Complete
Instrumentation Solutions

Newsletter

Structural Health Monitoring

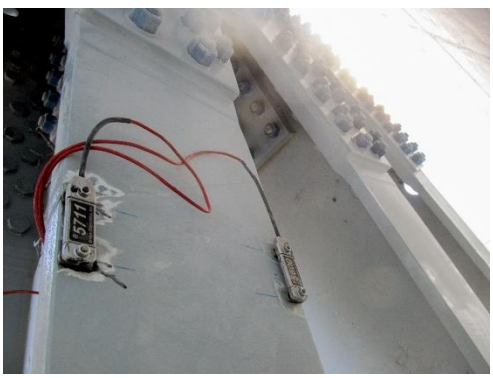
Newsletter on Structural Health Monitoring

- Structural Health Monitoring Sensors
- IoT Sensors for Health Monitoring
- Mobile Bridge Inspection Unit



These Structural Health Monitoring (SHM) devices have proven successful for road and railway bridges. Additionally, they are effective for other structures like foundations and hydraulic structures such as dams. A broad range of parameters can be monitored, including strain, vibration, and load distribution. Strain transducers, accelerometers, and vibrating wire load cells provide precise measurements crucial for live-load testing, dynamic structural analysis, and load monitoring. These technologies collectively ensure comprehensive, accurate evaluations of structural health, empowering engineers to maintain infrastructure safety and integrity effectively.

The integration of Internet of Things (IoT) devices has further revolutionized SHM. Advanced data acquisition systems and solar-mount telemetry loggers facilitate seamless, real-time monitoring. Wireless systems and intuitive software interfaces streamline data collection and analysis, enhancing operational efficiency. IoT devices enable continuous monitoring, transmitting data via satellite or cellular networks, and support diverse environmental and geotechnical sensors.



Structural Health Monitoring Sensors

STS4

The new STS4 from BDI is the world's only data acquisition system that has been designed by structural engineers for structural testing. This next-generation wireless system is rugged, highly efficient, and now supports long-term monitoring applications. Once you see how much time this system saves you in the field, you won't use anything else!

The STS4 is smaller, lighter, and will make your testing operation even more efficient:

- No programming required—Our STS-LIVE software is very easy to use!
- STS4 Base Stations have wireless repeater capabilities, increased range, and POE support.
- Hardware and software can now support long-term monitoring projects.
- Efficient power saving modes for longer battery life.
- Increased sensor voltage input ranges and programmable excitation voltages.
- Auto-temperature compensation support for sensors with thermistors.
- Compatible with existing STS-Wi-Fi hardware and WinSTS Software.
- STS4 Extension Nodes: Communication and power for up to 16 data channels at a much lower cost than a full STS4 system.

STS4-4 nodes

The STS4-4 nodes are 4-Channel data acquisition devices with 4 analog and 4 temperature inputs per node.

They are the 4th generation design based on our experiences over 25 years of structural testing and data acquisition designed specifically with our experience in mind.

Battery-powered and water-resistant with 40/15 hours of data collection time make these rugged nodes ideal for all diagnostic testing applications. Intelliducer connectors simplify the installation by automatically applying all sensors settings and can be used with the full range of BDI sensors, in addition to most analog sensor types.

Structural Health Monitoring Sensors

ST350 Strain Transducer

Features

- Cost-effective
- Installs in 5 minutes or less
- Reusable, lasts for >10 years
- Waterproof to 20ft (6 m)
- Industrial cable, custom lengths
- Standard millivolt output
- N.I.S.T traceable calibration

Applications

- Steel
- Pre-stress/post-tension concrete
- Reinforced concrete
- Timber
- Fiber Reinforced Polymer (FRP)
- Live-Load testing & monitoring
- Laboratory testing
- Fatigue monitoring
- Tension rod forces

ST350 Strain Transducer

The ST350 Strain Transducer has been designed for structural testing in tough field conditions. These accurate, rugged, and fully weatherproofed units can be installed very quickly for all types of measurement applications.

Tiltmeter

The T500 electrolytic tilt sensor is a high precision sensor with integrated mechanical offset adjustment, designed for short-term testing applications. The T600 MEMS tilt sensors are ideal for longer term installations due to their temperature stability.

Accelerometers

The A1521 & A2521 Accelerometers have been designed for dynamic structural testing in tough field conditions. These accurate, rugged, and fully-weatherproofed units can be installed very quickly and are available in ranges between 2g and 100g.

