

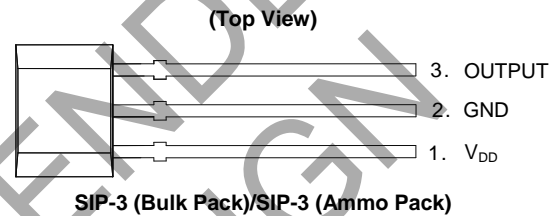
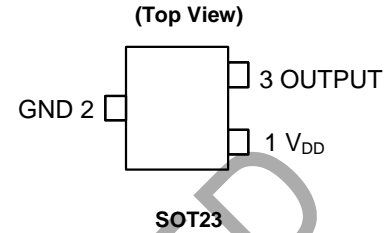


## Description

The AH3391Q is an AEC-Q100 qualified high-voltage low-sensitivity Hall-effect Unipolar switch IC designed for position and proximity sensing in automotive applications such as in seat and seatbelt buckle, steering lock/immobilisation, gear stick, transmission actuator and gear position, HVAC compression, wiper, door/trunk closure, etc. To support the wide range of the demanding applications, the design has been 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 AH3391Q 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. When the magnetic flux density (B) perpendicular to the package is larger than the operate point (B<sub>OP</sub>) the output is switched on (pulled low) and is held on until the magnetic flux density B is lower than the release point (B<sub>RP</sub>). The output remains switched off for North pole fields to or no magnetic fields.

## Pin Assignments



## Features

- Unipolar Operation
- Medium Sensitivity: B<sub>OP</sub> and B<sub>RP</sub> of 275G and 250G 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°C to +150°C Operating Temperature
- ESD: HBM > 8kV, CDM: > 2kV
- AEC-Q100 Grade 0 Qualified
- Industry Standard SOT23, SIP-3 (Ammo Pack) and SIP-3 (Bulk Pack) Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The AH3391Q is suitable for automotive applications requiring specific change control; this part is AEC-Q100 qualified, PPAP capable, and manufactured in IATF16949 certified facilities.**

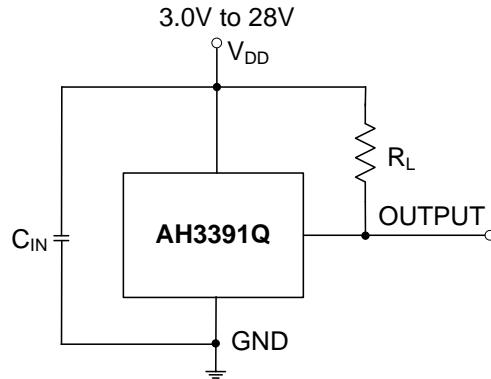
<https://www.diodes.com/quality/product-definitions/>

## Applications

- Position and proximity sensing in automotive applications
- Seat positions
- Seatbelt buckles
- Steering locks/immobilisation
- Gear sticks
- HVAC compression
- Transmission actuators
- Transmission gear positions
- Wipers
- Sunroofs and windows
- Door/trunk closure
- Door locks
- Contactless switches

Notes: 1. No purposely added lead. Fully EU Directive 2002/95/EC (RoHS), 2011/65/EU (RoHS 2) & 2015/863/EU (RoHS 3) compliant.  
 2. See <https://www.diodes.com/quality/lead-free/> for more information about Diodes Incorporated's definitions of Halogen- and Antimony-free, "Green" and Lead-free.  
 3. Halogen- and Antimony-free "Green" products are defined as those which contain <900ppm bromine, <900ppm chlorine (<1500ppm total Br + Cl) and <1000ppm antimony compounds.

