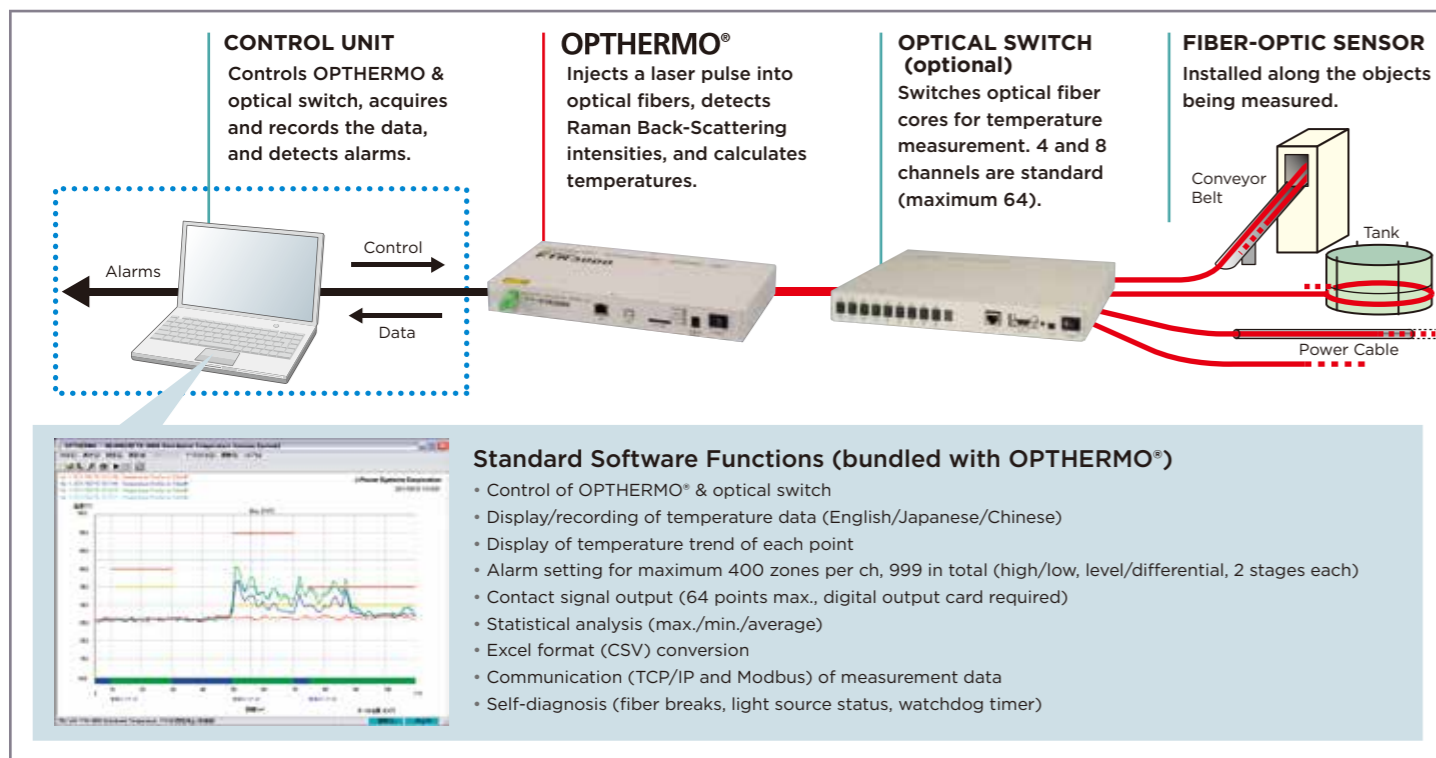


## 5. System Configuration



# OPHTHERMO®

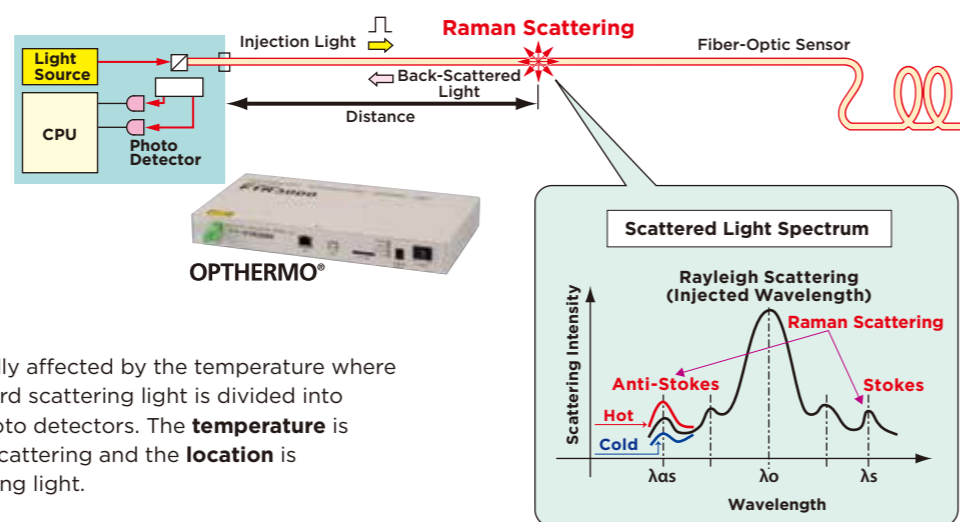
## FIBER-OPTIC DISTRIBUTED TEMPERATURE SENSING SYSTEM

## 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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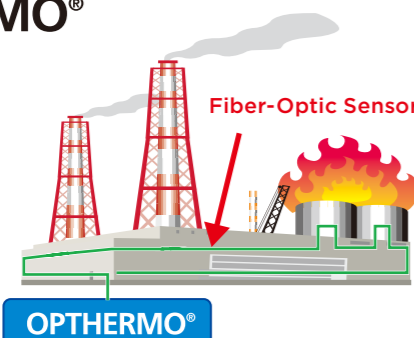
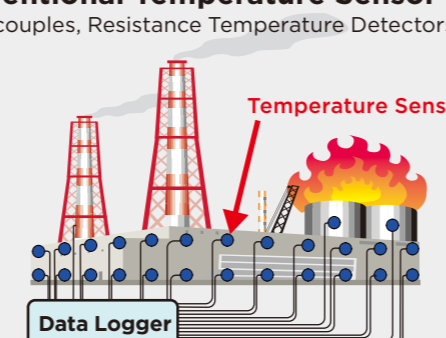
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SUMITOMO ELECTRIC GROUP

## 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><b>Simple</b> 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><b>Low Cost</b> Low initial and maintenance cost for multi-point monitoring</p>	<p>← Large initial and maintenance costs for multi-point monitoring</p>
<p><b>Seamless</b> Seamless temperature monitoring</p>	<p>← Discrete Monitoring, not seamless</p>
<p><b>Long Lifetime</b> Sensor lifetime: &gt; 30 years (under normal temperature conditions)</p>	<p>← Sensor Lifetime: 10 to 15 years</p>
<p><b>Harsh Environments</b> Applicable in explosive environments and strong electromagnetic fields</p>	<p>← Not applicable under strong electromagnetic fields. Protection required in explosive areas</p>
<p><b>Easy Installation</b> 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®

