

High Sensitivity Unipolar Hall IC

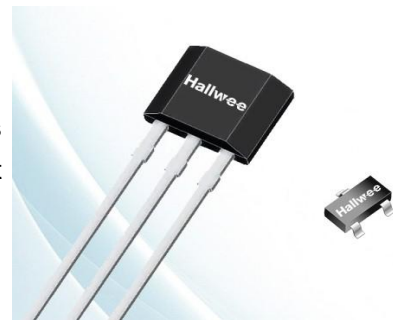
1. Description

The HAL581 is a unipolar Hall effect sensor IC fabricated from mixed signal CMOS technology. The device integrates a voltage regulator, Hall sensor with dynamic offset cancellation system, Schmitt trigger and an open-drain output driver, all in a single package.

It incorporates advanced chopper stabilization techniques to provide accurate and stable magnetic switch points. There are many applications for this HED – Hall Electronic Device - in addition to those listed below.

Thanks to its wide operating voltage range and extended choice of temperature range, it is quite suitable for use in automotive, industrial and consumer applications.

The device is delivered in a Small Outline Transistor (SOT) for surface mount process and in a Plastic Single In Line (TO-92S flat) for through-hole mount. Both 3-lead packages are RoHS compliant.



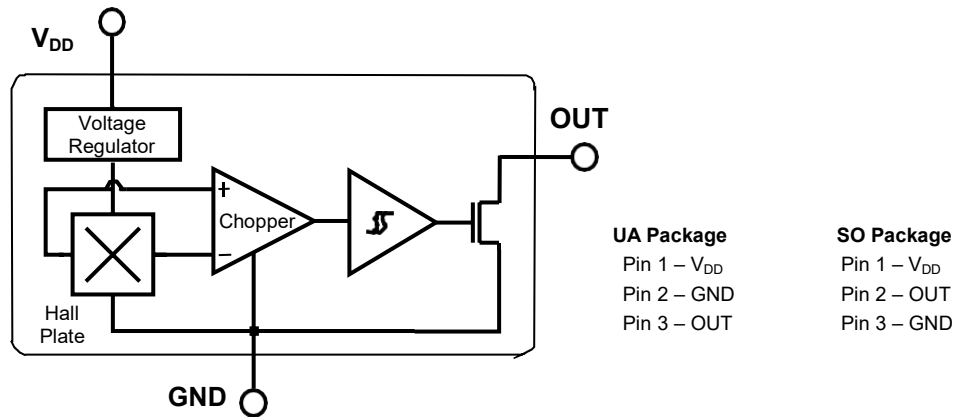
2. Features

- ◆ Wide operating voltage range from 3.5V to 24V
- ◆ Medium sensitivity
- ◆ CMOS technology
- ◆ Chopper-stabilized amplifier stage
 - Superior temperature stability
 - Extremely low switchpoint drift
 - Insensitive to physical stress
- ◆ Low current consumption
- ◆ Open drain output
- ◆ Tiny SOT23 3L and flat TO-92S 3L, both RoHS compliant packages

3. Applications

- ◆ Automotive, Consumer and Industrial
- ◆ Solid-state switch
- ◆ Interrupter
- ◆ Speed detection
- ◆ Linear position detection
- ◆ Angular position detection
- ◆ Proximity detection

4. Functional Block Diagram

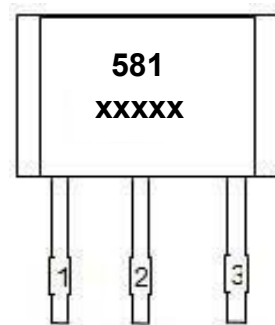
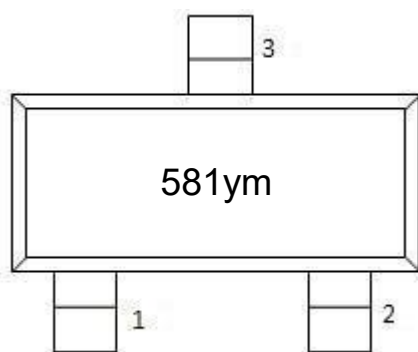


5. Glossary of Terms

Glossary	Descriptions
MilliTesla (mT)	Gauss, Units of magnetic flux density: 1mT = 10 Gauss
RoHS	Restriction of Hazardous Substances
SOT	Small Outline Transistor (SOT package) – also referred with the package code “SO”
ESD	Electro-Static Discharge
BLDC	Brush-Less Direct-Current
Operating Point (B_{OP})	Magnetic flux density applied on the branded side of the package which turns the output driver ON ($V_{OUT} = V_{DS(on)}$)
Release Point (B_{RP})	Magnetic flux density applied on the branded side of the package which turns the output driver OFF ($V_{OUT} = \text{high}$)

