

Description

The AH1711Q/AH1712Q/AH1713Q/AH1714Q is an AEC-Q100 qualified low-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 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 AH1711Q/AH1712Q/AH1713Q 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 (AH1714Q 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).

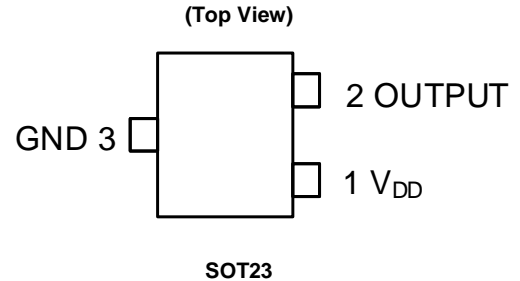
Features

- 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
- Fast 30kHz Sensing Bandwidth
- -40°C to +150°C Operating Temperature
- ESD: HBM 8kV, CDM 2kV
- AEC-Q100 Grade 0 Qualified
- Industry Standard SOT23 Package
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green Device (Note 3)**
- **The AH1711Q/AH1712Q/AH1713Q/AH1714Q 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.

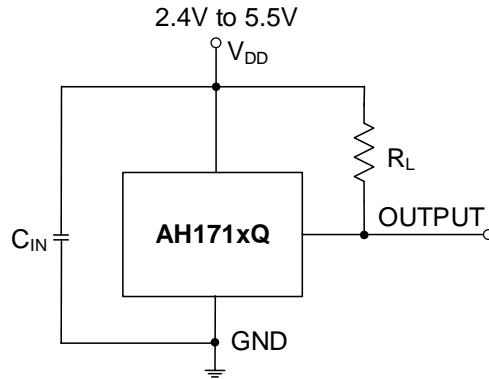
Pin Assignments



Applications

- Brushless DC-motor commutation
- Revolution per minute (RPM) measurements
- Wheel speed/angular/speed sensing
- Fuel pumps/windows/sunroofs/sliding doors
- Human machine interface knobs

Typical Applications Circuit (Note 4)



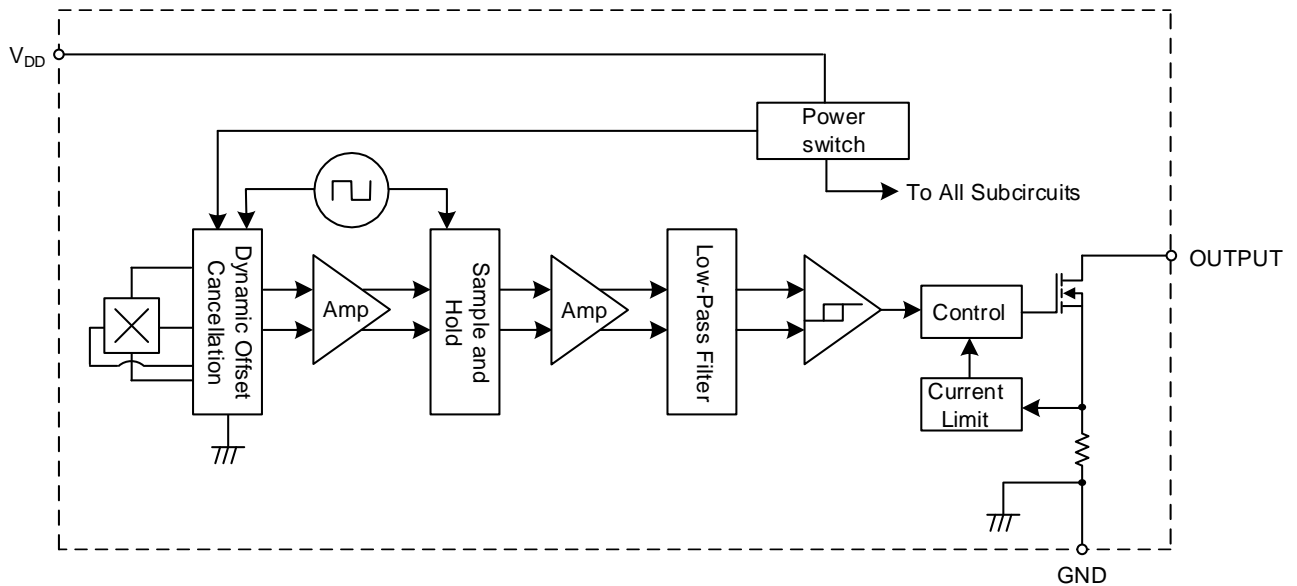
Note: 4. C_{IN} is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF. R_L is the pullup resistor.

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 +150 | °C |
| T _J | Maximum Junction Temperature | +170 | °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:
- 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 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 +150°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 +150 | °C |

Electrical Characteristics (Notes 7 & 8) (@T_A = -40°C to +150°C, V_{DD} = 2.4V to 5.5V, unless otherwise specified.)

