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.

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.

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.
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

<table>
<thead>
<tr>
<th>Device</th>
<th>Description</th>
<th>Design Considerations</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMAG5273</td>
<td>Linear 3D Hall-effect position sensor with I2C interface available in 6 pin SOT-23 package</td>
<td>Multi-axis sensing with in-chip angle calculation.</td>
</tr>
<tr>
<td>TMAG5253</td>
<td>Ratiometric Linear Hall Effect sensor with analog output and enable pin</td>
<td>Sensing fields along the z-axis of the device at multiple device locations.</td>
</tr>
</tbody>
</table>
IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to TI's Terms of Sale or other applicable terms available either on ti.com or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2023, Texas Instruments Incorporated