AH750

Equipped with true TPO programmable Hall sensor

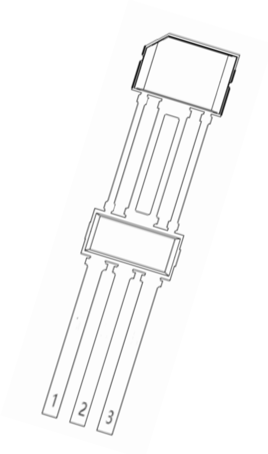
Alfa Electronics Co.,Ltd

1. Product Introduction

AH750 is an active Hall sensor suitable for camshaft applications and similar industrial applications such as speedometers. Its basic function is to map a tooth or groove into a unique electrical output state. It has online programming function, which can modify parameters after manufacturing to achieve true power on function even in the presence of different magnetic configurations or alignment errors during the production process. In addition, a self calibration module has been implemented to achieve optimal accuracy during normal operation. It adopts a three pin package, providing power supply voltage and open drain output. The working temperature range is -40 ℃ to 150 ℃. Packaging form PG-SSO-3−52.

2. Product Features

- Hall switch sensors are used to measure the speed or phase of polar wheels/gears
- Digital output signal (voltage interface)
- Independent unit chopper system
- TPO True Power On function
- Dynamic self calibration algorithm
- Online programmable switch points
- Electrically erasable programmable read-only memory for various algorithm options （EEPROM）
- TC pre programmed with back biased magnet
- High resistance to mechanical stress
- Immunity to high electrostatic discharge (ESD) and high electromagnetic compatibility (EMC)
- Improved micro cutting capability
- Operating temperature range：-40℃-150℃



3. Application

- Position detection of camshaft

  •Application：In the automotive engine management system, it is used to detect the position of the camshaft for precise control of valve timing and fuel injection timing.

  •Advantages: High precision and reliability, capable of stable operation in harsh environments.

- Crankshaft position detection

  •Application：Used to detect the position of the engine crankshaft to determine the engine speed and position.

  •Advantages: High anti-interference ability and wide temperature range, suitable for use in automotive engine environments.

- Gearbox position detection

  •Application: Detecting the position of gears in automatic transmissions to achieve precise gear shifting control.

  •Advantages: High mechanical stress resistance and enhanced electromagnetic compatibility, suitable for working in vibration and electromagnetic interference environments.

- Speedometer

  •Application: Used to measure the speed of vehicles.

  •Advantage: The dynamic self calibration algorithm ensures accurate speed measurement during vehicle operation.

- Rotary encoder

  •Application: Used for rotational position detection in industrial automation equipment.

  •Advantages: High precision and dynamic self calibration algorithms ensure long-term stability and reliability.

- Industrial sensors

  •Application: Used for position detection and speed measurement in various industrial equipment.

  •Advantages: Wide temperature range and enhanced electrostatic discharge (ESD) and electromagnetic compatibility (EMC) immunity, suitable for use in harsh environments.

- Gate control safety system

  •Application: Used to detect the position and motion status of doors or gates.

  •Advantages: High mechanical stress resistance and enhanced anti-interference ability, ensuring system stability and safety.

- Flow meter

  •Application: Used to detect the flow rate of liquids or gases.

  •Advantages: High precision and reliable output signals, suitable for various flow measurement applications.

- Motor control

  •Application: Used to detect the position and speed of motors for precise control.

  •Advantages: High precision and dynamic self calibration algorithms ensure precise control of the motor under various working conditions

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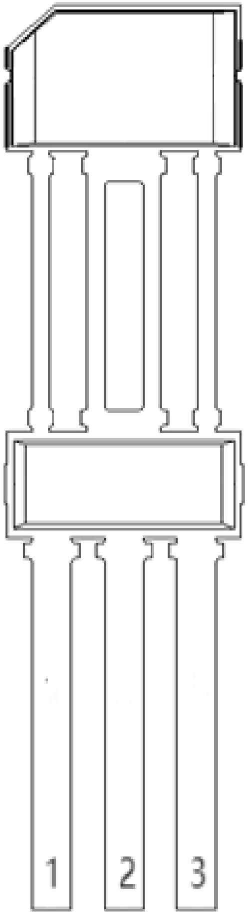
4. Product packaging

