XC62KN Series Negative Voltage Regulators

Application Notes

=============== **Index** ===============

Torex Semiconductor Ltd.

WARNING
As the voltage regulator depends on not only the IC's characteristics but also on those of the load / Input capacitors and the surrounding circuitry, please fully ensure that the 'notes on use' provided are followed. In actual operation we suggest that you allow ample margins above the recommended specifications and take the IC's and the peripheral's absolute maximum ratings into consideration.

❍ Introduction

The XC62KN series is a group of negative voltage output, three-pin regulators, that provide a high current even when the input/output voltage differential is small. Low power consumption and high accuracy is achieved through CMOS and laser trimming technologies.

The series consists of a high-precision voltage reference, an error correction circuit and a current limited output driver.

SOT-23 (150mW) and SOT-89 (500mW) packages are available.

❍ Load / Input Capacitors

The following explanation concerns the large influence that the load and input capacitors have on the voltage regulator.

1. Load Capacitor CL

In general, the connection of a load capacitor CL is necessary when using voltage regulators in order to safeguard operations, protect against oscillation and provide a high quality output.

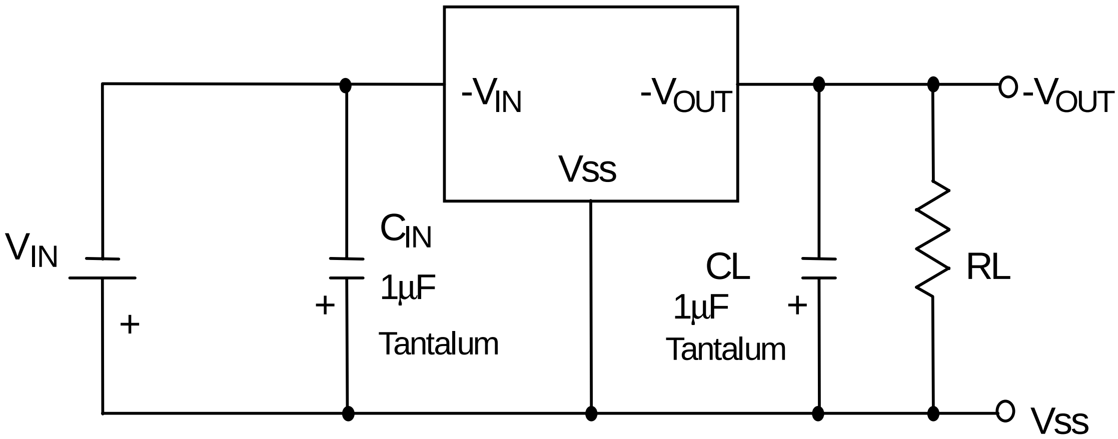


Diagram 1.   XC62KN series standard circuit

With the XC62KN series, the capacitance of the load capacitor CL is standardized at 1μF (Tantalum). Should there be no capacitor or only a capacitor with a relatively small capacitance value, the phase margin will become smaller and oscillation may occur. Do not use ceramic capacitors and capacitors where the ESR value is small as there is again the possibility that the phase margin will become smaller and oscillation could occur. The load capacitor is regulated by load current. Should the value of the current exceed 100mA or should there be a large load change in the region of between 10mA to 100mA, stability can be improved by increasing load capacitance by between 3.3 to 22μF (Tantalum).

2. Input Capacitor C_{IN}

It is recommended that an input capacitor be connected to the input side of the IC in order to prevent oscillation that may occur as a result of input voltage changes, and to lower the level of impedance between the IC's input pin and the power supply.

It is further recommended that an input capacitor with a C_{IN} capacitance value of more than 1.0μF be used, as when the level of impedance up to the IC's input is high, operations may become unstable and oscillation could occur.

Please note that it is possible to use a ceramic condenser of low ESR with input capacitor C_{IN}.

