

Description

The AH3231Q-AH3234Q/AH3270Q-AH3272Q are high-voltage, high-sensitivity two-wire Hall-effect unipolar/latch switch ICs with automotive-compliant AEC-Q100 qualification; designed for position and proximity sensing in automotive applications, such as seat and seatbelt buckle, transmission actuator, gear position, wiper, door/trunk closure, etc.

To support a wide range of demanding applications, the design is optimized to operate over a supply range of 2.7V to 27V. These features include a chopper-stabilized architecture and an internal bandgap regulator to provide temperature compensated supply for internal circuits. For robustness and protection, the device has built-in reverse blocking diode with a zener clamp on the supply.

The built-in thermal protection also shuts down the chip if temperature rises to an abnormal value. This will automatically restart the chip once the junction temperature drops below the safe value.

For the AH3231Q, AH3232Q, AH3233Q, and AH3234Q two-wire unipolar switches: when the flux density (south pole) exceeds B_{OP} , the supply current state is turned on (low or high). The output is held until a magnetic flux density falls below B_{RP} , causing output current to be turned off.

For the AH3270Q, AH3271Q, and AH3272Q two-wire latch switches: when the magnetic flux density is larger than B_{OP} , output current is turned on (high). The output state is held until a magnetic flux density reversal falls below B_{RP} , causing output current to be turned off (low).

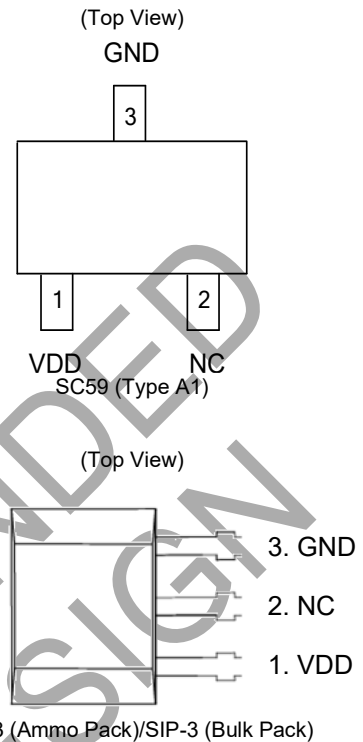
Features and Performance

- Unipolar: AH3231Q, AH3232Q, AH3233Q, AH3234Q
Latch: AH3270Q, AH3271Q, AH3272Q
- Output Polarity:
 - Direct: AH3232Q, AH3233Q
 - Inverted: AH3231Q, AH3234Q
- Wide Supply Voltage Operation: 2.7V to 27V
- Temperature Coefficient -1100ppm/°C (AH3232Q, AH3233Q, AH3234Q)
- Chopper Stabilized Design Provides:
 - Superior Temperature Stability
 - Minimal Switch Point Drift
 - Enhanced Immunity to Stress
- Battery Polarity Reverse Connection Protection
- Transient Spike Voltage Protection
- Overtemperature Shutdown and Auto-Restart
- UVLO Protection
- High ESD Rating: HBM = 8kV, CDM = 1kV
- Temperature Range: -40°C to +150°C
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1, 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The AH3231Q-AH3234Q/AH3270Q-AH3272Q are suitable for automotive applications requiring specific change control; these parts are AEC-Q100 qualified, PPAP capable, and manufactured in IATF 16949 certified facilities.**

<https://www.diodes.com/quality/product-definitions/>

- 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.

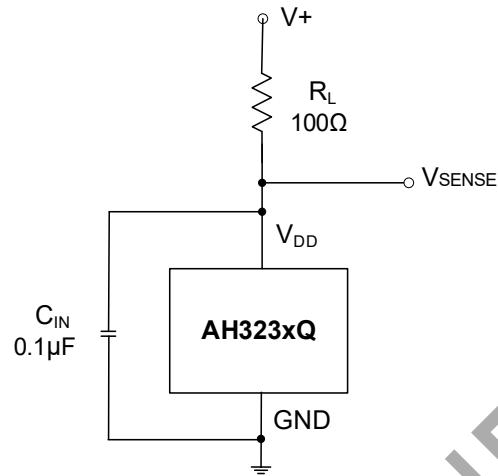
Pin Assignments



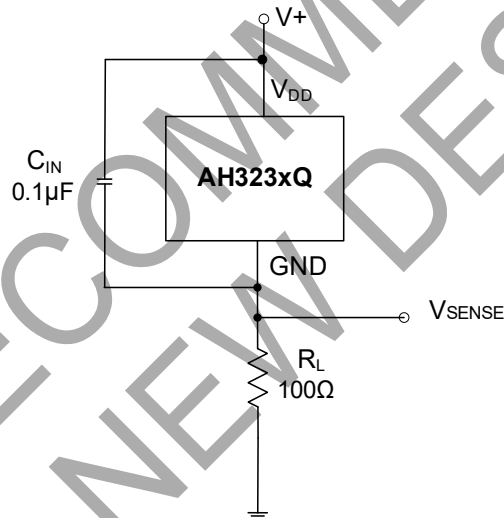
Applications

- Position and proximity sensing in automotive applications
- Seat positioning
- Seatbelt buckles
- Wiper positioning
- Window lifters
- Gear selection positioning

Typical Applications Circuit



High-Side Sensing



Low-Side Sensing

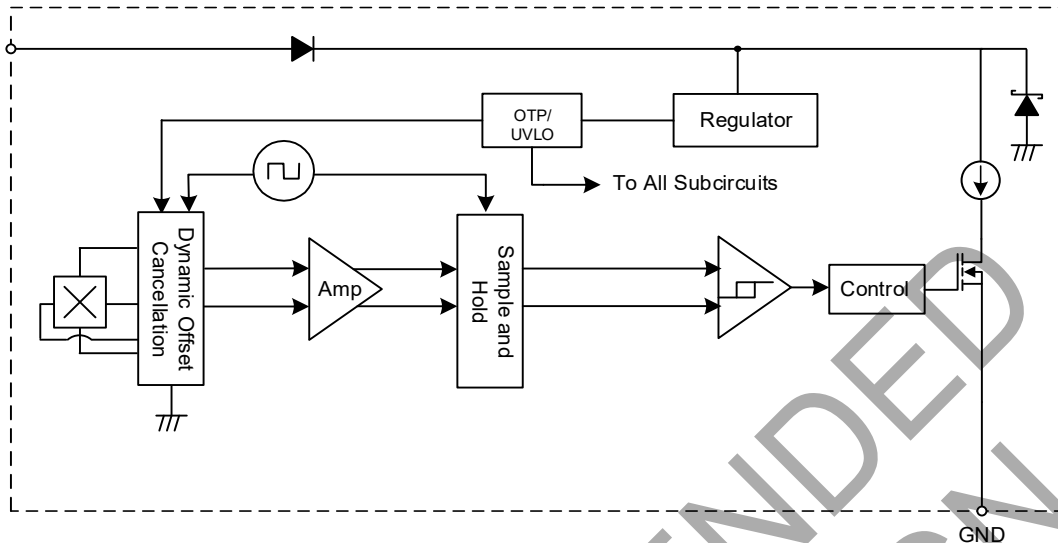
Note: 4. A 100nF or larger decoupling capacitor (C_{IN}) between V_{DD} and GND pins is needed for power stabilization and to strengthen noise immunity; C_{IN} needs to be as close to IC as possible. Typical R_L value is 100Ω. Larger or additional series resistor is recommended if there are disturbances on V_{DD} .

