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

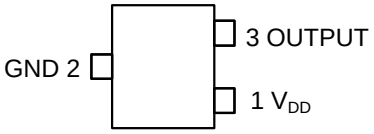
Description

The AH3781 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, consumer home appliance and personal care applications. To support a wide range of demanding applications, the design is optimized to operate over the supply range of 3.0V to 28V. With chopper stabilized architecture and an internal bandgap regulator to provide temperature compensated supply for internal circuits, the AH3781 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}).

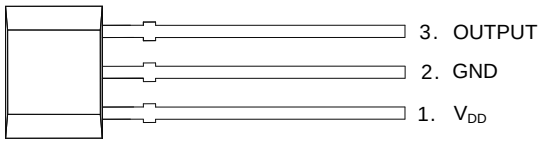
Pin Assignments

(Top View)



SOT23

(Top View)



SIP-3

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 +25G and -25G 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 SOT23 and SIP-3 Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**

Applications

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

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 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.

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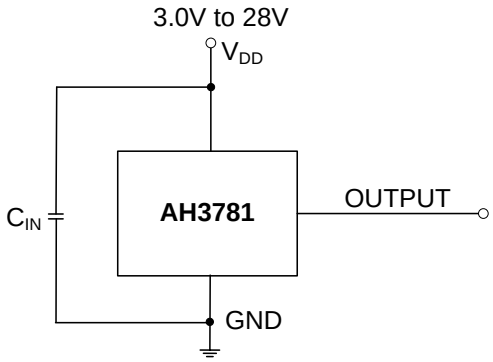
Typical Applications Circuit



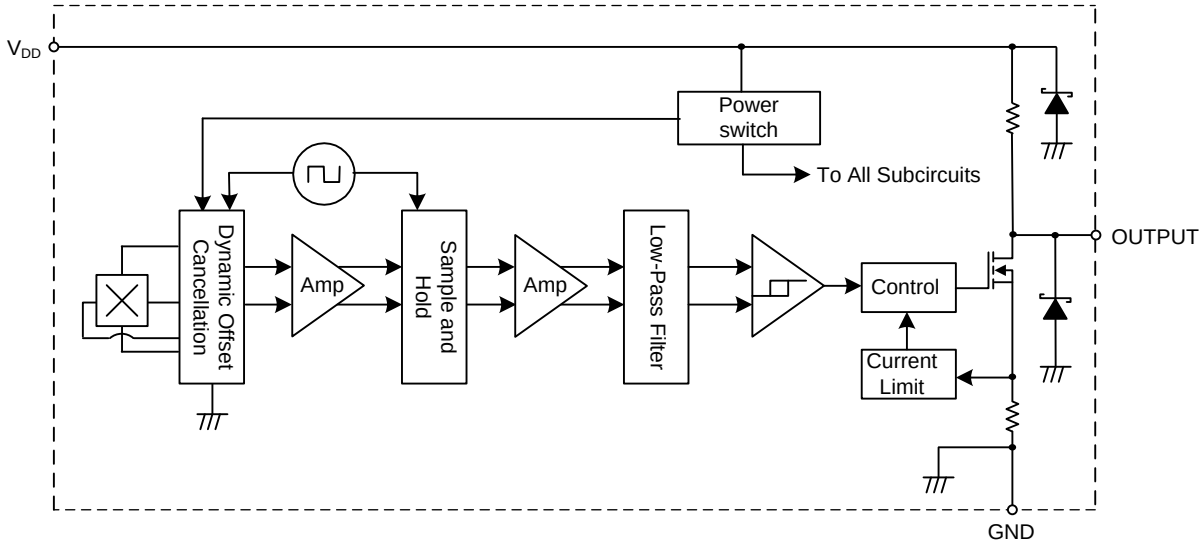
Note: 4. C_{IN} is for power stabilization and to strengthen the noise immunity, the recommended capacitance is 10nF ~ 100nF. R_L is the pull-up resistor.