Strain Gage Completion Modules

Available in both 120Ω and 350Ω configurations, as well as standard or amplified outputs, these rugged and re-usable Strain Gage Completion Modules significantly reduces field installation time since only the lead wires from either a ¼-arm or ½-bridge foil gages are connected to a waterproof connector.

Structural Health Monitoring Sensors

Features

Displacement Sensor

- 6 to 18 Vdc input range
- Stainless steel construction
- Spring return armature
- High cycle life
- High accuracy
- < 0.0001” resolution

Automatic Load Position Tracker

- Rugged machined aluminum enclosure
- Weatherproof
- Quadrature encoder, providing <1% accuracy
- 900Mhz & 2.4GHz radios
- >1-mile range
- Universal mounting bracket

Displacement Sensor

In addition to LVDTs, our selection includes cable potentiometers, resistive displacement transducers, and ultrasonic displacement sensors, catering to a diverse range of applications and environments. This comprehensive array of options ensures that our customers have the flexibility to choose the most suitable technology for their specific structural deflection monitoring requirements, whether it's for precise measurements in controlled settings or rugged conditions where reliability is paramount.

Automatic Load Position Tracker

Crafted with precision, this innovative device seamlessly integrates wireless technology to monitor the longitudinal position of the loading vehicle throughout the test. By capturing data in relation to load position rather than just time, engineers gain invaluable insights into the structural behavior under varying loads, enhancing the accuracy and depth of their analyses. This enables a more nuanced understanding bridge responses to different stress levels, facilitating informed decisions for repairs, and structural enhancements.

Structural Health Monitoring Sensors

Features

Temperature Sensor

- Robust for hostile environments
- Responds quickly to temperature variations
- PVC housing immune to degradation from most chemicals
- Surface mount models attach quickly with BDI Mounting Tabs or screws
- High temperature stainless steel versions available

VW Load Cells

- **Rated Capacities:** 100 to 10,000 kN
- **Over Range:** 150% F.S.
- **Resolution:** 0.025% F.S.
- **Accuracy:** ±0.5% F.S.
- **Temperature Range**: 20°C to +80°C
- **Internal Diameters:** 25, 50, 75, 100, 125, 150, 200, 250 mm

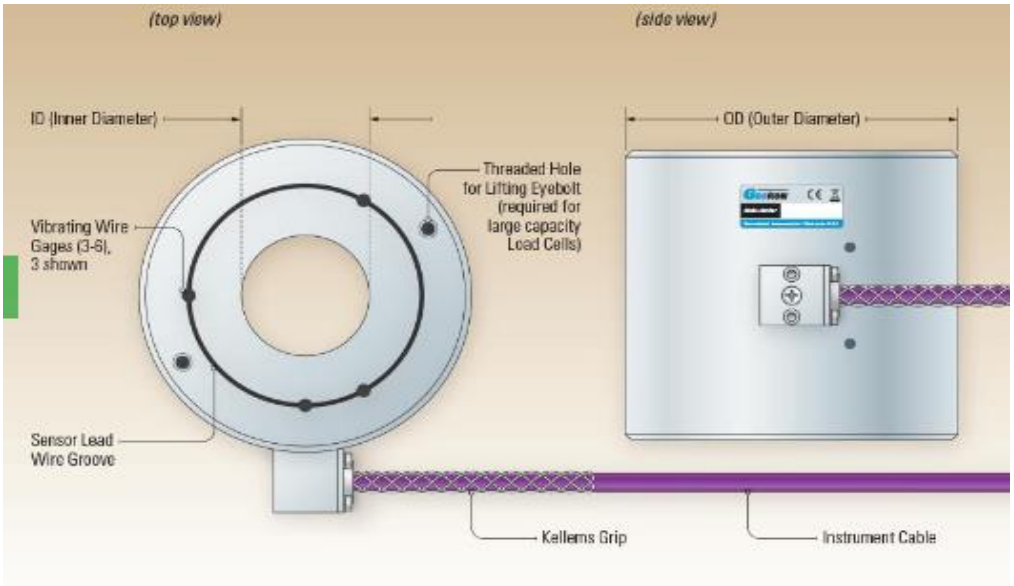
Temperature Sensor

The BDI Thermistor Probes are supplied inside a housing at the end of a cable ready to be attached to a structure, or buried in concrete or in the ground. Thermistor Probes are particularly well suited for measuring the heat of hydration in concrete and RCC dams.

Thermistors have a negative temperature coefficient (NTC) where their resistance decreases with increasing temperature. The NTC can be as large as several percent per degree C, which allows the thermistor to detect minute changes in temperature. Thermistors are very small, which means they will respond quickly to temperature changes.

