

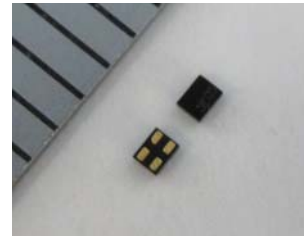
Ultra Small Voltage Regulators with 0.6 μ A Ultra Low Supply Current

XC6504 Series

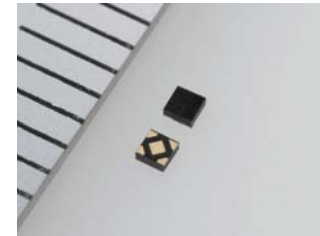


The XC6504 series can operate at an ultra-low supply current of 0.6 μ A, and the output voltage is highly accurate even when the output current is 1 μ A (light load), which making this series ideal for applications that require very little output current. These regulators consist of a reference voltage supply, error amplifier, driver transistor, over-current protection circuit, phase compensation circuit, and other internal components.

A ceramic or other low ESR capacitor can be used for C_L , however, internal phase compensation enables stable operation even without C_L . The IC is put in the stand-by mode by inputting L level in the CE pin, reducing the supply current to 0.1 μ A or less. In the stand-by mode, the electrical charge on C_L can be discharged by an internal switch to quickly return the IC to the V_{SS} level.



USPN-4B02
(0.95 × 0.75 × 0.4mm)



USPQ-4B04
(1.0 × 1.0 × 0.6mm)

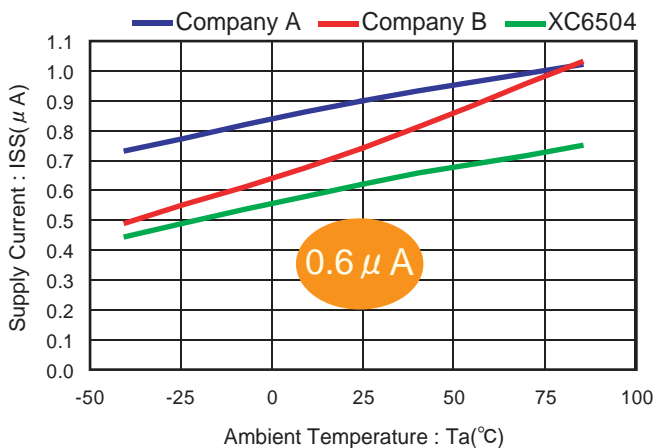


Own supply current of 0.6 μ A is realized

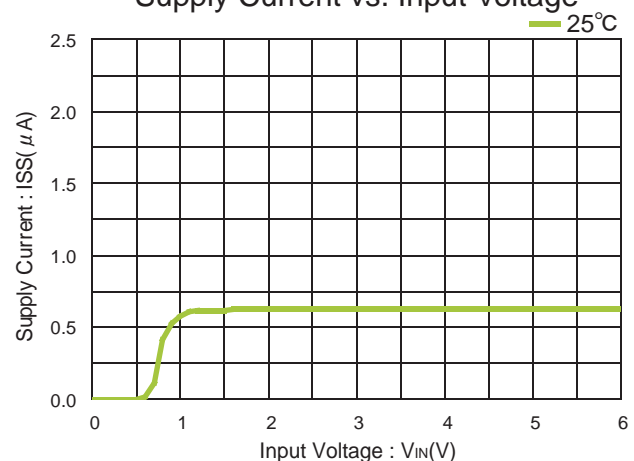
Battery run time is determined by the LDO's own supply current and the current of the system to which the LDO supplies power (load current as seen from the LDO). In cases where a system current of several tens of mA to several hundreds of mA is required, the LDO's own supply current has almost no effect on the battery run time; however, when the operation at a very small current of several mA or less continues over an extended time (when the system is nearly in the standby state, such as waiting for communication), the proportion of the LDO's own supply current to the overall current (system current + LDO's own supply current) increases, and the magnitude of the LDO's own supply current has a large effect on the run time.

The XC6504 series achieves 0.6 μ A for its own supply current, which is the smallest in the industry. This makes it possible to extend the run time of battery-operated devices and contributes to make the battery run time longer.

