

# Product Information for Wearable Devices



**TOIREX**...*Powerfully Small!*

# Expanding use of wearable devices

## Why is Torex power supply solution chosen ?

- Small package profile realizes smaller and thinner devices.
- High-efficiency power supply allows longer battery life.
- High-efficiency power supply reduces heat generation.
- Plentiful lineup ensures you to find the right power supply IC.

### micro DC/DC

Ultra small DC/DC converters with integrated coil based on Torex's unique technology. Our exacting standards as a power IC manufacturer have created this product line without sacrificing DC/DC converter characteristics.

### DC/DC Converters

DC/DC converters that enable configuration of a power supply with high efficiency. Torex has original technology that has been cultivated over many years of product development. Step down DC/DC converters with an efficiency of over 90%. Step-Up DC/DC converters which only consume 6.3μA in operation. Our lineup of power saving products is ideal for wearable devices due to their small size and high efficiency.

### LDO

Electronic devices require a stable power source. We have a high performance lineup of LDO products that let you place the right power source in the right place, from low voltage/low current to high voltage/high current applications. Naturally, these LDOs are small and power saving.



**TOREX**  
Power Solution

### Li-ion Battery Linear Charger IC

A battery is a typical input for a power IC. In particular, Li-ion/polymer batteries are essential for portable devices. Torex has a product lineup especially designed for use with low capacity Li-ion/polymer batteries as used on wearable devices.

### Load Switch

An essential item for the configuration of power circuits in most devices. Our line/load switches incorporate a variety of functions such as current limiting and CL discharge, heightening usage value and providing low resistance.

### Reset IC

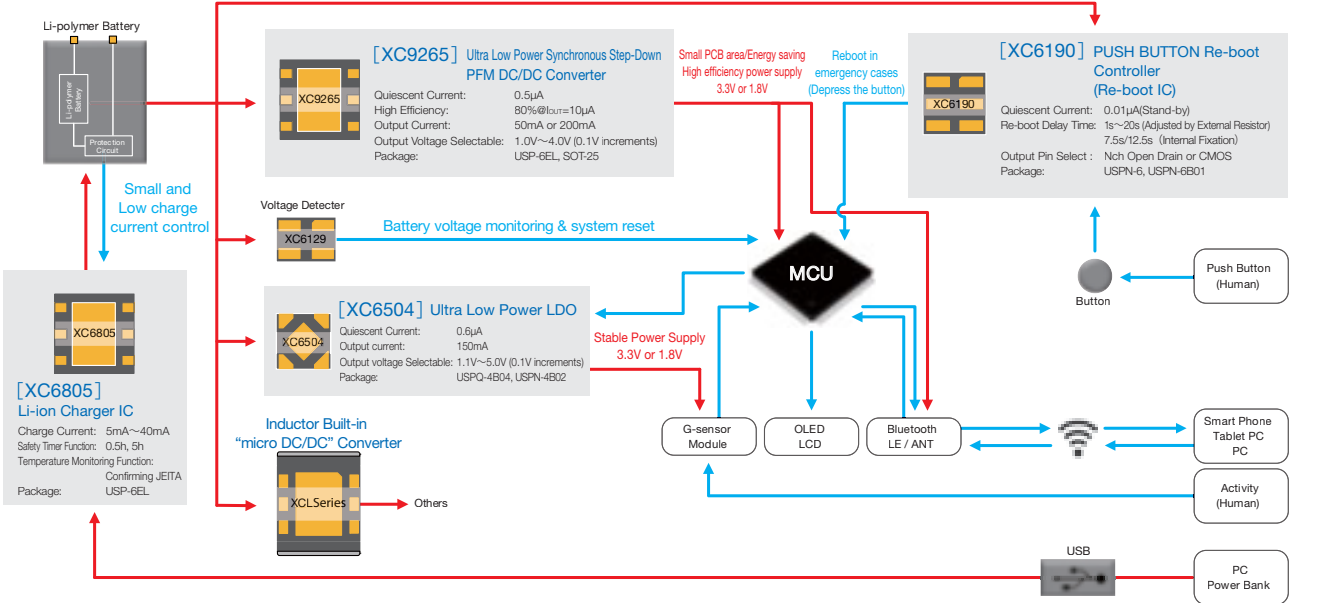
A reset IC is a voltage detector that monitors voltage and sends a signal to the microprocessor. A low quiescent current enables non-stop monitoring of either input voltage or output voltage. High accuracy and stable operation make this IC suitable for microprocessor reset use. A delay time can also be set externally.

### Reboot IC

This is a convenient IC for forced microprocessor reset or system reboot by long press of a button. During normal system operation, the XC6190 waits in standby, consuming just 0.01μA, and when needed, it is ready to operate.

IC cards (smart cards) have come into common use in recent years. The number of cards issued continues to increase dramatically, and use extends over diverse fields, including official identification documents (licenses, passports, ID cards), access control (employee ID cards, student ID cards, restricted area access), medical cards (health insurance cards, consultation tickets), payment cards (credit, debit, and bank cards), and information security (Internet transactions, data access control). The dimensions and thickness (54.0mm×85.6mm×0.76mm) of smart cards is determined by the ISO/IEC7810 international standard. The IC chip in a smart card incorporates an antenna, and is equipped with a recording function, calculation functions, and wireless modules such as RFID and BT. An increasing number of models have a display, and cards with an Li-ion secondary battery are becoming common. These cards use a DC/DC converter, and an LDO and charger IC.

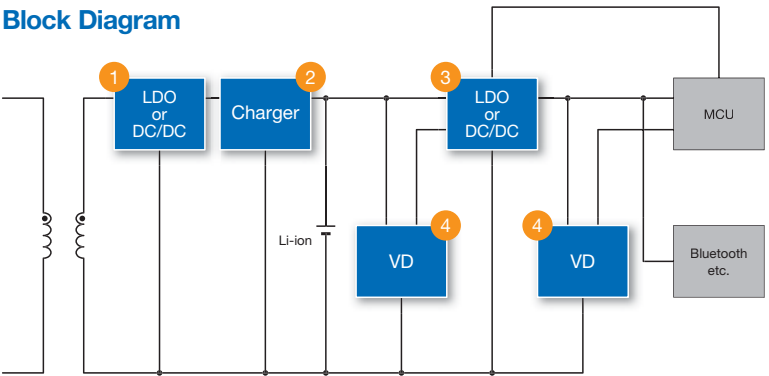
## Example of a power supply configuration solution for the periphery of a microcontroller in a wearable device



Torex Semiconductor power supplies provide a total solution.

## Power solution for smart card

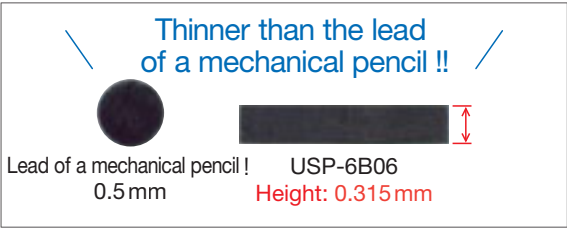
### Block Diagram



- 1 Even when a high voltage is input from the charging system due to the distance or position, the mid-withstand voltage VR XC6216 provides firm support. Moreover, the package height is only 0.33mm.
- 2 The low-charge current XC6805 is ideal for lithium-ion secondary batteries for cards. Charging from a current as low as 5mA is supported.
- 3 A stable power supply is essential for stable operation. You will always find the right power IC in Torex's series of reliable power ICs.  
DC/DC : XC9265 series  
LDO : XC6504 series  
Small and thin sizes are also further evolved.
- 4 This IC handles power voltage monitoring on both the input side and output side. The high-accuracy VD XC6129 series operates at a supply current of only 0.42μA.

