

Description

The AH3713Q/AH3714Q/AH3715Q/AH3716Q/AH3717Q is an AEC-Q100 qualified high-voltage, high-sensitivity Hall-effect latch IC designed for brushless DC-motor commutation speed measurement, angular or linear encoders and position sensors in automotive applications. To support a wide range of demanding applications, the design is optimized to operate over the supply range of 3.0V to 27V. 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. For robustness and protection, the device has a reverse blocking diode with a Zener clamp on the supply. The output has an overcurrent limit and a Zener clamp.

The single, open-drain output can be switched on with South pole of sufficient strength and switched off with 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 latched until magnetic flux density reverses and becomes lower than the release point (B_{RP}).

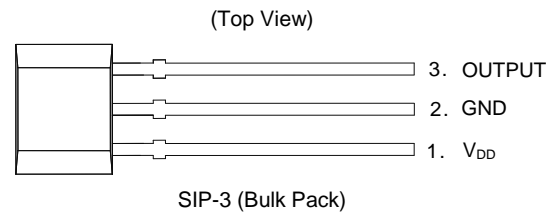
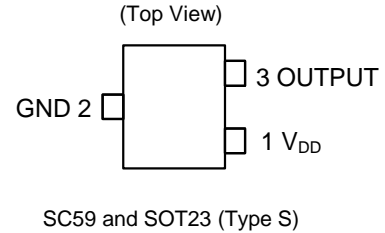
The magnetic operating and release polarity is opposite for SOT23 (Type S) and SC59 packages. SOT23 (Type S) and SIP-3 (Bulk Pack) packages will require South pole to the part marking side to operate while SC59 will require South pole to the non part-marking side.

Features

- Bipolar Latch (South Pole: On, North Pole: Off)
- 3.0V to 27V Operating Voltage Range
- 40V Load Dump Protection
- Sensitivity Options: B_{OP} and B_{RP} of ±30G to ±140G Typical
- Resistant to Physical Stress
- Single, Open-Drain Output with Overcurrent Limit
- Chopper-Stabilized Design Provides
 - Superior Temperature Stability
 - Minimal Switch-Point Drift
 - Enhanced Immunity to Stress
- Good RF Noise Immunity
- Reverse-Blocking Diode and Zener Clamp on Supply
- -40°C to +150°C Operating Temperature
- ESD HBM: 8kV, CDM: 1kV
- AEC-Q100 Grade 0 Qualified
- Industry Standard SC59, SOT23 (Type S), SIP-3 (Bulk Pack) Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The AH3713Q/AH3714Q/AH3715Q/AH3716Q/AH3717Q is suitable for automotive applications requiring specific change control; this part is AEC-Q100 qualified, PPAP capable, and manufactured in IATF16949 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.

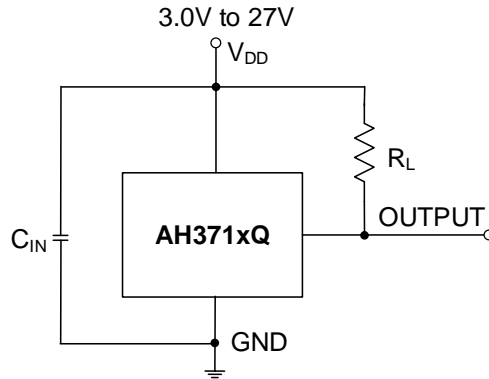
Pin Assignments



Applications

- Brushless DC motor commutation
- Revolution per minute (RPM) measurement
- Flow meters
- Angular and linear encoders and position sensors
- Contactless commutation, speed measurement and angular position sensing/indexing in automotive applications

Typical Applications Circuit (Note 4)



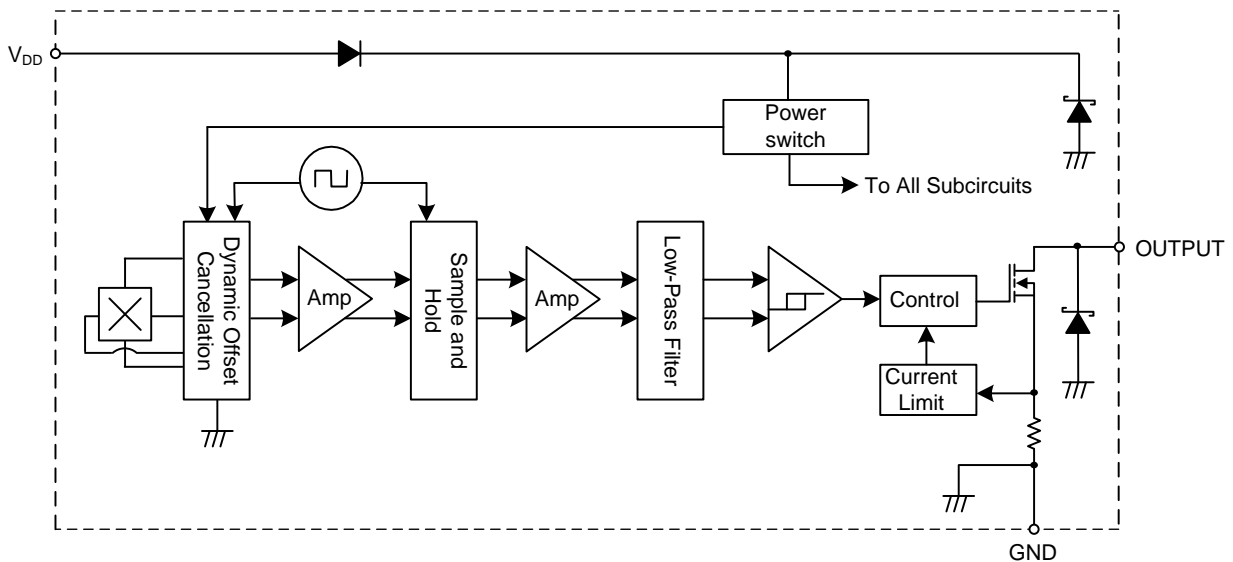
Note: 4. C_{IN} is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF. R_L is the pullup resistor.

