ACC6531 Programmable Linear Hall-Effect IC

FEATURES

- GaAs + Si Hybrid Programmable Linear Hall-Effect IC
- Single Power Supply: VCC 3.3V ~3.5V
- Ambient Temperature Range: -40℃~125℃
- Quick response for magnetic field with wide bandwidth
- AEC-Q100 Compliant

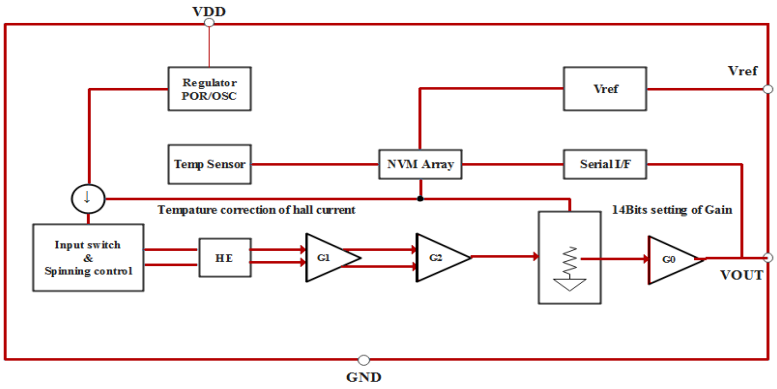
APPLICATIONS

- Current Sensing
- Motor Control
- Linear Position Detection
- Rotation Position Detection
- Magnetic Encoder
- Level Sensing
- Vibration Sensing

DESCRIPTIONS

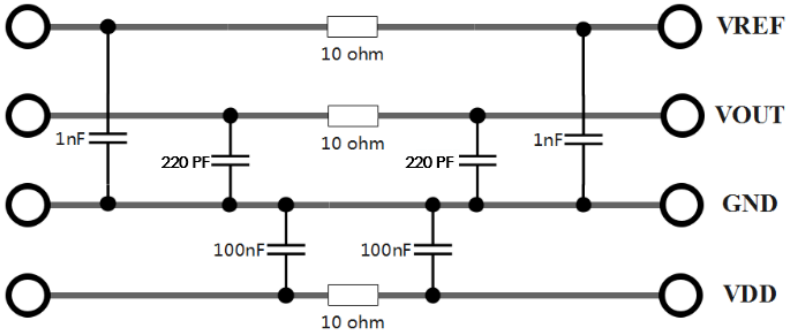
The ACC6531 is a programmable sensitivity linear Hall IC that integrates a high-performance GaAs material Hall element and a Si-based signal processing circuit.The ACC6531 is sensitive to external magnetic fields in the orthogonal direction on the IC package surface, and its output is an analog voltage proportional to the magnitude of the applied external magnetic field.

FUNCTIONAL BLOCK DIAGRAM

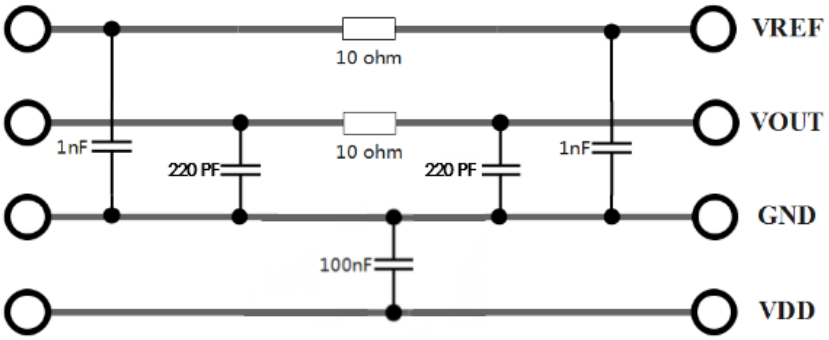


APPLICATION CIRCUITS

Fixed output mode:

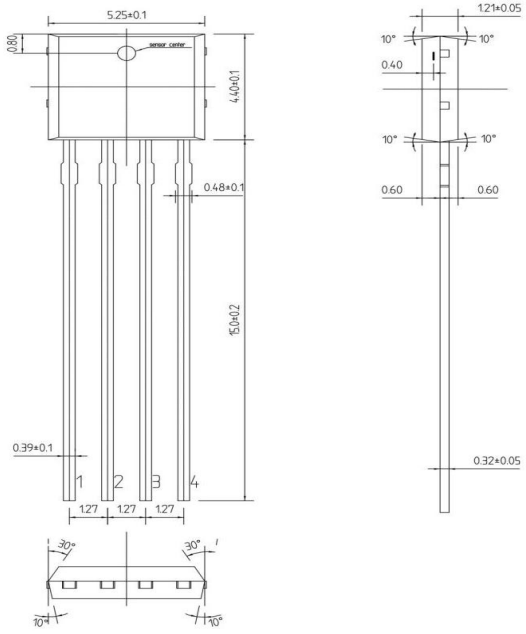


Ratiometric output mode:

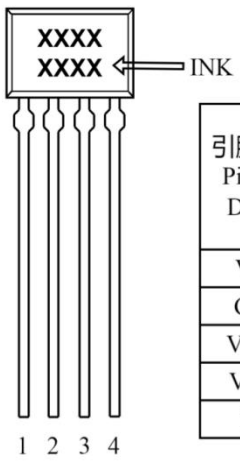


Note: The B2 foot sequence has no reference voltage (VREF) and the VREF pin can be left unloaded.

Dimensional Drawing(Unit MM)



Pinning Define



引脚定义 Pinning Define	引脚顺序 Pinning Sequence		描述 Description
	B1	B2	
VCC	1	1	供电引脚
GND	2	4	地线引脚
VOUT	3	2	输出引脚
VREF	4	-	参考电压引脚
NC	-	3	未接线

3. CHARACTERISTICS DIFINITIONS

1. Sens 【mV/Gs】 Sensitivity

Sensitivity is defined as the slope of the approximate straight line calculated by the least square method, using data of OUT voltage (Vout) when the magnetic flux density (B) is swept within the range of input magnetic flux density (Bin).

$$\text{Sens} = \frac{\text{VOUT(B)} - \text{V(0)}}{\text{B}}$$

2. Sens_{TC} 【%】Sensitivity drift through temperature

Sensitivity temperature drift is defined as the ratio of the value of the sensitivity change due to temperature to the sensitivit at the calibrated tem erature（25℃）.

$$\text{Sens}_{\text{TC}} = \frac{\Delta\ \text{Sens}}{\text{Sens(25℃)}} * 100 = \frac{\text{Sens(T)} - \text{Sens(25℃)}}{\text{Sens(25℃)}} * 100$$

3. Lin_{ERR} 【%】 Linearity Error

Linearity error is defined as the ratio of the maximum perpendicular deviation (MFD) to the full scale (F.S.), where MFD is the maximum difference between the OUT voltage (Vout) and the approximate straight line calculated in the sensitivity definition. Definition formula is shown in below:

$$\text{Lin}_{\text{ERR}} = 100 * \frac{\text{MFD}}{\text{F.S.}} = 100 * \frac{\text{MFD}}{\text{V}_{\text{H}} - \text{V}_{\text{L}}}$$

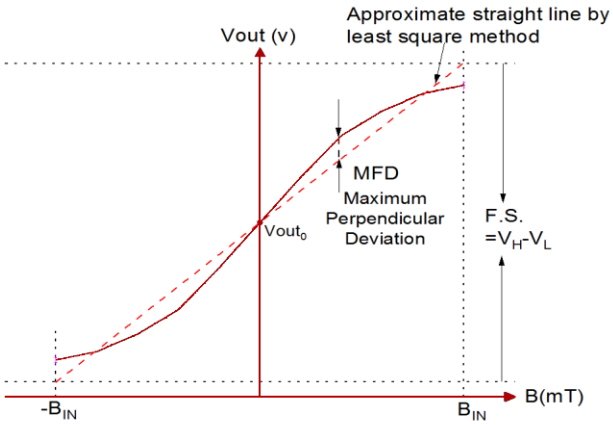


Figure 1. Output characteristics of CC6531

4. $\text{Rat}_{\text{ERR}}\text{Sens}$ [%] Ratiometric output error of sensitivity

$\text{Rat}_{\text{ERR}}\text{V}_0$ [%] Rationmetric output error of Quiescent voltage（Only valid for proportional output mode）

