



**Modify Record:**

| 版次         | 新版本 | 旧版本 | 修改单位 | 修改内容                 |
|------------|-----|-----|------|----------------------|
| 2019-06-01 | 1.0 | NA  | 研发部  | 新文件制成（因工程产品，故 RD 开头） |
| 2020-06-11 | 1.1 | 1.0 | 研发部  | 增加典型应用电路图            |
| 2020-06-24 | 1.2 | 1.1 | 研发部  | 增加 EMSOP8 封装         |
| 2020-07-31 | 1.3 | 1.2 | 研发部  | 增加应用信息，增加EN 耐压信息     |
| 2020-08-17 | 1.4 | 1.3 | 研发部  | 更新典型应用电路、增加PSRR      |
| 2020-09-28 | 1.5 | 1.4 | 研发部  | 增加SOP8脚位图            |
| 2020-11-06 | 1.6 | 1.5 | 研发部  | 增加T0252脚位图           |
| 2021-08-05 | 1.7 | 1.6 | 研发部  | 增加SOT89-3导电胶脚位图      |



## General Description (产品描述)

SE86XX series is designed for power-sensitive applications. It includes a precision and high voltage input stage, an ultra-low-power bias current branch, and results in a ultra-low-power and low-dropout linear regulator.

The SE86XX operates from an input voltage of  $V_{OUT}+1V$  to 65V, consumes only 1.8 $\mu$ A of quiescent current, and offers 1% initial accuracy and low dropout voltage, 70mV typical at 10mA.

SE86XX is a fixed output LDO with available has available voltages at 3.3V and 5.0V.

Although designed primarily as fixed voltage regulators, the device can be used with external resistors to obtain variable output voltages. The typical such application circuit, along with the needed calculations for accurate output voltages, are attached on the following page.

Other features include short-circuit protection and thermal shutdown.

## Features(产品特性)

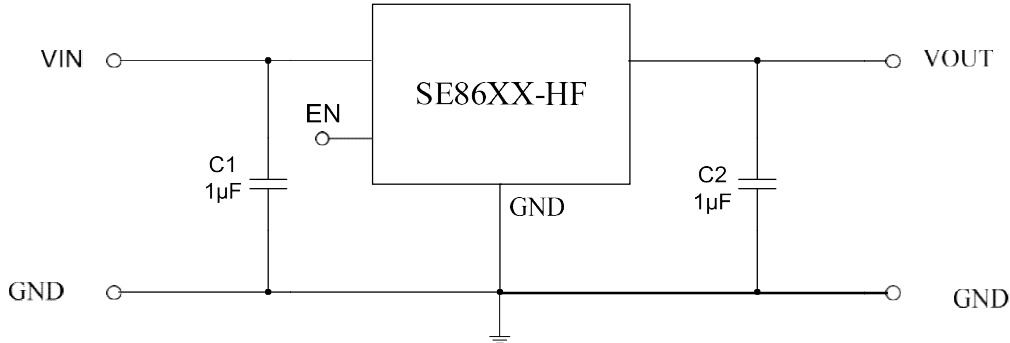
- Ultra Low Quiescent Current: 1.8uA(Typ.)
- Wide Operating Voltage:  $V_{OUT}+1V$  to 65V (max  $V_{in}$  can be up to 80V)
- High output current:  $\geq 200mA$
- System startup with no overshoot
- Short circuit protection is designed with no overshoot
- Low Dropout Voltages:
  - 70mV@10mA
  - 700mV@100mA
- High Accuracy Output Voltage:  $\pm 2\%$ 
  - Accuracy can be 1% for special orders
- Excellent power / load transient response
- Low temperature coefficient:  $\pm 100ppm/^{\circ}C$
- Thermal and Short-Circuit Protection
- With EN pin
- Available Packages: SOT23-3, SOT23-5, SOT89, EMSOP8, SOP8, TO252

