NHC3000FSWXXXBXTR Current Sensor IC

NHC3000 provides economical and precise solutions for AC or DC current sensing. Typical applications include photovoltaic system, industrial power supply, charging pile, and motor control.

Features

- Current sensing range: ±20A ~ ±100A
- Primary conductor resistance: 0.3 mΩ
- Bandwidth: 450 kHz
- Sensitivity temperature drift: within ±2.5%
- Surge current withstand capability: 20 kA
- Operating temperature range: -40 ~ 125° C
- Withstand isolation voltage: 5000 V_{RMS}
- Output response time: 0.9 μs
- Surge voltage withstand capability: 11kV



Applications

- Photovoltaic(PV) System
- Industrial Power Supply
- Charging Pile
- Load Detection System
- Motor Control
- OBC/DCDC/PTC

Ordering Informations

Part Number	Primary Current(A)	Supply Voltage(V)	Sensitivity(mV/A)	Overcurrent Threshold(%)	Package
NHC3000FSW020B5TR	±20A	5	100	50%~200%IP_MAX	SOP16W
NHC3000FSW030B5TR	±30A	5	66.7		SOP16W
NHC3000FSW040B5TR	±40A	5	50		SOP16W
NHC3000FSW050B5TR	±50A	5	40		SOP16W
NHC3000FSW075B5TR	±75A	5	26.7		SOP16W
NHC3000FSW100B5TR	±100A	5	20		SOP16W
NHC3000FSW020B3TR	±20A	3.3	66		SOP16W
NHC3000FSW030B3TR	±30A	3.3	44		SOP16W
NHC3000FSW040B3TR	±40A	3.3	33		SOP16W
NHC3000FSW050B3TR	±50A	3.3	26.4		SOP16W
NHC3000FSW075B3TR	±75A	3.3	17.6		SOP16W
NHC3000FSW100B3TR	±100A	3.3	13.2		SOP16W
More part numbers can be customized within the primary current range of 20 to 100A...					

The overcurrent threshold of NHC3000 can be set by the pin voltage of the VOC. The voltage source for the setting can be VREF or other external voltage inputs. Taking NHC3000FSW050B5TR as an example:

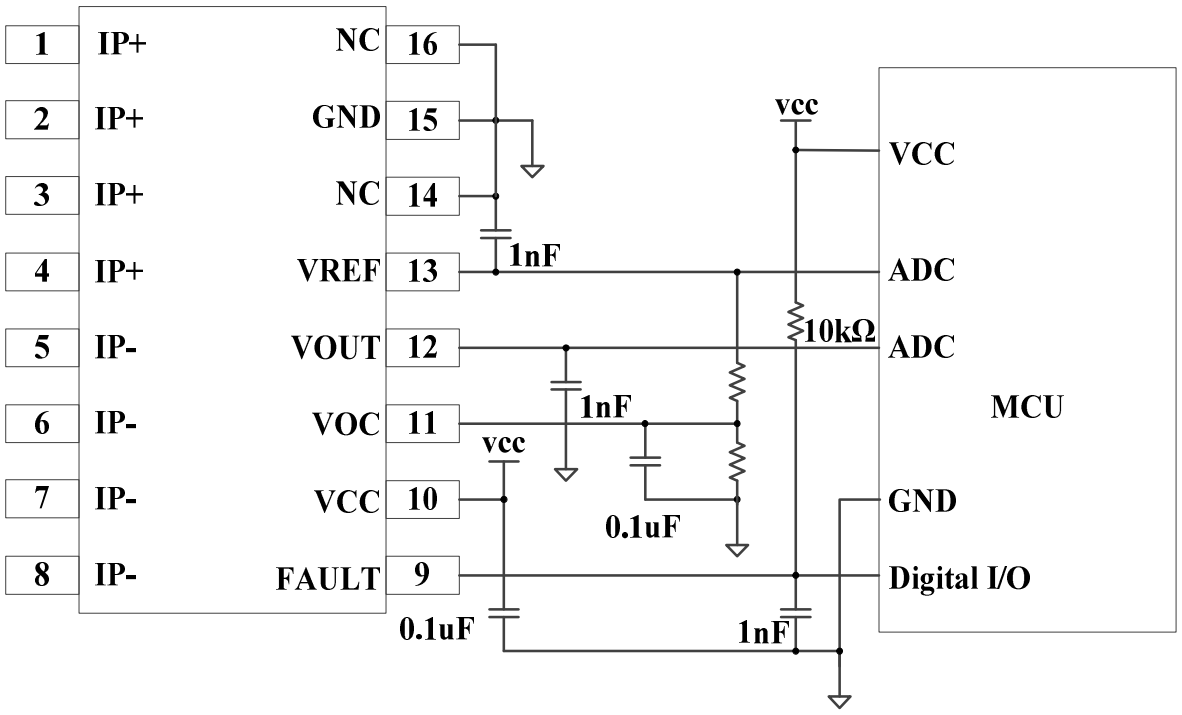
Parameters	Overcurrent Threshold			
V_{OC}	$0.2V_{REF}$	$0.4V_{REF}$	$0.6V_{REF}$	$0.8V_{REF}$
Overcurrent Threshold[1]	25A	50A	75A	100A

[1]Overcurrent Threshold: $I_{FAULT} = \frac{V_{OC}}{V_{REF}} \times 2.5 \times IP_MAX$, $0.2 \times V_{REF} < V_{OC} < 0.8 \times V_{REF}$

