

## Intelligent DTS Solutions for Load Maximization and Hot Spot Detection

### Overview

Maximizing the current-carrying capacity within thermal limits is a principle concern in the design, installation, operation, and maintenance of a reliable and efficient power transmission and distribution system.

Current methods of load optimization base ampacity estimates on models of ambient thermal conditions and can result in underutilization of circuit capacity or over stressing of the power cables.

Fiber optic-based Distributed Temperature Sensing (DTS) technology has proven to be an effective tool for real-time thermal monitoring and load optimization. DTS systems are able to monitor multiple power circuits to capture and record dense temperature measurements over time. By combining actual thermal data with dynamic cable ratings, operators are able to maximize load carrying capacity while minimizing the risk of overheating the circuit. Overheating can result in reduced cable life or complete loss of the circuit.

Even with controlled backfills, the thermal impact of the environment varies along the length of the cable, throughout the life of cable, and with changing seasonal weather conditions. In order to accommodate these thermal fluctuations, models incorporate significant safety margins which serve to reduce the recommended load capacity. By monitoring the cable in real-time, guesswork related to the thermal environment is eliminated, allowing operators to use actual temperature measurements to adjust loads – thus maximizing available capacity without exceeding the thermal limit. At the same time, the risk of circuit damage due to overheating is reduced – avoiding outages (cable loss) and extending cable life.

Using DTS technology to monitor transmission and distribution power systems reduces costs by increasing the usable capacity of the circuits, avoiding cable damage, and extending cable life by maintaining optimal loading.



### Better Decisions from Better Data

- Small hotspot identification
- Load optimization through real-time thermal monitoring
- Access to all usable capacity without exceeding thermal limits
- Lifetime asset protection and monitoring of aging circuits
- Verification of mathematical models
- Early identification of joint deterioration
- Fire detection capability in cable tunnels, ducts, and chases

### Intelligent Monitoring Solutions

DTS measures the temperature for up to 40,000 discrete points along a standard telecommunications-grade optical fiber with fine resolution, high accuracy, and fast measurement speeds.

Such systems have an open-communications architecture allowing for reliable and easy interfacing with 3<sup>rd</sup> party systems and networks over, for example, Ethernet, OPC and SCADA.

SensorTran's specifically developed application software presents the data in a meaningful, representative and intuitive graphical form to the operator.

Intelligent alarm types and configurations can be readily tailored to each specific project to alert the operator to both potential and present over-heating and other undesirable health events.

## System Features and Benefits

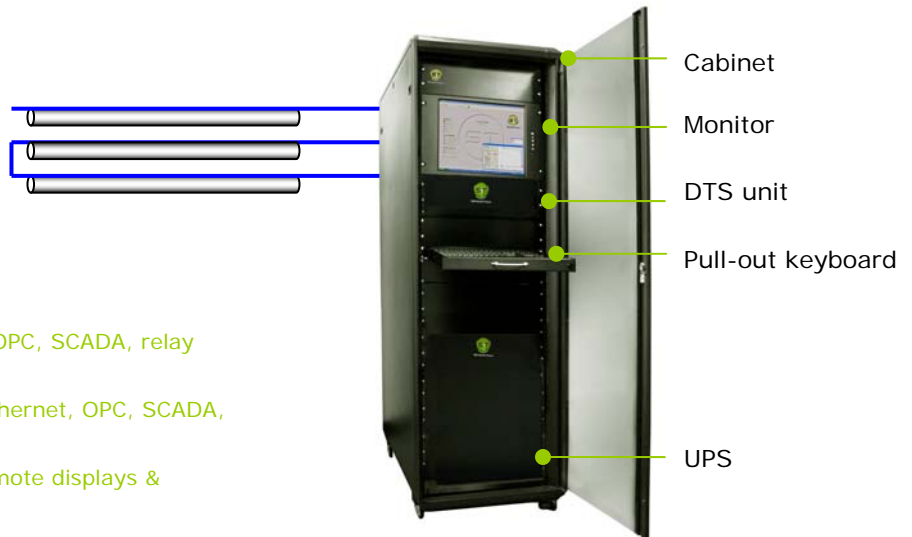
**SensorTran** offers intelligent solutions provide a wealth of features:

- ⇒ up to 50 fiber-optic channels available to provide monitoring for large power cable networks from a single DTS unit
- ⇒ Available with Active Plug & Play solution and PerfectVision™ dual laser technology, to simplify setup, calibration, and operation and extend the useful life of the fiber itself.
- ⇒ open-communications architecture provides reliable, easy interfacing with third-party systems and networks (Ethernet, OPC, SCADA, etc.) together with flexible remote control and data output/input capabilities
- ⇒ intelligent and multiple alarm types and configurations readily tailored to each project to alert operators of potential and present over-heating and other undesirable health events
- ⇒ each power cable can be defined into unlimited zones with individual alarm types and set-points for each zone, allowing alarms to fully reflect the changing characteristics along its complete length
- ⇒ Asset-specific visualizations via the SensorTran AssetViewer™ present the data to the operator in a meaningful, representative, and intuitive graphical form
- ⇒ wide range of cabinet packages available to meet exacting project requirements
- ⇒ on-board and expandable data storage provides for historical data archiving
- ⇒ Extensive on-board self diagnostics and autonomous operation with safe shut-down and auto-start-up capabilities

## System Configuration

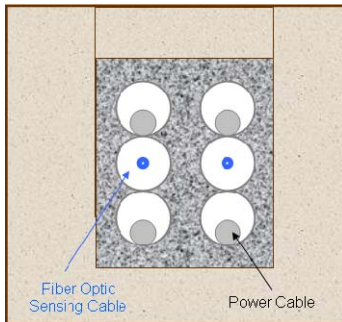
Single or multiple DTS units can be provided within a single cabinet. A typical single-DTS unit configuration is shown below. DTS networks can also be readily implemented providing expanded coverage for large power cable networks.

Fiber-optic channels: Up to 50 channels can be provided to allow for multiple power cable monitoring in either single-ended or double-ended configuration



- ◆ Data and alarm output: Ethernet, OPC, SCADA, relay contacts, RS232, RS485, etc
- ◆ Remote control and data input: Ethernet, OPC, SCADA, RS232, RS485, etc
- ◆ Peripheral equipment: printers, remote displays & keyboards, data back-up, etc
- ◆ Extensive historian capability able to replay/revisit alarm events and asset performance

