

High Voltage, Low Power LDO

DESCRIPTION

The SUM3574 is a high voltage, low power consumption and high performance LDO. The family uses an advanced CMOS process and a PMOSFET pass device to achieve fast start-up, with high output voltage accuracy. The SUM3574 is stable with a 1.0 μF ~ 10 μF ceramic output capacitor, and uses a precision voltage reference and feedback loop to achieve a worst-case accuracy of 2% over all load, line, process and temperature variations.

FEATURES

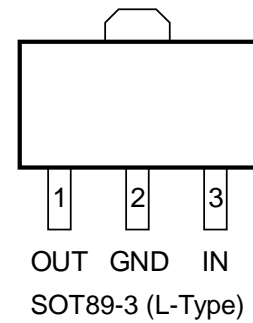
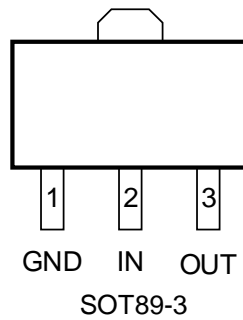
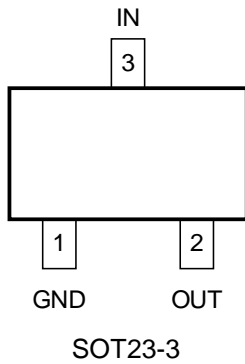
- Wide Input Voltage Range: up to 40 V
- Output Current: 150 mA
- Standard Fixed Output Voltage Options: 2.5 V, 2.7 V, 3.0 V, 3.3 V, 3.6 V, 4.0 V, 4.4 V and 5.0 V
- Other Output Voltage Options Available on Request
- Low I_Q : 2 μA
- Low Dropout Voltage
- Short current protection
- Excellent Load/Line Transient Response
- Package: SOT23-3, SOT89-3, SOT89-3 (L-Type)

ORDER INFORMATION

Model	Package	Ordering Number	Packing Option
SUM3574	SOT23-3	SUM3574-XXKA3	Tape and Reel, 3000
	SOT89-3	SUM3574-XXP	Tape and Reel, 1000
	SOT89-3 (L-Type)	SUM3574-XXPL	Tape and Reel, 1000

*XX: When expressed as 33, the output voltage is 3.3 V; when expressed as 50 the output voltage is 5.0 V.

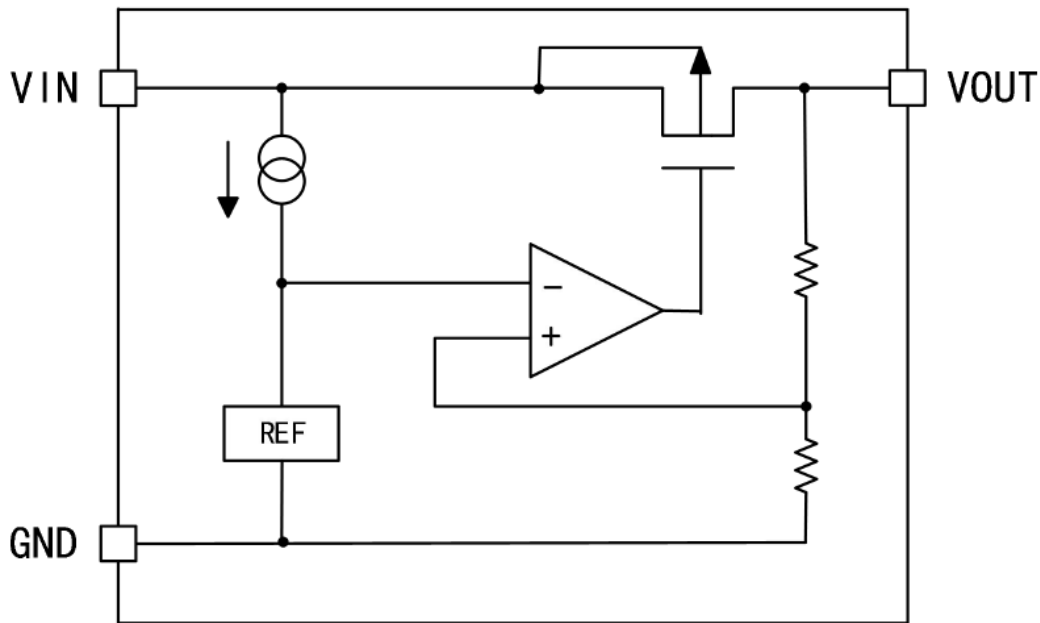
PIN CONFIGURATION (Top View)



PIN DESCRIPTIONS

Pin			Symbol	Description
SOT23-3	SOT89-3	SOT89-3 (L-Type)		
2	3	1	OUT	Output pin.
1	1	2	GND	Ground.
3	2	3	IN	Supply input pin.

