

INDUSTRIAL AND MEDICAL APPLICATIONS

Application Note

Honeywell Zephyr™ Analog and Digital Airflow Sensors: HAF Series-High Accuracy

SOLUTION

Honeywell's Zephyr™ Analog and Digital Airflow Sensors: HAF Series-High Accuracy are designed to measure mass flow of air and other non-corrosive gases. The Microelectronic and Microelectromechanical System (MEMS) sense die is located in a precise and calculated airflow channel to provide repeatable flow response.

These sensors provide an analog or digital interface for reading airflow over the specified full scale flow span and temperature range. With thermally isolated heater and temperature sensing elements, they provide a fast response to the air or gas flow. They are available in a standard flow range of 200 SCCM, and are fully calibrated and temperature compensated with an on-board Application Specific Integrated Circuit (ASIC). See Figure 1.

Figure 1. Zephyr Analog and Digital Airflow Sensors: HAF Series-High Accuracy



VALUE PROPOSITIONS (★ = *competitive differentiator*)

- ★ **Meet high accuracy specifications:** High forward flow accuracy ($\pm 0.25\%$ FSS or $\pm 2.5\%$ of reading, whichever is greater) allows for very precise airflow measurement, often ideal for demanding applications with high accuracy requirements
- ★ **Customizable:** Sensors can be designed to meet end-user needs
- ★ **High sensitivity at very low flows:** Allows the customer's application to detect presence or absence of airflow
- ★ **High stability:** Reduces errors due to thermal effects and null shift to provide accurate readings over time, often eliminating need for system calibration after printed circuit board (PCB) mount and periodically over time

- ★ **Low pressure drop:** Low pressure drop typically improves patient comfort in medical applications, and reduces noise and system wear in components such as motors/pumps
- ★ **Saves customers time and money:** Linear output provides a more intuitive sensor signal than the raw output of basic airflow sensors, often eliminating the need for customers having to linearize the output which can help to reduce production and design costs and implementation time
- **Simplifies customer's production requirements:** Leveraging the ASIC-based I²C digital output option eases integration to micro-processors or micro-controllers, reducing PCB complexity and component count
- **Small:** Occupies little space on PCB, allowing for an easier fit and potentially reducing production costs; PCB size may also be reduced for easier fit into space-constrained applications
- **Flexible:** Analog and digital output options, low 3.3 Vdc voltage option, and a low power supply requirement that allows for battery-driven and other portable applications increase flexibility within the application

POTENTIAL APPLICATIONS

Figures 2 through 17 show a variety of potential industrial and medical applications in which the Zephyr Sensors may be used.

Industrial

Figure 2: Air-to-Fuel Ratio



Function: Air-to-fuel ratio is the mass ratio of air to fuel present during combustion. In air-fuel ratio sensing applications, such as fired heaters, power plant steam generators and large gas-fired turbines, Honeywell's airflow sensors may be used to control the mixture of air and fuel to optimize operation.

Customer Benefits: Improves accuracy and reliability.

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Figure 3: Analytical Instrumentation (Spectrometry, Chromatography)



Function: Analytical instrumentation includes equipment used in the analysis of solid materials, gases or chemical compounds in many industrial, scientific, environmental and security applications. Spectrometry assesses the amount of a given chemical, while chromatography separates mixed chemical substances. These applications require precise control for accurate measurement. Honeywell's airflow sensor measures the gas flowing through the instrument to validate that the correct amount of gas is flowing through the system, and then notifies the machine if it is not correct so that the machine can compensate. The flow rate eliminates outgassing and provides the most accurate result for the instrument.

Customer Benefits: Improves accuracy, reliability and stability.

Figure 4: Fuel Cells

Function: Fuel cells are chemically-generated energy that require controlled amounts of air or gas to optimize operation. Honeywell's airflow sensor enables precise control over the different gases involved in the fuel cell system to optimize performance.

Customer Benefits: Improves accuracy, reliability and stability.

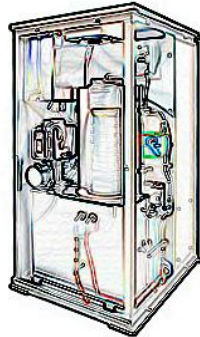


Figure 5: Gas Leak Detection

Function: Airflow sensors on a gas meter can detect small amounts of gas flow so that even the smallest leaks in a gas system are reported.

Customer Benefits: Provides accurate reporting and enhances safety.



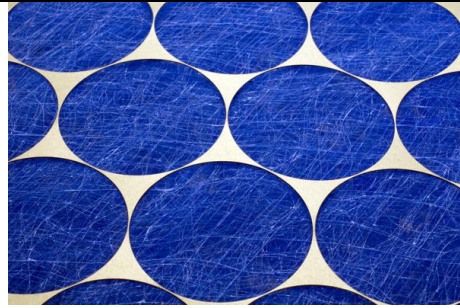
Figure 6: Gas Meters



Function: A gas meter is used to measure the volume of natural gas and propane used at residential, commercial and industrial buildings that consume fuel gas. Honeywell's airflow sensor measures the precise amount of gas used to provide accurate information for reporting needs.

Customer Benefits: Provides enhanced accuracy and reliability.

Figure 7: HVAC Filters



Function: Proper HVAC filter maintenance is crucial to keeping HVAC ductwork clean. If dirt accumulates in the ductwork and relative humidity reaches the dewpoint level, leading to condensation, then bacteria and mold may grow. Honeywell's airflow sensor may be used to inform the HVAC system when the filter is clogged so that it can be changed. The sensor is designed to detect flow at a very low pressure level (2 inches H₂O or less).

