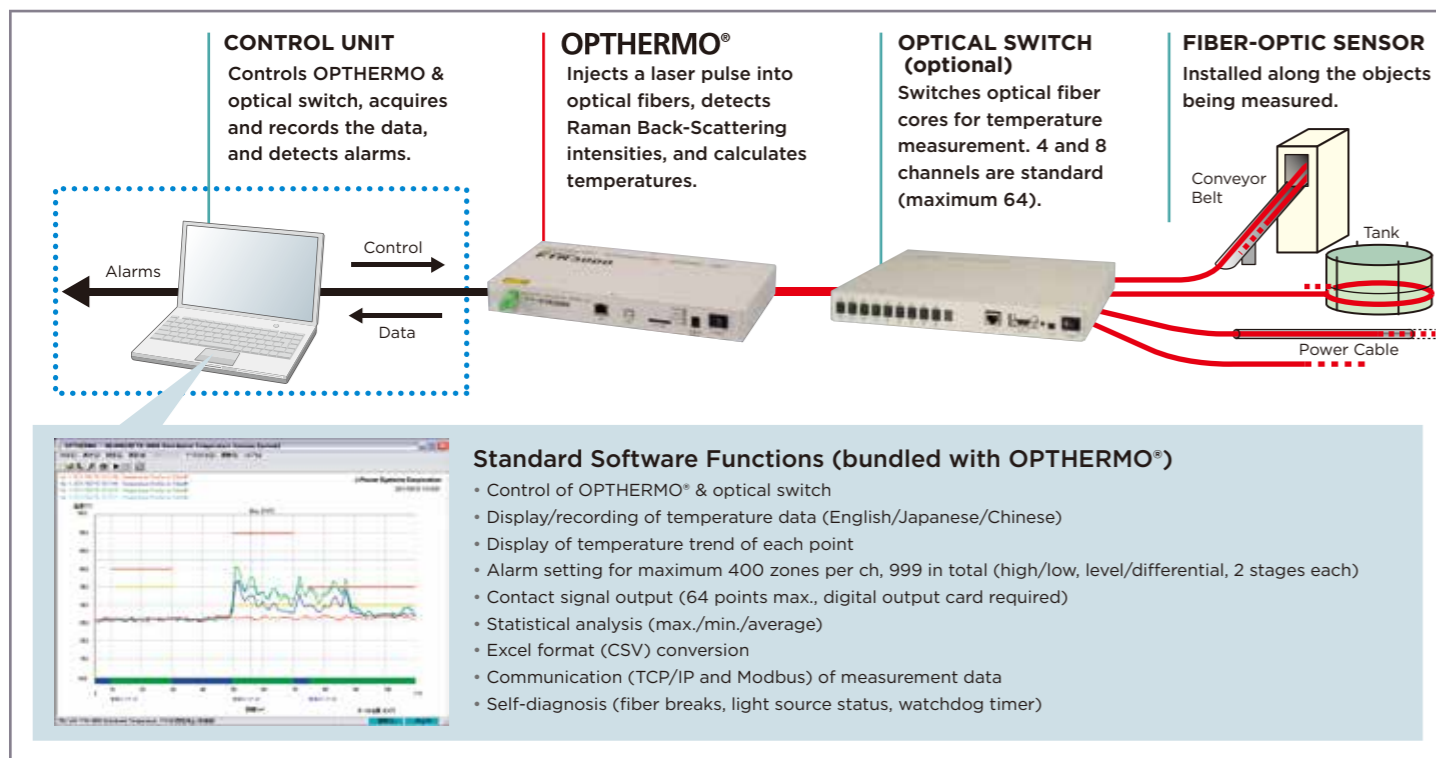


5. System Configuration



OPHTHERMO®

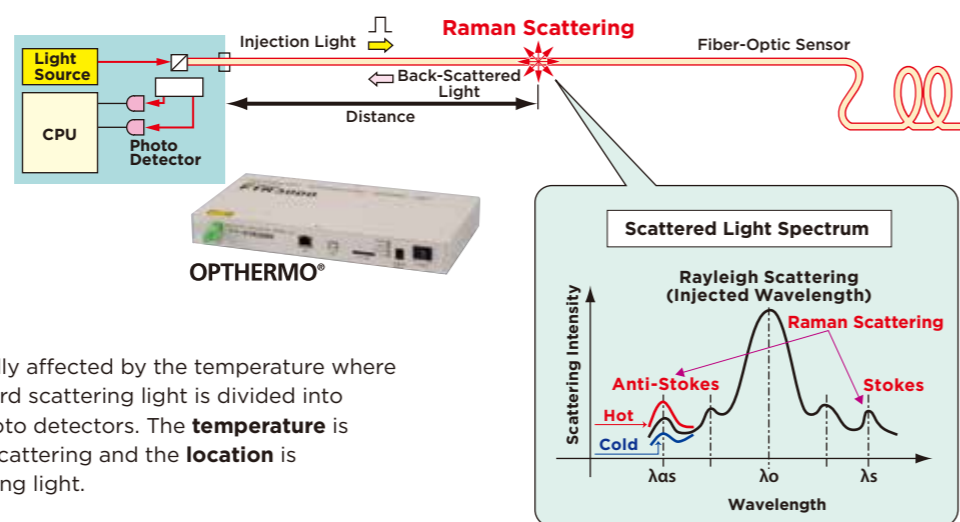
FIBER-OPTIC DISTRIBUTED TEMPERATURE SENSING SYSTEM

6. Measurement Principle

The **light pulse** injected at one end of the optical fiber is subjected to **scattering** due to temperature gradients as it travels along the fiber.

Raman scattering describes the light scattering phenomenon, and consists of **Stokes and Anti-stokes** light components.

The **intensity of Anti-stokes light** is especially affected by the temperature where the scattering occurred. The Raman backward scattering light is divided into Stokes and Anti-stokes and captured by photo detectors. The **temperature** is calculated by the **intensity ratio** of Raman scattering and the **location** is determined by the **traveling time** of scattering light.



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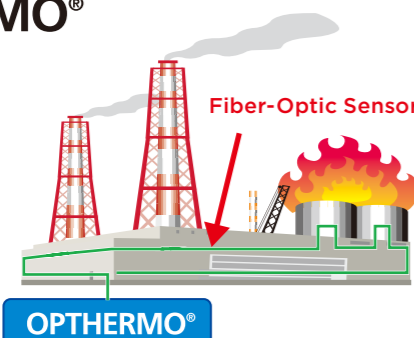
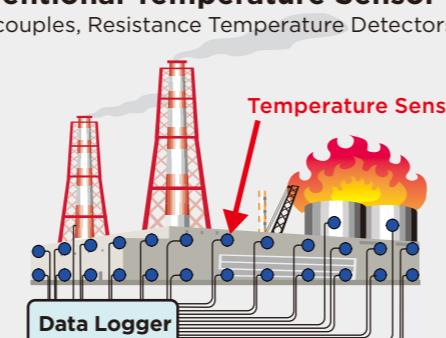
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SUMITOMO ELECTRIC GROUP

1. What is OPTHERMO®?

- ✓ OPTHERMO® is a Fiber-Optic Distributed Sensing System produced by **Sumitomo Electric Industries, Ltd.**
- ✓ Only one optical fiber sensor cable installation provides up to **35km temperature distribution** on a real-time basis.
- ✓ Standard **telecommunication-grade optical fibers** are used. **Compact, lightweight, easy to install and immune from Electromagnetic Interference.**

