

## HIGH-VOLTAGE, HIGH-SENSITIVITY HALL EFFECT LATCH WITH INTERNAL PULL-UP RESISTOR

### Description

The AH3782 is a high-voltage, high-sensitivity Hall Effect latch IC with internal pull-up resistor designed for commutation of brushless DC motors, flow meters, linear encoders and position sensors in industrial and consumer home appliances and personal care applications. To support a wide range of 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 AH3782 provides a reliable solution over the whole operating range. For robustness and protection, the device has a Zener clamp on the supply. The output has an overcurrent limit and a Zener clamp.

The internally pulled-up 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 part marking surface 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 ( $B_{RP}$ ).

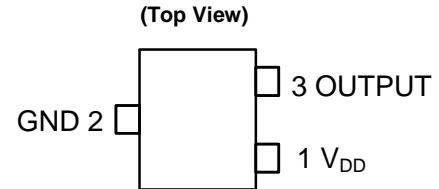
The magnetic operating and release polarity is opposite for SOT23 and SC59 packages. SOT23 and SIP-3 packages will require South pole to the part marking side to operate while SC59 will require North pole to the part marking side.

### Features

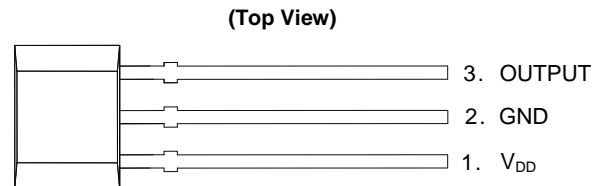
- Bipolar Latch Operation (South Pole: On, North Pole: off)
- 3.0V to 28V Operating Voltage Range
- High Sensitivity:  $B_{OP}$  and  $B_{RP}$  of +40G and -40G Typical
- Internally Pull-up Resistor on the Output Pin
- Output Overcurrent Limit
- Chopper Stabilized Design Provides
  - Superior Temperature Stability
  - Minimal Switch Point Drift
  - Enhanced Immunity to Stress
- Good RF Noise Immunity
- Zener Clamp on Supply and Output Pins
- -40°C to +125°C Operating Temperature
- ESD (HBM): 6kV
- Industry Standard SC59, SOT23 and SIP-3 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) compliant.  
 2. See [http://www.diodes.com/quality/lead\\_free.html](http://www.diodes.com/quality/lead_free.html) 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



**SC59 and SOT23**

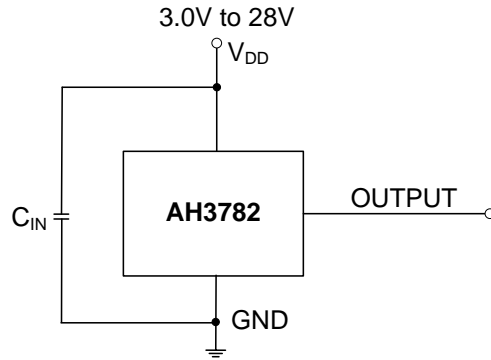


**SIP-3**

### Applications

- Brushless DC Motor Commutation
- Revolution Per Minute (RPM) Measurement
- Flow Meters
- Angular and Linear Encoder and Position Sensors
- Contact-less Commutation, Speed Measurement and Angular Position Sensing/Indexing in Consumer Home Appliances, Office Equipments and Industrial Applications

**Typical Applications Circuit**



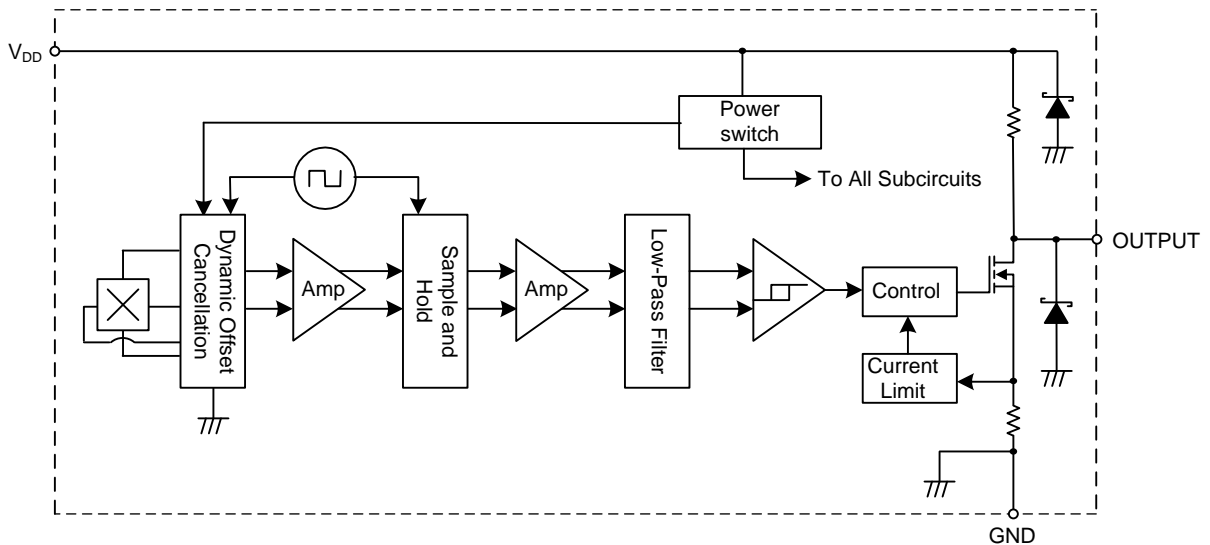
Note: 4.  $C_{IN}$  is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF ~ 100nF.  $R_L$  is the pull-up resistor.

