LOW-VOLTAGE, HIGH-SENSITIVITY HALL EFFECT LATCH SWITCH

Description

The AH1711/AH1712/AH1713/AH1714 is a low-voltage, high-sensitivity Hall effect latch IC designed for brushless DC-motor commutation speed measurement, angular or linear encoders and position sensors in industrial applications. To support a wide range of demanding applications, the design is optimized to operate at 2.4V to 5.5V. With chopper stabilized architecture and an internal bandgap regulator to provide temperature compensated supply for internal circuits, the device provides a reliable solution over the whole operating range.

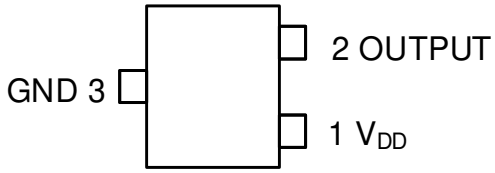
The open-drain output of AH1711/AH1712/AH1713 can be switched on when applying South pole with sufficient magnetic near the top of the package, while North pole with sufficient magnetic strength causes the open-drain output switched off (AH1714 polarity inverted). When the magnetic flux density (B) perpendicular to the package is larger than the operate point (Bop) the output is switched on (pulled low). The output is held latched until magnetic flux density reverses and becomes lower than the release point (Brp).

Features

- Latch Operation
- High Sensitivity: Bop and Brp of ±7 Gauss and ±18 Gauss
- Open-Drain Output
- 2.4V to 5.5V Operating Voltage Range
- Chopper Stabilized Design Provides
  - Superior Temperature Stability
  - Minimal Switch Point Drift
  - Enhanced Immunity to Stress
- Good RF Noise Immunity
- -40°C to +125°C Operating Temperature
- ESD: HBM 8kV, CDM 2kV
- Industry Standard SOT23 Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green Device (Note 3)**
- **For automotive applications requiring specific change control (i.e. parts qualified to AEC-Q100/101/104/200, PPAP capable, and manufactured in IATF 16949 certified facilities), please contact us or your local Diodes representative. https://www.diodes.com/quality/product-definitions/**

Pin Assignments

(Top View)



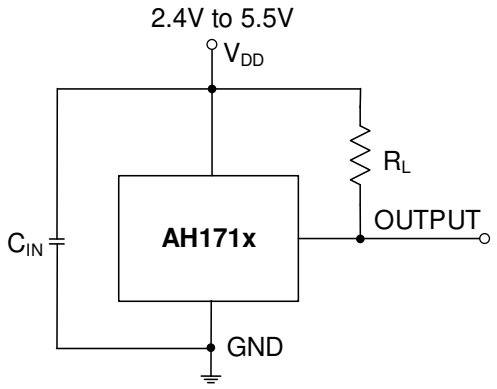
SOT23

Applications

- Brushless DC-motor commutation
- Revolution per minute (RPM) measurements
- Wheel speed/angular/speed sensing
- Flow meters
- E-bikes
- Knobs

Notes:
1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.
2. See https://www.diodes.com/quality/lead-free/ for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.
3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

Typical Applications Circuit (Note 4)



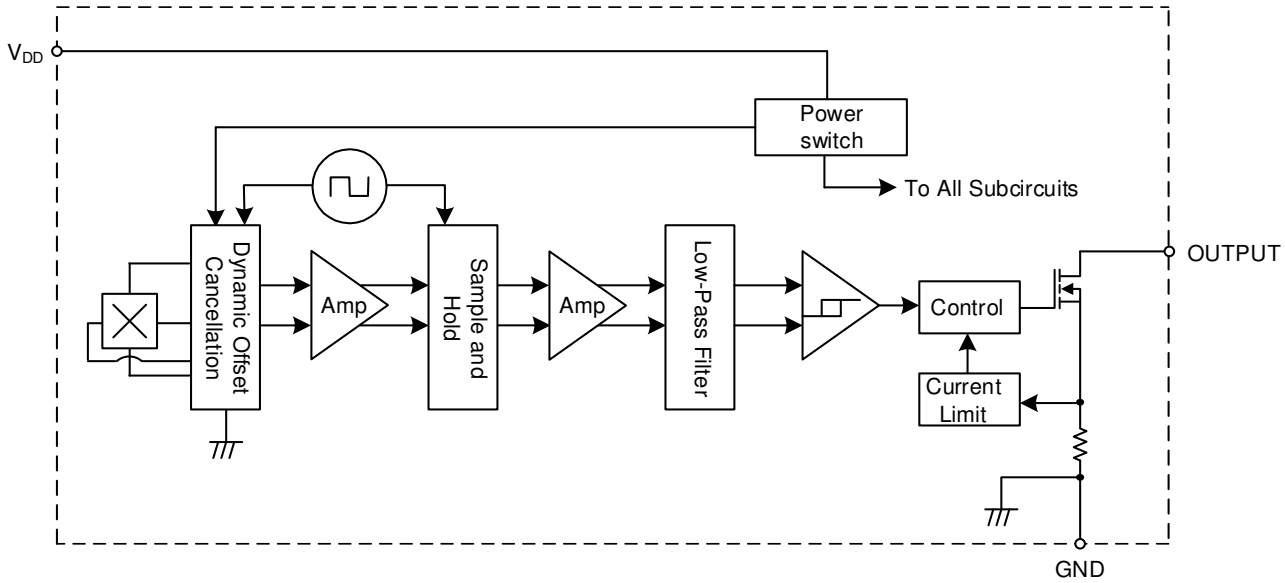
Note: 4. C_{IN} is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF. R_L is the pullup resistor.

