Description

The CL9593 is a ultra low noise and fast response low dropout voltage regulator which designed for applications requiring low dropout voltage and high power supply ripple rejection. It guarantees delivery of 300mA output current, and supports preset output voltage versions range include 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.3V.

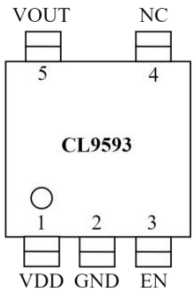
The CL9593 features a precise ±1.5% output regulation over load, line and temperature variations, also the CL9593 integrates many functions. A power-on-reset control through input voltage to prevent wrong operations, the function of thermal shutdown and over current limit protect the device against thermal and current over-loads. Based on its low quiescent current consumption and its less than 1uA shutdown mode current, Besides with high power supply rejection ratio make the device holds well for low input voltages typically encountered in battery operation systems. The regulator is stable with small ceramic capacitor (typical 1.0uF).

Features

- Input voltage range: 1.7V ~ 5.5V
- Output current up to 300mA
- ±1.5% initial voltage reference accuracy
- Low dropout voltage: 150mV@300mA
- 0.1uA low shutdown current
- Fast transient response over line and load transient
- High power supply rejection rate 80dB at 1KHz
- Over current protection and short-circuit protection
- Over-temperature protection
- Stable with 1μF minimum ceramic output capacitor
- Green product RoHS Compliant and Halogen Free

Applications

- Portable and Battery-Powered
- Notebook Computer and Smart Meters
- Medical Equipments
- Digital Cameras
- Wireless Infrastructures
- Audio Devices



Package Type: SOT-23-5L

Typical Application

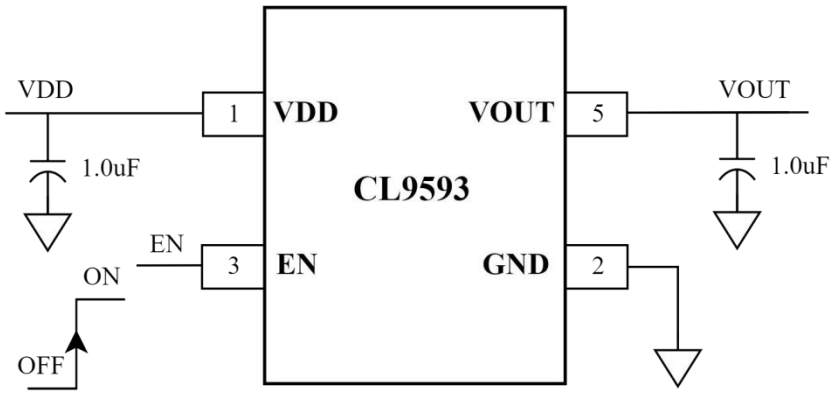


Figure 1. Typical Application of CL9593

Pin Description

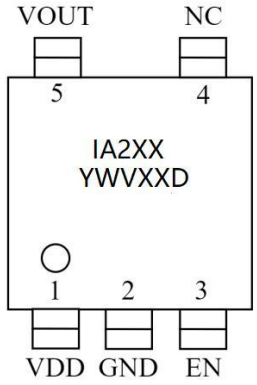


Figure 2. SOT23-5L Package

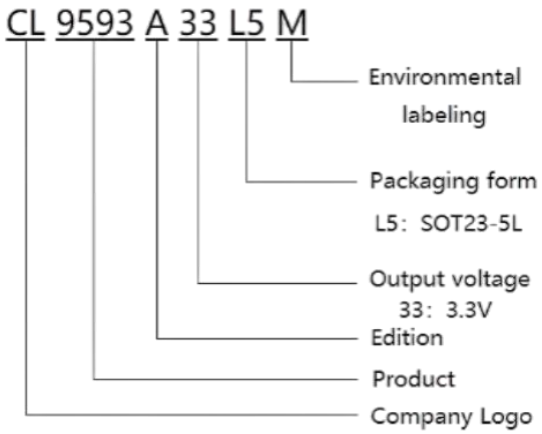
Marking Information

As shown in the left figure:
First row:
IA2: Model code
XX: Output voltage（33：VOUT=3.3V）
Second row:
Y: Age code
W: Week code
VXX: Batch code
D: Environmental code

PIN NO.	NAME	DESCRIPTION
1	VDD	Supply input voltage. A 1μF ceramic capacitor is recommended at this pin.
2	GND	IC ground.
3	EN	Enable control input (Active High). If EN pin is left open, then EN is pulled down by an internal current sink to shutdown the chip.
4	NC	Not connected.
5	VOUT	Output voltage. The power output of the device. A 1.0μF ceramic capacitor is recommended at this pin.