**Pin Descriptions**

Package: SC59, SOT23 and SIP-3

| Pin Number | Pin Name | Function           |
|------------|----------|--------------------|
| 1          | $V_{DD}$ | 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                                          | -0.3           | V      |
| V <sub>OUT_MAX</sub> | Output Off Voltage (Note 6)                                     | 32V            | V      |
| I <sub>OUT</sub>     | Continuous Output Current                                       | 60             | mA     |
| B                    | Magnetic Flux Density                                           | Unlimited      |        |
| P <sub>D</sub>       | Package Power Dissipation                                       | SIP-3          | 550 mW |
|                      |                                                                 | SC59 and SOT23 | 230 mW |
| T <sub>s</sub>       | Storage Temperature Range                                       | -65 to +165    | °C     |
| T <sub>J</sub>       | Maximum Junction Temperature                                    | +150           | °C     |
| ESD                  | Electrostatic Discharge Withstand Capability - Human Body Model | 6              | 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 +125°C, unless otherwise specified.)

| Symbol          | Parameter                   | Conditions | Rating      | Unit |
|-----------------|-----------------------------|------------|-------------|------|
| V <sub>DD</sub> | Supply Voltage              | Operating  | 3.0 to 28   | V    |
| T <sub>A</sub>  | Operating Temperature Range | Operating  | -40 to +125 | °C   |

### Electrical Characteristics (Notes 7 & 8) (@T<sub>A</sub> = -40°C to +125°C, V<sub>DD</sub> = 3V to 28V, unless otherwise specified.)

| Symbol               | Parameter                                                                                    | Conditions                                                | 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>OUT_OFF</sub> | Output Leakage Current                                                                       | V <sub>OUT</sub> = 28V, B < B <sub>RP</sub> , Output off  | -   | <0.1 | 15  | µA   |
| I <sub>DD</sub>      | Supply Current                                                                               | Output open, V <sub>DD</sub> = 12V, T <sub>A</sub> = 25°C | -   | 3.8  | 4.9 | mA   |
|                      |                                                                                              | Output open, T <sub>A</sub> = -40°C to +125°C             | -   | 3.8  | 5.8 | mA   |
| R <sub>PU</sub>      | Internal Pull-Up Resistance                                                                  | T <sub>A</sub> = -40°C to 125°C,                          | 10  | 14   | 18  | kΩ   |
| t <sub>ST</sub>      | Device Start-Up Time                                                                         | V <sub>DD</sub> ≥ 3V, B > B <sub>OP</sub> (Note 7)        | -   | 10   | -   | µs   |
| f <sub>c</sub>       | Chopping Frequency                                                                           | V <sub>DD</sub> = 3V to 28V                               | -   | 800  | -   | kHz  |
| t <sub>d</sub>       | The time delay 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    |

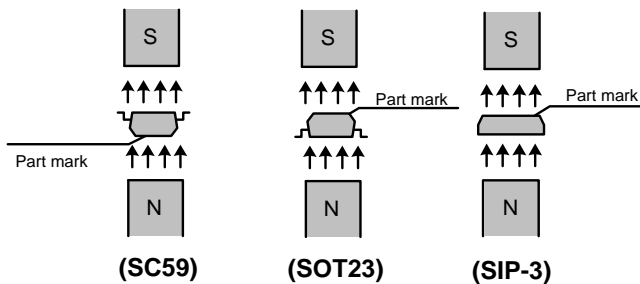
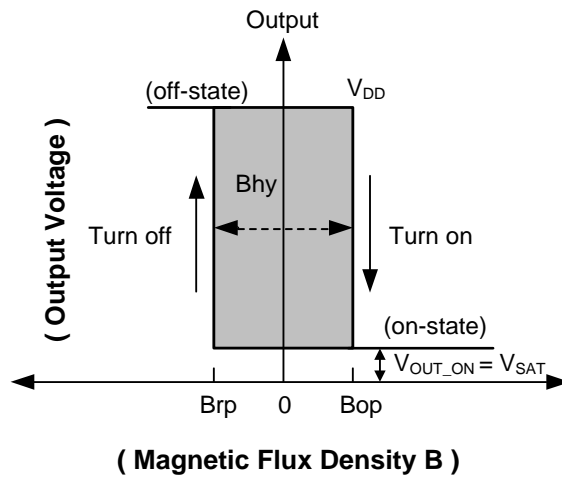
- Notes:
- When power is initially turned on, V<sub>DD</sub> must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the start-up time of 10µs typical from the operating voltage reaching 3V.
  - Typical values are defined at T<sub>A</sub> = +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** (Notes 11 & 12) ( $T_A = -40^{\circ}\text{C}$  to  $+125^{\circ}\text{C}$ ,  $V_{DD} = 3.0\text{V}$  to  $28\text{V}$ , unless otherwise specified)

