XENSIV™ cost optimized miniature TMR current sensor

RoHS

Features

- Ultra-compact linear magnetic field sensor for current measurements
- Enabling galvanically isolated current measurement on external current rails
- Minimized power losses on external current rails
- Lowest possible parasitic inductance
- Perfect for shunt replacements:
  - reducing BOM
  - reducing footprint occupation and costs
- Accurate AC and DC current sensing with stable sensitivity and offset over temperature and lifetime:
  - Typical sensitivity error over temperature: ±2.7%
  - Typical offset error over temperature: ±150 µT
- Minimum bandwidth 1 MHz
- Fast response time 140.4 ns
- Ultra low noise, up to 8.1 μT_{RMS} until 1 MHz bandwidth
- Magnetic input range between ±4 mT and ±35 mT for low and high current applications
- 5 V and 3.3 V supply voltage

Potential applications

- Battery powered tools
- Service robots and drones
- e-Bikes and e-Scooters
- Home appliances and smart home
- Flaps, actuators, power-closing and pumps
- Redundant sensing

Product validation

Product validation according to JEDEC JESD47.

Description

The TLx5572 is a TMR (Tunnel Magneto Resistance) based coreless current sensor, suitable for cost sensitive current sensing applications.

Product type	Description and feature	Package	Marking Type	Ordering code
TLI5572-AE24E1-E0001	Industrial variant. FS = 41 mT at V_{DD} = 5 V FS = 25 mT at V_{DD} = 3.3 V	PG-SOT23-6-4	72I	SP006034925
TLI5572-AE15E1-E0001	Industrial variant. FS = 25 mT at V_{DD} = 5 V FS = 16 mT at V_{DD} = 3.3 V	PG-SOT23-6-4	72J	SP006042493
TLI5572-AE12E1-E0001	Industrial variant. FS = 20 mT at V_{DD} = 5 V FS = 12 mT at V_{DD} = 3.3 V	PG-SOT23-6-4	72K	SP006042470
TLI5572-AE08E1-E0001	Industrial variant. FS = 13 mT at V_{DD} = 5 V FS = 8 mT at V_{DD} = 3.3 V	PG-SOT23-6-4	72L	SP006042450

Product type	Description and feature	Package	Marking Type	Ordering code
TLI5572-AE06E1-E0001	Industrial variant. FS = 10 mT at V_{DD} = 5 V FS = 6 mT at V_{DD} = 3.3 V	PG-SOT23-6-4	72M	SP006042443
TLI5572-AE04E1-E0001	Industrial variant. FS = 6 mT at V_{DD} = 5 V FS = 4 mT at V_{DD} = 3.3 V	PG-SOT23-6-4	72N	SP006042435

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1 Standard configuration

Table 1 TLx5572 standard configuration

Product type	Sensitivity (S_x) [mV/mT]	Full scale range (*FS*) V_{DD} = 5 V [mT]	Full scale range (*FS*) V_{DD} = 3.3 V [mT]
TLI5572-AE24E1-E0001	53.5	41[1)]	25
TLI5572-AE15E1-E0001	85.5	25	16
TLI5572-AE12E1-E0001	107	20	12
TLI5572-AE08E1-E0001	172	13	8
TLI5572-AE06E1-E0001	214	10	6
TLI5572-AE04E1-E0001	340	6	4

1) Product specifications are valid only within the functional range of B_{TMR} as specified in Chapter 4.2.

2 Functional block diagram

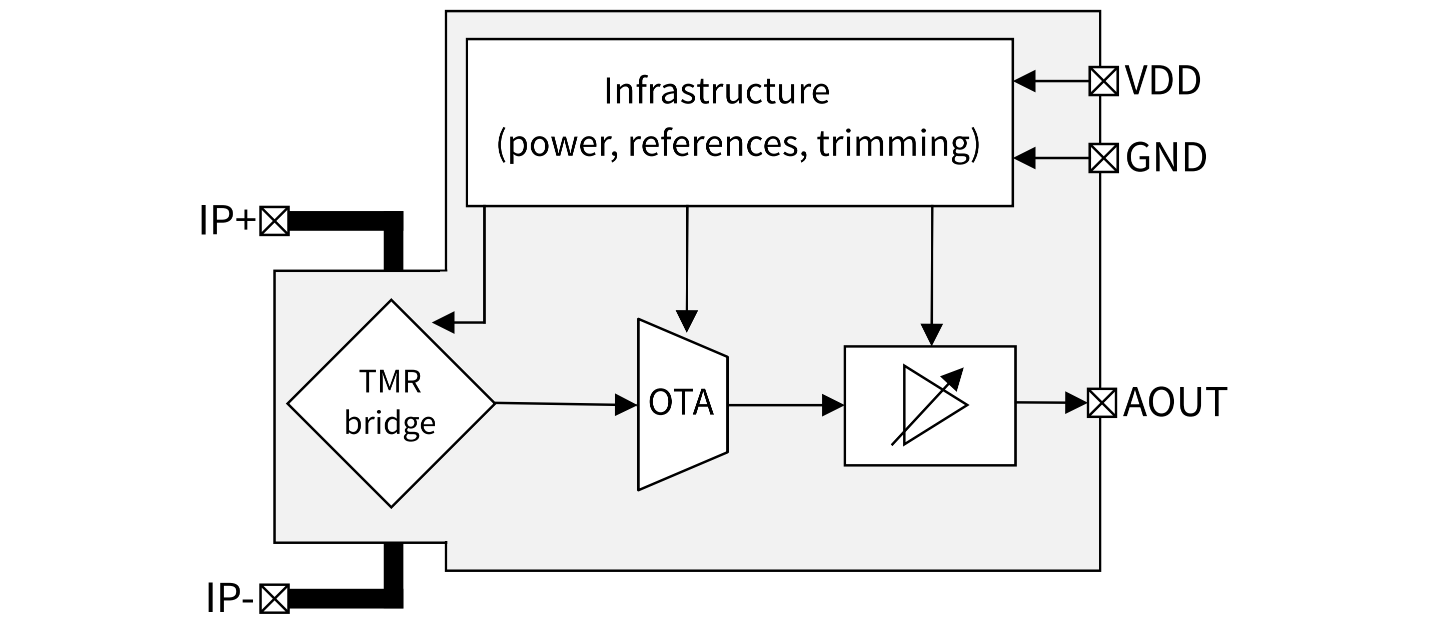


Figure 1 **Device functional block diagram**

The device measures a magnetic field via a Tunnel Magneto Resistance (TMR) bridge. The output signal from the TMR bridge is fed into a first stage of amplification via an Operational Transconductance Amplifier (OTA). The output of the OTA runs through a differential amplifier, which provides a signal on the AOUT pin. The sensor is temperature compensated, pre-calibrated and trimmed.

