Low Quiescent Current_Low Dropout CMOS Voltage Regulator

AD73XX Series 300mA

■ Ferture:

- high output voltage accuracy ±2%
- low dropout voltage 3.0mV Iout=1mA
- low quiescent current 1.2uA
- Max input voltage 15V
- Output current 300mA

■ Applications

- Power source for home electric/electronic appliances
- Power source for battery-powered devices
- Power source for personal communication devices

■ Selection table

Part NO.	Output voltage (Note)	Tolerance	MARK SOT-89 TO-92	MARK SOT-23-3
AD7315	1.5V	±2%	MD3-15	M15
AD7318	1.8V	±2%	MD3-18	M18
AD7325	2.5V	±2%	MD3-25	M25
AD7328	2.8V	±2%	MD3-28	M28
AD7330	3.0V	±2%	MD3-30	M30
AD7333	3.3V	±2%	MD3-33	M33
AD7336	3.6V	±2%	MD3-36	M36
AD7344	4.4V	±2%	MD3-44	M44
AD7350	5.0V	±2%	MD3-50	M50

NOTE: for semi_custom parts selectable output voltage from 1.2~7.0V in 0.1v increment

■ Package and Pin Assignment

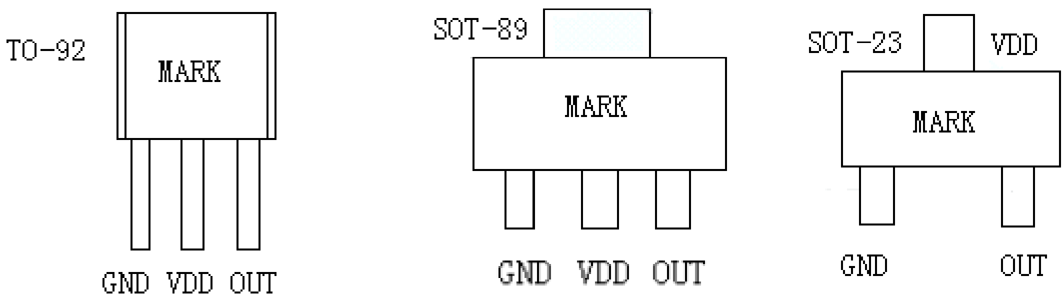


Figure 1

■ Absolute Maximum Ratings：

(Ta=25℃ unless otherwise specified)

Item	symbol	Absolute Maximum Ratings	Unit
Input voltage	V_{in}	18	V
Output voltage	V_{out}	ss-0.3~ VIN+0.3	
power dissipation	P_D	SOT_89 500	mW
		T092 300	
		SOT_23 200	
Operation temperature range	Topr	-40~+85	℃
Storage temperature range	Tstg	-40~+125	

Caution The absolute maximum ratings are rated values exceeding which the product could suffer physical damage. These values must therefore not be exceeded under any conditions.