(1mT=10 Gauss)

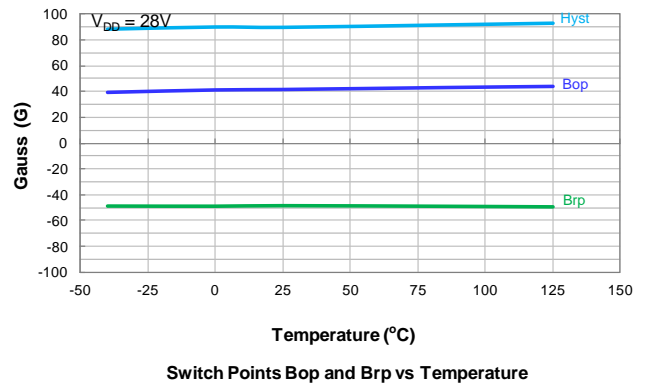
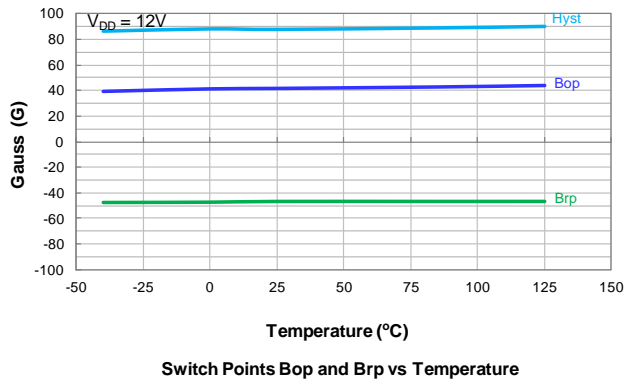
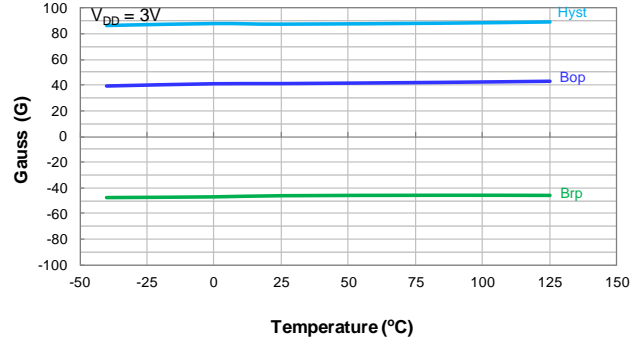
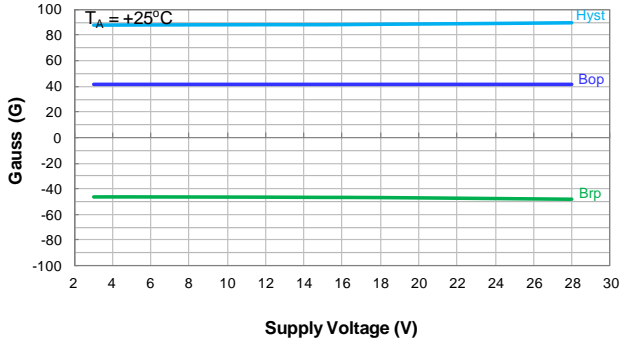
| Symbol                                                                                                                                                  | Parameter            | Conditions                                            | Min | Typ | Max | Unit  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|-------------------------------------------------------|-----|-----|-----|-------|
| $B_{OP}$ (South pole to part marking side for SOT23 and SIP-3 packages;<br>South pole to the non-part marking side for SC59 package. See diagram below) | 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  |       |
| $B_{RP}$ (North pole to part marking side for SOT23 and SIP-3 packages;<br>North pole to the non-part marking side for SC59 package. See diagram below) | Release Point        | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | -   | -40 | -   |       |
|                                                                                                                                                         |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | -60 | -40 | -20 |       |
| $B_{HY}$ ( $ B_{OPX}  -  B_{RPX} $ )                                                                                                                    | Hysteresis (Note 13) | $V_{DD} = 12\text{V}$ , $T_A = +25^{\circ}\text{C}$   | -   | 80  | -   |       |
|                                                                                                                                                         |                      | $T_A = -40^{\circ}\text{C}$ to $+125^{\circ}\text{C}$ | 40  | 80  | 120 |       |

- 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.

