THE AH3390Q IS NOT RECOMMENDED FOR NEW DESIGNS.
PLEASE USE THE AH3320Q.

AH3390Q

Lead-free Green

HIGH-VOLTAGE ULTRA LOW-SENSITIVITY AUTOMOTIVE HALL-EFFECT UNIPOLAR SWITCH

Description

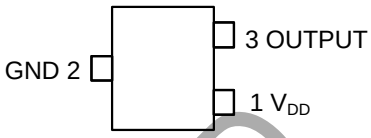
The AH3390Q is an AEC-Q100 qualified high-voltage low-sensitivity Hall-effect Unipolar switch IC designed for position and proximity sensing in automotive applications such as in seat and seatbelt buckle, steering lock/immobilisation, gear stick, transmission actuator and gear position, HVAC compression, 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.

Pin Assignments

(Top View)



SC59 and SOT23

(Top View)

SIP-3 (Bulk Pack) and SIP-3 (Ammo Pack)

Features

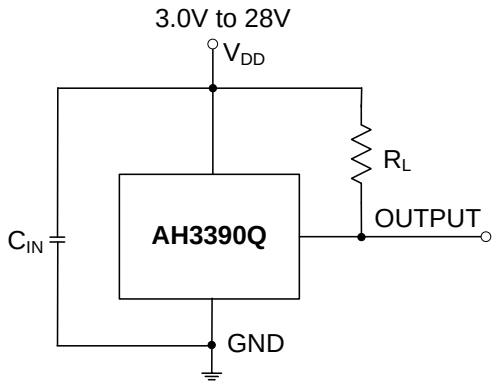
- Unipolar Operation
- Medium Sensitivity: B_{OP} and B_{RP} of 210G and 185G Typical
- Single Open-Drain Output with Overcurrent Limit
- 3.0V to 28V Operating Voltage Range
- Chopper Stabilized Design Provides
  - Superior Temperature Stability
  - Minimal Switch Point Drift
  - Enhanced Immunity to 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/

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)



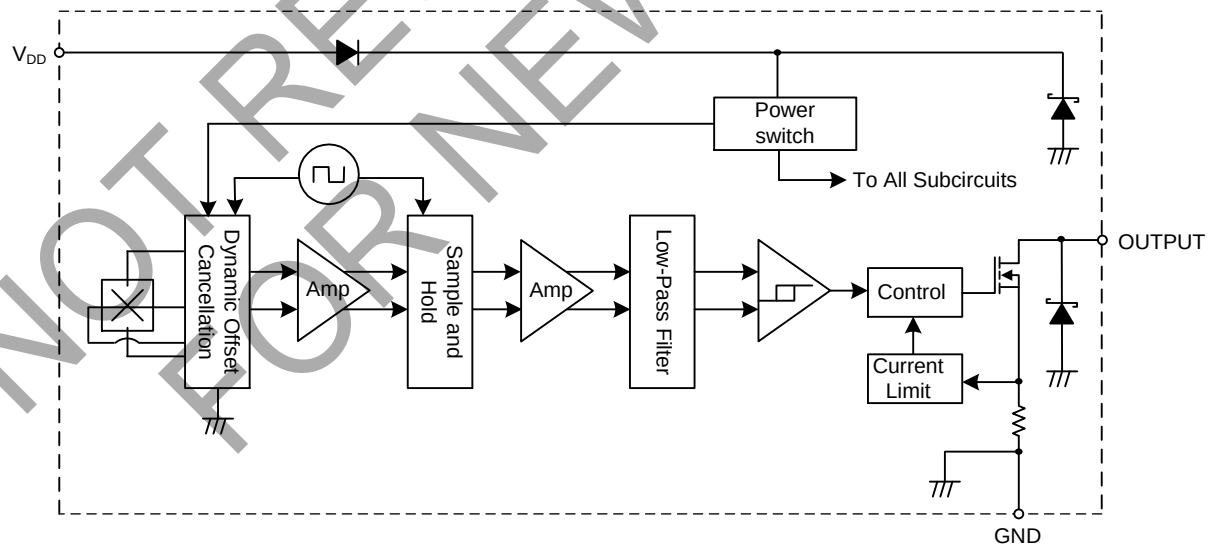
Note: 4. C_{IN} is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF to 100nF. R_L is the pullup resistor.

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_A = +25°C, unless otherwise specified.)

