

Torex...Powerfully Small!

I_q=200nA 150mA Step-down with V_{SET} function

Built-in Inductor "micro DC/DC" Converter

XCL233 Series Product Overview

June. 2023

TOREX Semiconductor

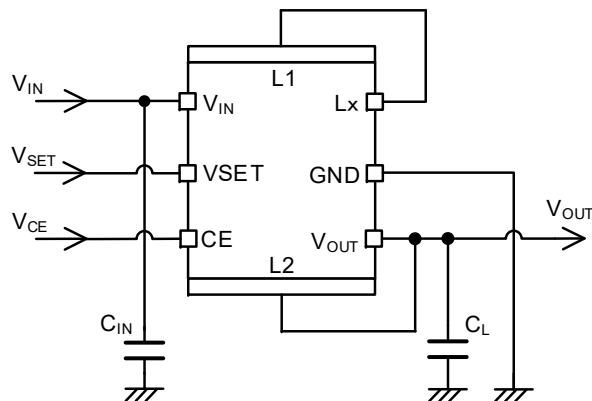
Rev. 2.0

Ultra Low Power / Output Voltage Selectable (via V_{SET} pin) / Output voltage Supported from 0.5 V

■ Features

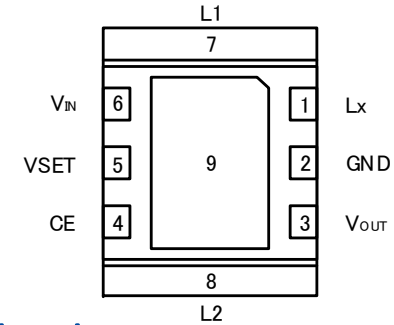
Input Voltage	: 1.8V ~ 6.0V (Absolute max : 7.0V)
Output Voltage	: 0.5V ~ 1.9V (0.05V increments) 2.0V ~ 3.6V (0.1V increments)
Output Voltage Accuracy	: $\pm 20\text{mV}$ ($V_{OUT} \leq 1.0\text{V}$) $\pm 2.0\%$ ($V_{OUT} > 1.0\text{V}$)
Output Current	: 150mA
I_q	: 200nA@ $V_{OUT}=1.8\text{V}$
Control Method	: PFM
Efficiency	: 86% ($V_{IN}=3.6\text{V}$, $V_{OUT}=1.8\text{V}$, $I_{OUT}=10\text{mA}$)
Functions	: C_L Discharge (Type D) UVLO
Protection	: Short Protection ($V_{OUT} \geq 1.2\text{V}$)
C_{IN} & C_L Capacitors	: Ceramic Capacitor
Package	: CL-2025-03
Operation Temp Range	: $-40^\circ\text{C} \sim 85^\circ\text{C}$

■ Typical Application Circuit



■ Package

CL-2025-03
(2.5x2.0x1.04mm)



■ Product Classification

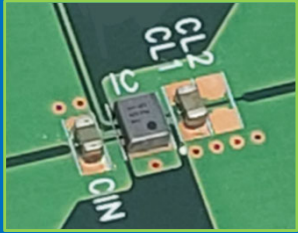
XCL233①②③④⑤⑥-⑦

DESIGNATOR	ITEM	SYMBOL	DISCRIPTION
①	Type	B	Without C_L Discharge
		D	With C_L Discharge
②③④	Output Voltage	Refer to the table shown below	$V_{OUT1,2}$: 0.50V ~ 3.60V ($V_{OUT1,2} \leq 1.9\text{V}$: 0.05V increments, $V_{OUT1,2} > 1.9\text{V}$: 0.1V increments)
⑤⑥-⑦	Package (Order Unit)	KR-G	CL-2025-03 (3,000pcs/Reel)

