

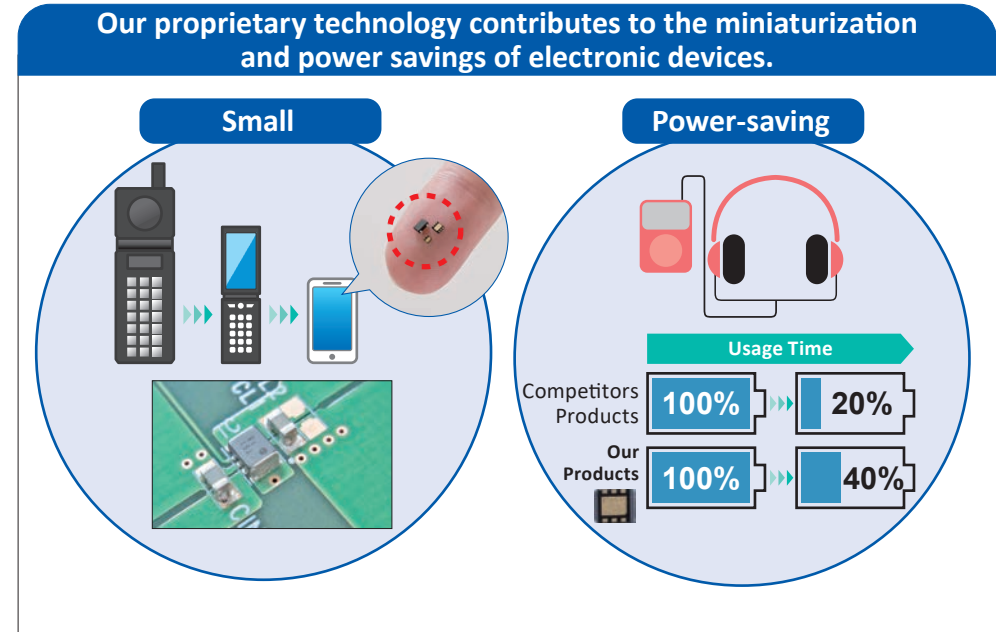
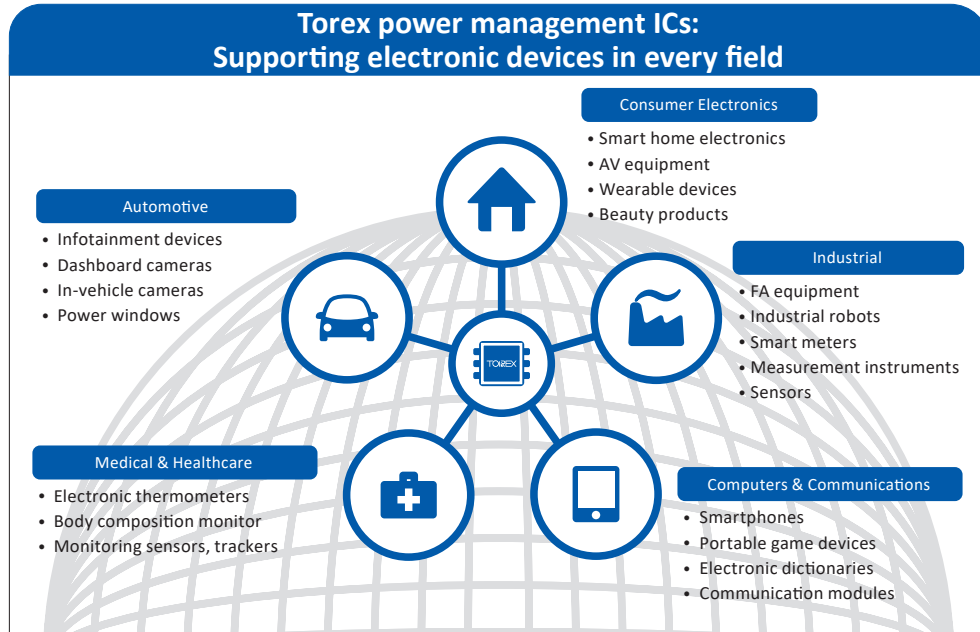


Power Management Solutions 2024



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TOREX SEMICONDUCTOR is specialized in manufacturing power management ICs featuring small size, low Iq, and low noise. We offer the most effective solutions to advance both sustainability and digital transformation in our society.



TOREX SEMICONDUCTOR LTD.

Address : 3F DAIHO ANNEX 1-24-1 Shinkawa, Chuo-Ku, Tokyo 104-0033 Japan

Founded : March 1995

Capital : 2967.93 million JPY

Operations : 1. Research and Development, Manufacturing of ICs and active discrete components.
2. Sales of ICs and active discrete components.

Stock Exchange : Prime Market of the Tokyo Stock Exchange

WEB Site : Corporate Site <https://www.torexsemi.com/>
Product Site <https://product.torexsemi.com/en>



New Products, Featured Products Introduction

XCL
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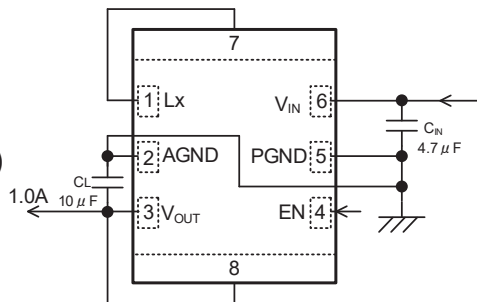
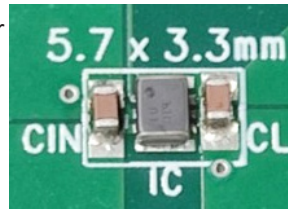
HiSAT-COT
Page 30

NEW

■ XCL239 / XCL240 - Built-in inductor HiSAT-COT 1.0A Step-down Micro DC/DC

- Smaller size, Easy design and Lower EMI by Built-in inductor
- High-speed transient response with HiSAT-COT control
- 1A Pocket type, suitable for any application

V_{IN} : 2.5V ~ 5.5V
 V_{OUT} : 0.8V ~ 3.6V
 I_{OUT} : 1.0A
 I_q : 25 μ A
 f_{osc} : 3MHz
 Control : HiSAT-COT
 F-PWM (XCL239)
 PWM/PFM (XCL240)
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : CL-2025-02
 (Pocket type)

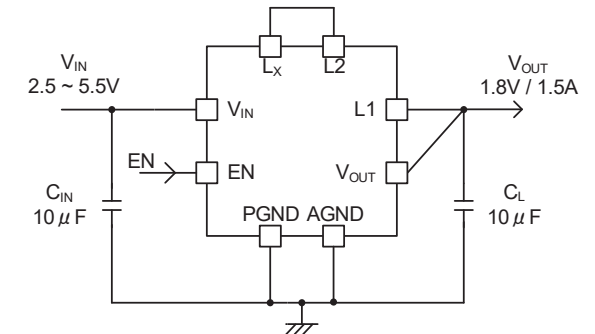


NEW

■ XCL237 / XCL238 - Built-in inductor HiSAT-COT 1.5A Step-down Micro DC/DC

- Smaller size, Easy design and Lower EMI by Built-in inductor
- High-speed transient response with HiSAT-COT control
- High heat dissipation and small size with high output by Multiple type

V_{IN} : 2.5V ~ 5.5V
 V_{OUT} : 0.8V ~ 3.6V
 I_{OUT} : 1.5A
 I_q : 25 μ A
 f_{osc} : 3MHz
 Control : HiSAT-COT
 F-PWM (XCL237)
 PWM/PFM (XCL238)
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : USP-9B01
 (Multiple type)

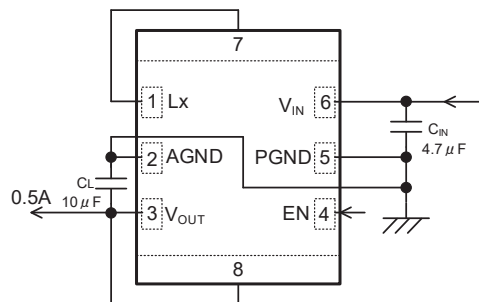
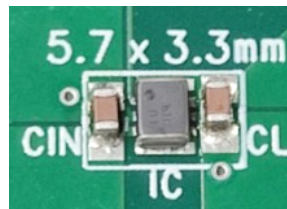


NEW

■ XCL241 / XCL242 - Built-in inductor HiSAT-COT 500mA Step-down Micro DC/DC

- Smaller size, Easy design and Lower EMI by Built-in inductor
- Ultra-low EMI by 1.2 MHz
- High-speed transient response with HiSAT-COT control

V_{IN} : 2.5V ~ 5.5V
 V_{OUT} : 0.8V ~ 3.6V
 I_{OUT} : 500mA
 I_q : 15 μ A
 f_{osc} : 1.2MHz
 Control : HiSAT-COT
 F-PWM (XCL241)
 PWM/PFM (XCL242)
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : CL-2025-02
 (Pocket type)

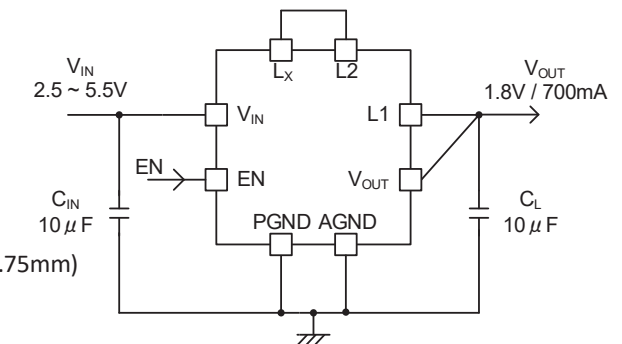
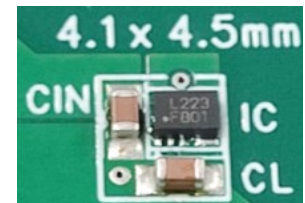


NEW

■ XCL243 / XCL244 - Built-in inductor HiSAT-COT 700mA Step-down Micro DC/DC

- Smaller size / Easy design / Lower EMI by Built-in inductor
- High-speed transient response with HiSAT-COT control
- Small size and Low profile by Multiple type

V_{IN} : 2.5V ~ 5.5V
 V_{OUT} : 0.8V ~ 3.6V
 I_{OUT} : 700mA
 I_q : 25 μ A
 f_{osc} : 3MHz
 Control : HiSAT-COT
 F-PWM (XCL243)
 PWM/PFM (XCL243)
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : USP-8B04
 (Multiple type, 2.25x1.5x0.75mm)



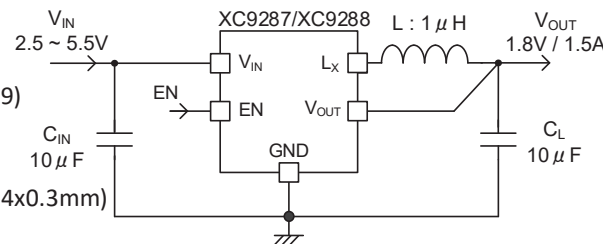
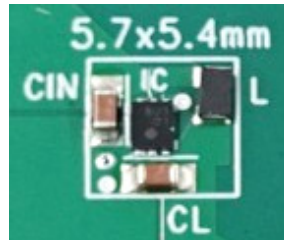
NEW

■XC9287 / XC9288 / XC9289 - HiSAT-COT 1.5A Step-down DC/DC

- High-speed transient response with HiSAT-COT control
- 1.5A, ideal for all applications
- LGA ultra-small package also available

V_{IN} : 2.5V ~ 5.5V
 V_{OUT} : 0.8V ~ 3.6V
 I_{OUT} : 1.5A
 I_q : 15 μ A
fosc : 1.2MHz, 3MHz
Control : HiSAT-COT

F-PWM (XC9287)
PWM/PFM (XC9288)
MODE selectable (XC9289)
Topr : -40°C ~ 105°C
Package : USP-6C, SOT-89-5
LGA-8B01 (XC9289, 1.2x1.4x0.3mm)



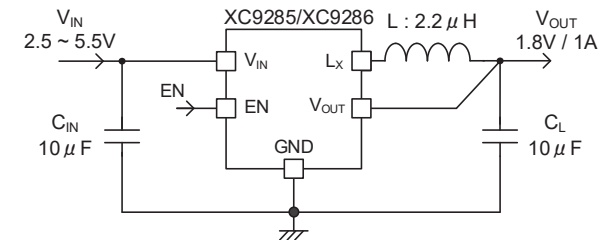
NEW

■XC9285 / XC9286 - HiSAT-COT 1.0A Step-down DC/DC

- High-speed transient response with HiSAT-COT control
- 1.0A, ideal for all applications

V_{IN} : 2.5V ~ 5.5V
 V_{OUT} : 0.8V ~ 3.6V
 I_{OUT} : 1.0A
 I_q : 15 μ A
fosc : 1.2MHz
Control : HiSAT-COT

F-PWM (XC9285)
PWM/PFM (XC9286)
Topr : -40°C ~ 105°C
Package : USP-6C, SOT-25



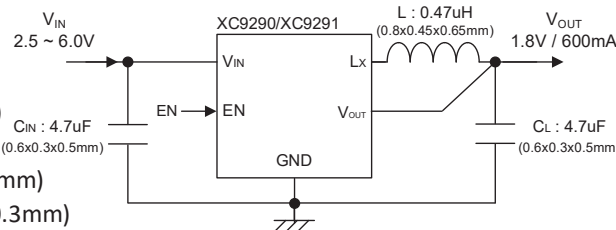
NEW

■XC9290 / XC9291 - HiSAT-COT Ultra space-saving 600mA step-down DC/DC

- World's smallest solution size
- High-speed transient response with HiSAT-COT control
- Compatible with ultra-small capacitors/inductors

V_{IN} : 2.5V ~ 6.0V
 V_{OUT} : 0.7V ~ 3.6V
 I_{OUT} : 600mA
 I_q : 11 μ A
fosc : 4MHz, 6MHz
Control : HiSAT-COT

F-PWM (XC9290)
PWM/PFM (XC9291)
Topr : -40°C ~ 105°C
Package : LGA-6B01 (1.2x1.2x0.3mm)
WLP-5-08 (0.96x0.88x0.3mm)

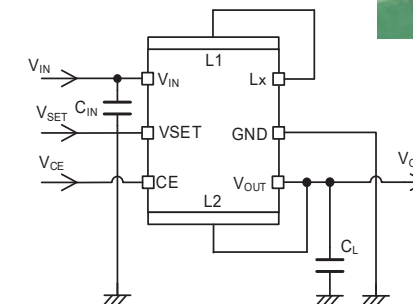
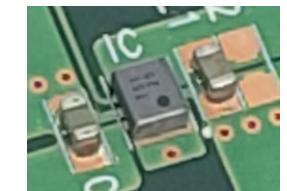


NEW

■XCL233 - Built-in inductor, Ultra-low Iq Step-down Micro DC/DC with VSET

- Smaller size / Easy design / Lower EMI by Built-in inductor
- 80% or higher efficiency even at IOU=10µA with 200nA Ultra-low Iq
- VSET function enhancing further lower power consumption

V_{IN} : 1.8V ~ 6.0V
 V_{OUT} : 0.5V ~ 3.6V : 2 values
Selected by H/L of VSET pin
 I_{OUT} : 150mA
 I_q : 200nA
Control : PFM
Topr : -40°C ~ 85°C
Package : CL-2025-03
(Pocket type)



VSET
Page 26

XCL
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New Products, Featured Products Introduction

NEW

High voltage Step-down and Monitoring: Page 34

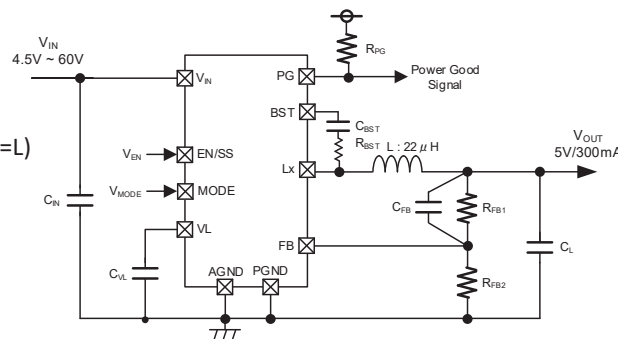
NEW

■XC9702 - 60V 0.3A High voltage Space-saving Step-down DC/DC

- World's smallest 60V buck DC/DC in terms of total solution size
- Low Iq and high efficiency at light loads
- Supports High voltage, Low ripple, High temperature operation and High step-down ratios



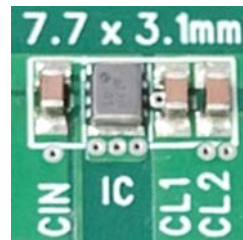
V_{IN} : 4.5V ~ 60.0V
 V_{OUT} : 2.5V ~ 12.0V (FB voltage: 0.75V)
 I_{OUT} : 300mA
 I_q : 12 μ A
 f_{osc} : 1.0MHz
 Control : F-PWM (MODE=H)
 PWM/PFM (MODE=L)
 T_{opr} : -40 $^{\circ}$ C ~ 125 $^{\circ}$ C
 Package : HSOP-8N
 USP-10B



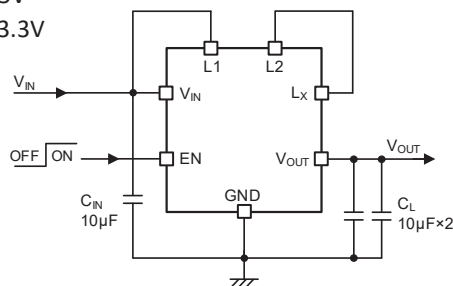
NEW

■XCL108 - Built-in inductor, Ultra-low Iq Step-up Micro DC/DC

- Smaller size / Easy design / Lower EMI by Built-in inductor
- 85.9% efficiency even at I_{OUT}=10 μ A with 400nA Ultra-low I_q
- For longer battery life in IoT/wearable applications



V_{IN} : 0.65V ~ 5.5V
 V_{ST} : 1.6V
 V_{OUT} : 3.0V ~ 5.5V
 f_{osc} : 1.2MHz
 I_{OUT} : 300mA @3.3V \rightarrow 5V
 200mA @1.8V \rightarrow 3.3V
 Control : PWM/PFM
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : CL-2025-02
 (Pocket type)



XCL
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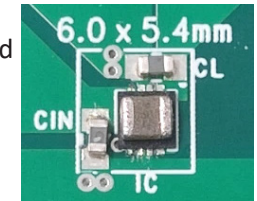
Bypass
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OR connection
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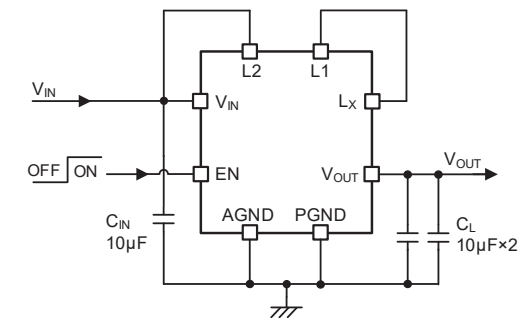
FEATURED

■XCL104 / XCL105 - Small, Multi-func. Built-in inductor Step-up Micro DC/DC

- Built-in inductor realizing space-saving and high efficiency
- Load disconnection / V_{OUT} OR / Bypass types can be selected