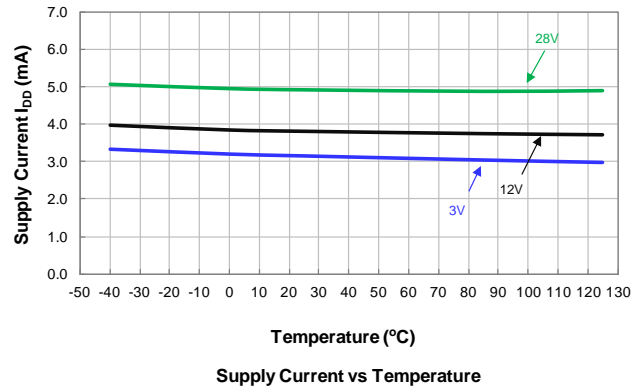
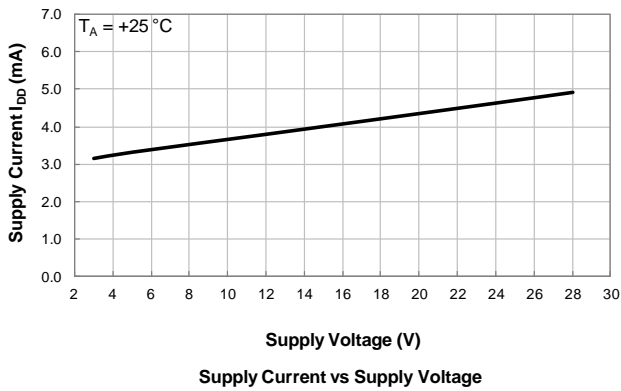


