



## Description

The AH3390Q 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 AH3390Q 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.

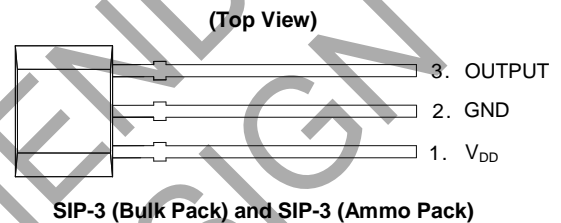
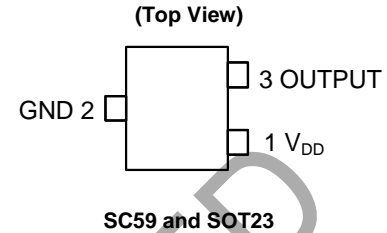
The single open-drain output can be switched on with South pole of sufficient strength. When the magnetic flux density (B) perpendicular to the package is larger than the operate point ( $B_{OP}$ ) the output is switched on (pulled low) and is held on until the magnetic flux density B is lower than the release point ( $B_{RP}$ ). The output remains switched off for North pole fields to or no magnetic fields.

The magnetic operating and release polarity is opposite for SOT23 and SC59 packages. The SOT23, SIP-3 (Ammo Pack) and SIP-3 (Bulk Pack) packages require south pole to the part marking side to operate while SC59 requires south pole to the non-part marking side.

## Features

- Unipolar Operation
- Medium Sensitivity:  $B_{OP}$  and  $B_{RP}$  of 210G and 185G 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 SC59, 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 AH3390Q 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/>

## Pin Assignments



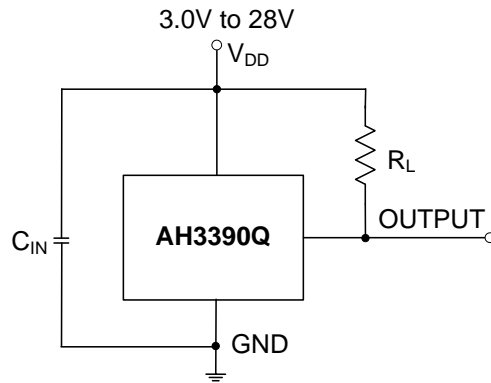
## Applications

- 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)



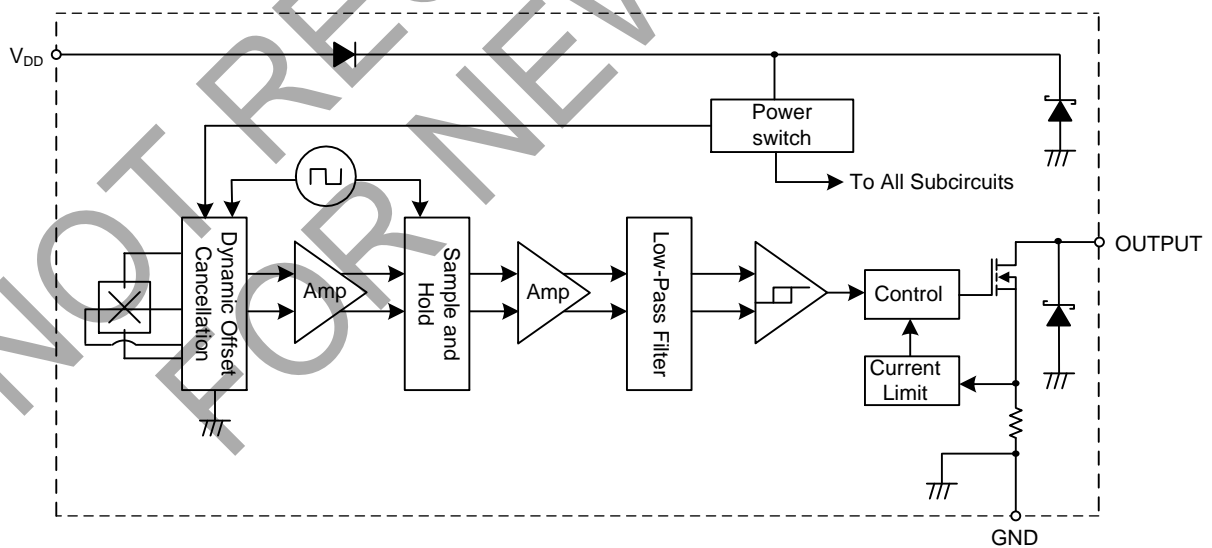
Note: 4.  $C_{IN}$  is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF.  $R_L$  is the pullup resistor.

