HIGH-VOLTAGE, HIGH-SENSITIVITY HALL EFFECT LATCH

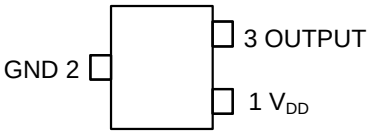
Description

The DIODES™ AH3712 is a high-voltage, high-sensitivity, Hall-effect latch IC designed for commutation of brushless DC motors, flow meters, linear encoders, and position sensors in industrial and consumer home appliances and personal care applications. To support a wide range of demanding applications, the design is optimized to operate over a 3.0V to 27V supply range. With chopper-stabilized architecture and an internal bandgap regulator to provide temperature-compensated supply for internal circuits, the AH3712 provides a reliable solution over the whole operating range. The output also has an overcurrent limit.

The single open-drain output can be switched on with a South pole of sufficient strength and switched off with a North pole of sufficient strength. When the magnetic-flux density (B) perpendicular to the package is larger than the operate point (B_{OP}), the output is switched on (pulled low). The output is held and latched until magnetic-flux density reverses and becomes lower than the release point (B_{RP}).

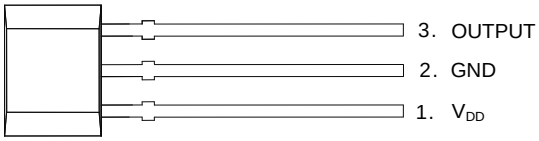
Pin Assignments

(Top View)



SC59 and SOT23

(Top View)



SIP-3

Features

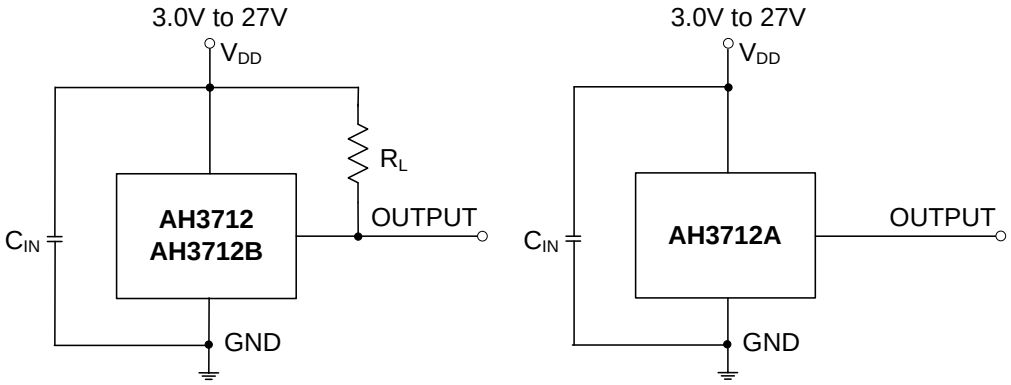
- Bipolar Latch
  - AH3712/AH3712A: South Pole On, North Pole Off
  - AH3712B: South Pole Off, North Pole On
- 3.0V to 27V Operating Voltage Range
- High Sensitivity: B_{OP} and B_{RP} of ±25G Typical
- Resistant to physical stress
- Single Open-Drain (AH3712, AH3712B) or Internal Pull-Up Resistor (AH3712A)
- Output Polarity:
  - Direct: AH3712, AH3712A
  - Inverted: AH3712B (*Future product)
- Output with Overcurrent Limit
- 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: 1kV
- Industry-Standard SC59, SOT23 and SIP-3 Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **An automotive-compliant part is available under separate datasheet DIODES™ (AH3712Q)**

Applications

- Brushless DC motor commutation
- Revolutions per minute (RPM) measurements
- Flow meters
- Angular and linear encoders and position sensors
- Contactless commutation, speed measurements, and angular position sensing/indexing in consumer home appliances, office equipment, and industrial applications

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)



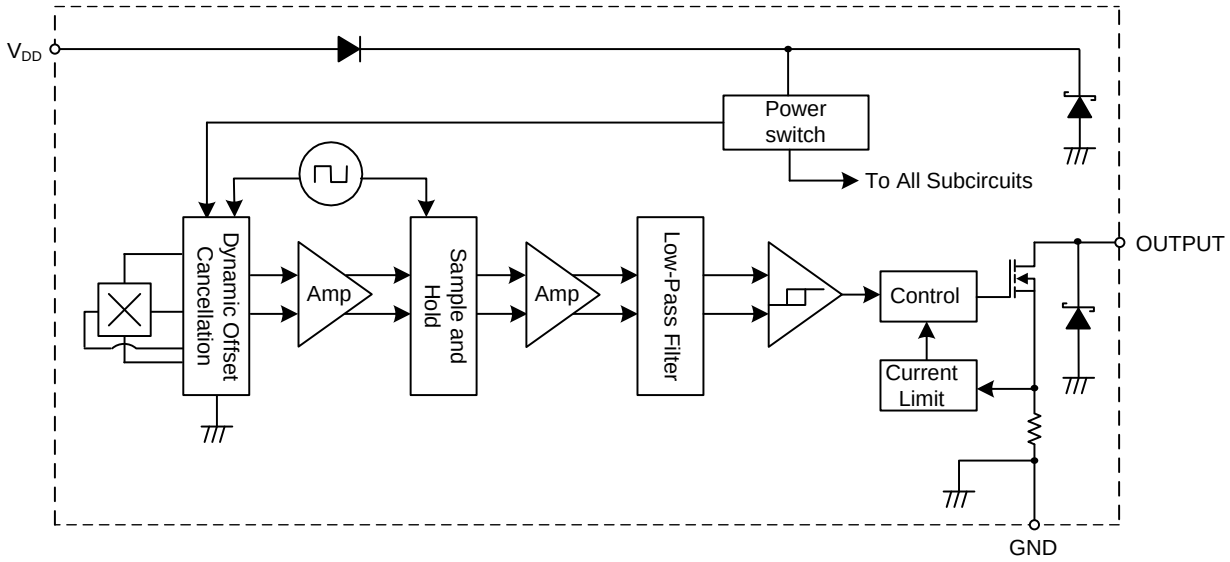
Note: 4. C_{IN} is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF ~ 100nF. R_L is the pull-up resistor.