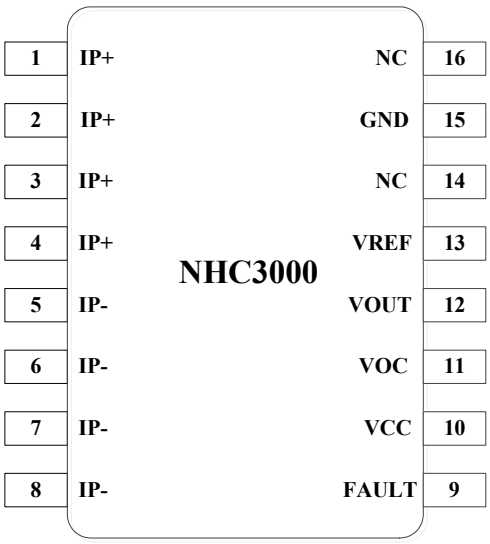
Part Number Definition

Instance	Parameters	Definition
NHC3000FSW050B5TR Packing Designator Supply Voltage Output Directionality Current Sensing Range Package Designator Temperature Range Product Series Number	Product Series Number	NHC3000
	Temperature Range	F – -40~125℃
	Package Designator	SW – SOP16W
	Current Sensing Range	050 – IPR = -50A~50A(Bidirectional) or 0~50A(Unidirectional)
	Output Directionality	B – Bidirectional U – Unidirectional
	Supply Voltage	5 – VCC = 5V 3 – VCC = 3.3V
	Packing Designator	TR – Tape and Reel

Typical Application Circuit

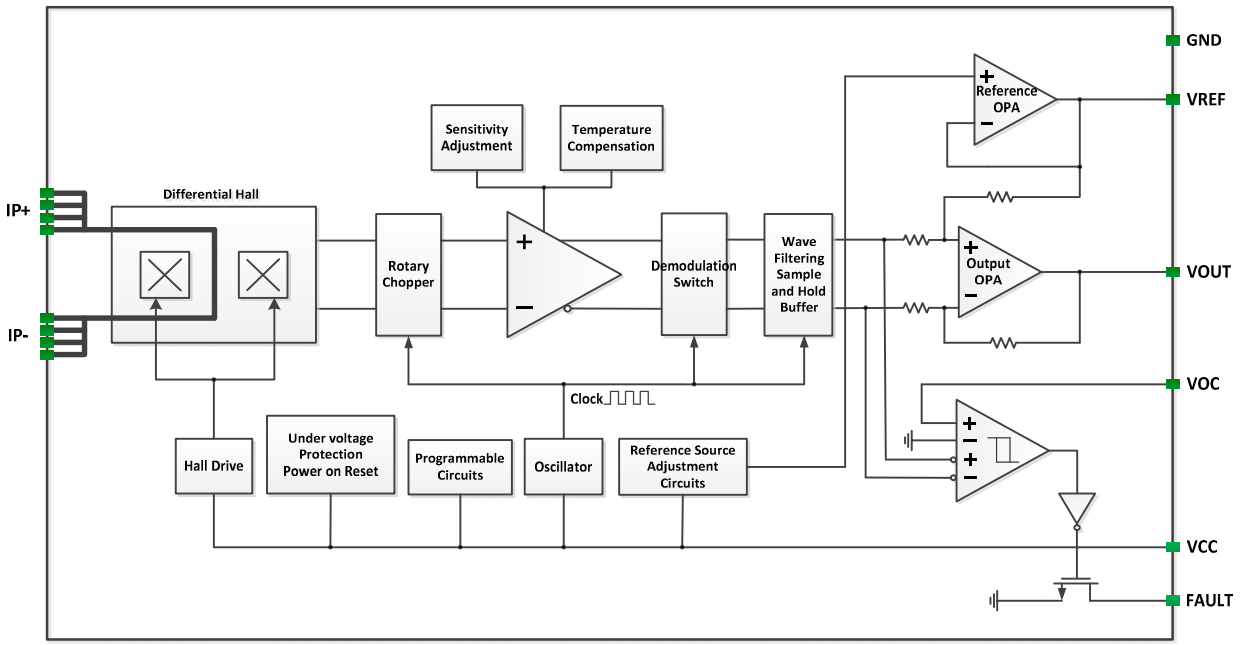


Pin Configuration



Symbol	Number	Function
IP+	1	Current flows into the chip, positive direction
IP+	2	
IP+	3	
IP+	4	
IP−	5	Current flows out of the chip, negative direction
IP−	6	
IP−	7	
IP−	8	
FAULT	9	Overcurrent fault, Active Low
VCC	10	Supply Voltage
VOC	11	Overcurrent fault operation point input
VOUT	12	Output Voltage
VREF	13	Reference Voltage Output
NC	14	Not Connection
GND	15	Ground
NC	16	Not Connection

Functional Block Diagram



Absolute Maximum Ratings

Parameters	Symbol	Min	Typ	Max	Unit
Supply Voltage	V_{CC}	-0.3		6.5	V
Output Voltage	V_{OUT}	-0.3		VCC+0.3	V
Others Pin		-0.3		VCC+0.3	V
Ambient Temperature	T_A	-40		125	° C
Junction Temperature	T_J			165	° C
Storage Temperature	T_S	-55		150	° C
Electrostatic Discharge	HBM	±4			kV
	CDM	±1			kV
Moisture Sensitivity Level	MSL	3			
Latch-up	LU	500			mA

Note: Do not exceed the limit parameter values during use to prevent damage. Operating continuously at the limit parameter values for a long time may affect the reliability of the current sensor.