## Small and thin package supports smart cards

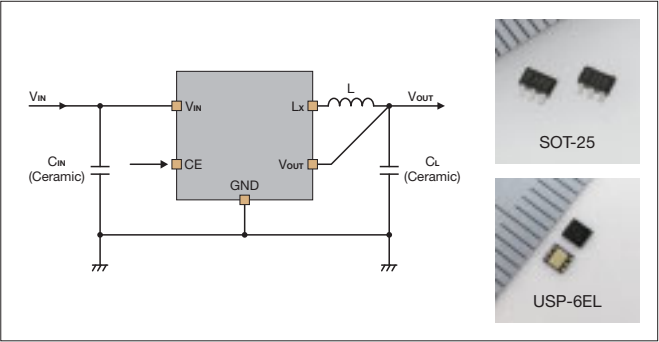
1. Clear height restrictions with our many products of height 0.4 mm or less.
2. Passes bending, strength, and other reliability tests.
3. The low supply current and high efficiency of the power supply IC contribute to a longer battery life.
4. High withstand voltage during non-contact charging.  
(A high charge voltage may be supplied at some distances and in some positions.)



XC9265

Ultra Low Power Synchronous Step-Down PFM DC/DC Converter

Typical Application Circuit



Product Features

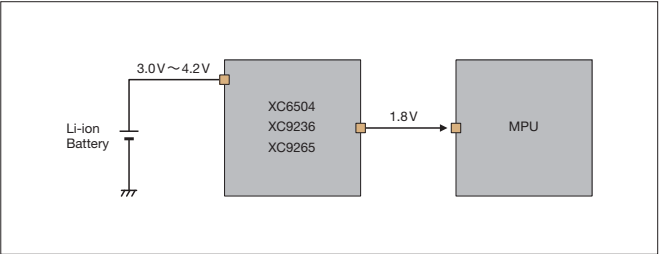
The new XC9265 series consumes only 0.5  $\mu$ A during operation making it ideal for applications that run from batteries for long periods of time. This ultra low quiescent current is achieved by implementing a synchronous PFM architecture to minimize the switching losses during low loads. Developed using Torex's proprietary CMOS process, the XC9265 integrates a 0.5  $\Omega$  P-ch driver transistor and a 0.5  $\Omega$  synchronous N-ch switching transistor to ensure high levels of efficiency and superior performance for demanding battery powered applications.

Only an inductor and two ceramic capacitors are needed externally and the XC9265 is able to operate from 6.0V down to inputs as low as 2.0V to help further maximise battery life in portable applications.

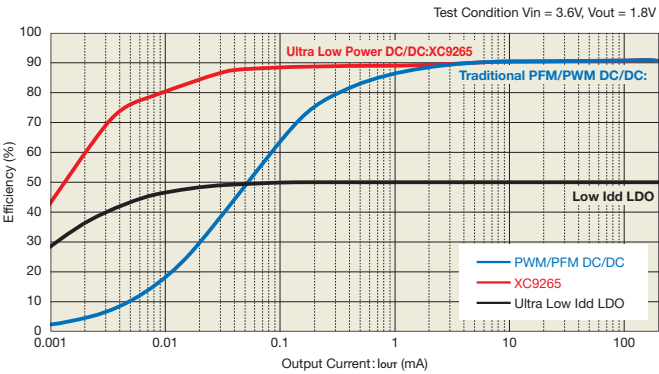
The output voltage is set internally between 1.0V to 4.0V ( $\pm 2\%$ ) in 0.1V increments. The XC9265 series also features an enable pin to turn the IC on and off and an optional CL discharge function that can quickly discharge the output capacitor when the IC is turned off. During stand-by, all circuits are shutdown to reduce consumption to less than 0.1  $\mu$ A.

Application Examples to Improve Battery Life

Measurement Circuit



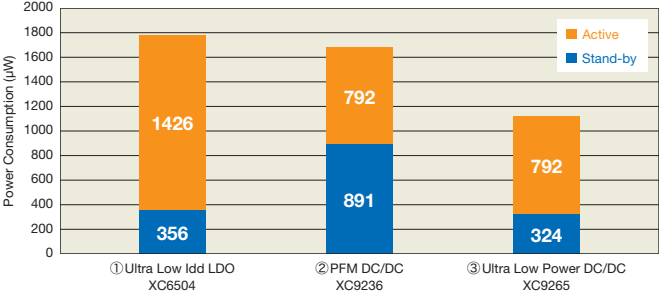
Test Condition | VIN=3.0V ~ 4.2V -> VOUT=1.8V  
Active: IOUT=20mA @ 10ms  $\leftrightarrow$  Stand-by: IOUT=50  $\mu$ A @ 1s



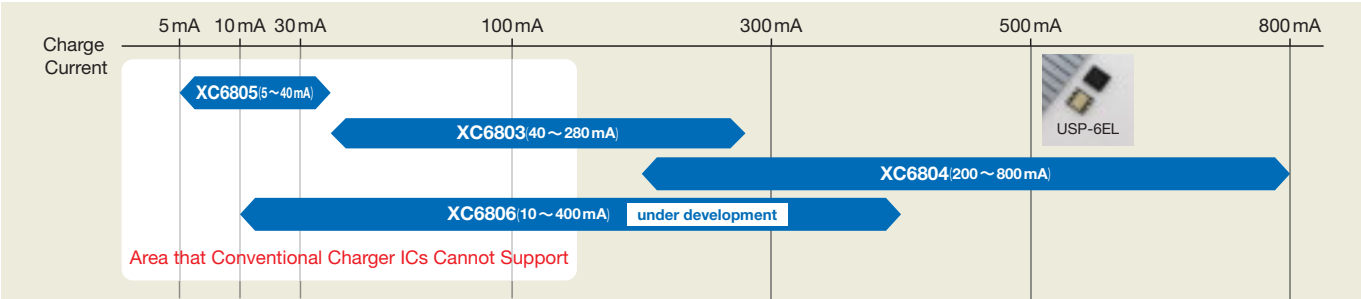
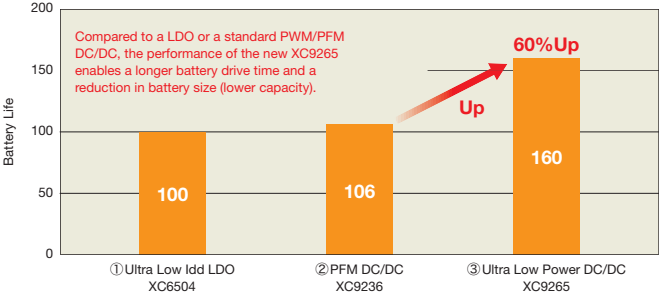
KEY FEATURES

SERIES		XC9265A/C	XC9265B/D
Quiescent Current		0.5 $\mu$ A	
Output Current		200mA	50mA
PFM Switching Current		330mA	180mA
ON Resistance	P-Ch	0.4 $\Omega$ (TYP)	
	N-Ch	0.4 $\Omega$ (TYP)	
Input Voltage Range		2.0V ~ 6.0V	
Output Voltage Range		1.0V ~ 4.0V (0.1V increments)	
Control Method		PFM Only	
Protection Circuits		Short Circuit Protection UVLO	
Additional Features		Optional CL Auto Discharge	
Packages		SOT-25, USP-6EL	

Active/Stand-by Performance



Battery driving life (Comparison when ①=100)



Product features

The XC6803/04/05 are Constant-Voltage (CV) and Constant-Current (CC) type charging IC for linear charging of single-cell Li-ion and Li-polymer batteries. The basic charging cycle consists of trickle charge mode followed by main charge mode.

