

N4385A / N4386A Distributed Temperature System (DTS)

Enabling fast, reliable and cost-effective sensing
through highly integrated optical measurement systems



Distributed Temperature Sensing

- Oil & Gas downhole performance monitoring
- Pipeline leakage detection
- Power cable monitoring
- Fire detection

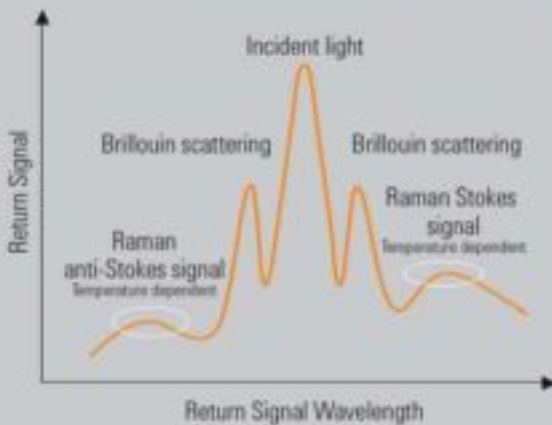
Advantages of fiber based distributed temperature sensing over electrical probes

We have tested the DTS unit in a special hazard application and are very impressed and has rigorously designed the quality into the product. The level of integration and unique optical assembly technology ensures repeatable, accurate measurements and easy deployment.

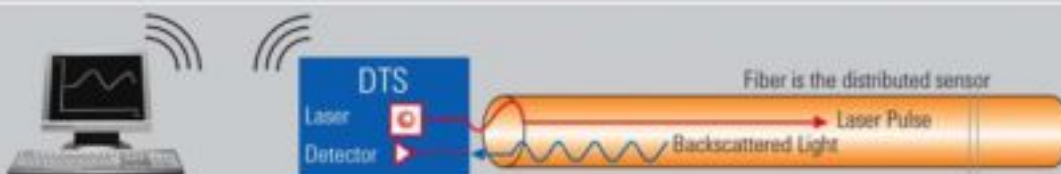


If you strive for increased productivity or safety in a variety of application areas, you can gain insight into your processes by using an optical fiber as a sensing element. The fiber is the only sensing solution that leaves no area unmonitored and is intrinsically safe (EMI).

DTS utilizes the Raman effect to measure temperature. An optical laser pulse propagating through the fiber gets scattered light back to the transmitting end, where it is analyzed. The intensity of the Raman scattering is a measure for the temperature along the fiber. The position of the temperature reading is determined by measuring the arrival timing of the returning light pulse similar to a radar echo.



- Worry-free permanent monitoring
- Reduced cost of operation
- Increased efficiency





Reservoir performance monitoring

Today's Oil & Gas reservoir management requires real time, continuous downhole monitoring to optimize the economic and operational performance of the assets (intelligent well). Through real-time understanding of the production and injection dynamics, the reservoir engineer is able to optimize production and maximize recovery, helping to improve profit.

Analysis of DTS data and geothermal gradient gives deep insight into the well behavior allowing the determination of flow volume and changes per sections.

This next-generation DTS technology provides economical solutions even for low-producing wells. This allows to enable the move from retrievable temperature measurement services to permanent installations.