The AA1363 device features ratiometric output. This means that the Quiescent Voltage Output, V_0, magnetic sensitivity, Sens are proportional to the Supply Voltage, VCC. In other words, when the supply voltage increases or decreases by a certain percentage, each characteristic also increases or decreases by the same percentage. Error is the difference between the measured change in the supply voltage relative to 5 V, and the measured change in each characteristic.

$$\text{Rat}_{\text{ERR}}\text{Sens} = \left[1 - \frac{\text{Vout(VCC)}}{\text{Vout(5V)}} * \frac{5V}{\text{VCC}}\right] * 100\%$$

$$\text{Rat}_{\text{ERR}}\text{V0} = \left[1 - \frac{\text{V}_0\text{(VCC)}}{\text{V}_0\text{(5V)}} * \frac{5\text{V}}{\text{VCC}}\right] * 100\%$$

5. T_r [μs] Rise response time

Rise response time is defined as the time delay from the 90% of input magnetic field (B) to the 90% of the OUT voltage (Vout) under the pulse input of magnetic flux density.

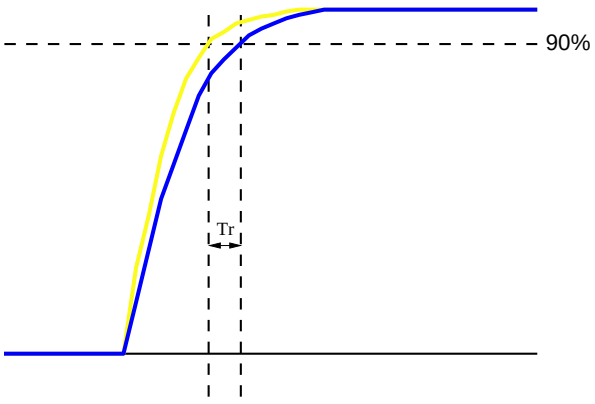


Figure 2. Definition of response time

6. $\mathbf{V}_{\text{out-SatH}}$ 、 $\mathbf{V}_{\text{out-SatL}}$ Saturation Output Voltage

The output can oscillate between the maximum $\mathbf{V}_{\text{out-SatH}}$ and minimum $\mathbf{V}_{\text{out-SatL}}$ as the magnetic field strength changes.

7. Sym_{ERR} 【%】 Symmetry Sensitivity Error

The magnetic sensitivity of device is constant for any two applied magnetic fields of equal magnitude and opposite polarities. Sym_{ERR} (%) is measured and defined as:

$$\text{Sym}_{\text{ERR}} = \left(1 - \frac{\text{Sens}_{\text{BPOS}}}{\text{Sens}_{\text{BNEG}}}\right) * 100\%$$

4. Absolute Maximum Rating

Table 1. ACC6531 Working conditions

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	**VCC**	$\mathbf{T}_a$ = 25℃	-0.3		6.5	V
Output Current	$\mathbf{I}_{\text{out}}$	$\mathbf{T}_a$ = 25℃	-45		45	mA
Output Voltage	$\mathbf{V}_{\text{out}}$	$\mathbf{T}_a$ = 25℃	0.1		**VCC**-0.006	V
Storage Temp.	$\mathbf{T}_s$		-40		150	℃
Operation Temp.	$\mathbf{T}_a$		-40		125	℃

5. Operation Conditions

Table 2. Electric and magnetic characteristics Ta=-40 to 125℃

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	VCC	Ta = 25℃	3	3.3/5	5.5	V
Current Consumption	I_{CC}	In nomal operation @Ta=25℃	-	6.5/8	11	mA
Sensitivity Range	Sens	Ta = 25℃	0.1		30	mV/Gs
Response Time	T_r	C=20pF@ LF=600kHz，Ta = 25℃，Au=64	-	0.5	-	μs
		C=20pF@ LF=500kHz，Ta = 25℃，Au=64	-	0.7	-	
		C=20pF@ LF=250kHz，Ta = 25℃，Au=64		1.5	2	
		C=20pF@ LF=50kHz，Ta = 25℃，Au=64	-	4	-	
Signal bandwidth	B_w	Spin on/off	-	250	500	KHz
Load Capacitance	C_L	Ta = 25℃	-	220p	10n	F
Reference Load Capacitance	C_{ref}	Ta = 25℃	-	1n	50n	F
Reference Voltage	Vref	S③	2.470		2.530	V
		SS③	2.490		2.510	
Quiescent Voltage	V_0	VCC=5V@25℃	2.490	2.500±0.002	2.510	V
		VCC=3.3V@25℃	1.640	1.650±0.002	1.660	
Quiescent Voltage of Differential Output	V_0-Vref	TA@-40~125℃	-0.005	±0.001	0.005	V
Sensitivity Drift through Temperature	$Sens_{TC}$	Ta@-40℃~105℃	-1		1	%
		Ta@25℃~125℃	-1.5		1.5	
Output Saturation Voltage	$V_{out-SatH}$		VCC-0.1			V
	$V_{out-SatL}$				0.1	
Noise	V_{Noise}	TA=25℃，Sens=5mV/Gs，LF=250KHz	-	3	-	mV_{RMS}
		TA=25℃，Sens=5mV/Gs，LF=500KHz	-	6	-	mV_{RMS}

