

## High Sensitivity Micropower Unipolar Hall-effect Switch

### Features

- High sensitive unipolar operation.
- Micropower operation.  
Typ 0.45 $\mu$ A (average :V<sub>DD</sub>=1.8V).
- Ultra small package: DFN 1.4mm  $\times$  1.1mm  $\times$  0.37mm-4L.
- On board voltage regulator for 1.6V to 5.5V range.
- Wide operating temperature range: -40  $^{\circ}$ C to 85 $^{\circ}$ C.
- ESD (HBM) > 6KV.

### Applications

- Smartphone.
- Notebook computer.
- Handheld gaming consoles.
- Bluetooth headset.
- DV.
- Contact-less switch, Level, proximity and position switches in consumer products.

### General Description

AW86503DNR is a high-sensitivity micropower unipolar Hall effect switch IC with internal pull up and pull down capability. AW86503DNR uses a hibernating clocking system to reduce power consumption, which the total power consumption in normal operation is typically 0.45 $\mu$ A with a 1.8V power source. Mainly designed for portable devices such as laptop computer, smartphone and bluetooth headset etc. The supply range of AW86503DNR is 1.6V to 5.5V to support portable equipment. To minimize PCB space, the AW86503DNR has ultra small SON package: DFN 1.4mm  $\times$  1.1mm  $\times$  0.37mm-4L.

The output1 is activity with a north pole of sufficient magnetic field strength. When the magnetic flux density perpendicular to the package is large than operate point(BopN) , the output will be turned on (pulled low) and held until B is lower than release point (BrpN). The output2 is activity with a south pole of sufficient magnetic field strength. When the magnetic flux density perpendicular to the package is large than operate point(BopS) , the output will be turned on (pulled low) and held until B is lower than release point (BrpS).

### Typical Application Circuit

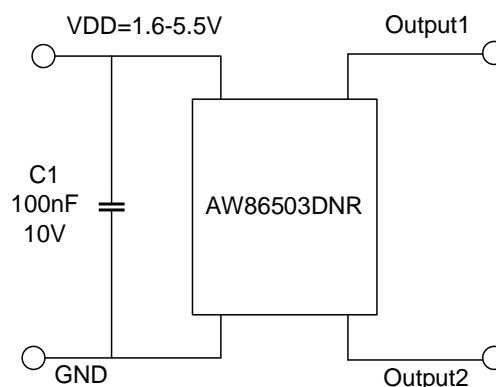


Figure 1 Typical Application Circuit of AW86503DNR

## Pin Configuration And Top Mark

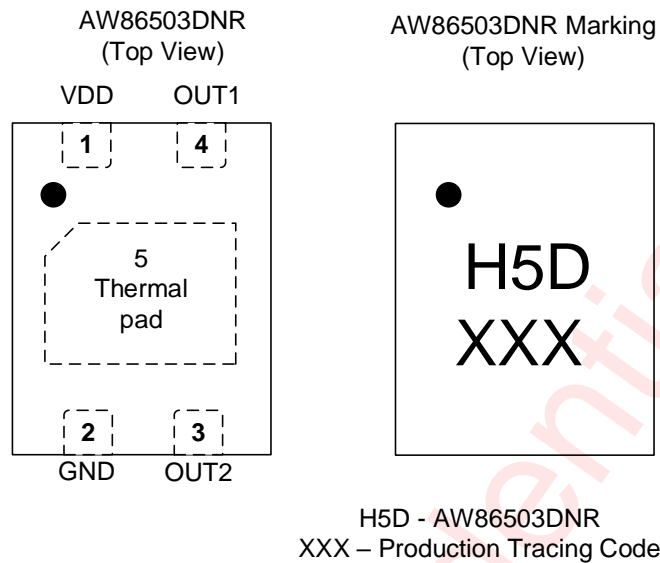


Figure 2 Pin Configuration and Top Mark

## Pin Definition

NO	Name	Description
1	VDD	Power Supply
2	GND	Ground
3	OUT2	S pole detection output
4	OUT1	N pole detection output
5	Thermal pad	Connect to GND or Not Connect