**Typical Operating Characteristics**

**Magnetic Operating Switch Points – B<sub>OP</sub> and B<sub>RP</sub>**

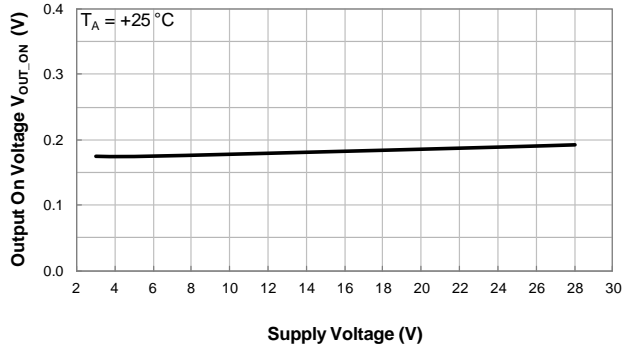


**Supply Current**

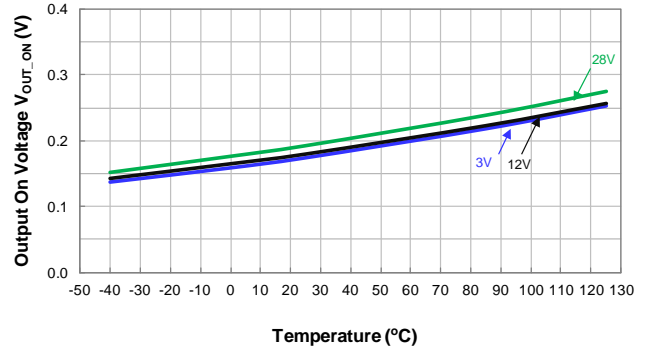


## Typical Operating Characteristics

### Output Switch On Voltage

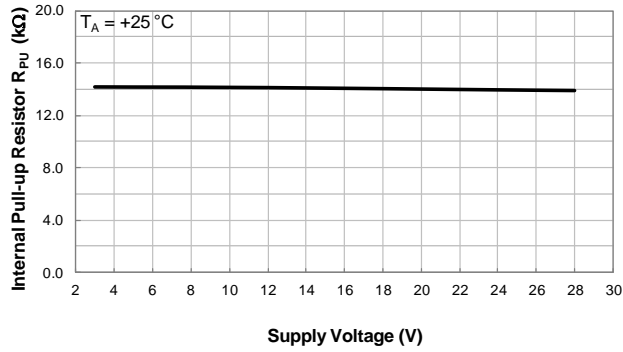


Output On Voltage vs Supply Voltage

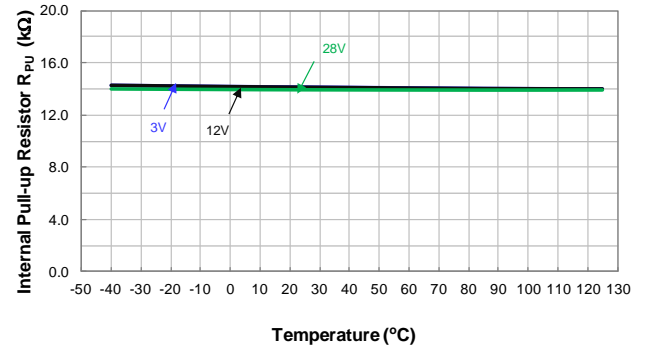


Output On Voltage vs Temperature

### Output Pull-Up Resistor (Internal)

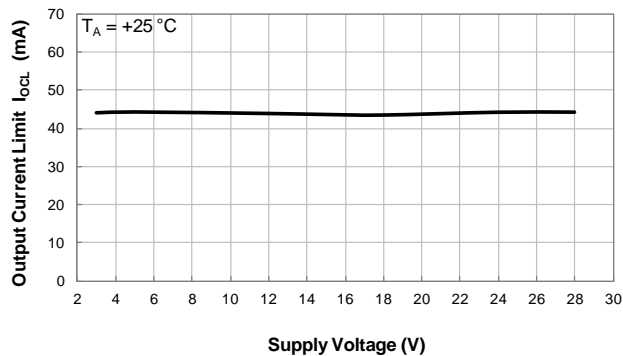


Internal Output Pull-up Resistor vs Supply Voltage

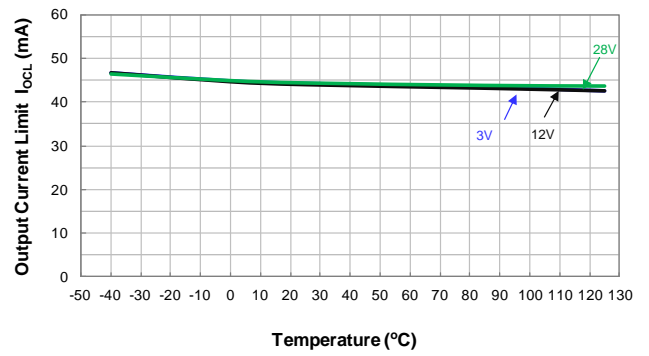


Internal Output Pull-up Resistor vs Temperature

### Output Current Limit



Output Current Limit vs Supply Voltage

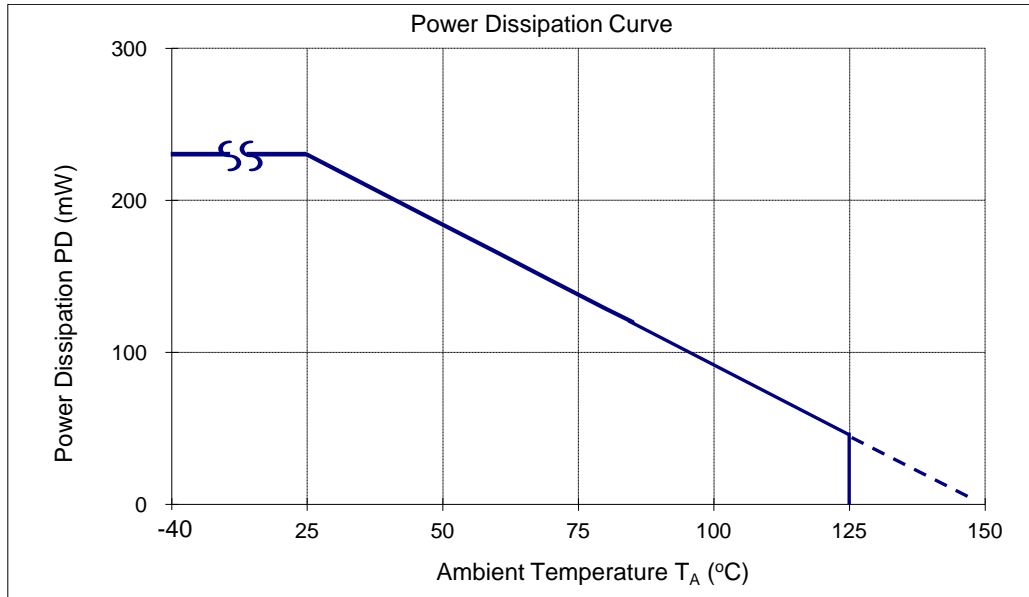


Output Current Limit vs Temperature

**Thermal Performance Characteristics**

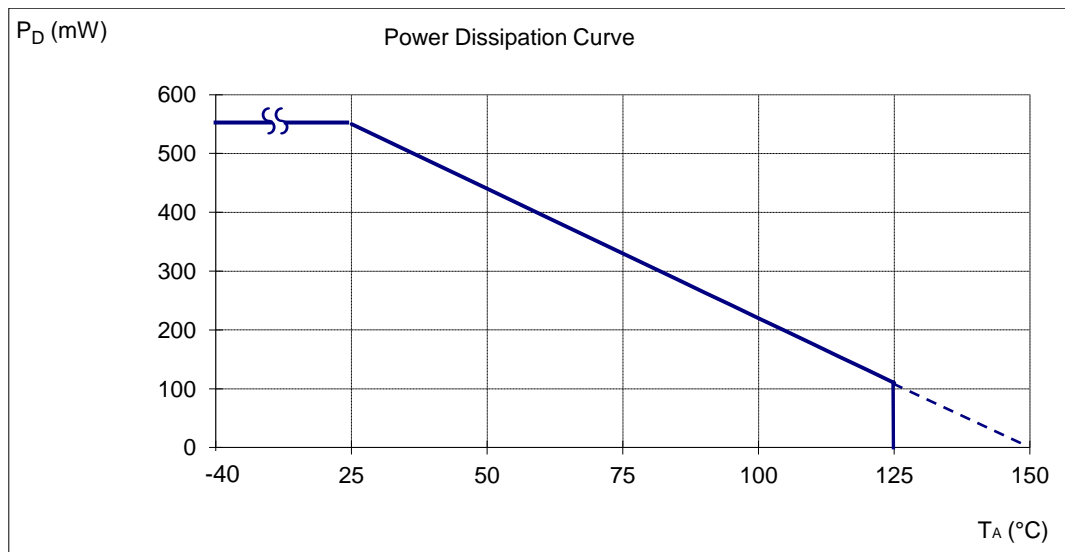
**(1) Package Type: SC59 and SOT23**

| 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   |

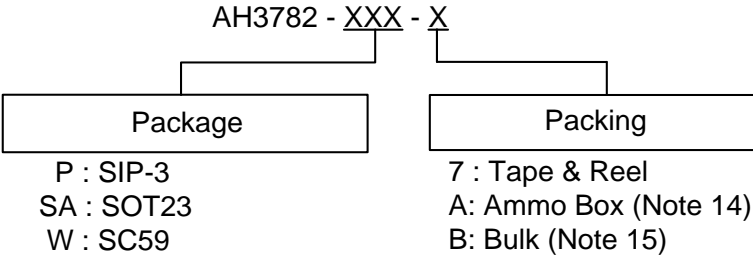


**(2) Package type: SIP-3**

| 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**

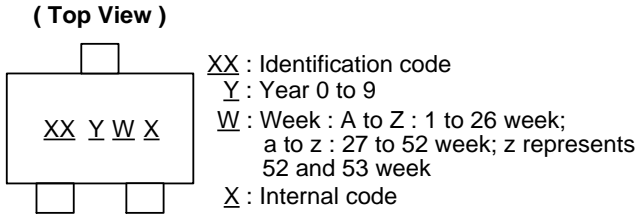


| Part Number | Package Code | Packaging | Bulk     |                    | 7" Tape and Reel  |                    | Ammo Box  |                    |