VW Load Cells

The Model 4900 Vibrating Wire Load Cell consists of a cylinder of high-strength steel with 3, 4 or 6 vibrating wire strain gages located around the circumference of the cell. Loads applied to the cell are measured by the vibrating wire strain gages. The effects of uneven and eccentric loading are minimized by averaging the output of all 3, 4 or 6 individual readings.



Structural Health Monitoring Sensors

Features
STS-LIVE Software

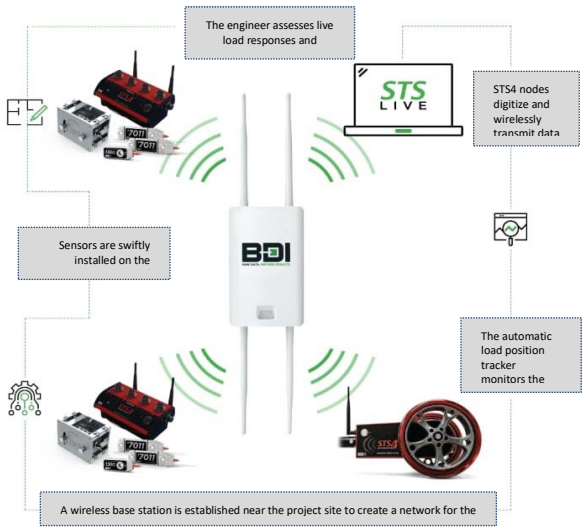
- Configure STS4 hardware seamlessly.
- Choose real-time viewing options.
- Utilize real-time filtering.
- Customize test lengths with programmable rates.
- Fine-tune excitation voltages and sensor gain.
- Streamline setup with automatic or manual zeroing.
- Benefit from automatic temperature compensation.

STS-VIEW Software

- Import raw data files, merge for analysis, and reduce file size using decimation.
- Apply gage/correction factors to specified sensors or entire data files for processing.
- Utilize filtering to remove spikes and noise, with graphical comparison.
- Compute average responses from sensors for axial force determination.
- Compare data with WinSAC and Strand7 responses for model accuracy.

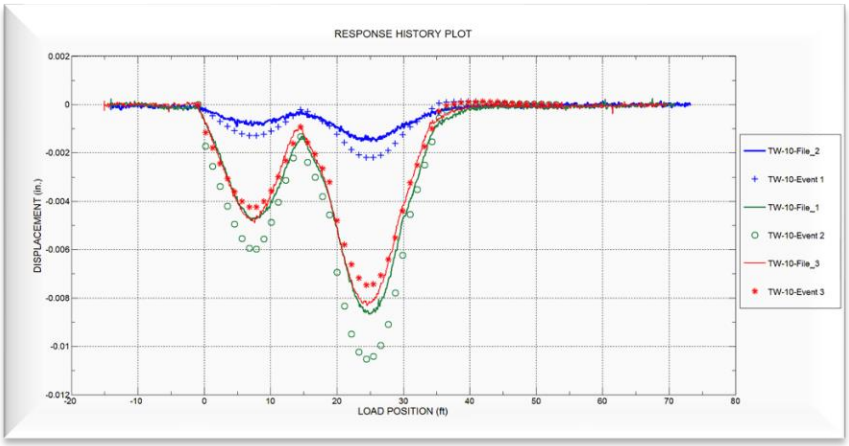
STS-LIVE Software

Harnessing the enhanced capabilities of our latest STS4 data acquisition hardware, we proudly introduce the STS-LIVE application, meticulously crafted to offer unparalleled versatility while upholding the user-friendly interface of our acclaimed WinSTS program. As our existing STS users can attest, our systems eliminate the need for any programming hassles! With the seamless integration of Intelliducer nodes, data collection begins within seconds of hardware connection. Furthermore, configuring terminal nodes is a breeze with intuitive drop-down menus, ensuring swift setup and effortless operation for all users.



STS-VIEW Software

STS-VIEW is a user-interactive graphing application specifically designed for viewing data obtained from our STS4 data acquisition systems. Rather than spending endless hours formulating and checking spreadsheets, STS-VIEW allows the engineer to quickly interpret the responses with many easy-to-use features. For example, the user can view data as a function of time, load position, load event, or even as a function of one of the recorded sensor measurements.



IoT Sensors for Health Monitoring

Features
Vibrating Wire Telemetry

- Supports satellite (Iridium) and CatM1 LTE communication.
- Works with all Vibrating Wire Sensors in dual, 4, and 8-channel options.
- Offers rechargeable or long-life battery options with ultra-low power draw.
- Configurable via Bluetooth app and remotely over Iridium.
- Rugged for harsh environments, with automatic cloud upload and storage for 260,000 events.