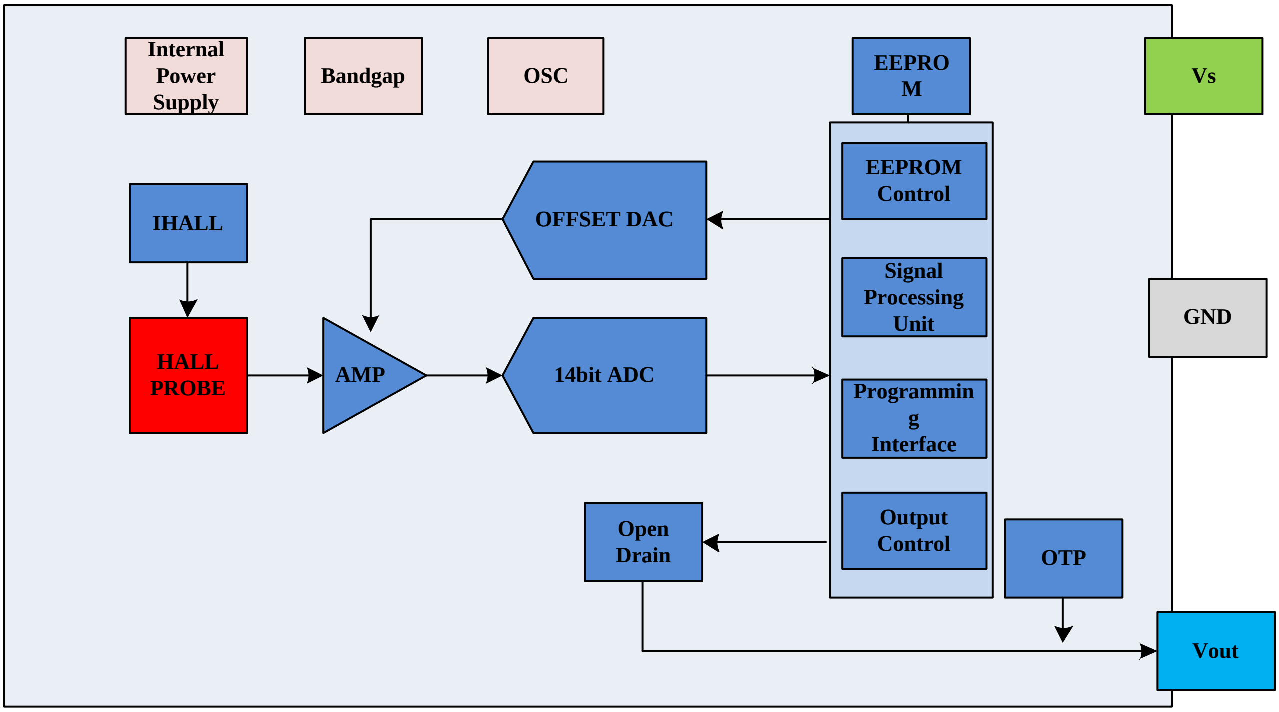
Part No.	operation temperature	Packages	Packing
AH750PG	-40℃～150℃	PG-SSO-3-52	1000PCS/bag

5. Pin information



No.	Pin Name	Type	Functions
1	V_{DD}	SUPPLY	Power/programming pins
2	GND	GND	Grounding/programming pins
3	Q	OD	OPEN DRAIN

6. Functional Block Diagram



7.Definition of magnetic field direction

The magnetic field of a permanent magnet emanates from the North Pole and enters the South Pole. If the North Pole is attached to the back of AH750, the magnetic field at the sensor position will be positive, as shown in Figure 1 (front view, green box represents internal wafer).

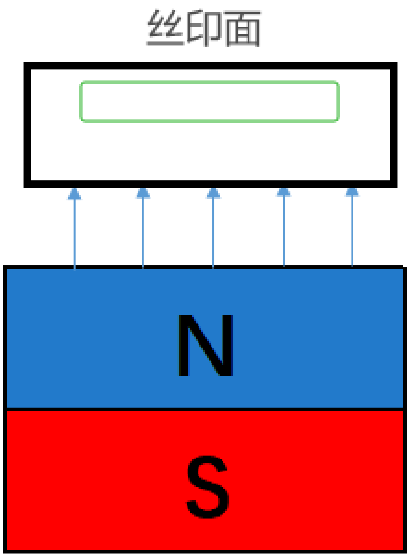


Figure 1: Definition of positive magnetic field direction

7.1 Functional Description

The basic operation of the AH750 is to map a „large” positive magnetic field (tooth) into a “low” electrical output signal and to map a „weak” positive magnetic field (notch) into a “high” electrical output. Optionally the other output polarity can be chosen by programming the EEPROM. A magnetic field is considered as positive if the North Pole of a magnet shows towards the rear side of the IC housing. Since backbias-reduced magnetic configurations still show significant flux densities in one distinct direction the circuit is optimized for one flux direction in order to provide an optimal signal to noise behavior.

For understanding the operation of the AH750 three different phases have to be considered:

• Initial operation after power up. This phase will be referred to as „initial phase“.

• Operation following the initialisation before having full information about the target wheel. This phase will be referred to as “precalibrated phase”.

• Normal operation with running target wheel. This phase will be referred to as „calibrated phase“.。

7.2 Initial Phase

The magnetic information is derived from a chopped Hall amplifier. The threshold information comes from a EEPROM-register that may be programmed at any time. The magnetic information is compared against the threshold and the output state is set correspondingly. Some hysteresis is introduced in order to avoid false switching due to noise.