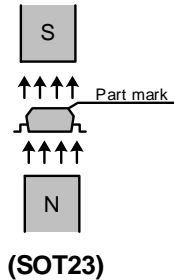
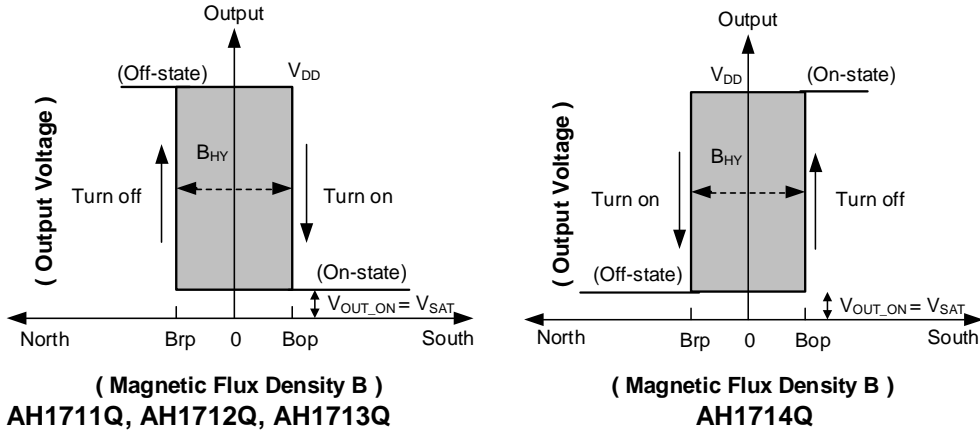
| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|-------------------|--|---|-----|-------|-----|------|
| V _{OL} | Low-Level Output Voltage | I _{OUT} = 20mA | — | 0.2 | 0.4 | V |
| I _{LKG} | Output Leakage Current (When Output is Off) | V _{OUT} = 5.5V, output off | — | < 0.1 | 3 | μA |
| I _{DD} | Supply Current | Output open, T _A = +25°C | — | 2.0 | 2.8 | mA |
| | | Output open, T _A = -40°C to +150°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-on 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 > B _{OP} (Note 10) | 30 | — | 60 | mA |

- Notes:
- 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.
 - 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.
 - Guaranteed by design, process control and characterization. Not tested in production.
 - The device will limit the output current to current limit of I_{OCL}.

Magnetic Characteristics (Notes 11 & 12) ($T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$, $V_{DD} = 2.4\text{V}$ to 5.5V , unless otherwise specified.)

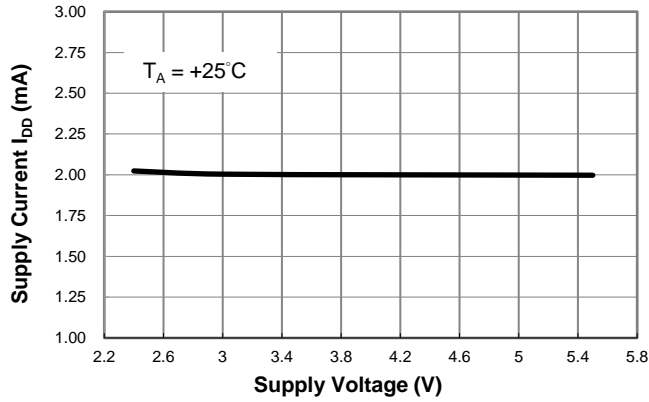
| Part Name | Symbol | Parameter | Conditions | Min | Typ | Max | Unit | Output Polarity |
|-----------|-----------------|----------------------|---|------|-----|-----|-------|-----------------|
| AH1711Q | Bop | Operation Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -2 | 7 | 20 | Gauss | Direct |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | -5 | 7 | 29 | | |
| | Brp | Release Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -20 | -7 | 2 | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | -29 | -7 | 5 | | |
| | B _{HY} | Hysteresis (Note 13) | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 3.5 | 14 | — | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 3 | 14 | — | | |
| AH1712Q | Bop | Operation Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 5 | 18 | 37 | Gauss | Direct |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 2 | 18 | 45 | | |
| | Brp | Release Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -37 | -18 | -5 | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | -45 | -18 | -2 | | |
| | B _{HY} | Hysteresis (Note 13) | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 23 | 36 | — | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 17.5 | 36 | — | | |
| AH1713Q | Bop | Operation Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 16 | 50 | 81 | Gauss | Direct |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 15 | 50 | 88 | | |
| | Brp | Release Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -81 | -50 | -16 | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | -88 | -50 | -15 | | |
| | B _{HY} | Hysteresis (Note 13) | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 60 | 100 | — | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 50 | 100 | — | | |
| AH1714Q | Bop | Operation Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 5 | 18 | 37 | Gauss | Inverted |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 2 | 18 | 45 | | |
| | Brp | Release Point | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -37 | -18 | -5 | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | -45 | -18 | -2 | | |
| | B _{HY} | Hysteresis (Note 13) | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 23 | 36 | — | | |
| | | | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 17.5 | 36 | — | | |

- Notes:
- 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 38 μs typical from the operating voltage reaching 2.4V.
 - Typical values are defined at $T_A = +25^{\circ}\text{C}$. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization.
 - Maximum and minimum hysteresis is guaranteed by design, process control and characterization.