3 Pin configuration

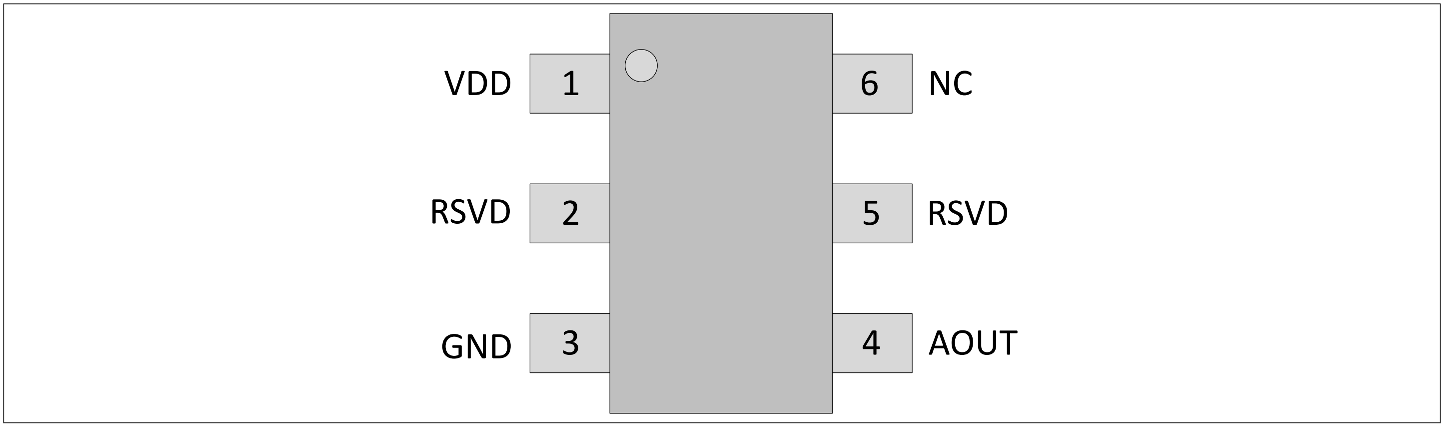


Figure 2 Package pinout

Table 2 Pin definitions and function

Pin No.	Symbol	Function	Comment
1	VDD	Supply voltage	–
2	RSVD	Pin shorted with sensor lead frame	1)
3	GND	Ground	–
4	AOUT	Analog output	–
5	RSVD	Pin shorted with sensor lead frame	1)
6	NC	Not connected	–

1) Lead frame shall be connected to GND. Only one of the pins connected to the lead frame shall be connected to GND to avoid GND loops through the lead frame. The other RSVD pins shall be left open.

4 General product characteristics

4.1 Absolute maximum ratings

Table 3 Absolute maximum ratings

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Electrical						
Supply voltage	V_{DD_ABS}	-0.3	–	6.5	V	Maximum 10 hours between 5.5 V to 6.5 V
Voltage on AOUT pin	V_{AOUT}	-0.3	–	V_{DD}	V	
ESD voltage	V_{ESD_HBM}	-2	–	2	kV	Human Body Model, according to AEC-Q100-002
	V_{ESD_CDM}	-1	–	1	kV	Charged Device Model, according to AEC-Q100-011
Temperature						
Storage temperature	T_S	-40	–	150	°C	
Junction temperature	T_J	-40	–	175	°C	
Magnetic						
Magnetic field at TMR sensing element	B_{TMR_ABS}	-75	–	75	mT	$B_{TMR\_ABS}=\pm\sqrt{(B_X^2 + B_Y^2)}$

***Attention**: Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only and functional operation of the device at these or any other conditions above those indicated in the section "functional range" is not implied. Furthermore, only single error cases are assumed. More than one stress/error case may also damage the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. During absolute maximum rating overload conditions the voltage on VDD pins with respect to ground shall not exceed the values defined by the absolute maximum ratings. Lifetime statements are an anticipation based on an extrapolation of Infineon's qualification test results. The actual lifetime of a component depends on its form of application and type of use etc. and may deviate from such statement. Lifetime statements shall in no event extend the agreed warranty period.*

4.2 Functional range

The following functional range shall not be exceeded in order to ensure correct operation of the device. All parameters specified in the following sections refer to these operating conditions unless otherwise indicated.

Table 4 Functional range

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Electrical						
Operating supply voltage	V_{DD}	3	–	5.5	V	
Analog output linear range	V_{AOUT_LR}	0.3	–	V_{DD} - 0.3	V	
Temperature						
Operating ambient temperature	T_A	-40	–	150	°C	
Operating junction temperature	T_{J_OP}	-40	–	160	°C	
Magnetic						
Operating magnetic field at TMR sensing element	B_{TMR}	-35	–	35	mT	$B_{TMR}=\pm\sqrt{(B_X^2 + B_Y^2)}$ Magnetic field component in the sensing direction at TMR sensing element location.
Magnetic input field (BFS1)	B_{FS1}	-41	–	41	mT	V_{DD} = 5 V. Valid for TLI5572-AE24E1-E0001 [1)]
		-25	–	25	mT	V_{DD} = 3.3 V. Valid for TLI5572-AE24E1-E0001
Magnetic input field (BFS2)	B_{FS2}	-25	–	25	mT	V_{DD} = 5 V. Valid for TLI5572-AE15E1-E0001
		-16	–	16	mT	V_{DD} = 3.3 V. Valid for TLI5572-AE15E1-E0001
Magnetic input field (BFS3)	B_{FS3}	-20	–	20	mT	V_{DD} = 5 V. Valid for TLI5572-AE12E1-E0001
		-12	–	12	mT	V_{DD} = 3.3 V. Valid for TLI5572-AE12E1-E0001
Magnetic input field (BFS4)	B_{FS4}	-13	–	13	mT	V_{DD} = 5 V. Valid for TLI5572-AE08E1-E0001
		-8	–	8	mT	V_{DD} = 3.3 V. Valid for TLI5572-AE08E1-E0001
Magnetic input field (BFS5)	B_{FS5}	-10	–	10	mT	V_{DD} = 5 V. Valid for TLI5572-AE06E1-E0001
		-6	–	6	mT	V_{DD} = 3.3 V. Valid for TLI5572-AE06E1-E0001
Magnetic input field (BFS6)	B_{FS6}	-6	–	6	mT	V_{DD} = 5 V. Valid for TLI5572-AE04E1-E0001
		-4	–	4	mT	V_{DD} = 3.3 V. Valid for TLI5572-AE04E1-E0001
Circuit						
Capacitance on VDD pin	C_{VDD}	–	100	–	nF	External capacitance connected to VDD pin. Typical value is a condition valid for all performance parameters unless otherwise specified

(table continues...)