Pin Descriptions

Package: SOT23

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

Functional Block Diagram



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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		-0.3	V
V_{OUT_MAX}	Output Off Voltage (Note 6)		32V	V
I_{OUT}	Continuous Output Current		60	mA
B	Magnetic Flux Density		Unlimited	
P_D	Package Power Dissipation	SIP-3	550	mW
		SOT23	230	mW
Ts	Storage Temperature Range		-65 to +165	°C
T_J	Maximum Junction Temperature		+150	°C
ESD	Electrostatic Discharge Withstand Capability - Human Body Model		6	kV

Notes: 5. 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.

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 +125°C, unless otherwise specified.)

Symbol	Parameter	Conditions	Rating	Unit
V_{DD}	Supply Voltage	Operating	3.0 to 28	V
T_A	Operating Temperature Range	Operating	-40 to +125	°C

Electrical Characteristics (Note 7 & 8) (@T_A = -40°C to +125°C, V_{DD} = 3V to 28V, unless otherwise specified.)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V_{OUT_ON}	Output On Voltage	I_{OUT} = 20mA, B > B_{OP}	-	0.2	0.4	V
I_{OUT_OFF}	Output Leakage Current	V_{OUT} = 28V, B < B_{RP}, Output off	-	<0.1	15	μA
I_{DD}	Supply Current	Output open, V_{DD} = 12V , T_A = +25°C	-	3.8	4.9	mA
		Output open, T_A = -40°C to +125°C	-	3.8	5.8	mA
R_{PU}	Internal Pull-Up Resistance	T_A = -40°C to +125°C	10	14	18	kΩ
t_{ST}	Device Start-Up Time	V_{DD} >= 3V, B > B_{OP} (Note 7)	-	10		μs
f_c	Chopping Frequency	V_{DD} = 3V to 28V	-	800	-	kHz
t_d	The time delay from magnetic threshold reached to the start of the output rise or fall	(Note 9)	-	3.75	-	μs
t_r	Output Rising Time (external pull-up 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 start-up 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}.

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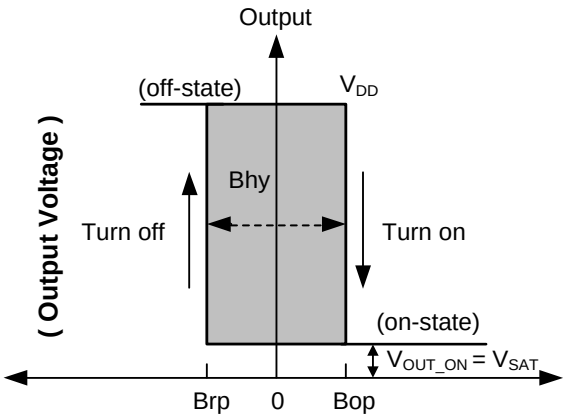
Magnetic Characteristics (Notes 11 &12) (T_A = -40°C to +125°C, V_{DD} = 3.0V to 28V, unless otherwise specified)

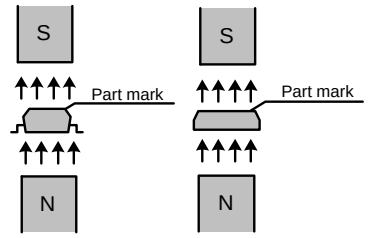
(1mT=10 Gauss)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
B_{OP} (South pole to part marking side)	Operation Point	V_{DD} = 12V, T_A = +25°C	-	25	-	Gauss
		T_A = -40°C to +125°C	10	25	40	
B_{RP} (North pole to part marking side)	Release Point	V_{DD} = 12V, T_A = +25°C	-	-25	-	
		T_A = -40°C to +125°C	-40	-25	-10	
B_{HY} ($\|B_{OPX}\|$-$\|B_{RPX}\|$)	Hysteresis (Note 13)	V_{DD} = 12V, T_A = +25°C	-	50	-	
		T_A = -40°C to +125°C	20	50	80	

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 start-up 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.



