VIGO
SYSTEM

INFRARED DETECTORS FOR **RAILWAY TRANSPORT SAFETY**

RAILWAY TRANSPORT SAFETY

Safety is the most important aspect of railway transport. Nevertheless every year there are at least few serious accidents in rail traffic. Some of them are caused by defective wheel bearings or brakes and some of them are caused by overheating of the transported materials (i.e. coal, oil) which may result in a serious fire.

Thermal monitoring is the way to minimize unscheduled breakdowns of all undercarriage elements and prevent costly failures and downtime. The best solution for temperature measurement in railway industry are systems using infrared technology.

VIGO has come up with a advanced and most effective detection devices designed specifically for railway applications. All these devices have one thing in common – very sensitive and fast HgCdTe detectors.

Advantages of HgCdTe technology in comparison with other competitive solutions used in railway applications are presented in the table.

HgCdTe	PbSe	Bolometric camera
• Very good accuracy (mK range) • High speed from 15 kHz to 100 MHz • Operation at any environmental conditions	• Accuracy not more than 1 K • Speed only up to few 1 kHz • Easily disturbed by sunlight / sun radiation	• Low sampling frequency (usually 50 Hz) • Requires complex image analysis

CONTACTLESS TEMPERATURE MEASUREMENTS

Each object with a temperature above absolute zero (0 Kelvin = −273.15°C) emits electromagnetic radiation from its surface, which is proportional to its temperature.
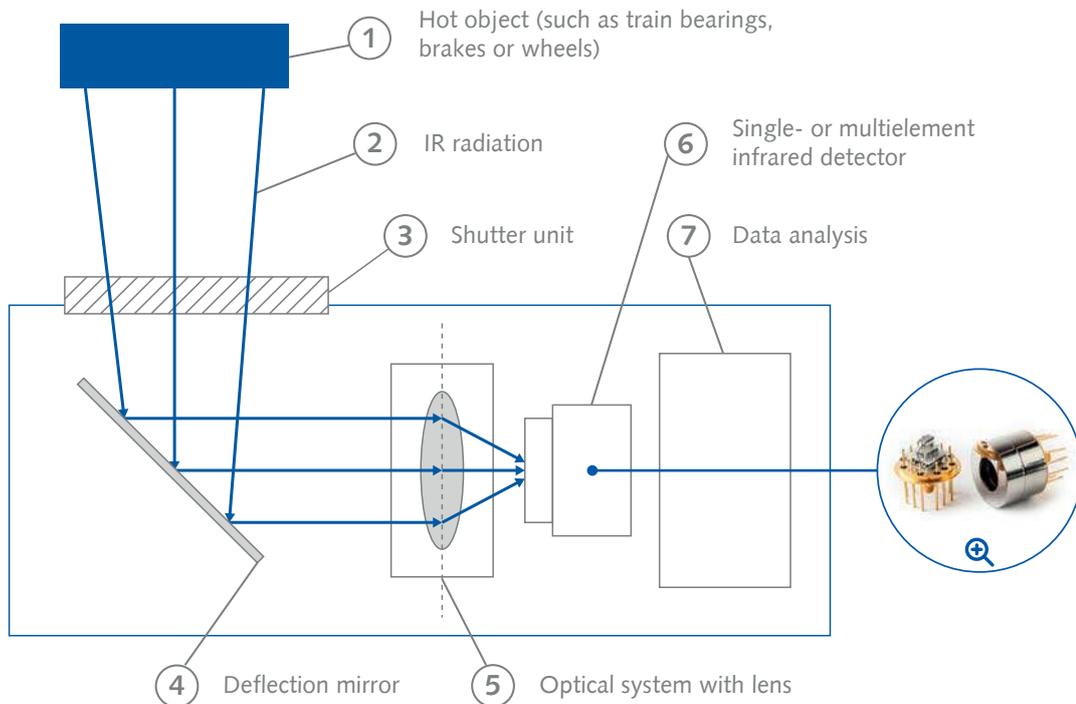A part of this radiation is the infrared radiation, which can be used to measure an object's temperature.

The intensity of the radiation and the wavelength where the intensity of this radiation has a maximum value, depend mainly on the temperature of the object (Planck's law, Wien's displacement law).

Optimal spectral range in railway systems is between 3.0 – 5.5 µm.

