Low Power Linear Regulator with Current Limiting Function

1 Description

The CN88LXXX is a wide input voltage, high-precision, low-dropout linear regulator that offers high PSRR and delivers up to 150mA of output current. It integrates short-circuit protection, overcurrent protection, and thermal overload protection, and is available in SOT89-3, DFN2x2-6, SOT23-5, and SOT23-3 packages.

2 Features

- Low static current: 6μA
- High accuracy: ±2%
- Dropout voltage：500mV/100mA ，V_{OUT} =5V
- Maximum output current: 150mA
- Input voltage range: Max. 35V
- Output short circuit protection
- Internal Thermal Overload Protection
- Internal Short-Circuit Limiting
- Recommend Capacitor: 1μF~10μF

3 Applications

- Smart Electric Meter
- Switch Power

4 Ordering information

Product Number	Package	Quantity/Tape
CN88LXXXDSR	DFN2x2-6	4000/Tape
CN88LXXXTCR	SOT23-5	3000/Tape
CN88LXXXATCR	SOT23-5	3000/Tape
CN88LXXXOGR	SOT89-3	1000/Tape
CN88LXXXAOGR	SOT89-3	1000/Tape
CN88LXXXTGR	SOT23-3	3000/Tape

Product Number	Output voltage
CN88L025	Vout=2.5V
CN88L033	Vout=3.3V
CN88L040	Vout=4.0V
CN88L050	Vout=5.0V
CN88L056	Vout=5.6V

5 Marking

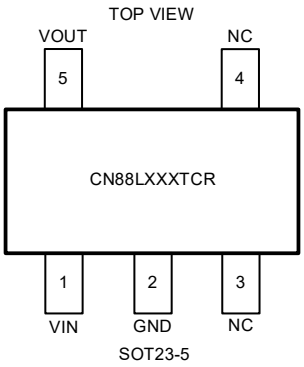
Product Number	Marking
CN88LXXXDSR	CN88XX YYWW
CN88LXXXTCR	88LXXX YYWW
CN88LXXXATCR	88LXXXA YYWW
CN88LXXXOGR	CN88LXXX YYWW
CN88LXXXAOGR	CN88LXXXA YYWW
CN88LXXXTGR	88XXXT YYWW

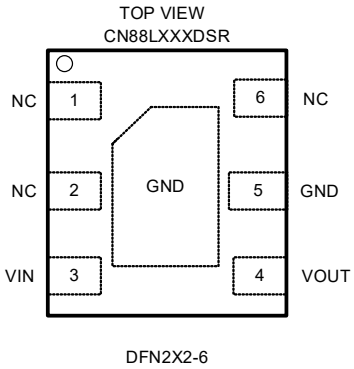
Note: YY=Year WW=Week.

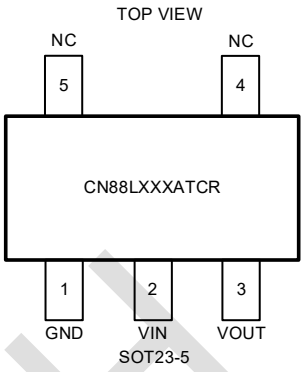
Green (RoHS & HF): CHIPNORTH defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your CHIPNORTH representative directly.