**Typical Applications Circuit** (Note 4)



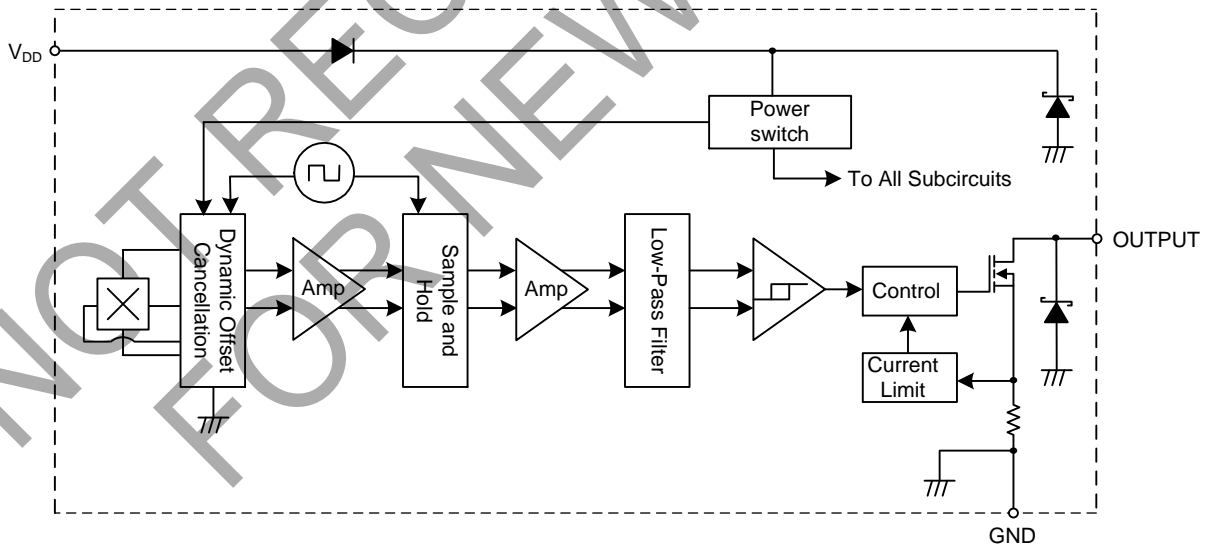
Note: 4.  $C_{IN}$  is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF.  $R_L$  is the pullup resistor.

**Pin Descriptions**

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

| Pin Number | Pin Name        | Function           |
|------------|-----------------|--------------------|
| 1          | V <sub>DD</sub> | Power Supply Input |
| 2          | GND             | Ground             |
| 3          | OUTPUT          | Output Pin         |

**Functional Block Diagram**



### Absolute Maximum Ratings (Notes 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              | Electros Static Discharge Withstand - Human Body Model (HBM)     | 8                                       | kV   |    |
| ESD MM               | Electros Static Discharge Withstand - Machine Model (MM)         | 800                                     | V    |    |
| 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<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 (Notes 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 (Startup 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 pullup 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    |

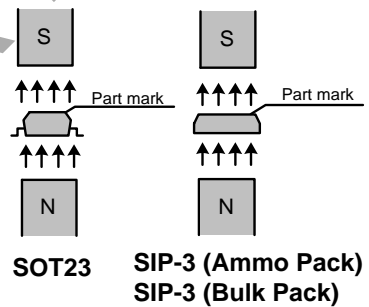
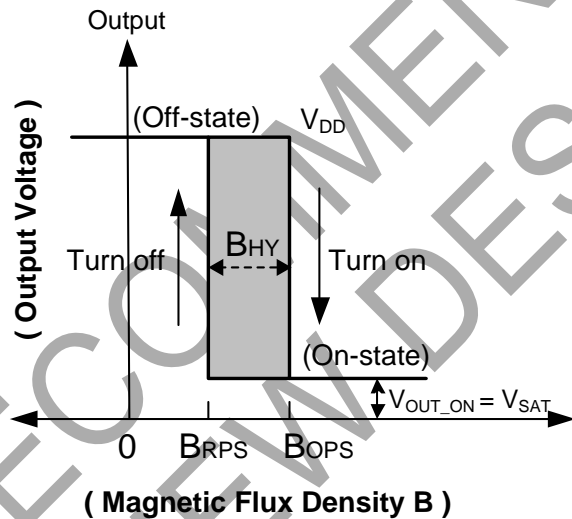
- Notes:
- When power is initially turned on, V<sub>DD</sub> must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the startup time of 10μs typical from the operating voltage reaching 3V.
  - Typical values are defined at T<sub>A</sub>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