Isolation Characteristics

Parameters	Symbol	Conditions	Rating	Unit
Withstand Isolation Voltage	V_{ISO}	50/60Hz, 1min	5000	V_{RMS}
		t = 1s	6000	
Working Voltage for Basic Insulation	V_{IWBI}	Maximum approved working voltage for basic insulation according to UL 62368-1	2121	V_{PK} or V_{DC}
			1500	V_{RMS}
Working Voltage for Reinforced Insulation	V_{IWRI}	Maximum approved working voltage for reinforced insulation according to UL 62368-1	1060	V_{PK} or V_{DC}
			750	V_{RMS}
Clearance	D_{cl}	Minimum distance through air from IP pins to signal pins	8.3	mm
Creepage	D_{cr}	Minimum distance along package surface from IP pins to signal pins	8.3	mm
Surge Voltage	V_{surge}	IEC61000-4-5, 1.2us/50us waveform	11	kV
Surge Current	I_{surge}	IEC61000-4-5, 8us/20us waveform	20	kA

Common Electrical Characteristics (unless otherwise specified, V_{CC}=5V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25℃)

Parameters	Symbol	Min	Typ	Max	Unit	Conditions
Primary conductor Parameter						
Primary conductor resistance	R_p		0.3		mΩ	T_A = 25℃
Power Supply Parameters						
Supply Voltage	V_{CC}	4.5	5	5.5	V	5V version
		3	3.3	3.6		3.3V version
Supply Current	I_{CC}	18	22	28	mA	No load, VCC=5V
		16	19	25		No load, VCC=3.3V
Power-On Time	T_{PO}		22		μs	Time from Vcc > V_{UVLOH} until V_{OUT}、V_{REF} power-on
Under Voltage Lockout Rising Threshold	V_{UVLOH}		3.2		V	5V version, Vcc > V_{UVLOH}, V_{OUT}、V_{REF} power-on
			2.6			3.3V version, Vcc > V_{UVLOH}, V_{OUT}、V_{REF} power-on
Under Voltage Lockout Hysteresis	$V_{UVLOHYS}$		300		mV	5V version, Vcc < V_{UVLOH} - $V_{UVLOHYS}$, V_{OUT}、V_{REF} power-off
			200			3.3V version, Vcc < V_{UVLOH} - $V_{UVLOHYS}$, V_{OUT}、V_{REF} power-off
VOUT Characteristics						
Output capacitance load	C_{OUTL}		1	2.2	nF	
Output resistance load	R_{OUTL}	4.7			kΩ	
Output short current	I_{SOURCE}		8		mA	TA = 25℃, V_{OUT} short to GND
	I_{SINK}		28		mA	TA = 25℃, V_{OUT} short to Vcc
Response time	$T_{response}$		0.9		μs	T_A = 25℃, C_{OUTL}=1nF, VCC=5V
Bandwidth	BW		450		kHz	T_A = 25℃, C_{OUTL}=1nF, VCC=5V
VREF Characteristics						
V_{REF} capacitance load	C_{REFL}		1	2.2	nF	
V_{REF} resistance load	R_{REFL}	4.7			kΩ	
V_{REF} short current	I_{VREF_SOURCE}		2.8		mA	TA = 25℃, V_{REF} short to GND
	I_{VREF_SINK}		6		mA	TA = 25℃, V_{REF} short to Vcc
Reference Voltage	V_{REF}	2.49	2.5	2.51	V	Bidirectional version, Vcc=5V
		1.64	1.65	1.66	V	Bidirectional version, Vcc=3.3V
Overcurrent Fault Detection						
VOC Voltage range	V_{OC}	0.2× V_{REF}		0.8× V_{REF}	V	

Continued from the previous table

Parameters	Symbol	Min	Typ	Max	Unit	Conditions
VOC leakage current	I_{LKVOC}	-50		50	nA	
Overcurrent Fault Gain	A_{VOC}		2.5			I_{Fault}=IP_MAX×(V_{OC}/V_{REF})×A_{VOC}
Fault hysteresis	I_{hys}		0.125×IP_MAX		A	TA = 25° C, C_{OUTL}=1nF
Fault response time	T_{fr}		1		μs	The input current suddenly jumps from 0A to 1.2×I_{Fault}, and Fault is pulled from high to low and held at V_{Fault} for a delay time
Fault error	E_{Fault}		±5		%IP_MAX	V_{OC} = 0.4×V_{REF}, TA=25° C, C_{OUTL}=1nF
Fault output low voltage	V_{Fault}			0.3	V	In the case of overcurrent, the Fault output voltage is at a low level. The Fault pin is connected to a 10kΩ pull-up resistor to VCC
Fault holding time	T_{HOLD}		2.5		μs	The input current suddenly jumps from 1.2×I_{Fault} to 0A, and Fault is pulled from low to high and held at VCC for a delay time
Reliability Test[1]						
Sensitivity lifetime drift	E_{sens_drift}		±2.5		%	After the reliability test, T_A=25℃
Offset lifetime drift	V_{OE_drift}		±8		mV	After the reliability test, T_A=25℃
Reference voltage lifetime drift	V_{REF_drift}		±12		mV	After the reliability test, T_A=25℃
Output voltage lifetime drift	$V_{OUT(Q)_drift}$		±15		mV	After the reliability test, T_A=25℃

[1]Reliability test data is inplemented in accordance with the JESD47 standard.