Table 4 (continued) Functional range

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Capacitance on AOUT pin	C_{AOUT}	80	220	250	pF	External capacitance connected to AOUT, including parasitic capacitance on the PCB. Typical value is a condition valid for all performance parameters unless otherwise specified
Pull-up resistor on AOUT pin	R_{PU_AOUT}	24.3	33	–	kΩ	Pull-up resistor to V_{DD} connected to AOUT pin. Typical value is a condition valid for all performance parameters unless otherwise specified

1) Product specifications are valid only within the functional range of B_{TMR}.

4.3 Thermal resistance

Table 5 Thermal resistance

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Thermal resistance	$R_{th,JA}$	–	152	200	K/W	Junction to air, according to JEDEC JESD51-7

5 Product features

5.1 Electrical characteristics

Table 6 Electrical characteristics

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Current consumption	I_{DD}	–	5.5	8	mA	I_{AOUT} = 0 A
Power-on time	t_{PON}	–	–	100	µs	1)
Analog output nominal quiescent voltage	V_{OQ}	–	$V_{DD}/2$	–	V	Nominal value in case of input magnetic field B_X = 0
Analog output slew rate	SL_{AOUT_MAX}	10	–	–	V/µs	V_{DD} = 5 V and B_{FSX} from 10% to 90%
		6	–	–	V/µs	V_{DD} = 3.3 V and B_{FSX} from 10% to 90%
Analog output maximum drive capability	I_{AOUT_MAX}	1	–	–	mA	DC
Analog output impedance	Z_{AOUT}	–	4	20	Ω	B_X = 0 and I_{AOUT} = I_{AOUT_MAX}

1) V_{DD} rising from 0 V to the nominal value of V_{DD}. Device functions according to specification after power-on time, which starts when the V_{DD} reaches the minimum value specified in the functional range and stops when the device is fully operational.

5.2 Sensing characteristics

Table 7 Sensing characteristics valid for all variants

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Analog output propagation delay	t_{PD}	–	–	100	ns	From 20% of the magnetic input field to 20% of the output voltage. Input rise time from 10% to 90% equal to 10 ns
Analog output response time	$t_{RESPONSE}$	–	–	300	ns	From 90% of the magnetic input field to 90% of the output voltage. Input rise time from 10% to 90% equal to 10 ns
Transfer function cutoff frequency	BW	1	–	–	MHz	-3 dB criterion
Hysteresis	B_{HYS}	-0.5	-	0.5	%	$\pm B_{FSX}$ applied

Table 8 Sensing characteristics TLI5572-AE24E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity (S1)	$S1$	–	53.5	–	mV/mT	T_A = 25°C, 0 h.
Output noise	B_{NOISE}	–	4.1	8.1	μT_{RMS}	BW = 1 MHz. Referenced to magnetic input field
Initial offset	E_{OFF_INIT}	-180	±120	180	µT	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1]; Strayfields like earth magnetic field and possible hysteresis are excluded from this parameter.
Offset drift over temperature	E_{OFF_T}	-150	±90	150	µT	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1]
		-180	±120	180	µT	-20°C ≤ T_A ≤ 105°C. Difference with respect to 25°C [1]
		-230	±150	230	µT	-40°C ≤ T_A ≤ 125°C. Difference with respect to 25°C [1]
		-230	±150	230	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1]
Offset drift over temperature and lifetime	E_{OFF_L}	-300	±200	300	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1]
Offset ratiometricity error over temperature	$E_{OFF\_RATIO\_T}$	-100	±40	100	µV/ %V_{DD}	±10% V_{DD} variation [1]
Offset ratiometricity error over temperature and lifetime	$E_{OFF\_RATIO\_L}$	-100	±40	100	µV/ %V_{DD}	±10% V_{DD} variation [1]

(table continues...)

Table 8 (continued) Sensing characteristics TLI5572-AE24E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Initial sensitivity error	E_{SENS}	-4	±2.4	4	%	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1]
Sensitivity drift over temperature	E_{SENS_T}	-4	±2.5	4	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C [1]
		-4	±2.5	4	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1]
	E_{SENS_T}	-3	±1.5	3	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1]
Sensitivity drift over temperature and lifetime	E_{SENS_L}	-4.75	±3	4.75	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C at 0 h [1]
		-4.75	±3	4.75	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1]
		-3.75	±2	3.75	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C at 0 h [1]
Non-linearity error over temperature and lifetime	E_{NL}	-1.82	±1	1.82	%	% of B_{FSX} [1]

1) Typical values are ±3σ.

Table 9 Sensing characteristics TLI5572-AE15E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity (S2)	$S2$	–	85.5	–	mV/mT	T_A = 25°C, 0 h.
Output noise	B_{NOISE}	–	4.1	8.1	μT_{RMS}	BW = 1 MHz. Referenced to magnetic input field
Initial offset	E_{OFF_INIT}	-180	±120	180	µT	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1]; Strayfields like earth magnetic field and possible hysteresis are excluded from this parameter.
Offset drift over temperature	E_{OFF_T}	-150	±90	150	µT	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1]
		-180	±120	180	µT	-20°C ≤ T_A ≤ 105°C. Difference with respect to 25°C [1]
		-230	±150	230	µT	-40°C ≤ T_A ≤ 125°C. Difference with respect to 25°C [1]
		-230	±150	230	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1]
Offset drift over temperature and lifetime	E_{OFF_L}	-300	±200	300	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1]

(table continues...)

Table 9 (continued) Sensing characteristics TLI5572-AE15E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Offset ratiometricity error over temperature	$E_{OFF\_RATIO\_T}$	-100	±40	100	µV/ %V_{DD}	±10% V_{DD} variation [1]
Offset ratiometricity error over temperature and lifetime	$E_{OFF\_RATIO\_L}$	-100	±40	100	µV/ %V_{DD}	±10% V_{DD} variation [1]
Initial sensitivity error	E_{SENS}	-4	±2.4	4	%	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1]
Sensitivity drift over temperature	E_{SENS_T}	-4	±2.5	4	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C [1]
	E_{SENS_T}	-4	±2.5	4	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1]
		-3	±1.5	3	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1]
Sensitivity drift over temperature and lifetime	E_{SENS_L}	-4.75	±3	4.75	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C at 0 h [1]
		-4.75	±3	4.75	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1]
		-3.75	±2	3.75	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C at 0 h [1]
Non-linearity error over temperature and lifetime	E_{NL}	-1	±0.5	1	%	% of B_{FSX} [1]

1) Typical values are ±3σ.

Table 10 Sensing characteristics TLI5572-AE12E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity (S3)	$S3$	–	107	–	mV/mT	T_A = 25°C, 0 h.
Output noise	B_{NOISE}	–	4.1	8.1	µT_{RMS}	BW = 1 MHz. Referenced to magnetic input field
Initial offset	E_{OFF_INIT}	-180	±105	180	µT	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1]; Strayfields like earth magnetic field and possible hysteresis are excluded from this parameter.

