NST60
±2°C High Precision Ultra-low Current Analog Temperature Sensor
Datasheet (EN) 1.2

Product Overview

The NST60 is a high precision CMOS analog output temperature sensor. The device offers a maximum accuracy of ±2°C at 25°C and a maximum of ±4°C over the full temperature range. The device is specified at the full temperature range of -40°C to 125°C and the power supply operating range is 2.4V to 5.5V.

The NST60 device provides a positive slope output of

6.25mV/°C over -40°C to 125°C. it is highly linear and does not require complex calculations or lookup tables to derive temperature.

The NST60 is a low power device, and the typical operating current is 20μA. Therefore, self-heating is negligible. The NST60 is available in a SOT23(3) package, making it suitable for on-board and off-line applications in the industrial, and consumer markets applications in the IoT.

Key Features

- Operating Voltage Range: 2.4V to 5.5V
- Operating Temperature Range: –40°C to 125°C
- Accuracy at 25 °C: ±2 °C (Maximum)
- Accuracy at -40°C and 125°C: ±4°C (Maximum)
- Average Sensor Gain: 6.25 mV/°C
- Output Impedance: 1 Ω (Typical)
- Operating Current: 20μA (Typical)
- Push-Pull Output Current Drain: 500μA (Maximum)
- Predictable Curvature Error
- Output Short Protection
- Suitable for Remote Applications
- Package: SOT-23(3)

Applications

- Smartphones
- Portable Medical Instruments
- Notebook Computers
- Industrial Internet of Things (IoT)
- Power Supply Modules
- Power-system Monitors
- Thermal Protection
- Environmental Monitoring and HVAC
- Disk Drives

Device Information

Part Number	Package	Body Size
NST60	SOT-23(3)	2.92mm × 1.30mm

Functional Block Diagrams

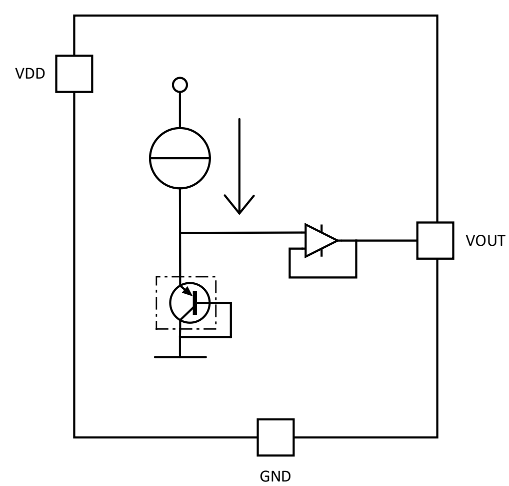

Figure 1 NST60 Functional Block Diagram

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1 Pin Configuration and Functions

(Top View)

Package:3-Pin SOT-23

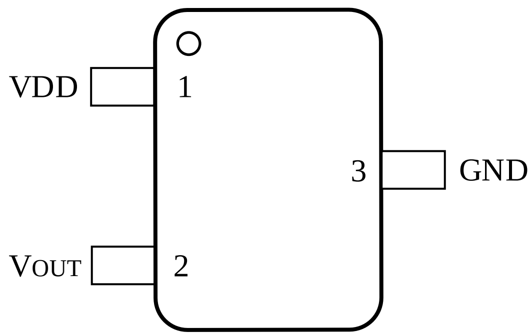

Figure 1.1 NST60 Pin Configuration

Table 1.1 NST60 Pin Function Description

Pinout No.	Pinout Name	Type	Description
1	VDD	Power	Power supply input pin
2	V_{OUT}	Analog output	Analog voltage output
3	GND	GND	Ground pin, connect to power supply negative terminal. This pin must be grounded for optimum thermal conductivity.