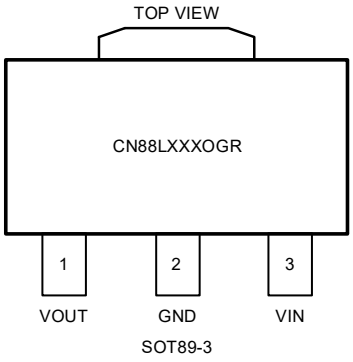
Moisture sensitivity level(MSL):3

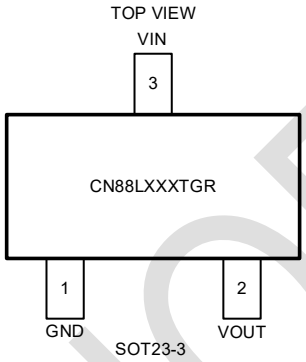
6 Pinout

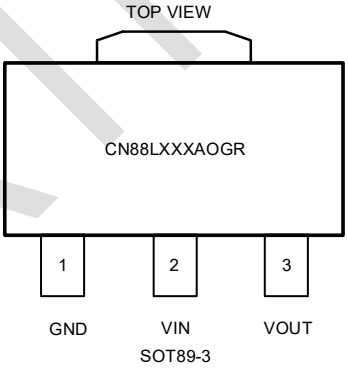




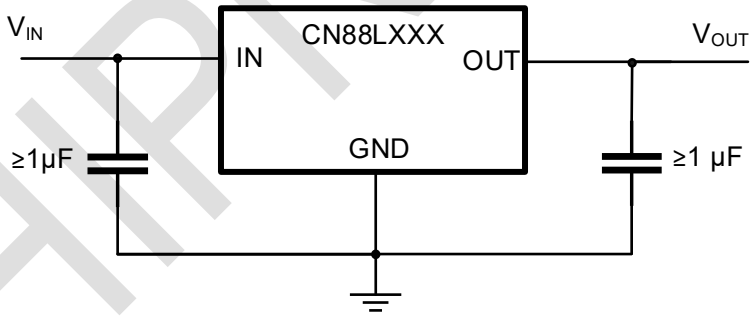






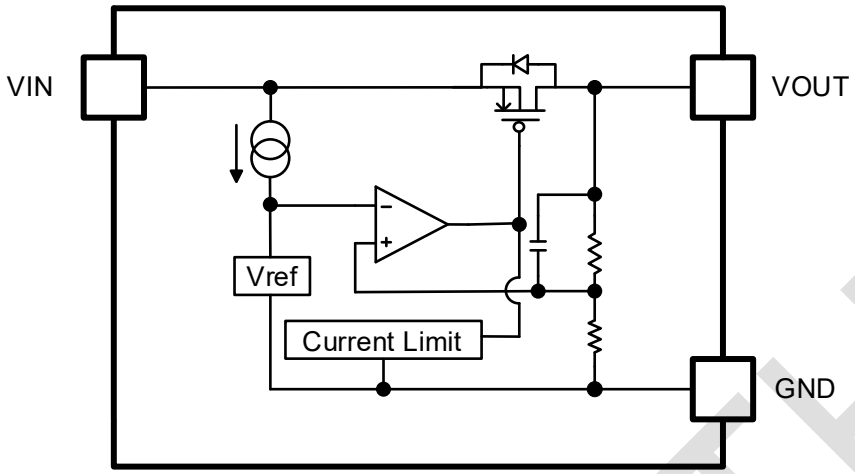


7 Typical Application



Note: Input capacitance CIN≥1μF is recommended for general application circuits, close to the chip input end; Output capacitance COUT≥1μF, close to the chip output end.

8 Block Diagram



9 Pin Descriptions

Pin Number							Description
Pin Name	CN88L XXXAOGR	CN88L XXXOGR	CN88L XXXDSR	CN88L XXXTCR	CN88L XXATCR	CN88L XXTGR	
GND	1	2	5	2	1	1	GND
VIN	2	3	3	1	2	3	Input
VOUT	3	1	4	5	3	2	Output
NC			1、2、6	3、4	4、5		No Connect

10 Specifications

10.1 Absolute Maximum Ratings

Parameter	Symbol	Value	Units
Maximum input voltage	V_{IN}	-0.3 ~ 40	V
Maximum output voltage	V_{OUT}	-0.3 ~ 12	V
Storage temperature range	T_{STG}	-55 ~ 150	°C
Soldering temperature	T_{LEAD}	260(Soldering 10s)	°C

(1) Stress exceeding the values listed under the absolute maximum rating may cause permanent damage to the device. These listed values are stress levels only and do not indicate that the device will operate properly under these conditions and under any other conditions other than the recommended operating conditions. Prolonged operation under maximum absolute rated conditions will affect device reliability.

(2) All voltage values are based on the ground terminal.

10.2 ESD Ratings

Discharge mode	Norm	Value	Units
HBM	ESDA/JEDEC JS-001-2017	±4000	V
CDM	ESDA/JEDEC JS-002-2018	±2000	V

10.3 Recommended Operating Range

Parameter	Symbol	Min.	Max.	Units
Input Voltage	V_{IN}	V_{OUT}+1	35	V
Atmosphere Pressure	p	63	106	kPa
Operating Temperature	T_A	-40	105	°C

10.4 Thermal Information

Parameter	Package	Value	Unit
Junction to ambient thermal resistance ($R_{\theta JA}$)	SOT23-3	220	°C/W
	SOT23-5	188	°C/W
	DFN2x2-6	140	°C/W
	SOT89-3（OGR）	100	°C/W
	SOT89-3（AOGR）	165	°C/W

(1) Thermal resistance is not a fixed constant; its value is influenced by the following factors: PCB heat dissipation capacity, number and thickness of copper layers, ambient temperature, airflow velocity, etc.

(2) The thermal resistance values listed in the datasheet are provided solely for customers to compare the thermal performance of different packages. Since the heat dissipation conditions of the PCB in actual customer applications differ from those of our test boards, the actual measured thermal resistance values may vary from the nominal values in the datasheet. Customers should conduct verification on their own system boards to ensure that the thermal design meets the requirements of the product application.