(table continues...)

Table 10 (continued) Sensing characteristics TLI5572-AE12E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Offset drift over temperature	E_{OFF_T}	-120	±80	120	µT	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1)]
		-160	±110	160	µT	-20°C ≤ T_A ≤ 105°C. Difference with respect to 25°C [1)]
		-230	±130	230	µT	-40°C ≤ T_A ≤ 125°C. Difference with respect to 25°C [1)]
		-230	±150	230	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1)]
Offset drift over temperature and lifetime	E_{OFF_L}	-300	±200	300	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1)]
Offset ratiometricity error over temperature	$E_{OFF\_RATIO\_T}$	-100	±40	100	µV/ %V_{DD}	±10% V_{DD} variation [1)]
Offset ratiometricity error over temperature and lifetime	$E_{OFF\_RATIO\_L}$	-100	±40	100	µV/ %V_{DD}	±10% V_{DD} variation [1)]
Initial sensitivity error	E_{SENS}	-4	±2.4	4	%	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1)]
Sensitivity drift over temperature	E_{SENS_T}	-4	±2.5	4	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C [1)]
	E_{SENS_T}	-4	±2.5	4	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1)]
		-3	±1.5	3	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1)]
Sensitivity drift over temperature and lifetime	E_{SENS_L}	-4.75	±3	4.75	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C at 0 h [1)]
		-4.75	±3	4.75	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1)]
		-3.75	±2	3.75	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C at 0 h [1)]
Non-linearity error over temperature and lifetime	E_{NL}	-1	±0.5	1	%	% of B_{FSX} [1)]

1) Typical values are ±3σ.

Table 11 Sensing characteristics TLI5572-AE08E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity (S4)	*S4*	–	172	–	mV/mT	T_A = 25°C, 0 h.
Output noise	B_{NOISE}	–	4.1	8.1	μT_{RMS}	*BW* = 1 MHz. Referenced to magnetic input field
Initial offset	E_{OFF_INIT}	-180	±105	180	µT	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1); Strayfields like earth magnetic field and possible hysteresis are excluded from this parameter.
Offset drift over temperature	E_{OFF_T}	-120	±80	120	µT	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1)
		-160	±110	160	µT	-20°C ≤ T_A ≤ 105°C. Difference with respect to 25°C [1)
		-230	±130	230	µT	-40°C ≤ T_A ≤ 125°C. Difference with respect to 25°C [1)
		-230	±150	230	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1)
Offset drift over temperature and lifetime	E_{OFF_L}	-300	±200	300	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1)
Offset ratiometricity error over temperature	$E_{OFF\_RATIO\_T}$	-150	±70	150	µV/ %V_{DD}	±10% V_{DD} variation [1)
Offset ratiometricity error over temperature and lifetime	$E_{OFF\_RATIO\_L}$	-150	±70	150	µV/ %V_{DD}	±10% V_{DD} variation [1)
Initial sensitivity error	E_{SENS}	-4	±2.4	4	%	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1)
Sensitivity drift over temperature	E_{SENS_T}	-4	±2.5	4	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C [1)
	E_{SENS_T}	-4	±2.5	4	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1)
		-3	±1.5	3	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1)
Sensitivity drift over temperature and lifetime	E_{SENS_L}	-4.75	±3	4.75	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C at 0 h [1)
		-4.75	±3	4.75	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1)
		-3.75	±2	3.75	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C at 0 h [1)
Non-linearity error over temperature and lifetime	E_{NL}	-1.2	±0.6	1.2	%	% of B_{FSX} [1)

1) Typical values are ±3σ.

Table 12 Sensing characteristics TLI5572-AE06E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity (S5)	*S5*	–	214	–	mV/mT	T_A = 25°C, 0 h.
Output noise	B_{NOISE}	–	4.1	8.1	μT_{RMS}	*BW* = 1 MHz. Referenced to magnetic input field
Initial offset	E_{OFF_INIT}	-180	±90	180	µT	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller 1) ; Strayfields like earth magnetic field and possible hysteresis are excluded from this parameter.
Offset drift over temperature	E_{OFF_T}	-120	±80	120	µT	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C 1)
		-160	±110	160	µT	-20°C ≤ T_A ≤ 105°C. Difference with respect to 25°C 1)
		-230	±130	230	µT	-40°C ≤ T_A ≤ 125°C. Difference with respect to 25°C 1)
		-230	±150	230	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C 1)
Offset drift over temperature and lifetime	E_{OFF_L}	-300	±200	300	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h 1)
Offset ratiometricity error over temperature	$E_{OFF\_RATIO\_T}$	-150	±70	150	µV/ %V_{DD}	±10% V_{DD} variation 1)
Offset ratiometricity error over temperature and lifetime	$E_{OFF\_RATIO\_L}$	-150	±70	150	µV/ %V_{DD}	±10% V_{DD} variation 1)
Initial sensitivity error	E_{SENS}	-4	±2.4	4	%	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller 1)
Sensitivity drift over temperature	E_{SENS_T}	-4	±2.5	4	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C 1)
	E_{SENS_T}	-4	±2.5	4	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C 1)
		-3	±1.5	3	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C 1)
Sensitivity drift over temperature and lifetime	E_{SENS_L}	-4.75	±3	4.75	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C at 0 h 1)
		-4.75	±3	4.75	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h 1)
		-3.75	±2	3.75	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C at 0 h 1)

(table continues...)

Table 12 (continued) Sensing characteristics TLI5572-AE06E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Non-linearity error over temperature and lifetime	E_{NL}	-1.2	±0.6	1.2	%	% of B_{FSX} [1)]

1) Typical values are ±3σ.

Table 13 Sensing characteristics TLI5572-AE04E1-E0001

Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity (S6)	*S6*	–	340	–	mV/mT	T_A = 25°C, 0 h.
Output noise	B_{NOISE}	–	4.1	8.1	μT_{RMS}	*BW* = 1 MHz. Referenced to magnetic input field
Initial offset	E_{OFF_INIT}	-180	±90	180	µT	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1)] ; Strayfields like earth magnetic field and possible hysteresis are excluded from this parameter.
Offset drift over temperature	E_{OFF_T}	-120	±80	120	µT	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1)]
		-160	±110	160	µT	-20°C ≤ T_A ≤ 105°C. Difference with respect to 25°C [1)]
		-230	±130	230	µT	-40°C ≤ T_A ≤ 125°C. Difference with respect to 25°C [1)]
		-230	±150	230	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1)]
Offset drift over temperature and lifetime	E_{OFF_L}	-300	±200	300	µT	-40°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1)]
Offset ratiometricity error over temperature	$E_{OFF\_RATIO\_T}$	-150	±70	150	µV/ %V_{DD}	±10% V_{DD} variation [1)]
Offset ratiometricity error over temperature and lifetime	$E_{OFF\_RATIO\_L}$	-150	±70	150	µV/ %V_{DD}	±10% V_{DD} variation [1)]
Initial sensitivity error	E_{SENS}	-4	±2.4	4	%	T_A = 25°C, 0 h; it can be compensated in the application by EOL-calibration at RT in the microcontroller [1)]
Sensitivity drift over temperature	E_{SENS_T}	-4	±2.5	4	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C [1)]
		-4	±2.5	4	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C [1)]
	E_{SENS_T}	-3	±1.5	3	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C [1)]

(table continues...)