## Functional Block Diagram

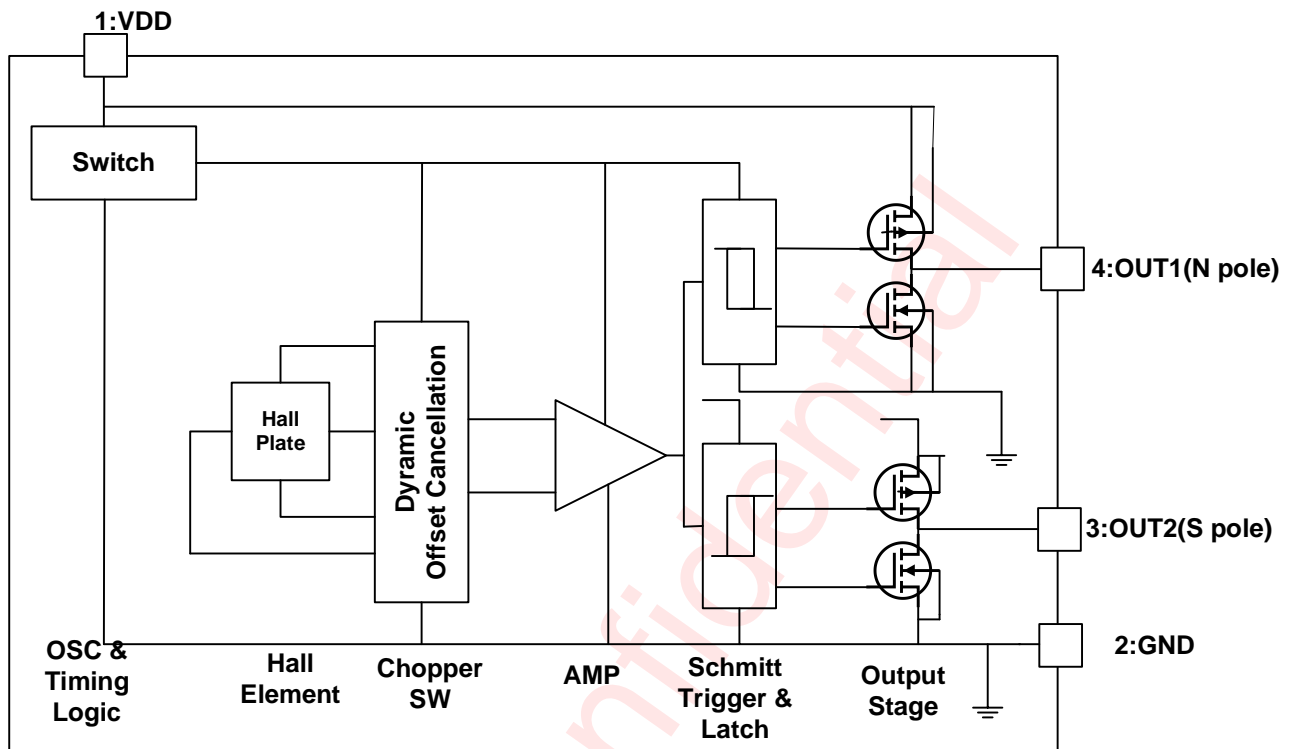


Figure 3 Functional Block Diagram

## Ordering Information

Part Number	Temperature	Package	Marking	Moisture Sensitivity Level	Environmental Information	Delivery Form
AW86503DNR	-40°C~85°C	DFN 1.4mm×1.1mm ×0.37mm-4L	H5D	MSL1	ROHS+HF	4500 units/Tape and Reel

## Detailed Functional Description

The output1 is activity with a north pole of sufficient magnetic field strength. When the magnetic flux density perpendicular to the package is larger than operate point(BopN) , the output will be turned on (pulled low) and held until B is lower than release point (BrpN). The output2 is activity with a south pole of sufficient magnetic field strength. When the magnetic flux density perpendicular to the package is larger than operate point(BopS) , the output will be turned on (pulled low) and held until B is lower than release point (BrpS).

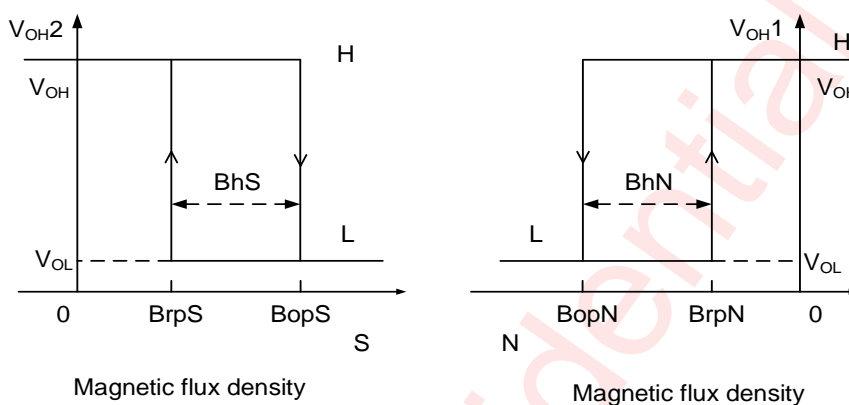


Figure 4 The Working Process of AW86503DNR

## Absolute Maximum Ratings <sup>(NOTE1)</sup>

PARAMETERS	RANGE
Supply Voltage	6V
V <sub>DD</sub> Reverse Voltage V <sub>DD</sub>	-0.3v
Supply Current	3mA
Output Voltage	-0.4V to V <sub>DD</sub> +0.4V
Output Current	4mA
Operating Ambient Temperature T <sub>A</sub>	-40°C to 85°C
Storage Temperature T <sub>STG</sub>	-65°C to 150°C
Junction temperature T <sub>J</sub>	-50°C to 165°C
Magnetic Flux	No limit
Lead temperature (soldering 10 seconds)	260°C
ESD Rating <sup>(NOTE2 3)</sup>	
Human Body Model (HMB) ESD capability	6kV
Charged-device model (CDM) ESD capability	1.5kV
Latch-up	
Test Condition: JESD78E	+ IT: 200mA
	- IT: 200mA