Pin Descriptions

Package: SOT23

Pin Number	Pin Name	Function
1	V_{DD}	Power Supply Input
2	OUTPUT	Output
3	GND	Ground

Functional Block Diagram



Absolute Maximum Ratings (Notes 5 & 6) (@T_A = +25°C, unless otherwise specified.)

Symbol	Characteristic		Value	Unit
V_{DD}	Supply Voltage (Note 6)		-0.3 to 6.0	V
V_{OUT_MAX}	Output Off Voltage (Note 6)		6.0	V
I_{OUT}	Output Current		60	mA
B	Magnetic Flux Density		Unlimited	
P_D	Package Power Dissipation	SOT23	230	mW
T_S	Storage Temperature Range		-65 to +125	°C
T_J	Maximum Junction Temperature		+150	°C
ESD HBM	Electros Static Discharge Withstand - Human Body Model (HBM)		8	kV
ESD CDM	Electros Static Discharge Withstand - Charged Device Model (CDM)		2	kV

Notes: 5. Stresses greater than those listed under *Absolute Maximum Ratings* can cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to *Absolute Maximum Ratings* for extended periods can affect device reliability.

6. The absolute maximum V_{DD} of 6V is a transient stress rating and is not meant as a functional operating condition. It is not recommended to operate the device at the absolute maximum rated conditions for any period of time.

Recommended Operating Conditions (@T_A = -40°C to +125°C, unless otherwise specified.)

Symbol	Parameter	Rating	Unit
V_{DD}	Supply Voltage	2.4 to 5.5	V
I_{OUT}	Output Sinking Current	0 to 20	mA
T_A	Operating Temperature Range	-40 to +125	°C

Electrical Characteristics (Notes 7 & 8) (@T_A = -40°C to +125°C, V_{DD} = 2.4V to 5.5V, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OL}	Low-Level Output Voltage	I_{OUT} = 20mA	—	0.2	0.4	V
I_{LKG}	Output Leakage Current (When Output is Off)	V_{OUT} = 5.5V, output off	—	< 0.1	3	µA
I_{DD}	Supply Current	Output open, T_A = +25°C	—	2.0	2.8	mA
		Output open, T_A = -40 to +125°C	—	—	3.2	mA
t_{P_ON}	Device Power-On Time (Startup Time)	V_{DD} ≥ 2.4V, B < Brp (min) – 10G B > Bop (max) + 10G (Note 7) dV_{DD}/dt > 2V/µs	—	38	70	µs
POS	Power-On State, Output	Power-up time < t_{P_ON}, B = 0	Low			—
f_c	Chopping Frequency	V_{DD} > 2.4V	—	800	—	kHz
t_d	Response Time Delay (Time from Magnetic Threshold Reached to the Start of the Output Rise or Fall)	(Note 9)	—	10	20	µs
t_r	Output Rising Time (External Pullup Resistor R_L and Load Capacitance Dependent)	R_L = 1kΩ, C_L = 20pF	—	0.2	1	µs
t_f	Output Falling Time (Internal Switch Resistance and Load Capacitance Dependent)	R_L = 1kΩ, C_L = 20pF	—	0.1	1	µs
f_{BW}	Sensing Bandwidth	B ≥ ±400G and square wave magnetic field (Note 9)	20	30	—	kHz
I_{OCL}	Output Current Limit	B > Bop (Note 10)	30	—	60	mA

Notes: 7. When power is initially turned on, V_{DD} must be within its correct operating range (2.4V to 5.5V) to guarantee the output sampling. The output state is valid after the startup time of 10µs typical from the operating voltage reaching 2.4V.

8. Typical values are defined at T_A = +25°C. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization.

9. Guaranteed by design, process control and characterization. Not tested in production.

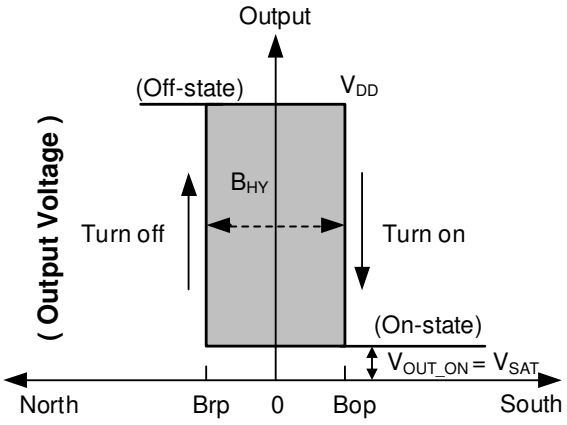
10. The device will limit the output current to current limit of I_{OCL}.

Magnetic Characteristics (Notes 11 & 12) (T_A = -40°C to +125°C, V_{DD} = 2.4V to 5.5V, unless otherwise specified.)

