High-definition (HD) fiber optic sensors are distributed sensors based on the naturally-occurring Rayleigh backscatter in optical fiber, delivering maximum spatial resolution for static and quasi-static applications. HD strain sensors, constructed with polyimide-coated fiber with a diameter of 155 µm, are NIST-traceable calibrated, deliver a gage pitch down to 0.65 mm and are available in lengths from 1 m to 100 m.

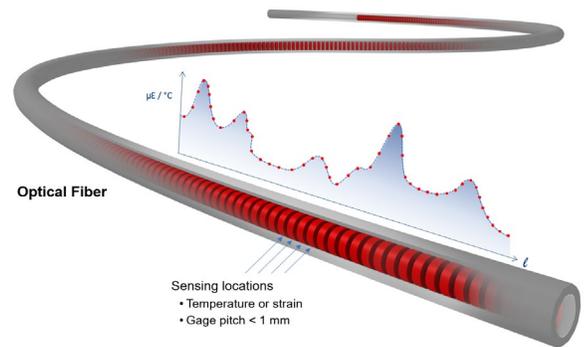
HD sensors are supplied with calibrated scaling coefficients and a reference key for easy plug-and-play operation with the ODiSI system. Measurement gage pitch (spacing) and location are completely software-configurable.

HD-SC Strain Compensated Temperature Sensors

HD-SC temperature sensors utilize an advanced interrogation mode of the ODiSI to increase the accuracy of measurements when the sensors are subjected to strain, such as in embedded and surface-mount installations.

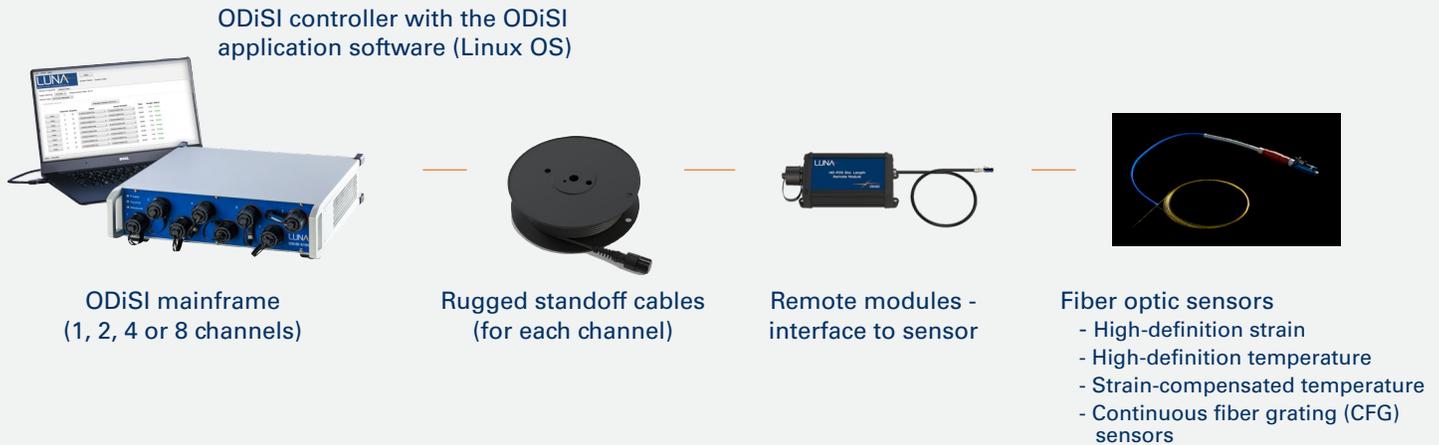
Continuous Fiber Grating (CFG) Sensors

CFG sensors utilize fiber with fiber Bragg gratings (FBG) continuously inscribed along the fiber. When used with the ODiSI, CFG sensors exhibit an increased tolerance to vibration and improved dynamic performance.



| | High-Definition (HD) Sensors - Strain & Temperature | Continuous Fiber Grating (CFG) Sensors | Strain-Compensated (HD-SC) Temperature Sensors |
|-----------------------------|--|---|---|
| Application feature | Maximum spatial resolution, maximum sensor length | Increased dynamic performance | Temperature sensing with embedded or mounted sensors |
| Sensor gage pitch | 0.65 mm, 1.3 mm, 2.6 mm and 5.2 mm | 6 mm | 1.04 cm |
| Sensor lengths | 1 to 100 m | 1 to 15 m | 1 to 5 m |
| Measurement rate | Up to 250 Hz | Up to 62.5 Hz | 2.5 Hz |
| Remote module compatibility | Standard & Extended Range | Standard | Extended Range |

ODiSI SYSTEM



ODiSI SYSTEM CONFIGURATIONS

The ODiSI system comes configured with 1, 2, 4 or 8 channels able to measure standard Rayleigh HD sensors or CFG sensors. In standard mode, with Standard Remote Modules, each channel supports an HD-FOS sensor up to 20 m in length, or a CFG sensor up to 15 m in length. When used with the optional Extended Range Remote Modules, each channel can support sensors up to 100 m in length, as well as HD-SC strain-compensated temperature sensors.

