■ Introduction

CN87L0XX is a highly accurate low dropout voltage regulator manufactured in CMOS processes. It can deliver up to 300mA of current while consuming only 0.6uA of quiescent current. It consists of a reference voltage generator, an error amplifier, a current foldback circuit, and a phase compensation circuit plus a driver transistor.

■ Features

- Ultra-low Quiescent Current: 600nA
- Highly Accurate: ±2%
- Dropout Voltage: 60mV@IOUT=100mA
- Maximum Output Current: 300mA
- Input Voltage Range: 1.4V~7.0V
- Temperature Stability: ±50ppm/℃
- ON/OFF Logic = Enable High
- Standby Current: 10nA
- COUT Discharge Circuit when EN Disable is
- Active
- Protections Circuits: Current Limiter, Short Circuit, Foldback
- Output Capacitor: Low ESR Ceramic Capacitor Compatible

■ APPLICATIONS

- Smart wearer
- Long-life battery-powered devices
- Portable mobile devices, such as mobile phones, cameras, and so on
- Wireless communication equipment

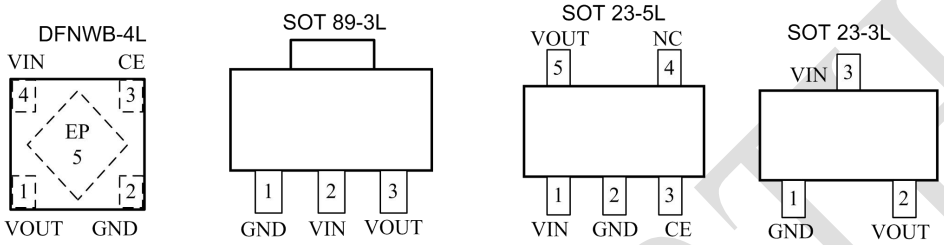
■ Product Selections:

Type	Output Voltage	Current Limit	Accuracy	Package	MARKING
87L018	1.8V	450mA	±2%	DFNWB-4L\SOT89-3L\SOT23-5L\SOT23-3L	CN87L018
87L028	2.8V	450mA	±2%	DFNWB-4L\SOT89-3L\SOT23-5L\SOT23-3L	CN87L028
87L030	3.0V	450mA	±2%	DFNWB-4L\SOT89-3L\SOT23-5L\SOT23-3L	CN87L030
87L033	3.3V	450mA	±2%	DFNWB-4L\SOT89-3L\SOT23-5L\SOT23-3L	CN87L033
87L036	3.6V	450mA	±2%	DFNWB-4L\SOT89-3L\SOT23-5L\SOT23-3L	CN87L036

■ Order Information

Part NO.	Package Type	Qty	Mark*
CN87L0XX	DFNWB-4L (1X1)	10000 /Tape	CN87LXXX/YYWW
	SOT89-3L	1000 /Tape	
	SOT23-5L	3000 /Tape	

■ PIN CONFIGURATION(TOP VIEW):



■ Absolute Maximum Ratings: (Unless otherwise indicated: T_a=25℃)

PARAMETER	SYMBOL	RATINGS	UNITS
Input Voltage	V_{IN}	-0.3 ~ 7.0	V
Output Voltage	V_{OUT}	-0.3 ~ V_{IN}+0.3V	
Power Dissipation	P_D	DFNWB–4L 100 SOT23-3L 250 SOT23-5L 250 SOT89-3L 500	mW
Operating Ambient Temperature	T_{opr}	-40 ~ +85	℃
Storage Temperature	T_{stg}	-40 ~ +125	
ESD Protection	ESD HBM	6000	V

Note: Stresses above those listed under “Absolute Maximum Ratings” may cause permanent damage to the device.

■ ELECTRICAL CHARACTERISTICS:

CN87L0XX Series(Unless otherwise indicated：T_a=25℃)

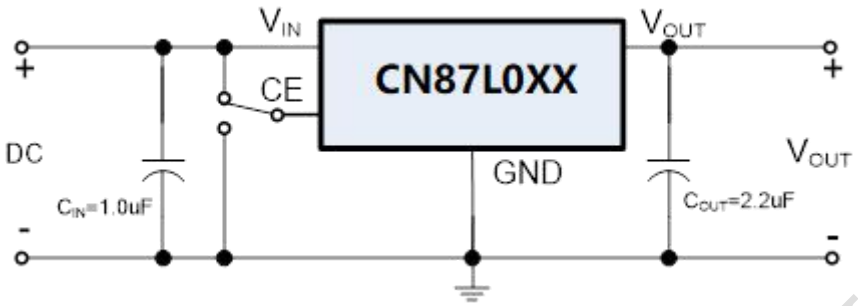
PARAMETER	SYMBOL	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Output Voltage*1	$V_{OUT(S)}$	V_{IN}=$V_{OUT(S)}$+2.0V I_{OUT}=10mA, $V_{OUT(S)}$ < 2.0V	$V_{OUT(S)}$-0.03	$V_{OUT(S)}$	$V_{OUT(S)}$+0.03	V
		V_{IN}=$V_{OUT(S)}$+1.0V I_{OUT}=10mA, $V_{OUT(S)}$≥2.0V	$V_{OUT(S)}$×0.98		$V_{OUT(S)}$×1.02	