Pin Descriptions

Packages: SC59 (Type A1) and SIP-3 (Ammo Pack and Bulk Pack)

Pin Number	Pin Name	Function
1	V_{DD}	Supply Voltage Input
2	NC	No connection; can be connected to V_{DD} , GND, or left open.
3	GND	Ground

Functional Block Diagram



Absolute Maximum Ratings (Note 5) (@ $T_A = +25^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Rating	Unit
V_{DD} (Note 6)	Supply Voltage	32	V
V_{DDR} (Note 6)	Reverse Supply Voltage	-32	V
B	Magnetic Flux Density	Unlimited	Gauss
T_{J_MAX}	Maximum Junction Temperature	+180	$^\circ\text{C}$
T_S	Storage Temperature	-55 to +180	$^\circ\text{C}$
ESD (HBM)	ESD (Human Body Model)	8000	V
ESD (CDM)	ESD (Charged Device Model)	1000	V

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. Should not be exceeded the maximum junction temperature and maximum duration of 500ms.

Recommended Operating Conditions (@ $T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$, $T_J = -40^\circ\text{C}$ to $+165^\circ\text{C}$, unless otherwise specified.)

Symbol	Parameter	Min	Max	Unit
V_{DD}	Supply Voltage, between V_{DD} and GND Pins	2.7	27	V
T_{OP}	Operating Ambient Temperature	-40	+150	$^\circ\text{C}$

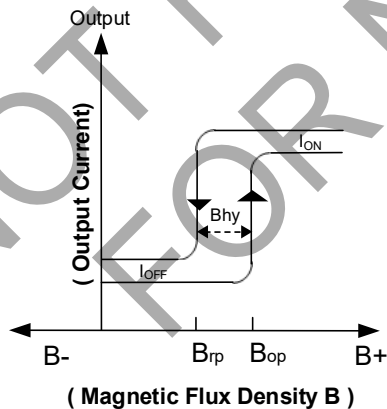
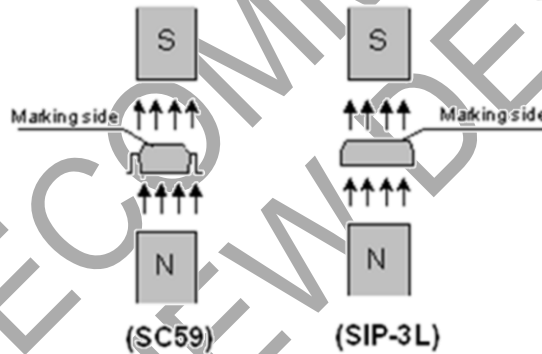
Electrical Characteristics (Note 7) (@ $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$, $T_J = -40^{\circ}\text{C}$ to $+165^{\circ}\text{C}$, $V_{DD} = 2.7\text{V}$ to 27V , unless otherwise specified)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{DD}	Supply Voltage (Note 8)	—	2.7	12	27	V
$I_{OFF}(1)$	Supply Current Off State	$V_{DD} = 2.7\text{V}$ to 27V (AH3270Q, AH3272Q)	2	3.3	5	mA
$I_{OFF}(2)$	Supply Current Off State	$V_{DD} = 2.7\text{V}$ to 27V (AH3231Q, AH3232Q, AH3233Q, AH3234Q, AH3271Q)	5	6	6.9	mA
I_{ON}	Supply Current On State	$V_{DD} = 2.7\text{V}$ to 27V	12	14.5	17	mA
V_{UVLO}	Undervoltage Lockout Threshold	Voltage dropping	—	2.2	2.7	V
t_{UVLO}	Undervoltage Lockout Reaction Time	—	—	10	—	μs
I_{DDR}	Reverse Supply Current	$V_{DD} = -18\text{V}$, $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$	-1.5	—	—	mA
T_{TP}	Thermal Protection Threshold	Junction temperature	—	+190	—	$^{\circ}\text{C}$
T_{TPR}	Thermal Protection Release Threshold	Junction temperature	—	+180	—	$^{\circ}\text{C}$
f_M	Maximum Magnet Switching Frequency	$B > 3 \cdot B_{OP}$, alternative square magnet field	30	50	—	kHz
f_C	Chopping Frequency	—	—	1000	—	kHz
t_{PON}	Power-On Delay Time (Note 9)	$B > B_{OP} + 10\text{GS}$	—	28	40	μs
t_D	Response Delay Time (Note 10)	$B > 3 \cdot B_{OP}$	—	7	—	μs
t_{RF}	Current Rise/Fall Time	$V_{DD} = 12\text{V}$, No bypass capacitor, $C_{LOAD} = 50\text{pF}$ to GND	0.1	0.3	1	μs
POS	Power-up State (Notes 9, 11)	$t > t_{PON}(\text{max})$, V_{DD} slew rate $> 1\text{V}/\mu\text{s}$	—	I_{OFF}	—	—
—	Output Jitter	$B \geq 3 \cdot B_{OPMAX}$ 1000 successive square wave switching under 1kHz.	—	± 3.3	—	μs

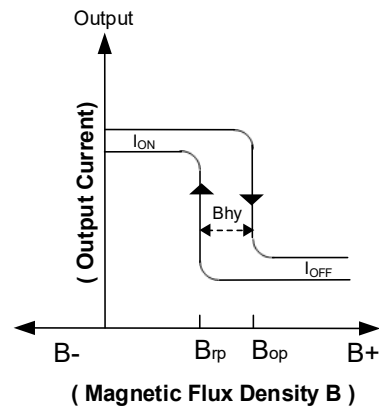
- Notes:
- Typical values are defined at $T_A = +25^{\circ}\text{C}$, $V_{DD} = 12\text{V}$. Maximum and minimum values over the operating temperature range are not tested in production but guaranteed by design, process control and characterization.
 - V_{DD} is the voltage between the VDD pin and the GND pin.
 - When power is initially turned on, V_{DD} must be operated in the correct voltage range to guarantee proper magnetic field sampling, output supply current state level is valid after the startup time of $28\mu\text{s}$ from V_{DD} higher than 2.7V . Guaranteed by design.
 - Time delayed from the magnetic threshold reached to the output rise or fall.
 - $t > t_{PON}$ and $B_{RP} < B < B_{OP}$.

Magnetic Characteristics (Notes 12, 13) ($T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$, $T_J = -40^\circ\text{C}$ to $+165^\circ\text{C}$, $V_{DD} = 2.7\text{V}$ to 27V , unless otherwise specified)

Part Name	Test Condition	Operating Point B_{OP} (Gauss)			Release Point B_{RP} (Gauss)			Temperature Coefficient (ppm/ $^\circ\text{C}$)	I_{OFF} (mA)	Active Pole	Output Polarity
		Min	Typ	Max	Min	Typ	Max	Typ	Typ		
AH3231Q	$T_A = +25^\circ\text{C}$	65	90	120	45	70	100	0	6	South	Inverted
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	55	90	135	35	70	115				
AH3232Q	$T_A = +25^\circ\text{C}$	40	60	80	20	40	60	-1100	6	South	Direct
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	30	60	90	10	40	70				
AH3233Q	$T_A = +25^\circ\text{C}$	27	45	63	10	28	46	-1100	6	South	Direct
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	20	45	70	3	28	53				
AH3234Q	$T_A = +25^\circ\text{C}$	27	45	63	10	28	46	-1100	6	South	Inverted
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	20	45	70	3	28	53				
AH3270Q	$T_A = +25^\circ\text{C}$	8	18	28	-28	-18	-8	0	3.3	South	Direct
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	3	18	33	-33	-18	-3				
AH3271Q	$T_A = +25^\circ\text{C}$	8	18	28	-28	-18	-8	0	6	South	Direct
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	3	18	33	-33	-18	-3				
AH3272Q	$T_A = +25^\circ\text{C}$	15	30	45	-45	-30	-15	0	3.3	South	Direct
	$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	10	30	50	-50	-30	-10				



