1 Description

The LDO is a high-precision low dropout linear regulator with current limiting function, output current up to 300mA, low power consumption, high PSRR, as well as short-circuit protection and over-temperature protection, available in SOT89-3, DFN2X2-6L, SOT-23-5, SOT23-3 and other package forms.

2 Features

- Ultra-low quiescent current：1.2μA
- High accuracy：±2%
- Low dropout voltage：200mV@I_{OUT}=100mA, V_{OUT} =5V
- Maximum output current：300mA
- Input Voltage Range：Max 36V
- Output short circuit protection
- Thermal shutdown

3 Applications

- Cell phone
- Battery-powered equipment
- Wireless telephones
- Camera Recorder
- Portable audio-visual equipment
- Palmtop computer
- Smart electricity/water/gas meters
- Industrial instruments

4 Ordering information

Product Number	Package	Quantity/Tape
CN86LXXXDSR	DFN2x2-6	4000/Tape
CN86LXXXTCR	SOT23-5	3000/Tape
CN86LXXXATCR	SOT23-5	3000/Tape
CN86LXXXTGR	SOT23-3	3000/Tape
CN86LXXXOGR	SOT89-3	1000/Tape
CN86LXXXAOGR	SOT89-3	1000/Tape

Product Number	Output voltage
CN86L028	V_{OUT}=2.8V
CN86L030	V_{OUT}=3.0V
CN86L033	V_{OUT}=3.3V
CN86L036	V_{OUT}=3.6V
CN86L040	V_{OUT}=4.0V
CN86L050	V_{OUT}=5.0V
CN86L056	V_{OUT}=5.6V
CN86L120	V_{OUT}=12.0V

5 Marking

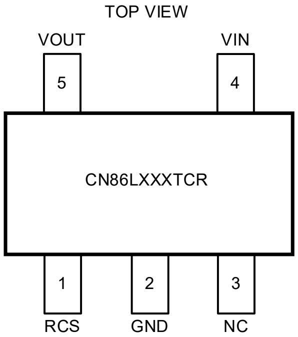
Product Number	Marking*
CN86LXXXDSR	CN86XX YYWW
CN86LXXXTCR	6XXYW
CN86LXXXATCR	86LXXXA YYWW
CN86LXXXTGR	6XXYW
CN86LXXXOGR	CN86LXXX YYWW
CN86LXXXAOGR	CN86LXXXA YYWW

Note: YY=Year WW=Week.

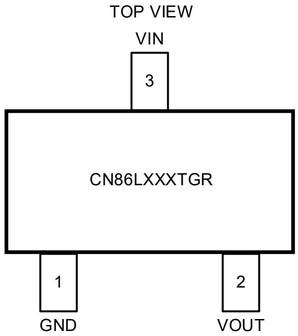
Green (RoHS & HF): CHIPNORTH defines "Green" to mean Pb-Free (RoHS compatible) and free of halogen substances. If you have additional comments or questions, please contact your CHIPNORTH representative directly.

Moisture sensitivity level(MSL):3

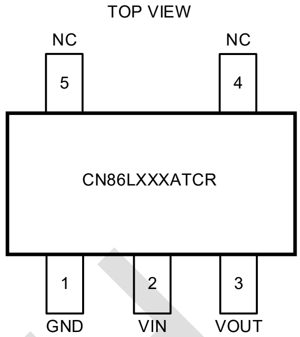
6 Pinout



SOT23-5



SOT23-3



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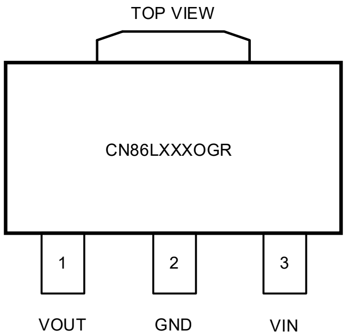
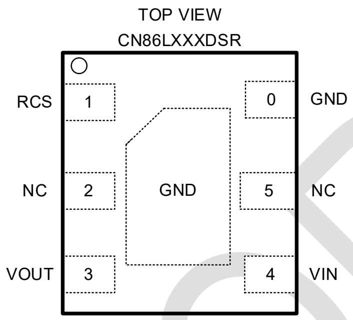
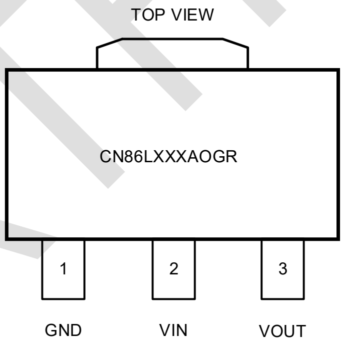


