Dual Integrity systems use fiber optic technology to combine speed of detection, reliability, and versatility in one proven fire detection solution for tunnels.

- Fast detection from low thermal inertia sensors
- Maintenance-free robust sensor cable ensuring low through-life cost
- Sensor not affected by electromagnetic interference (EMI)
- A wide range of products to cater for all tunnel requirements
- Unique Dual Integrity technology for Class A style circuit design
- Comprehensive functionality with user programmability
- Fire progression monitoring
Dual Integrity Fire Detection

The distributed temperature sensing (DTS) technology used in Sensa’s Dual Integrity fire detection system comprises a sensor control unit and a fiber optic sensor cable that is temperature sensitive along its whole length. The control unit sends light pulses into the fiber optic cable. The system provides temperature data at thousands of points.

Advantages of fiber optic fire detection

- The sensor cable requires minimal maintenance by virtue of having no active components, which ensures a low through-life cost.
- The sensor cable can withstand temperatures beyond its specified operating range for a short time.
- The sensor cable is unaffected by smoke obscuration.
- Ease of installation.
- The sensor cable is EMI immune.

Linear heat detection technology is a well-established component of tunnel protection systems, and Sensa’s technology sets new standards.

The control unit sends light pulses into the fiber optic cable. The system provides temperature data at thousands of points. A Dual Integrity system can operate as a stand-alone detector, or can share the data with third-party systems, for example, SCADA control systems. These data can be used to influence the decisions made for external systems such as ventilation or extinguishant systems.

A range of Dual Integrity systems ensures that any tunnel length or configuration can be monitored. The systems are versatile and recognize the different communication protocols and levels of sophistication that operators and specifiers require for cost-effective fire detection solutions.

A visualization option, Data2View, is available, as well as training and maintenance contracts.
Dual Integrity – the right choice for tunnels

Dual Integrity systems use Sensa’s proprietary fiber optic DTS technology. They are ideally suited for fire detection and temperature monitoring in areas that are difficult to monitor using traditional technology. In tunnels and tunnel infrastructures, Sensa’s Dual Integrity Fire Detection Systems offer significant advantages over other systems.

Dual Integrity systems provide constant detection along the length of a tunnel, wherever the fiber is deployed, to give the temperature continuously at any point along the tunnel. Sensa’s systems are immune to EMI and are therefore unaffected by equipment such as transformers and switchgear, power cables, and leaky feeder cables in close proximity. In such environments, electrical and electronic fire detection systems may be susceptible to EMI and suffer reliability problems or failures that result in false alarms. Dual Integrity systems offer convincing alternatives to these traditional systems.

Fire detection in road tunnels

Sensa’s Dual Integrity systems offer robust and reliable fire detection in road tunnels where the fiber optic sensor can be deployed throughout the tunnel, its crossings, and its passages. Immunity to increased levels of EMI from power cables or leaky feeder cables makes Dual Integrity systems particularly suitable for use in the dirty, dusty, and/or damp environment often found in road tunnels.

Programmable alarm thresholds can be set and changed to reflect the operating conditions of a road tunnel, for example, seasonal changes in ambient temperature, or temperature changes caused by regular traffic buildup. The alarm temperatures can be changed once the pattern of temperature behavior within the tunnel is established.

Data from the Dual Integrity system are displayed via the SCADA system display.

The sensor cable monitors along its length to provide detection throughout the tunnel.
Sensa's Dual Integrity Fire Detection Systems are ideal for use in railway tunnels, which are often in remote, unmanned locations that require reliable, robust fire detection systems. In addition, immunity to EMI ensures that these systems are ideal for use on electrified lines.

Dual Integrity systems provide fast, reliable fire detection that is free from interference from train transformers and power supplies, and power cables in the tunnels. Sensa systems have been installed in underground/metro and other rail tunnels since 1999.