Table 13 (continued) Sensing characteristics TLI5572-AE04E1-E0001

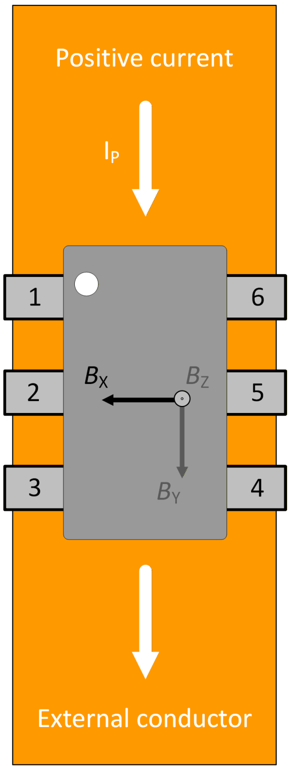
Parameter	Symbol	Values			Unit	Note or condition
		Min.	Typ.	Max.		
Sensitivity drift over temperature and lifetime	E_{SENS_L}	-4.75	±3	4.75	%	-40°C ≤ T_A < 25°C. Difference with respect to 25°C at 0 h [1)]
		-4.75	±3	4.75	%	25°C ≤ T_A ≤ 150°C. Difference with respect to 25°C at 0 h [1)]
		-3.75	±2	3.75	%	-5°C ≤ T_A ≤ 85°C. Difference with respect to 25°C at 0 h [1)]
Non-linearity error over temperature and lifetime	E_{NL}	-1.2	±0.6	1.2	%	% of B_{FSX} [1)]

1) Typical values are ±3σ.

5.3 Functional description

5.3.1 Output voltage and current polarity

The sensor is sensitive to the sensing element plane magnetic field component directed from pin 5 to pin 2. The magnetic field on the sensing element location is positive when directed from pin 5 to pin 2. The magnetic field generated by a current flowing in an external conductor is positive when the current flows from pin 1 to pin 3. The sensor provides an output voltage higher than V_{OQ} when the magnetic field is positive and lower than V_{OQ} when the magnetic field is negative.



TLx5572 is sensitive to fields in B_X axis.

Field vector B_X points from pin 5 to pin 2.

A positive current I_P flowing an external conductor in the direction from pin 1 to pin 3 leads to a voltage increase in the AOUT pin.

Figure 3 Polarity definition

5.3.2 Full scale definition

The magnetic input full scale and analog output full scale are defined in the following figure.

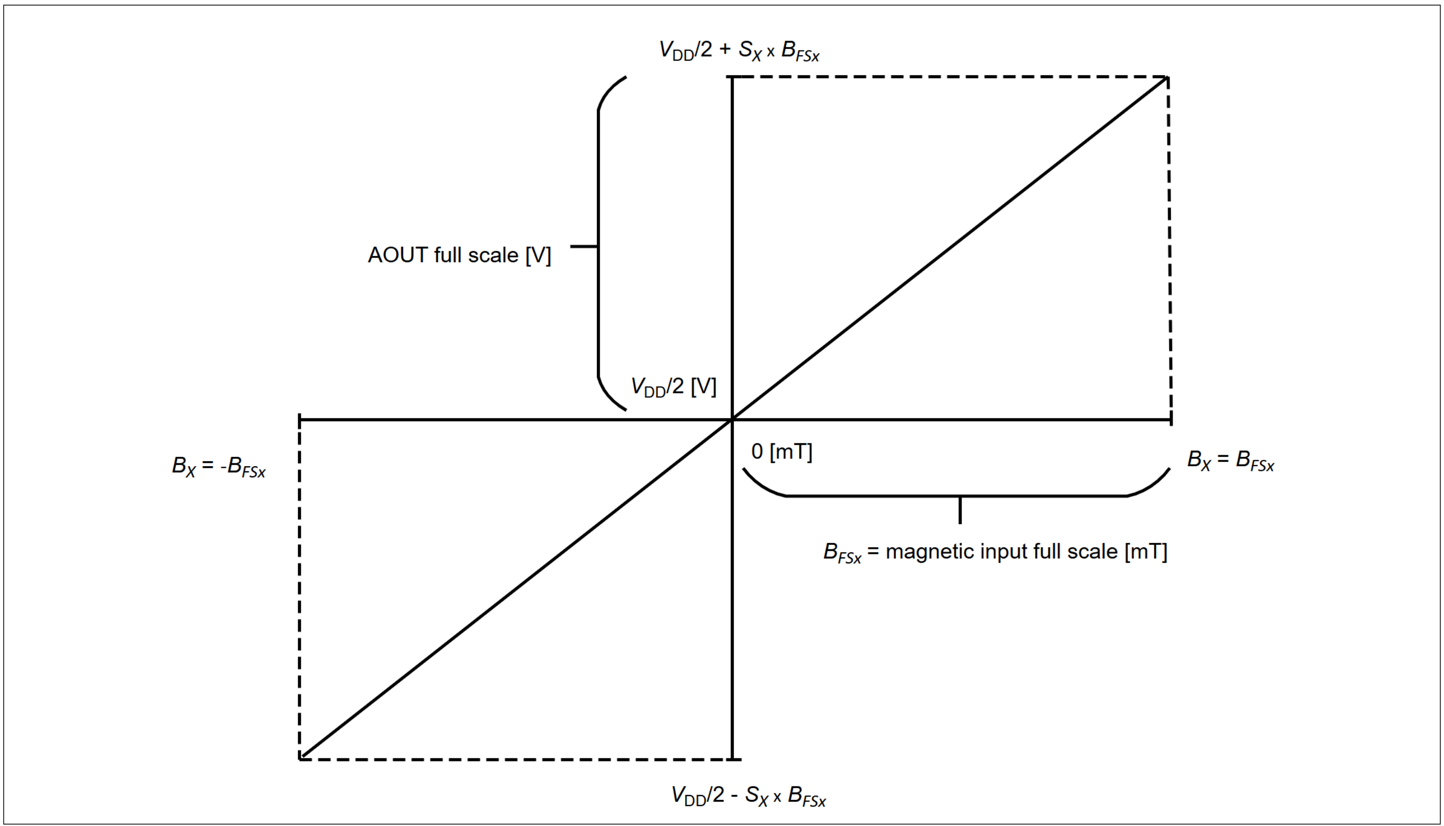


Figure 4 Full scale (B_{FSx}) definition

The errors specified in Table 8 are referred to the magnetic input full scale (B_{FSx}).
Referring the errors to the whole [-B_{FSx}... B_{FSx}] range reduces the errors by a factor of two.