Pin Descriptions

Package: SOT23, SC59 and SIP-3

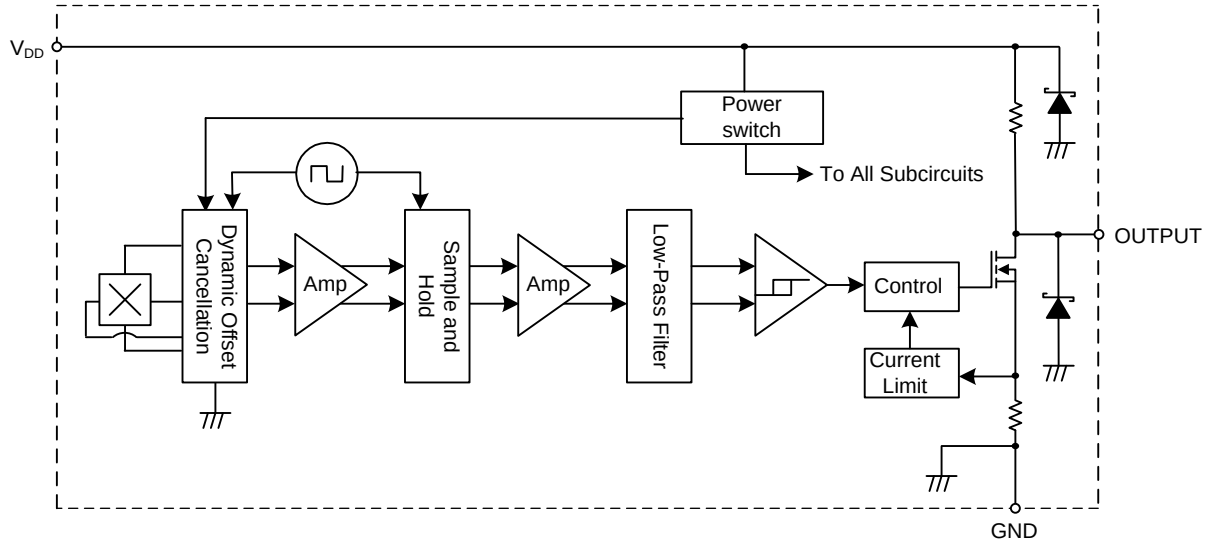
Pin Number	Pin Name	Function
1	V_{DD}	Power Supply Input
2	GND	Ground
3	OUTPUT	Output Pin

Functional Block Diagram



AH3712, AH3712B

Functional Block Diagram (continued)



AH3712A

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

Symbol	Characteristic		Value	Unit
V_{DD}	Supply Voltage (Note 6)		40	V
V_{DDR}	**Reverse Supply Voltage** (AH3712 Only)		-18	V
V_{OUT_MAX}	Output Pin Voltage (Note 6)		40	V
I_{OUT}	Output Current Sink		60	mA
I_{OUT_R}	Reverse Output Current		-50	mA
B	Magnetic Flux Density		Unlimited	
P_D	Package Power Dissipation	SIP-3	550	mW
		SC59 and SOT23	230	
Ts	Storage Temperature Range		-65 to +165	°C
T_J	Maximum Junction Temperature		+150	°C
ESD HBM	Electrostatic Discharge Withstand Capability—Human Body Model		8	kV
ESD CDM	Electrostatic Discharge Withstand Capability—Charged Device Model		1	kV

Notes: 5. Stresses greater than the *Absolute Maximum Ratings* specified above can cause permanent damage to the device. These are stress ratings only; functional operation of the device at these or any other conditions exceeding those indicated in this specification is not implied. Device reliability may be affected by exposure to absolute maximum rating conditions for extended periods of time.

6. The absolute maximum V_{DD} of 40V 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	Conditions	Rating	Unit
V_{DD}	Supply Voltage	Supply voltage, between VDD and GND pins	3.0 to 27	V
T_A	Operating Temperature Range	Operating ambient temperature range	-40 to +125	°C

Electrical Characteristics (Notes 7, 8) (@T_A = -40°C to +125°C, V_{DD} = 3V to 27V, C_{IN} = 0.1µF unless otherwise specified.)

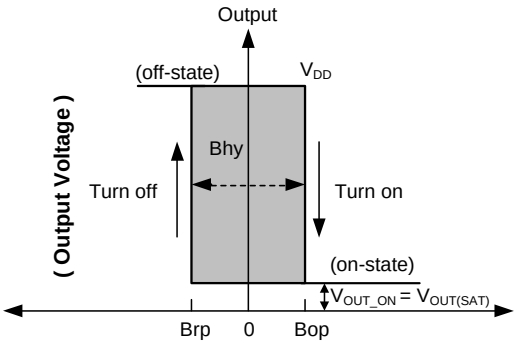
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OUT_ON}	Output On Voltage	I_{OUT} = 20mA, Output on	—	0.25	0.42	V
I_{OUT_OFF}	Output Leakage Current	V_{OUT} = 27V, Output off	—	<0.1	10	µA
I_{DD}	Supply Current	Output off T_A = +25°C	—	2.8	3.8	mA
		Output off T_A = -40°C to +125°C	—	2.8	4.8	mA
I_{DD_R}	Reverse Battery Current (AH3712/AH3712B)	V_{DD} = -18V, T_A = -40°C to +125°C	—	0.001	1.2	mA
R_{PU}	Internal Pull-Up Resistance (AH3172A only)	T_A = -40°C to +125°C	10	14	18	kΩ
t_{ST}	Device Start-Up Time	V_{DD} >= 3V, B > B_{OP} + 10Gs or B < BRP - 10Gs (Note 7)	—	13	—	µs
f_c	Chopping Frequency	V_{DD} >= 3V (Note 8)	—	500	—	kHz
t_d	The time delay from magnetic threshold reached to the start of the output rise or fall	B > 3*BOP_{MAX}, square wave magnetic field (Note 8)	—	10	—	µs
t_r	Output Rising Time (external pull-up resistor R_L and load capacitance dependent)	R_L = 1kΩ, C_L = 20pF	—	0.1	1	µs
t_f	Output Falling Time (Internal switch resistance and load capacitance dependent)	R_L = 1kΩ, C_L = 20pF	—	0.3	1	µs
I_{OCL}	Output Current Limit	Output on (Note 9)	30	—	60	mA
V_Z	Zener Clamp Voltage	I_{DD} = 8mA, T_A = +25°C, Output off	36	—	—	V