(Magnetic Flux Density B)



(SOT23) **(SIP-3)**

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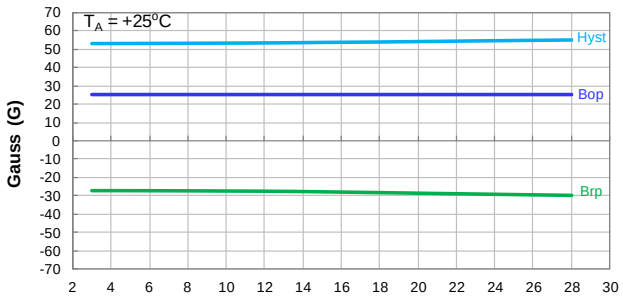
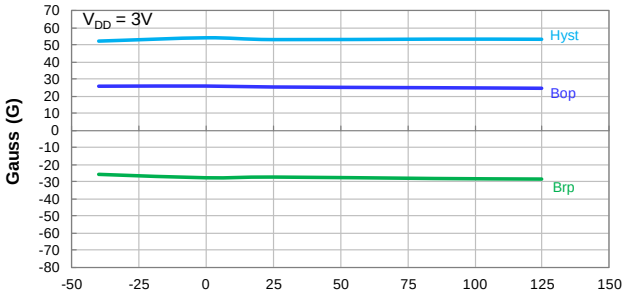
Typical Operating Characteristics

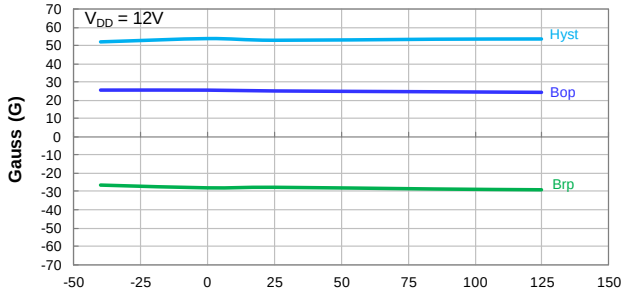
Magnetic Operating Switch Points – B_{OP} and B_{RP}



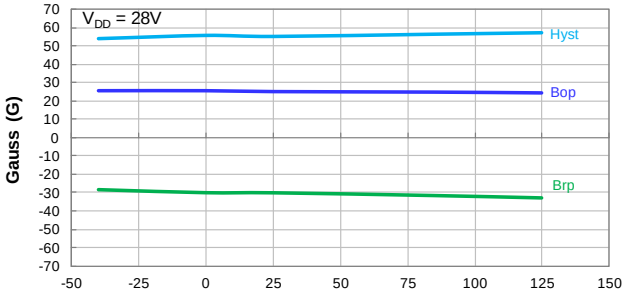
Switch Points Bop and Brp vs Supply Voltage



