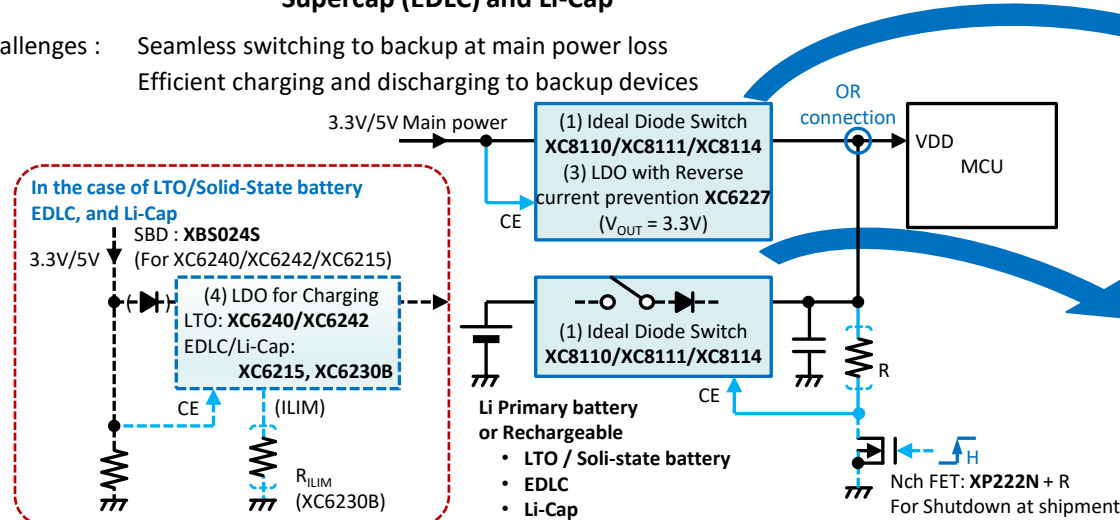
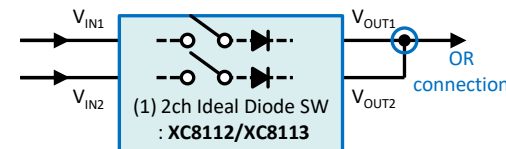


Supercap (EDLC) and Li-Cap

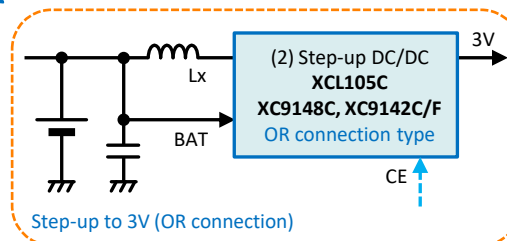
- Challenges : Seamless switching to backup at main power loss
Efficient charging and discharging to backup devices



Ideal diode load switch with 2 built-in channels for OR Connection is also available



XC8112 : 2ch x 500mA, **XC8113** : 2ch x 1.0A



OR connection : How to connect the backup device and Main power

(1) Supplies battery voltage directly to MCU : Ideal Diode Load Switch

1ch XC8110/XC8111/XC8114, 2ch XC8112/XC8113

(2) Supplies boosted voltage to MCU : XCL110C, XC9148C

(3) LDO, DC/DC for Main power side

LDO with reverse current prevention to prevent reverse current flowing into the main power supply. (XC6227)

(4) LTO / Solid-State battery /Supercap (EDLC) / Li-Cap charging

For LTO / Solid-State battery : Dedicated LDO, **XC6240/XC6242.**

For EDLC/Li-Cap : **XC6215**, a low Iq LDO, or **XC6230B** with current limit external adjustment and reverse current prevention. Insert a few Ω resistor at V_{OUT} .

(5) Battery voltage monitoring : XC6140/XC6142

Detect/Release voltage set according to battery characteristics.