Notes:
7. When power is initially turned on, VDD must be within its correct operating range (3.0V to 27V) to guarantee the output sampling. The output state is valid after the start-up time of 13µs typical from the operating voltage reaching 3V. The VCC slew rate must exceed 3V/µs from 0 to 3V. A slower slew rate through the specific range may affect device performance.
8. Typical values are defined at T_A = +25°C, V_{DD} = 12V. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization
9. The device limits the output current I_{OUT} to current limit of I_{OCL}.

Magnetic Characteristics (Note 10) (T_A = -40°C to +125°C, V_{DD} = 3.0V to 27V, unless otherwise specified)

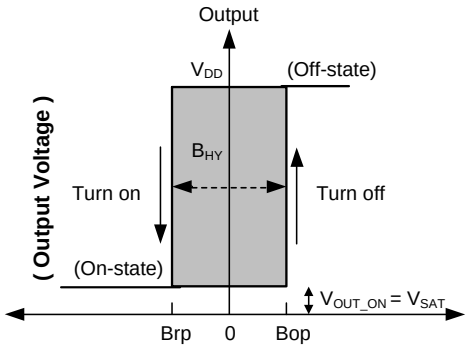
Part Number	Symbol	Parameter	Min	Typ	Max	Unit	Output Polarity	Output Type
AH3712 / AH3712A	B_{OP} (South pole to part-marking side for SOT23 and SIP-3) (South pole to non-part-marking side for SC59) (See diagram below)	Operation Point	10	25	40	Gauss	Direct	Open-Drain / Internal Pull-up Resistor
	B_{RP} (North pole to part-marking side for SOT23 and SIP-3) (North pole to non-part-marking side for SC59) (See diagram below)	Release Point	-40	-25	-10			
	B_{HY} ($\|B_{OPX}\|$ - $\|B_{RPX}\|$)	Hysteresis (Note 11)	20	50	80			
AH3712B	B_{OP} (South pole to part-marking side for SOT23) (See diagram below)	Operation Point	10	25	40	Gauss	Inverted	Open-Drain
	B_{RP} (North pole to part-marking side for SOT23) (See diagram below)	Release Point	-40	-25	-10			
	B_{HY} ($\|B_{OPX}\|$ - $\|B_{RPX}\|$)	Hysteresis (Note 11)	20	50	80			

Notes: 10. When power is initially turned on, V_{DD} must be within its correct operating range (3.0V to 27V) to guarantee the output sampling. The output state is valid after the start-up time of 13µs typical from the operating voltage reaching 3V.
11. Maximum and minimum hysteresis is guaranteed by design, process control, and characterization.



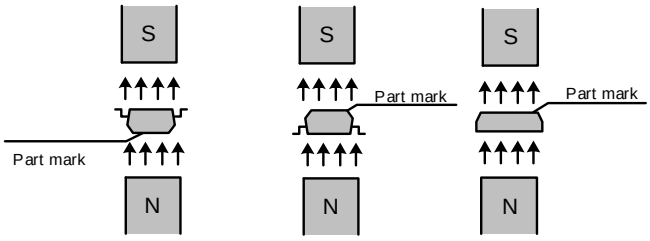
(Magnetic Flux Density B)

AH3712, AH3712A



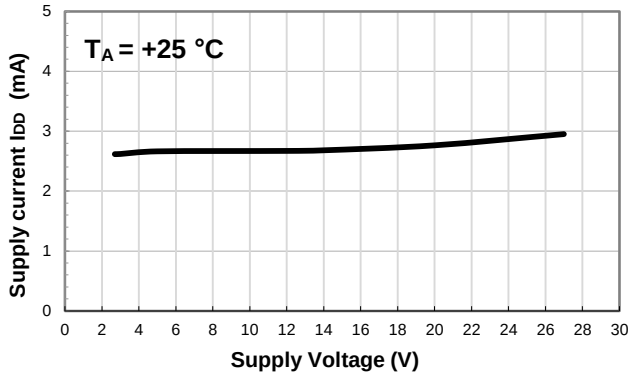
(Magnetic Flux Density B)