**Underground stations**

Sensa's Dual Integrity Fire Detection Systems can provide comprehensive fire detection throughout the large infrastructure typical of underground rail stations. Fiber optic sensors can reach the many locations where an incipient fire may take hold unnoticed, for example, in cable runs, voids behind paneling, and above ceilings in the concourse and on the platforms.

Alarm programming can accommodate the changes in temperature that result from wide variations in passenger numbers, daily temperature changes, different types of rolling stock, and differences in the volume of traffic using the station. Zone temperatures can be communicated to the SCADA system, which, in turn, can implement emergency response events.

**SCADA emergency scenarios screen:** a color representation of temperature provides the operator with visual feedback of the monitored areas.
Escalator installations

Escalators often form an integral part of the communication routes in buildings. It is, therefore, important that fire detection measures extend to the escalators themselves. Escalator fires can be caused by faulty electrical equipment or roller bearings, or hot works igniting accumulated dust and discarded materials inside the escalator. Sensa’s Dual Integrity systems are easy to install on escalators and provide reliable fire detection and continuous condition monitoring.

A typical layout for the fiber optic heat detection cable with system zoning information. In this example, the system is programmed with multiple detection zones along the length of the escalator. Areas at either end of the escalator are typically higher risk, as they are often sites for electrical equipment and are most prone to collecting discarded materials.
Tunnel control room and floor voids

Floor voids in manned and unmanned control rooms are used to carry communications and utility cables. Degradation of insulation materials through wear and tear, or vermin damage is an invisible threat that can result in an incipient fire. Fires in voids can become serious before they are detected using traditional detection techniques. Dual Integrity systems reduce the threat of an undetected fire taking hold. The system can be seamlessly linked into the site’s fire alarm panel, and Sensa’s Data2View can provide an easy-to-understand visualization of the installation for quick, accurate location of any temperature event.

Identifying the location of the seat of a fire helps in deciding on the appropriate deployment of emergency services.

The EMI-immune, low-maintenance sensor provides continuous monitoring with low through-life cost.
Utility Tunnels

Tunnels carrying power, telecommunications, data, and other services require fire detection. Dual Integrity systems are ideal in this environment; they offer reliable, intelligent fire detection and ambient temperature monitoring for tunnels and cables, and are immune to EMI. The system is easy and cost-effective to install, and, having no active components, is low maintenance, which is reflected in its low through-life cost. Dual Integrity systems provide real-time temperature and position data, thus safeguarding, and giving confidence in the reliability of, essential services.
Tunnel infrastructure protection
Dual Integrity – customized installations for all tunnel applications

Flexible system architecture
Several interface options are available to meet the differing needs of our clients:

- Alarm decisions are communicated to the main fire alarm control panel by relay contacts. This low-level interface provides a secure alarm communication path.
- Alarm, real-time temperature, and distance data are sent via a Modbus communications path. The fire alarm control panel (and network) may have a proprietary graphic command-and-control workstation that provides a single visualization for managing the entire fire detection system. This usually includes a site visualization, alarm display, and alarm management system.
- Ethernet connectivity can enable remote monitoring over a wide variety of network topologies. The data may be used to provide visualization using Sensa’s Sensor Manager or Data2View PC-based software options. Various network solutions are available, and redundant topologies are available for systems requiring the highest integrity.

There are a large number of accepted gateway solutions available to ensure effective data communication between Sensa’s Dual Integrity system and fire alarm control panels (networks). A dedicated PC can be used to display temperature traces, the asset visualization (Data2View), and other important information. The output options (including relays and Modbus), which operate concurrently, enable flexible system design.

Data2View
Dual Integrity systems have an optional visualization function, Data2View. Lifelike pictorial models are color-coded to indicate the temperature in each zone.

Sensor cable
Sensa offers application-specific cable solutions. The use of fiber optic sensing cables with low thermal mass ensures fast responsiveness to changes in the ambient temperature. Conventional technologies have restrictive temperature limitations beyond which
Fiber optic solutions are able to operate. Sensa cable solutions ensure superior response time, combined with long life, and are suitable for all tunnel environments. They have a proven track record in harsh environments where they are under continuous exposure to mechanical and chemical attack. High-temperature sensors are available to ensure the most effective fire progression monitoring.