Symbol	Characteristic		Value	Unit
V_{DD}	Supply Voltage (Note 6)		32	V
V_{DDR}	Reverse Supply Voltage (Note 6)		-32	V
V_{OUT_MAX}	Output Off Voltage (Note 6)		32	V
I_{OUT}	Continuous Output Current		60	mA
I_{OUT_R}	Reverse Output Current		-50	mA
B	Magnetic Flux Density		Unlimited	
P_D	Package Power Dissipation	SIP-3 (Ammo Pack) SIP-3 (Bulk Pack)	550	mW
		SC59 and SOT23	230	
T_S	Storage Temperature Range		-65 to +165	°C
T_J	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:
5. 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.
6. The absolute maximum V_{DD} 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_A = -40°C to +150°C, unless otherwise specified.)

Symbol	Parameter	Condition	Rating	Unit
V_{DD}	Supply Voltage	Operating	3.0 to 28	V
T_A	Operating Temperature Range	Operating	-40 to +150	°C

Electrical Characteristics (Notes 7 & 8) (@T_A = -40°C to +150°C, V_{DD} = 3V to 28V, unless otherwise specified.)

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{OUT_ON}	Output ON Voltage	I_{OUT} = 20mA, B > B_{OP}	—	0.2	0.4	V
I_{LKG}	Output Leakage Current (When output is off)	V_{OUT} = 28V, B < B_{RP}, Output off	—	< 0.1	10	μA
I_{DD}	Supply Current	Output open, T_A = +25°C	—	3	3.5	mA
		Output open, T_A = -40°C to +150°C	—	—	4	mA
I_{DD_R}	Reverse Supply Current	V_{DD} = -18V, T_A = +25°C	—	0.6	—	μA
		V_{DD} = -18V, T_A = -40°C to +150°C	—	0.6	1500	μA
		V_{DD} = -28V, T_A = +25°C	—	1.6	—	μA
		V_{DD} = -28V, T_A = -40°C to +150°C	—	1.6	2500	μA
t_{P_ON}	Device Power-On Time (Startup time)	V_{DD} ≥ 3V, B > B_{OP} (Note 7)	—	10	—	μs
f_C	Chopping Frequency	—	—	800	—	kHz
t_D	Response Time Delay (Time from magnetic threshold reached to the start of the output rise or fall)	(Note 9)	—	3.75	—	μs
t_R	Output Rising Time (External pullup resistor R_L and load capacitance dependent)	R_L = 1kΩ, C_L = 20pF	—	0.2	1	μs
t_F	Output Falling Time (Internal switch resistance and load capacitance dependent)	R_L = 1kΩ, C_L = 20pF	—	0.1	1	μs
I_{OCL}	Output Current Limit	B > B_{OP} (Note 10)	30	—	55	mA
V_Z	Zener Clamp Voltage	I_{DD} = 5mA	28	—	—	V

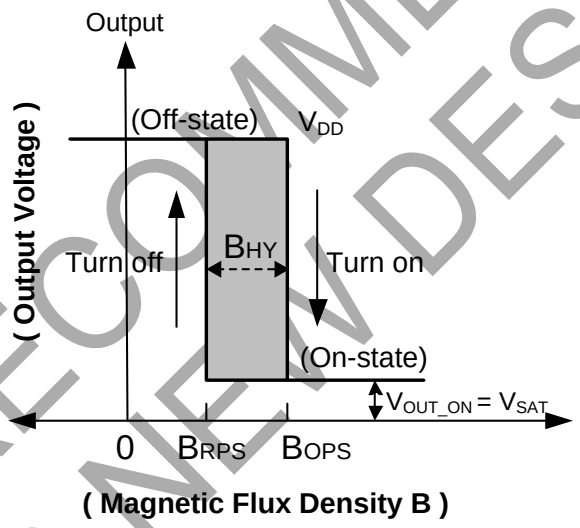
Notes:
7. When power is initially turned on, V_{DD} must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the startup time of 10μs typical from the operating voltage reaching 3V.
8. Typical values are defined at T_A = +25°C, V_{DD} = 12V. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization.
9. Guaranteed by design, process control and characterization. Not tested in production.
10. The device will limit the output current I_{OUT} to current limit of I_{OCL}.

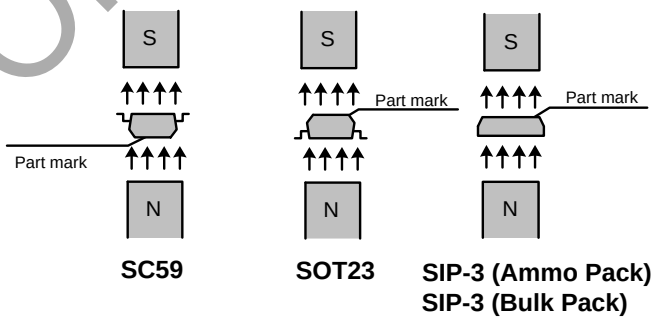
Magnetic Characteristics (Notes 11 & 12) (T_A = -40°C to +150°C, V_{DD} = 3.0V to 28V, unless otherwise specified.)

