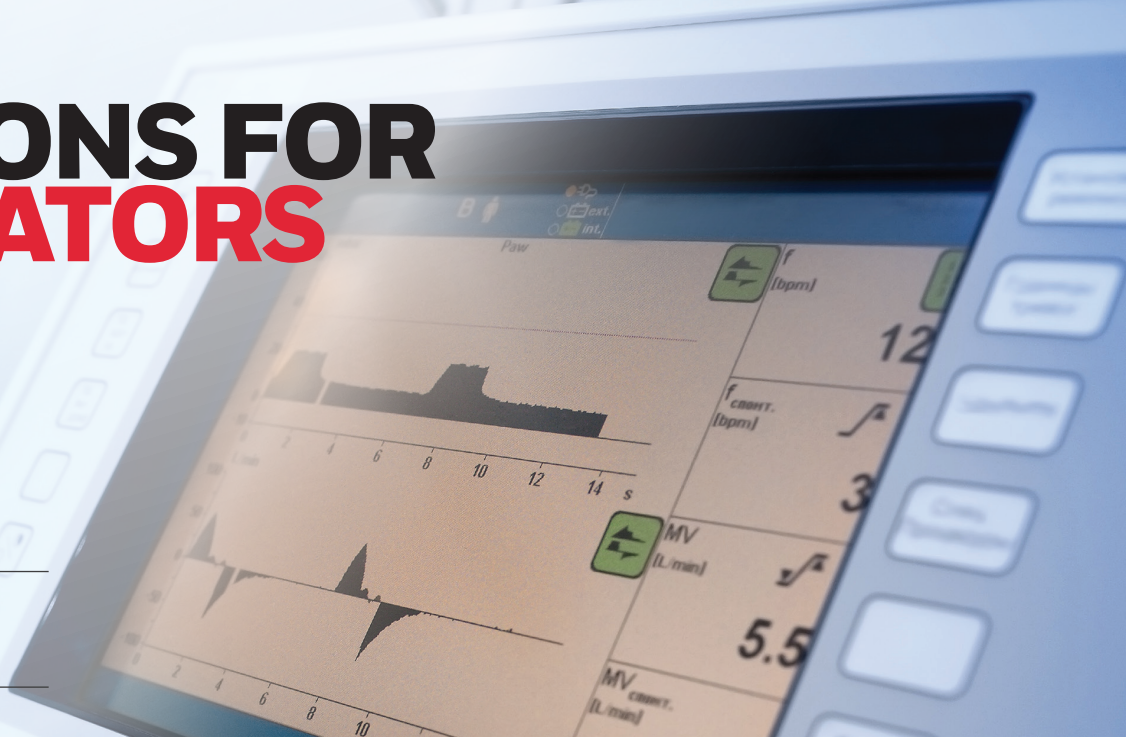
SOLUTIONS FOR VENTILATORS

Sensors and Switches



Application Note

A ventilator is designed to move a mixture of air and oxygen into and out of a patient's lungs to either assist in breathing or, in some cases, do the mechanical breathing for a patient who is breathing insufficiently or is physically unable to breathe.

BACKGROUND

Ventilators are used in hospital intensive care or high dependency units, during patient transport or at homes, to provide assisted breathing or to provide breathing for patients who are no longer able to breathe for themselves.

Supporting a vital function, the breathing machines need to be stable, accurate and reliable.

The assistance provided by ventilators is personalized for each patient and can be set and adapted at any time to the patient's specific breathing conditions and needs.

