

Sensors and Switches in Medical Chemistry and Immunoassay Analyzers

An Application Note

Background

Clinical laboratories conduct many complex and diverse tests in order to diagnose illnesses. Chemical and immunoassay analyzers (which can be combined into one piece of equipment) are used to determine the presence or concentration of a substance in blood, urine or serum. They are used to test glucose, cholesterol, hormones, drugs, infectious diseases, cardiac markers, tumor markers, etc., which helps diagnose and treat many diseases or other conditions such as cancer, diabetes, fertility, hepatitis, kidney conditions, and thyroid, to name a few.

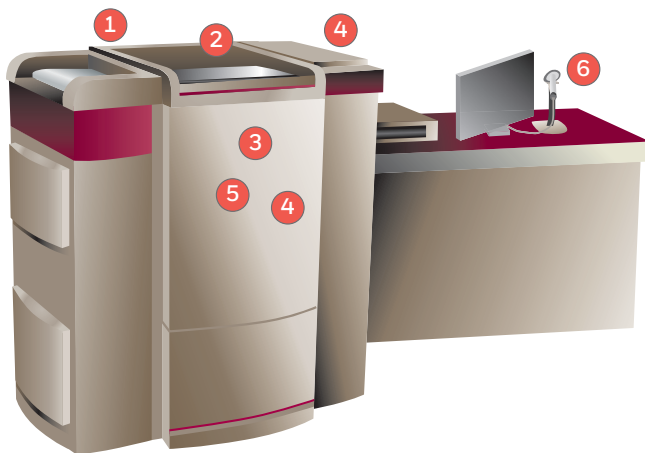
Various test methodologies may be available on a machine, including immunoassay, potentiometric, calorimetric and enzyme-linked immunosorbent assay (ELISA). While differences in test methodologies exist, overall operation is similar. Smaller-sized analyzers can be placed bench-top or on carts, while larger-sized equipment requires floor space.



Solutions

Honeywell manufactures many products that may be used to measure fluid volume; detect blockages; heat and cool samples/reagents; open and close covers/doors; humidity detection; filling level detection; sample carriage/reagent position detection; and positive patient confirmation and reading the physician's test orders off the barcode. (See Figure 1.)

Figure 1. Potential Honeywell Products Used in Chemistry Analyzers



- 1 Sample/Reagent Dispenser**
Measurement of fluid volume; detection of air and occlusion in pipetting system
Pressure Sensors - Board Mount
TruStability™ RSC Series, HSC Series, SSC Series, 24PC and 26PC Flow-Through Series
Pressure Transducers - Heavy Duty
MLH Series, PX2 Series

- 2 Incubator**
Heating and cooling of samples and reagents

- 3 Covers/Doors**
Open detection
Hall-effect Position Sensor ICs
SS351AT, SS451A
MICRO SWITCH Snap-in Panel Mount Basic Switches
DM Series
MICRO SWITCH Subminiature Basic Switches
ZM Series, ZX Series
- 4 Leak Detection System**
Measurement of high humidity levels to detect leaks
HIH6000, HIH6100, HIH7000 Series Honeywell HumidCon™ Digital Humidity/Temperature Sensors
- 5 Reagent or Waste Container**
Liquid level and position sensing: filling level detection for magnet and buffer container
Hall-effect Position Sensor ICs
SS351AT, SS451A
- 6 Sample Identification**
Barcode scanning for patient confirmation and, sometimes, verification of the physician's order
Ultra-Slim Area-Imaging Engine
N6600 Series
Barcode Decoding Software
SwiftDecoder™

Customer Needs of a Chemical or Immunoassay Analyzer (See Table 1 and Figure 2.)