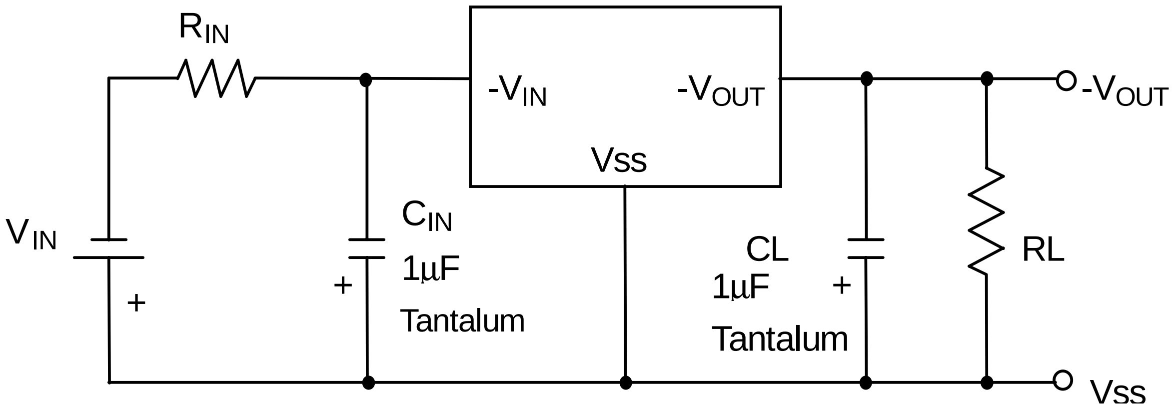


Diagram 2.   Input impedance circuit example

❍ Notes on Use

1. Oscillation

There is a possibility that oscillation may occur as a result of the impedance present between the power supply and the IC's input. Where impedance is 10Ω or more, please use a capacitor C_{IN} (Tantalum) of at least 1.0μF. Further, with large output currents, operations can be stabilized by increasing the capacitance value of C_{IN}. If C_{IN} is small and the capacitance value of C_L is increased, there exists the possibility of oscillation occurring due to input impedance. In such cases, operations can be stabilized by either increasing the value of C_{IN} or decreasing the value of C_L.

2. Power Dissipation Pd

Please take ample care not to exceed the stipulated power dissipation Pd for the package. Ensure that output current (I_{OUT}) is less than Pd ÷ (V_{IN} – V_{OUT}).

The XC62KN comes in SOT-23 and SOT-89 packages with respective power dissipation values of 150mW and 500mW. Please also note that these figures represent Pd values when Ta=25°C. Be aware that the value for Pd will fall should ambient temperature rise.

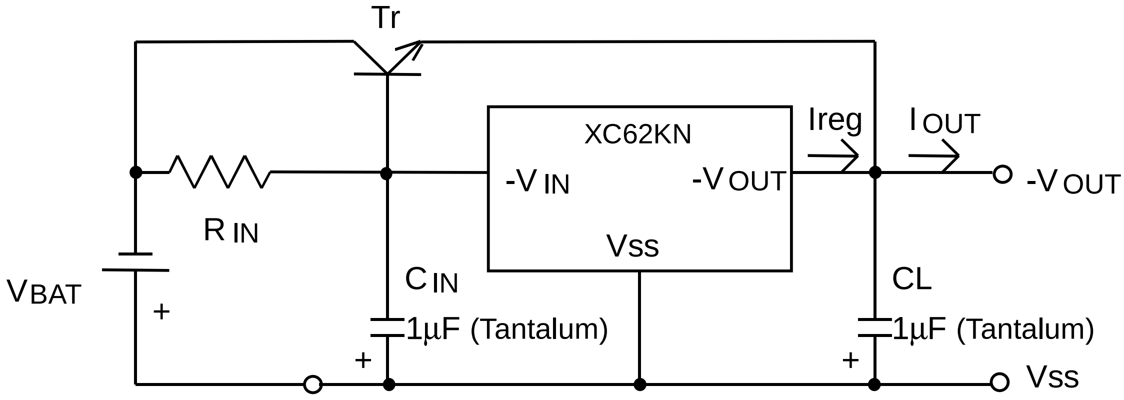
3. Peripheral Layout

Please locate the input capacitor C_{IN} and the load capacitor C_L as close to the IC as is possible and use short, thick wires in order to reduce wiring impedance and stabilize operations.

Should the distance between the IC and the load circuit be too great, output may become unstable if large current fluctuations exist on the load circuit side. Therefore, in order to stabilize output, it is recommended that a capacitor be connected close to both the IC and the load circuit.

❍ Application Circuits

1. Output current increases in relation to the external transistor.



XC62KN3002MR

Peripherals :

Tr	:	2SD1628D (Toshiba)
C_{IN}	:	1µF (Tantalum capacitor, Nichicon F93)
C_L	:	1µF (Tantalum capacitor, Nichicon F93)
R_{IN}	:	Please refer to the explanation below.