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-20		20	A
Sensitivity	Sens	Current sensing range		100		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		22		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		2.5		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-30		30	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}-V_{REF}$, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-30		30	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW030B5TR (Unless otherwise specified, V_{CC}=5V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-30		30	A
Sensitivity	Sens	Current sensing range		66.7		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		15		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		2.5		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW040B5TR (Unless otherwise specified, V_{CC}=5V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-40		40	A
Sensitivity	Sens	Current sensing range		50		mV/A
Noise RMS (V_{OUT})	$V_{N(RMS)}$	IP=0A		14		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		2.5		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW050B5TR (Unless otherwise specified, V_{CC}=5V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-50		50	A
Sensitivity	Sens	Current sensing range		40		mV/A
Noise RMS (V_{OUT})	$V_{N(RMS)}$	IP=0A		11		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		2.5		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW075B5TR (Unless otherwise specified, V_{CC}=5V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit

Current sensing range	IP		-75		75	A
Sensitivity	Sens	Current sensing range		26.7		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		7.5		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		2.5		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)} = V_{OUT(Q)}_T_A - V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT} - V_{REF}$, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW100B5TR (Unless otherwise specified, V_{CC}=5V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-100		100	A
Sensitivity	Sens	Current sensing range		20		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		5.5		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		2.5		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)} = V_{OUT(Q)}_T_A - V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT} - V_{REF}$, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW020B3TR (Unless otherwise specified, V_{CC}=3.3V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-20		20	A

Sensitivity	Sens	Current sensing range		66		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		22		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		1.65		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)_T_A}$ - $V_{OUT(Q)_25℃}$	-30		30	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}-V_{REF}$, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-30		30	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW030B3TR (Unless otherwise specified, V_{CC}=3.3V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-30		30	A
Sensitivity	Sens	Current sensing range		44		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		14.7		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		1.65		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)_T_A}$ - $V_{OUT(Q)_25℃}$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}-V_{REF}$, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW040B3TR (Unless otherwise specified, V_{CC}=3.3V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-40		40	A
Sensitivity	Sens	Current sensing range		33		mV/A

Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		11		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		1.65		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW050B3TR (Unless otherwise specified, V_{CC}=3.3V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-50		50	A
Sensitivity	Sens	Current sensing range		26.4		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		8.8		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		1.65		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW075B3TR (Unless otherwise specified, V_{CC}=3.3V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-75		75	A
Sensitivity	Sens	Current sensing range		17.6		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		7.5		mV

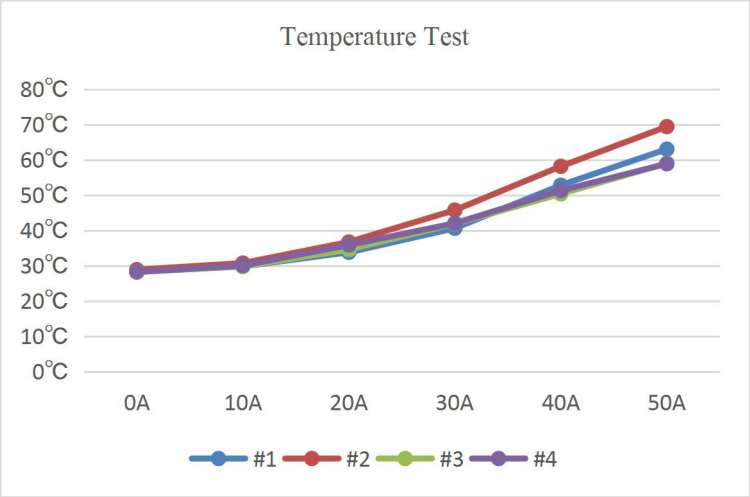
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		1.65		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

NHC3000FSW100B3TR (Unless otherwise specified, V_{CC}=3.3V, C_{OUTL}=1nF, C_{REFL}=1nF, T_A=25° C)

Parameters	Symbol	Conditions	Min	Typ	Max	Unit
Current sensing range	IP		-100		100	A
Sensitivity	Sens	Current sensing range		13.2		mV/A
Noise RMS(V_{OUT})	$V_{N(RMS)}$	IP=0A		5.5		mV
Zero current output voltage	$V_{OUT(Q)}$	IP=0A		1.65		V
Zero current output voltage temperature drift	$\Delta V_{OUT(Q)}$	T_A = -40° C ~ 125° C $\Delta V_{OUT(Q)}$ = $V_{OUT(Q)}_T_A$ - $V_{OUT(Q)}_25℃$	-25		25	mV
Offset error	V_{OE}	$V_{OE}=V_{OUT}$ - V_{REF}, IP=0A, T_A=25° C	-5		5	mV
Offset error temperature drift	ΔV_{OE}	T_A = -40° C ~ 125° C ΔVOE = VOE_T_A - VOE_25℃	-20		20	mV
Sensitivity temperature drift	ΔSens	T_A = -40° C ~125° C	-2.5		2.5	%
Total output error	E_{TOT}	T_A = -40° C ~ 125° C	-3.0		3.0	%
Non-linearity error	E_{NL}	T_A = -40° C ~ 125° C	-0.4	±0.2	0.4	%

Typical Characteristics

Temperature Characteristics[1]

