

Product Overview

NSM2311 is an integrated path linear current sensor with a very low on-resistance of $100\mu\Omega$, reducing heat loss on the chip.

NOVOSENSE innovative isolation technology and signal conditioning design can meet high isolation levels.

Current flowing through a busbar generates a magnetic field that is sensed by the monolithic, low-offset, linear Hall IC. Compared with the current sampling method of the Shunt+ isolated op-amp, NSM2311 eliminates the need for the primary side power supply and has a simple and convenient layout. At the same time, it has extremely high isolation withstand voltage and Lifetime stability.

In high-side current monitoring applications, NSM2311 can reach a working voltage of 1358Vpk, and it can withstand 8kV surge voltage without adding any protection devices.

Due to NSM2311 internal accurate temperature compensation algorithm and factory accuracy calibration, this current sensor can maintain good accuracy in the full temperature working range, and the customer does not need to do secondary programming or calibration.

Key Features

- 2.4 μ s response time
- $\pm 2\%$ sensitivity error over full temperature range
- ± 5 mV offset error over full temperature range
- High isolation level that meets UL standards
- Working Voltage for Basic Isolation (V_{WVBI}): 1358Vpk / 960Vrms
- Withstand isolation voltage (V_{ISO}): 5000Vrms
- Maximum surge isolation withstand voltage (V_{surge}): 8kV
- CMTI > 100V/ns
- CTI (I)

- Creepage distance/ Clearance distance: 6.9mm
- NOVOSENSE innovative 'Spin Current' technology makes offset temperature drift very small
- Working temperature: $-40^{\circ}\text{C} \sim 150^{\circ}\text{C}$
- Support power supply ratiometric and fix mode
- Primary conductor resistance: $100\mu\Omega$
- High bandwidth and ultrafast response time
- ROHS& REACH Compliance

Applications

- Solar System
- Switching Power Supply
- Motor Control
- DC/DC Converter
- Charging Pile

Device Information

Part Number	Package	Body Size
NSM2311	DIP-5L	13mm \times 10mm

Functional Block Diagrams

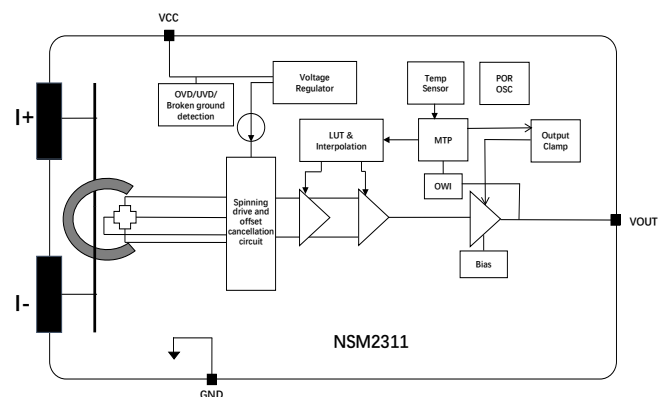


Figure 1. NSM2311 Block Diagram

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1. Pin Configuration and Functions

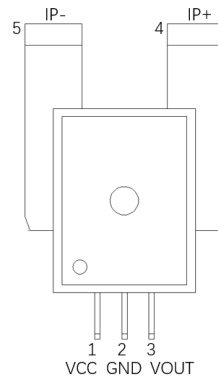


Figure 1.1 NSM2311 Package

Table 1.1 NSM2311 Pin Configuration and Description

NSM2311 Pin No.	Symbol	Function
1	VCC	Power supply
2	GND	Ground
3	VOUT	Output voltage
4	IP+	Current flows into the chip, positive direction
5	IP-	Current flows out of the chip, negative direction

2. Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit	Comments
VCC	VCC	-0.3		6.5	V	25°C
Vout		-0.3		VCC+0.3	V	25°C
Others Pin		-0.3		VCC+0.3	V	25°C
Storage temperature	T _{storage}	-40		150	°C	
Ambient temperature	T _{operation}	-40		150	°C	
Junction temperature	T _j	-40		150	°C	

3. ESD Ratings

Ratings		Value	Unit
Electrostatic discharge	Human body model (HBM), per AEC-Q100-002-RevD ● All pins	±8	kV
	Charged device model (CDM), per AEC-Q100-011-RevB ● All pins	±2	kV