VIGO single-element devices recommended for temperature measurements

- PVI-5-1×1-TO39-NW-36
- PVI-2TE-5-1×1-TO8-wAl2O3-36
- AM03120-01/02

(1)	Hot object (such as train bearings, brakes or wheels)
(2)	IR radiation
(6)	Single- or multielement infrared detector
(3)	Shutter unit
(7)	Data analysis
(4)	Deflection mirror
(5)	Optical system with lens

Figure 1. Principle of thermal radiation detection system

With the input optics (mirrors, lenses) the beams are focused on a detector element, which generates an electrical signal proportional to the incident radiation.

The signal is amplified and, using successive digital signal processing, is transformed into an output signal proportional to the object temperature.

The measured value may be released as analog output signal, which supports an easy connection to control systems of the process management.

HOT AXLE BOX AND HOT WHEEL DETECTION

Sensors installed on tracks allow monitoring of overheating of the outer and inner bearings, brakes and wheels of the rolling stock units. System provides absolute, relative and differential temperatures of the elements in real time. HgCdTe technology enables fast and accurate measurements at any environmental conditions.

Key features of the VIGO product

- 1×4 or 2×4 single-colour HgCdTe photovoltaic detectors array
- Very good accuracy: 100 mK at 30 °C, 10 mK at 150 °C
- High speed: from 15 kHz to 100 MHz

- Small spot size: from 5 mm to 1 m distance
- Compact size: i.e. 50 × 50 × 25 mm3 (complete mechanical design according to the customer's specification)
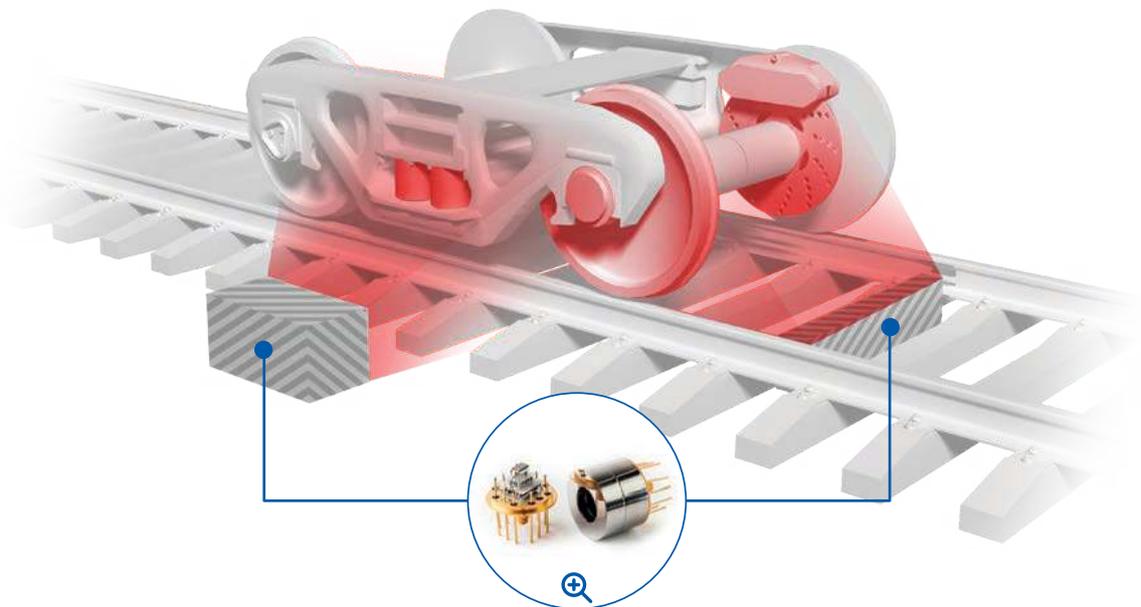- Low power, single supply: 2 – 6 W, 3 – 24 V

Figure 2. Thermal scanning system of the undercarriage

TRAIN FIRE DETECTION (THERMAL SCANNING SYSTEM)

An accurate scanner, which is a part of automated inspection and measuring system (mounted on gates over the rail tracks), performs the train thermal analysis. It uses cutting-edge multielement photovoltaic detectors, specifically designed to achieve very high measuring system accuracy and reduce the number of false alarms.

