



MAGNETIC SWITCH AND LATCH APPLICATIONS IN WHITE GOODS

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INTRODUCTION

In the rapidly evolving landscape of home appliances, or white goods, manufacturers are constantly seeking innovative solutions to enhance performance, reliability, and energy efficiency. At the heart of many modern white goods lies sophisticated sensing technology, and Allegro MicroSystems stands as a leader in providing highly flexible, robust, and precise Hall-effect switches and latches.

This application note explores how Allegro Hall-effect switches and latches, particularly those featuring industry-leading low-jitter performance, are revolutionizing key applications within white goods. This application note explores their use in critical functions such as motor control for pumps, fans, and compressors, fluid level detection, valve position sensing, open/close mechanisms, flow metering, and even novel applications like dishwasher spray arm obstruction detection. By understanding the inherent advantages of these sensors, especially the impact of their low jitter, designers can achieve quieter operation, higher efficiency, and superior control in their next-generation appliances.

MOTOR CONTROL FOR PUMPS, FANS, AND COMPRESSORS

Brushless DC (BLDC) motors are ubiquitous in modern white goods—from washing machines and dishwashers to refrigerators—due to their superior efficiency, quiet operation, and longevity.

Allegro magnetic latch sensors are a key component of the DC motors used in pumps and fans found in many white goods platforms. In BLDC motors, Hall-effect latches are commonly used for commutation, position, and speed sensing. Many white goods, such as washing machines, dishwashers, and refrigerators, use BLDC motors due to their highly efficient and quiet operation. Latches are particularly suitable for these types of rotational applications since they remember their state even after the magnetic field is removed, a critical function for precise motor control. While not required for commutation in brushed DC motors, Hall latches are useful for encoding functions and to detect speed and position within the motor.

One of the key features of Allegro latches for BLDC motor control of white goods pumps and fans is their low jitter. Jitter is a key parameter for DC motor control since it determines the cycle-to-cycle repeatability of the Hall sensor control signal. This in turn determines the precision with which the motor stator winding can be excited relative to the rotor position. The higher precision of a low-jitter sensor yields a motor that operates more quietly and with higher torque and efficiency. Allegro has many parts with industry-leading jitter specifications.

A low jitter sensor translates to:

- **Quieter Operation:** More precise commutation reduces unwanted vibrations and acoustic noise, a key differentiator in home appliances.
- **Higher Torque and Efficiency:** Accurate timing ensures optimal power delivery, maximizing the motor torque output and overall energy efficiency, which is crucial for meeting stringent energy consumption standards.

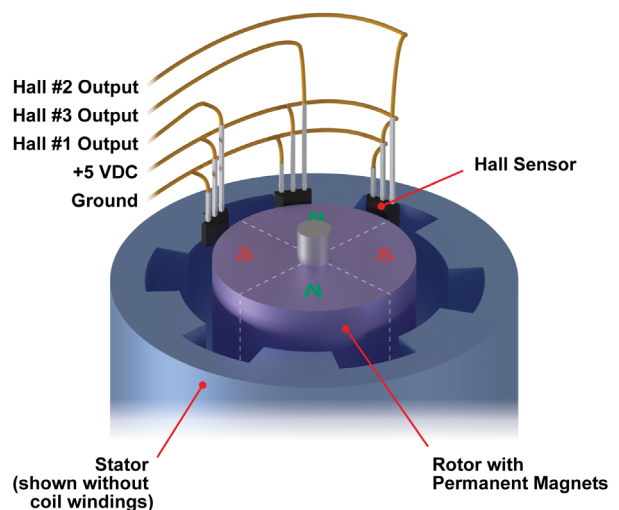
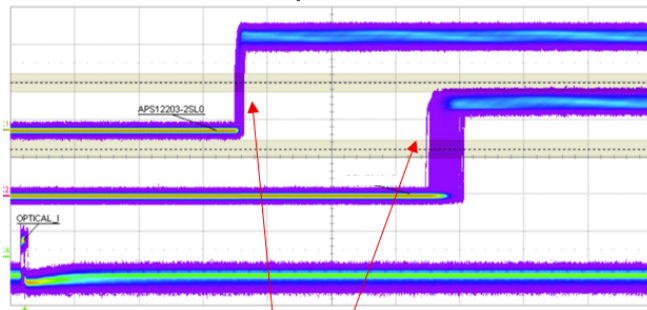


Figure 1: Brushless DC (BLDC) motor commutation for white goods using Hall-effect latch sensors



Allegro performs 4.5 times better than competition

Figure 2: Allegro Gen 3 Products vs. Competitor

For washing machines, precision DC motors are critical to managing the wash and spin cycles of the drum in both top-load and front-load machines. Having low jitter enables exact management of wash and spin cycles, protecting fabrics, and conserving water. In dishwashers, BLDC motors can be used to drive the circulation pump that pushes water throughout the appliance for washing and rinsing dishes and utensils. In refrigerators, motors are used broadly for both cooling distribution fans and compressors within the refrigerant system, and Allegro low-jitter devices provide optimal performance for temperature regulation.