2 Specifications

2.1 Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply Voltage Pin (VDD)	VDD	-0.3		6.5	V	
Output Volatge	Vout	-0.3		VDD+0.3	V	
Storage Temperature		-60		155	°C	
Operation Temperature	$TB_{operation}$	-40		125	°C	
Maximum Junction Temperature				155	°C	
ESD Susceptibility	HBM	±4.5			KV	
	CDM	±0.5			KV	

2.2 Electrical Characteristics

at T_A = +25°C and VDD = +2.4V to +5.5V, unless otherwise noted.

Parameters	*Symbol*	*Min*	*Typ*	*Max*	*Unit*	*Comments*
Supply						
Supply voltage Range	VDD	2.4		5.5	V	
Supply sensitivity			0.1		°C /V	
Operation current	Iconv		20		µA	
Shutdown current	I_{SD}		0.1		µA	VDD≤0.6V
Temperature Range						
Temperature Range		-40		125	°C	
Accuracy(Using equation 4-2)		-2		2	°C	25°C
		-4		4	°C	-40°C to 125°C
Output Voltage at 0°C			0.424		V	
Vout drive capability			500		µA	
Sensor Gain			6.25		mV/°C	
Output Impedance			1		Ω	
Load Regulation			0.5		mV	Source ≤50uA
Temperature Coefficient of Quiescent Current			-44		nA/°C	
Thermal response						
Stirred oil thermal response time to 63% of final value (package only)			0.418		s	
Drift						
Drift[1]			±0.2		°C	

Notes: 1. Drift data is based on a 1000-hour stress test at +125°C with VDD = 5.5V.

2.3 Typical Characteristics

at T_A = +25°C and VDD = 3.3V, unless otherwise noted.

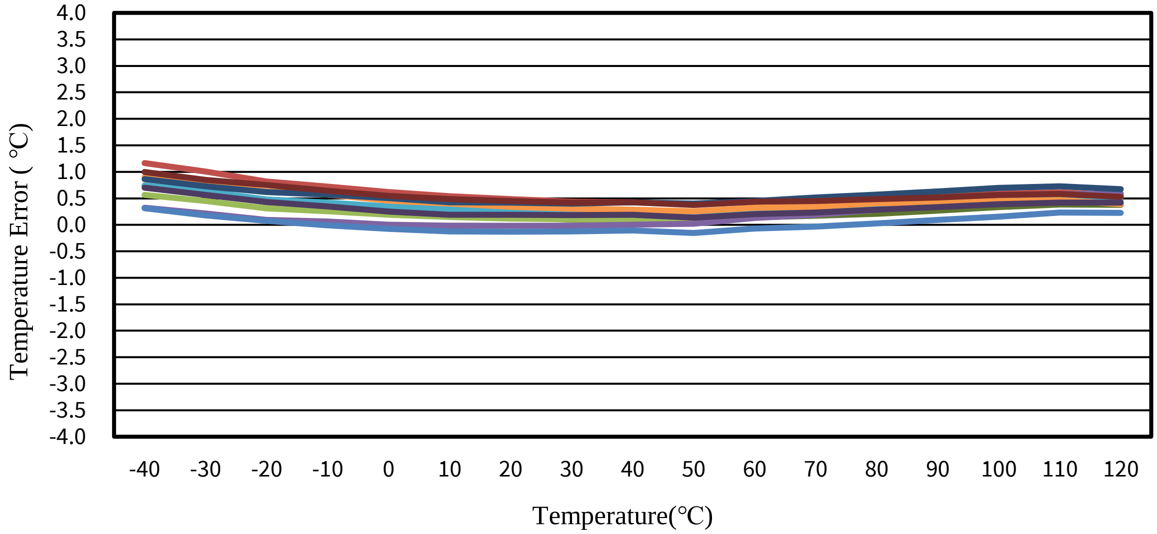

Figure 2.1 Temperature Error vs Temperature

3 Function Description

3.1 Overview

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3.2 Functional Block Diagram

The NST60 Functional Block Diagram as shown in Figure 3.1.