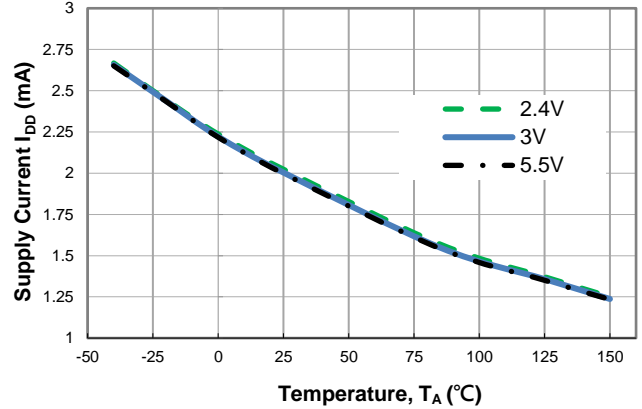


Typical Operating Characteristics

Supply Current

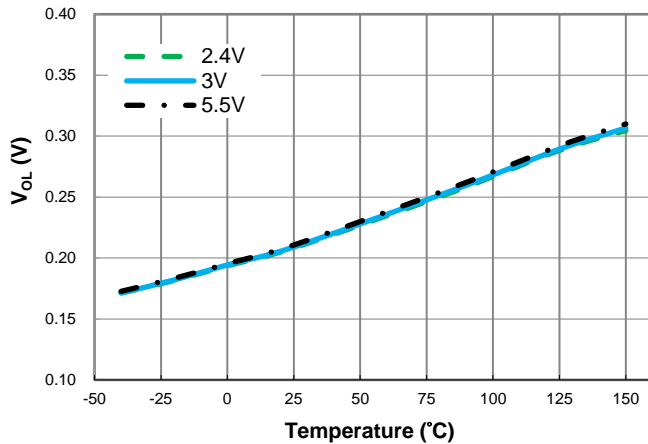


Operation Current vs. Supply Voltage



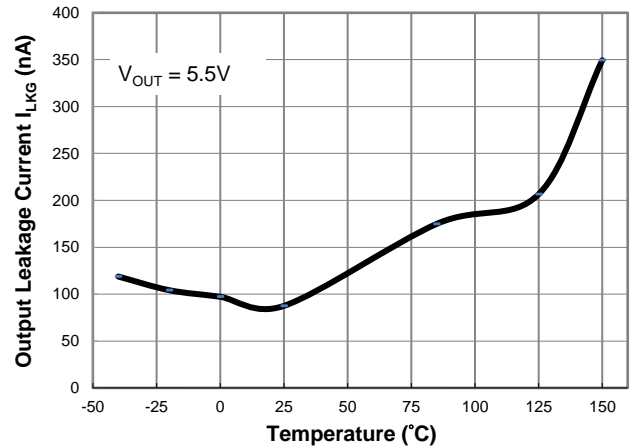
Operation Current vs. Temperature

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



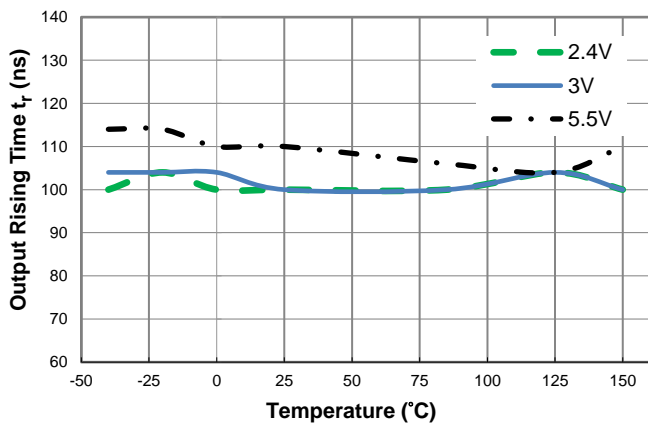
Output Voltage V_{OL} vs. Temperature

Output Leakage Current

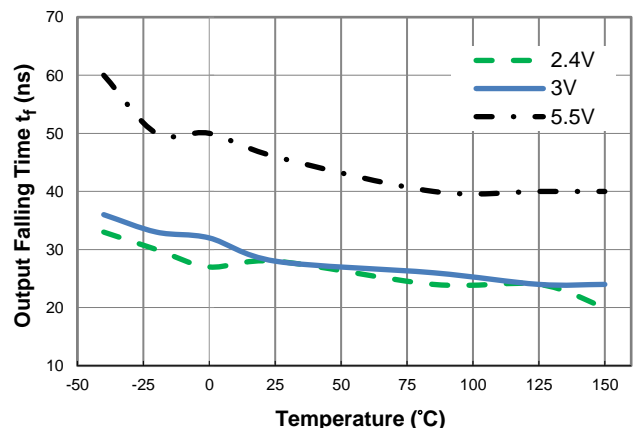


Output Leakage Current vs. Temperature

Output Rising/Falling Time

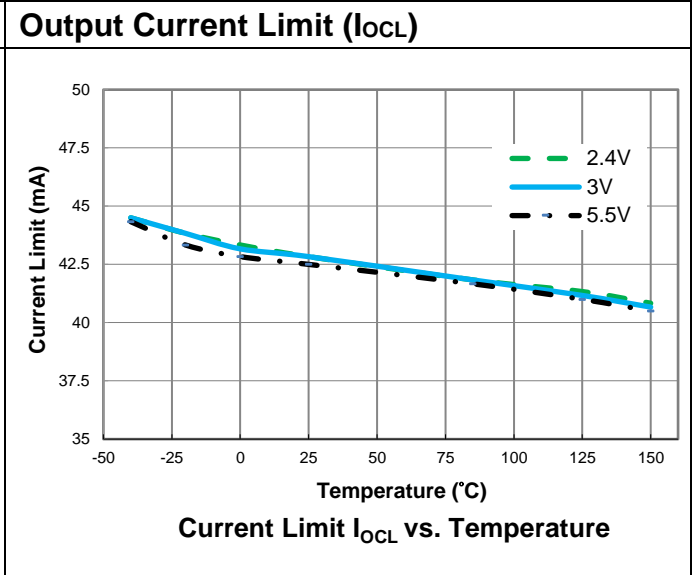
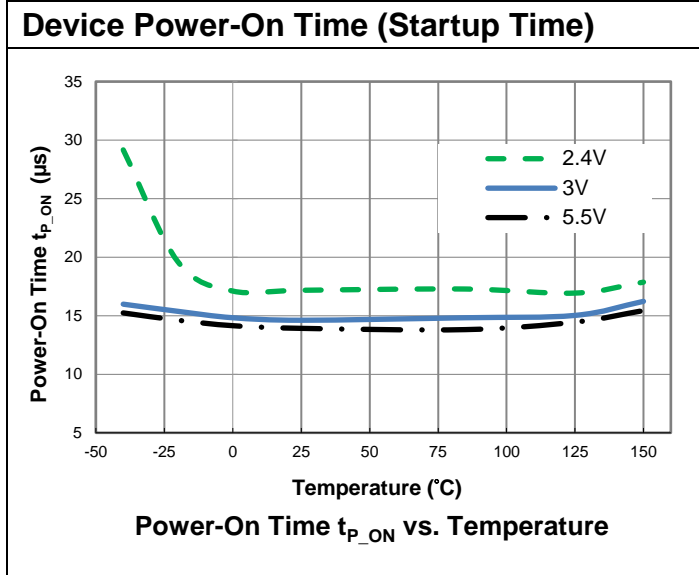