6. Electrical Characteristics

Working Characteristics: Ta= -40～125℃， CBYPASS=0.1uF (Unless otherwise specified)

Characteristics	Symbol	Conditions	Min.	Typ.	Max.	Unit
Error of Sensitivity	$Rat_{ERR}Sens$	VCC 4.85~5.15V @-40~125℃	-0.5		0.5	%
Error of Quiescent Voltage	$Rat_{ERR}V_0$	VCC 4.85~5.15V @-40~125℃	-0.5		0.5	%
Linearity Error	Lin_{ERR}	VCC=5V@-40~125℃	-0.5	±0.1	0.5	%
Fixed Output Mode：						
Reference Voltage	ΔVref	VCC=5V@-40~125℃	-0.03	±0.02	0.03	V
		VCC=3.3V@-40~125℃	-0.02	±0.015	0.02	
Quiescent Voltage drift through temperature	ΔV_0	VCC=5V@25~125℃	-0.015		0.015	V
		VCC=5V@-40~25℃	-0.03		0.01	
		VCC=3.3V@25~125℃	-0.012		0.012	
		VCC=3.3V@-40~125℃	-0.025		0.01	
Quiescent Voltage of Differential Output drift through temperature	△（V_0-Vref）	VCC=5V@-40~125℃，Sense>4mV/Gs	-0.075		0.075	mV/℃
		VCC=5V@-40~125℃，Sense＜4mV/Gs	-0.05		0.05	
		VCC=3.3V@-40~125℃，Sense>4mV/Gs	-0.075		0.075	
		VCC=3.3V@-40~125℃，Sense＜4mV/Gs	-0.05		0.05	

Ratiometric Output Mode ：

Reference Voltage	ΔVref	VCC=5V@-40~125℃	-0.01	±0.005	0.01	V
		VCC=3.3V@-40~125℃	-0.007	±0.005	0.007	
Quiescent Voltage drift through temperature	ΔV_0	VCC=5V@-40~125℃	-0.015	±0.01	0.015	V
		VCC=3.3V@-40~125℃	-0.01	±0.007	0.01	
Quiescent Voltage of Differential Output drift through temperature	△（V_0-Vref）	VCC=5V@-40~125℃，Sense>4mV/Gs	-0.075		0.075	mV/℃
		VCC=5V@-40~125℃，Sense＜4mV/Gs	-0.05		0.05	
		VCC=3.3V@-40~125℃，Sense>4mV/Gs	-0.075		0.075	
		VCC=3.3V@-40~125℃，Sense＜4mV/Gs	-0.05		0.05	

Note:

① When the sensitivity exceeds 20mV/GS, the response time is greater than 2us

② Response time can be controlled programmatically

③ S and SS represent different gears of the chip

④ Fixed output mode：The output voltage does not fluctuate with the supply voltage

⑤ Ratiometric mode：Output voltage fluctuates with the supply voltage

⑥ $$\text{Quiescent Voltage of Differential Output} = V_0 - \text{Vref}$$

$$\text{Differential sensitivity} = \frac{\text{VOUT(B)} - \text{Vref}}{\text{B}}$$

Differential Output：Quiescent Voltage output is equal to V0 subtract Vref while Magnetized Output is equal to Vout（B） subtract Vref

