High Speed Low Dropout LDOs MD53UXX Series

CMOS Voltage Regulator Circuit 500mA

The MD53UXX Series are positive voltage regulator circuits with low dropout voltage, high accuracy output voltage, low power consumption, and high ripple immunity developed using CMOS technology. The built-in low ON-resistance transistors result in low input/output dropout voltage. With a maximum operating voltage of 10V, these ICs are suitable for applications requiring high withstand voltages.

■ Characteristics:

-High output voltage accuracy. Accuracy ±2%
-Output Current Typical 500mA
-Low input/output differential pressure. Typical 1.5mV Iout=1mA
-Ultra-low power current consumption. Typical 25uA
-Low Output Voltage Temperature Drift Typical 50 PPm/℃
-Input withstand voltage. Rise to 10V to maintain output regulation
-Output short-circuit protection Short-circuit current 50 mA
-High Ripple Resistance Typical value 65db

■ Uses:

-Use of regulated power supplies for battery-powered equipment
-Voltage stabilized power supply for communication equipment
-Voltage regulator for home appliances and toys
-Regulated power supply for cell phones
-Portable medical instrument voltage stabilized power supply

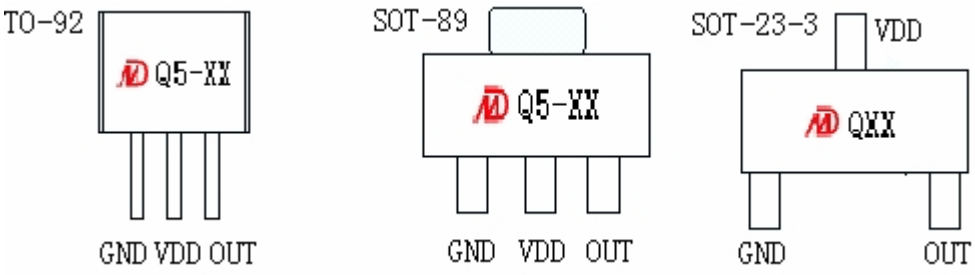
■ Product Catalog

model number	Output Voltage (Note)	inaccuracies	Print MARK SOT-89 TO-92	Print MARK SOT-23-3
MD53U18	1.8V	±2%	Q5-18	Q 18
MD53U27	2.7V	±2%	Q5-27	Q 27
MD53U28	2.8V	±2%	Q 5-28	Q 28
MD53U30	3.0V	±2%	Q 5-30	Q 30
MD53U33	3.3V	±2%	Q 5-33	Q 33
MD53U36	3.6V	±2%	Q 5-36	Q 36
MD53U44	4.4V	±2%	Q 5-44	Q 44
MD53U50	5.0V	±2%	Q 5-50	Q 50

Note 1: If you want to use products other than the above output voltage range, customers can request customized output voltage range of 1.5V~7V per 0.1V.

Make a breakdown.

Package type and pinout



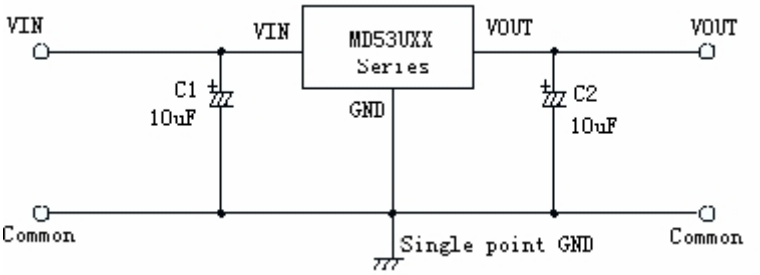
■ Absolute maximum rating:

(Unless otherwise indicated: Ta = 25°C)

sports event	markings	Absolute maximum rating	unit (of measure)
Input Voltage	VIN	12	V
output voltage	VOUT	Vss-0.3~ VIN+0.3	
Allowable power consumption	PD	SOT_89 500 TO_92 300 SOT_23 200	Mw
Operating ambient temperature range	Topr	-40~+85	°C
Storage ambient temperature range	Tstg	-40~+125	

Caution. The absolute maximum rating is a rating that cannot be exceeded under any conditions. If this rating is exceeded, physical damage such as product deterioration may occur.