NOTE1: Conditions out of those ranges listed in "absolute maximum ratings" may cause permanent damages to the device. In spite of the limits above, functional operation conditions of the device should within the ranges listed in "recommended operating conditions". Exposure to absolute-maximum-rated conditions for prolonged periods may affect device reliability.

NOTE2: The human body model test method: ESDA/JEDEC JS -001-2017.

NOTE3: Charge Device Model test method: ESDA/JEDEC JS-002-2018.

## Electrical Characteristics

Parameters Specification ( $V_{DD}=3.3V$ supply, $T_A=-40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$ except where otherwise specified.)						
Symbol	Characteristic	Test Conditions	Min	Typ	Max	Unit
$V_{DD}$	Supply Voltage	Operating, $T_J < 165\text{ }^{\circ}\text{C}$	1.6		5.5	V
$I_{DD}(\text{awake})$	Supply Current	During awake period, $T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD}=3.3V$	-	0.95	1.3	mA
$I_{DD}(\text{sleep})$	Supply Current	During sleep period, $T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD}=3.3V$	-	0.4	-	$\mu\text{A}$
$I_{DD}(\text{avg})$	Average supply current	$T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD} = 1.8V$		0.45		$\mu\text{A}$
		$T_A = 25\text{ }^{\circ}\text{C}$ , $V_{DD} = 3.3V$		0.7		$\mu\text{A}$
$V_{OL}$	Output low voltage(on)	$I_{OUT}=1\text{ mA}$	-	0.1	0.2	V
$V_{OH}$	Output high voltage(off)	$I_{OUT} = -1\text{mA}$	$V_{DD}-0.2$	$V_{DD}-0.1$	-	V
$T_{\text{awake}}$	Awake time	(note)	-	40	60	$\mu\text{s}$
$T_{\text{period}}$	Period	(note)	-	200	280	ms
D.C.	Duty cycle	-	-	0.02	-	%
$f_c$	Chopping Frequency		-	500	-	kHz
$I_{OFF}$	Output Leakage Current	$V_{OUT} = 5.5\text{ V}$ ; Switch state=off	-	-	0.1	$\mu\text{A}$

Note: Maximum and minimum parameters values over operating temperature range are not tested in production. They are guaranteed by design, characterization and process control. The magnetic field strength (Gauss) required to cause the switch to change state (operate and release) will be as specified in the magnetic characteristics. To test the switch against the specified magnetic characteristics, the switch must be placed in a uniform magnetic field.