Pin Descriptions

Packages: SOT23 (Type S), SC59 and SIP-3 (Bulk Pack)

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

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)	40	V
V _{DDR}	Reverse Supply Voltage	-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 (Bulk Pack)	550
		SC59 and SOT23 (Type S)	230
T _S	Storage Temperature Range	-65 to +165	°C
T _J	Maximum Junction Temperature	+170	°C
ESD HBM	Electrostatic Discharge Withstand Capability—Human Body Model	8	kV
ESD CDM	Electrostatic Discharge Withstand Capability—Charged Device Model	1	kV

- Notes:
- 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.
 - 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 +150°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Rating	Unit
V _{DD}	Supply Voltage	Supply voltage, between V _{DD} and GND pins	3.0 to 27	V
T _A	Operating Temperature Range	Operating ambient temperature range	-40 to +150	°C

Electrical Characteristics (Notes 7 & 8) (@T_A = -40°C to +150°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, B > B _{OP}	—	0.25	0.42	V
I _{OUT_OFF}	Output Leakage Current	V _{OUT} = 27V, B < B _{RP} , output off	—	<0.1	10	μA
I _{DD}	Supply Current	Output open, T _A = +25°C	—	2.8	3.8	mA
		Output open, T _A = -40°C to +150°C	—	2.8	4.8	mA
I _{DD_R}	Reverse Battery Current	V _{DD} = -18V, T _A = -40°C to +150°C	—	0.001	2.3	mA
t _{st}	Device Startup Time	V _{DD} ≥ 3V, B > B _{OP} +10Gs or B < B _{RP} - 10Gs (Note 7)	—	13	—	μs
f _c	Chopping Frequency	V _{DD} ≥ 3V (Note 9)	—	500	—	kHz
t _d	The Time Delay from Magnetic Threshold Reached to the Start of the Output Rise or Fall	B > 3 x B _{OPMAX} , square wave magnetic field	—	10.	—	μs
t _r	Output Rising Time (External Pullup Resistor R _L and Load Capacitance Dependent)	R _L = 1kΩ, C _L = 20pF (Note 9)	—	0.1	1	μs
t _f	Output Falling Time (Internal Switch Resistance and Load Capacitance Dependent)	R _L = 1kΩ, C _L = 20pF (Note 9)	—	0.3	1	μs
I _{OCL}	Output Current Limit	Output on (Note 10)	30	—	60	mA
V _Z	Zener Clamp Voltage	I _{DD} = 8mA, T _A = +25°C, output off	36	—	—	V

- Notes:
- 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 startup time of 13μs typical from the operating voltage reaching 3V.
 - 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.
 - Guaranteed by design, process control, and characterization. Not tested in production.
 - The device limits the output current I_{OUT} to current limit of I_{OCL}.

Magnetic Characteristics (Notes 11 & 12) ($T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$, $V_{DD} = 3.0\text{V}$ to 27V , unless otherwise specified)

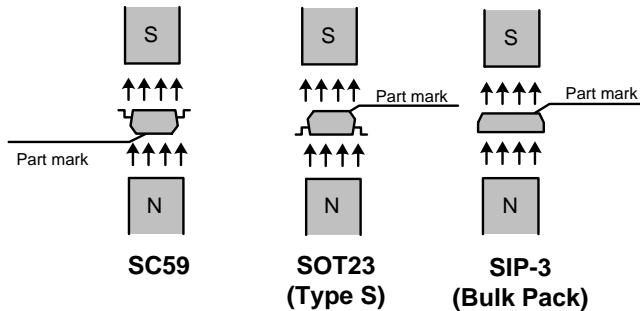
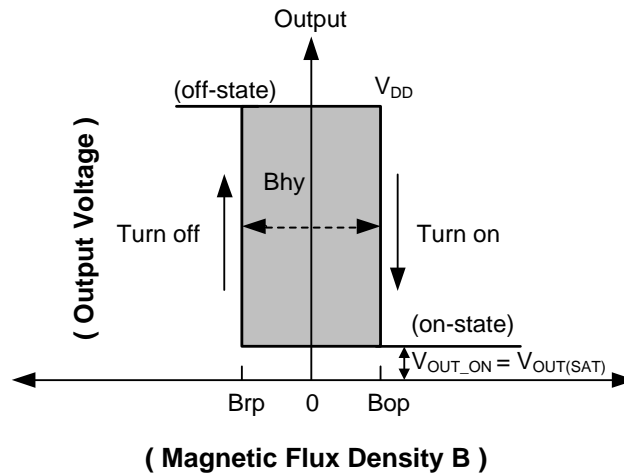
Part Number	Symbol	Parameter	Min	Typ	Max	Unit	Output Type
AH3713Q	B_{OP} (South pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); South pole to non-part marking side for SC59. See diagram below)	Operation Point	15	30	45	Gauss	Open-Drain
	B_{RP} (North pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); North pole to non-part marking side for SC59. See diagram below)	Release Point	-45	-30	-15		
	$B_{HY} (B_{OPX} - B_{RPX})$	Hysteresis (Note 13)	30	60	90		
AH3714Q	B_{OP} (South pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); South pole to non-part marking side for SC59. See diagram below)	Operation Point	20	40	60	Gauss	Open-Drain
	B_{RP} (North pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); North pole to non-part marking side for SC59. See diagram below)	Release Point	-60	-40	-20		
	$B_{HY} (B_{OPX} - B_{RPX})$	Hysteresis (Note 13)	40	80	120		
AH3715Q	B_{OP} (South pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); South pole to non-part marking side for SC59. See diagram below)	Operation Point	50	70	90	Gauss	Open-Drain
	B_{RP} (North pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); North pole to non-part marking side for SC59. See diagram below)	Release Point	-90	-70	-50		
	$B_{HY} (B_{OPX} - B_{RPX})$	Hysteresis (Note 13)	100	140	180		
AH3716Q	B_{OP} (South pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); South pole to non-part marking side for SC59. See diagram below)	Operation Point	80	110	140	Gauss	Open-Drain
	B_{RP} (North pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); North pole to non-part marking side for SC59. See diagram below)	Release Point	-140	-110	-80		
	$B_{HY} (B_{OPX} - B_{RPX})$	Hysteresis (Note 13)	160	220	280		

- Notes:
11. 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 startup time of 13 μs typical from the operating voltage reaching 3V.
 12. 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.
 13. Maximum and minimum hysteresis is guaranteed by design, process control, and characterization.