Basic Application Circuits Application Circuits:



Electrical Characteristics:

MD53UXX Series (MD53U18, Output Voltage +1.8V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	prerequisite	minimal (be) worth	typical case (be) worth	greatest (be) worth	unit (of measure)	survey and evaluate circuits
output voltage	VOUT	VIN= 2.8V, IOUT=40mA	1.764	1.8	1.836	V	1
Output current*1	IOUT	VIN=2.8V	350			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=100 mA		15 140	21 210	mV	1
Input Stability	△VOUT1 △VIN-VOUT	2.8V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=2.8V 1.0mA≤IOUT≤150mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+1V+1Vp_p f = 1KC Iout=50mA		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=2.8V, IOUT=10mA -40°C≤Ta≤85°C		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	--			10	V	

MD53UXX Series (MD53U27, Output Voltage +2.7V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	conditional	mini mal (be) worth	typica l case (be) worth	greate st (be) worth	unit (of measure)	surve y and evalu ate circui ts
output voltage	VOUT	VIN= 3.8V, IOUT=50mA	2.646	2.7	2754	V	1
Output current*1	IOUT	VIN= 3.8V	450			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		12 220	18 300	mV	1
Input Stability	△VOUT1 △VIN-VOUT	3.8V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=3.8V 1.0mA≤IOUT≤150mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+1V+1Vp_p f = 1KC Iout=50mA		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=3.8V, IOUT=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	–			10	V	
Output short-circuit current	Ilim	Vout=0V		50	70	mA	

MD53UXX Series (MD53U28, Output Voltage +2.8V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	prerequisite	mini mal (be) worth	typica l case (be) worth	greate st (be) worth	unit (of measure)	surve y and evalu ate circui ts
output voltage	VOUT	VIN= 3.8V, IOUT=50mA	2.744	2.8	2.856	V	1
Output current*1	IOUT	VIN= 3.8V	450			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		12 220	18 300	mV	1
Input Stability	△VOUT1 △VIN-VOUT	3.8V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=3.8V 1.0mA≤IOUT≤150mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+1V+1Vp_p f = 1KC Iout=50mA		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=3.8V, IOUT=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	–			10	V	
Output short-circuit current	Ilim	Vout=0V		50	70	mA	

MD53UXX Series (MD53U30, Output Voltage +3.0V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	prerequisite	mini mal (be) worth	typica l case (be) worth	greate st (be) worth	unit (of measure)	surve y and evalu ate circui ts
output voltage	VOUT	VIN= 4.0V, IOUT=50mA	2.940	3.0	3.060	V	1
Output current*1	IOUT	VIN= 4.0V	500			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		10 200	14 280	mV	1

MD53UXX Series (MD53U33, Output Voltage +3.3V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	prerequisite	minimal (be) worth	typical case (be) worth	greatest (be) worth	unit (of measure)	survey and evaluate circuits
output voltage	VOUT	VIN= 4.3V, IOUT=50mA	3.234	3.3	3.366	V	1
Output current*1	IOUT	VIN= 4.3V	500			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		10 200	14 280	mV	1
Input Stability	△VOUT1 △VIN-VOUT	4.3V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=4.3V 1.0mA≤IOUT≤200mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+1V+1Vp_p f = 1KC Iout=50mA		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=4.3V, IOUT=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	–			10	V	
Output short-circuit current	Ilim	Vout=0V		50	70	mA	

