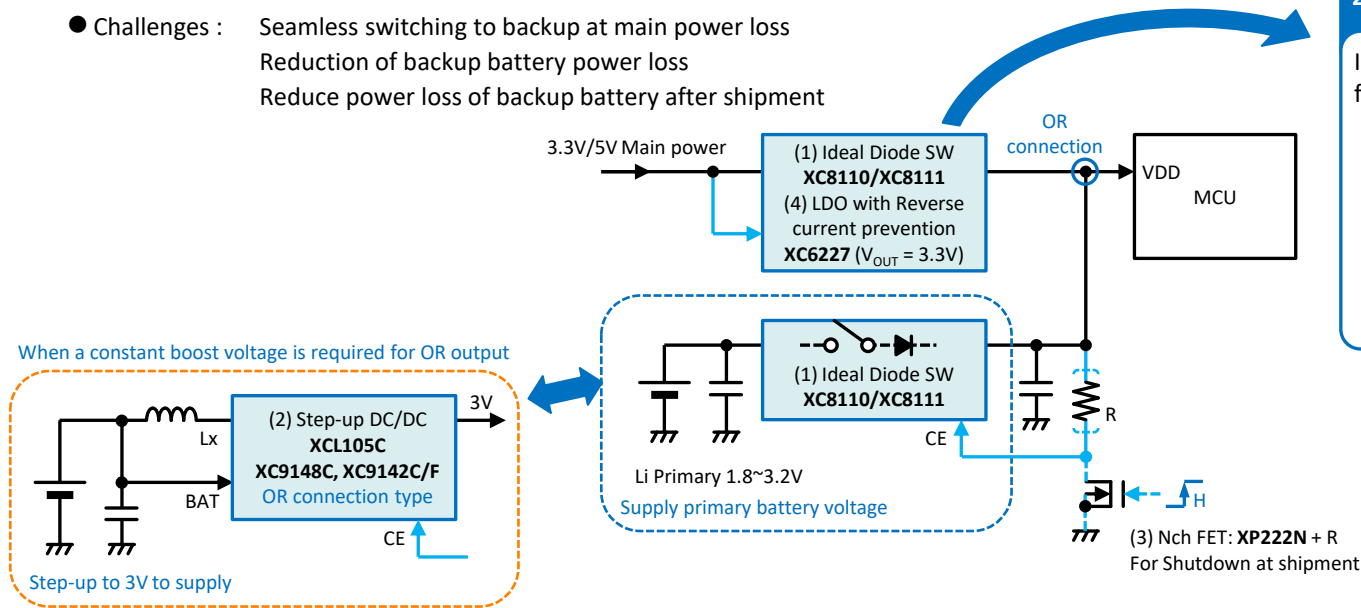


OR Connection Solutions for Backup and Multiple Power Sources (1)

Backup power supply with Primary battery

- Challenges :
 - Seamless switching to backup at main power loss
 - Reduction of backup battery power loss
 - Reduce power loss of backup battery after shipment



2ch product for OR Connection

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

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

Block	Product	Features
(1) Ideal diode SW	XC8110 / XC8111 <small>FEATURED</small>	True Reverse current prevention Ideal Diode Load SW VF=20mV, 500mA (XC8110), 1A (XC8111), IEC 62368-1 certified
	XC8112 / XC8113 <small>UNDER DEVELOPMENT</small>	2ch True Reverse current prevention Ideal Diode Load SW VF=20mV 2ch x 500mA (XC8112), 2ch x 1A (XC8113), IEC 62368-1 certified.
(2) Step-up DC/DC	XCL105C <small>FEATURED</small>	Built-in inductor, PWM/PFM, 1.2MHz 710mA@3.3V→5V, For OR connection
	XC9148C <small>FEATURED</small>	1.2MHz/3MHz, PWM/PFM 750mA@3.3V→5V, For OR connection
	XC9142C/F	1.2MHz/3MHz, PWM/PFM 450mA@3.3V→5V, For OR connection
(4) LDO with Reverse current prevention	XC6227	High-speed PSRR=65dB, 700mA True Reverse current prevention

OR connection : How to connect Backup battery

(1) Supplying backup battery voltage directly to MCU

OR connection by using **Ideal Diode SW. (XC8110/XC8111)**

VF loss/leakage current can be significantly reduced compared to SBD.
2ch type for OR connection of 2 lines is also available. **(XC8112/XC8113)**

(2) Supplying boosted voltage to MCU

Step-up DC/DC with **OR connection. (XCL105C, XC9148C, XC9142C/F)**

Please note that OR connection availability differs depending on the product and its option.