(1mT = 10 Gauss)

Symbol	Parameter	Condition	Min	Typ	Max	Unit
B_{OPS} (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} = 12V, T_A = +25°C	—	210	—	Gauss
		T_A = -40°C to +150°C	180	210	240	
B_{RPS} (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} = 12V, T_A = +25°C	—	185	—	
		T_A = -40°C to +150°C	155	185	220	
B_{HY} ($\|B_{OPX}\|$-$\|B_{RPX}\|$)	Hysteresis (Note 13)	V_{DD} = 12V, T_A = +25°C	—	25	—	
		T_A = -40°C to +150°C	17	25	35	

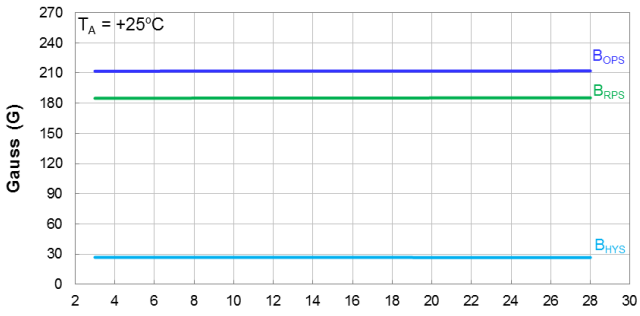
Notes:
11. When power is initially turned on, V_{DD} must be within its correct operating range (3.0V to 28V) to guarantee the output sampling. The output state is valid after the startup time of 10µs typical from the operating voltage reaching 3V.
12. Typical values are defined at T_A = +25°C, V_{DD} = 12V. Maximum and minimum values over the operating temperature range is not tested in production but guaranteed by design, process control and characterization.
13. Maximum and minimum hysteresis is guaranteed by design, process control and characterization.



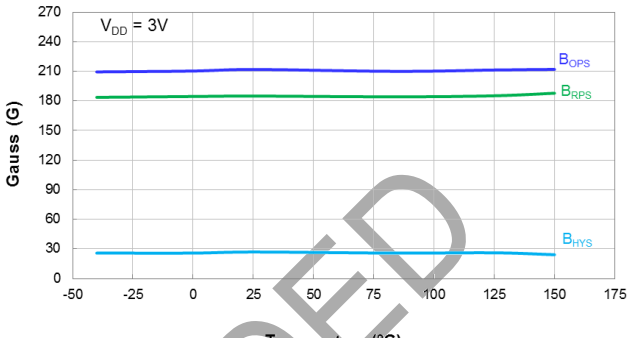


Typical Operating Characteristics

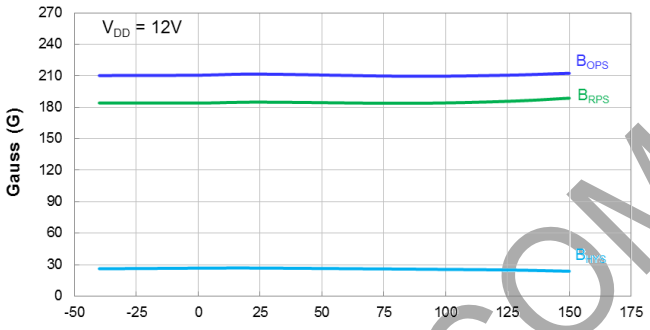
Output Switch Operate and Release Points (Magnetic Thresholds) – B_{OPS} and B_{RPS}



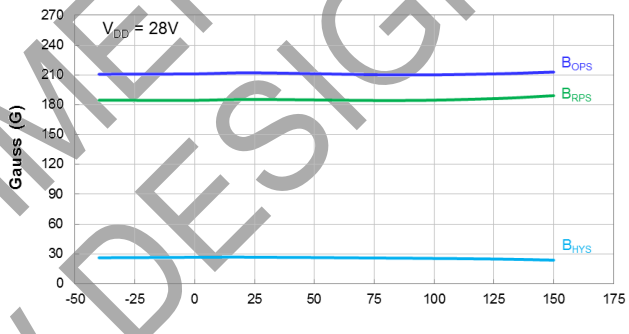
Switch Points B_{OPS} and B_{RPS} vs Supply Voltage



