

## Description

The AH3564Q is an AECQ100-qualified high-voltage, high-sensitivity Hall effect omnipolar switch IC designed for position and proximity sensing in automotive applications, such as in seat and seatbelt buckle, steering lock/immobilization, gear stick, transmission actuator and gear position, HVAC compression, wiper, door/trunk closure, and so on. To support a wide range of demanding applications, the design is optimized to operate over the supply range of 3.0V to 28V. With chopper-stabilized architecture and an internal bandgap regulator to provide temperature compensated supply for internal circuits, the AH3564Q 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.

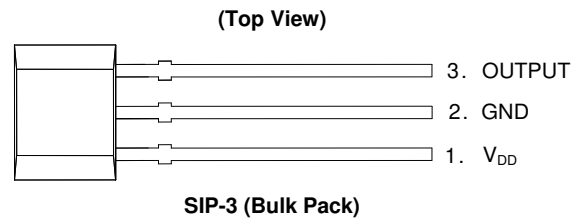
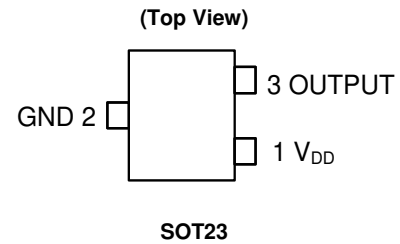
The single open-drain output can be switched on with south or north pole of sufficient strength. When the magnetic flux density (B) perpendicular to the package is larger than the operate point ( $B_{OP}$ ), the output is switched on (pulled low) and stays on until the magnetic flux density B is lower than the release point ( $B_{RP}$ ).

## Features

- Omnipolar Operation
- High Sensitivity:  $B_{OP}$  and  $B_{RP}$  of  $\pm 40G$  and  $\pm 25G$  Typical
- Single Open Drain Output with Overcurrent Limit
- 3.0V to 28V Operating Voltage Range
- Chopper Stabilized Design Provides
  - Superior Temperature Stability
  - Minimal Switch Point Drift
  - Enhanced Immunity to Stress
- Good RF Noise Immunity
- Reverse Blocking Diode
- Zener Clamp on Supply and Output Pins
- $-40^{\circ}C$  to  $+150^{\circ}C$  Operating Temperature
- ESD: HBM  $> 8kV$ , CDM:  $> 2kV$
- Industry Standard SOT23 and SIP-3 (Ammo Pack), SIP-3 (Bulk Pack) Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

- 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.

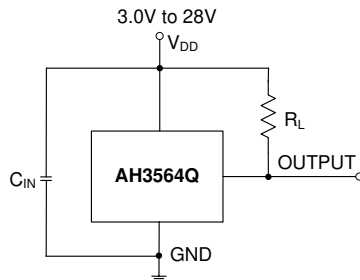
## Pin Assignments



## Applications

- Position and Proximity Sensing in Automotive Applications.
- Open and Close Detect
- Position Detect
- Level Detect
- Flow Meters
- Contactless Switches
- Seatbelt Buckle
- Seat Position

**Typical Applications Circuit**



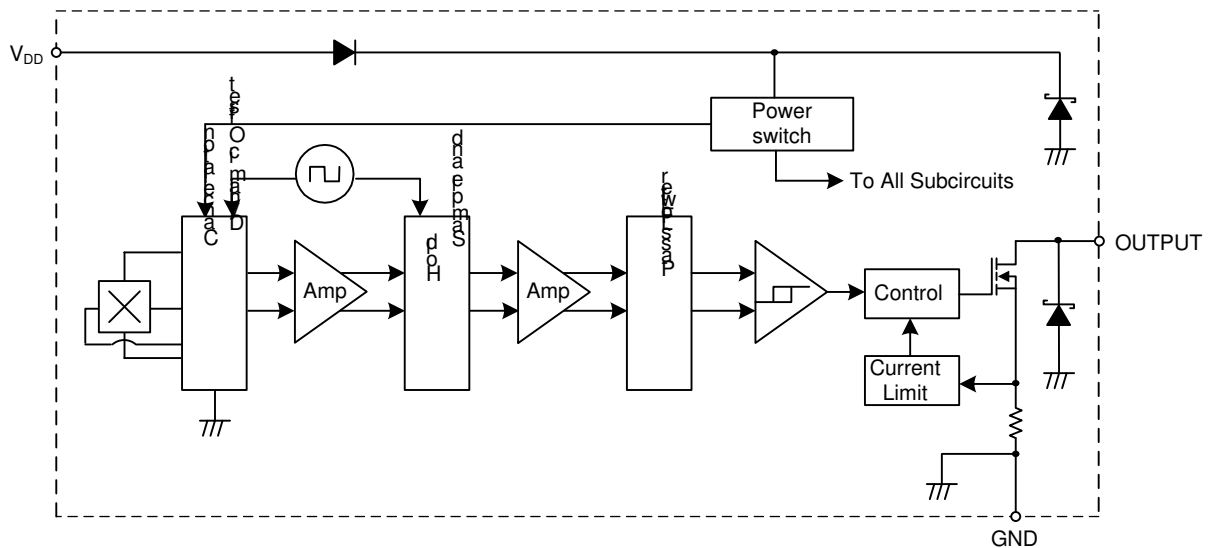
Note: 4.  $C_{IN}$  is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF ~ 100nF.  $R_L$  is the pull-up resistor.