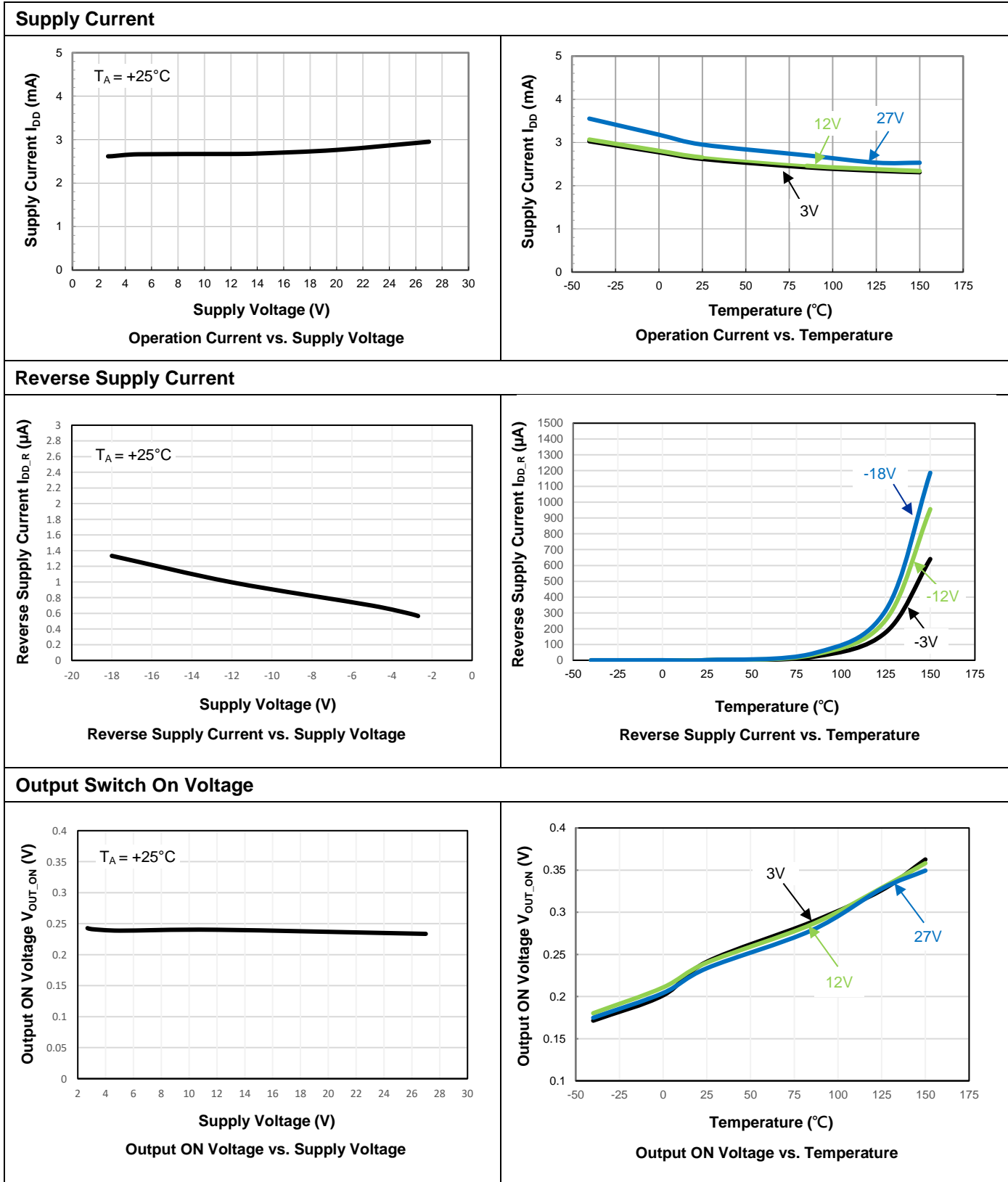
Magnetic Characteristics (Notes 11 & 12) ($T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$, $V_{DD} = 3.0\text{V}$ to 27V , unless otherwise specified) (continued)

Part Number	Symbol	Parameter	Min	Typ	Max	Unit	Output Type
AH3717Q	B_{OP} (South pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); South pole to non-part marking side for SC59. See diagram below)	Operation Point	110	140	170	Gauss	Open-Drain
	B_{RP} (North pole to part-marking side for SOT23 (Type S) and SIP-3 (Bulk Pack); North pole to non-part marking side for SC59. See diagram below)	Release Point	-170	-140	-110		
	$B_{HY} (B_{OPX} - B_{RPX})$	Hysteresis (Note 13)	210	280	350		

- Notes:
11. 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 startup time of 13 μs typical from the operating voltage reaching 3V.
 12. 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.
 13. Maximum and minimum hysteresis is guaranteed by design, process control, and characterization.

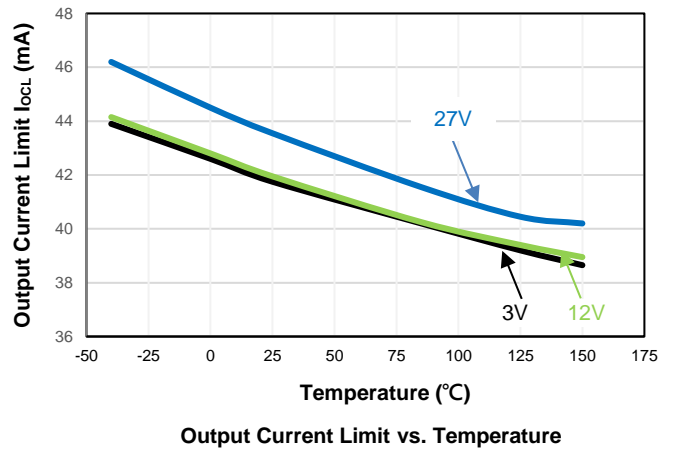
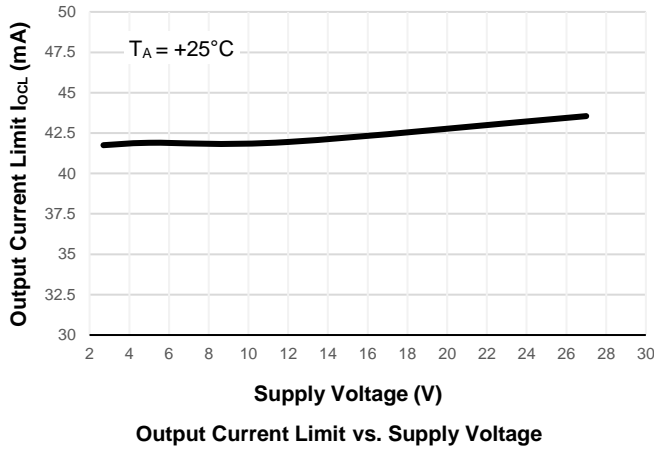