V_{IN} : 0.65V ~ 6.0V
 V_{ST} : 0.9V
 V_{OUT} : 1.8V ~ 5.5V
 f_{osc} : 1.2MHz
 I_{OUT} : 710mA @3.3V \rightarrow 5.0V
 420mA @1.8V \rightarrow 3.3V
 Control : F-PWM (XCL104)
 PWM/PFM (XCL105)
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : DFN3030-10B



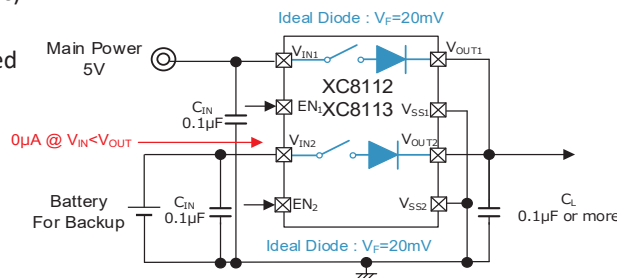
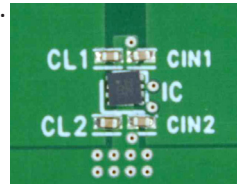
New Products, Featured Products Introduction

UNDER DEVELOPMENT

XC8112 / XC8113 – 2ch Ideal Diode Load Switch

- Load SW with **Ideal Diode function** equivalent to $V_F=20mV$
- Supports OR connection of two lines with only one IC.
- 1ch 1A/2A, $R_{on}=60m\Omega$ in parallel connection

V_{IN} : 1.5V ~ 6.0V
 I_{OUT} : 2ch x 500mA (XC8112)
 2ch x 1A (XC8113)
 R_{on} : 120m Ω /ch
 I_q : 3.6 μ A/ch (at Forward bias)
 0 μ A (at Reverse bias)
 Standard : IEC 62368-1:2018 certified
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : USP-8B06



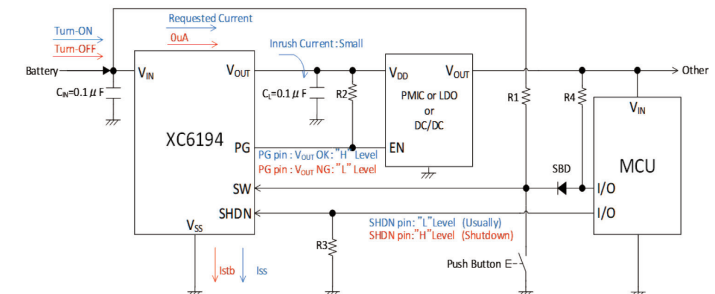
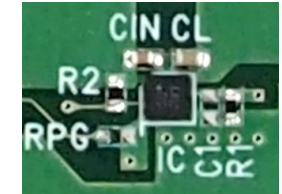
2ch OR connection
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FEATURED

XC6193 / XC6194 - Push Button Load Switch equipped with Shutdown function

- **Shutdown Function** cuts off current consumption to 1 nA
- Preventing discharge during shipment / System power switch / Freeze measures
- Essential for long battery life

V_{IN} : 1.8V ~ 6.0V
 I_{OUT} : 1A (XC6194)
 1A + External Pch FET (XC6193)
 I_{STB} : 1nA (at shutdown)
 R_{on} : 0.14 Ω @3.0V
 I_q : 0.13 μ A
 T_{opr} : -40 $^{\circ}$ C ~ 85 $^{\circ}$ C
 Package : USP-8B06



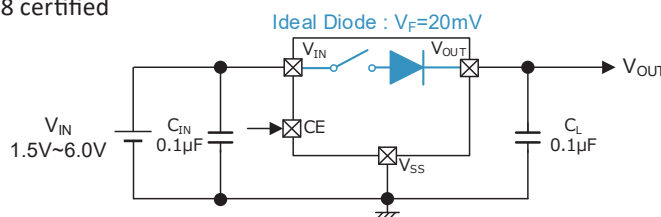
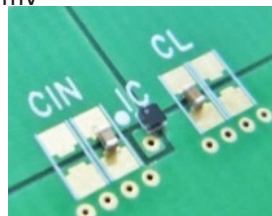
XC6194
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FEATURED

XC8110 / XC8111 - Ideal Diode Load Switch

- Load SW with **Ideal Diode function** equivalent to $V_F = 20mV$
- For OR connection of multiple power lines and backup

V_{IN} : 1.5V ~ 6.0V
 I_{OUT} : 500mA (XC8110)
 1A (XC8111)
 R_{on} : 120m Ω @WLP-4-02
 I_q : 3.6 μ A (at Forward bias)
 0 μ A (at Reverse bias)
 Standard : IEC 62368-1:2018 certified
 T_{opr} : -40 $^{\circ}$ C ~ 105 $^{\circ}$ C
 Package : SOT-25
 USP-6B06
 WLP-4-02



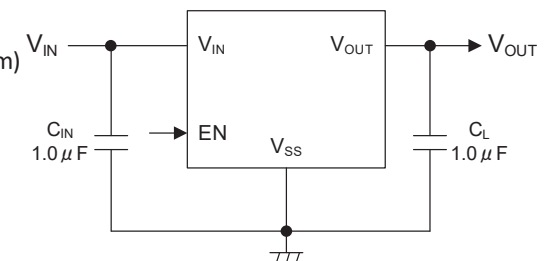
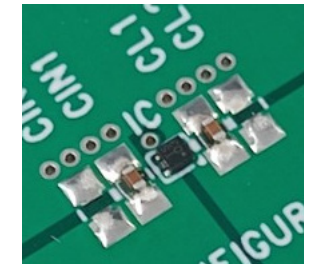
Ideal Diode
Page 27

NEW

XD6239 - 300mA High-speed LDO for Automotive 125 $^{\circ}$ C operation

- AEC-Q100 Grade1 compliant and High PSRR

V_{IN} : 2.0V ~ 6.0V
 V_{OUT} : 1.2V ~ 3.4V
 I_{OUT} : 300mA
 I_q : 100 μ A
 R_{on} : 0.66 Ω
 $PSRR$: 75dB @1kHz
 Function : Inrush current prevention
 T_{opr} : -40 $^{\circ}$ C ~ 125 $^{\circ}$ C
 Package : DFN1010-4C (1.0x1.0x0.6mm)
 SOT-25
 SOT-89-5



Automotive
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New Products, Featured Products Introduction

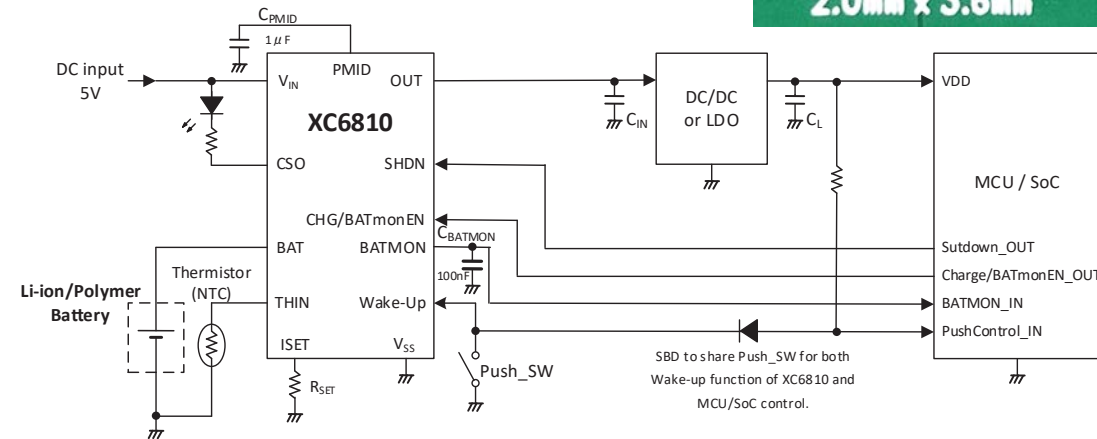
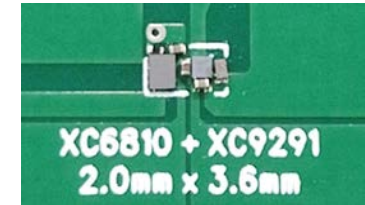
FEATURED

XC6810 - Ultra-small Charger IC for Li-ion batteries compatible with Wireless charging

- Optimized for small-capacity Li-Ion, with Shutdown Function for shipping
- Two-wire communication / Charging status & Battery voltage monitoring

Input Voltage(Chargeable)	: 3.5V ~ 28.0V
Charge Voltage	: 3.80V ~ 4.40V (0.05V increments)
Charge Current	: 1mA ~ 25mA
BAT Sink Current	: 10nA (TYP. at shutdown)
Function	: Current path, Shutdown/Wake-up Charging status & Battery voltage monitoring OUT line switch interlocked with UVLO (option) Battery temperature monitor Charge Enable control
Protection	: Battery Over Discharge, Output Short Thermal control, Safety timer
Package	: WLP-12-01 (1.17 x 1.57 x 0.33 mm)
Topr	: -40°C ~ 85°C

Solution example
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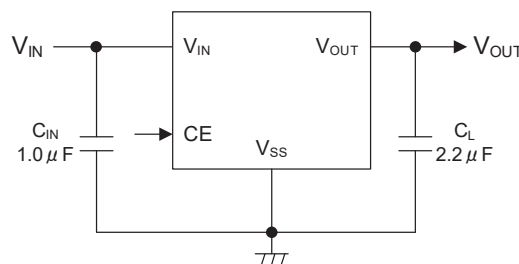


FEATURED

XC6705 / XC6706 - 20V 200mA High-speed, Low Iq LDO with seamless GO

- Seamless GO function achieving both low Iq and fast response
- Ideal for Li 2 cells in series and 12V input

V _{IN}	: 3.5V ~ 20.0V
V _{OUT}	: 2.5V ~ 5.5V
I _{OUT}	: 200mA
I _q	: 1.2µA
PSRR	: 50dB @1kHz
Topr	: -40°C ~ 105°C
Package	: SOT-25 (XC6705) USP-4 (XC6705) SOT-89 (XC6706)



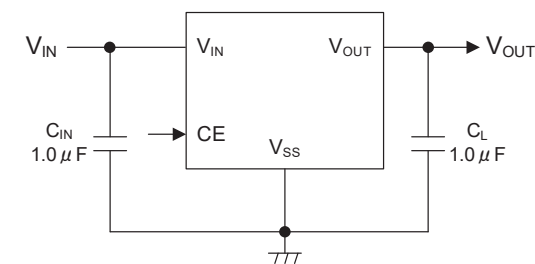
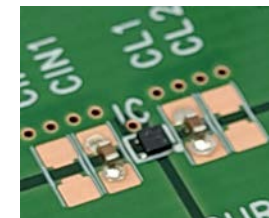
Solution example
Page 32

FEATURED

XC6241 - Low Iq, High-speed "GO" LDO

- Achieving both low Iq and fast response with Low Ron and 105°C operation
- Ideal for IoT/wearables and all other applications

V _{IN}	: 1.6V ~ 6.0V
V _{OUT}	: 1.2V ~ 5.0V
I _{OUT}	: 150mA
I _q	: 0.6µA
R _{on}	: 1.1Ω @3.3V
PSRR	: 60dB @1kHz
Topr	: -40°C ~ 105°C
Package	: USPQ-4B05 SSOT-24



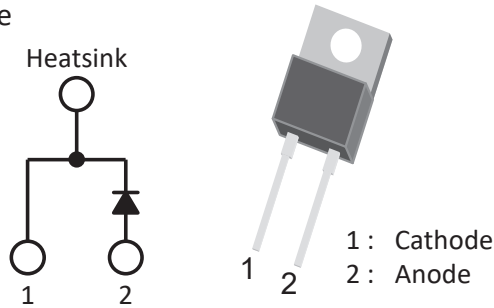
New Products, Featured Products Introduction

NEW

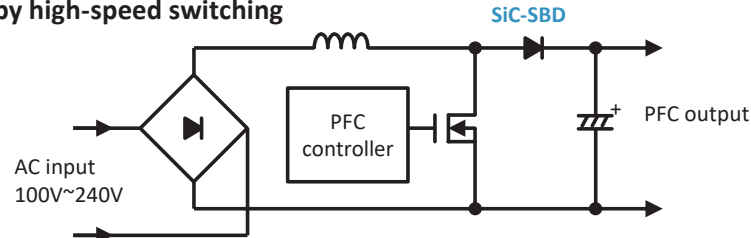
■XBSC11A108CS - 850V/10A SiC Schottky Barrier Diode

- Repetitive peak reverse voltage : $V_{RM}=850V$
- Fast switching operation / Low recovery loss

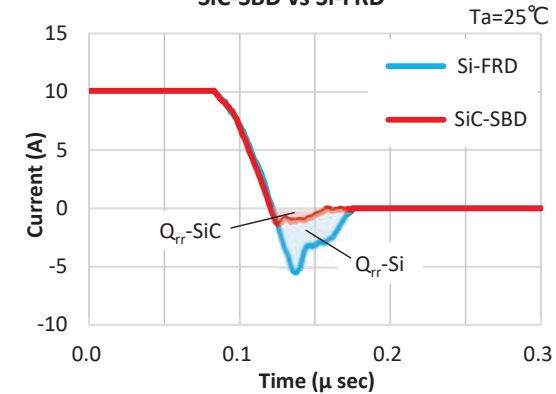
V_{RM}	: 850V
V_R	: 850V
$I_{F(AVE)}$: 10A
V_F	: 1.5V
I_{FSM}	: 36A@Pulse Width=10ms
I_R	: 2 μ A@ $V_R=650V$
Package	: TO-220AC
T_{jmax}	: 175 $^{\circ}C$



High efficiency of PFC circuits by high-speed switching



Fast switching characteristics
SiC-SBD vs Si-FRD



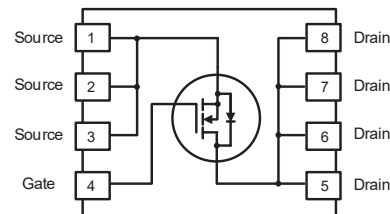
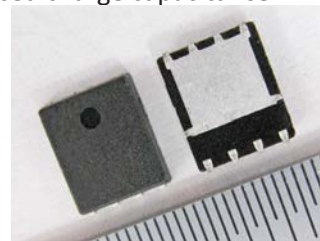
Discrete Products
SBD,TVS: Page 57

NEW

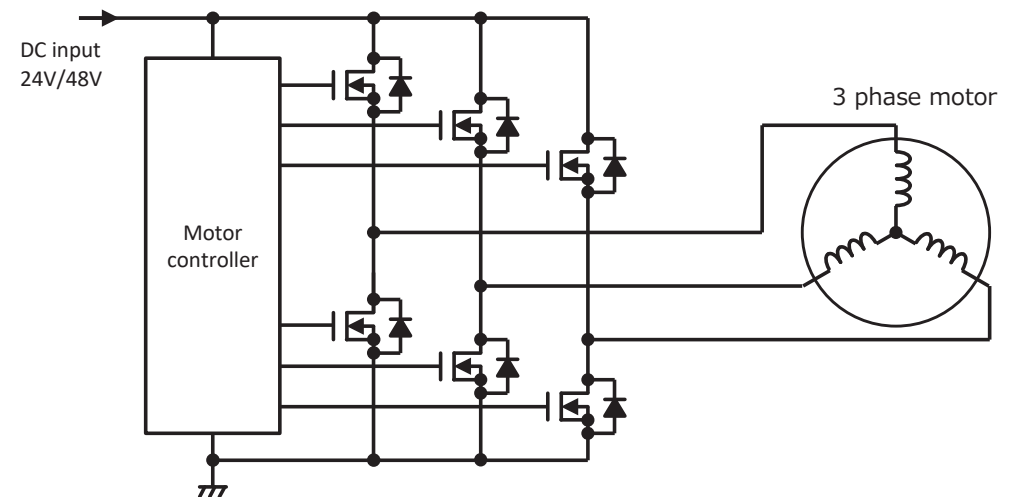
■XPJ102N09N8R / XPJ101N04N8R - N-channel MOSFET 100V, 8.4m Ω /3.8m Ω , 61A/122A

- 100V operation N-ch MOSFET, mounted in small DFN5060 package
- Low loss due to low on-resistance and reduced charge capacitance

V_{DS}	: 100V
V_{GS}	: $\pm 20V$
I_D	: 61A/122A
$V_{GS(th)}$: 2.8V
$R_{DS(on)}$: 8.4m Ω /3.8m Ω (TYP)
I_{DSS}	: 1 μ A ($V_{DS}=100V, V_{GS}=0V$)
I_{GSS}	: $\pm 100nA$ ($V_{GS}=\pm 20V, V_{DS}=0V$)
Q_{gs}	: 7.6nC/15.0nC
Q_{gd}	: 3.0nC/6.0nC
Q_g	: 19.0nC/40.5nC
Package	: DFN5060-8L (4.9 x 6.0 x 1.1mm)
T_{jmax}	: 150 $^{\circ}C$



Nch MOS FET



Discrete Products
FET: Page 56

TOREX Product Groups and Features

■ lineup for the power supplies of automotive, industrial, and consumer products including DC/DC converters, voltage regulators, and voltage detectors

Built-in inductor DC/DC converter Micro DC/DC (XCL Series)

- DC/DC converter with integrated inductor
- Space-saving / low EMI DC/DC converter that can be used like an LDO
- HiSAT-COT control ideal for high performance POL

Voltage Detector, Watchdog Timer (Reset, WDT)

- Ultra-low quiescent current in the nanoampere (nA) range, ideal for battery-powered applications
- Various functions and 125°C operation required for industrial equipment etc.