■ Electrical Characteristics：

AD73XX series（AD7315，Output voltage +1.5V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=3.5V，I_{OUT}=10mA	1.470	1.5	1.530	V	1
Output current *1	I_{OUT}	V_{IN}= 3.5V	100			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=5 mA		120		mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	2.5V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=3.5V 1.0mA≤I_{OUT}≤100mA		45	90	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=3.5V，I_{OUT}=1mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7318，Output voltage +1.8V）　（Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=3.8V，I_{OUT}=10mA	1.764	1.800	1.836	V	1
Output current *1	I_{OUT}	V_{IN}= 3.8V	200			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=10 mA		120		mV	1
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \cdot V_{OUT}}$	2.5V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	ΔV_{OUT2}	V_{IN}=3.8V 1.0mA≤I_{OUT}≤150mA		45	90	mV	
Temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \cdot V_{OUT}}$	V_{IN}=3.8V，I_{OUT}=1mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7325，Output voltage +2.5V）　（Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=4.5V，I_{OUT}=50mA	2.450	2.500	2.550	V	1
Output current *1	I_{OUT}	V_{IN}= 4.5V	250			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=50 mA		5 150		mV	1
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \cdot V_{OUT}}$	3.5V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	ΔV_{OUT2}	V_{IN}=4.5V 1.0mA≤I_{OUT}≤250mA		45	90	mV	
Temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \cdot V_{OUT}}$	V_{IN}=4.5V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7328，Output voltage +2.8V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=4.8V，I_{OUT}=50mA	2.744	2.800	2.856	V	1
Output current *1	I_{OUT}	V_{IN}= 4.8V	300			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=50 mA		5 120		mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.8V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	1
Load regulation	$\triangle V_{OUT2}$	V_{IN}=4.8V 1.0mA≤I_{OUT}≤300mA		60	100	mV	1
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=4.8V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	1
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				10	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7330，Output voltage +3.0V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=5.0V，I_{OUT}=10mA	2.940	3.000	3.060	V	1
Output current *1	I_{OUT}	V_{IN}= 5.0V	300			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=100 mA		5 250		mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.0V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	1
Load regulation	$\triangle V_{OUT2}$	V_{IN}=5.0V 1.0mA≤I_{OUT}≤300mA		60	100	mV	1
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=4.0V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	1
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7333，Output voltage +3.3V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=5.3V，I_{OUT}=10mA	3.234	3.300	3.366	V	1
Output current *1	I_{OUT}	V_{IN}= 5.3V	300			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=100 mA		5 220		mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.3V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=5.3V 1.0mA≤I_{OUT}≤300mA		60	100	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=5.3V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7336，Output voltage +3.6V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=5.6V，I_{OUT}=10mA	3.528	3.600	3.672	V	1
Output current *1	I_{OUT}	V_{IN}= 5.6V	300			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=100 mA		5 200		mV	1
Line regulation	$\frac{\triangle V_{OUT1}}{\triangle V_{IN} \cdot V_{OUT}}$	4.6V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	$\triangle V_{OUT2}$	V_{IN}=5.6V 1.0mA≤I_{OUT}≤300mA		60	100	mV	
Temperature coefficient	$\frac{\triangle V_{OUT}}{\triangle Ta \cdot V_{OUT}}$	V_{IN}=5.6V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7344，Output voltage +4.4V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=6.4V，I_{OUT}=10mA	4.312	4.400	4.488	V	1
Output current *1	I_{OUT}	V_{IN}= 6.4V	300			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=100 mA		5 180		mV	1
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \cdot V_{OUT}}$	5.4V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	ΔV_{OUT2}	V_{IN}=6.4V 1.0mA≤I_{OUT}≤300mA		60	100	mV	
Temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \cdot V_{OUT}}$	V_{IN}=5.4V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

AD73XX series（AD7350，Output voltage +5.0V） （Ta=25℃ unless otherwise specified）

ITEM	SYMBOL	CONDITIONS	MIN	TYPE	MAX	UNITS	Test circuits
Output voltage	V_{OUT}	V_{IN}=7.0V，I_{OUT}=50mA	4.900	5.000	5.100	V	1
Output current *1	I_{OUT}	V_{IN}= 7.0V	300			mA	3
Dropout voltage *2	V_{drop}	I_{OUT}=1 mA I_{OUT}=100 mA		5 180		mV	1
Line regulation	$\frac{\Delta V_{OUT1}}{\Delta V_{IN} \cdot V_{OUT}}$	6.0V≤V_{IN}≤15V I_{OUT}=1mA		0.05	0.2	%/V	
Load regulation	ΔV_{OUT2}	V_{IN}=7.0V 1.0mA≤I_{OUT}≤300mA		60	100	mV	
Temperature coefficient	$\frac{\Delta V_{OUT}}{\Delta Ta \cdot V_{OUT}}$	V_{IN}=7.0V，I_{OUT}=10mA -40℃≤Ta≤85℃		±50	±100	Ppm/℃	
Current consumption	I_{SS1}	V_{IN}=15V No Load		1.2	2.5	uA	2
Input voltage	V_{IN}				15	V	
Short current limit	I_{lim}	Vout=0V		15	50	mA	

*1. Increasing output current slowly , The I_{OUT} when output voltage decreasing two percent