Typical Operating Characteristics

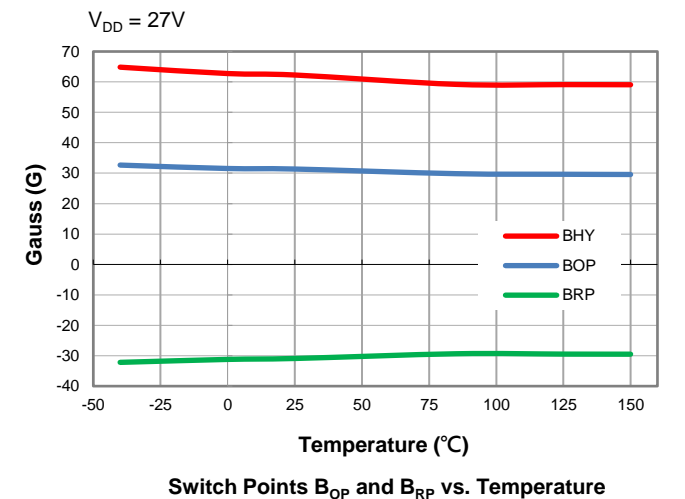
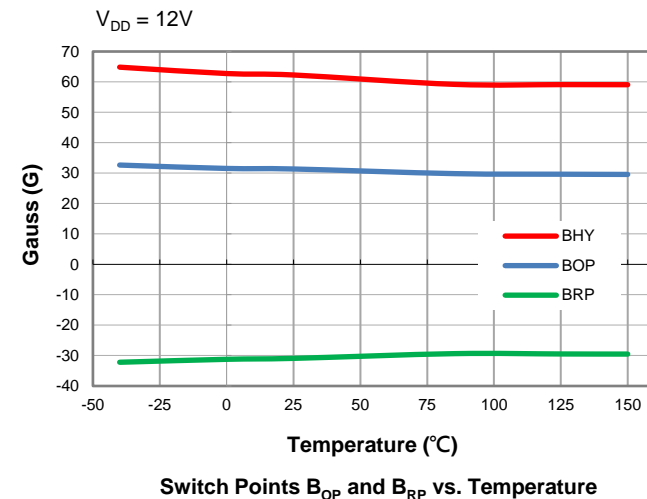
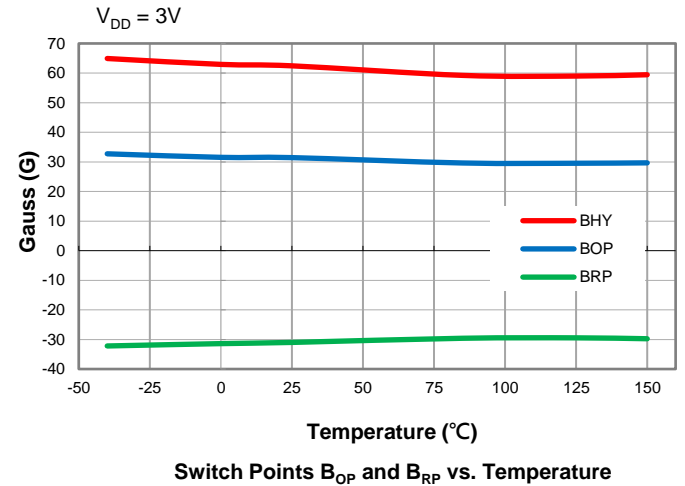
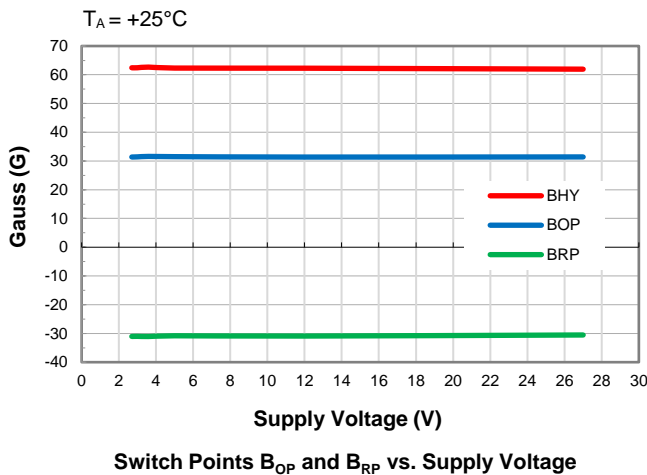


Typical Operating Characteristics (continued)