②③④	V_{OUT1} (V)															
	0.50	0.60	0.65	0.70	0.80	0.90	1.00	1.10	1.20	1.30	1.50	1.80	1.85	2.00	2.20	2.50
0.50	-	-	R04	-	R16	-	-	-	-	-	-	-	-	-	-	-
0.60	N02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.65	N03	001	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0.70	N04	002	061	-	-	-	-	-	-	-	-	-	-	-	-	-
0.80	N06	004	063	121	-	-	-	-	-	-	-	-	-	-	-	-
0.90	N08	006	065	123	236	-	-	-	-	-	-	-	-	-	-	-
1.00	N10	008	067	125	238	347	-	-	-	-	-	-	-	-	-	-
1.10	N12	010	069	127	240	349	454	-	-	-	-	-	-	-	-	-
1.20	N14	012	071	129	242	351	456	557	-	-	-	-	-	-	-	-
1.30	N16	014	073	131	244	353	458	559	656	-	-	-	-	-	-	-
1.50	N20	018	077	135	248	357	462	563	660	753	-	-	-	-	-	-
1.80	N26	024	083	141	254	363	468	569	666	759	933	-	-	-	-	-
1.85	N27	025	084	142	255	364	469	570	667	760	934	B67	-	-	-	-
2.00	N30	028	087	145	258	367	472	573	670	763	937	B70	C06	-	-	-
2.20	N34	032	091	149	262	371	476	577	674	767	941	B74	C10	D10	-	-
2.50	N40	038	097	155	268	377	482	583	680	773	947	B80	C16	D16	E35	-
3.00	N50	048	107	165	278	387	492	593	690	783	957	B90	C26	D26	E45	F93
3.30	N56	054	113	171	284	393	498	599	696	789	963	B96	C32	D32	E51	F99

- Ultra-small / Ultra-low power / V_{SET} function enable further downsizing and higher efficiency.

$I_q=200nA$ 150mA
 with V_{SET} function,
 "micro DC/DC" Converter
 XCL233



High efficiency at standby mode

①

① Ultra small / High efficiency at light load

- ✓ High efficiency even when equipment is in standby mode
- ✓ High efficiency over a wide range
- ✓ Built-in Inductor and Small mounting area

Lower consumption of MCUs

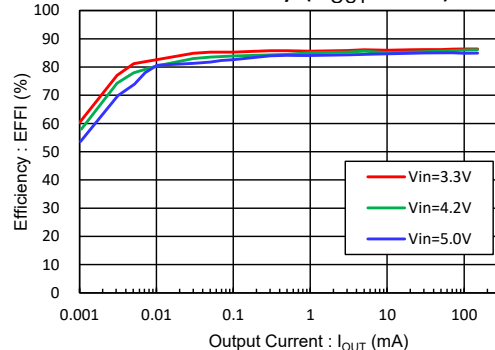
②

② Lower consumption of MCUs via selecting output voltage

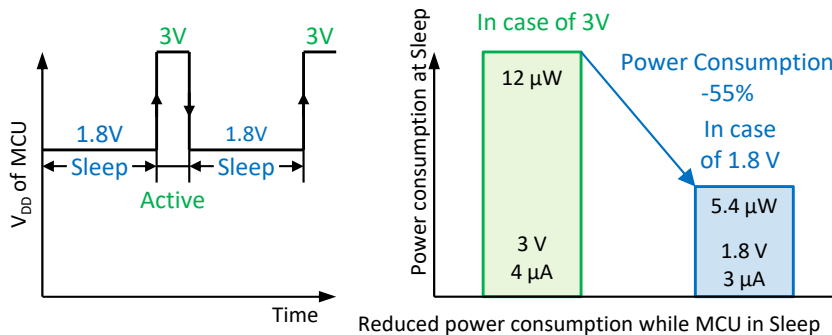
“ V_{SET} (Output Voltage Selectable) function”

- ✓ The output voltage is switched dynamically according to the operating state of the MCU. Significantly reduced current consumption in standby mode.

XCL233 efficiency ($V_{OUT}=1.8V$)