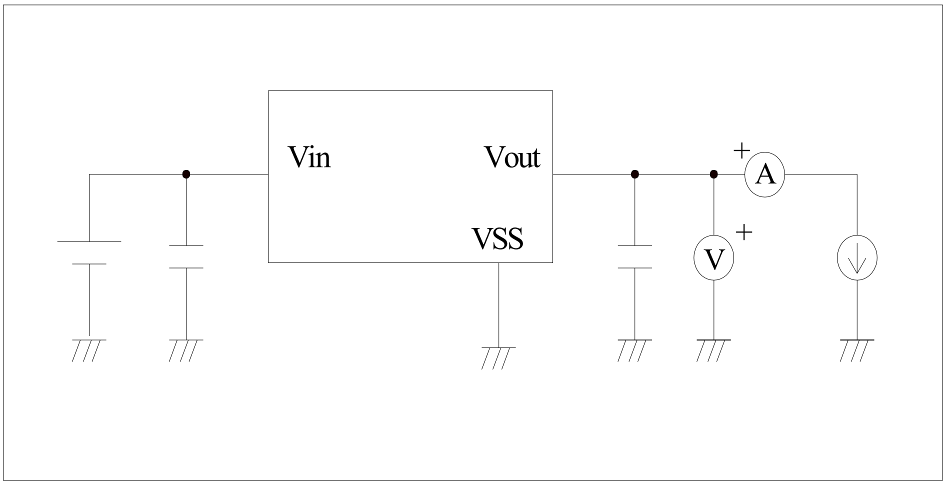
* 2.V_{drop}=V_{IN1}-($V_{OUT(E)}$ × 0.98V)

$V_{OUT(E)}$ Effective output voltage, i.e., the output voltage when fixing I_{OUT}(1mA) and inputting $V_{OUT(S)}$ 2.0 V.

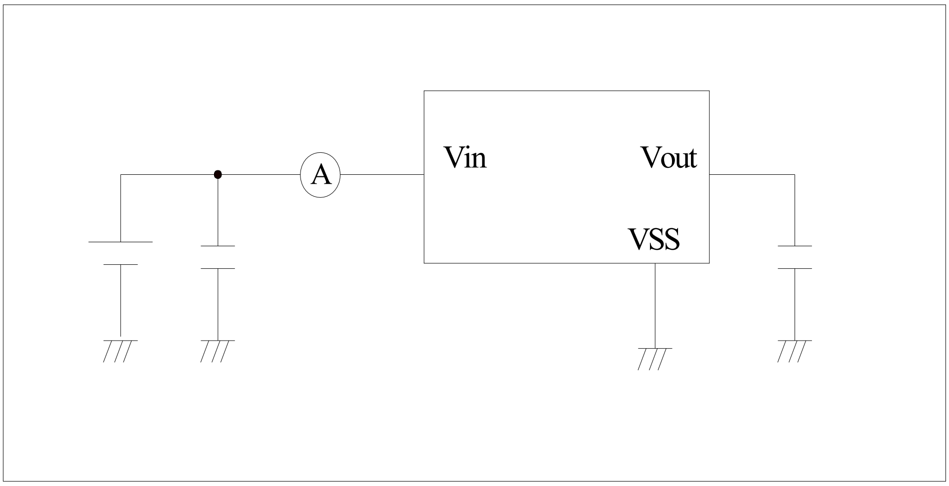
V_{IN1}： is the Input voltage at which output voltage becomes 98 of $V_{OUT(E)}$ after gradually decreasing input voltage