|-------------|--------------|-----------|----------|--------------------|-------------------|--------------------|-----------|--------------------|
|             |              |           | Quantity | Part Number Suffix | Quantity          | Part Number Suffix | Quantity  | Part Number Suffix |
| AH3782-P-A  | P            | SIP-3     | NA       | NA                 | NA                | NA                 | 4,000/Box | -A                 |
| AH3782-P-B  | P            | SIP-3     | 1,000    | -B                 | NA                | NA                 | NA        | NA                 |
| AH3782-SA-7 | SA           | SOT23     | NA       | NA                 | 3,000/Tape & Reel | -7                 | NA        | NA                 |
| AH3782-W-7  | W            | SC59      | NA       | NA                 | 3,000/Tape & Reel | -7                 | NA        | NA                 |

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

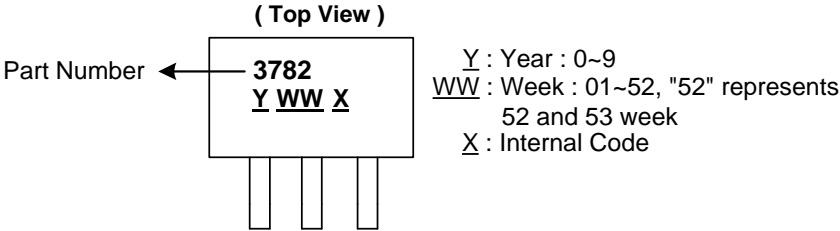
**Marking Information**

(1) Package Type: SC59 and SOT23



| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| AH3782      | SC59    | YY                  |
| AH3782      | SOT23   | WY                  |