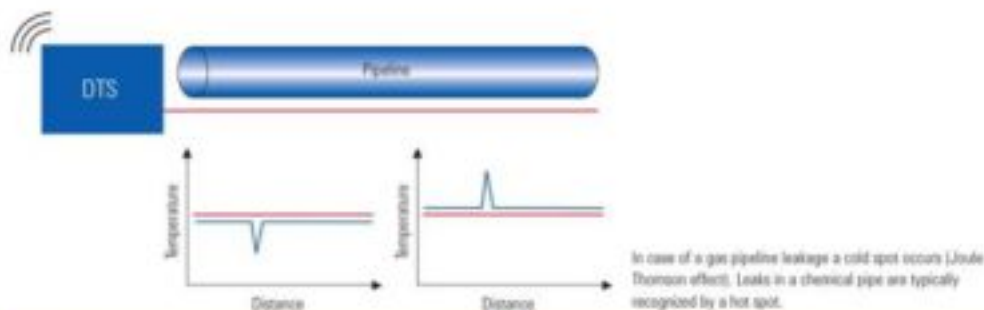
Features	Benefits
Outdoor housing (IP66 /~ NEMA 4)	Cost effective deployment, no extra cooling or buildings required
Operating temp. range of -10° to 60°C (14° to 140°F)	Withstands rain, dust, heat, shock and vibration
Ultra low power consumption (~ 15 W)	Suitable for solar panel operation
	Cost effective power source
Real-time measurement with high temperature and spatial resolution (up to 0.01 K; 1 m)	Sensitive well analysis over long periods
Extremely high measurement repeatability for indoor and outdoor environments.	Detecting water breakthroughs and reservoir trends more effectively than intervention-based monitoring
Integrated switch and autonomous scheduling functionality	Multiple well monitoring
Standard interfaces, integrated trace memory	Very cost effective network solution and easy integration
Industry-leading quality and long life-time	Reduces cost of service and support

Pipeline leakage detection



- Liquefied Natural Gas (LNG)
- Natural gas
- Hydrocarbon gas
- Sulphur
- Steam
- Refinery
- Umbilicals

Modern pipeline management needs to assure pipeline integrity, immediate leakage detection and risk mitigation. The DTS provides the capability to monitor the entire downstream process at once, identifies and localizes leakages even in hazardous processes. The continuous sensor element (fiber) leaves no area unmonitored, for the maximum level of coverage.



Features	Benefits
Real-time leakage detection, high temperature and spatial measurement resolution (0.01 K; 1 m) Extremely high measurement repeatability	Reliable detection of smallest leakages Identification of changes in the process environment, resulting in process optimizations, increased production and process efficiency Protects employee safety, reduces downtime and minimizes loss
Outdoor housing (IP66 /~ NEMA 4) Operating temp. range of -10° to 60°C (14° to 140°F)	Cost effective deployment no extra cooling or buildings required
Ultra low power consumption	Solar panel operation suitable Cost effective power source
Integrated switch and autonomous scheduling functionality	Dual direction measurement or multiple pipeline coverage
Standard interfaces, integrated trace memory	Effective network solution and easy integration into pipeline management control systems
Industry-leading quality and life-time expectations	Reduced cost of service and support

Power cable monitoring

- Power cable tunnels
- Underground power cables
- Submarine power cables
- Substation equipment
- Overhead lines



Distributed temperature monitoring provides continuous monitoring of high power cable temperatures, detecting hot spots, delivering operational status, condition assessment and power circuit rating data. This helps operators to optimize the transmission and distribution networks, and reduce cost of operation and capital.

The sensing fiber is either embedded in the power cable, close to the conductors or deployed along the outside of the cable. It is intrinsically immune to electromagnetic interference and provides reliable temperature measurements, ideal for use in a high voltage environment.

Features	Benefits
The operator can define alarm conditions, structure the cable into zones and set corresponding actions	Monitoring of the alarm conditions protects power cable investment, by insuring "in limit" operation, avoiding unplanned network failures and assisting in contingency planning
Real-time data, high temperature and spatial measurement resolution (0.01 K; 1 m) High measurement repeatability	Insight into utilization level, for example, resulting in deferment of capital expenditure or even higher utilization Hotspot detection, localization and display on the connected PC for optimization and confirmation of cable design and installation
Optical fiber	EMI proof, no electrical or moving parts, easy deployment to existing and new assets
Integrated switch and autonomous scheduling functionality	Multiple power cable coverage
Standard interfaces	Easy system integration into power cable control systems The online-generated data can also be integrated into a real-time thermal rating system or database
Industry-leading quality and long life-time	Reduces cost of service and support

Fire detection

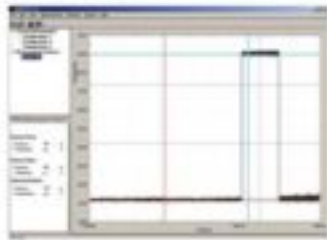
- Tunnels
- Mining
- Cable Trays/Bundles
- Conveyer belts
- Warehouses

Safety systems demand highly reliable and extremely quick heat detection. Especially in hazardous environments, solutions need to be immune from interference or false alarms. They also have to continue monitoring irrespective of the enormous heat generated and the rapid spread of smoke.