SOLUTIONS

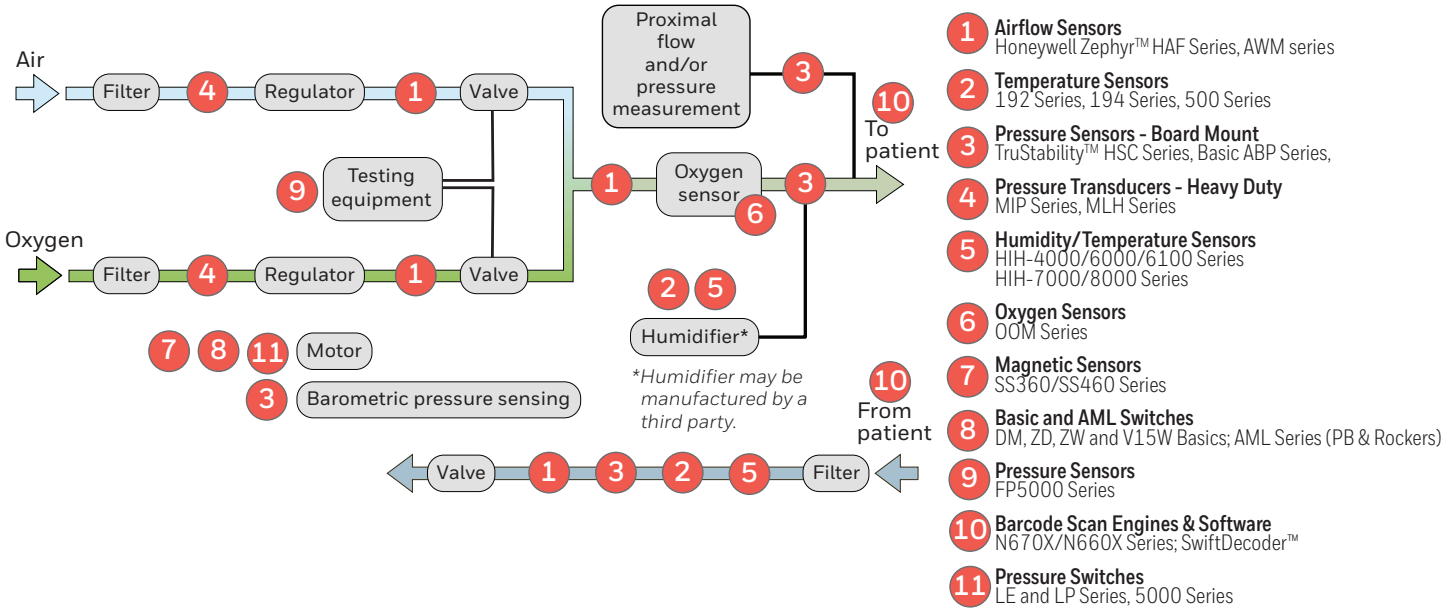
Honeywell sensor and switch solutions are designed to enhance the performance and reliability of ventilators, monitor patient breathing and ensure the safe and efficient operation of the equipment. (See Figure 1).

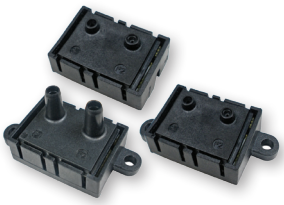
SOLUTIONS FOR VENTILATOR APPLICATIONS

- Airflow Sensors
- Temperature Sensors
- Pressure Sensors and Transducers
- Humidity/Temperature Sensors
- Oxygen Sensors
- Magnetic Sensors
- Basic and AML Switches
- Barcode Scan Engines & Software
- Pressure Switches

Honeywell

Figure 1. Solutions for Ventilator Applications

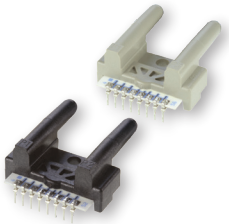




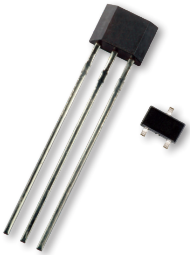
HAF Series - Low Flow



HAF Series - High Flow



AWM90000 Series



AIRFLOW SENSORS

Honeywell Zephyr™ HAF Series; AWM90000 Series

Functions/Actions

- Monitor a patient's breathing and ensure air/oxygen delivery is controlled efficiently
- Improve patient comfort

Honeywell airflow sensors (see Table 1) are designed to measure the flow of air, oxygen and nitrous oxide and monitor the patient's breathing. They may be used so that the desired mixture, as set by the doctor, is delivered to the patient. The total mixture that is delivered to the patient is also measured and displayed on the ventilator panel.