Test Specification Conditions : V_{BAT} = -4V ; $-V_{OUT}$ = -3V

Explanation :

By adding an external transistor and an input resistor (R_{IN}), an output current higher than the IC's established current can be achieved. Please set R_{IN} so that the required output current value can be achieved.

$$R_{IN} = \frac{Vbe}{Ireg - \left(\frac{I_{OUT}}{hfe} \right)}$$

Example :

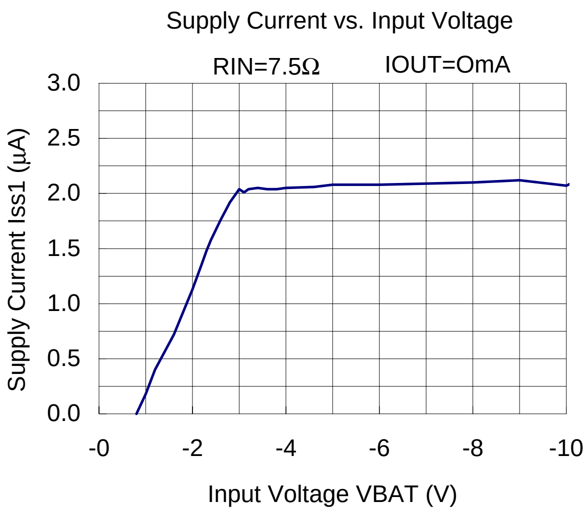
If	Ireg	=	0.08A	IC (max. output current) (at – 3V)
	hfe	=	100	as per the transistor manual
	Vbe	=	0.06V	as per the transistor manual
	I_{OUT}	=	0.4A	required output current

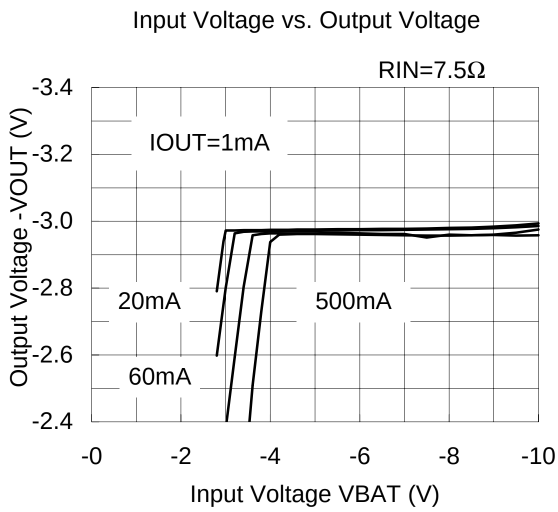
Then R_{IN} = 7.89Ω (data measured at 7.5Ω)

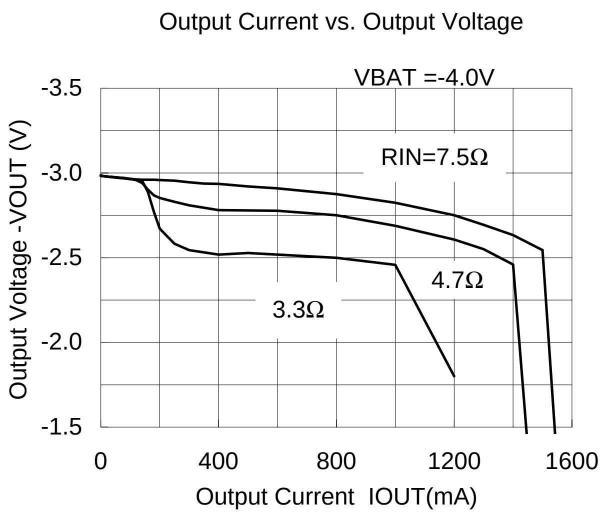
Note :

Please set R_{IN} to less than 10Ω as above 10Ω oscillation may occur. Set Ireg to within the IC's max. output current value.