Selection Guide

PART NUMBER	PACKAGE TYPE	MARKING
CL9593A33L5M	SOT23-5L	IA233 YWVXXD



Absolute Maximum Ratings (Note 1)

SYMBOL	PARAMETER	LIMIT	UNIT
V_{DD}	Power supply operation voltage	-0.3<V_{DD}<6.0	V
V_{OUT}	Output voltage	-0.3V<V_{OUT}<V_{DD}+0.3	V
V_{EN}	Enable input voltage	-0.3<V_{DD}<6.0	V
I_{OUT}	Output operation current	300	mA
$P_{D\_SOT23-5L}$	Package power dissipation at $T_A \leqq 25°C$	420	mW
T_J	Junction temperature	-40~150	℃
T_{STG}	Storage temperature	-65~150	℃
T_{LEAD}	Lead temperature soldering time	260(10S)	℃
V_{ESD_HBM}	ESD (Human body mode) (Note 2)	2K	V
V_{ESD_MM}	ESD (Machine mode) (Note 2)	200	V

Thermal Information (Note 3)

SYMBOL	PARAMETER	LIMIT	UNIT
$\theta_{JA\_SOT23-5}$	Thermal resistance junction to ambient	238	℃/W

Recommended Operating Condition (Note 4)

SYMBOL	PARAMETER	LIMIT	UNIT
V_{DD}	Power supply operation voltage	1.7 to 5.5	V
T_J	Junction temperature	-40~125	℃
T_A	Operating temperature range	-40~85	℃