Switch Points Bop and Brp vs Temperature

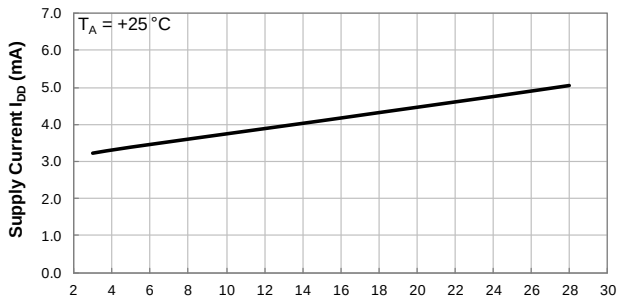


Switch Points Bop and Brp vs Temperature

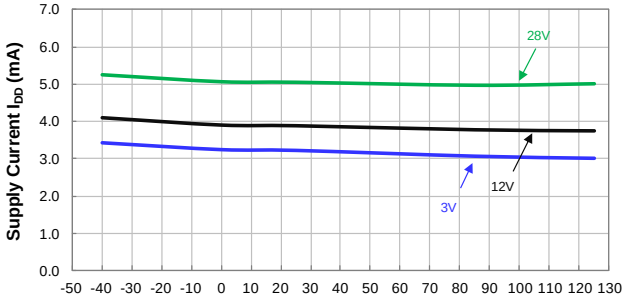


Switch Points Bop and Brp vs Temperature

Supply Current



Supply Current vs Supply Voltage

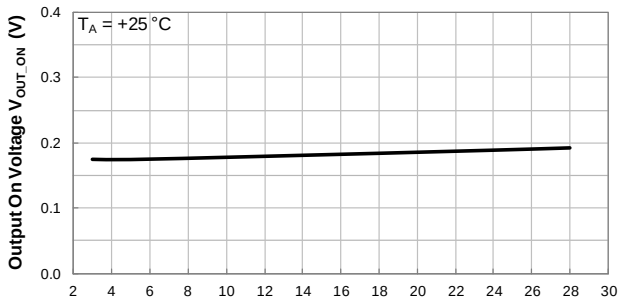


Supply Current vs Temperature

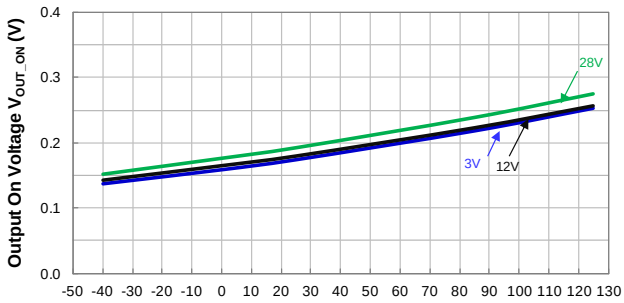
© Diodes Incorporated

Typical Operating Characteristics

Output Switch On Voltage

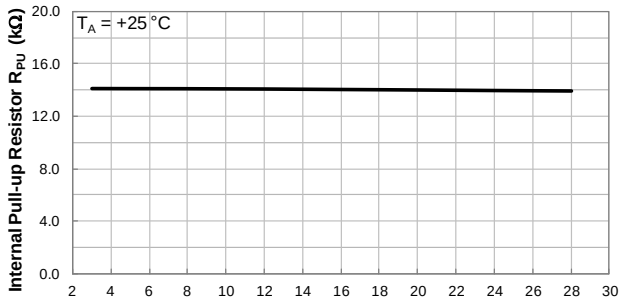


Output On Voltage vs Supply Voltage

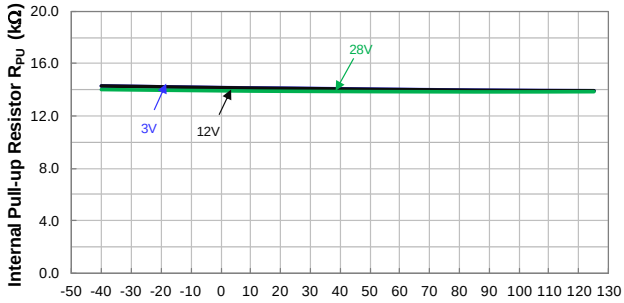


Output On Voltage vs Temperature

Output Pull-Up Resistor (Internal)