Test Circuits：

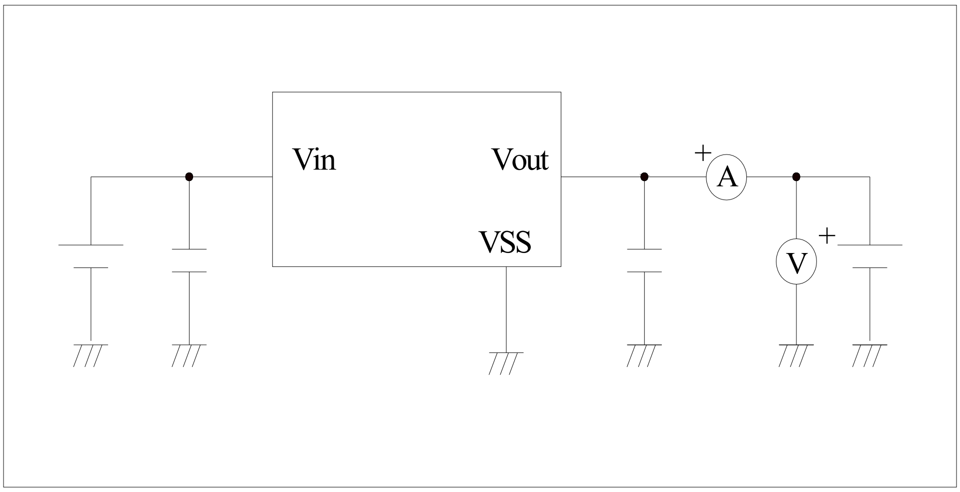
1.



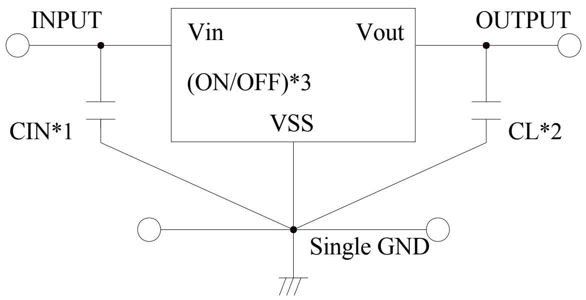
2.



3.



Standard Circuit:



*1. C_{IN} is a capacitor for stabilizing the input.
*2.A ceramic capacitor can be used for C_L besides a tantalum capacitor.
*3.In case of product with shutdown function.
Caution the above connection diagram and constant will not guarantee successful operation.
Perform through evaluation using the actual application to set the constant.
Input capacitors(CIN): >1.0 μF.
Output capacitors(CL): >2.2μF(tantalum capacitors)Or
>10.0μF(tantalum capacitors).

■Technical Terms

1. Output capacitors（CL）

Output capacitors are generally used to stabilize regulation operation and to improve transient response characteristics. But the AD73XX series can provide stable operation without output capacitors. Capacitors are used only to improve transient response characteristics. Output capacitors can hence be removed in applications in which transient response can be negligible. When an output capacitor is used, a low ESR (Equivalent Series Resistance) capacitor like ceramic capacitor can also be used.

2. Output voltage (VOUT)

The accuracy of the output voltage is ± 2.0% guaranteed under the specified conditions for input voltage, which differs depending upon the product items, output current, and temperature. Caution: If the above conditions change, the output voltage value may vary and go out of the accuracy range of the output voltage. See the electrical characteristics and characteristics data for details.

3. Line regulations (ΔVOUT1/ΔVIN*VOUT)

These parameters indicate the input voltage dependence on the output voltage. That is, the values show how much the output voltage changes due to a change in the input voltage with the output current remained unchanged.

4. Load regulation(ΔVOUT2)

This parameter indicates the output current dependence on the output voltage. That is, the value shows how much the output voltage changes due to a change in the output current with the input voltage remained unchanged.

5. Dropout voltage (Vdrop)

This parameter indicates the difference between the input voltage (VIN1) and the output voltage when output voltage falls to 98% of VOUT(E) by gradually decreasing the input voltage (VIN). Vdrop = VIN1-[VOUT(E) × 0.98]

■Description of Operation

1.Basic Operation

Figure 8 shows the block diagram of the AD73XX series.The error amplifier compares a reference voltage Vref with a part of the output voltage divided by the feedback resistors Rs and Rf, and supplies the gate voltage to the output transistor, necessary to ensure certain output voltage independent from change of input voltage and temperature.