MD53UXX Series (MD53U36, Output Voltage +3.6V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	prerequisite	minimal (be) worth	typical case (be) worth	greatest (be) worth	unit (of measure)	survey and evaluate circuits
output voltage	VOUT	VIN= 4.6V, IOUT=50mA	3.528	3.6	3.672	V	1
Output current*1	IOUT	VIN= 4.6V	500			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		10 200	14 280	mV	1
Input Stability	△VOUT1 △VIN-VOUT	4.6V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=4.6V 1.0mA≤IOUT≤200mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+1V+1Vp_p f = 1KC Iout=50mA		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=4.6V, IOUT=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	–			10	V	
Output short-circuit current	Ilim	Vout=0V		50	70	mA	

MD53UXX series (MD53U3.9, output voltage +3.9 V) (unless otherwise indicated: Ta = 25°C)

sports event	markings	conditional	minimal (be) worth	typical case (be) worth	greatest (be) worth	unit (of measure)	survey and evaluate circuits
output voltage	VOUT	VIN= 3.9V, IOUT=50mA	3.822	3.9	3.978	V	1
Output current*1	IOUT	VIN= 3.4V	500			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		10 200	14 280	mV	1

MD53UXX Series (MD53U44, Output Voltage +4.4V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	prerequisite	mini mal (be) worth	typica l case (be) worth	greate st (be) worth	unit (of measure)	surve y and evalu ate circui ts
output voltage	VOUT	VIN= 5.4V, IOUT=50mA	4.312	4.4	4.488	V	1
Output current*1	IOUT	VIN= 5.4V	500			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		10 200	14 280	mV	1
Input Stability	△VOUT1 △VIN-VOUT	5.4V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=5.4V 1.0mA≤IOUT≤200mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+2V f = 1KC		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=5.4V, IOUT=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	–			10	V	
Output short-circuit current	Ilim	Vout=0V		50	70	mA	

MD53UXX Series (MD53U50, Output Voltage +5.0V) (Unless otherwise noted: Ta = 25°C)

sports event	markings	conditional	mini mal (be) worth	typica l case (be) worth	greate st (be) worth	unit (of measure)	surve y and evalu ate circui ts
output voltage	VOUT	VIN= 6.0V, IOUT=50mA	4.900	5.0	5.100	V	1
Output current*1	IOUT	VIN= 6.0V	500			mA	3
Input and output voltage difference	Vdrop	IOUT=10 mA IOUT=200 mA		10 200	14 280	mV	1
Input Stability	△VOUT1 △VIN-VOUT	6.0V≤VIN≤10V IOUT=1mA		0.05	0.2	%/V	
Load Stability	△VOUT2	VIN=6.0V 1.0mA≤IOUT≤200mA		25	40	mV	
Ripple Resistance	PSRR	VIN=VOUT(S)+1V+1Vp_p f = 1KC Iout=50mA		65		dB	
Output Voltage Temperature Coefficient	△VOUT △Ta-VOUT	VIN=6.0V, IOUT=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/°C	
current consumption	ISS	VIN= VOUT(S)+2V unloaded		25	40	uA	
Input Voltage	VIN	–			10	V	
Output short-circuit current	Ilim	Vout=0V		50	70	mA	

*1. VOUT(S) Sets the output voltage value *2. Slowly increase the output current, the output current value when the output voltage drops by 2%.

*3. Slowly decreasing the input voltage, the difference between input and output voltage when the output voltage decreases by 2%.

@VOUT(S) Specificed output voltage.

*Increasing output current slowly, The IOUT when output voltage decreasing two percent.

*Decreasing Vin, the dropout is (VIN-VOUT) when output voltage decreases two percent.

Measurement circuits

1.