## Applications(产品应用)

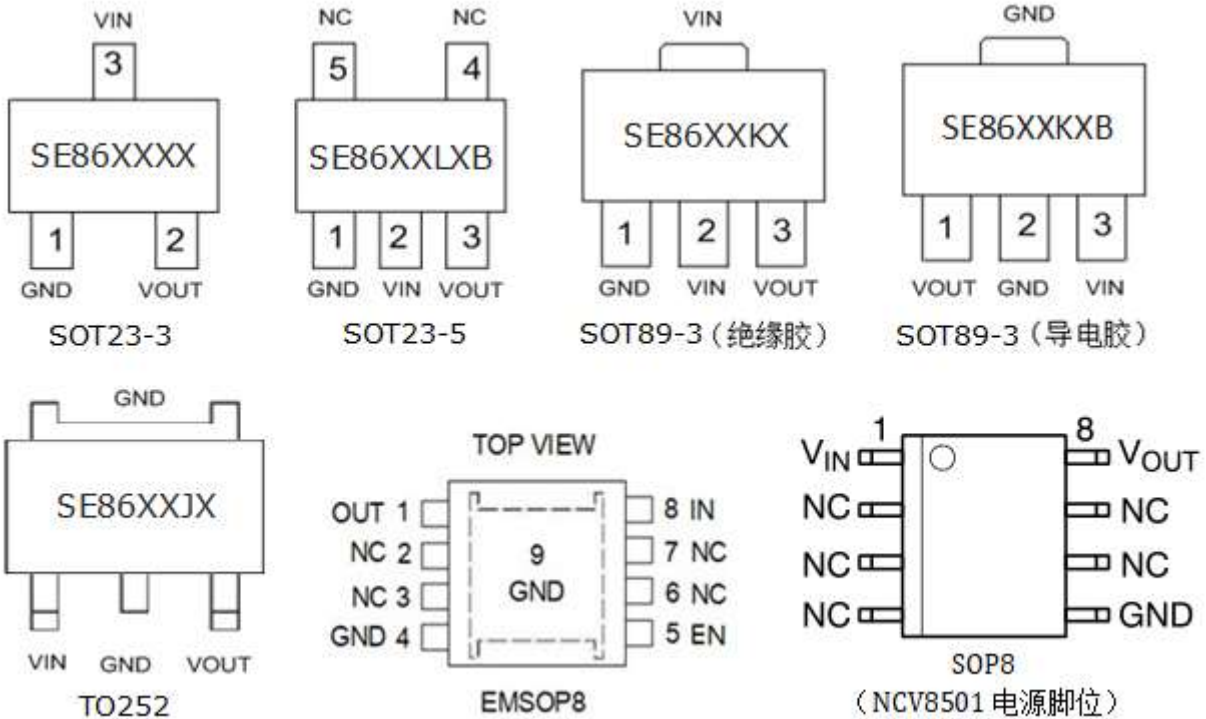
- Battery-powered equipment
- Smoke detector and sensor
- Microcontroller Applications
- Smart electric meter



### Typical Application (典型应用电路)



### Pin Configuration (管脚排列)



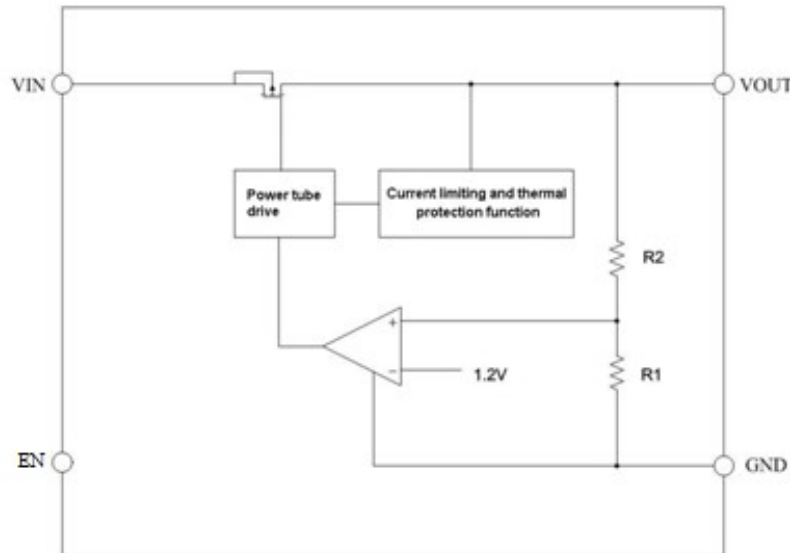
注：芯片上对应的标识为成品名称，只作为下单参考。

### Pin Description (管脚功能描述)

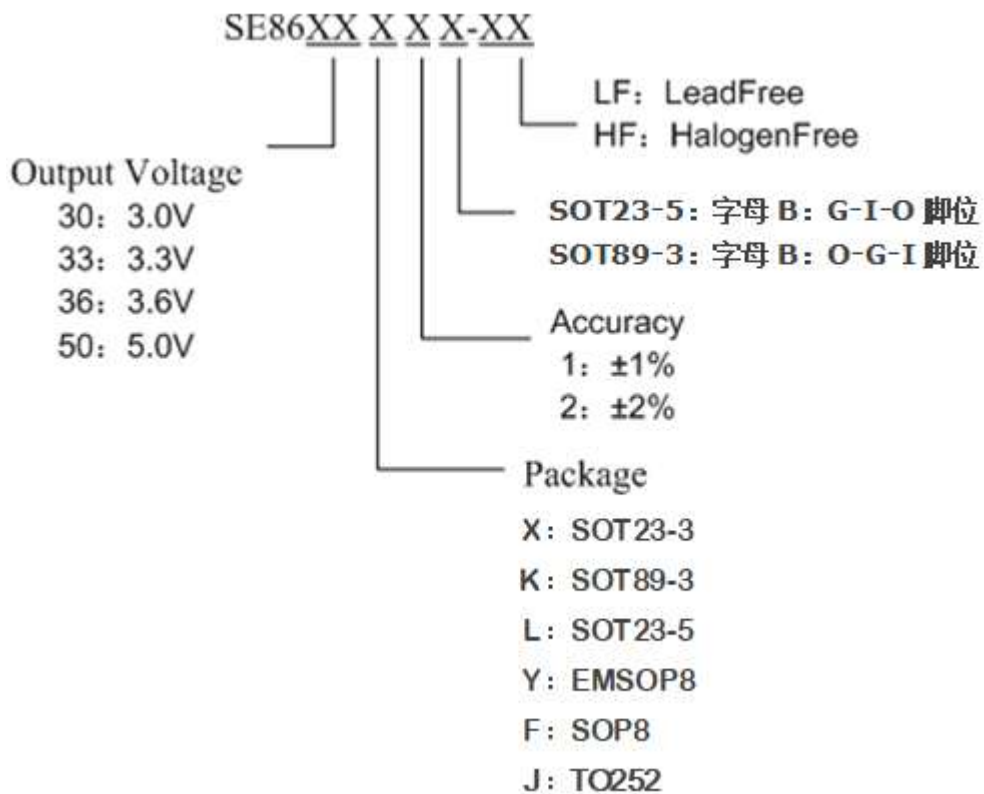
| Pin Name | Pin Function Description |
|----------|--------------------------|
| VIN      | In put pin               |
| VOUT     | Out put pin              |
| GND      | Ground pin               |
| EN       | Enable pin               |
| NC       | No connection            |