10.5 Electrical Characteristics

Test Condition：V_{IN}=V_{OUT}+1V, C_{IN}=1μF, C_{OUT}=1μF, T_A=25°C, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input voltage range	V_{IN}	I_{OUT}=10mA	V_{OUT}+1V		35	V
Output voltage	V_{OUT}	V_{IN}=V_{OUT}+2V, I_{OUT}=1mA	V_{OUT} x0.98	V_{OUT}	V_{OUT} x1.02	V
Output voltage accuracy	V_{OUT}%	V_{IN}=V_{OUT}+2V, I_{OUT}=10mA	98%		102%	
Linear adjustment rate	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \cdot V_{OUT}}$	V_{IN}=V_{SET}+1V~19V I_{OUT}=1mA@V_{OUT}=5V		0.04		%/V
Load adjustment rate	ΔV_{OUT}	V_{IN}=V_{OUT}+2V I_{OUT}=1~150mA@V_{OUT}=5V			40	mV
Quiescent current	I_Q	V_{IN}=12V, I_{OUT} =0mA		6	12	μA
Dropout voltage	V_{DROP}	I_{OUT}=100mA@V_{OUT}=5V		500		mV
Maximum output current	I_{OUT_MAX}			150		mA
Current limitation	I_{LIMIT}	V_{IN}=V_{OUT}+1.0V		203		mA
Short-circuit current	I_{SHORT}			340		mA
Output Voltage Temperature Coefficient	TC_{VOUT}	V_{IN}=7V, T_A=-40°C~85°C, I_{OUT}=1mA		80		ppm/°C
Temperature protection point				150		°C
Temperature protection point hysteresis				30		°C
PSRR		f=120HZ I_{OUT}=50mA, T_J=25°C		60		dB

Note:

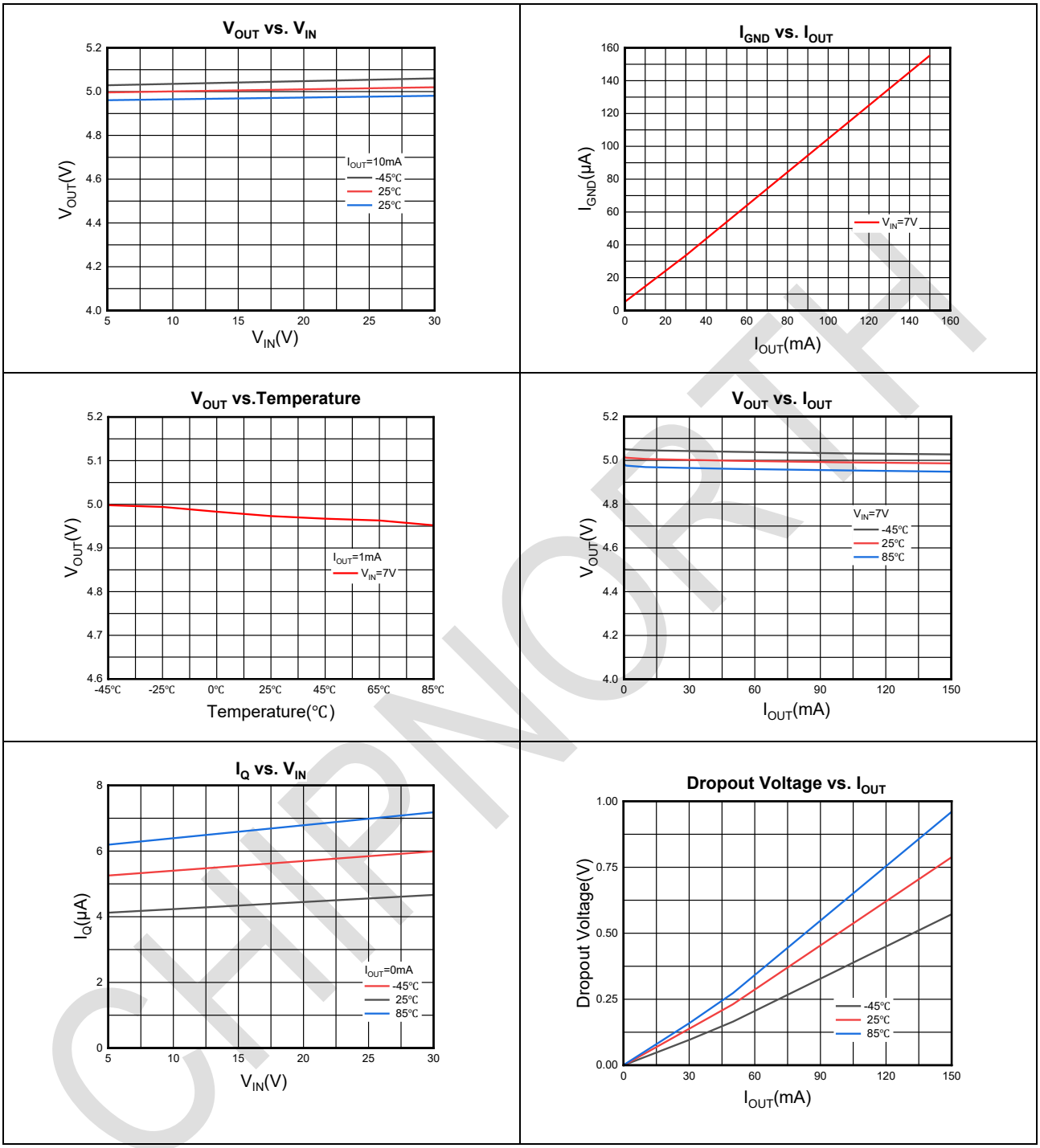
$V_{OUT(S)}$: Output voltage when V_{IN} = V_{OUT} + 1V, I_{OUT} = 1mA.