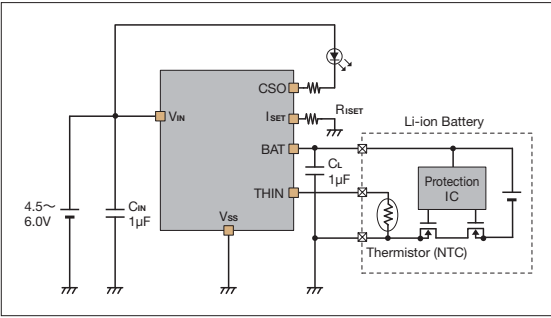
An LED can be connected to the charge status output pin to allow confirmation of charging by LED illumination. The IC is housed in the small USP-6EL package with high heat dissipation, and a charge circuit can be configured using a minimum of external components.

These IC also support temperature control based on JEITA, making it possible to safely charge Li-ion batteries by controlling the CV charge voltage and CC charge current according to the temperature.

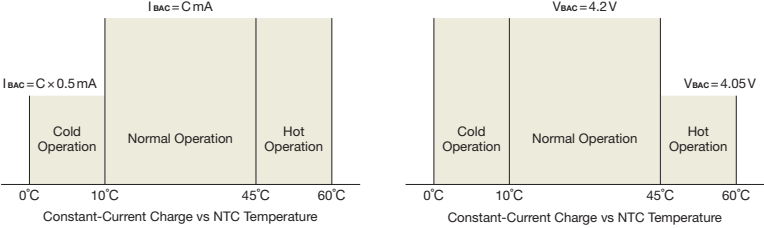
KEY FEATURES

SERIES		XC6803	XC6804	XC6805
Input Voltage		4.5V ~ 6.0V		
Charge Current (Externally Set)		40 mA ~ 280 mA	200 mA ~ 800 mA	5 mA ~ 40 mA
Charge Termination Voltage		4.2V		
Trickle Charge Voltage		2.9V		
Supply Current (Stand-by)		50 μA		
Charge Judgment Function				
Trickle Charge Mode		YES	YES	OPTIONAL
Recharge Function		OPTIONAL	OPTIONAL	YES
Battery Temperature Monitor		YES	YES	OPTIONAL
Protection Circuits				
Thermal Shutdown		YES	YES	YES
Dropout Voltage Monitoring		YES	YES	YES
Charging over-voltage and over-current monitoring		YES	YES	YES
Safety Timer Function	Main Charge	5 hrs	10hrs	5hrs
	Trickle Charge	0.5 hrs	2 hrs	0.5hrs
Packages		USP-6EL	USP-6EL, SOP-8FD	USP-6EL

Temperature Monitoring Function

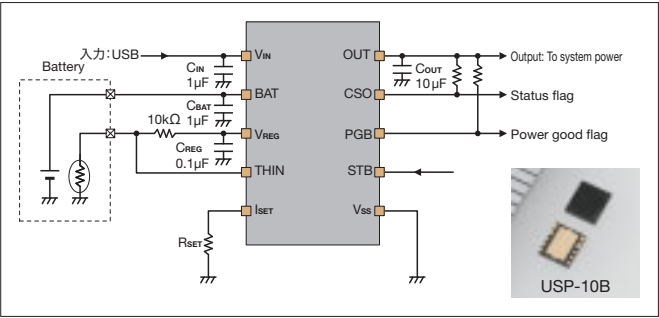


The IC monitors the Li-ion battery temperature during charging by means of an NTC Thermistor connected to the THIN pin. CC charging and CV charging are controlled based on the Li-ion battery temperature as shown below to enable safe charging.



XC6806 Linear charger ID with current path function under development

An internal current path driver switch allows battery charging even while the system is being driven. This enables efficient charging by USB.



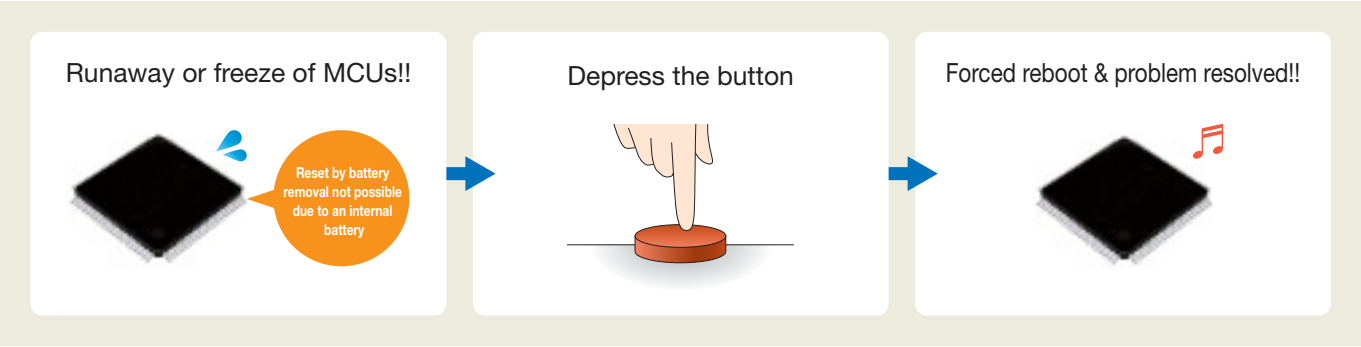
KEY FEATURES

SERIES	XC6806
Operation Voltage Range	4.7V ~ 6.0V
CV Charge Voltage	4.2V, 4.35V
CC Charge Current	10mA ~ 400mA (Ext. Resistor)
Input Current Limit	450mA (Internal Fixed)
Protection Circuit	Safety Timer Function Thermal Shutdown Dropout Voltage Monitor Function
Packages	USP-10B (2.6 x 2.9 x h0.6mm)



XC6190

Push Button Reboot Controller



The XC6190 is an ultra low current, push-button reset timer. The XC6190 uses a long timing setup delay to provide the intended system reset, and avoid resets from short push-button closures or key presses. **This reset configuration also allows for differentiation between software interrupts and hard system resets.**