4. Isolation Characteristics

Parameters	Symbol	Rating	Unit	Comments
Surge Voltage	V _{surge}	8	kV	Based on IEC61000-4-5 1.2μs /50μs waveform
Dielectric Strength Test Voltage	V _{ISO}	5000	V _{rms}	60s isolation voltage parameters, according to UL62368-1
Working Voltage for Basic Isolation	V _{WVBI}	960	V _{rms}	Maximum approved working voltage for basic isolation according to UL60950-1 and UL62368-1
		1358	V _{dc}	
Working Voltage for Reinforced Isolation	V _{WVRI}	475	V _{rms}	Maximum approved working voltage for reinforced isolation according to UL60950-1 and UL62368-1
		672	V _{dc}	
Common-mode transient immunity	CMTI	>100	V/ns	The criterion for judging the failure is that the output peak is greater than 100mV and the duration is longer than 1μs
Creepage	Creepage	6.9	mm	Minimum Creepage
Clearance	Clearance	6.9	mm	Minimum Clearance
Comparative Tracking Index	CTI	>=600		CTI I

5. Specifications

5.1. Common Characteristics (TA= -40°C~150°C, VCC = 5V or 3.3V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Supply voltage	VCC	3	3.3	3.6	V	3.3V version
		4.5	5	5.5	V	5V version
Supply current	ICC		10	13	mA	No load, VCC=5V
			7	10	mA	No load, VCC=3.3V
Primary conductor resistance	R _P		100		μΩ	TA = 25°C
Power-on time ^{[1][2]}	T _{PO}		1		ms	Recommend to read output after 1ms power-on time, TA = 25°C
Output capacitance load ^{[1][2]}	C _L		1		nF	
Output short current	I _{short}		25		mA	Short to GND, TA = 25°C
			45		mA	Short to VCC, TA = 25°C
Rail to Rail output voltage ^{[1][2]}	V _s	0.1		VCC-0.1	V	TA = 25°C, C _L =1nF, VCC=5V
Rise time ^{[1][2]}	T _r		3		μs	TA = 25°C, C _L =1nF, VCC=5V
Propagation delay ^{[1][2]}	T _{pd}		400		ns	TA = 25°C, C _L =1nF, VCC=5V
Response time ^{[1][2]}	T _{response}		2.4		μs	TA = 25°C, C _L =1nF, VCC=5V
Bandwidth ^{[1][2]}	BW		147		kHz	-3dB Bandwidth, TA = 25°C, C _L =1nF, VCC=5V
Ratiometric output sensitivity error	S _{ERR}		1.5		%	'R' version, VCC= 4.5V~5.5V or 3.0V~3.6V, TA = 25°C
Rationmetric output offset error	V _{outERR}		0.1		%	'R' version, VCC= 4.5V~5.5V or 3.0V~3.6V, TA = 25°C
Non-linearity ^[2]	E _{NL}		±0.2		%	
Noise density ^{[1][2]}	ND		140		uArms/ √Hz	TA = 25°C, C _L =1nF, VCC= 5V
			300			TA = 25°C, C _L =1nF, VCC= 3.3V

[1]: Guarantee by Design

[2]: Guarantee by Bench Validation

[3]: The increase or decrease of data in 5.X will not send a PCN to the customer if the evaluation does not affect the customer's use.

5.2. NSM2311-50B5R-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I_{pr}	-50		50	A	
Sensitivity	Sens		40		mV/A	$I_{prmin} < I_{pr} < I_{prmax}$
Zero current output voltage	VQVO		VCC/2		V	$I_{pr}=0A$
Sensitivity error [1][2]	E_{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, $I_{pr}=0A$, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, $I_{pr}=0A$, Vout-VCC/2
Total output error [1][2]	E_{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I_{ERRROM}		0.14		A	TA = 25°C, $I_{pr}=50A$
Sensitivity error lifetime drift [3][4]	E_{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E_{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 25A. A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.3. NSM2311-100B5R-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-100		100	A	
Sensitivity	Sens		20		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		VCC/2		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-VCC/2
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERRROM}		0.19		A	TA = 25°C, I _{pr} =100A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 50A. A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.4. NSM2311-100B3R-DDIET Characteristics (TA= -40°C~150°C, VCC = 3.3V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-100		100	A	
Sensitivity	Sens		13.2		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		VCC/2		V	I _{pr} =0A
Sensitivity error ^{[1][2]}	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error ^[2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-VCC/2
Total output error ^{[1][2]}	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERRROM}		0.19		A	TA = 25°C, I _{pr} =100A
Sensitivity error lifetime drift ^{[3][4]}	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift ^{[3][4]}	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift ^{[3][4]}	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 50A. A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.5. NSM2311-150B3F-DDIET Characteristics (TA= -40°C~150°C, VCC = 3.3V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-150		150	A	
Sensitivity	Sens		8.8		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		1.65		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-1.65V
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-1.65V
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERRROM}		0.26		A	TA = 25°C, I _{pr} =150A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 75A. A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.6. NSM2311-150B5R-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-150		150	A	
Sensitivity	Sens		13.33		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		VCC/2		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-VCC/2
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERROM}		0.26		A	TA = 25°C, I _{pr} =150A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 75A. A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.7. NSM2311-200B5R-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-200		200	A	
Sensitivity	Sens		10		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		VCC/2		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-VCC/2
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERRROM}		0.29		A	TA = 25°C, I _{pr} =200A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 100A, A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.8. NSM2311-200B3R-DDIET Characteristics (TA= -40°C~150°C, VCC = 3.3V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-200		200	A	
Sensitivity	Sens		6.6		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		VCC/2		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-VCC/2
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERROM}		0.29		A	TA = 25°C, I _{pr} =200A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 100A, A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.9. NSM2311-200B5F-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I_{pr}	-200		200	A	
Sensitivity	Sens		10		mV/A	$I_{prmin} < I_{pr} < I_{prmax}$
Zero current output voltage	VQVO		2.5		V	$I_{pr}=0A$
Sensitivity error [1][2]	E_{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, $I_{pr}=0A$, Vout-2.5V
			±5		mV	TA = -40°C~25°C, $I_{pr}=0A$, Vout-2.5V
Total output error [1][2]	E_{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I_{ERROM}		0.29		A	TA = 25°C, $I_{pr}=200A$
Sensitivity error lifetime drift [3][4]	E_{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E_{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 100A, A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.10. NSM2311-300B5R-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-300		300	A	
Sensitivity	Sens		6.67		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		VCC/2		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-VCC/2
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERROM}		0.35		A	TA = 25°C, I _{pr} =300A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 100A, A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.11. NSM2311-300B5F-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I _{pr}	-300		300	A	
Sensitivity	Sens		6.67		mV/A	I _{prmin} <I _{pr} <I _{prmax}
Zero current output voltage	VQVO		2.5		V	I _{pr} =0A
Sensitivity error [1][2]	E _{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, I _{pr} =0A, Vout-2.5V
			±5		mV	TA = -40°C~25°C, I _{pr} =0A, Vout-2.5V
Total output error [1][2]	E _{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I _{ERROM}		0.35		A	TA = 25°C, I _{pr} =300A
Sensitivity error lifetime drift [3][4]	E _{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E _{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 100A, A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