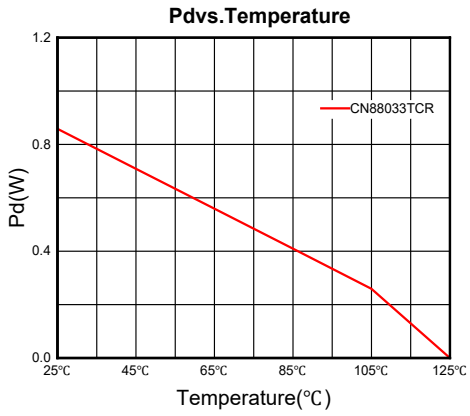
V_{DROP}=V_{IN}-(V_{OUT_REG}*0.98), where V_{OUT_REG} is the output voltage when V_{IN}=V_{OUT}+1.0V and I_{OUT}=100mA. V_{IN} is the input voltage, when the input voltage gradually decreases, the output voltage becomes 98% of V_{OUT_REG}.

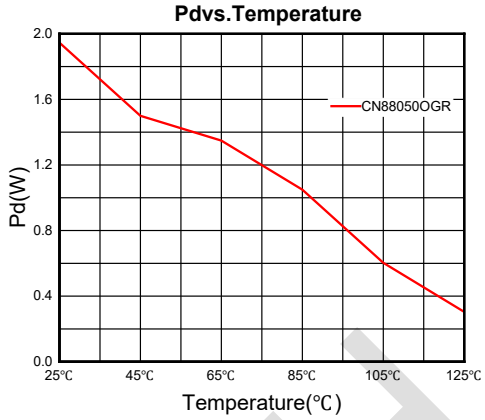
I_{LIMIT}: Output current when V_{IN} = V_{OUT} + 1V and V_{OUT} = 0.95 x $V_{OUT(S)}$.

10.6 Characteristics Curve（CN88L050AOGR）

Test condition: V_{IN}=V_{OUT}+1V, C_{IN}=1μF, C_{OUT}=1μF, TA=25°C, unless otherwise noted.







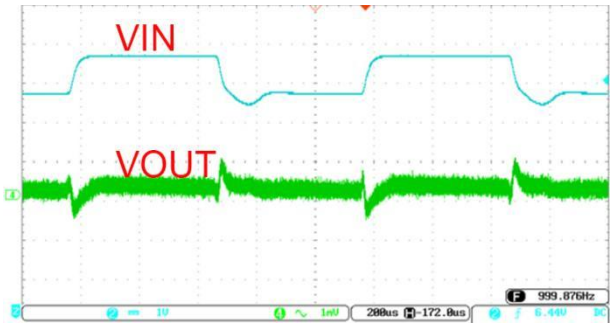


Figure 1 Line Transient

(VIN=from 5.6V to 12V to 5.6V IOUT=0mA)

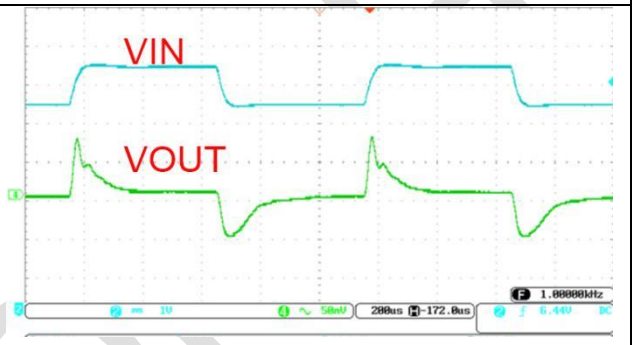


Figure 2 Line Transient

(VIN=from 5.6V to 7V to 5.6V IOUT=150mA)

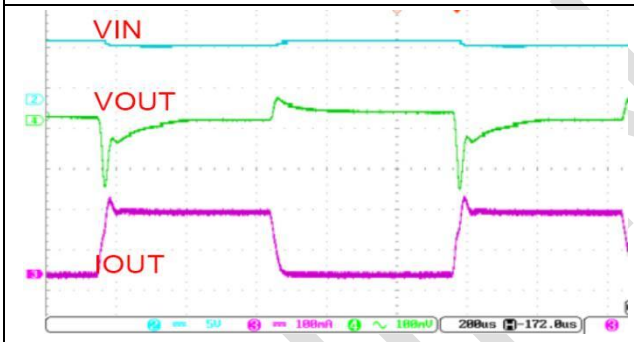


Figure 3 Load Transient

(VIN=7V, IOUT=0mA-150mA-0mA)

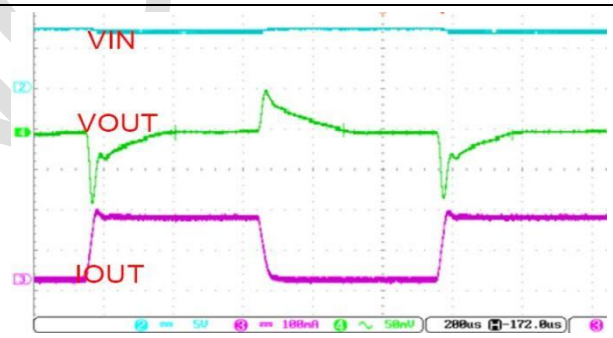


Figure 4 Load Transient

(VIN=7V, IOUT=1mA-150mA-1mA)

11 Application Information

CN88L is a low-dropout linear regulator fabricated with CMOS process, with a maximum input voltage of 35 V. The device offers a series of fixed output voltages ranging from 2.5 V to 5.6 V, featuring an output current capacity of 150 mA, and integrates short-circuit, over-current and thermal shutdown protection functions.