SOT89-3

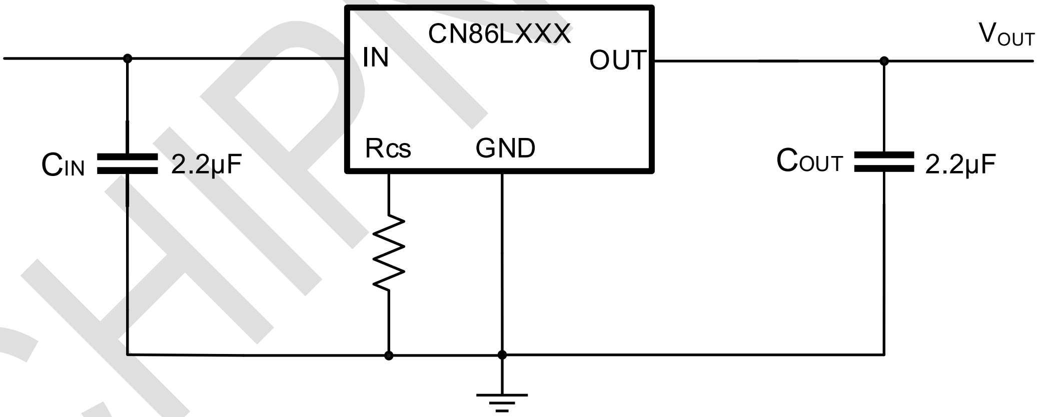


DFN2x2-6



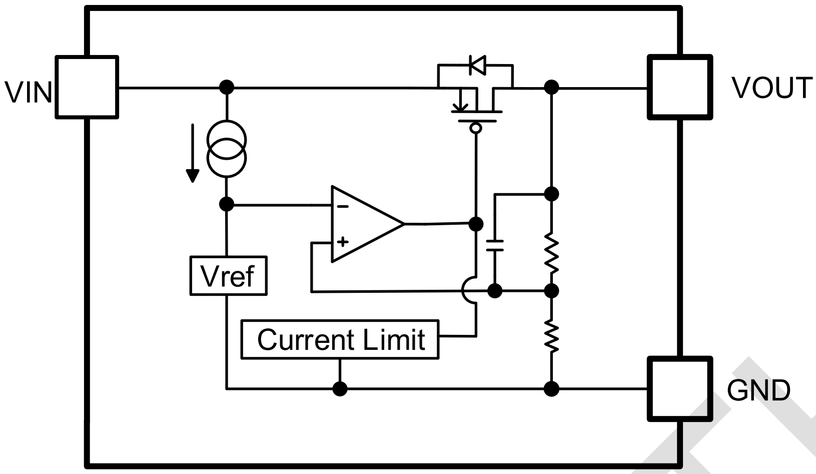
SOT89-3

7 Typical Application



Note： General application circuits are recommended input capacitance C_{IN} = 2.2μF, near the chip input; output capacitance C_{OUT} = 2.2μF, near the chip output.

8 Block Diagram



9 Pin Descriptions

Pin Name	Pin No. CN86LXXX OGR	CN86LXXX AOGR	CN86LXXX ATCR	Descriptions
GND	2	1	1	GND
VIN	3	2	2	Input
VOUT	1	3	3	Output
NC			4	No Connect
NC			5	No Connect

Pin Name	Pin No. CN86LXXX TCR	CN86LXXX TGR	CN86LXXX DSR	Descriptions
GND	2	1	6	GND
VIN	4	3	4	Input
VOUT	5	2	3	Output
NC	3		2	No Connect
NC			5	No Connect
RCS	1		1	Current limiting regulation

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 ~ 40	V
Storage temperature range	T_{STG}	-55 ~ 150	°C
Output Current	I_{OUT}	300	mA
Welding temperature	T_{LEAD}	260（Soldering,10s）	°C

(1) Stresses exceeding the values listed under Absolute Maximum Ratings may cause permanent damage to the device. These listed values are stress ratings only and do not imply that the device will operate properly under these conditions or any other conditions other than the recommended operating conditions. Prolonged operation at maximum absolute rating conditions can affect device reliability.