Charger IC (Li-ion/Polymer & LTO batteries)

- Small, simple, and easy-to-use charger IC for Li-ion/Polymer
- LDO for charging and battery voltage monitoring IC optimum for LTO (lithium titanate) batteries

DC/DC converter

- Wide lineups including Step-down, Step-up, etc.
- Ultra-small, ultra-low Iq, and fast transient response with HiSAT-COT

TOREX Product Groups Small size, High performance, Low Iq, Low noise

Automotive IC (XD Series)

- AEC-Q100 compliant
- Available in wide range of products such as LDO, voltage detector, and watchdog timer utilizing TOREX's small, high-performance devices

Voltage Regulator (LDO)

- Low Iq and high-speed LDO
- Low to medium and high voltages, small to higher currents
- Broad package lineup

Load Switch, Push Button Controller

- From simple load SW to USB protection and ideal diode function
- Load SW to cut off power supply with Push Button SW for Preventing discharge during shipment / System power SW / Freeze measures

Discrete (MOSFET, SBD/SiC SBD, TVS)

- MOSFET, Schottky barrier diode (SBD) and Transient voltage suppressor (TVS) used around power management ICs and for various other applications

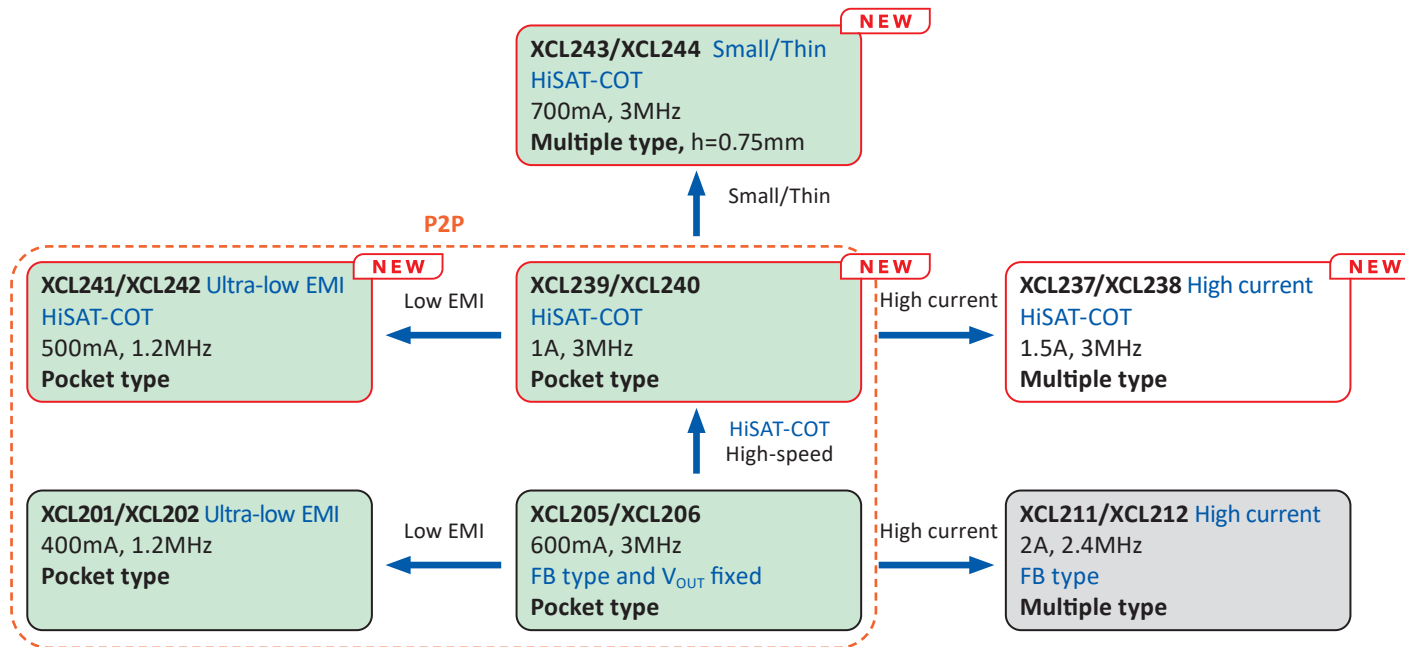
■ Features of TOREX built-in inductor DC/DC Converter Micro DC/DC

- Space-saving : Minimizes circuit board wiring of peripheral components. Makes small solutions possible.
- Design simplification : Only an input/output capacitor for the main components. Significantly reducing design evaluation workload.
- Noise reduction : The package configuration is optimized to suppress switching noise and achieves low EMI.
- Easy thermal design : Uses proprietary high heat dissipation packages.
- High efficiency : Small / High efficiency, even at light loads with Ultra-low Iq DC/DC.
- High-performance POL : **HiSAT-COT** ideal for FPGA/SoC, etc. with high-speed transient response and small components.

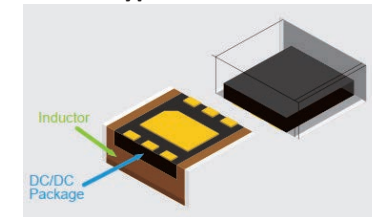
■ Typical Built-in inductor Micro DC/DC

Standard **HiSAT-COT** Small **HiSAT-COT Page 30**

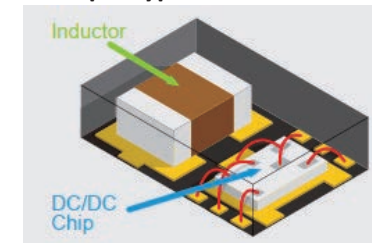
▶ High-speed response/low EMI step-down DC/DC



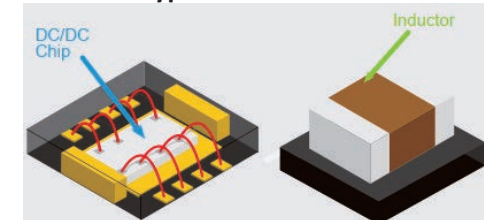
Pocket type



Multiple type



Cool Post type



Page 31 for technical details of Micro DC/DC XCL Series

Product name : Left "PWM", Right "PWM/PFM" control

Built-In Inductor DC/DC Converter Micro DC/DC (2)

(Selection Guide P.44)

■ Typical Built-in inductor Micro DC/DC

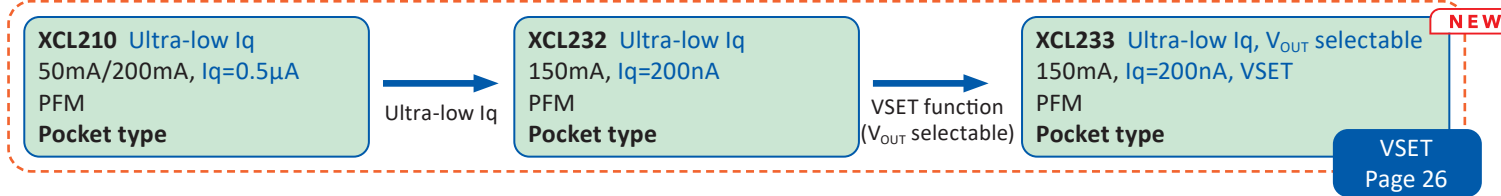
Standard

Low Iq

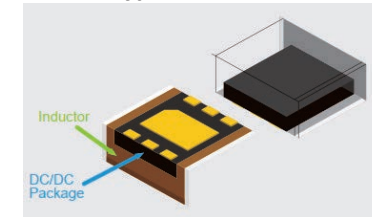
Small

▶ Ultra-low Iq Step-down DC/DC

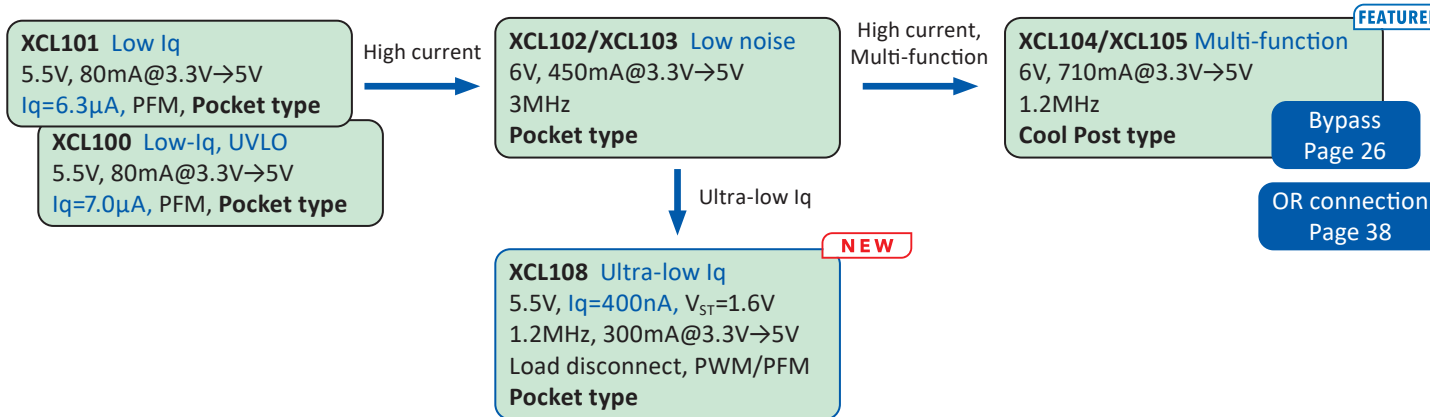
P2P



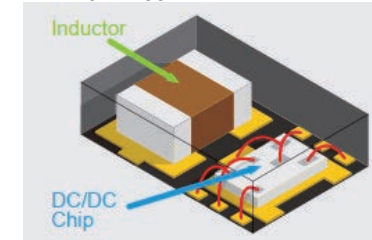
Pocket type



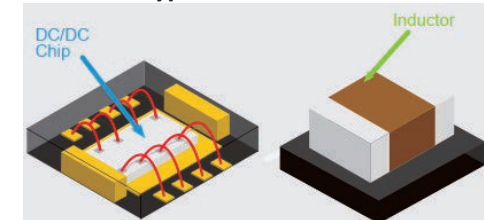
▶ Step-up DC/DC



Multiple type



Cool Post type



Page 31 for technical details of Micro DC/DC XCL Series

Product name : Left "PWM", Right "PWM/PFM" control

■ Features of TOREX DC/DC converter

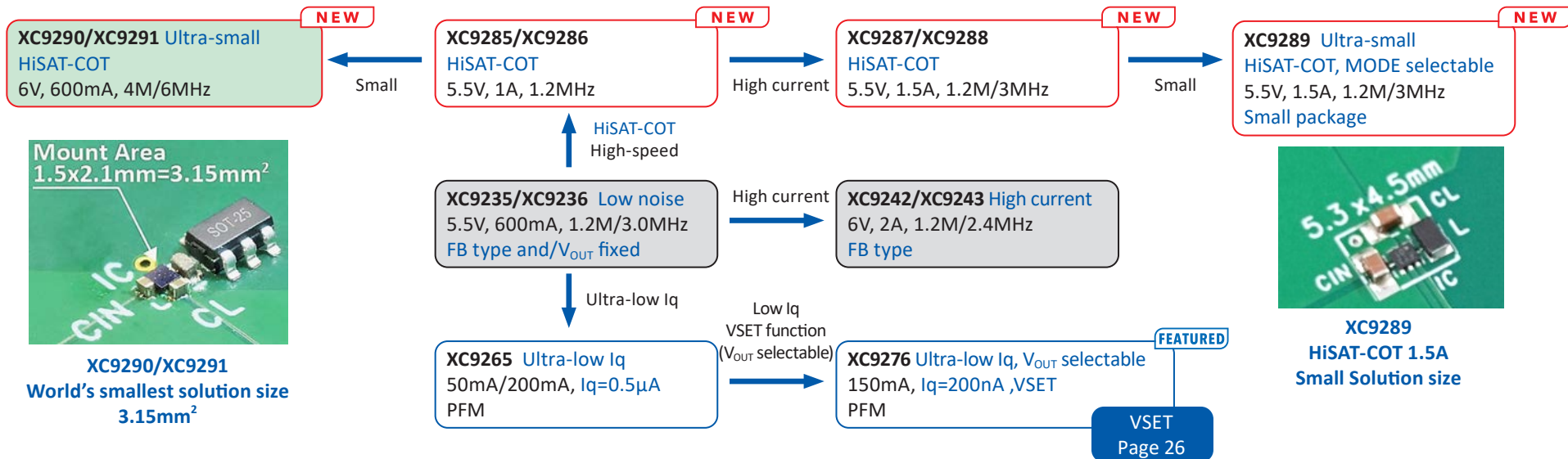
- Space-saving : Achieves space-saving not only with the IC but the peripheral components can be also made smaller.
- High-speed transient response : **HiSAT-COT** realizes high-speed transient response/good output stability and miniaturization of peripheral components.
- High functionality : Supports power supply start-up/shutdown sequences.
- Ultra-low Iq : Ultra-low Iq technology for higher efficiency and longer battery life.

HiSAT-COT
Page 30

■ Typical DC/DC converter



▶ Low voltage Step-down DC/DC



Product name : Left "PWM", Right "PWM/PFM" control

■ Features of TOREX DC/DC converter

- Space-saving : Achieves space-saving not only with the IC but the peripheral components can be also made smaller.
- High functionality : Step-up DC/DCs have options (Bypass/V_{OUT} OR/Load disconnection) for various power supply configurations.
- Ultra-low Iq : Ultra-low Iq technology for higher efficiency and longer battery life.

■ Typical DC/DC converter

Standard Low Iq **Small**

▶ Medium and high voltage Step-down DC/DC

XC9220/XC9221 16V,
Controller for driving Pch FET
300k/500k/1MHz, FB type

30V

XC9270/XC9271 30V, 2A
300k/500kHz, Sync CLK
FB type

60V

XC9702 60V, 300mA
Space-saving, Low Iq, High step-down ratios
60V, Iq=12μA, 1MHz, MODE selectable
FB type

NEW

High voltage Step-down
Page 34



60V 300mA DC/DC : XC9702
World's smallest class solution size
9.4mm x 7.4mm = 69.6mm²

▶ Inverting DC/DC (using Step-down DC/DC)

XC9271
30V, 200mA@12V→-5V
300k/500kHz, FB type

High Voltage

XC9702
60V, 50mA@12V→-5V
Space-saving, Low Iq
60V, Iq=12μA, 1MHz, FB type

NEW

Product name : Left "PWM", Right "PWM/PFM" control

▶ Low voltage Step-up DC/DC

XC9140 Low Iq
5.5V, Iq=6.3μA, PFM
80mA@3.3V→5V
Bypass/Load disconnection

High current

XC9147/XC9148 Multi-function **FEATURED**
6V, 750mA@3.3V→5V
1.2M/3MHz
Bypass/V_{OUT} OR/Load disconnection

Bypass
Page 26

OR connection
Page 38

High current/High efficiency
Multi-function

XC9141/XC9142 Low ripple
6V, 500mA@3.3V→5V
1.2M/3MHz
Bypass/V_{OUT} OR/Load disconnection

Ultra-low Iq

XC9145 Ultra-low Iq **FEATURED**
5.5V, Iq=400nA, V_{ST}=1.6V
1.2MHz, 430mA@3.3V→5V
Load disconnection, PWM/PFM

▶ Medium and high voltage Step-up DC/DC

XC9119 Space-saving
100mA@5V→12V
1MHz, PWM, FB type

High current

XC9103/XC9104
Controller for driving Nch FET
100k/180k/300k/500kHz
FB type

XC9133 LED / Back Light Driver
3.6V→3~4x LED, 20mA
PWM dimming control

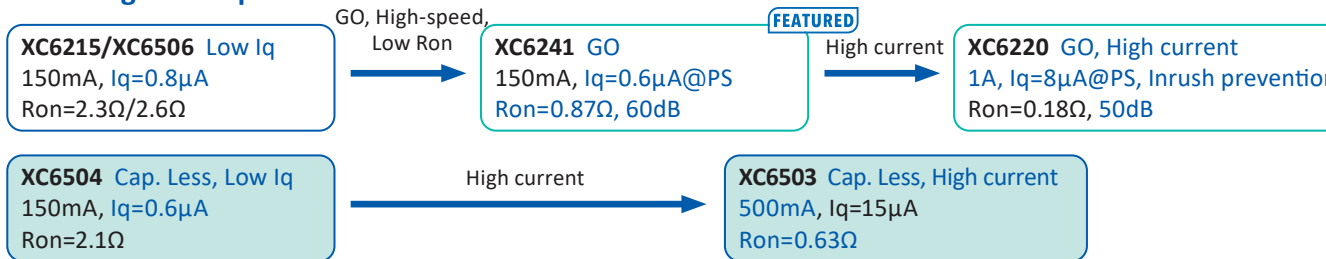
■ Features of TOREX Voltage Regulator

- Ultra-small : Wafer level and low-profile packages.
- Ultra-low Iq : Achieves long battery life.
- Various controls types : Green Operation (GO) type achieving both low Iq and high-speed response in addition to low Iq type and high-speed response type.