## Pin Descriptions

Packages: SC59, SOT23, SIP-3 (Ammo Pack) and 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 (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) SIP-3 (Bulk Pack) SC59 and SOT23	550 230 mW
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 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:

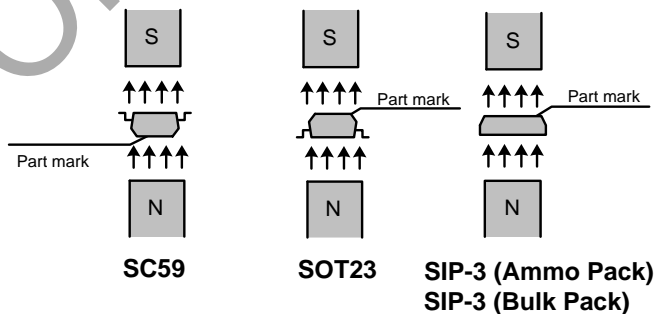
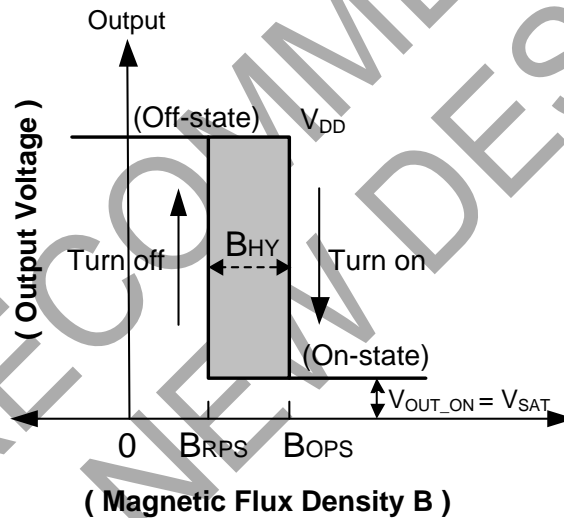
- When power is initially turned on, V<sub>DD</sub> must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the startup time of 10μs typical from the operating voltage reaching 3V.
- Typical values are defined at T<sub>A</sub> = +25°C,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

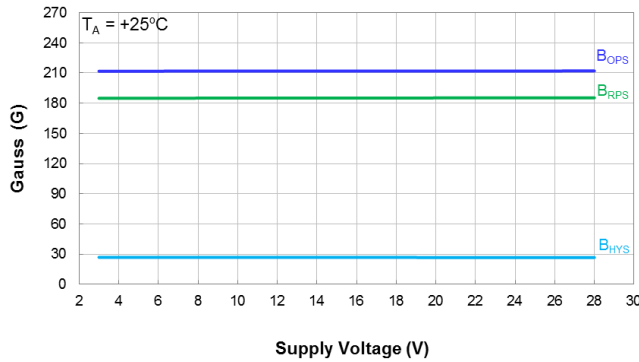
Symbol	Parameter	Condition	Min	Typ	Max	Unit
B <sub>OPS</sub> (South pole to the part marking side for SOT23 and SIP-3 (Ammo Pack), SIP-3 (Bulk Pack) packages; South pole to the non-part marking side for SC59 package. See diagram below)	Operation Point	$V_{DD} = 12\text{V}$ , $T_A = +25^\circ\text{C}$	—	210	—	Gauss
		$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	180	210	240	
B <sub>RPS</sub> (South pole to the part marking side for SOT23 and SIP-3 (Ammo Pack), SIP-3 (Bulk Pack) packages; South pole to the non-part marking side for SC59 package. See diagram below)	Release Point	$V_{DD} = 12\text{V}$ , $T_A = +25^\circ\text{C}$	—	185	—	
		$T_A = -40^\circ\text{C}$ to $+150^\circ\text{C}$	155	185	220	
B <sub>HY</sub> ( $ B_{OPX}  -  B_{RPX} $ )	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	35	

- 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.