2. Comparison with Conventional Sensors

OPTHERMO®	Conventional Temperature Sensor (Thermocouples, Resistance Temperature Detectors)
 <p>Simple Only one optical fiber sensor cable installation provides up to 35km temperature measurement with 1m sampling resolution</p>	 <p>← Complicated system configuration for larger number of measurement points. Every temperature sensor must be wired to data logger</p>
<p>Low Cost Low initial and maintenance cost for multi-point monitoring</p>	<p>← Large initial and maintenance costs for multi-point monitoring</p>
<p>Seamless Seamless temperature monitoring</p>	<p>← Discrete Monitoring, not seamless</p>
<p>Long Lifetime Sensor lifetime: > 30 years (under normal temperature conditions)</p>	<p>← Sensor Lifetime: 10 to 15 years</p>
<p>Harsh Environments Applicable in explosive environments and strong electromagnetic fields</p>	<p>← Not applicable under strong electromagnetic fields. Protection required in explosive areas</p>
<p>Easy Installation Just one light weight sensor cable installation</p>	<p>← Wiring and termination work required for each sensor</p>

3. Application Examples

- ✓ **TEMPERATURE MONITORING & MANAGEMENT**
Power Cables, Power Facilities, Data Center / Server Room, LNG Tank (Heating Control), etc.
- ✓ **ABNORMAL TEMPERATURE DETECTION**
LNG Tank (Leakage Detection), Steel Plant Facilities, Sulfur Pipelines, Bus Duct, Cable Trays / Cable Pits, etc.
- ✓ **FIRE DETECTION**
Tunnel, Coal Conveyor Belt, etc.



