

## Low Power Consumption High Voltage CMOS LDO Regulator

### 1 Features

- Low Quiescent Current IQ: 2 $\mu$ A Typical at Light Loads
- 150mA Nominal Output Current
- Low Dropout Voltage
- Low Temperature Coefficient
- High Input Voltage (up to 36V)
- Output Voltage Accuracy:  $\pm 2\%$
- Output voltage range is adjustable from 1.2V to 5V, and the step size is 0.1V.
- Over temperature Protection
- Short Circuit Protection
- Packages: SOT23-3 and SOT89-3L

### 2 Applications

- Audio/Video Equipment
- Communication Equipment
- Battery-Powered Equipment
- Automotive Head Unit
- Laptop, Palmtops, Notebook Computers

### 3 Description

The MCSO68 series is a set of low power high voltage regulators implemented in CMOS technology. Which can provide 150mA output current. The device allows input voltage as high as 36V. It is very suitable for multi-cell battery systems, bus voltage power supply systems and other high DC voltage systems. Wide input voltage can make it well withstand the impact of surge voltage and ensure the stability of output voltage. The MCSO68 series only 2 $\mu$ A (typical) current is consumed by itself, which is especially important in multi-battery power supply systems and can reduce the standby power consumption of the whole system.

### 4.Pin Configuration

Pin			Name	Function
SOT23-3	SOT89-3L (Pin2-VIN)	SOT89-3L (Pin2-GND)		
5	4	5	VIN	Input Supply Voltage Pin. It is recommended to use a 1 $\mu$ F or larger ceramic capacitor from VIN pin to ground. This ceramic capacitor should be placed as close as possible to IN pin.
3	3	4	GND	Ground.
4	5	3	VOUT	Regulator Output Pin. It is recommended to use an output capacitor with effective capacitance in the range of 1 $\mu$ F to 10 $\mu$ F. The capacitor should be located very close to this pin.

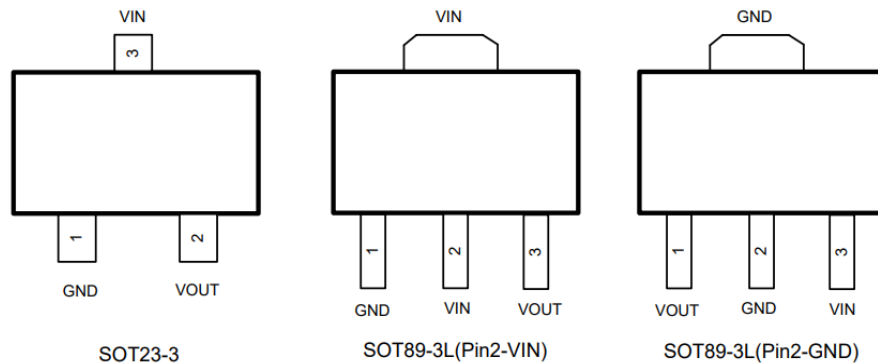


Figure4-1 Pin Description

## 5 Specifications

### 5.1 Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Unit
VIN to GND	$V_{IN}$	-0.3	40	V
Junction Temperature	$T_J$	-40	150	°C
Power Dissipation @ $T_A=25^{\circ}\text{C}$	$P_D$	Internally Limited		W
Storage Temperature Range	$T_{STG}$	-65	150	°C

#### Note:

Stress greater than 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 under "Recommended Operating Conditions" is not implied. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.

### 5.2 ESD Ratings:

Parameter	Symbol		Max	Unit
Electrostatic discharge	$I_{ESD}$	Latch up current	500	mA
	$V_{ESD}$	Human-body model (HBM)	±8000	V
		Charge device model (CDM)	±2000	



#### ESD SENSITIVITY CAUTION

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.