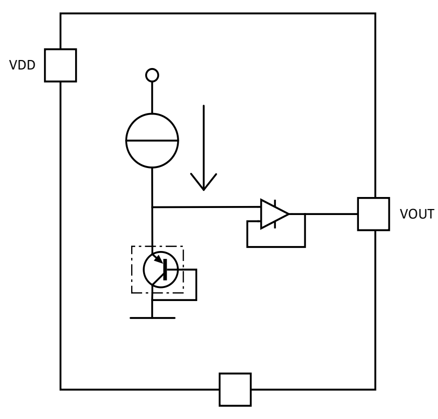


Figure 3.1 NST60 Functional Block Diagram

3.3 Feature Description

3.3.1 NST60 Transfer Function

The accuracy of NST60 can be expressed by a simple linear transfer function. In the full temperature range, the high-precision linear transfer function is:

$$Vo = 6.25mV/℃ \times T + 424mV \tag{3-1}$$

Table 3.1 Temperature to Voltage Output Characteristic Table

TEMP (℃)	VOUT (mV)
-40	174
-25	268
0	424
25	580
100	1049
125	1205

3.3.2 Application Curve

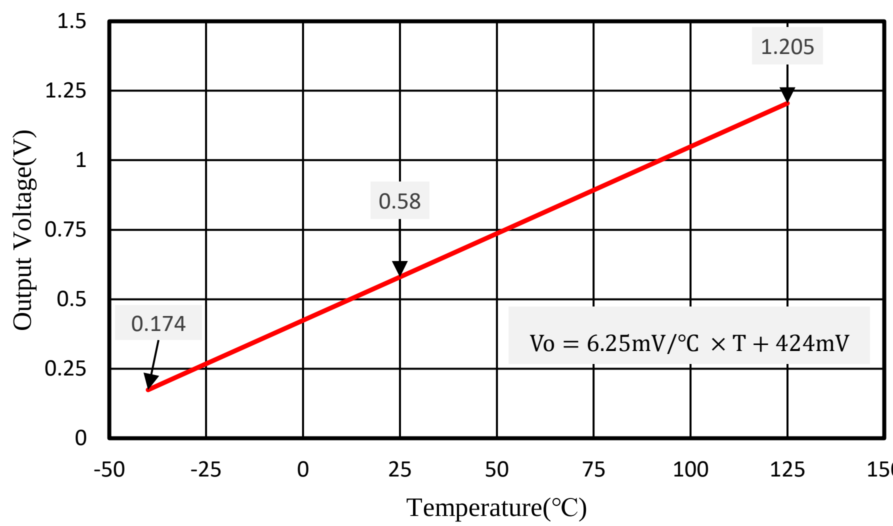


Figure 3.2 Output Voltage vs Temperature

4 Application Information

4.1 Capacitive Loads

As shown in the structure diagram, the output stage of NST60 is an amplifier. Generally, the output of the amplifier directly connected to the capacitive load is unstable. However, NST60 uses a special design, which makes it have 1000pF capacitive load capacity as shown in the Figure 4.1. If a larger capacitor is connected to filter the noise, an isolation resistance should be added between the output of NST60 and the capacitor as shown in the Table 4.1.

When the equipment is in an extremely noisy environment, it may be necessary to add an RC low-pass filter network to the output of NST60, such as a 1µF capacitor and a 200Ω series resistor. This low-pass filter will improve the thermal response time of NST60 and has the function of filtering high-frequency noise as shown in the Figure 4.2.