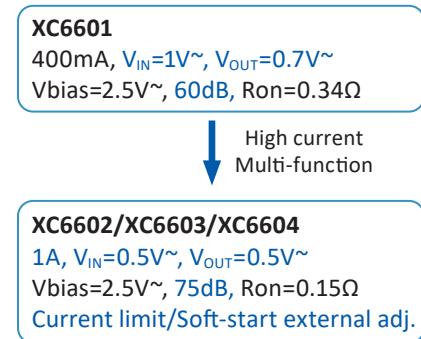
■ Typical Voltage Regulator



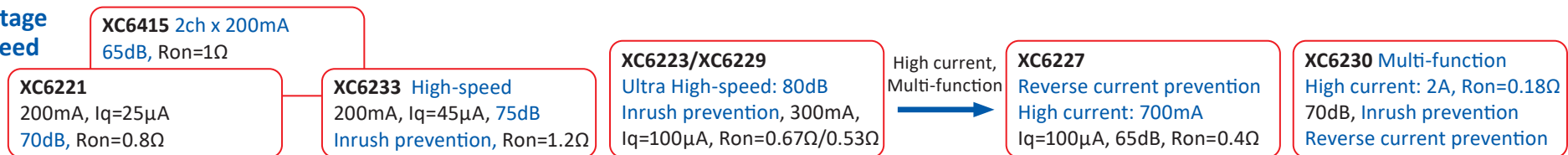
▶ Low voltage Low Iq



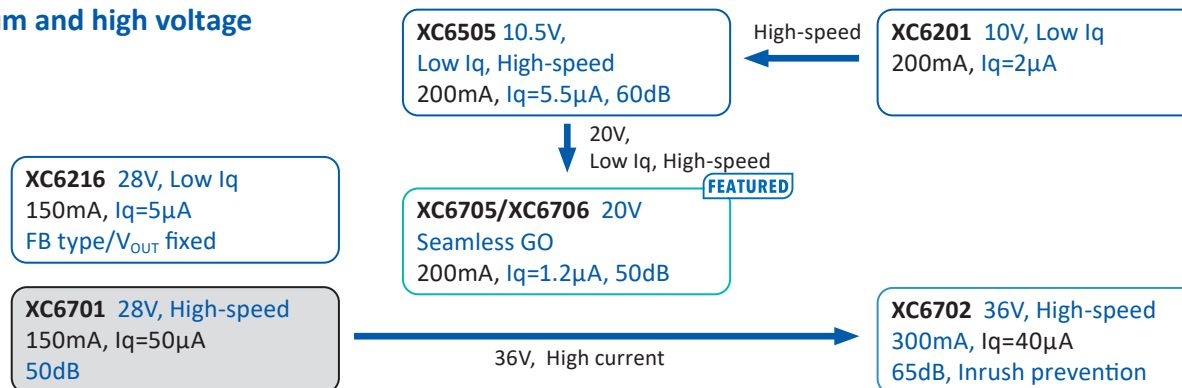
▶ Low input voltage, Bias type



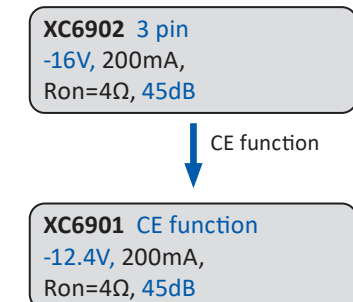
▶ Low voltage High-speed



▶ Medium and high voltage



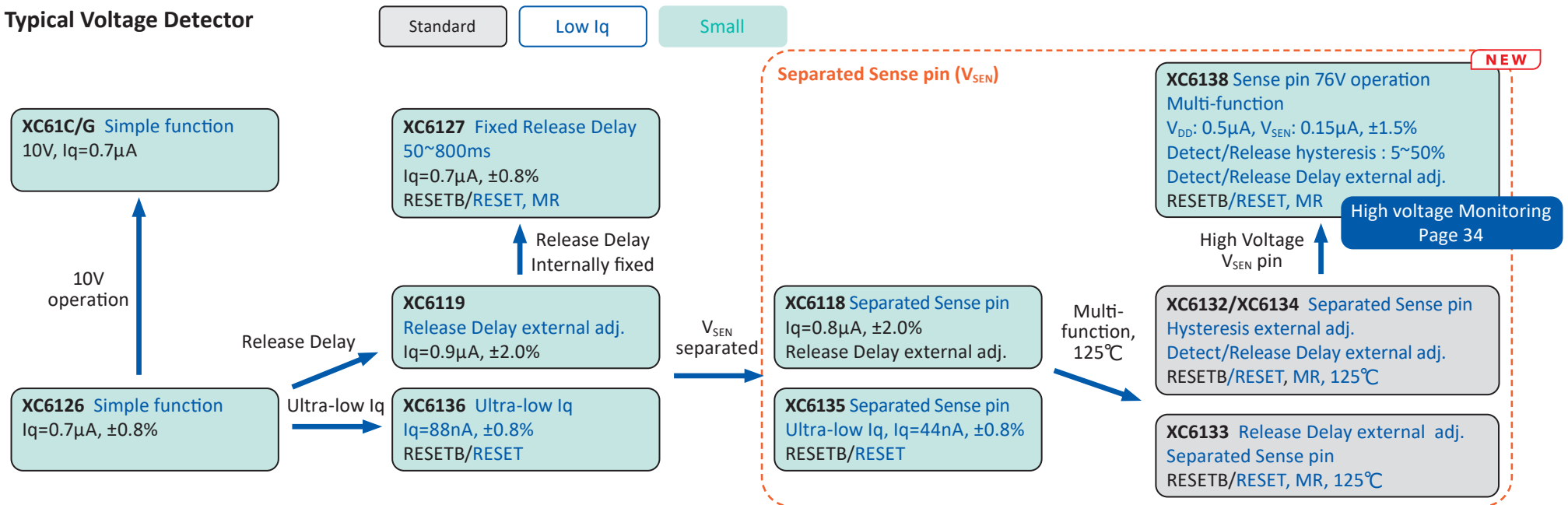
▶ Negative Voltage



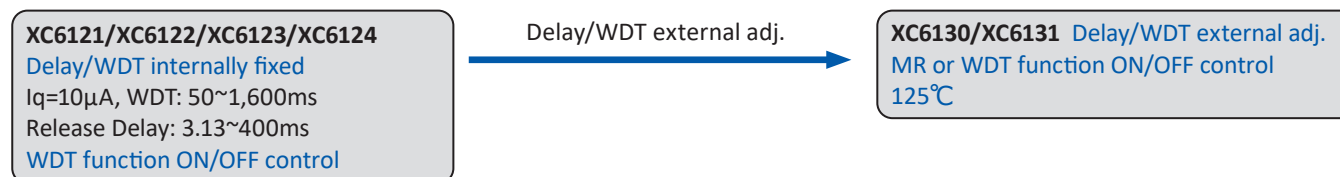
■ Features of TOREX Voltage Detector & Watchdog Timer

- Ultra-small : Ultra-small package and low-profile package.
- Ultra-low Iq : nA level low Iq achieving long battery life.
- Medium and high voltage monitoring : Separated Sense pin (V_{SEN}), Adjustable Hysteresis (HYS) /wide-selection, Detection Delay.
- Various functions : Release Delay, Manual Reset (MR), Output logic: RESETB/RESET

■ Typical Voltage Detector



■ Typical Watchdog Timer (WDT) + Voltage Detector



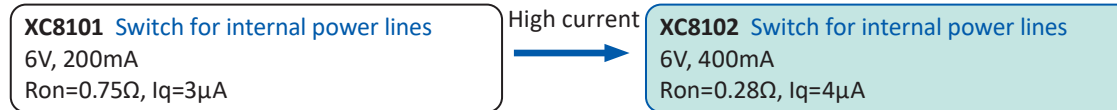
■ Load Switch

- Simple type : For internal power supply line distribution.
- Output protection : Current limit/protection for USB line, etc. Current limit external adjustment / Error flag function available.
- Built-in Ideal Diode function : Low VF 20mV / Low leakage / Reverse current prevention, also with protection functions. Two channel products also available.

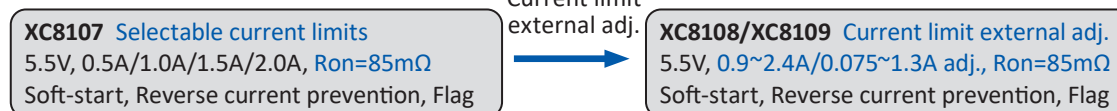
■ Typical Load Switch



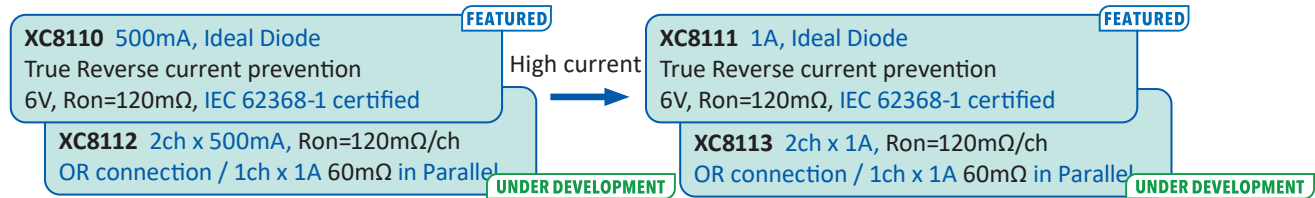
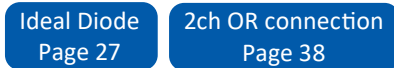
▶ Simple type



▶ Output protection for power supply lines



▶ Built-in Ideal Diode function

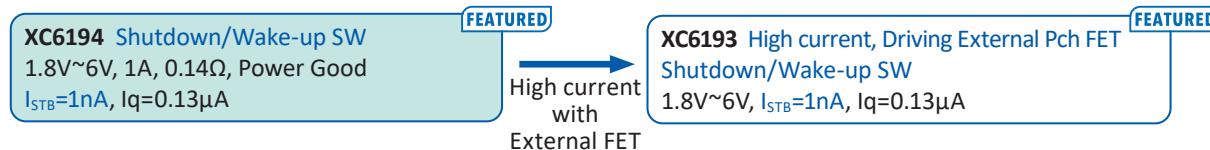
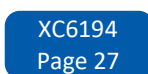


■ Push Button

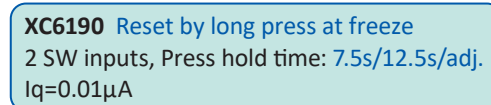
- Push Button Load SW : Current consumption 1nA at shutdown, for preventing discharge during shipment / System power switch / Freeze measures.
- Push Button Reboot controller : Long press of Push Button outputs reboot signal.
For countermeasures against freezes by system reset or toggling the power IC enable.

■ Typical Push Button Controller

▶ Push Button Load SW



▶ Push Button Reboot controller

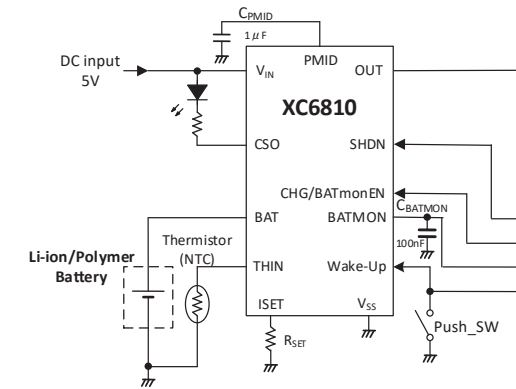
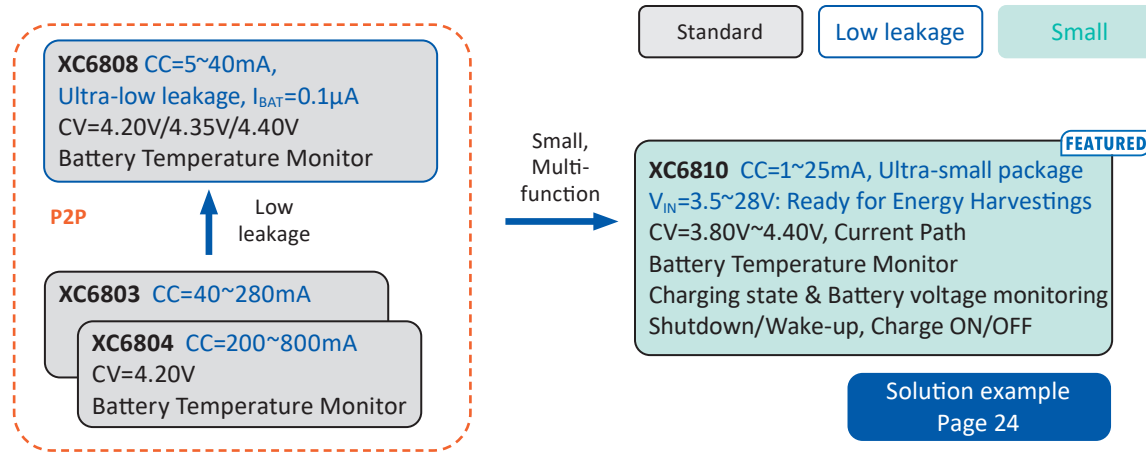


Charger IC : For Li-ion/Polymer & LTO batteries

(Selection Guide P.54)

Charger IC for Li-ion/Polymer batteries

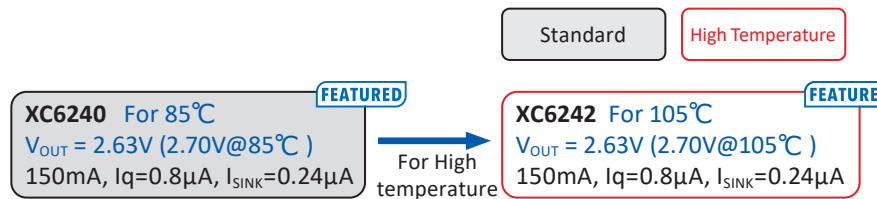
- Supports charging currents from 1mA to 800mA.
- For small-capacity Li-ion/polymer batteries, the multi-function all-in-one charger IC XC6810.



Charger IC & Voltage monitor for LTO batteries

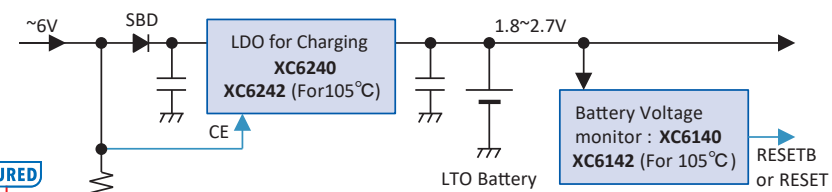
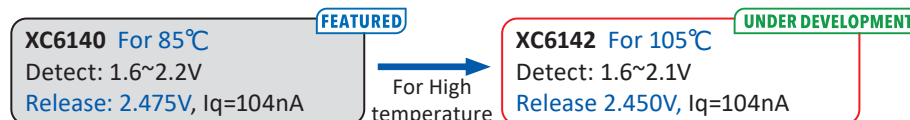
- LDO for charging and battery voltage monitoring IC recommended by LTO battery manufacturers.
- LDO for charging is selected based on operating temperature and output voltage including temperature variation
- Select a battery voltage monitoring IC set at a voltage to be released at the start of charging, depending on maximum temperature of the battery and operation.

LDO for Charging



*For charging at a lower voltage, use XC6215, $V_{OUT}=2.5V$.

LTO battery voltage monitor



Recommended charger IC/monitor for LTO batteries may vary depending on the battery used/conditions.

For details, please contact the battery manufacturer and us.

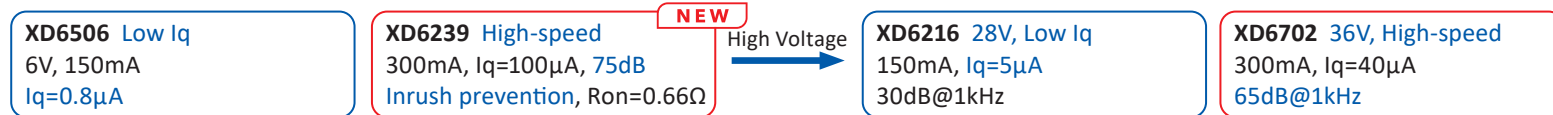
■ Features of TOREX Automotive IC (XD Series)

- Automotive reliability support : AEC-Q100 compliant.
- Quality management : Statistical Process Control (SPC) and Measurement System Analysis (MSA) are used for process control.
- Manufacturing process control : AEC-Q001 / AEC-Q002 compliant.
- Traceability : Manufacturing/sales traceability is enhanced compared to general products (XC series).

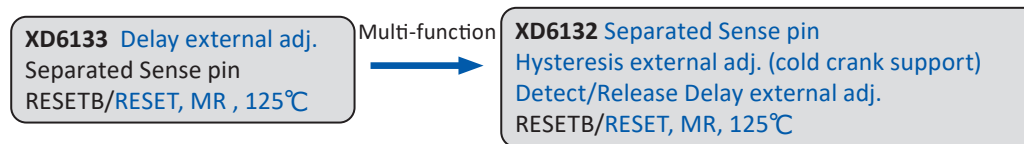
■ Typical Automotive IC (XD Series)



▶ Voltage Regulator

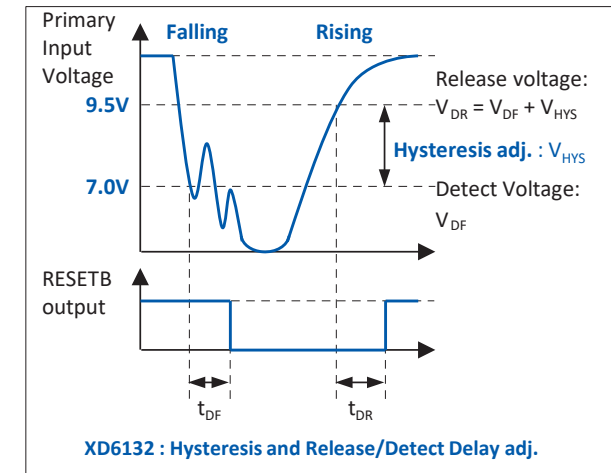
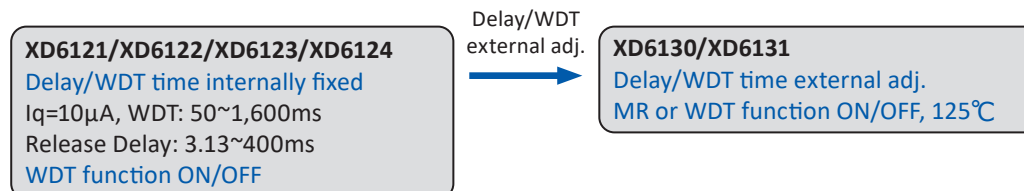


▶ Voltage Detector



▶ Watchdog Timer (WDT)

+ Voltage Detector



Various power supply configuration solutions to match each input power source, overall power supply requirements, and circuit applications

■ Optimal Power Supply Configuration for Each Power Source

- **Primary Battery** Small and Low Consumption 21-22
- **Li Rechargeable Battery** Small and Low Consumption 23
- Ultra-Small and Multi-Function 24
- Multiple Power Rail 25

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- Low Power Consumption by Utilizing Operation Range of MCU/SoC 26
 - ✓ VSET (Step-Down) and Bypass (Step-Up) Functions
- For Further Lower Power Consumption / Battery Life Improvement 27
 - ✓ Ideal Diode Load SW / Push Button Load SW

- **3.3V** Small Solutions for Multiple Power Rails 28

- **5V** POL Solutions for Multiple power rails 29

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- HiSAT-COT Control for Fast Transient Response 30
- TOREX Built-In Inductor Micro DC/DC for Achieving Small / Low EMI 31

- **12V/24V, Li multi cell and 4 dry cell** LDO Solutions 32

- **12V/24V ~60 input** Small Solutions 33

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- Space-Saving DC/DC and Voltage Monitoring 34
 - for Medium and High Voltage Inputs

- **12V/24V** Multiple Power Rail Solutions 35

■ OR Connection Solution for Backup and Multiple Power Sources

- **Backup Power Supply** with Primary Battery 36

- **Backup Power Supply** 37
 - with Rechargeable Battery / LTO Battery / Supercap (EDLC)**

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- Ideal Diode SW and Step-Up DC/DC Suitable for "OR" Connection 38
 - ✓ Ideal Diode SW / Step-Up DC/DCs

■ LTO Battery for Small and Low Consumption Devices

- Small and Low Consumption Devices 39

- Charge/Discharge Reference Solutions 40

■ Solution for Energy Harvesting

■ Space-Saving / Low Profile Solutions

- Compact and Space-Saving Power Supply 42

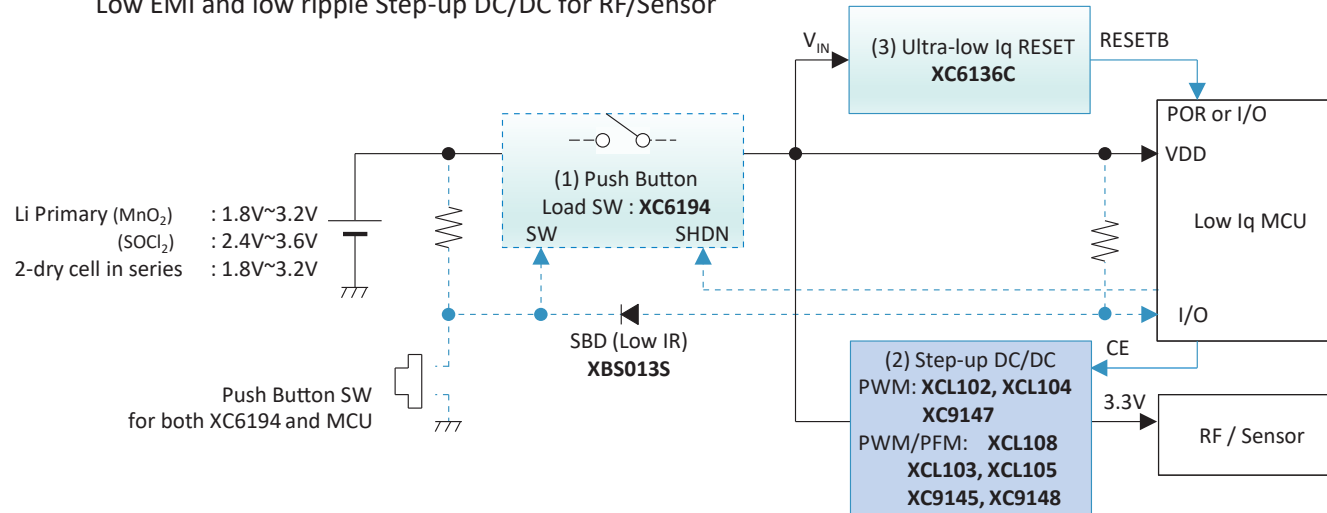
- Low Profile for h=0.33mm/0.40mm max. 43

Primary Battery : Small and Low Consumption Solutions

■ 3V Li Primary battery or 2-dry cell : Supplying battery voltage to MCU directly

- Challenges : Preventing discharge of battery after shipment / Countermeasure for system freeze
Low EMI and low ripple Step-up DC/DC for RF/Sensor

For Li Multi-cell
Page 32~



XC6194
Page 27

	Product	Features
(1) Push button SW	XC6194 FEATURED	I _{STB} =1nA, Shutdown function(Ship/Main power SW) For system freeze (XC6194A), Preventing liquid leakage (UVLO)
(2) Step-up DC/DC	XCL102 / XCL103	Built-in inductor, F-PWM, PWM/PFM 3MHz, 450mA@3.3V→5V
	XCL104 / XCL105 FEATURED	Built-in inductor, F-PWM, PWM/PFM 1.2MHz, 710mA@3.3V→5V
	XCL108 NEW	Built-in inductor, Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 300mA@3.3V→5V, V _{ST} =1.6V
	XC9145 FEATURED	Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 430mA@3.3V→5V, V _{ST} =1.6V
	XC9147 / XC9148 FEATURED	F-PWM, PWM/PFM 1.2MHz/3MHz, 750mA@3.3V→5V
(3) RESET IC	XC6136	Iq=100nA class Ultra-low Iq

(1) Push Button Load SW with Shutdown function : XC6194

Shutdown at shipment **to reduce the discharge current from the battery to 1nA.**
 For Main power SW / Forced shut-down at system freeze / Prevention of battery liquid leakage.