### 5.3 RECOMMENDED OPERATING RANGE:

Parameter	Symbol	Min	Max	Unit
Supply Voltage	$V_{IN}$	2.5	36	V
Output current	$I_{OUT}$	0	150	mA
Operating Temperature	$T_{OPT}$	-40	85	°C

### 5.4 Electrical Characteristics(3.3V):

( $V_{OUT}=3.3V, V_{IN}=V_{OUT}+2V, C_{IN}=C_{OUT}=1\mu F, T_A=25^\circ C$ , unless otherwise specified. )

Symbol	Parameter	Conditions	Min	TYP	Max	Unit
$V_{IN}$	Input Voltage <sup>[1]</sup>	$V_{OUT}=3.3V$			36	V
$V_{OUT}$	Output Voltage Accuracy	$I_{OUT}=10mA$	-2	0	+2	%
$I_Q$	Ground Pin Current <sup>[2]</sup>	No Load		2	3	$\mu A$
$I_{LIM}$	Current Limit	$V_{IN}=V_{OUT}+2V$		150		mA
$V_{DROP}$	Dropout Voltage <sup>[3]</sup>	$I_{OUT}=50mA, \Delta V_O=5\%$		254		mV
$S_{LINE}$	Line Regulation	$V_{IN}=V_{OUT}+2V$ to 36V, $I_{OUT}=1mA$	0.04	0.08	0.2	%/V
$S_{LOAD}$	Load Regulation	$V_{IN}=V_{OUT}+2V$ , $I_{OUT}=1mA$ to 150mA		254	373	mV
PSRR	Power Supply Rejection Ratio	$I_{OUT}=10$ mA	$f=217Hz$ $f=1KHz$	50 40		dB
$T_C$	Output Voltage Temperature Coefficient <sup>[4]</sup>	$I_{OUT}=10mA, T_A=-40\sim 120^\circ C$		100		ppm/°C
$T_{SD}$	Thermal Shutdown Temperature	Shutdown, temperature increasing		150		°C

#### Note:

- $V_{in} \geq V_{out}$ , whichever is greater.
- Maximum output current is affected the PCB layout, size of metal trace, the thermal conduction path between metal layers, ambient temperature and other environment factors of system. Attention should be paid to dropout voltage when  $V_{in} < V_{OUT} + V_{DROP}$ .
- The dropout voltage is defined as  $V_{IN} - V_{OUT}$ , when  $V_{OUT} = 95\% * V_{OUT(NOW)}$ .
- Output voltage temperature coefficient is defined as the worst-case voltage change divided by the total temperature range.

### 5.5 Typical Operating Characteristics

( $V_{in}=5.3V, V_{OUT}=3.3V, C_{IN}=C_{OUT}=1\mu F$ , Tested under  $T_J=25^\circ C$ , unless otherwise specified)