1) Direct South Pole Active

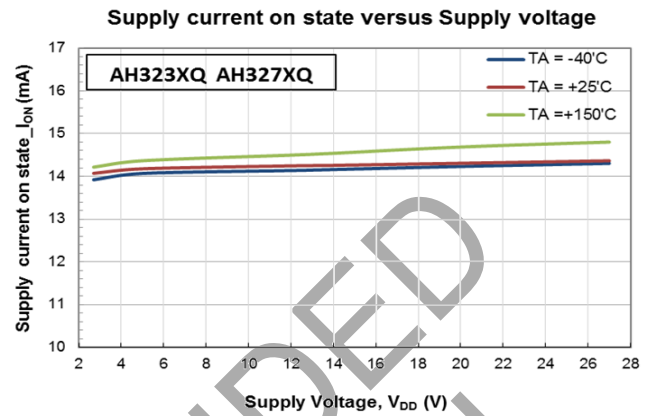
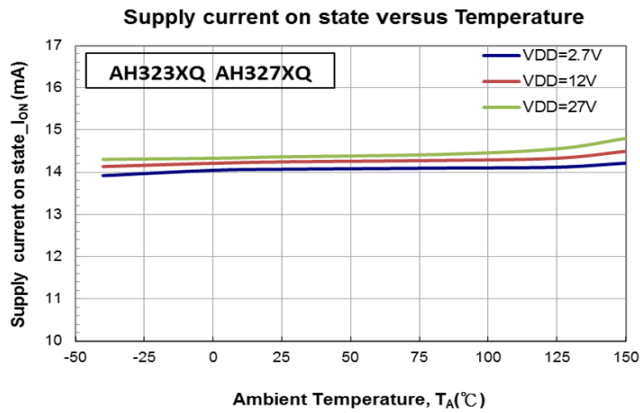


2) Inverted South Pole Active

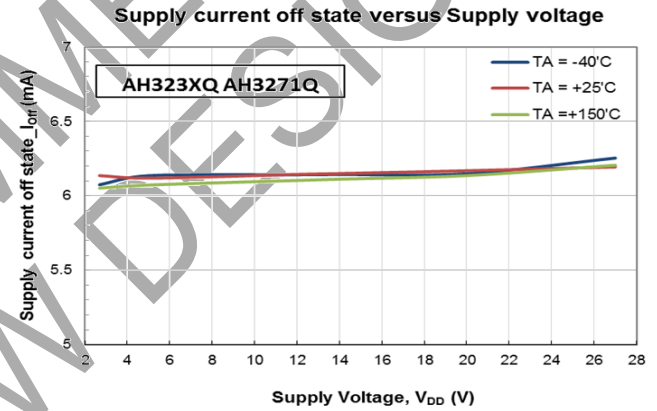
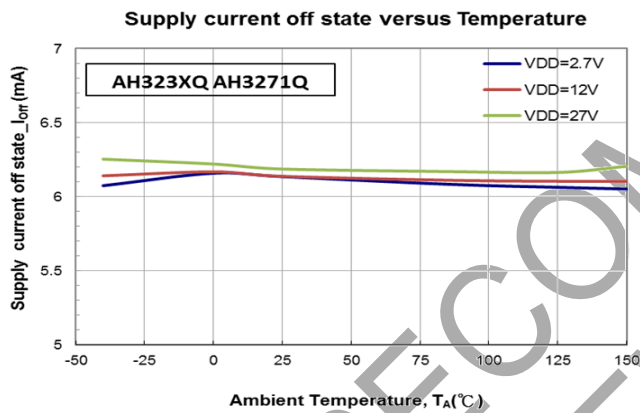
- Notes:
- Positive x-axis direction indicates the South Pole approaching the part marking surface of SIP3 and SC59 i.e. increasing south pole magnetic field strength to the sensor; reversing direction x-axis toward 0 means the decreasing south magnetic field strength to the sensor. Negative x-axis indicates north pole magnetic field to the part marking surface.
 - Typical values are defined at $T_A = +25^\circ\text{C}$, $V_{DD} = 12\text{V}$. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization.

Typical Operating Characteristics

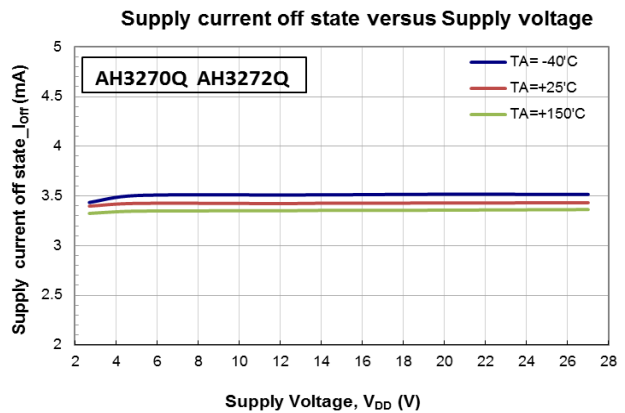
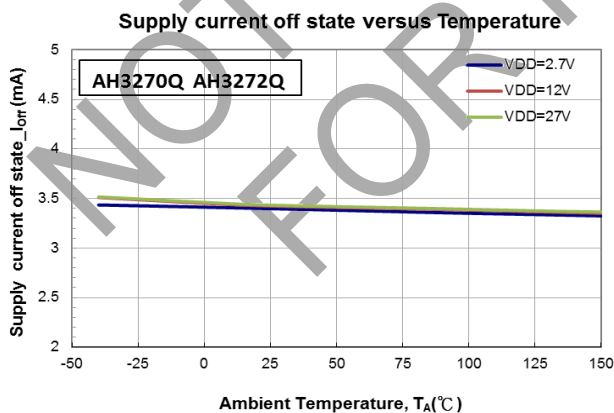
AH323XQ_AH327XQ Supply Current ON, I_{ON} Performance