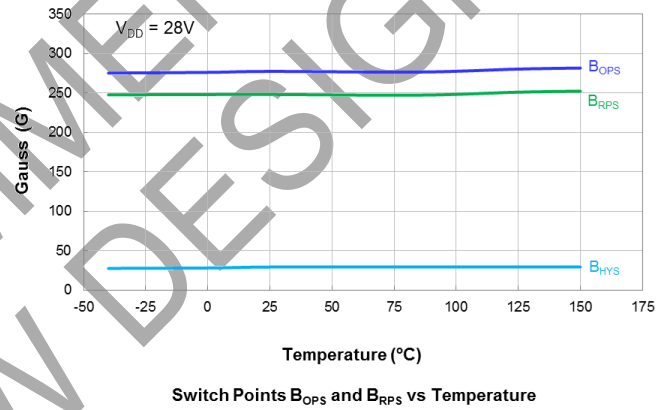
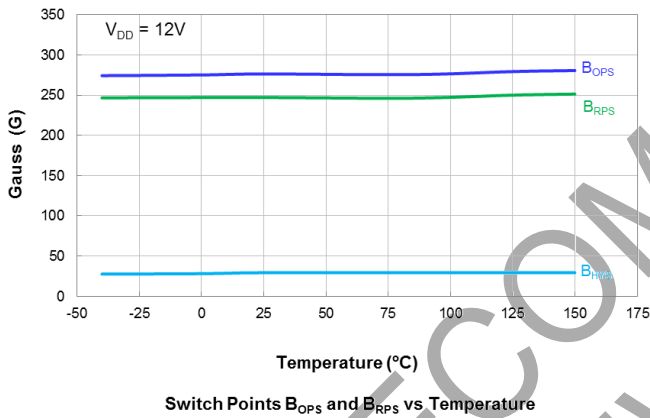
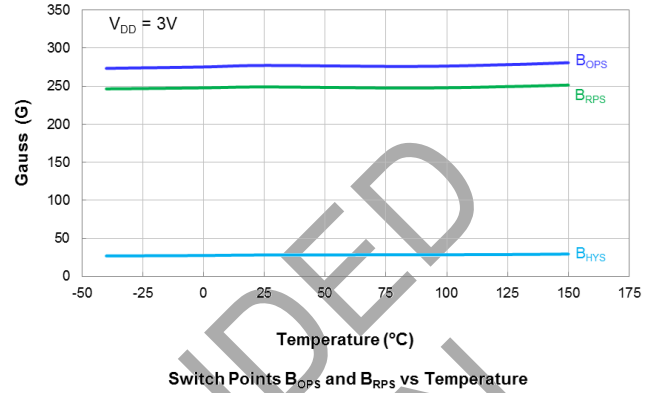
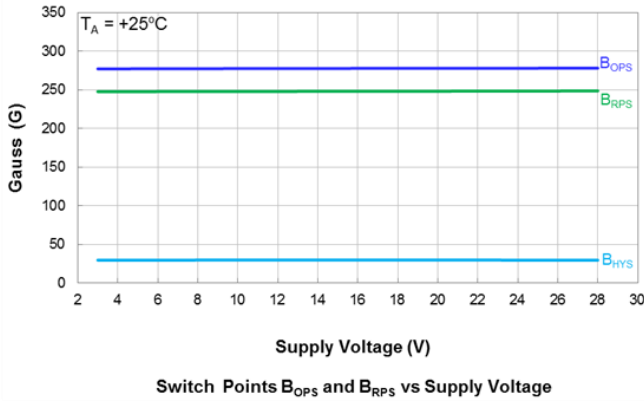
| Symbol   | Parameter            | Condition   | Min | Typ | Max | Unit  |
|--|----------------------|---|-----|-----|-----|-------|
| B <sub>OPS</sub><br>(South pole to the part marking side of SOT23 and SIP-3 (Ammo Pack), SIP-3 (Bulk Pack) packages) | Operation Point      | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | 275 | —   | Gauss |
|  |                      | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 235 | 275 | 300 |       |
| B <sub>RPS</sub><br>(South pole to the part marking side of SOT23 and SIP-3 (Ammo Pack), SIP-3 (Bulk Pack) packages) | Release Point        | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | 250 | —   |       |
|  |                      | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 210 | 250 | 275 |       |
| B <sub>HY</sub> ( B <sub>OPX</sub>   -  B <sub>RFX</sub>  )  | Hysteresis (Note 13) | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | —   | 25  | —   |       |
|  |                      | $T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$ | 17  | 25  | 36  |       |

- 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 startup 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.

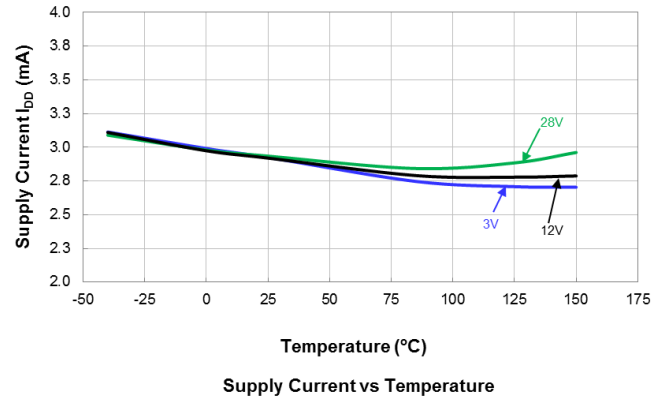
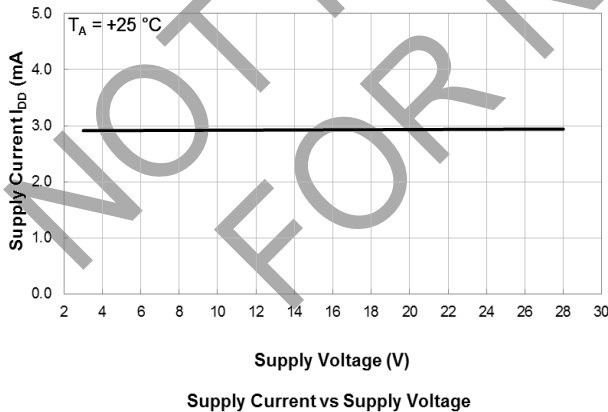


