Making AI Robots' Noses and Eyes

About the Company

Tempus Inc. is an infrared sensor manufacturer established in 2012. The company operates its own MEMS Fab and supplies optical NDIR gas sensors and infrared imaging sensors built based on its proprietary micro-thermopile device. As the use of eco-friendly refrigerants will be mandatory from 2025, there is a demand for low-end and long-lasting optical refrigerant sensors, and Tempus is leading the early-stage global market in this field.

Background

AI technology is based on data, and data is collected with sensors. Current development of AI semiconductors is focused on processing the collected data in data centers. In the future, the technology will expand to collecting and immediately reflecting everyday information. In that regard, EDGE AI technology is the answer.

For autonomous driving (ADAS), driving information must be analyzed and used in real time. Driving information includes various video information. For autonomous driving in bad weather, vehicles need SWIR (short-wave infrared) image information that penetrates water, and for night driving, LWIR (long-wave infrared) image information that detects heat is required. Sensors that provide such information already exist, but they are too expensive to apply to vehicles.

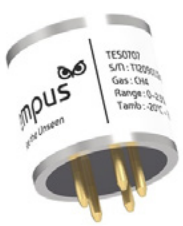
Vehicles need multi-channel gas sensors with a lifespan of ten years or more to selectively detect various gases and ensure safety. These sensors are also very expensive and cannot be used in home air conditioners (HVAC) or vehicle air conditioners (HVAC).

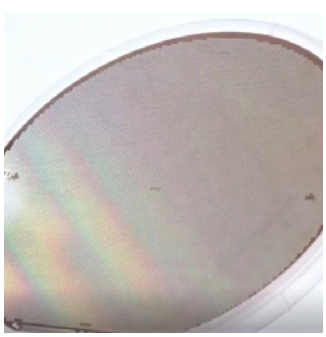
Tempus has revolutionized the prices of mono-frequency infrared imaging sensors, far-infrared imaging sensors, and multi-channel optical gas sensors with its micro-thermopile device, which is based on broadband, high-sensitivity, and ultra-low-cost infrared sensors. With the vision of creating AI robots' noses and eyes in the future, the company is leading the innovation of technology and price with its original device technology.

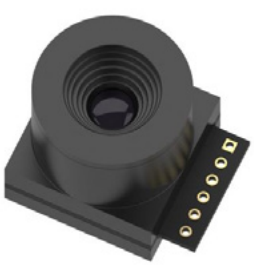
About the Product

From 2025, air conditioners (HVAC) marketed in the United States, Europe, and Japan will be required to use eco-friendly refrigerants with a global warming potential (GWP) of 750 or less. This is to limit the global warming potential of each refrigerant to 750 or less, assuming that the global warming potential of carbon dioxide (CO2) is 1. Existing refrigerants up to the third-generation had the safety rating of A1, so there was no need to install a refrigerant sensor. The fourth-generation eco-friendly refrigerant has a global warming potential of less than 750, but its safety classification is A2L or A3, meaning that it is flammable, and the installation of a refrigerant sensor is therefore mandatory.

The domestic and industrial air conditioners market, which produces 100 million products each year, now needs refrigerant sensors. The use of eco-friendly refrigerants in vehicle air conditioners has been postponed for about two years, and their installation will be mandatory for 80 million new vehicles per year from 2027.







Among various third-generation refrigerants, R32 is the only one with a GWP of less than 750 and a safety rating of A2L, and it needs to be fitted with a sensor. Its chemical formula is CH2F2, which means it is slightly flammable. Previously, R32 used metal oxide semiconductor (MOS) sensors. However, these sensors have a fatal flaw in that they detect gas by heating the sensor when the refrigerant gas contacts the sensor, which causes them to deteriorate. In other words, these sensors have a short life. In order to guarantee the life of the sensor for more than ten years, an optical NDIR sensor that is contactless is required.

The NDIR sensors guarantee durability and reliability, but they are very expensive, costing more than USD 100, which is much costlier than MOS sensors, which are USD 10 or cheaper. Tempus matched the price and interface of its optical NDIR R32 refrigerant sensor with the existing MOS sensors based on its proprietary source technology, which enabled the company to win orders from global Tier-1 HVAC manufacturers and expand its market share.

In addition to the optical NDIR R32, Tempus is expanding its offering of refrigerant sensors to R290, R744, and R1234yf. In addition, by expanding the application of its original technology, the company has developed a Battery Thermal Runaway Sensor that can detect off-gases, such as hydrogen (H2) and electrolyte gases (electrolytes), emitted in small quantities at the beginning of battery failure so that it can detect defective batteries that may have thermal runaway at an early stage. The product is not only used for measuring the degree of defects in electric vehicle batteries, but can also be used for preemptively detecting fires in ESS systems.

Tempy.eye, a 16-channel or 64-channel thermal imaging sensor, is attached to ceiling-mounted air conditioners to support efficient indoor air conditioning. It can detect the number of people in any location in the room to maximize pleasant air conditioning and energy efficiency. The high-end product has the performance and price compatible with affordable air conditioners.

Competitive Edge and Business Strategy

Tempus provides modular components to customers who make devices. The source of the performance and price competitiveness of its module is based on the differentiated and price-competitive device that is applied to the module. In order to develop and produce differentiated devices, it is necessary to operate a MEMS fab by investing a huge amount of money and time.

Over the past twelve years, Tempus has invested more than USD 25 million to maintain its own MEMS fab and develop its proprietary technology. The mandatory use of eco-friendly refrigerants in 2025 will provide the opportunity to become the unrivaled market leader in the large-scale market of more than 100 million units.

Tempus has 1) a wide-band sensor that can simultaneously detect the entire infrared spectrum from 1um to 25um, 2) a sensor operated with unique compound thin-film technology that has a sensitivity (SNR) five times higher than that of other global competitors, 3) a price-competitive sensor that uses an 8-inch wafer and achieves a yield of 95% or more, and 4) competitive advantage in modules that minimize additional costs by using digital chips in the operation of all modular products (ROIC).

Tempus commercialized 2-channel, 4-channel, and 16-channel optical gas sensors, and is working to put 64-channel and 4,800-channel versions on the market within five years. The 16-channel gas sensor selectively detects 15 different gases. As for short-wave infrared and far-infrared imaging sensors. 16-pixel and 64-pixel versions have been commercialized, with 4,800-pixel versions to be commercialized in 2025 and 300,000-pixel versions to be commercialized within five years.

Future Plans

In order to create a sustainable company, it is important to develop a differentiated core competitiveness while securing a stable cash flow structure. Tempus's goal for 2025 is to achieve sales of more than USD 15 million and make profit with its optical NDIR refrigerant sensor and Tempy.eye, which is a 64-channel thermal imaging sensor.

Going forward, Tempus plans to secure funds with a KOSDAQ listing in early 2026 to grow into the world's top global unicorn that supplies the most noses and eyes for future AI robots.

We are a small company. But our vision is to lead the world’s low-end multi-channel infrared spectroscopy technology (optical gas sensor, short-wave infrared imaging sensor, thermal imaging sensor) market. As a small company, we value “cooperation.” Hopefully, this introduction will help us expand global cooperation and lead to practical results.

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