## Optical Fiber Installation and Deployment

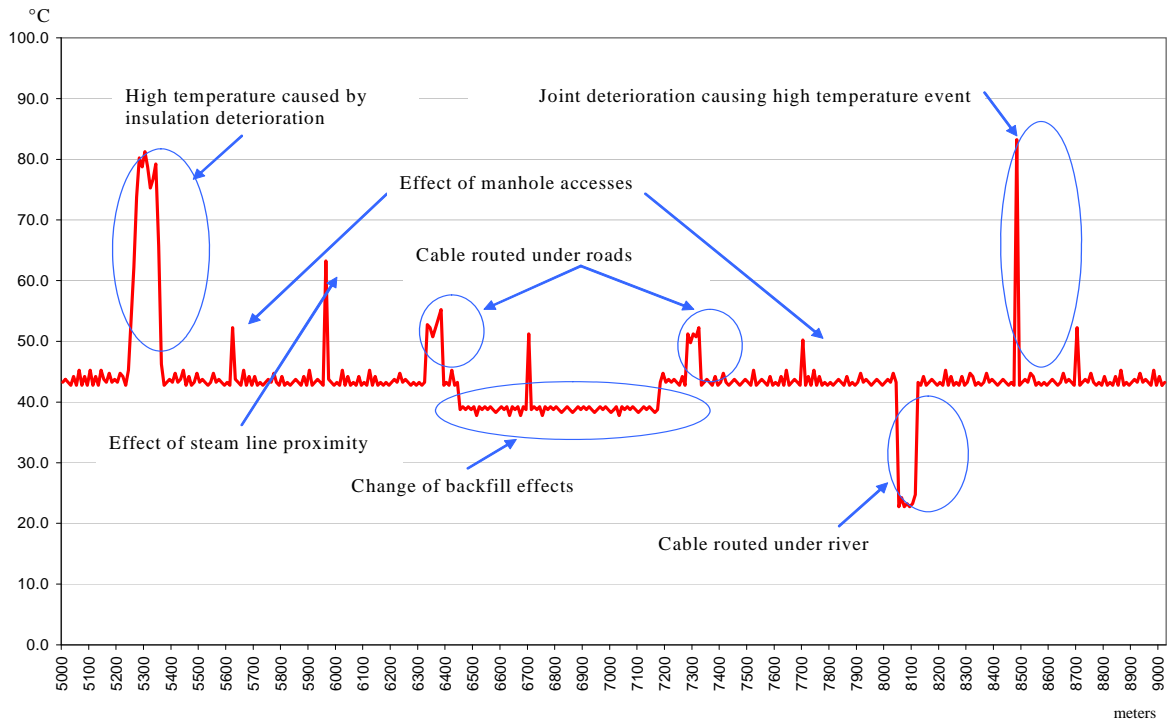


Optical fiber which is already integrated within the power cable itself can be easily utilized for monitoring. Where this is not the case, optical fiber can be retrospectively secured to the outside of the cable (typically within a stainless steel protective tube), or even retrofitted into a duct bank.

SensorTran has hands-on experience deploying monitoring solutions to direct buried, duct, and tunnel cable installations.

The optical fiber can be configured in either single-ended or double-ended configuration. Double-ended configuration is where both ends of the fiber are connected to the DTS system to form a "loop". This has the additional advantage that in the unlikely event of a fiber-break, the power cable can still be totally monitored by the system.

## Typical Temperature Trace



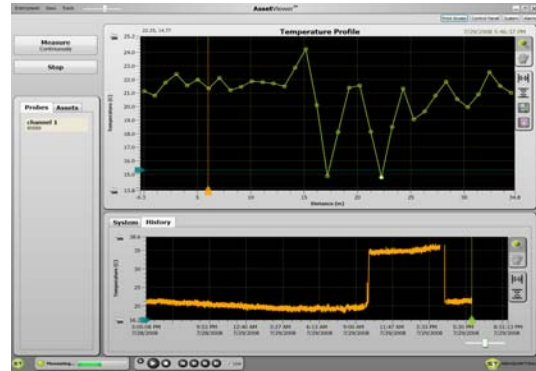
The example above shows a simple temperature trace along a single power distribution cable, clearly displaying events and features.

## Software

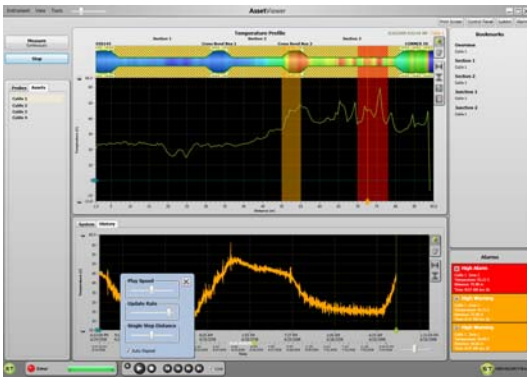
### SensorTran DTS Commander™

Running Microsoft Windows XP, the powerful onboard processor provides a stable and flexible environment for effective communication and remote access capabilities. Each SensorTran Gemini™ unit is supplied with DTS Commander™ software as standard.

- System Configuration Interface
- Intuitive Visual Calibration
- Controls Communications
- Conducts System Self Diagnostics
- Triggers Conditions-Based Alarms
- Allows Autonomous Operation
- Provides Basic Data Display Functions



SensorTran DTS Commander™



SensorTran AssetViewer™

### SensorTran AssetViewer™

The SensorTran AssetViewer™ is an optional software product that provides a graphical visualization of the temperature data. The software maps temperature data to a graphical representation of the asset being monitored. Each AssetViewer™ is configured according to specific customer requirements. The software simultaneously displays multiple temperature profiles, summary temperature data, and alarm status information for each zone. Recorded data can also be replayed using the powerful Data Control facility to view historical events at various speeds.

## The SensorTran Advantage

SensorTran, a NASA technology spin-off, is committed to supplying its customers with smart distributed monitoring solutions. SensorTran's systems are conceived to have a low lifetime cost of ownership (LCO) by way of efficient design, superior engineering and reliable construction. SensorTran's team is dedicated to providing "best-in-industry" customer care from project conception to the development of specifications, through installation, training and beyond.

SensorTran has made every effort to ensure information contained in this document is accurate at the time of printing, however, product specifications and features are subject to change without notice.

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Distributed Monitoring  
Solutions

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