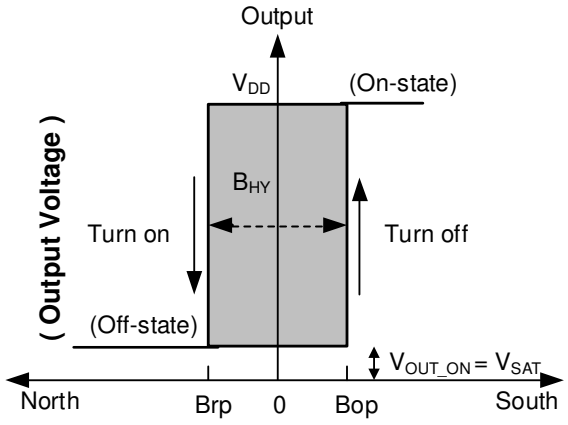
(1mT = 10 Gauss)

Part Number	Symbol	Parameter	Conditions	Min	Typ	Max	Unit	Output Polarity
AH1711	Bop	Operation Point	T_A = -40°C to +125°C	-2	7	20	Gauss	Direct
	Brp	Release Point	T_A = -40°C to +125°C	-20	-7	2		
	B_{HY}	Hysteresis (Note 13)	T_A = -40°C to +125°C	3.5	14	—		
AH1712	Bop	Operation Point	T_A = -40°C to +125°C	5	18	37	Gauss	Direct
	Brp	Release Point	T_A = -40°C to +125°C	-37	-18	-5		
	B_{HY}	Hysteresis (Note 13)	T_A = -40°C to +125°C	23	36	—		
AH1713	Bop	Operation Point	T_A = -40°C to +125°C	16	50	81	Gauss	Direct
	Brp	Release Point	T_A = -40°C to +125°C	-81	-50	-16		
	B_{HY}	Hysteresis (Note 13)	T_A = -40°C to +125°C	60	100	—		
AH1714	Bop	Operation Point	T_A = -40°C to +125°C	5	18	37	Gauss	Inverted
	Brp	Release Point	T_A = -40°C to +125°C	-37	-18	-5		
	B_{HY}	Hysteresis (Note 13)	T_A = -40°C to +125°C	23	36	—		

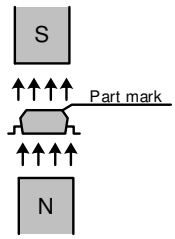
Notes:
11. When power is initially turned on, V_{DD} must be within its correct operating range (2.4V to 5.5V) to guarantee the output sampling. The output state is valid after the startup time of 38µs typical from the operating voltage reaching 2.4V.
12. Typical values are defined at T_A = +25°C. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization.
13. Maximum and minimum hysteresis is guaranteed by design, process control and characterization.



(Magnetic Flux Density B)
AH1711, AH1712, AH1713



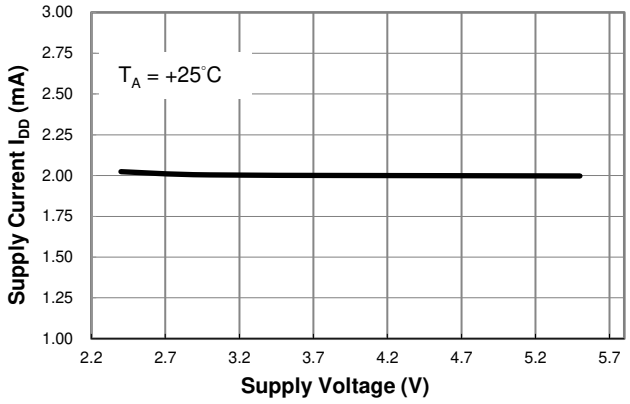
(Magnetic Flux Density B)
AH1714



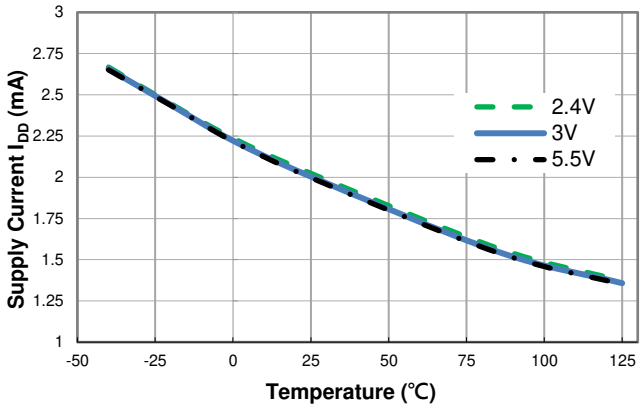
(SOT23)