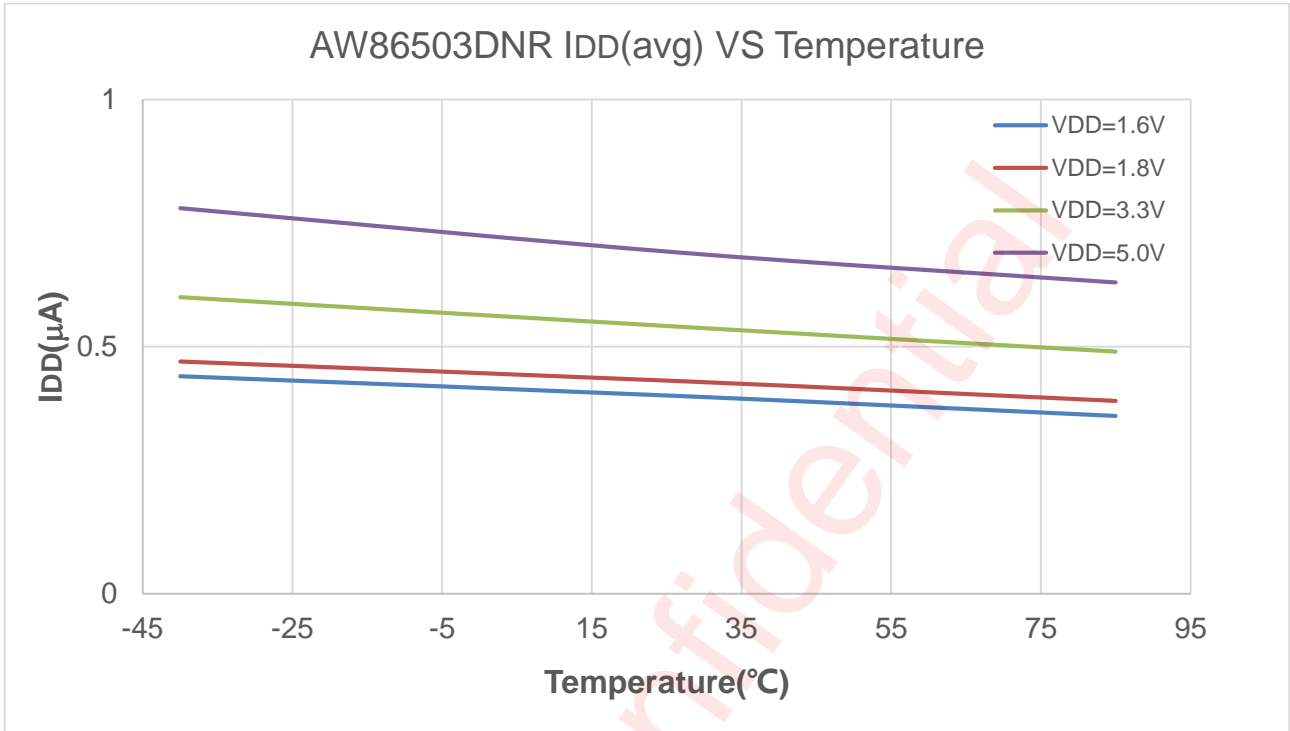
## Magnetic Characteristics

Magnetic Characteristics ( $T_A=+25^{\circ}\text{C}$ , $V_{DD}=3.3\text{V}$ , unless otherwise specified 1 mT=10 Gauss)						
Symbol	Characteristics	Test condition	Min	Typ	Max	Unit
Bops (south pole to part marking side)	Operation Point	$V_{DD}=1.6\text{V to }5.5\text{V}$ , $T_A= -40^{\circ}\text{C to }85^{\circ}\text{C}$	13	30	39	Gauss
Bopn (north pole to part marking side)		$V_{DD}=1.6\text{V to }5.5\text{V}$ , $T_A= -40^{\circ}\text{C to }85^{\circ}\text{C}$	-39	-30	-13	
