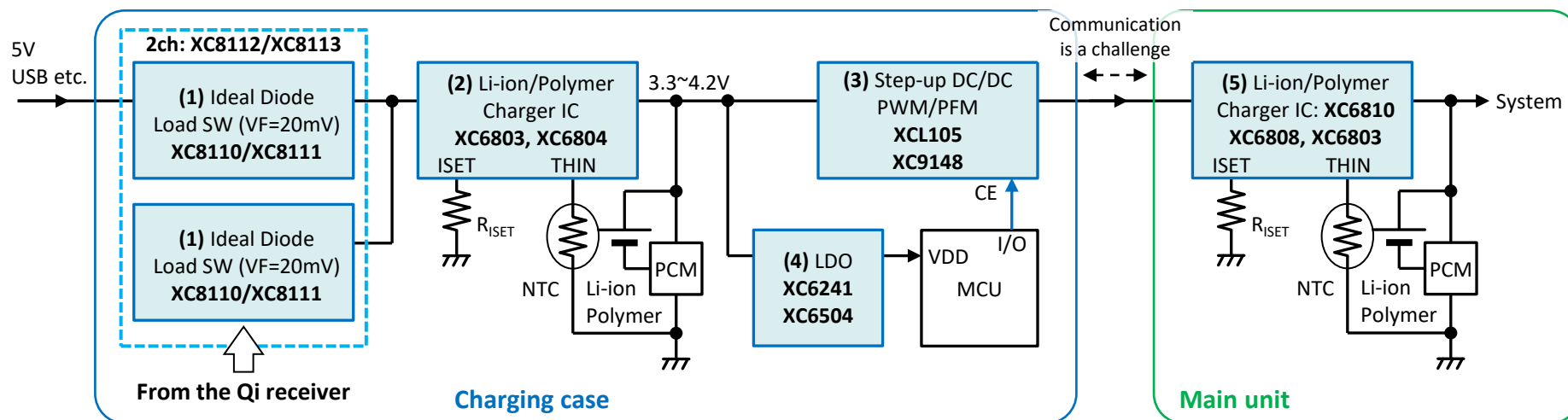


Typical power supply configurations and ICs to the charging case and main unit

■ Configuration with charging IC in the main unit

- How to disable the step-up IC (3) on the case side after charge completion of the Li battery on the main unit.
 - It is common to use **three contacts** to communicate the charging status of the main unit side to the case side.
 - If the charger IC (5) on the main unit has a **Two-wire communication** using the power line for the state of charge, it is possible with two contacts.
 - ✓ See configuration on [Page 5](#) using the charging IC **XC6810**, which supports **Two-wire communication**.
- OR connection of USB and Qi using ideal diode load switches **XC8110/XC8111**, **XC8112/XC8113**.



	Product	Features
(1) Ideal Diode Load Switch	XC8110 / XC8111	True Reverse current prevention Ideal Diode Load SW VF=20mV, 500mA (XC8110), 1A (XC8111), IEC 62368-1 certified
	XC8112 / XC8113	2ch True Reverse current prevention Ideal Diode Load SW VF=20mV 2ch x 500mA (XC8112), 2ch x 1A (XC8113), IEC 62368-1 certified.
(2) Li Charger IC	XC6803 / XC6804	CC/CC Charger, CC=40~280mA/~800mA, Batt Temp Monitor
(3) Step-up DC/DC	XCL105	Built-in inductor, PWM/PFM, 1.2MHz, 590mA@3.3V→5
	XC9148	Hi-efficiency, PWM/PFM, 1.2MHz/3MHz, 750mA

