

Description

The DIODES™ AH3712Q is an AEC-Q100 qualified, high-voltage, high-sensitivity, Hall-effect latch IC designed for commutation of brushless DC motors and their speed measurements, angular or linear encoders, and position sensors in automotive applications. To support a wide range of demanding applications, the device is optimized to operate over a 3.0V to 27V supply range. With chopper stabilized architecture and an internal bandgap regulator to provide temperature-compensated supply for internal circuits, the AH3712Q provides a reliable solution over the whole operating range. The device has a reverse blocking diode with Zener clamps on the supply and output, which also has an overcurrent limit.

The single, open-drain output can be switched on with a South pole of sufficient strength and switched off with a North 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). The output is held and latched until magnetic-flux density reverses and becomes lower than the release point (B_{RP}).

The SOT23 and SC59 packages have opposite magnetic operating and release polarity. The SOT23, SIP-3 (Bulk), and U-DFN2020-6/SWP packages require their south pole on the part-marking side while the SC59 requires its south pole to the non-part-marking side.

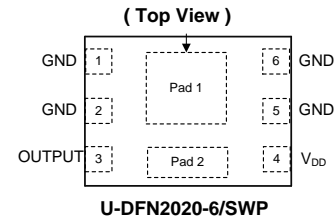
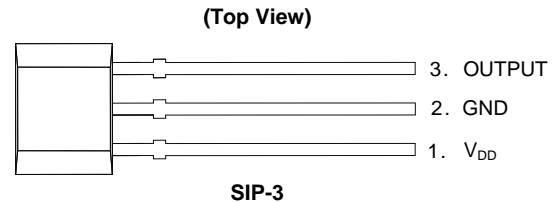
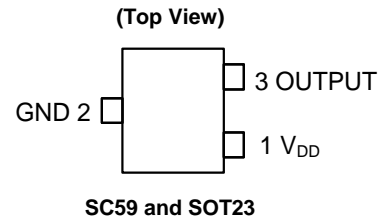
Features

- Bipolar Latch (South Pole: On, North Pole: Off)
- 3.0V to 27V Operating Voltage Range
- High Sensitivity: B_{OP} and B_{RP} of $\pm 25G$ Typical
- Resistant to Physical Stress
- Single, Open-Drain Output AH3712Q or Internal Pull-Up AH3712AQ (*Future product)
- Output with Overcurrent Limit
- Chopper-Stabilized Design Provides
 - Superior Temperature Stability
 - Minimal Switch-Point Drift
 - Enhanced Immunity to Stress
- Good RF Noise Immunity
- Reverse-Blocking Diode and Zener Clamp on Supply
- $-40^{\circ}C$ to $+150^{\circ}C$ Operating Temperature
- ESD HBM: 8kV, CDM: 1kV
- Industry-Standard SC59, SOT23, SIP-3, and U-DFN2020-6/SWP Packages
- **Totally Lead-Free & Fully RoHS Compliant (Notes 1 & 2)**
- **Halogen and Antimony Free. "Green" Device (Note 3)**
- **The DIODES™ AH3712Q 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/>

- 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.

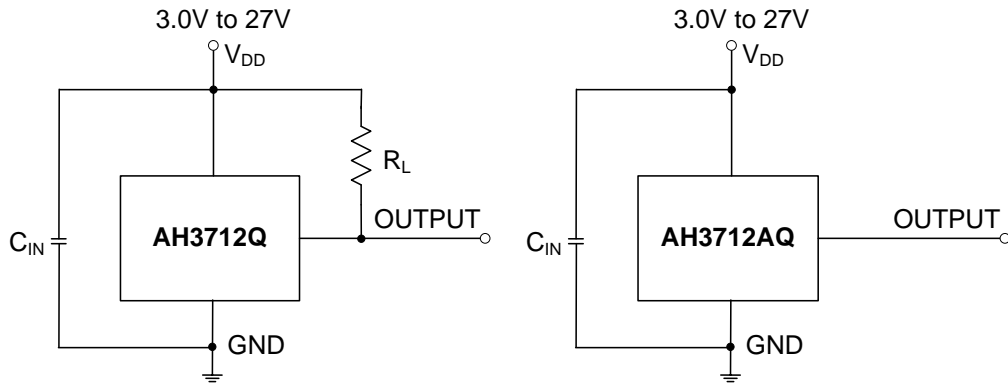
Pin Assignments



Applications

- Brushless DC motor commutation
- Revolutions per minute (RPM) measurements
- Flow meters
- Angular and linear encoders and position sensors
- Contactless commutation, speed measurements, and angular position sensing/indexing in automotive applications

Typical Applications Circuit (Note 4)