AH323XQ_AH3271Q Supply Current OFF, $I_{OFF(1)}$ Performance

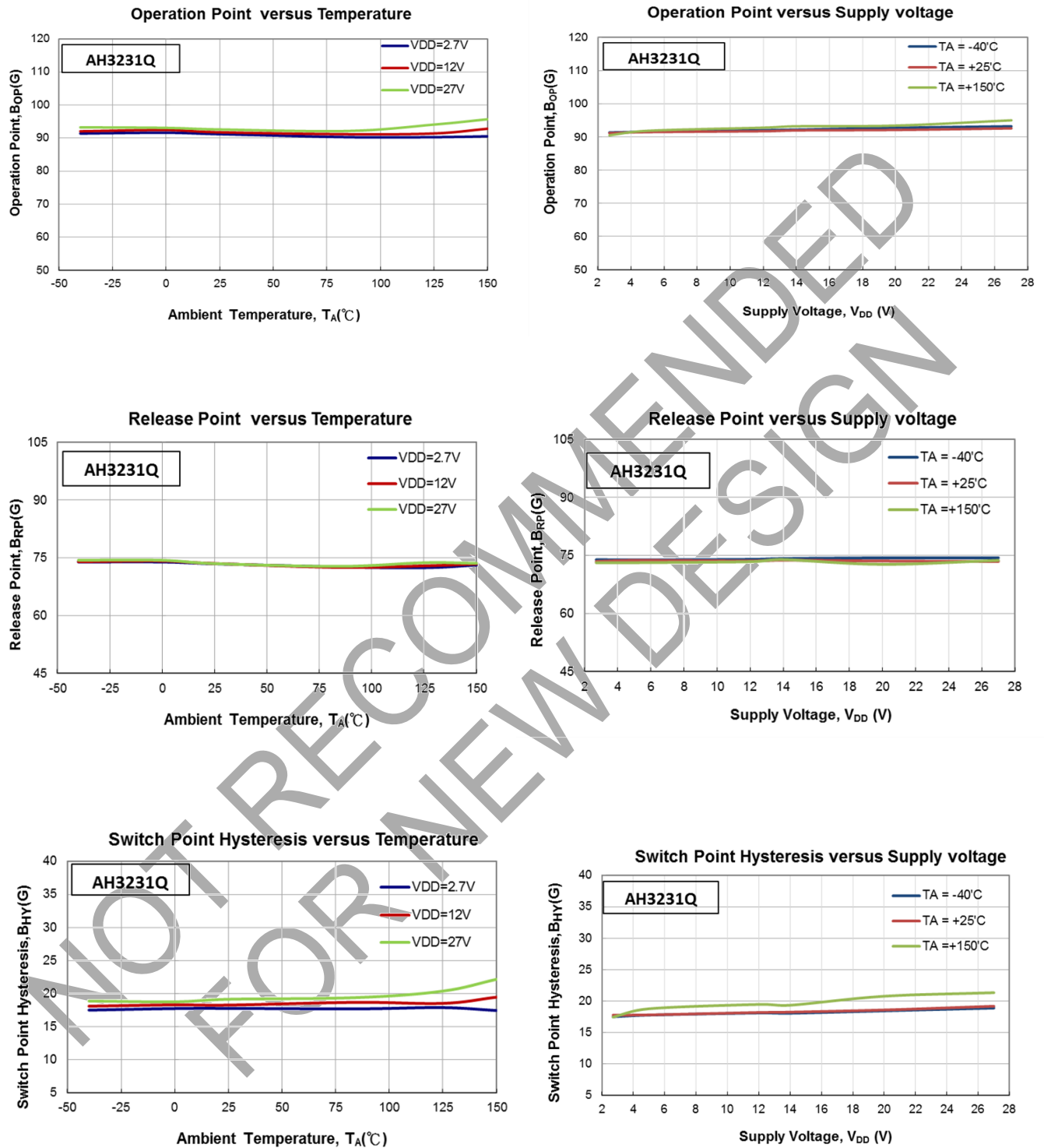


AH3270Q_AH3272Q Supply Current OFF, $I_{OFF(2)}$ Performance



Typical Operating Characteristics (continued)

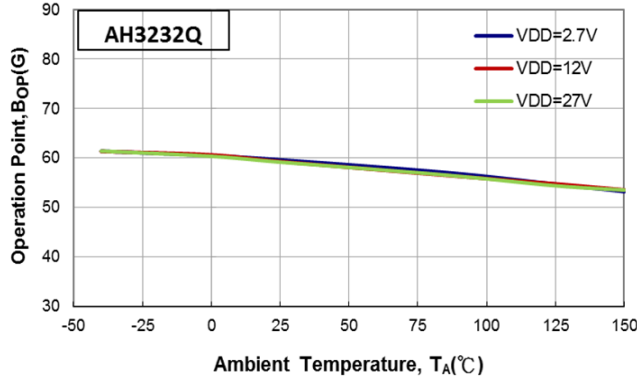
AH3231Q Magnetic Characteristics Performance



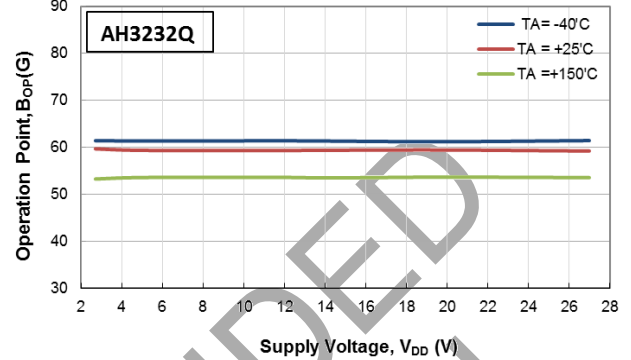
Typical Operating Characteristics (continued)