11.1 Over-current protection (current-limiting type)

The CN88L integrates a current-limiting protection circuit. When the output current exceeds the current limit value, the output voltage drops.

11.2 Short-circuit protection (current-limiting type)

When the output is shorted to ground, the output current will be limited to a typical value of 340 mA, and the output voltage will automatically recover after the fault is removed.

11.3 Output voltage tracking mode

Under normal regulation conditions, the CN88L requires the input voltage VIN to be at least 1 V higher than the set output voltage V_{OUT}, to ensure the internal error amplifier has sufficient headroom to maintain a constant output voltage. When VIN drops below V_{OUT} + 1 V, the regulator automatically enters the output voltage tracking mode. In this mode, the internal power transistor is fully turned on and the feedback loop saturates. The output voltage is no longer controlled by the reference voltage and is approximately equal to the input voltage.

$$V_{OUT} \approx V_{IN} - I_{OUT} * R_{DSON}$$

Since the on-resistance R_{DSON} of the power transistor is very small, we can approximate $V_{OUT} \approx V_{IN}$.

This tracking feature supplies the maximum available voltage to the subsequent circuits under input undervoltage conditions, preventing sudden output collapse or power transistor overload caused by forced operation of the regulation loop. Meanwhile, the chip’s internal short-circuit, over-current and thermal protection remain functional in this mode to safeguard the device under abnormal conditions.

When the input voltage rises back above V_{OUT} + 1 V, the error amplifier regains adequate supply headroom. The regulator smoothly exits tracking mode and automatically resumes precise regulation of the output voltage. It should be noted that in tracking mode, the power transistor operates in the linear region with zero loop gain, resulting in slightly worse output ripple and load regulation performance compared to normal regulation. This is an abnormal operating region and shall not be used for continuous operation.

11.4 Thermal protection

The CN88L integrates an internal thermal protection circuit to limit the total power consumption of the chip and prevent damage caused by excessive junction temperature. When the chip junction temperature exceeds the preset safety threshold of 150° C, the thermal protection circuit activates and turns off the power transistor to cool down the device. The power transistor will turn back on after the junction temperature drops by approximately 30° C, which may result in pulsed output waveforms under continuous overload conditions.

11.5 Operating Range and Power Dissipation

The maximum power dissipation of CN88L is determined by package thermal resistance, PCB copper area, ambient temperature and ventilation. Its internal power dissipation can be calculated via the formula below:

$$P_D = (V_{IN} - V_{OUT}) * I_{OUT} + V_{IN} * I_Q$$

where I_Q stands for quiescent current. The maximum allowable power dissipation is:

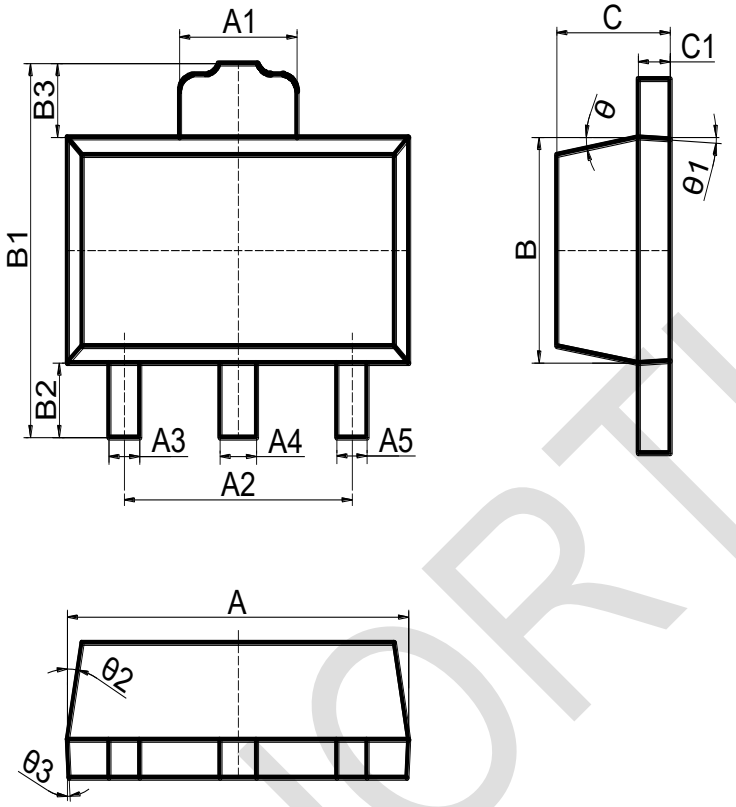
$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\Theta_{JA}}$$

where $T_{J(MAX)}$ is maximum junction temperature, T_A ambient temperature, θ_{JA} junction-to-ambient thermal resistance.