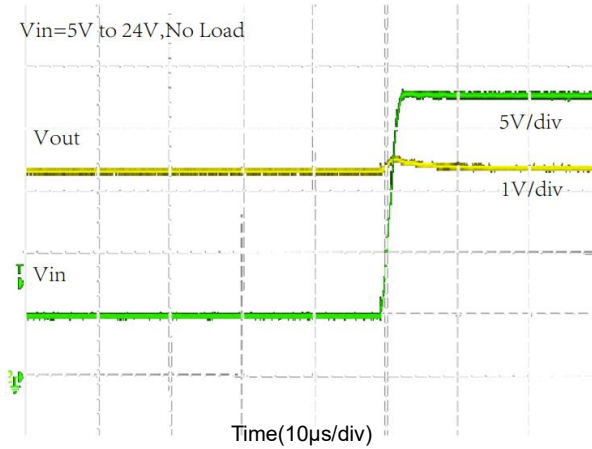


Figure 1 Line-Transient Response

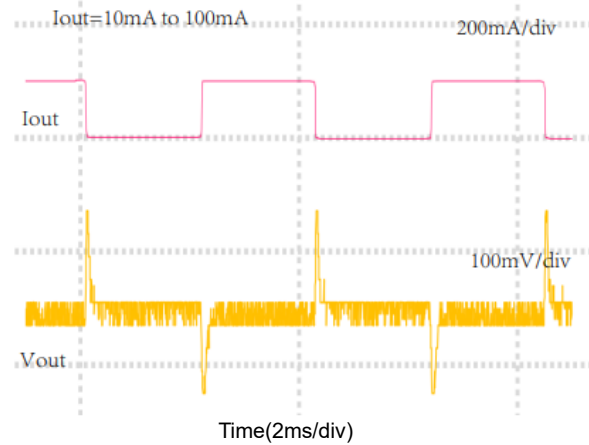


Figure 2 Load-Transient Response

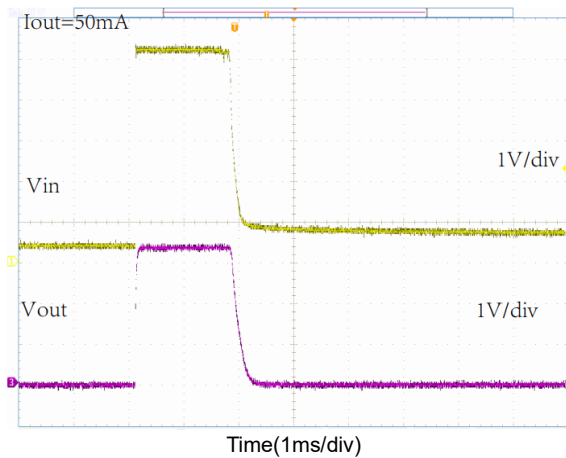


Figure 3 Power-Up/Power-Down Output Waveform

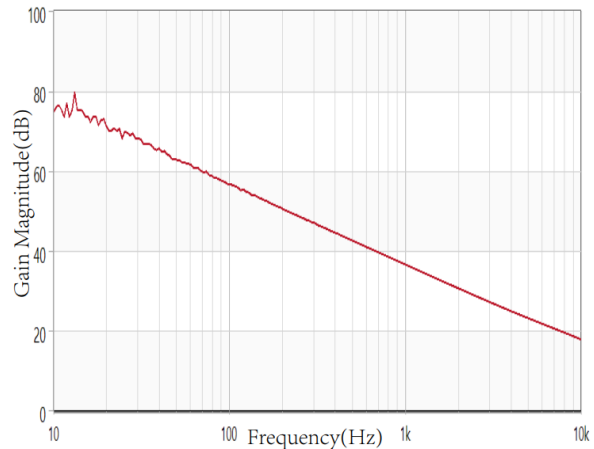


Figure 4 PSRR

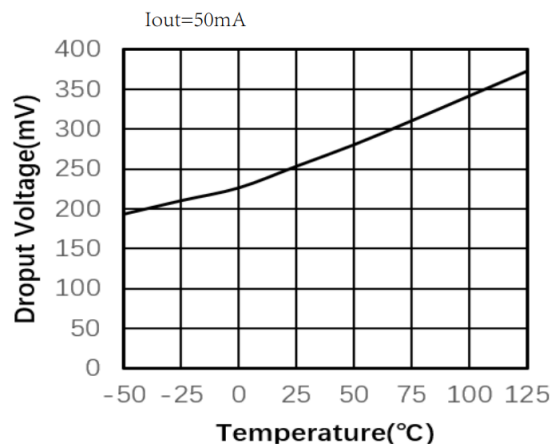


Figure 5 Dropout Voltage vs Temperature

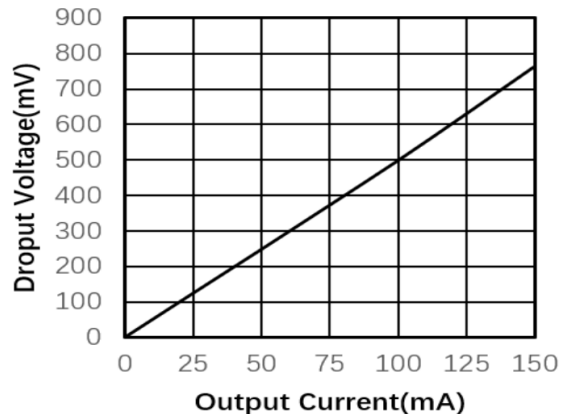


Figure 6 Dropout Voltage vs Output Current

**5.5 Typical Operating Characteristics(Cont.)**

( $V_{in}=5.3V, V_{out}=3.3V, C_{in}=C_{out}=1\mu F$ , Tested under  $T_J = 25^\circ C$ , unless otherwise specified)