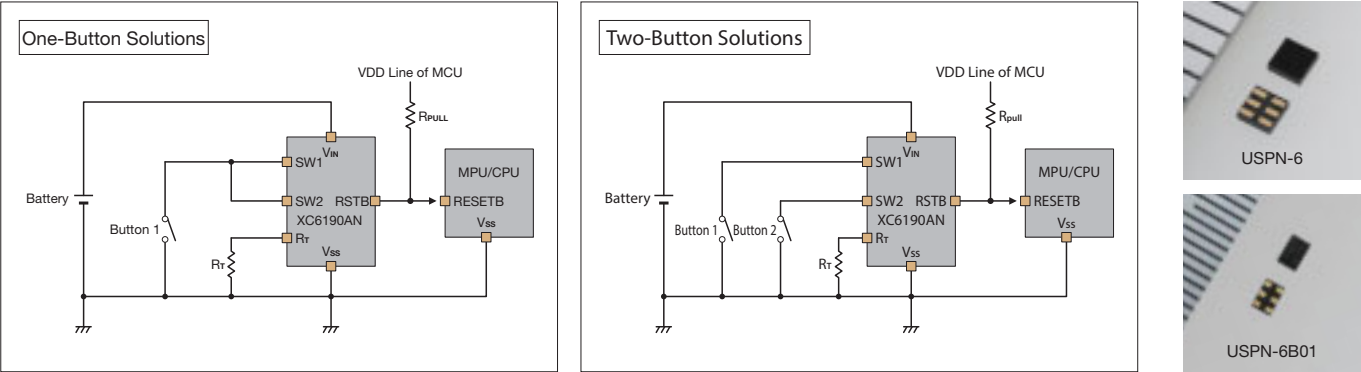
Two versions are available; with the XC6190A the reboot delay time (TDL) can be set as desired by changing the external resistance  $R_T$  within the range 1s to 20s. The XC6190B has the TDL fixed internally with a choice of two settings. When the TS pin is set to "H" level, the delay time is 12.5s. When the TS pin is set to "L" level, the delay time is 7.5s.

The standby quiescent current is a very small  $0.01\mu\text{A}$  (TYP) which contributes to a longer battery drive time and the series is available in a small USPN-6 or USPN-6B01 package, enabling reduction of mounting space.

KEY FEATURES

SERIES	XC6190A	XC6190B
Input Voltage Range	1.65V ~ 6.0V	
Re-Boot Delay Time	Adjustable	Fixed
Low power Consumption	0.01 $\mu\text{A}$ (TYP)	
RSTB Pin SINK Current ( $V_{\text{RSTBL}} = 0.3\text{V}$ )	30mA	
Re-Boot Delay Time ( $T_{\text{DL}}$ )	1s ~ 20s (set by Resistor)	7.5s ( $V_{\text{TS}} = \text{L}$ ) 12.5s ( $V_{\text{TS}} = \text{H}$ )
Re-Boot Delay Time Accuracy	$\pm 5\%$	
Re-Boot Time ( $T_{\text{RSTB}}$ )	0.4s $\pm 5\%$	
Output Configuration	Nch-Open Drain or CMOS	
Op. Ambient Temperature	-40 $^{\circ}\text{C}$ ~ +85 $^{\circ}\text{C}$	
Packages	USPN-6, USPN-6B01	

Typical Application Circuit



Torex Advantages

	Competition	XC6190	Torex Advantage
Significant reduction of quiescent current during stand-by			
Quiescent current	0.25 μA	0.01 μA	Longer battery drive time
Improved delay time accuracy / reboot time accuracy			
Delay time accuracy	± 20 %	± 5 %	Better delay time accuracy (By means of higher IC accuracy and external adjustment using a resistor)
Reboot time accuracy	± 20 %	± 5 %	
External adjustment method for delay time			
External adjustment method	Capacitance	Resistance	Increased freedom of design
Improved output drive ability			
Sink current	5 mA	30 mA	Can support a wider range of MPUs

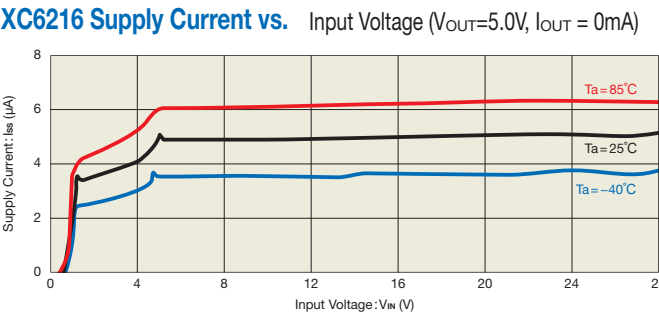
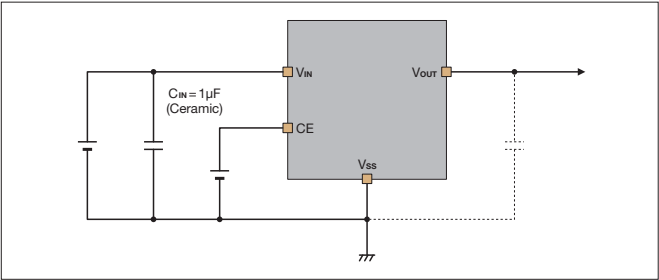
Advantages of changing to resistance

- Lower cost
- Higher accuracy (resistance accuracy ± 1 % or less)
- No bias dependence

XC6216

28V operation, low supply current regulators with an ON/OFF function

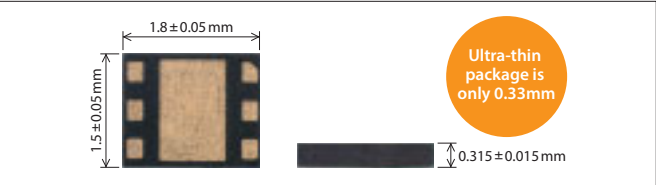
- Height : 0.33mm (MAX.), installed in USP-6B06
- Input voltage range enables input of wireless power supply
- CL capacitor not required (complete phase compensation inside IC)
- IC supply current is 5  $\mu\text{A}$



KEY FEATURES

SERIES	XC6216
Input Voltage Range	2.0V ~ 28V
Output Voltage Range	2.0V ~ 12.0V ( $\pm 2.0\%$ , 0.1V increments)
Output Current	150mA
Dropout Voltage	260mV@ $I_{\text{OUT}} = 20\text{mA}$ ( $V_{\text{OUT}} = 3.0\text{V}$ )
Low Power Consumption	5 $\mu\text{A}$
Stand-by Current	Less than 0.1 $\mu\text{A}$
High Ripple Rejection	30dB @ 1kHz
Built-in Protection	Current Limit Circuit Short Protection Thermal Shutdown Circuit
Other Functions	Ceramic Capacitor Compatible CL Capacitor Less
Packages	USP-6B06 (1.8 × 1.5 × h0.33mm) SOT-25, SOT-89, SOT-89-5, USP-6C, SOT-223, TO-252