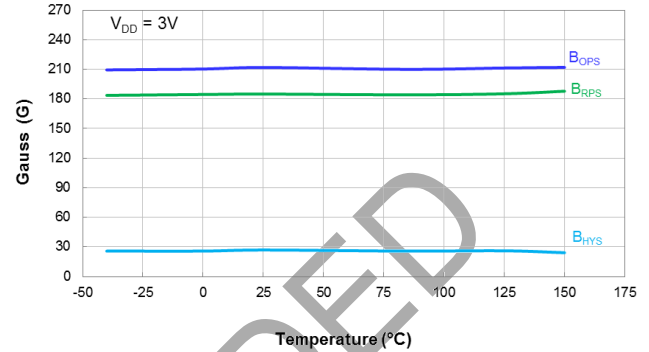


## Typical Operating Characteristics

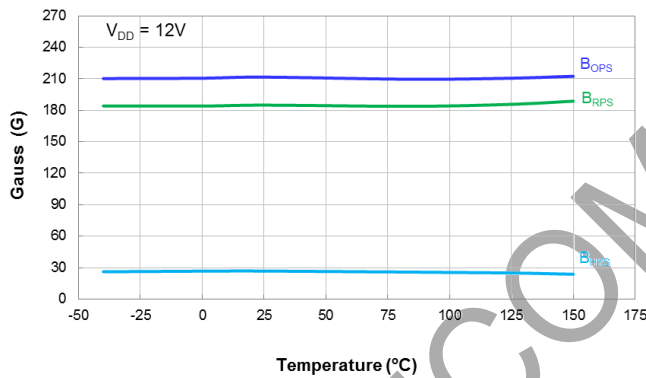
### Output Switch Operate and Release Points (Magnetic Thresholds) – $B_{OPS}$ and $B_{RPS}$



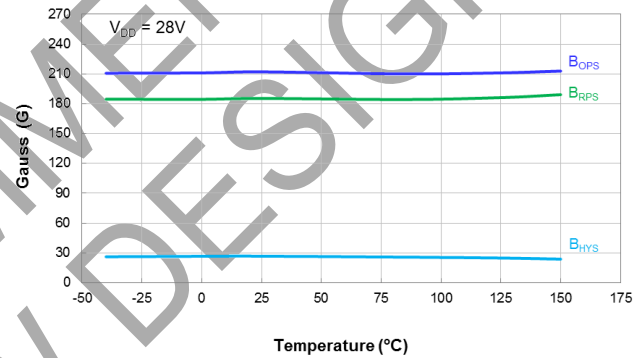
Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Supply Voltage