Brps (south pole to part marking side)	Release Point	$V_{DD}=1.6\text{V to }5.5\text{V}$ , $T_A= -40^{\circ}\text{C to }85^{\circ}\text{C}$	10	20	30	
Brpn (north pole to part marking side)		$V_{DD}=1.6\text{V to }5.5\text{V}$ , $T_A= -40^{\circ}\text{C to }85^{\circ}\text{C}$	-30	-20	-10	
Bhy ( $ \text{Bopx}  -  \text{Brpx} $ )	Hysteresis	$V_{DD}=1.6\text{V to }5.5\text{V}$ , $T_A= -40^{\circ}\text{C to }85^{\circ}\text{C}$	-	10	-	

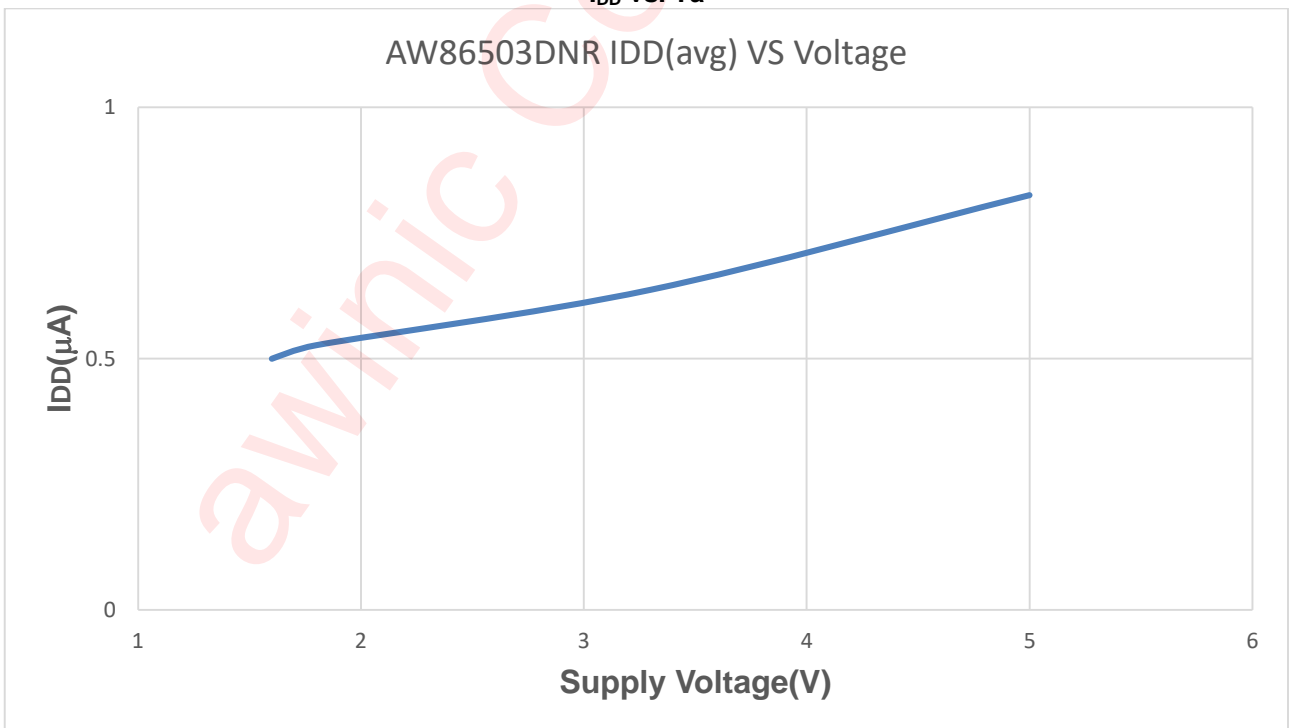
*Notes: Typical data is at  $T_A=25^{\circ}\text{C}$ ,  $V_{DD}=3.3\text{V}$ .*