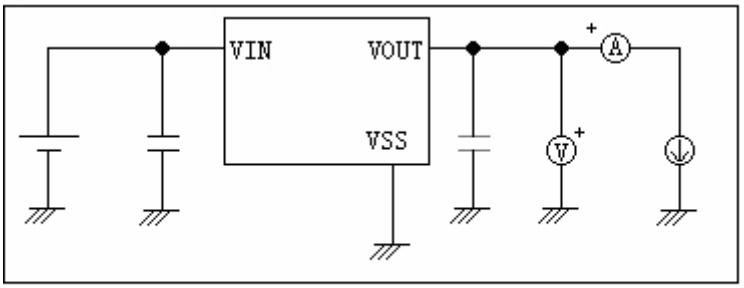


图 1

2.

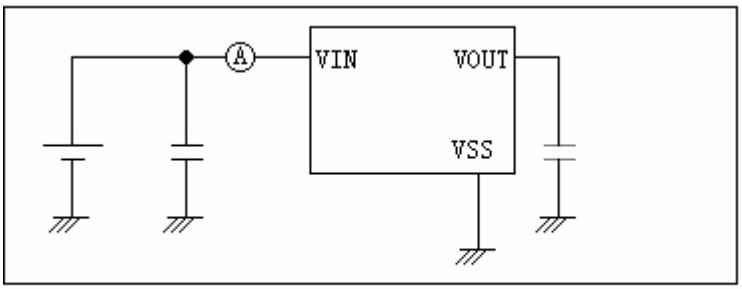


图 2

3.

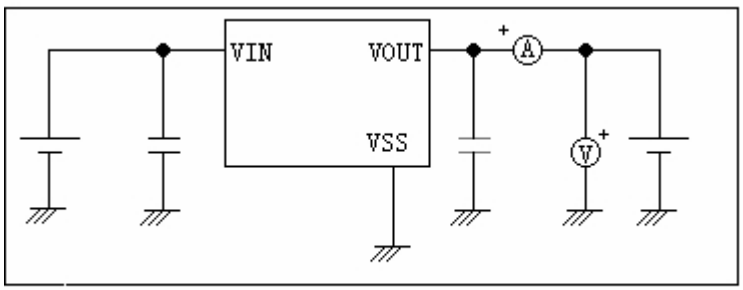
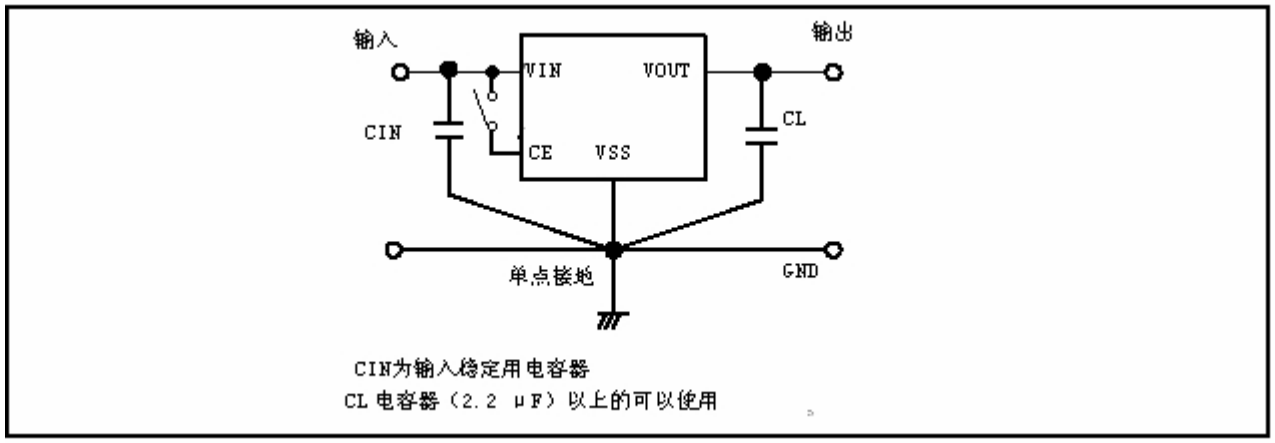


图 3

standard circuit



The above connection diagrams and parameters are not intended to guarantee the operation of the circuit. The actual circuit should be parameterized based on actual measurements.