As CN88L supports up to 35 V input voltage, pay close attention to power dissipation for large voltage drop and high current applications to ensure$P_D \leq P_{D(MAX)}$.

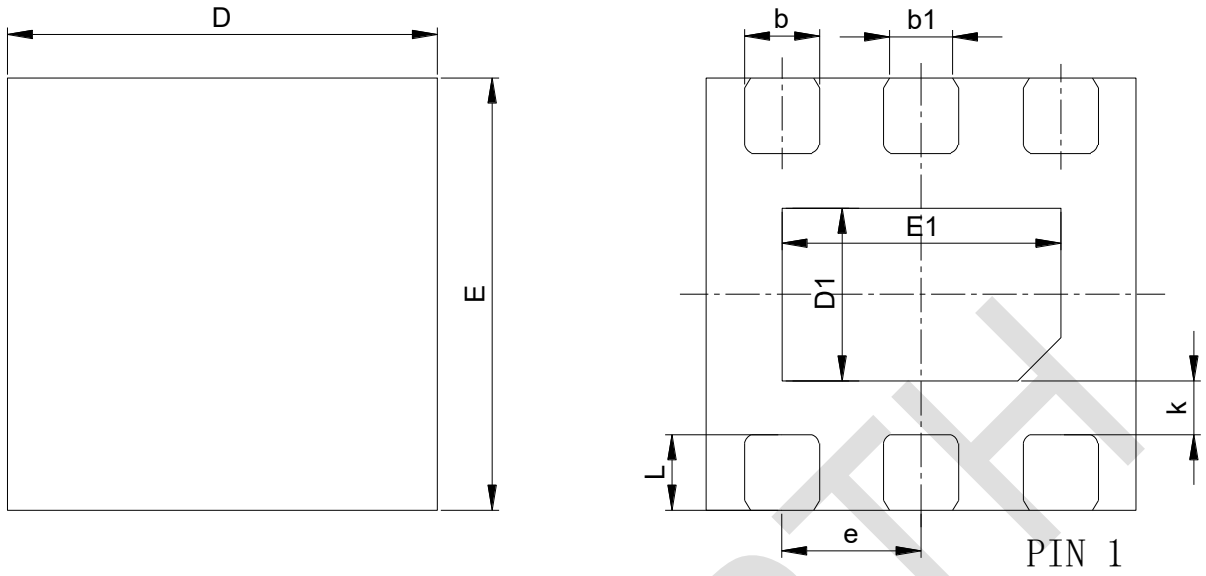
12 Package Information

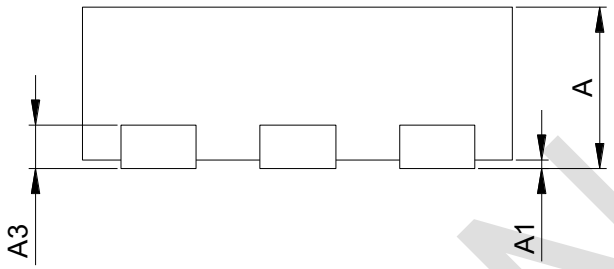
SOT89-3



Dimension / Symbol	Min (mm)	Nom (mm)	Max (mm)
A	4.4	4.5	4.6
A1	1.4	1.6	1.8
A2	2.8	3.0	3.2
A4	0.37	0.47	0.57
A5	0.22	0.42	0.62
B	2.4	2.5	2.6
B1	-	-	4.25
B2	0.8	-	-
C	1.4	1.5	1.6
C1	0.3	0.4	0.5