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

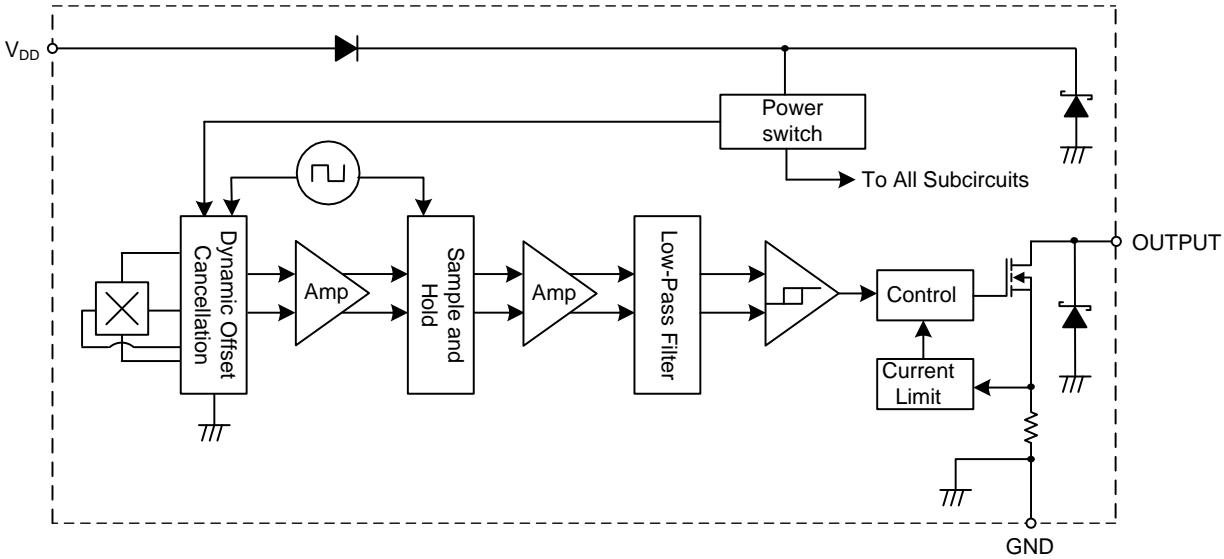
Package: SOT23, SC59 and SIP-3

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

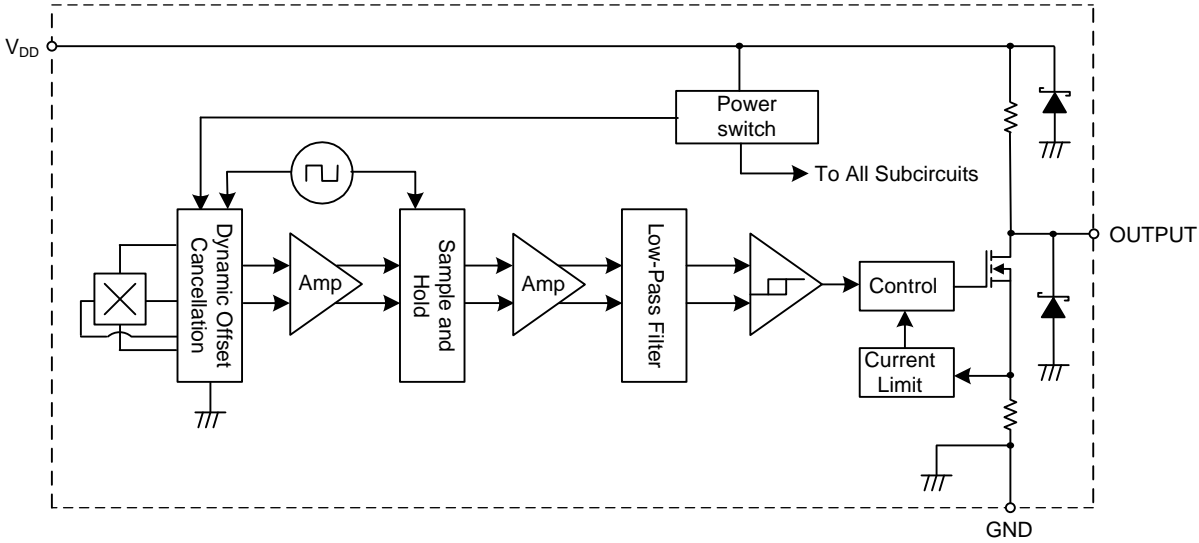
Package: SWP-DFN2020-6

Pin Number	Pin Name	Function
1	GND	Ground Pin
2	GND	Ground Pin
3	OUTPUT	Output Pin
4	V _{DD}	Power Supply Input
5	GND	Ground Pin
6	GND	Ground Pin
Pad 1	Exposed Pad	Connect to ground
Pad 2	Exposed Pad	No any connection (do not connect to Pad 1)

Functional Block Diagram



AH3712Q



AH3712AQ

Absolute Maximum Ratings (Notes 5, 6) (@T_A = +25°C, unless otherwise specified.)

Symbol	Characteristic	Value	Unit
V _{DD}	Supply Voltage (Note 6)	40	V
V _{DDR}	Reverse Supply Voltage	-18	V
V _{OUT_MAX}	Output Pin Voltage (Note 6)	40	V
I _{OUT}	Output Current Sink	60	mA
I _{OUT_R}	Reverse Output Current	-50	mA
B	Magnetic Flux Density	Unlimited	
P _D	Package Power Dissipation	SIP-3	550
		SC59 and SOT23	230
		U-DFN2020-6/SWP	670
T _s	Storage Temperature Range	-65 to +165	°C
T _J	Maximum Junction Temperature	+170	°C
ESD HBM	Electrostatic Discharge Withstand Capability—Human Body Model	8	kV
ESD CDM	Electrostatic Discharge Withstand Capability—Charged Device Model	1	kV

- Notes:
- Stresses greater than the *Absolute Maximum Ratings* specified above can 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_{DD} of 40V 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	Conditions	Rating	Unit
V _{DD}	Supply Voltage	Supply voltage, between VDD and GND pins	3.0 to 27	V
T _A	Operating Temperature Range	Operating ambient temperature range	-40 to +150	°C

Electrical Characteristics (Notes 7, 8) (@T_A = -40°C to +150°C, V_{DD} = 3V to 27V, C_{IN} = 0.1µF unless otherwise specified.)

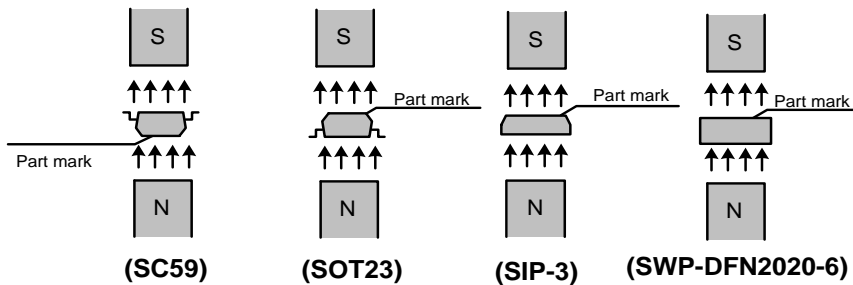
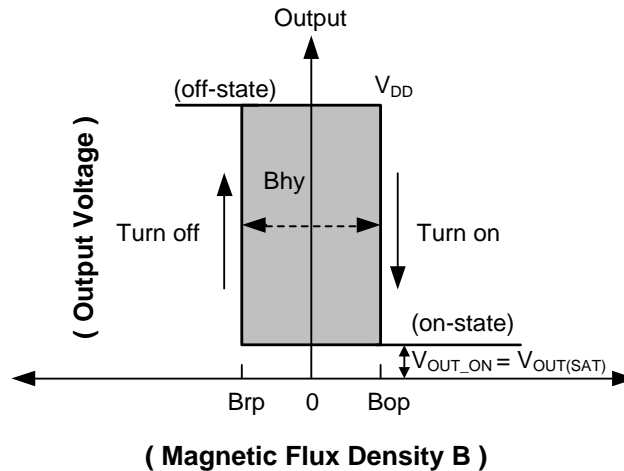
Symbol	Parameter	Conditions	Min	Typ	Max	Unit
V _{OUT_ON}	Output On Voltage	I _{OUT} = 20mA, B > B _{OP}	—	0.25	0.42	V
I _{OUT_OFF}	Output Leakage Current	V _{OUT} = 27V, B < B _{RP} , Output off	—	<0.1	10	µA
I _{DD}	Supply Current	Output open, T _A = +25°C	—	2.8	3.8	mA
		Output open, T _A = -40°C to +150°C	—	2.8	4.8	mA
I _{DD_R}	Reverse Battery Current (AH3712Q only)	V _{DD} = -18V, T _A = -40°C to +150°C	—	0.001	2.3	mA
R _{PU}	Internal Pull-Up Resistance (AH3172AQ only)	T _A = -40°C to +150°C	10	14	18	kΩ
t _{ST}	Device Start-Up Time	V _{DD} ≥ 3V, B > B _{OP} +10Gs or B < B _{RP} - 10Gs (Note 7)	—	13	—	µs
f _c	Chopping Frequency	V _{DD} ≥ 3V	—	500	—	kHz
t _d	The time delay from magnetic threshold reached to the start of the output rise or fall	B > 3*B _{OP_MAX} , square wave magnetic field	—	10.	—	µs
t _r	Output Rising Time (external pull-up resistor R _L and load capacitance dependent)	R _L = 1kΩ, C _L = 20pF (Note 9)	—	0.1	1	µs
t _f	Output Falling Time (Internal switch resistance and load capacitance dependent)	R _L = 1kΩ, C _L = 20pF (Note 9)	—	0.3	1	µs
I _{OCL}	Output Current Limit	B > B _{OP_MAX} + 10Gs (Note 10), T _J ≤ +150°C	30	—	60	mA
V _Z	Zener Clamp Voltage	I _{DD} = 8mA, T _A = +25°C	36	—	—	V

- Notes:
- When power is initially turned on, V_{DD} must be within its correct operating range (3.0V to 27V) to guarantee the output sampling. The output state is valid after the start-up time of 13µs typical from the operating voltage reaching 3V. The VCC slew rate must exceed 3V/µs from 0 to 3V. A slower slew rate through the specific range may affect device performance.
 - 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
 - Guaranteed by design, process control, and characterization. Not tested in production.
 - The device limits the output current I_{OUT} to current limit of I_{OCL}.