Function Block Diagram

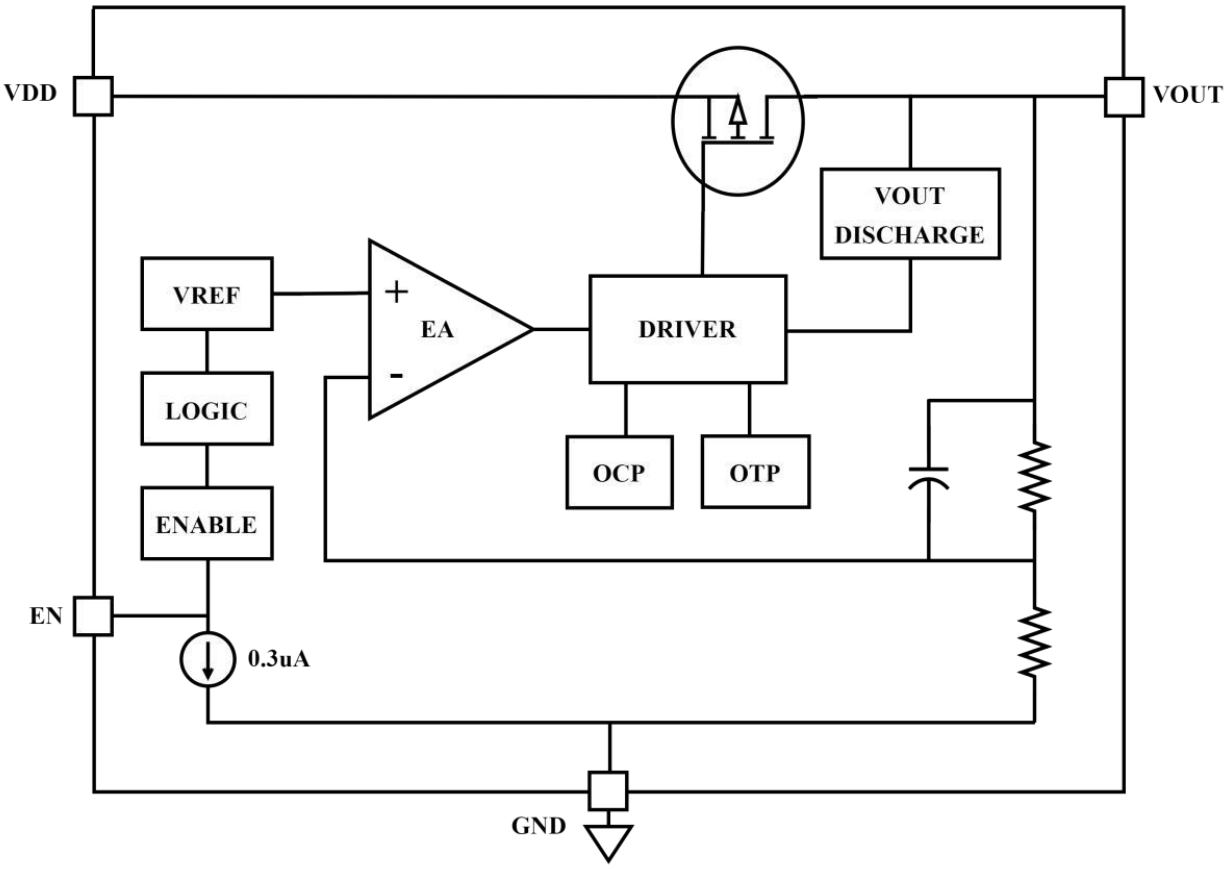


Figure 3. CL9593 Functional Block Diagram

DC Electrical Characteristics

(V_{DD} = $V_{OUT(NOM)}$ + 1V, C_{IN} = 1μF, C_{OUT} = 1μF, T_A = 25°C for typical specifications,unless otherwise noted.

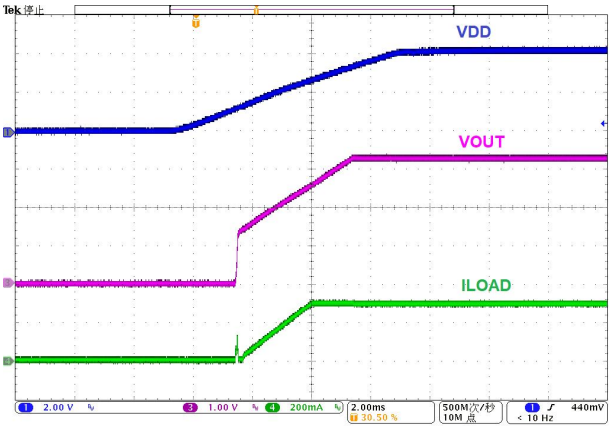
SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Supply Voltage Section						
V_{DD}	V_{DD} operation voltage range	V_{DD} input range	1.7		5.5	V
I_{VDD}	V_{DD} oupply current	V_{DD} = V_{EN} = 5V, unload		55		μA
I_{STBY}	Standby current	V_{DD} = 5V, V_{EN} = 0V		0.1	1	μA
I_{OUT}	Output current (Note 5)	Normal operation output current	300			mA
V_{DDH}	V_{DD} POR rising threshold	V_{EN} = 5V, I_{OUT} = 1mA		1.3	1.6	V
V_{DDL}	V_{DD} POR hysteresis	V_{EN} = 5V, I_{OUT} = 1mA		0.2		V
Enable						
V_{ENH}	EN input voltage high	V_{DD} = 5V, I_{OUT} = 1mA	1.2			V
V_{ENL}	EN input voltage low	V_{DD} = 5V, I_{OUT} =1mA			0.3	V
I_{EN}	EN input bias current	V_{DD} = V_{EN} = 5.5V		0.3	1	μA
Output Voltage Section						
V_{OUT}	Output voltage accuracy	I_{OUT} = 1mA	-1.5		+1.5	%
$\triangle V_{LNR}$	Line regulation for V_{DD}	V_{DD}=V_{OUT}+0.5V to 5.5V, I_{OUT}=1mA		0.02	0.2	%/V
$\triangle V_{LDR}$	Load regulation for V_{OUT}	V_{DD}=V_{OUT}+1V, I_{OUT}=1mA to 150mA		6	20	mV
R_{DISCHG}	Auto-discharge resistance	V_{DD} = 5V, V_{EN} = 0V		90		Ω
V_{DROP}	Dropout voltage (Note 6)	V_{OUT} = 3.3V, I_{OUT} = 300mA		150		mV
PSRR						
PSRR	Power supply ripple rejection rate	V_{DD}=Max{V_{OUT}+1.5V, 3V}, F=1KHz, Ripple=0.2Vpp, I_{OUT}=30mA		80		dB
Over Current Protection						
I_{LIM}	Limit current	V_{DD} = V_{EN} = 5V		450		mA
I_{SHORT}	Short current	V_{OUT} < 0.2V		100		mA
Thermal shutdown						
T_{SD}	Thermal shutdown temperature	T_J Rising		155		°C
	Thermal shutdown returned temperature			135		°C