*Maximum and minimum parameters values over operating temperature range are not tested in production. They are guaranteed by design, characterization and process control. The magnetic characteristics may vary with supply voltage, operating temperature and after soldering.*

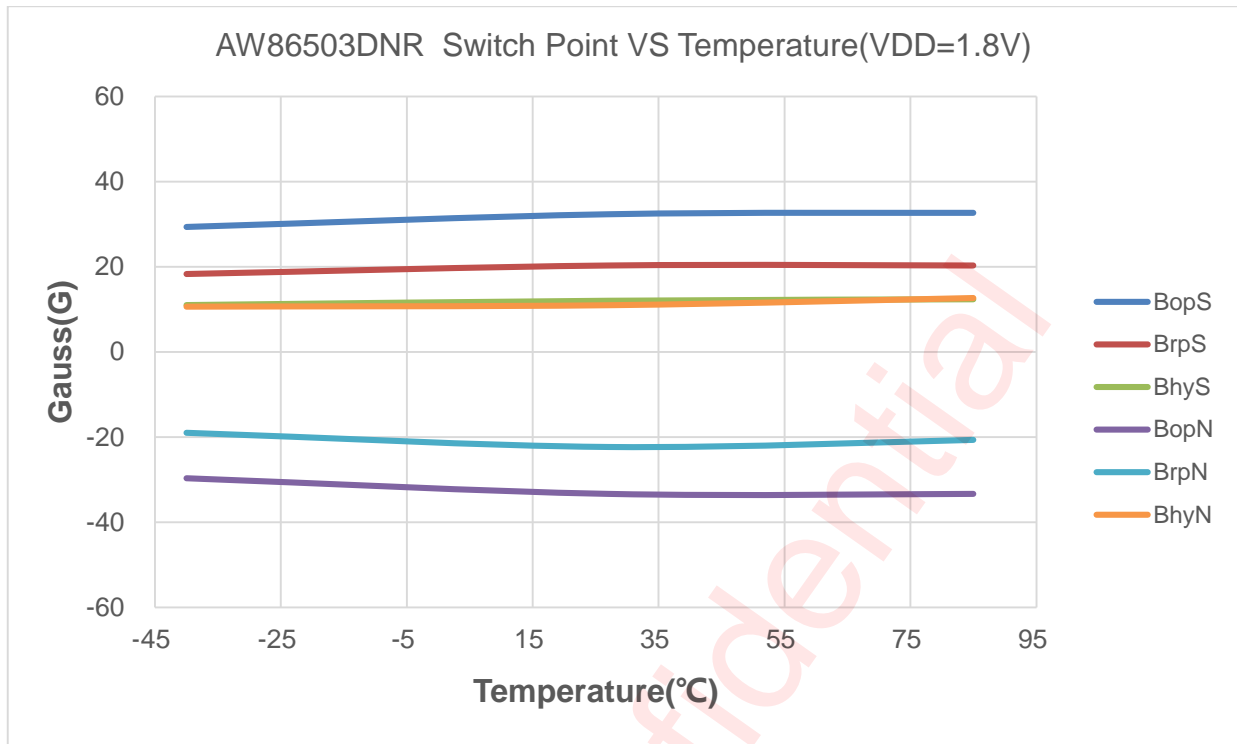
Typical Characteristics



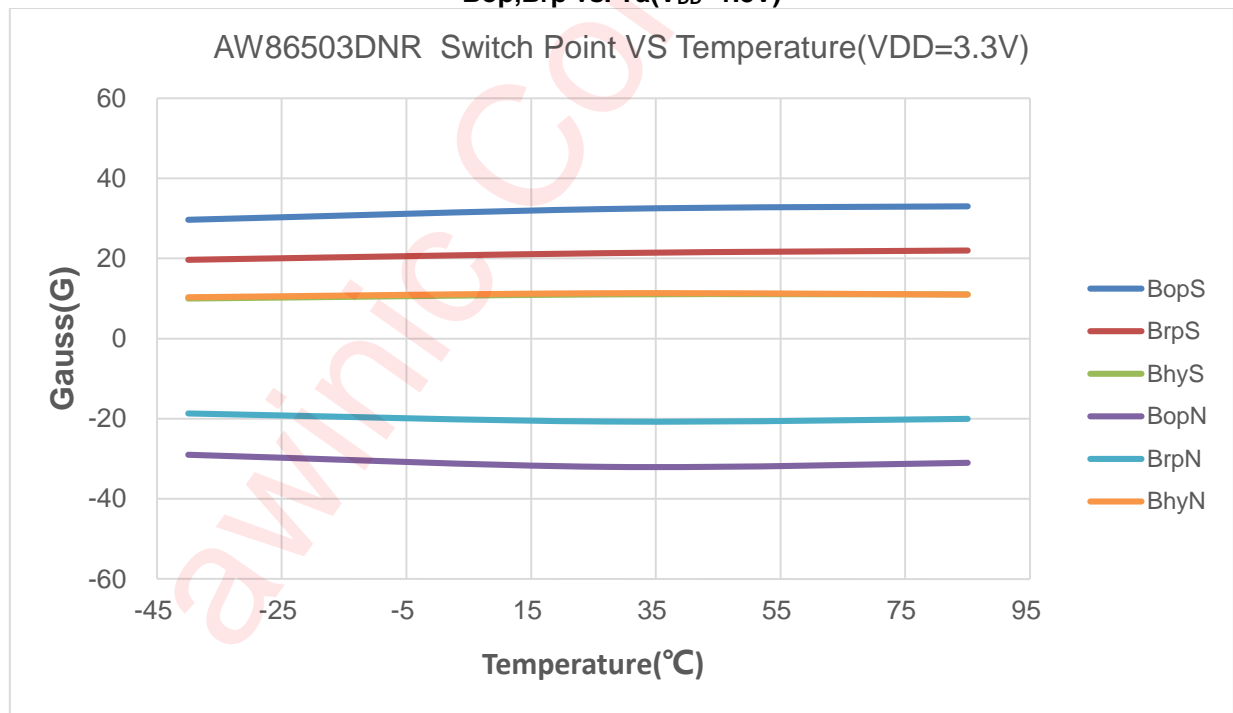
Ambient Temperature Ta[°C]  
IDD vs. Ta



Average Supply Current vs. Supply Voltage(Ta=27°C)



Ambient Temperature Ta[°C]  
Bop,Brp vs. Ta(V<sub>DD</sub>=1.8V)



Ambient Temperature Ta[°C]  
Bop,Brp vs. Ta(V<sub>DD</sub>=3.3V)

Figure 5 The Typical Characteristics of AW86503DNR



## Application Information

It is recommended to connect an external capacitor of  $0.1\mu\text{F}$  to VDD and GND. The noise of the injection device can be reduced.