5.3.3 Output behavior

The AOUT pin operates as an output and provides an output voltage with high bandwidth.
Being S the sensitivity and V_{OQ} the quiescent voltage of the sensor, the output voltage on AOUT is described as follows:

$$V\left(AOUT\right) = V_{OQ} + S \times B_X = \frac{V_{DD}}{2} + S \times B_X \quad (1)$$

Where B_X is the magnetic field at the TMR sensing element location.

5.3.4 Output noise

Output noise referenced to magnetic input field can be expressed according to the following formula:

$$B_{NOISE} = V_{NOISE} \times \frac{1}{S} \times 10^3 \quad (2)$$

Where:

- B_{NOISE} is the output noise referenced to magnetic input field [μT_{RMS}]

- V_{NOISE} is the output noise voltage in [mV_{RMS}]
- S is the sensitivity in [mV/mT]

5.3.5 Output error definitions and calculations

Initial offset (E_{OFF_INIT}) and initial sensitivity error (E_{SENS}) are residual errors after Infineon front-end and back-end trimming. They are part-to-part variations that can be compensated by the users at 0 h and room temperature, as explained in Chapter 6.3.

Both offset and sensitivity can drift due to temperature changes and lifetime effects. Temperature and lifetime drifts are defined by the E_{OFF_T}, E_{OFF_L}, $E_{OFF\_RATIO\_T}$, $E_{OFF\_RATIO\_L}$, E_{SENS_T}, E_{SENS_L} parameters.

If we consider sensitivity and offset drifts over temperature and over lifetime to have zero mean and statistically independent from each other, the total drift over temperature (ΔE_{TOT_T}) and the total drift over temperature and lifetime (ΔE_{TOT_L}) expressed in % of the sensor full scale FS can be estimated as:

$$E_{\mathrm{TOT\_T}\,[\%\,\mathrm{FS}]} = \sqrt{\left(\frac{E_{OFF\_RATIO\_T} \times 10}{FS_{[V]}}\,\%\right)^2 + \left(\frac{E_{\mathrm{OFF\_T}}}{FS_{[mT]} \times 10^3}\,\%\right)^2 + \left(E_{\mathrm{SENS\_T}}\right)^2} \quad (3)$$

$$E_{\mathrm{TOT\_L}\,[\%\,FS]} = \sqrt{\left(\frac{E_{OFF\_RATIO\_L} \times 10}{FS_{[V]}}\,\%\right)^2 + \left(\frac{E_{\mathrm{OFF\_L}}}{FS_{[mT]} \times 10^3}\,\%\right)^2 + \left(E_{\mathrm{SENS\_L}}\right)^2} \quad (4)$$

Additionally, the following error sources are taken into consideration for the calculation of the total error at system level.

Output noise (B_{NOISE}) is specified in [μT_{RMS}], as explained in Chapter 5.3.4. The RMS noise is dependent on utilized bandwidth in the application. The error due to the noise in % of full scale can be estimated as:

$$E_{\mathrm{NOISE}\,[\%\,FS]} = \frac{B_{\mathrm{NOISE}\,[\mu T]}}{FS_{[mT]} \times 10^3}\,\% \times \sqrt{\frac{Utilized\quad BW}{BW}} \quad (5)$$

The residual offset and sensitivity errors after user calibration ($E_{OFF\_RES\,[\mu T]}$, $E_{SENS\_RES\,[\%]}$) depend on the accuracy of the calibration environment. It is possible to consider them to have zero mean and being statistically independent from the other error components.

In case of variants with very low magnetic full scale range, and in case no shielding is done at system level, the Earth magnetic field contribution E_{EARTH} on the total error is non negligible and must be added arithmetically to the total error. The calculation below takes into account two times B_{EARTH_MAX} because the B_{EARTH} seen by the sensor in the application can be oriented in the opposite direction with respect to the B_{EARTH} seen by the sensor during user calibration:

$$E_{EARTH\,[\%\,FS]} = \frac{2 \times B_{EARTH\_MAX\,[mT]}}{FS_{[mT]}}\,\% \quad (6)$$

The total error from the sensor over temperature and lifetime can be estimated as:

$$E_{\mathrm{TOT}\,[\,\%\,FS]} = E_{EARTH} + E_{\mathrm{NL}} + \sqrt{\left(\frac{E_{OFF\_RATIO\_L} \times 10}{FS_{[V]}}\,\%\right)^2 + \left(\frac{E_{\mathrm{OFF\_L}}}{FS_{[mT]} \times 10^3}\,\%\right)^2 + \left(\frac{E_{OFF\_RES}}{FS_{[mT]} \times 10^3}\,\%\right)^2 + \left(E_{\mathrm{SENS\_L}}\right)^2 + \left(E_{\mathrm{SENS\_RES}}\right)^2 + \left(E_{NOISE}\right)^2} \quad (7)$$

6 Application information

6.1 Application circuit

The figure below shows an example application circuit of the device. Please refer to Table 4 for the value of passive components.