Output Current Limit

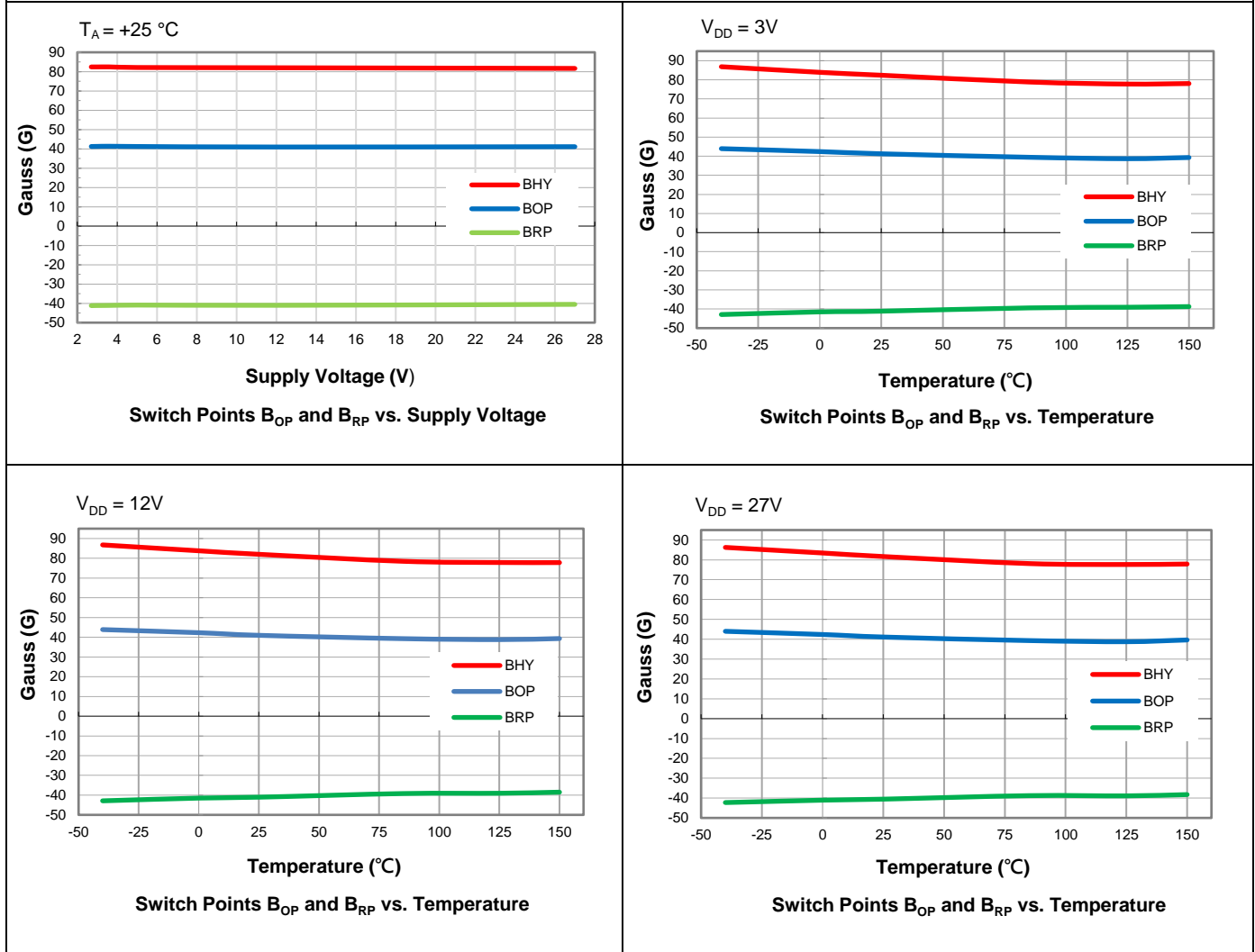


AH3713Q Output Points (Magnetic Thresholds) – B_{OP} and B_{RP}

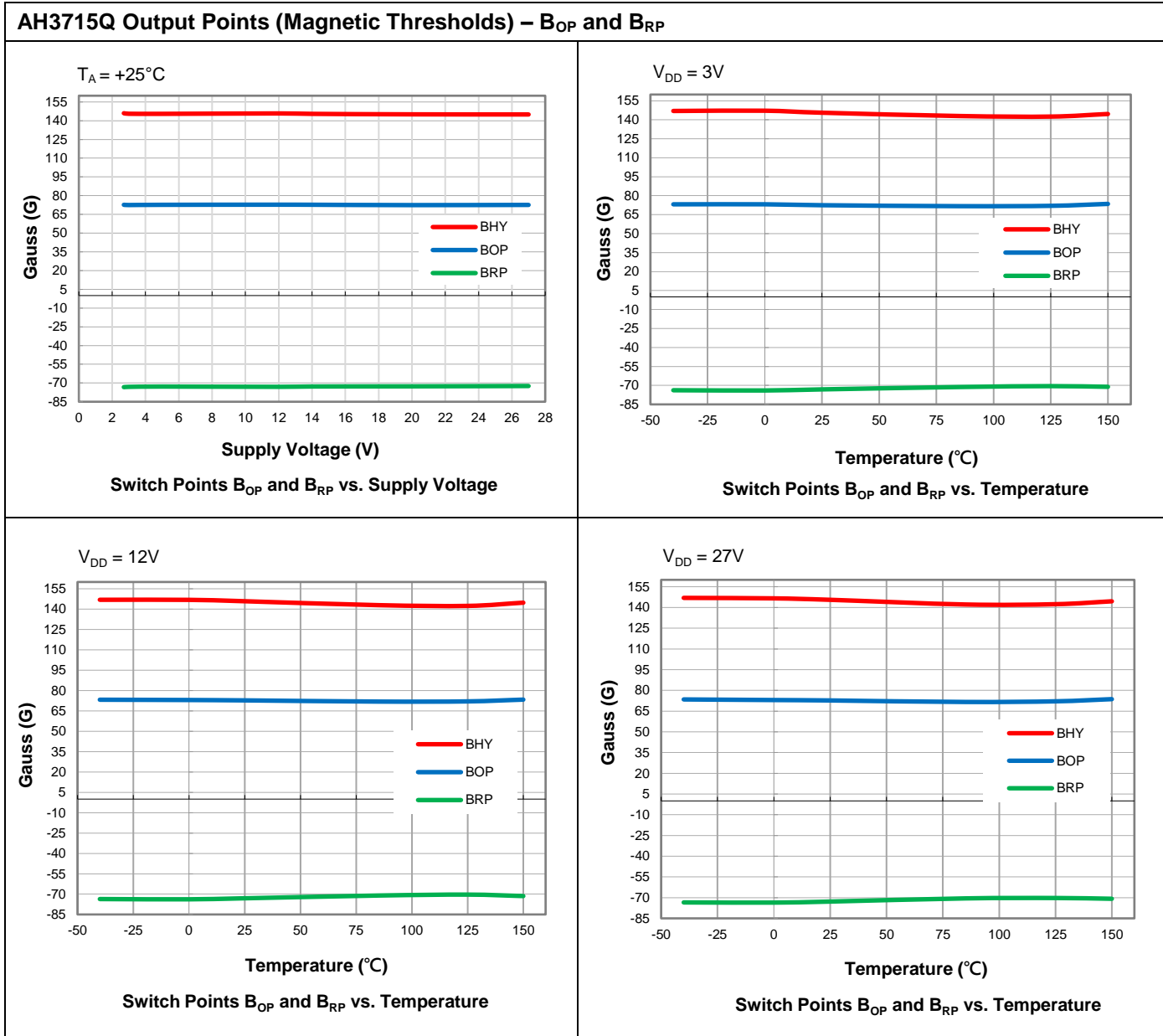


Typical Operating Characteristics (continued)

AH3714Q Output Points (Magnetic Thresholds) – B_{OP} and B_{RP}

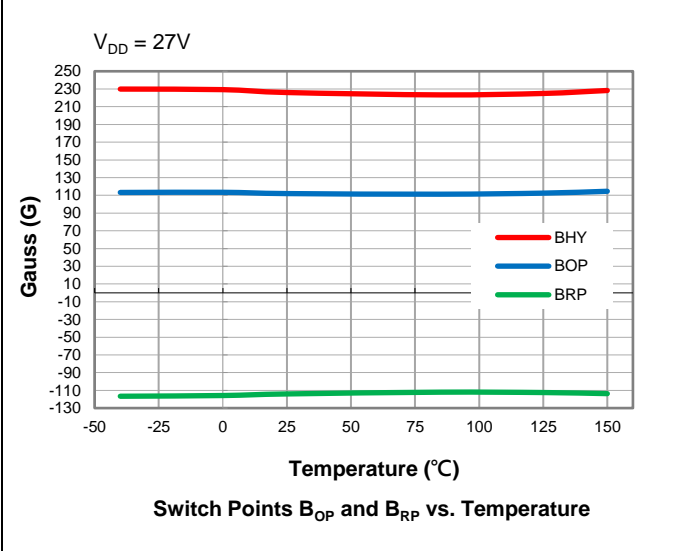
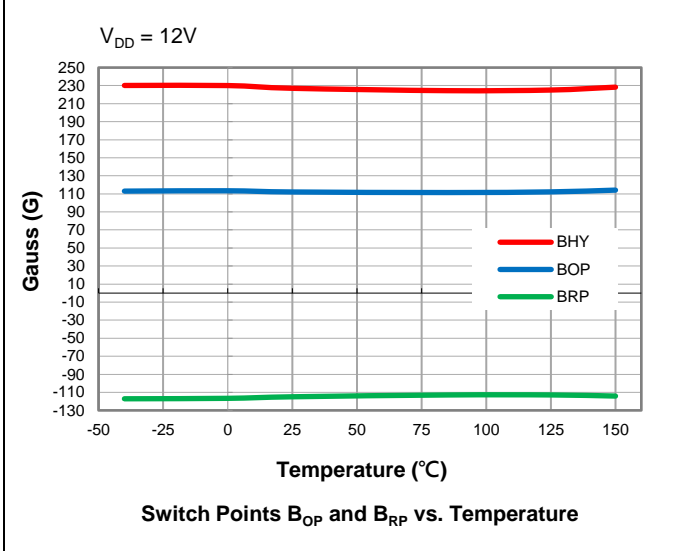
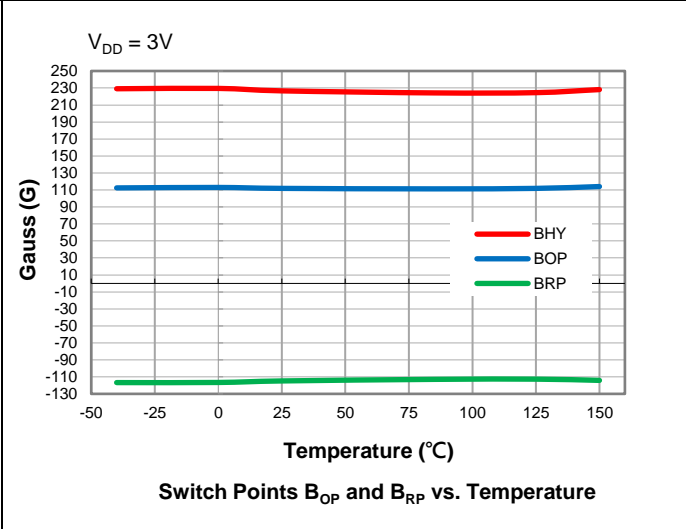
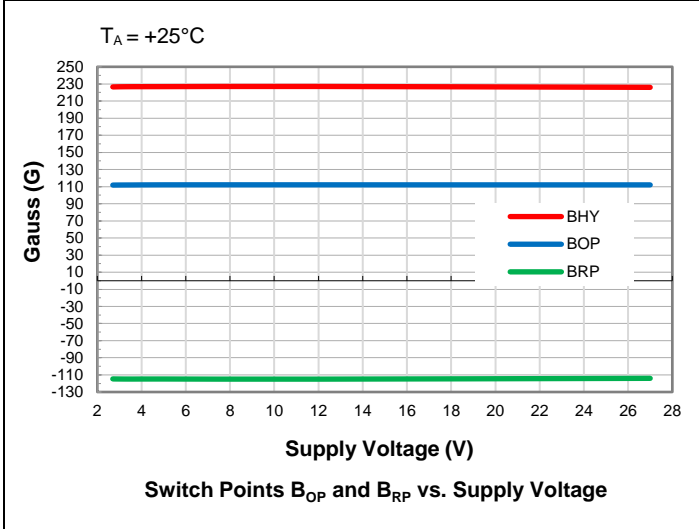