The ODiSI 610x models can be configured to measure strain or temperature with a gage pitch (spacing of adjacent gage centerpoints) of 0.65 mm, 1.3 mm, 2.6 mm or 5.2 mm. The ODiSI 600x models support a gage pitch of 5.2 mm. Both ODiSI systems also support a proprietary strain-compensated temperature measurement that optimizes accuracy and reliability when monitoring temperature in surface-mounted and embedded applications.

The ODiSI system is a complete data acquisition solution with many features for logging data, visualizing data and integrating data with external systems.

| Measurement Mode | | Model | |
|---|----------------|---------------------------------|--------------|
| | | ODiSI 610x | ODiSI 600x |
| Number of Channels | | 1, 2, 4 or 8 | 1, 2, 4 or 8 |
| High-Definition (HD) Strain & Temperature Sensors | Compatibility | √ | √ |
| | Gage Pitches | 0.65 mm, 1.3 mm, 2.6 mm, 5.2 mm | 5.2 mm |
| | Max Meas. Rate | 250 Hz | 30 Hz |
| Strain-Compensated Temperature Sensors (requires Extended Range Remote Modules) | | √ | √ |
| Continuous Fiber Grating (CFG) Sensors | | √ | √ |

Easy-to-Use Software

- Quickly identify and configure sensors
- View real-time data, plotted versus length or time
- Log measurement data to disk
- Replay saved data

Real-Time Streaming Data and Visualization

- Real-time remote access to ODiSI system and measured data via thin client software
- View and stream measurements in real time to a file or via TCP-IP to another computer
- Optional software for 3D and 2D visualization of data (real-time or file playback)

Reliability and Traceability

- Continuous optical alignment and calibration with every scan, requiring no user intervention
- Strain sensors calibrated with NIST-traceable fixtures
- Optional strain-compensation mode for more accurate temperature measurements
- Compatibility with continuous fiber grating (CFG) sensors for improved dynamic performance

Ease of Integration

- IEEE 1588 PTP network time synchronization
- JSON-based digital streaming data format
- Sync output TTL pulse
- Start and stop triggering functions

ODiSI APPLICATION SOFTWARE

The ODiSI system includes easy-to-use software to configure the system and to acquire, visualize and log measurement data.

- Automatic plug-and-play sensor identification
- Quickly identify and configure modes, timing, triggering and data logging
- Interactive touch-to-locate tool for identifying locations of key gages
- Save, replay and export measurement data files
- Real-time streaming of data over Ethernet



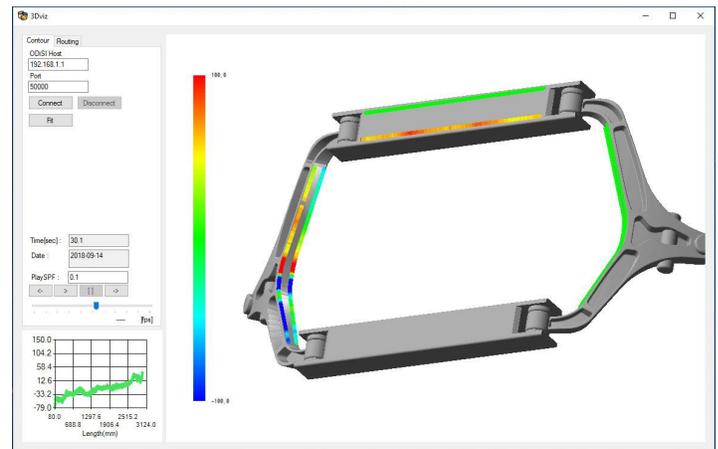
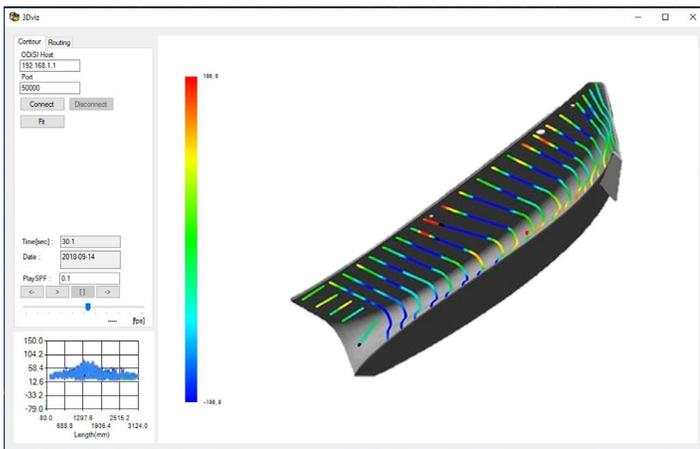
Multichannel sensor plot (strain/temperature versus length) in the ODiSI software.

