

SOLUTIONS FOR HEMATOLOGY ANALYZERS

Sensors and Switches

Application Note

Blood testing through the use of hematology analyzers is the primary and most common way of detecting anomalies and finding causes to illness and potential developing diseases.

BACKGROUND

Hematology analyzers are used for testing both human and animal blood in hospitals and research labs. Blood consists of two components: red blood cells (erythrocytes) account for 45% and white blood cells (leucocytes/thrombocytes/plasma) account for 55%. Plasma is the liquid that makes blood flow easily throughout the body. White blood cells are made of granulocytes (neutrophils, eosinophils, basophils) and agranulocytes (monocytes, lymphocytes). Hematology analyzers perform red/white blood cell counts, complete blood counts, reticulocyte analysis and coagulation tests.

Hematology analyzer technology

Hematology analyzers utilize three main physical technologies: electrical impedance, flow cytometry and fluorescent flow cytometry. Chemical reagents are used to lyse blood cells to enable precise measurements.

Electrical impedance

The traditional method for counting cells, and is used in almost every hematology analyzer. Whole blood is passed between two electrodes through an aperture so narrow that only one cell can pass through at a time. The impedance changes as a cell passes through, and this change is proportional to cell volume, resulting in a cell count and measure of volume. Hematology analyzers can count up to 10,000 cells/ second, and a typical impedance analysis can be carried out in less than a minute.

Flow cytometry

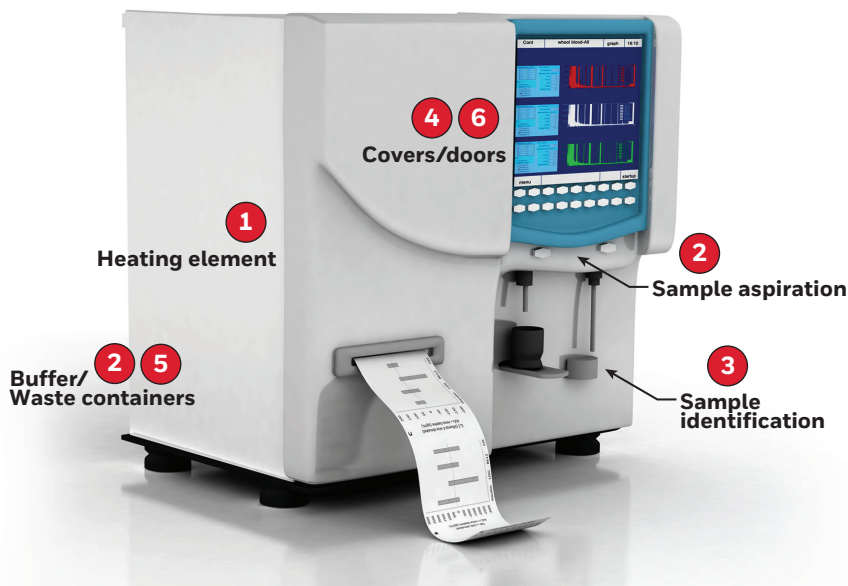
Laser flow cytometry is more costly than impedance analysis, as it requires expensive reagents, but returns more detailed information about the morphology of blood cells. A single-cell stream passes through a laser beam, the scattered light is measured at multiple angles to determine the cell's granularity, diameter and inner complexity.

SOLUTIONS FOR HEMATOLOGY ANALYZER APPLICATIONS

- Board-Mount Pressure Sensors
- Temperature Sensors
- Barcode Scan Engines & Software
- Magnetic Sensors
- Force Sensors
- Basic and AML Switches

Honeywell

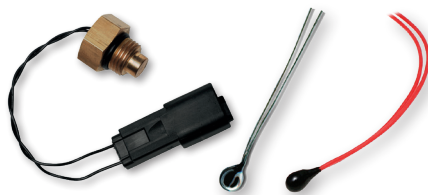
Figure 1. Solutions for Hematology Analyzers



- 1 Temperature Sensors**
192 Series, 194 Series, 500 Series
- 2 Board-Mount Pressure Sensors**
20PC; TruStability™ HSC Series, Basic ABP & ABP2 Series
- 3 Barcode Scan Engines & Software**
N670X/N660X Series; SwiftDecoder™
- 4 Magnetic Sensors**
SS360/SS460 Series
- 5 Force Sensors**
MicroForce FMA Series
- 6 Basic and AML Switches**
DM, ZD, ZW and V15W Basics; AML Series (PB & Rockers)

Fluorescent flow cytometry

Fluorescent reagents are used to extend the capabilities of flow cytometry. Manufacturers combine the above three technologies with uses of new reagents and data analysis tools to produce proprietary methods of testing.



TEMPERATURE SENSORS

[192/194 Series; 500 Series](#)

SOLUTIONS

Honeywell sensors and switches are used extensively within hematology analyzers equipment to ensure the accuracy of measurement and improve the efficiency, performance, reliability and safe operation of equipment (See Figure 1).

Function/Action

- Heat the blood sample to 37°C [98°F]
- Sense temperature throughout the analyzer

The 192/194 Series (see Table 1) is installed at various points within the analyzer to monitor the working temperature of the analyzers and control the fan operation. If the working temperature of the analyzer deviates from the operating specification then this can impact the performance of the equipment.