(2) Package Type: SIP-3



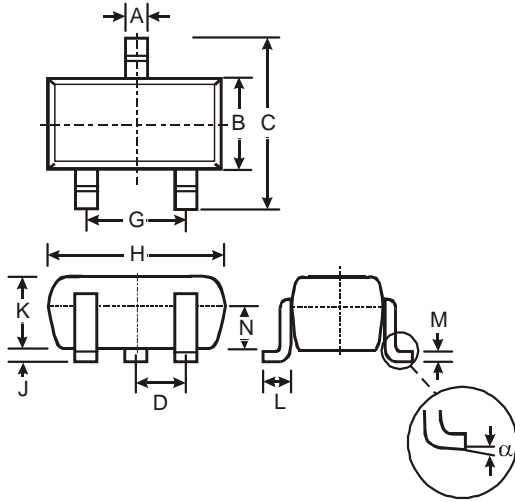
| Part Number | Package | Identification Code |
|-------------|---------|---------------------|
| AH3782      | SIP-3   | 3782                |



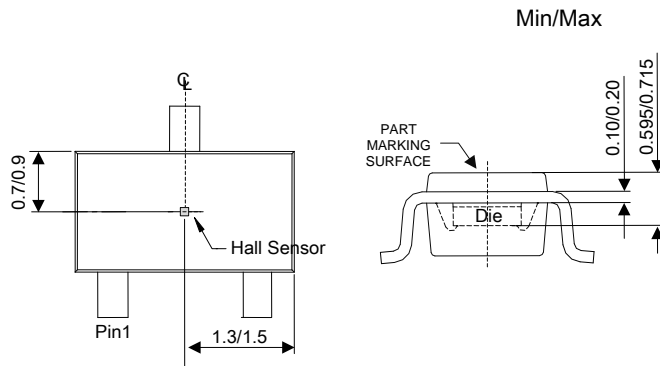
**Package Outline Dimensions** (All dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for latest version.

(1) 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 |       |      |      |

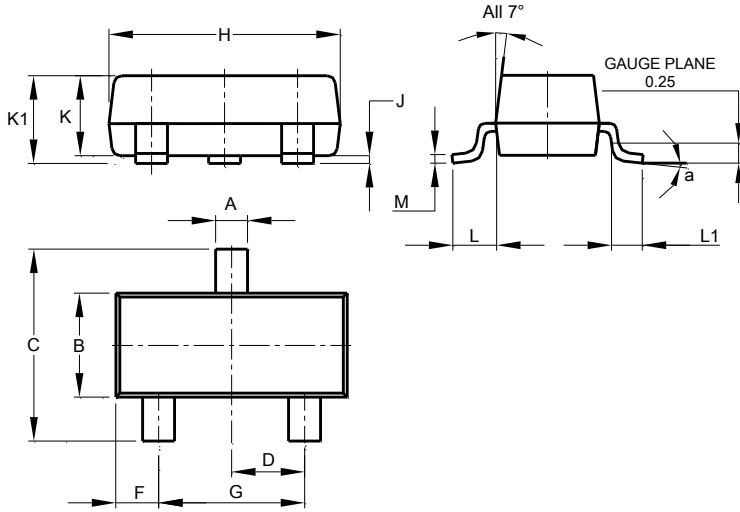


**Sensor Location**

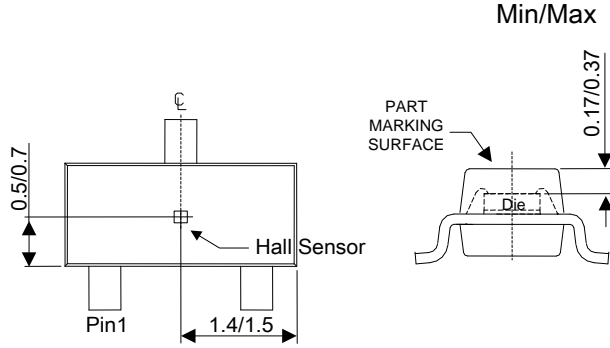
**Package Outline Dimensions** (All dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

(2) 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                    | 8°    |       |       |
| All Dimensions in mm |       |       |       |