**Pin Descriptions**

Package: SOT23 and SIP-3 (Ammo Pack), SIP-3 (Bulk Pack)

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

**Functional Block Diagram**



### Absolute Maximum Ratings (Note 5 & 6) (@T<sub>A</sub> = +25°C, unless otherwise specified.)

| Symbol               | Characteristic   | Value                                   | Unit |    |
|----------------------|--|---|------|----|
| V <sub>DD</sub>      | Supply Voltage (Note 6)                                      | 32                                      | V    |    |
| V <sub>DDR</sub>     | Reverse Supply Voltage (Note 6)                              | -32                                     | V    |    |
| V <sub>OUT_MAX</sub> | Output Off Voltage (Note 6)                                  | 32                                      | V    |    |
| I <sub>OUT</sub>     | Continuous Output Current                                    | 60                                      | mA   |    |
| I <sub>OUT_R</sub>   | Reverse Output Current                                       | -50                                     | mA   |    |
| B                    | Magnetic Flux Density  | Unlimited                               |      |    |
| P <sub>D</sub>       | Package Power Dissipation                                    | SIP-3 (Ammo Pack),<br>SIP-3 (Bulk Pack) | 550  | mW |
|                      |  | SOT23                                   | 230  |    |
| T <sub>s</sub>       | Storage Temperature Range                                    | -65 to +165                             | °C   |    |
| T <sub>J</sub>       | Maximum Junction Temperature                                 | +150                                    | °C   |    |
| ESD HBM              | Electrostatic Discharge Withstand—Human Body Model (HBM)     | 8                                       | kV   |    |
| ESD MM               | Electrostatic Discharge Withstand—Machine Model (MM)         | 800                                     | V    |    |
| ESD CDM              | Electrostatic Discharge Withstand—Charged Device Model (CDM) | 2                                       | kV   |    |

- Notes:
- Stresses greater than the 'Absolute Maximum Ratings' specified above may 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.
  - The absolute maximum V<sub>DD</sub> of 32V 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<sub>A</sub> = -40°C to +150°C, unless otherwise specified.)

| Symbol          | Parameter                   | Condition | Rating      | Unit |
|-----------------|-----------------------------|-----------|-------------|------|
| V <sub>DD</sub> | Supply Voltage              | Operating | 3.0 to 28   | V    |
| T <sub>A</sub>  | Operating Temperature Range | Operating | -40 to +150 | °C   |

### Electrical Characteristics (Note 7 & 8) (@T<sub>A</sub> = -40°C to +150°C, V<sub>DD</sub> = 3V to 28V, unless otherwise specified.)

| Symbol              | Parameter  | Condition  | Min | Typ  | Max  | Unit |
|---------------------|--|--|-----|------|------|------|
| V <sub>OUT_ON</sub> | Output ON Voltage  | I <sub>OUT</sub> = 20mA, B > B <sub>OP</sub>             | —   | 0.2  | 0.4  | V    |
| I <sub>LKG</sub>    | Output Leakage Current (When Output is Off)  | V <sub>OUT</sub> = 28V, B < B <sub>RP</sub> , Output Off | —   | <0.1 | 10   | μA   |
| I <sub>DD</sub>     | Supply Current   | Output open, T <sub>A</sub> = +25°C                      | —   | 3    | 3.5  | mA   |
|                     |  | Output open, T <sub>A</sub> = -40°C to +150°C            | —   | —    | 4    | mA   |
| I <sub>DD_R</sub>   | Reverse Supply Current   | V <sub>DD</sub> = -18V, T <sub>A</sub> = +25°C           | —   | 0.6  | —    | μA   |
|                     |  | V <sub>DD</sub> = -18V, T <sub>A</sub> = -40°C to +150°C | —   | 0.6  | 1500 | μA   |
|                     |  | V <sub>DD</sub> = -28V, T <sub>A</sub> = +25°C           | —   | 1.6  | —    | μA   |
|                     |  | V <sub>DD</sub> = -28V, T <sub>A</sub> = -40°C to +150°C | —   | 1.6  | 2500 | μA   |
| t <sub>P_ON</sub>   | Device Power-On Time (Start-up Time)   | V <sub>DD</sub> ≥ 3V, B > B <sub>OP</sub> (Note 7)       | —   | 10   | —    | μs   |
| f <sub>C</sub>      | Chopping Frequency   | —  | —   | 800  | —    | kHz  |
| t <sub>D</sub>      | Response Time Delay (Time from magnetic threshold reached to the start of the output rise or fall) | (Note 9)   | —   | 3.75 | —    | μs   |
| t <sub>R</sub>      | Output Rising Time (External pull-up resistor R <sub>L</sub> and load capacitance dependent)       | R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 20pF              | —   | 0.2  | 1    | μs   |
| t <sub>F</sub>      | Output Falling Time (Internal switch resistance and load capacitance dependent)                    | R <sub>L</sub> = 1kΩ, C <sub>L</sub> = 20pF              | —   | 0.1  | 1    | μs   |
| I <sub>OCL</sub>    | Output Current Limit   | B > B <sub>OP</sub> , (Note 10)                          | 30  | —    | 55   | mA   |
| V <sub>Z</sub>      | Zener Clamp Voltage  | I <sub>DD</sub> = 5mA                                    | 28  | —    | —    | V    |