BLOCK DIAGRAM



FUNCTIONAL DESCRIPTION

Input Capacitor

A 1 μF ~ 10 μF ceramic capacitor is recommended to connect between V_{IN} and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both V_{IN} and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1 μF to 10 μF , Equivalent Series Resistance (ESR) is from 5 m Ω to 100 m Ω , and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to OUT and GND pins.

Low Quiescent Current

The SUM3574, consuming only around 2 μA for all input range and output loading, provides great power saving in portable and low power applications.

Short Current Limit Protection

When output current at the OUT pin is higher than current limit threshold or the OUT pin is short-circuit to GND, the short current limit protection will be triggered and clamp the output current to approximately 20 mA to prevent over-current and to protect the regulator from damage due to overheating.

ABSOLUTE MAXIMUM RATINGS⁽²⁾

Parameter	Rating		Unit
IN pin to GND pin	-0.3 to 50		V
Maximum Output Current	180		mA
Thermal Resistance (Junction to Ambient) ⁽¹⁾	SOT23-3	360	°C/W
	SOT89-3	135	
Junction Temperature	150		°C
Storage Temperature	-65 to 150		°C
Lead Temperature (Soldering, 10 sec)	300		°C
ESD (HBM mode)	±3000		V

NOTE:

(1) This particular frame decreases the total thermal resistance of the package and increases its ability to dissipate power when an appropriate area of copper on the printed circuit board is available for heat-sinking.

(2) Stresses beyond those listed under “ABSOLUTE MAXIMUM RATINGS” may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING CONDITIONS