■ Output current increases in relation to the external transistor

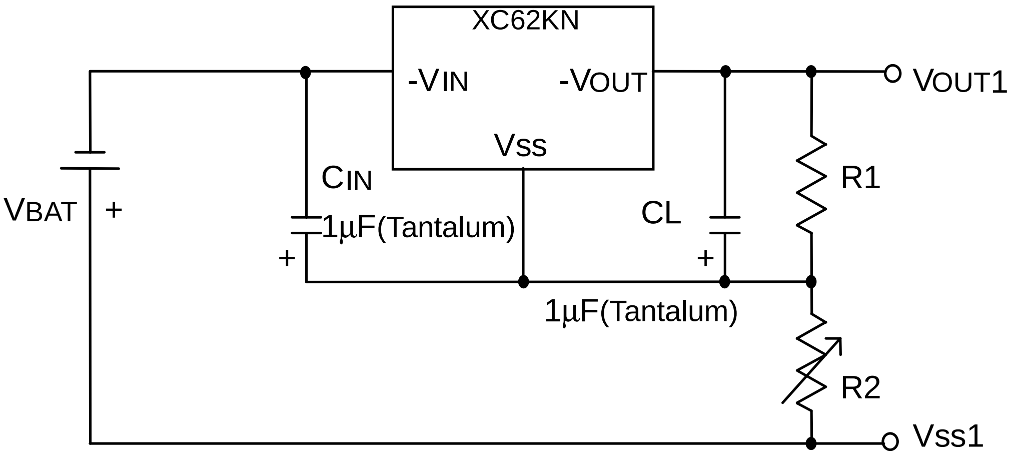






❍ Application Circuits

2. Output voltage variance (divided resistors)



XC62KN3002MR

Peripherals :

CIN	:	1µF (Tantalum capacitor, Nichicon F93)
CL	:	1µF (Tantalum capacitor, Nichicon F93)
R1	:	Please refer to the explanation below.
R2	:	Please refer to the explanation below.

Test Specification Conditions : VBAT = VOUT1 + (-1V) ; VOUT1 = -5V ~ -10V

Explanation :

By adding divided resistors to the output, output voltage can be set-up at will.
Please consult the Torex catalog for the electrical characteristics of ISS.

$$V_{OUT1} = -V_{OUT} \times \left(1 + \frac{R2}{R1}\right) + I_{SS} \times R2$$

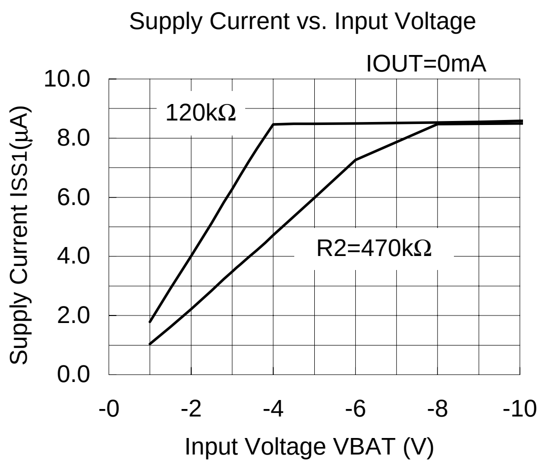
Example :

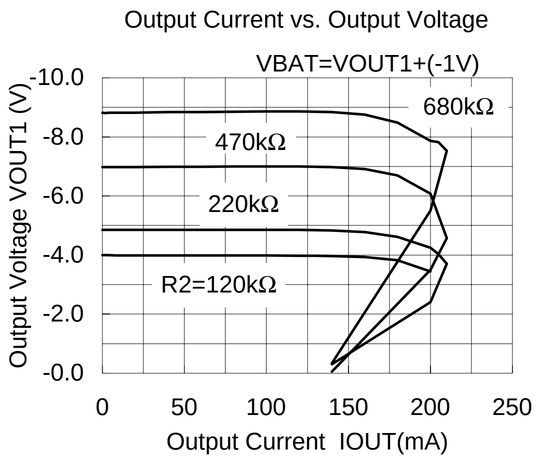
If	-VOUT	=	– 3V
	R1	=	470KΩ
	R2	=	470KΩ
	ISS	=	2.5µA
Then	VOUT1	=	-7.175V