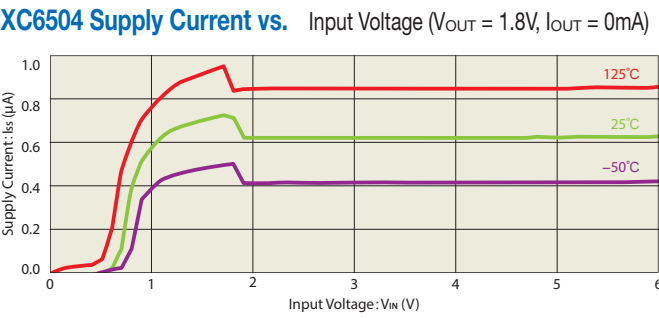
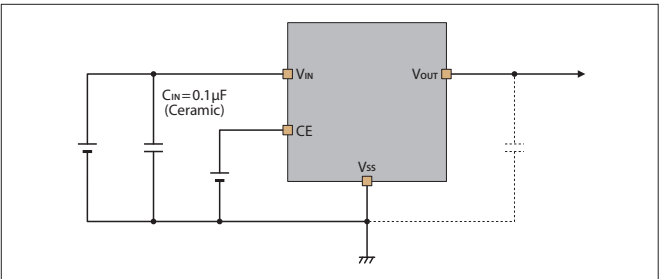
Ultra-thin USP-6B06 package



XC6504

0.6  $\mu\text{A}$  ultra-low supply current / ultra small voltage regulators

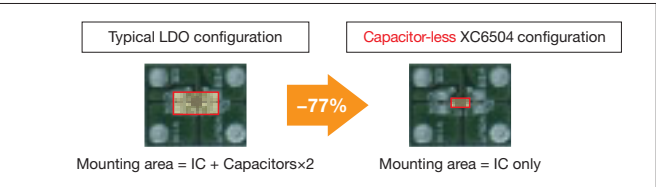
- Height: 0.33mm (MAX.) installed in USP-6B06 (under development)
- IC supply current is 0.6  $\mu\text{A}$
- CL capacitor not needed (complete phase compensation inside IC)
- With CE function



KEY FEATURES

SERIES	XC6504
Input Voltage Range	1.4V ~ 6.0V
Output Voltage Range	1.1V ~ 5.0V ( $\pm 1.0\%$ , 0.1V increments)
Output Current	150mA
Dropout Voltage	500mV@ $I_{\text{OUT}} = 150\text{mA}$ ( $V_{\text{OUT}} = 3.0\text{V}$ )
Low Power Consumption	0.6 $\mu\text{A}$
Stand-by Current	Less than 0.01 $\mu\text{A}$
High Ripple Rejection	25dB @ 1kHz
Built-in Protection	Current Limit Circuit Short Protection
Other Functions	CL Discharge Ceramic Capacitor Compatible CL Capacitor Less
Packages	USP-6B06 (1.8 × 1.5 × h0.33mm) USPN-4B02 (0.95 × 0.75 × h0.4mm) SSOT-24, SOT-25

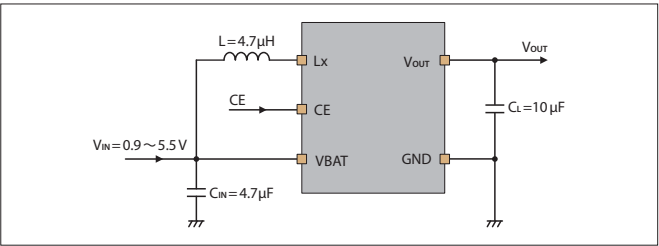
Mounting area comparison



XC9140

Step-Up Synchronous PFM DC/DC Converter

- Quiescent current of only 6.3  $\mu$ A even with synchronous rectification
- Fast transient response
- Load disconnect and input bypass function options
- Supports ceramic capacitors
- Synchronous rectification provides high efficiency



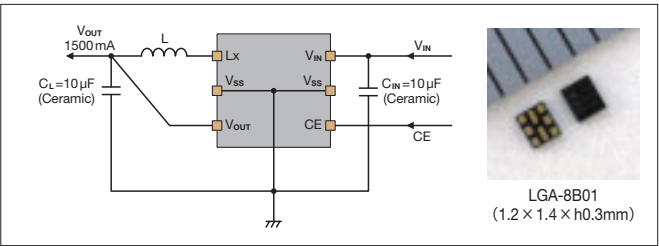
KEY FEATURES

SERIES		XC9140
Quiescent Current		6.3 $\mu$ A
Output Current		100 mA ( $V_{BAT} = 1.8V$ , $V_{OUT} = 3.3V$ )
ON Resistance	P-ch	0.65 $\Omega$
	N-ch	0.6 $\Omega$
Input Voltage Range		0.9V ~ 5.5V
Output Voltage		1.8V ~ 5.0V ( $\pm 2\%$ , 0.1V step)
Control Method		PFM (PFM Current = 350mA)
Optional Type	A Type	Load Disconnection Function
	C Type	Input Bypass Function
Op. Ambient Temperature		-40 $^{\circ}$ C ~ +85 $^{\circ}$ C
Additional Features		UVLO, $C_L$ Discharge
Low ESR Ceramic Capacitors		
Packages		USP-6EL, SOT-25

XC9260/61/62

HiSAT-COT  $I_{OUT}=1.5A$   
Synchronous Step-Down DC/DC Converter

- Ultra fast transient response
- $I_{OUT}=1.5A$ . World's smallest mounting space
- Even though the control method is COT control, switching frequency fluctuations due to load/input are small
- A switching frequency of 3 MHz can also be selected



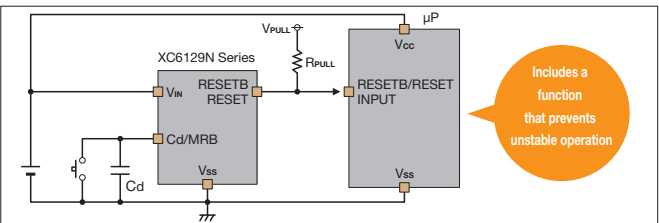
KEY FEATURES

SERIES		XC9260	XC9261	XC9262
Quiescent Current		15 $\mu$ A (1.2MHz), 25 $\mu$ A (3.0MHz)		
Output Current		1500mA		
Switching Frequency		1.2MHz and 3.0MHz		
ON Resistance	P-ch	0.14 $\Omega$	0.11 $\Omega$	
	N-ch	0.1 $\Omega$	0.07 $\Omega$	
Input Voltage Range		2.7V ~ 5.5V		
Output Voltage		0.8V ~ 3.6V ( $\pm 2\%$ , 0.05V step)		
Control Method		HiSAT-COT		
Protection Circuit		Thermal Shutdown, Current Limit Short Circuit Protection		
Op. Ambient Temperature		-40 $^{\circ}$ C ~ +105 $^{\circ}$ C		
Additional Features		UVLO, Soft Start		
Low ESR Ceramic Capacitors				
Packages		USP-6C, SOT89-5	LGA-8B01	

XC6129

0.42  $\mu$ A operation, external capacitor delay type voltage detector

- Ultra-small, high-accuracy voltage detector with external capacitor delay function
- Detect delay and release delay are selectable (delay time is set with the Cd pin capacitance)
- Output logic is selectable ("L" level at detection or "H" level at detection can be selected)
- The Cd pin can also be used for manual reset



