AUTOMOTIVE HVAC AND CABIN COMFORT SENSORS

TECHNOLOGIES

Sensata Technologies

The World Depends on Sensors and Controls

The supplier you want. The partner you need.
At Sensata we do everything in our power to ensure your personal satisfaction. We apply our unsurpassed experience and expertise to focus on your needs. We adhere to technical, manufacturing and testing standards that are second to none. And our experts work with your experts to ensure the quality and precision it takes to meet the most demanding application requirements. No wonder a world of businesses rely on the more than 600 million Sensor and Control devices we manufacture each year to hone their own - leading-edge technologies.

The Sensata Technologies success story.
It began in 1959. And although we have evolved over the years, we have always had one goal: to provide leaders in automotive, appliance, aircraft, industrial, HVAC, and other markets the sensors and controls they require to succeed. From our headquarters in Attleboro, Massachusetts to our manufacturing centers around the world, from our regional warehouses to our network of sales offices spanning the globe, we help businesses everywhere to make their products safer, more effective and efficient. Every day.

Sensata Technologies

SENSATA TECHNOLOGIES

Advanced Sensing Solutions for Tomorrow's HVAC Systems

Mobility is important in modern society. It allows people to visit other places. For food, for work, for leisure, for shopping. The invention of the combustion engine substantially enhanced mobility. Not only longer distances in shorter times could be realized, but also more people could enjoy the benefits of it. However, the evolution of cars has not been limited only to its mechanical developments. As the novelty of moving people around quicker became accessible to more people, a simultaneous development in making car rides more comfortable also became inevitable.

Air-conditioning systems

Among the most significant developments of such luxurious progression was the evolution of air-conditioning, or AC, systems. The first car with an actual AC system was the 1939 Packard. It consisted of a large evaporator, called the "cooling coil", which took up the entire trunk space. The only control was a blower switch. More car makers followed suit but it wasn't until the late 1970s that AC-equipped cars became a craze. Systems were getting better and people realized the pleasures and benefits of cars fitted with AC systems. It is estimated that now over 75 % of all new cars sold worldwide have AC and this number even continues to grow.

Today, Heating, Ventilation and AC, or HVAC, systems are very efficient. Modern automatic temperature control set-ups allow individual adjustments, even for those on the backseat. Computers ensure that both the passengers and driver are comfortable, maintaining the optimum temperature.

Global Insight forecasts that the worldwide take-rate of AC in cars will increase from 75 % in 2006 to close to 85 % in 2012.

Analysts predict that in 2010 one in every 4 or 5 new passenger cars will be equipped with humidity and air quality sensors.

AC: Continuous development

The future of automotive HVAC is changing, and for the better. Now there are new electronic and compressor designs. The concern over environmental effects of refrigerant leakage into the atmosphere has induced innovations in order to reduce the emissions. Most cars today use the R134a refrigerant, which contains no chlorine, but recently the European Union has ruled that future systems should also help reduce global warming. Various concepts are currently under investigation, ranging from improved variants of the current refrigerant to the introduction of a completely redesigned AC system, using R744/CO_2, which will also feature additional cooling and heating performance at improved fuel efficiency ratings.

Integrated Cabin Comfort

Air-conditioning systems, being the single largest auxiliary load on the vehicle, reduce fuel economy. Emission standards are providing the impetus for the HVAC industry to evaluate new climate control concepts. Solutions for size reduction of the climate control systems lie in re-evaluating the glazing systems, but more importantly in developing advanced techniques for delivering heating and cooling to the occupants. The sensor industry is driven by the need for fast response, and more sensitive sensors for monitoring the thermal comforts in the new designs of HVAC systems. Recirculation of cabin air, in an attempt to reduce the outside air take-up, also calls for the need of highly sensitive, fast response, low cost and maintenance-free gas analyzers and humidity sensors.

Where contemporary HVAC systems provide accurate, but basic, temperature control, the near future will see cars will increasingly fitted with sophisticated systems, that will control the entire cabin atmosphere with the help of humidity, air quality, light and radiation sensors.