5.12. NSM2311-400B5R-DDIET Characteristics (TA= -40°C~150°C, VCC = 5V, unless otherwise specified)

Parameters	Symbol	Min	Typ	Max	Unit	Comments
Current sensing range	I_{pr}	-400		400	A	
Sensitivity	Sens		5		mV/A	$I_{prmin} < I_{pr} < I_{prmax}$
Zero current output voltage	VQVO		VCC/2		V	$I_{pr}=0A$
Sensitivity error [1][2]	E_{sens}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Offset error [2]	VOE	-5		5	mV	TA = 25°C~150°C, $I_{pr}=0A$, Vout-VCC/2
			±5		mV	TA = -40°C~25°C, $I_{pr}=0A$, Vout-VCC/2
Total output error [1][2]	E_{total}	-1.5		1.5	%	TA = 25°C~150°C
			±2		%	TA = -40°C~25°C
Magnetic Offset Error	I_{ERRROM}		0.4		A	TA = 25°C, $I_{pr}=400A$
Sensitivity error lifetime drift [3][4]	E_{sens_drift}		±3		%	After reliability test, TA = 25°C
Offset lifetime drift [3][4]	VOE_drift		±3		mV	After reliability test, TA = 25°C
Total output error lifetime drift [3][4]	E_{total_drift}		±3		%	After reliability test, TA = 25°C

[1]: In production, total error and sensitivity error are measured and calculated at 100A, A single part will not have both the min/max sensitivity error and min/max offset voltage.

[2]: When TA = 25°C~150°C, Min/Max value is mean value +/-3sigma; When TA = -40°C~25°C, Typ value is mean value +/-3sigma.

[3]: Typ Value is mean±3sigma.

[4]: The reliability data is implemented in accordance with the AEC-Q100 standard. This item is derived from the experimental results with the largest change after the PC, HTS, HAST, UHAST, HTOL, TC and other test data required by AEC-Q100 Grade0 as a reference and it is the worst case.

In the fifth chapter, the increase or decrease of the material number and the tightening of the parameter range, NOVOSENSE reserves the right not to send PCN to the customer, unless the expansion of the parameter range affects the customer's use and product performance.

6. Typical Performance Characteristics

6.1. Overview

NSM2311 current sensor can accurately measure AC/DC current while minimizing the overall measurement cost. Current sensors based on the Hall principle can be widely used in all current monitoring applications such as consumption, industry, and automotive. Compared with current transformers, the extremely small size of NSM2311 DIP-5L can help customers reduce the overall PCB area; compared to Shunt + isolated op amps, NSM2311 only needs low-voltage side power supply, reducing the inconvenience of isolated op amps requiring power supply for both high and low voltages. When using NSM2311, you only need to string the primary side pin into the measured current. According to the part of Maxwell equations about electricity and magnetism, a magnetic field will be generated around the energized conductor of the primary side. The Hall and conditioning amplifier circuits in NSM2311 will convert magnetic field into an output voltage, and the output voltage increases or decreases in proportion to the input current.