TABLE 1. AIRFLOW SENSORS FEATURES

HONEYWELL ZEPHYR™
• Low Total Error Band
• High accuracy
• Fast response time (1 ms)
• High stability and sensitivity at very low flows
• Wide airflow range
• Choice of port styles
AWM90000 SERIES
• Bi-directional sensing capability
• Highly stable null and full-scale
• Low pressure drop
• Compact package design
• Low hysteresis and repeatability errors
• Fast response time (1 ms typical)
• Low power consumption

MAGNETIC SENSORS

SS360/SS460

Function/Action

- Control motors and sense motor speed

These sensors are designed to provide reliable, highly accurate output for smooth motor control that reduces noise and vibration in the pump's motor assembly and improves its efficiency (see Table 2). Its solid state reliability often reduces repair and maintenance costs.

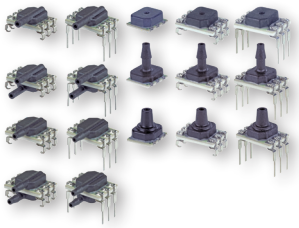
Their small size allows for design into many compact, automated, lower-cost assemblies. A thermally balanced integrated circuit is designed to provide proper fan functionality.

TABLE 2. MAGNETIC SENSORS FEATURES

SS360/SS460
• Fast response time
• No-chopper-stabilization
• High sensitivity; latching magnetics
• Wide operating voltage range



TruStability®
HSC Series, SSC Series



Basic ABP Series



MIP Series



MLH Series



FP5000
Series

PRESSURE SENSORS AND TRANSDUCERS

Board Mount: TruStability® HSC; Basic ABP & ABP2 Series
Heavy Duty: MIP, MLH Series; FP5000 Series

Functions/Actions

- Monitor a patient's breathing and detect if breathing deteriorates
- Detect when air and oxygen inlet filters are clogged and need to be replaced
- Heavy duty pressure sensors monitor and control the flow of air and oxygen delivered to ventilators
- Used to test ventilator valves

Honeywell board mount pressure sensors (see Table 3) are extensively used within medical equipment due to high levels of accuracy, sensitivity and reliability. Board mount pressure sensors are commonly utilized at ultra-low pressure ranges within ventilators to monitor a patient's breathing and detect when filters are clogged and need to be replaced.

Honeywell heavy duty pressure sensors (see Table 3) monitor and control the flow of air and oxygen delivered to ventilators. Heavy duty pressure sensors support a wide variety of media and are offered with a wide choice of ports and outputs.

Pressure transducers (see Table 3), known for their configurability, test the oxygen and air valves.

TABLE 3. PRESSURE SENSORS AND TRANSDUCERS FEATURES

TRUSTABILITY® HSC SERIES	MIP SERIES
• Pressure range 1.6 mbar to 10 bar • Measures absolute, gage and differential • Amplified and temperature compensated • Analogue or digital (I^2C/SPI) output • Supports liquids and dry gases	• Pressure range 1 bar to 60 bar • Extensive media compatibility • Ratiometric and current output • High over/burst protection • Wide choice of port options
BASIC ABP2/ABP SERIES	**MLH SERIES**
• Pressure range 5 mbar to 25 bar • Measures absolute, gage and differential • Amplified and temperature compensated • Analogue or digital (I^2C/SPI) output • Supports liquids and dry gases	• Pressure range 6 bar to 550 bar, 50 psi to 8,000 psi • Ratiometric and current output • High over/burst protection • Wide choice of port and connector options
	FP5000 SERIES
	• Pressure ranges from 10 in-H_2O [0.36 psi] up to 5,000 psi • Gage and absolute pressure types • Higher accuracy to 0.1 %FSS BFSL • Multiple output types: 0 Vdc to 5 Vdc, 0 Vdc to 10 Vdc, 4 mA to 20 mA • Multiple electrical and pressure connection options • Faster response and higher resolution