Laboratory technicians often require the following of a chemical or immunoassay analyzer:

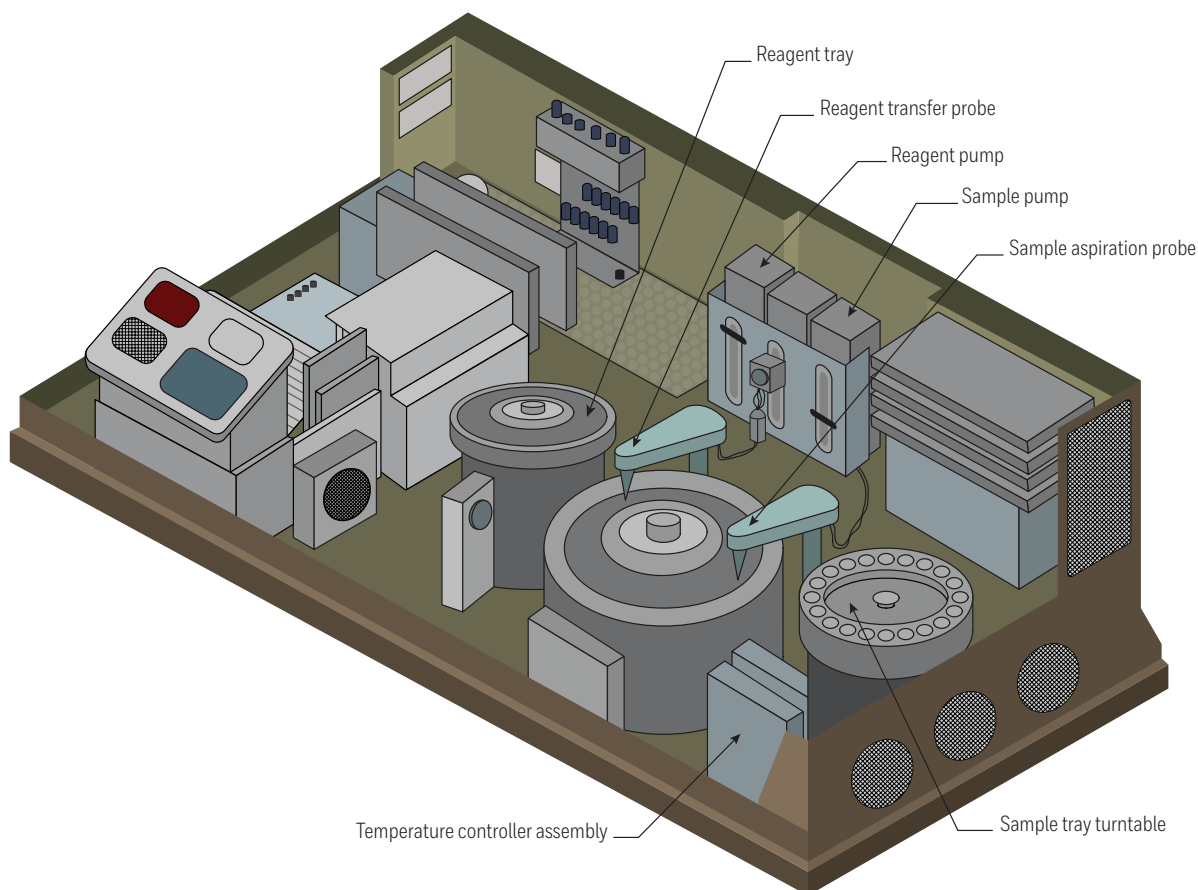
- Provides accurate, repeatable measurement results
- Provides fast delivery of measurement results

- Reduces or eliminates errors in data interpretation
- Contributes to efficient patient health care
- Reduces unscheduled downtime of equipment
- Provides a low MTBF (Mean Time Between Failure) rate
- Improves labor efficiency and effectiveness