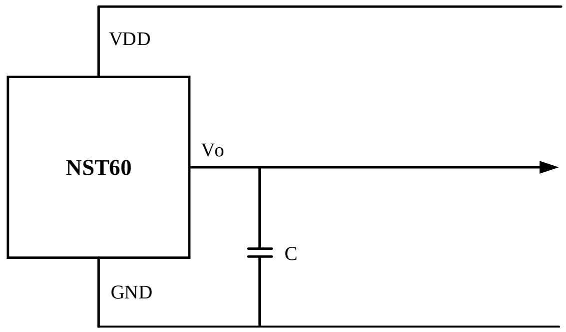


Figure 4.1 NST60 No Decoupling Required for Capacitive Loads Less Than 1000 pF

Table 4.1 Capacitive Loading Isolation

C(µF)	Minimum R(Ω)
1	200
0.1	470
0.01	680
0.001	1000

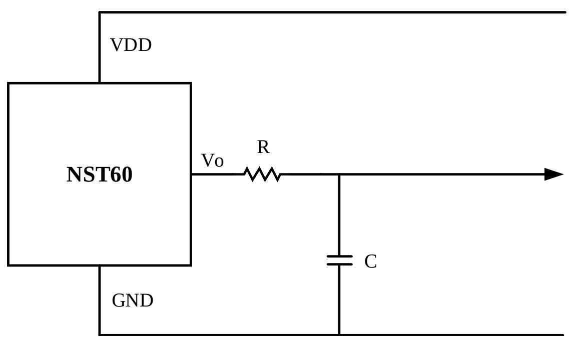


Figure 4.2 NST60 With RC Filter

4.2 Typical Application

As shown in Figure 4.3, the NST60 has an extremely low supply current and a wide supply range, therefore, it can be easily driven by a battery. In order to reduce the noise in the output voltage, it is recommended to add a 0.1µF capacitor between the power and the ground.

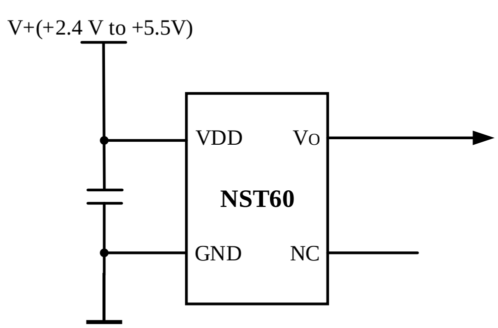


Figure 4.3 Typical Connections of the NST60

4.3 System Examples

4.3.1 Conserving Power Dissipation with Shutdown

Although NST60 has extremely low power consumption, for power-sensitive applications it can simply be shutdown by driving its supply pin with the output of a logic gate as shown in Figure 4.4.

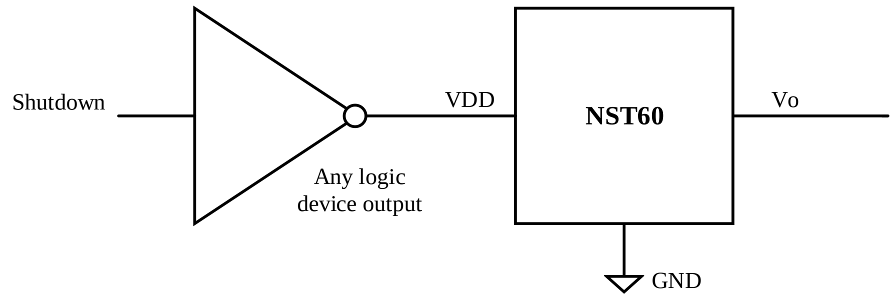


Figure 4.4 Conserving Power Dissipation with Shutdown

4.3.2 Analog-to-Digital Converter Input Stage

The input structure of most CMOS ADCs is sample and hold structure. When ADC charges the sampling capacitor, it needs to draw instantaneous current from the signal source (such as NST60 temperature sensor and many operational amplifiers). By adding RC filter to the output stage of NST60, this requirement can be met. At this time, the instantaneous current is provided by the output capacitor. This ADC is shown as an example only, in Figure 4.5.