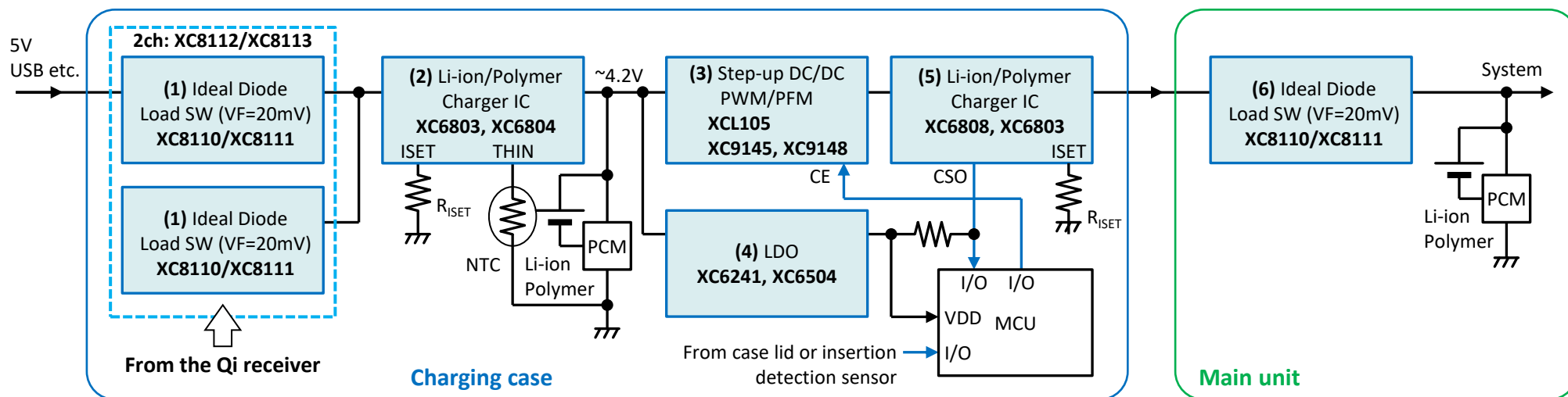
	Product	Features
(4) LDO	XC6241	Iq=0.6μA, PSRR=60dB, GO, 150mA
	XC6504	Iq=0.6μA, Cap. Less, 150mA
(5) Li Charger IC	XC6810 (See configuration on Page 5)	3.5V~28V, CV=3.80V~4.40V, CC=1mA~25mA Battery Temperature Monitor, Charge ON/OFF, Current path Charge status & Battery voltage monitoring Shutdown/Wake-up, Two-wire communication to Cradle Supports various types of energy harvesting
	XC6808 / XC6803	CC/CV Charger, CC=5~40mA/~240mA, Batt Temp Monitor

Configuration in which charging of the Li battery in the main unit controlled by the charging case

■ Configuration without Charger IC in the main unit

●The main unit consists only of an **Ideal Diode Load Switch** with reverse current prevention.

- The main unit is compact, low-cost and simple, and can be controlled by **only two contacts (5 V and GND)** with the charging case.
 - ✓ **Ideal Diode Load Switch (6) in the main unit** prevents the voltage of the internal Li battery from being output to the contact on the main unit.
- The charging case monitors the charge of the Li battery in the main unit and controls the termination of power supply after its charge completion.
 - ✓ Charge completion is detected by the MCU at the CSO pin of the Charger IC (5) for the main unit, so that the Step-up IC (2) can be stopped.



	Product	Features
(1), (6) Ideal Diode Load Switch	<u>XC8110 / XC8111</u>	True Reverse current prevention Ideal Diode Load SW VF=20mV, 500mA (XC8110), 1A (XC8111), IEC 62368-1 certified
	<u>XC8112 / XC8113</u>	2ch True Reverse current prevention Ideal Diode Load SW VF=20mV 2chx500mA(XC8112), 2chx1A(XC8113), IEC 62368-1
(2) Li Charger IC	<u>XC6803 / XC6804</u>	CC/CC Charger, CC=40~280mA/~800mA, Batt Temp Monitor
(3) Step-up DC/DC	<u>XCL105</u>	Built-in inductor, PWM/PFM, 1.2MHz, 710mA@3.3V→5V
	<u>XC9148</u>	Hi-efficiency, PWM/PFM, 1.2MHz/3MHz, 750mA@3.3V→5V
	<u>XC9145</u>	Iq=400nA, PWM/PFM, 1.2MHz, 430mA, V _{ST} =1.6V

	Product	Features
(4) LDO	<u>XC6241</u>	Iq=0.6μA, PSRR=60dB, GO, 150mA
	<u>XC6504</u>	Iq=0.6μA, Cap. Less, 150mA
(5) Li Charger IC	<u>XC6808 / XC6803</u>	CC/CV Charger, CC=5~40mA/~280mA

