Contents

1. Introduction

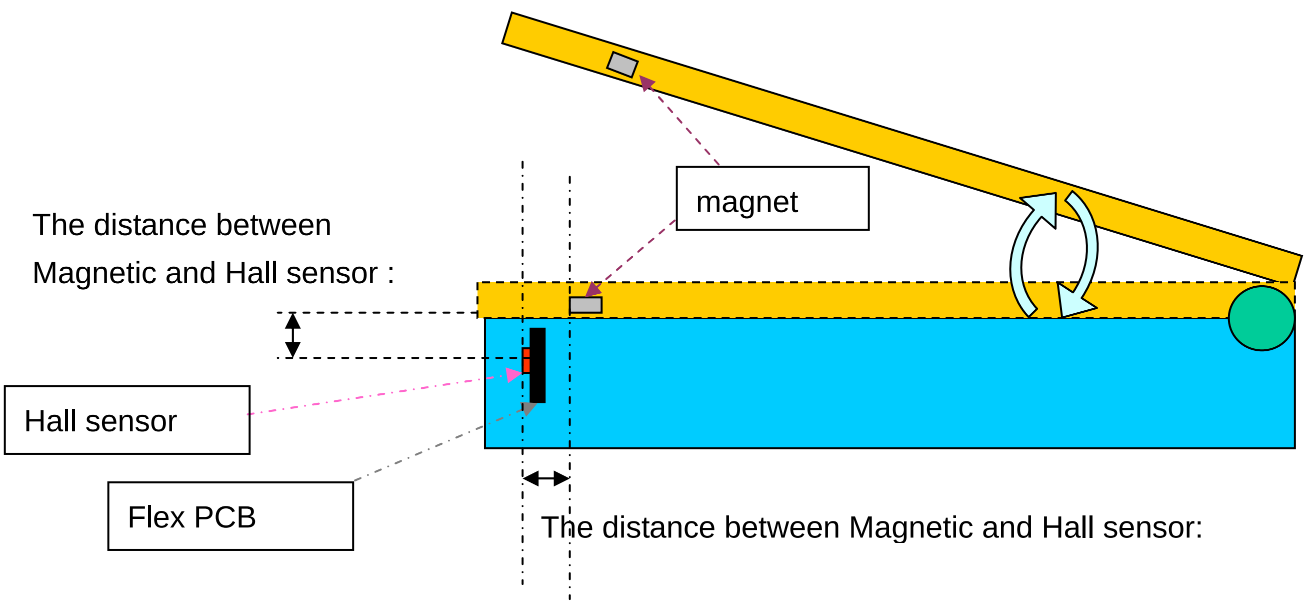
Omni-polar Hall effect sensor switches are activated by a magnetic field. In the absence of the magnetic field, Omni-polar Hall effect sensor switches are designed to be OFF. They will turn ON only if subjected to a magnetic field with sufficient strength.

To operate the switch, the magnetic flux lines must be perpendicular to this active area in Hall switches. In practice, a close approach to the IC body of a Hall switch by the South pole (or North pole) of a small permanent magnet will cause the output MOSFET to turn ON.

Simulation data in this application note shows that the AH1802 Hall Sensor with higher sensitivity can work in the vertical orientation position with regards to the magnet's field strength. Applications that require the Hall sensor to be non-perpendicular to the magnet or facing the magnet from the side will still operate properly. An example is that a flex PCB is oriented at a 90 degree in the Notebook cover switch while the magnet is placed on NB plane and AH1802 Hall sensor is located under the keyboard (vertically) thus preventing the device from being perpendicular to the magnet for maximum sensing (See Figure 1).