Parameter	Rating	Unit
Operation Temperature range	-40 to 85	°C

CAUTION

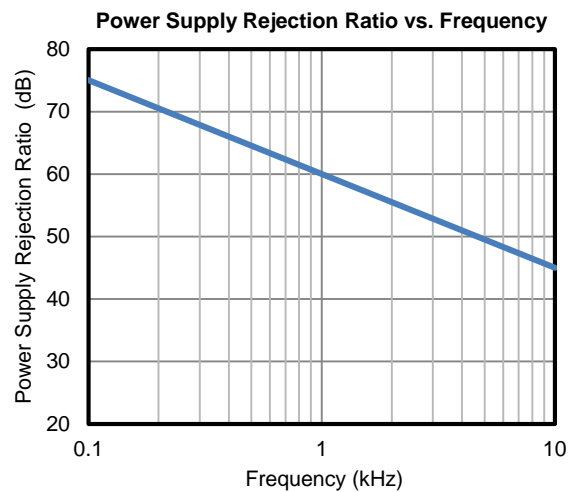
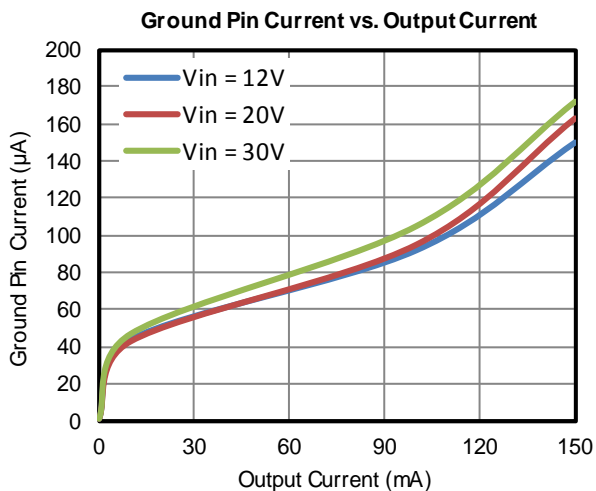
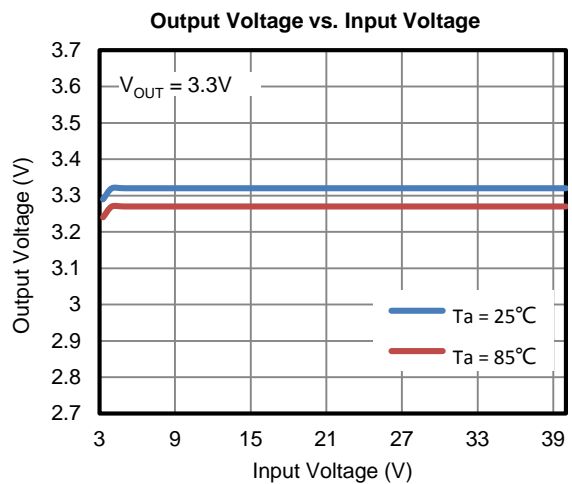
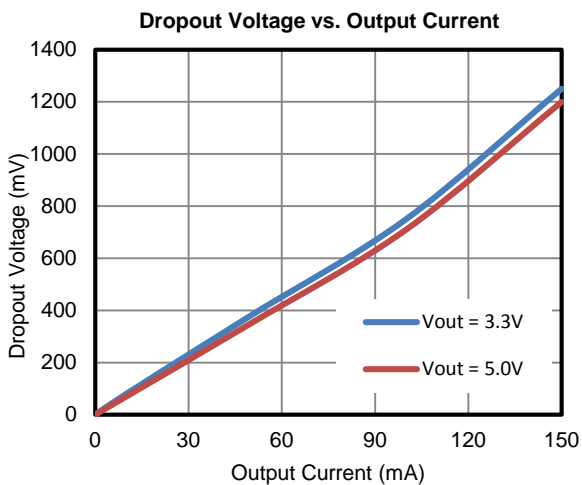
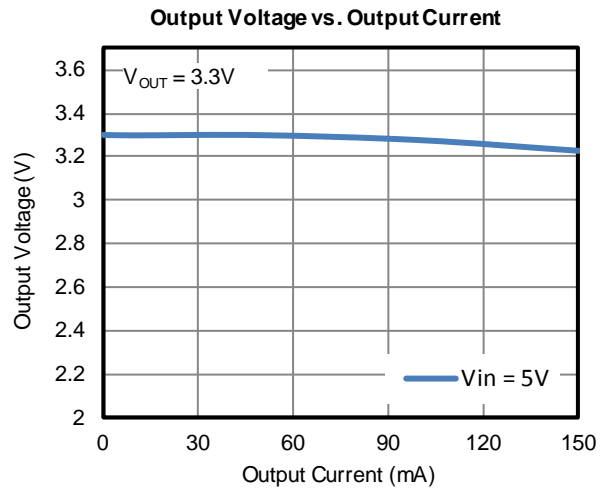
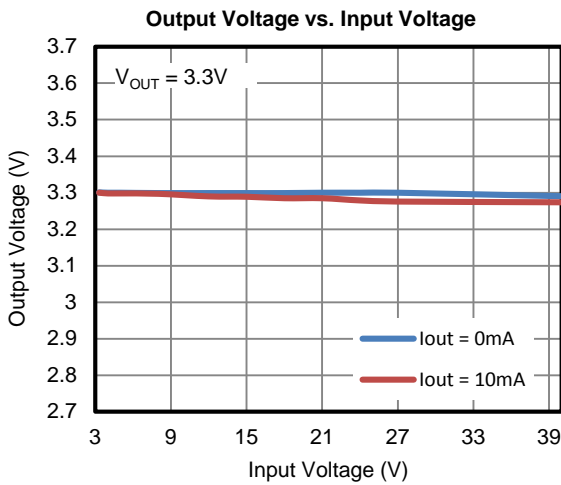
This integrated circuit can be damaged by ESD if you don't pay attention to ESD protection. SUMSEMI recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage. ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications. SUMSEMI reserves the right to make any change in circuit design, specification or other related things if necessary without notice at any time. Please contact SUMSEMI sales office to get the latest datasheet.

ELECTRICAL CHARACTERISTICS

T_A = 25°C, unless otherwise noted.