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

10.2 ESD Ratings

Discharge mode	Standardize	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 Range	V_{IN}	V_{OUT}+1	36	V
Atmospheric Pressure	p	63	106	kPa
Operating Temperature	T_A	-40	105	°C

10.4 Thermal Information

Parameter	Package	Value	Units
Junction to ambient thermal resistance ($R_{θJA}$)	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 conditions：$V_{IN}=V_{OUT}+1V$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$, $T_A=25℃$, unless otherwise specified.

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Input voltage range	V_{IN}	I_{OUT}=10mA	V_{OUT}+1V		36	V
Output voltage	V_{OUT}	$V_{IN}=V_{OUT}+2V$, I_{OUT}=10mA	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%	
Line regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN}\cdot V_{OUT}}$	$V_{IN}=V_{SET}$+1V~12V I_{OUT}=3mA（V_{OUT} =5V）		0.011	0.067	%/V
Load regulation	ΔV_{OUT}	V_{IN}=4.3V，V_{OUT}=3.3V，I_{OUT}=3~300mA		20	50	mV
		V_{IN}=6V，V_{OUT}=5V，I_{OUT}=3~300mA		20	50	
		V_{IN}=13V，V_{OUT}=12V，I_{OUT}=3~300mA		50	100	
Quiescent current	I_Q	V_{IN}=12V, I_{OUT} =0mA	0.2	1.2	3	μA
Dropout voltage*1	V_{DROP}	I_{OUT}=100mA@V_{OUT}=5V	0.1	0.2	0.3	V
Maximum output current	I_{OUT_MAX}	$V_{OUT}=0.95*V_{OUT(S)}$	300			mA
Current limit	I_{LIMIT}		300	500	700	mA
Short-Circuit Current	I_{SHORT}			250		mA
Temperature Coefficient of Output Voltage	TC_{VOUT}	T_A=-40℃~85℃，I_{OUT}=1mA		30		ppm/℃
OTP threshold				160		°C
OTP hysteresis				30		°C
PSRR		100Hz, I_{OUT}=50mA		50		dB

Note:

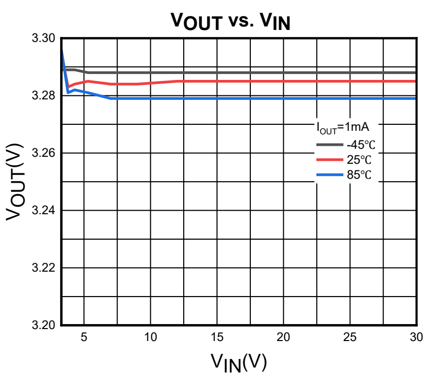
$V_{OUT(S)}$: Output voltage when $V_{IN} = V_{OUT} + 1V$, I_{OUT} = 1mA.

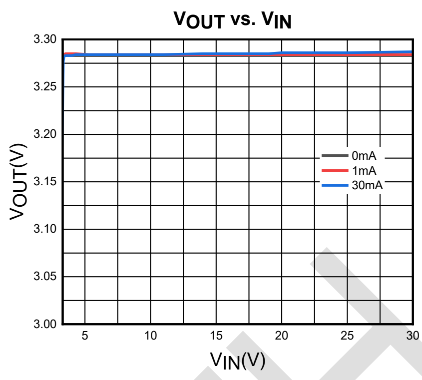
$V_{DROP}=V_{IN}-(V_{OUT\_REG}*0.98)$, where V_{OUT_REG} is the output voltage when $V_{IN}=V_{OUT}+1.0V$ and I_{OUT}=100mA. V_{IN} is the input voltage, when the input voltage gradually decreases, the output voltage becomes 98% of V_{OUT_REG}.

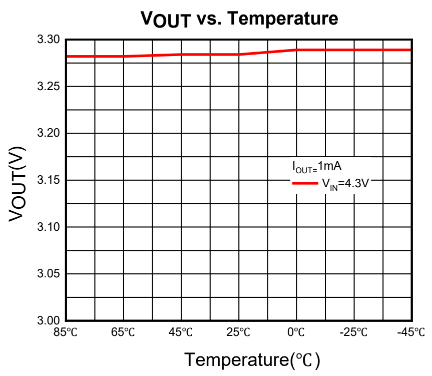
I_{LIMIT}: Output current when $V_{IN} = V_{OUT} + 1V$ and $V_{OUT} = 0.95 \times V_{OUT(S)}$.