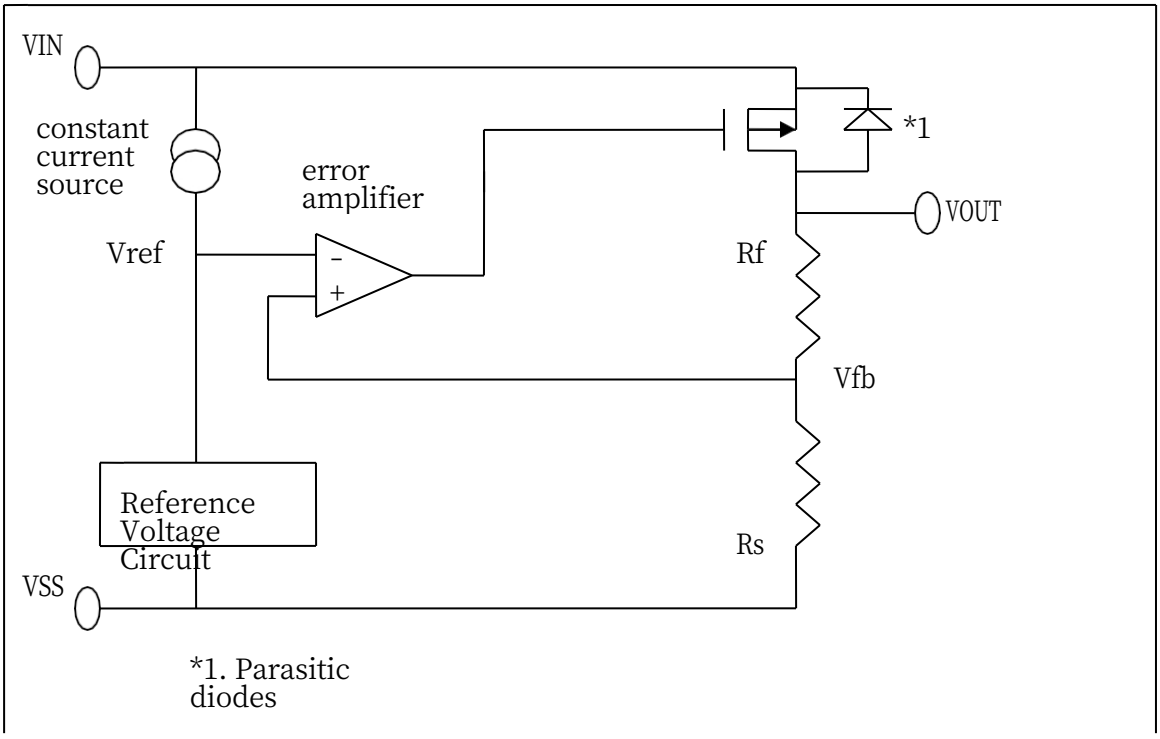
■ Explanation of terminology

1. Low Differential Voltage Regulators
   Voltage regulators with low dropout voltage using built-in low on-state resistance transistors.
2. Output Voltage (VOUT)
   Output Voltage, Input Voltage*1, Output Current, Temperature Under certain conditions, an output voltage accuracy of +2.0% is guaranteed.
   *1. Varies by product.
   Note When these conditions change, the value of the output voltage also changes, which may cause the accuracy of the output voltage to exceed the above range. For details, refer to Electrical Characteristics, and Data for Each Characteristic.
3. Input Stability {ΔVOUT1/ΔVIN*VOUT}
   Indicates the dependence of the output voltage on the input voltage. That is, the amount of change in output voltage with the change in input voltage when the output current is certain.
4. Load Stability (ΔVOUT2)
   Indicates the dependence of output voltage on output current. That is, the amount of change in output voltage with the change in output current when the input voltage is certain.
5. Input-output voltage difference (Vdrop)
   Indicates the difference between the input voltage VIN1 and the output voltage when the input voltage VIN is slowly reduced and the output voltage drops to 98% of the output voltage value VOUT (E) when VIN=VOUT+2.0V. Vdrop = VIN1 - (VOUT (E) x 0.98)