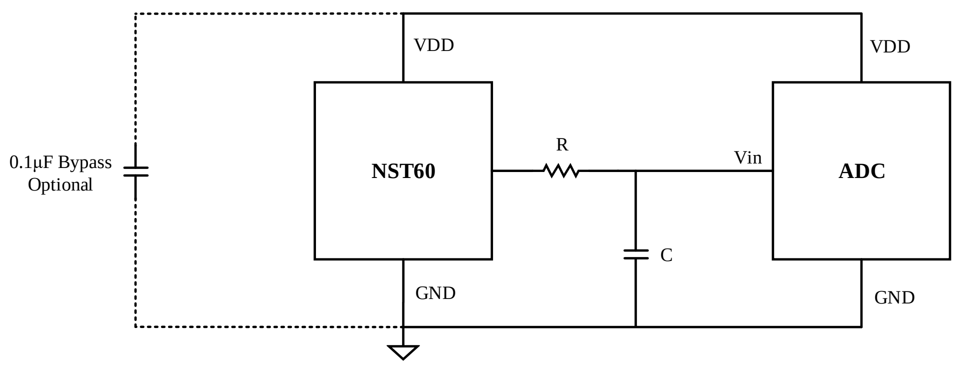
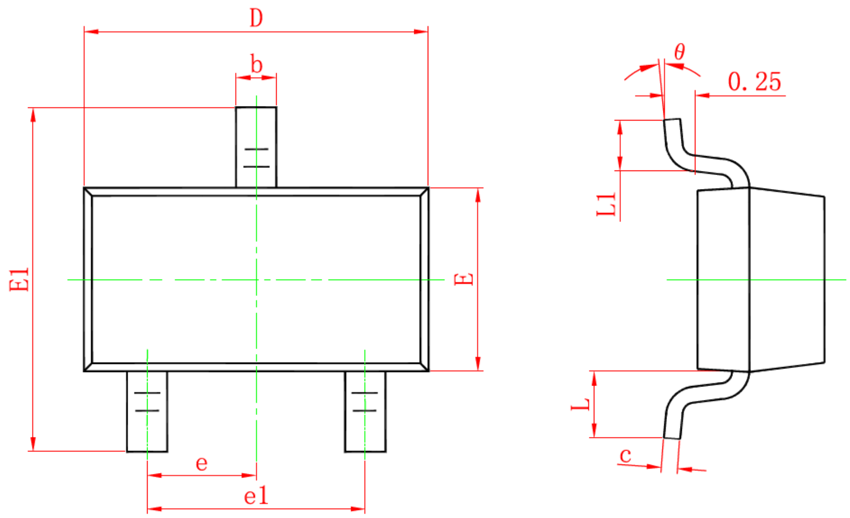
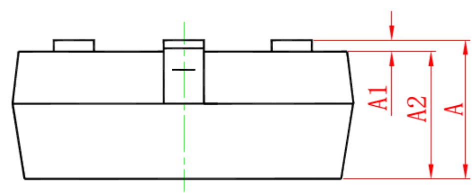


Figure 4.5 Suggested Connection to a Sampling Analog to Digital Converter Input Stage