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

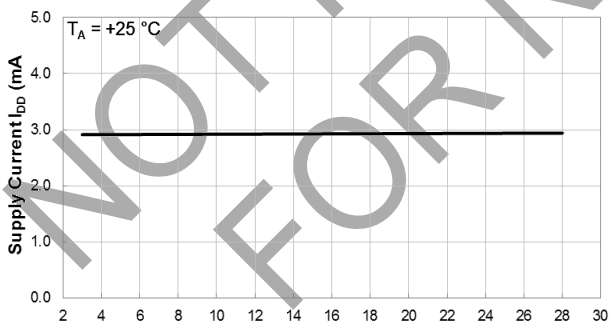


Switch Points B_{OPS} and B_{RPS} vs Temperature

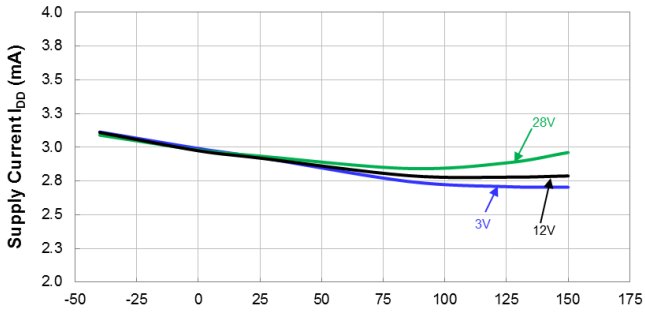


Switch Points B_{OPS} and B_{RPS} vs Temperature

Supply Current



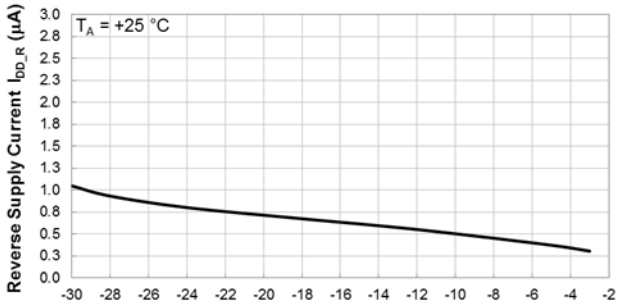
Supply Current vs Supply Voltage



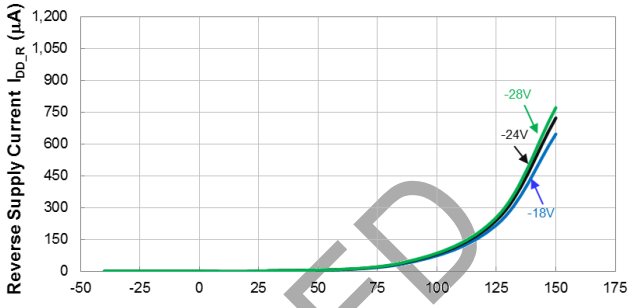
Supply Current vs Temperature

Typical Operating Characteristics (continued)