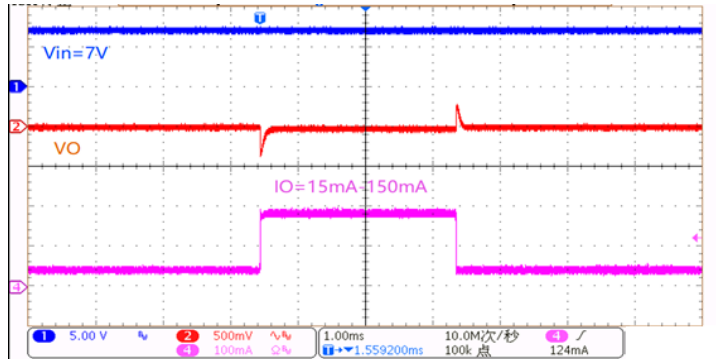
Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Operation Range	V _{IN}	I _{SS} = 5 μA			40	V
Regulated Output Voltage	V _{OUT}	I _{OUT} = 10 mA, V _{IN} = V _{OUT} + 2 V	V _{OUT} × 0.98		V _{OUT} × 1.02	V
Output Current	I _{OUT}	V _{IN} = V _{OUT} + 2 V		150		mA
Dropout Voltage	V _{DROP}	I _{OUT} = 50 mA, V _{OUT} = 3.3 V Δ V _{OUT} = ±2%*V _{OUT}	320	390	450	mV
		I _{OUT} = 100 mA, V _{OUT} = 3.3 V Δ V _{OUT} = ±2%*V _{OUT}	600	750	900	
Output Voltage Line Regulation	Δ V _{OUT}	V _{OUT} + 2 V ≤ V _{IN} ≤ 40 V, I _{OUT} = 5 mA	-30		30	mV
Output Voltage Load Regulation	Δ V _{OUT}	V _{IN} = V _{OUT} + 2 V , I _{OUT} from 1 mA to 100 mA	-50		50	mV
Power Supply Rejection Ratio	PSRR	I _{OUT} = 10 mA	f = 100 Hz		75	dB
			f = 1 kHz		60	
			f = 10 kHz		45	
DC Supply Quiescent Current	I _Q	V _{IN} = V _{OUT} + 2 V		2	5	μA
Short Current	I _{SHORT}	V _{OUT} = GND		15		mA
Temperature Coefficient	$\frac{\Delta V_{OUT}}{(\Delta T_A * V_{OUT})}$	V _{IN} = V _{OUT} + 1 V, I _{OUT} = 10 mA, -40°C ≤ T _A ≤ 85°C		±50	±100	ppm/°C

TYPICAL PERFORMANCE CHARACTERISTIC



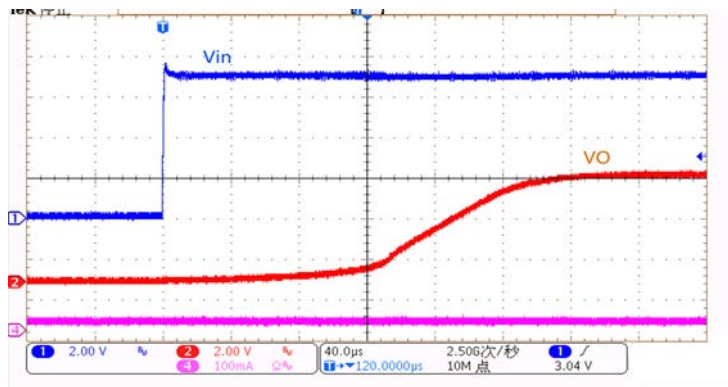
TYPICAL PERFORMANCE CHARACTERISTIC

Load-Transient Response



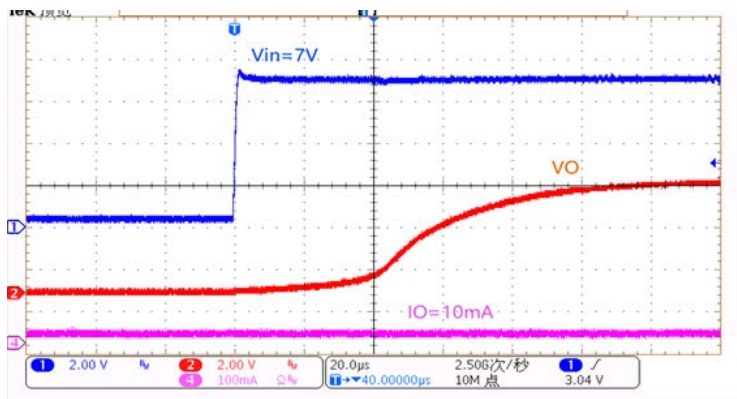
$V_{IN} = 7V, C_{IN} = 1\mu F, C_{OUT} = 1\mu F$

Start up



$V_{IN} = 7V, C_{IN} = 1\mu F, C_{OUT} = 1\mu F, \text{Load} = \text{NA}$

Start up



$V_{IN} = 7V, C_{IN} = 1\mu F, C_{OUT} = 1\mu F, \text{Load} = 10\text{mA}$

APPLICATION

This series of chips are three terminal low dropout linear regulators. The following application points must be strictly followed for correct operation.