5 Package Information

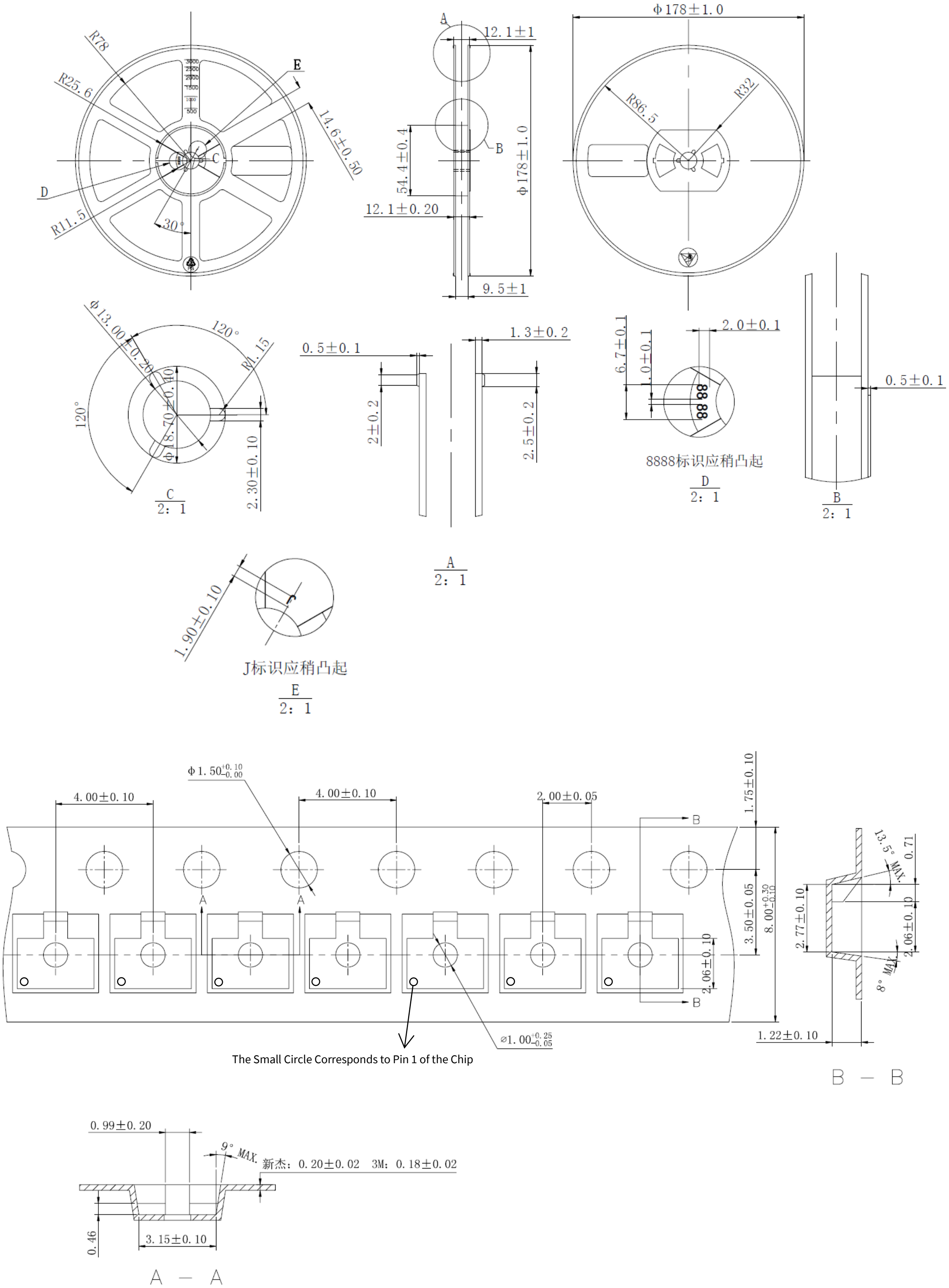
5.1 SOT-23(3) Package





Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 TYP.		0.037 TYP.	
e1	1.800	2.000	0.071	0.079
L	0.550REF.		0.022REF.	
L1	0.300	0.500	0.012	0.020
θ	0°	8°	0°	8°

5.2 SOT-23(3) Tape and Reel



Tape and Reel Information of SOT-23(3)

6 Order Information

Type	Unit	MSL	Marking	Description
NST60-DSTR	3000ea/Reel	1	60XX	SOT-23(3) package，Reel
NOTE: All packages are RoHS-compliant with peak reflow temperatures of 260 °C according to the JEDEC industry standard classifications and peak solder temperatures(Reflow profile:J-STD-020E).				

7 Revision History

Revision	*Description*	*Date*
1.0	Initial Version	2020/12/10
1.1	Revise information. Optimize text presentation	2022/03/30
1.2	Revise Accuracy Comments of Electrical Characteristics. Revise Capacitive Loads. Change Application Information. Tape and reel show 1 pin. Optimize text presentation.	2022/08/02

IMPORTANT NOTICE

For further information on applications, products and technologies, please contact Novosense(www.novosns.com).

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