### Functional Block Diagram (功能框图)



### Ordering Information (订货信息)





**Absolute Maximum Ratings(最大额定参数)**

| Symbol                               | Parameter                               | Value        | Units |
|--------------------------------------|---|--------------|-------|
| V <sub>IN</sub>                      | Input Supply Voltage                    | 80           | V     |
| EN                                   | Enable Voltage                          | 80           |       |
| V <sub>OUT</sub> --- GND             | Output Voltage TO GND                   | 6            |       |
| V <sub>out</sub> ----V <sub>IN</sub> | Output Voltage TO V <sub>IN</sub>       | -75          |       |
| T <sub>A</sub>                       | Operating Temperature                   | -40---105    | °C    |
| T <sub>STG</sub>                     | Storage Temperature                     | -40---150    |       |
| T <sub>J</sub>                       | Maximum Junction Temperature            | 150          |       |
| T <sub>LEAD</sub>                    | Lead Temperature (Soldering) 10 seconds | 260          |       |
| θ <sub>JA</sub>                      | Thermal Resistance, Junction-to-Ambient | 165(SOT89)   | °C/W  |
|                                      |   | 280(SOT23-3) |       |
|                                      |   | 270(SOT23-5) |       |
|                                      |   | 180(SOP8)    |       |
|                                      |   | 85(TO252)    |       |
| P <sub>D</sub>                       | Power Consumption                       | 750(SOT89)   | mW    |
|                                      |   | 446(SOT23-3) |       |
|                                      |   | 465(SOT23-5) |       |
|                                      |   | 700(SOP8)    |       |
|                                      |   | 1300(TO252)  |       |
| Electrostatic discharge rating       | Human Body Model (HBM)                  | 4            | kV    |
|                                      | Charged Device Model (MM)               | 100          | V     |

Note : Stresses exceeding the range specified under “Absolute Maximum Ratings” may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

**Recommended Operating Conditions(推荐工作条件)**

| Symbol            | Parameter                               | Maximum  | Units |
|-------------------|---|----------|-------|
| V <sub>IN</sub>   | Input Supply Voltage                    | 60       | V     |
| T <sub>A</sub>    | Operating Temperature                   | -20---85 | °C    |
| T <sub>LEAD</sub> | Lead Temperature (Soldering) 10 seconds | 260      | °C    |



## Electrical Characteristics(电气参数)

( TA=25° C, CIN=1uF, VIN=VOUT+1.0V, COUT=10uF, unless otherwise noted )