Table 1. Operation of a Chemistry or Immunoassay Analyzer

	Reagent Loading	Sample Loading	Liquid Handling	Mixing/ Separating	Analyzing	Rinsing/ Cleaning
Operation	<ul style="list-style-type: none"> • Barcoded reagents are loaded • Reagents/buffer are kept cool at 4°C [39.2°F] for longevity 	<ul style="list-style-type: none"> • Test tube or vials are loaded • Barcode identification of samples • Samples are kept at ambient temperature or heated to 37°C [98.6°F] 	<ul style="list-style-type: none"> • Draw fluid from sample vial and reagent container • Transfer to pipette or test tube 	<ul style="list-style-type: none"> • Magnetic beads, for breaking and absorption • Agitation, centrifuge • Sample maintained at 37°C [98.6 °F] or heated 	<ul style="list-style-type: none"> • Sample reagent mix passes through photometer • Optical or electric analysis of fluid 	<ul style="list-style-type: none"> • Flush between tests • System test with water
Sensor/Switch	<ul style="list-style-type: none"> • Switches may be used on covers and doors • Liquid level of reagent/buffer volume • Optical barcode reader for reagent identification 	<ul style="list-style-type: none"> • Optical sensors detect position of vials and carriage movement • Barcode scan engine or software for positive patient confirmation before sampling 	<ul style="list-style-type: none"> • Capacitive liquid level for detection of immersion of pipette tip • Pressure sensor for air or occlusion detection; liquid media compatible • Humidity sensor provides leakage detection 	<ul style="list-style-type: none"> • Custom heater • Thermistor or temperature sensor monitors reagent and sample temperature 	<ul style="list-style-type: none"> • LED light source • Photodiode 	<ul style="list-style-type: none"> • Pressure sensor or transducer for flush monitoring • Liquid level for waste container

Figure 2. Operation of a Chemistry or Immunoassay Analyzer



Fluid Handling in a Chemistry Analyzer

Typically, in a chemistry analyzer, a pipette draws the sample fluid and deposits it into another vial or container for mixing or analysis. (See Figure 3.) Pressure sensors are used to ensure that the right amount of fluid is being measured while the sample is being drawn. They can also be used to detect obstructions or misplacement of the pipette in the sample vial (see Figure 4), and if air is being drawn instead of fluid.

These pressure sensors need to provide consistent accuracy, stability and repeatability at low pressure levels. However, in the same systems they also need to withstand higher pressures that are produced when the fluid pathway is flushed or cleaned. All of this is done while in direct contact with the liquid media being measured.

Customer Needs:

- Accurate sample volumes
- Stable and repeatable
- Eliminate carry-over between tests; thorough flushing
- Fast cycle times

Pressure Sensor Function in the Application:

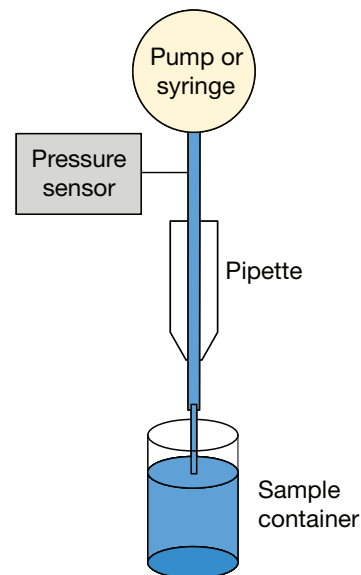
- Capable of detecting if the probe is clogged
- Capable of detecting if air is being drawn instead of fluid

Pressure Sensor Needs in the Application:

- Wet media compatibility
- Accuracy and repeatability at low pressures
- Ability to withstand higher pressures from flushing or cleaning

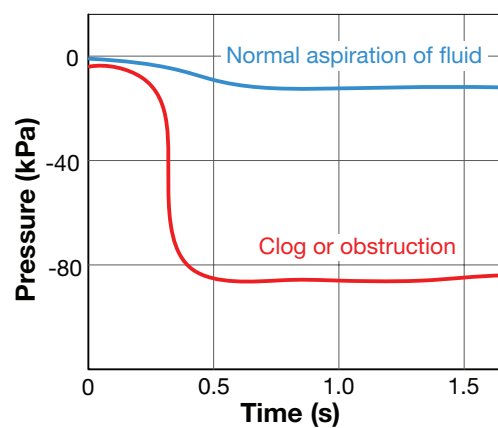
For more information about selecting pressure sensors for potential use in chemistry analyzers, view our white paper.

Figure 3. Fluid Handling in a Chemistry Analyzer



A pressure sensor ensures that the correct amount of fluid is being measured while the sample is being drawn.

