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

Dr. Grosswig, CEO GESO

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 enables the move from retrievable temperature measurement services to permanent installations.

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

In case of a gas pipeline leakage a cold spot occurs (Joule Thomson effect). Leaks in a chemical pipe are typically recognized by a hot spot.

**Features**

- Real-time leakage detection, high temperature and spatial measurement resolution (0.01 K, 1 m)
- Extremely high measurement repeatability
- Outdoor housing (IP66 /~ NEMA 4)
- Operating temp. range of -10° to 60°C (14° to 140°F)
- Ultra low power consumption
- Integrated switch and autonomous scheduling functionality
- Standard interfaces, integrated trace memory
- Industry-leading quality and life-time expectations

**Benefits**

- 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
- Cost effective deployment no extra cooling or buildings required
- Solar panel operation suitable
- Cost effective power source
- Dual direction measurement or multiple pipeline coverage
- Effective network solution and easy integration into pipeline management control systems
- Reduced cost of service and support
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.

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<td>The operator can define alarm conditions, structure the cable into zones and set corresponding actions</td>
<td>Monitoring of the alarm conditions protects power cable investment, by insuring “in limit” operation, avoiding unplanned network failures and assisting in contingency planning</td>
</tr>
<tr>
<td>Real-time data, high temperature and spatial measurement resolution (0.01 K; 1 m) High measurement repeatability</td>
<td>Insight into utilization level, for example, resulting in deferment of capital expenditure or even higher utilization</td>
</tr>
<tr>
<td>Optical fiber</td>
<td>EMI proof, no electrical or moving parts, easy deployment to existing and new assets</td>
</tr>
<tr>
<td>Integrated switch and autonomous scheduling functionality</td>
<td>Multiple power cable coverage</td>
</tr>
<tr>
<td>Standard interfaces</td>
<td>Easy system integration into power cable control systems</td>
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<td>Industry-leading quality and long life-time</td>
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- Power cable tunnels
- Underground power cables
- Submarine power cables
- Substation equipment
- Overhead lines
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.

### Features
- Fast, accurate and reliable fire detection
- Industry-leading quality and life-time
- Freely definable alarm conditions (maximum, rises or variations from normal temperature)
- Structuring of the cable into zones
- Integrated relay board
- Fiber / Cable:
  - very robust, resistant to moisture, corrosion, other environmental influences, immune to electrical interference
  - maintenance-free
- Easy system integration and standard interfaces allow online visualization of fire and heat detection
- Autonomous system with integrated permanent system health check

### Benefits
- Highest security and lowest downtime. Reduced number of deceptive alarms, even in hazardous environments, as well as reduced service and support costs
- Precise and selective activation of fire distinguishing systems, addressing only the effected area
- Easy deployment also in cable routes, underground conveyor belts and storage facilities
- Reduced cost periodic sensor tests and maintenance
- Valuable information to emergency services indicating how best to deal with any situation. Instruments can also be accessed simultaneously from different locations
- Worry-free monitoring

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.
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.

Agilent’s 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:**

<table>
<thead>
<tr>
<th>km/t</th>
<th>20 sec</th>
<th>1 min</th>
<th>10 min</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 km</td>
<td>3.55 K</td>
<td>2.05 K</td>
<td>0.65 K</td>
</tr>
<tr>
<td>6 km</td>
<td>1.61 K</td>
<td>0.93 K</td>
<td>0.29 K</td>
</tr>
<tr>
<td>4 km</td>
<td>0.82 K</td>
<td>0.47 K</td>
<td>0.15 K</td>
</tr>
<tr>
<td>2 km</td>
<td>0.46 K</td>
<td>0.27 K</td>
<td>0.08 K</td>
</tr>
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</table>

**at 3 meters spatial:**

<table>
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<th>km/t</th>
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<th>1 min</th>
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</tr>
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<tbody>
<tr>
<td>8 km</td>
<td>1.50 K</td>
<td>0.87 K</td>
<td>0.27 K</td>
</tr>
<tr>
<td>6 km</td>
<td>0.74 K</td>
<td>0.43 K</td>
<td>0.14 K</td>
</tr>
<tr>
<td>4 km</td>
<td>0.41 K</td>
<td>0.24 K</td>
<td>0.08 K</td>
</tr>
<tr>
<td>2 km</td>
<td>0.25 K</td>
<td>0.14 K</td>
<td>0.04 K</td>
</tr>
</tbody>
</table>

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
Agilent Technologies is your strategic business partner for success.

The world’s premier measurement company and market leader in photonic testing. If you demand the highest form of reliability, advanced performance and reduced cost of ownership you can base your monitoring needs on our solid foundation.

With decades of global leadership in photonic testing and tens of thousands of fiber-optical instruments sold we are in a position to combine our field-proven OTDR competency with our unique assembly technique used in 24x7 manufacturing test solutions to make the most reliable DTS sensing engine with the highest level of integration. Our reputation is founded on the industry’s lowest failure rate and best application fit in photonic test.

Agilent’s global service & support organization offers a wide range of additional services and extended warranty. In addition every instrument and system we sell comes with a global warranty.

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