Note 1. Stresses listed as the above "Absolute Maximum Ratings" may cause permanent damage to the device. These are for stress ratings. 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.
Note 2. Devices are ESD sensitive. Handling precaution recommended.
Note 3. θ_{JA} is measured in the natural convection at T_A=25℃ on a high effective thermal conductivity test board of JEDEC 51-7 thermal measurement standard.
Note 4. The device is not guaranteed to function outside its operating conditions.
Note 5. The output current at which the output voltage becomes 95% of VOUT after gradually increasing the output current. Also The output current can be at least this value. Due to restrictions on the package power dissipation, this value may not be satisfied. Attention should be paid to the power dissipation of the package when the output current is large.The specification is guaranteed by design.
Note 6. The dropout voltage is defined as VDD - VOUT, which is measured when VOUT is 98%*VOUT.

Typical Performance Characteristics

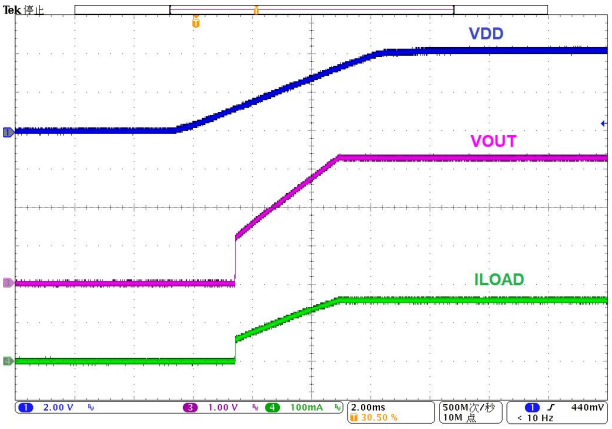
(T_A = 25°C, C_N = 1μF, C_{OUT} = 1μF, unless otherwise specified)

Power On from VDD With 300mA LOAD



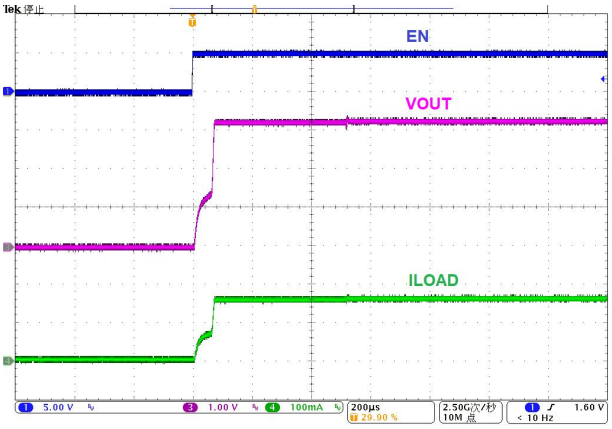
V_{DD}=4.3V, V_{OUT}=3.3V, ILOAD=300mA

Power On from VDD With 20ohm LOAD



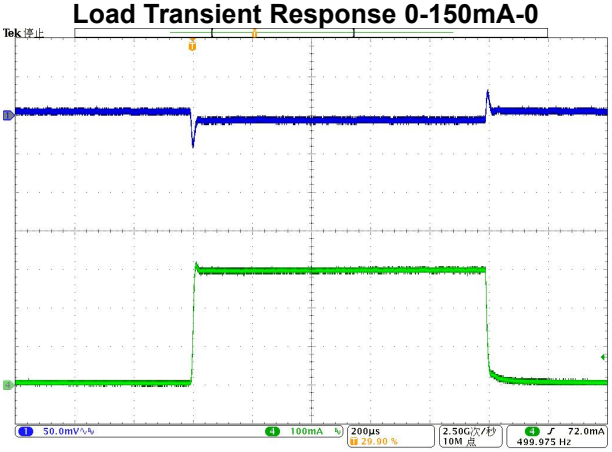
EN=5.0V, V_{DD}=4.3V, V_{OUT}=3.3V, ILOAD=300mA