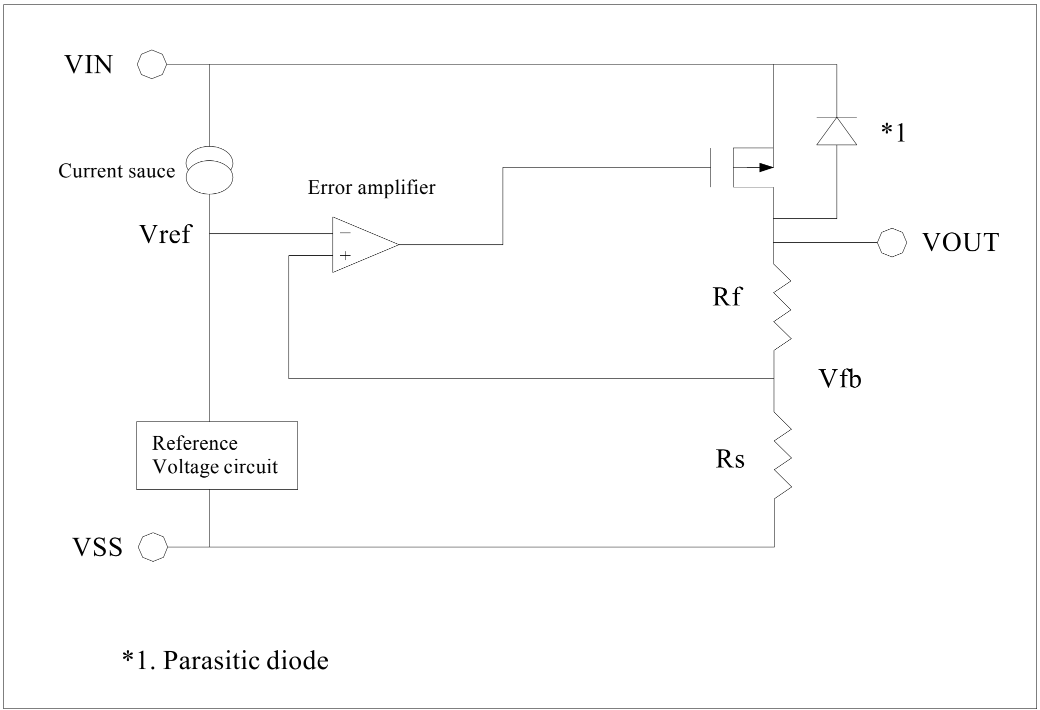


Figure 8

2.Output Transistor

Output AD73XX Series uses a Pch MOSFET as the output transistor.

The voltage at VOUT must not exceed VIN+0.3V. When the VOUT voltage becomes higher than that of VIN, reverse current flows and may break the regulator since a parasitic diode between VOUT and VIN exists inevitably

3. Short-circuit protection

Installation of the short-circuit protection which protects the output transistor against short-circuit between VOUT and VSS can be selected in the AD73XX series. The short-circuit protection controls output current as shown in the typical characteristics, (1) OUTPUT VOLTAGE versus OUTPUT CURRENT, and suppresses output current at about 40mA even if VOUT and VSS pins are short-circuited.

The short-circuit protection can not at the same time be a thermal protection. Attention should be paid to the Input voltage and the load current under the actual condition so as not to exceed the power dissipation of the package including the case for short-circuit.

When the output current is large and the difference between input and output voltage is large even if not shorted, the short-circuit protection may work and the output current is suppressed to the specified value. Products without short-circuit protection can provide comparatively large current by removing a short-circuit protection.

■Selection of External Components

Output capacitor(CL)
The AD73XX series can provide stable operation without output capacitor (CL) since the regulator has an internal phase compensation circuit to stabilize operation when the load changes. The transient response of the regulator, however, changes with the output capacitor and the magnitude of overshoot and undershoot on output voltage accordingly changes. Please refer to CL dependence data in “Transient Response Characteristics” to select suitable value for the capacitor.
When a tantalum or an aluminum electrolytic capacitor is used, the ESR of the capacitor shall be 10Ω or less. When an aluminum electrolytic capacitor is used attention should be especially paid to since the ESR of the aluminum electrolytic capacitor increases Precautions: Design wiring patterns for VIN, VOUT and GND pins to hold low impedance. hen mounting an output capacitor between the VOUT and VSS pins (CL) and a ng the input between VIN and VSS pins (CIN), the distance from the . regulator may oscillate when power source impedance is high and input capacitor · The appad current should not exceed the nditions for input/output voltage and load current so atic discharge to this IC that exceeds the performance rd pplication Circuits sic Circuits at low temperature and possibility of oscillation becomes large. Sufficient evaluation including temperature characteristics is indispensable.