In case that EEPROM is only pre-programmed by the supplier (EEPROM has not been programmed by the customer) the chip starts an auto-search for the actual magnetic value. The initial threshold value is set to this magnetic value. This feature can be used to find a TPO-value for providing correct programming information to the chip simply by setting the chip in front of a well-defined static target. In this case a moving target wheel is not necessary.

In case there is the EEPROM programming by the customer, the open drain output will be turned on or off by comparing the magnetic field against the pre-programmed value.

In case of EEPROM failure, after power on the open drain will be high ohmic for typical 2.6ms and then permanently locked to output low level.

7.3 Precalibrated Phase

The pre-calibrated phase follows the initial phase, where the IC permanently monitors the magnetic signal. It reliably detects minima (caused by a notch) and maxima (caused by a tooth) when the variation of the signal is larger than the DNC (Digital Noise Constant), of values proportional to 25% of the amplitude, but not smaller than DNCmin. Once the IC has found a pair of min / max values it calculates the optimum threshold level and adjusts the system offset in such a way, that the switching occurs on this level.

The internal offset update algorithm checks also the magnetic edge in that point in time when an offset update is to be released. Positive updates of the offset are released only at magnetic falling edges, negative offset updates only on magnetic rising edges. Otherwise an update on the wrong magnetic edge may cause additional switching. The threshold adjustment is performed through increments limited to a certain value, in order to avoid totally wrong updates caused by large signal disturbances (EMC-events or similar). The sum of these updates is programmable to either 48mT or 96mTmaximum value. The optimum threshold level may differ depending on the target wheel. For example, for regular gearwheels the magnetic signal is close to a sinusoid and the optimum threshold value can be considered as 50%value, which is the mean value between minimum and maximum signal. Depending on the starting position (start angle), especially for wheels showing imperfections, e.g. such as run-out or overshoot, the last updated switching threshold in precalibrated mode can have different values depending on power-on position. This is a consequence of the continuous offset updates with the new found pairs of min / max. But further threshold adaption is performed in calibrated phase (described in next chapter) either based on the highest maxima/ lowest minima or averaged extrema over multiple revolutions to a level, that is finally independent from the starting position. For camshaft wheels an optimum threshold may be at a different percent-value in order to have minimum phase error over airgap variations. See Figure 8 for definition of this dynamic switching level.

In case that the initial EEPROM-value does not lead to a switching of the IC because it is slightly out of the signal range the IC nevertheless does its threshold value correction in the background. After having corrected for a sufficient amount the IC will start its output switching. The output switching includes some hysteresis in order to avoid false switching.

If the IC has been pre-programmed only, it uses the default 51.17% value between the minimum and the maximumas a switching level.

7.4 Calibrated Phase

After a programmable number of switching events (2, 4...16, 18...30, 32...62, 64) the accuracy is considered to be quite high. At this time the chip is switched into a calibrated phase where only minor threshold corrections are allowed.

In this phase a period of a programmable number (1,2..15,16..32) of maxima is taken into account to find the range of the magnetic signal. Depending on the programming, the absolute minimum and maximum within this period, or the average values of the minima and maxima will be used to calculate the threshold. The threshold correction per cycle is limited to 1LSB or to a value proportional to the amplitude of the magnetic field, which can be programmed additionally.

At any time a maxima or a minima can be disregarded for the threshold calculation if it does not fit within the range defined by previously detected extrema, if this feature has been enabled by corresponding EEPROM programming.

Update filter algorithms are programmable and provide configurability for the calibration process. The programmability refers to the minimum distance from the current threshold to the one calculated to enable calibration and the necessary succession of the threshold updates directions for up to 4 consecutive periods.

The purpose of these strategies are to avoid large offset deviations by having single magnetic disturbances. Also irregularities of the target wheel are cancelled out, since the minimum and maximum values are derived over at least one full revolution of the wheel. The duration until achieving the final phase accuracy on one side depends on the choosen algorithm variant via EEPROM setting, but also strongly depends on the mounting air gap and the used camshaft wheel geometry, i.e. the number of teeth, tooth to notch ratio etc, as well as its mechanical accuracy. The output switching is done at the threshold level without visible hysteresis in order to achieve maximum accuracy. Nevertheless the chip has some internal protection mechanisms in order to avoid multiple switching due to noise.

7.5 Changing the Phase of Operation

Every time after power up the chip is reset into the initial phase. Subsequent phases (pre-calibrated, calibrated)are entered consecutively as described before. In addition, a plausibility check is implemented in order to enable some self-recovery strategy in case of unexpected events.

The IC checks if there is signal activity seen by the digital logic and at the same time there is no switching at the output. An event trigger is activated if there are 2 maxima and 2 minima (counting always starts with a maxima)detected without output switching, that means that the IC is reset into the initial mode.