External Circuit

Input and output pins must be connected to external capacitors. For the input pin, especially when high impedance is generated by battery power supply, a suitable bypass capacitor must be connected, it is recommended that the input capacitance value be at least 1 μF , it is also a ceramic capacitor to achieve better temperature coefficient and lower ESR (equivalent series resistance). As shown in the application circuit, for the output pin, especially when the load has transient performance, the appropriate capacitor must be connected, the output capacitor plays an important role in maintaining the stability of the output voltage. For ceramic capacitors, the capacitance value shall be at least 1 μF . Selecting a larger capacitance can limit the transient voltage output.

Thermal Considerations

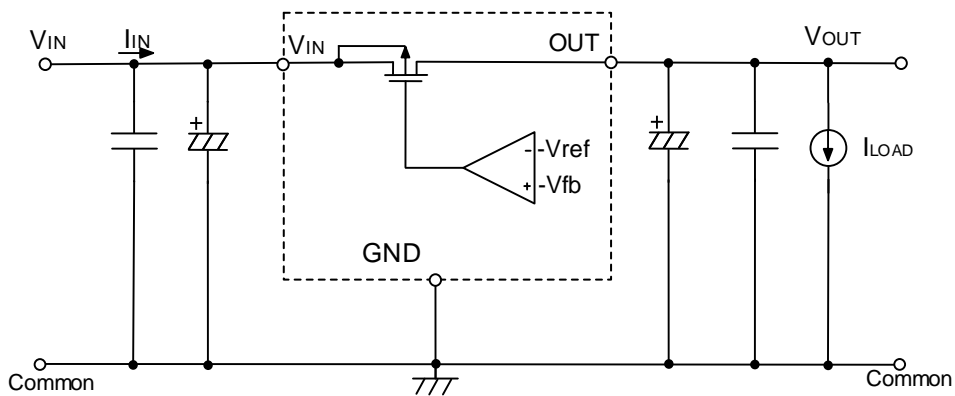
The maximum power consumption of the chip depends on the thermal resistance of the IC package, PCB layout, ambient air velocity and the temperature difference between the node and the ambient temperature. The maximum power consumption can be calculated by the following formula: $PD_{(\max)} = (T_{J(\max)} - T_A) / \theta_{JA}$ where $T_{J(\max)}$ is the maximum node temperature, T_A is the ambient temperature, and θ_{JA} is the node to ambient thermal resistance per watt degree in IC package. The following table shows the value of various package types θ_{JA} .

PACKAGE	θ_{JA} ($^{\circ}\text{C}/\text{W}$)
SOT23-3	360 $^{\circ}\text{C}/\text{W}$
SOT89-3	135 $^{\circ}\text{C}/\text{W}$

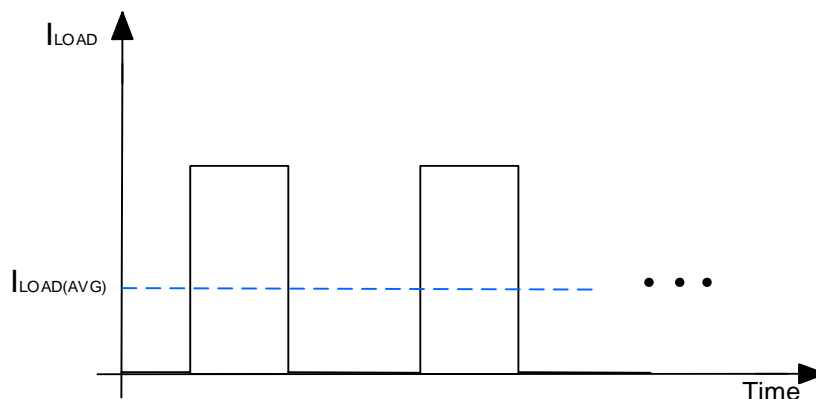
In the working limit parameters, the maximum junction temperature is 150 $^{\circ}\text{C}$. Nevertheless, it is recommended that the maximum junction temperature during normal operation should not exceed 125 $^{\circ}\text{C}$ to ensure its reliability.