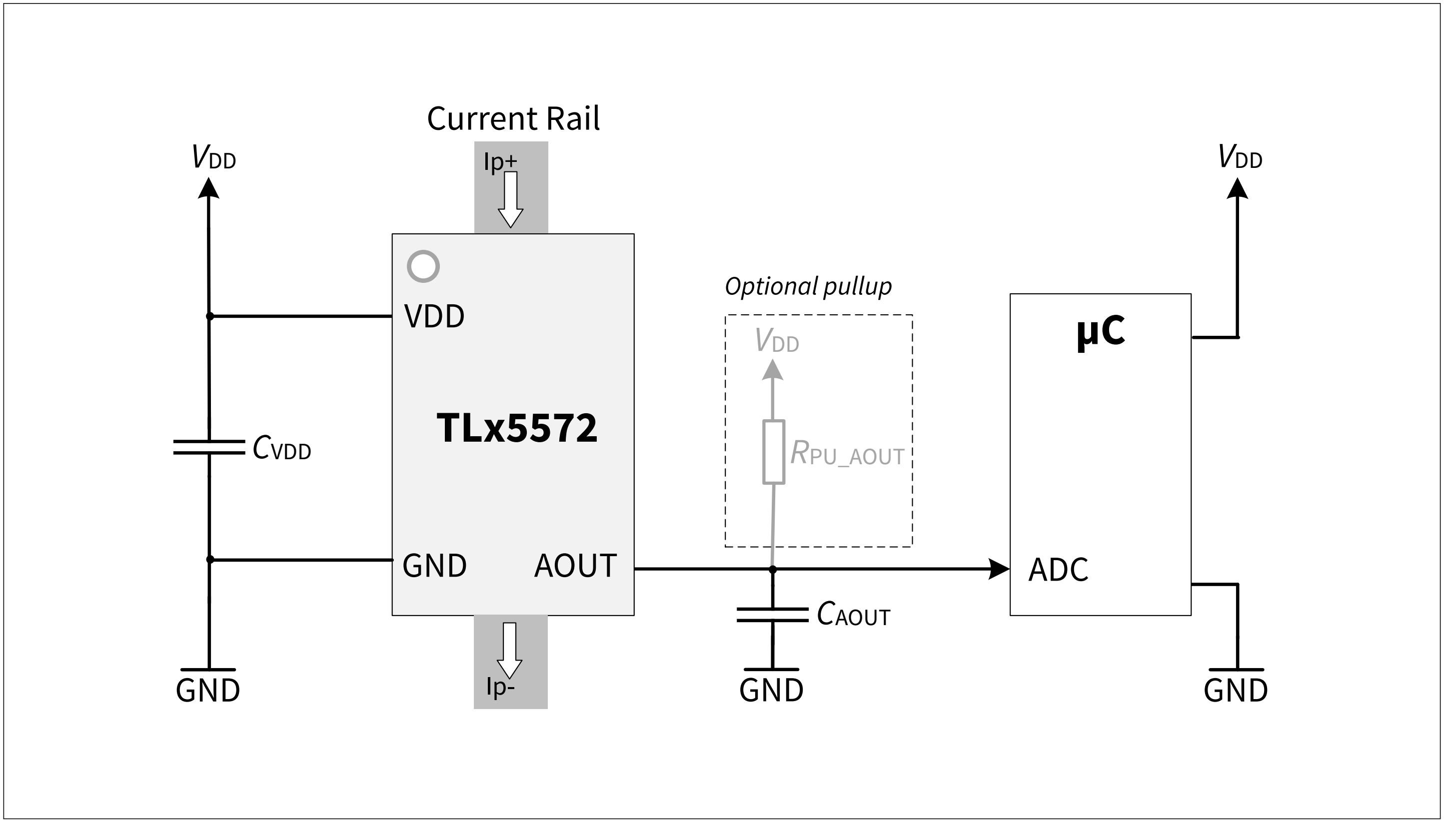


Figure 5 **Application circuit example**

Note: *This is a simplified example of an application circuit. The function must be verified in the real application. The Pullup on AOUT is optional and can be used for safety critical applications to increase the safety coverage*

6.2 External current rail design

TLx5572 senses the current flowing in an external conductor like a PCB track or a bus-bar. Depending on the external conductor design, different transfer factors [µT/A] can be achieved. Additionally, depending on the conductor design and sensor placement, different performance in terms of accuracy and response time are obtained at system level.

The following figure shows an example of straight conductor configuration. In this example, the center of TLx5572 is aligned to the middle of the straight conductor. The current Ip generates a magnetic field in the sensitive direction Bx.

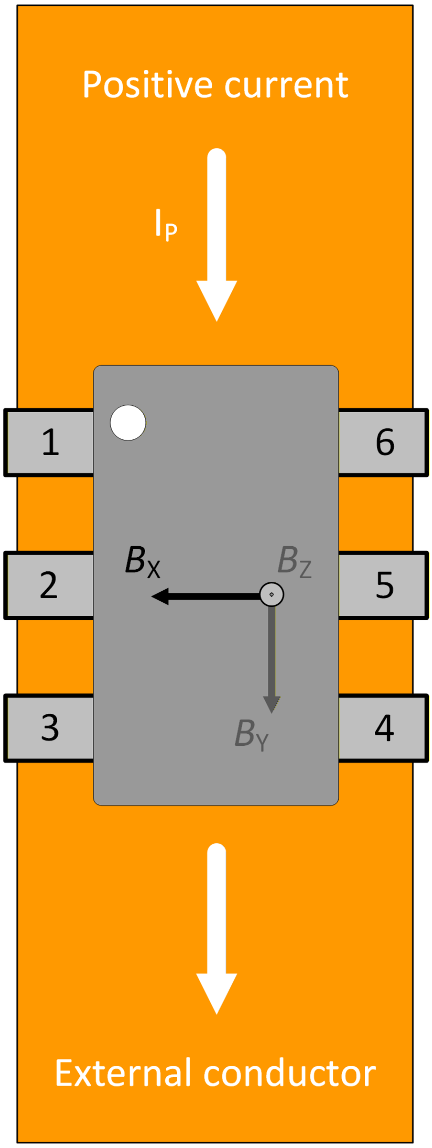


Figure 6 **Example of straight conductor**

6.3 In-system calibration

In order to achieve optimal accuracy performance at system level it is recommended to perform the calibration of sensitivity [V/A] and offset [V] at room temperature when the sensor is integrated into the system. This calibration is usually performed at end of line.

The sensitivity needs to be calibrated in order to compensate the errors due to displacement of the sensor during mounting and soldering, mechanical tolerances of the package as well as the initial sensitivity error of the sensor [mV/mT] due to part to part variation.

The offset needs to be calibrated in order to compensate the offset introduced by the interface between sensor and microcontroller, as well as the initial offset error of the sensor due to part to part variation.

6.3.1 Error due to mechanical displacement

Due to mechanical placement and production tolerances, the sensor actual position with respect to the conductor are affected, hence the transfer factor of the system [mT/A] may be different compared to the nominal value simulated during the design. For this reason, to achieve optimal accuracy performance a calibration is recommended in the system.

6.3.2 Initial offset error calibration

The initial offset error V_{OFF} is defined as the difference between the output voltage on the AOUT pin when the current flowing in the external conductor is zero and the nominal quiescent voltage V_{OQ}.

$$V_{OFF} = V_{AOUT}(0A) - \frac{V_{DD}}{2} \tag{8}$$

In order to measure the offset of the sensor, the user can:
- control the current in the external conductor to zero
- measure the voltage on the AOUT pin in correspondence of zero current
- subtract the nominal quiescent voltage from the measured value

The obtained value corresponds to the offset.