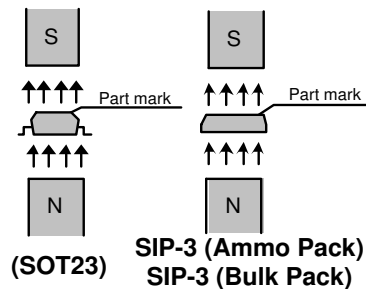
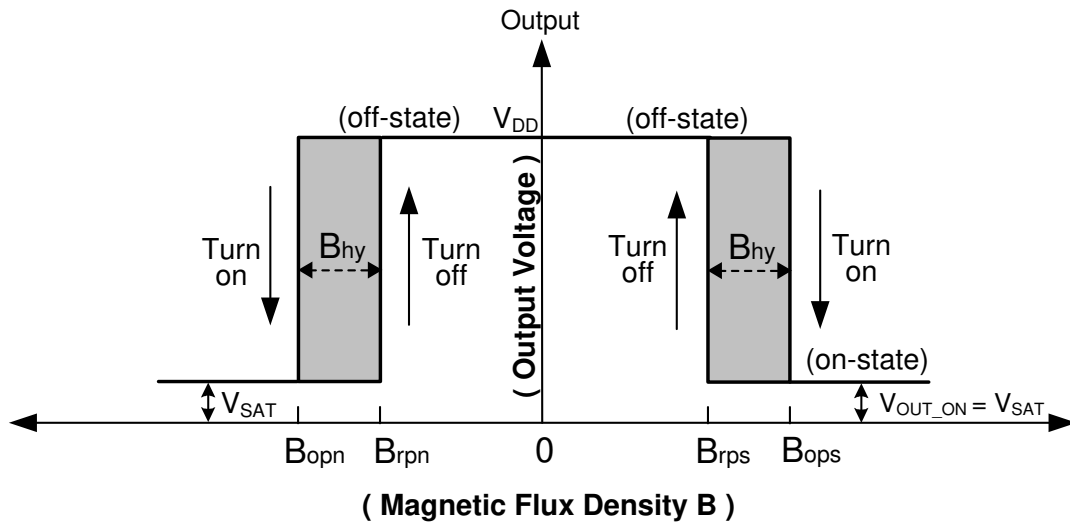
- Notes:
- When power is initially turned on, V<sub>DD</sub> must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the start-up time of 10μs typical from the operating voltage reaching 3V.
  - Typical values are defined at T<sub>A</sub> = +25°C, V<sub>DD</sub> = 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 will limit the output current I<sub>OUT</sub> to current limit of I<sub>OCL</sub>.

**Magnetic Characteristics** (Note 11 &12) ( $T_A = -40^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ ,  $V_{DD} = 3.0\text{V}$  to  $28\text{V}$ , unless otherwise specified.)

(1mT=10 Gauss)

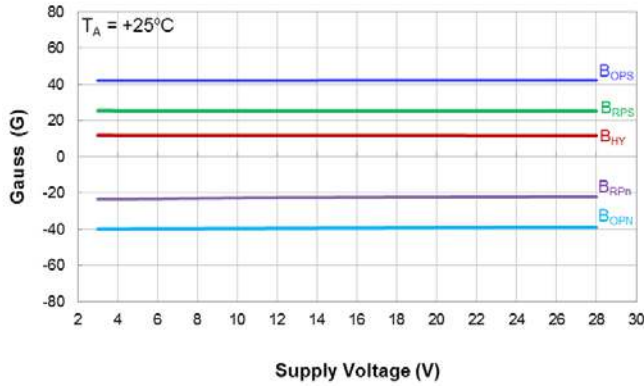
| Symbol  | Parameter            | Condition   | Min | Typ | Max | Unit  |
|---|----------------------|---|-----|-----|-----|-------|
| $B_{OPS}$ (South Pole to the Part Marking Side) | Operation Point      | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | 40  | —   | Gauss |
|   |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 20  | 40  | 60  |       |
| $B_{OPN}$ (North Pole to the Part Marking Side) |                      | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | -40 | —   |       |
|   |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -60 | -40 | -20 |       |
| $B_{RPS}$ (South Pole to the Part Marking Side) | Release Point        | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | 25  | —   |       |
|   |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 10  | 25  | 45  |       |
| $B_{RPN}$ (North Pole to the Part Marking Side) |                      | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | -25 | —   |       |
|   |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -45 | -25 | -10 |       |
| $B_{HY}$ ( $ B_{OPX}  -  B_{RPX} $ )            | Hysteresis (Note 13) | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | 15  | —   |       |
|   |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 9   | 15  | 22  |       |

- Notes:
- When power is initially turned on,  $V_{DD}$  must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the start-up time of 10 $\mu\text{s}$  typical from the operating voltage reaching 3V.
  - 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.
  - Maximum and minimum hysteresis is guaranteed by design, process control and characterization