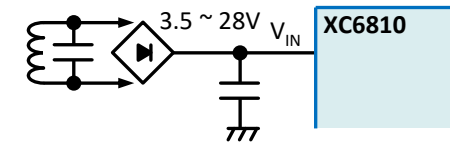
Ultra-compact Charger IC with 2-wire communication for the main unit



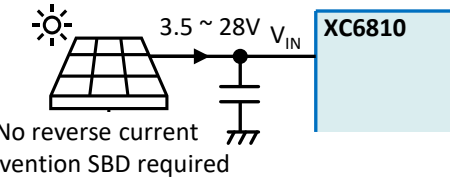
Multi-function Charger IC for small Li batteries

- Two-wire communication supported (**XC6810xxxE/F/G/J types**).
 - Current modulation of the power input line using the CSO pin and transmission of the state of charge to the Charging case in frequency.
 Charge level (32, 16, 8kHz for < 60%, < 90%, 90% ≤), Charge completion (4kHz) / Stopped (OFF) / Error (1kHz)
 - Charging case can be turned on and off by detection of a simple current sense circuit (R+OPamp) in it.
- Also available with OUT switched off/on depending on the presence/absence of V_{IN} input (A, B, E, F).
- Various functions such as Shutdown/Wake-up function and wireless power supply support are available.

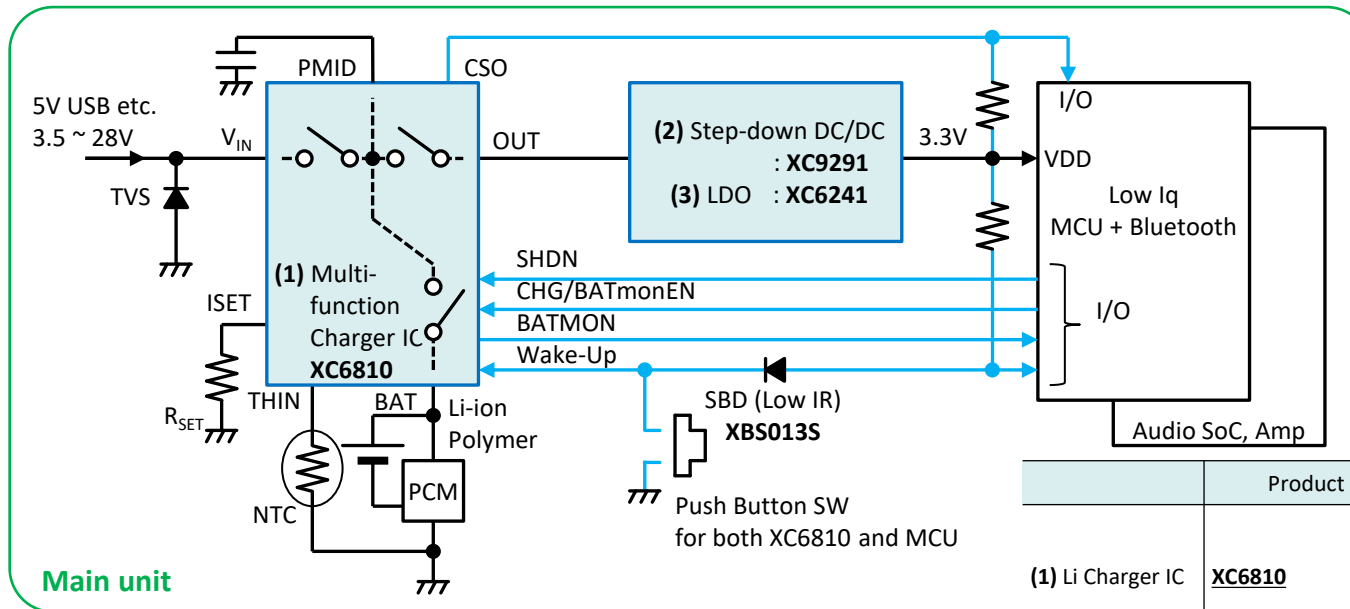
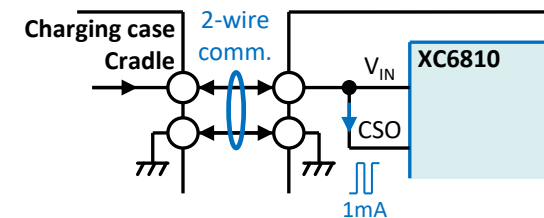
Wireless power transfer