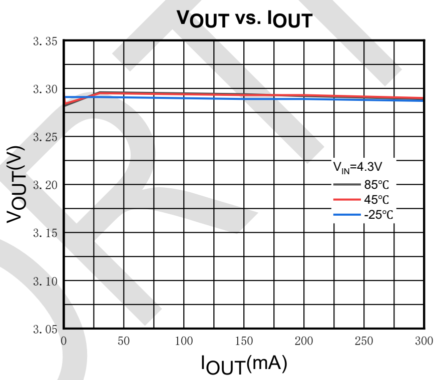
10.6 Characteristics Curve（CN86L033OGR）

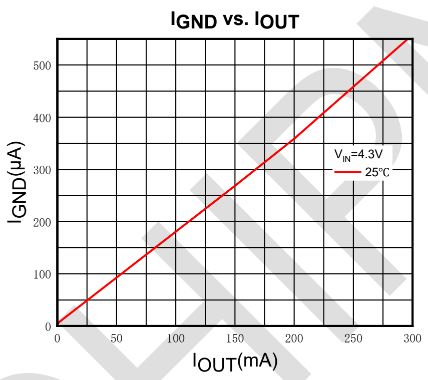
Test conditions: $V_{IN}=V_{OUT}+1V$, $C_{IN}=2.2\mu F$, $C_{OUT}=2.2\mu F$, $T_A=25℃$, unless otherwise specified.

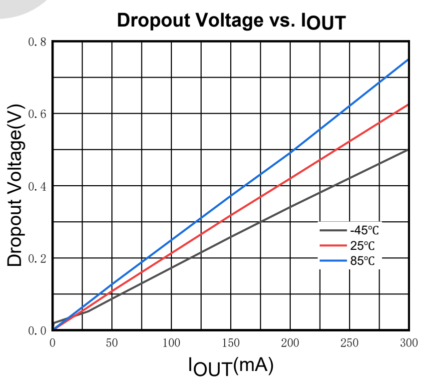


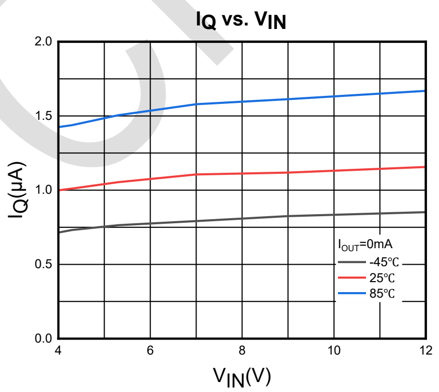


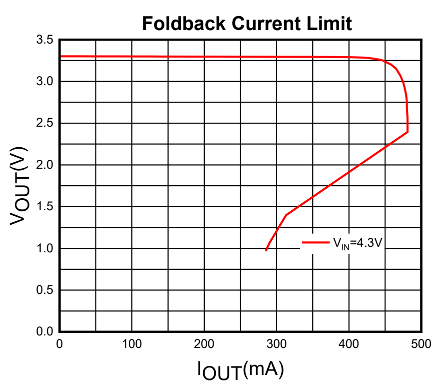












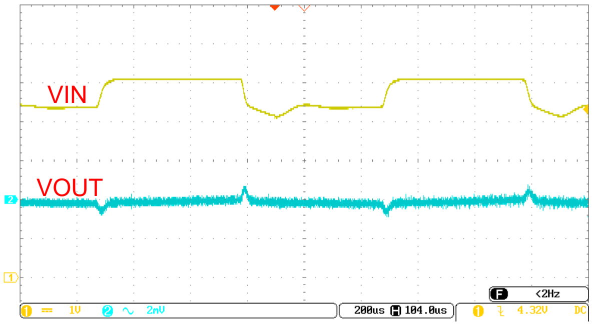


Figure 1 Line Transient

(V_{IN}=from 4.3V to 5V to 4.3V, I_{OUT}=0mA)

Figure 2 Line Transient

(V_{IN}=from 4.3V to 5V to 4.3V, I_{OUT}=300mA)

