

VENTILATORS

MEDICAL APPLICATION

Background

The modern medical ventilator is a sophisticated device that is used to supply human lungs with life-sustaining, breathable air. These devices are employed during times of medical emergency, surgical procedures, intensive care, and in-home long term care environments for patients that are unable to support healthy breathing function on their own. The air is delivered to the patient through both non-invasive (masks) and more invasive methods (i.e. intubation) for those patients suffering from long term or permanent conditions.

A ventilator uses pressure to move air or a mixture of gases (like oxygen and air) into the lungs. This pressure is known as positive pressure. You usually exhale (breathe out the air on your own), but in some situations the ventilator may have to perform this function for the person.

The ventilator air production/delivery system consists of a compressed air reservoir or turbine that supplies a metered volume of air/oxygen mixture to the patient. In those systems utilizing the compressed air method, a motor is typically used to drive a mechanical pump to fill the tank or reservoir. In the turbine driven system, the motor is used to rotate an impeller specifically designed to generate the required air flow and pressure. The compact and transportable battery powered devices have trended towards higher efficiency while the larger reservoir-based systems used in hospitals and long term care environments require a more cost-effective integrated motor/pump approach.

We use proprietary magnetic design technologies to produce custom solutions for performant, reliable and precise medical ventilators.

Solution

To control the inhalation and exhalation valves which help control the amount of air delivered to the patient, linear voice coil actuators (VCAs) are often used. These actuators must be designed to meet the ultra-small size and precise specifications required for life-critical medical applications such as ventilators.

Sensata has been a long time supplier of custom BLDC motion components and pressure sensors into the medical ventilator device market for more than three decades. Each application specific design benefits from decades of custom magnetic design expertise. VCA motors provide many advantages for use in valve control as their bi-directional capabilities, permanent magnets, and magnetic latches enable the VCAs to remain in position at either end of a stroke during a power failure, ensuring the valves stay open or closed in a disruptive power situation.

Sensata has also a broad portfolio of pressure sensors based on a variety of technologies with the configurability, approvals and high performance needed for highly demanding requirements in medical applications. Not all ventilators are the same but the common areas where pressure sensors are being used are as follows and as shown in the below diagram:

- Measurement of pressure between the filter and regulator from the initial air and oxygen inputs.
- After the oxygen sensor, which measures the Air/Oxygen mix, a pressure sensor is used to measure pressure applied to the patient (inhalation) and in some ventilators to measure pressure of the gases leading to an external humidifier.
- Pressure measurement is also taken from the patient when breathing back (exhalation) into to the ventilator.
- Dependent on the physical location of where the ventilator is being used barometric pressure measurement is taken to offset any elevation changes.

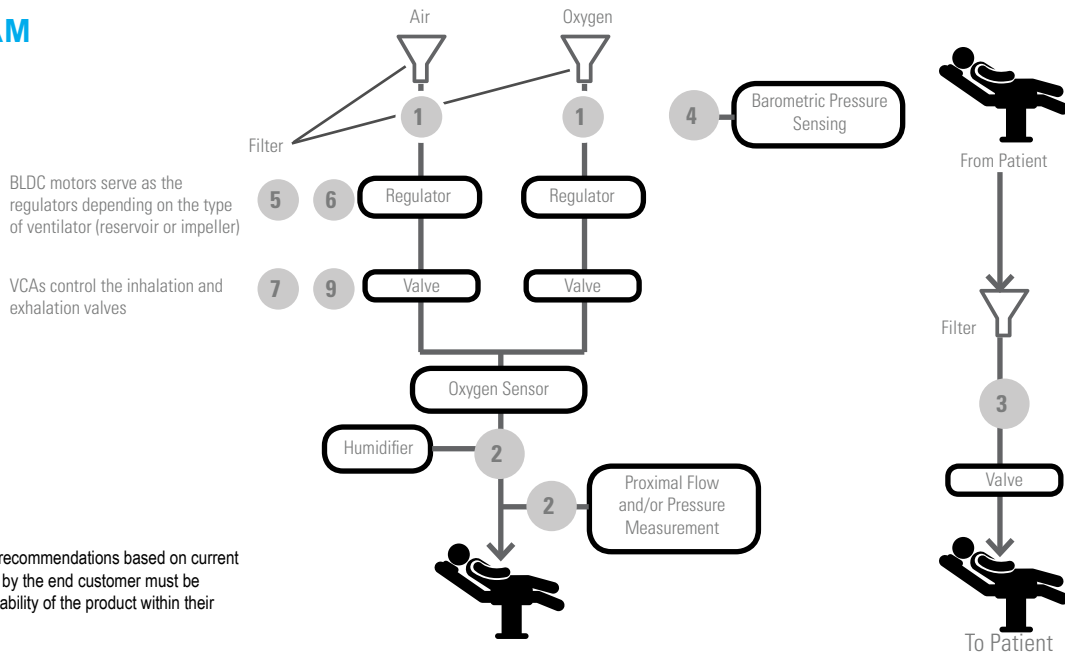


RECOMMENDED PRODUCTS

Reference on Diagram	Product	Features	Function	Brand
1	P500, P265 and PTA5000	Ceramic capacitive sense element with state of the art proprietary ASIC, available in brass or stainless steel housings.	Measurement of pressure between the filter and regulator from the initial air and oxygen inputs	Sensata Technologies
2, 3, 4	P992, P993, P1K, P1J	Differential pressure sensors incorporating a piezo-resistive sensing element in a compact package	Measurement of the pressure applied to the patient (inhalation); in some ventilators it measures the pressure of the gases leading to an external humidifier. Depending on the physical location of where the ventilator is being used, barometric pressure measurement is taken to offset any elevation changes.	Sensata Technologies
5,6	used Size 23, 2.0" O.D. BLDC Motors	Low Noise, Extended Life High Speed (30K RPM)	Drives the impeller, generating the required amount of air flow and pressure	BEI Kimco
7	Frameless 2.0" BLDC Motor	Cost Efficient	Used to generate the air volume in multi-function ventilator/Bi-PAP	BEI Kimco
8	Frameless Rotor/Stator 1.0" O.D.	High Speed (40KRPM)	Drives the impeller, generating the required amount of air flow and pressure	BEI Kimco
9	Linear VCA	Low Noise, High Reliability	Controls the inhalation and exhalation valves, helping to control the amount of air delivered to the patient	BEI Kimco



DIAGRAM



Please note that these are just recommendations based on current applications. A thorough review by the end customer must be performed to determine the suitability of the product within their application.

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