Supply Reverse Current

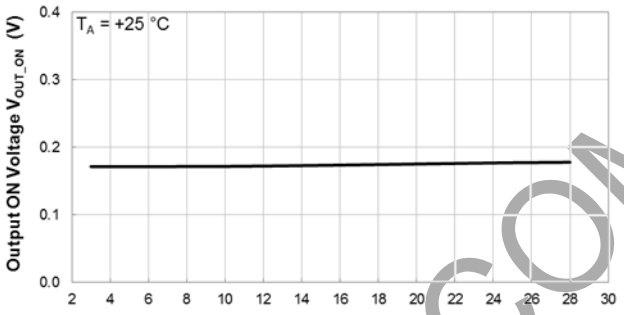


Reverse Supply Current vs Supply Voltage

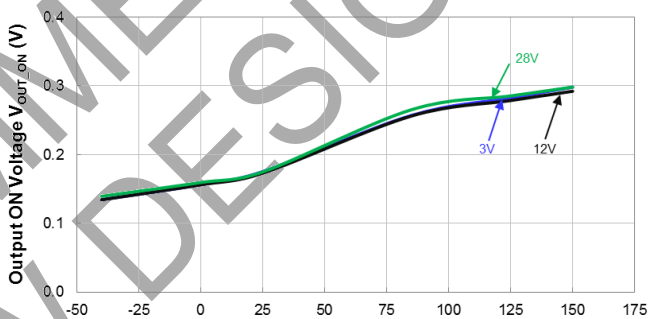


Reverse Supply Current vs Temperature

Output Switch On Voltage

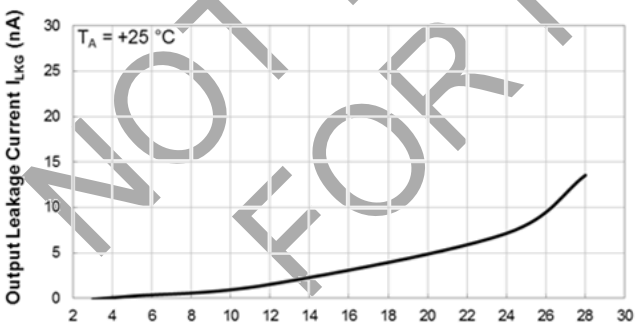


Output ON Voltage vs Supply Voltage

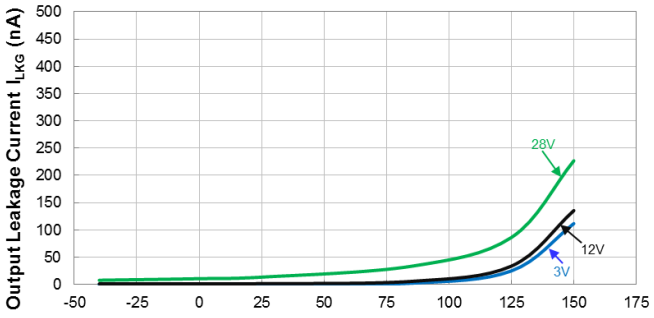


Output ON Voltage vs Temperature

Output Switch Leakage Current



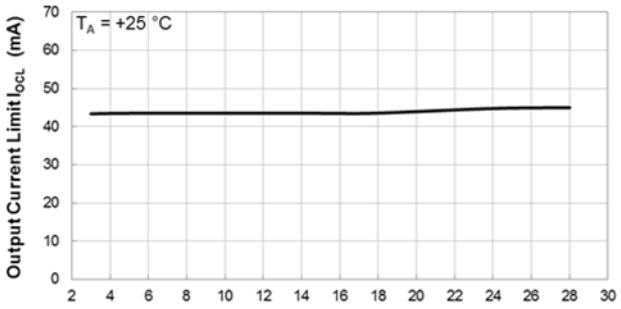
Output Leakage Current vs Supply Voltage



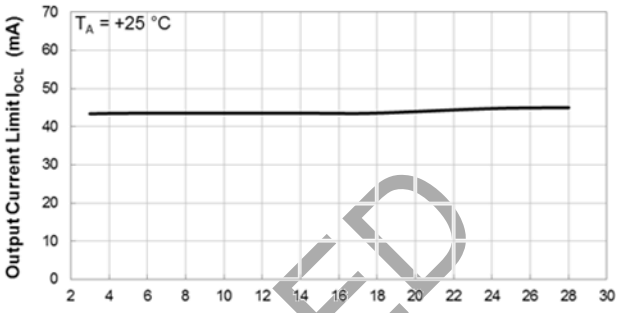
Output Leakage Current vs Temperature

Typical Operating Characteristics (continued)