Typical Operating Characteristics

Supply Current

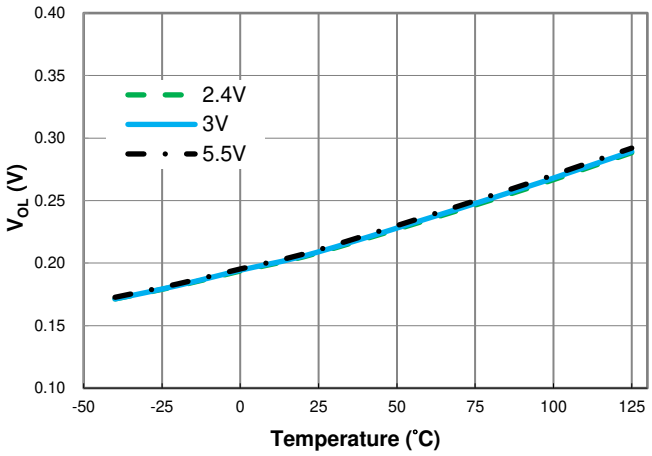


Operation Current vs. Supply Voltage



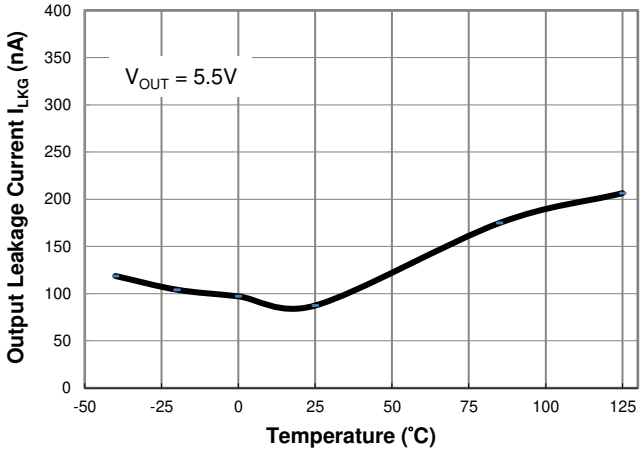
Operation Current vs. Temperature

Low-Level Output Voltage, I_{OUT} = 20mA



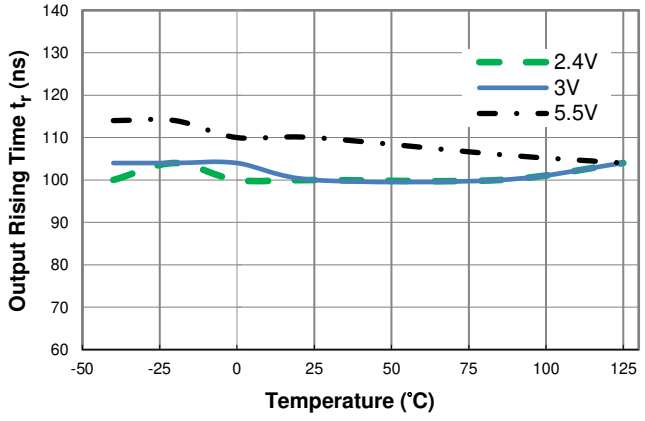
Output Voltage V_{OL} vs. Temperature

Output Leakage Current

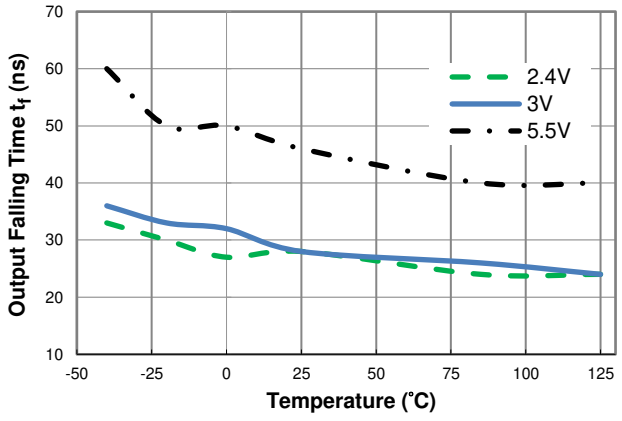


Output Leakage Current vs. Temperature

Output Rising/Falling Time



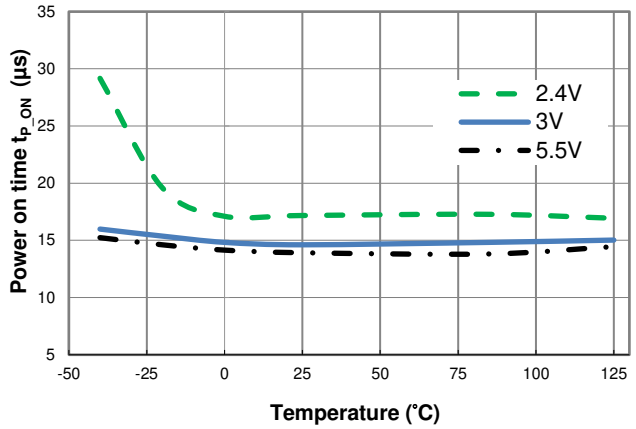
Output Rising Time (t_r) vs. Temperature



Output Falling Time (t_f) vs. Temperature

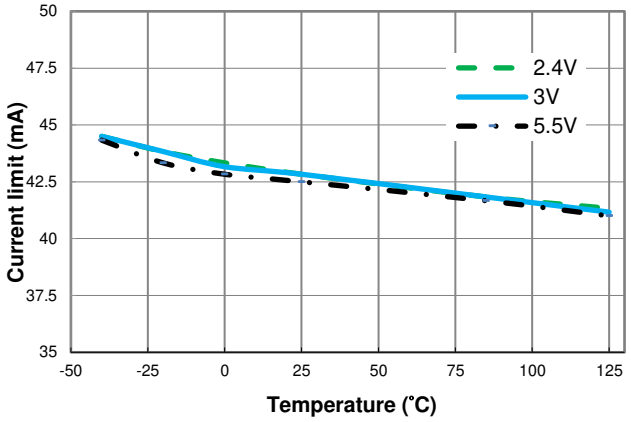
Typical Operating Characteristics (continued)