■ Job description

1. Groundwork

Figure 11 shows the block diagram of the MD53UXX series.
The input voltage Vfb of the error amplifier is the same as the reference voltage according to the voltage divider resistor consisting of feedback resistors Rs and Rf. (Vref) is compared. This error amplifier provides the necessary gate voltage to the output transistor so that the output voltage remains constant regardless of input voltage or temperature variations.


VIN
constant
current
source
error
amplifier
*1
VOUT
Vref
Rf
Vfb
Reference
Voltage
Circuit
Rs
VSS
*1. Parasitic
diodes

2. Output Transistor

The output transistors of the MD53UXX series utilize P-channel MOSFET transistors with low on-state resistance.

The transistor is constructed with a parasitic diode between the VIN-VOUT terminals, and when the potential of VOUT is higher than that of VIN, the IC may be destroyed due to reverse current. Therefore, please make sure that VOUT does not exceed V IN by more than 0.3V.

3. Short-circuit protection circuit

The MD53UXX series is designed to operate in the VOUT-VSS

Protects the output transistor in the event of a short circuit between the terminals, and can be selected to short-circuit protect even if the

The output current can be suppressed by approximately 40 mA even when the VOUT-VSS terminals are short-circuited.

However, the short-circuit protection circuit does not also have a heating protection function, so under conditions of use that include a short-circuit condition, sufficiently Pay attention to the conditions of input voltage and load current to ensure that the power consumption of the IC does not exceed the allowable power consumption of the package. Even when there is no short circuit, if a large current is output and the voltage difference between input and output is large, the short circuit protection circuit starts to operate to protect the output transistor and the current is limited to the specified value.

Output Capacitor (CL) Selection

For the MD53UXX Series, a phase compensation circuit and the ESR (Equivalent Series Resistance) of the output capacitor are used inside the IC for phase compensation in order to stabilize operation even when the output load varies. Therefore, be sure to use a capacitor (CL) of 2.2uF or more between VOUT-VSS.

For stable operation of the MD53UXX Series, it is necessary to use a capacitor with an appropriate range of ESR. A large or small ESR compared to the appropriate range (0.5 to 5Ω or so) may cause output instability and oscillation. Therefore, tantalum electrolytic capacitors are recommended.

If a ceramic capacitor or OS capacitor with a small ESR is used, it is necessary to add a resistor to replace the ESR in series with the output capacitor. The value of the resistor to be added is about 0.5 to 5Ω, depending on the conditions of use, so please make a decision after thorough measurement and verification. In general, it is recommended to use a resistor of about 1.0Ω.

Aluminum electrolytic capacitors may increase ESR and cause oscillation at low temperatures. Please note that the ESR of aluminum electrolytic capacitors may increase at low temperatures and cause oscillation. When in use

Please make sure that the temperature characteristics are adequately verified by testing.

■ Caution.

- Wiring of the VIN terminal, VOUT terminal, and GND, pay full attention to the wiring method in order to reduce impedance. In addition, please connect the output power as much as possible to the VIN terminal, VOUT terminal and GND.

The container is connected near the VOUT.VSS terminal.

-Please note that the output voltage may sometimes rise when the linear voltage regulator is normally used at low load current (1.0 mA or less).

-This IC uses a phase compensation circuit inside the IC and the ESR of the output capacitor for phase compensation. Therefore, be sure to use a capacitor of 2.2 μF or more between the VOUT-VSS terminals. Tantalum capacitors are recommended.

In addition, in order for the MD53UXX series to operate stably, it is necessary to use a capacitor with an ESR in the appropriate range (0.5 ~ 5Ω). A small or large ESR compared to the appropriate range may cause the output to become unstable and may result in oscillation. Therefore, the decision should be made only after sufficient measurement and verification under actual operating conditions.