Solar and Other Energy Harvesting



Charge state communication to Charging case



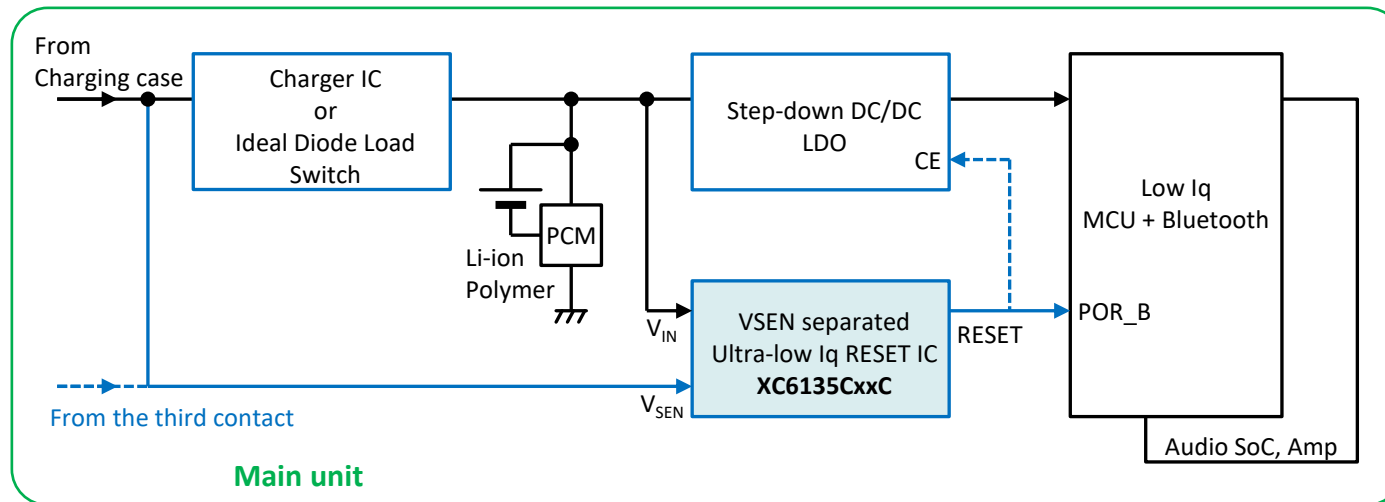
Main unit

	Product	Features
(1) Li Charger IC	XC6810	3.5V~28V, CV=3.80V~4.40V, CC=1mA~25mA Battery Temperature Monitor, Charge ON/OFF, Current path Charge status & Battery voltage monitoring Shutdown/Wake-up, Two-wire communication to Cradle Supports various types of energy harvesting
(2) Step-down DC/DC	XC9290 / XC9291	World's smallest class of mounting area F-PWM, PWM/PFM, 4MHz/6MHz, 600mA
(3) LDO	XC6241	Iq=0.6μA, PSRR=60dB, GO, 150mA

Appendix: RESET IC to control the operation of the main unit

■ A way to turn the main unit off and on depending on whether the V_{IN} input is present or not, as well as to prevent freezing.

- The voltage supply from the charging case is detected by the ultra-low consumption RESET IC of the SENSE pin (V_{SEN}) separated type.
 - With voltage applied : RESET output "L" resets the MCU or turns off the Step-up DC/DC or LDO.
 - No voltage applied : RESET output "H" resets releases the MCU from reset or turns on the Step-up DC/DC or LDO.
- Then releases the reset of the main unit when starting to use it and enables the start of Bluetooth connections, etc.
 The system is also reset each time it is placed in a Charging case, thus releasing it from a system freeze.
- With two contacts : After charge completion, a low voltage, e.g. 2V, is applied from the charging case through a high resistance and detected by this RESET IC in the main unit.
- With three contacts : The bias of the signal line can be detected by this RESET IC in the same way.



	Product	Features
RESET IC	XC6135	Separated Sense pin, Ultra-low Iq44nA

Ideal Diode SW and Step-Up DC/DC Suitable for "OR" Connection

■ OR connection of power supply rails

● Technical trend and challenges

- For high efficiency and long battery life of the device, the circuit using SBD has large loss due to VF. Leakage current of reverse bias is also an issue.
- Difficult to supply stable voltage due to voltage drop and fluctuation caused by the VF characteristic of the diode which may cause unstable operation.