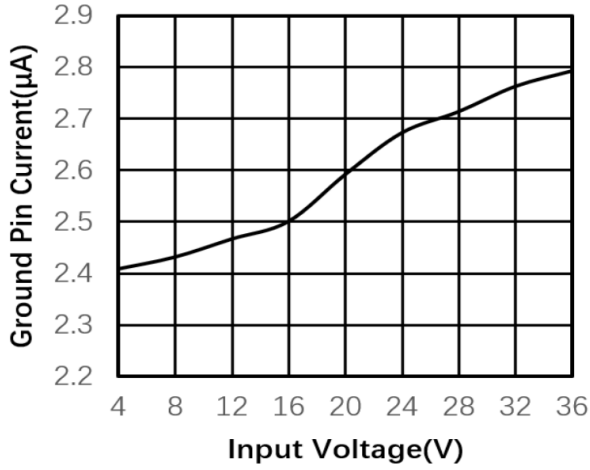


Figure 7 Ground Pin Current vs Input Voltage

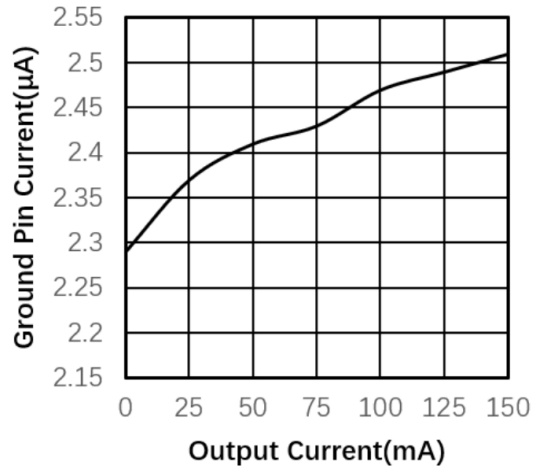


Figure 8 Ground Pin Current vs output current

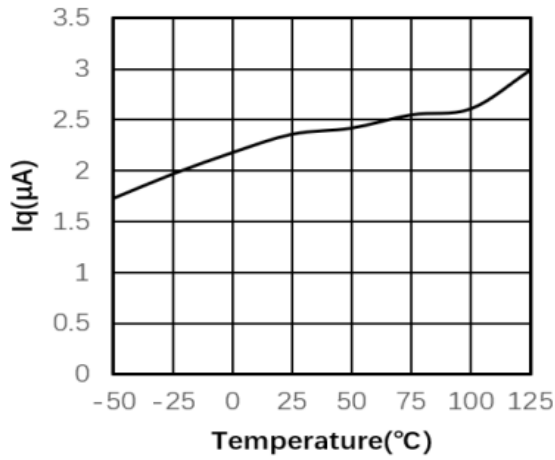


Figure 9 Iq vs Temperature

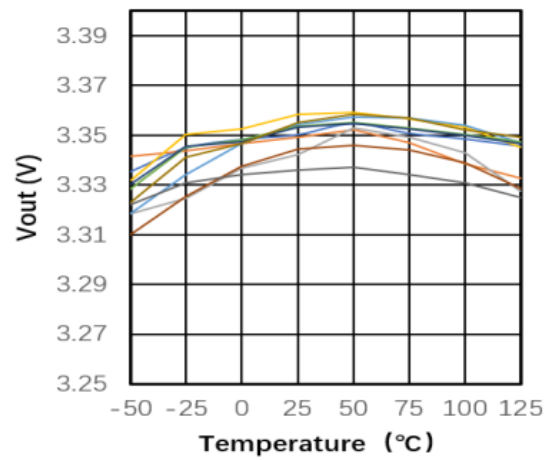


Figure 10 Vout vs Temperature

**6 Applications Information**

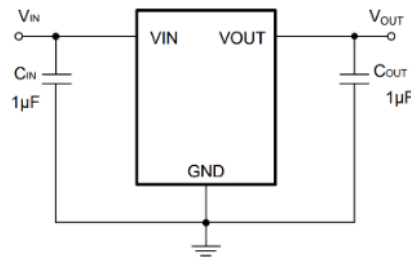


Figure6-1 Typical Application Circuit

## 7 Detailed Description

### 7.1 Functional Block Diagram

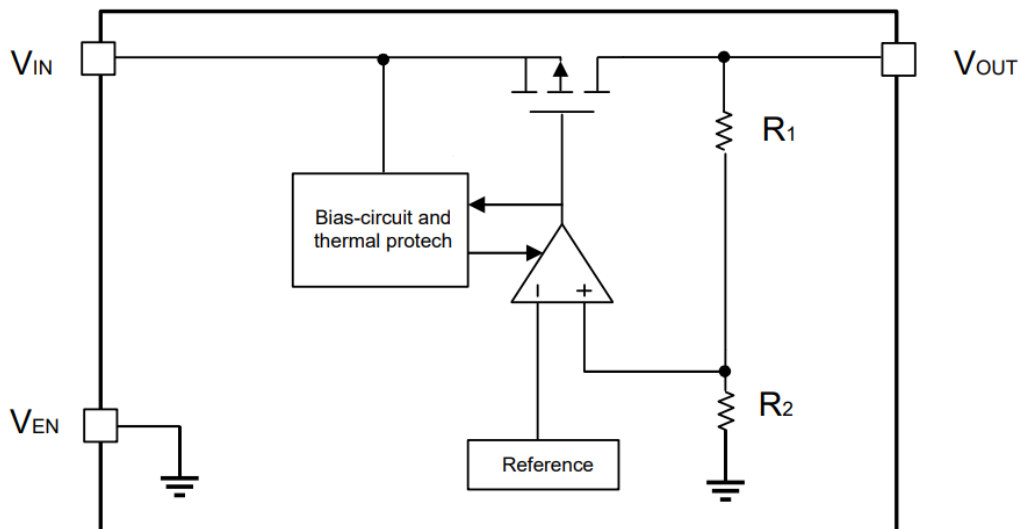


Figure7-1 MCSO68 Functional Block Diagram

### 7.2 DETAIL OPERATION DESCRIPTION

#### Overview

The MCSO68 low-dropout regulators (LDO) consumes only 2μA of quiescent current at light load and delivers excellent line and load transient performance. These characteristics, combined with low noise and good PSRR with low dropout voltage, make this device ideal for portable consumer applications.