Comparison of supply current characteristics



XC6504A111
Supply Current vs. Input Voltage



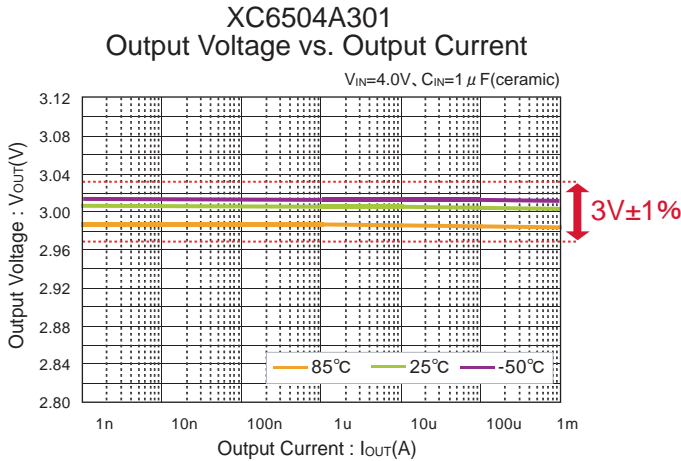
Features			
Input Voltage Range	1.4V~6.0V	Stand-by Current	0.01 μ A
Output Voltage Range	1.1V~5.0V (0.1V increments)	Protection Circuits	Current Limit
Output Voltage Accuracy	$\pm 0.02V @ V_{OUT} < 2.0V, I_{OUT} = 1 \mu A / 1mA$ $\pm 1% @ V_{OUT} \geq 2.0V, I_{OUT} = 1 \mu A / 1mA$	Functions	C_L High-speed Discharge
Maximum Output Current	150mA	Capacitor	Low ESR Capacitor
ON Resistance	3.3 $\Omega @ V_{OUT(T)} = 3.0V$	Packages	USPN-4B02, SSOT-24, SOT-25, USPQ-4B04



Ultra Small Voltage Regulators with 0.6 μ A Ultra Low Supply Current **XC6504 Series**



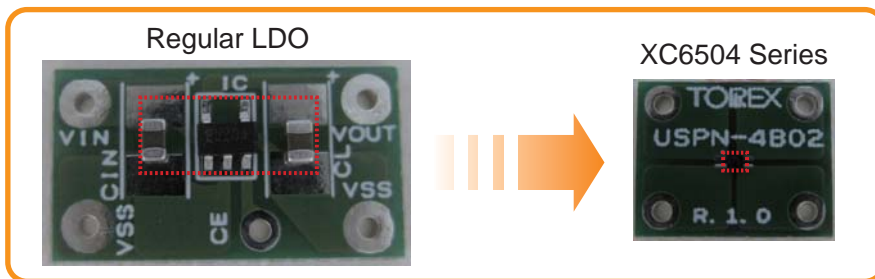
Reduces fluctuations of output voltage at light loads



The accuracy of output voltage at the light loads that are commonly used with low supply current LDOs has been improved. Even at an output current I_{OUT} of 1mA or less, the fluctuations of output voltage with respect to output current are very small, and the increases of output voltage are minimal even at high temperatures.



Ultra-small package and fewer external components with no capacitor reduced the mounting area!



Most of LDOs require that an output capacitor C_L be connected to the output pin to stabilize the output voltage. This is because the output capacitance C_L is used for phase compensation and if there is no C_L , the IC becomes unable to perform phase compensation, and abnormal oscillation occurs in the output. For this reason, it is common practice to connect a capacitor exclusively for the LDO near the LDO output pin. However, the XC6504 series has an internal phase compensation circuit that makes it possible to obtain a stable output voltage without C_L . The Operation is also stable if an output capacitance is temporarily connected, and thus even in cases where a bypass capacitor is connected to an IC on the load side, the XC6504 series can be used without any limitations due to by the capacitor.



Comparison of characteristics to previous products

	XC6504	XC6215	XC6218
Supply Current	0.6 μ A	0.8 μ A	1.0 μ A
Input Voltage Range	1.4V ~ 6.0V	1.5V ~ 6.0V	1.5V ~ 6.0V
Output Voltage Range	1.1V ~ 5.0V	1.1V ~ 5.0V	0.9V ~ 4.0V
Output Voltage Accuracy	$\pm 0.02V @ V_{OUT} < 2.0V$ $\pm 1% @ V_{OUT} \geq 2.0V$	$\pm 30mV (0.9 < V_{OUT} \leq 1.5V)$ $\pm 2% (1.5 < V_{OUT} \leq 5.0V)$	$\pm 30mV (0.9 < V_{OUT} \leq 1.5V)$ $\pm 2% (1.5 < V_{OUT} \leq 4.0V)$
Maximum Output Current	150mA	200mA	200mA
Protection Circuits	Current Limit Short Circuit Protection	Current Limit Short Circuit Protection	Current Limit Short Circuit Protection
Functions	C_L High-speed Discharge	-	-
Packages	USPQ-4B04 USPN-4B02 SSOT-24 SOT-25	USP-4 SSOT-24 SOT-25 USPN-4	USP-3 SSOT-24