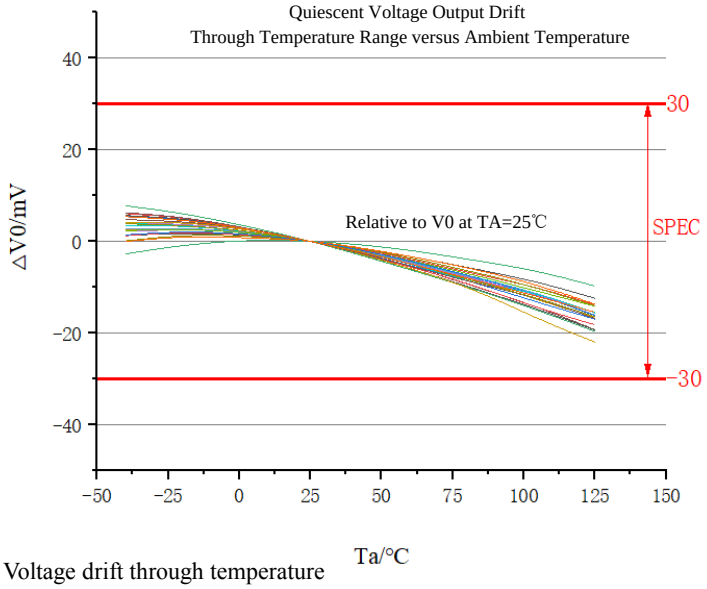
⑦ Static voltage and sensitivity can be set to vary with or without voltage, respectively

7. Output Characteristics

1. Static voltage temperature drift and reference voltage temperature drift

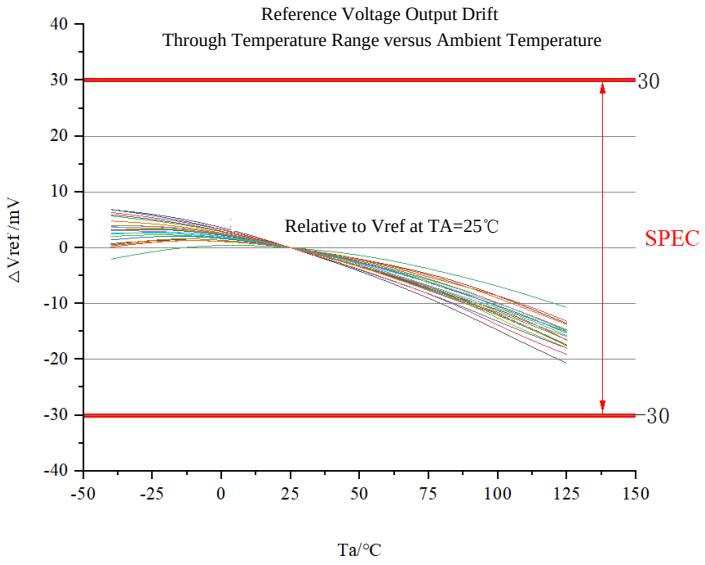
1.1 Fixed Output Mode（Sens=10mV/Gs、B=200Gs、V0=2.5V）