Typical Operating Characteristics (continued)

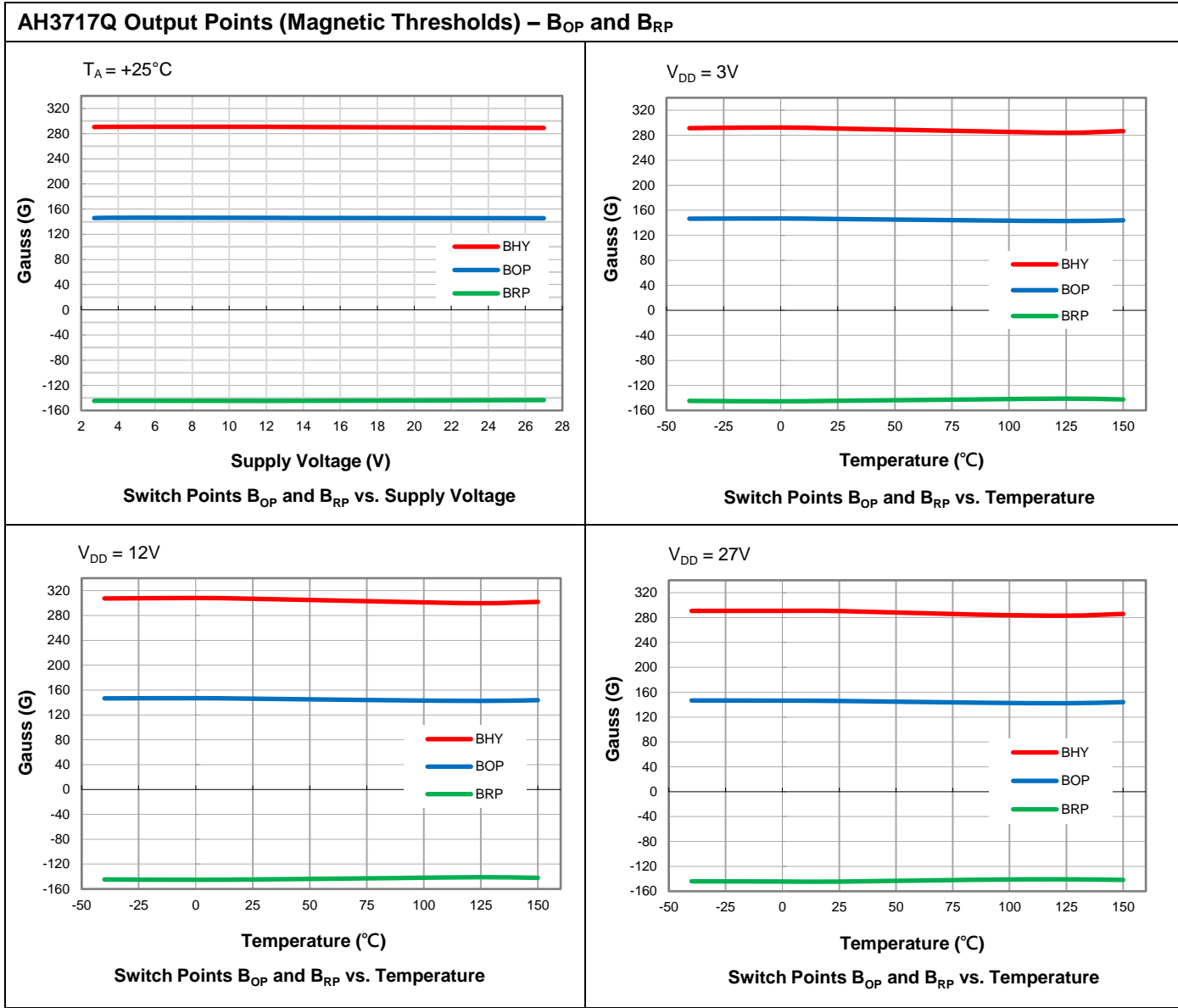


Typical Operating Characteristics (continued)

AH3716Q Output Points (Magnetic Thresholds) – B_{OP} and B_{RP}



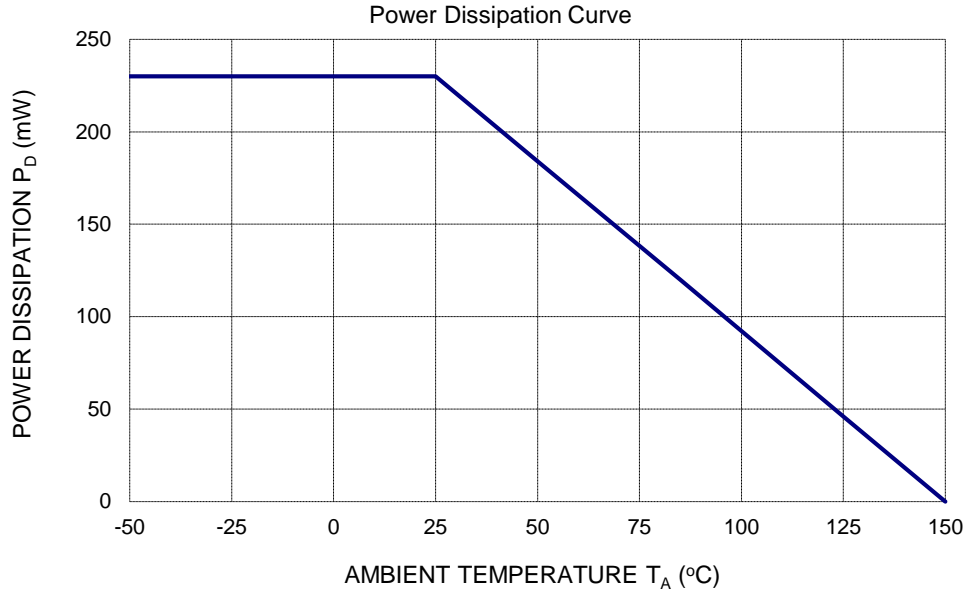
Typical Operating Characteristics (continued)