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

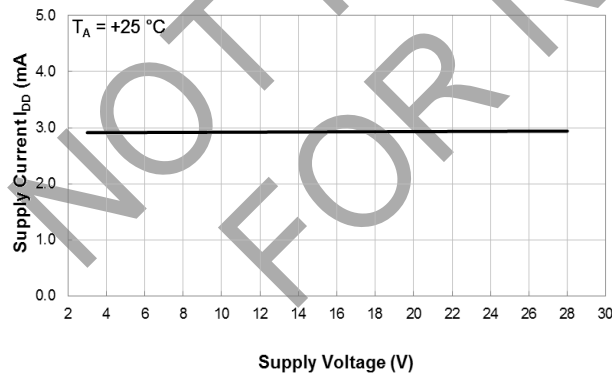


Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Temperature

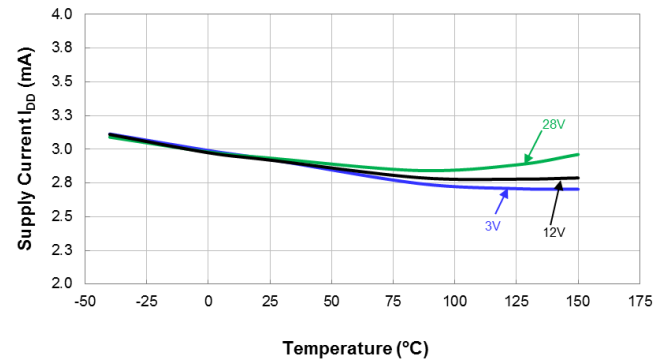


Switch Points  $B_{OPS}$  and  $B_{RPS}$  vs Temperature

### Supply Current



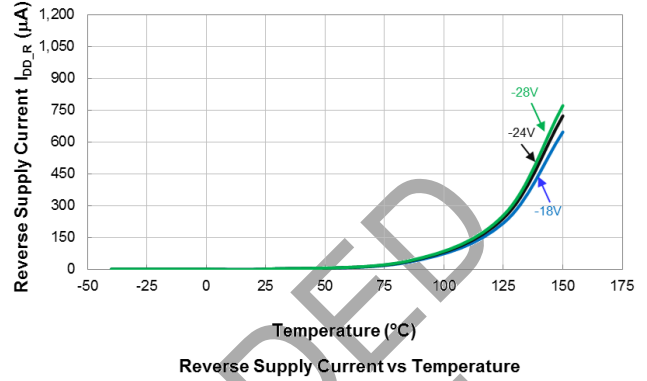
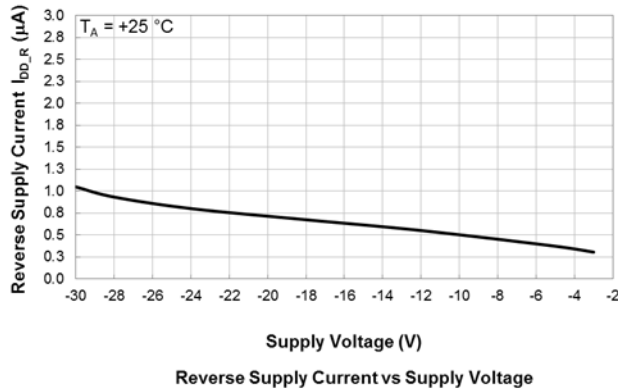
Supply Current vs Supply Voltage



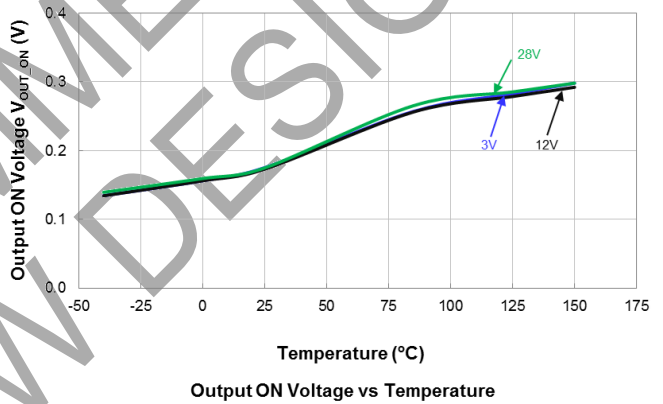
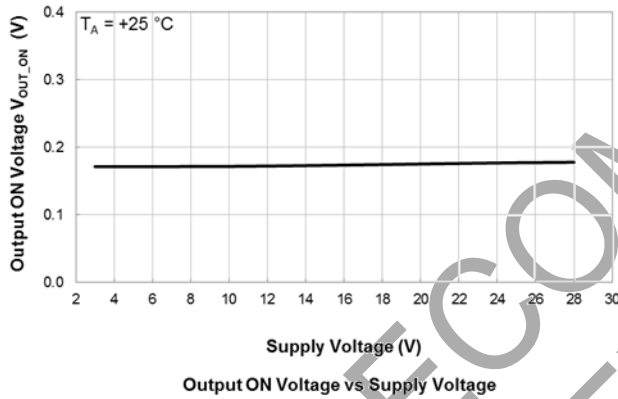
Supply Current vs Temperature

## Typical Operating Characteristics (continued)

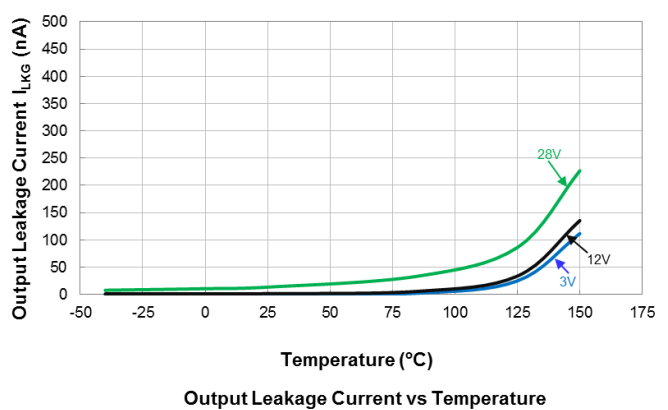
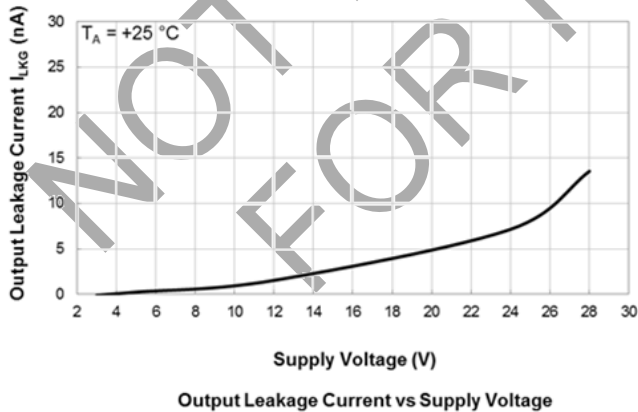
### Supply Reverse Current