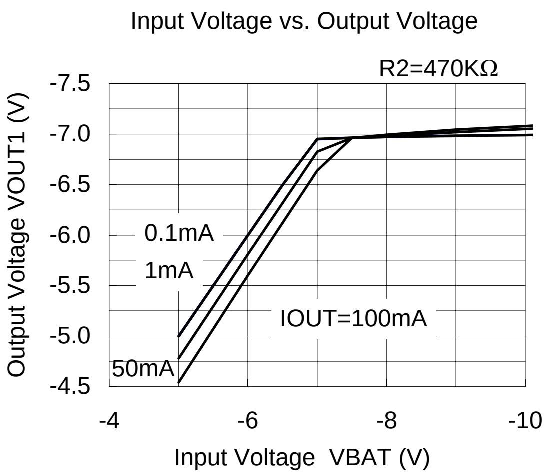
Note :

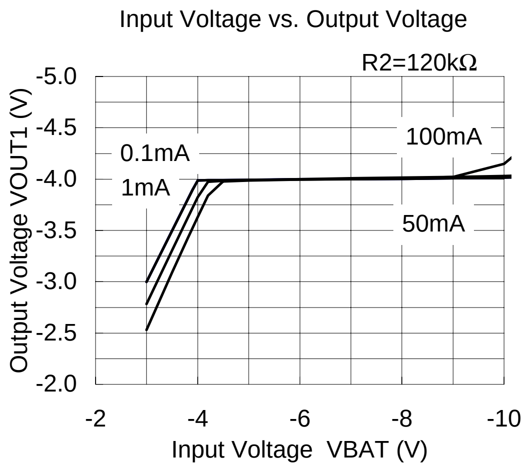
Please use with a voltage of below 10V between the VIN – VSS pins.

■ Output voltage variance (divided resistors)



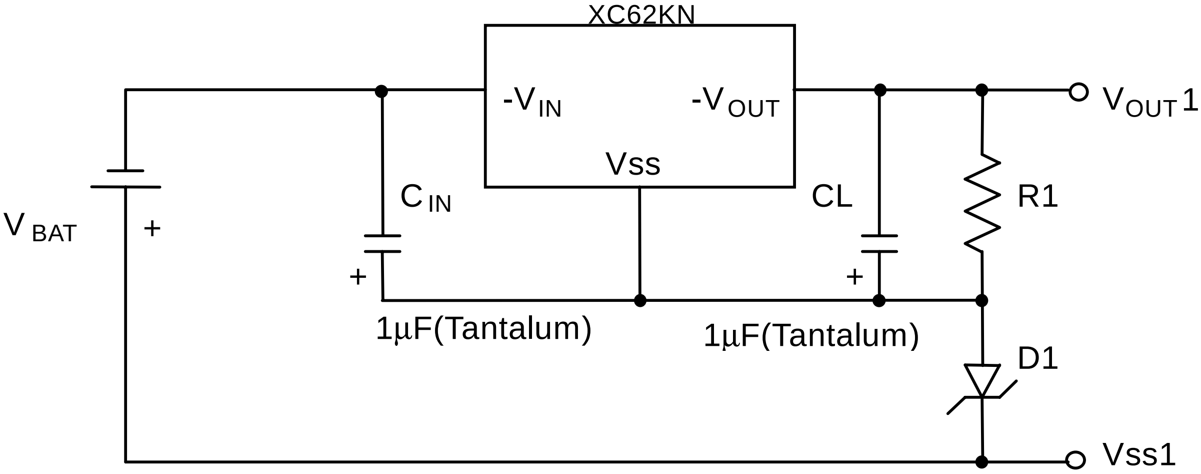






❍ Application Circuits

3. Output voltage variance (zener diode)



XC62KN3002MR

Peripherals :

CIN	:	1µF (Tantalum capacitor, Nichicon F93)
CL	:	1µF (Tantalum capacitor, Nichicon F93)
R1	:	Please refer to the explanation below.
D1	:	Please refer to the explanation below.

Test Specification Conditions : VBAT = VOUT1 + (-1V) ; VOUT1 = -5V ~ -10V

Explanation :

By adding a zener diode to the output, required output voltage can be set-up at will. R1 will be decided according to the zener current. Note that by using a zener diode with a small zener current, supply current can be minimalized.

The required output voltage (VOUT1) equals the IC's established voltage (-VOUT) minus the zener diode's voltage.

Example :

If -VOUT = -3V
R1 = 68KΩ
ZeDi = 6.8V

Then VOUT1 = -9.8V

Note :

Please select a zener diode D1 with as minimal a voltage range and zener current as possible. Please use with a voltage of below 10V between the VIN – VSS pins.

■ Output voltage variance (zener diode)