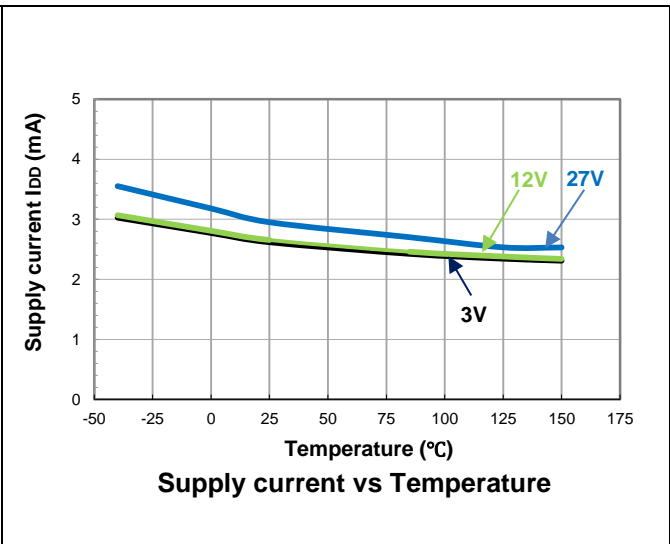
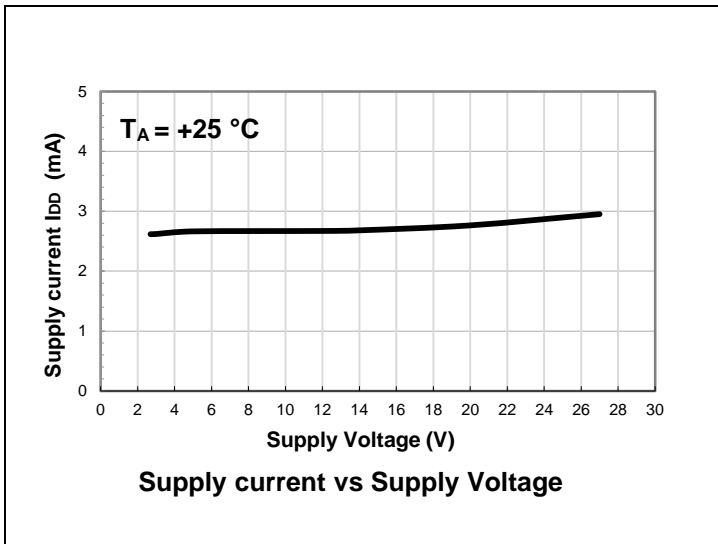
Magnetic Characteristics (Notes 11, 12) ($T_A = -40^{\circ}\text{C}$ to $+150^{\circ}\text{C}$, $V_{DD} = 3.0\text{V}$ to 27V , unless otherwise specified)

Part Number	Symbol	Parameter	Min	Typ	Max	Unit	Output Type
AH3712Q / AH3712AQ	B_{OP} (South pole to part-marking side for SOT23, DFN, and SIP-3) (South pole to non-part-marking side for SC59) (See diagram below)	Operation Point	10	25	40	Gauss	Open-Drain / Internal Pull-Up Resistor
	B_{RP} (North pole to part-marking side for SOT23, DFN, and SIP-3) (North pole to non-part-marking side for SC59) (See diagram below)	Release Point	-40	-25	-10		
	B_{HY} ($ B_{OPX} - B_{RPX} $)	Hysteresis (Note 13)	20	50	80		

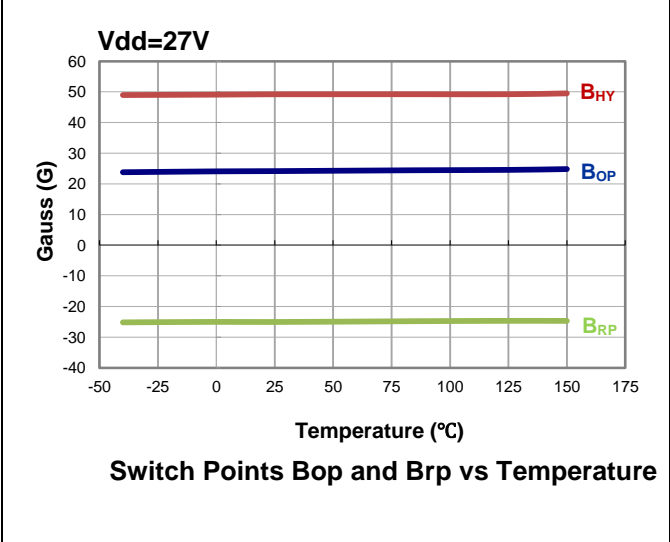
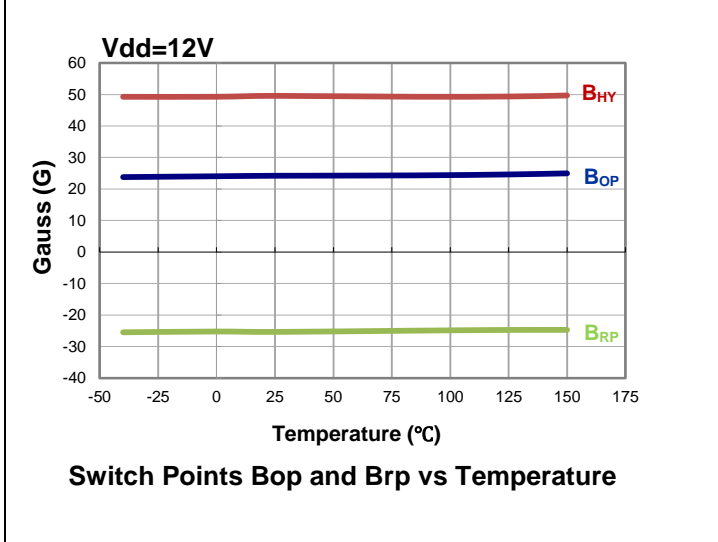
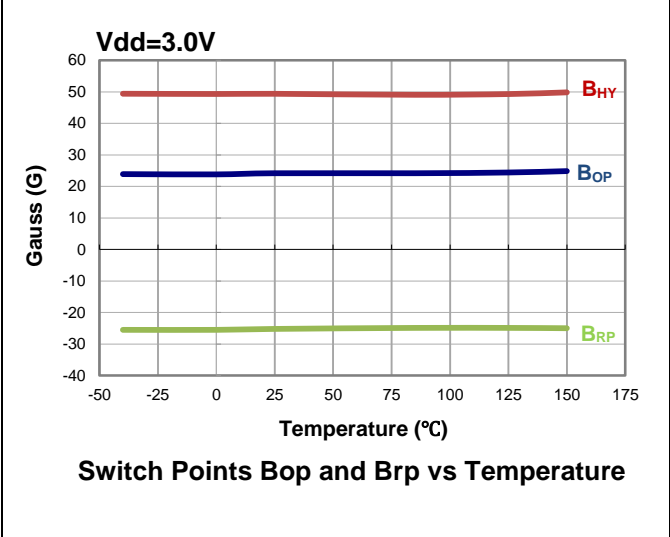
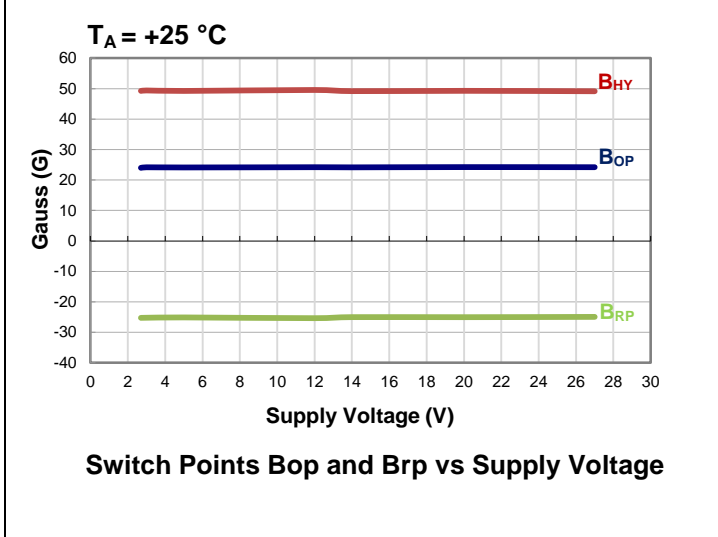
- Notes:
- When power is initially turned on, V_{DD} must be within its correct operating range (3.0V to 27V) to guarantee the output sampling. The output state is valid after the start-up time of 10 μs typical from the operating voltage reaching 3V.
 - Typical values are defined at $T_A = +25^{\circ}\text{C}$, $V_{DD} = 12\text{V}$. 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