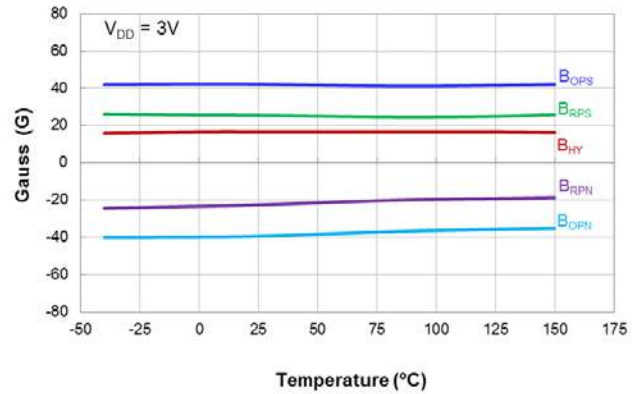


## Typical Operating Characteristics

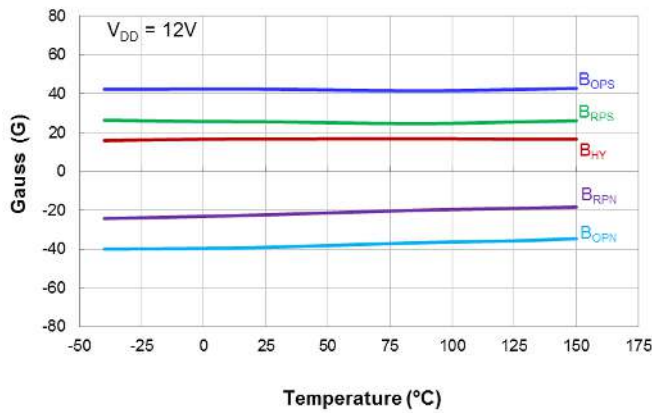
### Output Switch Operate and Release Points (Magnetic Thresholds)— $B_{OP}$ and $B_{RP}$



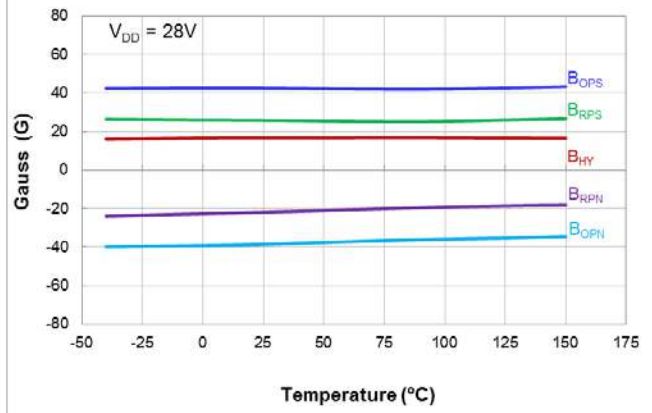
Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Supply Voltage



Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Temperature

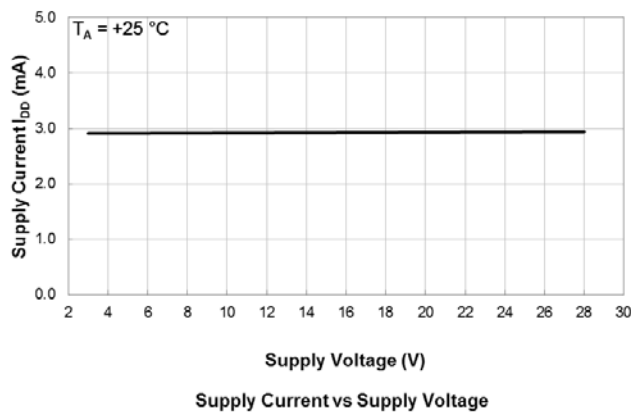


Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Temperature

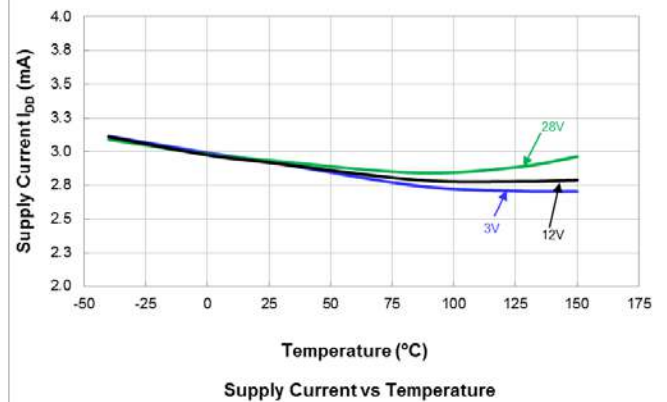


Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Temperature

### Supply Current



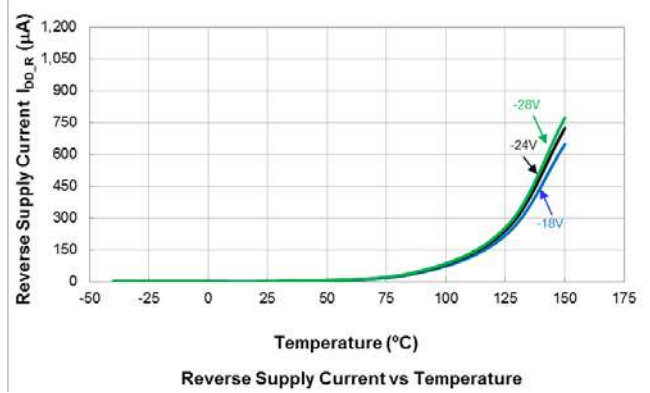
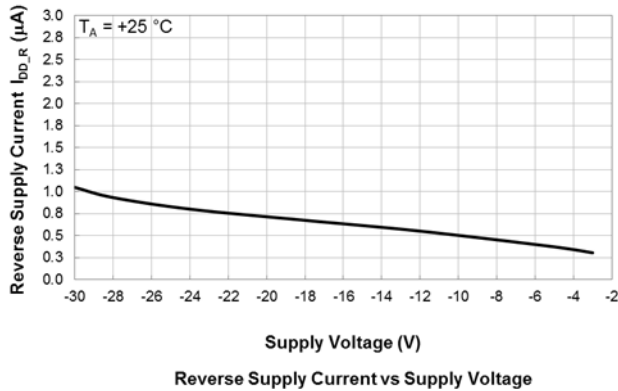
Supply Current vs Supply Voltage