Benefiting from the typical value of the primary resistance of NSM2311 is only 100 μ ohm, as long as the customer conducts a reasonable heat dissipation design, the temperature rise brought by the measurement of large current can be effectively reduced.

6.2. NSM2311 F version (Fixed output)

In some applications, the ADC and the current sensor do not share a power rail, so the sensor needs to have absolute sensitivity that does not vary with the power supply voltage. The value of the sensing current can be obtained by $(V_{out} - 2.5V) / \text{Sensitivity}$. For $\pm 50A$ measurement range, if V_{out} measures 3.7V, then the input current is $(3.7V - 2.5V) / 40mV/A = 30A$. In practical applications, V_{out} can be directly collected by ADC to obtain input current, and the measurement accuracy will not be affected by power supply changes.

6.3. Definition of NSM2311 Terms

Power-on time (T_{po})

When the power supply climbs from 0 to the chip's working range, NSM2311 needs some time to establish the internal working logic. T_{po} time is defined as: the time from the power supply climbing to V_{ccmin} to the output reaching the steady state within $\pm 10\%$, As shown below:

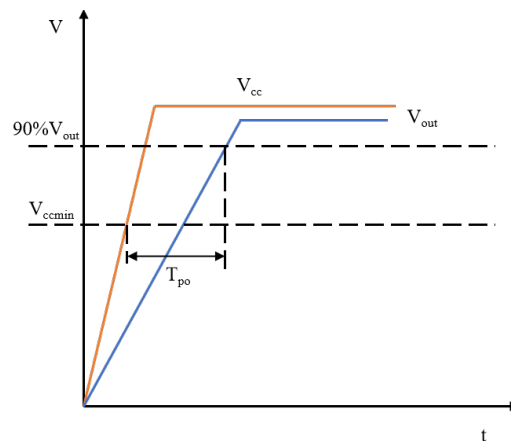


Figure 6.1 NSM2311 Power-on time

Rise time (T_r)

The time from 10% to 90% of the output signal is defined as the output rise time. For step input signals, there is such an approximate relationship between the rise time and bandwidth of the output signal: $f(-3dB) = 0.35/T_r$.

Propagation delay (T_{pd})

The time from 20% of the primary current to 20% of the output signal is defined as the output propagation delay time.

Response time (Tresponse)

The time from 90% of the primary current to 90% of the output signal is defined as the output response time.

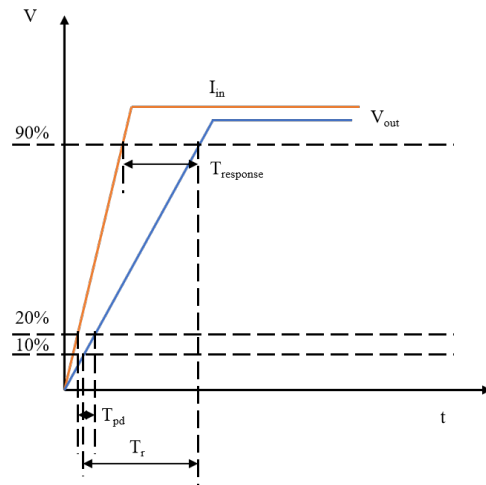


Figure 6.2 NSM2311 response time

Sensitivity and sensitivity error

Sensitivity is defined as the ratio of the output voltage proportional to the primary input current. Sensitivity is the slope of the curve in the figure below.

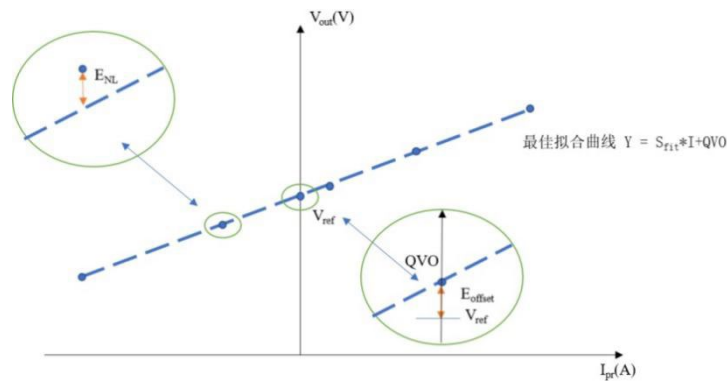


Figure 6.3 NSM2311 Sensitivity and error

The sensitivity error is defined as the deviation between the slope of the best-fit curve and the slope of the ideal curve. The slope of the best-fit curve comes from the measured value:

$$E_{sens} = \frac{(S_{fit} - S_{ideal})}{S_{ideal}} * 100\%$$

Offset error

The zero current output error is defined as the difference between the output voltage and the reference voltage when the primary current is 0A, the reference voltage here is VCC/2 or 0.1×VCC (R Version):

$$E_{offset} = QVO - V_{ref}$$

Nonlinear error

The linearity error is defined as the error from the maximum deviation point of the best-fit curve to the full scale. The mathematical expression is as follows:

$$V_{NL} = V_{out_{max}} - (S_{fit} * I_{max} + QVO)$$

among them:

V_{out_{max}} is the output voltage furthest from the fitted curve;

I_{max} is the primary current farthest from the fitted curve;

Therefore, the nonlinear error can be mathematically expressed as the following formula:

$$E_{NL} = \frac{V_{NL}}{FS} * 100\%$$

Total output error

The total output error is defined as the error between the actual given current and the current measured by the chip, in other words, the difference between the actual output voltage and the ideal output voltage. It should be known that in different current ranges, the factors that dominate the total output error are different. If it is under low current measurement, the zero point error is the main source of error; if under high current measurement, the total output error caused by the zero point error is very small, and the dominant error is the sensitivity error.

Ratiometric output sensitivity error

The ratiometric output sensitivity error is defined as the error of the sensitivity change with the change of VCC. In a perfectly ideal situation, when VCC changes by 10%, the sensitivity should also change by 10%. The error is expressed by the following formula:

$$S_{ERR} = 100\% \times \left[\left(\frac{S_{VCC}}{S_{5V}} \right) - \left(\frac{VCC}{5V} \right) \right]$$

Ratiometric output offset error

The offset error of the ratiometric output is defined as the error condition of the zero-point change with the change of VCC. In a perfectly ideal situation, the output zero point is VCC/2, VCC changes 10%, and the zero point should also change 10%. The error is expressed by the following formula:

$$V_{out0ERR} = 100\% \times \left[\left(\frac{V_{out0VCC}}{V_{out05V}} \right) - \left(\frac{VCC}{5V} \right) \right]$$