Telemetry Tilt Meter

- World's first satellite-enabled wireless tilt meter (Iridium and 4GLTE).
- Accurate triaxial MEMS tilt sensor with ultra-low power lithium batteries.
- Configurable via Bluetooth app and remotely over Iridium.
- Compact and rugged design (45mm x 110mm x 180mm).
- Stores up to 260,000 events, with automatic cloud upload.

Vibrating Wire Telemetry

The EWS VWT (Vibrating Wire Telemetry) is a versatile IoT device designed for remote geotechnical and structural monitoring. It supports single, 4-channel, or 8-channel configurations, making it suitable for both individual and grouped instrument sites. Compatible with a variety of Vibrating Wire sensors, including strain gauges and crack meters, it ensures reliable data transmission via 4GLTE or satellite connectivity. The device is compact, robust, and easy to install, ideal for harsh environments. Its plug-and-play setup and scalable nature facilitate quick deployments and large monitoring projects, with each device transmitting data independently to eliminate the risk of single-point failures. The EWS VWT is particularly effective for tailings dam monitoring and both new and retrofit instrumentation projects.

Telemetry Tilt Meter

The EWS Telemetry Tilt Meter combines advanced EWS wireless IoT technology with a precise triaxial tilt sensor for remote geotechnical and structural monitoring. Each device logs and transmits tilt data independently via 4GLTE or satellite, avoiding single-point failures and enabling deployment in remote locations. The device is compact, easy to install with a plug-and-play setup, and designed for harsh environments. It requires no additional communication infrastructure and supports remote configuration changes. Ideal for remote slope stability, slip detection, rail, and structural monitoring, it is straightforward and scalable for quick deployments and large monitoring campaigns.

IoT Sensors for Health Monitoring

Features
EWS Switch

- Offers Satellite (Iridium) or 4G LTE communication.
- Reads various sensor protocols and has relay output.
- Features rechargeable or non-rechargeable battery options, with solar input.
- Configurable via Bluetooth app and remotely over Iridium.
- Compact, rugged design with automatic cloud upload and storage for up to 260,000 events.

Solar-Mount Telemetry Logger

- Sends data via Iridium Satellite or 4GLTE.
- Reads various sensor types.
- Low power with solar panel backup.
- Bluetooth for local app connection and remote settings.
- Compact design with automatic data upload to Orion portal. Web portal, and UV protected housing.

EWS Switch

The EWS Switch is a compact, multi-communication IoT device for remote environmental monitoring, capable of switching between satellite and 4G LTE communications. It connects to all standard sensors, making it versatile for various applications. Its ease of use allows for quick field installations, reducing costs and risks. The rugged device is ideal for harsh environments. It features a plug-and-play setup, is scalable for large deployments, and is suitable for both new and retrofit projects, offering programmable capabilities for complex monitoring tasks.

Solar-Mount Telemetry Logger

The EWS Solar-Mount Telemetry Logger is a cost-effective, compact, and self-contained device featuring a 3-watt solar panel and external panel mount plugs for monitoring various environmental applications. Pre-programmed for simple plug-and-play installation, it connects to most standard environmental and geotechnical sensors. This rugged logger is designed for harsh environments and ideal for both new and retrofit projects requiring long-term, unattended data collection. Its discreet design eliminates the need for bulky cabinets or external batteries, making it easy to install and relocate.

IoT Sensors for Health Monitoring

Features

- Multi-communication options via Iridium Satellite or 4GLTE/NBIoT.
- Reads various sensors including SDI12, Modbus485, 4-20mA, Pulse, and Vibrating Wire.
- Ultra-low power consumption with internal battery backup and a clip-on 3-watt solar panel.
- Bluetooth embedded for local app connection and programming, with remote settings changes via Iridium.
- Compact form factor (175 x 110 x 60mm) with UV protected housing and easy on-site sensor connection.

EWS-EMT

The EWS – EMT (Environmental Monitoring Telemetry), part of our Switch Data Logger family, is a compact, cost-effective, and self-contained datalogger and transmitter with multi-communication options, including Iridium Satellite and 4G LTE/NBIoT. It supports SDI-12, Modbus485, 4-20mA, Pulse, and Vibrating Wire Sensors. With ultra-low power draw and an internal battery backup, it features a 3-watt solar panel attachment for long-term unattended monitoring. Embedded Bluetooth enables local app connection and programming, while two-way communications allow remote setting adjustments. Measuring just 175 x 110 x 60mm, it offers four physical inputs supporting up to 60 channels, panel mount plugs for easy sensor connections, automatic data uploads to the Orion web portal, and UV-protected housing. Other than monitoring structures, this device is also ideal for applications like surface water monitoring, flood warning, weather tracking, and geotechnical assessments, it is perfect for new and retrofit projects due to its quick installation and relocation capabilities.