6. Pin Definitions and Descriptions

SO Pin No.	UA Pin No.	Name	Type	Function
1	1	V_{DD}	Supply	Supply Voltage Pin
2	3	OUT	Output	Open Drain Output Pin
3	2	GND	Ground	Ground Pin



7. Unique Features

Based on mixed signal CMOS technology, HAL581 is a Hall-effect device with high magnetic sensitivity. This multi-purpose latch suits most of the application requirements.

The chopper-stabilized amplifier uses switched capacitor technique to suppress the offset generally observed with Hall sensors and amplifiers. The CMOS technology makes this advanced technique possible and contributes to smaller chip size and lower current consumption than bipolar technology. The small chip size is also an important factor to minimize the effect of physical stress. This combination results in more stable magnetic characteristics and enables faster and more precise design.

The wide operating voltage from 3.5V to 24V, low current consumption and large choice of operating temperature range according to “L”, and “E” specification make this device suitable for automotive, industrial and consumer applications.

8. Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Supply Voltage	V_{DD}	28	V
Supply Current	I_{DD}	50	mA
Output Voltage	V_{OUT}	28	V
Output Current	I_{OUT}	50	mA
Storage Temperature Range	T_S	-50 ~ 150	°C
Maximum Junction Temperature	T_J	165	°C

9. General Electrical Specifications

DC Operating Parameters: $T_A = 25^\circ\text{C}$, $V_{DD} = 3.5\text{V}$ to 24V (unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Supply Voltage	V_{DD}	Operating	3.5		24	V
Supply Current	I_{DD}	$B < B_{RP}$			5	mA
Output Saturation Voltage	V_{DSon}	$I_{OUT} = 20\text{mA}$, $B > B_{OP}$			0.5	V
Output Leakage Current	I_{OFF}	$B < B_{RP}$, $V_{OUT} = 24\text{V}$		1	10	μA
Output Rise Time	T_R	$R_L = 1\text{K}\Omega$, $C_L = 20\text{pF}$		0.25		μs
Output Fall Time	T_F	$R_L = 1\text{K}\Omega$, $C_L = 20\text{pF}$		0.25		μs
Maximum Switching Frequency	F_{SW}			10		KHz
Package Thermal Resistance	R_{TH}	Single layer (1S) JEDEC board		301		°C/W

Note: The output of HAL581 will be switched after the supply voltage is over 2.2V, but the magnetic characteristics won't be normal until the supply is over 3.5V.

10. Magnetic Specifications

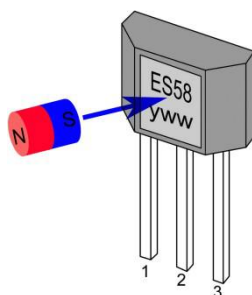
DC Operating Parameters: $V_{DD} = 3.5V$ to $24V$ (unless otherwise specified)

Parameter	Symbol (Test Conditions)	Min	Typ	Max	Units
Operating Point	B_{OP} ($T_A=25^\circ C$, $V_{DD}=12V$ DC)	5.0	7.0	10.0	mT
Release Point	B_{RP} ($T_A=25^\circ C$, $V_{DD}=12V$ DC)	2.0	4.5	8.5	mT
Hysteresis	B_{HYS} ($T_A=25^\circ C$, $V_{DD}=12V$ DC)	2.0	2.5	4.0	mT

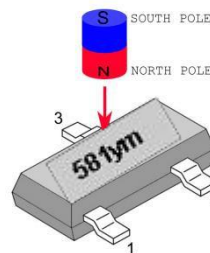
11. Output Behavior versus Magnetic Pole

DC Operating Parameters: $T_A = -40^\circ C \sim 150^\circ C$, $V_{DD} = 3.5V \sim 24V$ (unless otherwise specified)

Parameter	Test Conditions	OUT
South pole (UA)	$B > B_{OP}$	Low
North pole (SO)	$B > B_{OP}$	Low
Null or weak magnetic field	$B = 0$ or $B < B_{RP}$	High



OUT = Low (V_{Dson})



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12. Application Information

It is strongly recommended that an external bypass capacitor be connected (in close proximity to the Hall sensor) between the supply (V_{DD} Pin) and ground (GND Pin) of the device to reduce both external noise and noise generated by the chopper stabilization technique. As is shown in the two figures in next page, a $0.1\mu F$ capacitor is typical.