1.1.1 △V0 Quiescent Voltage drift through temperature

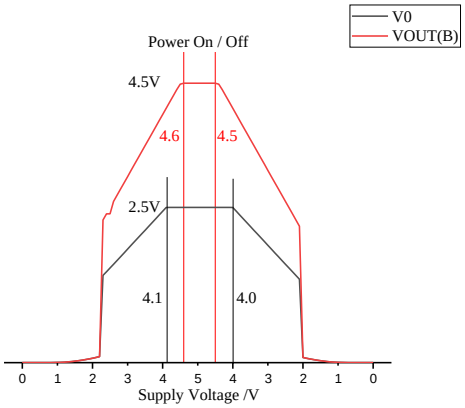


1.1.2 △Vref

Reference Voltage drift through temperature

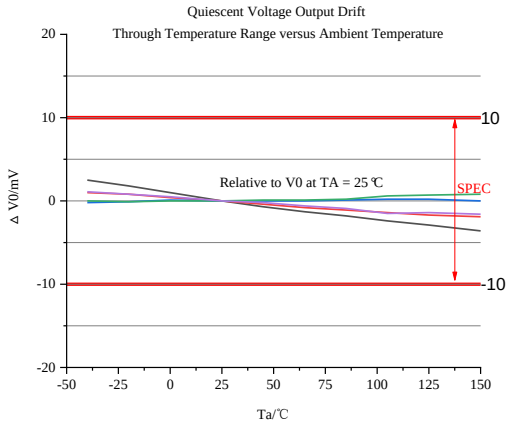


1.1.3 Power On /Off

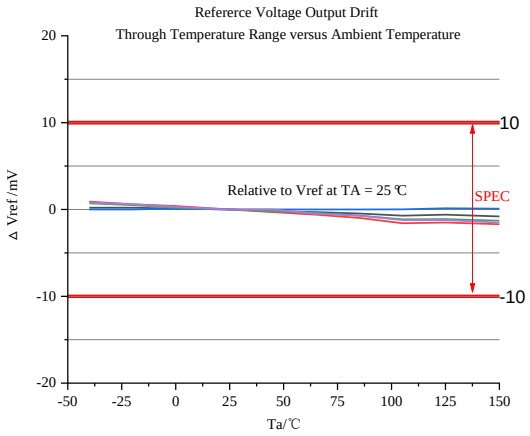


1.2 Ratiometric Output Mode （Sens=10mV/Gs、B=200Gs、V0=1/2VCC）

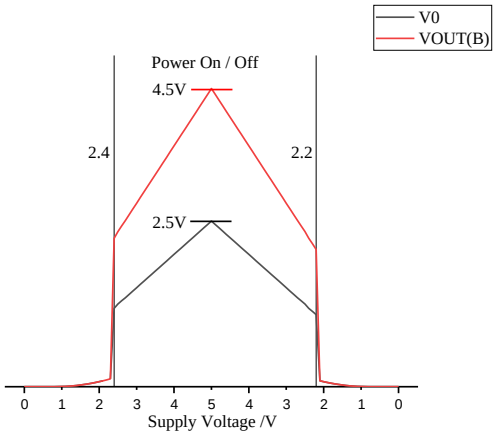
1.2.1△V0 Quiescent Voltage drift through temperature



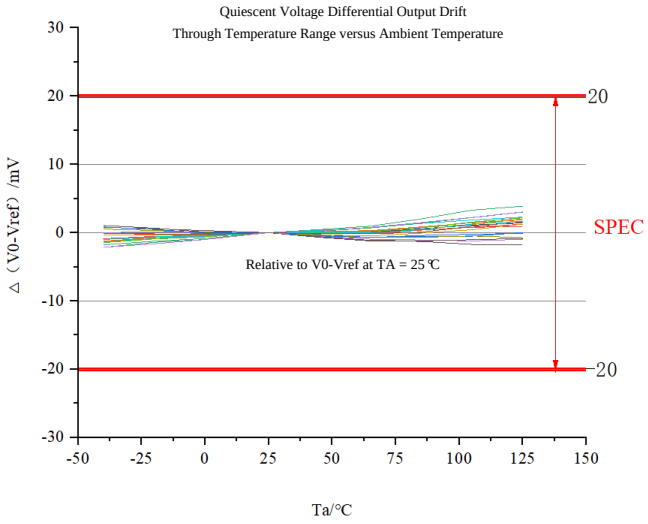
1.2.2 △Vref Reference Voltage drift through temperature



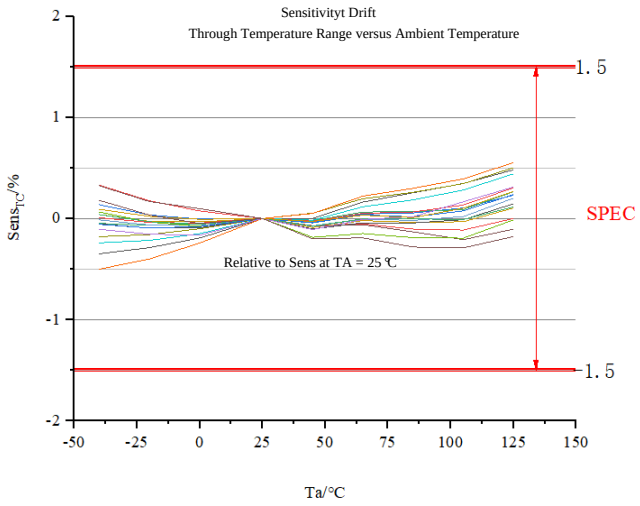
1.2.3 Power On /Off



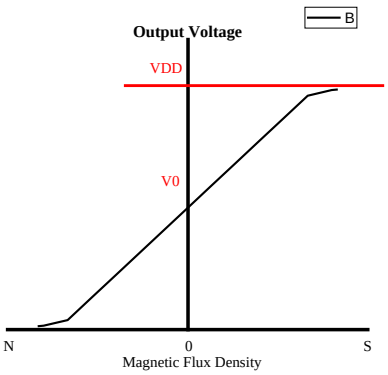
2. △（V0-Vref）Quiescent Voltage of Differential Output drift through temperature（Sens=10mV/Gs、B=200Gs）