AH3232Q Magnetic Characteristics Performance

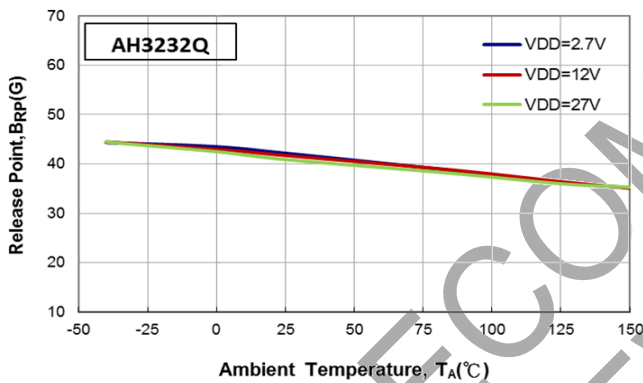
Operation Point versus Temperature



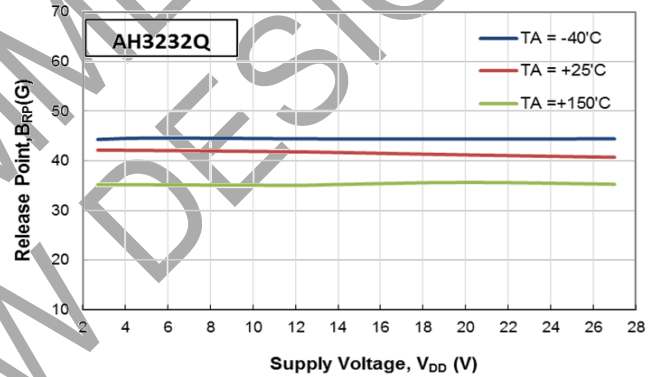
Operation Point versus Supply voltage



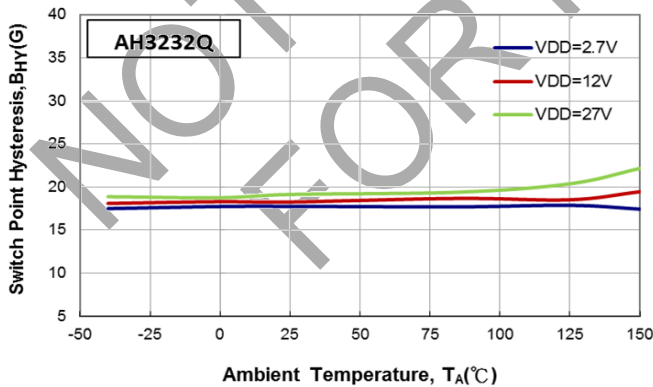
Release Point versus Temperature



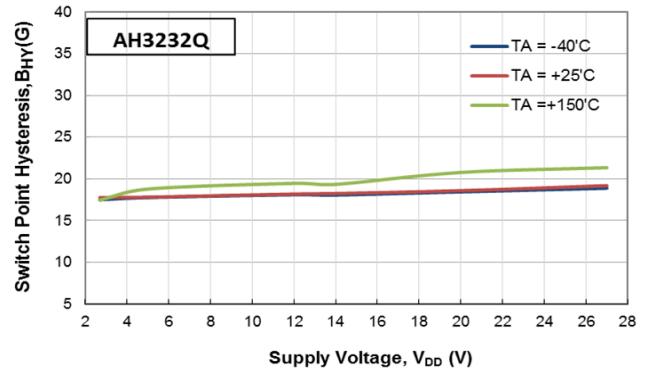
Release Point versus Supply voltage



Switch Point Hysteresis versus Temperature

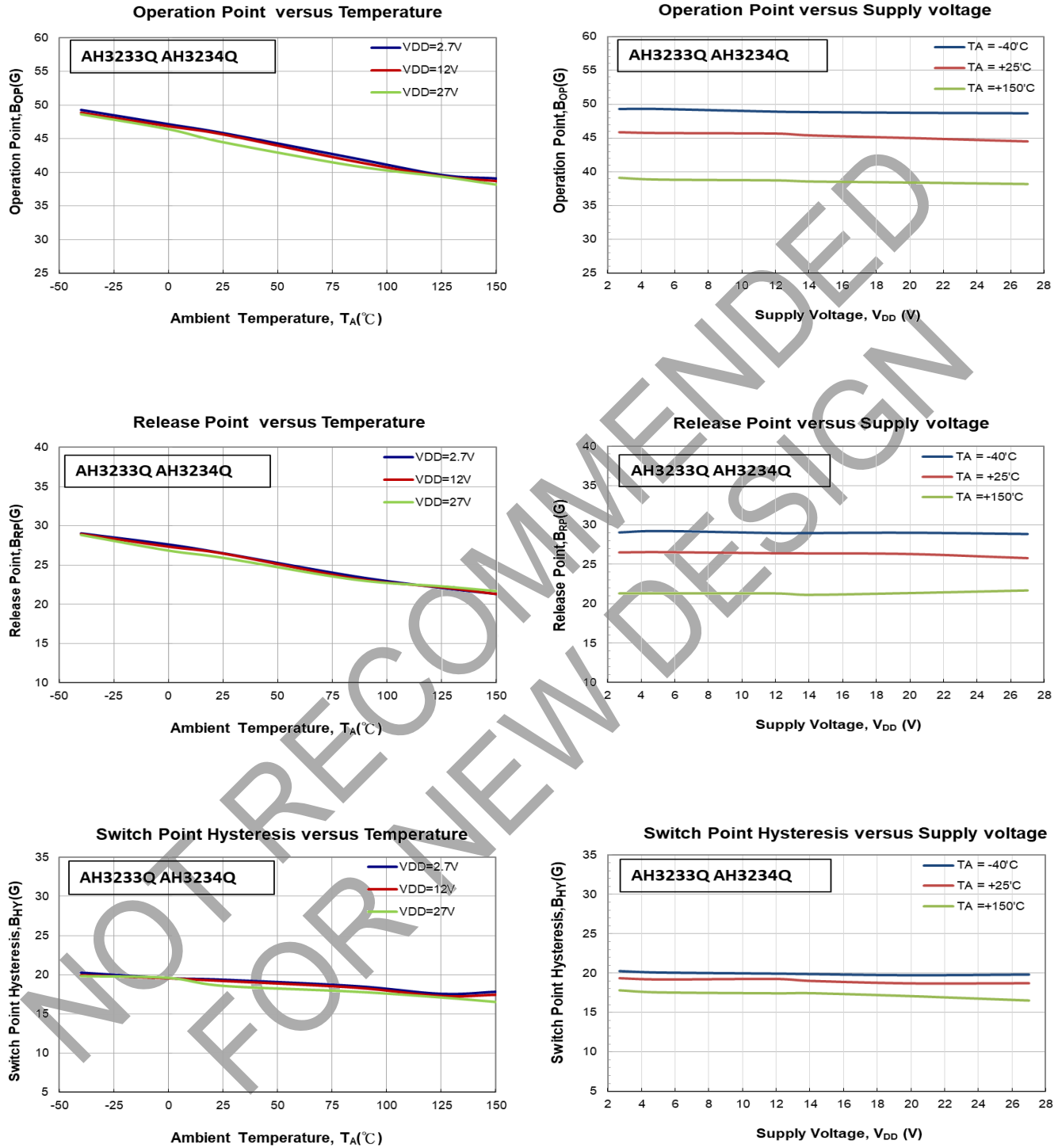


Switch Point Hysteresis versus Supply voltage



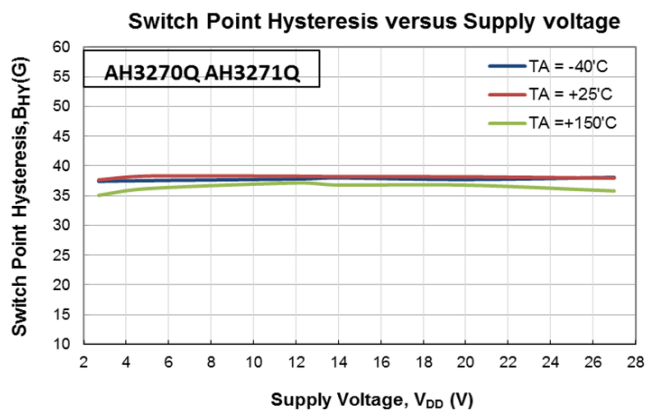
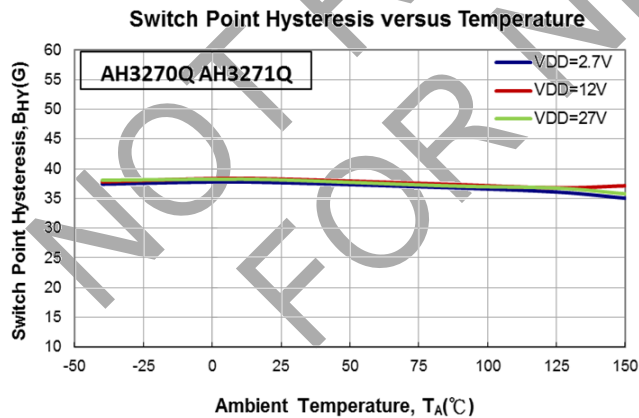
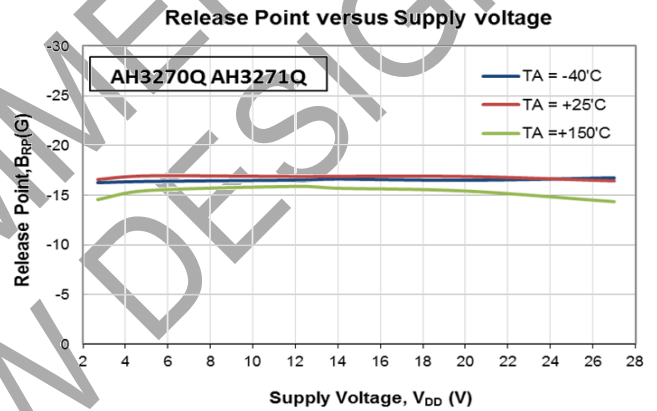
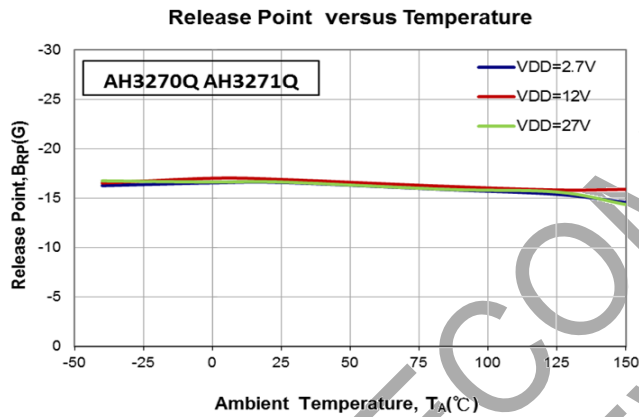
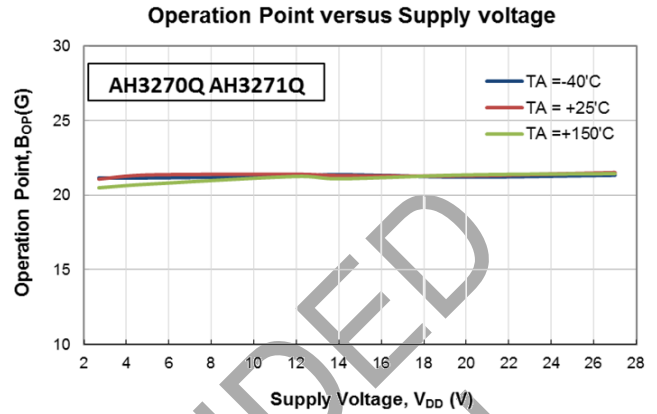
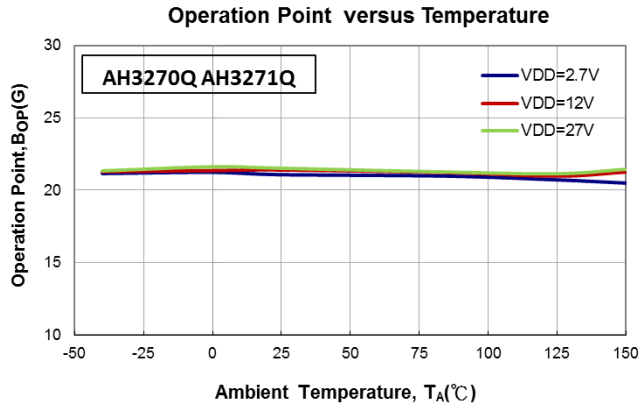
Typical Operating Characteristics (continued)