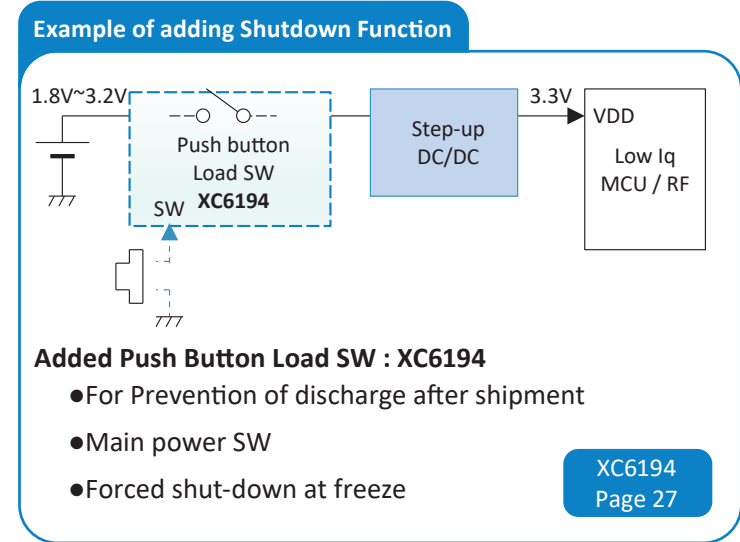
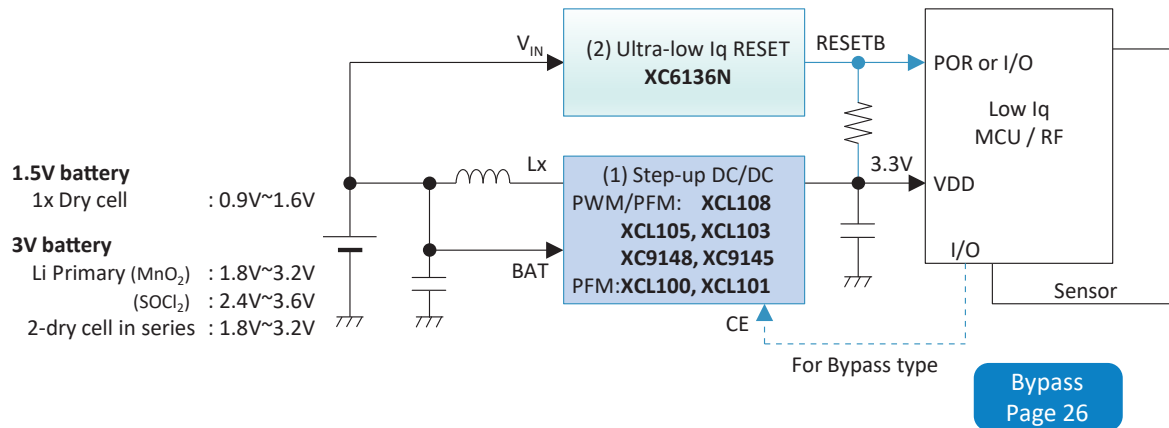
(2) Step-up DC/DC for RF/Sensor

- Step-up when only in use, cut-off by Load disconnection function when not in use.
- Built-in inductor Micro DC/DC** is suitable due to small size and low EMI.
(XCL102/XCL103, XCL104/XCL105, XCL108)
- For RF/sensors always operating
400nA Ultra-low Iq PWM/PFM step-up XCL108 and XC9145 achieving high-efficiency always.
- When low ripple is important
PWM step-up DC/DC XCL102, XCL104, and XC9147 are suitable for low ripple regardless of load.

Primary Battery : Small and Low Power Consumption Solutions

■ From 3V Li Primary battery, 1 or 2-dry cell : Supplying boosted voltage to MCU

- Challenges : High efficiency / low EMI / Low ripple Step-up DC/DC
Small / Low Iq / Long battery life



	Product	Features
(1) Step-up DC/DC	XCL100 / XCL101	Built-in inductor, Low Iq PFM 80mA@3.3V→5V, UVLO (XCL100)
	XCL103	Built-in inductor, PWM/PFM 3MHz, 450mA@3.3V→5V
	XCL105 FEATURED	Built-in inductor, PWM/PFM 1.2MHz, 710mA@3.3V→5V
	XCL108 NEW	Built-in inductor, Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 300mA@3.3V→5V, V _{ST} =1.6V
	XC9145 FEATURED	Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 430mA@3.3V→5V, V _{ST} =1.6V
	XC9148 FEATURED	Low Ron Bypass, PWM/PFM 1.2MHz/3MHz, 750mA@3.3V→5V,
(2) RESET IC	XC6136	Iq=100nA class Ultra-low Iq

(1) Step-up DC/DC for MCU

(a) For low power consumption

- General use - Supply with always boosting at high efficiency
For 3V battery : Iq=400nA PWM/PFM step-up DC/DC XCL108 and XC9145
High efficiency 89.9%@10μA
For 1.5V battery : **Built-in inductor PFM Step-up Micro DC/DC XCL101**
- Low Iq power technique - Boost only when MCU is active
Use products with "Bypass" function to boost only when necessary, and supply through battery voltage when the MCU is in sleep mode for even lower power consumption. (XCL101C, XCL103E, XCL105B/E/H/K, XC9148B/E/H/K)

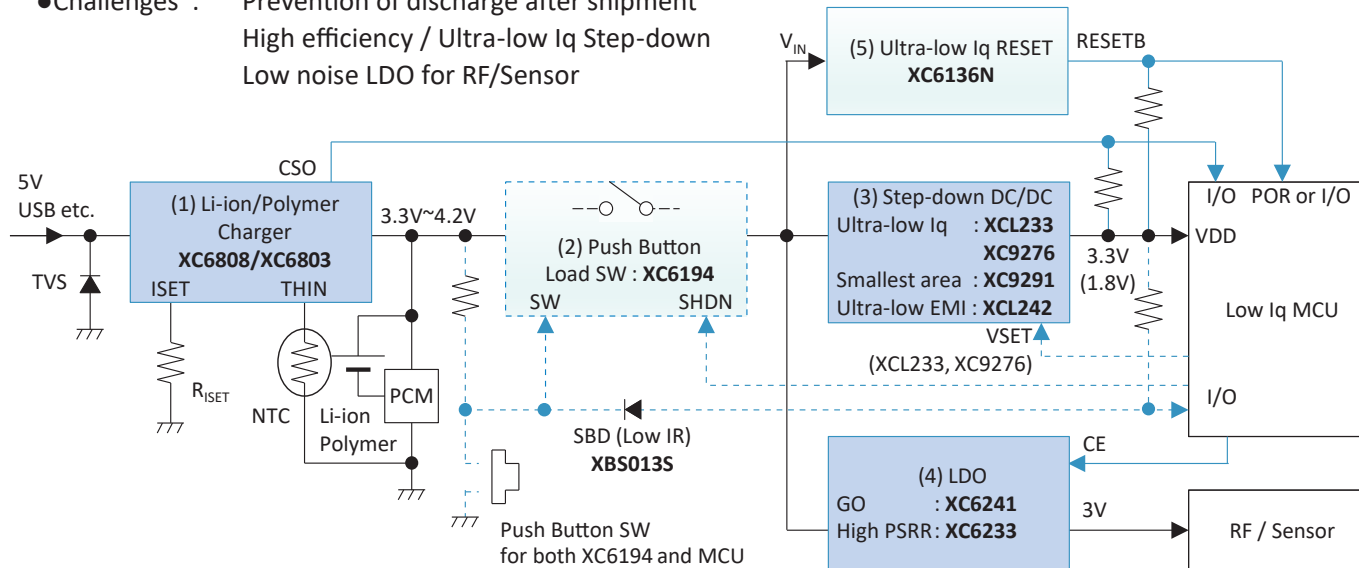
(b) For Small / Low EMI

Use **Built-in inductor Micro DC/DC (XCL101, XCL103, XCL105, XCL108)**

Li Rechargeable Battery : Small and Low Power Consumption Solutions

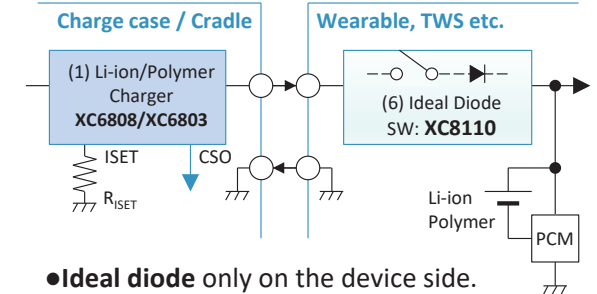
■ Products using Li-ion/Polymer rechargeable battery : IoT Sensor/Wearable etc.

- Challenges : Prevention of discharge after shipment
- High efficiency / Ultra-low Iq Step-down
- Low noise LDO for RF/Sensor



(6) Example of charge control by the case/cradle

Configuration for charging control of Li batteries in **Wearable/Hearable/TWS**, etc. by the charging case/cradle side.



- Ideal diode only on the device side. Prevents terminal corrosion by reverse current prevention.
- Charging is controlled on the charging case side, **making it easy to stop output from the case** after charging is complete.

Ideal Diode
Page 27

	Product	Features
(1) Li Charger IC	XC6808 / XC6803	CC/CV Charger, CC~280/40mA, Battery Temperature Monitor
(2) Push button SW	XC6194 FEATURED	I _{STB} =1nA, Shutdown function(Ship/Main power SW) For system freeze
(3) Step-down DC/DC	XCL233 NEW	Built-in inductor, I _q =200nA, PFM, 150mA, VSET(V _{OUT} selectable)
	XCL242 NEW	Built-in inductor, HiSAT-COT , Ultra-low EMI, PWM/PFM, 1.2MHz, 500mA
	XC9291 NEW	HiSAT-COT , Smallest area, PWM/PFM, 4MHz/6MHz, 600mA
	XC9276 FEATURED	I _q =200nA, PFM, 150mA, VSET(V _{OUT} selectable)
(4) LDO	XC6241 FEATURED	I _q =0.6μA, PSRR=60dB, GO, 150mA
	XC6233	High-speed PSRR=75dB, 200mA, Inrush prevention
(5) RESET IC	XC6136	I _q =100nA class Ultra-low Iq
(6) Ideal diode SW	XC8110 / XC8111 FEATURED	True Reverse current prevention Ideal Diode Load SW V _F =20mV, 500mA (XC8110), 1A (XC8111), IEC 62368-1 certified

(2) Push Button Load SW with Shutdown function : XC6194

Shutdown at shipment to **reduce the discharge current from the battery to 1nA**.
Main power SW / Forced shut-down at system freeze

XC6194
Page 27

(3) Ultra-low Iq Step-down DC/DC for MCU

Ultra-low Iq DC/DC is suitable. (**XCL233, XC9276 : Iq=200nA**)
VSET function lowers V_{OUT} in sleep mode to achieve lower Iq.
World's smallest solution XC9291 with ultra low EMI.
XCL242 for ultra-low EMI to further reduce noise to the Sensors.

VSET
Page 26

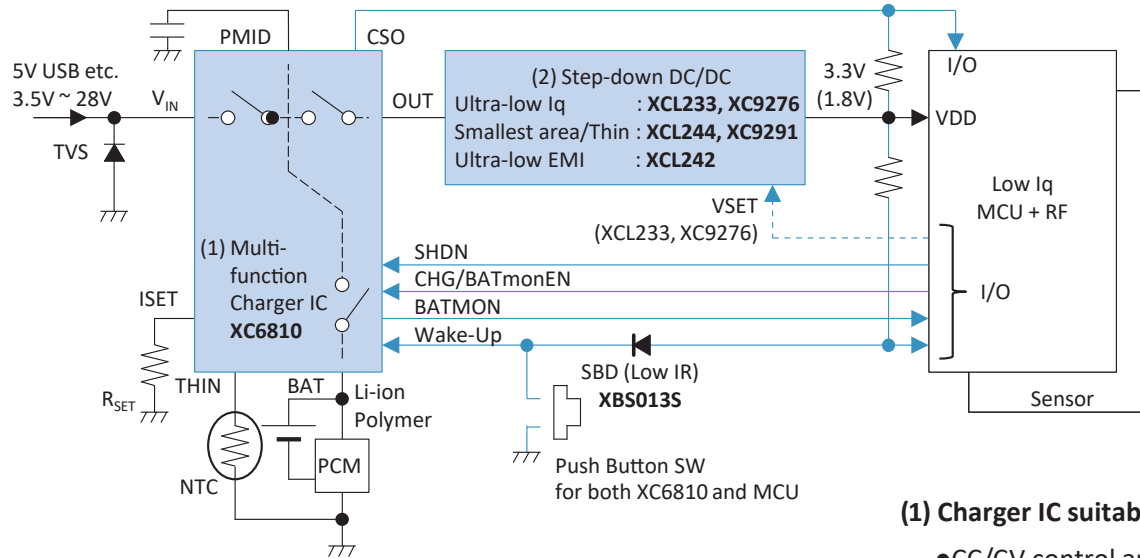
(4) LDO for RF/Sensor : XC6241

GO function automatically switches between low Iq and high-speed according to the output current, achieving both low consumption and high-speed response.

Li Rechargeable Battery : Ultra-Small and Multi-Function Solutions

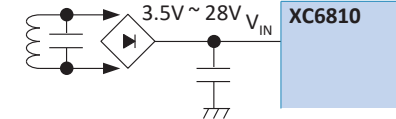
■ Ultra-small products using Li-ion/Polymer Rechargeable battery : Hearables/Wearables/IoT Sensor etc.

- Challenges : Various controls and protections suitable for small Li-ion/Polymer
Prevention of discharge after shipment / Charge status & Battery voltage monitoring
Two-wire communication to Cradle / Supports various types of energy harvesting

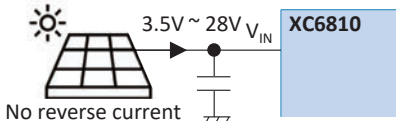


XC6810 Application Examples

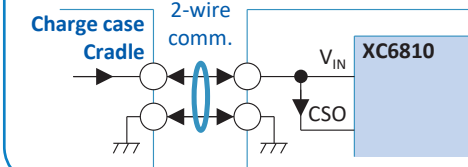
Wireless power transfer



Solar and Other Energy Harvesting



Charge state communication to Cradle



(1) Charger IC suitable for small and small-capacity Li batteries : XC6810

- CC/CV control and protection suitable for Li batteries up to 50mAh.
- Battery voltage monitor, **BATMON**, for monitoring by A/D of MCU.
- Two types of the charger status monitor, **CSO**, are available.

LED drive type and frequency notification type based on charge level which can be used for **two-wire communication with the charger case or cradle.**

- Shutdown by **SHDN** signal to prevent discharge of Li battery after shipment.
Start-up by inputting "L" to **Wake-up** with Push Button SW or by applying V_{IN} .
- Input range up to **28V** to support various types of Energy harvesting.