**Typical Operating Characteristics**

**Output Switch Operate and Release Points (Magnetic Thresholds) –  $B_{OPS}$  and  $B_{RPS}$**

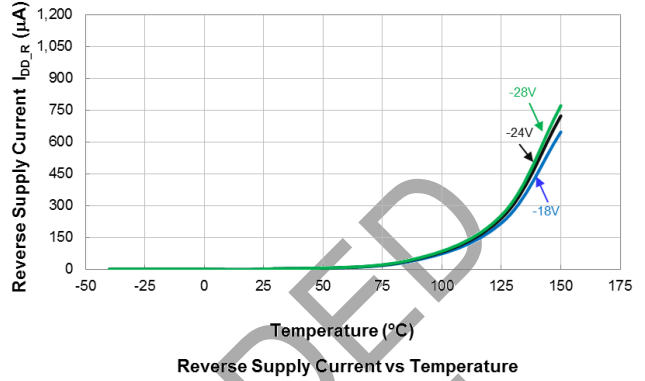
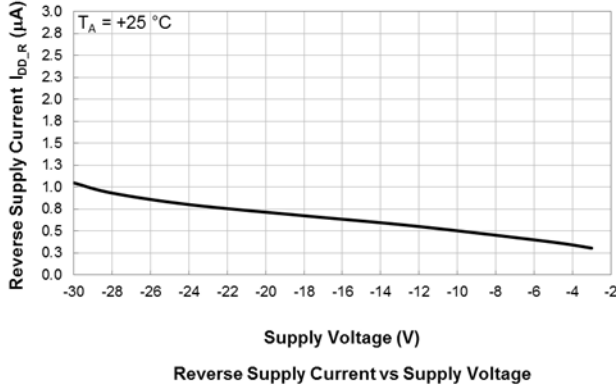


**Supply Current**

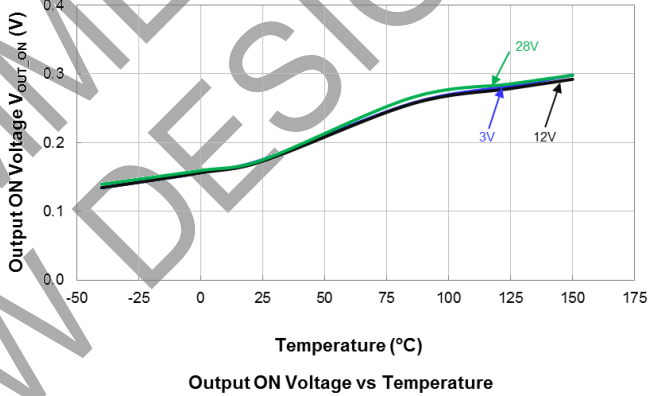
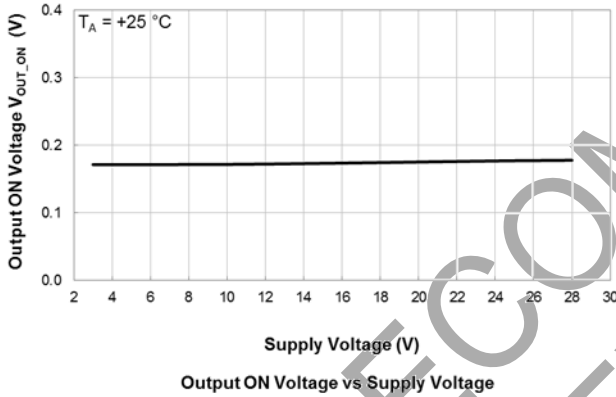