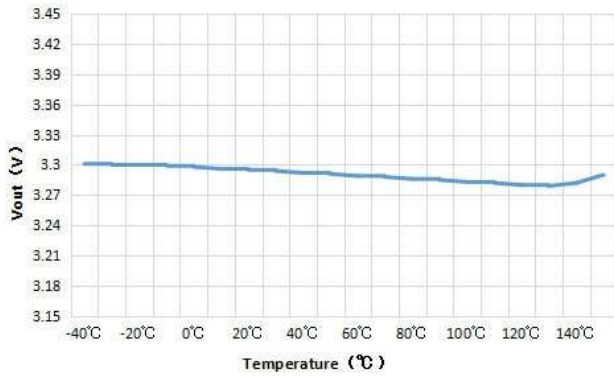
| Symbol             | Parameter                              | Conditions   | Min | Typ | Max | Unit   |
|--------------------|--|--|-----|-----|-----|--------|
| V <sub>IN</sub>    | Input Supply Voltage                   |  | 2.8 |     | 60  | V      |
| V <sub>OUT</sub>   | Output Voltage Accuracy                | I <sub>OUT</sub> =10mA   | -1% |     | 1%  | V      |
|                    |  |  | -2% |     | 2%  | V      |
| I <sub>Q</sub>     | Quiescent Current                      | V <sub>IN</sub> =6V~60V  |     | 1.8 | 4   | μA     |
| I <sub>OUT</sub>   | Output Current                         |  |     | 200 |     | mA     |
| V <sub>DROP</sub>  | Dropout Voltage                        | I <sub>OUT</sub> =10mA<br>ΔV <sub>OUT</sub> = - V <sub>OUT</sub> *2%               |     | 70  |     | mV     |
|                    |  | I <sub>OUT</sub> =100mA<br>ΔV <sub>OUT</sub> = - V <sub>OUT</sub> *2%              |     | 700 |     | mV     |
| V <sub>LR</sub>    | Load Regulation                        | 1mA ≤ I <sub>OUT</sub> ≤ 100mA   |     | 20  |     | mV     |
| V <sub>SR</sub>    | Line Regulation                        | I <sub>OUT</sub> =1mA,<br>V <sub>IN</sub> =(V <sub>OUT</sub> +1V) to 60V           |     | 0.2 |     | %/V    |
| PSRR               | Power Supply Rejection Ratio           | V <sub>in</sub> =12V ,<br>I <sub>out</sub> =10mA<br>F=1KHz, V <sub>out</sub> =3.3V | —   | 70  | —   | dB     |
| V <sub>ENH</sub>   | Enable High Level                      | Enabled  | 1   | —   | —   | V      |
| V <sub>ENL</sub>   | Enable Low Level                       | Disabled   |     | —   | 0.4 | V      |
| I <sub>EN</sub>    | EN Current                             | EN=0~V <sub>IN</sub> (R <sub>EN</sub> =100K)                                       |     | 1   |     | μA     |
| I <sub>LIMIT</sub> | Current Limit                          |  |     | 250 |     | mA     |
| T <sub>SHDN</sub>  | Thermal Protection                     |  |     | 150 |     | °C     |
| TC <sub>VOUT</sub> | Output Voltage Temperature Coefficient | I <sub>OUT</sub> =10mA<br>-40°C ≤ T <sub>AMB</sub> ≤ 100°C                         |     | -17 |     | ppm/°C |



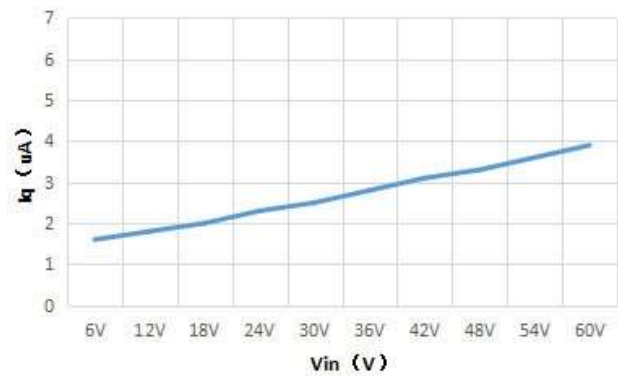
### Typical Performance Characteristics(典型性能特性)

( TA=25° C, CIN=1uF, VIN=VOUT (3.3V) +1.0V, COUT=10uF, unless otherwise noted )