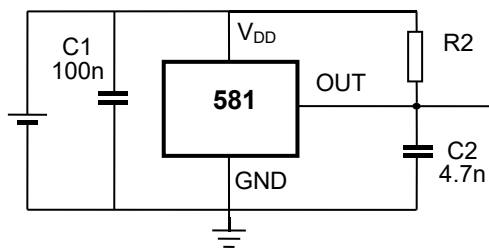
For reverse voltage protection, it is recommended to connect a resistor or a diode in series with the V_{DD} pin. When using a resistor, three points are important:

- the resistor has to limit the reverse current to 50mA maximum ($V_{CC} / R1 \leq 50mA$)
- the resulting device supply voltage V_{DD} has to be higher than V_{DD} min ($V_{DD} = V_{CC} - R1 \cdot I_{DD}$)
- the resistor has to withstand the power dissipated in reverse voltage condition ($P_D = V_{CC}^2 / R1$)

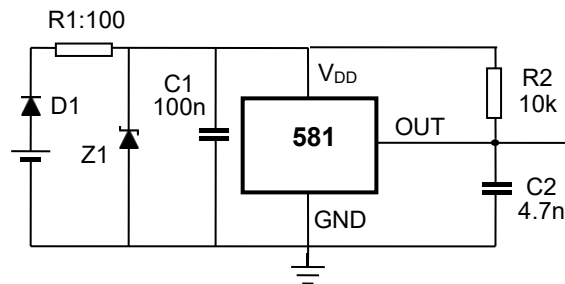
When using a diode, a reverse current cannot flow and the voltage drop is almost constant ($\approx 0.7V$). Therefore, a $100\Omega/0.25W$ resistor for 5V application and a diode for

higher supply voltage are recommended. Both solutions provide the required reverse voltage protection. When a weak power supply is used or when the device is intended to be used in noisy environment, it is recommended the following right figure. The low-pass filter formed by R1 and C1 and the zener diode Z1 bypass the disturbances or voltage spikes occurring on the device supply voltage VDD. The diode D1 provides additional reverse voltage protection.

Typical Three-Wire Application Circuit



Automotive and Severe Environment Protection Circuit

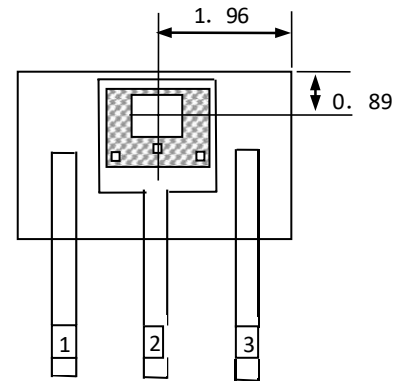
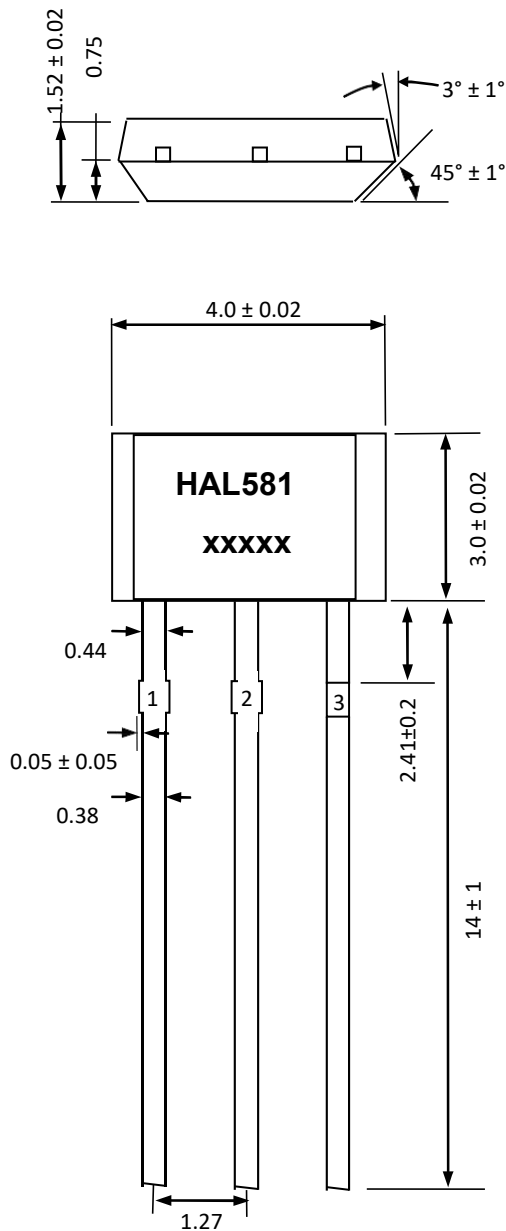