6.4. Characteristic Performance Data

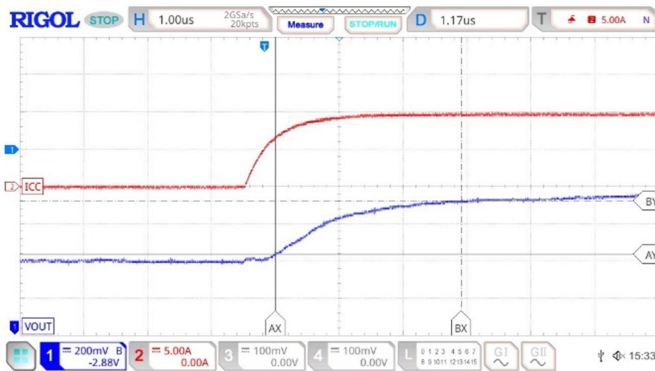


Figure 6.4 Rising time performance of step current

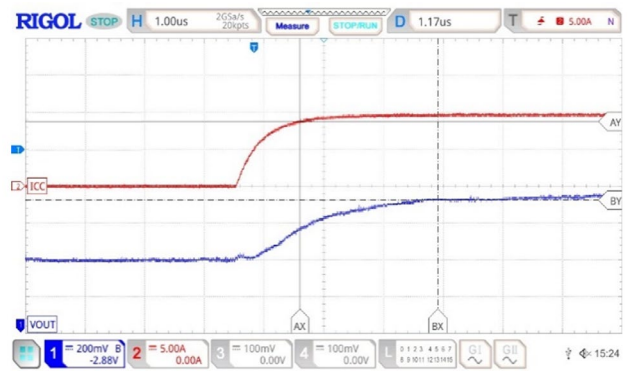


Figure 6.5 Response time performance of step current

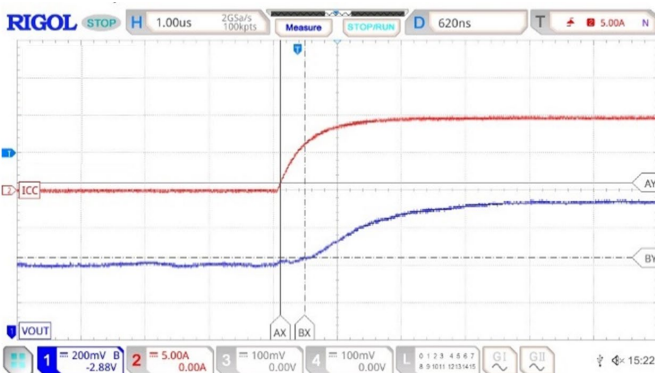


Figure 6.6 Propagation delay of step current

7. Application Note

7.1. Typical Application Circuit

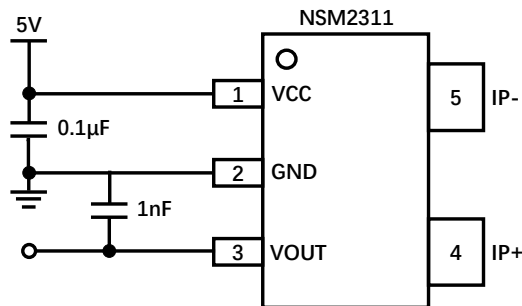


Figure 7.1 Typical application diagram

7.2. PCB Layout

For NSM2311 in high-current monitoring applications, a reasonable layout will make the system heat dissipation faster and better. The copper area on the NSM2311 Demo board is 26mm*26mm (very small copper area is used to illustrate the worse situation, rather than a large copper area), the top layer and the bottom layer are 4oz copper thick. If customers want to achieve better heat dissipation, they can use multi-layer boards and thicken the copper thickness to achieve it, and can use active heat dissipation solutions in the system, such as adding heat sinks and fans. If you need to use the NSM2311 Demo board to evaluate the performance of this current sensor, please contact NOVOSENSE sales team for support.

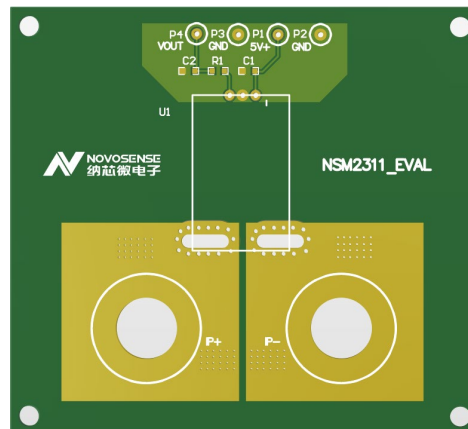


Figure7.2 NSM2311 PCB Layout

7.3. Thermal Evaluation

The thermal evaluation experiment is executed at room temperature, which mainly illustrates the temperature rise of the NSM2311 current sensor under different currents. With these data and the above-mentioned layout guide, customers can design heat dissipation according to actual application requirements. The ambient temperature in this experiment is room temperature. The chip is mounted on the demo board mentioned above for temperature rising test. There is no extra active heat dissipation devices (such as a fan, etc.). The relationship between junction temperature and time is measured for 15 minutes. Under normal circumstances, the temperature rising is normally stable in about 15 minutes. And the specific test data are as follows:

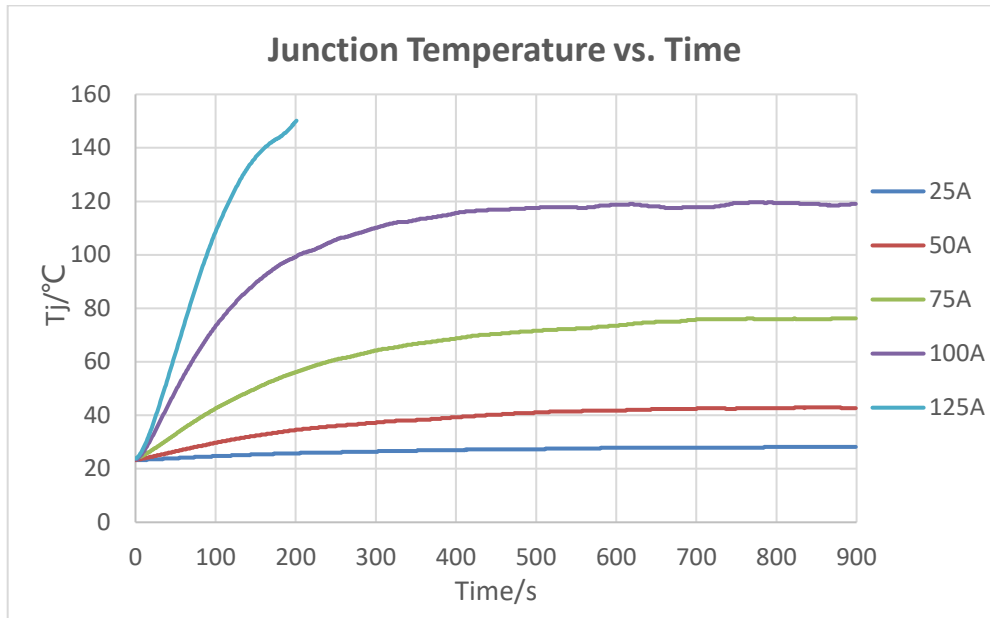


Figure 7.3 NSM2311 Junction temperature vs. Different continues current

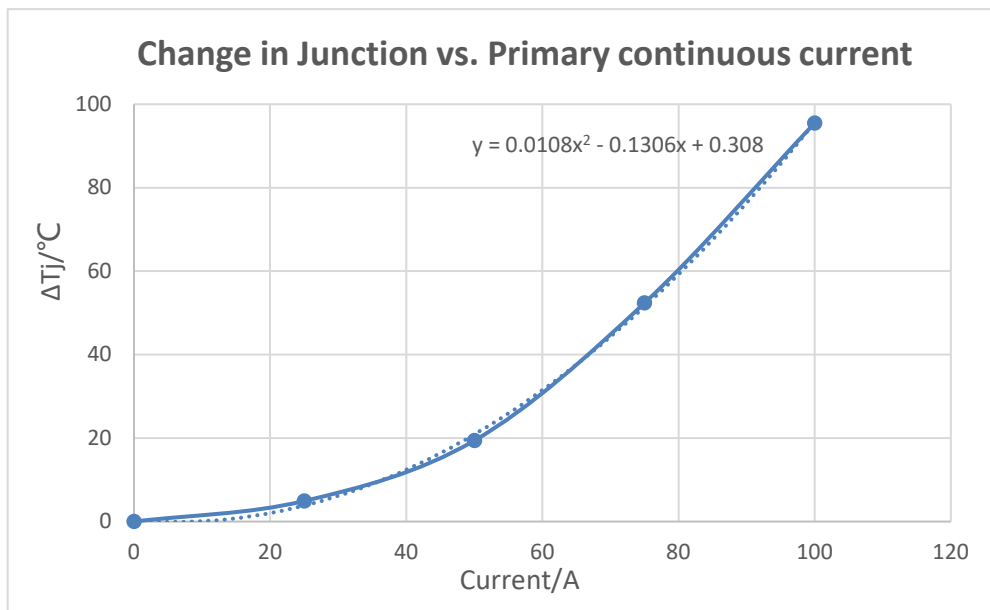
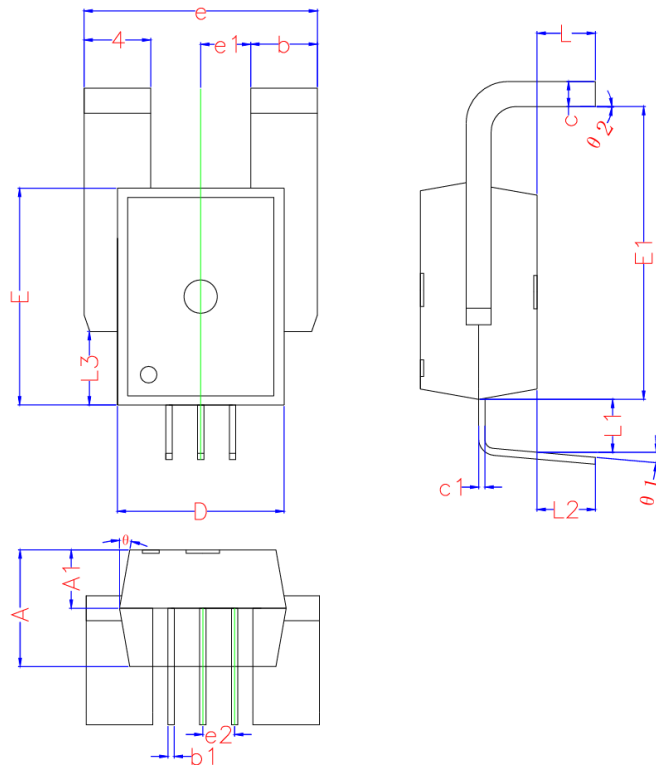


Figure 7.4 NSM2311 Estimation function of junction temperature at different currents

It is important to noted that the above temperature rising experiment data is only based on the demo board, in order to reflect the relationship between NSM2311 current and temperature in a worst case. Customers can reduce the temperature rising of Tj by increasing or thickening the copper area of the PCB, using multi-layer boards, or adding active heat dissipation devices such as fans (Tj<150°C). If customers compare NSM2311 with other competing products, please refer to the same PCB design instead of using specially designed PCB provided by competing products. NOVOSENSE can provide DIP-5L general-purpose Demo board for comparison of temperature rises of competing products.

8. Package Information

DIP-5L Package



* CONTROLLING DIMENSION : MM

SYMBOL	MM		
	MIN	NOM	MAX
A	6.950	7.000	7.050
A1	3.450	3.500	3.550
b	3.850	4.000	4.150
b1	0.280	0.380	0.480
c	1.400	1.500	1.600
c1	0.280	0.380	0.480
D	9.950	10.000	10.050
E	12.950	13.000	13.050
E1	17.300	17.500	17.700
e	13.800	14.000	14.200
e1	2.800	3.000	3.200
e2	1.705	1.905	2.105
L	3.300	3.500	3.700
L1	2.700	2.900	3.100
L2	3.300	3.500	3.700
L3	4.300	4.400	4.500
theta	9°	10°	11°
theta 1	0°	5°	10°
theta 2	-1°	-	3°