Platform-type Mobile Bridge Inspection Unit

Features

- **Large Working Range:** Covers 12-21m horizontally for varied bridge sizes.
- **Lightweight Construction:** Ensures safety while staying within weight limits.
- **Multiple Safety Features:** Equipped with safety/limit switches for secure deployment.
- **Versatile Repair Access:** 1.1m wide platforms with power outlets for repair work.
- **Flexible Control Options:** Manual, remote, and control panel operation.

The Platform-type Mobile Bridge Inspection Unit (MBIU) stands as a pivotal solution in ensuring the safety and maintenance of bridges and viaducts. This vehicle offers efficient, and cost-effective means of access, particularly in scenarios where traditional scaffolding installation proves impractical or economically unfeasible. It stands to its true mobility, eliminating the need for additional hydraulic feet during deployment, thereby streamlining the setup process. Within a mere 10 minutes, the MBIU can be fully operational, boasting platform lengths ranging from 15- 26 meters. It enables bridge inspectors and engineers to navigate beneath the structure swiftly and safely, transporting both personnel and non-destructive testing (NDT) equipment as needed. Equipped with features such as an "Assistant Ladder," it facilitates seamless personnel access between girder intradoses, enhancing overall efficiency during inspections and repair tasks. With its robust bearing capacity, the MBIU ensures uninterrupted operation, making it an ideal solution for expedited bridge maintenance endeavors.

The unit is available in the following working ranges:
(distances are measured in-meter, loads are measured in-kg)

MODELS	CIS-PT-15	CIS-PT-18	CIS-PT-20	CIS-PT-22	CIS-PT-24	CIS-PT-26
WORKING RANGE	15	18	20	22	24	26
OVERCOMING OF SIDEWALK	2.8	2.8	3	3	3	3.5
OVERCOMING OF SOUND BARRIER	4.4	4.4	4.6	4.6	4.6	5.2
DEPTH UNDER THE BRIDGE	8	8	8	8.5	8.5	9
PLATFORM WIDTH	1	1	1	1.05	1.05	1.05
TOTAL RATED LOAD	800	800	800	800	800	800
UNIT WIDTH	2.8	2.8	2.8	2.8	3	3
TOTAL WEIGHT	26500	26500	28000	28000	28000	2800




Bucket-type Mobile Bridge Inspection Unit

Features

- **Wide Working Range:** full series of models, 16~22m horizontal working range.
- **Lightweight:** Ensures the overall weight is within the permissible limits & structural safety.
- **Multiple safety protection:** The unit is equipped with safety/limit switches, which ensures the vehicle operation more assured.
- The **bucket always remains in a horizontal position** by use of actuators and sensors.

The Mobile Bridge Inspection Unit serves as a specialized solution, providing secure, efficient, and cost-effective access to bridges and viaducts where conventional scaffolding methods are impractical or economically unviable. Exceptionally mobile, it does away with the need for extra hydraulic support during setup, allowing for rapid deployment within a brief 10-minute window. Offering boom lengths ranging from 16 to 22 meters, it accommodates diverse bridge structures, facilitating various inspection and maintenance operations. Fitted with an articulated boom and basket, it enables thorough examination and light upkeep tasks on bridges and viaducts. Its articulated-boom configuration, combined with a bucket at the tip, emphasizes agility, maneuverability, and safe usage. Whether accessing positions atop the bridge, beneath it, or at bridge piers, this unit ensures swift and secure transportation of personnel, NDT equipment, and maintenance gear, guaranteeing comprehensive coverage for inspection and minor repair duties on road bridges.

The unit is available in the following working ranges:
(distances are measured in-meter, loads are measured in-kg)

MODELS	CIS-PT-16	CIS-PT-18	CIS-PT-20	CIS-PT-22
WORKING RANGE	16	18	20	22
OVERCOMING OF SIDEWALK	3.5	3.5	3.8	3.5
OVERCOMING OF SOUND BARRIER	3.8	3.8	4	3.8
DEPTH UNDER THE BRIDGE	17	19	21	23
PLATFORM WIDTH	16	18	20	22
TOTAL RATED LOAD	280	280	280	280
UNIT WIDTH	3	3	3	3
TOTAL WEIGHT	25000	26500	28000	28000

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