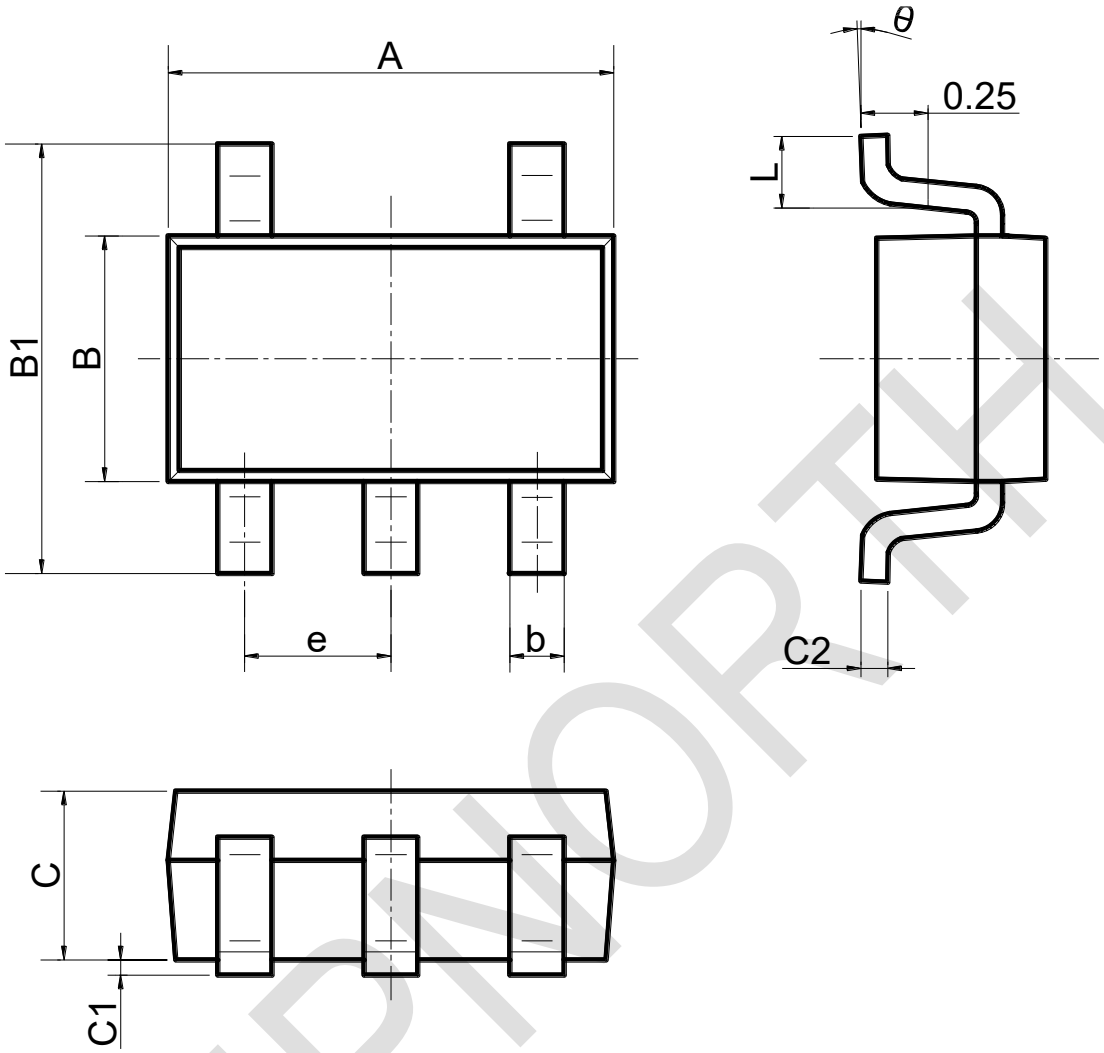
DFN2x2-6





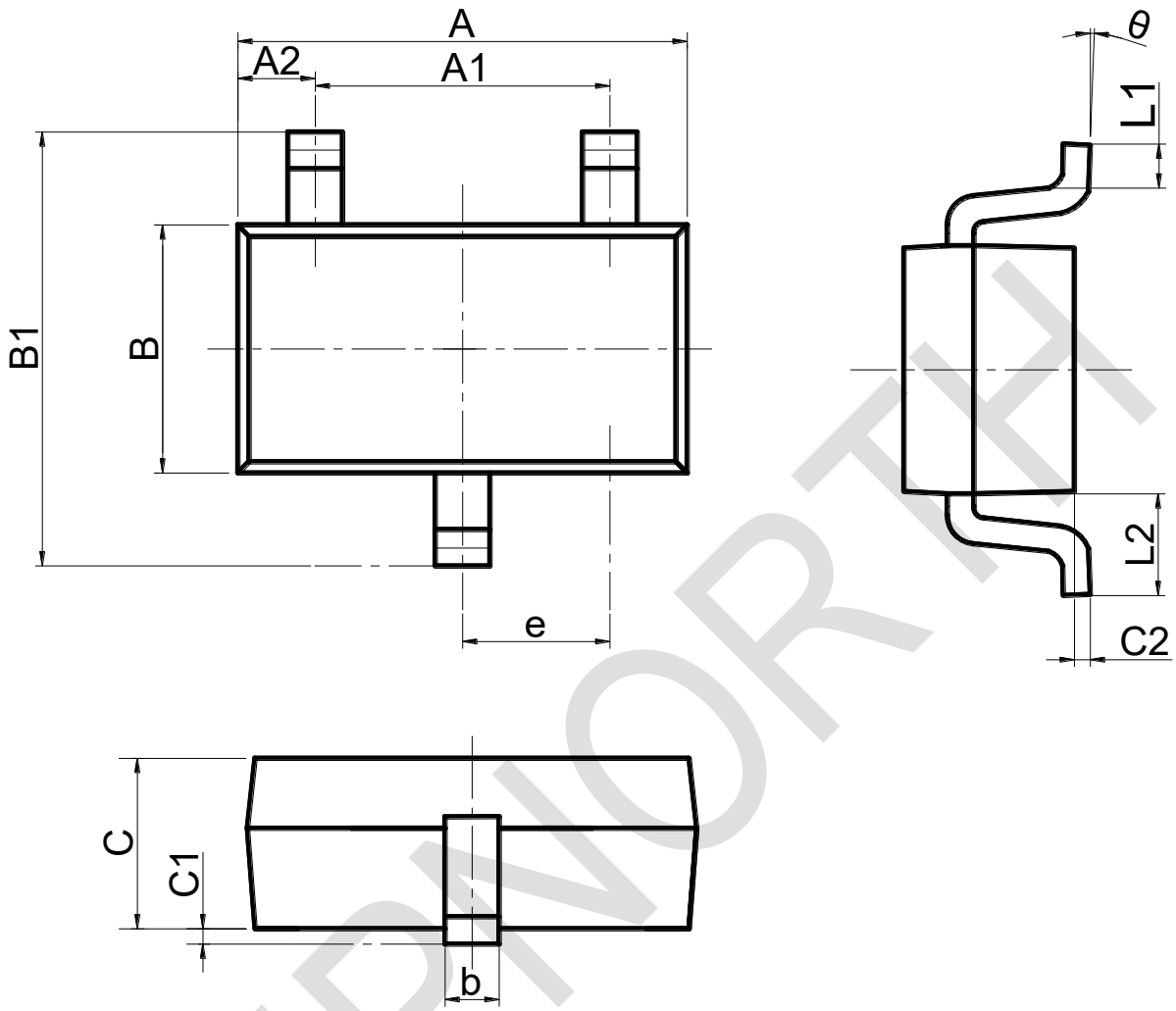
Dimension / Symbol	Min (mm)	Nom (mm)	Max (mm)	Dimension / Symbol	Min (mm)	Nom (mm)	Max (mm)
A	0.7	0.75	0.8	E1	1.5	1.6	1.7
A1	0	0.025	0.05	k	0.25REF		
A3	0.203REF			b	0.25	0.3	0.35
D	1.9	2.0	2.1	b1	0.22REF		
E	1.9	2.0	2.1	e	0.65REF		
D1	0.9	1.0	1.1	L	0.2	0.25	0.3