NOTE:
 1. ALL DIMENSIONS ARE IN MILLIMETERS.
 2. DIMENSION D DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
 PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.25MM PER SIDE.
 3. DIMENSION E DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSION.
 INTERLEAD FLASH OR PROTRUSION SHALL NOT EXCEED 0.25MM PER SIDE.
 4. DIMENSIONS D AND E ARE DETERMINED AT THE OUTERMOST EXTREMES OF THE PLASTIC BODY EXCLUSIVE OF MOLD FLASH, TIE BAR BURRS, INTERLEAD FLASH AND GATE BURRS.
 BUT INCLUDING ANY MISMATCH BETWEEN THE TOP AND BOTTOM OF THE MOLDED BODY.
 5. ALL MATERIAL MUST MEET RoHS REQUIREMENT.

Figure 8.1 DIP-5L Package Shape and Dimension in millimeters

9. Tube Information

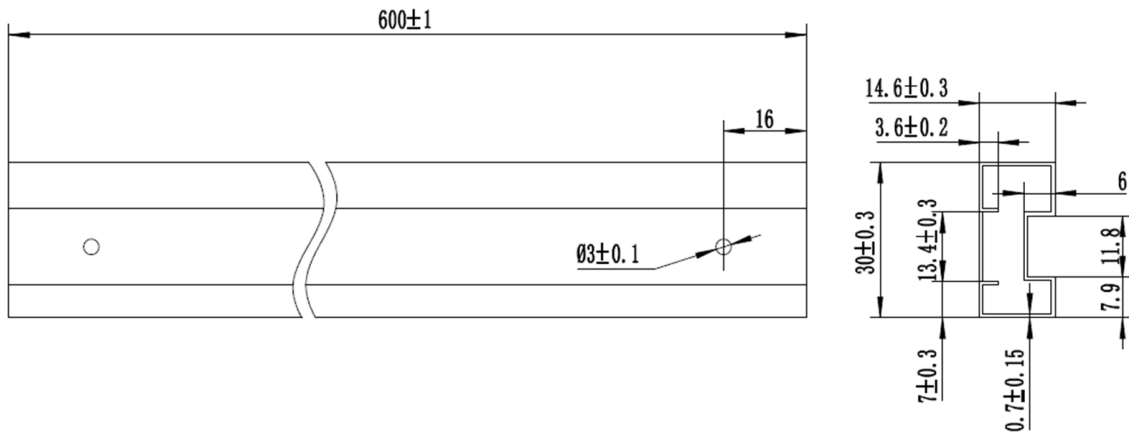


Figure 9.1 Tube Information

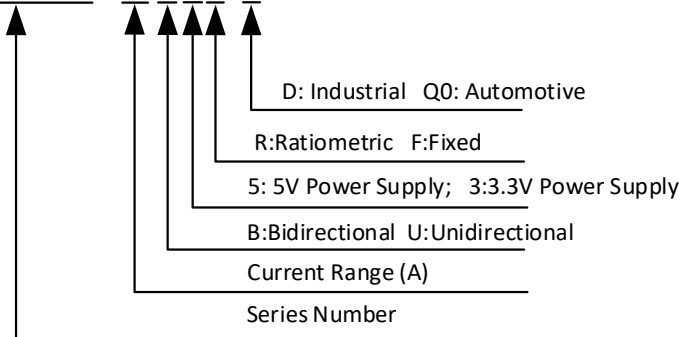
10. Ordering Information

Orderable Part	Primary Current(A)	Power Supply(V)	Sensitivity (mV/A)	SPQ	Package
NSM2311-50B5R-DDIET	±50	5V	40	400	DIP-5L
NSM2311-100B5R-DDIET	±100	5V	20	400	DIP-5L
NSM2311-100B3R-DDIET	±100	3.3V	13.2	400	DIP-5L
NSM2311-150B3F-DDIET	±150	3.3V	8.8	400	DIP-5L
NSM2311-150B5R-DDIET	±150	5V	13.33	400	DIP-5L
NSM2311-200B5R-DDIET	±200	5V	10	400	DIP-5L
NSM2311-200B3R-DDIET	±200	3.3V	6.6	400	DIP-5L
NSM2311-200B5F-DDIET	±200	5V	10	400	DIP-5L
NSM2311-300B5R-DDIET	±300	5V	6.67	400	DIP-5L
NSM2311-300B5F-DDIET	±300	5V	6.67	400	DIP-5L
NSM2311-400B5R-DDIET	±400	5V	5	400	DIP-5L

*If you need other version, please contact NOVOSENSE for special support

10.1. Device Naming Rule:

NSM2311-50B5F-DDIET



11. Revision History

<i>Revision</i>	<i>Description</i>	<i>Date</i>
1.0	Initial Version.	2025/11/21

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