Power On from EN With 20ohm LOAD



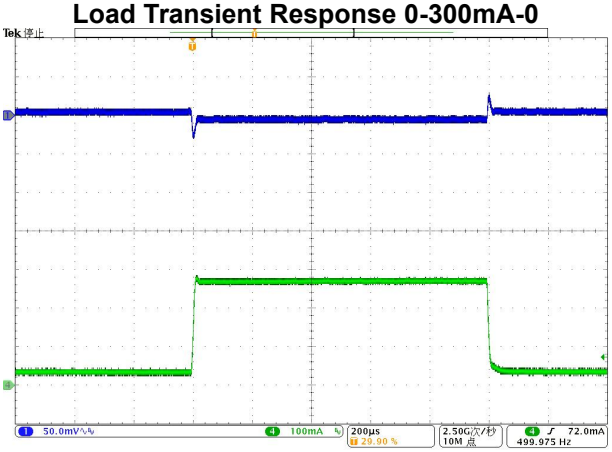
V_{DD}=4.3V, V_{OUT}=3.3V, RLOAD=20ohm

Load Transient Response 0-150mA-0



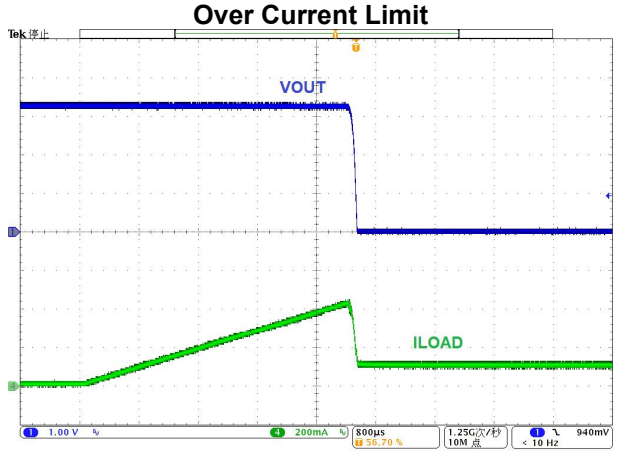
V_{DD}=4.3V, V_{OUT}=3.3V, ILOAD=0-150mA-0

Load Transient Response 0-300mA-0



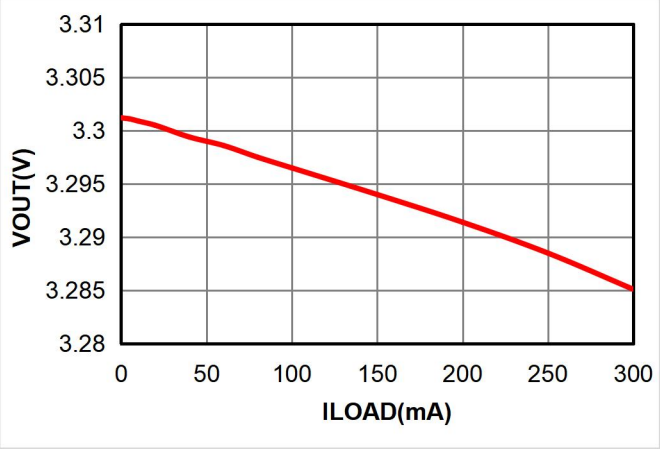
V_{DD}=4.3V, V_{OUT}=3.3V, ILOAD=0-300mA-0