The IC checks if the necessary threshold update is larger than a calculated value proportional with the magnetic field amplitude, equivalent to loosing calibration. If the digital circuitry detects this condition as met, the IC is reset into the pre-calibrated phase.

7.6 Reset

There are several conditions, which can lead to a reset condition. For the IC behavior we have to distinguish between a “output hold mode”, a “long reset”, a “short reset” and a “software reset”.

7.6.1 Output Hold Mode

This operating mode means that the output is held in the actual state and there is no reset on the digital part performed. This state will be released after the IC reaches his normal operation condition again and goes back into the operating mode he was before.

The following conditions lead to the output hold mode:

• A drop in the supply voltage to a value less than 2.4 V but higher than 2.0 V for a time not longer than 1 μs to 2 μs.

7.6.2 Long Reset

This reset means a total reset of the analogue as well as for the digital part of the IC. The output is forced to its default state (“high”). This condition remains for less than 1ms. After this time the IC is assumed to run in a stable condition and enters the initial phase where the output represents the state of the target wheel (EEPROM value).

The following conditions lead to a long reset:

• Power-on condition.

• Low supply voltage: In case of drop of the supply voltage to values less than 2.4V for a time longer than 500μs, a total reset of the analog as well as for the digital part of the IC will occur.

7.6.3 Short Reset

This reset means a reset of the digital circuitry. The output remains locked in the state it had before the triggering of the short reset for 50 μs. During this time the BTPO is loaded. After 50 μs the IC goes to initial phase. For an pre-programmed device (BTPO not programmed by customer) the output is locked in its current state for 1200µs during which internally successive approximation is performed. After this time interval the device goes to initial phase. Then the output is released again and represents the state of the target wheel (EEPROM value).

The following conditions lead to a short reset:

• If there are two min- and two max-events found without a switching event at the output (counting always starts with a maxima).

7.6.4 Software Reset

This reset can be performed in the test mode through the serial-interface. The IC output is then used as data output for the serial interface.

The following condition lead to a software reset:

• There is a reset applied through the serial Interface

The table bellow shows an overview over the behavior of the output under certain conditions.

Output Behavior Under Certain Conditions

	Pre-Programmed		Programmed	
	Noninverted	Inverted	Noninverted	Inverted
Output hold mode	Q_{n-1} 1)	-	Q_{n-1}	Q_{n-1}
Long reset	High	-	High	High
Short reset	Q_{n-1}	-	Q_{n-1}	Q_{n-1}
Initial phase	High((self calibration)	-	Normal TPO	Inverted TPO
Precalibrated phase	Normal	-	Normal	Inverted
Calibrated phase	Normal	-	Normal	Inverted

1) Q_{n-1}： State of output before a reset occurs

2）Normal： "low" if $B > B_{Threshold}$; "high" if $B < B_{Threshold}$

3）Inverted： "high" if $B > B_{Threshold}$; "low" if $B < B_{Threshold}$

8. Electromagnetic characteristics

8.1 limit parameter

Exceeding the limit parameters may cause permanent damage to the IC, under which conditions the IC may no longer function as it should, and prolonged exposure to the limit parameter environment can affect the reliability of the IC. The device includes circuits that protect the input and output from high static voltage or electric field damage; However, it is recommended to take normal precautions to avoid applying any voltage higher than the absolute maximum rated voltage to the circuit.

All listed voltages are referenced to ground（GND）

Symbol	Parameter	Min.	Max.	Unit	Test Condition
V_{SUP}	supply voltage	-18	18	V	Continuos
		-24	24	V	H=1h，$R_S \geq 100\Omega$
		-26	26	V	H=5min，$R_S \geq 100\Omega$
		-28	28	V	H=60s，$R_S \geq 100\Omega$
V_{OUT_OFF}	Output OFF voltage	-0.5	18	V	Continuos
			24	V	1 hour max, $R_{Load} \geq 500\ \Omega$
			26	V	5 min, $R_{Load} \geq 500\ \Omega$
			28	V	60 s max, $R_{Load} \geq 500\ \Omega$
V_{OUT_ON}	Output ON voltage		16	V	Restricted by internal short circuit protection
			18	V	
			26	V	
I_{OUT}	output current	-50	50	mA	-
T_J	Junction temperature range	-40	175	℃	≤2500h
			195	℃	≤10h
R_{THJA}	Thermal resistance junction - air		190	K/W	-
B_Z	Magnetic field induction	-5000	5000	mT	-
ESD-HBM	ESD compliance	-6	6	kV	HBM[1)]

Table 8-1 Limit Parameters

1) Electrostatic sensitivity under high temperature storage environment (HBM) according to EIA/JESD

22-A114B standard

8.2 Recommended operating conditions

The operating environment of the sensor exceeds the range shown in the "Recommended Operating Conditions/Characteristics", which may lead to unpredictable risks and reduce the reliability and lifespan of the sensor.