AH3233Q_AH3234Q Magnetic Characteristics Performance



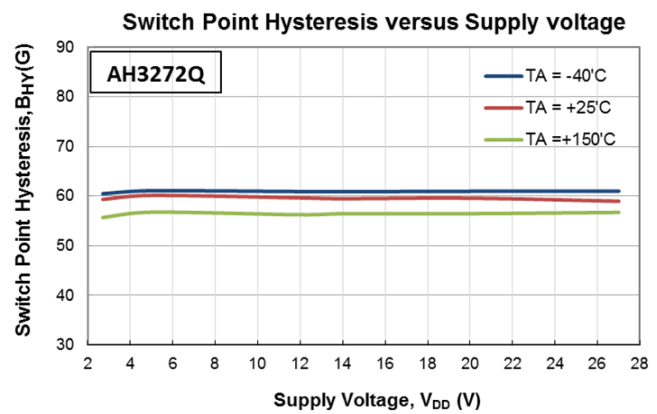
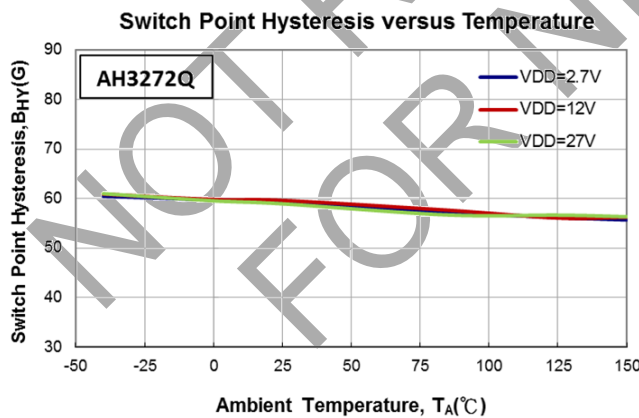
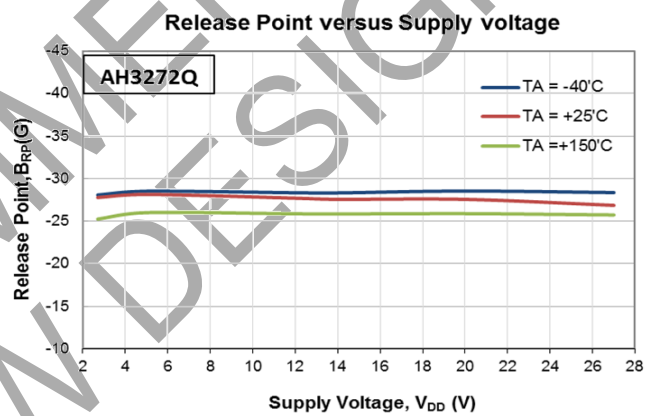
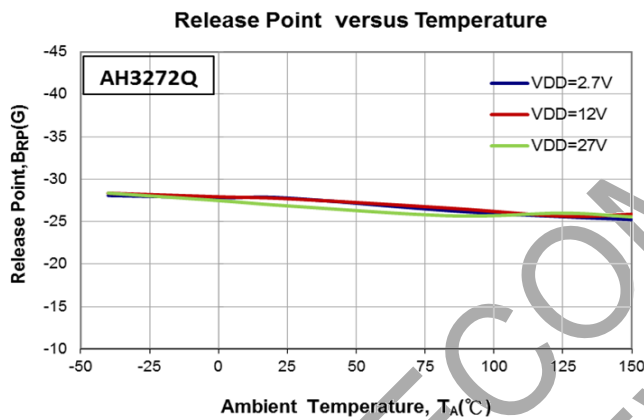
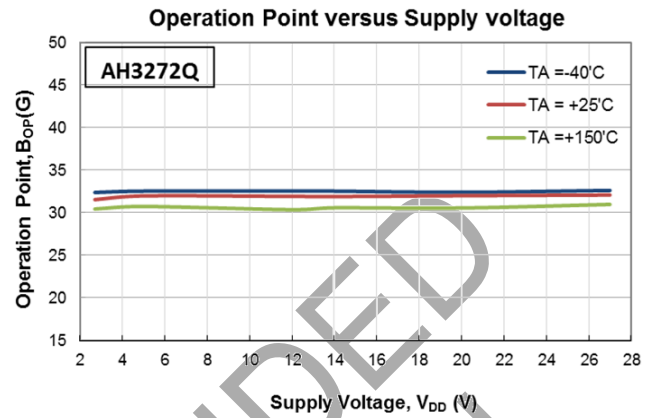
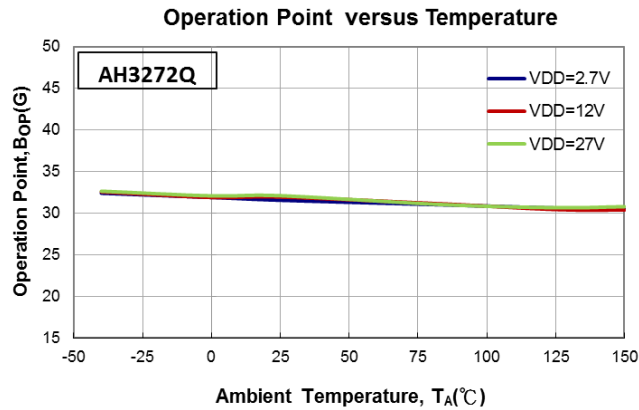
Typical Operating Characteristics (continued)

AH3270Q_AH3271Q Magnetic Characteristics Performance



Typical Operating Characteristics (continued)

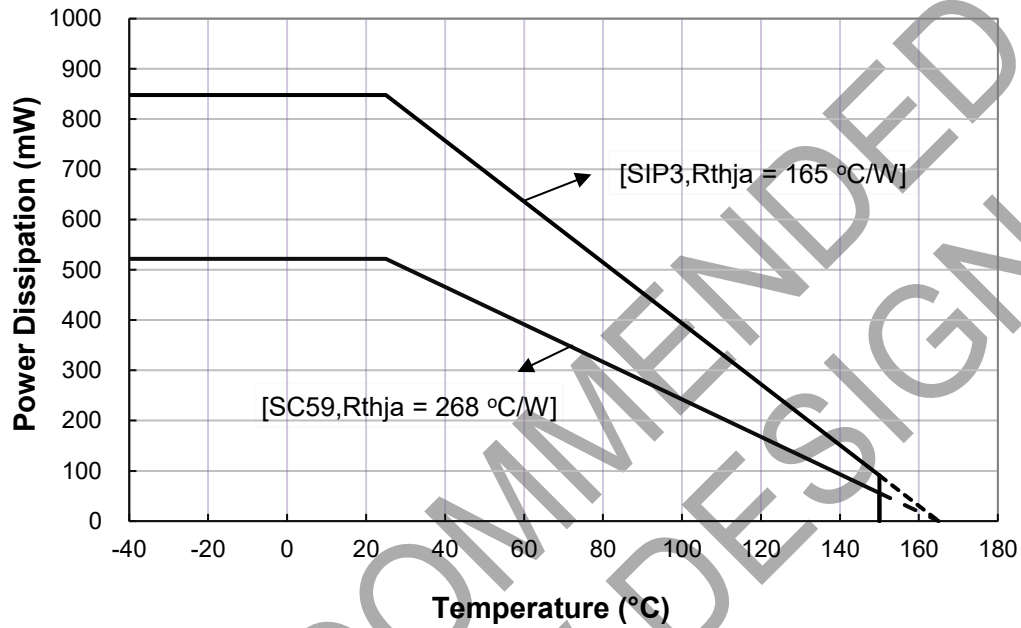
AH3272Q Magnetic Characteristics Performance