Over Current Limit



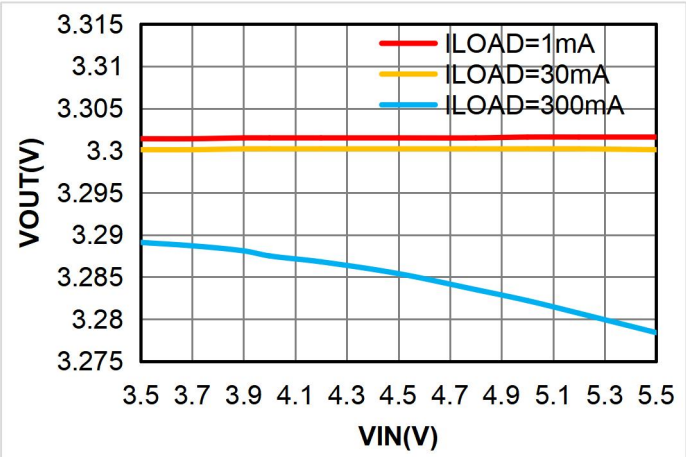
V_{DD}=4.3V, V_{OUT}=3.3V

Output Voltage vs. Load Current



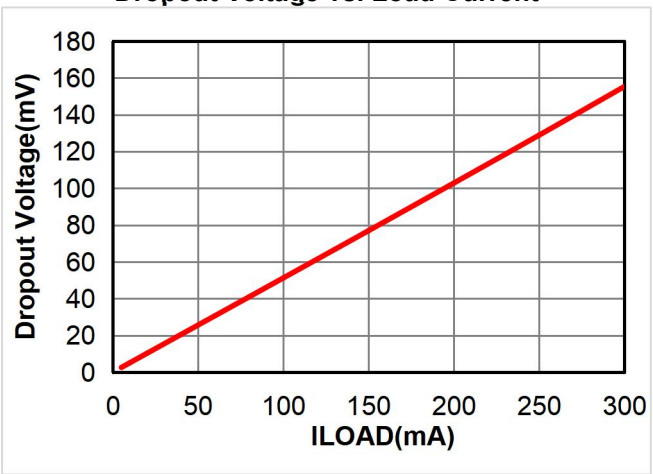
V_{DD}=4.3V, V_{OUT}=3.3V, ILOAD=0-300mA

Output Voltage vs. Input Voltage



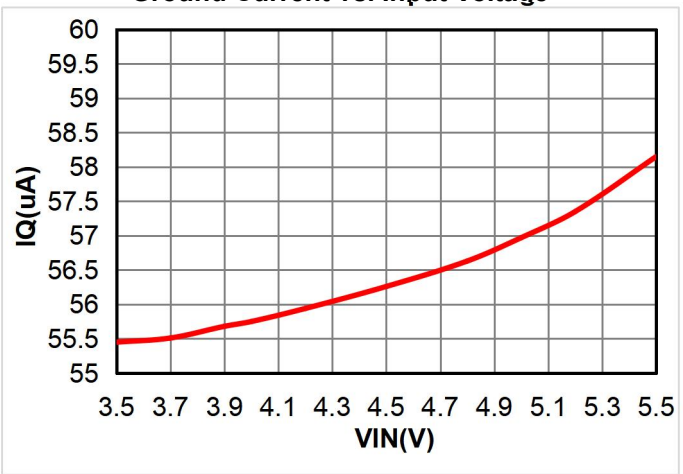
V_{DD}=3.5-5.5V, V_{OUT}=3.3V, ILOAD=1mA-300mA

Dropout Voltage vs. Load Current



V_{OUT}=3.3V, ILOAD=0-300mA

Ground Current vs. Input Voltage



V_{DD}=3.5-5.5V, V_{OUT}=3.3V, ILOAD=0

Application Information

Input Capacitor

Good bypassing capacitor is recommended from input to ground to help improve IC ac performance. Bypass VDD to ground with a 1uF capacitor for normal operation in most applications. Place the capacitors physically as close as possible to the device with wide and direct PCB traces to supply current during stepping load transients to prevent the input voltage rail from dropping.

Output Capacitor

The output capacitor must meet both requirements for minimum amount of capacitance and ESR in all LDO applications. The CL9593 is specifically designed to employ ceramic output capacitors as low as 1μF.