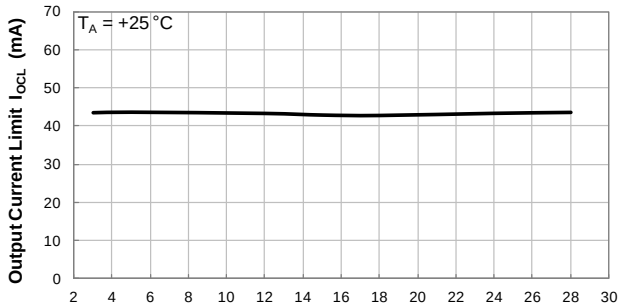


Internal Output Pull-up Resistor vs Supply Voltage

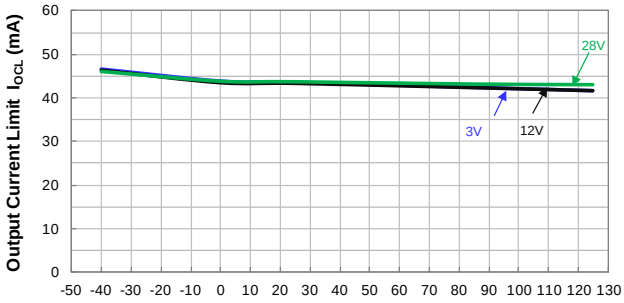


Internal Output Pull-up Resistor vs Temperature

Output Current Limit



Output Current Limit vs Supply Voltage



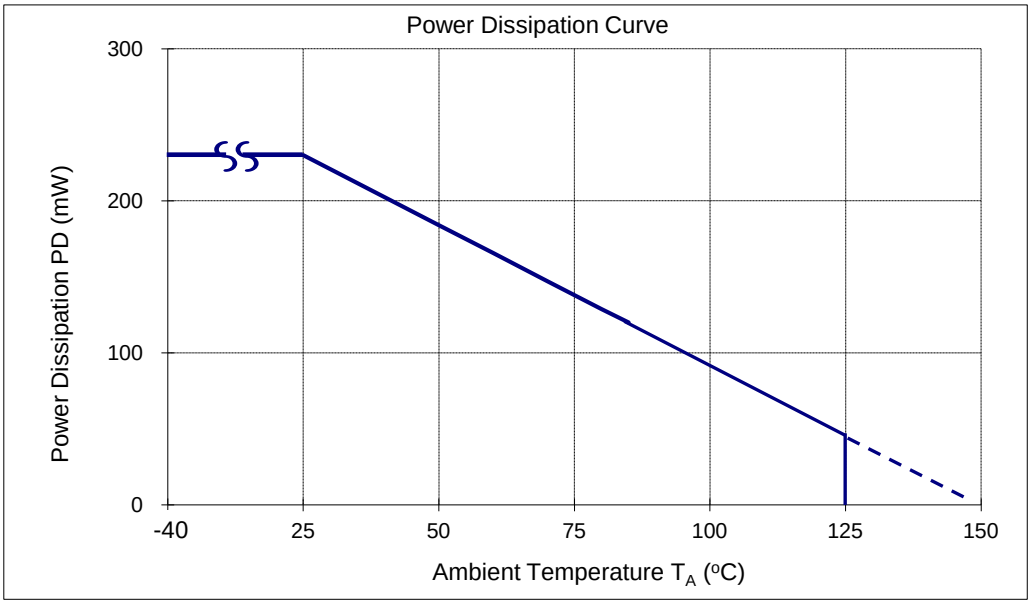
Output Current Limit vs Temperature

© Diodes Incorporated

Thermal Performance Characteristics

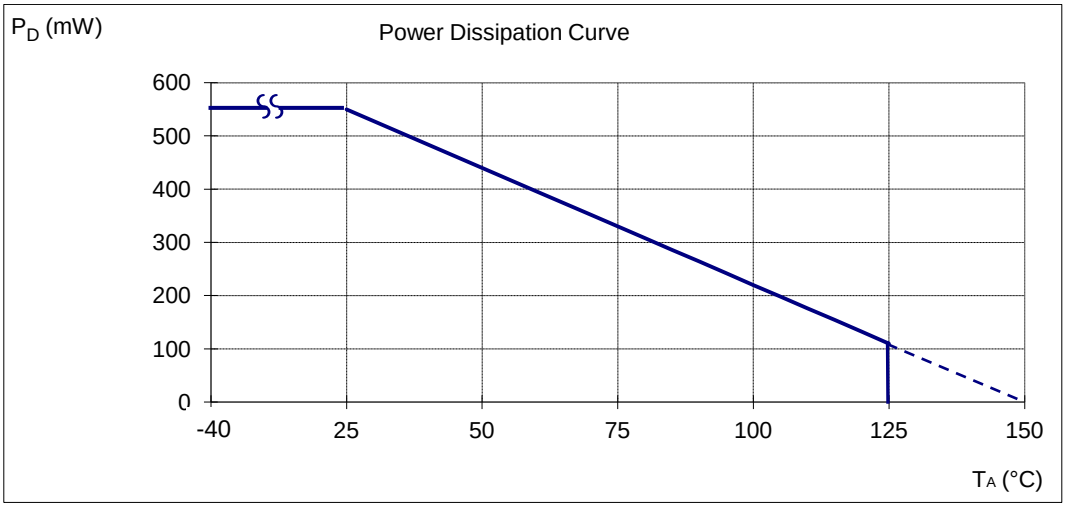
(1) Package Type: SOT23

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 type: SIP-3

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



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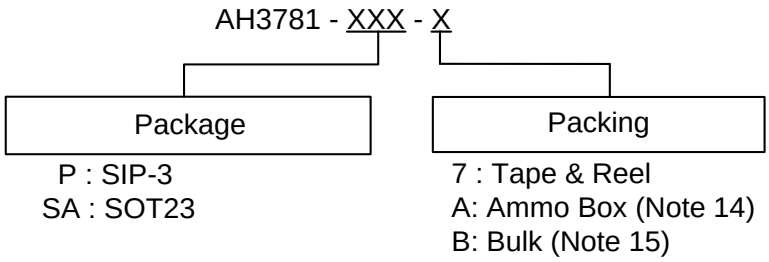
Ordering Information