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Condition
V_{SUP}	Supply Voltage with supply resistance Rs	4.9	-	18	V	R_{Series}=100Ω
VS	Supply Voltage without supply resistance Rs	4.3	-	18	V	
Vout OFF	Continuos Output Off voltage	-0.3	-	18	V	
I_{OUT}	Output current		-	20	mA	Load
C_1	VCC-GND	42.3	47	51.7	nF	50V
C_2	VOUT-GND	4.23	4.7	5.17	nF	50V
R_{Series}	Series resistance on supply line of the IC	0	-	100	Ω	V_S=13.5V；no RS needed for 5 V applications
N_{PROG}	Maximum No. of EEPROM programming cycles	-		100	n	-
F_{CAM}	Magnetic signal frequency range for camshaft applications	0	-	5000	Hz	-
T_J	Normal operating junction temperature	-40	-	175	℃	2500h
$T_{Storage}$	Storage temperature	-60	-	170	℃	2000h
T_{RDPROG}	Ambient temperature range for device features reading and programming	15	25	80	℃	-
ΔT_{SG}	Temperature variations between engine stop and restart.	-	-	60	℃	

Table 8-2 Recommended operating conditions

8.2.1 Temperature coefficient

Symbol	Parameter	Values			Unit	Test Condition
		Min.	Typ.	Max.		
Programmable temperature coefficient of BTPO	TC_{BTPO}	-1400	-600	-200	ppm/K	-

Deviation to programmed temperature coefficient of BTPO	ΔTC_{BTPO}	-300	-	300	ppm/K	-40°C-150°C
		-1.95	-	1.95	%	TC deviation at -40°C
		-3.75	-	3.75	%	TC deviation at 150°C

Table 8-3 Temperature Coefficient

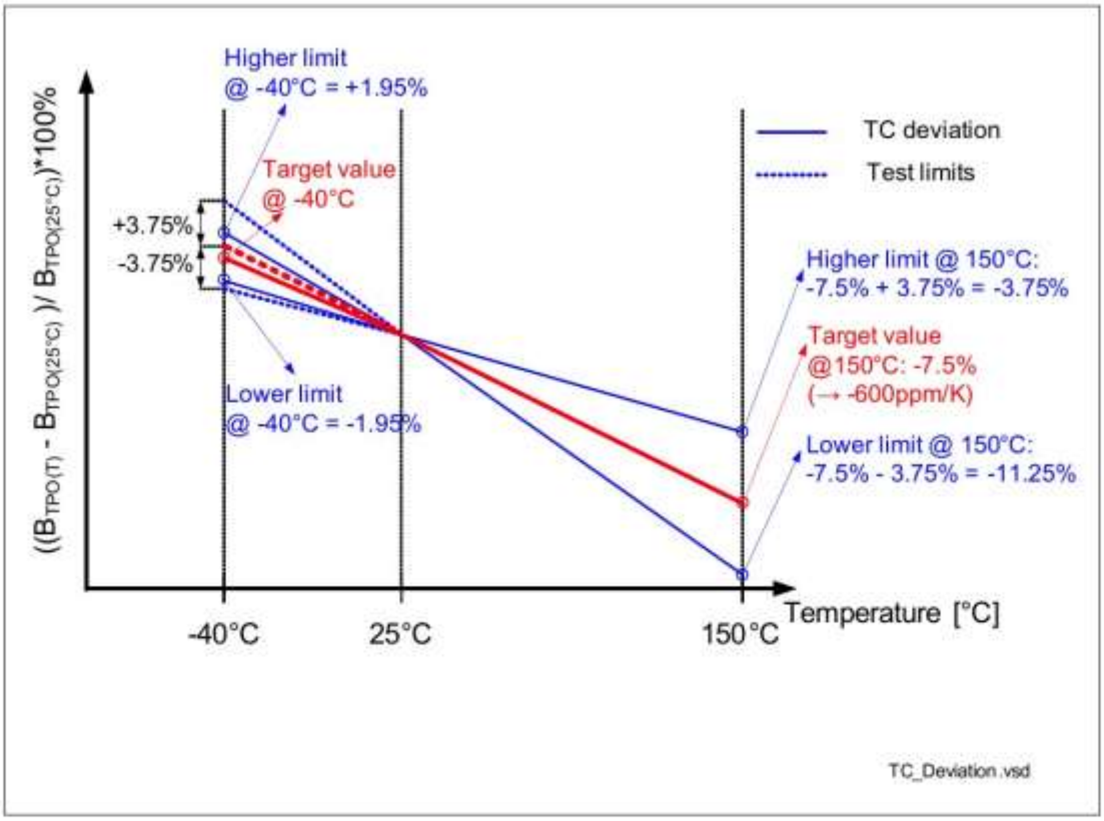


Diagram: Temperature coefficient of (TPO) switch point

8.4 Electrical and Magnetic Characteristic

V_{CC}=12V 和 T_A=25°C.