### Output Switch On Voltage

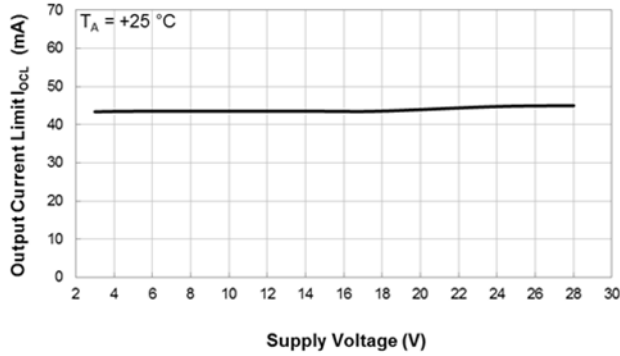


### Output Switch Leakage Current

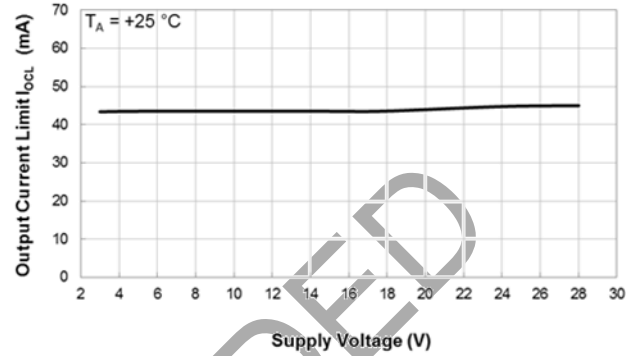


## Typical Operating Characteristics (continued)

### Output Current Limit



Output Current Limit vs Supply Voltage

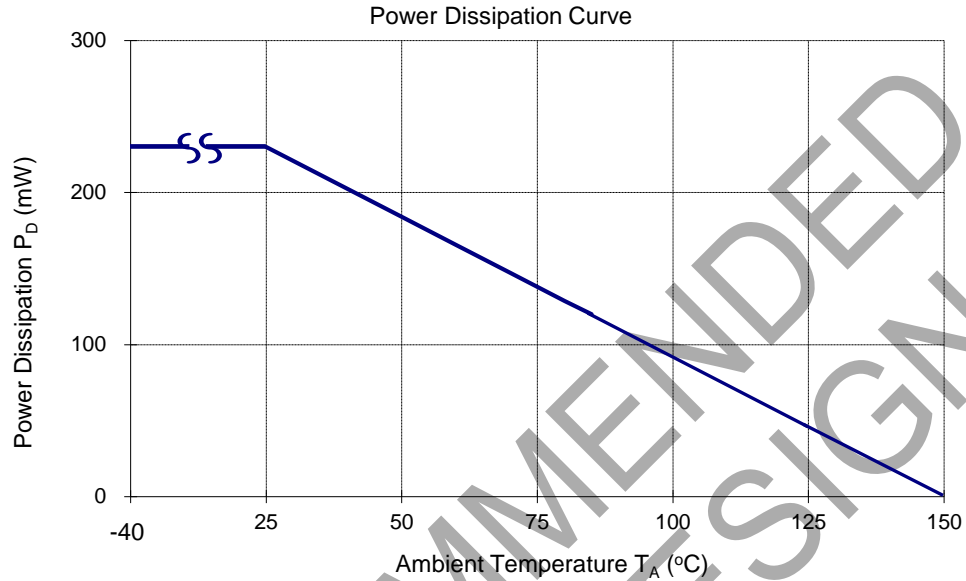


Output Current Limit vs Supply Voltage

## Thermal Performance Characteristics

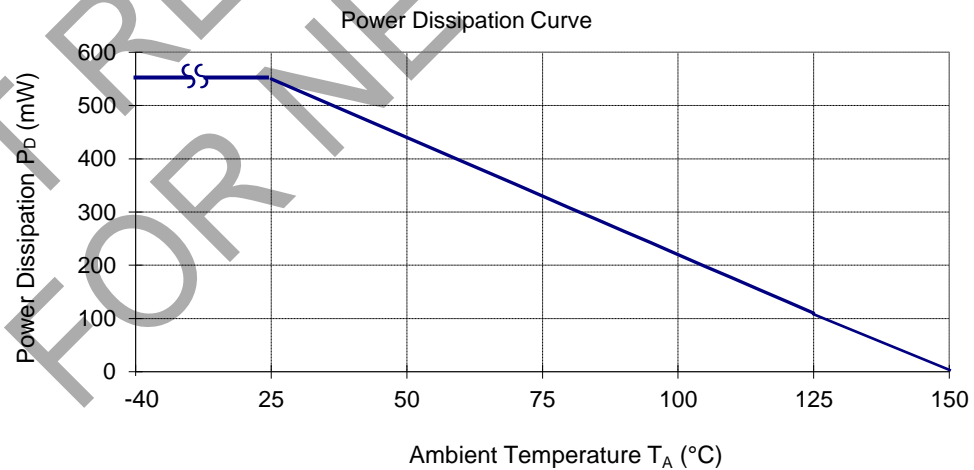
### (1) Package Types: SC59 and SOT23

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



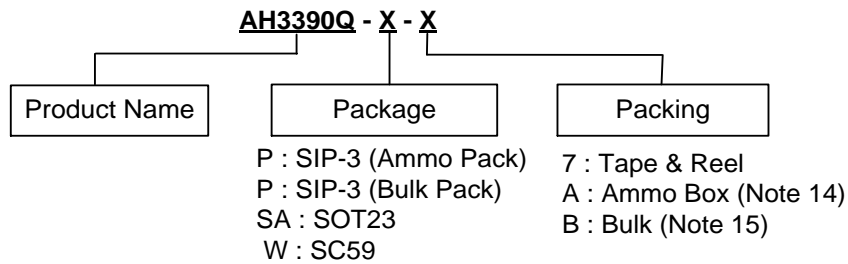
### (2) Package Types: SIP-3 (Ammo Pack) and SIP-3 (Bulk Pack)

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



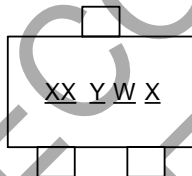
Part Number	Package Code	Package	Part Number Suffix	Packing	
				Qty.	Carrier
AH3390Q-P-A	P	SIP-3 (Ammo Pack)	-A	4000	Ammo Box