Comfort and safety: Sensors will help enhance driver and passanger comfort as well as allow drivers to concentrate on what's most important: driving safely.

Combined, these sensors are able to provide the best possible environment for people inside cars, in terms of comfort and safety. Radiation and light sensors will help understand when and where to apply additional heating, ventilation or air conditioning of the driver or passengers, humidity sensors will help control the optimal humidity setting inside cars, at the same time preventing windows from fogging up. Air quality sensors will detect undesired gasses and odours outside as well inside the car, automatically triggering actuators to adjust the flow of air in and out of the cabin.

Every day Sensata produces 300,000 automotive sensors.

SENSING THE ENVIRONMENT

Sensors supply the information about the changing environment to the HVAC control unit. The location and the quality of the measurements that are made, play a significant role in climate control of automobiles. Sensors are key for measuring the physical quantities required for the HVAC control unit to adjust its settings.

To have a better understanding of the operation of a sensor in automotive systems, consider a situation where the vehicle enters into a polluted region.

The air quality sensors located near the air inlets, detect the changes in the air composition entering the vehicle compartment and control the pollution from increasing in the passenger cabin by sending an appropriate signal to the HVAC control unit. The HVAC unit responds to this by closing the ventilation flaps, activating recirculation. Humidity sensors continuously monitor the amount of water vapour in the air and regulate the blow out air temperature, thereby preventing fogging of windshields. The internal and external temperatures are continuously measured to maintain the thermal levels as requested by the passengers. Solar radiation can end up in increasing the temperature levels and hence is accounted for by the radiation or the solar sensors to provide compensatory measures.

SENSATA SENSOR TECHNOLOGY FOR HVAC AND CABIN COMFORT SOLUTIONS

The Perfect Connection

Electronics are key when it comes to system control in cars, HVAC and cabin comfort systems are no different. These electronic controls get their inputs from sensors. Sensors measure physical parameters, like pressure, gas or humidity concentration and convert these into electronic signals. Did you know that Sensata have been developing sensors for the automotive industry for more then 25 years? These sensors have been developed for engine, transmission, suspension, exhaust-gas post-treatment, brakes, AC and other systems.

Sensata have developed sensors for all automotive manufacturers and almost all their system suppliers. This has resulted in a broad sensor capability ranging from pressure, acceleration, force, position, speed, flow to gas sensors, and in great expert knowledge of the application of these sensors in motor vehicles.

Sensata has already produced over 500 million pressure sensors.

EXAMPLES OF SENSORS

Sensata Technologies: The choice is yours

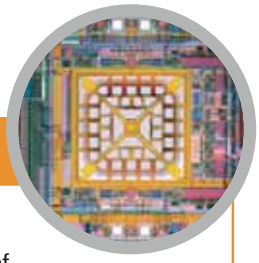
Sensata's pressure sensor and switch portfolio has developed such, that virtually all automotive applications, independent of pressure range, 1 bar or 2000 bar, independent of principle, absolute-relative-differential, are or can be served. The basis is a rich technology choice, from micro-electromechanical-systems, to capacitive ceramic and micro fused strain gauges on metal membranes.

A closer Look at Sensor Technologies Sensata uses for HVAC and Cabin Comfort Applications

Monometallic Pressure Switch

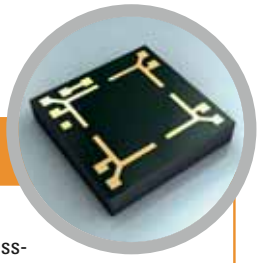
Pressure switches provide on/off controls for many automotive systems. The snap action disc reacts to changing pressure by reversing its curvature when critical pressures are reached and activating electrical switch contacts. The discs are specially formed out of stainless steel to provide long device life and durability. When pressure reaches a certain point, the disc trips the switch that cuts off power to the AC system providing reliable control and safety to the world of automotive applications. Pressure switches are used to provide reliable safety against high pressure situations, shut of AC equipment if there are leaks in the system, and control compressor and AC fan function.