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Condition
Voltages						
V_{sat}	Output saturation voltage	-	0.25	0.5	V	I_{OUT} = 20 mA
		-	-	0.4	V	I_{OUT} = 15 mA
		-	-	0.3	V	I_{OUT} = 10 mA
		-	-	0.2	V	I_{OUT} = 5 mA

$V_{CCclamp}$	Clamping voltage VS-Pin	42	65	-	V	-
$V_{OUTclamp}$	Clamping voltage V_{Out}-Pin	42	50	60	V	I_{OUT}=2mA
V_{Sreset}	Analog reset voltage	-	3	3.3	V	-
oltage drop (µCut)						
V_{drop_min}	Voltage drop	0	-	2.4	V	25°C
t_{drop}	Voltage drop time			100	µs	
				110	µs	T_J<30°C
t_{slope}	Voltage drop slope	-	-	3	µs	
$t_{undefined}$	Undefined output state			70	µs	
t_{old_state}	Old output state			150	µs	
Currents						
$I_{Outleak}$	Output leakage current		0.1	10	µA	V_Q= 18 V
$I_{Outshort}$	Current limit for short circuit protection	30	50	80	mA	-
I_S	Supply current	4	5.5	7	mA	
I_{Smax}	Supply current @ 24 V	-	-	8	mA	$R_{Series} \geq 100\ \Omega$
Temperature						
T_{prot}	Junction temperature limit for output protection	195	210	230	℃	-
Times						
t_{rise}	Output rise time	4.5	8.7	13	µs	Vcc=4.5-24V R_{Load}=1kΩ valid between 20% - 80%
t_{fall}	Output fall time	2.2	3.8	5.4	µs	Vcc=12V R_{Load}=1kΩ valid between 20% - 80%
t_{fall}	Output fall time	0.9	1.6	2.3	µs	Vcc=5V R_{Load}=1kΩ valid between 20% - 80%
t_{on}	Power on time	-	0.56	1	ms	Programmed device. Time to achieve specified BTPO- accuracy. During this time the output is locked

		1.1	1.6	2.1	ms	Pre-programmed device (as delivered by IFX to customer). During this time the output is locked to high
		2.2	3.4	4.6	ms	Device with EEPROM failure. During this time the output is locked to high. After this time the output will be locked to low
td	Delay time of output to magnetic edge	10	17	24	µs	
Δtd	Temperature drift of delay time of output to magnetic edge	-3.6	-	3.6	µs	Not additional to td
F_{clk}	Clock frequency of digital part	-	6	-	MHz	
$F_{chopper}$	Clock frequency used by the chopper		375		kHz	
ΔB/Δt	Slope of magnetic edge	-	-	2	mT/µs	Magnetic signal edge is not allowed to rise faster (otherwise tracking ADC is not able to follow)
FSR_{ODAC}	Full scale range of the offset-DAC	141	189	237	mT	Typ.BODAC_0=-35 mT Typ.BODAC_2047=155mT
FSR_{ODAC}	Full scale range of the offset-DAC	163	189	237	mT	Tj = 25°C
B_{TPO_res}	Resolution of prog-rammable threshold in TPO mode	-	0.092	-	mT	-
$ΔB_{TPO}$	Drift of BTPO-point2)	-2.11	-	2.36	mT	BTPO = 44 mT
$B_{Hys}1$	Hysteresis Option 1	0.4	0.9	1.3	mT	
$B_{Hys}2$	Hysteresis Option 2	2.5	4	5.1	mT	
$B_{Hys/2}$	Adaptive Hysteresis Option 1	-	12.5	-	%	Minimum level: 0.4 mT
$B_{Hys/2}$	Adaptive Hysteresis Option 2	-	12.5	-	%	Minimum level: 2.5 mT, percentage of peak to peak amplitude
$ΔB_{AC\_cal}$	Accuracy of threshold in calibration phase3)	-200	-	200	µT	
k_0	Adjustment range of switching level		38.67; 51.17; 63.67; 69.92		%	Switching point in calibrated phase is digitally determined by:Bcal = Bmin + (Bmax – Bmin) * k0

B	Magnetic switching level range	-20	-	130	mT	Valid for k0 =51,17%
$B_{TPOrange}$	True power on range	-20	-	75	mT	Allowed programmable TPO values; Hysteresis not included
B_{AC_TPO}	Magnetic signal swing for TPO-function	5.15	-	125	mTpp	BTPO=44mT
B_{AC_cal}	Magnetic signal swing for calibrated phase	3	-	125	mTpp	Min value depends on hyst. option; Max value depends on k-factor

Table 8-4 Electrical and Magnetic Parameters

8.5 Electrical characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit	Test Condition
B_{neff}	Effective noise value of the magnetic switching points	-	33	-	µT	Tj=25°C1)
		-	55	70[2)]	µT	T_j≤175°C3),F_{CAM} ≤2kHz
		-	-	120[2)]	µT	Tj≤175°C3),F_{CAM} >2kHz

Table 8-5 Electrical Characteristics

1) The magnetic noise is normal distributed. The typical value represents the RMS-value and corresponds therefore to 1 Sigma probability of normal distribution. Consequently a 3 Sigma value corresponds to 0.3% probability of appearance.