AH3390Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk Box
AH3390Q-SA-7	SA	SOT23	-7	3000	7" Tape & Reel
AH3390Q-W-7	W	SC59	-7	3000	7" Tape & Reel

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 Types: SC59 and SOT23

( Top View )

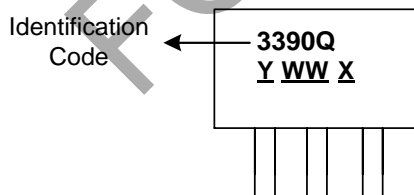


**XX** : Identification Code  
**Y** : Year 0 to 9 (ex: 3 = 2023)  
**W** : Week : A to Z : week 1 to 26;  
a to z : week 27 to 52; z represents  
week 52 and 53  
**X** : Internal Code

Part Number	Package	Identification Code
AH3390Q-W-7	SC59	DA
AH3390Q-SA-7	SOT23	MX

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

( Top View )



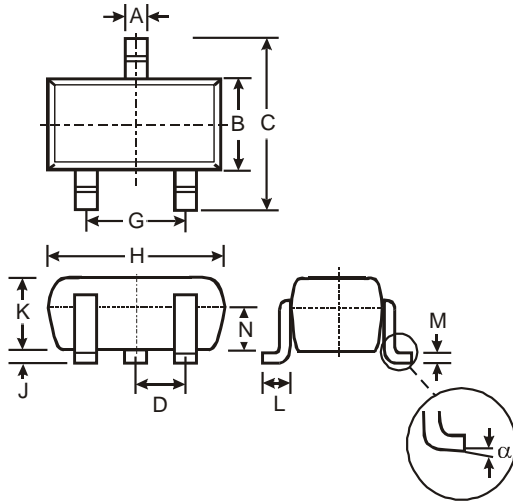
**Y** : Year : 0 to 9 (ex: 3 = 2023)  
**WW** : Week : 01 to 52, "52" represents  
week 52 and 53  
**X** : Internal Code

Part Number	Package	Identification Code
AH3390Q-P-A	SIP-3 (Ammo Pack)	3390Q
AH3390Q-P-B	SIP-3 (Bulk Pack)	3390Q