■Precautions:

・Design wiring patterns for V_{IN}, V_{OUT} and GND pins to hold low impedance. When mounting an output capacitor between the V_{OUT} and VSS pins (CL) and a capacitor for stabilizing the input between V_{IN} and V_{SS} pins (C_{IN}), the distance from the capacitor to the V_{OUT} pin and to the V_{SS} pin should be as short as possible.

• Note that output voltage may be increased at low load current of less than 1uA.

• To prevent oscillation, it is recommended to use the external parts under the following conditions.

Equivalent Series Resistance (ESR): 30Ωor less
Input series resistance (R_{IN}): 10Ωor less

• A voltage regulator may oscillate when power source impedance is high and input capacitor is low or not connected.

• The application condition for input voltage and load current should not exceed the package power dissipation.

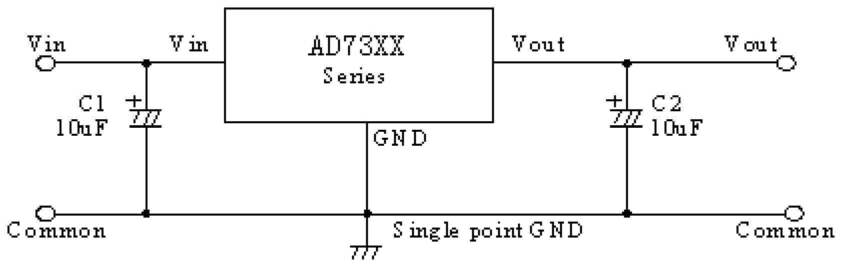
• Pay attention to the operating conditions for input/output voltage and load current so that the power loss in the IC does not exceed the power dissipation of the package.

• Do not apply an electrostatic discharge to this IC that exceeds the performance ratings of the built-in electrostatic protection circuit.

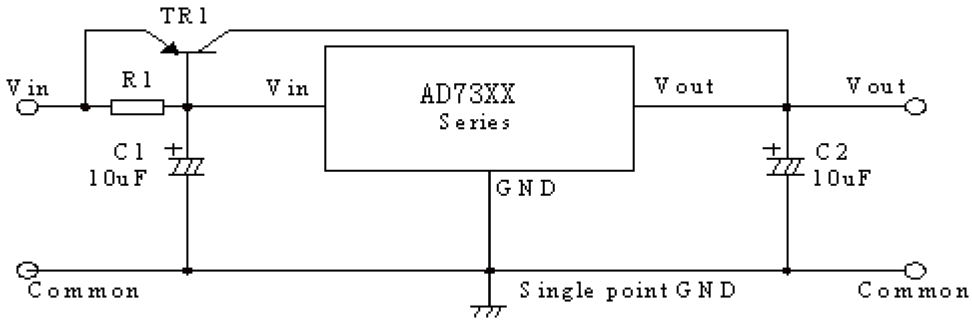
• SII claims no responsibility for any and all disputes arising out of or in connection with any infringement of the products including this IC upon patents owned by a third party.