2. Simulation conditions

2.1 Test Structure



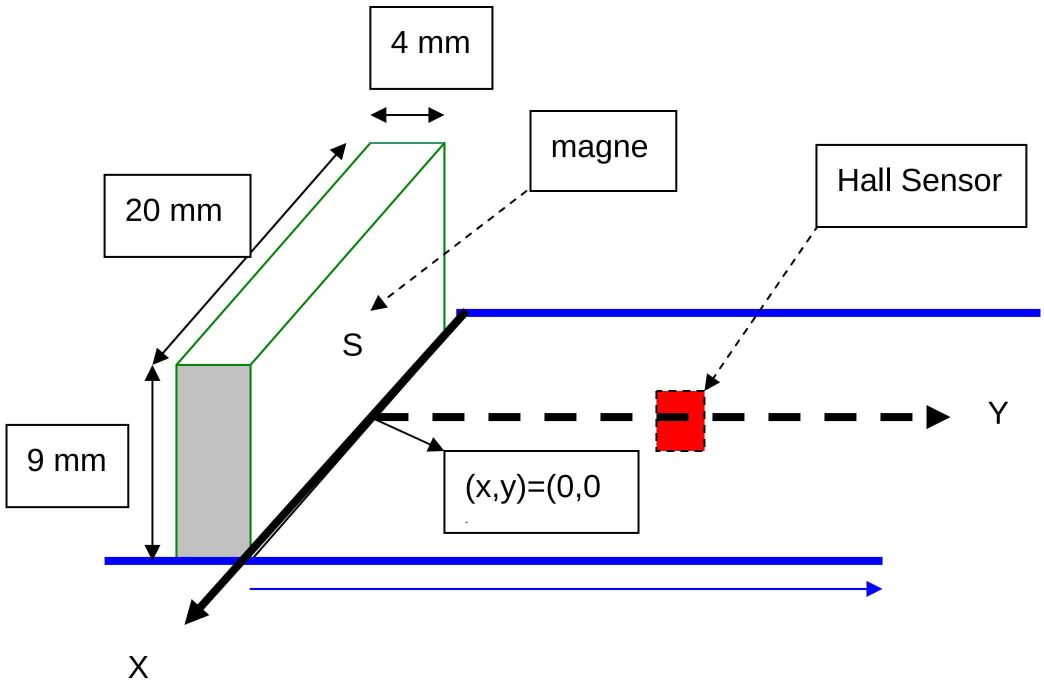


Figure 1

2.2 Magnetic Measurement

In order to measure the magnetic flux which varies with distance from X axis and Y axis, each device is tested for sensitivity using Gauss Meter – results are recorded and plotted in the following sensitivity table, showing areas of sensitivity as X (or Y) as oriented in different directions by 2mm.

2.3 The color code scheme is defined in the following table:

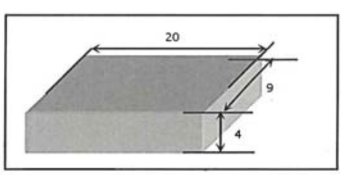
Yellow	**Active for cover close: Magnetic approach, Hall IC Output Low**
Green	**Release for cover open: Magnetic leave, Hall IC Output High**

2.4 AH1802 Magnetic Characteristics

(1mT=10 Gauss)

Symbol	Characteristic	Min	Typ.	Max	Unit
Bops(south pole to brand side)	Operate Point	20	28	40	Gauss
Bopn(north pole to brand side)		-40	-28	-20	
Brps(south pole to brand side)	Release Point	10	20	-	
Brpn(north pole to brand side)		-	-20	-10	
Bhy(|Bopx – Brpx|)	Hysteresis	5	8	-	

2.5 Permanent magnet information



size(D*W*L) [mm]	9*4*20
material	ferrite (Ba、Sr)
Br [mT]	330~380
	1mt=10 Gauss

3. Simulation results

3.1 The typical case: Closed Open

AH1802		BOP(typical)= 28 Gauss														
		Y axis (mm)														
		2 mm	4 mm	6 mm	8 mm	10 mm	12 mm	14 mm	16 mm	18 mm	20 mm	22 mm	24 mm	26 mm	28 mm	
X axis (mm)	26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss
	24 mm	13.9	15.7	15.6	14.3	13.4	12.6	11.3	9.7	8.5	7.4	6.8	5.7	4.4	4.2	Gauss
	22 mm	20.5	21.1	21.5	20.5	19.4	17.1	14.7	12.2	10.5	9.3	7.8	6.1	5.7	5.1	Gauss
	20 mm	29.8	33.6	33.2	29.5	27.1	23.7	19.9	15.6	13.9	11.3	9.2	7.7	6.7	5.7	Gauss
	18 mm	54.5	60.9	54.9	45.9	38	30.6	24.6	20.5	16.2	12.9	10.6	8.7	7.4	6.5	Gauss
	16 mm	107.3	101.3	89.7	69.2	54.3	42.4	32.5	26.7	21.5	16.1	12.5	10	8.4	6.4	Gauss
	14 mm	218	187.3	144.9	108.1	74.6	55.6	39.8	29.1	23.1	19.5	15.1	11.1	9.7	7.2	Gauss
	12 mm	482	351	220	155.2	96.6	69.1	49.3	34.6	25.7	19	14.6	11.8	9.4	7.3	Gauss
	10 mm	976	498	306	196.7	129.9	84.1	62.1	45.5	32.8	23.5	18.3	14.9	9.8	8.8	Gauss
	8 mm	1452	769	423	272	158.1	107.7	71.2	50.3	36.9	27.5	18.7	14.3	11.5	9.3	Gauss
	6 mm	1554	801	437	255	168.2	109.8	73.9	49.5	37.2	26.7	19.9	14.1	10.9	9	Gauss
	4 mm	1604	899	505	266	146.9	119.8	72.7	49.3	36.9	24.6	18.8	14	11.2	8.6	Gauss
	2 mm	1654	854	459	291	186	104.1	76.7	48.4	33.3	22.7	15.9	12.4	9.4	7.8	Gauss
	0 mm	1700	833	498	305.3	186.2	125.4	78.3	54.7	37.3	25.5	15.1	12.2	11.6	7.6	Gauss
	-2 mm	1654	854	459	291	186	104.1	76.7	48.4	33.3	22.7	15.9	12.4	9.4	7.8	Gauss
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	-18 mm	54.5	60.9	54.9	45.9	38	30.6	24.6	20.5	16.2	12.9	10.6	8.7	7.4	6.5	Gauss
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	-26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss

AH1802		BRP(typical)= 20 Gauss														
		Y axis (mm)														
		2 mm	4 mm	6 mm	8 mm	10 mm	12 mm	14 mm	16 mm	18 mm	20 mm	22 mm	24 mm	26 mm	28 mm	
X axis (mm)	26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss
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	-26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss

3.2 The worst case: Closed (yellow) Open (green)

AH1802	BOP(max)= 40 Gauss														
	Y axis (mm)														
X axis (mm)	2 mm	4 mm	6 mm	8 mm	10 mm	12 mm	14 mm	16 mm	18 mm	20 mm	22 mm	24 mm	26 mm	28 mm	
26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss
24 mm	13.9	15.7	15.6	14.3	13.4	12.6	11.3	9.7	8.5	7.4	6.8	5.7	4.4	4.2	Gauss
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18 mm	54.5	60.9	54.9	45.9	38	30.6	24.6	20.5	16.2	12.9	10.6	8.7	7.4	6.5	Gauss
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2 mm	1654	854	459	291	186	104.1	76.7	48.4	33.3	22.7	15.9	12.4	9.4	7.8	Gauss
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-2 mm	1654	854	459	291	186	104.1	76.7	48.4	33.3	22.7	15.9	12.4	9.4	7.8	Gauss
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-6 mm	1554	801	437	255	168.2	109.8	73.9	49.5	37.2	26.7	19.9	14.1	10.9	9	Gauss
-8mm	1452	769	423	272	158.1	107.7	71.2	50.3	36.9	27.5	18.7	14.3	11.5	9.3	Gauss
-10 mm	976	498	306	196.7	129.9	84.1	62.1	45.5	32.8	23.5	18.3	14.9	9.8	8.8	Gauss
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-26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss

AH1802		BRP(min)= 10 Gauss														
		Y axis (mm)														
		2 mm	4 mm	6 mm	8 mm	10 mm	12 mm	14 mm	16 mm	18 mm	20 mm	22 mm	24 mm	26 mm	28 mm	
	26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss
	24 mm	13.9	15.7	15.6	14.3	13.4	12.6	11.3	9.7	8.5	7.4	6.8	5.7	4.4	4.2	Gauss
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	-24 mm	13.9	15.7	15.6	14.3	13.4	12.6	11.3	9.7	8.5	7.4	6.8	5.7	4.4	4.2	Gauss
	-26 mm	9.2	9.8	10	10.2	9.8	9.5	8.7	8.1	7.1	5.9	5.1	4.5	4	3.4	Gauss

4. Summary

The simulation results show that a Hall Sensor such as the AH1802 with higher sensitivity can operate in a vertical orientation in regards to the magnet, which works fundamentally from a perpendicular orientation. Several other factors need to be taken into consideration when designing a Hall Sensor – Magnet strength and size will also determine the sensitivity level needed to operate properly. The strength of the magnetic field can be measured with a gauss meter or a calibrated linear Hall sensor.

The simulation tables show the results of measuring the sensitivity as the Hall devices are moved by 2mm in either X axis or Y axis orientation. The results from the “yellow” column table, show the AH1802 output change to be low from high as cover is “closed” when the magnetic is moving towards the Hall device. Results from the “green” column table, show the AH1802 output change to be high from low as cover is “opened” when the magnetic is moving away from the Hall device.