Power Consumption Calculation

In order to make the chip work within the limit range and maintain a stable output voltage, the power consumption PD of the chip must not exceed the maximum. High power consumption $PD_{(\max)}$, i.e. $PD \leq PD_{(\max)}$. As can be seen from the belowing figure, almost all power is generated through transistors, which is equivalent to connecting a variable resistor in series with the load to keep the output voltage constant. The power generated here is expressed as heat energy. It must be ensured that the chip cannot exceed the maximum node temperature.



Due to the transient performance of load, the regulator is required to provide steady-state and transient current in practical application. Although this series of chips operate within the limit range and work well under its steady-state current, we must pay attention to the transient load that may cause the current to rise close to the limit parameters, which will also lead to the increase of chip node temperature. The mean value of the current in the chip and the current generated in the transient state should be considered, more precisely, the RMS value of the current in the chip. The following figure shows the average current associated with the transient current.



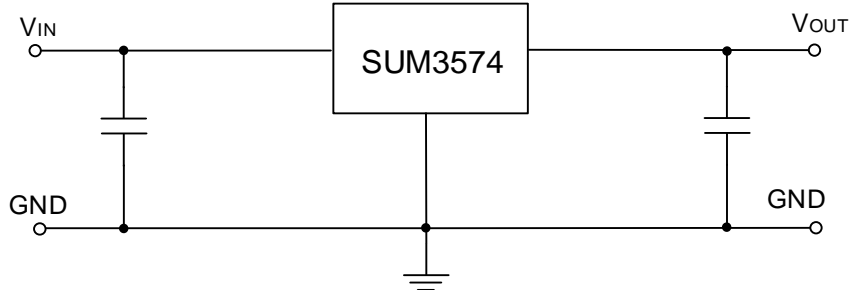
Because the transient current of the chip is very small and can generally be ignored, assuming that the input current is equal to the output current, the power consumption PD of the chip can be calculated as the voltage difference between the input voltage and the output voltage multiplied by the current, and the formula $PD = (V_{IN} - V_{OUT}) \times I_{IN}$, Because the input current is also equal to the load current, the formula $PD = (V_{IN} - V_{OUT}) \times I_{LOAD}$, but due to the existence of transient load current, the power consumption PD should be $PD = (V_{IN} - V_{OUT}) \times I_{LOAD(AVG)}$.

Current Protection Function

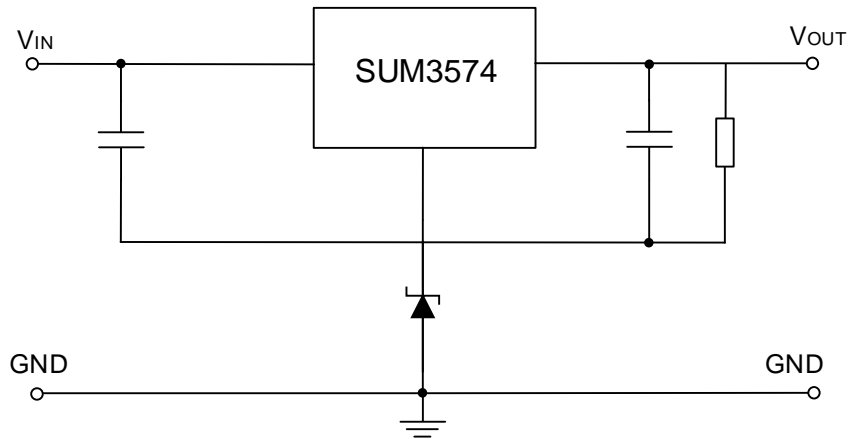
SUM3574 realizes the short-circuit protection function. If the output voltage is lower than 0.7 V, the short-circuit protection function will take effect, and the SCP current is set to 15 mA. Once the output voltage is greater than 0.7 V, the over-current protection function will be closed. Even if the output is short circuited and grounded, IC damage can be prevented. When the output is short circuited to ground, the output current will be clamped to I_{sc} .