(2) Various ultra-small step-down DC/DCs with low consumption

- Ultra-low consumption / VSET function, Built-in inductor : **XCL233**
- World's smallest solution with ultra low EMI : **XC9291**

VSET
Page 26

HiSAT-COT
Page 30

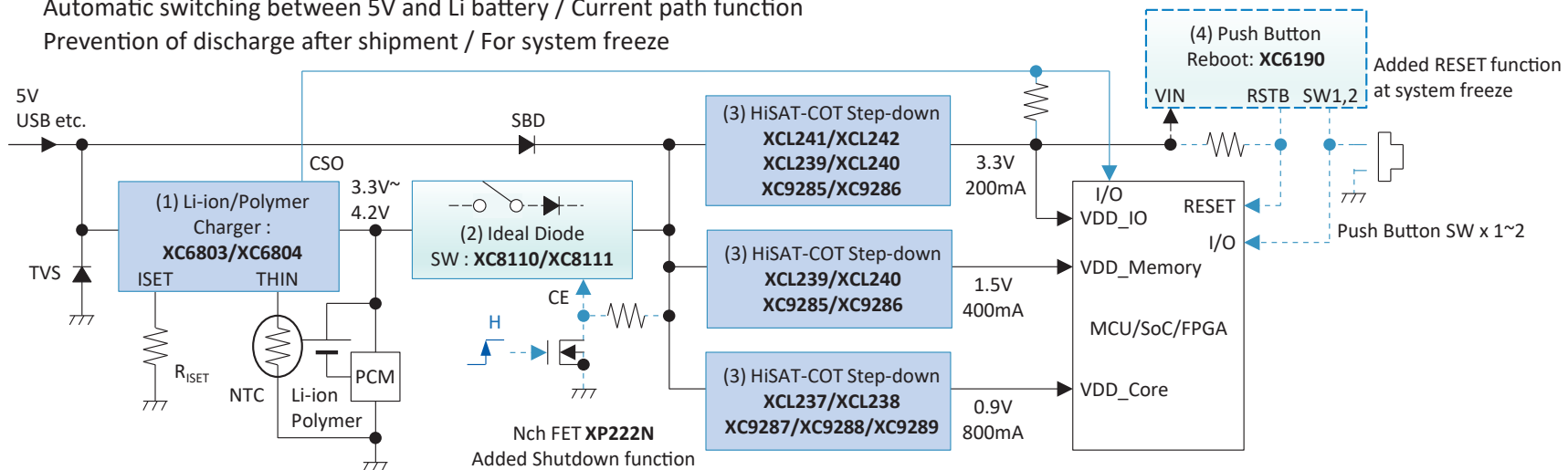
	Product	Features
(1) Li Charger IC	XC6810 FEATURED	3.5V~28V, CV=3.80V~4.40V, CC=1mA~25mA Battery Temperature Monitor, Charge ON/OFF, Current path Charge status & Battery voltage monitoring Shutdown/Wake-up, Two-wire communication to Cradle Supports various types of energy harvesting
(2) Step-down DC/DC	XCL244 NEW	Built-in inductor, HiSAT-COT , Small area/Thin, PWM/ PFM3MHz, 700mA
	XCL233 NEW	Built-in inductor, Iq=200nA, PFM, 150mA, VSET(V _{OUT} selectable)
	XCL242 NEW	Built-in inductor, HiSAT-COT , Ultra-low EMI, PWM/ PFM,1.2MHz, 500mA
	XC9291 NEW	HiSAT-COT , Smallest area, PWM/PFM, 4MHz/6MHz, 600mA
	XC9276 FEATURED	Iq=200nA, PFM, 150mA, VSET

Li Rechargeable Battery : Multiple Power Rail Solutions

■ Products that requires multi-voltage from Li-ion/Polymer Rechargeable battery

- Challenges : Small / High efficiency / High-speed response / Low EMI Step-down DC/DC
- Automatic switching between 5V and Li battery / Current path function
- Prevention of discharge after shipment / For system freeze

For Li Multi-cell
Page 32~



Block	Product	Features
(1) Li Charger IC	XC6803 / XC6804	CC/CV Charger, CC~280/800mA, Battery Temperature Monitor
(2) Ideal diode SW	XC8110 / XC8111 FEATURED	True Reverse current prevention Ideal Diode Load SW VF=20mV, 500mA (XC8110), 1A (XC8111), IEC 62368-1 certified
(3) Step-down DC/DC	XCL241 / XCL242 NEW	Built-in inductor, HiSAT-COT, F-PWM, PWM/PFM 1.2MHz, 500mA, Ultra-low EMI
	XCL239 / XCL240 NEW	Built-in inductor, HiSAT-COT, F-PWM, PWM/PFM 3MHz, 1A
	XCL237 / XCL238 NEW	Built-in inductor, HiSAT-COT, F-PWM, PWM/PFM 3MHz, 1.5A
	XC9285 / XC9286 NEW	HiSAT-COT, F-PWM, PWM/PFM 1.2MHz, 1A
	XC9287 / XC9288 XC9289 NEW	HiSAT-COT, F-PWM, PWM/PFM, Selectable by MODE 1.2MHz/3MHz, 1.5A
(4) Reboot IC	XC6190	For system freeze, Hold SW 1 and 2 "L" to output reset signal

(2) Ideal Diode Load SW : XC8110/XC8111 Ideal Diode
Page 27

Ideal Diode achieves **automatic switching between 5V input and Li battery**
VF loss is also reduced. Adding Nch FET enables Shutdown function at shipment.

(3) Step-down DC/DC for MPU/Memory/FPGA (POL converter) HiSAT-COT
Page 30

HiSAT-COT controlled DC/DC with high-speed transient response
arranged as POL power supply.
Built-in inductor Micro DC/DC achieves miniaturization and low EMI.
(XCL241/XCL242, XCL239/XCL240, XCL237/XCL238)

(4) Push Button Reboot controller : XC6190

Added Push Button Reboot IC that can **reboot the system by long pressing the physical SW** for freeze countermeasure.
Physical SW can be shared with other uses.

Low Power Consumption by Utilizing Operation Range of MCU/SoC : VSET, Bypass

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

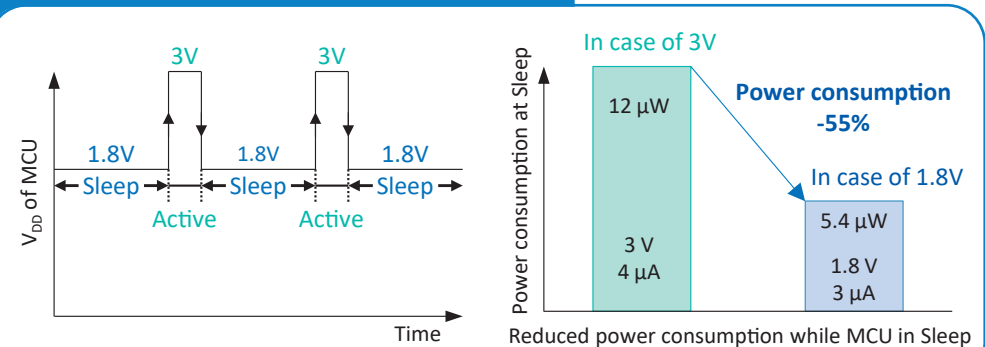
● Technical trend and challenges

- 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

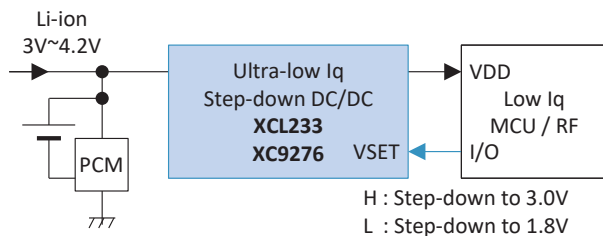
- Dynamically changing output voltage according to MCU/SoC operation, greatly reducing power consumption in standby state.

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

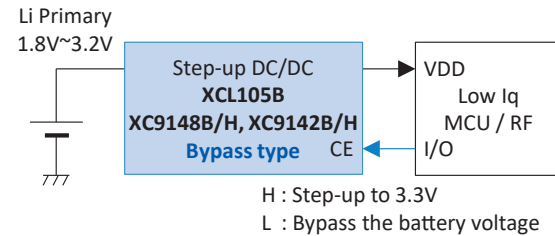


■ Ultra-low I_q VSET (V_{OUT} selectable) function Step-down DC/DC

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package
XCL233 NEW	Built-in inductor VSET(V _{OUT} selectable) I _q =200nA, PFM	1.8 ~ 6.0	0.5 ~ 3.6 2 values	150	CL-2025-03 (2.5x2.0x1.04mm)
XC9276 FEATURED	VSET(V _{OUT} selectable) 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 FEATURED	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)

■ Ideal Diode to reduce power loss of diode

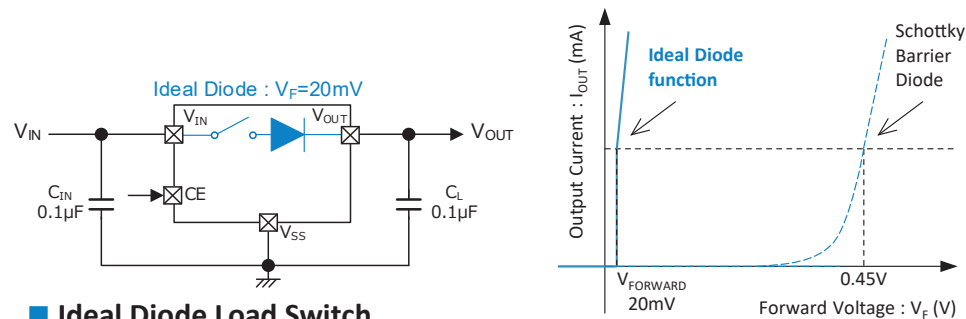
● Technical trend and challenges

- Many diodes used in each power lines for reverse current prevention, etc.
- SBD generates about 0.4V of VF loss and reverse current due to leakage, and the loss is more than 0.4W at IF=1A, which is an obstacle to high efficiency and miniaturization.

● TOREX Proposal : Significantly reducing VF loss

▶ Ideal Diode Load SW: XC8110 / XC8111, XC8112 / XC8113

- Achieving VF=20mV. Loss is 1/20 of SBD@200mA or less and 1/6@500mA. Parallel connection of XC8112/XC8113 halves VF at high current.
- Leakage current is 0 μA, preventing reverse current harmful to batteries.
- IEC 62368-1:2018 certified with current limit and other protections.



■ Ideal Diode Load Switch

Product	Features	V _{IN} (V)	R _{on}	I _{OUT}	Package
XC8110 FEATURED	VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias) IEC 62368-1:2018 certified	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 FEATURED	1A				
XC8112 UNDER DEVELOPMENT	2ch (Parallel is allowed) VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias) IEC 62368-1:2018 certified	1.5 ~ 6.0	2ch x 120mΩ or 1ch x 60mΩ	2 x 500mA or 1 x 1A	USP-8B06 (2.0x2.0xh0.33mm)
XC8113 UNDER DEVELOPMENT	2 x 1A or 1 x 2A				

2ch OR connection
Page 38

■ "Ship function" to prevent battery discharge during shipment.

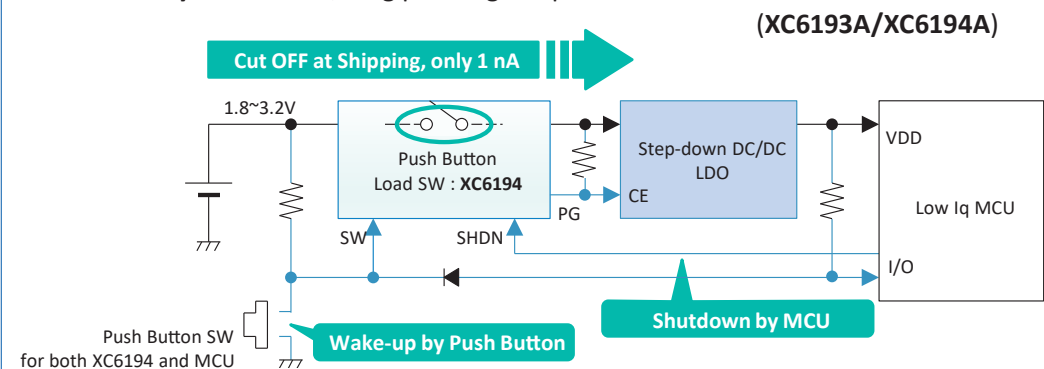
● Technical trend and challenges

- Discharge current from the battery after shipment is so large that the battery may not be usable at the time of usage.
- Due to an increase in the number of devices with built-in batteries and the need to ensure water resistance, the conventional method of preventing discharge by using plastic insulating tabs has become difficult.

● TOREX Proposal : Preventing battery discharge by Ship function

▶ Push Button Load SW: XC6194 (1A) / XC6193 (1A + External Pch FET)

- Ship function greatly reduces discharge after shipment to 1nA.
- Useful as main power switch as well.
Turn ON by the push-button, and OFF by the signal from MCU to SHDN after processing termination. Safety shutdown is possible.
- At system freeze, long pressing the push button forces OFF.



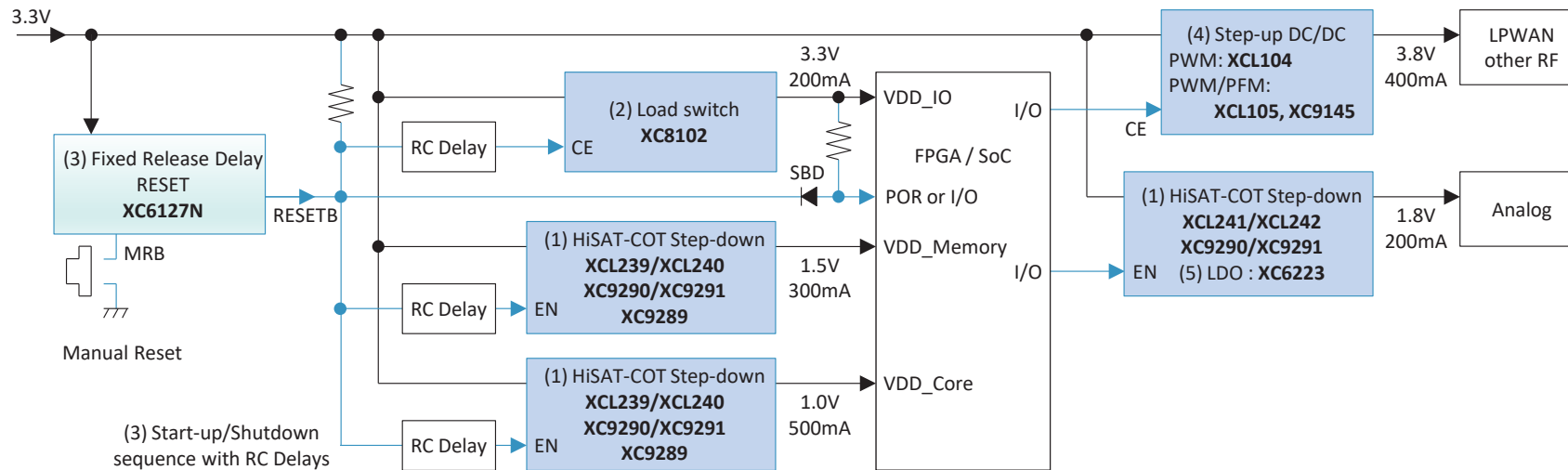
■ Push Button Load Switch with Ship function

Product	Features	V _{IN} (V)	R _{on}	I _{OUT}	Package
XC6193 FEATURED	I _{STB} =1nA Shutdown function (Ship/Main power SW) For system freeze (XC6193A/XC6194A)	1.8 ~ 6.0	140mΩ	1A	USP-8B06 (2.0x2.0xh0.33mm)
XC6194 FEATURED	UVLO: Prevents battery leakage				

3.3V : Small Solutions for Multiple Power Rails

■ Compact multiple power supplies for MCU/SoC/FPGA, sensors, and various modules

- Challenges : Fast transient response/High stability, Small size/High efficiency/Heat dispersion/Low EMI, Start-up/Shutdown sequence



HiSAT-COT
Page 30

Block	Product	Features
(1) Step-down DC/DC	XCL241 / XCL242 NEW	Built-in inductor, HiSAT-COT , F-PWM, PWM/PFM 1.2MHz, 500mA, Ultra-low EMI
	XCL239 / XCL240 NEW	Built-in inductor, HiSAT-COT , F-PWM, PWM/PFM 3MHz, 1A
	XC9289 NEW	HiSAT-COT , Ultra-small, F-PWM-PWM/PFM MODE selectable 1.2MHz/3MHz, 1.5A
	XC9290 / XC9291 NEW	HiSAT-COT , Smallest area, F-PWM, PWM/PFM 4MHz/6MHz, 600mA
(2) Load SW	XC8102	Low Iq, Small size, 400mA, Foldback current limit
(3) RESET IC	XC6127	Low Iq, High accuracy, Selectable Release delay, Manual reset
(4) Step-up DC/DC	XCL104 / XCL105 FEATURED	Built-in inductor, F-PWM, PWM/PFM 1.2MHz, 710mA@3.3V→5V
	XC9145 FEATURED	Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 430mA@3.3V→5V, V _{ST} =1.6V
(5) LDO	XC6223	High speed PSRR=80dB, 300mA, Inrush prevention

(1) Step-down DC/DC for MCU/SoC/FPGA, RF/Sensor (POL power supply)

High-speed transient response **HiSAT-COT** controlled DC/DC arranged as POL.
Built-in inductor Micro DC/DC realizes miniaturization and low EMI.
(XCL241/XCL242, XCL239/XCL240)

For RF and other analogs requiring even lower noise
Ultra-low EMI Built-in inductor **Micro DC/DC XCL241/XCL242**,
World's smallest solution size XC9290/XC9291.

XCL
Page 31

(4) 3.3V input monitoring and Start-up/Shutdown Power supply sequence

Monitored by voltage detector with Manual reset function : **XC6127**
RC delay to the EN(CE) pin of each DC/DC is **driven by XC6127**
for start-up/shutdown sequence.

Sequence
Page 29

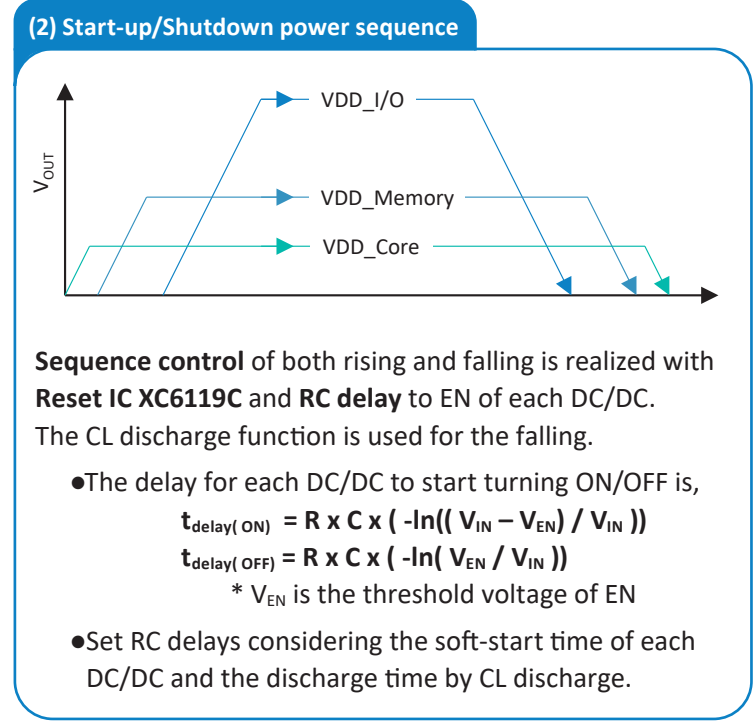
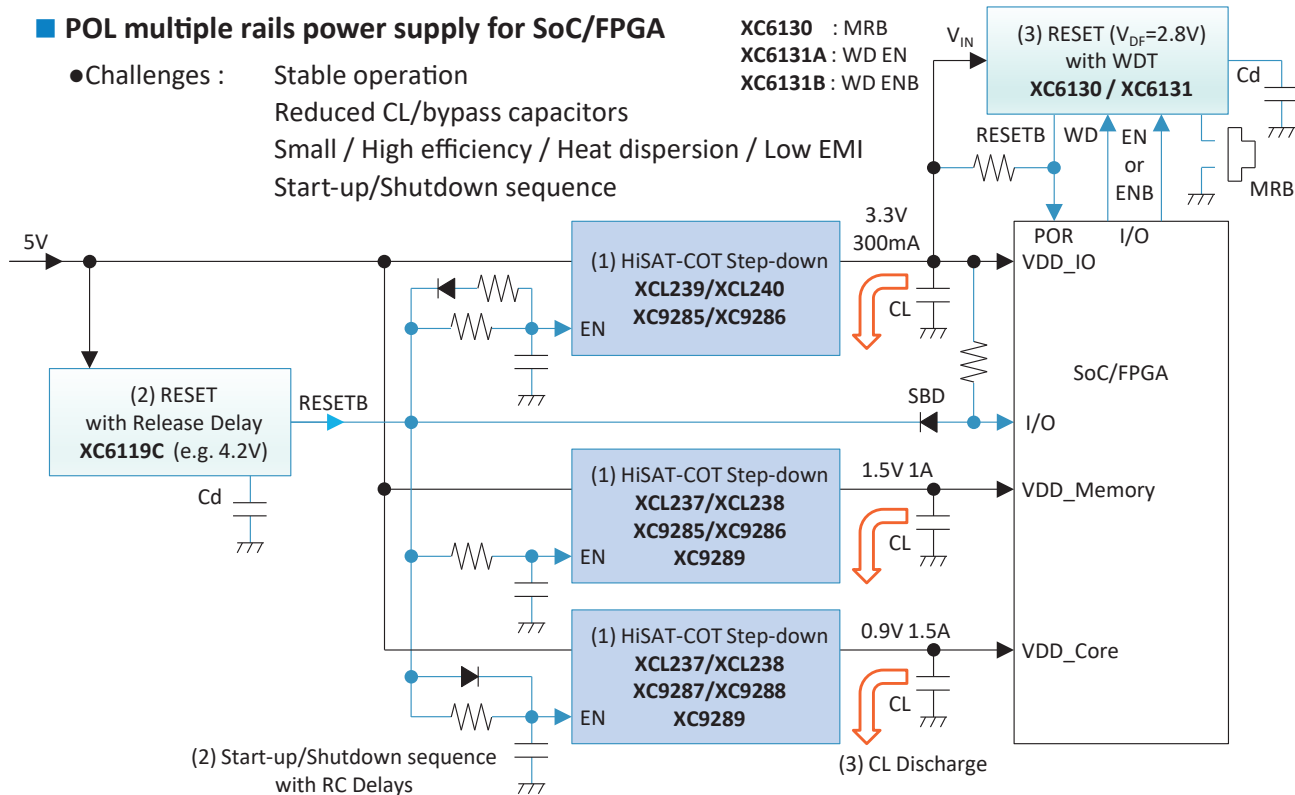
(5) Step-up DC/DC for LPWAN and other RF