Customer Benefits: Helps the HVAC system produce cleaner, purer air, reduces indoor air quality-related problems and improves energy efficiency.

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Figure 8: VAV System on HVAC Systems

Function: A variable air volume (VAV) system within an HVAC system is a means of varying the amount of conditioned air in different parts of the building to meet its heating and cooling needs. Honeywell's airflow sensor helps determine the precise amount of air going through the ductwork to allow precise adjustment of airflow into rooms. Honeywell's airflow sensor is designed to detect flow at a very low pressure level (2 inches H₂O or less).

Customer Benefits: Helps improve occupant comfort.



Medical

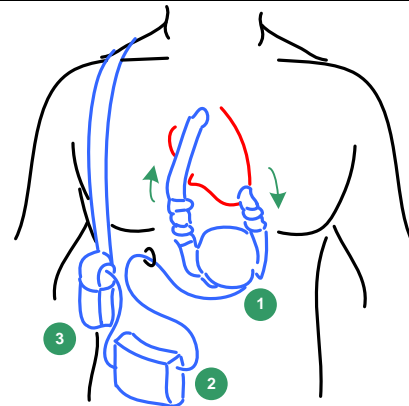
Figure 9: Anesthesia Delivery Machines



Function: Measures the flow of air, oxygen and nitrous oxide so that a specified mixture, as set by the doctor, is delivered to the patient.

Customer Benefits: Improves patient comfort and eases patient breathing; reliable and accurate.

Figure 10: Ventricular Assist Device



Function: A ventricular assist device (VAD) is a mechanical pump that assists the heart by pumping blood to the rest of the body for patients with congestive heart failure. Almost all VADs are made up of three parts:

- 1 Pump: A pump is placed inside or outside the body, and is connected to the heart by a tube. Blood travels from the heart, down the inflow tube, and into the VAD. The VAD then pumps the blood into the outflow tube and delivers it to a major blood vessel.
- 2 Controller: A system controller is placed outside the body to control the VAD. The Honeywell Zephyr™ Digital Airflow Sensor may be used in the controller to measure the flow of air so that the correct amount of air is delivered to the pump that drives blood flow through the heart. The VAD and the controller are connected by a cord that exits the body via an opening on the side of the abdomen.
- 3 Energy source: An outside energy source, either an AC power adapter or a battery pack, powers the pump.

Customer Benefits: Highly accurate, sensitive and stable; low pressure drop typically improves patient comfort; fast response time improves response to airflow change; low operating voltage and power consumption enhance portability

Figure 11: Hospital Diagnostics – Gas Chromatography



Function: Regulates the flow rate to eliminate outgassing.

Customer Benefits: Reliable, reduces the risk of contamination, accurate, stable and easy to implement.

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Figure 12: Nebulizers

Function: A nebulizer converts liquid medication to a mist so it can be more easily inhaled into the lungs, often ideal for infants or small children. Honeywell's airflow sensors help to deliver a specified concentration of medication.

Customer Benefits: Improves patient comfort; reliable and accurate.



Figure 13: Oxygen Concentrators

Function: Detects ultra-low levels at 0.1 cm³ to detect when the patient exhales and when the system should reduce airflow.

Customer Benefits: Improves patient comfort and eases patient breathing; quiet, portable and reliable.



Figure 14: Patient Monitoring Systems – Respiratory Monitoring



Function: Monitors the patient's respiratory function.

Customer Benefits: Improves measurement sensitivity and accuracy; portable and reliable.

Figure 15: Sleep Apnea Machines



Function: Monitors the patient's breathing and sends an output that can be used to reduce the flow of the machine's internal blower fan when the patient starts to exhale.

Customer Benefits: Improves patient comfort and eases patient breathing; quiet, portable and reliable.

Figure 16: Spirometers

Function: A spirometer is an instrument that measures lung capacity for patients with respiratory disorders. Honeywell's airflow sensor measures the airflow from the patient on exhalation.

Customer Benefits: Sensitive, accurate and reliable.



Figure 17: Ventilators

Function: Measures the flow of air, oxygen and nitrous oxide so that a specified mixture, as set by the doctor, is delivered to the patient.

Customer Benefits: Improves patient comfort and eases patient breathing; reliable.



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FEATURES AND BENEFITS (in addition to Value Propositions)

- Full calibration and temperature compensation typically allow customers to remove additional signal conditioning components from the PCB, reducing PCB size and costs often associated with those components (e.g., acquisition, inventory, assembly)
- Fast response time allows customer's application to respond quickly to airflow change, important in medical (i.e., anesthesia) and industrial (i.e., fume hood) applications
- High 12-bit resolution (digital) and high 11-bit resolution (analog) increase ability to sense small airflow changes, allowing customers to more precisely control their application
- Bidirectional flow sensing capability eliminates the need for two airflow sensors, helping customers reduce production costs and implementation time
- Insensitivity to mounting orientation allows customers to position sensor in the most optimal point in the system, eliminating concern for positional effects
- Insensitivity to altitude eliminates customer-implemented altitude adjustments in the system, easing integration and reducing production costs by not having to purchase additional sensors for altitude adjustments
- RoHS-compliant materials meet Directive 2002/95/EC

WARNING

PERSONAL INJURY

- DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

WARRANTY/REMEDY

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

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WARNING

MISUSE OF DOCUMENTATION

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

SALES AND SERVICE

Honeywell serves its customers through a worldwide network of sales offices, representatives and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact your local sales office or:

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