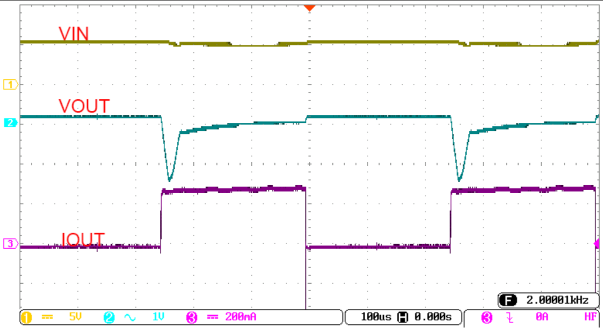


Figure 3 Load Transient

(V_{IN}=5.3V, I_{OUT}=0mA-300mA-0mA)

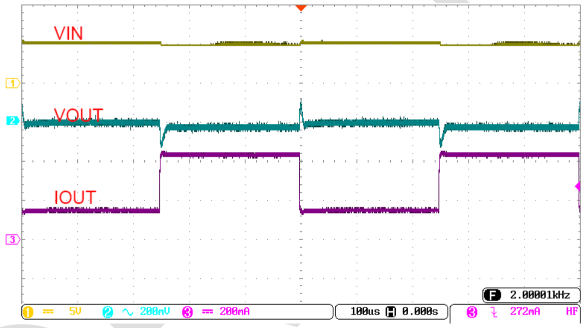


Figure 4 Load Transient

(V_{IN}=5.3V, I_{OUT}=150mA-300mA-150mA)

11 Functional Description

CN86L is a low-dropout linear regulator (LDO) fabricated by CMOS process, with a maximum input voltage of 36 V. The device is available in fixed output versions ranging from 2.8 V to 12 V, capable of delivering an output current up to 300 mA, and integrates built-in short-circuit, overcurrent and thermal shutdown protection functions.

11.1 Overcurrent Protection (Current-Limiting Type)

CN86L integrates foldback current-limit protection. When output current exceeds the limit, output voltage drops and the circuit reduces output current accordingly.

11.2 Short-Circuit Protection (Current-Limiting Type)

When output shorted to GND, the current limit automatically drops (typical 250mA) to reduce regulator power dissipation and protect power MOSFET; output voltage recovers automatically after fault clearance.

11.3 Output Voltage Tracking Mode

In normal regulation mode of CN86L, the input voltage V_{IN} shall be at least 1 V higher than the preset output voltage V_{OUT}, so that the internal error amplifier has sufficient supply headroom to maintain a constant output voltage.When V_{IN} drops below V_{OUT} + 1 V, the regulator will automatically enter 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,i.e:

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

Since the on-resistance RDSON of the power transistor is very small, it can be approximated that $V_{OUT} \approx V_{IN}$

This tracking feature can supply the maximum available voltage to the post-stage circuit under low input voltage conditions, preventing sudden output voltage drop or power transistor overload caused by forced operation of the regulation loop.Meanwhile, the internal short-circuit protection, overcurrent protection and thermal shutdown protection of the chip remain functional under this mode to guarantee device safety under abnormal conditions.

When the input voltage rises back above V_{OUT}+ 1 V, the error amplifier regains sufficient supply headroom. The regulator will smoothly exit the tracking mode and automatically restore 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. The output ripple and load regulation performance are slightly inferior to those under normal regulation. This is an abnormal operating region and shall not be used as a continuous operating point.

11.4 RCS Pin Function

The RCS pin is used to control the chip current limit. The details are as follows：

1、When the RCS pin is floating, the current limit is 500mA.

2、When RCS pin is short-circuited, the current limit is 500mA.

3、When RCS is connected to a resistor, the current limit is determined by the resistor, when RCS<2.63K, the current limit is 500mA. when RCS>2.63K, the current limit is determined by the following formula:

$$I_{Limit}\ (mA) = \frac{1460}{R_{CS}(k\Omega)}$$

11.5 Thermal shutdown

The CN86L features an internal thermal shutdown circuit that limits the overall power dissipation and protects the device from junction overtemperature damage. Once the junction temperature rises above the preset threshold of 160°C, the thermal shutdown circuitry disables the power MOS, allowing the die to cool. The power MOS automatically re-enables after the junction temperature falls by about 30°C. As a result, a pulsed output waveform may occur during continuous overload conditions.