Output Rising Time (t_r) vs. Temperature

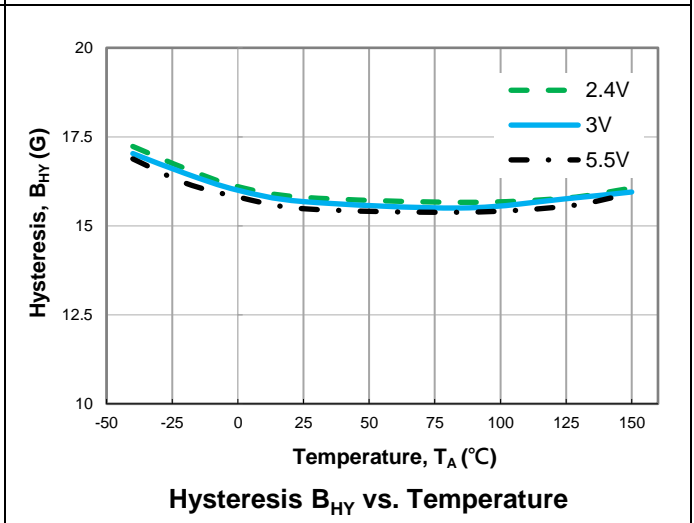
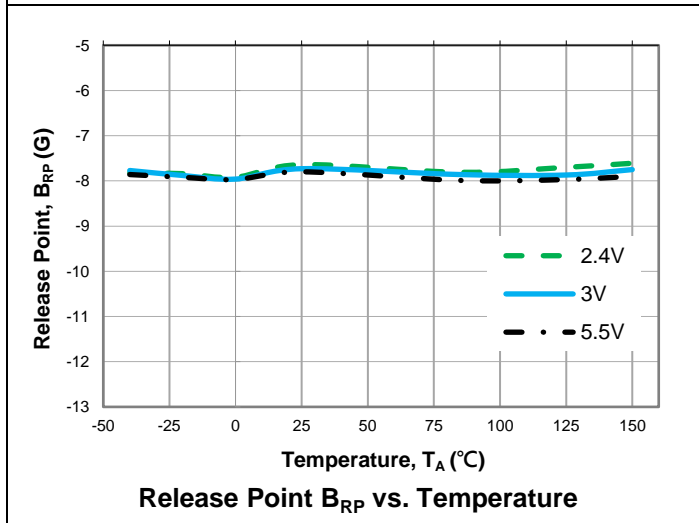
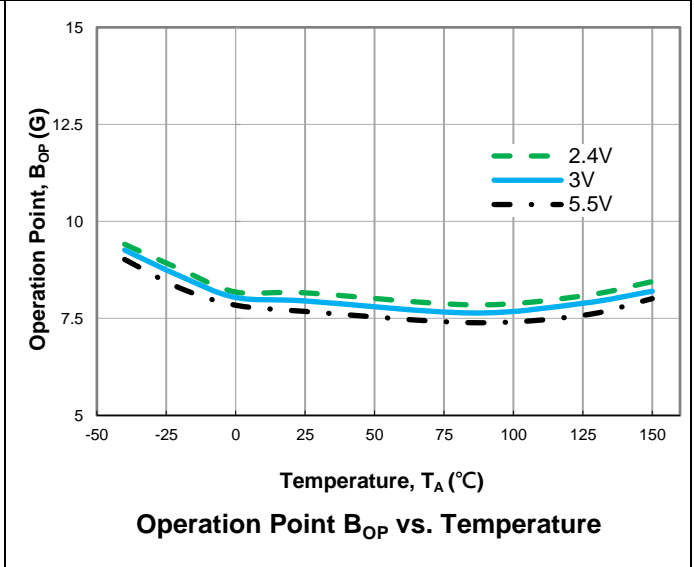
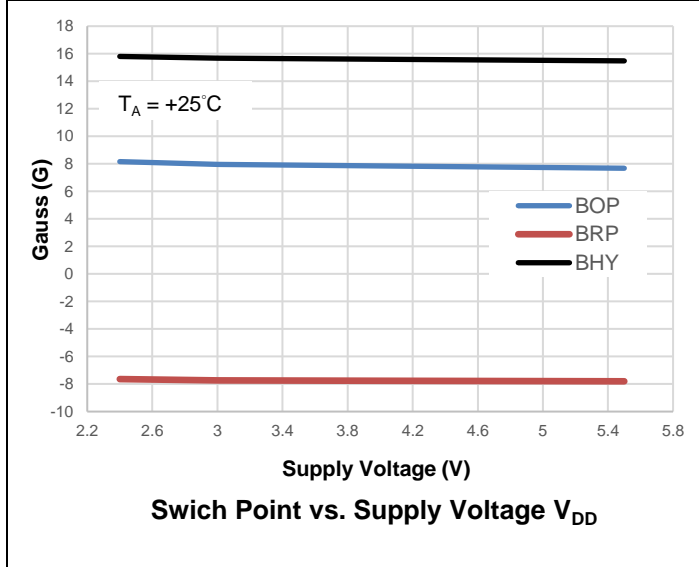


Output Falling Time (t_f) vs. Temperature

Typical Operating Characteristics (continued)