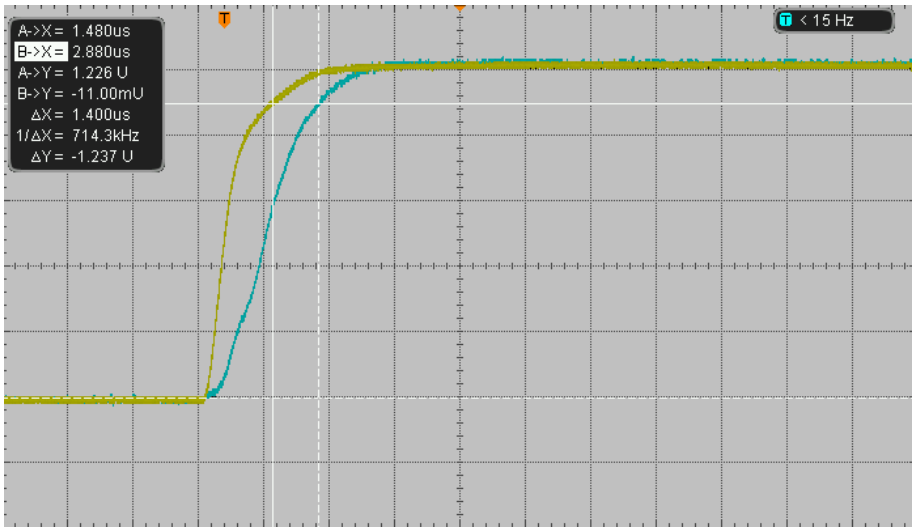
3. $Sens_{TC}$ Sensitivity drift through temperature（Sens=10mV/Gs、B=200Gs）



4. Sensitivity as a function of magnetic flux density B



5. Tr Response Time（Sens=10mV/Gs、B=50Gs、C_L=1nF，LF=250KHz）



8. Reliability Test Conditions

No.	Terms	Conditions	Duration
1	PCT Pressure Cooker Test	121℃/100%RH/205kPa	96hr
2	THS Temp. Humidity Storage	85℃/85%RH	1000hr
3	TCT Thermal Cycling Test	[-55℃，150℃]/1000cycle	
4	HTS High Temperature Storage	150℃	1000hr
5	LTS Low Temp. Storage Test	-40℃	1000hr
6	HTO High Temp. Operating	125℃/5V 1000hr	1000hr
7	ESD Electriostatic Discharge	HBM 8000V	
8	THB Temp. Humidity Bias Storage	85℃/85%RH/5V	1000hr

9. Packaging and Storage Methods

9.1 Packaging Specifications

Product	Package	Packing Type	Quantity
ACC6531	T094	Bag	300pcs/bag
		reel	4000pcs/reel

9.2 Storage Methods

9.2.1 The products should be stored in an appropriate temperature and humidity environment (5 to 35°C, 40% to 85%RH), and kept away from chlorine and corrosive gases.

9.2.2 Even under appropriate conditions, long-term storage mad lead to decrease of solderability and electrical properties of products. For products stored for a long time, the weldability should be checked before use.

9.2.3 If it is stored for more than 2 years, it is recommended to stored it in a nitrogen environment. Oxygen in the atmosphere will oxidize the lead of the product, resulting in poor solderablity of the lead.

10. Safety Protection and Precautions

10.1 This product is sensitive to ESD (electrostatic discharge). When contacting Hall elements marked with ESD-Caution,the environmental requirements are as follows:

（1）Electrostatic charges are unlikely to occur in the environment (for example, the relative humidity exceeds 40%RH).

（2）Wear anti-static clothing and wrist strap when touching products.

（3）Implement anti-static measures for equipment or containers that are in direct contact with products.

10.2 Do not turn the product into gas, powder or liquid by burning, crushing or chemical treatment.

10.3 Please abide by the laws and company regulations when discarding this product.