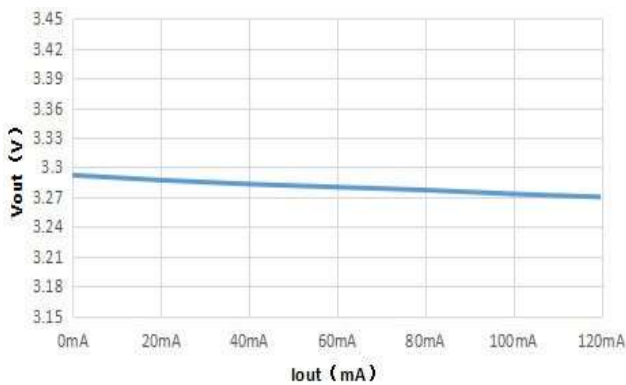
Output Voltage vs Temperature



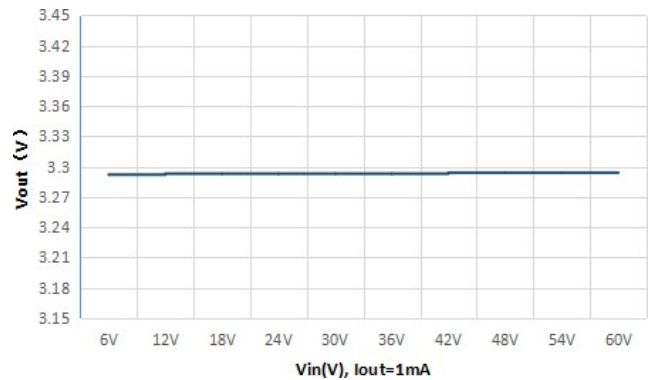
Quiescent current vs Input Voltage



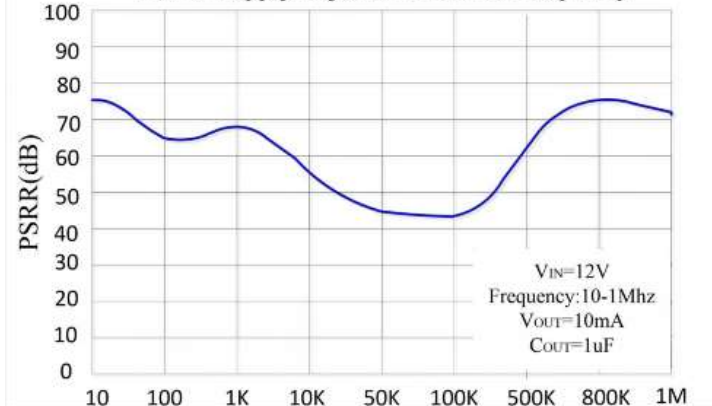
Load Regulation (Vin=30V)



Line Regulation

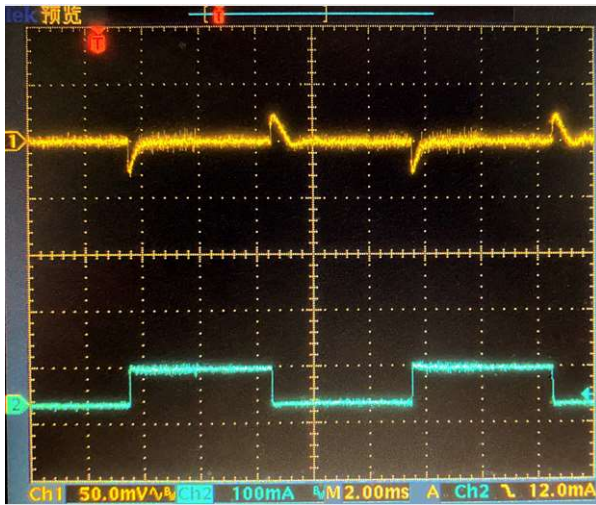


Power-Supply Rejection Ratio vs. Frequency

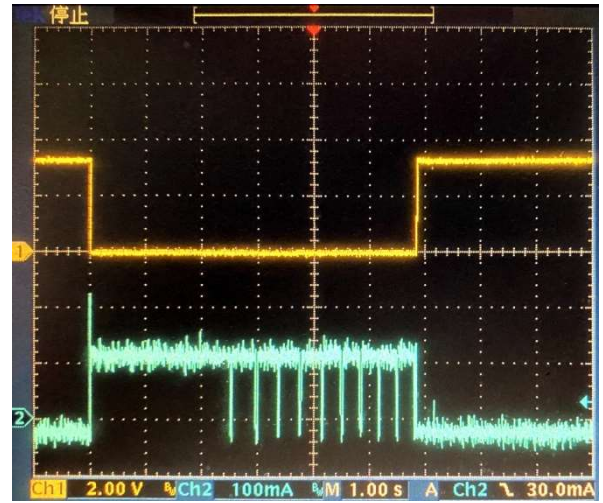




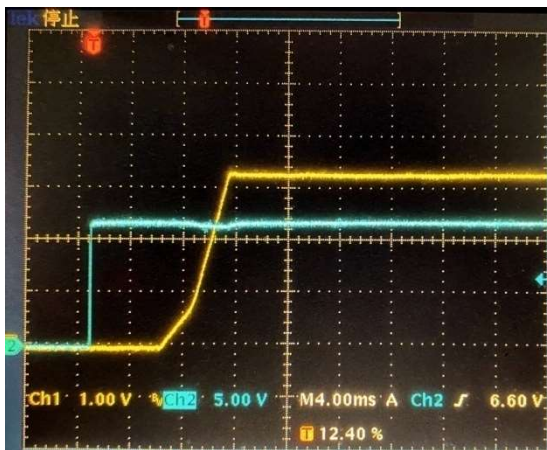
Load Transient ( $V_{in}=12V$ )  
10mA~100mA



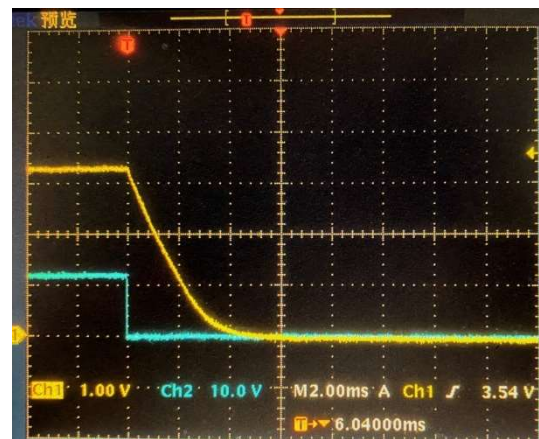
Short-Circuit and OTP ( $V_{in}=24V$ )