KEY FEATURES

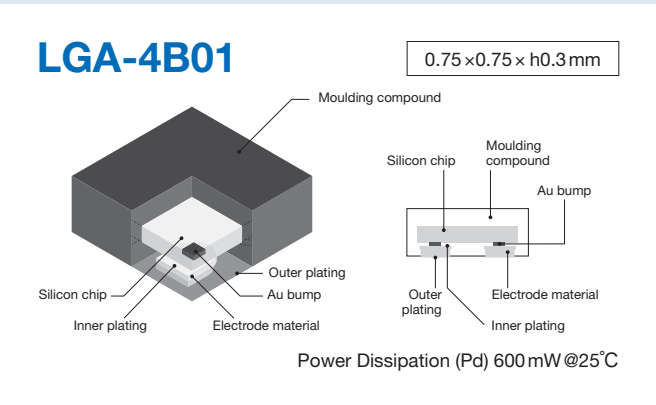
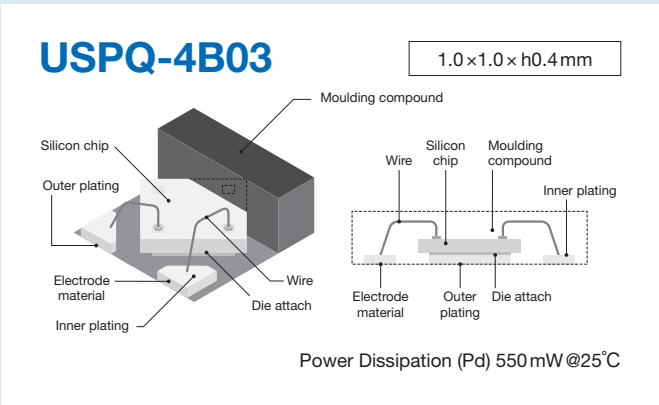
SERIES		XC6129
Quiescent Current		0.42 $\mu$ A (at Detect) 0.58 $\mu$ A (at Release)
High Accuracy		$\pm 0.8\%$ ( $\pm 50$ ppm/ $^{\circ}$ C Temp. Characteristic)
Detect Voltage		1.5V ~ 5.5V (0.1V step)
Hysteresis Width		$V_{DF} \times 5\%$ or Less than $V_{DF} \times 1\%$
Operating Voltage Range		1.3V ~ 6.0V
Output Configuration		CMOS or Nch Open Drain
Output Logic		Active High or Active Low
Release Delay Time		13.9ms ( $C_d = 0.01\mu F$ , $R_n = 2M\Omega$ )
Detect Delay Time		17.9ms ( $C_d = 0.01\mu F$ , $R_n = 2M\Omega$ )
Packages		USPN-4, SSOT-24

High-performance LDO product lineup

SERIES	XC6233	XC6223	XC6229
Output Current	200mA	300mA	300mA
Dropout Voltage ( $V_{OUT}=3.0V$ )	240mV@ $I_{OUT}=200mA$	200mV@ $I_{OUT}=300mA$	160mV@ $I_{OUT}=300mA$
Operating Voltage Range	1.7V ~ 5.5V	1.6V ~ 5.5V	1.6V ~ 5.5V
Output Voltages	1.2V ~ 3.6V (0.05V steps)	1.2V ~ 4.0V (0.05V steps)	1.2V ~ 4.0V (0.05V steps)
Output Accuracy	$\pm 1\%$	$\pm 1\%$	$\pm 1\%$
Quiescent Current (TYP.)	45 $\mu$ A	100 $\mu$ A	100 $\mu$ A
Stand-by Current (TYP.)	0.01 $\mu$ A	0.01 $\mu$ A	0.01 $\mu$ A
Ripple Rejection	75dB	80dB	80dB
Current Limit Threshold (TYP.)	255mA	400mA	400mA
Short Circuit Protection (TYP.)	60mA	50mA	50mA
In-Rush Current Protection	YES	YES	YES
Thermal Shutdown	—	YES	YES
Additional Features	$C_L$ Auto Discharge, Low ESR Ceramic capacitors		
Smallest Package	USPQ-4B04	USPQ-4B03	LGA-4B01

Small package lineup

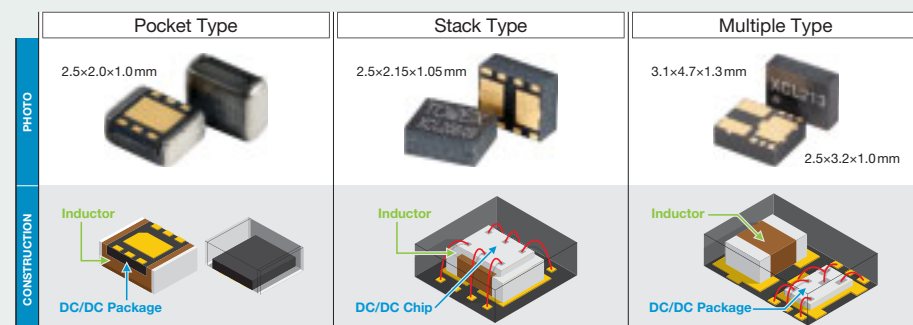
Package	Size (mm)	Pd (mW)	Series
WLP-4-01	0.7 $\times$ 0.7 $\times$ 0.2	—	XC6501
LGA-4B01	0.75 $\times$ 0.75 $\times$ 0.3	600	XC6229
LGA-8B01	1.2 $\times$ 1.4 $\times$ 0.3	1000	XC9259 XC9262
USP-6B06	1.5 $\times$ 1.8 $\times$ 0.33	900	XC6216 XC6504 (under development)
USPN-4B02	0.75 $\times$ 0.95 $\times$ 0.4	400	XC6504 XC6126
USPN-4	0.9 $\times$ 1.2 $\times$ 0.4	600	XC6221 XC6129
USPQ-4B03	1.0 $\times$ 1.0 $\times$ 0.4	550	XC6223
WLP-5-02	0.88 $\times$ 1.25 $\times$ 0.4	750	XC6602
WLP-5-03	1.06 $\times$ 1.26 $\times$ 0.4	750	XC9235/36/37
USPN-6B01	1.0 $\times$ 1.45 $\times$ 0.4	600	XC6190
USP-6B04	1.2 $\times$ 1.2 $\times$ 0.4	600	XC6420
USPN-6	1.3 $\times$ 1.3 $\times$ 0.4	600	XC9244/45 XC6420 XC6415 XC6190
USP-6EL	2.0 $\times$ 1.8 $\times$ 0.4	1000	XC9265 XC9235/36/37 XC9140 XC6803/04/05



## Torex "micro DC/DC" – Innovative Construction

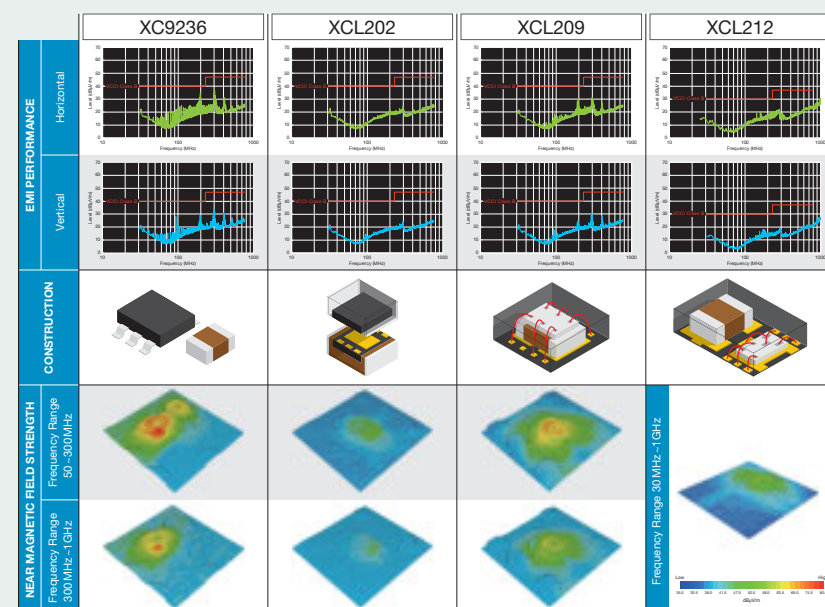
Torex "micro DC/DC" converters are available in three different structures, an ultra-small, low EMI noise "Pocket Type" that supports currents up to 1A, a "Stack Type" that simplifies the manufacturing process and helps reduce costs and a "Multiple Type" that is designed to support large currents (currently up to 2A). We are building the "micro DC/DC" XCL series from a variety of approaches based on coil capacity.