**Typical Operating Characteristics** (continued)

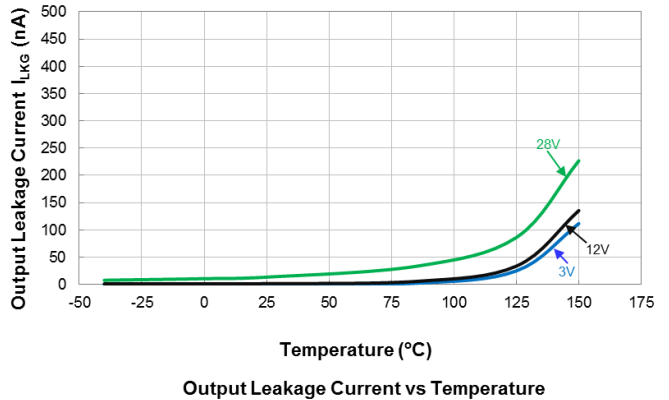
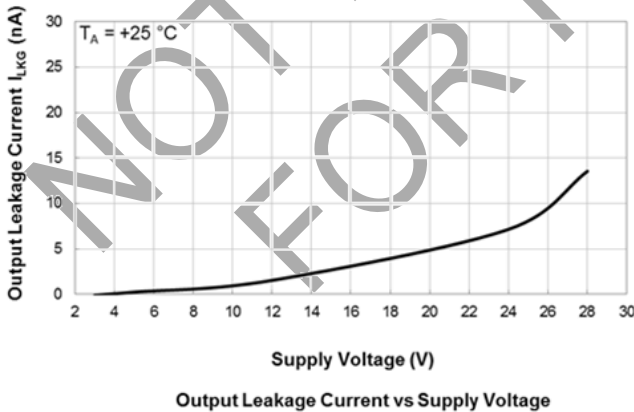
**Supply Reverse Current**