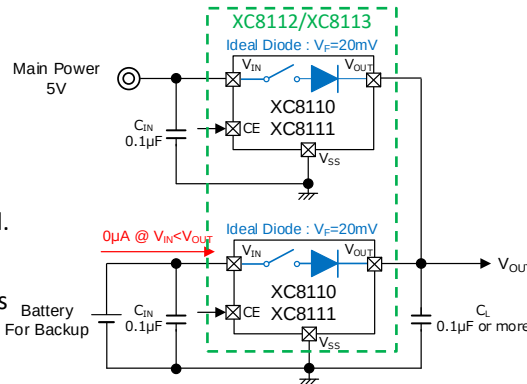
● TOREX Proposal : Dedicated ICs for OR connection

- Low consumption design to reduce battery discharge / Easy automatic switching of power supply path without control / Low VF to minimize power loss.

➤ OR connection with Ideal Diode Load SW : XC8110 / XC8111 (1ch)

XC8112 / XC8113 (2ch)

- Low VF: 20mV
- 0μA leakage current from output at reverse bias.
- Various built-in protection functions.
- IEC 62368-1:2023 certified.
- Low loss requires no heat dissipation and contributes to miniaturization.

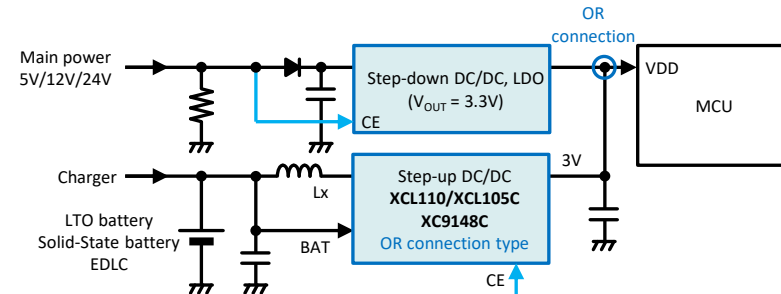


■ Load Switch with Ideal Diode function

Product	Features	V _{IN} (V)	R _{on}	I _{OUT}	Package
XC8110	VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias) IEC 62368-1:2023 certified	1.5 ~ 6.0	120mΩ	500mA	WLP-4-02 (0.82x0.82x0.5mm)
XC8111				1A	SOT-25 (2.9x2.8x1.3mm)
XC8114			60mΩ	3A	USP-6B06 (1.8x1.5x0.33mm)
XC8112	2ch VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias) IEC 62368-1:2023 certified	1.5 ~ 6.0	2ch x 120mΩ	2 x 500mA	WLP-4-04 (0.82x1.48x0.495mm)
XC8113				2 x 1A	SOT-89-5 (4.5x4.6x1.6mm)
					DFN1820-6G (1.8x2.0x0.6mm)
					USP-8B06 (2.0x2.0x0.33mm)

➤ Step-up DC/DC for OR connection : XCL105C, XC9148C, XC9142C/F

- Switching without control when main power is input or disconnected.
- When main power is lost, immediately starts boosting to supply power.
- Low Iq 0.12μA minimizes battery discharge when main power supply.



■ Step-up DC/DC for OR connection

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA) @3.3V→5V	Package
XCL110C	Built-in inductor PWM/PFM, 3MHz	0.65 ~ 6.0 V _{ST} = 0.9	1.8 ~ 5.5	610	CL-2025-02 (2.5x2.0x1.04mm)
XCL105C	Built-in inductor PWM/PFM, 1.2MHz	0.65 ~ 6.0 V _{ST} = 0.9	1.8 ~ 5.5	710	DFN3030-10B (3.0x3.0x1.7mm)
XC9148C	PWM/PFM 1.2MHz/3MHz	0.65 ~ 6.0 V _{ST} = 0.9	1.8 ~ 5.5	750	USP-6C (1.8x2.0x0.6mm) SOT-89-5 (4.5x4.6x1.6mm)