Dropout Voltage*2	V_{DROP}	$V_{CE}=V_{IN}$, V_{OUT} < 3V I_{OUT}=100mA		70		mV
		$V_{CE}=V_{IN}$, V_{OUT}≥3V I_{OUT}=100mA		60		
Line Regulation	$\frac{\Delta V_{OUT}}{\Delta V_{IN} \bullet V_{OUT(s)}}$	$V_{OUT(S)}$+0.5V≤V_{IN}=V_{CE} ≤7V I_{OUT}=10mA		0.05	0.1	%/V
Load Regulation	ΔV_{OUT2}	V_{IN}=V_{CE}=$V_{OUT(S)}$+1.0V 1mA≤I_{OUT}≤100mA		6	20	mV
Temperature Stability	$\frac{\Delta V_{OUT}}{\Delta T_a \bullet V_{OUT(s)}}$	V_{IN}=V_{CE}=$V_{OUT(S)}$+1.0V I_{OUT}=1mA -40℃≤T_a≤85℃		±50		ppm/℃
GND Current (CE=V_{IN})	I_{GND}	no load		0.6	0.9	uA
		I_{OUT}=100mA		40		uA
Shutdown Current (CE=0)	I_{SHUT}	V_{IN}=7.0V, V_{CE}=0		0.01	0.1	uA
Input Voltage	V_{IN}	---	1.5		7	V
Maximum Output Current	I_{OUTMAX}		250	300		mA
Current Limit*2	I_{LIM}	V_{IN}=V_{CE}=$V_{OUT(S)}$+1.0V V_{OUT} = 0.95 ×$V_{OUT(S)}$	300	470		mA
Short Circuit Current	I_{SHORT}	V_{IN}=V_{CE}=$V_{OUT(S)}$+1.0V V_{OUT}=0V		65		mA
C_{OUT} Auto Discharge	R_{DCHG}	V_{CE}=0, V_{OUT}=$V_{OUT(S)}$	280	450	640	Ω
Power Supply Rejection Ratio	PSRR	f=10Hz, $V_{OUT(S)}$=2.5V		60		dB
		f=100Hz, $V_{OUT(S)}$=2.5V		45		
		f=1kHz, $V_{OUT(S)}$=2.5V		25		
CE 'H' Level Voltage	V_{CEH}	---	1.0		6.0	V
CE 'L' Level Voltage	V_{CEL}	---	0		0.38	
CE 'H' Level Current	I_{CEH}	V_{IN}=6.0V, V_{CE}=V_{IN}	-0.1		0.1	uA
CE 'L' Level Current	I_{CEL}	V_{IN}=6.0V, V_{CE}=0	-0.1		0.1	

Notes：

1. $V_{OUT(S)}$: Output voltage when V_{IN}=V_{OUT}+2V, I_{OUT}=1 mA.
2. V_{DROP}=V_{IN1} - ($V_{OUT(S)}$× 0.98) where V_{IN1} is the input voltage when V_{OUT} = $V_{OUT(S)}$× 0.98.
3. I_{LIM} : Output current when V_{IN}=$V_{OUT(S)}$+2V and V_{OUT} = 0.95*$V_{OUT(S)}$.

■ TYPICAL APPLICATIONS:

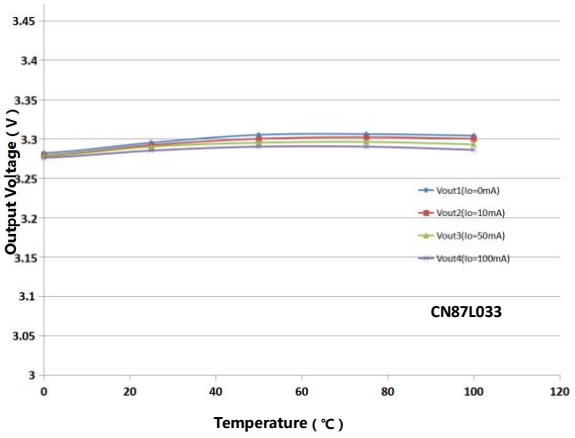


■ Notes on Use:

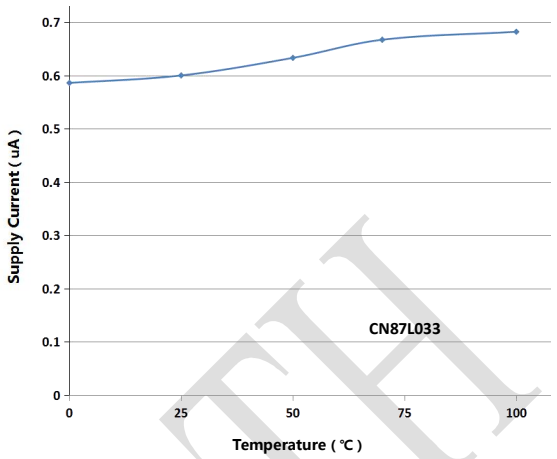
Input Capacitor (C_{IN}): 1.0μF above
Output Capacitor (C_{OUT}):0.1μF above

■ TYPICAL PERFORMANCE CHARACTERISTICS:

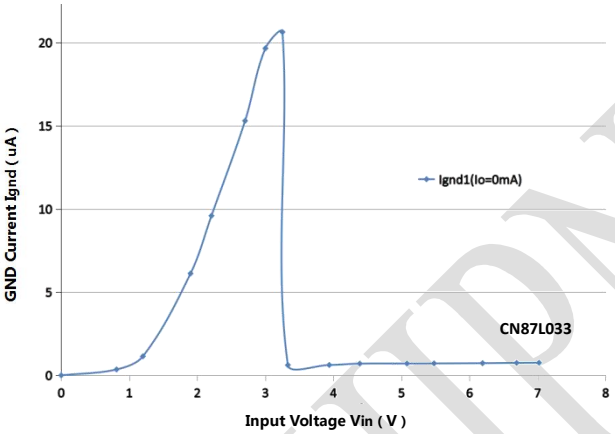
Test Conditions: V_{IN}=V_{OUT}+1.0V, C_{IN}=1.0uF, C_{OUT}=0.1uF or 1.0uF, T_a=25℃, unless otherwise indicated.