The ceramic capacitors offer significant cost and space savings, along with high frequency noise filtering. Place the capacitors physically as close as possible to the device with wide and direct PCB traces. Capacitor ESR should be less than 50mohm.

Current Limit

The CL9593 contains an independent current limit and short circuit current protection to prevent unexpected events. The current limit monitors and controls the pass transistor`s gate voltage, which allows the output current to reach the value of 450mA. Then further decreases in the load resistance reduce both the load current and the load voltage. Once the output current is higher than current limit threshold, the current limit function will be triggered, clamping the output current at a pre-designed level to prevent over current stress and thermal damage.

If Vout is in short condition, the short circuit current protection starts and remains the load current about to 100mA, the output can be shorted to ground without damaging the device.

OTP Protection

A Thermal shutdown protection circuit disables the CL9593 when the junction temperature of the pass transistor rises to 155°C (typical). Thermal shutdown hysteresis assures that the device resets (turns on) when the temperature falls to 135°C (typical).

The thermal shutdown feature provides the protection IC against overheating power dissipation due to some application failure and it is not intended to be used as a normal working function.

Enable

The CL9593 uses the dedicated EN pin to enable its operation. If the EN pin voltage is < 0.3 V, the regulator will be turned off. If the EN pin voltage is > 1.2 V, the regulator will be turned on. If EN is left open, the EN pin is pulled down by an internal current sink to shutdown the regulator.

Power Dissipation

Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum power dissipation is dependent on the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

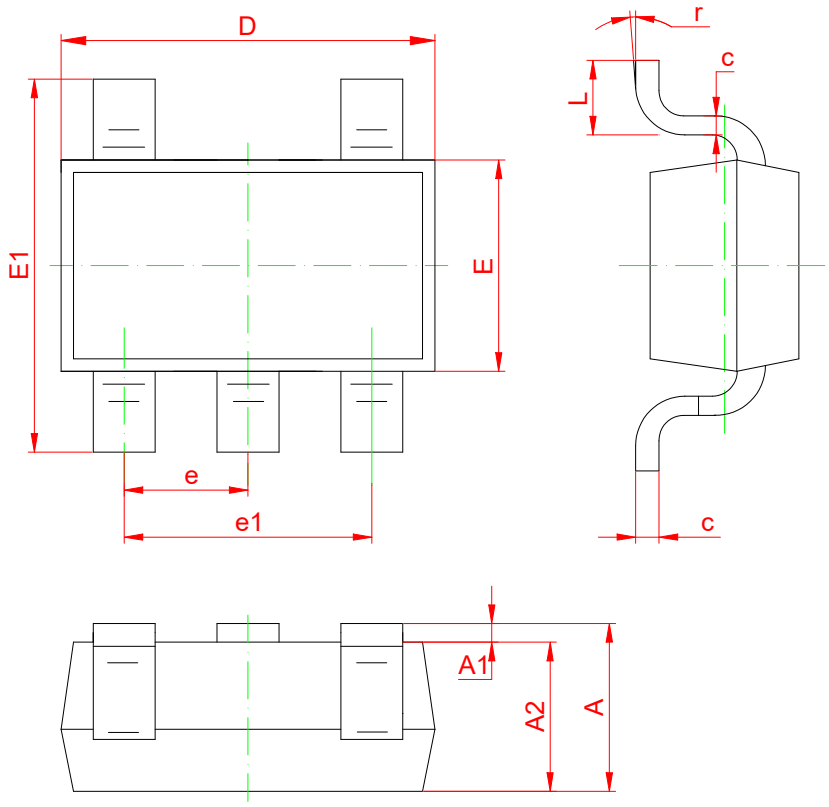
Power dissipation in the regulator depends on the input-to-output voltage difference and load conditions.

$$PD = (V_{DD} - V_{OUT}) \times I_{OUT}$$

Power dissipation can be minimized, and thus greater efficiency achieved, by proper selection of the system voltage rails. To avoid thermally overloading the CL9593, refrain from exceeding the absolute maximum junction temperature

rating of 150℃ under continuous operating condition. Over-stressing the regulator with high loading currents and elevated input-to-output differential voltages can increase the IC die temperature significantly.

Package Dimensions: SOT-23-5L



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
r	0°	8°	0°	8°

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