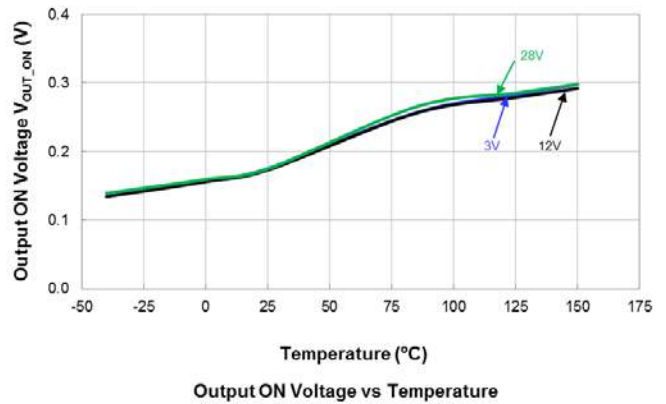
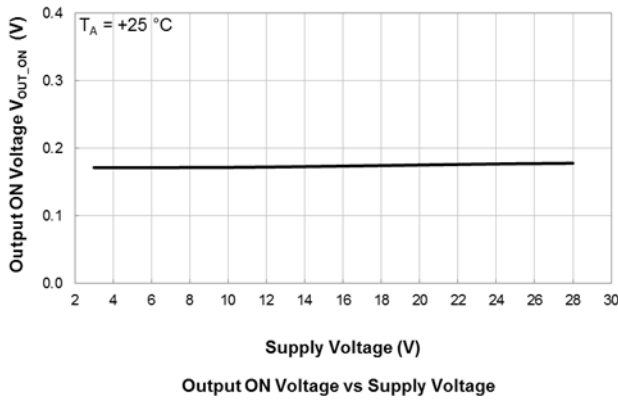
Supply Current vs Temperature

**Typical Operating Characteristics** (continued)

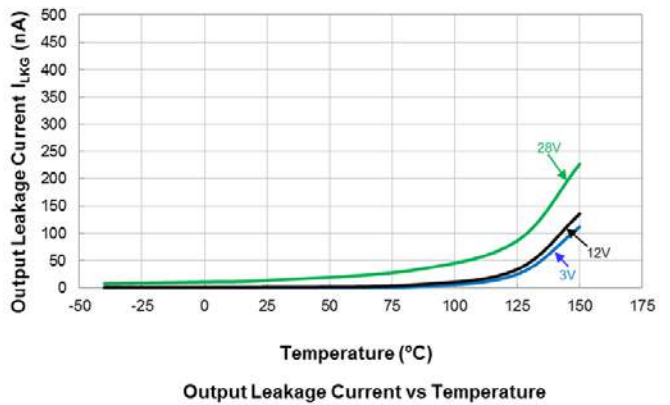
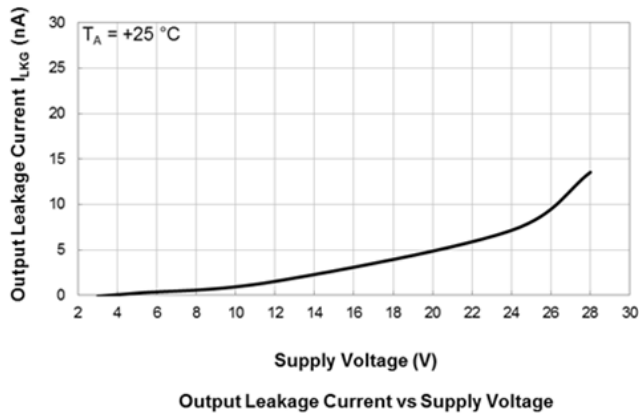
**Supply Reverse Current**



**Output Switch On Voltage**

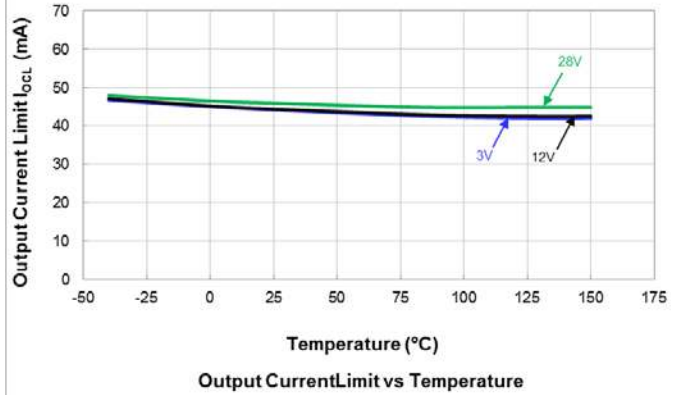
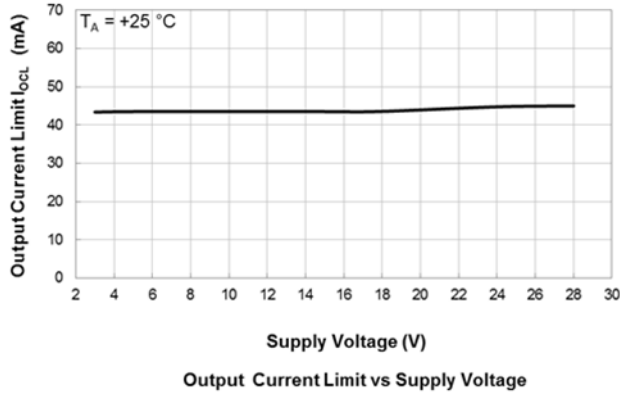