Figure 3: Hall-effect latches for motor control in white goods

FLUID LEVEL DETECTION

Accurate fluid level sensing is vital in appliances like dishwashers, washing machines, coffee makers, and water coolers. For these use cases, Hall-effect latches are an excellent sensor choice. Within the dishwasher, or washing machine, a magnetic float rises and falls with the internal fluid level of the appliance. One or more Allegro Hall latch sensors can precisely detect the position of the magnet and therefore fluid levels.

When more than one level must be detected, [a series or ladder](#)

[of latches](#) can be used, with each latch triggered at a set level threshold.

Allegro latch high-accuracy magnetic thresholds ensure reliable and repeatable level detection, preventing overflows or insufficient water usage.

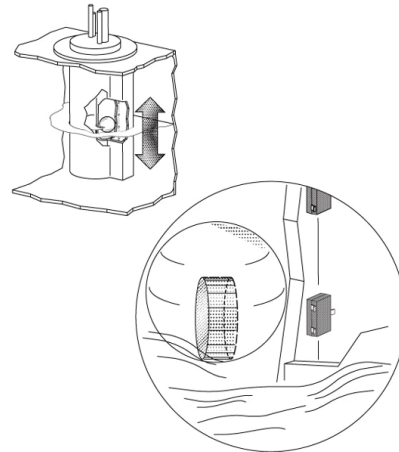


Figure 4: Using a floating magnet and Hall-effect latch(s) to detect fluid levels

VALVE POSITION SENSING

Regulating fluid or gas flow in white goods often relies on precise valve control. Allegro latches or switches can accurately detect the open or closed position of these valves. A common setup involves a two-pole ring magnet rotating with the valve. An Allegro Hall sensor detects the magnetic field, providing unambiguous feedback on the state of the valve. The consistent and reliable switching behavior, supported by the stable output of Allegro sensors, ensures that the control system of the appliance receives accurate and timely information about the valve position, critical for safe and efficient operation.

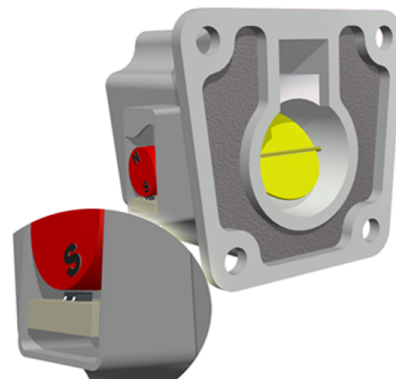


Figure 5: Application using a magnet and a Hall sensor latch or switch to detect the position of a valve

OPEN AND CLOSE DETECT APPLICATIONS

Magnetic switch sensors are a good choice for white goods applications where the closure status of a door, lid, shelf, or other moving part must be detected. Dishwashers, refrigerators, vacuum cleaners, air conditioners, washing machines, and many other white goods platforms typically require multiple open/close detect sensors in a single platform.

Some specific examples of open/close detection in white goods include:

- **Washing Machine/Dryer Doors:** To detect if the door is open or closed for safety interlocks and operational control.
- **Refrigerator Doors:** For sensing door status, which can trigger internal lights or alarms if left open.



- **Dishwasher Trays/Drawers:** To confirm proper closure before operation.
- **Motorized Window Blinds/Garage Door Openers:** While not strictly white goods, these applications share similar position sensing requirements.
- **Control Knob Rotation:** Magnetic switches can be used to detect the position of control knobs commonly found in appliances and other white goods. A typical implementation is to use a notched ferromagnetic vane attached to the knob that rotates alongside the knob. Placed between a fixed magnet and a Hall sensor, the ferromagnetic vane interrupts the magnetic field as the knob rotates, allowing its position to be determined.



Figure 7: Washing machine flow meter

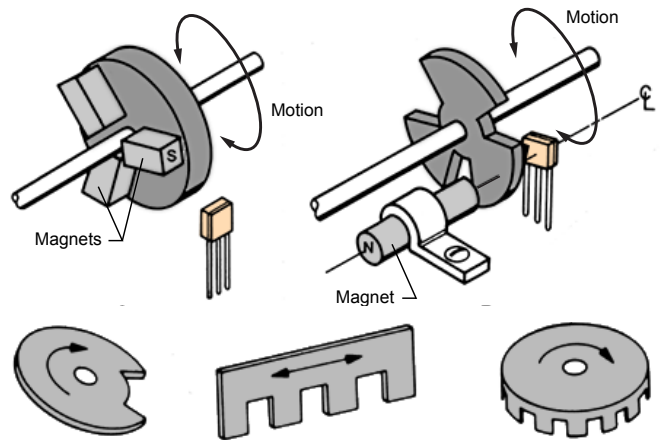


Figure 6: Fixed magnet and ferromagnetic vane configuration for knob rotation detection. Also, examples of different vane configurations

Allegro has a wide range of switching thresholds (15 to 400 G) and even customer-selectable thresholds, providing highly flexible magnetic sensor solutions for designers developing open/close detect solutions for white goods.