***Note**: Being the nominal V_{OQ} equal to $V_{DD}/2$, V_{DD} shall also be measured to exclude the errors due to V_{DD} variations.*

6.3.3 Initial sensitivity error calibration

In order to measure the sensitivity of the sensor the user can:
- inject a test current I_{TEST} in the sensing structure. I_{TEST} shall be at least 10% of the target full scale current in order to achieve low noise in the sensitivity measurement and it shall be low enough to prevent a high temperature rise of the device during calibration
- measure the voltage on the AOUT pin when no current is flowing in order to measure the offset
- measure the voltage on the AOUT pin in correspondence of I_{TEST}
- measure the I_{TEST} itself using a calibrated current source, a shunt combined with a multimeter or any other precise current measurement device

The measured sensitivity S_M is then calculated using the following formula:

$$S_M = \frac{V_{AOUT}(I_{TEST}) - V_{AOUT}(0A)}{I_{TEST}} \tag{9}$$

6.3.4 Initial errors calibration

Once the initial offset and sensitivity errors due to mechanical displacement and part to part variations are known, they can be compensated in the microcontroller by using the following formula:

$$I = \frac{V_{AOUT} - \frac{V_{DD}}{2} - V_{OFF}}{S_M} \tag{10}$$

7 Package

The device is mounted in the PG-SOT23-6-4 package.

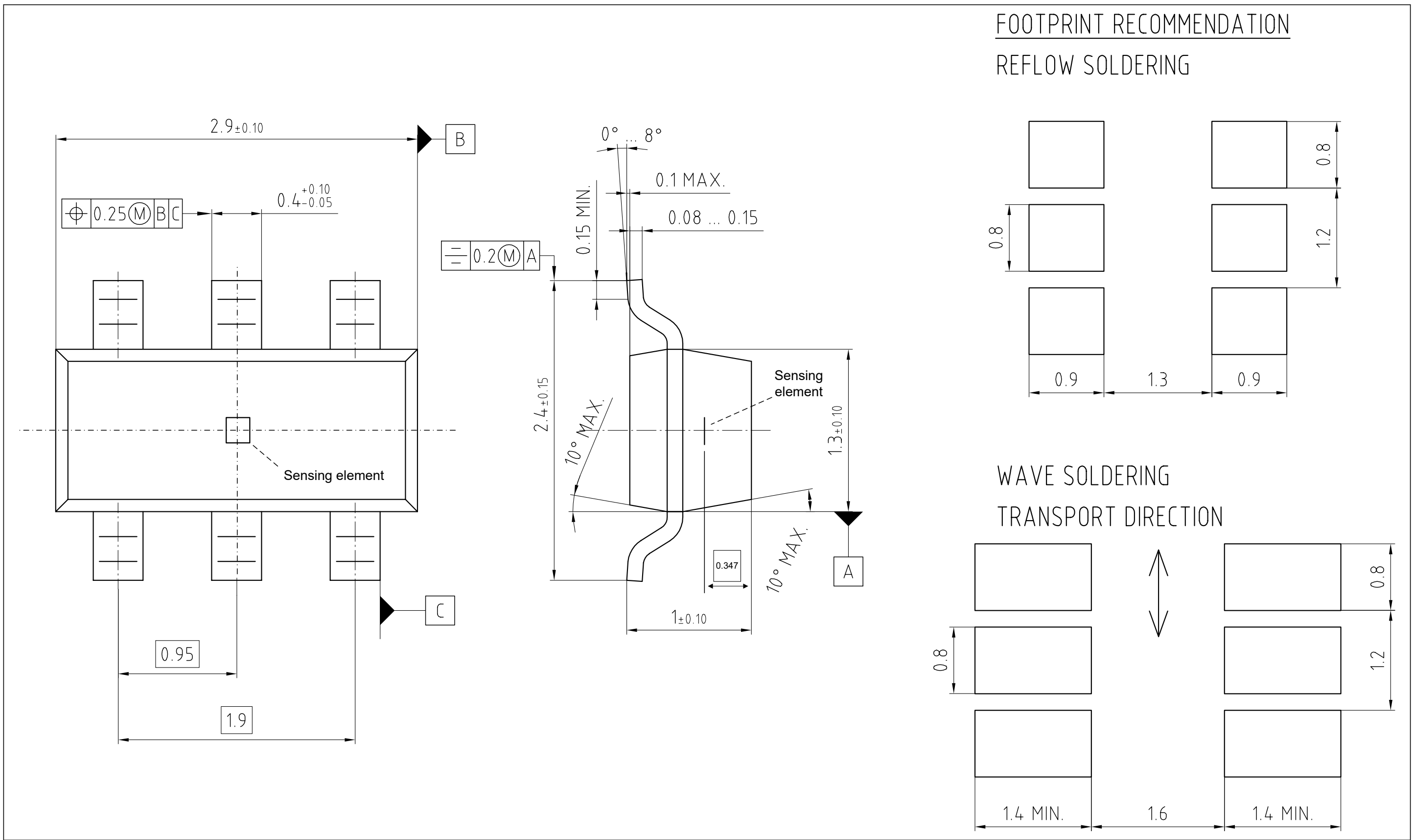


Figure 7 **PG-SOT23-6-4 package outline. Sensing element dimensions and position are not in scale**

The sensing element is placed in the center of the package. The in-plane sensing element position tolerance referenced to mold housing edge is ±100 µm. The vertical tolerance referred to top mold housing edge is ±50 µm. The vertical tolerance referred to bottom mold housing edge is ±100 µm (including lead bending tolerances).

The PG-SOT23-6-4 package fulfills the MSL level 1 according to IPC/JEDEC J-STD-033B.1.

The package marking of the device is as shown in the figure below:

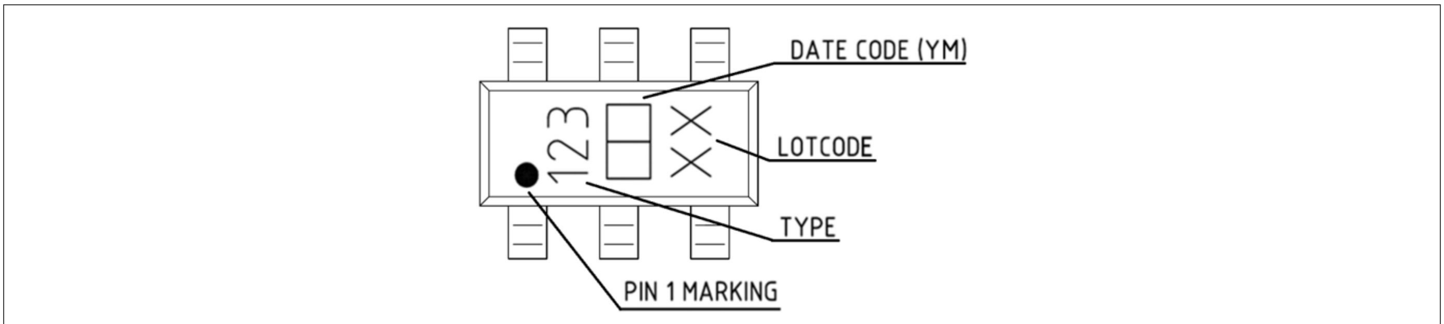


Figure 8 **Package marking - front side**

8 Revision history

Table 14 Revision history

Revision number	Date of release	Description of changes
1.10	2026-01-20	Initial public release for industrial variant
1.00	2025-12-12	Initial release

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