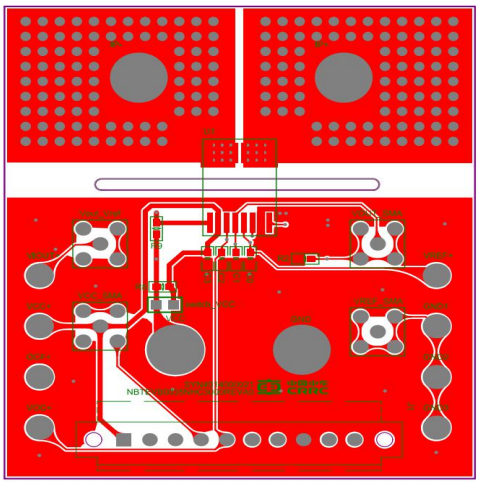


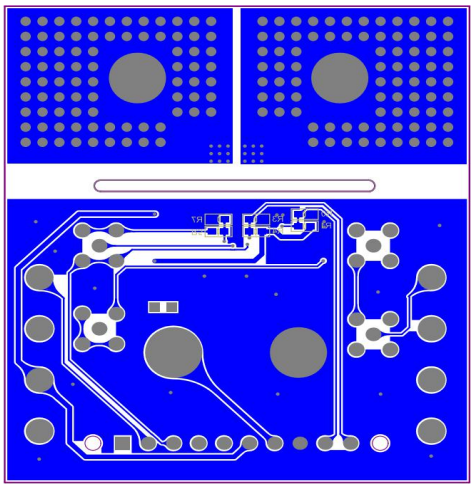
[1]The temperature curve data results are dependent on the PCB heat dissipation design. These data were obtained through testing on the NHC3000 demo board.

NHC3000 demo board

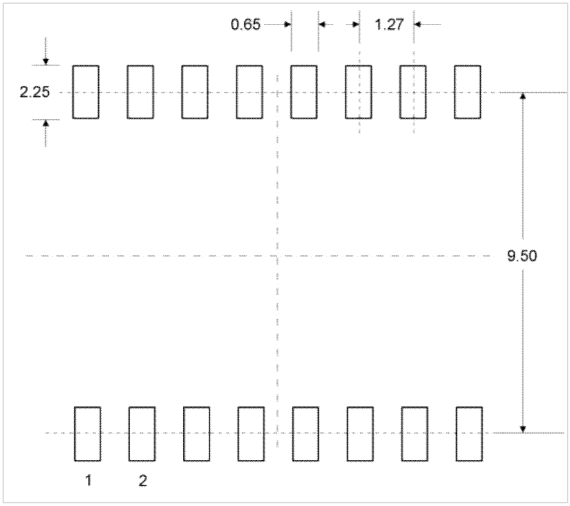
The NHC3000 demo board uses a 2-layer PCB with 34 mm × 26 mm copper pour areas connected to pins 1 through 4, and to pins 5 through 8. Each layer has a copper thickness of 4oz, and the PCB board thickness is 1.6mm.

The heat dissipation capacity of the chip is not only determined by its own design, but also closely related to the measurement of current and the heat dissipation structure of the PCB design. To ensure good heat dissipation of the PCB, the following measures are recommended: increasing the thickness of the copper plate on the PCB, using multi-layer boards, adopting through-hole heat dissipation or adding active heat dissipation around primary conductor of the chip.





PCB Layout Reference View (Unit: mm) :



Term Definitions

IP and IPR

The input current is considered positive when flowing from IP+ to IP−, and negative otherwise. IP denotes the actual current from IP+ to IP−, For instance, when the actual current flowing from IP+ to IP− is 20A, IP equals 20A.

IP_MAX represents the max current within the current range, and IPR denotes the current range. Taking NHC3000FSW050B5TR as an example, IP_MAX is ±50A, and IPR is from -50A to 50A.

Parallel resistors are prohibited between IP+ and IP−. This is except for extremely special cases, in which case the current flowing through the chip will decrease, and the resistance of the wires will also be affected by temperature drift. An external system calibration for temperature and accuracy correction is required.

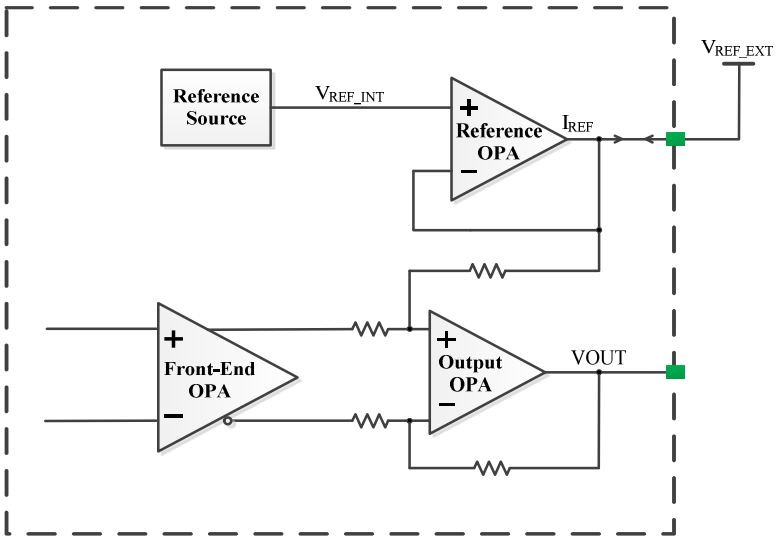
VREF Input/Output Characteristics

V_{REF} has two modes: input and output. When using the VREF output mode for external use, it is recommended that the current of V_{REF} be ≤ 2mA during application.

When using the VREF input mode, when the driving capacity of the external reference exceeds the output of the reference operational amplifier, the external reference forces $V_{OUT(Q)}$ to use the external reference as the reference. When the input voltage is lower than the nominal value of V_{REF}, the driving capacity of the input source needs to be higher than I_{VREF_SOURCE}; when the input voltage is higher than the nominal value of V_{REF}, the driving capacity of the input source needs to be higher than I_{VREF_SINK}. It is recommended that customers use an external reference source with ±10mA driving capacity for input.