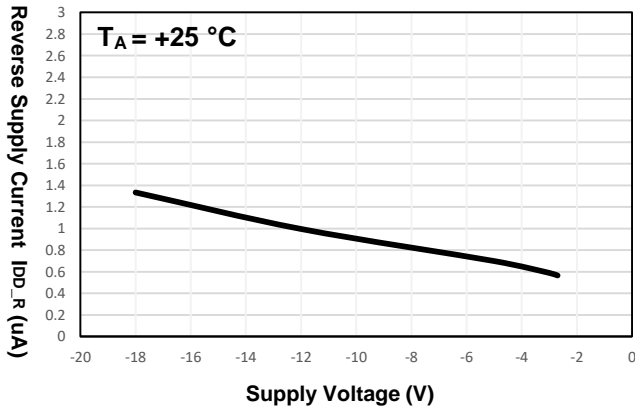


Output Switch Operate and Release Points (Magnetic Thresholds) – Bop and Brp

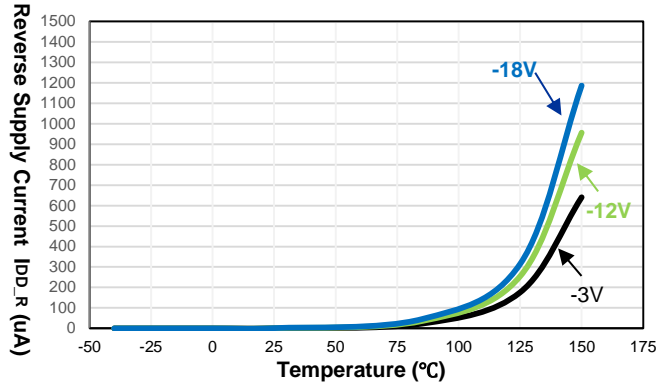


Typical Operating Characteristics (continued)