-Please note that oscillation occurs when the impedance of the power supply is high, and when no capacitor is connected to the input of the IC or when the value of the connected capacitor is very small.

-Please pay attention to the use conditions of input/output voltage and load current so that the power consumption in the IC does not exceed the allowable power consumption of the package.

Although this IC has a built-in anti-static protection circuit, do not apply excessive static electricity to the IC that exceeds the performance of the protection circuit.

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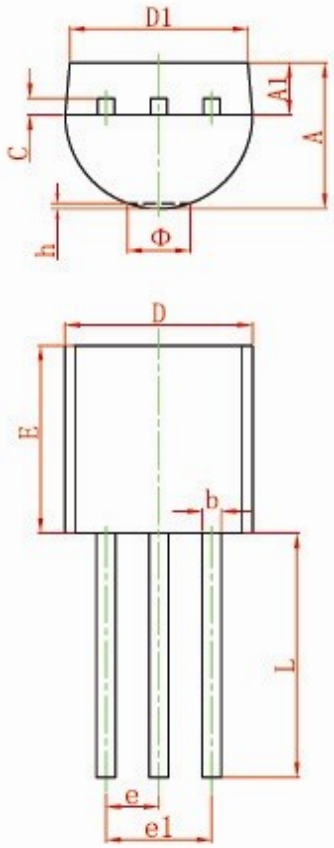
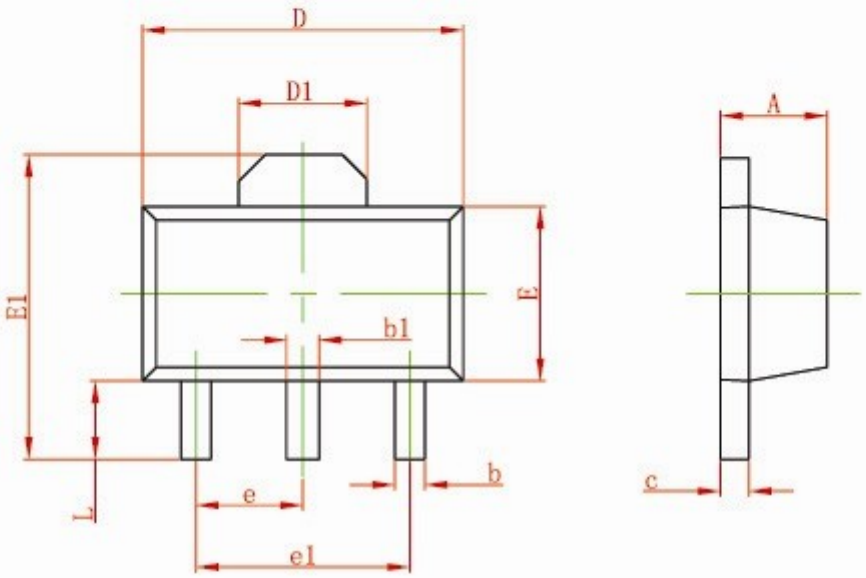
TO-92 PACKAGE OUTLINE DIMENSIONS



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	3.300	3.700	0.130	0.146
A1	1.100	1.400	0.043	0.055
b	0.380	0.550	0.015	0.022
c	0.360	0.510	0.014	0.020
D	4.400	4.700	0.173	0.185
D1	3.430		0.135	
E	4.300	4.700	0.169	0.185
e	1.270 TYP		0.050 TYP	
e1	2.440	2.640	0.096	0.104
L	14.100	14.500	0.555	0.571
Φ		1.600		0.063
h	0.000	0.380	0.000	0.015

封装尺寸

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	0.197
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 TYP		0.060TYP	
e1	3.000 TYP		0.118TYP	
L	0.900	1.200	0.035	0.047