Thermal Performance Characteristics

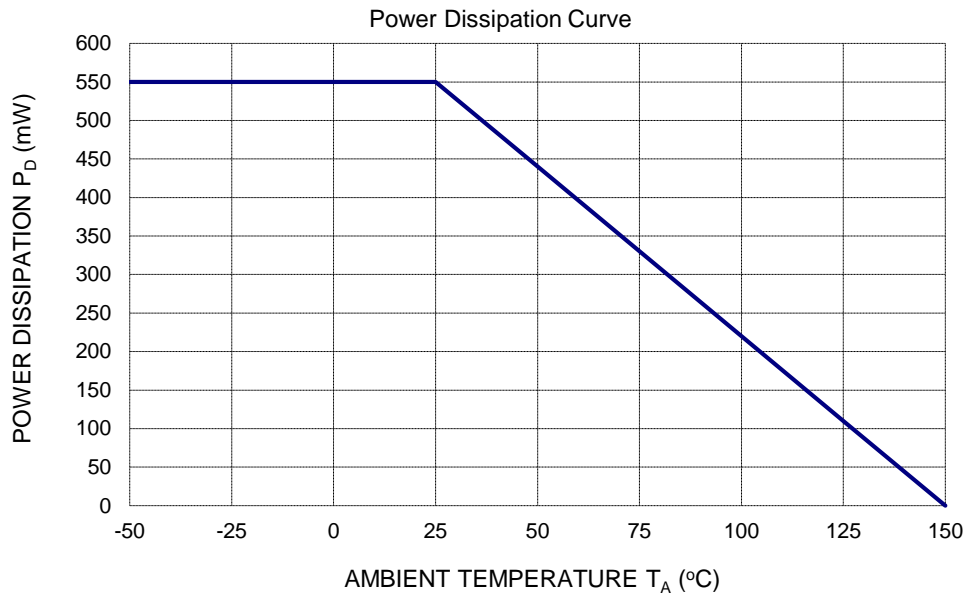
(1) Packages: SOT23 (Type S)/SC59

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

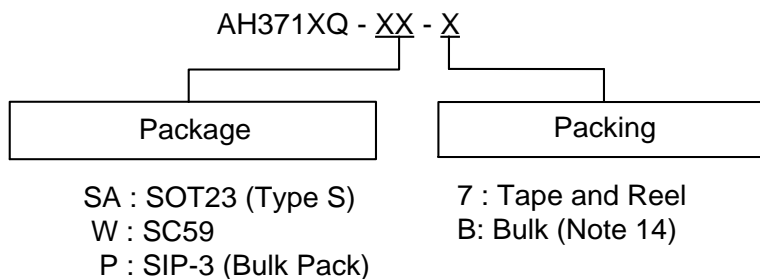


(2) Package: SIP-3 (Bulk Pack)

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



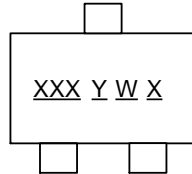
Part Number	Package Code	Package	Part Number Suffix	Packing	
				Qty.	Carrier
AH3713Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk
AH3713Q-SA-7	SA	SOT23 (Type S)	-7	3000	Tape & Reel
AH3713Q-W-7	W	SC59	-7	3000	Tape & Reel
AH3714Q-SA-7	SA	SOT23 (Type S)	-7	3000	Tape & Reel
AH3714Q-W-7	W	SC59	-7	3000	Tape & Reel
AH3714Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk
AH3715Q-SA-7	SA	SOT23 (Type S)	-7	3000	Tape & Reel
AH3715Q-W-7	W	SC59	-7	3000	Tape & Reel
AH3715Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk
AH3716Q-SA-7	SA	SOT23 (Type S)	-7	3000	Tape & Reel
AH3716Q-W-7	W	SC59	-7	3000	Tape & Reel
AH3716Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk
AH3717Q-SA-7	SA	SOT23 (Type S)	-7	3000	Tape & Reel
AH3717Q-W-7	W	SC59	-7	3000	Tape & Reel
AH3717Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk

Note: 14. Bulk is for SIP-3 (Bulk Pack) Straight Lead.

Marking Information

(1) Package Type: SOT23 (Type S) and SC59

(Top View)

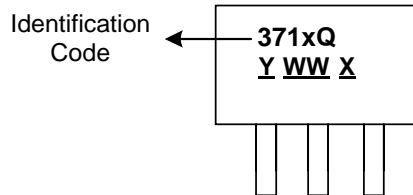


XXX : Identification Code
Y : Year : 0 to 9 (ex: 3 = 2023)
W : Week : A to Z : week 1 to 26;
 a to z : week 27 to 52; z represents
 week 52 and 53
X : Internal Code

Part Number	Package	Identification Code
AH3713Q-SA-7	SOT23 (Type S)	N3Q
AH3713Q-W-7	SC59	UFQ
AH3714Q-SA-7	SOT23 (Type S)	N4Q
AH3714Q-W-7	SC59	UGQ
AH3715Q-SA-7	SOT23 (Type S)	N5Q
AH3715Q-W-7	SC59	UHQ
AH3716Q-SA-7	SOT23 (Type S)	N6Q
AH3716Q-W-7	SC59	UJQ
AH3717Q-SA-7	SOT23 (Type S)	N7Q
AH3717Q-W-7	SC59	UKQ

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

(Top View)



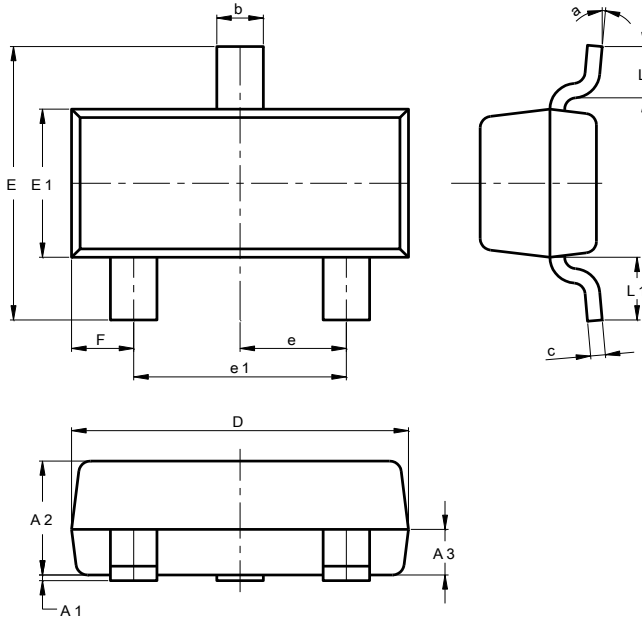
Y : Year : 0 to 9 (ex: 3 = 2023)
WW : Week : 01 to 52, "52" represents
 week 52 and 53
X : Internal Code

Part Number	Package	Identification Code
AH3713Q-P-B	SIP-3 (Bulk Pack)	3713Q
AH3714Q-P-B	SIP-3 (Bulk Pack)	3714Q
AH3715Q-P-B	SIP-3 (Bulk Pack)	3715Q
AH3716Q-P-B	SIP-3 (Bulk Pack)	3716Q
AH3717Q-P-B	SIP-3 (Bulk Pack)	3717Q

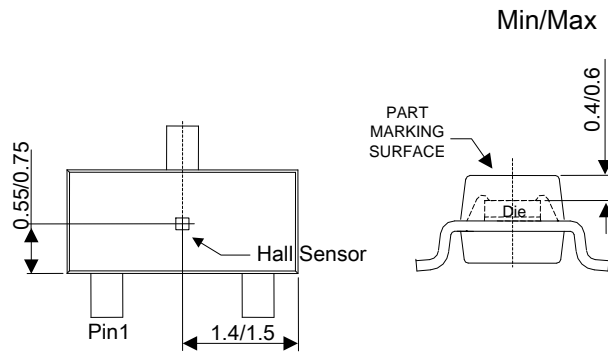
Package Outline Dimensions (All dimensions in mm.)