Reverse Supply Current

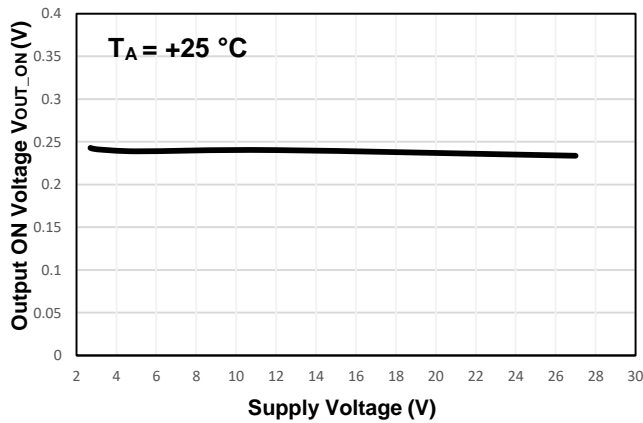


Reverse Supply Current vs Supply Voltage

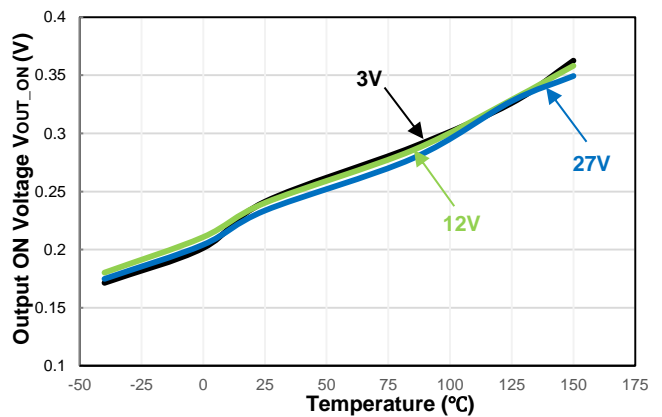


Reverse Supply Current vs Temperature

Output Switch On Voltage

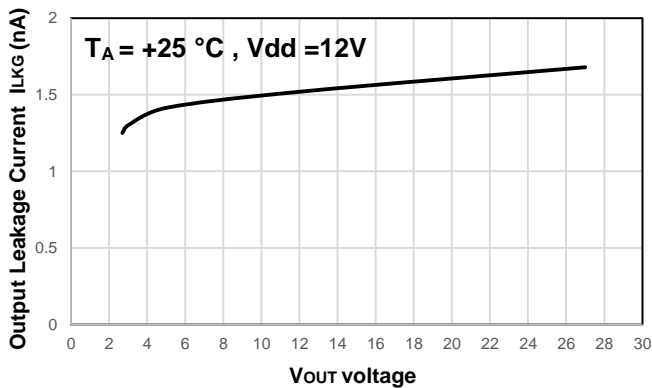


Output ON Voltage vs Supply Voltage

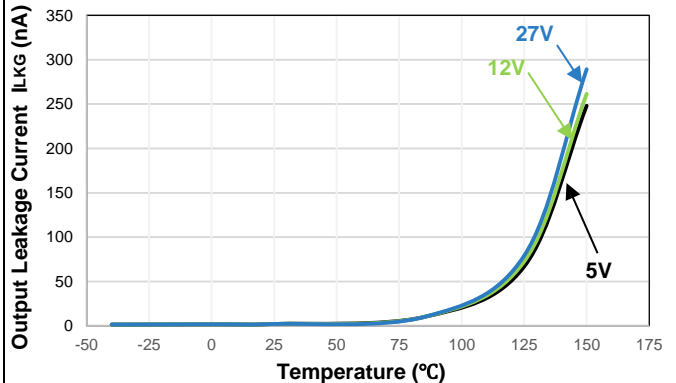


Output ON Voltage vs Temperature

Output Switch Leakage Current



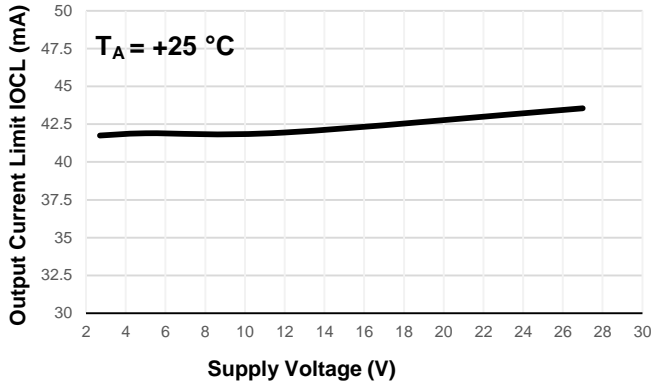
Output Leakage current vs VOUT Voltage



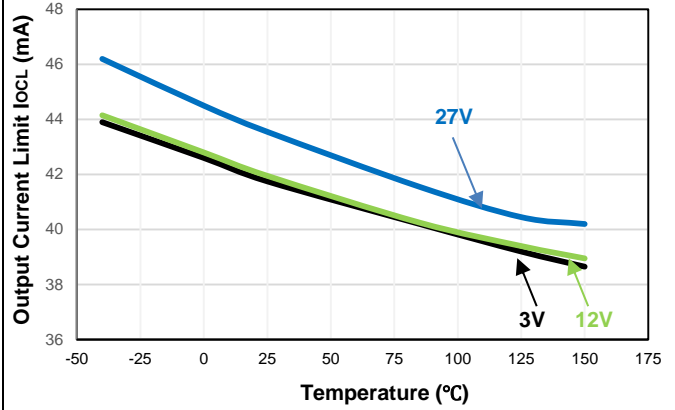
Output Leakage current vs VOUT Voltage

Typical Operating Characteristics (continued)

Output Current Limit

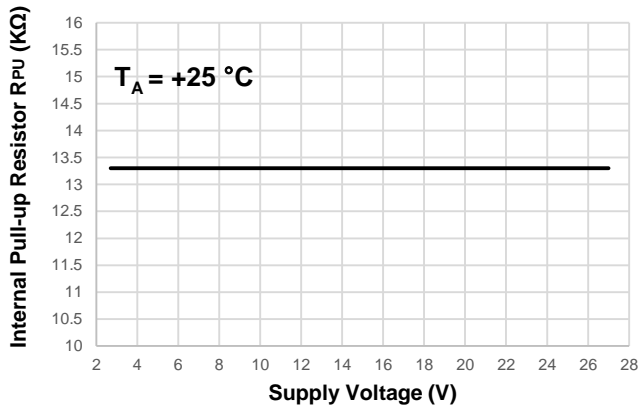


Output Current Limit vs Supply Voltage

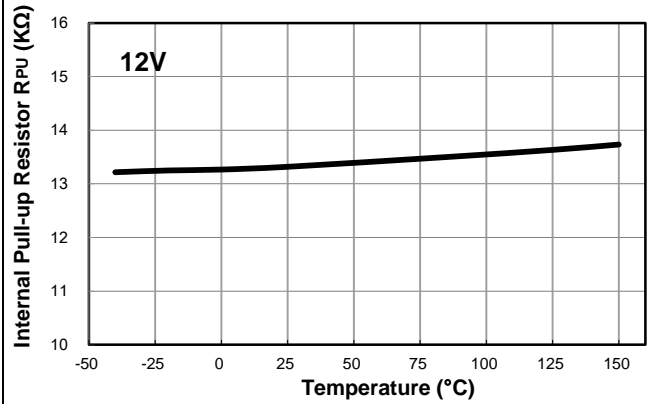


Output Current Limit vs Temperature

Output Pull-Up Resistor (Internal)