Due to the rail-to-rail output range limitation, the voltage range of V_{REFIN} is 0.1×VCC ~ 0.9×VCC. VOUT(Q) changes with V_{REFIN} while the sensitivity remains unchanged. At this time, the output voltage of VOUT is:

$$V_{OUT} = 2500 + IP \times Sens \quad mV$$



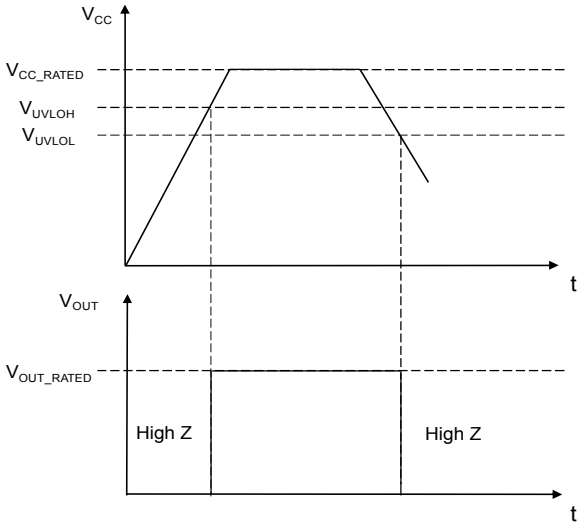
Reference output function circuit

Under Voltage Lockout Rising Threshold (V_{UVLOH})

To ensure accurate the current sensor operation and prevent malfunctions, NHC3000 includes a UVLO circuit. When V_{CC} rises above the rising threshold V_{UVLOH}, the current sensor begins normal operation.

Under voltage Lockout Hysteresis ($V_{UVLOHYS}$)

The UVLO circuit incorporates a hysteresis voltage $V_{UVLOHYS}$ to prevent chattering and oscillation when V_{CC} is near the threshold. The current sensor enters UVLO (output high impedance) when V_{CC} falls below V_{UVLOH}–$V_{UVLOHYS}$ and recovers when V_{CC} rises above V_{UVLOH}. The typical hysteresis voltage $V_{UVLOHYS}$ is defined as the difference between the rising threshold and the falling threshold.



UVLO Timing Diagram

Overcurrent Fault Response Time (T_{fr})

The NHC3000 has overcurrent protection functionality. When the primary current exceeds the overcurrent threshold I_{Fault}, the internal comparator reverses and drives the open-drain output, and the Fault pin is pulled down. The overcurrent threshold can be set by the external resistor on the VOC pin. The voltage of the VOC pin can be set based on the VREF pin voltage. The reference voltage source can be either VREF or other external voltage inputs. When using the FAULT function, VREF can only use the reference output mode.

The valid input voltage of VOC is between 0.2×VREF and 0.8×VREF. The corresponding relationship between the overcurrent threshold and the VOC voltage is as follows:

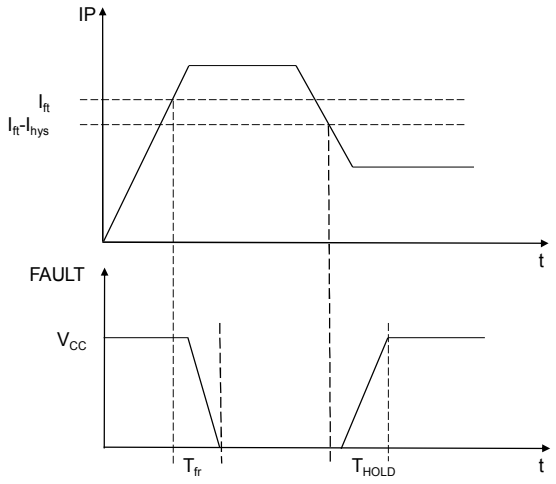
$$I_{FAULT} = \frac{V_{OC}}{V_{REF}} \times 2.5 \times IP_MAX$$

For example, NHC3000FSW050B5TR, the adjustable threshold range for overcurrent protection is from 25A to 100A.

When VOC = 0.2 × VREF = 0.5V, the threshold is 25A. If the current flows forward and exceeds 25A or backward and is less than -25A, the FAULT pin will be pulled low.

When VOC = 0.8 × VREF = 2.0V, the threshold is 100A. If the current flows forward and exceeds 100A or backward and is less than -100A, the FAULT pin will be pulled low.

When the current (either positive or negative) exceeds the overcurrent threshold, an overcurrent fault will be triggered. If the absolute value of the current is less than the current threshold setting minus the current lag I_{hys}, the fault will be cleared. T_{fr} is the fault response time:The time from when the current is greater than the overcurrent threshold to when the faulty pin is pulled down to a low voltage level. When the absolute value of the primary current is less than the set current threshold minus the current lag, the overcurrent alarm will be cleared after T_{HOLD}. The timing sequence of overcurrent protection is as follows



Overcurrent Fault Timing Diagram

Rise Time (T_r)

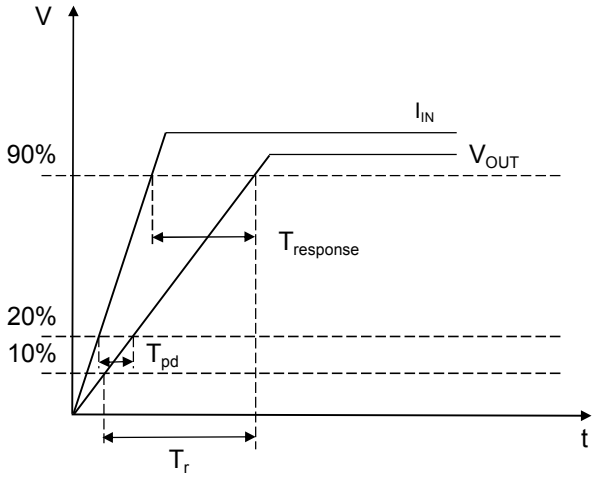
Rise time is defined as the time taken for the output signal to go from 10% to 90% of its final value.