APPLICATION CIRCUITS

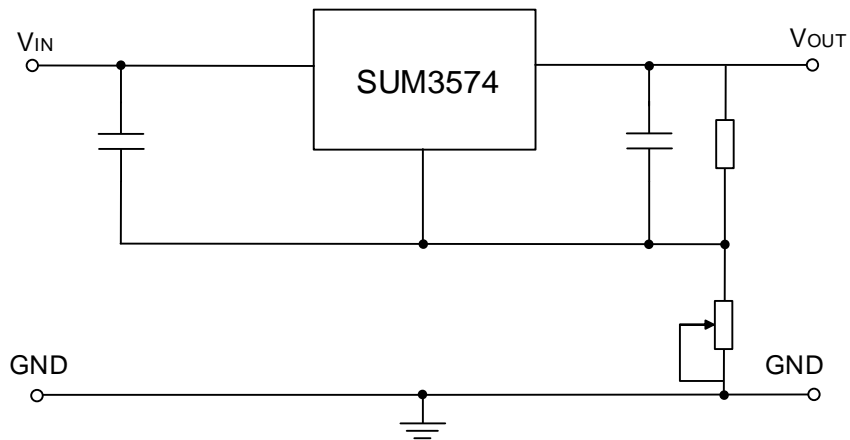
Basic Application Circuit



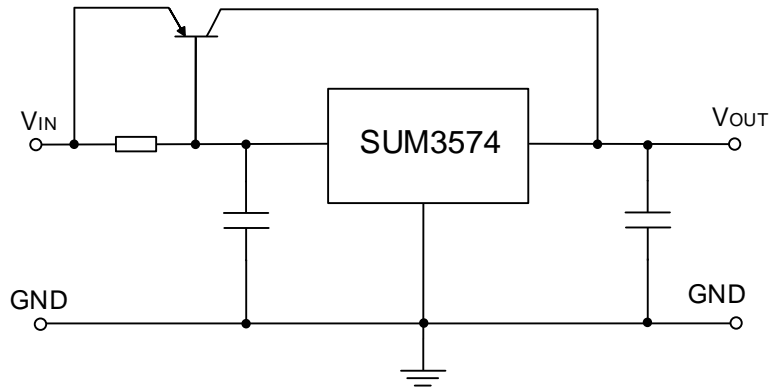
Extended Output Voltage Application Circuit



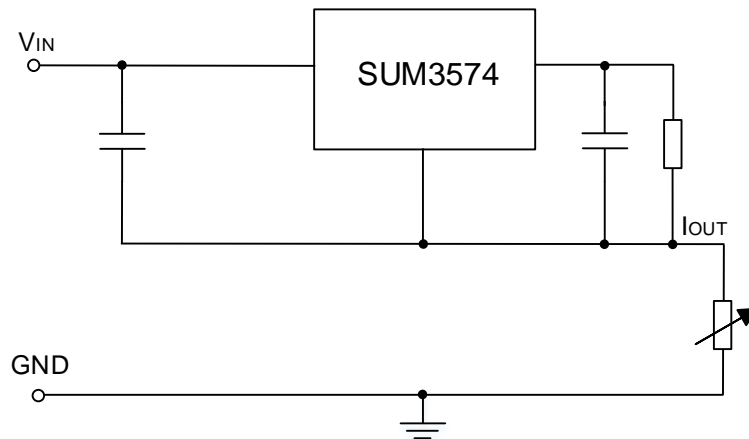
Extended Output Voltage Application Circuit 2



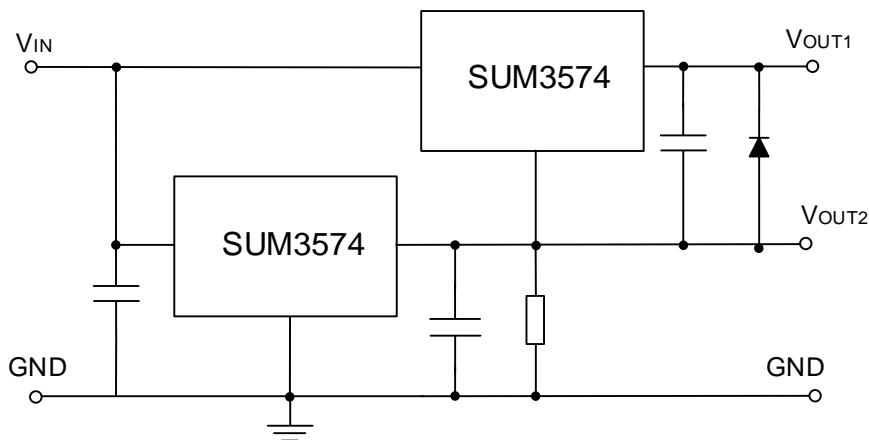
High Output Current Positive Voltage Stabilizing Application Circuit