Internal Output Pull-up Resistor vs Supply Voltage

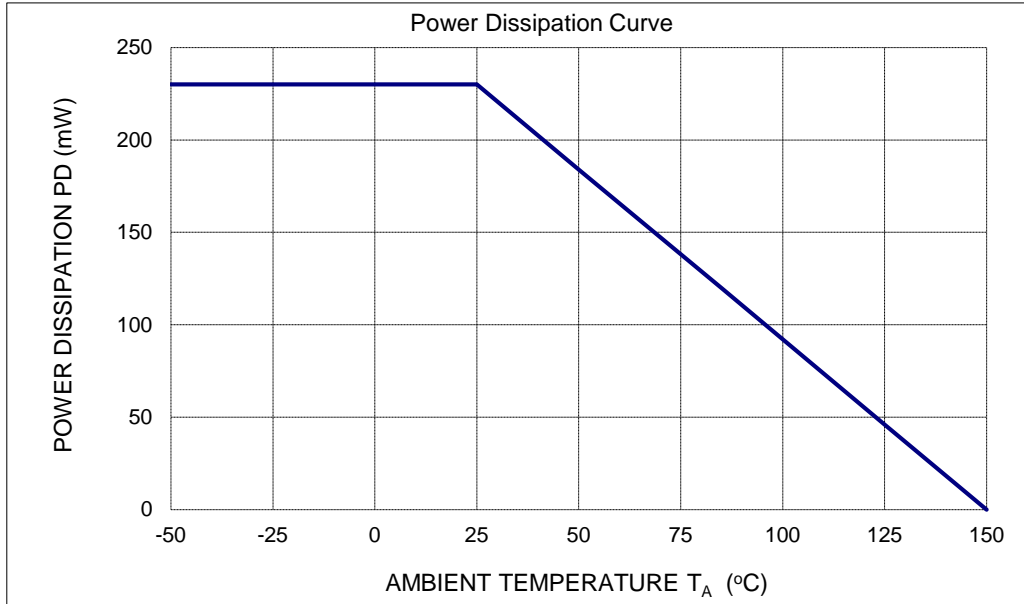


Internal Output Pull-up Resistor vs Temperature

Thermal Performance Characteristics

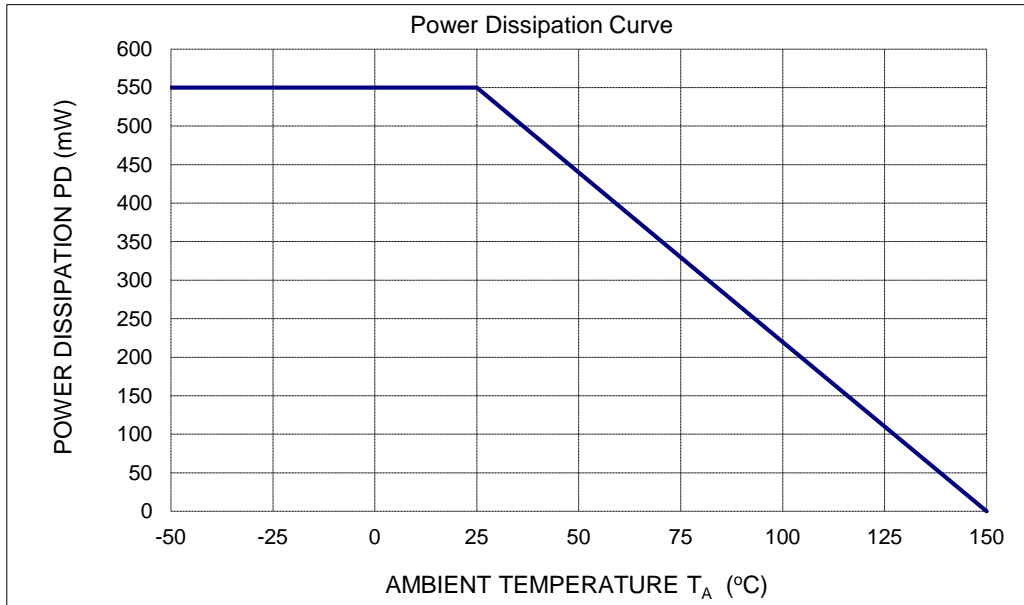
(1) Package: SOT23/SC59

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 : SIP3

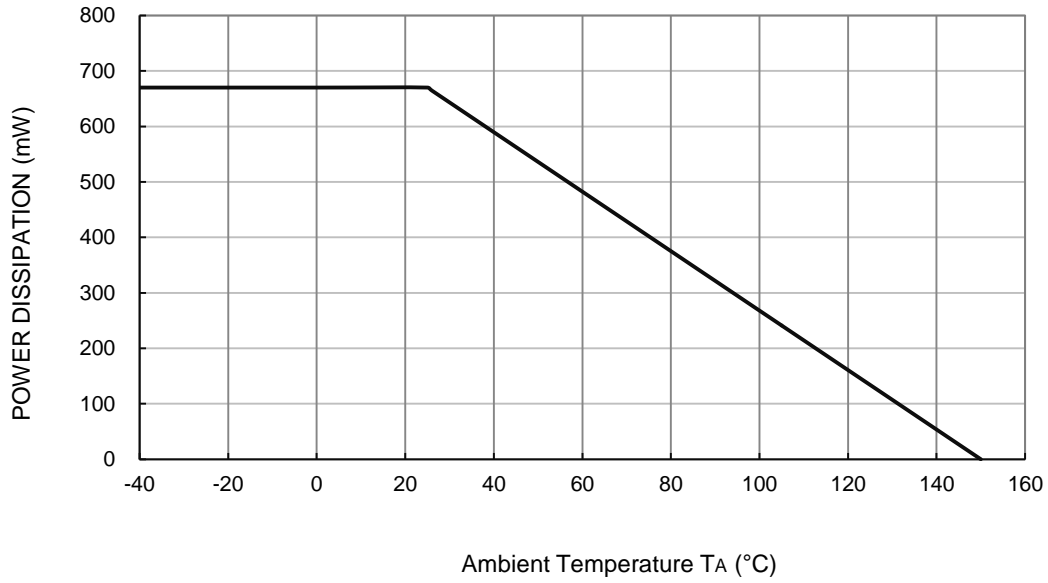
T _A (°C)	25	50	60	70	80	85	90	100	105	110	120	125	130	140	150
P _D (mW)	550	440	396	352	308	286	264	220	198	176	132	110	88	44	0



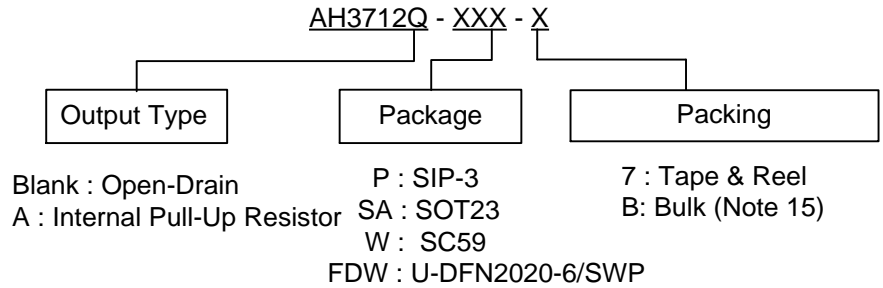
Thermal Performance Characteristics (continued)

(3) Package : U-DFN2020-6/SWP

T _A (°C)	25	50	60	70	80	90	95	100	105	110	120	125	130	140	150
P _D (mW)	670	536	482	429	375	322	295	268	241	214	161	134	107	54	0



Ordering Information



Part Number	Package Code	Packaging	Bulk (Note 14)		7" Tape and Reel	
			Quantity	Part Number Suffix	Quantity	Part Number Suffix
AH3712Q-P-B	P	SIP-3	1000	-B	—	—
AH3712Q-SA-7	SA	SOT23	—	—	3000/Tape & Reel	-7
AH3712Q-W-7	W	SC59	—	—	3000/Tape & Reel	-7
AH3712Q-FDW-7	FDW	U-DFN2020-6/SWP	—	—	3000/Tape & Reel	-7
* AH3712AQ-P-B	P	SIP-3	1000	-B	—	—
* AH3712AQ-SA-7	SA	SOT23	—	—	3000/Tape & Reel	-7
* AH3712AQ-W-7	W	SC59	—	—	3000/Tape & Reel	-7

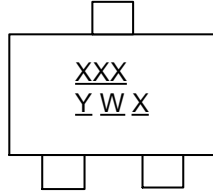
* Future new product

Note: 14. Bulk is for SIP-3 Straight Lead.

Marking Information

(1) Package Type: SOT23 and SC59

(Top View)



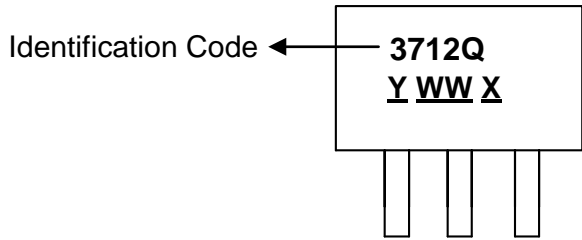
XX : Identification code
Y : Year 0 to 9
W : Week : A to Z : 1 to 26 week;
a to z : 27 to 52 week; z represents
52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AH3712Q-SA-7	SOT23	N2Q
AH3712Q-W-7	SC59	UEQ
*AH3712AQ-SA-7	SOT23	N8Q
*AH3712AQ-W-7	SC59	UMQ

* Future new product

(2) Package Type: SIP-3

(Top View)



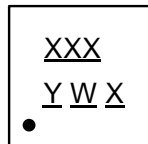
Y : Year : 0~9
WW : Week : 01~52, "52" represents
52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AH3712Q-P-B	SIP-3	3712Q
*AH3712AQ-P-B	SIP-3	3712AQ