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

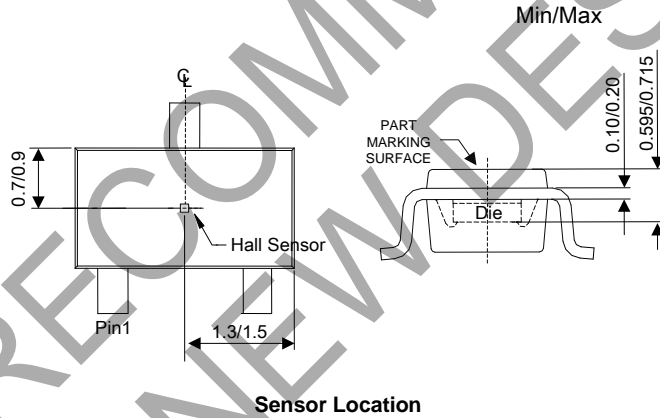
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### (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°	-

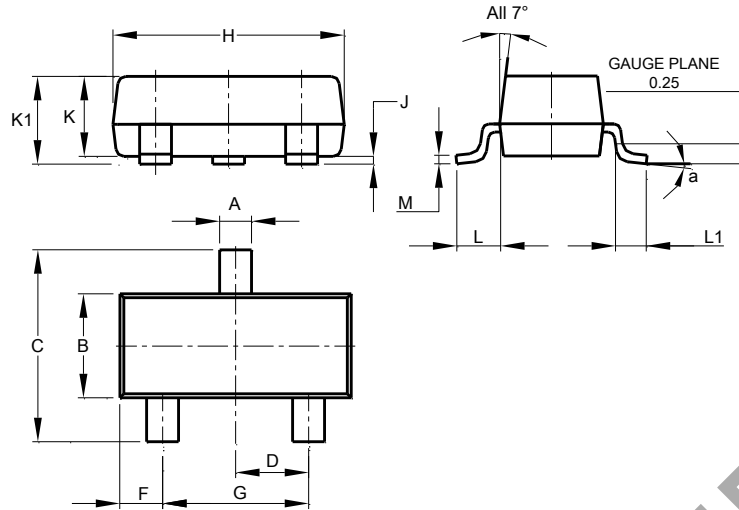
All Dimensions in mm



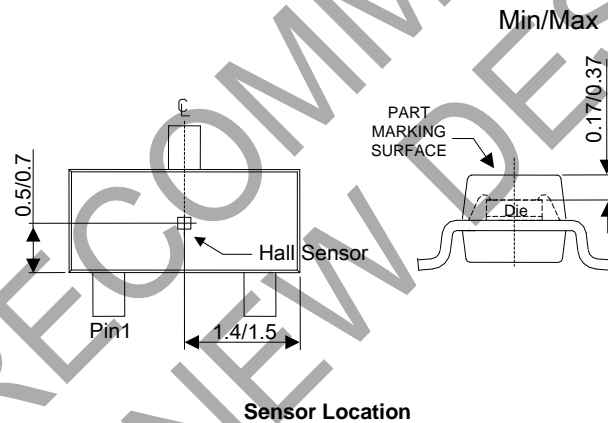
**Package Outline Dimensions** (continued) (All dimensions in mm.)

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

(2) Package Type: SOT23



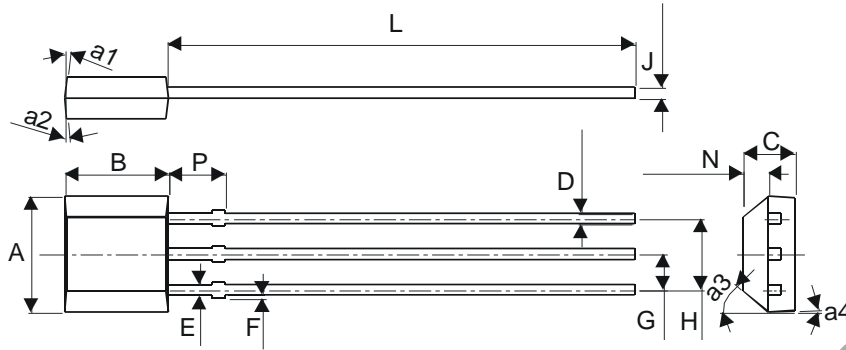
SOT23			
Dim	Min	Max	Typ
A	0.37	0.51	0.40
B	1.20	1.40	1.30
C	2.30	2.50	2.40
D	0.89	1.03	0.915
F	0.45	0.60	0.535
G	1.78	2.05	1.83
H	2.80	3.00	2.90
J	0.013	0.10	0.05
K	0.890	1.00	0.975
K1	0.903	1.10	1.025
L	0.45	0.61	0.55
L1	0.25	0.55	0.40
M	0.085	0.150	0.110
a	0°	8°	--
All Dimensions in mm			