Low ripple/Low EMI Built-in inductor **Micro DC/DC : XCL104/XCL105, XC9145**

5V : POL Solutions for Multiple Power Rails

■ POL multiple rails power supply for SoC/FPGA

- Challenges : Stable operation
- Reduced CL/bypass capacitors
- Small / High efficiency / Heat dispersion / Low EMI
- Start-up/Shutdown sequence



Block	Product	Features
(1) Step-down DC/DC	XCL239 / XCL240 NEW	Built-in inductor, HiSAT-COT, F-PWM, PWM/PFM 3MHz, 1A
	XCL237 / XCL238 NEW	Built-in inductor, HiSAT-COT, F-PWM, PWM/PFM 3MHz, 1.5A
	XC9285 / XC9286 NEW	HiSAT-COT, F-PWM, PWM/PFM 1.2MHz, 1A
	XC9287 / XC9288 XC9289 NEW	HiSAT-COT, F-PWM, PWM/PFM, MODE selectable 1.2MHz/3MHz, 1.5A
(2) RESET IC	XC6119	Low Iq, External Cd Release Delay
(4) WDT	XC6130 / XC6131	WDT/Release delay adjustable by an external Cd MR (XC6130) or WD ON/OFF control (XC6131)

(1) Step-down DC/DC for FPGA/SoC (POL converter)

HiSAT-COT Page 30 XCL Page 31

High-speed transient response HiSAT-COT controlled DC/DC arranged as POL. Built-in inductor Micro DC/DC realizes miniaturization and low EMI.
(XCL239/XCL240, XCL237/XCL238)

(3) Freeze countermeasure with Watchdog timer : XC6130/XC6131

Monitoring of 3.3V line voltage and detection of freezing by the WD function. In case of abnormality, SoC/FPGA is automatically restarted. Manual reset function is also available **(XC6130)**

HiSAT-COT® Control for Fast Transient Response

TOREX original COT control : HiSAT-COT®

Technical trend and challenges

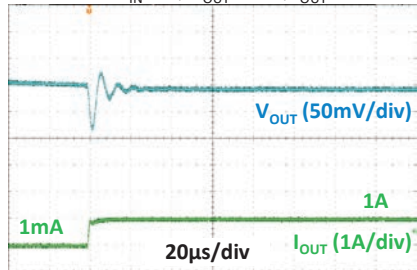
- Stable power supply including transient response to MCU/SoC/FPGA, etc.
- Miniaturization of circuits including peripheral components, and low EMI.

TOREX Proposal : HiSAT-COT® controlled Step-down DC/DC converter

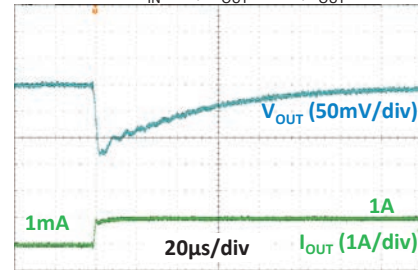
Significantly faster transient response

- Compared to conventional PWM and PWM/PFM control, it achieves **overwhelmingly fast response** and thus **good voltage stability**.

HiSAT-COT® $V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=1mA \rightarrow 1A$



Conventional $V_{IN}=5V, V_{OUT}=1.8V, I_{OUT}=1mA \rightarrow 1A$



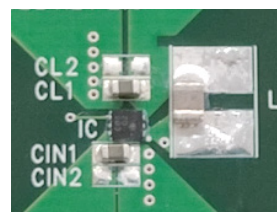
Miniaturization including peripheral components

- High-speed transient response enables **significant reduction of large capacitance** required due to lack of response of conventional PWM.
- Unlike conventional PWM phase compensation, load capacitance CL can be reduced. Also **supports a significant reduction in effective capacitance due to the bias effect of ultra-small Ceramic capacitors**.

HiSAT-COT®



Conventional

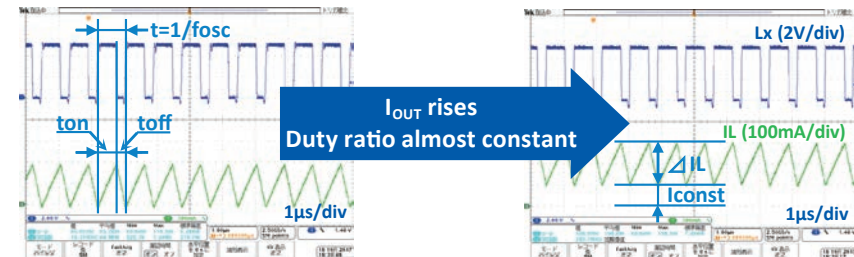


Overview of COT control and HiSAT-COT®

What is COT (Constant on time) control?

- PFM control with the “ton” determined by V_{IN} and V_{OUT} voltages, resulting that appears to be PWM control with constant frequency (f_{osc}).
High-speed PFM comparator enables fast transient response.
- Generate “ton” in CCM of the targeted f_{osc} from the V_{IN} and V_{OUT} set voltages so that it appears to be a constant frequency PWM control.

CCM (Continuous Conduction Mode) operation



- Ideal Duty ratio and t_{on} of step-down DC/DC at CCM PWM operation are
 $t_{on} = (1/f_{osc}) \times \text{Duty} = (1/f_{osc}) \times (V_{OUT} / V_{IN})$.
If there is no loss, **Duty ratio is constant** even if I_{OUT} rises.

How to determine the oscillation frequency of COT control

- Generate the t_{on} of COT control to be the t_{on} of ideal PWM control.
- Continuous mode operation with this t_{on} operates with the same duty as PWM control at the oscillation frequency f_{osc} .

COT issues and HiSAT-COT®

HiSAT-COT improves the issues of COT control with its own circuits.

- Improved issue of increased oscillation frequency due to output current.
- Improved the deterioration of load stability with an original circuit with an additional amplifier.

TOREX Built-In Inductor Micro DC/DC for Achieving Small / Low EMI

TOREX original Built-in inductor Micro DC/DC XCL Series

Technical trend and challenges

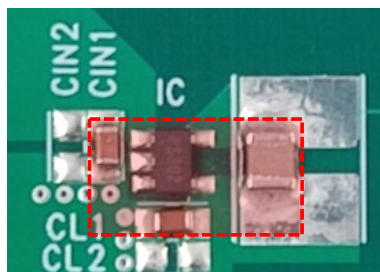
- For stable operation of devices, it is important to place power supply ICs close to MCUs and FPGAs. Especially in cases where multiple power supplies are required, selecting power supply ICs suitable for POL (Point of Load) is a challenge.
- Miniaturization of power circuits including ICs and low EMI are essential.

TOREX Proposal : Built-in inductor Micro DC/DC

Significant miniaturization of power supply circuit

- Achieves a significant reduction in mounting area and providing smallest class of power supply solution.
- Unique package structure / Optimum inductor for the internal IC.
- Efficient heat dissipation performance with structures that connect IC/coil and substrate with low thermal resistance.

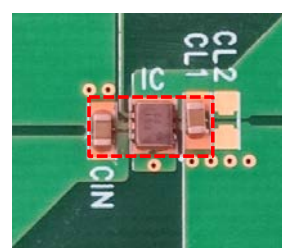
9.6×5.8mm = 56mm²



Stand-alone DC/DC
External parts : 3 pcs

65%
reduction

6.5×3.0mm = 19.5mm²

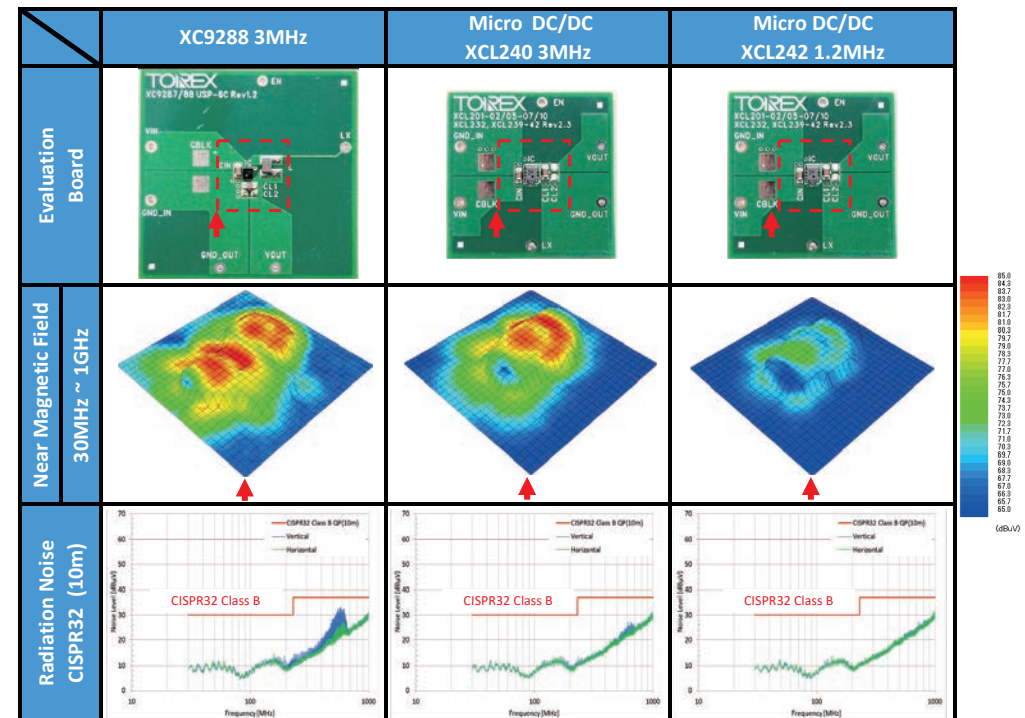


Built-in inductor Micro DC/DC
External parts : 2 pcs

EMI reduction due to unique Built-in inductor structure

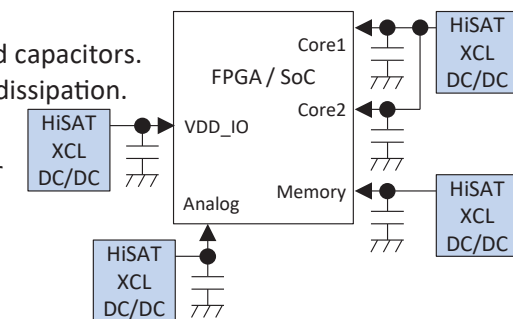
- The pocket-type structure covering the IC with a coil and the optimum placement of the IC enable a **significant reduction of radiated noise** compared to the stand-alone IC.
- Can be placed near RF ICs/Sensors, etc., contributing to miniaturization.

EMI comparison of Built-in inductor Micro DC/DC and stand-alone DC/DC



Benefits of POL (Point of Load) power supply and Micro DC/DC & HiSAT-COT®

- Shorter power supply wiring length. In addition to stable operation, reduced capacitors. Heat source dispersion facilitates heat dissipation.
- Using Micro DC/DC XCL Series with built-in inductor for POL converter enables further miniaturization, lower EMI, and easier design.
- HiSAT-COT provides highly stable power supply, including transient response.

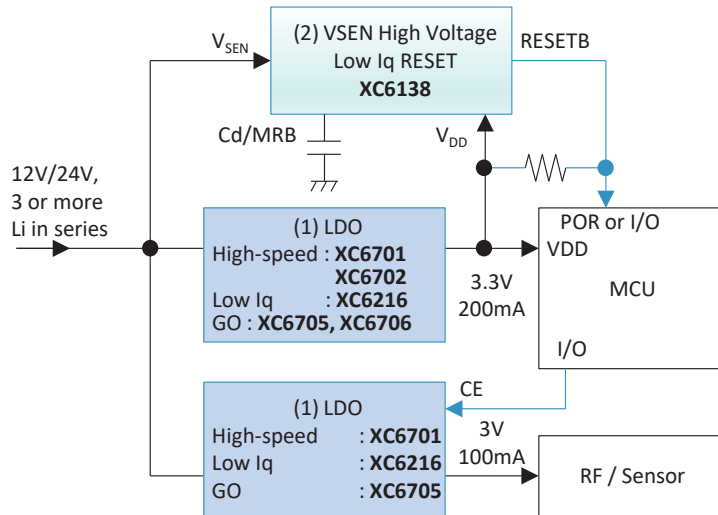


12V/24V, Li Multi-Cell and 4-Dry Cell : LDO Solutions

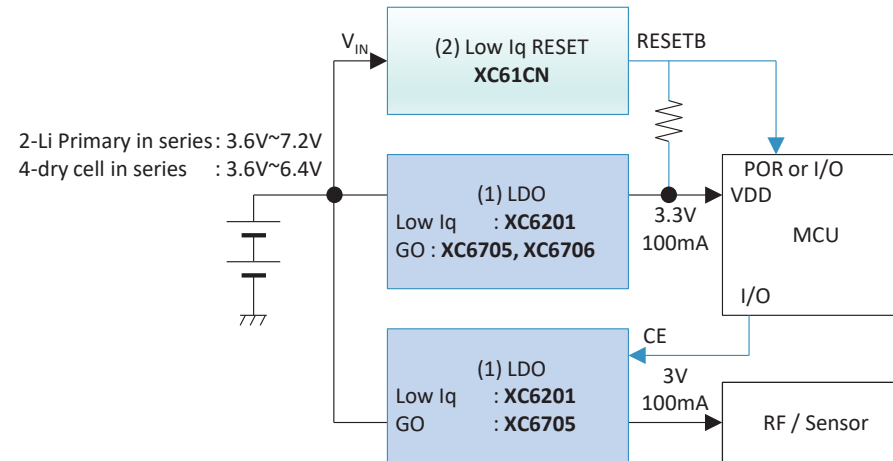
12V/24V input, Li multi-cell and 4-cell dry cell operation: Low Power Consumption system with simple LDO

- Challenges : Small / Low Iq / Simple Load transient response to RF/Sensor

12V/24V or 3 or more Li in series input



2-cell Li Primary or 4-dry cell in series



Block	Product	Features
(1) LDO	XC6701	28V, High-speed PSRR=50dB, 150mA
	XC6702	36V, High-speed PSRR=65dB, 300mA
	XC6216	28V, Iq=5μA, 150mA
	XC6705 / XC6706 FEATURED	20V, Iq=1.2μA, 200mA PSRR=50dB, Seamless GO, Soft-start, CE (XC6705)
	XC6201	10V, Iq=2.0μA, 200mA
(2) RESET IC	XC6138 NEW	High Voltage Sense pin: 76V Ultra-low Iq V _{DD} : 0.5μA, V _{SEN} : 0.15μA@12V Detect/Release Delay external adj. Hysteresis: selectable from 5~50%
	XC61CN	10V, Iq=0.7μA

(1) Medium Voltage LDO

- For 12V/24V or 3 or more Li in series input
Selecting by input voltage range and current consumption.
- For 2-Li / 4-dry cell in series : XC6705/XC6706
Seamless GO achieves both low Iq and high-speed response.
Supports high-speed response required by RF and Sensor.

(2) RESET IC

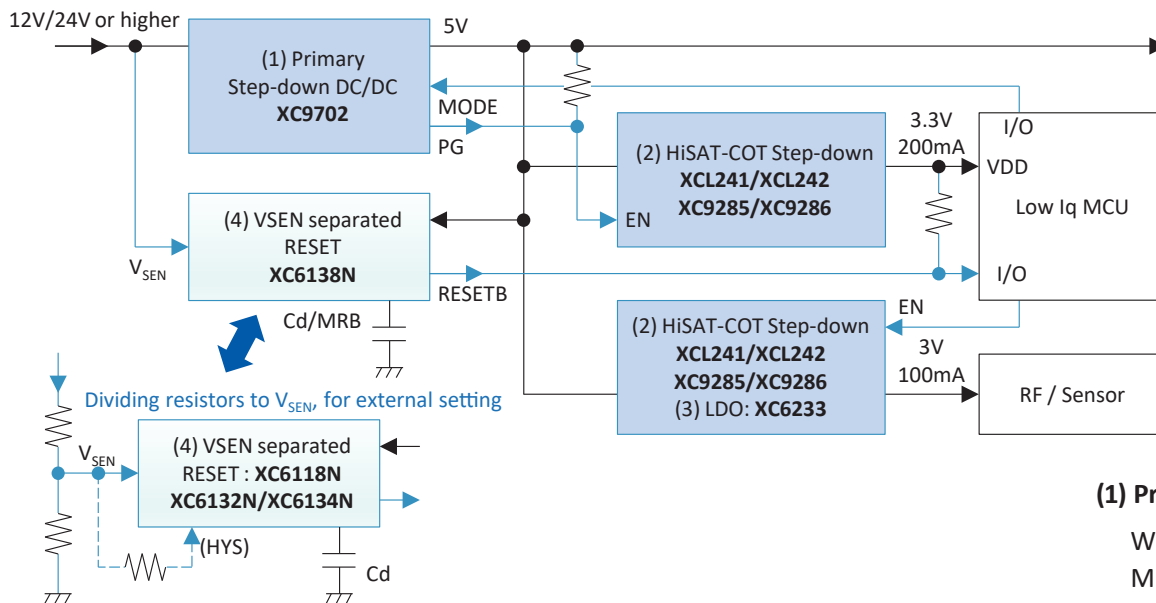
- Direct monitoring of 12V/24V input with V_{SEN} pin of XC6138, no dividing resistors required resulting in low Iq and high accuracy.
- For 10V or less, monitoring voltage with low Iq RESET IC XC61CN.