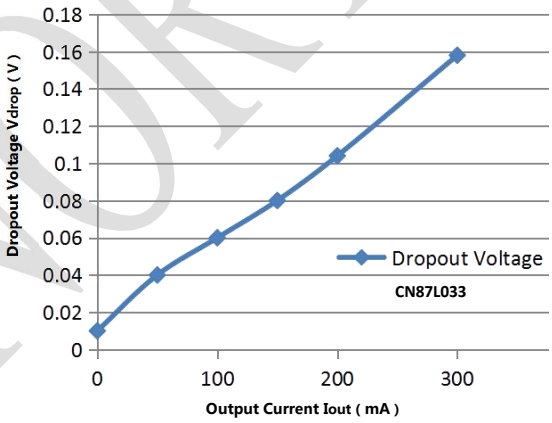
Output Voltage vs. Temperature
(C_{OUT}=0.1uF)



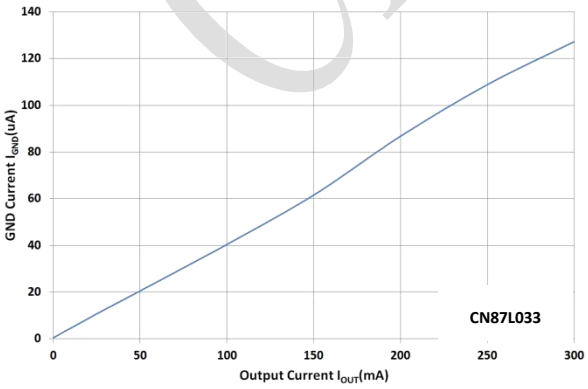
Supply Current vs. Temperature
(C_{OUT}=0.1uF)



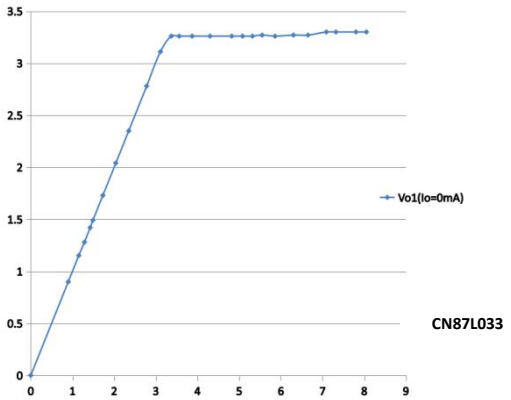
GND Current vs. Input Voltage
(C_{OUT}=0.1uF)



Dropout Voltage vs. Output Current
(C_{OUT}=0.1uF)



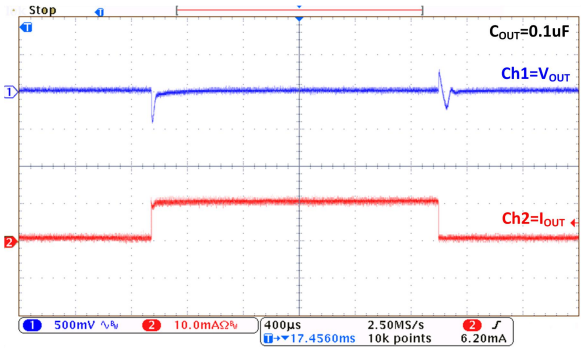
GND Current vs Output Current
(C_{OUT}=1.0uF)



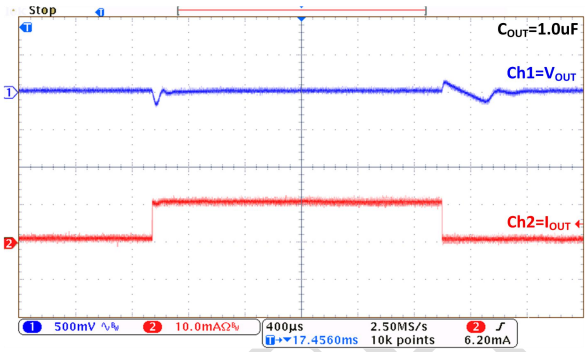
Output Voltage vs Input Voltage
(C_{OUT}=0.1uF,I_{load}=0mA)

■ TYPICAL PERFORMANCE CHARACTERISTICS(CONTINUTED):

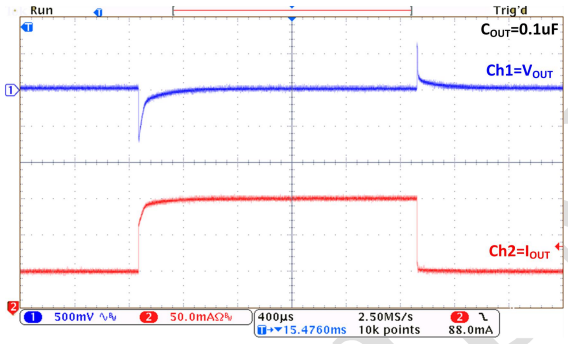
Test Conditions: V_{IN}=V_{OUT}+1.0V, C_{IN}=1.0uF, C_{OUT}=0.1uF or 1.0uF, T_a=25℃, unless otherwise indicated.