* Future new product

(3) Package Type:U-DFN2020-6/SWP (Type C)

(Top View)



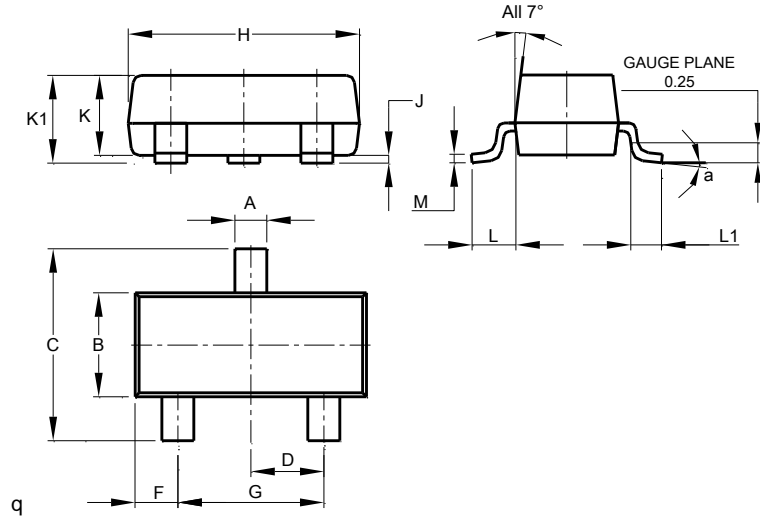
XX : Identification Code
Y : Year : 0~9
W : Week : A~Z : 1~26 week;
a~z : 27~52 week; z represents
52 and 53 week
X : Internal Code

Part Number	Package	Identification Code
AH3712Q-FDW-7	U-DFN2020-6/SWP	K2Q

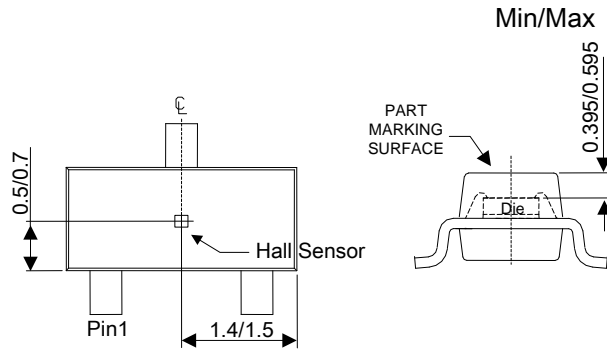
Package Outline Dimensions (All dimensions in mm.)

Please see <https://www.diodes.com/design/support/packaging/> 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			

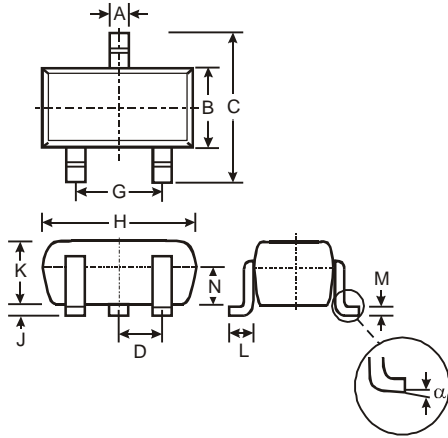


Sensor Location

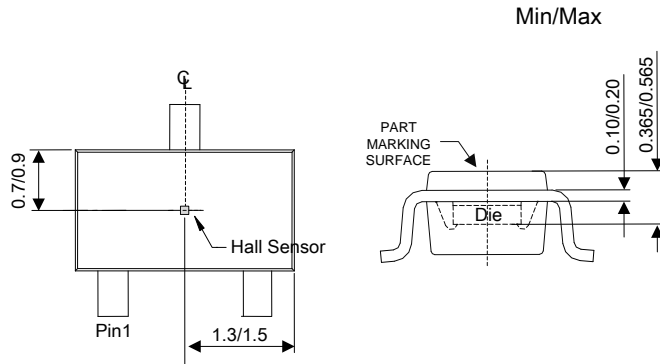
Package Outline Dimensions (continued) (All dimensions in mm.)

Please see <https://www.diodes.com/design/support/packaging/> for the latest version.

(2) 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			

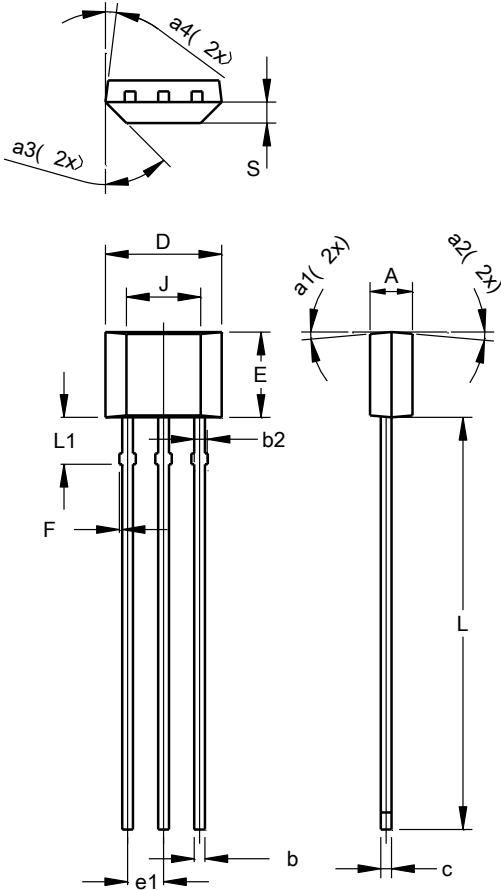


Sensor Location

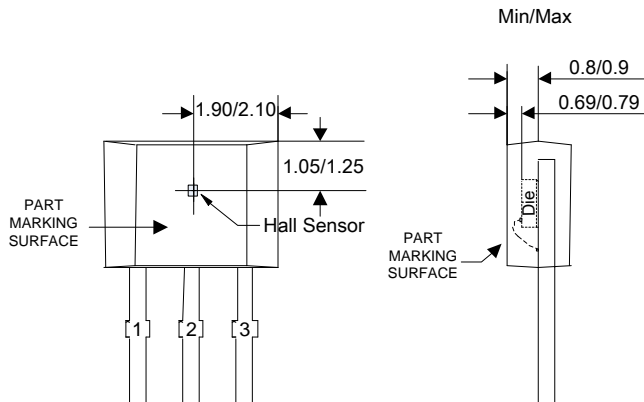
Package Outline Dimensions (continued) (All dimensions in mm.)

Please see <https://www.diodes.com/design/support/packaging/> for the latest version.