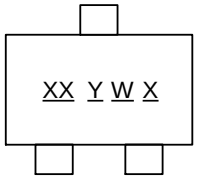
Part Number	Package Code	Packaging	Bulk		7" Tape and Reel		Ammo Box	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix	Quantity	Part Number Suffix
AH3781-P-A	P	SIP-3	NA	NA	NA	NA	4,000/Box	-A
AH3781-P-B	P	SIP-3	1,000	-B	NA	NA	NA	NA
AH3781-SA-7	SA	SOT23	NA	NA	3,000/Tape & Reel	-7	NA	NA

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

Marking Information

(1) Package Type: SOT23

(Top View)

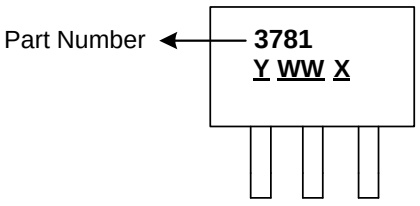


XX : Identification code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal code

Part Number	Package	Identification Code
AH3781	SOT23	WX

(2) Package Type: SIP-3

(Top View)



Y : Year : 0~9
WW : Week : 01~52, "52" represents
52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AH3781	SIP-3	3781

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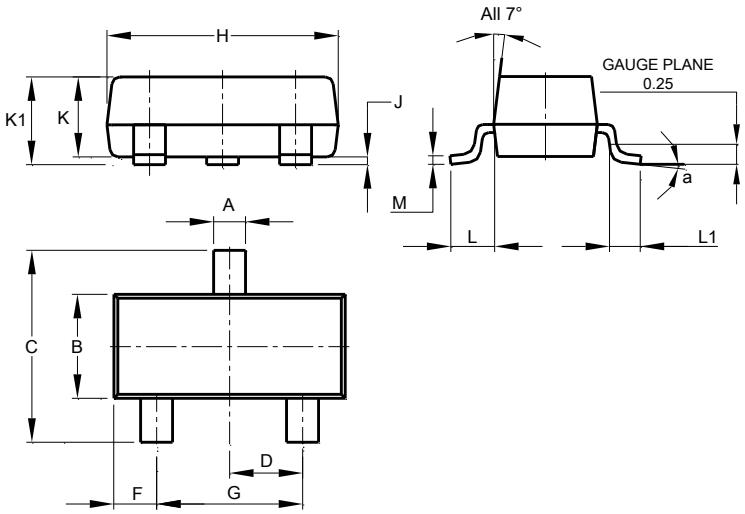
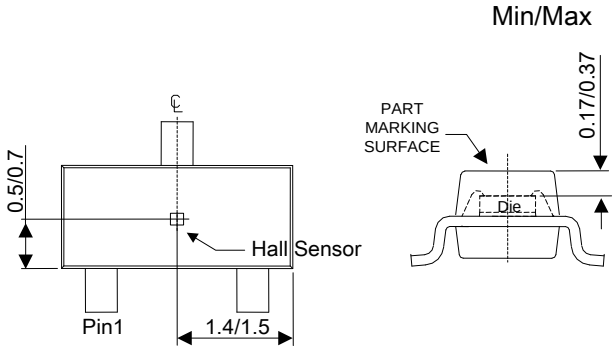
Package Outline Dimensions (All dimensions in mm.)