**Output Switch On Voltage**

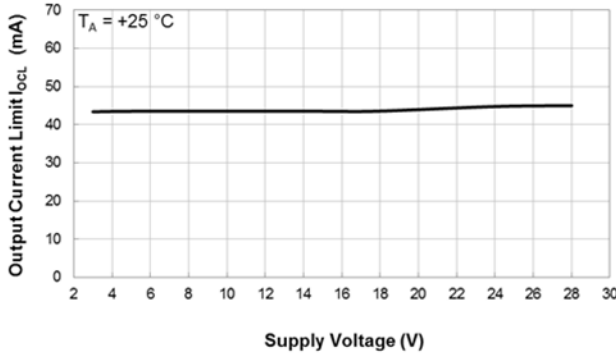


**Output Switch Leakage Current**

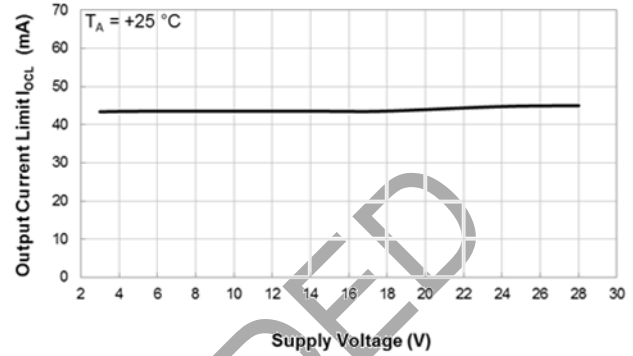


**Typical Operating Characteristics** (continued)

**Output Current Limit**



Output Current Limit vs Supply Voltage



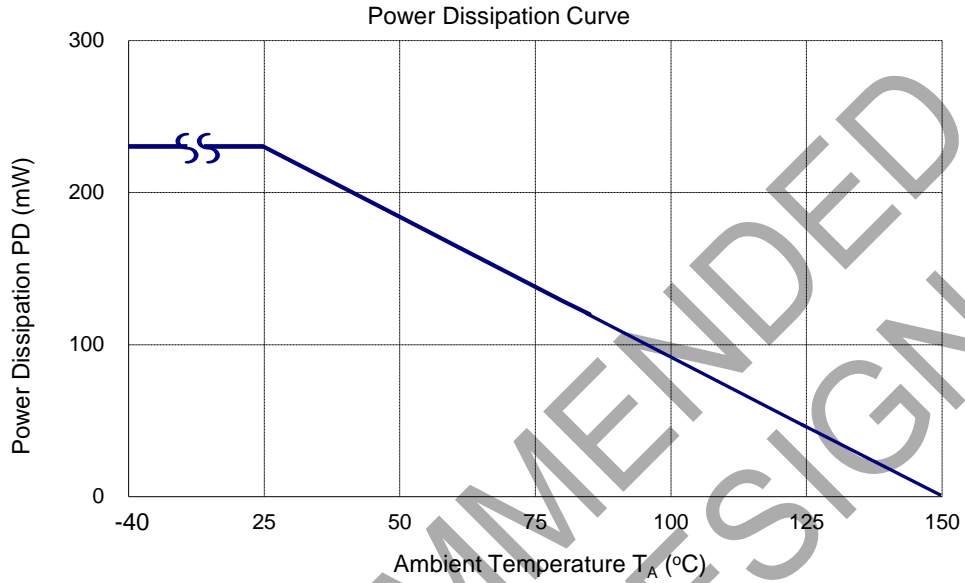
Output Current Limit vs Supply Voltage

NOT RECOMMENDED FOR NEW DESIGN

**Thermal Performance Characteristics**

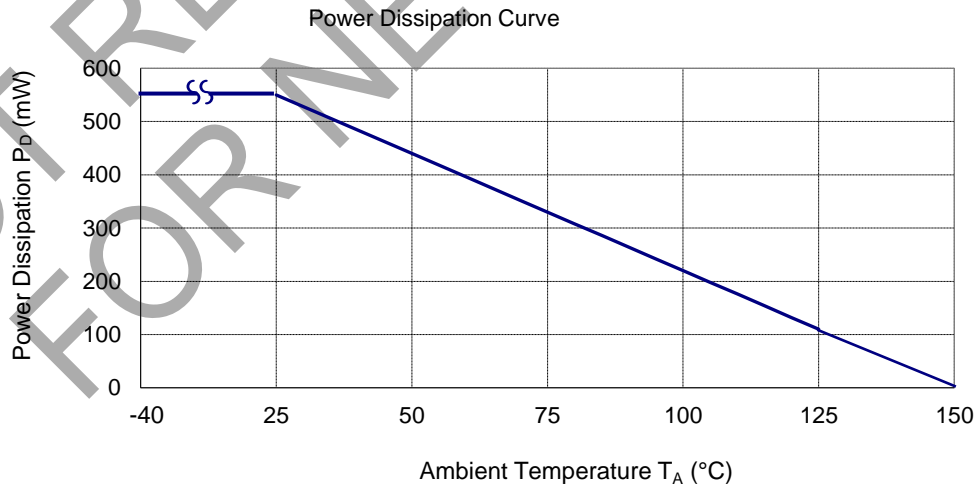
(1) Package Type: SOT23

| 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   |



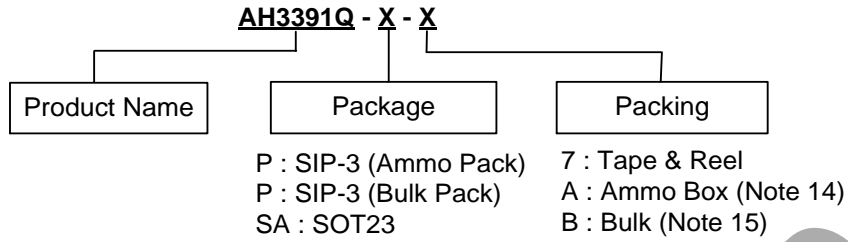
(2) Package Types: SIP-3 (Ammo Pack), SIP-3 (Bulk Pack)

| 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**

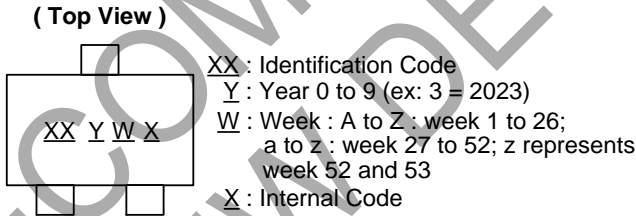


| Part Number  | Package Code | Package           | Part Number Suffix | Packing |                |
|--------------|--------------|-------------------|--------------------|---------|----------------|
|              |              |                   |                    | Qty.    | Carrier        |
| AH3391Q-P-A  | P            | SIP-3 (Ammo Pack) | -A                 | 4000    | Ammo Box       |
| AH3391Q-P-B  | P            | SIP-3 (Bulk Pack) | -B                 | 1000    | Bulk Box       |
| AH3391Q-SA-7 | SA           | SOT23             | -7                 | NA      | 7" Tape & Reel |

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

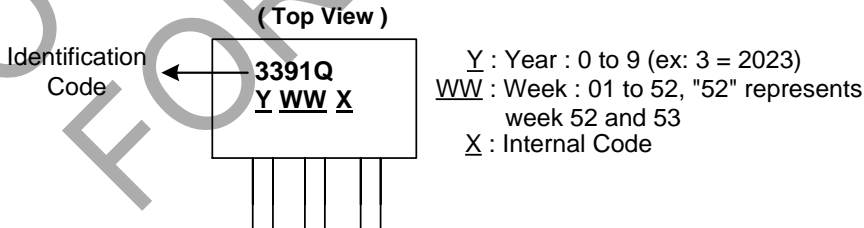
**Marking Information**

(1) Package Type: SOT23



| Part Number  | Package | Identification Code |
|--------------|---------|---------------------|
| AH3391Q-SA-7 | SOT23   | MY                  |