### TOREX micro DC/DC Innovative Construction



## Ideal solutions for Noise Sensitive environments

### TOREX micro DC/DC Unbeatable EMI Performance



When using a DC/DC converter, there is always a concern about noise. With wireless devices in particular, that concern is not only about noise from the power line, but EMI as well. Torex DC/DC converters are designed to be used with ceramic capacitors and with an appropriate switching speed to help create a stable power supply with low ripple voltage.

What's more, the XCL series of "micro DC/DC" converters enables the reduction of EMI. The structure of the Pocket Type, which is Torex's original technology, is designed so that the inductor covers the DC/DC converter IC, enabling suppression of externally emitted noise.

The comparison between the XCL202 and the XC9236 (left) shows clearly the difference in noise. (The noise characteristics of the XC9236 are not particularly poor; the XC9236 is a typical product in terms of noise.)

## Selection Guide for the XCL Series

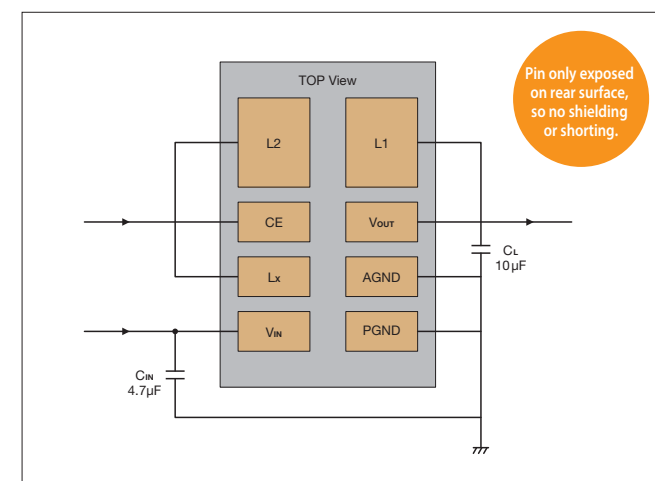
Good fit for the wearable devices

SERIES	XCL101	XCL201 XCL202	XCL205 XCL206 XCL207	XCL208 XCL209	XCL210	XCL211 XCL212	XCL213 XCL214	XCL219 XCL220	XCL223 XCL224
Type	Step Up	Step Down	Step Down	Step Down	Step Down	Step Down	Step Down	Step Down	Step Down
Control Method	PFM	PWM PWM/PFM	PWM PWM/PFM	PWM PWM/PFM	PFM	PWM PWM/PFM	HiSAT-COT PWM PWM/PFM	HiSAT-COT PWM PWM/PFM	HiSAT-COT
Input Voltage	0.9V~5.5V	2.0V~6.0V	2.0V~6.0V	1.8V~6.0V	2.0V~6.0V	2.7V~6.0V	2.5V~5.5V	2.5V~5.5V	2.7V~5.5V
Output Voltage	1.8V~5.0V	0.8V~4.0V	0.8V~4.0V	0.8V~4.0V	1.0V~4.0V	0.9V~V <sub>IN</sub>	0.8V~3.6V	0.8V~3.6V	0.8V~3.6V
Accuracy	± 2 %	± 2 %	± 2 %	± 2 %	± 2 %	± 2 %	± 2 %	± 2 %	± 2 %
Oscillation Frequency	—	1.2MHz	3MHz	3MHz	—	2.4MHz	3MHz	3MHz	3MHz
Output Current	100mA	400mA	600mA	400mA	50mA/200mA	2000mA	1500mA	1000mA	700mA/400mA
Package	CL-2025	CL-2025	CL-2025	USB-10B03	CL-2025	USP-11B01	USP-9B01	CL-2025	USP-8B04
Construction	Pocket Type	Pocket Type	Pocket Type	Stack Type	Pocket Type	Multiple Type	Multiple Type	Pocket Type	Multiple Type

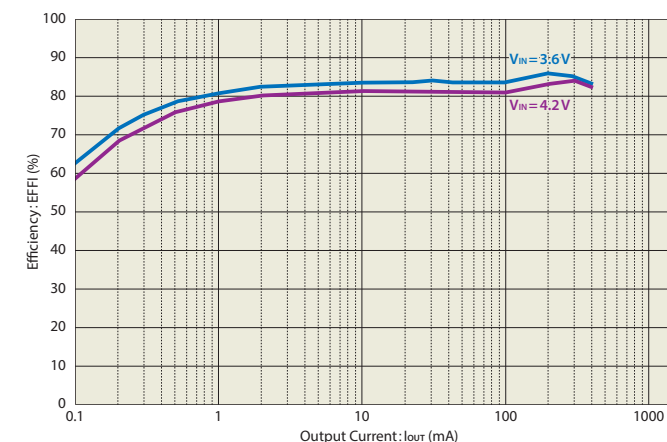
## XCL223/224

0.4A/0.7A Inductor Built-in "micro DC/DC" Converters

### Diagram of typical circuit



### Efficiency vs Output Current



### Product features

The XCL223/XCL224 series are ultra-small, low-profile (2.25mm × 1.5mm, h=0.75mm MAX) step-down DC/DC converters with an integrated coil and control IC. A power supply circuit can be created by simply adding two external ceramic capacitors. The internal coil simplifies the board layout and makes it possible to minimize malfunctioning and noise due to component placement and wiring routing.

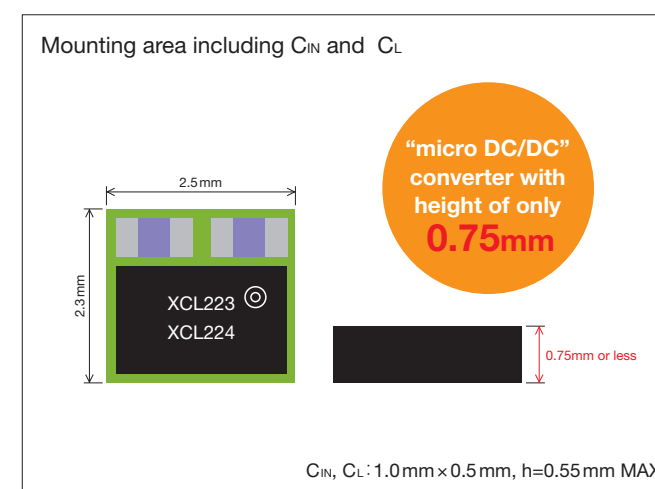
The output voltage is from 0.8V to 3.6V (accuracy ± 2.0%), and can be set internally in steps of 0.05V. The switching frequency is 3.0MHz, and synchronous rectification is used for the circuit scheme. The operation mode is "HiSAT-COT(\*) control, which has excellent transient response characteristics, and "PWM control" or "PWM/PFM auto switching control" can be selected as appropriate for the application. Either 400mA or 700mA can be selected for the maximum load current.