Block	Product	Features
(1) Ideal diode switch	<u>XC8110</u> / <u>XC8111</u> <u>XC8114</u> FEATURED	True Reverse current prevention Ideal Diode Switch, VF=20mV 0.5A (XC8110), 1A (XC8111), 1A (XC8114), Other : <u>XC8112</u> / <u>XC8113</u> , 2ch x 500mA/1A IEC 62368-1:2023 certified(XC8110/XC8111/XC8112/XC8113)
(2) Step-up DC/DC	<u>XCL110C</u> FEATURED	Inductor built-in, 3MHz, 610mA@3.3V→5V, For OR connection Other : <u>XC9148C</u> , 1.2MHz/3MHz, 750mA@3.3V→5V
(3) LDO with Reverse current prevention	<u>XC6227</u>	High-speed PSRR=65dB, 700mA True Reverse current prevention
(4) LDO for Charging	<u>XC6240</u> / <u>XC6242</u>	For LTO/Solid-State battery charging, 150mA Topr=105°C (XC6242)
	<u>XC6215</u>	Iq=0.8μA, 150mA, Select V _{OUT} voltage suitable for EDLC
	<u>XC6230B</u>	2A, Current limit adj, True Reverse current prevention
(5) Battery voltage monitor	<u>XC6140</u> / <u>XC6142</u>	Solid-State battery voltage monitoring Release voltage: 2.475V/2.450V, Iq=104nA For 105°C compatible battery: XC6142

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

■ OR connection of power supply rails

● Technical trend and challenges

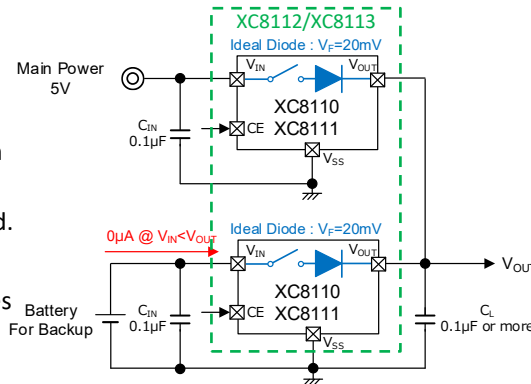
- For high efficiency and long battery life of the device, the circuit using SBD has large loss due to VF. Leakage current of reverse bias is also an issue.
- Difficult to supply stable voltage due to voltage drop and fluctuation caused by the VF characteristic of the diode which may cause unstable operation.

● 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 Switch : 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.

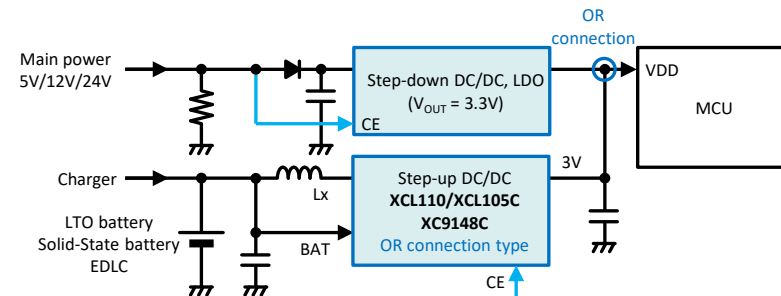


■ Load Switch with Ideal Diode function

Product	Features	V _{IN} (V)	R _{on}	I _{OUT}	Package
XC8110 FEATURED	VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias) IEC 62368-1:2023 certified (XC8110/XC8111)	1.5 ~ 6.0	120mΩ	500mA	WLP-4-02 (0.82x0.82x0.5mm)
XC8111				1A	SOT-25 (2.9x2.8x1.3mm) USP-6B06 (1.8x1.5x0.33mm)
XC8114 FEATURED			45mΩ	3A	WLP-4-04 (0.82x1.48x0.495mm) SOT-89-5 (4.5x4.6x1.6mm) DFN1820-6G (1.8x2.0x0.6mm)
XC8112 FEATURED	2ch VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias) IEC 62368-1:2023 certified		2ch x 120mΩ	2 x 500mA	USP-8B06 (2.0x2.0x0.33mm)
XC8113				2 x 1A	