SOT23-5



Dimension / Symbol	Min (mm)	Max (mm)	Dimension / Symbol	Min (mm)	Max (mm)
A	2.82	3.02	C	1.05	1.15
e	0.95(BSC)		C1	0.03	0.15
b	0.28	0.45	C2	0.12	0.23
B	1.50	1.70	L	0.35	0.55
B1	2.75	3.05	θ	0°	8°

SOT23-3



Dimension / Symbol	Min (mm)	Nom (mm)	Max (mm)
A	2.70	2.90	3.10
A1	1.70	1.90	2.10
A2	-	-	0.6
e	0.85	0.95	1.05
b	0.30	0.40	0.50
B	1.50	1.60	1.80
B1	2.60	2.80	3.00
C	1.00	1.10	1.20
C1	-	-	0.10
C2	0.02	-	0.08
L1	0.20	-	0.55
L2	-	0.60	-
θ	0°	-	15°

13 Important Statement

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14 Revision History

Date	Version Number	Revision Notes
2026/06/26	R3.2	Update EC parameters
2026/07/06	R3.3	Update Application Information.

15 版本修订

日期	版本号	修订说明	修订人
2023/10/10	R1.0	Create	杨静
2024/06/27	R1.1	Update company logo Add parameters to be filled in the tables of Absolute Maximum Ratings, ESD Ratings and Recommended Operating Conditions Supplement detailed descriptions and content to be filled in Application Information Delete packaging information	鲁飘
2024/10/28	R1.3	Set the body text spacing to single spacing, and set hanging indent of 2 characters for paragraph lists. Clarify specifications for the company logo on the first page, model text box, brief description text box, header, footer, etc., and embed these specifications into the template. For the brief description text box: set line spacing to 18 lb for Chinese version and 15 lb for English version. For blank lines in headers: set line spacing to 5 lb for Chinese version and 9 lb for English version. For the horizontal line in footer: align left horizontally, 0.03 cm below the paragraph vertically; check the option of object moving with text; set height to 0 and width to 17 cm; set fixed line spacing of 15 lb for footer.	鲁飘
2024/11/06	R1.4	1、 Use the Figure format for captions below images. 2、 If subheadings are required in the sections of Device Design and Device Selection, adopt the format of (1) + title with bold 5pt font. 3、 Add a "Important Statement" section.	鲁飘
2024/11/08	R2.3	Revise the format	欧阳逸杰
2024/11/18	R2.4	1. Update the English datasheet in accordance with the Chinese version to keep consistent content. 2. Correct the inconsistent data between POD drawings and dimension tables based on the old datasheet.	陆梓煊
2024/11/27	R2.5	1. Update the Important Statement, adjust the connection points of different nets in the block diagram, and remove the black borders of characteristic curve legends. 2. Add 5.0 V and 5.6 V output versions to the Ordering Information section. 3. Add soldering temperature of 260°C to Section 10.1 Absolute Maximum Ratings.	谭贤斌