**Output Switch Leakage Current**



**Typical Operating Characteristics** (cont.)

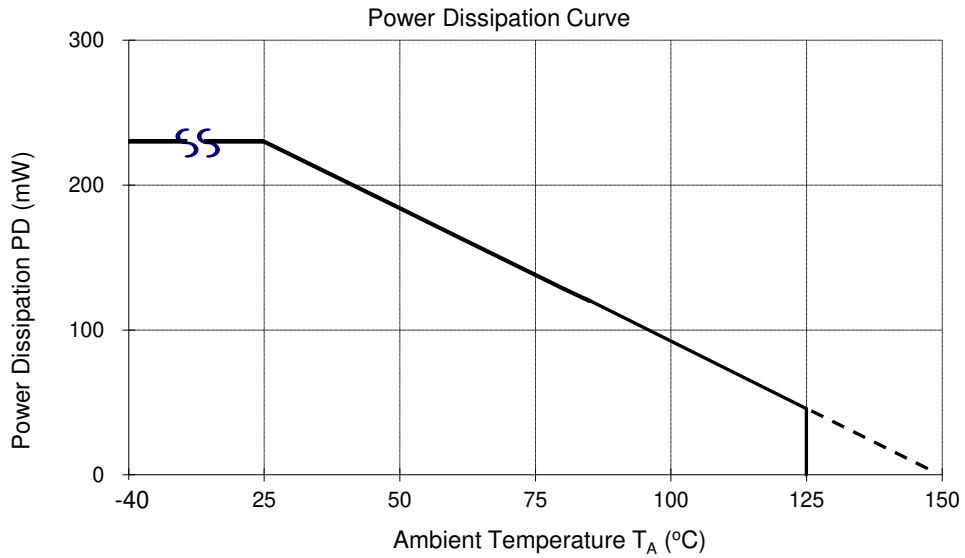
**Output Current Limit**



**Thermal Performance Characteristics**

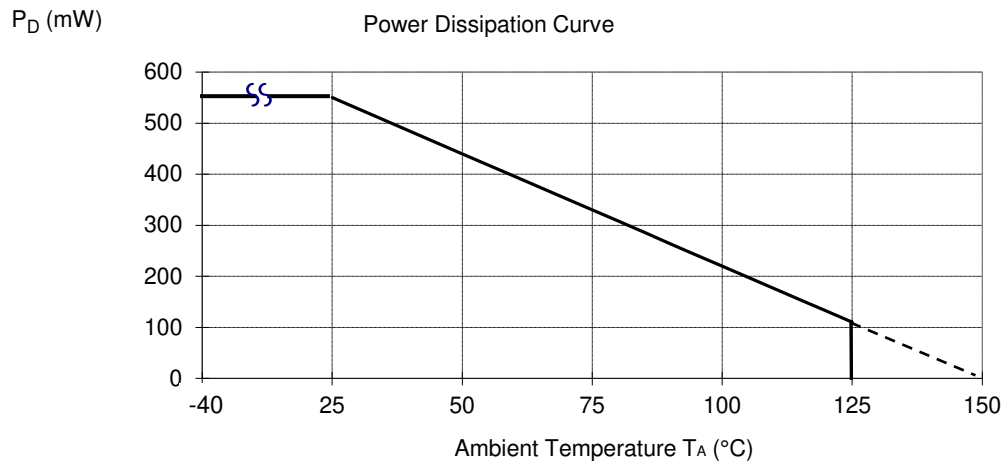
(1) Package Type: SOT23

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



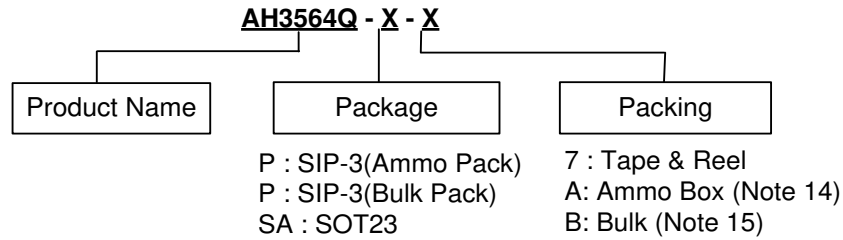
(2) Package Type: SIP-3 (Ammo Pack), SIP-3 (Bulk Pack)

| T <sub>A</sub> (°C) | 25  | 50  | 60  | 70  | 80  | 85  | 90  | 100 | 105 | 110 | 120 | 125 | 130 | 140 | 150 |
|---------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| P <sub>D</sub> (mW) | 550 | 440 | 396 | 362 | 308 | 286 | 264 | 220 | 198 | 176 | 132 | 110 | 88  | 44  | 0   |





## Ordering Information

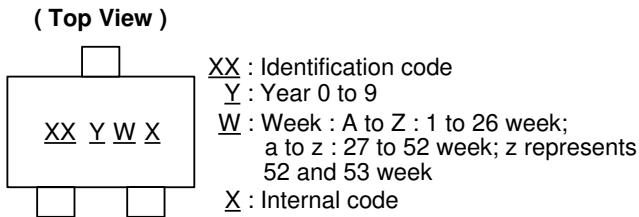


| Part Number  | Package Code | Packaging         | Bulk     |                    | 7" Tape and Reel |                    | Ammo Box |                    |
|--------------|--------------|-------------------|----------|--------------------|------------------|--------------------|----------|--------------------|
|              |              |                   | Quantity | Part Number Suffix | Quantity         | Part Number Suffix | Quantity | Part Number Suffix |
| AH3564Q-P-A  | P            | SIP-3 (Ammo Pack) | NA       | NA                 | NA               | NA                 | 4000/Box | -A                 |
| AH3564Q-P-B  | P            | SIP-3 (Bulk Pack) | 1000     | -B                 | NA               | NA                 | NA       | NA                 |
| AH3564Q-SA-7 | SA           | SOT23             | NA       | NA                 | 3000/Tape & Reel | -7                 | NA       | NA                 |

Notes: 14. Ammo Box is for SIP-3 (Ammo Pack) Spread Lead.  
 15. Bulk is for SIP-3 (Bulk Pack) Straight Lead.