Delay Time (T_{pd})

Propagation delay is defined as the time from when the primary current crosses 20% of its final value to when the output voltage crosses 20% of its final value.

Response Time ($T_{response}$)

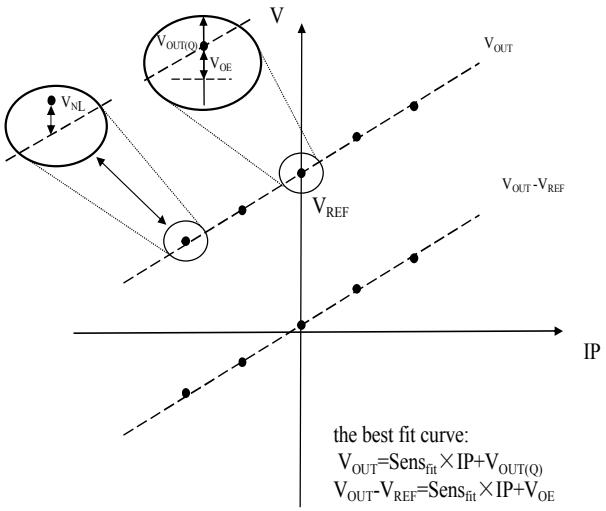
Response time is defined as the time from when the primary current crosses 90% of its final value to when the output voltage crosses 90% of its final value.



Response Time

Sensitivity and Sensitivity Temperature Drift

Sensitivity is defined as the ratio of the output voltage to the primary current.



Output vs IP

Temperature drift of sensitivity is the change in sensitivity relative to its value at 25° C, expressed as a percentage:

$$\Delta Sens = \frac{[Sens@T_A - Sens@25℃]}{Sens@25℃} \times 100\%$$

Offset Error and Offset Temperature Drift

Offset error is defined as the difference between the output voltage and the reference voltage when the primary current is 0 A; VREF = 2.5 V @ VCC = 5 V.

$$V_{OE} = V_{OUT(Q)} - V_{REF}$$

Offset temperature drift is defined as the variation of the zero-current output offset error with temperature:

$$\Delta V_{OE} = V_{OE}@T_A - V_{OE}@25℃$$

Nonlinear Error

Nonlinear error is defined as the error from the point with the maximum deviation from the best-fit curve to the full scale range. The mathematical expression is as follows:is the maximum deviation of the actual output (as a function of IP) from an ideal straight line, calculated using the best-fit straight line method, and expressed as a percentage of the full-scale range.

$$V_{NL} = V_{OUTMAX} - (S_{fit} \times I_{MAX} + V_{OUT(Q)})$$

V_{OUTMAX} is the output voltage furthest from the fitted curve; I_{MAX} is the primary current furthest from the fitted curve;

Therefore, the nonlinear error data expression is as follows:

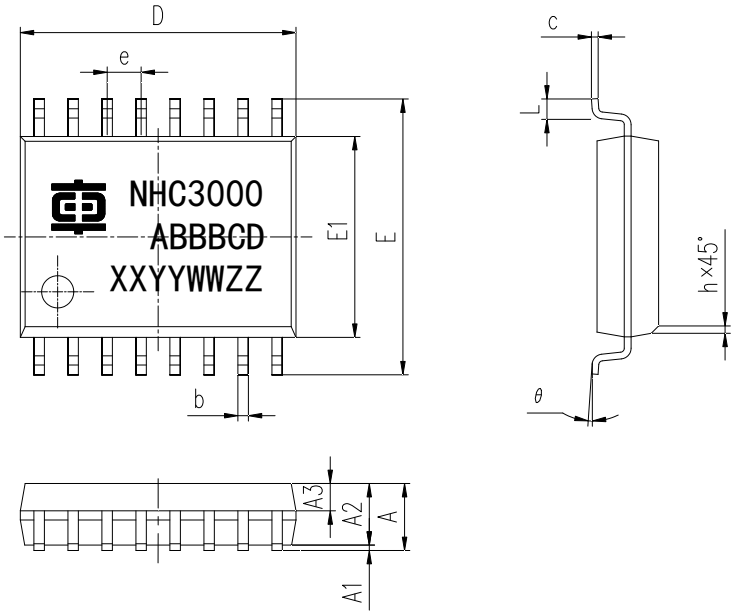
$$E_{NL} = \frac{V_{NL}}{FS} \times 100\%$$

Total Output Error

Total output error is defined as the discrepancy between the actual specified current and the current measured by the chip; in other words, it is the difference between the actual output voltage and the ideal output voltage. It should be noted that the factors dominating the total output error vary across different current ranges. During small-current measurements, offset error is the primary source of error; during large-current measurements, the total error caused by offset error is minimal, with sensitivity error constituting the dominant source of error.