Device Power-On Time (Startup Time)



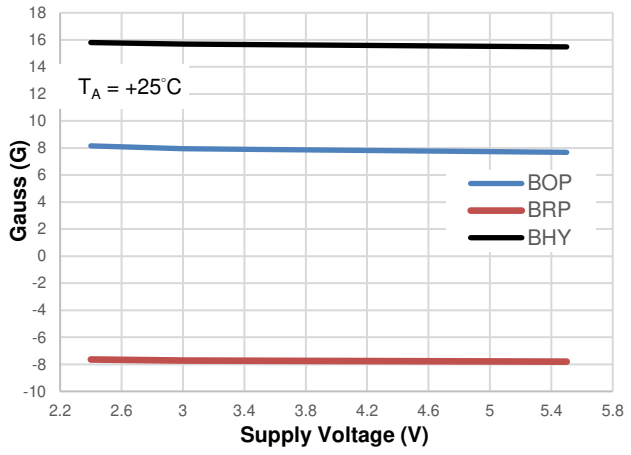
Power on time t_{P_ON} vs. Temperature

Output Current Limit (I_{OCL})

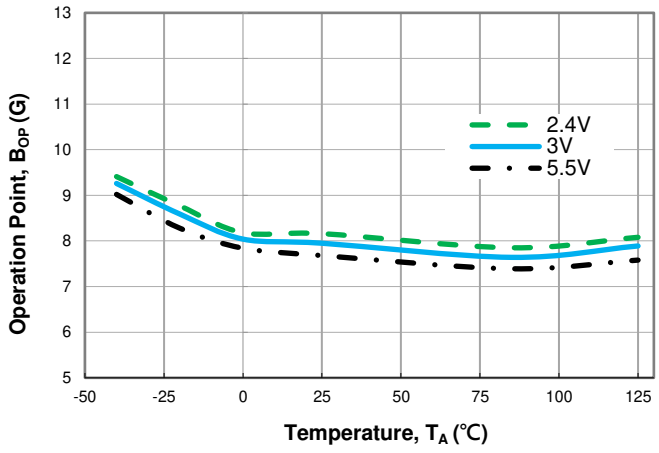


Current limit I_{OCL} vs. Temperature

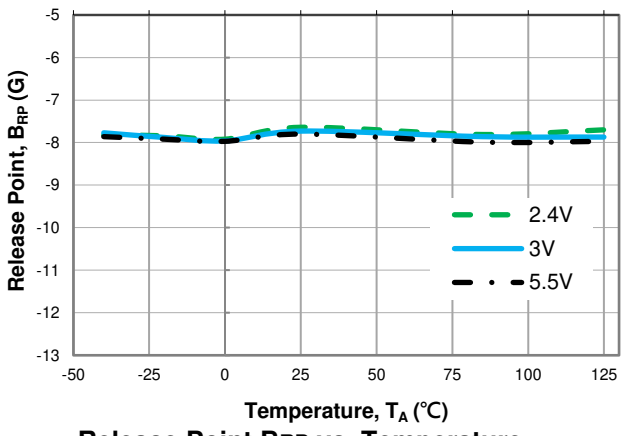
AH1711 - B_{OP}/B_{RP} Switch Point and Hysteresis B_{HY}