Tunnel for Power Cables

4. Specifications

OPTHERMO®

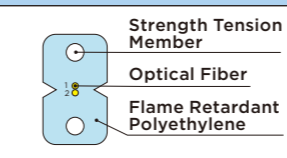
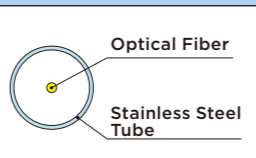
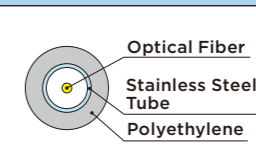
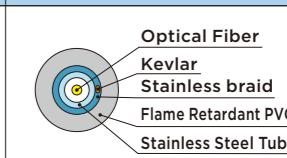
ITEM	FTR3000	FTR3000X	REMARK
Maximum Measuring Length	2km	5, 10, 15, 30, 35km	
Sampling Resolution	1m	0.25m/0.5m/1m (Selectable)	2m for 35km model
Temperature Resolution	<1°C		*1
Averaging Time	8 seconds to 10 minutes	10 seconds to 15 hours	*2
Spatial Resolution	1.5m	1m	*3
Optical Fiber Type	Multi-mode (GI 50/125μm)		*4
Optical Pulse Wavelength	785nm band	1550nm band	
Optical Connector Type	E2000 / APC (8 degrees angle)		
Communication Interface	LAN or USB		
Storage Media	SD Card	N/A	without optical switch
Measuring Temperature Range	-200°C to 380 °C	-200°C to 327 °C	*5
Operating Temperature Range	0°C to 40 °C	0°C to 50 °C	
Dimension	300(W) × 160(D) × 37(H) mm	400(W) × 200(D) × 88(H) mm	
Weight	3 kg	6 kg	
Power Consumption	<15W	<30W	at 20 °C environment

- *1: The temperature resolution is defined as the standard deviation of the temperature measured over a section of the fibre held at a uniform temperature, and values are representative data using Sumitomo's recommended optical fiber with a few splices.
 *2: Measuring time is tunable by the standard software as a value of which 2 to the power. Longer measuring time results better temperature resolution.
 *3: The spatial resolution is defined as the actual distance between the 10% and 90% points of the step temperature change.
 *4: Please contact with Sumitomo if another type of optical fiber to be used.
 *5: At two decimal place (0.01°C) recording. Actual measurable temperature range is limited by the specification of optical fibers.

OPTICAL SWITCH

ITEM	JOFS -OPTICAL SWITCH		REMARK
Type Number	JOFS -4A-MM	JOFS -8A-MM	
Number of Channels	4	8	
Insertion Loss	Typ. 1dB / Max. 2dB		
Wavelength Range	700 to 1700nm		
Optical Fiber Type	Multi-mode (GI 50/125μm)		
Optical Connector Type	SC / APC (8 degrees angle)		
Communication Interface	LAN or RS232C		
Dimension	300(W) × 260(D) × 38(H) mm		
Weight	3 kg		
Power Consumption	<1W		

FIBER-OPTIC SENSOR

Type	Non-metallic	Built-in stainless steel tube	Built-in stainless steel tube with PE sheath	Protection spiral steel with PVC sheath
Structure				
Temperature Range	-20 to 70 °C (continuous) 150 °C or less (for short time)	-20 to 75 °C (standard) -200 to 60°C (for low-temp) -20 to 300°C (for high-temp)	-20 to 75 °C (standard)	-20 to 70 °C (standard)
Applications	•Power cable temperature monitoring •Tunnel fire monitoring •Factory equipment temperature monitoring, etc.	•LNG plant LNG leakage •Sulfur piping temperature monitoring •Dam structural concrete temperature monitoring, etc.	•Power cable temperature monitoring (buried cable) •Cable rack temperature monitoring •Tunnel fire monitoring, etc.	•Cable rack temperature monitoring •Coal conveyor fire detection, etc.
Dimension	2 × 4 mm	1.4 to 3.2 mm dia.	3 to 5 mm dia.	2.9 mm dia.
Minimum Bending Radius	70 mm	70 mm	70 mm	60 mm
Maximum Tensile	100 N	300 N	300 N	200 N