HAL403 Linear Hall Effect Sensor – Engineering Translation & Design Notes

1. Overview

HAL403 is a compact, general-purpose linear Hall-effect sensor. Its output voltage is proportional to the magnetic flux density applied to the sensitive surface. At zero magnetic field, the output is nominally VDD/2. For TO/SW packages, the presence of a north magnetic pole on the marked surface causes the output voltage to increase linearly with magnetic field strength; a south pole causes a linear decrease. For SO packages, the magnetic polarity response is reversed. The device integrates thin-film resistors to improve temperature stability and accuracy, and features low output noise, eliminating the need for external filtering. The operating temperature range is –40 °C to +150 °C, suitable for industrial environments.

2. Key Features

- Good long-term stability
- Rail-to-rail output
- Low power consumption (VDD = 1.8 V, IDD < 1.5 mA)
- High sensitivity (VDD = 3.3 V, typ. 4.1 mV/Gauss)

3. Typical Applications

- Joysticks
- Motion detection
- Magnetic-axis keyboards
- Rotary encoders

4. Pin Definitions

Pin	Name	Description
1	VDD	Supply voltage
2	GND	Ground
3	OUT	Analog output

5. Electrical Characteristics (TA = 25 °C)

Supply voltage range: 1.6 V to 3.6 V (absolute max 7 V). Supply current: typ. 0.8 mA at 1.8 V, typ. 1.4 mA at 3.3 V. Output resistance: typ. 10 kΩ. Output noise (BW = 10 Hz–10 kHz): typ. 2.4 mVRMS. Bandwidth: typ. 5 kHz. Startup time: typ. 4 µs, max 8 µs (dvcc/dt ≥ 5 V/µs).

6. Magnetic Characteristics

Sensitivity at VDD = 3.3 V: min 3.6, typ. 4.1, max 4.6 mV/Gauss. Sensitivity at VDD = 1.8 V: typ. 2.2 mV/Gauss. Linear magnetic field range: ±390 Gs (rated), ±500 Gs max. Linearity error: ±1.5 % of full scale. Zero-field output voltage (VDD = 3.3 V): typ. 1.65 V. Zero-offset drift: ±0.10 %/°C.

7. Recommended Application Circuit

A standard decoupling configuration is recommended: place a 0.1 µF ceramic capacitor (C1) between VDD and GND, and an optional 0.1 µF capacitor (C2) from OUT to GND for additional noise suppression if required. Keep traces short and provide a solid ground plane for best noise performance.

8. Engineering Design Notes

- The ratiometric output (VOUT ≈ VDD/2 at 0 Gs) simplifies ADC interfacing when using the same reference as VDD.

- For maximum linearity, operate within the ±390 Gs magnetic range.

- Temperature drift should be considered in precision applications; calibration may be required.

- Avoid placing strong stray magnetic fields or ferromagnetic materials near the sensor.

- Use proper ESD handling; device rating is HBM ±4 kV.