FLOW METERING

Water flow metering, essential in washing machines, dishwashers, and filtered water dispensers in refrigerators, also benefits from Allegro Hall sensor technology

The construction of a flow meter for white goods is simple. Water flows through the filter and causes an internal impellor to rotate. The speed of rotation of the impellor is proportional to the flow rate of the water through the meter which can in turn be used to determine both flow rate and volumes.

To measure the rotation of the internal impellor, a small magnet (or magnetic material) can be placed on one of the blades. A Hall sensor can be placed on the meter housing to detect the magnet on the internal impellor. The output of the Hall switch is a digital pulse train whose frequency is proportional to the speed of rotation of the impellor.

In this application, the low jitter of Allegro Hall switches ensures a highly consistent and accurate pulse train, leading to more precise and reliable flow measurements, which is critical for water conservation and optimal appliance performance.

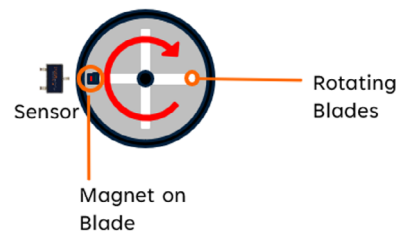


Figure 8: Flow metering with a magnetic switch Hall sensor

DISHWASHER SPRAY ARM OBSTRUCTION DETECTION

One use case for magnetic sensors is spray arm obstruction detection in dishwashers. In a dishwasher, the spray arm rotates and distributes the steam, hot water, and air needed to clean and dry dishes and utensils. Under certain scenarios, a poorly positioned dish could disrupt the free rotation of the spray arm, leading to improper operation, poor cleaning, or potential damage to the appliance.

To detect an obstruction, a small magnet can be placed on the underside of the spray arm, and a Hall switch can be placed at the bottom of the dishwasher. During operation, the normal rotation of the spray arm is detected by the Hall switch. If the spray arm becomes obstructed and stops rotating, the Hall switch is not triggered by the passing magnet on the spray arm. The system MCU can use this information to determine that the spray arm is likely obstructed, stop the operation of the dishwasher, and issue a warning to the user to have the obstruction cleared.

Allegro switches with very low magnetic thresholds can be the perfect choice for this type of application where there can be large air gaps between the magnet and the sensor. Having large air gaps creates a small magnetic field when the magnet is on top of the sensor. However, Allegro can deal with this issue by providing switches with very low magnetic switch points.

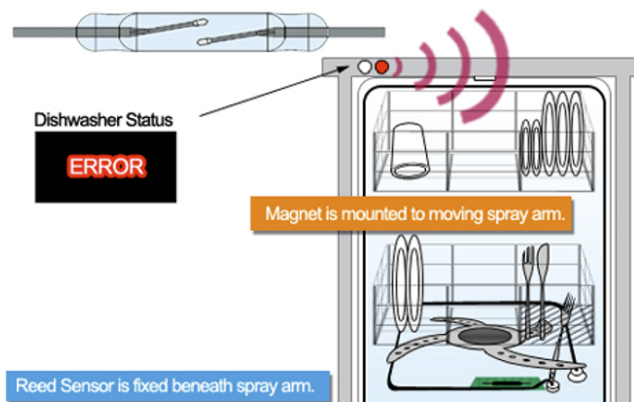


Figure 9: Spray arm obstruction detection with a Hall switch versus a reed sensor

CONCLUSION

Allegro Hall-effect switches and latches are exceptionally versatile sensors, offering significant advantages for a wide range of applications in white goods (washers, dryers, refrigerators, etc.) due to their precision, reliability, affordability, and ability to operate across a range of challenging environments. They offer several benefits compared to reed switches, especially providing a longer lifetime and higher reliability. Allegro offers the widest switches and latches portfolio on the market, with higher performance compared to competitors. They are suitable for any present and future white goods applications, with different magnetic switch points (even customer programmable), micro-power, and nanopower options, 2-wire and 3-wire outputs, different axis sensing (X, Y, or Z), and many other options leading the way towards more intelligent, efficient, and reliable home appliances.

Revision History

Number	Date	Description
-	October 22, 2025	Initial release

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