11.6 Operating Region and Power Dissipation

The maximum power dissipation of CN86L is determined by package thermal resistance, PCB copper foil area, ambient temperature and ventilation conditions.Its internal power dissipation can be calculated by the following formula:

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

Where I_Q refers to the quiescent operating current.The maximum allowable power dissipation is calculated as follows:

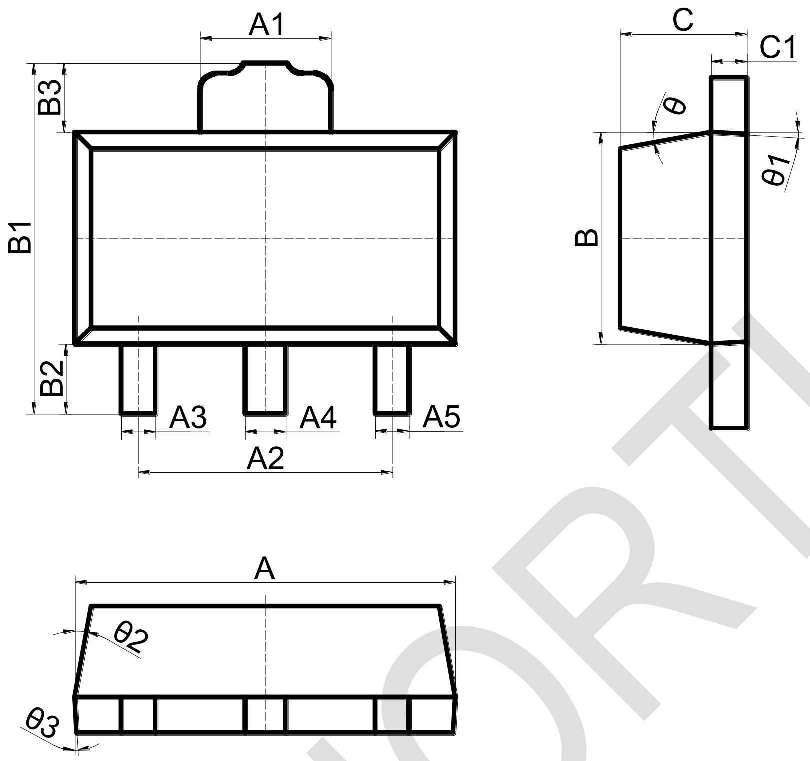
$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\Theta_{JA}}$$

In the formula,$T_{J(MAX)}$ is the maximum operating junction temperature,T_A is the ambient temperature, andθ_{JA} is the junction-to-ambient thermal resistance.

Since CN86L supports an input voltage up to 36 V, special attention shall be paid to power dissipation in applications with large voltage drop and high load current to ensure　do$P_D$es not exceed $P_{D(MAX)}$。