Fiber-based linear heat detection is especially suitable for fire detection as it leaves no area unmonitored and displays the real-time temperature development and heat transport of the entire area at once. It can even automatically actuate the protective systems in the affected zones.

Features	Benefits
Fast, accurate and reliable fire detection Industry-leading quality and life-time	Highest security and lowest downtime. Reduced number of deceptive alarms, even in hazardous environments, as well as reduced service and support costs
Freely definable alarm conditions (maximum, rises or variations from normal temperature) Structuring of the cable into zones Integrated relay board	Precise and selective activation of fire distinguishing systems, addressing only the effected area
Fiber / Cable: - very robust, resistant to moisture, corrosion, other environmental influences, immune to electrical interference - maintenance-free	Easy deployment also in cable routes, underground conveyer belts and storage facilities Reduced cost periodic sensor tests and maintenance
Easy system integration and standard interfaces allow online visualization of fire and heat detection	Valuable information to emergency services indicating how best to deal with any situation. Instruments can also be accessed simultaneously from different locations.
Autonomous system with integrated permanent system health check	Worry-free monitoring

N4385A DTS Indoor Series N4386A DTS Outdoor Series



Our superior DTS Series targets people like you: reservoir engineers, pipeline operators, high voltage power cable experts and fire detection system installers. We listened to your application-driven requirements, challenges, and your observations with existing DTS solutions. We applied your experiences and requirements to create two innovative complementary sensing solutions.

The **DTS architecture** uses a proprietary code correlation technique, which drives high temperature resolution by meeting the **1M Laser Class** requirements and avoiding the severe Laser Safety implications for each installer and operator that apply to 3B instruments.

The heart of both DTS series is based on a **highly integrated optical building block, hermetically sealed** and filled with inert gas, enabling extended operating conditions and preventing condensation on the sensitive optical components.

Long-term measurement stability is powered by an innovative single receiver design, eliminating tracking issues.

The integrated temperature reference design and the temperature stabilized opto-electronics ensure **insensitivity to changing operating conditions**, superior repeatability over the entire operating temperature range.

The **outdoor series** is designed for **rough environment** (IP66 / ~NEMA 4), withstanding rain, dust, heat, shock and vibration. The ultra low power consumption of both series enables **solar panel** powering.

An incorporated switch with a flexible scheduling functionality, trace memory and inside alarm analysis support autonomous sensing and a cost effective e.g. wireless network solution.

Using **industry standards** for the fiber, computing and programming interface ensures easy integration into existing solutions and infrastructure.

The PC software is **easy to handle** and intuitive. In a few minutes the user is in a position to perform the first measurements and does not require days of training. The visualization software features set up and calibration, alarm parameterization, tracking and real-time temperature trace display.

Performance characteristics (preliminary)

Temperature resolution (1 sigma)

at 1.5 meter spatial:

km/h	20 sec	1 min	10 min
8 km	3,55 K	2,05 K	0,65 K
6 km	1,61 K	0,93 K	0,29 K
4 km	0,82 K	0,47 K	0,15 K
2 km	0,46 K	0,27 K	0,08 K

at 3 meters spatial:

km/h	20 sec	1 min	10 min
8 km	1,50 K	0,87 K	0,27 K
6 km	0,74 K	0,43 K	0,14 K
4 km	0,41 K	0,24 K	0,08 K
2 km	0,25 K	0,14 K	0,04 K

Sampling resolution: 0.5 m

Spatial resolution: 1 m

Repeatability over operating temp: ± 0.5 K

Measurement temp range: -250 to 400°C

/ 418 to 752°F (dependent on sensor)

Operating temp: -10 to 60°C / 14 to 140°F

Storage temp: -40 to 80°C / -40 to 176°F

Humidity: 0 to 95% r.h.

Supply voltage: 10 to 30V DC

Power: 15 W at room temperature

Number of sensor channels: 1, 2 or 4

Laser Class: 1M