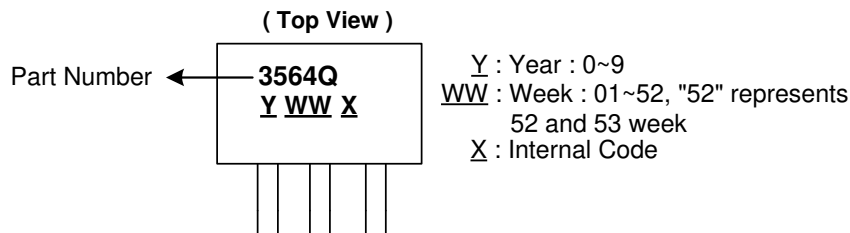
## Marking Information

### (1) Package Type: SOT23



| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| AH3564Q     | SOT23   | Z4                  |

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

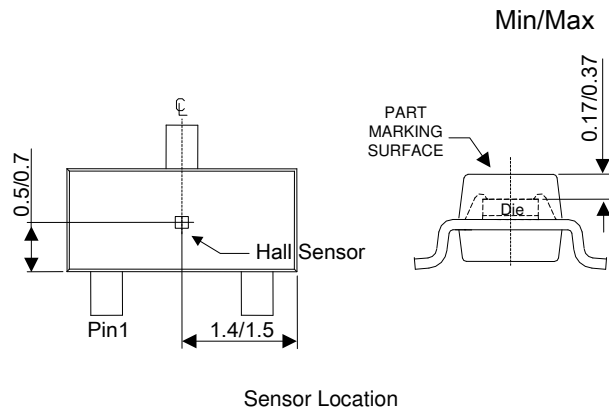
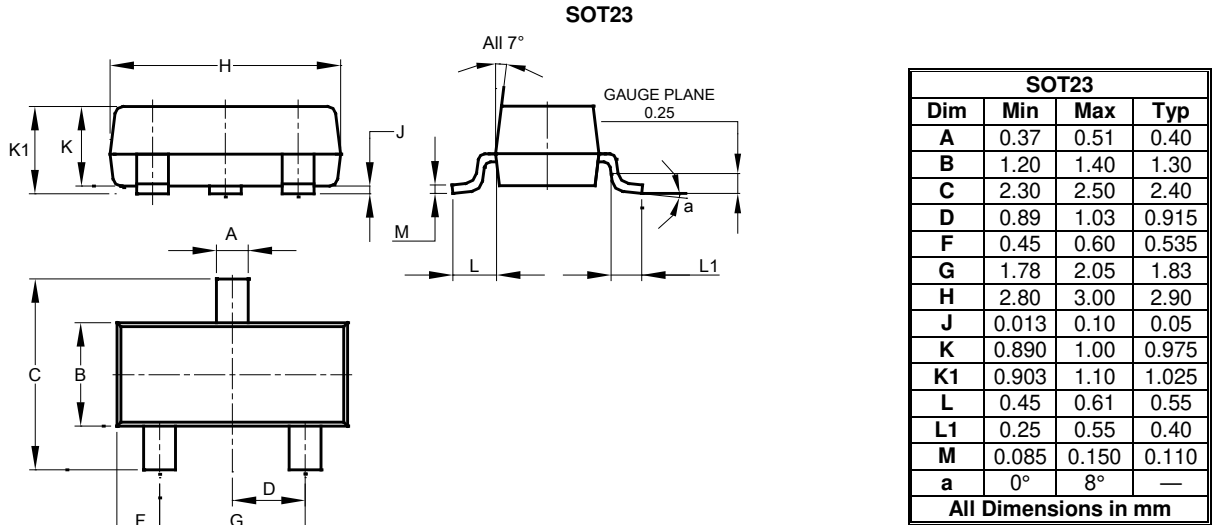


| Part Number | Package           | Identification Code |
|-------------|-------------------|---------------------|
| AH3564Q     | SIP-3 (Ammo Pack) | 3564Q               |
| AH3564Q     | SIP-3 (Bulk Pack) | 3564Q               |