Sensa can advise on the right combination of fast-responding sensor cable and sensor control unit to ensure the best overall system performance.

Service and support
Sensa solutions include services to ensure that the fire detection system purchased is specified, engineered, installed, and maintained to meet the safety and operational requirements stipulated for individual projects.

Project management
Given the complexity of some tunnel construction and refurbishment projects, Sensa offers project management to ensure that the system configuration is defined and agreed, and that documentation, schedules, site and other subcontractor liaison, factory acceptance tests, delivery, and installation are accomplished on time and within budget.

Training
Sensa’s training courses are ideal for pre-installation understanding of the operation and the versatility of the system, and for post-installation site-specific training. Site-specific training provides familiarization with the configurations of the systems, and includes set-up of the Data2View or data modeling options. Refresher courses are also available; these are ideal when operatives or job functions change.

Maintenance contracts
To ensure continuous reliable monitoring, Sensa recommends regular health checks, either through an on-site visit or by using dial-up diagnostics. System reviews will also be provided on demand to advise on software upgrades, refresher training or additional system options such as Data2View.
Dual Integrity – detection, location and fire development

Not only do the systems identify and locate an emerging fire quickly and reliably, they also pinpoint the temperature event and track its development. Real-time information on the spread or movement of a fire is presented either as a temperature trace or as a graphic visual display.

The location, the affected area, and the direction of fire spread, together with the prevailing temperature conditions along the sensor cable, can be viewed on a PC from a safe location or a remote control room. This information is particularly valuable to the rescue services, as it can help to minimize the severity of fire damage.

System integrity – fiber-break detection and recovery

A Sensa Dual Integrity system is uniquely able to automatically detect and recover from breakage or degradation of the sensing fiber, and also triggers alarms to warn of the condition. In a loop circuit (double-ended or Class A style), the system switches automatically to single-ended operation (from both ends), which ensures continuity of the temperature trace and maintains cover in the unaffected zones. The fiber optic sensor is intrinsically safe; even when broken, it is still safe for use in occupied areas. (Sensa systems use either Class 1 or Class 1M laser products.)

Dual Integrity – dual function

Sensa’s systems are able to differentiate between the peak and the average temperatures within a zone. Fire detection applications are normally based on identifying peak temperatures. Temperature data can be used for other tunnel management applications such as monitoring general conditions or controlling ventilation. For example, ambient temperature information sent to the site’s SCADA/BMS system can be used to safely switch ventilation fans on and off when the temperature fluctuates between set limits, without the concern that the temperature rise has been caused by a fire.
Dual Integrity – programmability and false alarms

The system can be programmed to monitor physical zones by mapping them to sections of the fiber optic sensor. In each zone, alarms can be triggered when the temperature or rate of temperature rise exceeds the thresholds preset for that zone. A variable rate-of-rise alarm can be specified for each zone to increase resilience to false alarms. The sensor control unit is programmed with fire detection algorithms so that verified alarm decisions are made. Settings can be adjusted on-site to reflect the prevailing conditions; for example, the tunnel temperatures can be recorded during commissioning to determine the appropriate thresholds. Thresholds can also be set for different operating conditions, to reflect, for example, summer or winter ambient temperatures and the use of electric or diesel trains. A highly responsive system can, therefore, be configured to meet individual application requirements.

System integration for better fire management

Dual Integrity systems are designed with an open protocol to integrate into other tunnel control systems. Sensa systems interface directly with fire alarm control panels, fire detection systems, and ventilation systems. The fire detection system can, therefore, initiate staged alarm events, including activation of alarm signaling devices, ventilation control, or extinguishing measures. Dual Integrity systems provide information on the location of the fire and its development to enable assessment and appropriate execution of fire event management.
Sensa operates a policy of continuous product improvement and, therefore, reserves the right to change specifications without notice. Pictures of products are representations only and are not to scale.

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