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 1. TEMPERATURE SENSOR FEATURES

192/194 SERIES

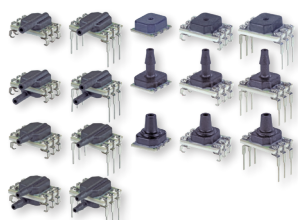
- Resistance temperature curve interchangeability
- Enhanced life
- Small size
- Epoxy coated

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



TruStability®
HSC Series



Basic ABP Series



20PC Series

PRESSURE SENSORS AND TRANSDUCERS

Board Mount: TruStability® HSC; Basic ABP & ABP2; 24PC FlowThrough Series

Functions/Actions

- Control the flow of blood
- Measurement of fluid volume
- Measurement of fluid level

Board mount pressure sensors (see Table 2) are extensively used within medical equipment due to high levels of accuracy, sensitivity, reliability and small-size. Pressure sensors are used to control the flow of blood through the analyzer, control the volume of reagent applied to the sample and monitor the liquid level in the reagent containers and detect when this needs to be refilled.

TABLE 2. BOARD MOUNT PRESSURE SENSOR FEATURES

TRUSTABILITY® HSC SERIES

- Pressure range 1.6 mbar to 10 bar
- Absolute, gage and differential
- Amplified and temperature compensated
- Analog or digital (I²C/SPI) output
- Supports liquids and dry gases

BASIC ABP2/ABP SERIES

- Pressure range 5 mbar to 12 bar
- Absolute, gage and differential
- Amplified and temperature compensated
- Analog or digital (I²C/SPI) output
- Supports liquids and dry gases

24PC FLOWTHROUGH SERIES

- Pressure range 0.5 psi to 250 psi
- Absolute, differential, wet-wet differential, gage and vacuum gage
- Robust media compatibility
- Selectable seals available to match media used
- Also available in DIP, SIP and SMT packages



BARCODE SCAN ENGINE & SOFTWARE

N670X, N660X, SwiftDecoder™

Functions/Actions

- Automated, more accurate and faster tracking of patient samples and results
- Ensures the right sample 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 samples, results and equipment can enhance patient's safety when the patient and/or equipment is relocated. Historical readings can be bound to a particular patient if needed, by associating the patient ID to the results.

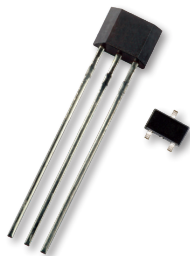
TABLE 3. SCAN ENGINE AND SOFTWARE FEATURES

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



MAGNETIC SENSORS

[SS360/SS460](#)

Function/Action

- Switches for covers and doors
- Open cover detection

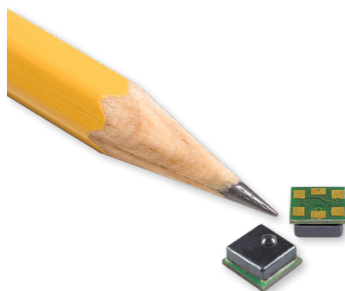
Magnetic Hall-effect Sensor ICs are designed to provide reliable, highly accurate output for smooth motor/fan control and operation that reduces noise and vibration and improves efficiency (see Table 4). Magnetic sensors can also be used to detect when a door panel or flap is open or ajar to ensure the safe operation of the equipment. 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 4. MAGNETIC SENSOR FEATURES

SS360/SS460

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



FORCE SENSORS

[MicroForce FMA Series](#)

Function/Action

- Detect presence and weight of blood specimens and reagent
- Filling level detection for buffer and waste containers

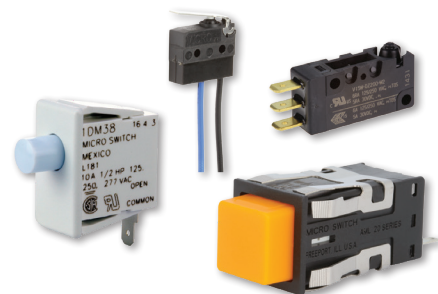
Force sensors (see Table 5) can be used in hematology analyzers to detect the presence and weight of blood specimens prior to the start of testing. In addition, they can be used to detect the presence and weight of the reagent containers to detect when these need to be refilled.

Direct mechanical coupling allows for easy interface with the sensor, coupling with tubing, membrane or a plunger, providing repeatable performance and a reliable mechanical interface to the application.

TABLE 5. FORCE SENSOR FEATURES

FMA SERIES

- Amplified and temperature compensated
- Accuracy: $\pm 2\%$ FSS typical
- Small form factor: 5 mm x 5 mm [0.20 in x 0.20 in]
- Digital (I²C/SPI) output
- Available in a wide variety of standard and configurable force ranges
- Stable, stainless steel sphere interface
- Internal diagnostic functions available



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 6). Several Series are sealed to protect against fluids.

MICRO SWITCH AML Series are available as pushbuttons, key switches and rockers/paddles (see Table 6). They are often used in medical equipment as off/on operator controls on the external face of the equipment.

TABLE 6. BASIC AND PUSHBUTTON SWITCH FEATURES

MICRO SWITCH BASIC SWITCHES

- 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-charge actions (DM)

AML PUSHBUTTON SWITCHES

- 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



⚠ 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.

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