Sensata produces the largest number of pressure sensors for automotive HVAC systems worldwide.



MEMS-BASED PRESSURE SENSORS

Silicon is an ideal material for integrated piezo-resistive resistors, which are often combined with the integration of signal conditioning. Especially at low pressures, these concepts can be provided at low cost. Silicon or MEMS (Micro-electromechanical systems) are very small and have a high sensitivity.



PIEZO-RESISTIVE SENSING ELEMENTS

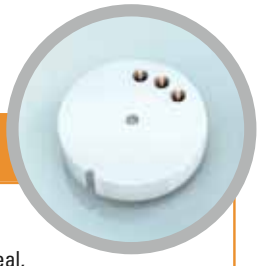
The piezo resistive structures are formed in monolithic silicon that are used for standard semi-conductor manufacturing processes. After processing of the resistive structures and metallization for interconnection, wet etching techniques are used to create a thin pressure diaphragm at the location of the stress sensitive piezo-resistive structures.

Sensata operates manufacturing sites in Mexico, Malaysia, Hungary and China.

Ceramic Capacitive Pressure sensors

Ceramic transducers using a capacitive measurement principle have proven to be the automotive world's first choice for medium pressure ranges. Capacitive transducers are well known for their high sensitivity and low power consumption. The material is impervious to harsh media, and the transducer is very stable over a wide temperature range.

Packaging is very simple, by clamping the ceramic transducer in a metal can and using an elastomere seal for medium pressures. This principle is commonly accepted as the most cost effective pressure sensing technology for pressure ranges between 1 and 200 bar.



CERAMIC SENSING ELEMENTS

A ceramic substrate and diaphragm are plated with metal to serve as electrodes. Both ceramic parts are united by a glass seal, maintaining a well-controlled gap, with both electrodes forming an electrical capacitance. Applying pressure to the element will cause a change in the gap between substrate and diaphragm, resulting in a change in capacitance of the sensing element, which can subsequently be processed into an electrical output signal.

Micro-fused Strain Gauge Pressure Sensors

Steel membranes with piezo-resistive resistors have been adopted as the common transducers for high pressures. Various concepts exist. All have in common the fact that the piezo-resistors are placed on a metal diaphragm, where stresses or strain from deflection under pressure induce the piezo-resistance effect. The difference is in the realization of the resistors, where a compromise among stable performance over temperature, minimum drift over its life time, high sensitivity, and lowest cost has to be made.

Also here, packaging is rather simple, as the diaphragm can be constructed in one part with the port.

Electro-chemical Sensors

Sensata offers a range of air quality sensors that measure the concentration of a number of gasses using MetalOxide Semiconductor (MOS) technology where oxide-based thick films are deposited onto silicon micromachined substrates. These microsensors are equipped with electrodes that enable extremely accurate measurement of the resistance of the sensing layer. To ensure quick, sensitive, and selective detection, heaters are incorporated into the substrate. Changes in the composition of the ambient atmosphere create a corresponding change in the resistance of the sensing layer, allowing the sensor to detect a wide range of toxic gases even at very low concentrations.

Sensata operates three business centres around the world with commercial and technical specialists to bring the innovations for tomorrow's HVAC and Cabin Comfort systems.

STRAIN GAUGES

Sensata technologies use bulk micro machined silicon strain gauges that are glass fused to a steel diaphragm. These strain gauges are realized in monolithic silicon in a batch process. One (6 or 8 inch) silicon wafer will yield thousands of strain gauge elements.

Capacitive Detection of Relative Humidity

Sensata's Relative Humidity (RH) and Dew Point sensors are based on a polymer capacitive type sensing technology, similar with the technology used in the pressure sensors that Sensata has been producing for many years.

The humidity in the probed air changes the dielectric capacity of the polymer layer in the sensing element. The change in capacity of the RH sensing element is subsequently converted into a calculated relative humidity and with the help of accurate NTC elements, a dew point is calculated.

Sensata Technologies doesn't just make sensors, we deliver solutions.

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