AH3712B

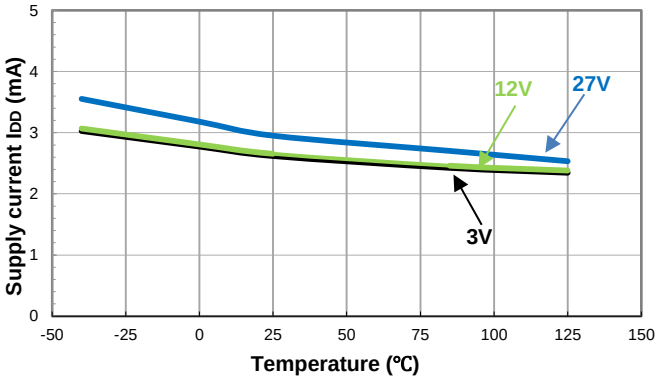


SC59 **SOT23** **SIP-3(Bulk Pack)**

Typical Operating Characteristics

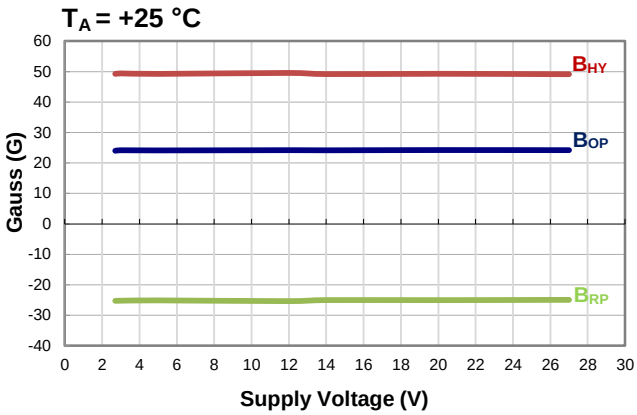


Supply current vs Supply Voltage

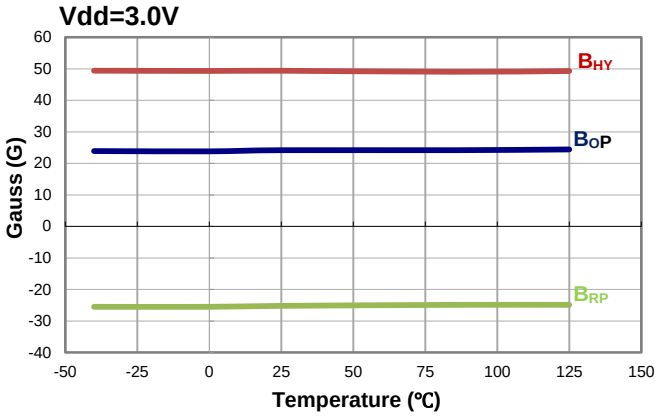


Supply current vs Temperature

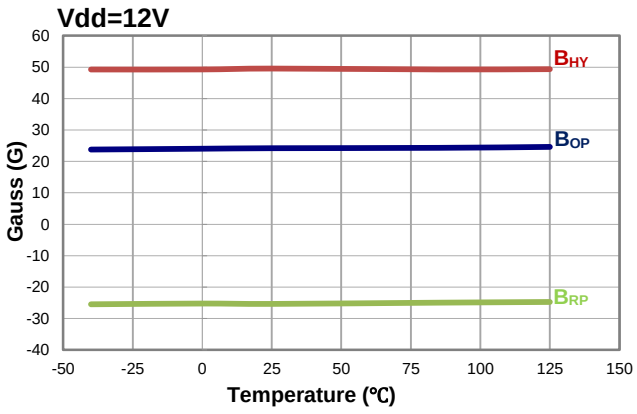
Output Switch Operate and Release Points (Magnetic Thresholds) – Bop and Brp



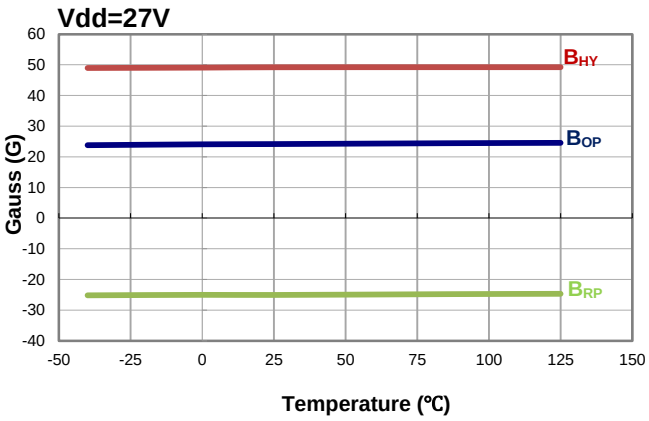
Switch Points Bop and Brp vs Supply Voltage



Switch Points Bop and Brp vs Temperature



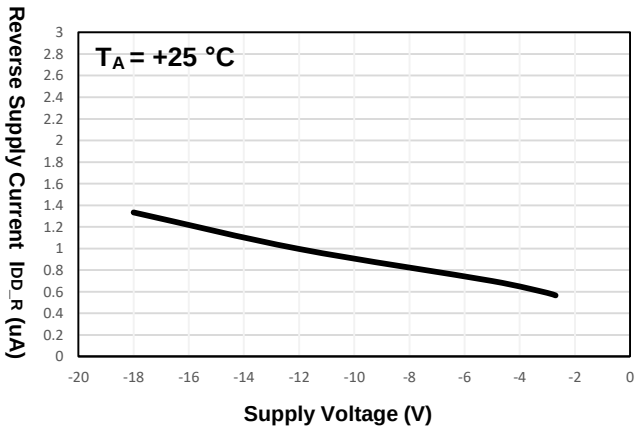
Switch Points Bop and Brp vs Temperature



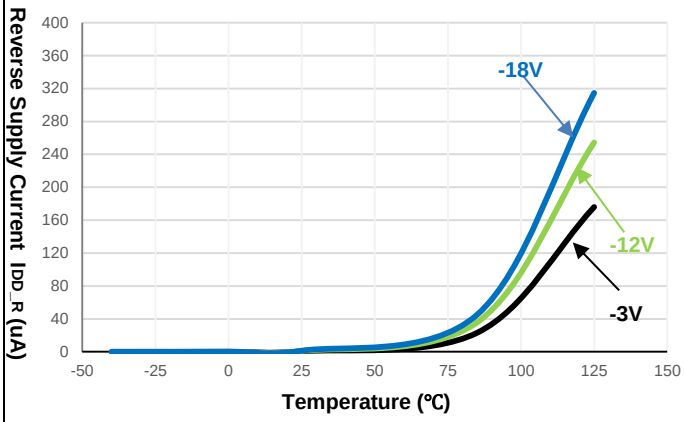
Switch Points Bop and Brp vs Temperature

Typical Operating Characteristics (continued)