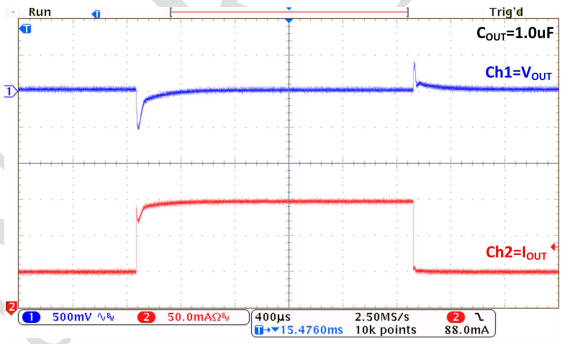
Load Transient:
87L033 (I_{OUT}=1mA~10mA~1mA)



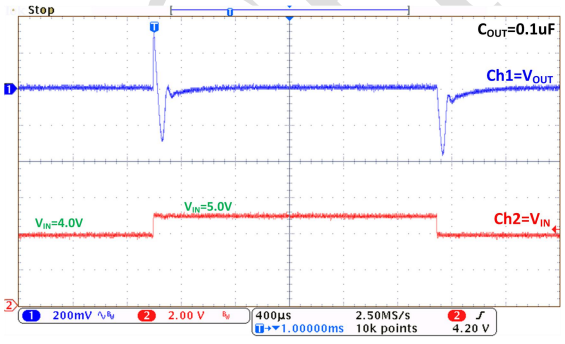
Load Transient:
87L033 (I_{OUT}=1mA~10mA~1mA)



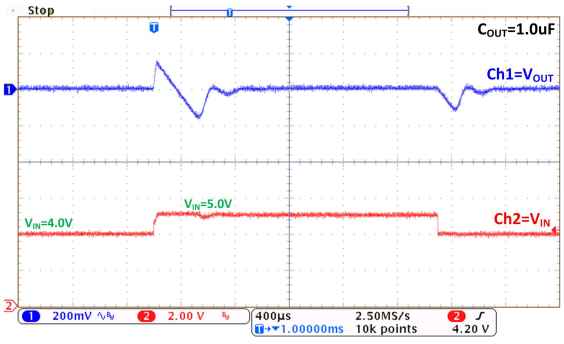
Load Transient:
87L033 (I_{OUT}=50mA~100mA~50mA)



Load Transient:
87L033 (I_{OUT}=50mA~100mA~50mA)



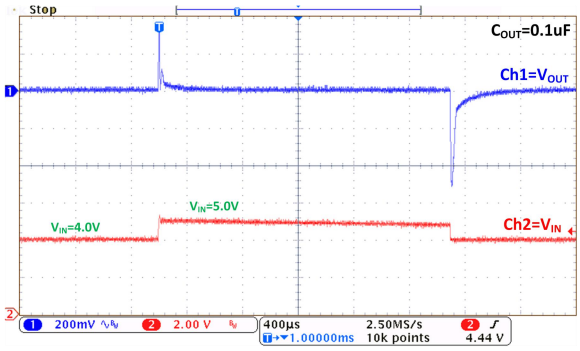
Line Transient:
87L033 (I_{OUT}=1mA)



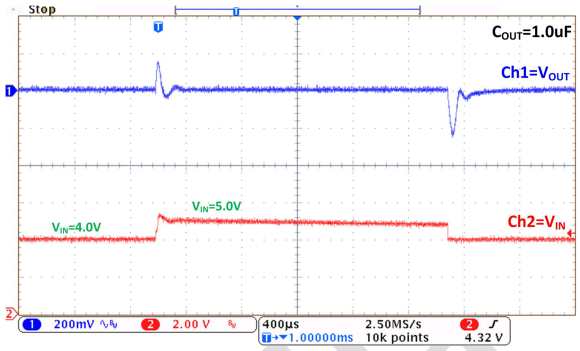
Line Transient:
87L033 (I_{OUT}=1mA)

■ TYPICAL PERFORMANCE CHARACTERISTICS(CONTINUTED):

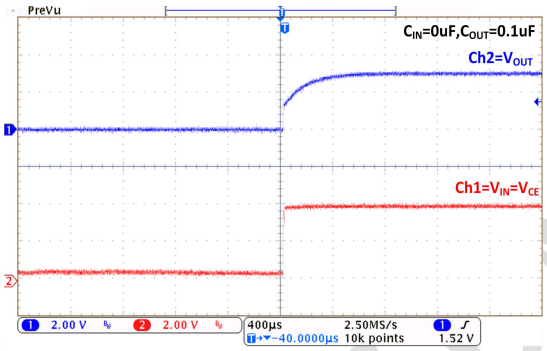
Test Conditions: V_{IN}=V_{OUT}+1.0V, C_{IN}=1.0uF, C_{OUT}=0.1uF or 1.0uF, T_a=25℃, unless otherwise indicated.