Method to extend battery life with Ship function

(3) Cut off supply from backup power source at shipment

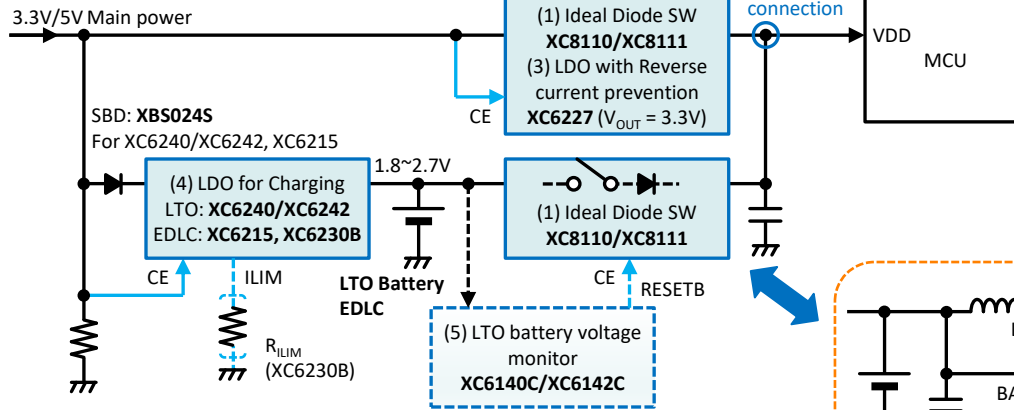
Turn on the Nch FET to turn off the CE.

Significantly reduces the discharge from the battery until the start of use.

OR Connection Solutions for Backup and Multiple Power Sources (2)

Backup power supply with Rechargeable battery / LTO battery / Supercap (EDLC)

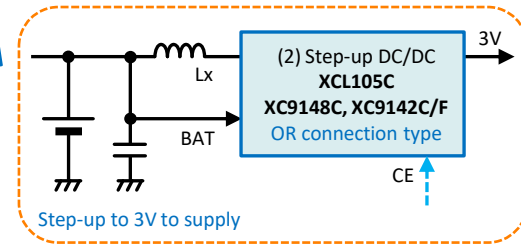
- Challenges : Seamless switching to backup at main power loss
Efficient charging and discharging to backup devices



2ch product for OR Connection

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

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



Block	Product	Features
(1) Ideal diode SW	XC8110 / XC8111 <small>FEATURED</small>	True Reverse current prevention Ideal Diode Load SW VF=20mV, 500mA (XC8110), 1A (XC8111), IEC 62368-1 certified
	XC8112 / XC8113 <small>UNDER DEVELOPMENT</small>	2ch True Reverse current prevention Ideal Diode Load SW VF=20mV 2ch x 500mA (XC8112), 2ch x 1A (XC8113), IEC 62368-1 certified.
(2) Step-up DC/DC	XCL105C <small>FEATURED</small>	Inductor built-in, 1.2MHz, 710mA@3.3V→5V, For OR connection
	XC9148C <small>FEATURED</small>	1.2MHz/3MHz, 750mA@3.3V→5V, For OR connection
	XC9142C/F	1.2MHz/3MHz, 450mA@3.3V→5V, For OR connection
(3) LDO with Reverse current prevention	XC6227	High-speed PSRR=65dB, 700mA True Reverse current prevention
(4) LDO for Charging	XC6240 / XC6242 <small>FEATURED</small>	For LTO charging, 150mA, Topr=105°C (XC6242)
	XC6215	Iq=0.8µA, 150mA, Select V _{OUT} voltage suitable for EDLC
	XC6230B	2A, Current limit adj, True Reverse current prevention
(5) LTO battery voltage monitor	XC6140 / XC6142 <small>FEATURED UNDER DEVELOPMENT</small>	LTO battery voltage monitoring Release voltage: 2.475V/2.450V, Iq=104nA For 105°C compatible LTO battery: XC6142

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

- Supplies battery voltage directly to MCU : **XC8110/XC8111, XC8112/XC8113**
- Supplies boosted voltage to MCU : **XCL105C, XC9148C, XC9142C/F**
- LDO, DC/DC for Main power side

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

Also, DC/DC or standard LDO with a SBD can be configured for OR connection.

(4) LTO battery / Supercap (EDLC) charging

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

For EDLC : **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 LTO battery characteristics.