Output Current Limit



Output Current Limit vs Supply Voltage

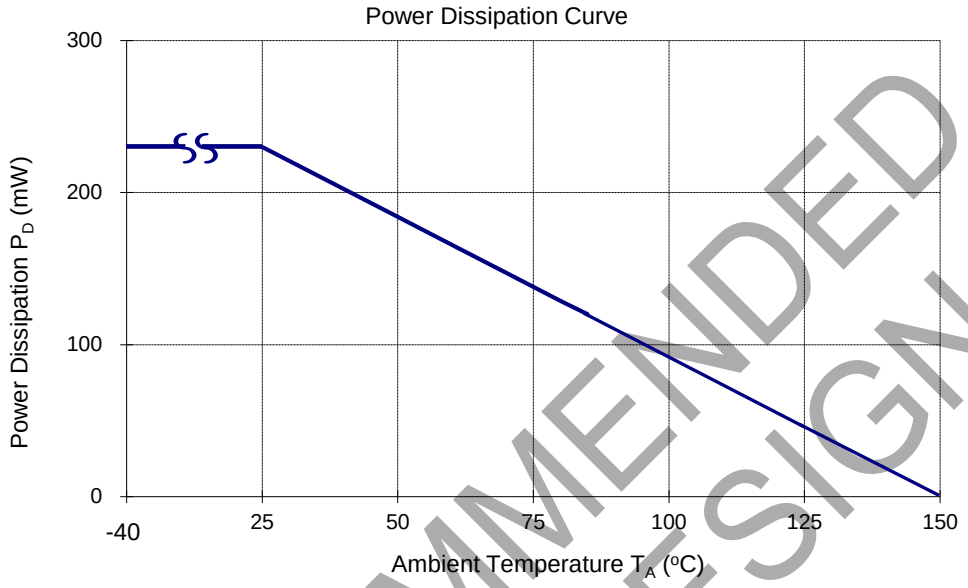


Output Current Limit vs Supply Voltage

Thermal Performance Characteristics

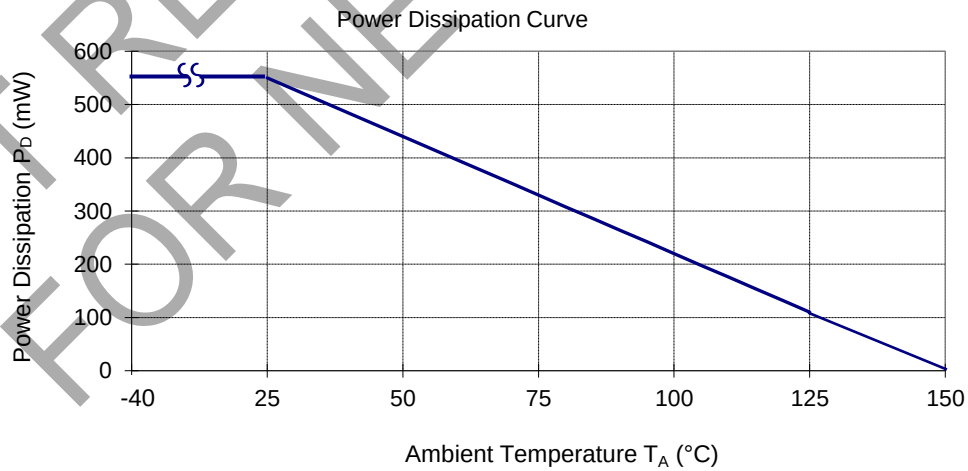
(1) Package Types: SC59 and SOT23

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

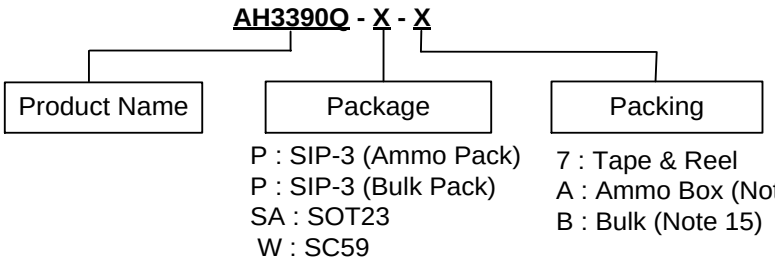


(2) Package Types: SIP-3 (Ammo Pack) and SIP-3 (Bulk Pack)

T_A (°C)	25	50	60	70	80	85	90	100	105	110	120	125	130	140	150
P_D (mW)	550	440	396	362	308	286	264	220	198	176	132	110	88	44	0



Ordering Information



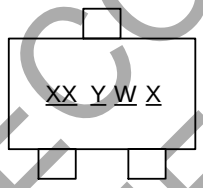
Part Number	Package Code	Package	Part Number Suffix	Packing	
				Qty.	Carrier
AH3390Q-P-A	P	SIP-3 (Ammo Pack)	-A	4000	Ammo Box
AH3390Q-P-B	P	SIP-3 (Bulk Pack)	-B	1000	Bulk Box
AH3390Q-SA-7	SA	SOT23	-7	3000	7” Tape & Reel
AH3390Q-W-7	W	SC59	-7	3000	7” Tape & Reel

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)

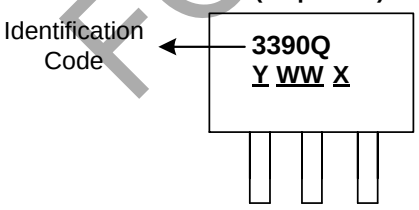


XX : Identification Code
Y : Year 0 to 9 (ex: 3 = 2023)
W : Week : A to Z : week 1 to 26;
a to z : week 27 to 52; z represents week 52 and 53
X : Internal Code

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)