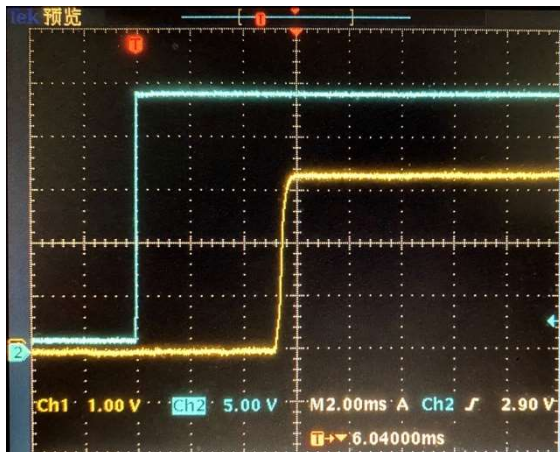
EN OFF  $\rightarrow$  ON



EN ON  $\rightarrow$  OFF (No Load)  
Discharge



VCC Power ON





## APPLICATION INFORMATION

### INPUT CAPACITOR

An input ceramic capacitor of 1 $\mu$ F is required between the VIN and GND pin. The capacitor shall be placed as close as possible to VIN pin, and the wide copper trace is also recommended.

### OUTPUT CAPACITOR

The recommended is 10 $\mu$ F ceramic capacitor. The minimum capacitance for stable and correct operation is 1 $\mu$ F. The higher the value of this output capacitor, the lower the ripple during the operations. The output capacitor should be placed as close to the Output Pin as possible. The wide copper trace is recommended.

### NO-LOAD STABILITY

The SE86XX will remain stable and in regulation with no external load.

### FOLD-BACK SHORT-CIRCUIT PROTECTION

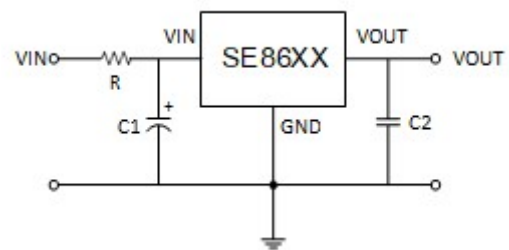
When short-circuit occurs, SE86XX will fold back the short-circuit currents to a pre-determined lower level, This will reduce excessive heat in otherwise large current conditions. This feature provides another level of protection to IC itself and also the whole system.

### EN Functions

EN is Hi-Z internally. EN must be connected to either to Vcc (through a resistor) or GND externally, if SOT23-5 package is used. If left floating, the Vout is unknown.

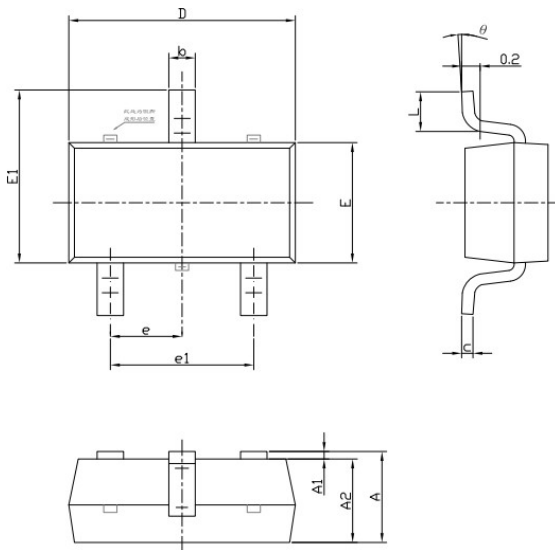
### IN-RUSH CURRENT AND VOLTAGE

The following figure shows a typical application circuit for the SE86XX devices. Please keep in mind that in-rush current can push up the Vin overshoot by as much as 50%. For example, when Vin=50V, the in-rush caused spike voltage can be as high as 75V. Therefore the voltage rating of Cin needs to be higher than 50% of the application.

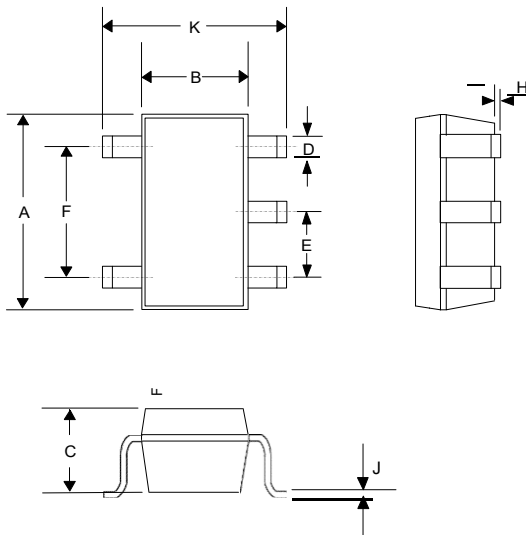


In live insertion application, it is suggested that R, C1 are selected as following:

1. C1=10 $\mu$ F ~ 100 $\mu$ F ceramic or electrolytic capacitor with maximum voltage greater than 80V, R=0
2. If the average current is known, for example at 10mA, then for an input voltage of 55V, the C1=1 $\mu$ F ~ 10 $\mu$ F ceramic or electrolytic with maximum voltage greater than 80V and R=2K $\Omega$  in the type of 1206 at 1/4W rating can be selected.