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

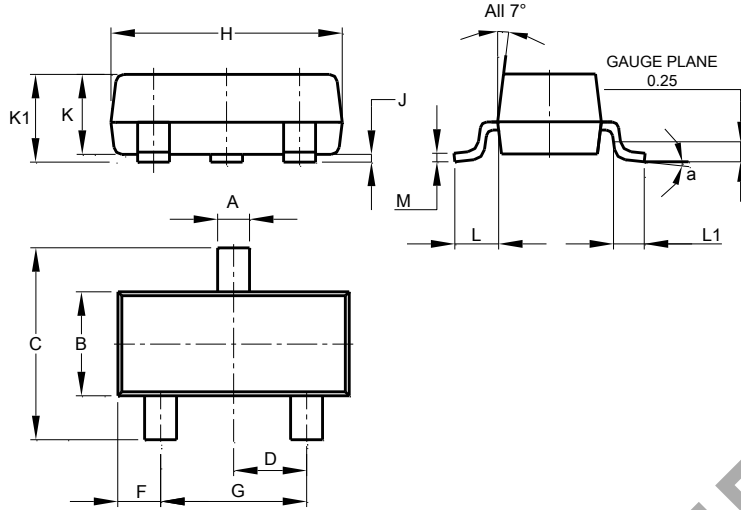


| Part Number | Package           | Identification Code |
|-------------|-------------------|---------------------|
| AH3391Q-P-A | SIP-3 (Ammo Pack) | 3391Q               |
| AH3391Q-P-B | SIP-3 (Bulk Pack) | 3391Q               |

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

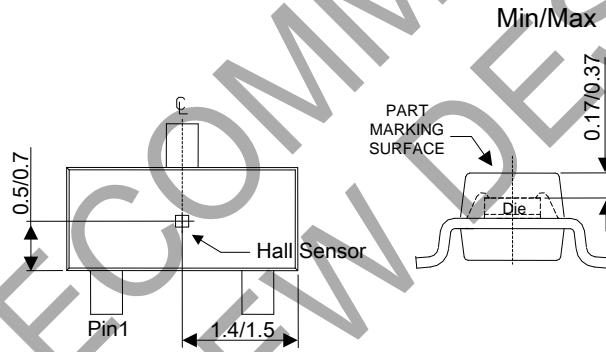
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

(1) Package Type: SOT23



| SOT23 |       |       |       |
|-------|-------|-------|-------|
| Dim   | Min   | Max   | Typ   |
| A     | 0.37  | 0.51  | 0.40  |
| B     | 1.20  | 1.40  | 1.30  |
| C     | 2.30  | 2.50  | 2.40  |
| D     | 0.89  | 1.03  | 0.915 |
| F     | 0.45  | 0.60  | 0.535 |
| G     | 1.78  | 2.05  | 1.83  |
| H     | 2.80  | 3.00  | 2.90  |
| J     | 0.013 | 0.10  | 0.05  |
| K     | 0.890 | 1.00  | 0.975 |
| K1    | 0.903 | 1.10  | 1.025 |
| L     | 0.45  | 0.61  | 0.55  |
| L1    | 0.25  | 0.55  | 0.40  |
| M     | 0.085 | 0.150 | 0.110 |
| a     | 0°    | 8°    | --    |