Additionally, the ODiSI Remote software allows the control and viewing of real-time data from a remote, networked ODiSI system. The ODiSI Remote Software can perform basic control (start, stop, etc.), display live real-time streaming data or replay previously saved measurement data. The ODiSI Remote software is available for Windows OS and Linux OS.

3DViz - 2D AND 3D VISUALIZATION SOFTWARE

The ODiSI 3DViz software enables strain or temperature data to be visualized in three dimensions directly on a CAD model or in two dimensions on a standard photo or 2D image. Simply load an .stl or graphics file of the test article, map the sensor routing onto the model or image, and then view color-coded temperature or strain data directly on the image or 3D model.

Data can be loaded from a previously acquired ODiSI data file or streamed in real-time from an ODiSI system that is connected to the network. The visualization software can create videos of the evolution of strain and temperature over time to provide greater insight into designs. Refer to the 3DViz data sheet for more details.



The ODiSI 2D and 3D Visualization Software displays real-time data, as well as previously recorded data on 2D images or 3D models, which can be manipulated and moved to visualize different perspectives.

PERFORMANCE

| Parameter | | Specification | | | | | |
|---|----------------|--|---------|---------|---------|--------------------------|---------|
| Number of channels | | 1, 2, 4 or 8 channels | | | | | |
| Maximum sensor length per channel | Standard mode | 20 m | | | | | |
| | Extended range | 100 m ¹ | | | | | |
| Standoff cable length ² | | 10, 50, 100, 150 or 200 m | | | | | |
| Maximum patch cord length ³ | | Up to 19 m (depending on sensor length) | | | | | |
| High-Definition (HD) and Continuous Fiber Grating (CFG) Modes | | | | | | | |
| | | High Definition (Rayleigh) Sensors | | | | CFG Sensors ⁴ | |
| Gage pitch ⁵ | | 0.65 mm | 1.3 mm | 2.6 mm | 5.2 mm | 6 mm | |
| Gages (measurement locations) per meter of sensor | | 1,538 | 768 | 384 | 192 | 166 | |
| ODiSI System Compatibility | ODiSI 610x | √ | √ | √ | √ | - | √ |
| | ODiSI 600x | - | - | - | - | √ | √ |
| Measurement rates for (Rates are aggregate; divide by number of active channels to determine the per-channel rate) | 2.5 m mode | 62.5 Hz | 125 Hz | 250 Hz | 250 Hz | 30 Hz | 62.5 Hz |
| | 5 m mode | 40 Hz | 80 Hz | 160 Hz | 160 Hz | 20 Hz | 40 Hz |
| | 10 m mode | 25 Hz | 50 Hz | 100 Hz | 100 Hz | 12.5 Hz | 25 Hz |
| | 20 m mode | 12.5 Hz | 25 Hz | 50 Hz | 50 Hz | 6.3 Hz | 12.5 Hz |
| | 50 m mode | - | 10 Hz | 20 Hz | 20 Hz | 2.5 Hz | - |
| | 100 m mode | - | - | 10 Hz | 10 Hz | 1 Hz | - |
| Strain measurement range | | ±15,000 µε | | | | | |
| Resolution | | 0.1 µε | | | | | |
| Instrument accuracy | | ±1 µε | | | | | |
| System (instrument and sensor) accuracy ⁶ | | ±25 µε | ±30 µε | ±30 µε | ±30 µε | ±30 µε | ±30 µε |
| Measurement uncertainty ⁷ | | ±5 µε | ±4 µε | ±2 µε | ±2 µε | ±2 µε | ±5 µε |
| Dynamic loading rate | | 1 Hz | 2.5 Hz | 5 Hz | 5 Hz | 5 Hz | tbd |
| Temperature measurement range ⁸ | | -40 to 200 °C (with standard Luna sensors) | | | | | |
| Temperature measurement resolution | | 0.1 °C | | | | | |
| Temperature measurement uncertainty ⁷ | | ±2.2 °C | ±1.6 °C | ±0.6 °C | ±0.6 °C | ±0.6 °C | ±1.0 °C |
| Strain-Compensated Temperature Mode⁹ | | | | | | | |
| Gage pitch ⁵ | | 1.04 cm | | | | | |
| Measurement rate (all lengths) | | 2.5 Hz | | | | | |
| Resolution | | 0.1 °C | | | | | |
| Measurement uncertainty ⁷ | | ±0.9 °C | | | | | |
| Strain compensation | | Over an applied strain range of 0 to 1800 µε, measurement accuracy is ± 2.8 °C ¹⁰ | | | | | |