$$E_{TOT}(IP) = \frac{V_{OUT}(IP) - V_{OUTIDEAL}(IP)}{FS}$$

Package Information



Symbol	Size（mm）		
	Min	Typ	Max
A	-	-	2.65
A1	0.10	-	0.30
A2	2.25	2.30	2.35
A3	0.97	1.02	1.07
b	0.35	-	0.43
c	0.23	-	0.29
D	10.20	10.30	10.40
E1	7.40	7.50	7.60
E	10.10	10.30	10.50
e	1.27BSC		
L	0.55	-	0.85
h	0.25	-	0.75
θ	0°	-	8°

Labeling Instructions:

The first line: NHC3000—Product Series Number

The second line: ABBBCD —Product Specifications

A—Temperature Range

BBB — Current Sensing Range

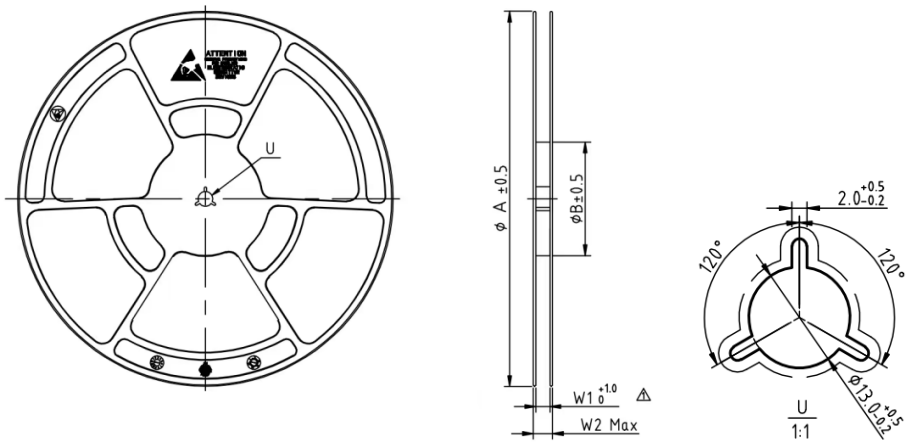
C—Output Directionality

D—Supply Voltage

The third line: XXYYWWZZ — Production batch number

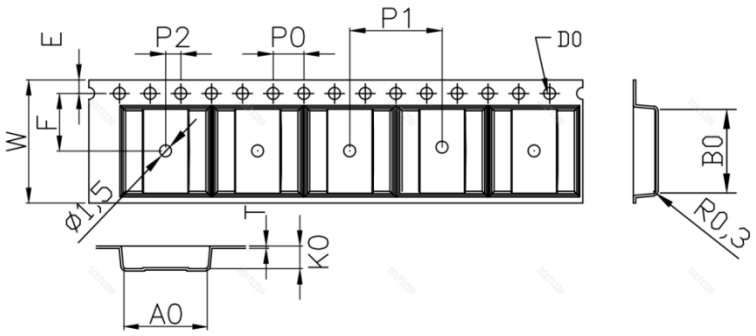
Packing Information

Reel Dimensions

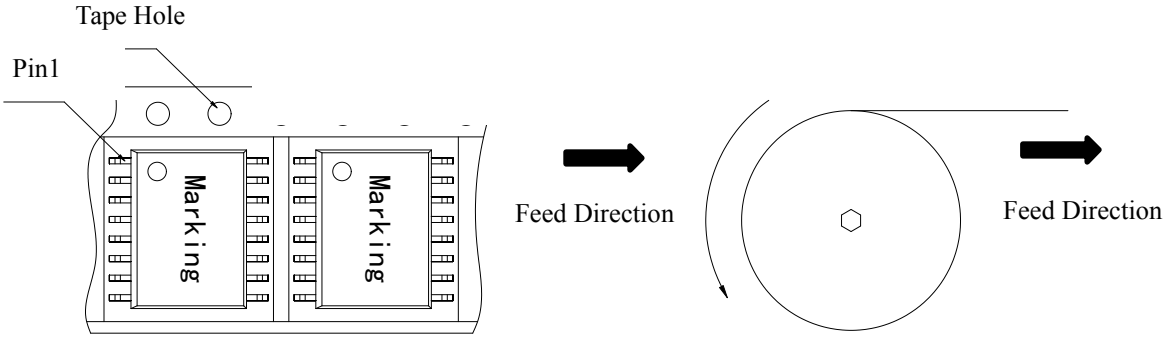


Reel（mm）			
A	B	W	W2
330	100	16.4	22.4

Tape Dimensions



Tape（mm）					
W	A0	B0	K0	P0	P1
16.0±0.3	10.7±0.1	10.7±0.1	3.00±0.1	4.0±0.1	12.00±0.1
P2	F	S	E	D0	T
2.0±0.1	7.5±0.1	0.0±0.1	1.75±0.1	1.5 +0.1 0.0	0.3±0.05



Remark

Although the differential Hall architecture effectively suppresses common-mode magnetic fields, measurement errors can still be introduced by stray magnetic fields in complex industrial environments. During PCB layout, avoid routing high-current traces directly underneath the chip.

Comments:

- Items with “*” in this datasheet are recommended value for reference only. The final value must be determined by customer.
- CRRC reserves the right to carry out modifications on its transducers, in order to improve them.
- Product updates will not notified separately. The final version of the datasheet shall be confirmed through specific communication between both parties.

Revision History

Revised Date	Revised Content	Edition
2025-04-18	Initial release	V0
2025-09-12	Add part number definition and Labeling Instructions	V1
2025-10-16	Add sensitivity lifetime drift	V2
2026-3-20	Updated layout, performance specifications, and typical characteristics	V3
2026-8-1	Updated bandwidth, noise	V4