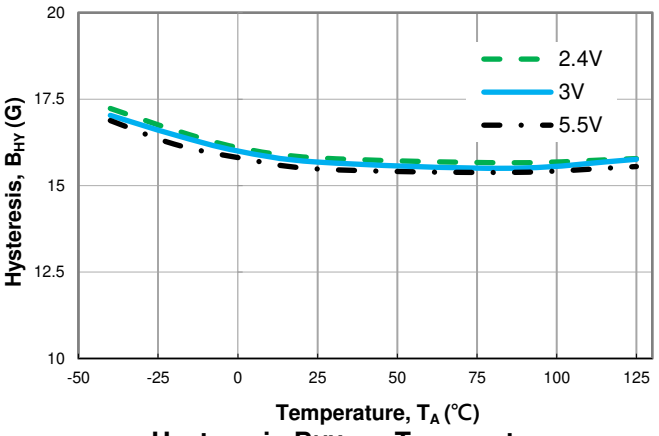
Swich Point vs. Supply Voltage V_{DD}



Operation Point B_{OP} vs. Temperature



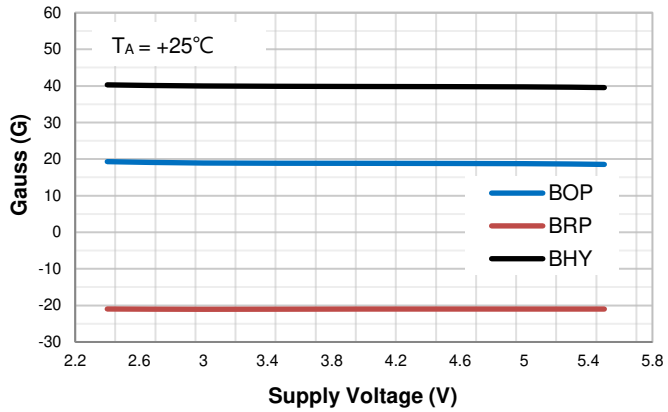
Release Point B_{RP} vs. Temperature



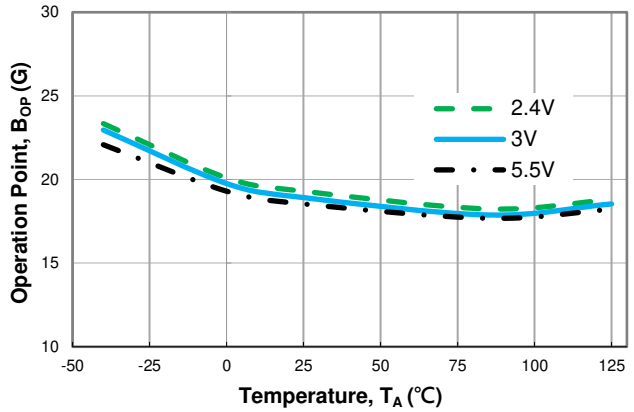
Hysteresis B_{HY} vs. Temperature

Typical Operating Characteristics (continued)

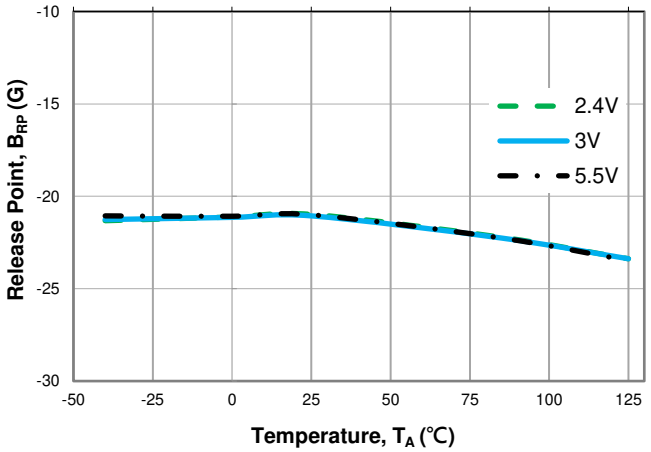
AH1712/AH1714 - Switch Point B_{OP}/B_{RP} and Hysteresis B_{HY}



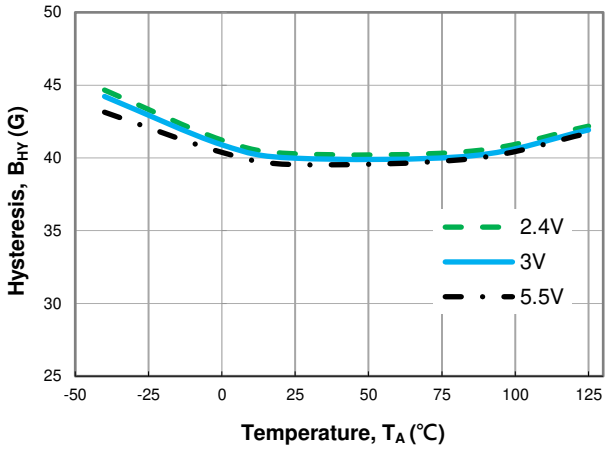
Switch Points vs. Supply Voltage V_{DD}



Operation Point B_{OP} vs. Temperature



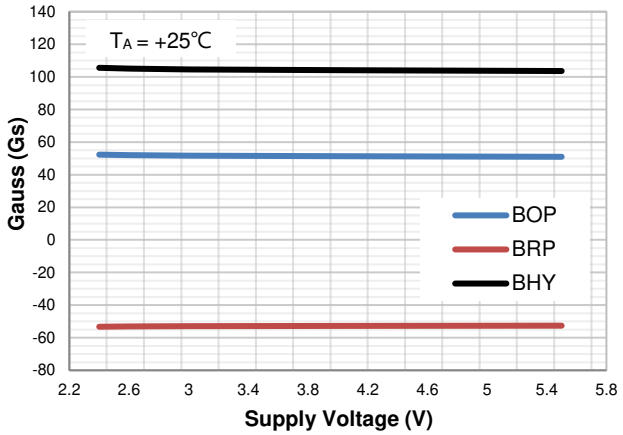
Release Point B_{RP} vs. Temperature



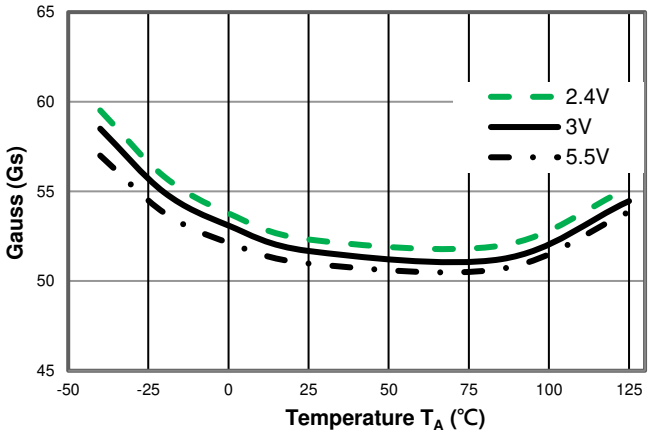
Hysteresis B_{HY} vs. Temperature

Typical Operating Characteristics (continued)