2) Guaranteed by design, characterized in laboratory

3) The typical value corresponds to the RMS-value at Tj = 175°C. The max value corresponds to the RMS-values in the full temperature range and includes technological spreads.

8.6 Electromagnetic Compatibility

(values depend on RSERIES!)

Ref: ISO 7637-2; 2nd edition 06/2004; test circuit 1（See Nine. Application Circuit）; conducted on supply line

ΔB =10 mT (amplitude sinus signal), V_S = 13.5 V, f_B = 100 Hz, T = 25°C, RSERIES ≥ 100 Ω.

Symbol	Parameter	Level/Type	Status
VEMC	Testpulse 1	IV / -100 V	C
	Testpulse 2a	IV / 100 V	A

	Testpulse 2b	IV / 10 V	C
	Testpulse 3a	IV / -150 V	A1)
	Testpulse 3b	IV / 100 V	A1)
	Testpulse 4	IV / -7 V	A
	Testpulse 5a	IV / 86.5 V	C
	Testpulse 5b	IV / 86.5 V	A[2)]

Table 8-6 ISO 7637 - 2

1) Output signal overlaid by burst pulse

2) Suppressed Vs* = 35 V

Ref: ISO 7637-3; 1st edition 11/1995； test circuit 1 1 （See Nine. Application Circuit）； coupling clamp；

ΔB =10 mT (amplitude sinus signal), VS = 13.5 V ± 0.5 V, f_B = 100 Hz, T = 25°C, RSERIES ≥ 100Ω.。

Symbol	Parameter	Level / Type	Status
VEMC	Testpulse 3a	IV/-300V	A[1)]
	Testpulse 3a	IV/300V	A[1)]

Table 8-7 ISO 7637-3

1) The output signal is superimposed by sudden pulses

9. Application Circuit

The device has integrated two capacitors C1 and C2 (47nF/4.7nF) on the lead frame. These capacitors enhance the electromagnetic compatibility performance of the device. In addition, it is recommended to use a 100 Ω series resistor RSERIES on the power line for protection. The pull-up resistor RLOAD must be used on the output pin, which determines the maximum current flowing through the output transistor. The recommended value is 1.2k Ω.