TEMPERATURE SENSORS

192/194 Series; 500 Series

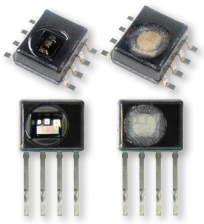
Function/Action

- Monitor and control the temperature of the air delivered to the patient, improving patient comfort

Warm, moist air from ventilators helps to provide the patient with comfortable breathing, reducing sore throats caused by breathing cold, dry air. The 192 Series and 194 Series (see Table 4) are installed directly into the air stream and are designed to monitor and control the air temperature. The sensor is coupled to a microcontroller designed to measure air stream temperature and interact with the controller that operates and regulates the temperature of the air stream. Packaged temperature sensors are available as discrete components for customer-built assemblies, or Honeywell can provide a full assembly solution that can simply pigtail into the system.

TABLE 4. TEMPERATURE SENSORS FEATURES

192/194 SERIES
• Resistance temperature curve interchangeability • Enhanced life • Small size • Epoxy coated
500 SERIES
• Air/gas, surface, immersion and liquid level • NTC type output • Enhanced sensitivity • Small package size • Easy to install • Enhanced reliability, accuracy, and stability/low drift



HUMIDITY/ TEMPERATURE SENSORS

Honeywell HumidIcon™ Products

Functions/Actions

- Monitor and control the temperature and moisture content of the air delivered to the patient
- Measure and monitor ambient temperature and humidity either in the hospital room or in the patient's breath/respiratory path

Honeywell humidity/temperature sensors (see Table 5) play a vital role in medical equipment and may be used to deliver warm and moist air, which enhances patient comfort. When introducing moisture into the air stream, it must be monitored and controlled. Honeywell's humidity sensors are installed either directly into the air stream or in a parallel branch. The sensor is coupled to a microcontroller designed to measure the humidity of the air stream and to interact with the controller that ensures the correct level of moisture is present.

TABLE 5. HUMIDITY & TEMPERATURE SENSORS FEATURES

HONEYWELL HUMIDICON™
• Enhanced long-term stability and reliability • Lowest total cost solution • Low supply voltage and low power consumption • High 14-bit humidity sensor resolution and 14 bit temperature sensor resolution • True, temperature-compensated digital I^2C or SPI output



OXYGEN SENSORS

OOMLF Series

Function/Action

- Measure and control oxygen concentration level of the air mixture delivered to the patient

Oxygen sensors are the oxygen-sensing component of an oxygen analyzer that measures oxygen concentration in breathing gas mixtures (see Table 6). Honeywell's lead-free oxygen sensors are an innovative one-to-one, drop-in replacement for existing lead-based oxygen sensors.

The OOMLF Series fulfills the lead-free RoHS II regulatory requirements. In addition, these oxygen sensors are also temperature compensated and provide high accuracy of the sensor signal, low signal drift and low cross interferences from common components of breathing gases.

TABLE 6. OXYGEN SENSORS FEATURES

OOMLF SERIES
• Compliant with European MDD (CE certification) • Compliant to EU RoHS Directive 2011/65/EU as amended by Directive 2015/863 • Meets ISO 80601-2-55 • Designed and manufactured according to EN ISO 13485 • Higher accuracy and reliability in response • Resistant to N_2O



BASIC AND AML PUSHBUTTON SWITCHES

DM, V15W, ZW Series; ZD Series; AML Series

Function/Action

- Used as on/off operator controls, as well as detection for covers, panels and doors

MICRO SWITCH basic switches can be used as presence/detection for covers, panels and doors acting as a fail-safe to prevent switching the machine when doors/panels are ajar (see Table 7). Several series are sealed to protect against fluids.

MICRO SWITCH AML Series are available as pushbuttons, key switches and rockers/paddles (see Table 7). They are often used in medical equipment as off/on operator controls on the external face of the equipment.