Reverse Supply Current

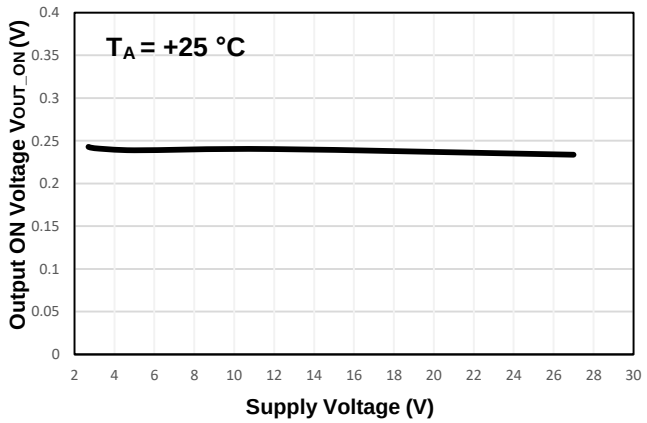


Reverse Supply Current vs Supply Voltage

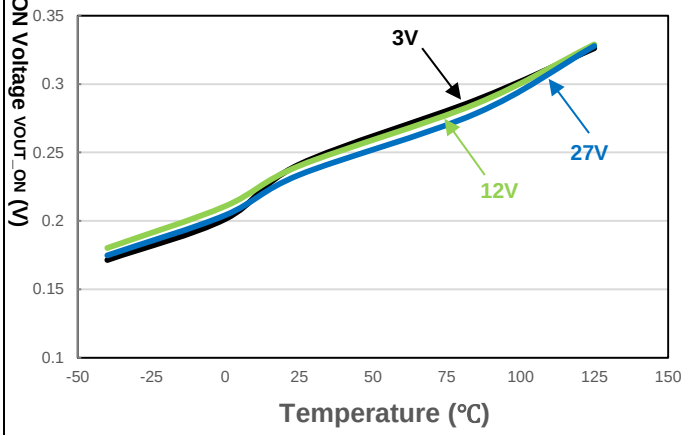


Reverse Supply Current vs Temperature

Output Switch On Voltage

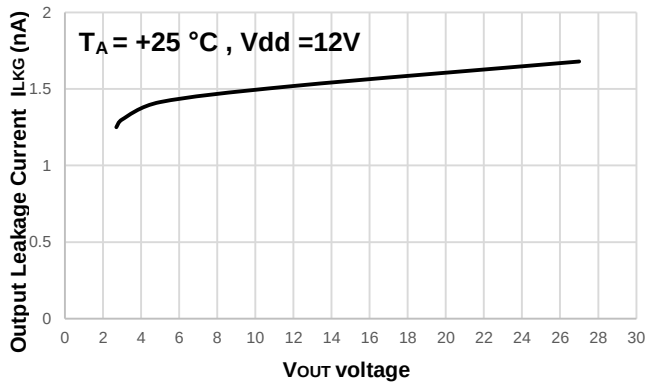


Output ON Voltage vs Supply Voltage

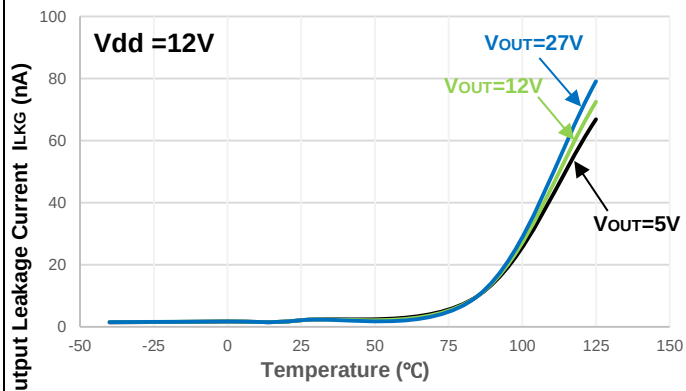


Output ON Voltage vs Temperature

Output Switch Leakage Current



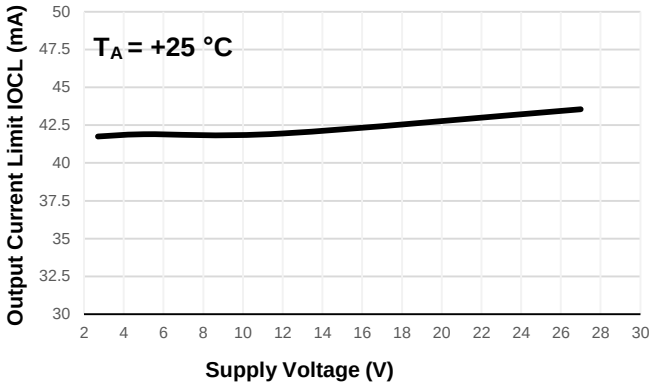
Output Leakage current vs V_{OUT} Voltage



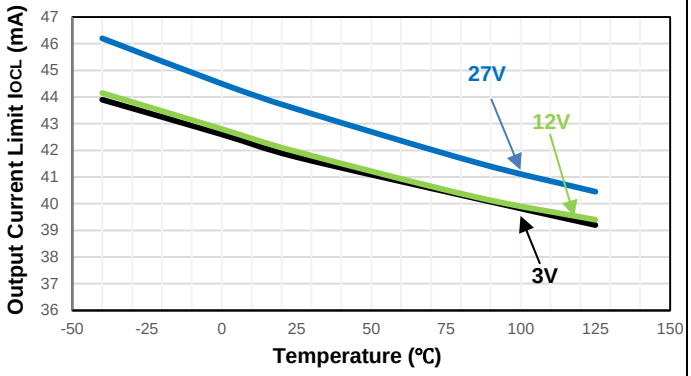
Output Leakage current vs V_{OUT} Voltage

Typical Operating Characteristics (continued)