Reduced power consumption while MCU in Sleep



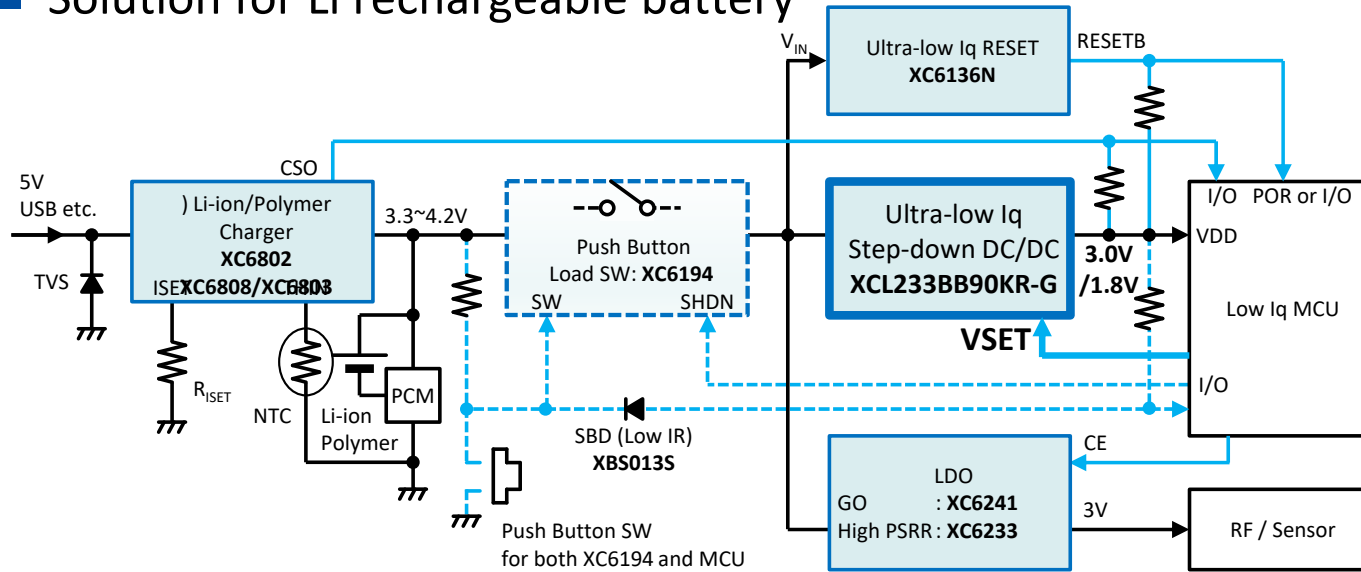
Contributing to battery life in small devices.

- Sensor module for IoT / Security systems

V_{SET} function further reduces power consumption and contributes downsizing of batteries.

- Further downsizing in a Battery powered equipment

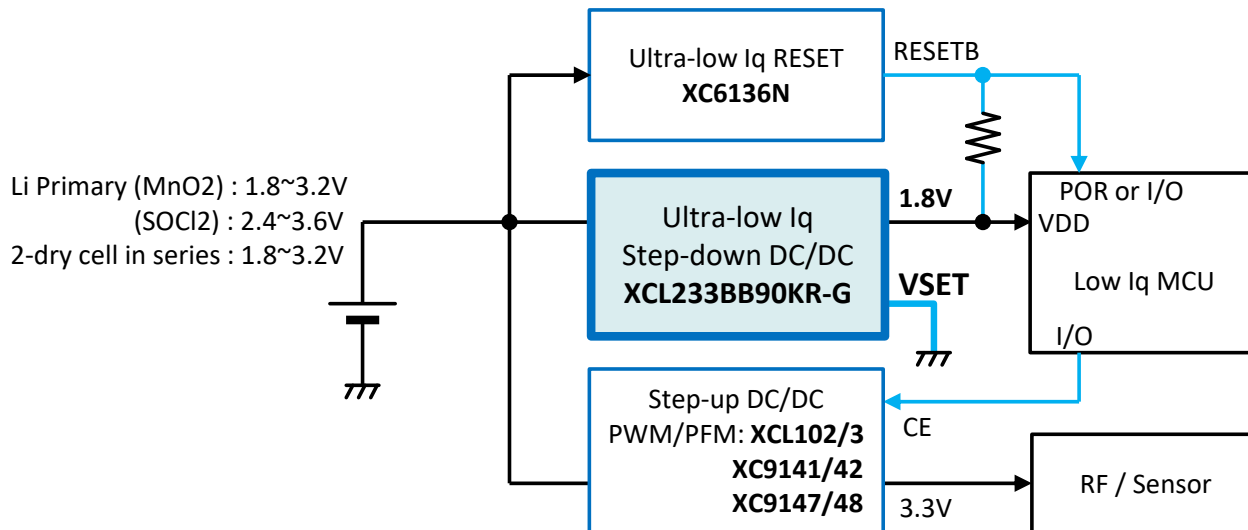
■ Solution for Li rechargeable battery



V_{OUT} switch by signal input to VSET pin

- High : 3.0V
⇒ MCU in active mode
- Low : 1.8V
⇒ MCU in standby mode

■ Solution for Primary battery



General use for low power consumption

When using

XCL233BB90K2-G (3.0V /1.8 V),

connect VSET to GND for a fixed 1.8V output.

✘ The 3.0V & 1.8V combination also supports a fixed 3.0V output.

Suitable for a wide range of applications.