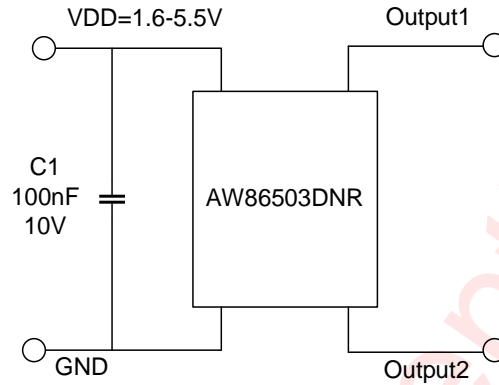
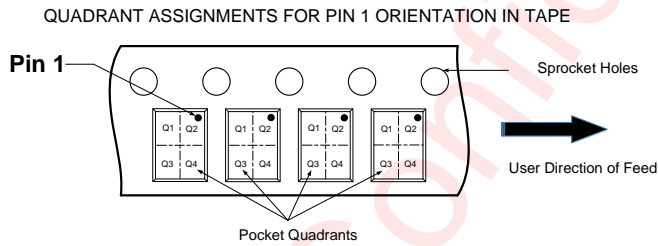
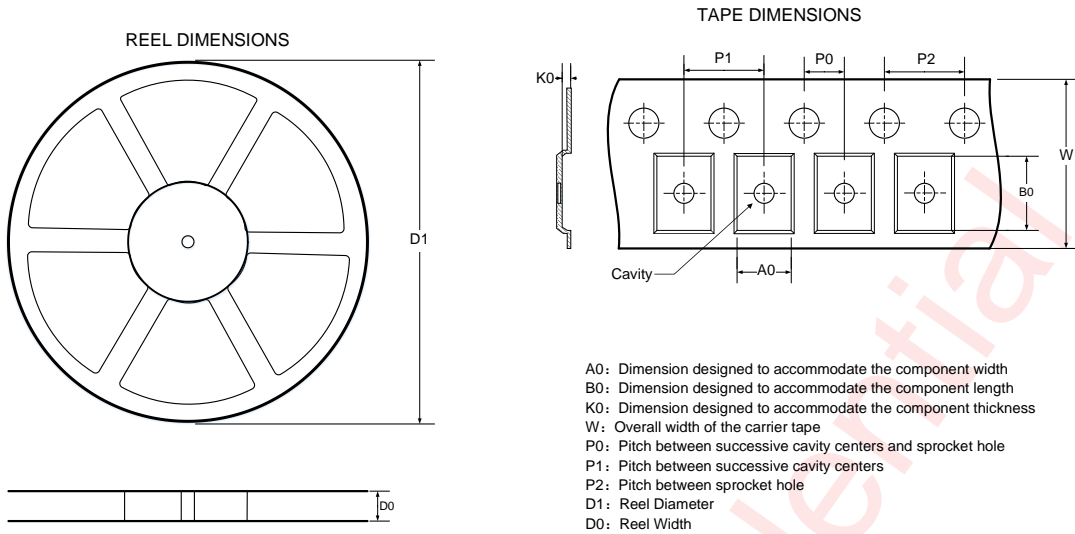


Figure 6 The Application Circuit of AW86503DNR

## Tape And Reel Information



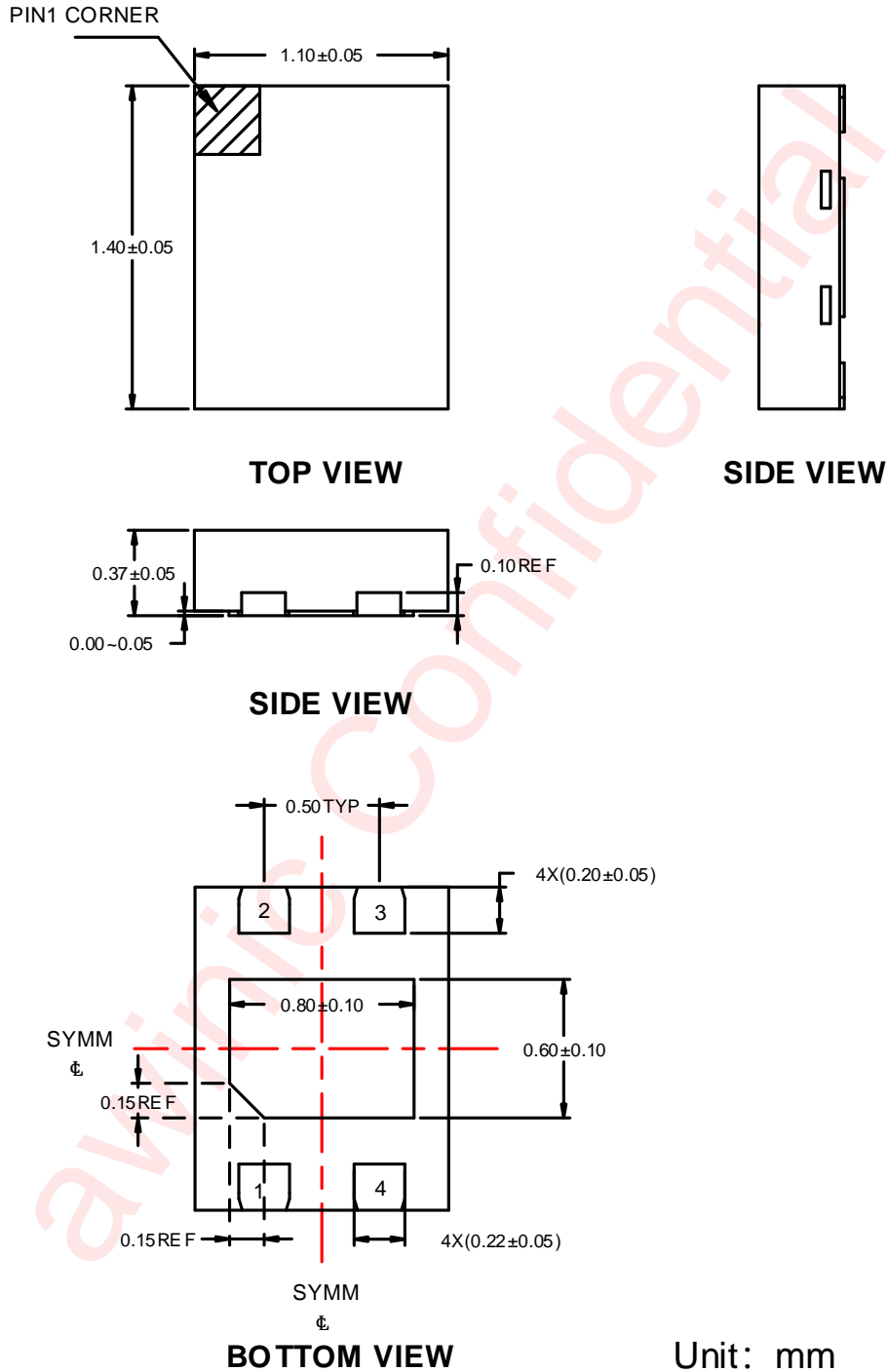
Note: The above picture is for reference only. Please refer to the value in the table below for the actual size