The system creates a thermal map of the train surface and identifies temperature anomalies. The thermal map is not affected by the thermal emissivity of the materials. Real-time scanning takes place at a full train speed.
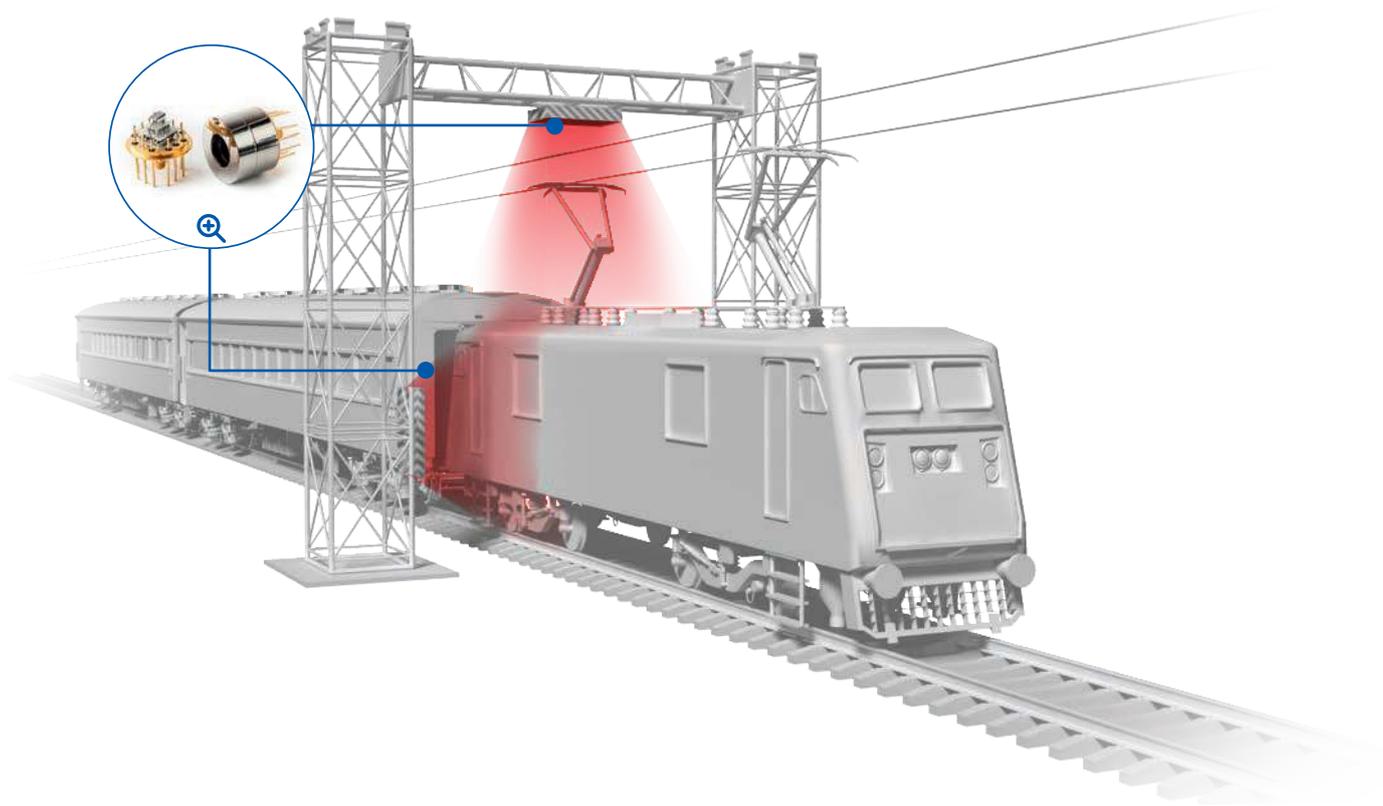
Figure 3. Thermal scanning system with VIGO infrared detection modules.

This inspection system guarantees online monitoring of trains in the critical points (i.e. tunnels, bridges, railroad intersections, country borders) and alert the potential risks. It ensures an instant detection of any safety issues (i.e. fire on board or irregular train shape) reducing risks of major accidents and increasing network availability.

Thanks to this solution, it is possible to measure the temperature of coal or oil – transported in rail cars and rail tanks.

Temperature measurement combined with gas analysis make it possible to detect leaks of gases or technical liquids, prevent fires and explosions.

Scanning system is integrated with signalling system enabling to automatically stop trains whenever hazardous defects are detected, without the intervention of the operator.

Key features of the VIGO product

- 2×12 two-colour HgCdTe photovoltaic detectors array
- Two different spectral bands
- Object temperature measurement range from 80 to 300 °C
- High sample rate of each channel up to 80 kSPS
- Simultaneous sampling on all channels
- Precise A/D conversion
- Fast LVDS data output
- Control interface RS422/485 full duplex
- Single power supply 9..18 VDC
- Short start-up time 40 s (typical)

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