Compact and Space-Saving Power Supply Solutions

■ World's smallest class product line of space-saving solutions

XC9290/XC9291

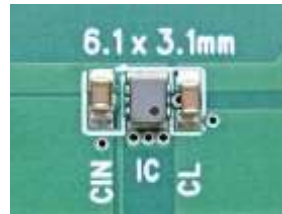
World's smallest class 6.0V 600mA step-down DC/DC



Actual Size

XCL239/XCL240, XCL109/XCL110

Built-in inductor Micro DC/DC: Step-down, Step-up



Actual Size

XC8110/XC8111

Ideal Diode Load Switch 0.5A/1.0A



Actual Size

XCL247/XCL248

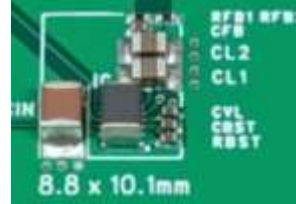
Built-in inductor 36V 600mA Step-down Micro DC/DC



Actual Size

XCL249

Built-in inductor 60V 150mA Step-down Micro DC/DC



Actual Size

XC6241, XC6135/XC6136

150mA LDO with GO function, Ultra-low Iq RESET



Actual Size

■ List of Compact and Space-saving Power Supply ICs

	Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package	Size
LDO	XC6241	High-speed, i _q =0.6μA, GO	1.6 ~ 6.0	1.5 ~ 5.0	150	DFN1010-4D	1.0 x 1.0 x h 0.4mm
	XC6228	High-speed, PSRR=75dB, 300mA	1.6 ~ 5.5	1.2 ~ 4.0	300	USPQ-4B04	1.0 x 1.0 x h 0.6mm
	XC6504	Cap. Less, I _q =0.6μA	1.4 ~ 6.0	1.1 ~ 5.0	150	USPN-4B02	0.75 x 0.95 x h 0.40mm
Step-up DC/DC	XCL109/XCL110	Built-in inductor, F-PWM, PWM/PFM	0.65 ~ 6.0	1.8 ~ 5.5	610 @3.3V→5V	CL-2025-02	2.0 x 2.5 x h 1.04mm
	XCL104/XCL105	Built-in inductor, F-PWM, PWM/PFM	0.65 ~ 6.0	1.8 ~ 5.5	710 @3.3V→5V	DFN3030-10B	3.0 x 3.0 x h 1.7mm
Step-down DC/DC	XCL243/XCL244	Built-in inductor, HiSAT-COT , 700mA, h=0.75mm max	2.5 ~ 5.5	0.8 ~ 3.6	700	USP-8B04	2.25 x 1.5 x h 0.75mm
	XCL239/XCL240	Built-in inductor, HiSAT-COT , 1A	2.5 ~ 5.5	0.8 ~ 3.6	1000	CL-2025-02	2.0 x 2.5 x h 1.04mm
	XCL233	I _q =200nA, Step-down DC/DC, VSET(V _{OUT} selectable)	1.8 ~ 6.0	0.5 ~ 3.6	150	CL-2025-03	2.0 x 2.5 x h 1.04mm
	XC9290/XC9291	HiSAT-COT , 600mA, World's smallest mounting area 3.15mm ²	2.5 ~ 6.0	0.7 ~ 3.6	600	WLP-5-08	0.96 x 0.88 x h 0.33 mm
	XCL247/XCL248	Built-in inductor, 36V, 600mA, I _q =11μA	3.0 ~ 36.0	2.8 ~ 6.0	600	DFN3030-10B	3.0 x 3.0 x h 1.7mm
	XCL249	Built-in inductor, 60V, 150mA, I _q =12μA, High step-down ratio	4.5 ~ 60.0	2.5 ~ 6.0	150	CL-3225	3.2 x 2.5 x h 2.0mm
RESET IC	XC6135/XC6136	Ultra-low I _q : 88nA Voltage Detector	1.1 ~ 6.0	1.2 ~ 5.0	-	DFN1010-4D	1.0 x 1.0 x h 0.4mm
Charger IC	XC6810	For 1 cell Li-ion, Multi-function Charger IC	3.5 ~ 28	3.8 ~ 4.4	1 ~ 25	WLP-12-01	1.17 x 1.57 x h 0.33mm
Load SW	XC8110/XC8111	Ideal diode load SW, V _F =20mV, IEC 62368-1 certified	1.5 ~ 6.0	-	1000	WLP-4-02	0.82 x 0.82 x h 0.5mm