NOTES

- Sensor lengths longer than 20 m, as well as HD-SC strain-compensated sensors, require optional Extended Range Remote Modules.
- Standoff cables connect the ODiSI mainframe to the remote modules and sensors, and are available in standard lengths of 10, 50 and 100 m. Additionally, two cables can be combined to form standoff lengths of 150 and 200 m.
- A patch cord can be used to connect the remote module's tether to the sensor. For each channel, the total length of the patch cord plus the active sensor fiber must not exceed 20 m for Standard length mode or 100 m for Extended Range mode.
- Continuous fiber grating (CFG) mode requires Luna CFG sensors. Accuracy and uncertainty specifications for CFG sensors are preliminary.
- Gage pitch is the distance between centerpoints of consecutive gages.
- Accuracy reflects ODiSI measurements compared to NIST-traceable extensometer measurements. Data based on average of 150 measurements at each of seven increments of strain, from 0 to maximum strain. System accuracy includes errors from ODiSI instrument and Luna strain sensors.
- Measurement uncertainty at zero and across the full strain range. Uncertainty is equal to twice the standard deviation calculated from a set of 1000 measurements. Measurement uncertainty includes the effects of the ODiSI interrogator and Luna sensors.
- Temperature measurement range with standard temperature sensors (HD6T and HD6SCT). Wider range is available with other sensor fiber.
- Strain-compensated temperature mode requires Luna HD-SC temperature sensors and Extended Range Remote Modules.
- RMS error with the HD-SC sensor subjected axial strain over the range of 0 to 1800 µε. Also includes effects of the ODiSI interrogator.

| Parameter | Specification |
|--|------------------|
| Environmental and Physical | |
| Class 1 laser | <10 mW |
| Operating temperature range — mainframe and controller | 5 to 40 °C |
| Operating temperature range — standoff cable and remote module | 5 to 60 °C |
| Storage temperature range | 0 to 40 °C |
| Operating and storage relative humidity (non-condensing) | 10 to 90 % RH |
| Operating altitude | -15 to 3,000 m |
| Dimensions — mainframe (W x D x H) | 34 x 35 x 11 cm |
| Dimensions — laptop controller (W x D x H) | 36 x 24 x 1.7 cm |
| Weight (mainframe and controller) | 17 lb (7.8 kg) |
| Power (mainframe and controller) | 160 W |

Certifications



ODiSI ORDERING

| Catalog # | Description | Includes |
|-------------------|---|--|
| ODiSI 610x | ODiSI 6101/2/4/8 Distributed Sensing Instrument | System for maximum speed and resolution (gage pitch down to 0.65 mm). Includes mainframe with 1, 2, 4 or 8 channels, instrument controller laptop and ODiSI application software. Also includes one standoff cable and standard length remote module for each channel. |
| ODiSI 600x | ODiSI 6001/2/4/8 Distributed Sensing Instrument | System with standard gage pitch of 5.2 mm. Includes system with 1, 2, 4 or 8 channels, instrument controller laptop and ODiSI application software. Also includes one standoff cable and standard length remote module for each channel. |
| OP06150 | Extended Range Remote Module | Remote module supporting extended sensor lengths of 50 m and 100 m, in addition to standard sensor lengths and strain-compensated temperature (HD-SC) sensors. |
| OPT06100-R | Rack Mount Controller Option | Rack mount (1U) instrument controller (substituted for laptop). |
| OPT06020 | USB-3106 Analog Output | 16-channel analog output module for ODiSI (voltage or current outputs). |
| OPT06125 | 3Dviz - 3D/2D Visualization Software | Visualization software for mapping real-time or saved ODiSI data onto 3D models and 2D images. Compatible with Windows OS. |
| OPT06123 | 3Dviz - 2D Visualization Software | Visualization software for mapping real-time or saved ODiSI data onto 2D images. Compatible with Windows OS. |

SENSOR ORDERING

| Catalog # | Description |
|-----------------------|--|
| HD6SXXLC300P | HD strain sensor, LC2+ connector, polyimide coating, 300 °C, length = XX m (1 to 100 m) |
| HD6TXXLC220P | HD temperature sensors with PTFE sleeving, length = XX m (1 to 5 m) |
| HD6SCTXXLC220P | HD strain-compensated temperature sensors with PTFE sleeving, 200 °C, length = XX m (1 to 5 m) |
| HDCFGXXXLCP | HD continuous fiber grating (CFG) sensors, length = XXX m (1 to 15 m) |
| FOSAPPKIT | Fiber Optic Sensor Application Kit Materials (epoxy, tools, etc.) required to install 10 m of sensing fiber |



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