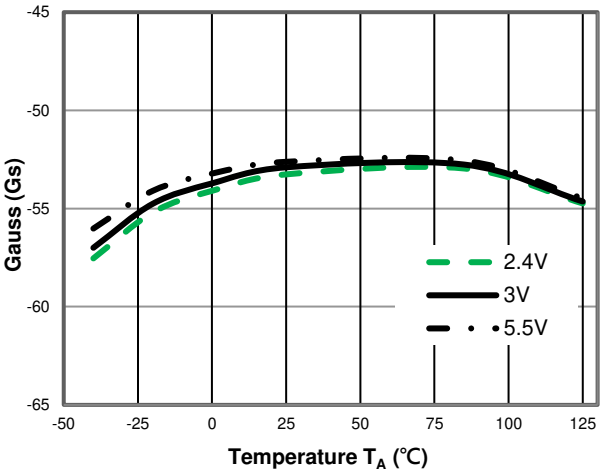
AH1713 - Switch Point B_{OP}/B_{RP} and Hysteresis B_{HY}



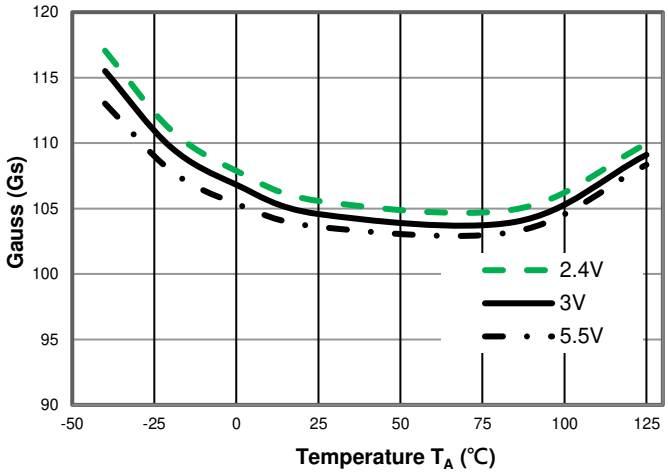
Switch Points vs. Supply Voltage



Operating Point B_{OP} vs. Temperature



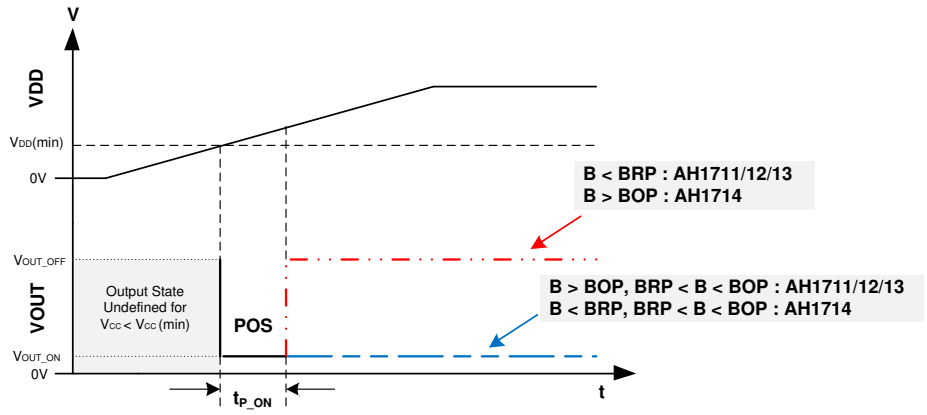
Realease Point B_{RP} vs. Temperature



Hysteresis B_{HY} vs. Temperature

Application Information

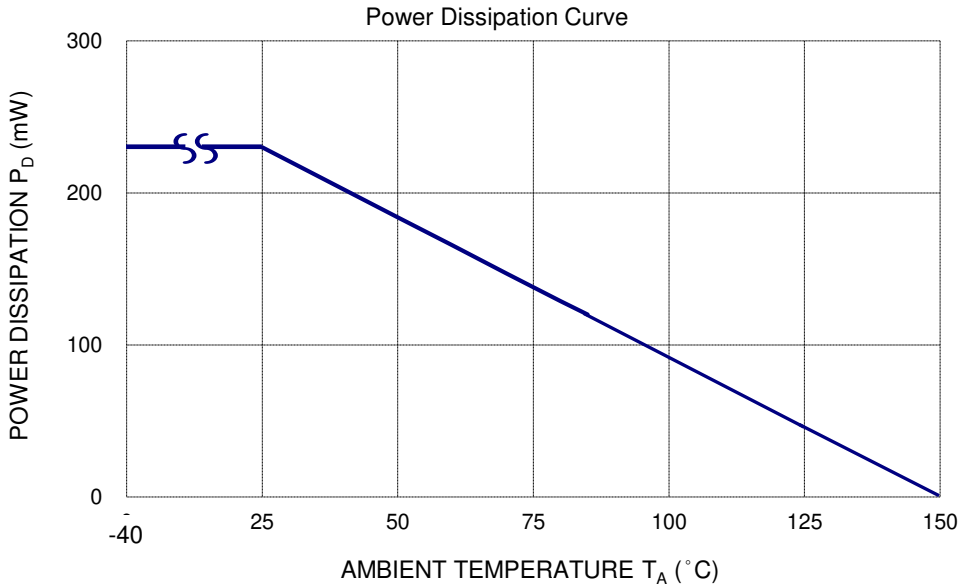
Power-On State (POS)