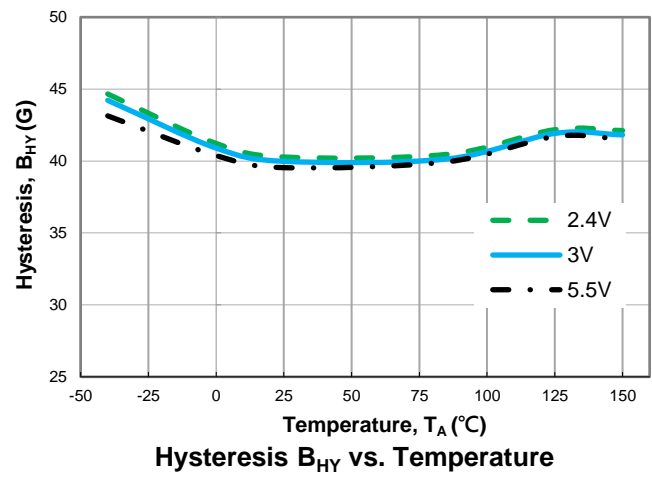
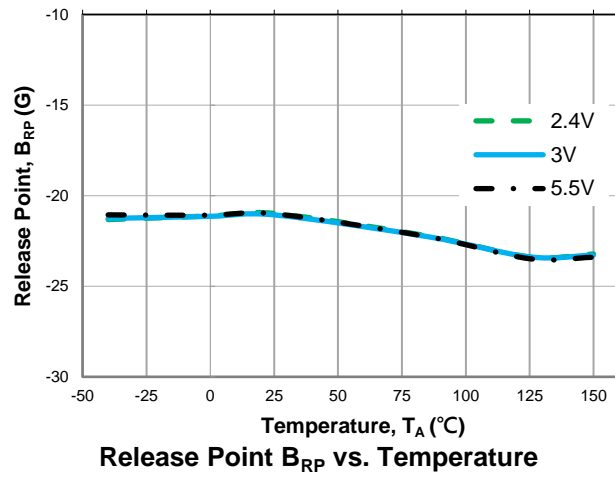
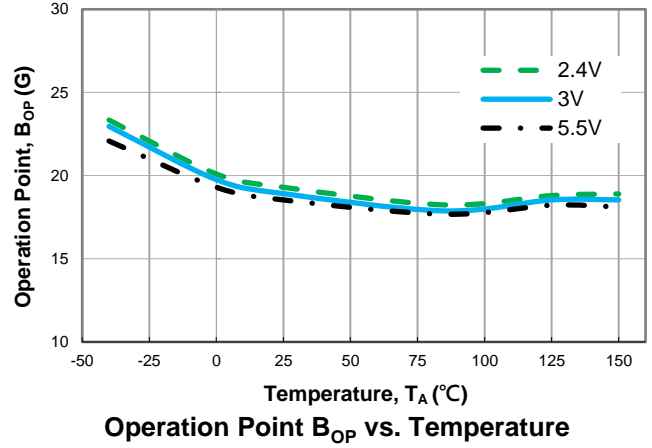
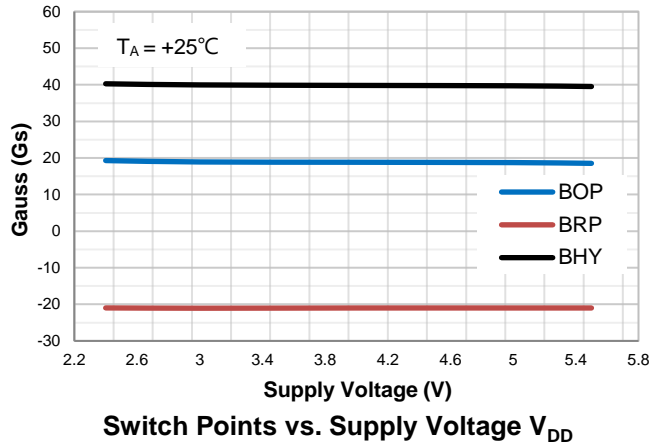


AH1711Q - Switch Point B_{OP}/B_{RP} and Hysteresis B_{HY}