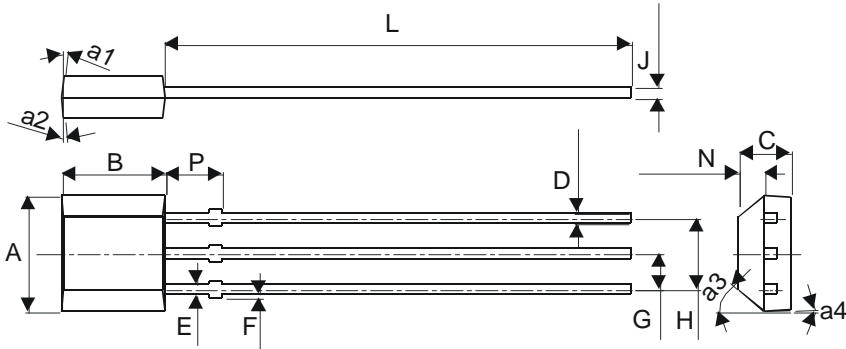


**Sensor Location**

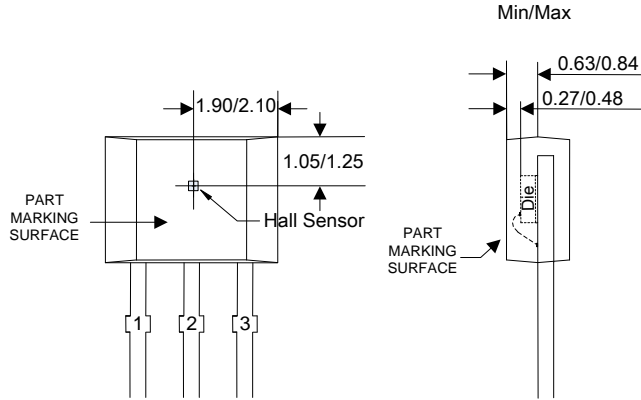
**Package Outline Dimensions** (cont.) (All dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

(3) Package Type: SIP-3 Bulk



| SIP-3 (Bulk)                |         |       |
|-----------------------------|---------|-------|
| 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    | -     |
| <b>All Dimensions in mm</b> |         |       |

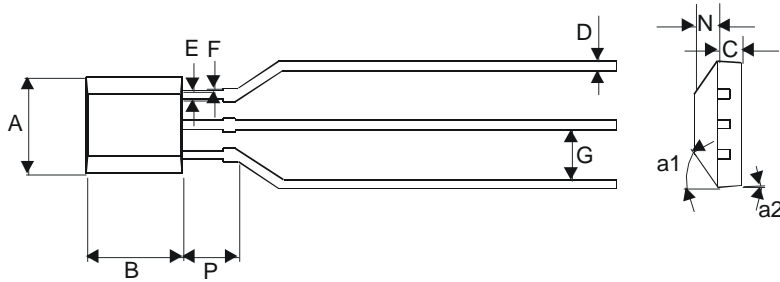


**Sensor Location**

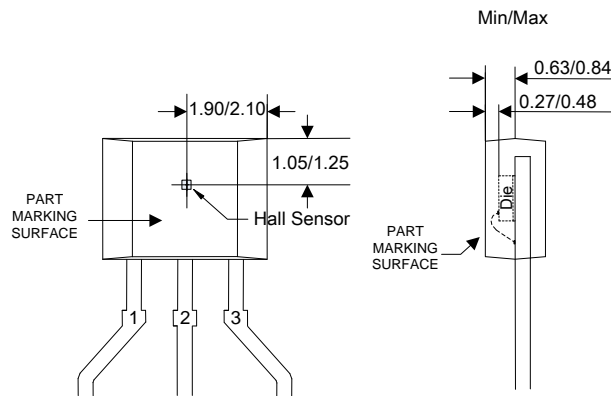
**Package Outline Dimensions** (cont.) (All dimensions in mm.)

Please see AP02002 at <http://www.diodes.com/datasheets/ap02002.pdf> for the latest version.

(4) 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 |         |      |

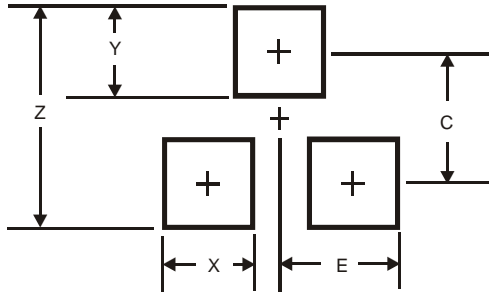


**Sensor Location**

**Suggested Pad Layout**

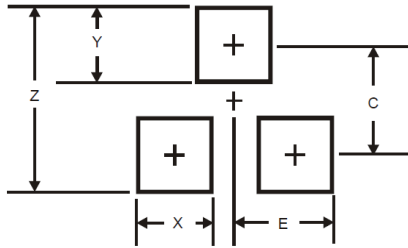
Please see AP02001 at <http://www.diodes.com/datasheets/ap02001.pdf> for the latest version.

(1) Package Type: SC59



| Dimensions | Value (in mm) |
|------------|---------------|
| Z          | 3.4           |
| X          | 0.8           |
| Y          | 1.0           |
| C          | 2.4           |
| E          | 1.35          |

(2) Package Type: SOT23



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

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