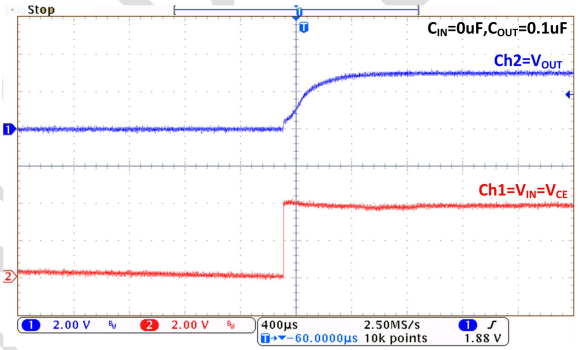
Line Transient:
87L033 (I_{OUT}=10mA)



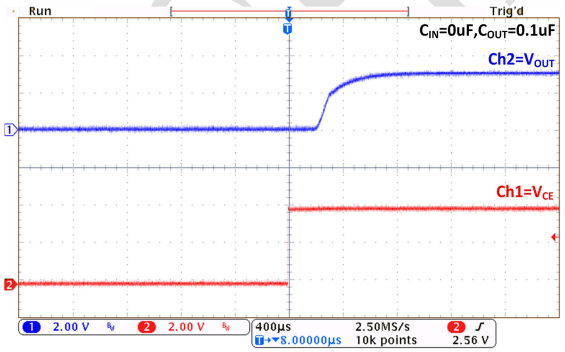
Line Transient:
87L033 (I_{OUT}=10mA)



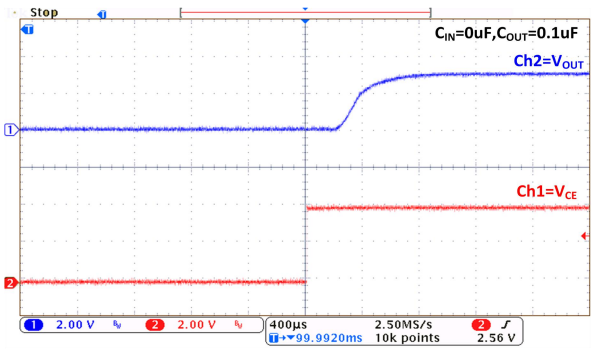
Power Up:
87L033 (I_{OUT}=1mA)



Power Up:
87L033(I_{OUT}=100mA)



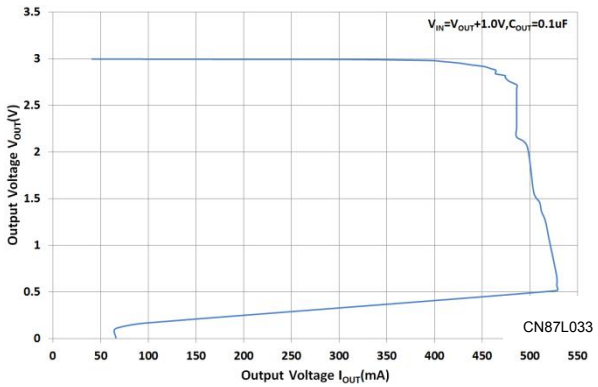
EN Enable:
87L033(I_{OUT}=1mA)



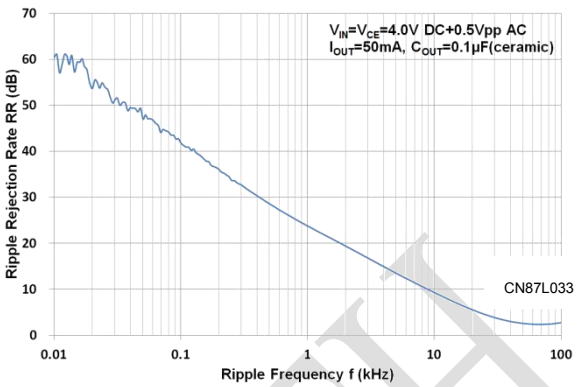
EN Enable:
87L033 (I_{OUT}=100mA)

■ TYPICAL PERFORMANCE CHARACTERISTICS(CONTINUTED):

Test Conditions: V_{IN}=V_{OUT}+1.0V, C_{IN}=1.0uF, C_{OUT}=0.1uF or 1.0uF, T_a=25℃, unless otherwise indicated.



87L033 Output Current Fold-back

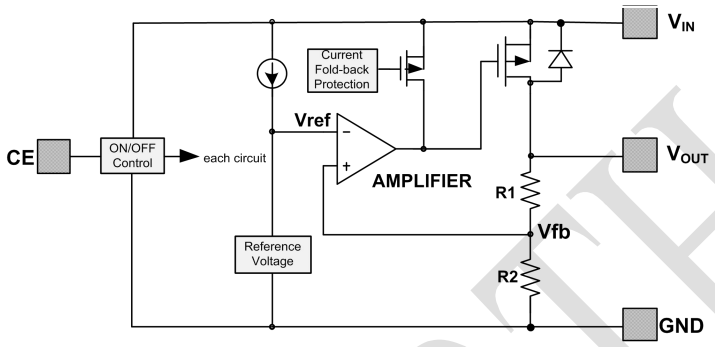


87L033 Power Supply Rejection Ratio

■ OPERATIONAL EXPLANATION:

1. Output voltage control

The voltage divided by resistors R1 and R2 is compared with the internal reference voltage by the error amplifier. The amplifier output then drives the P-channel MOSFET connected to the V_{OUT} pin. The output voltage at the V_{OUT} pin is regulated by this negative feedback system. The current limit circuit and short protect circuit operate in relation to output current level. Further, the IC's internal circuitry can be in operation or shutdown modes controlled by the CE pin's signal.