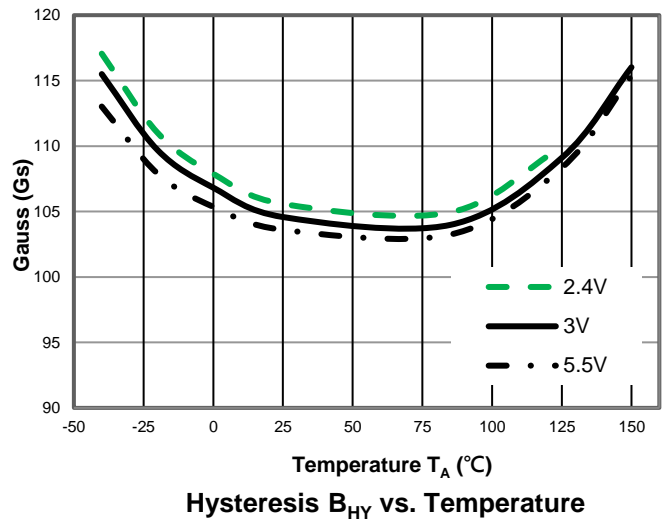
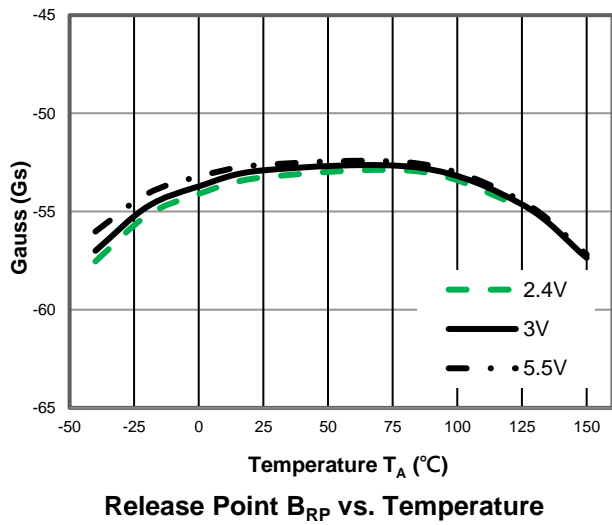
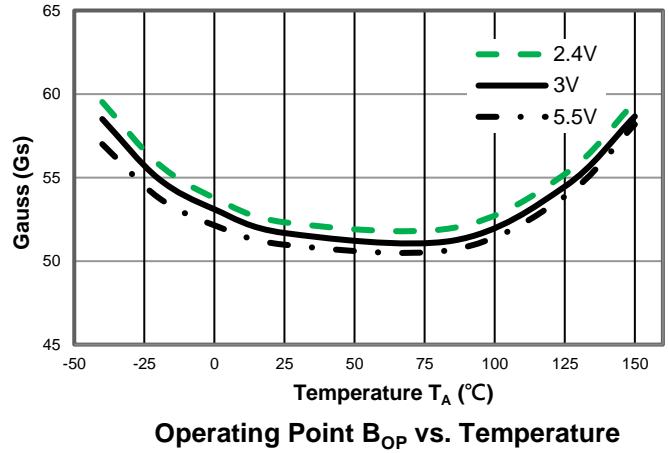
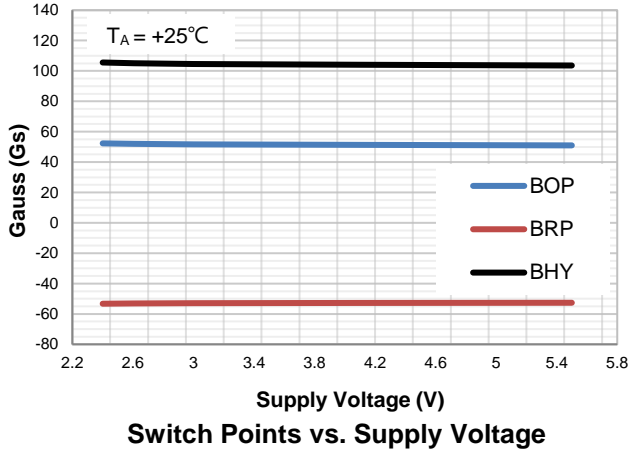
Typical Operating Characteristics (continued)