Achieving longer battery life & low power consumption by changing the output voltage based on an operation of MCU/SoC

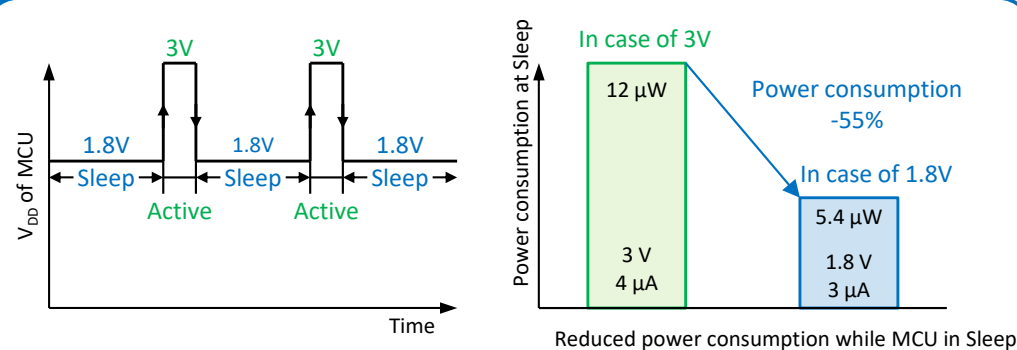
● Technical trend and challenges

- Current MCU/SoC can operate in a wide voltage range (e.g. 1.6 to 3.8V).
- 3V is required for the analog part and high-speed processing, but a low supply voltage such as 1.8V can be used during sleep mode. This results in lower power consumption.

● TOREX Proposal : Low power consumption by changing output voltage

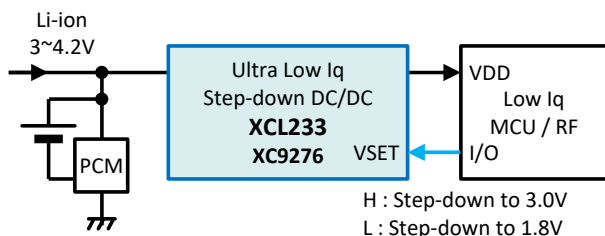
- Dynamically changing output voltage according to MCU/SoC operation, greatly reducing power consumption in standby state.

Change supply voltage according to MCU operation



➤ Ultra-low I_q Step-down DC/DC with VSET function : XCL233, XC9276

- V_{OUT} can be switched by the VSET pin.
- 200nA Ultra-low I_q achieves always high efficiency: 85.5%@10μA

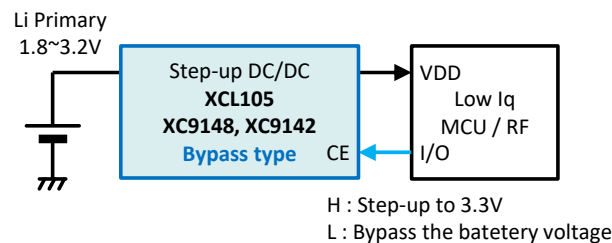


■ Ultra-low I_q VSET (V_{OUT} selectable) function Step-down DC/DC

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package
XCL233 NEW	Built-in inductor VSET(V _{OUT} 切替) I _q =200nA, PFM	1.8 ~ 6.0	0.5 ~ 3.6 2 Values	150	CL-2025-03 (2.5x2.0xh1.04mm)
XC9276 FEATURED	VSET(V _{OUT} 切替) I _q =200nA, PFM	1.8 ~ 6.0	0.5 ~ 3.6 2 Values	150	USP-8B06 (2.0x2.0xh0.33mm) SOT-26W (2.8x2.9x1.3mm) WLP-6-03 (1.72x1.07xh0.33mm)

➤ Step-up DC/DC with Bypass function : XCL105B, XC9148B/H, XC9142B/E

- Switching between voltage boost and battery voltage through
- During MCU sleep, supplying through battery voltage, and I_q of the IC is 0μA.



■ Bypass type Step-up DC/DC

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA) @3.3V→5V	Package
XCL105B NEW	Built-in inductor PWM/PFM, 1.2MHz	0.65 ~ 6.0 V _{ST} = 0.9	1.8 ~ 5.5	710	DFN3030-10B (3.0x3.0xh1.7mm)
XC9148B/H FEATURED	PWM/PFM 1.2MHz/3MHz	0.65 ~ 6.0 V _{ST} = 0.9	1.8 ~ 5.5	750	USP-6C (1.8x2.0xh0.6mm) SOT-89-5 (4.5x4.6xh1.6mm)
XC9142B/E	PWM/PFM 1.2MHz/3MHz	0.65 ~ 6.0 V _{ST} = 0.9	1.8 ~ 5.5	500	SOT-25 (2.9x2.8xh1.3mm) USP-6C (1.8x2.0xh0.6mm) WLP-6-01 (1.08x1.28xh0.4mm)