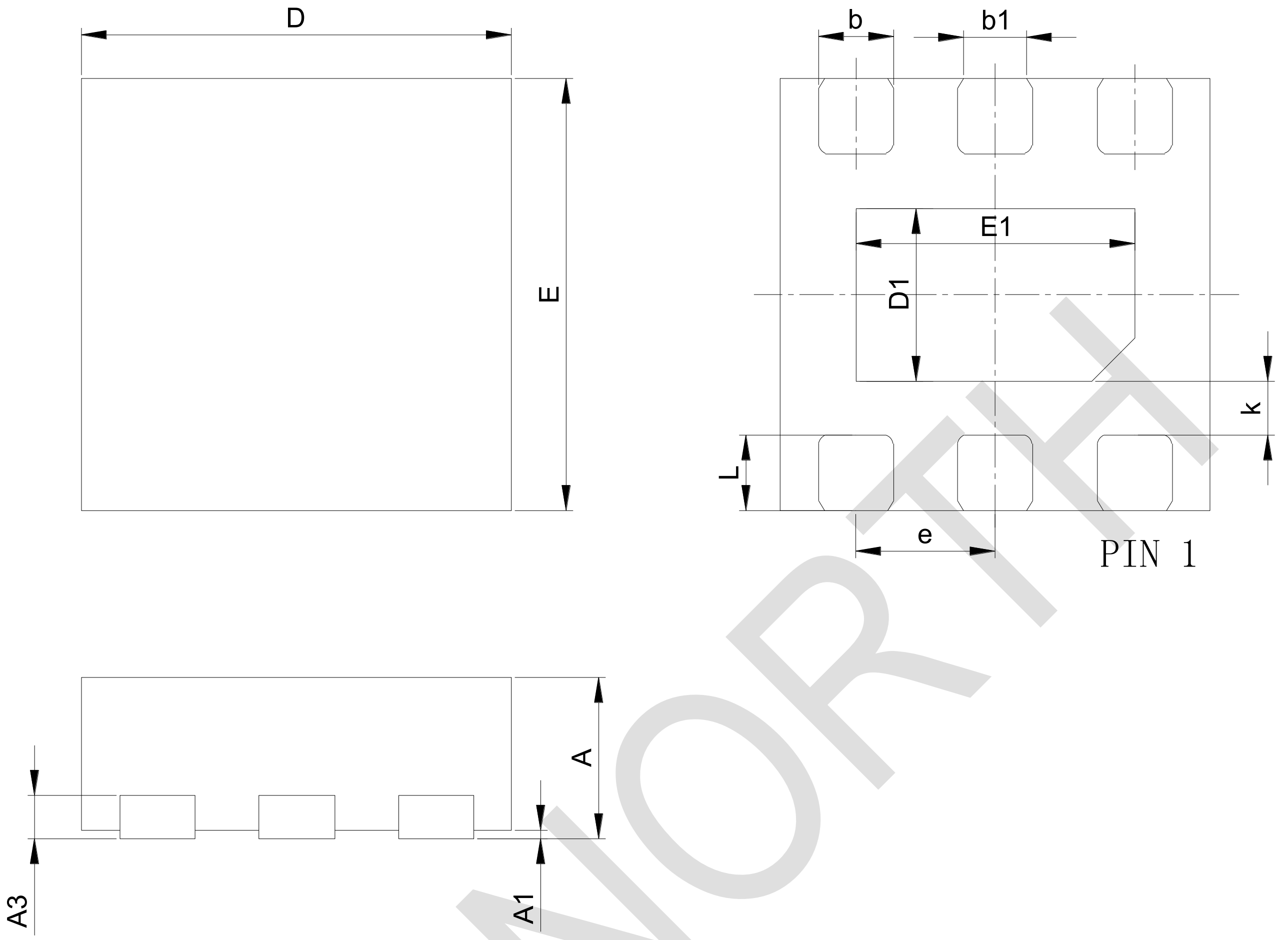
12 Package Information

SOT89-3



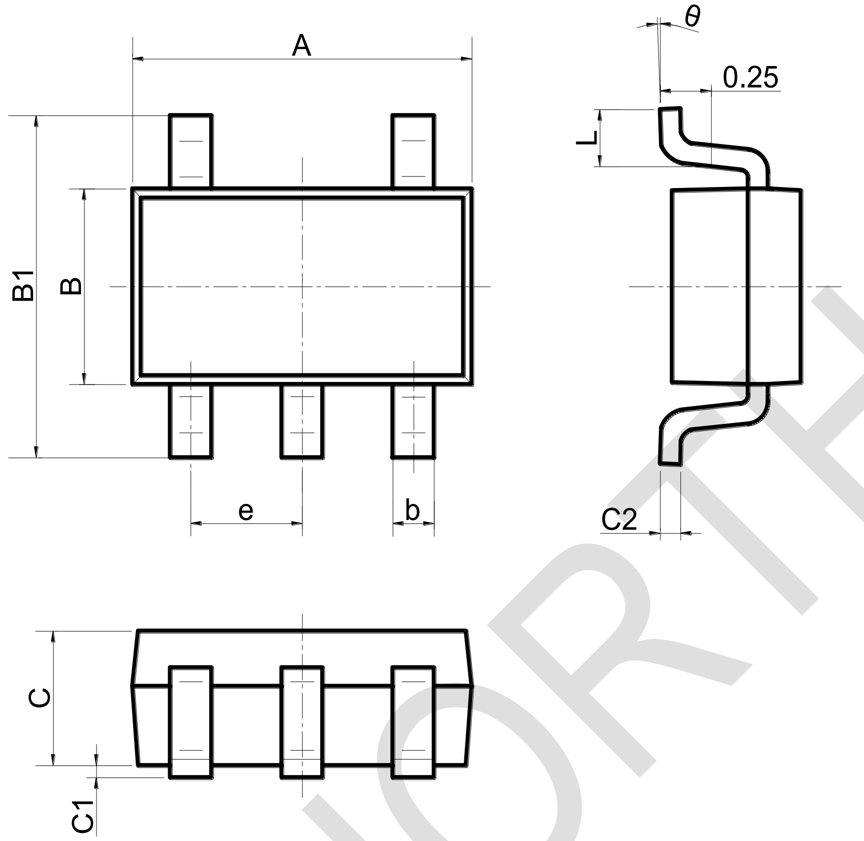
Dimension / Symbol	Min (mm)	Nom (mm)	Max (mm)
A	4.4	4.5	4.6
A1	1.4	1.6	1.8
A2	2.8	3.0	3.2
A4	0.37	0.47	0.57
A5	0.22	0.42	0.62
B	2.4	2.5	2.6
B1	-	-	4.25
B2	0.8	-	-
C	1.4	1.5	1.6
C1	0.3	0.4	0.5