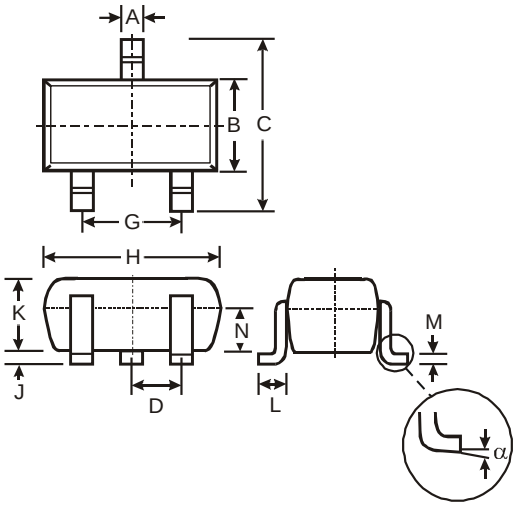
Y : Year : 0 to 9 (ex: 3 = 2023)
WW : Week : 01 to 52, "52" represents week 52 and 53
X : Internal Code

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

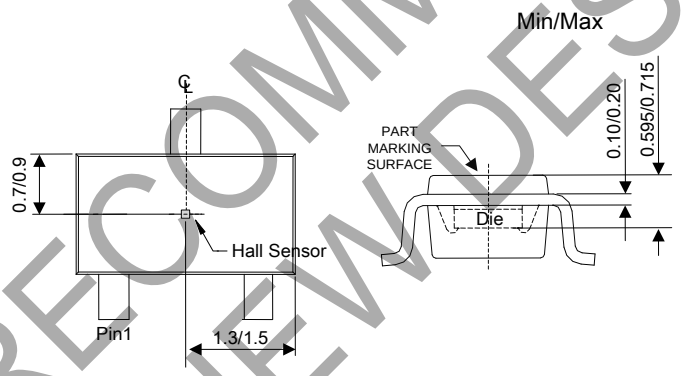
Package Outline Dimensions (All dimensions in mm.)

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			

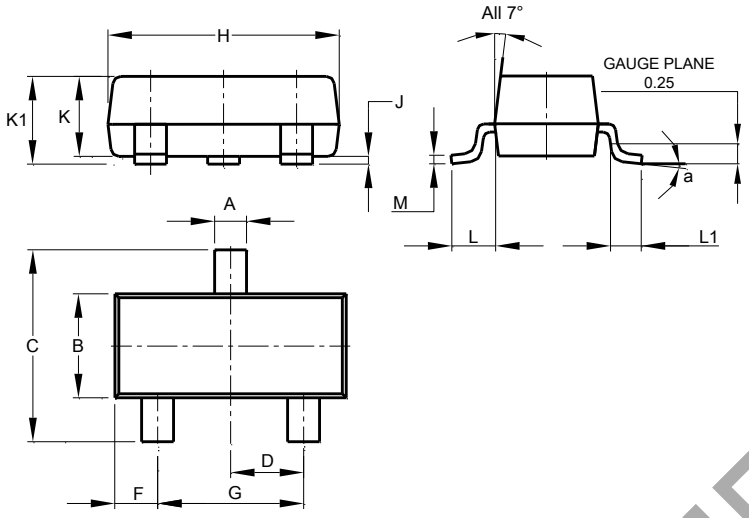


Sensor Location

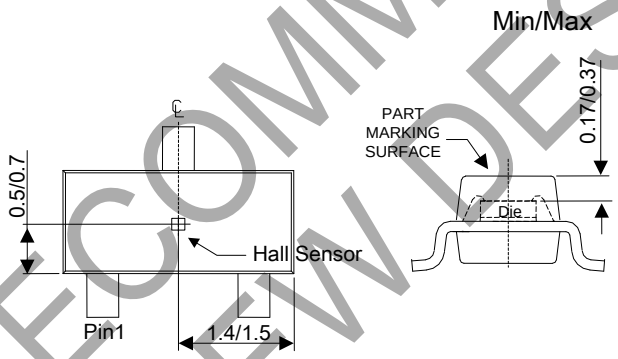
Package Outline Dimensions (continued) (All dimensions in mm.)