(\*) HiSAT-COT: Name of our unique fast transient response technology

### KEY FEATURES

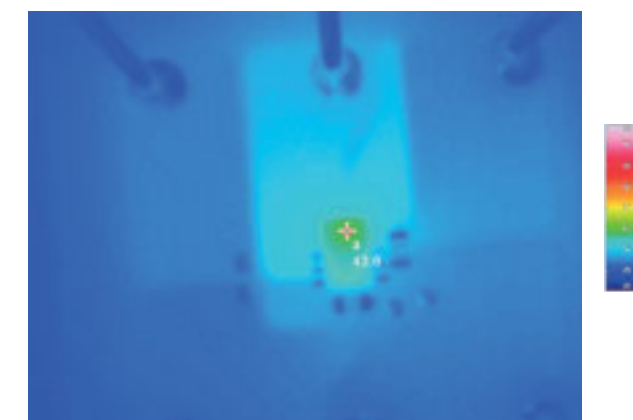
SERIES	XCL223/XCL224 Series
Quiescent Current	25µA (3.0MHz)
Output Current	700mA (A type) 400mA (B type)
Switching Frequency	3.0MHz
Input Voltage Range	2.7V~5.5V
Output Voltage	0.8V~3.6V (± 2 %, 0.05V step)
Control Method	HiSAT-COT Control 100 % Duty Cycle XCL223 : PWM XCL224 : PWM/PFM Auto Switch
Protection Circuit	Thermal Shutdown Current Limit Short Circuit Protection
Op. Ambient Temperature	- 40 °C ~ +105 °C
Additional Features	UVLO, Soft Start, CL Discharge
Low ESR Ceramic Capacitors	
Packages	USP-8B04 (2.25 × 1.5mm, h0.75mm MAX)

### Mount space-saving



### Example of surface temperature characteristics during mounting

43.0°C @ I<sub>OUT</sub>=500mA, T<sub>a</sub>=25°C



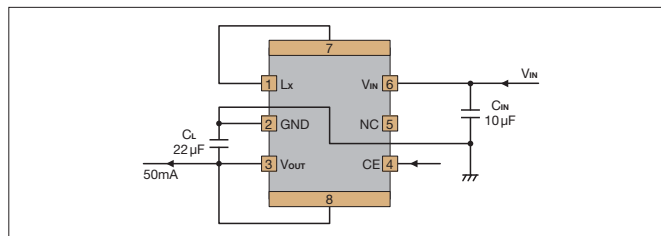
Sample number : XCL223A0M3DR, V<sub>OUT</sub>=0.95V



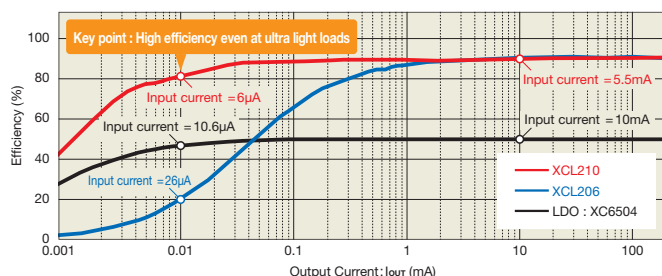
# XCL210

Ultra-low supply current, step-down, synchronous “micro DC/DC” converters

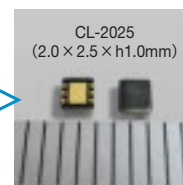
- IC supply current is 0.5μA
- High efficiency even with light loads  
80 % @ 3.6V → 1.8V/10μA  
90 % @ 3.6V → 1.8V/10mA



**XCL210 Output Current vs. Efficiency** ( $V_{IN}=3.6V$ ,  $V_{OUT}=1.8V$ )



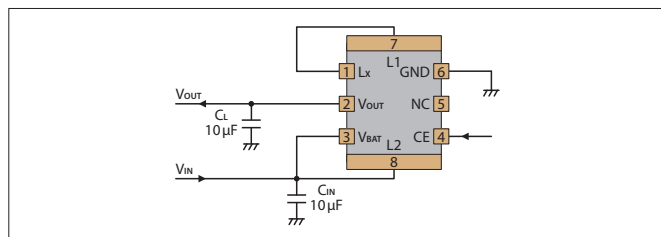
Our standard pocket type



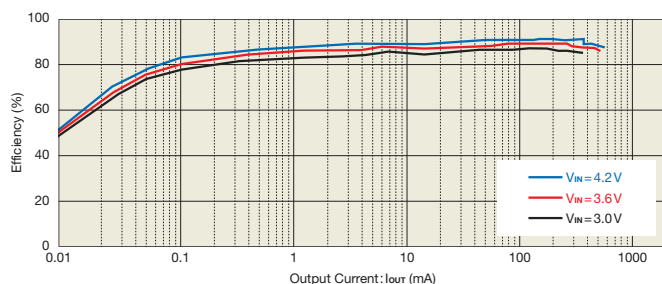
# XCL101

Integrated coil, step-up synchronous “micro DC/DC” converters

- Operation starts from an input voltage of 0.9V
- IC supply current is 6.3 μA
- Operates at 0.9V with one battery

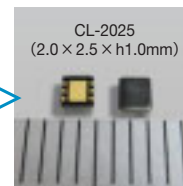


**XCL101 Output Current vs. Efficiency** ( $V_{OUT}=5.0V$ )



Our standard pocket type

You can select Load Disconnection and input bypass functions necessary for step-up DC/DC



## KEY FEATURES

SERIES	XCL210A/C	XCL210B/D
Quiescent Current	0.5μA	
Output Current	200mA	50mA
Input Voltage Range	2.0V ~ 6.0V	
Output Voltage	1.0V ~ 4.0V (± 2 %, 0.05V step)	
Control Method	PFM Control	
PFM Switching Current	180mA/330mA	
Functions	Short Circuit Protection UVLO CL Discharge (XCL210C/XCL210D)	
Op. Ambient Temperature	- 40℃ ~ +85℃	
Low ESR Ceramic Capacitors		
Packages	CL-2025	

## KEY FEATURES

SERIES	XCL101
Quiescent Current	6.3μA
Output Current	100mA ( $V_{IN}=1.8V$ , $V_{OUT}=3.3V$ )
Input Voltage Range	0.9V ~ 5.5V
Output Voltage	1.8V ~ 5.0V (± 2 %, 0.1V step)
Control Method	PFM Control
PFM Switching Current	350mA
Optional Type	A Type: Load Disconnection Function C Type: Input Bypass Function
Op. Ambient Temperature	- 40℃ ~ +85℃
Low ESR Ceramic Capacitors	
Packages	CL-2025

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