AH1712Q/AH1714Q - Switch Point B_{OP}/B_{RP} and Hysteresis B_{HY}



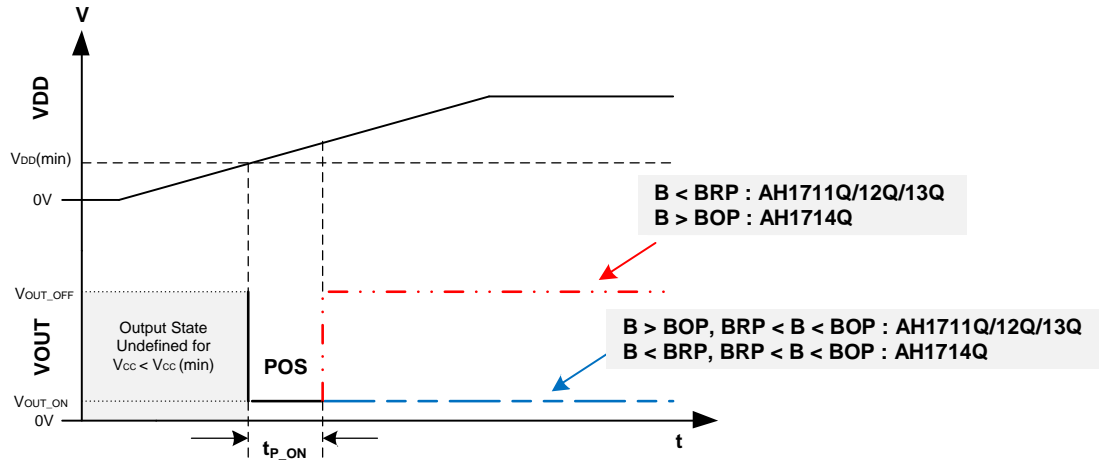
Typical Operating Characteristics (continued)

AH1713Q - Switch Point B_{OP}/B_{RP} and Hysteresis B_{HY}



Application Information

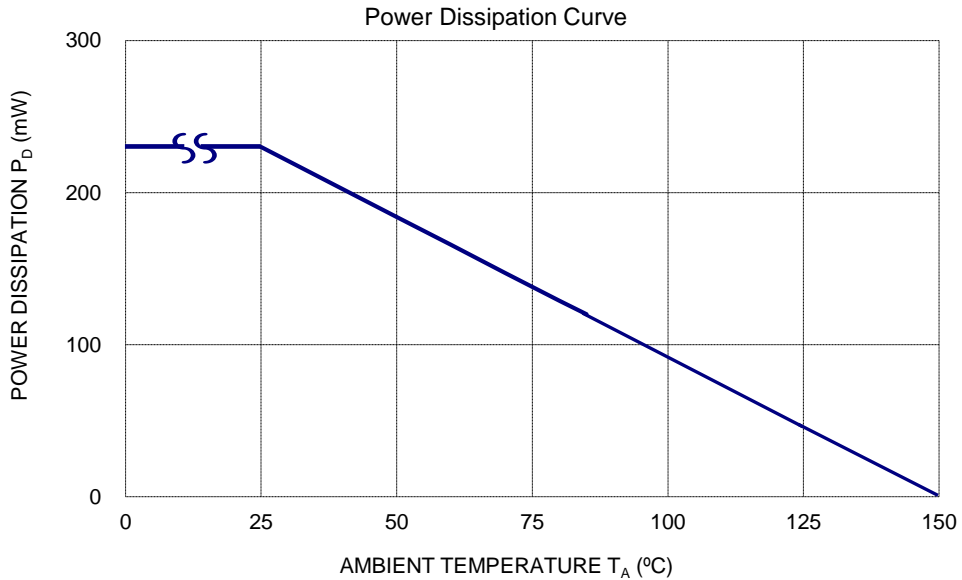
Power-On State (POS)