**Outline Drawing for SOT-23-3**


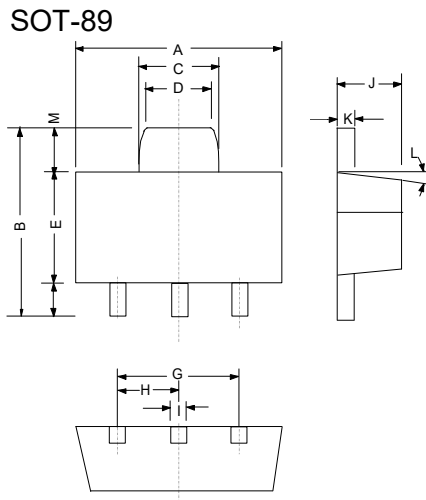
| Symbol   | Dimensions In Millimeters |       | Dimensions In Inches |       |
|----------|---------------------------|-------|----------------------|-------|
|          | Min                       | Max   | Min                  | Max   |
| A        | 1.050                     | 1.250 | 0.041                | 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 |
| $\theta$ | 0°                        | 8°    | 0°                   | 8°    |

**Outline Drawing for SOT-23-5**


| DIMENSIONS       |        |       |       |      |
|------------------|--------|-------|-------|------|
| DIM <sup>N</sup> | INCHES |       | MM    |      |
|                  | MIN    | MAX   | MIN   | MAX  |
| A                | 0.110  | 0.120 | 2.80  | 3.05 |
| B                | 0.059  | 0.070 | 1.50  | 1.75 |
| C                | 0.036  | 0.051 | 0.90  | 1.30 |
| D                | 0.014  | 0.020 | 0.35  | 0.50 |
| E                | -      | 0.037 | -     | 0.95 |
| F                | -      | 0.075 | -     | 1.90 |
| H                | -      | 0.006 | -     | 0.15 |
| J                | 0.0035 | 0.008 | 0.090 | 0.20 |
| K                | 0.102  | 0.118 | 2.60  | 3.00 |

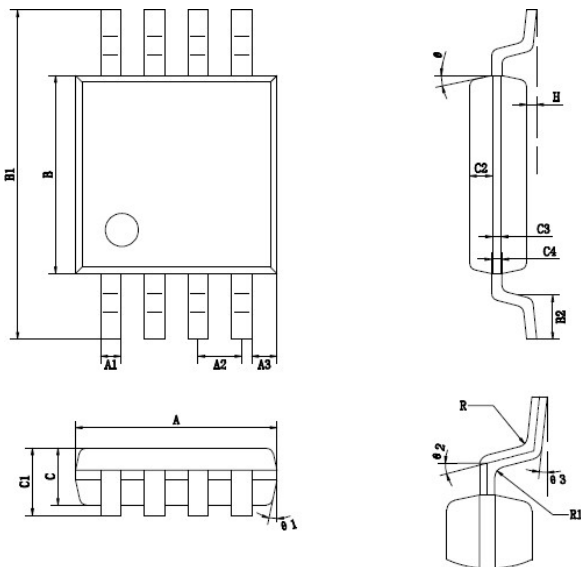


Outline Drawing for SOT-89



| DIMENSIONS       |          |       |          |       |
|------------------|----------|-------|----------|-------|
| DIM <sup>N</sup> | INCHES   |       | M M      |       |
|                  | MIN      | MAX   | MIN      | MAX   |
| A                | 0.173    | 0.181 | 4.400    | 4.600 |
| B                | 0.159    | 0.167 | 4.050    | 4.250 |
| C                | 0.067    | 0.075 | 1.700    | 1.900 |
| D                | 0.051    | 0.059 | 1.300    | 1.500 |
| E                | 0.094    | 0.102 | 2.400    | 2.600 |
| F                | 0.035    | 0.047 | 0.890    | 1.200 |
| G                | 0.118REF |       | 3.00 REF |       |
| H                | 0.059REF |       | 1.50 REF |       |
| I                | 0.016    | 0.020 | 0.400    | 0.520 |
| J                | 0.055    | 0.063 | 1.400    | 1.600 |
| K                | 0.014    | 0.016 | 0.350    | 0.410 |
| L                | 10 °TYP  |       | 10 °TYP  |       |
| M                | 0.028REF |       | 0.70 REF |       |