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

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

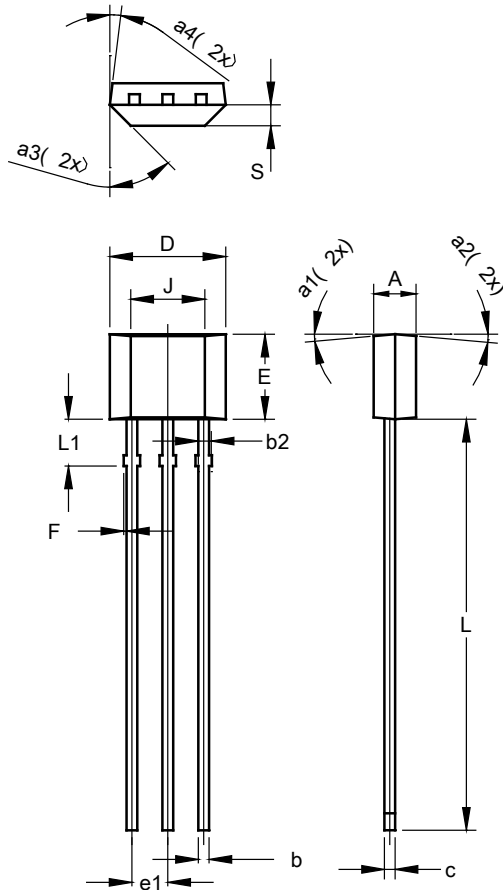
(1) Package Type: SOT23



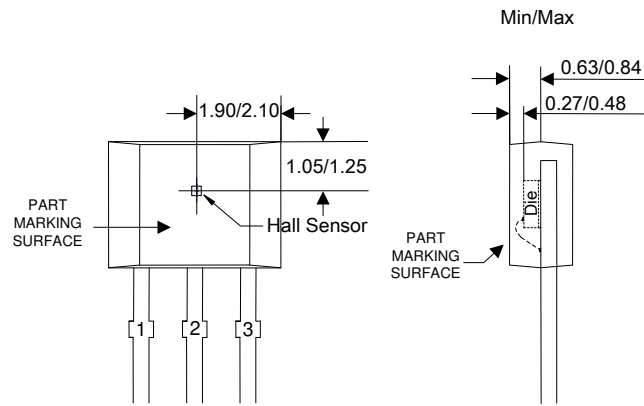
**Package Outline Dimensions** (continued) (All dimensions in mm.)

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 |          |       |       |

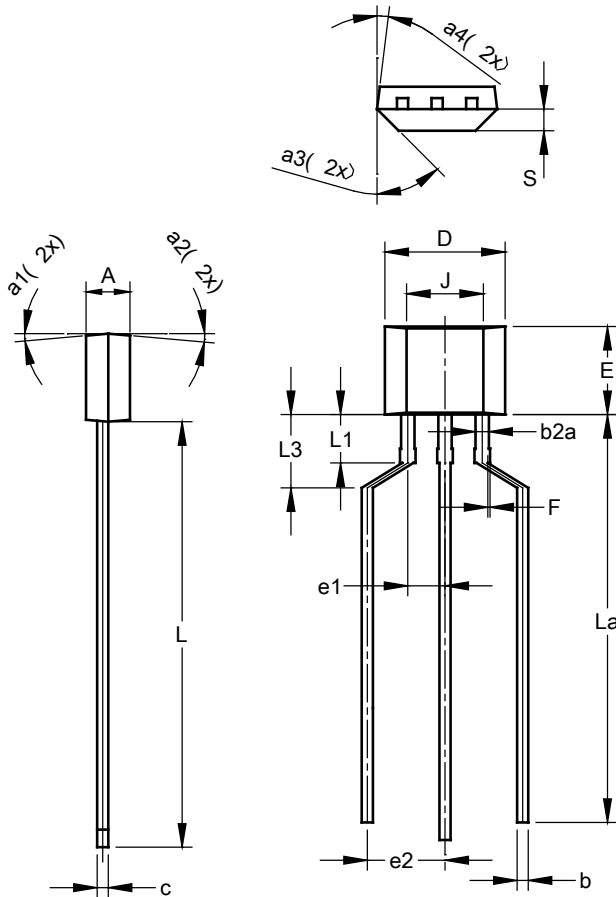


**Sensor Location**

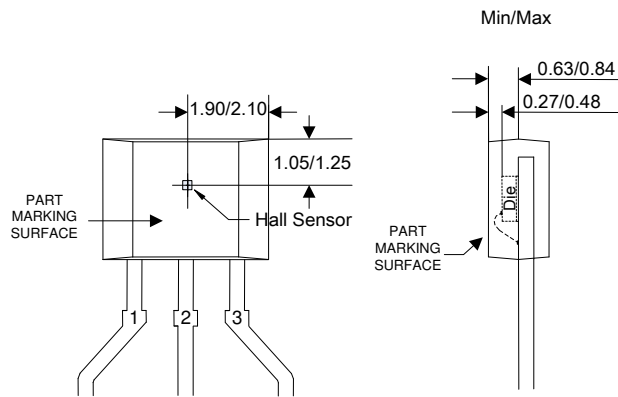
**Package Outline Dimensions** (cont.) (All dimensions in mm.)

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

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



| SIP-3<br>(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°    |
| <b>All Dimensions in mm</b> |          |       |       |

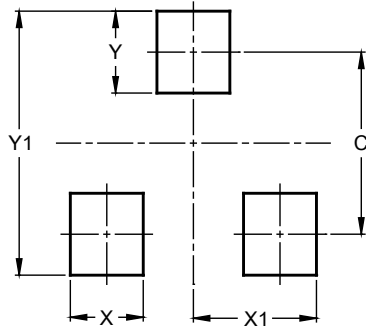


**Sensor Location**

## Suggested Pad Layout

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

(1) Package Type: SOT23



| Dimensions | Value (in mm) |
|------------|---------------|
| <b>C</b>   | 2.0           |
| <b>X</b>   | 0.8           |
| <b>X1</b>  | 1.35          |
| <b>Y</b>   | 0.9           |
| <b>Y1</b>  | 2.9           |

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