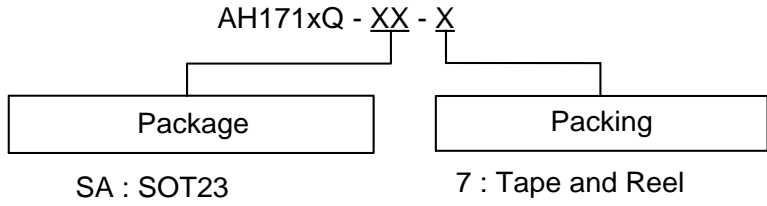
Thermal Performance Characteristics

Package : SOT23

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



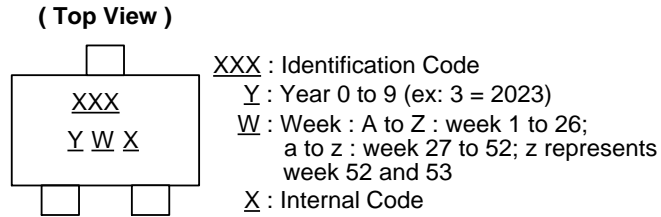
Ordering Information



| Part Number | Part Number Suffix | Package Code | Package | Packing | |
|--------------|--------------------|--------------|---------|---------|------------------|
| | | | | Qty. | Carrier |
| AH1711Q-SA-7 | -7 | SA | SOT23 | 3,000 | 7" Tape and Reel |
| AH1712Q-SA-7 | -7 | SA | SOT23 | 3,000 | 7" Tape and Reel |
| AH1713Q-SA-7 | -7 | SA | SOT23 | 3,000 | 7" Tape and Reel |
| AH1714Q-SA-7 | -7 | SA | SOT23 | 3,000 | 7" Tape and Reel |

Marking Information

Package Type: SOT23

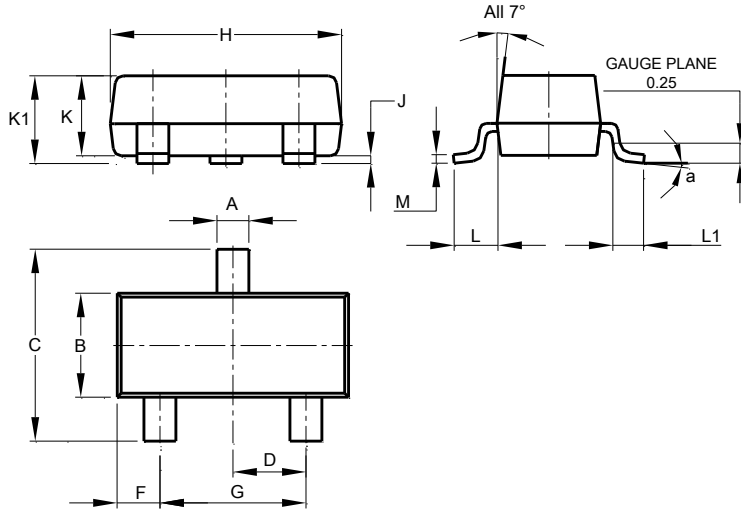


| Part Number | Package | Identification Code |
|--------------|---------|---------------------|
| AH1711Q-SA-7 | SOT23 | XKQ |
| AH1712Q-SA-7 | SOT23 | XMQ |
| AH1713Q-SA-7 | SOT23 | XNQ |
| AH1714Q-SA-7 | SOT23 | XPQ |

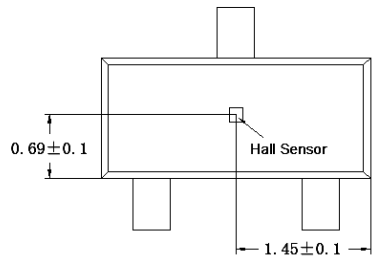
Package Outline Dimensions

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

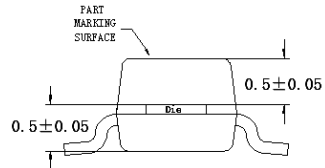
SOT23



| 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



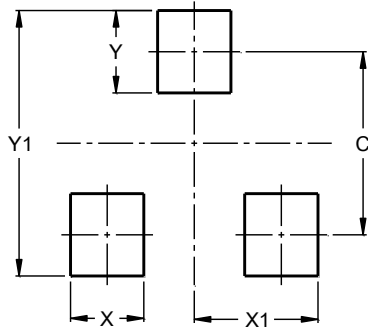
Side VIEW

Sensor Location

Suggested Pad Layout

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

SOT23



| 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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