Output Current Limit

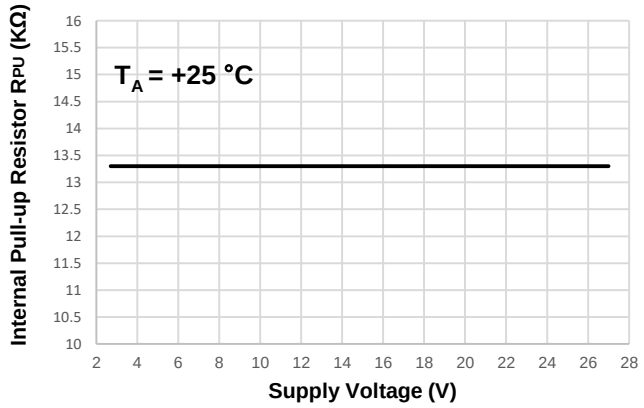


Output Current Limit vs Supply Voltage

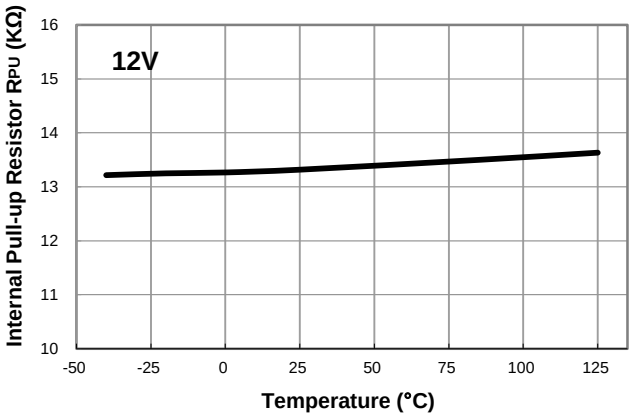


Output Current Limit vs Temperature

Output Pull-Up Resistor (Internal)



Internal Output Pull-up Resistor vs Supply Voltage

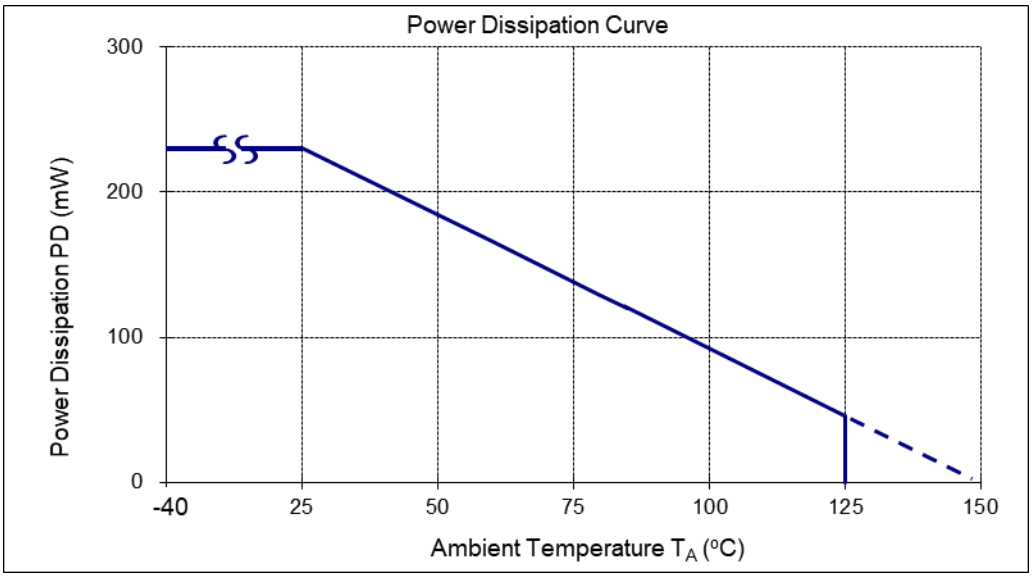


Internal Output Pull-up Resistor vs Temperature

Thermal Performance Characteristics

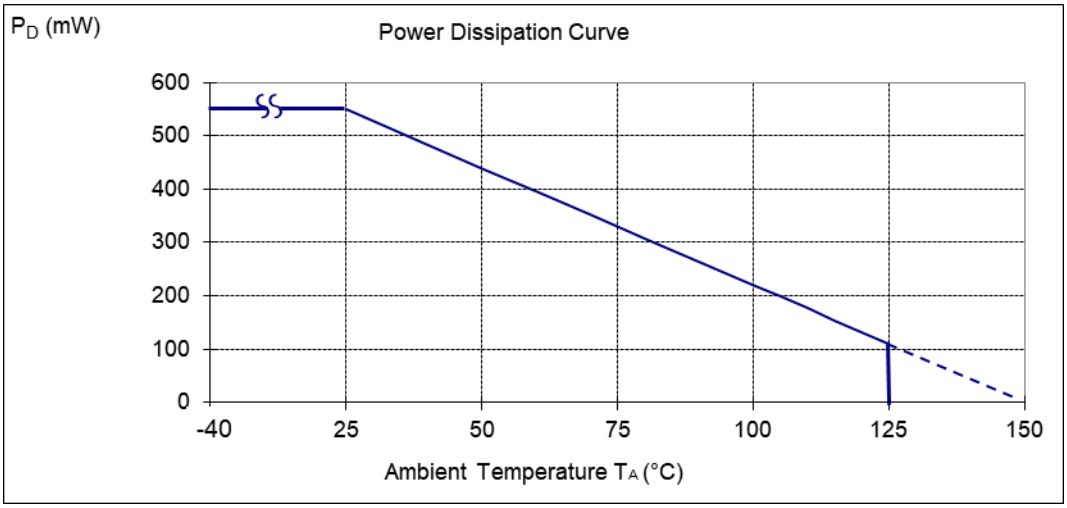
(1) Package: SOT23/SC59

T_A (°C)	25	50	60	70	80	85	90	100	105	110	120	125	130	140	150
P_D (mW)	230	184	166	147	129	120	110	92	83	74	55	46	37	18	0