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			

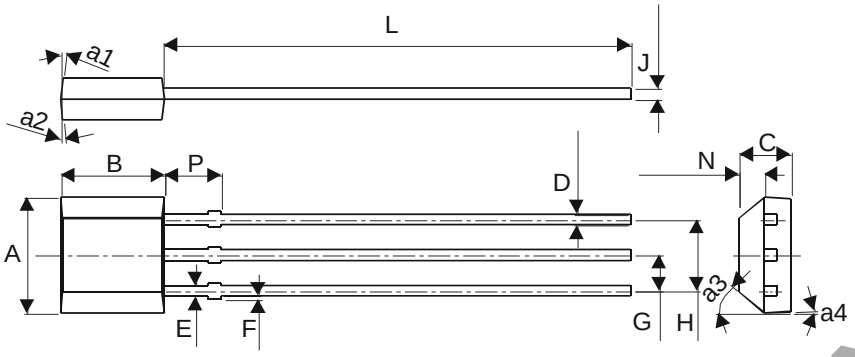


Sensor Location

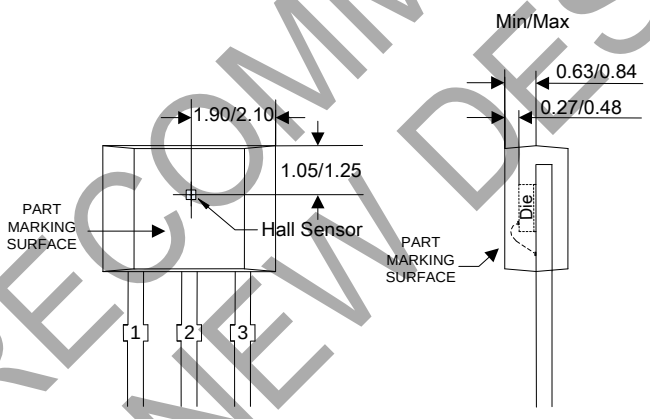
Package Outline Dimensions (continued) (All dimensions in mm.)

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

(3) Package Type: SIP-3 (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		

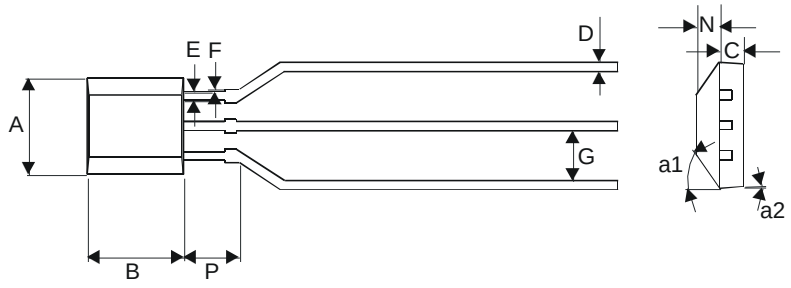


Sensor Location

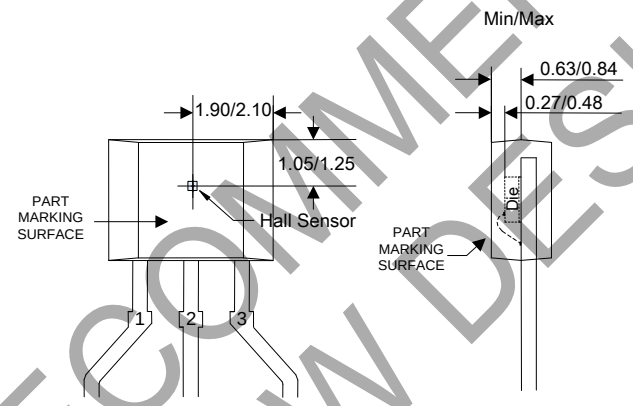
Package Outline Dimensions (continued) (All dimensions in mm.)

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		

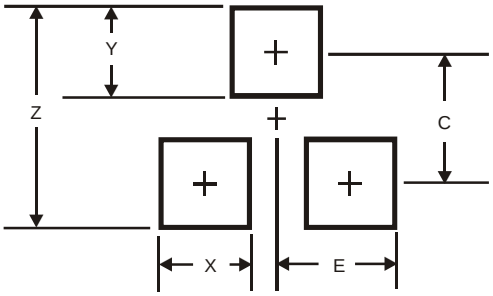


Sensor Location

Suggested Pad Layout

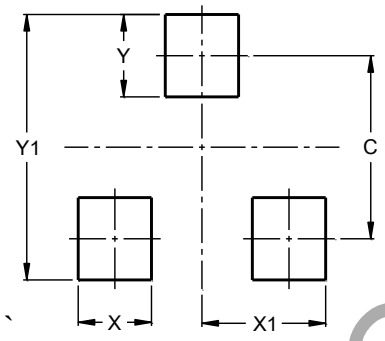
Please see http://www.diodes.com/package-outlines.html for the latest version.

(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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