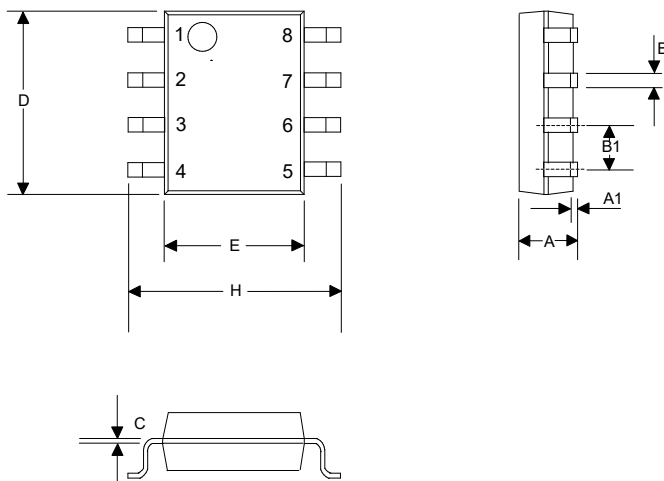
Outline Drawing for EMSOP8



| 标注 | 尺寸 | 最小(mm)   | 最大(mm) | 标注 | 尺寸 | 最小(mm)   | 最大(mm) |
|----|----|----------|--------|----|----|----------|--------|
| A  |    | 2.90     | 3.10   | C3 |    | 0.152    |        |
| A1 |    | 0.30TYP  |        | C4 |    | 0.172    |        |
| A2 |    | 0.65TYP  |        | H  |    | 0.02     | 0.15   |
| A3 |    | 0.375TYP |        | θ  |    | 12° TYP4 |        |
| B  |    | 2.90     | 3.10   | θ1 |    | 12° TYP4 |        |
| B1 |    | 4.70     | 5.10   | θ2 |    | 14° TYP  |        |
| B2 |    | 0.50     | 0.70   | θ3 |    | 0° ~ 6°  |        |
| C  |    | 0.75     | 0.95   | R  |    | 0.15TYP  |        |
| C1 |    | --       | 1.10   | R1 |    | 0.15TYP  |        |
| C2 |    | 0.37     |        |    |    |          |        |

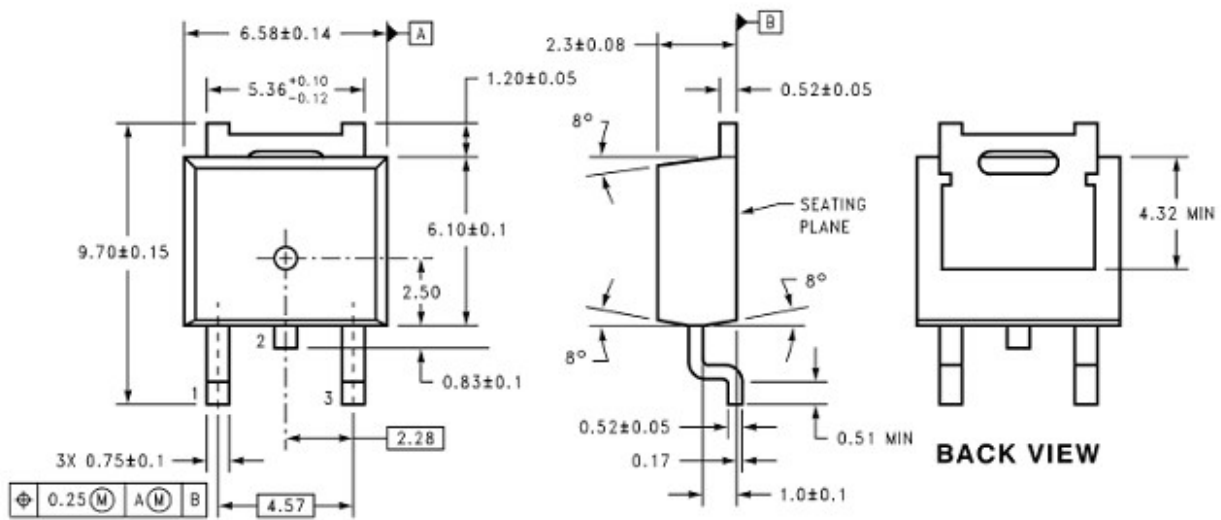


**Outline Drawing for SOP8**



| DIMENSIONS       |           |        |          |      |
|------------------|-----------|--------|----------|------|
| DIM <sup>N</sup> | INCHES    |        | MM       |      |
|                  | MIN       | MAX    | MIN      | MAX  |
| A                | 0.0532    | 0.0688 | 1.35     | 1.75 |
| A1               | 0.0040    | 0.0098 | 0.10     | 0.25 |
| B                | 0.0130    | 0.0200 | 0.33     | 0.51 |
| B1               | 0.050 BSC |        | 1.27 BSC |      |
| C                | 0.0075    | 0.0098 | 0.19     | 0.25 |
| D                | 0.1890    | 0.1968 | 4.80     | 5.00 |
| H                | 0.2284    | 0.2440 | 5.80     | 6.20 |
| E                | 0.1497    | 0.1574 | 3.80     | 4.00 |

**Outline Drawing for TO252**



**DIMENSIONS ARE IN MILLIMETERS**

**3-Lead TO-252 Package**



SEAWARD  
ELECTRONICS

**SE86XX**

80V/2uA,Ultra Low Quiescent Current LDO

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