2. Pass transistor

The pass transistor with low turn-on resistance used inCN87L0XX is a P-channel MOSFET. If the potential on V_{OUT} pin is higher than VIN, it is possible that IC will be destroyed due to reverse current which is caused by parasitic diodes between V_{IN} and V_{OUT}. Therefore, the V_{OUT} pin potential exceeds V_{IN}+0.3V is not allowed.

3. Current foldback and short circuit protection

The CN87L0XX series includes a combination of a fixed current limiter circuit and a foldback circuit, which aid the operations of the current limiter and circuit protection. When the load current reaches the current limit level, the fixed current limiter circuit operates and output voltage drops. As a result of this drop in output voltage, the foldback circuit operates, output voltage drops further and output current decreases. The short circuit current is about 65mA (typical value). This design can prevent the chip be damaged due to over temperature, moreover, the heat dissipation is limited by the package type.

Special attention should be paid to that the product of the dropout voltage on the chip and the output current must be smaller than the heat dissipation.

4. C_{OUT} Auto-Discharge Function

The CN87L0XX series can quickly discharge the electric charge at the output capacitor (C_{OUT}), when a low signal is set to the CE pin, which puts the whole IC into OFF state. The discharge function is achieved by an internal switch located between the V_{OUT} pin and the GND pin. In this state, the application is protected from a glitch operation caused by the electric charge at the output capacitor (C_{OUT}).

Moreover, discharge time of the output capacitor (C_{OUT}) is set by the C_{OUT} auto-discharge resistance (R_{DCHG}) and the output capacitor (C_{OUT}). By setting time constant of a C_{OUT} auto-discharge resistance value (R_{DCHG}) and an output capacitor value (C_{OUT}) as τ ($\tau = C_{OUT} \times R_{DCHG}$), the output voltage after discharge via the internal switch is calculated by the following formulas.

$V = V_{OUT(S)} \times e^{-t/\tau}$ or $t = \tau \ln (V_{OUT(S)} / V)$

V: Output voltage after discharge
$V_{OUT(S)}$: Output voltage
t: Discharge time

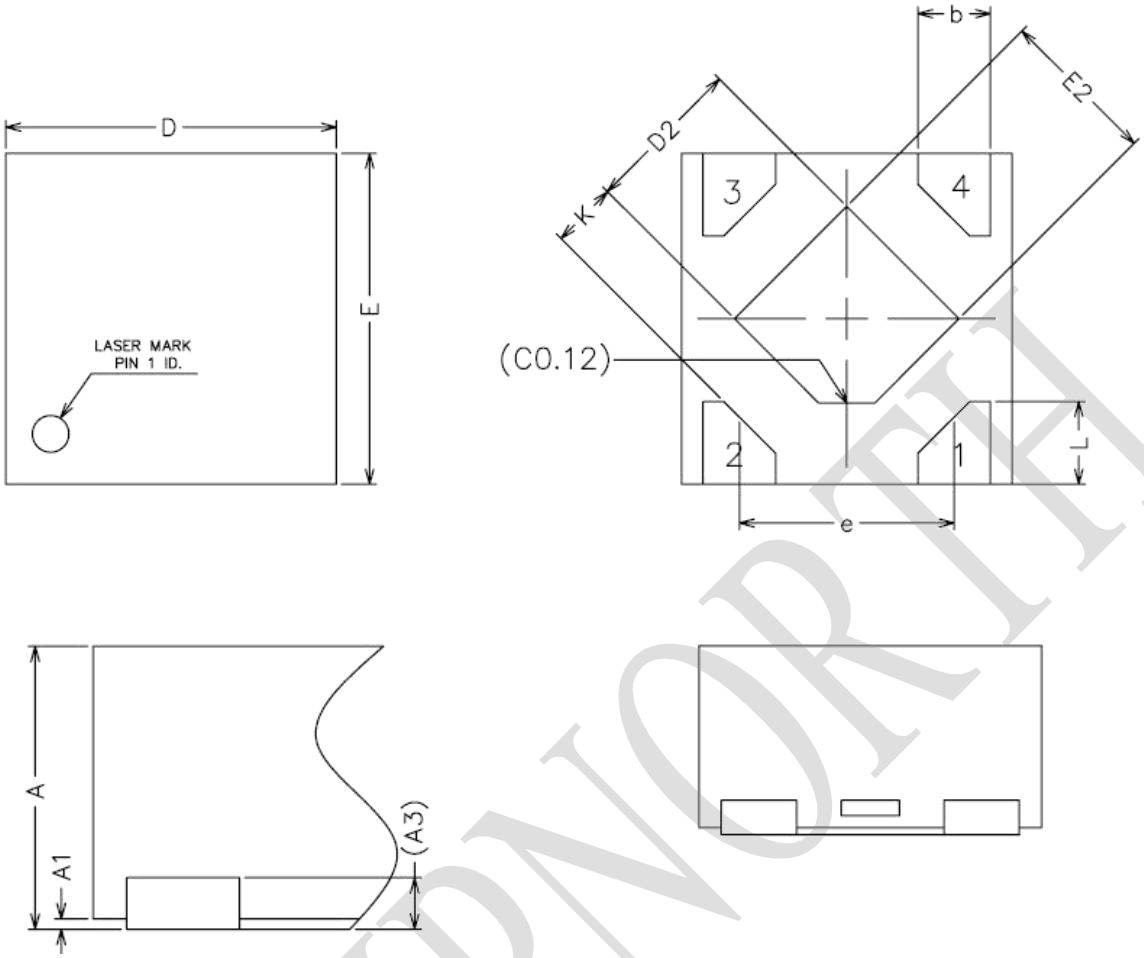
τ: C_{OUT} x R_{DCHG}

Please also note R_{DCHG} is depended on V_{IN} and When V_{IN} is high, R_{DCHG} is low.