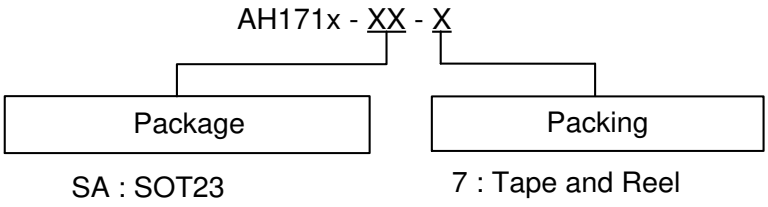
Thermal Performance Characteristics

Package : SOT23

T_A (°C)	25	50	60	70	80	85	90	100	105	110	120	125
P_D (mW)	230	184	166	147	129	120	110	92	83	74	55	46



Ordering Information

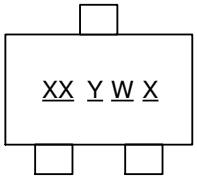


Part Number	Part Number Suffix	Package Code	Package	Packing	
				Qty.	Carrier
AH1711-SA-7	-7	SA	SOT23	3,000	7” Tape & Reel
AH1712-SA-7	-7	SA	SOT23	3,000	7” Tape & Reel
AH1713-SA-7	-7	SA	SOT23	3,000	7” Tape & Reel
AH1714-SA-7	-7	SA	SOT23	3,000	7” Tape & Reel

Marking Information

Package Type: SOT23

(Top View)



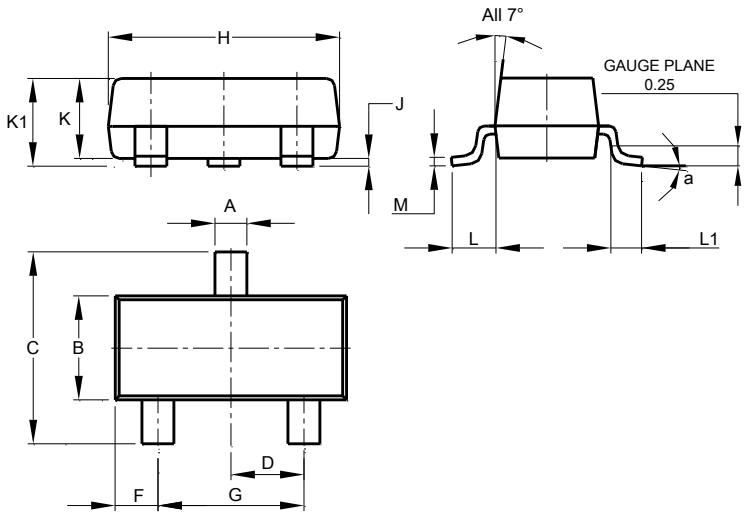
XX : Identification Code
Y : Year 0 to 9 (ex: 3 = 2023)
W : Week : A to Z : week 1 to 26;
a to z : week 27 to 52; z represents
week 52 and 53
X : Internal Code

Part Number	Package	Identification Code
AH1711-SA-7	SOT23	XK
AH1712-SA-7	SOT23	XM
AH1713-SA-7	SOT23	XN
AH1714-SA-7	SOT23	XP

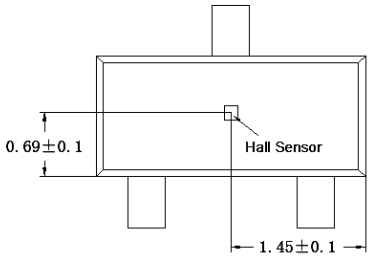
Package Outline Dimensions

Please see http://www.diodes.com/package-outlines.html for the latest version.

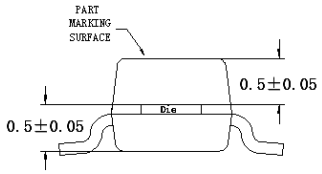
SOT23



SOT23			
Dim	**Min**	**Max**	**Typ**
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			



TOP VIEW



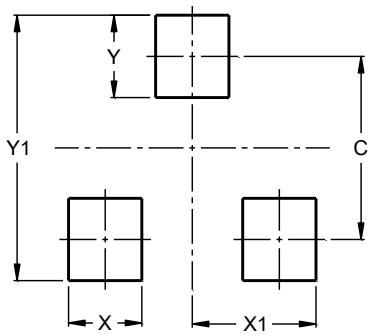
Side VIEW

Sensor Location

Suggested Pad Layout

Please see http://www.diodes.com/package-outlines.html for the latest version.

SO23



Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

Mechanical Data

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 e3
- Weight: 0.009 grams (Approximate)

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