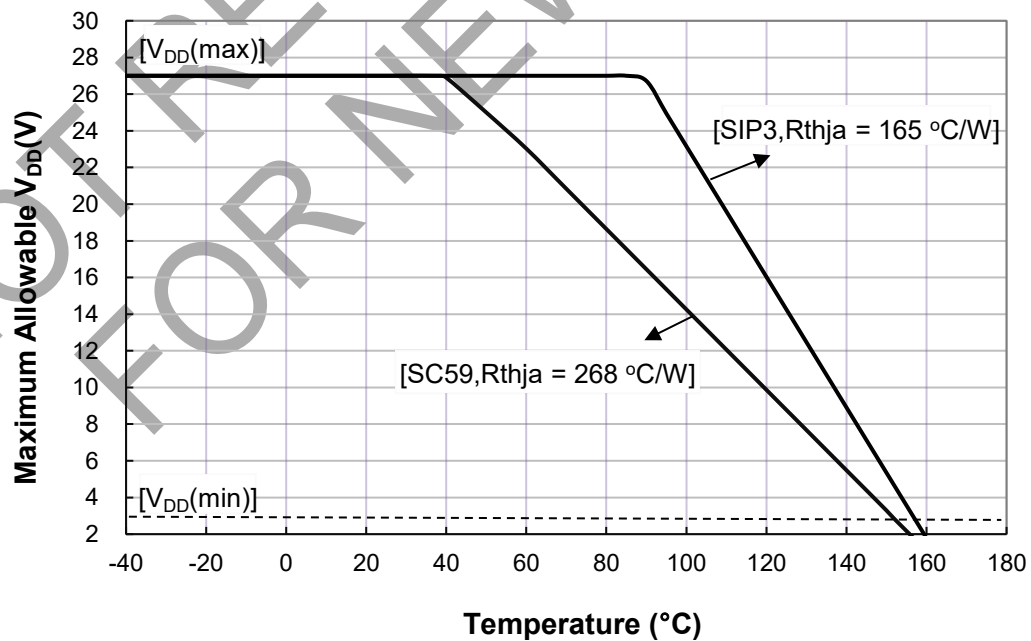
Thermal Performance Characteristics

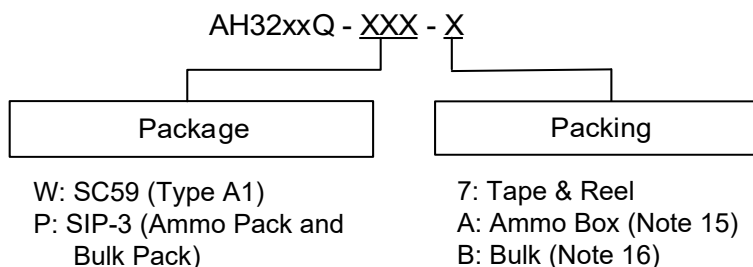
Symbol	Parameter	Conditions	Rating	Unit
R _{θJA}	Package Thermal Resistance	SC59 (Type A1), 50mm*50mm 2oz MRB PCB, single layer	268	°C/W
		SIP-3 (Ammo Pack and Bulk Pack), 50mm*50mm 2oz MRB PCB, single layer	143	°C/W

Thermal Derating Curve vs. Ambient Temperature



Power Derating Curve



Ordering Information (Note 14)


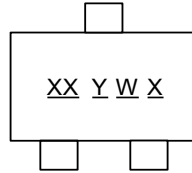
Orderable Part Number	Package Code	Package	Packing	
			Qty.	Carrier
AH3231Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3231Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3231Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel
AH3232Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3232Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3232Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel
AH3233Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3233Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3233Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel
AH3234Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3234Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3234Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel
AH3270Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3270Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3270Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel
AH3271Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3271Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3271Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel
AH3272Q-P-A	P	SIP-3 (Ammo Pack)	4000	Ammo Box
AH3272Q-P-B	P	SIP-3 (Bulk Pack)	1000	Bulk Box
AH3272Q-W-7	W	SC59 (Type A1)	3000	7" Tape & Reel

Notes: 14. For packaging details, go to our website at <https://www.diodes.com/design/support/packaging/diodes-packaging/>.
 15. Ammo Box is for SIP-3 (Ammo Pack) Spread Lead.
 16. Bulk is for SIP-3 (Bulk Pack) Straight Lead.

Marking Information

(1) Package Type: SC59 (Type A1)

(Top View)

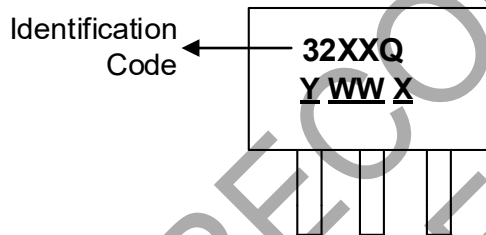


XX : Identification Code
Y : Year 0 to 9 (ex: 5 = 2025)
W : Week : A to Z : week 1 to 26;
a to z : week 27 to 52; z represents
week 52 and 53
X : Internal Code

Orderable Part Number	Package	Identification Code
AH3231Q-W-7	SC59 (Type A1)	AT
AH3232Q-W-7	SC59 (Type A1)	AR
AH3233Q-W-7	SC59 (Type A1)	AV
AH3234Q-W-7	SC59 (Type A1)	AX
AH3270Q-W-7	SC59 (Type A1)	AW
AH3271Q-W-7	SC59 (Type A1)	AU
AH3272Q-W-7	SC59 (Type A1)	AS

(2) Package Type: SIP-3 (Ammo Pack), SIP-3 (Bulk Pack)

(Top View)



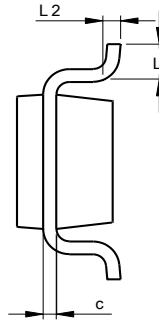
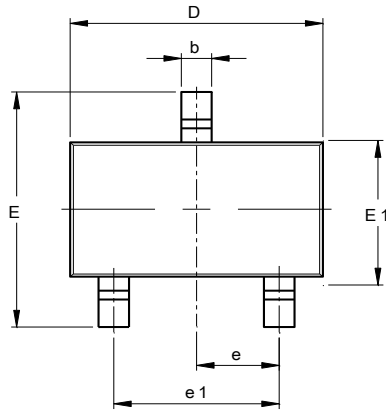
32XXQ : Identification Code
Y : Year : 0 to 9 (ex: 5 = 2025)
WW : Week : 01 to 52, "52" represents
week 52 and 53
X : Internal Code

Orderable Part Number	Package	Identification Code
AH3231Q-P-A	SIP-3 (Ammo Pack)	3231Q
AH3231Q-P-B	SIP-3 (Bulk Pack)	3231Q
AH3232Q-P-A	SIP-3 (Ammo Pack)	3232Q
AH3232Q-P-B	SIP-3 (Bulk Pack)	3232Q
AH3233Q-P-A	SIP-3 (Ammo Pack)	3233Q
AH3233Q-P-B	SIP-3 (Bulk Pack)	3233Q
AH3234Q-P-A	SIP-3 (Ammo Pack)	3234Q
AH3234Q-P-B	SIP-3 (Bulk Pack)	3234Q
AH3270Q-P-A	SIP-3 (Ammo Pack)	3270Q
AH3270Q-P-B	SIP-3 (Bulk Pack)	3270Q
AH3271Q-P-A	SIP-3 (Ammo Pack)	3271Q
AH3271Q-P-B	SIP-3 (Bulk Pack)	3271Q
AH3272Q-P-A	SIP-3 (Ammo Pack)	3272Q
AH3272Q-P-B	SIP-3 (Bulk Pack)	3272Q

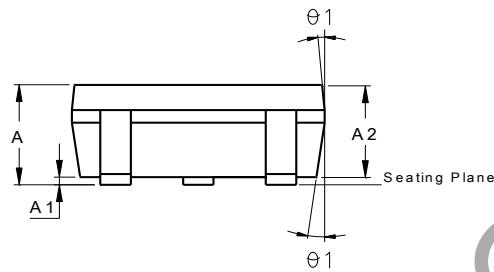
Package Outline Dimensions (All dimensions in mm.)