13. ESD Precautions

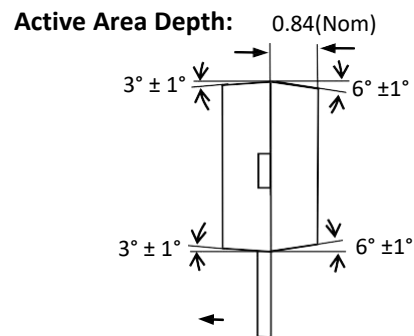
Electronic semiconductor products are sensitive to Electro Static Discharge (ESD). Always observe Electro Static Discharge control procedures whenever handling semiconductor products.

14. Package Information

14.1 UA Package (TO-92S flat)



Sensor Location



Notes:

- 1). Controlling dimension: mm;
- 2). Leads must be free of flash and plating voids;
- 3). Do not bend leads within 1 mm of lead to package interface;
- 4). PINOUT: Pin 1 V_{DD}

Pin 2 GND

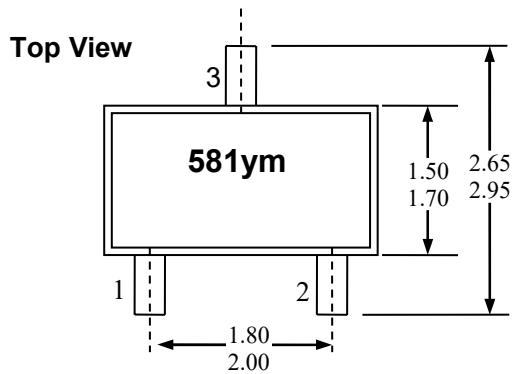
Pin 3 Output

Marking:

HAL581-- Code of Device (HAL581);

xxxxx -- Production Lot.;

14.2 SO Package (SOT-3L)



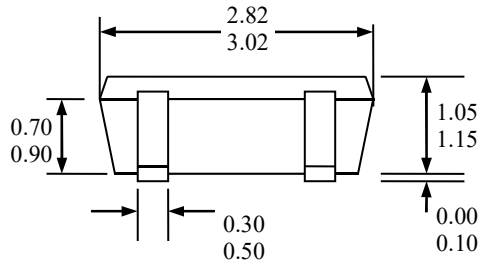
Notes:

- 1). PINOUT: Pin 1 V_{DD}
Pin 2 Output
Pin 3 GND
- 2). All dimensions are in millimeters;

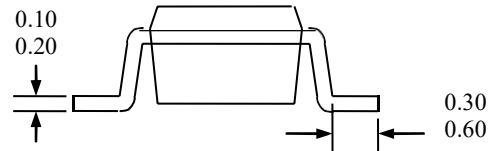
Marking:

581 -- Code of Device
y – Year, No. 0~9;
m—Product No., 0~9 and A~Z;

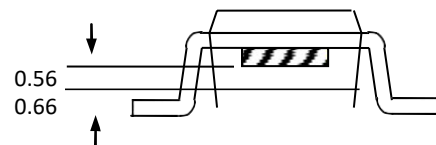
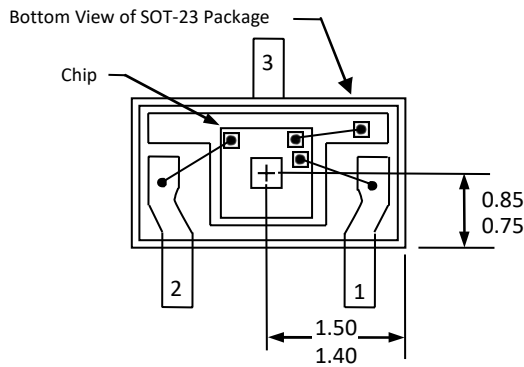
Side View



End View



Hall plate location



15. Ordering Information

Part No.	Package Code	Mini packing
HAL581S0	S0 (SOT-23-3L)	3000PCS
HAL581UA	UA (T092S)	1000PCS