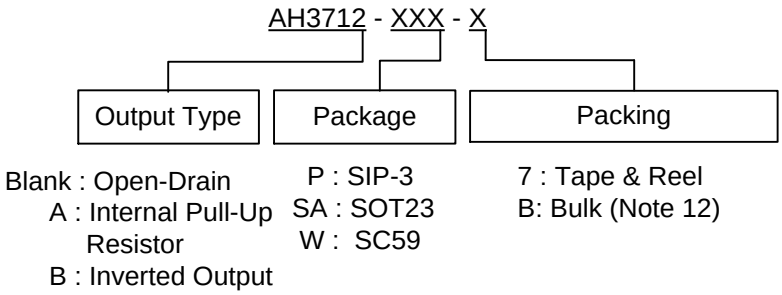


(2) Package: SIP3

T_A (°C)	25	50	60	70	80	85	90	100	105	110	120	125	130	140	150
P_D (mW)	550	440	396	352	308	286	264	220	198	176	132	110	88	44	0



Ordering Information



Part Number	Package Code	Package	Bulk (Note 12)		7" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AH3712-P-B	P	SIP-3	1000	-B	—	—
AH3712-SA-7	SA	SOT23	—	—	3000/Tape & Reel	-7
AH3712-W-7	W	SC59	—	—	3000/Tape & Reel	-7
* AH3712A-P-B	P	SIP-3	1000	-B	—	—
AH3712A-SA-7	SA	SOT23	—	—	3000/Tape & Reel	-7
AH3712A-W-7	W	SC59	—	—	3000/Tape & Reel	-7
* AH3712B-SA-7	SA	SOT23	—	—	3000/Tape & Reel	-7

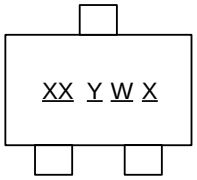
* Future new product

Note: 12. Bulk is for SIP-3 Straight Lead.

Marking Information

(1) Package Type: SOT23 and SC59

(Top View)



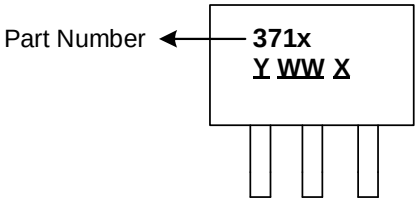
XX : Identification code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal code

Part Number	Package	Identification Code
AH3712-SA-7	SOT23	N2
AH3712-W-7	SC59	UE
AH3712A-SA-7	SOT23	N8
AH3712A-W-7	SC59	UM
* AH3712B-SA-7	SOT23	UN

* Future new product

(2) Package Type: SIP-3

(Top View)



Y : Year : 0~9
WW : Week : 01~52, "52" represents
52 and 53 week
X : Internal Code

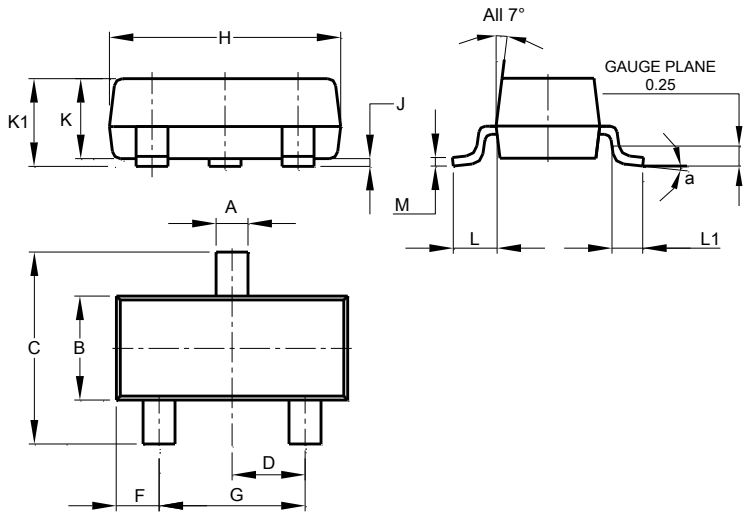
Part Number	Package	Identification Code
AH3712-P-B	SIP-3	3712
* AH3712A-P-B	SIP-3	3712A

* Future new product

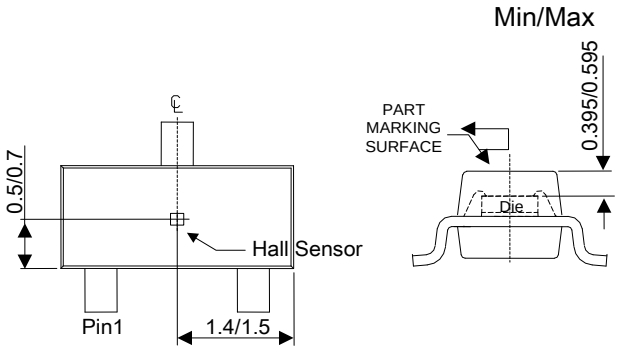
Package Outline Dimensions (All dimensions in mm.)

Please see https://www.diodes.com/design/support/packaging/ for the latest version.

(1) Package Type: 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			

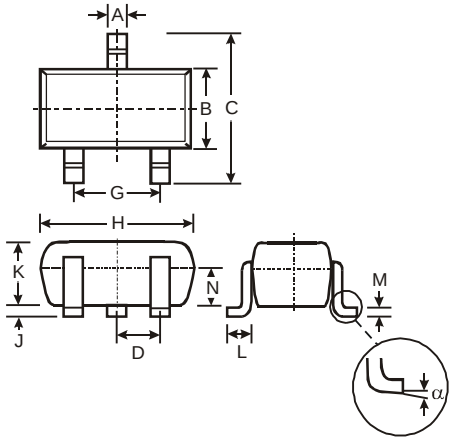


Sensor Location

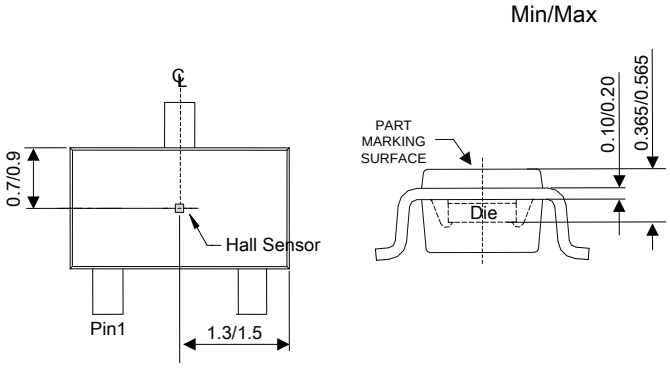
Package Outline Dimensions (continued) (All dimensions in mm.)