■ **Notes:**

1. The input and output capacitors should be placed as close as possible to the IC.
2. If the impedance of the power supply is high, which is caused by forgetting installing input capacitor or installing too small value capacitor, the oscillation may occur.
3. Pay attention to the operation conditions of input and output voltage and load current, such that the power consumption in the IC should not exceed the allowable power consumption of the package even though the chip has short circuit protection.
4. IC has a built-in anti-static protection (ESD) circuit, but please do not add excessive stress to the IC.

■ PACKAGING INFORMATION:

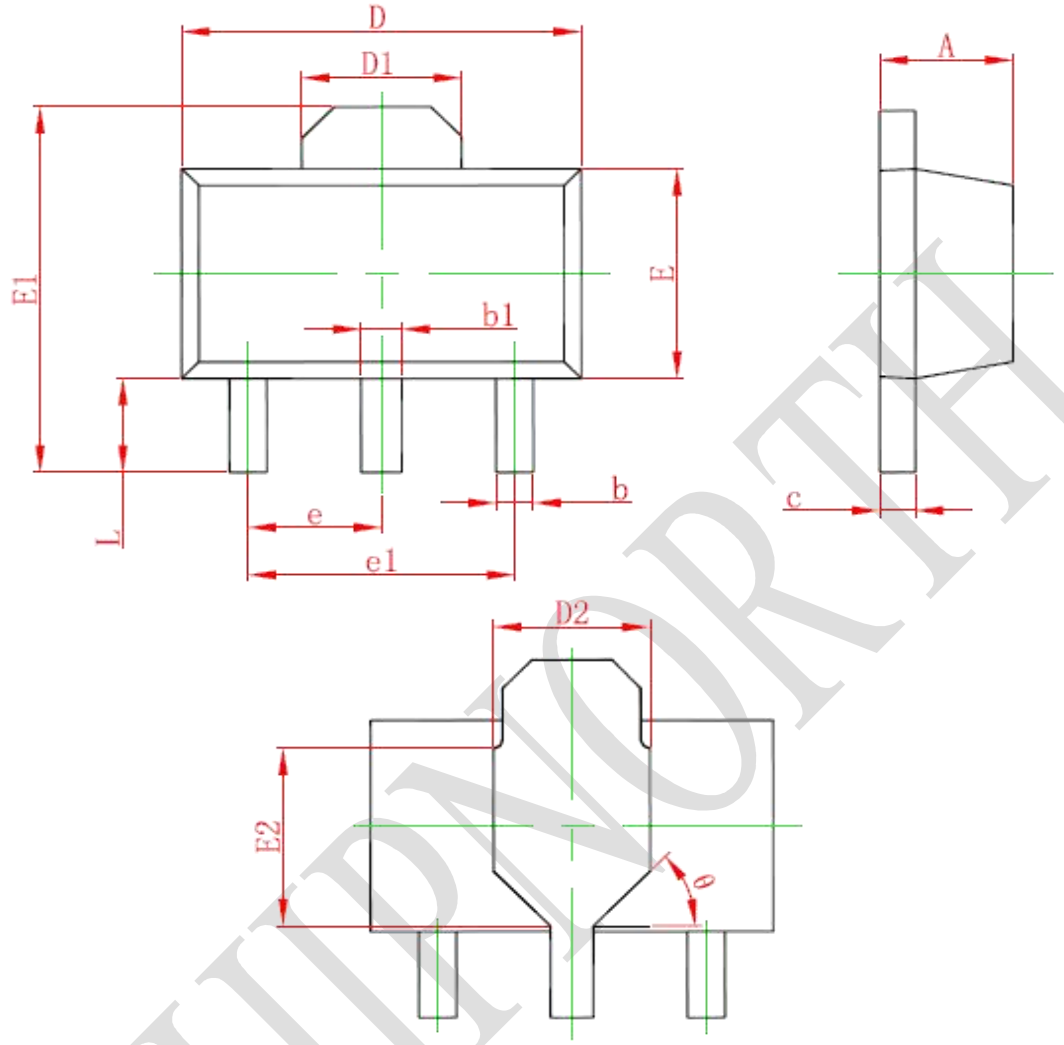


COMMON DIMENSIONS
(UNITS OF MEASURE=MILLIMETER)

SYMBOL	MIN	NOM	MAX
A	0.50	0.55	0.60
A1	0.00	0.02	0.05
A3		0.100REF	
b	0.17	0.22	0.27
D	0.95	1.00	1.05
E	0.95	1.00	1.05
D2	0.43	0.48	0.53
E2	0.43	0.48	0.53
L	0.20	0.25	0.30
e	0.60	0.65	0.70
K	0.15	–	–