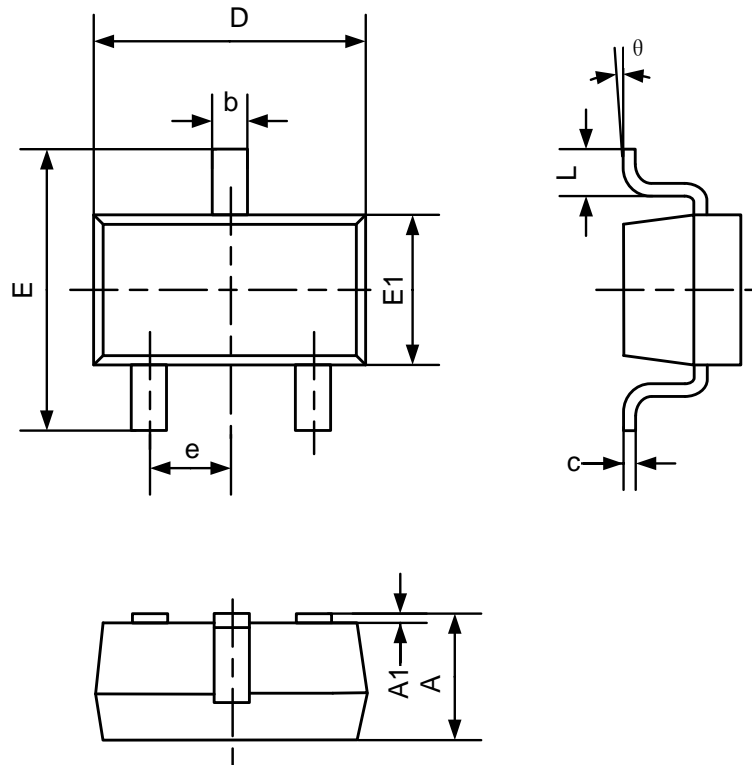


Constant Current Source Output Application Circuit

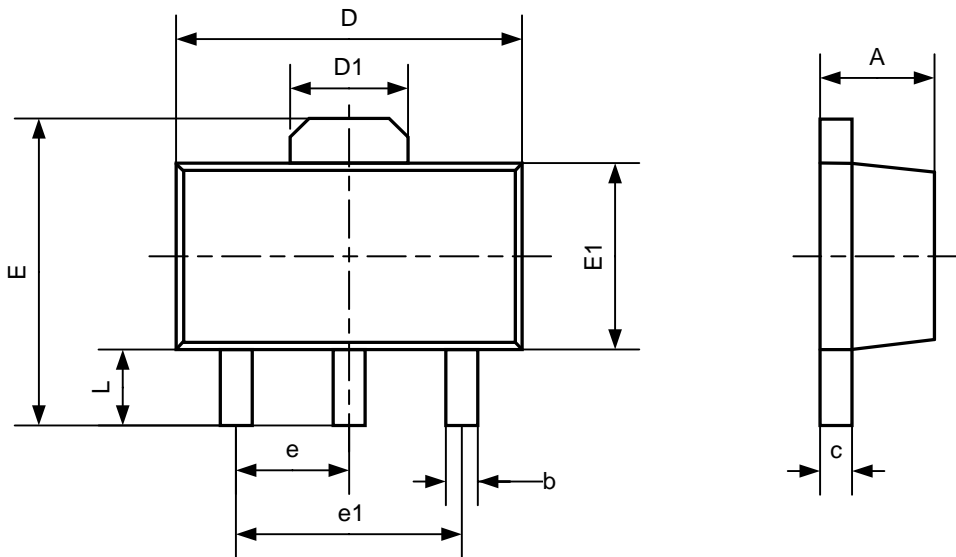


Dual Channel Output Application Circuit



PACKAGE OUTLINE
SOT23-3


Symbol	Dimensions In Millimeters	
	Min	Max
A	1.050	1.250
A1	0.000	0.100
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E	2.650	2.950
E1	1.500	1.700
e	0.950BSC	
L	0.300	0.600
θ	0°	8°

PACKAGE OUTLINE
SOT89-3


Symbol	Dimensions In Millimeters	
	Min	Max
A	1.400	1.600
b	0.320	0.520
c	0.350	0.440
D	4.400	4.600
D1	1.550REF	
E	3.940	4.250
E1	2.300	2.600
e	1.500BSC	
e1	3.000BSC	
L	0.900	1.200