➤ 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 FEATURED	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)

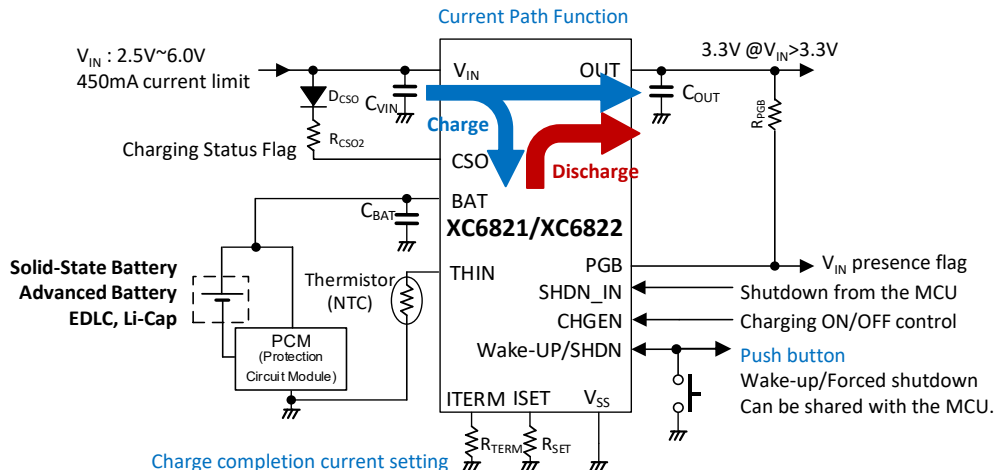
Solid-State Batteries and Advanced Batteries Reference Solutions

■ Solid-state battery: A Li secondary battery excelling in reliability, lifespan, and operating temperature range

● Ideal for backup circuits in FA/industrial machinery/automotive equipment

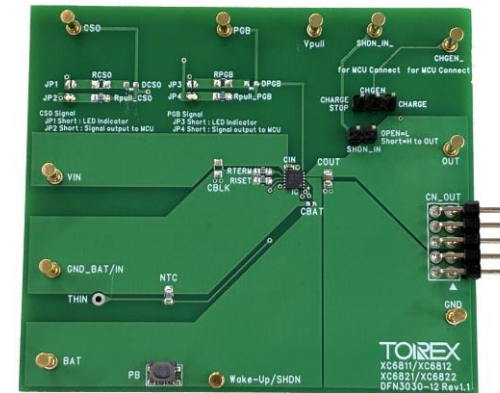
- Highly reliable and safe.
- Long lifespan and robust against repeated charge-discharge cycles.
- Supports low-temperature and high-temperature operation.
- Note that CV and charge completion current differ per battery/model number.

■ Solid-state and advanced batteries reference solutions



Block	Product	CV	CC / Charge completion current	Features
Charger IC	XC6821 UNDER DEVELOPMENT	2.5~2.9V	Adj. CC=1mA~50mA Adj. charge completion current =0.1mA~10mA	Charge ON/OFF Current path $V_{OUT}=3.3V@V_{IN}>3.3V$ Shutdown(SHDN, Push button) Wake-up(V_{IN} applied, Push button)
	XC6822		Adj. CC=25mA~400mA Adj. charge completion current =1mA~50mA	Other : XC6811 , CV=3.1V~4.5V, Adj. CC=1mA~50mA Other : XC6812 , CV=3.1V~4.5V, Adj. CC=25mA~400mA

■ Evaluation board for solid-state and advanced battery reference solutions



■ Optimal charge control for solid-state and advanced batteries

➤ Charge/Discharge Control

- CV Charging
CV Voltage Support for **Sulfide/Oxide Solid-State and LTO Batteries**
Also Ideal for EDLC / Li-Cap
For CV $\geq 3.1V$, use XC6811 / XC6812.
- CC current / Charge completion current
CC current and **charge completion current** can be individually adjusted externally
- Current path