Application Circuits

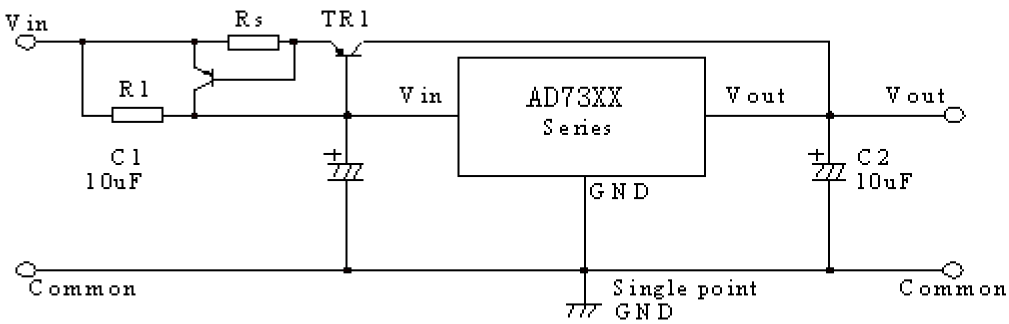
Basic Circuits



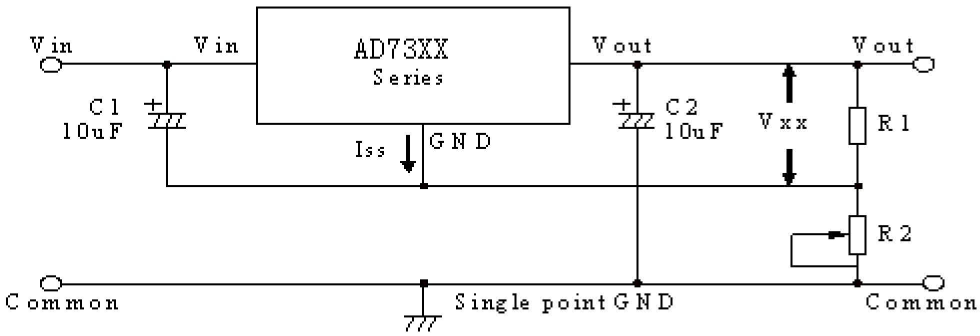
High Output Current Positive Voltage Regulator



Short-Circuit Protection by Tr1

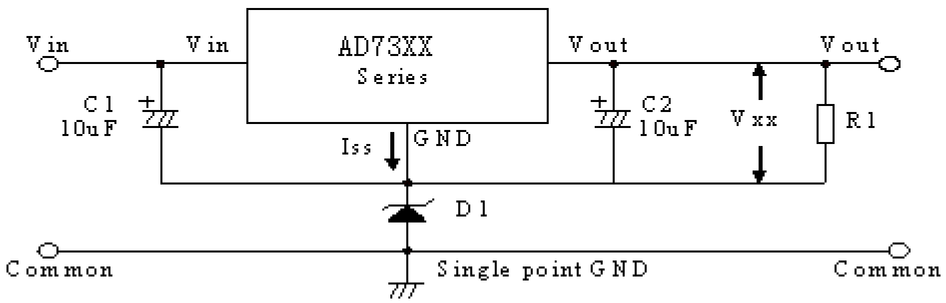


Circuit for Increasing Output Voltage



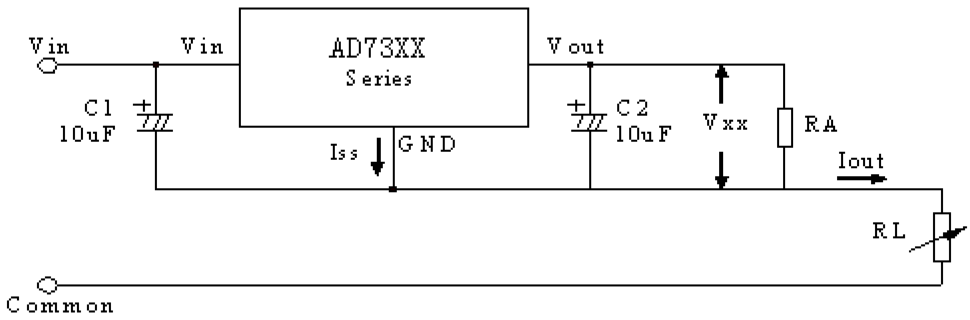
$V_{OUT}=V_{XX}(1+R2/R1)+Iss \times R2$

Circuit for Increasing Output Voltage



$V_{OUT}=V_{XX}+V_{D1}$

Constant Current Regulator



$I_{OUT}=V_{xx}/RA+I_{ss}$

Dual Supply