Please see https://www.diodes.com/design/support/packaging/ for the latest version.

(2) Package Type: SC59



SC59			
Dim	**Min**	**Max**	**Typ**
A	0.35	0.50	0.38
B	1.50	1.70	1.60
C	2.70	3.00	2.80
D	-	-	0.95
G	-	-	1.90
H	2.90	3.10	3.00
J	0.013	0.10	0.05
K	1.00	1.30	1.10
L	0.35	0.55	0.40
M	0.10	0.20	0.15
N	0.70	0.80	0.75
α	0°	8°	-
All Dimensions in mm			



Sensor Location

Package Outline Dimensions (continued) (All dimensions in mm.)

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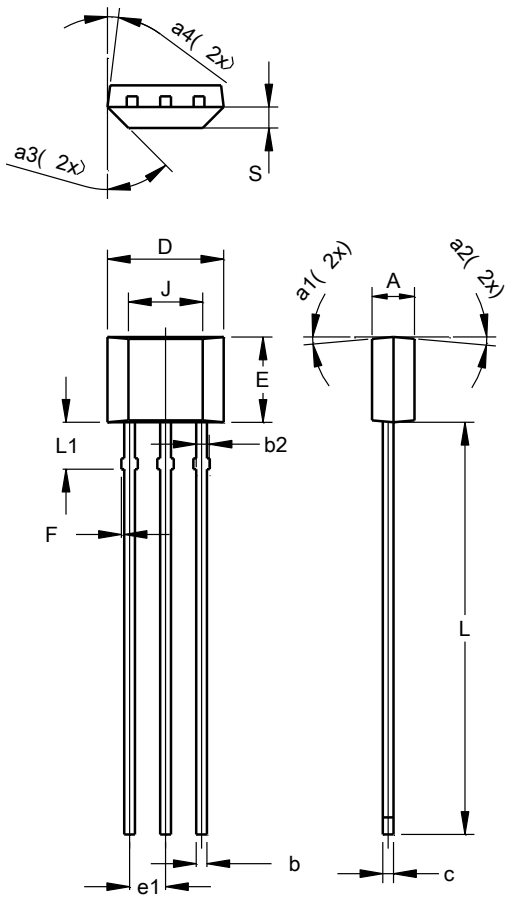
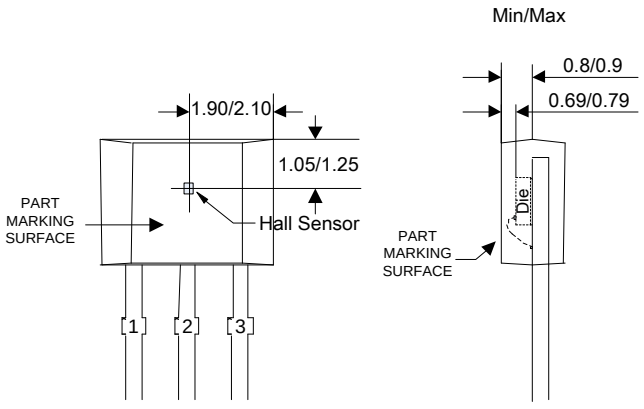
(3) Package Type: SIP-3 Bulk



SIP-3 (Bulk Pack)			
Dim	**Min**	**Max**	**Typ**
A	1.40	1.60	1.50
b	0.33	0.43	0.38
b2	0.40	0.508	0.46
c	0.35	0.41	0.38
D	3.90	4.30	4.10
E	2.80	3.20	3.00
e1	1.24	1.30	1.27
F	0.00	0.20	--
J	2.62 REF		
L	14.00	15.00	14.50
L1	1.55	1.75	1.65
S	0.63	0.84	0.74
a1	--	--	5°
a2	--	--	5°
a3	--	--	45°
a4	--	--	3°
All Dimensions in mm			

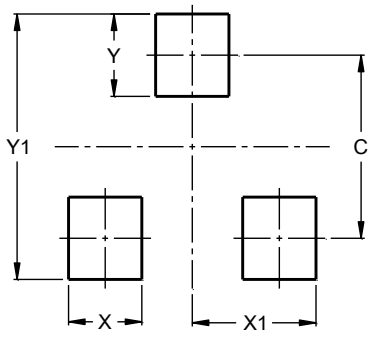


Sensor Location

Suggested Pad Layout

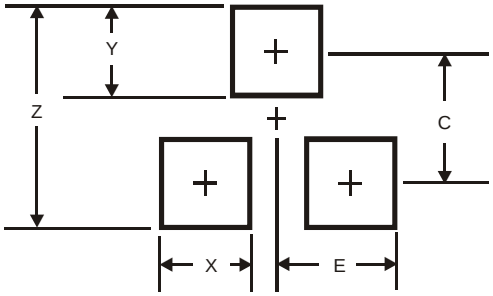
Please see https://www.diodes.com/design/support/packaging/ for the latest version.

(1) Package Type: SOT23



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

(2) Package Type: SC59



Dimensions	Value (in mm)
Z	3.4
X	0.8
Y	1.0
C	2.4
E	1.35

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: 0.008/9 grams (Approximately)

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