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

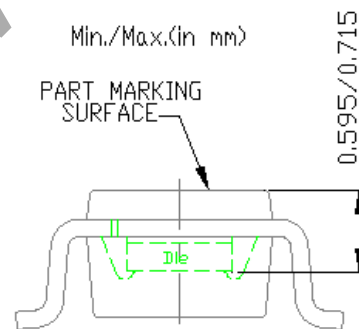
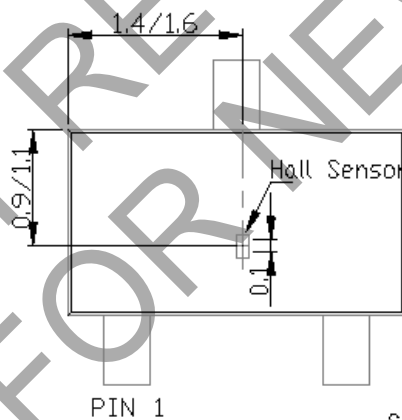
(1) Package Type: SC59 (Type A1)



SC59 (Type A1)			
Dim	Min	Max	Typ
A	--	1.45	--
A1	0.00	0.15	--
A2	0.90	1.30	1.15
b	0.30	0.50	--
c	0.08	0.22	--
D	2.90 BSC		
E	2.80 BSC		
E1	1.60 BSC		
e	0.95 BSC		
e1	1.90 BSC		
L	0.30	0.60	0.45
L2	0.25 BSC		
θ1	5°	15°	10°
All Dimensions in mm			



AH32xx0 Hall sensor

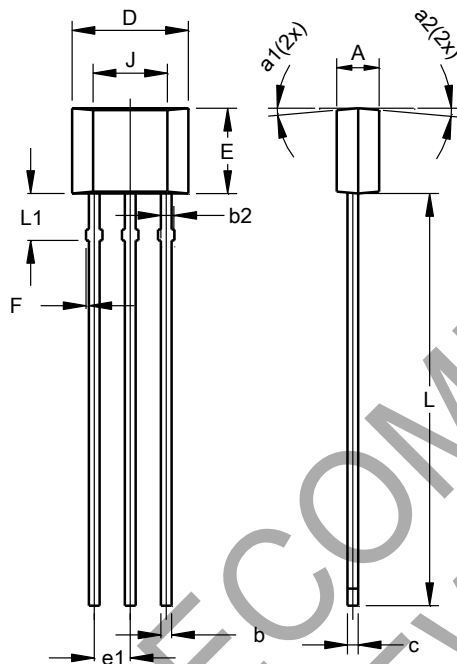
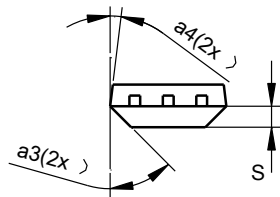


SENSOR LOCATION

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

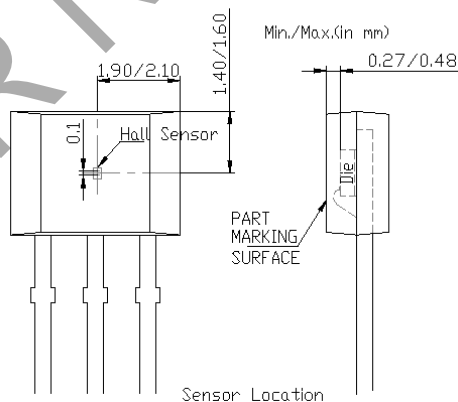
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(2) Package Type: SIP-3 (Bulk Pack)



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			

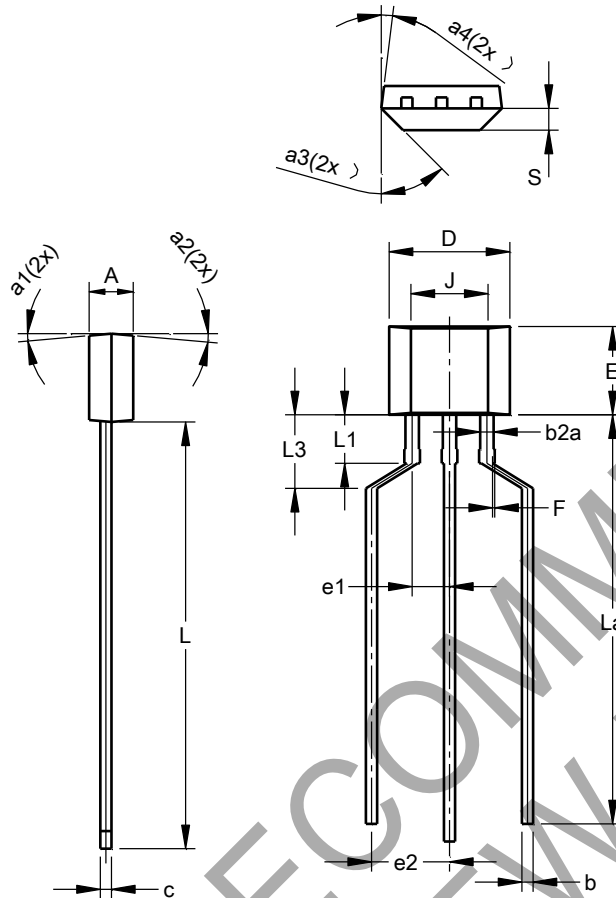
AH32xxQ SIP3 Hall sensor



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

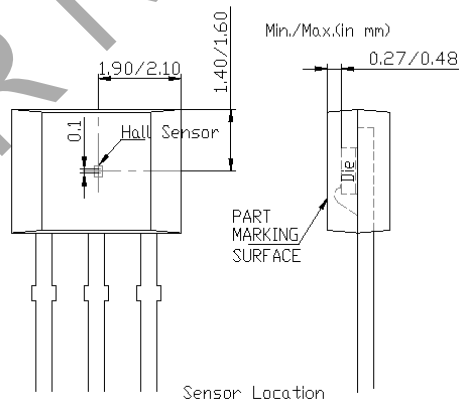
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(3) Package Type: SIP-3 (Ammo Pack)



SIP-3 (Ammo Pack)			
Dim	Min	Max	Typ
A	1.40	1.60	1.50
b	0.33	0.43	0.38
b2a	0.40	0.52	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
e2	2.40	2.90	2.65
F	0.00	0.20	—
J	2.62 REF		
L	14.00	15.00	14.50
La	12.90	14.90	13.90
L1	1.55	1.75	1.65
L3	2.00	3.00	2.50
S	0.63	0.84	0.74
a1	—	—	5°
a2	—	—	5°
a3	—	—	45°
a4	—	—	3°
All Dimensions in mm			

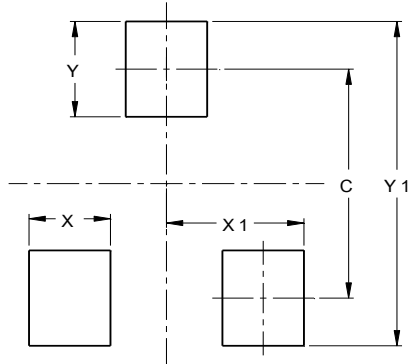
AH32xxQ SIP3 Hall sensor



Suggested Pad Layout

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

(1) Package Type: SC59 (Type A1)



Dimensions	Value (in mm)
C	2.40
X	0.80
X1	1.35
Y	1.00
Y1	3.40

NOT RECOMMENDED
FOR NEW DESIGN

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