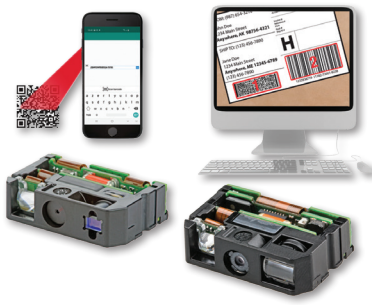
TABLE 7. BASIC AND PUSHBUTTON SWITCHES FEATURES

MICRO SWITCH BASICS

- Watertight, dust tight; leaded versions are sealed to IP67
- High current capacity
- Many different switch characteristics, actuators, and terminations
- Miniature and subminiature size
- Lower power consumption
- Choice of momentary, push-pull, or pull-to-cheat actions (DM)

AML PUSHBUTTONS

- Pushbuttons, paddles, rockers, key-actuated, and indicators within AML Series for coordinated panel appearance
- Less than 1.75 inch panel depth
- Furnished lighted or unlighted



BARCODE SCAN ENGINE & SOFTWARE

N670X, N660X, SwiftDecoder™

Functions/Actions

- Automated, more accurate and faster tracking of patient & caregiver IDs
- Ensures the right medication and equipment match the right patient

Honeywell barcode scan engines, modules and decoding software are used in medical applications to help improve patient safety and enhance operational effectiveness.

Tracking patient and caregiver IDs can enhance patient's safety when equipment is relocated from station to station. Within a station, historical readings can be bound to a particular patient if needed, by associating the patient ID to the readings as they are taken and/or uploaded. This positive confirmation provides assurance that the right readings match the right patient.

TABLE 8. SCAN ENGINES AND SOFTWARE FEATURES

N670X, N660X SERIES SCAN ENGINES

- Slim height makes it easier to fit compact devices
- Wider operational temperature range
- Available with SR or HD optics
- Delivers motion tolerance of up to 6 m/s
- Lower power consumption
- Parallel or MIPI interface availability

SWIFTDECODER™ SOFTWARE

- More quickly and reliably scans millions of barcodes
- Faster barcode scanning
- Capable of aggressive and more accurate reading
- Effectively reads poor quality barcodes



PRESSURE SWITCHES

LP Series; LE Series; 5000 Series

Function/Action

- Act as high pressure warnings in the event of error or over-pressure

Honeywell LP/LE pressure switches are often located on the output of the oxygen concentrator's pressure regulator and can act as high-pressure warnings in the event of an error (see Table 9). The switch could illuminate a warning light/sound, or simply cut power in the event of a dangerous, over-pressure event. In some cases, it may also just shut down the motor.

TABLE 9. PRESSURE SWITCHES FEATURES

LP SERIES, LE SERIES

- Pressure switching set point range: 3.5 psi to 150 psi
- Factory set and field adjustable
- 500 psi proof
- Configurable
- IP67 sealing rating
- Hysteresis option (LP)
- More than 15 pressure port options and over 30 electrical terminations
- Smart diagnostic technology option

5000 SERIES

- Designed to stand up to extended duty applications
- 0 psi to 150 psi
- Factory set
- Gold contacts
- 500 psi proof
- #8-32 screws, 1/4 in blade, Metripack options



⚠WARNING IMPROPER INSTALLATION

- Consult with local safety agencies and their requirements when designing a machine control link, interface and all control elements that affect safety.
- Strictly adhere to all installation instructions.

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 during the applicable warranty period. 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 that Honeywell, in its sole discretion, 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 Honeywell may provide application assistance personally, through our literature and the Honeywell web site, it is buyer's sole responsibility 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 writing. However, Honeywell assumes no responsibility for its use.

FOR MORE INFORMATION

Honeywell Advanced Sensing Technologies services its customers through a worldwide network of sales offices and distributors. For application assistance, current specifications, pricing, or the nearest Authorized Distributor, visit sps.honeywell.com/ast or call:

USA/Canada	+302 613 4491
Latin America	+1 305 805 8188
Europe	+44 1344 238258
Japan	+81 (0) 3-6730-7152
Singapore	+65 6355 2828
Greater China	+86 4006396841

Honeywell
Advanced Sensing Technologies
830 East Arapaho Road
Richardson, TX 75081
honeywell.com

009041-14-EN | 14 | 11/21
© 2021 Honeywell International Inc. All rights reserved.

Honeywell