(3) Package Type: SIP-3 Bulk



SIP-3 (Bulk Pack)			
Dim	Min	Max	Typ
A	1.40	1.60	1.50
b	0.33	0.43	0.38
b2	0.40	0.508	0.46
c	0.35	0.41	0.38
D	3.90	4.30	4.10
E	2.80	3.20	3.00
e1	1.24	1.30	1.27
F	0.00	0.20	--
J	2.62 REF		
L	14.00	15.00	14.50
L1	1.55	1.75	1.65
S	0.63	0.84	0.74
a1	--	--	5°
a2	--	--	5°
a3	--	--	45°
a4	--	--	3°
All Dimensions in mm			

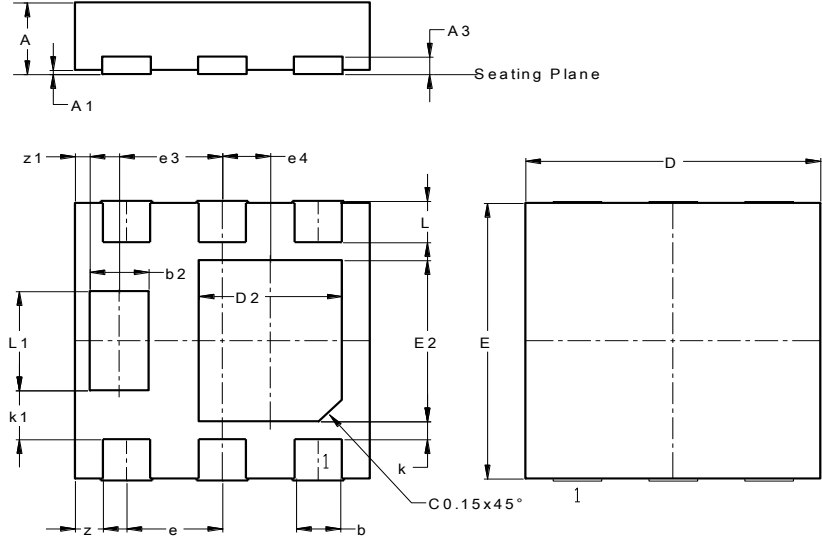


Sensor Location

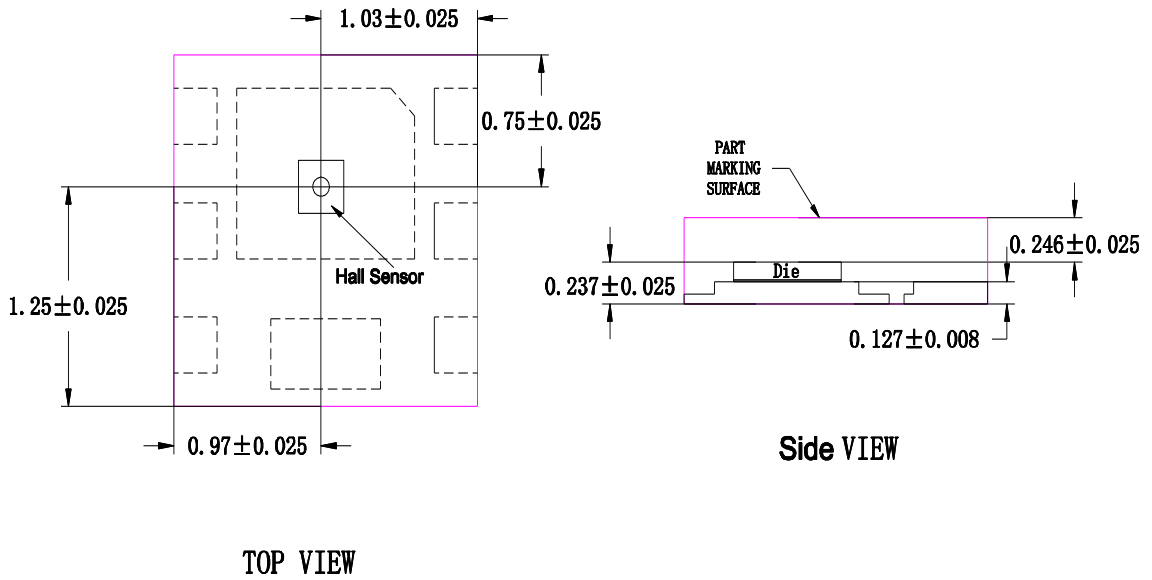
Package Outline Dimensions (continued) (All dimensions in mm.)

Please see <https://www.diodes.com/design/support/packaging/> for the latest version.

(4) Package Type: U-DFN2020-6/SWP (Type C)



U-DFN2020-6 (SWP) (Type C)			
Dim	Min	Max	Typ
A	0.47	0.57	0.52
A1	0.00	0.05	0.03
A3	--	--	0.127
b	0.27	0.37	0.32
b2	0.35	0.45	0.40
D	1.95	2.05	2.00
D2	0.87	1.07	0.97
E	1.95	2.05	2.00
E2	1.07	1.27	1.17
e	0.65 BSC		
e3	0.70 BSC		
e4	0.325 BSC		
k	--	--	0.13
k1	--	--	0.355
L	0.25	0.35	0.30
L1	0.67	0.77	0.72
z	--	--	0.19
z1	--	--	0.10
All Dimensions in mm			

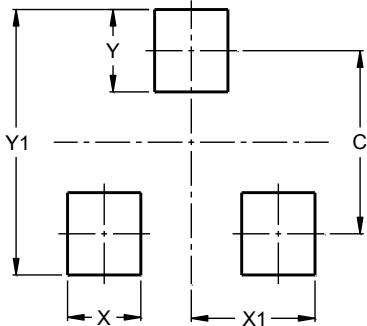


Sensor Location

Suggested Pad Layout

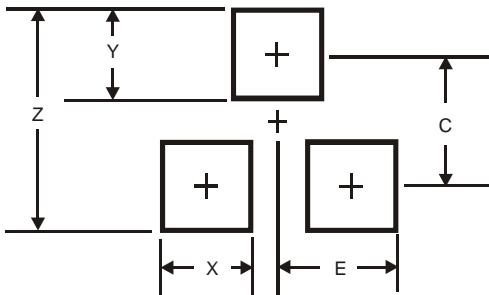
Please see <https://www.diodes.com/design/support/packaging/> for the latest version.

(1) Package Type: SOT23



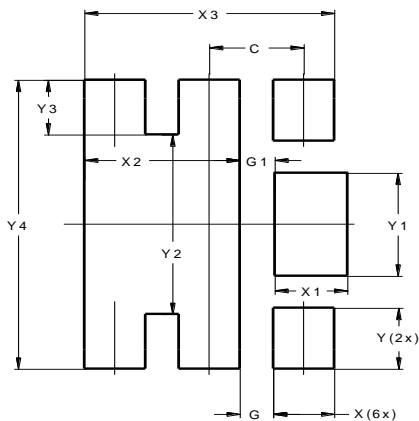
Dimensions	Value (in mm)
C	2.0
X	0.8
X1	1.35
Y	0.9
Y1	2.9

(2) Package Type: SC59



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

(3) Package Type: U-DFN2020-6/SWP (Type C)



Dimensions	Value (in mm)
C	0.650
G	0.230
G1	0.240
X	0.420
X1	0.500
X2	1.070
X3	1.720
Y	0.485
Y1	0.820
Y2	1.430
Y3	0.435
Y4	2.300

Mechanical Data

- Moisture Sensitivity: Level 1 per J-STD-020
- Terminals: Finish – Matte Tin Plated Leads, Solderable per MIL-STD-202, Method 208 (E3)
- Weight: 0.007 to 0.008 grams (Approximate)

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