Please see AP02002 at http://www.diodes.com/datasheets/ap02002.pdf 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	8°		
All Dimensions in mm			



Sensor Location

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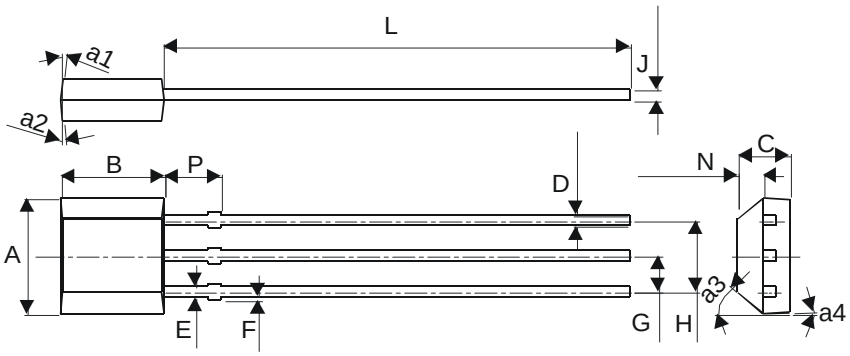
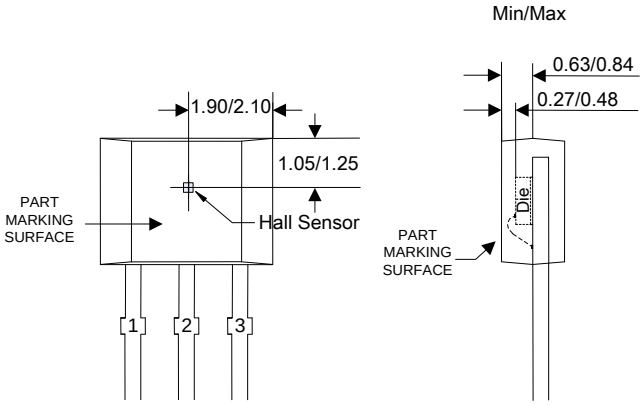
Package Outline Dimensions (cont.) (All dimensions in mm.)

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

(2) 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	-
All Dimensions in mm		



Sensor Location

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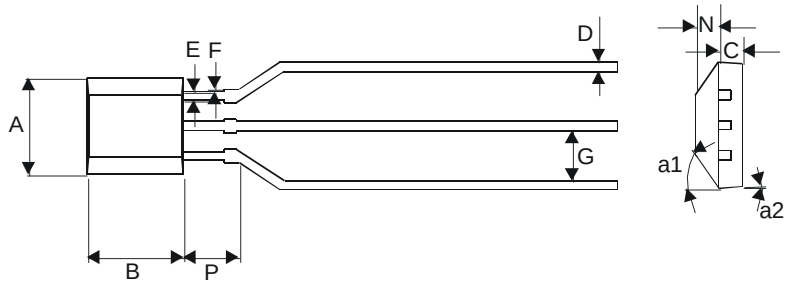
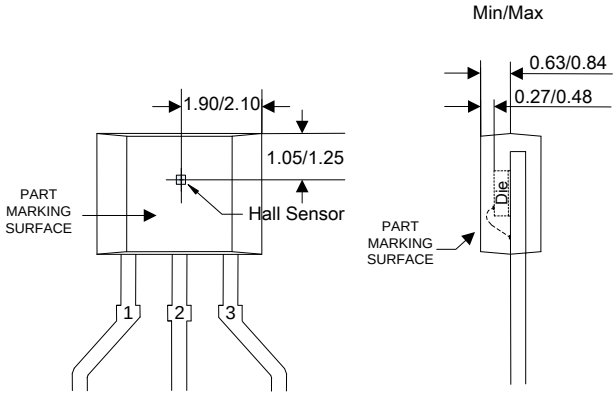
Package Outline Dimensions (cont.) (All dimensions in mm.)

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

(3) Package Type: SIP-3 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

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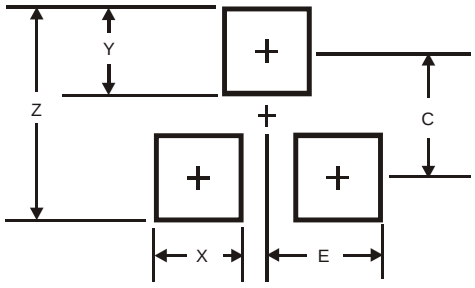
Suggested Pad Layout

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

(1) 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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Тел: +7 (812) 336 43 04 (многоканальный)
Email: org@lifeelectronics.ru

www.lifeelectronics.ru