All Dimensions in mm



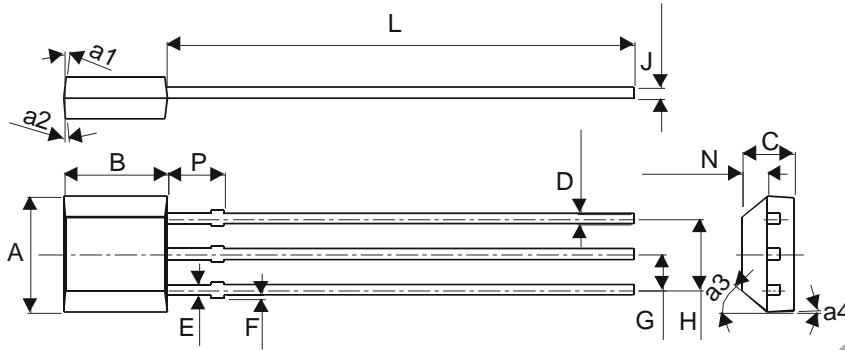
Sensor Location

NOT RECOMMENDED FOR NEW DESIGN

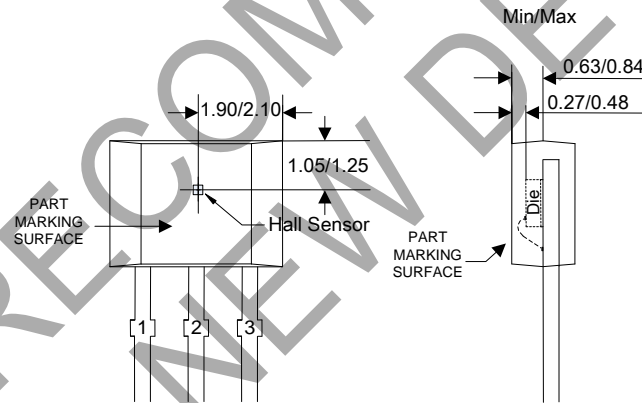
**Package Outline Dimensions** (continued) (All dimensions in mm.)

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   |
| A                    | 3.9     | 4.3   |
| a1                   | 5° Typ  |       |
| a2                   | 5° Typ  |       |
| a3                   | 45° Typ |       |
| a4                   | 3° Typ  |       |
| B                    | 2.8     | 3.2   |
| C                    | 1.40    | 1.60  |
| D                    | 0.33    | 0.432 |
| E                    | 0.40    | 0.508 |
| F                    | 0       | 0.2   |
| G                    | 1.24    | 1.30  |
| H                    | 2.51    | 2.57  |
| J                    | 0.35    | 0.43  |
| L                    | 14.0    | 15.0  |
| N                    | 0.63    | 0.84  |
| P                    | 1.55    | -     |
| All Dimensions in mm |         |       |

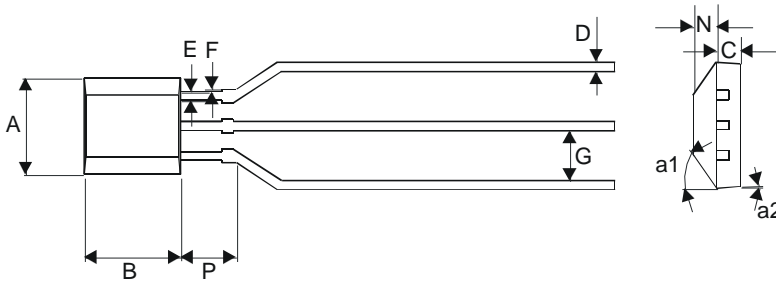


Sensor Location

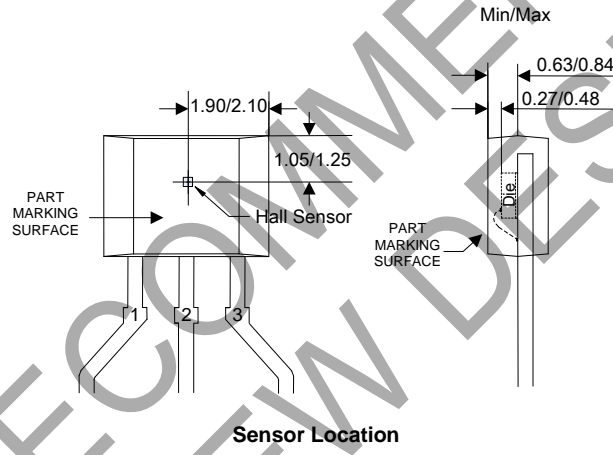
**Package Outline Dimensions** (continued) (All dimensions in mm.)

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

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



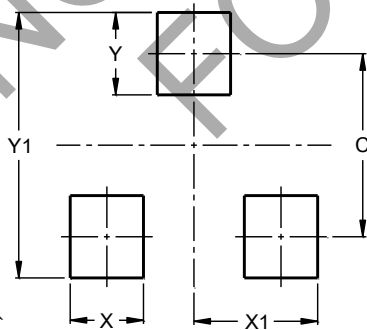
| SIP-3 (Ammo Pack)    |         |      |
|----------------------|---------|------|
| Dim                  | Min     | Max  |
| A                    | 3.9     | 4.3  |
| a1                   | 45° Typ |      |
| a2                   | 3° Typ  |      |
| B                    | 2.8     | 3.2  |
| C                    | 1.40    | 1.60 |
| D                    | 0.35    | 0.41 |
| E                    | 0.43    | 0.48 |
| F                    | 0       | 0.2  |
| G                    | 2.4     | 2.9  |
| N                    | 0.63    | 0.84 |
| P                    | 1.55    | -    |
| All Dimensions in mm |         |      |



**Suggested Pad Layout**

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

(1) Package Type: SOT23



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

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