■ PACKAGING INFORMATION(Continued):

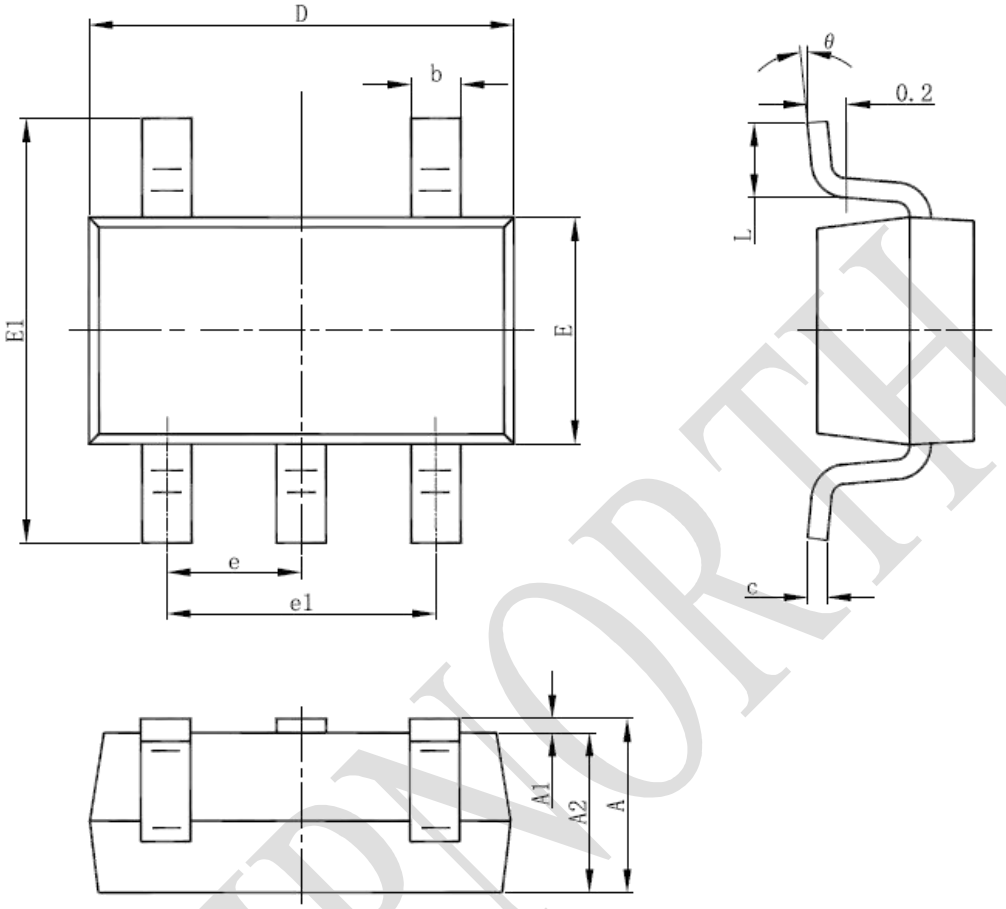
SOT-89-3L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	1.400	1.600	0.055	0.063
b	0.320	0.520	0.013	0.020
b1	0.400	0.580	0.016	0.023
c	0.350	0.440	0.014	0.017
D	4.400	4.600	0.173	0.181
D1	1.550 REF.		0.061 REF.	
D2	1.750 REF.		0.069 REF.	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
E2	1.900 REF.		0.075 REF.	
e	1.500 TYP.		0.060 TYP.	
e1	3.000 TYP.		0.118 TYP.	
L	0.900	1.200	0.035	0.047
θ	45°		45°	

■ PACKAGING INFORMATION(Continued):

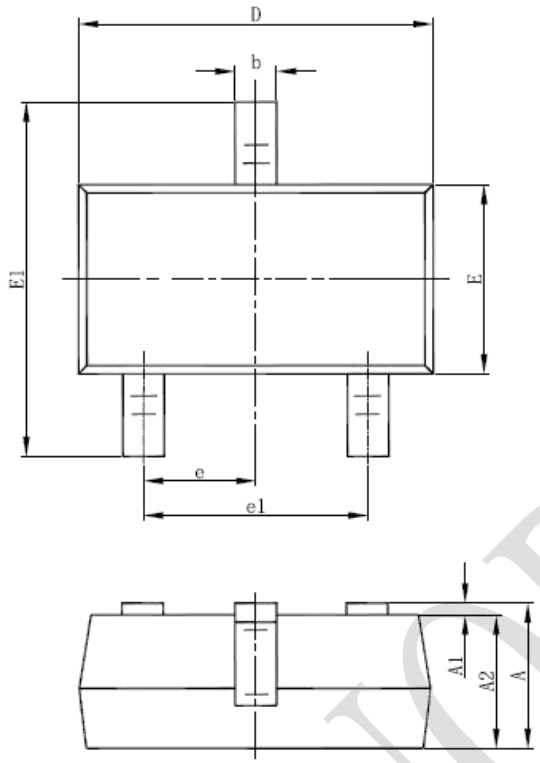
SOT-23-5L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

■ PACKAGING INFORMATION(Continued):

SOT-23-3L PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

■ ORDER INFORMATION:

date	Version	Revision notes	Reviser
2020.3.6	V1.0	Initial data compilation	ZhangSongfeng