Automatically distributes current between charging and OUT
With V_{IN} applied, OUT **provides a regulated 3.3V to the MCU - no LDO required.**

Automatically switches between the battery and main power supply, essential for **backup applications.**

➤ Push-Button Control : Wake-Up / Shutdown

- **Wake up** via push button or V_{IN} application.
- **Shutdown** via MCU-driven SHDN_IN
Supports **ship mode to prevent discharge during storage/shipment.**
Long-press push button forces shutdown for **freeze recovery.**

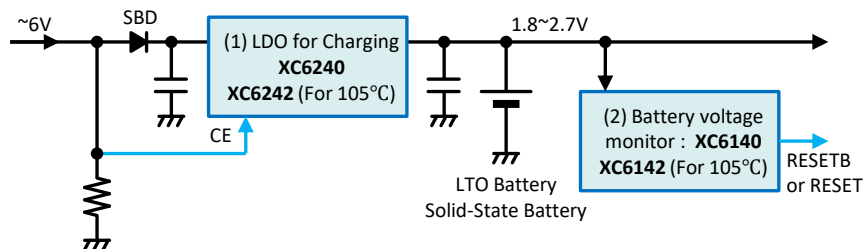
LTO and Solid-State batteries Reference Solutions

■ LTO battery :

Li rechargeable battery using lithium titanate for negative electrode

- Ideal for power supplies and backup circuits for small devices and modules in Industrial/IoT/Automotive applications.
 - Constant voltage charging by LDO is possible.
No need for dedicated expensive CC/CV charger ICs.
 - Reliable and safe with long life and resistance to repeated charge/discharge.
 - Resistant to over-discharge. Simple voltage detector is sufficient.
 - Stable voltage of 2.1V~2.4V.
Easy energy extraction compared to Supercap (EDLC).
 - 105°C high-temperature operation, reflow-compatible, thin and hot-laminate-compatible products are also available.

■ Reference circuit for LTO and Solid-State battery charging and battery voltage monitoring

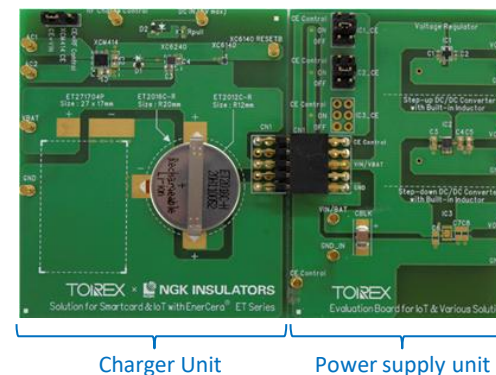


Block	Product	Features
(1) LDO for Charging	XC6240	For LTO/Solid-State battery charging, 2.63V, 150mA
	XC6242	For 105°C compatible charging, 2.63V, 150mA
(2) Battery voltage monitor	XC6140	RESET IC for battery voltage monitoring Detect voltage: 1.6~2.2V, Release voltage: 2.475V, Iq=104nA
	XC6142	105°C compatible, RESET IC for battery voltage monitoring Detect voltage; 1.6~2.1V, Release voltage: 2.450V, Iq=104nA

■ Reference Solution / Evaluation board for LTO batteries

Adopted as reference designs for charger IC and battery monitoring IC for LTO batteries by each manufacturer.

Evaluation boards for charging and power supply are provided for each battery.



(1) LDO for charging LTO and Solid-State battery : XC6240, XC6242

Charging with low Iq LDO of max. $V_{OUT} = 2.70V$ including temperature range in accordance with battery specifications.
To suppress inrush current, insert a few ohms resistor between the LDO and the battery.

(2) Battery voltage monitoring : XC6140, XC6142

Set the voltage to release when charging starts by the LDO in accordance with the charging and discharging characteristics of the battery.