#### Thermal Considerations

When the junction temperature is too high, the thermal protection circuitry sends a signal to the control logic that will shut down the IC. The IC will restart when the temperature has sufficiently cooled down. The maximum power dissipation is dependent on the thermal resistance of the case and the circuit board, the temperature difference between the die junction and the ambient air, and the rate of air flow. The GND pin must be connected to the ground plane for proper dissipation.

[1] The phase compensation circuit and ESR of the output capacitor are used inside the circuit to compensate, so a capacitor larger than 1μF must be connected to the ground.

[2] It is recommended to use 1μF polar capacitors for input and output, and to keep the capacitors as close to the V<sub>IN</sub> and V<sub>OUT</sub> pins of LDO as possible.

[3] Pay attention to the use conditions of input and output voltages and load currents to avoid the power consumption (P<sub>D</sub>) inside the IC exceeding the maximum power consumption allowed by the package.

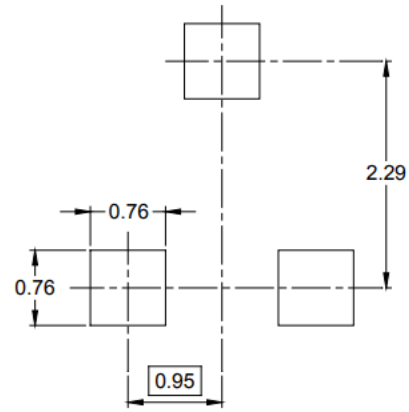
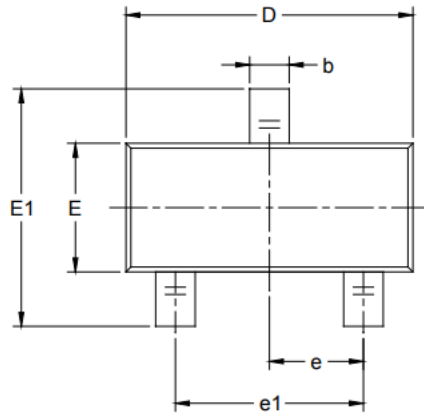
$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT}$$