Figure 4. Pressure Sensor Detecting Obstruction in a Pipette



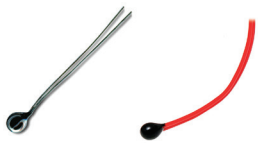
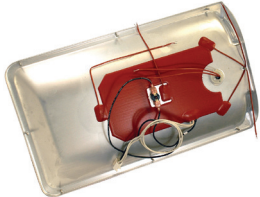
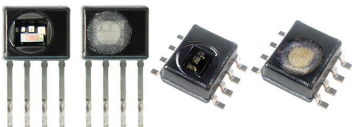



Some systems will compare the pressure profile of the aspiration to a known "good" or "bad" profile.

Table 2. Capabilities for Diagnostic and Analytical Equipment

Broad portfolio of products is designed to provide enhanced performance, accuracy, and reliability.

HONEYWELL PRODUCT	KEY FEATURES	FUNCTION IN APPLICATION
PRESSURE – BOARD MOUNT		
	TruStability™ RSC Series, HSC Series, SSC Series	Enhanced stability and accuracy; configurable; liquid media options; digital output; stable; accurate at low pressure; contamination and corrosion resistant; small size high resolution (RSC Series)
	24PC Series, 26PC Series	Wet/wet capability; variety of port configurations provide flexibility making pneumatic connections; miniature package; flow-through configurations; analog output
PRESSURE – HEAVY DUTY		
	MLH Series	Fully media-isolated for harsh chemicals; pressures up to 8,000 psi; multiple configurations simplify design; all metal wetted parts allow for potential use in a variety of fluid applications; rated IP65 or better for protection from most harsh environments
	PX2 Series	Liquid compatible; pressures up to 1000 psi; compatibility with a variety of harsh media, up to IP69K ingress protection and 100 V/m radiated immunity allow for use in tough environments
POSITION DETECTION		
	DM Series MICRO SWITCH Snap-in Panel Mount Basic Switches	Compact, lightweight design; accurate; repeatable and consistent performance up to one million lifecycles
	ZM Series, ZX Series MICRO SWITCH Subminiature Basic Switches	Subminiature package size; integral stainless steel levers; variety of electrical terminations
	SS351AT, SS451A Hall-effect Position Sensor ICs	Omnipolar; sensitive; flexible use; low voltage 3 Vdc capability; built-in reverse polarity protection; non-contact; long-term reliability, small size; easy to install

Table 2. Capabilities for Diagnostic and Analytical Equipment (continued)

HONEYWELL PRODUCT	KEY FEATURES	FUNCTION IN APPLICATION
THERMAL MANAGEMENT		
	192 Series, 194 Series Thermistors Resistance temperature curve; interchangeability; accurate; enhanced stability; enhanced life; cost effective; small; can be integrated into the heater assembly	May be used to monitor reagent and sample temperature at 37°C [98.6°F] during the sample loading process and the mixing/separation process to provide consistent test results.
	Heater Assemblies Custom flexible heater assemblies with thermal modeling capabilities for optimizing designs in unique applications; thermal modeling; one-stop-shop for assembly	May be used to monitor reagent and sample temperature at 37°C [98.6°F] during the mixing/separation process to provide consistent test results.
	HIH6000 Series, HIH6100 Series, HIH7000 Series Humidcon Digital Humidity/Temperature Sensors Combined humidity and temperature sensor; industry-leading long term stability (1.2 %RH over five years); enhanced reliability; enhanced relative humidity; more energy efficient; ultra-small package	May be used for leakage detection during the liquid handling process.
BARCODE SCANNING		
	CM Series Compact 2D Imager Module for Kiosk Data Capture Operations Self-contained, easy-to-mount 1D and 2D barcode scanning solution, whether decoding mobile phone screens or paper; selection of optics allow you to meet the performance requirements of your application	May be used for positive patient confirmation and sometimes verification of the physician's order prior to the reagent loading process and the sample loading process.
	N6600 Series Ultra-Slim Area-Imaging Engine High-performance barcode imaging; slim and compact; integrates Honeywell Adaptus 6.0 technology for unparalleled 1D and 2D scanning performance	
	SwiftDecoder™ Barcode Decoding and Character Recognition Software Accurate industrial grade decoding and character recognition; proven in millions of barcode scanners and OEM products worldwide	

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 acknowledgment 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.

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