DFN2x2-6



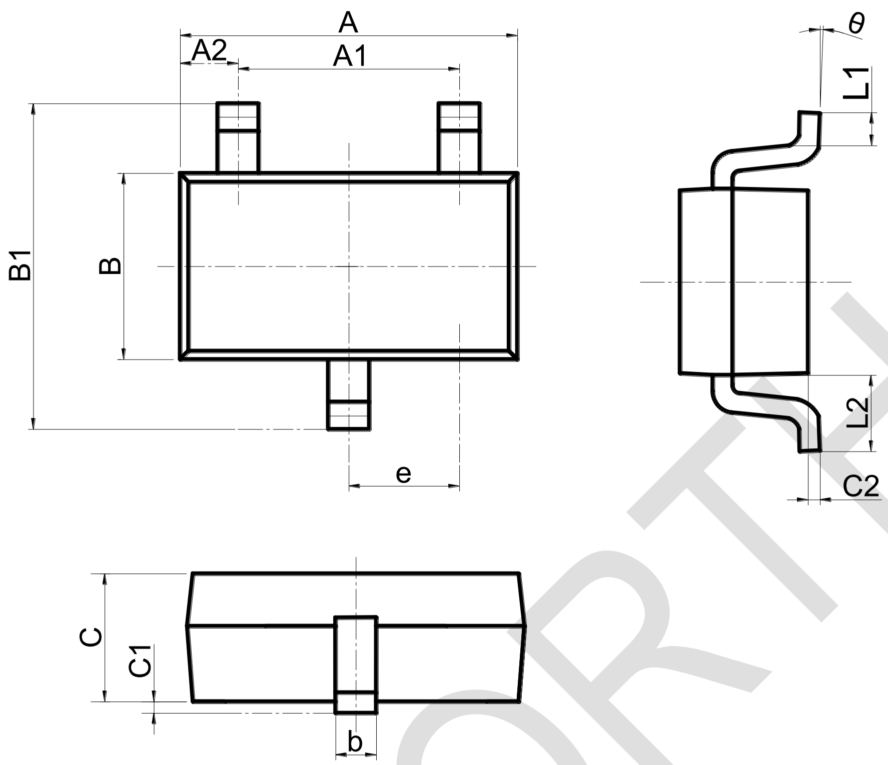
Dimension / Symbol	Min （mm）	Nom (mm)	Max (mm)	Dimension / Symbol	Min （mm）	Nom (mm)	Max (mm)
A	0.7	0.75	0.8	E1	1.5	1.6	1.7
A1	0	0.025	0.05	k	0.25REF		
A3	0.203REF			b	0.25	0.3	0.35
D	1.9	2.0	2.1	b1	0.22REF		
E	1.9	2.0	2.1	e	0.65REF		
D1	0.9	1.0	1.1	L	0.2	0.25	0.3

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°

SOT23-3L



Dimension / Symbol	Min (mm)	Max (mm)	Min (inch)	Max (inch)
A	2.820	3.020	0.111	0.119
A1	1.800	2.000	0.071	0.079
B	1.500	1.700	0.059	0.067
B1	2.650	2.950	0.104	0.116
b	0.300	0.500	0.012	0.020
e	0.950(BSC)		0.037(BSC)	
C	1.050	1.250	0.041	0.049
C1	0.000	0.100	0.000	0.004
C2	0.100	0.200	0.004	0.008
L1	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

13 Important Statement

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14 Revision History

Date	Version	Revision Notes
2026/07/06	R3.1	Update Functional Description
2026/08/14	R3.2	Update Applications
2026/09/01	R3.3	Update EC Table