$$T_J = P_D \times R_{\theta JA} + T_A$$

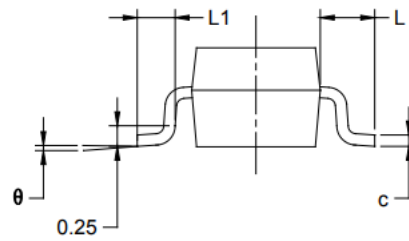
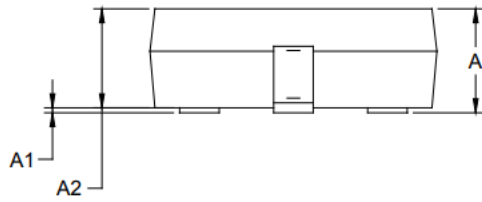
[4] When the input voltage V<sub>IN</sub> is greater than 2.5V, if V<sub>IN</sub> is also higher than the output set value plus the device dropout voltage, V<sub>OUT</sub> is equal to the set value. Otherwise, V<sub>OUT</sub> is equal to V<sub>IN</sub> minus the dropout voltage. If V<sub>IN</sub> lower than 2.5V, the V<sub>OUT</sub> is:

$$V_{OUT} = V_{IN} - V_{Dropout}$$

**PACKAGE OUTLINE**  
**SOT23 Package**

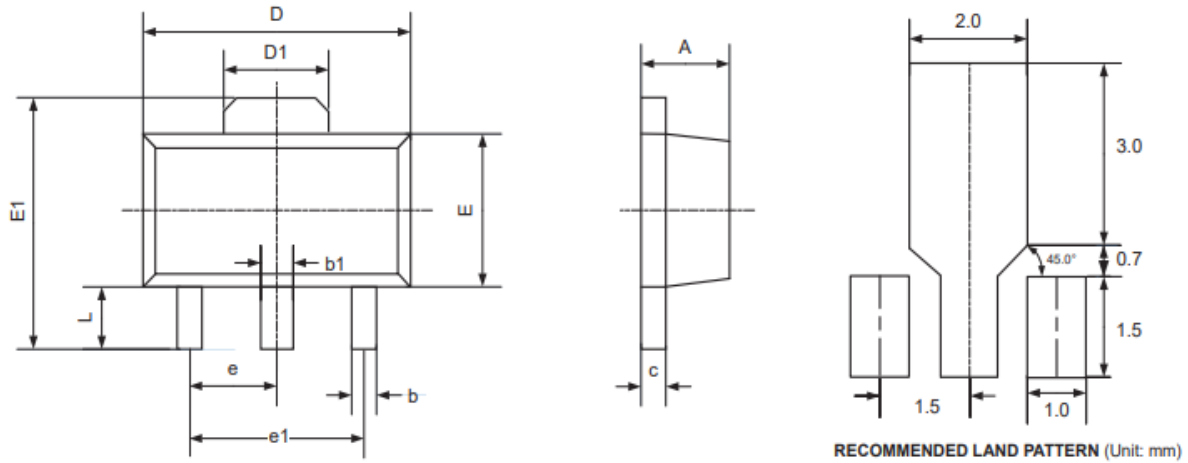


**RECOMMENDED LAND PATTERN** (Unit: mm)



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	MIN	MAX	MIN	MAX
A	0.900	1.150	0.035	0.045
A1	0.000	0.100	0.000	0.004
A2	0.900	1.050	0.035	0.041
b	0.300	0.500	0.012	0.020
c	0.080	0.150	0.003	0.006
D	2.800	3.000	0.110	0.118
E	1.200	1.400	0.047	0.055
E1	2.250	2.550	0.089	0.100
e	0.950 BSC		0.037 BSC	
e1	1.900 BSC		0.075 BSC	
L	0.550 REF		0.022 REF	
L1	0.300	0.500	0.012	0.020
θ	0°	8°	0°	8°

**PACKAGE OUTLINE**  
**SOT89-3 Package**



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	
E	2.300	2.600	0.091	0.102
E1	3.940	4.250	0.155	0.167
e	1.500 TPY		0.060 TPY	
e1	3.000 TPY		0.118 TPY	
L	0.900	1.200	0.035	0.047

# Order Information

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Part Number	Package	Ordering Number	Packing Option
MCSO68	SOT23-3	MCSO68-XXTR3	Tape and Real, 3000
	SOT89-3L(Pin2-VIN)	MCSO68-XXSTR3	Tape and Real, 3000
	SOT89-3L(Pin2-GND)	MCSO68Y-XXSTR3	

**Note:** "xx" represents the type of voltage value.