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

■ OR connection of power supply rails

● Technical trend and challenges

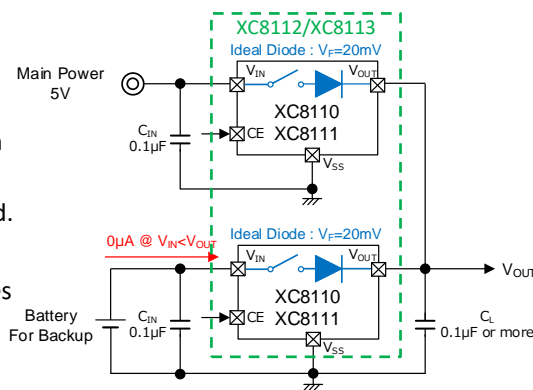
- For high efficiency and long battery life of the device, the circuit using SBD has large loss due to VF. Leakage current of reverse bias is also an issue.
- Difficult to supply stable voltage due to voltage drop and fluctuation caused by the VF characteristic of the diode which may cause unstable operation.

● 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 and response to minimize output voltage fluctuation and 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 62368-1:2018 certified.
- Low loss requires no heat dissipation and contributes to miniaturization.

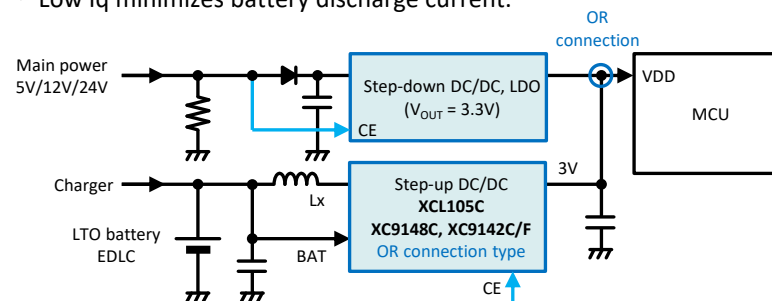


■ Load Switch with Ideal Diode function

Product	Features	V _{IN} (V)	R _{on}	I _{OUT}	Package
XC8110 <small>FEATURED</small>	VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias)	1.5 ~ 6.0	120mΩ	500mA	WLP-4-02 (0.82x0.82xh0.5mm) SOT-25 (2.9x2.8xh1.3mm) USP-6B06 (1.8x1.5xh0.33mm)
XC8111 <small>FEATURED</small>	IEC 62368-1:2018 certified			1A	
XC8112 <small>UNDER DEVELOPMENT</small>	2ch (Parallel is allowed) VF=20mV 3.6μA (Forward bias)	1.5 ~ 6.0	2ch x 120mΩ	2 x 500mA or 1 x 1A	USP-8B06 (2.0x2.0xh0.33mm)
XC8113 <small>UNDER DEVELOPMENT</small>	0μA (Reverse bias) IEC 62368-1:2018 certified		or 1ch x 60mΩ	2 x 1.0A or 1 x 2A	

➢ 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 I_q minimizes battery discharge current.



■ Step-up DC/DC for OR connection

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA) @3.3V→5V	Package
XCL105C <small>FEATURED</small>	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)
XC9148C <small>FEATURED</small>	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)
XC9142C/F	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)

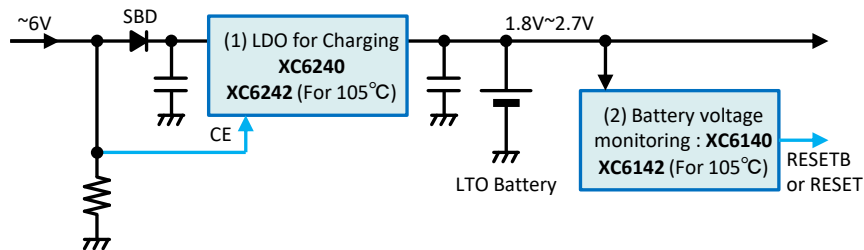
LTO battery : Charge/Discharge Reference solutions

■ 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 battery charging and battery voltage monitoring



Block	Product	Features
(1) LDO for Charging	XC6240 FEATURED	For LTO charging, 2.63V, 150mA
	XC6242 FEATURED	105°C compatible, For LTO charging, 2.63V, 150mA
(2) LTO battery voltage monitor	XC6140 FEATURED	RESET IC for LTO battery voltage monitoring Detect voltage: 1.6~2.2V, Release voltage:2.475V, Iq=104nA
	XC6142 UNDER DEVELOPMENT	105°C compatible, RESET IC for LTO 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.



NGK Insulators
EnerCera ET Series

Nichicon
SLB Series



Charger Unit

Power supply unit

(1) LDO for charging LTO battery : XC6240, XC6242

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

(2) LTO 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 LTO battery.