DIMENSIONS AND PIN1 ORIENTATION

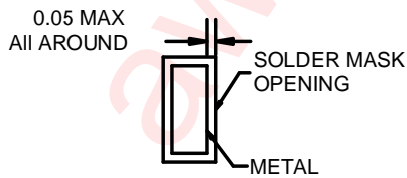
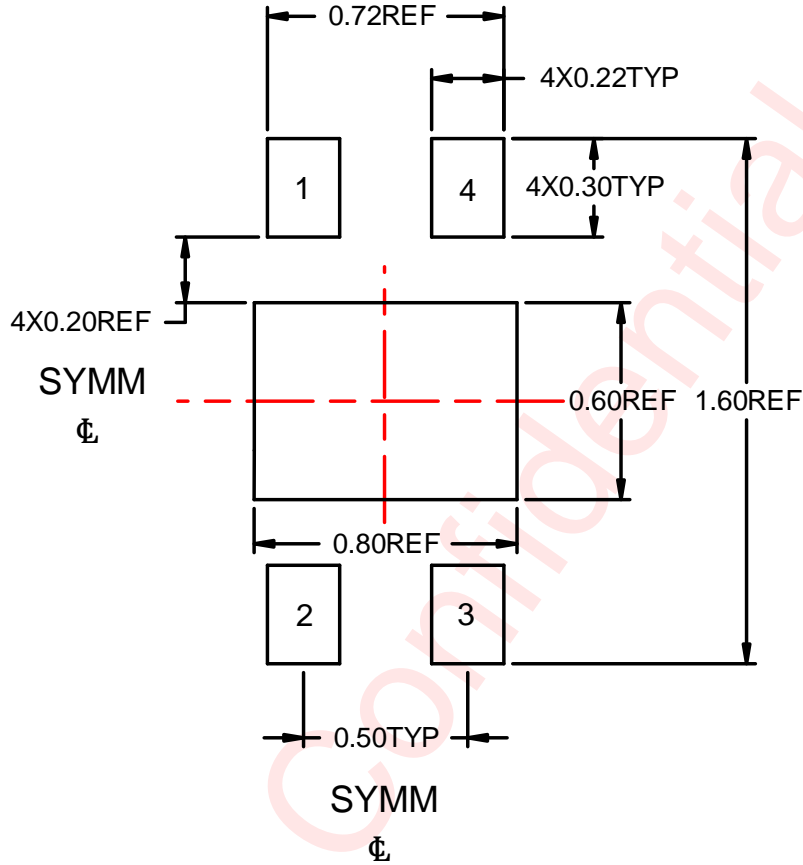
D1 (mm)	D0 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P0 (mm)	P1 (mm)	P2 (mm)	W (mm)	Pin1 Quadrant
178	8.4	1.6	1.3	0.5	2	4	4	8	Q2

All dimensions are nominal

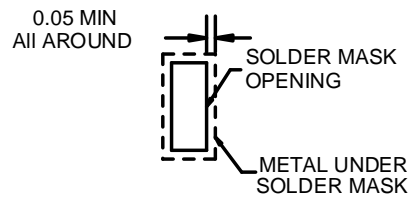
Package Description



Land Pattern Data



NON SOLDER MASK DEFINED



SOLDER MASK DEFINED

Unit: mm

## Revision History

Version	Date	Change Record
V1.0	Apr. 2021	Officially initial version
V1.1	Sep. 2021	Revise current value from 0.55 $\mu$ A to 0.7 $\mu$ A When $V_{DD}=3.3V$
V1.2	Mar. 2022	Temperature range of magnetic parameters
V1.3	Jul. 2022	Chart temperature changed from -20 $^{\circ}$ C to -40 $^{\circ}$ C

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