Application Brief

Position Sensing in Gaming, AR, and VR Controllers

Patrick Simmons *Power Switches*

Sensing in Controllers

In this digital age there are many types of controls for interfacing with video games and machines. These controls can take the form of triggers, joysticks, levers, rocker switches, and buttons. In the past, many of these controls were executed with metal contact or resistive designs. Since dust and dirt can disrupt metal contacts, and degradation can lead to drift in resistive wiper devices, Hall-effect sensors can be seen as a robust and viable alternative.

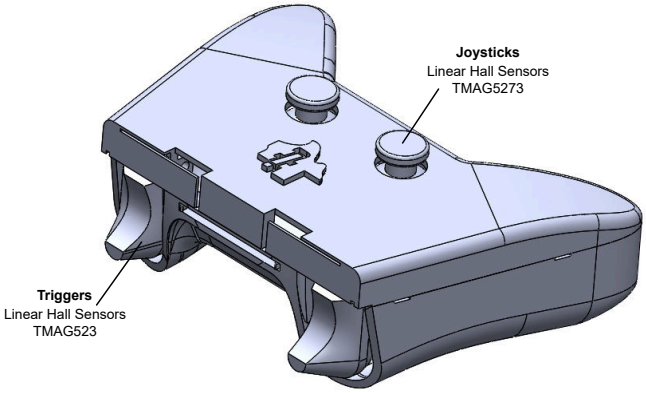

Figure 1. Gaming Controller Controls

Low-Power Hall-Effect Designs

Hall-Effect sensors can be a low power design. The *Low Power Design Using Hall-Effect Sensors* application note provides examples of how multiple TMAG5253 linear output sensors can have their enable pins multiplexed so that the devices are sharing an ADC pin and are enabled long enough to periodically capture user input and otherwise remain in a low power state such as in Figure 2. As the device enable transition period and device bandwidth are sufficiently fast, the active time that the sensor is enabled is short without compromising accuracy or user experience. Such devices can be used for triggers, joysticks, levers, and any other control that can benefit from a variable analog response.

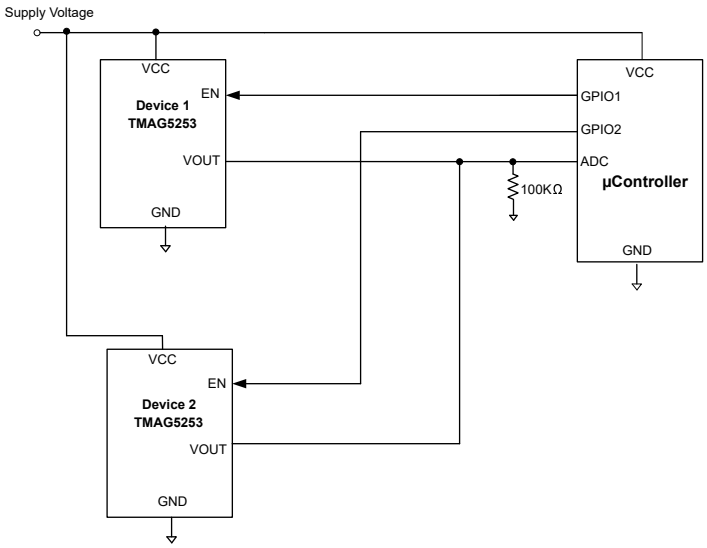

Figure 2. Duty Cycled Sensors

For those who prefer a digital output response device, TMAG5273 and TMAG5170 devices are possible alternatives. These devices have features that include self duty cycling, conversion on demand, and wake on magnetic threshold detection. These features reduce the hardware and software design effort required for optimizing the power consumption of a controller's sensing design.

Designing with a Hall-Effect Sensor

While the robustness and power handling of the aforementioned sensors can be appealing, some engineers can hesitate to design with a Hall-effect sensor due to the perceived complexity of magnetic fields. Fortunately, TI has produced a program to help reduce the analytical burden and has also put together various application notes providing details on how to design such controls. The Magnetic-Sense-Enhanced-Proximity tool is the latest tool allowing the user to enter magnet dimensions, relative magnet-sensor placement, range of motion, and device selection. With TI software access approval, users can work with this tool to quickly calculate what field to expect in their application and determine if the device output signal is sufficiently large and free of aliasing.

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The following is a list of documents presenting a general design with guidelines for a particular control.

- *Gaming Trigger With Hall-Effect Sensors*, application note.
- *Joysticks With Hall-Effect Sensors*, application note.
- *HMI Rocker Switch With Hall-Effect Switches*, application note.
- *Inductive Touch and Magnetic Dial Contactless User-Interface Reference Design*.

Table 1. Alternative Device Recommendation

Device	Description	Design Considerations
TMAG5273	Linear 3D Hall-effect position sensor with I2Cinterface available in 6 pin SOT-23 package	Multi-axis sensing with in-chip angle calculation.
TMAG5253	Ratiometric Linear Hall Effect sensor with analog output and enable pin	Sensing fields along the z-axis of the device at multiple device locations.

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