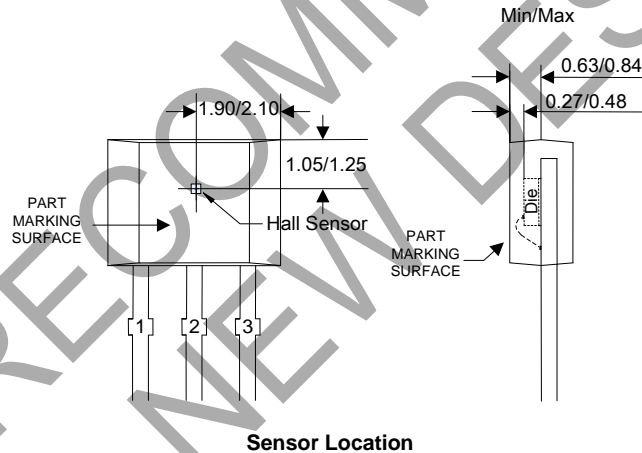
**Package Outline Dimensions** (continued) (All dimensions in mm.)

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

(3) Package Type: SIP-3 (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		

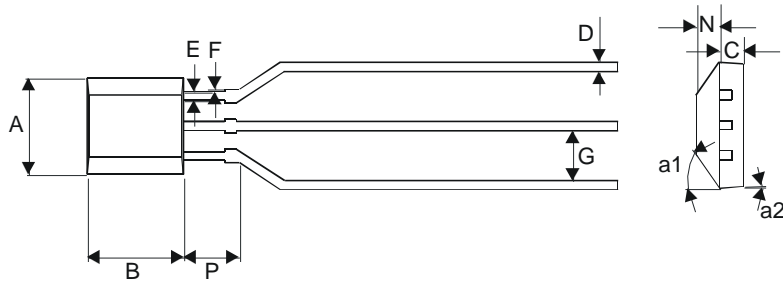


Sensor Location

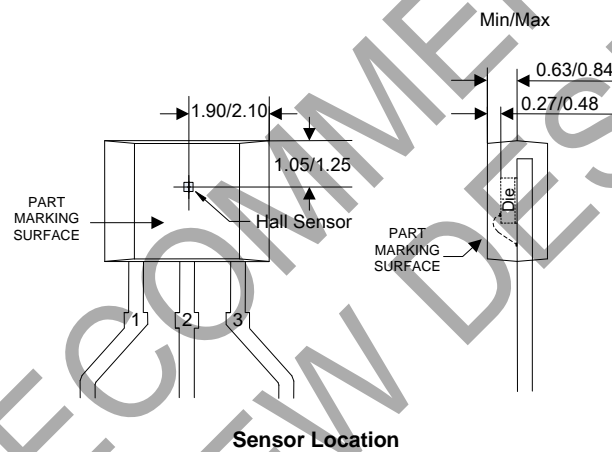
**Package Outline Dimensions** (continued) (All dimensions in mm.)

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

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



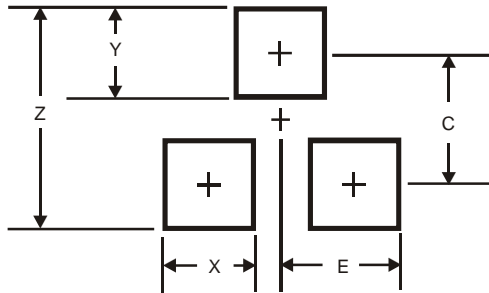
SIP-3 (Ammo Pack)		
Dim	Min	Max
A	3.9	4.3
a1	45° Typ	
a2	3° Typ	
B	2.8	3.2
C	1.40	1.60
D	0.35	0.41
E	0.43	0.48
F	0	0.2
G	2.4	2.9
N	0.63	0.84
P	1.55	-
All Dimensions in mm		



## Suggested Pad Layout

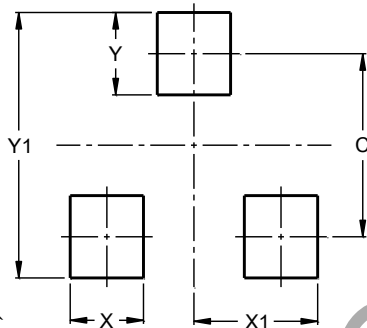
Please see <http://www.diodes.com/package-outlines.html> for the latest version.

### (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)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

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