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

(1) Package Type: SOT23 (Type S)



SOT23 (Type S)			
Dim	Min	Max	Typ
A1	0.013	0.10	0.05
A2	0.90	1.025	1.00
A3	0.375	0.425	0.40
b	0.37	0.51	0.40
c	0.10	0.18	0.125
D	2.80	3.00	2.90
E	2.30	2.50	2.40
E1	1.20	1.40	1.30
e	0.89	1.03	0.915
e1	1.78	2.05	1.83
F	0.45	0.60	0.535
L1	0.45	0.61	0.55
L	0.25	0.55	0.40
a	0°	8°	--
All Dimensions in mm			

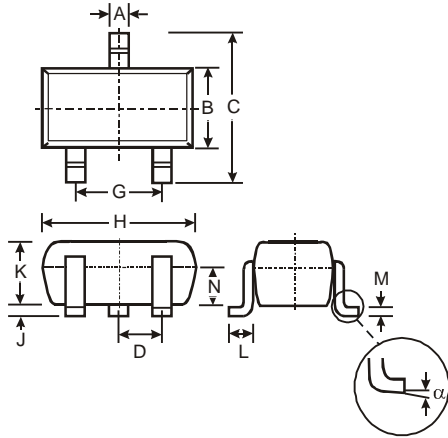


Sensor Location

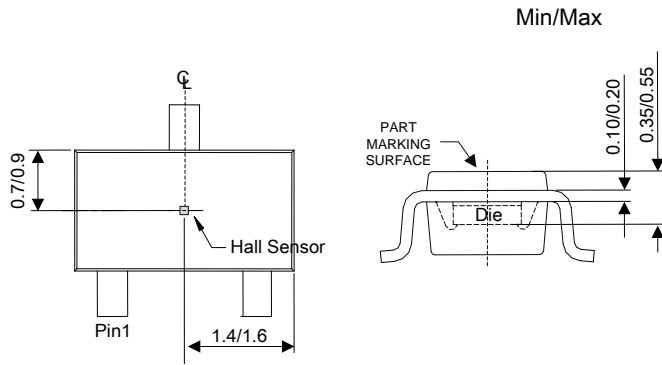
Package Outline Dimensions (All dimensions in mm.) (continued)

Please see <http://www.diodes.com/package-outlines.html> 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			

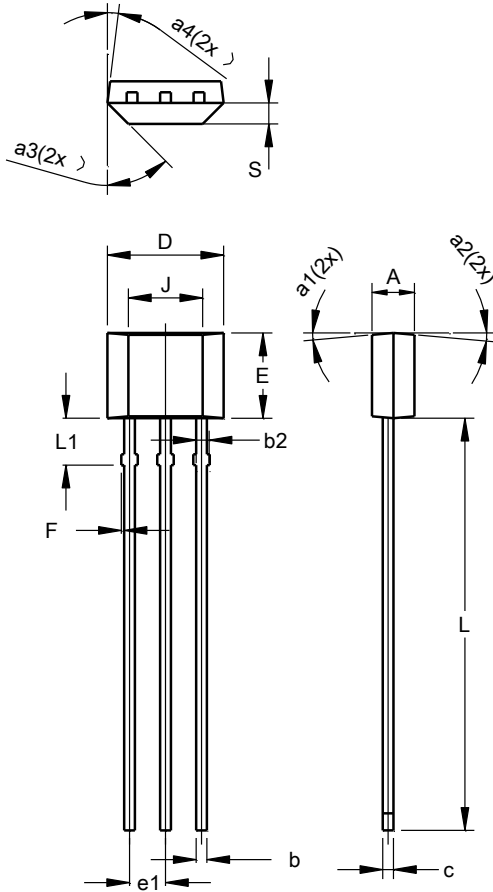


Sensor Location

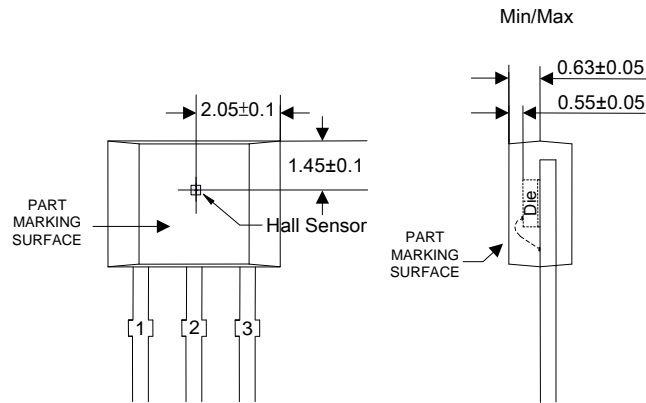
Package Outline Dimensions (All dimensions in mm.) (continued)

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

(3) 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			

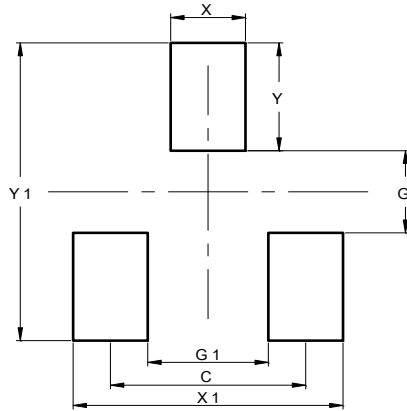


Sensor Location

Suggested Pad Layout

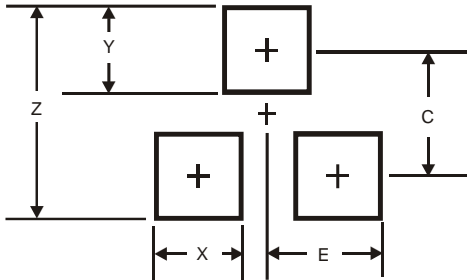
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SOT23 (Type S)



Dimensions	Value (in mm)
C	1.830
G	0.800
G1	1.130
X	0.700
X1	2.530
Y	1.050
Y1	2.900

(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: SOT23 (Type S)/SC59 – Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (B3)
- Weight: SIP-3 (Bulk Pack) – 0.077 grams (Approximate)
 SOT23 (Type S) – 0.009 grams (Approximate)
 SC59 – 0.015 grams (Approximate)

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