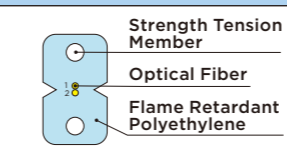
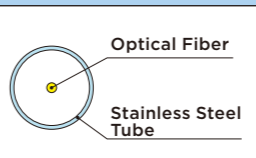
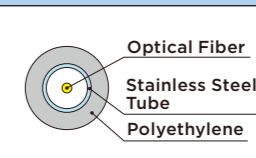
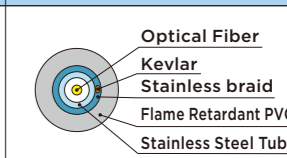
ITEM	FTR3000	FTR3000X	REMARK
Maximum Measuring Length	2km	5, 10, 15, 30, 35km	
Sampling Resolution	1m	0.25m/0.5m/1m (Selectable)	2m for 35km model
Temperature Resolution	<1°C		*1
Averaging Time	8 seconds to 10 minutes	10 seconds to 15 hours	*2
Spatial Resolution	1.5m	1m	*3
Optical Fiber Type	Multi-mode (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	<ul style="list-style-type: none"> <li>•Power cable temperature monitoring</li> <li>•Tunnel fire monitoring</li> <li>•Factory equipment temperature monitoring, etc.</li> </ul>	<ul style="list-style-type: none"> <li>•LNG plant LNG leakage</li> <li>•Sulfur piping temperature monitoring</li> <li>•Dam structural concrete temperature monitoring, etc.</li> </ul>	<ul style="list-style-type: none"> <li>•Power cable temperature monitoring (buried cable)</li> <li>•Cable rack temperature monitoring</li> <li>•Tunnel fire monitoring, etc.</li> </ul>	<ul style="list-style-type: none"> <li>•Cable rack temperature monitoring</li> <li>•Coal conveyor fire detection, etc.</li> </ul>
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