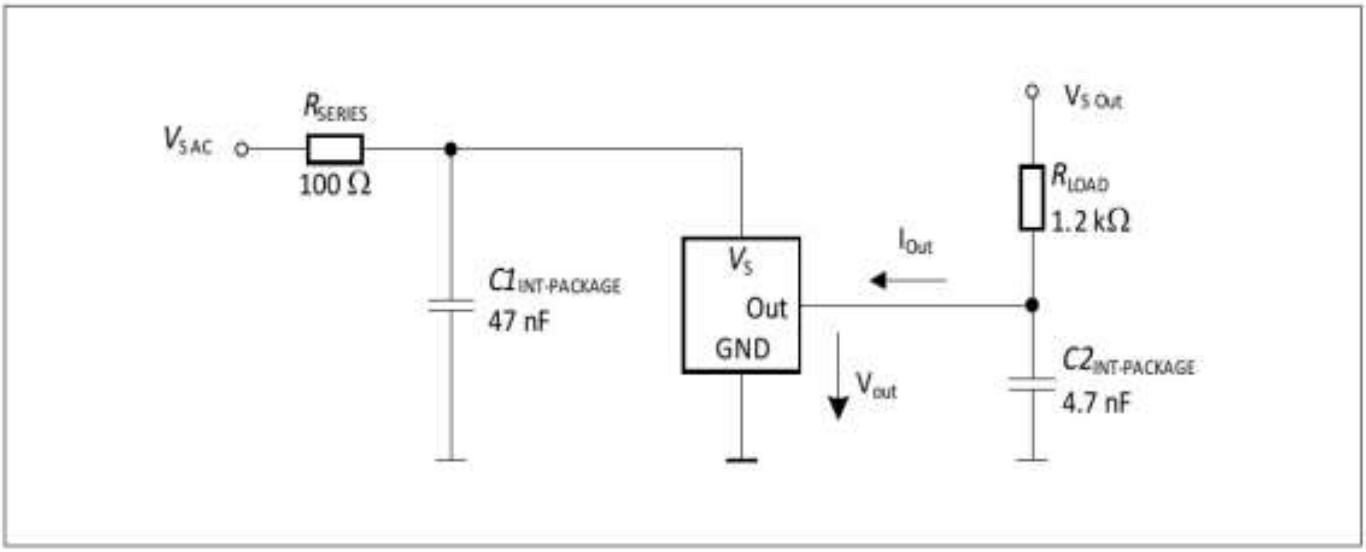
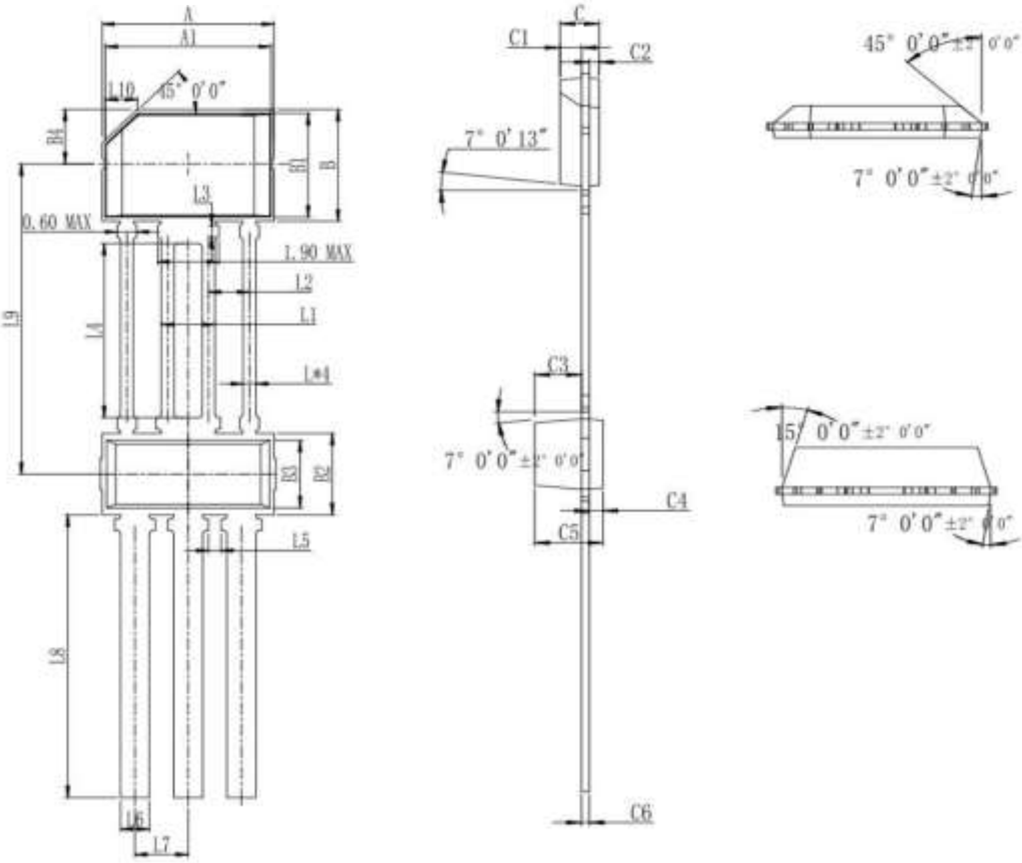


Diagram: Typical Application Circuit

10. Package information



Symbol	Dimensions in Millimeters		
	Min	Typ	Max
A	5.24	5.34	5.44
A1	5.05	5.15	5.25
B	3.52	3.64	3.76
B1	3.28	3.38	3.48
B2	2.40	2.65	2.90
B3	2.10	2.20	2.30
B4	1.68	1.78	1.88
C	0.92	0.96	1.00
C1	0.47	0.52	0.57
C2	0.19	0.24	0.29
C3	1.15	1.20	1.25
C4	0.30	0.35	0.40
C5	1.65	1.75	1.85
C6	–	0.200	–
L	0.35	0.40	0.45
L1	1.62	1.67	1.72
L2	–	1.27	–
L3	0.319	0.369	0.419
L4	5.62	5.67	5.72
L5	0.35	0.39	0.44
L6	0.85	0.90	0.95
L7	1.62	1.665	1.72
L8	9.16	9.21	9.26
L9	9.905	10.105	10.305
L10	–	1.00	–

11.Note

- Hall chips are sensitive devices, and electrostatic protection measures should be taken during use, installation, and storage.

- During installation and use, mechanical stress applied to the device casing and leads should be minimized as much as possible.
- It is recommended that the welding temperature should not exceed 350 ℃ and the duration should not exceed 5 seconds.
- To ensure the safety and stability of Hall chips, it is not recommended to use them beyond the parameter range for a long time.

12. Historical Version

No.	Time	Describe
1	May,2024	Compile and update some ambiguous text descriptions
2	December,2024	Update TO94-3 package
3	April,2025	Update the encapsulation type and add PG-SSO-3-52 encapsulation

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