12V/24V ~60V Input : Small Solutions

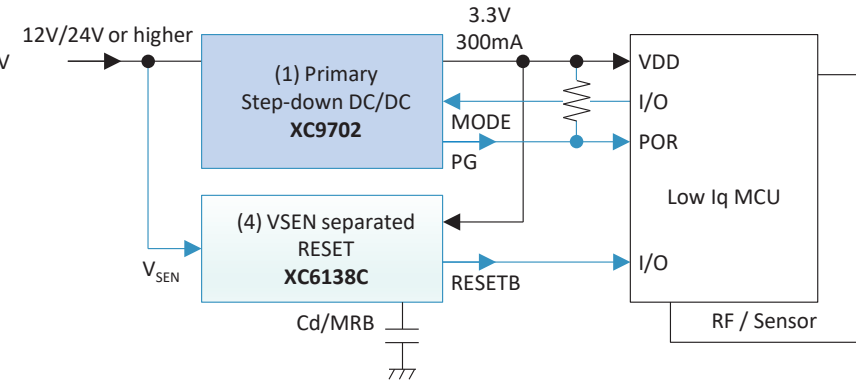
■ 12V/24V and higher input : Small products, modules, industrial sensors, and IoT

- Challenges : High voltage input / Overshoot capability / Monitoring and handling of input voltage fluctuation, Miniaturization / low EMI / Heat dissipation

(a) Step-down to 5V, then create 3.3V and other secondary voltages



(b) Output 3.3V directly



(1) Primary step-down DC/DC for 12V/24V or higher input

- Wide input voltage range to handle **overshoot of 24V line**.
- Miniaturization of products by **space-saving** including peripheral components.
- High efficiency including light loads.**
- High step-down ratio** enabling direct step-down to 3.3V including overshoot.

High voltage Step-down
Page 34

(2) Secondary step-down DC/DC for MCU/RF/Sensor

- Realizing stable operation, small size, low EMI, and low ripple by placing Built-in inductor Micro DC/DC close to the load as POL converter. **(XCL241/XCL242)**

(3) LDO for RF/Sensor : High-speed LDO XC6233 is suitable.

(4) 12V/24V input monitoring Voltage Detector : XC6138

- Monitoring with **76V** high-voltage sense pin that supports overshoot.
- Directly monitors without dividing resistor**, realizing low Iq and high accuracy, as well as supports Release Delay and Detect/Release Hysteresis options.

High voltage Monitoring
Page 34

Block	Product	Features
(1) Primary Step-down DC/DC	XC9702 NEW	60V, MODE: F-PWM, PWM/PFM, 1MHz, 300mA, Low Iq: 12µA Small area/High efficiency at light loads, High step-down ratio
(2) Step-down DC/DC	XCL241 / XCL242 NEW	Built-in inductor, HiSAT-COT , F-PWM, PWM/PFM 1.2MHz, 500mA, Ultra-low EMI
	XC9285 / XC9286 NEW	HiSAT-COT , F-PWM, PWM/PFM 1.2MHz, 1A
(3) LDO	XC6233	High-speed PSRR=75dB, 200mA, Inrush prevention
(4) RESET IC	XC6138 NEW	High Voltage Sense pin: 76V, Ultra-low Iq V _{DD} : 0.5µA V _{SEN} : 0.15µA, Detect/Release Delay adj, Hysteresis: selectable
	XC6132 / XC6134	Separated Sense pin, Hysteresis adj., Release/Detect Delay adj.
	XC6118	Separated Sense pin, Low Iq, Release Delay external adj.

■ For fluctuating 12V/24 or higher lines

● Technical trend and challenges

- Overshooting must be addressed. Power supply inputs of 40 V or higher are also becoming more common, and heat generated by LDOs is also an issue.
- Large fluctuations in the power supply line due to impedance, load fluctuations and induction from motors, etc., must be addressed.

● TOREX Proposal : Space-saving step-down DC/DC for high voltage and high step-down ratio, and voltage detector with wide range of release/detection voltage

▶ 60V 300mA High-voltage Step-down DC/DC : XC9702 NEW

- Supports 60V operation and high step-down ratio.
- Capable of direct step-down from 24V with large fluctuation to 3.3V.
- High efficiency from light loads. F-PWM and PWM/PFM can be selected from MCU by MODE pin.
- Small and Space-saving suitable for replacing LDOs

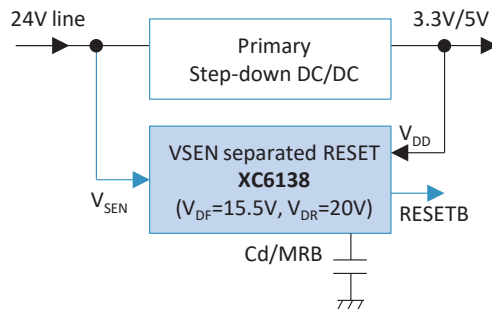


60V 300mA DC/DC : XC9702
World's smallest class of solution size
9.4mm x 7.4mm = 69.6mm²

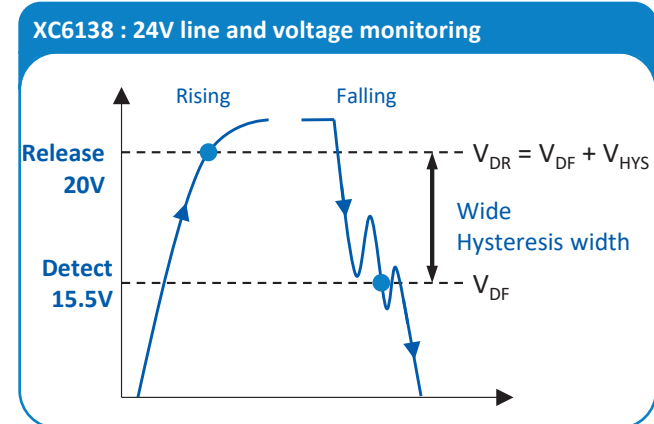
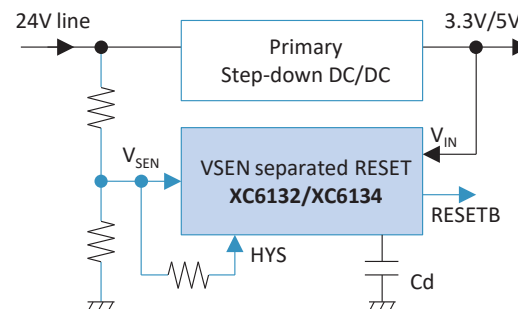
▶ Voltage detector with large release/detection difference : XC6138 NEW, XC6132/XC6134

- Release voltage is set to a voltage sufficient for rise.
- A large hysteresis is set for Detect voltage, considering large fluctuations in the power supply line. Before the 3.3V/5V line voltage drops, the MCU can be notified to perform stop processing, etc., to ensure stable and safe operation of products.

XC6138 : 76V high-voltage sense pin Wide hysteresis width selectable



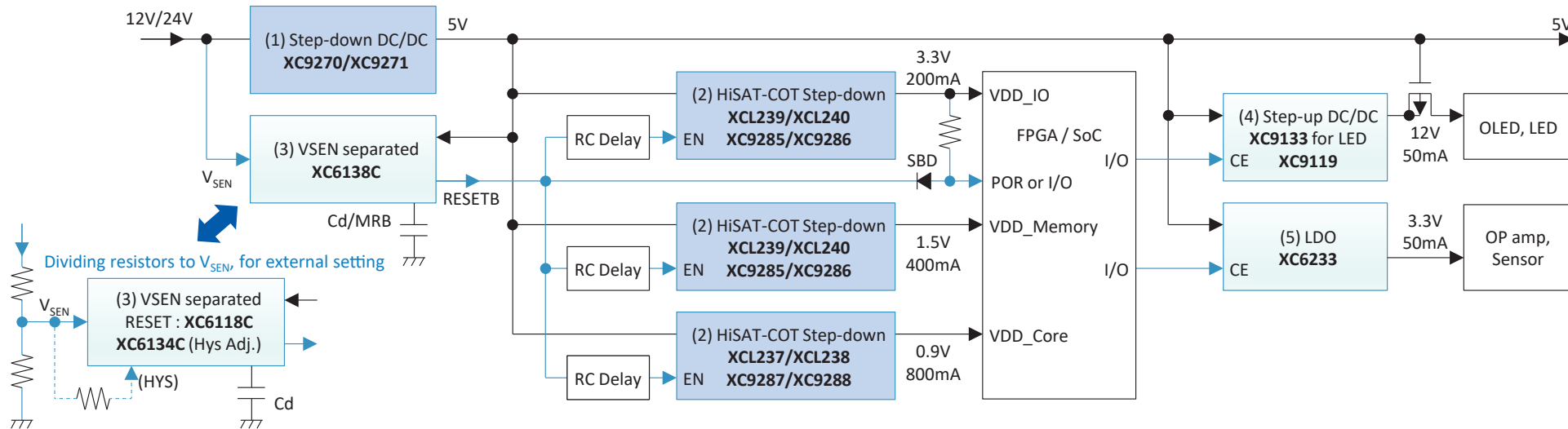
XC6132/XC6134 Hysteresis width set by an external resistor (XC6132 : VSEN pin surge voltage protection)



12V/24V : Multiple power rail solutions

12V/24V POL multiple rail and Positive/Negative power supply

- Challenges : Small / High efficiency / Heat source dispersion / Low EMI power supply from 12V/24V, Start-up/Shutdown sequence



Block	Product	Features
(1) Primary Step-down DC/DC	XC9270 / XC9271	30V, PWM, PWM/PFM, 300kHz/500kHz, 2A
	XCL239 / XCL240 NEW	Built-in inductor, HiSAT-COT , F-PWM, PWM/PFM 3MHz, 1A
(2) Step-down DC/DC	XCL237 / XCL238 NEW	Built-in inductor, HiSAT-COT , F-PWM, PWM/PFM 3MHz, 1.5A
	XC9285 / XC9286 NEW	HiSAT-COT , F-PWM, PWM/PFM 1.2MHz, 1A
	XC9287 / XC9288 NEW	HiSAT-COT , F-PWM, PWM/PFM 1.2MHz/3MHz, 1.5A
	XC6138 NEW	High Voltage Low Iq Sense pin: 76V, 0.15μA@12V Ultra-low Iq 0.5μA, Release Delay adj., Selectable Hysteresis
(3) RESET IC	XC6118 / XC6134	Separated Sense pin, Delay adj., Hysteresis adj. (XC6134)
	XC6134C (Hys Adj.)	
(4) Step-up DC/DC	XC9119 / XC9133	~19.5V, PWM, 1MHz, 100mA@5V→12V, For LED: XC9133
(5) LDO	XC6233	High-speed PSRR=75dB, 200mA, Inrush prevention

(1) Primary Step-down DC/DC for 12V/24V input

Input voltage range, output current, and frequency suitable for industrial products.

(2) Step-down DC/DC for FPGA/SoC (POL power supply)

HiSAT-COT PAGE 30 **XCL** PAGE 31

High-speed transient response **HiSAT-COT** controlled DC/DC arranged as POL. Built-in inductor Micro DC/DC realizes miniaturization and low EMI. (XCL241/XCL242, XCL239/XCL240, XCL237/XCL238)

(3) 12V/24V input monitoring Voltage Detector

High voltage Monitoring Page 34

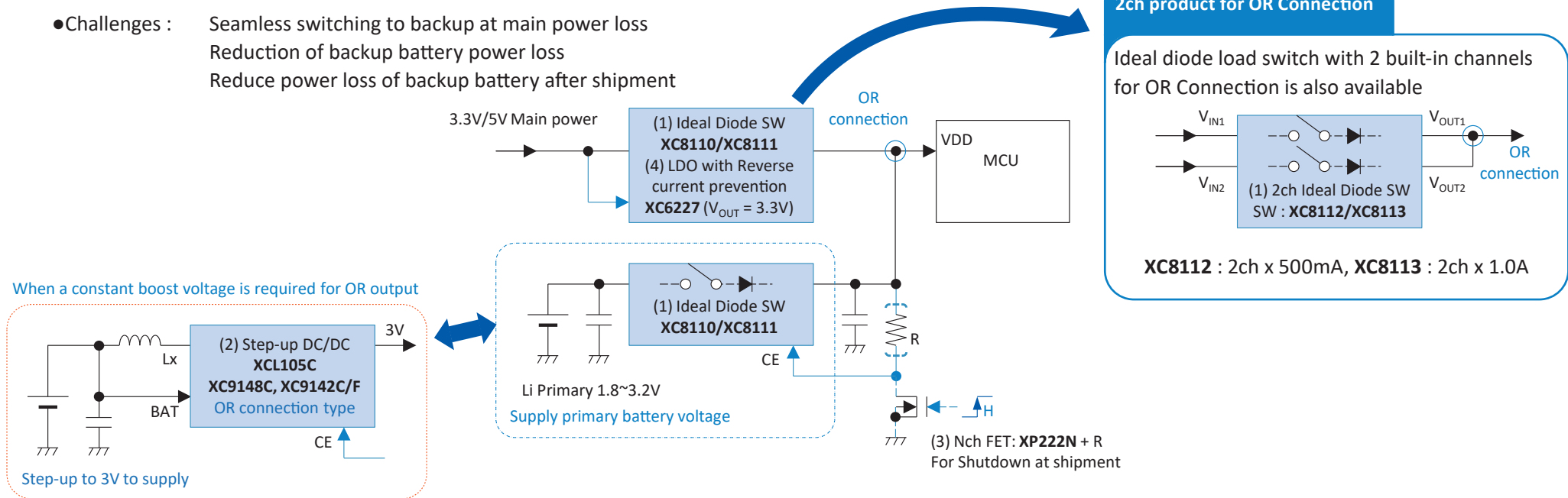
12V/24V input monitoring and driving RC delay for Start-up/Shutdown sequence. Outputs voltage drop signal to FPGA/SoC, then shutdown each DC/DC.

(4) Step-up DC/DC for OLED/LED and other I/O : Medium voltage step-up XC9119.

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



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

OR connection
Page 38

(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

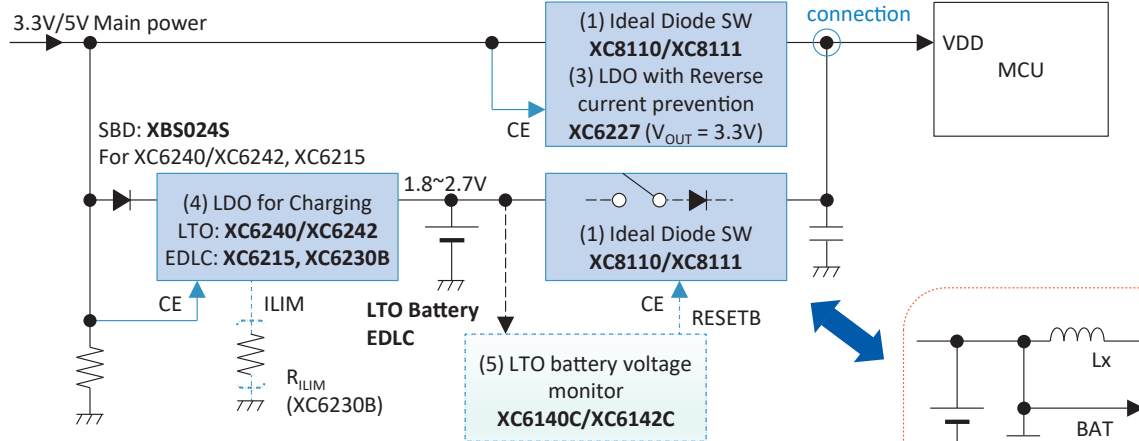
(3) Cut off supply from backup power source at shipment

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)

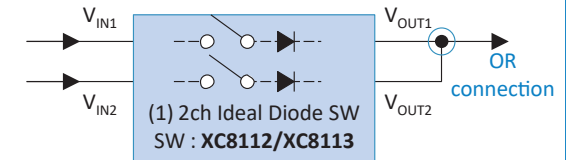
Backup power supply with Rechargeable battery / LTO battery / Supercap (EDLC)

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

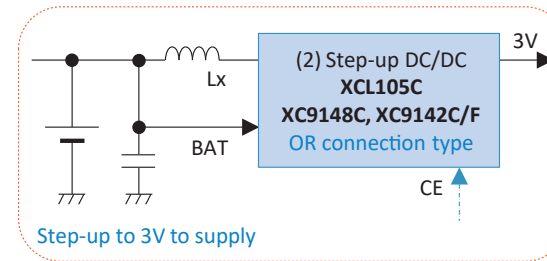


2ch product for OR Connection

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



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



Step-up to 3V to supply

OR connection
Page 38

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 VOUT 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 VOUT.

(5) Battery voltage monitoring : XC6140/XC6142

Detect/Release voltage set according to LTO battery characteristics.

Reference circuit for
LTO batteries: Page 40

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

■ OR connection of power supply rails

● Technical trend and challenges

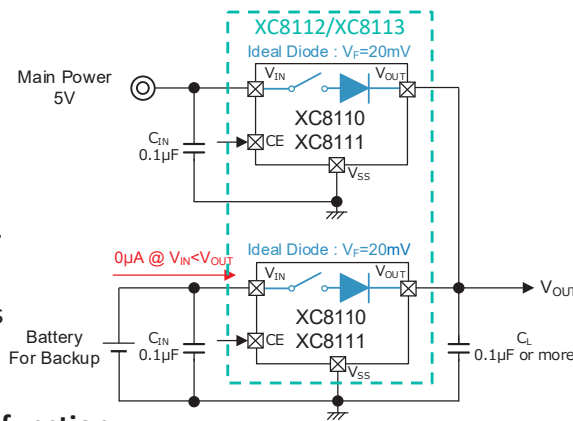
- For high efficiency and long battery life of the device, the circuit using SBD has large loss due to VF. Leakage current of reverse bias is also an issue.
- Difficult to supply stable voltage due to voltage drop and fluctuation caused by the VF characteristic of the diode which may cause unstable operation.

● 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.

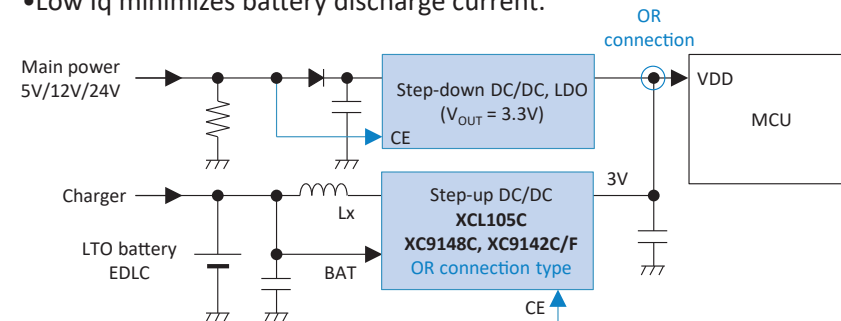


■ Load Switch with Ideal Diode function

Product	Features	V _{IN} (V)	R _{on}	I _{OUT}	Package
XC8110 FEATURED	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 FEATURED	IEC 62368-1:2018 certified			1A	
XC8112 UNDER DEVELOPMENT	2ch (Parallel is allowed) VF=20mV 3.6μA (Forward bias) 0μA (Reverse bias)	1.5 ~ 6.0	2ch x 120mΩ or 1ch x 60mΩ	2 x 500mA or 1 x 1A	USP-8B06 (2.0x2.0xh0.33mm)
XC8113 UNDER DEVELOPMENT	IEC 62368-1:2018 certified			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.



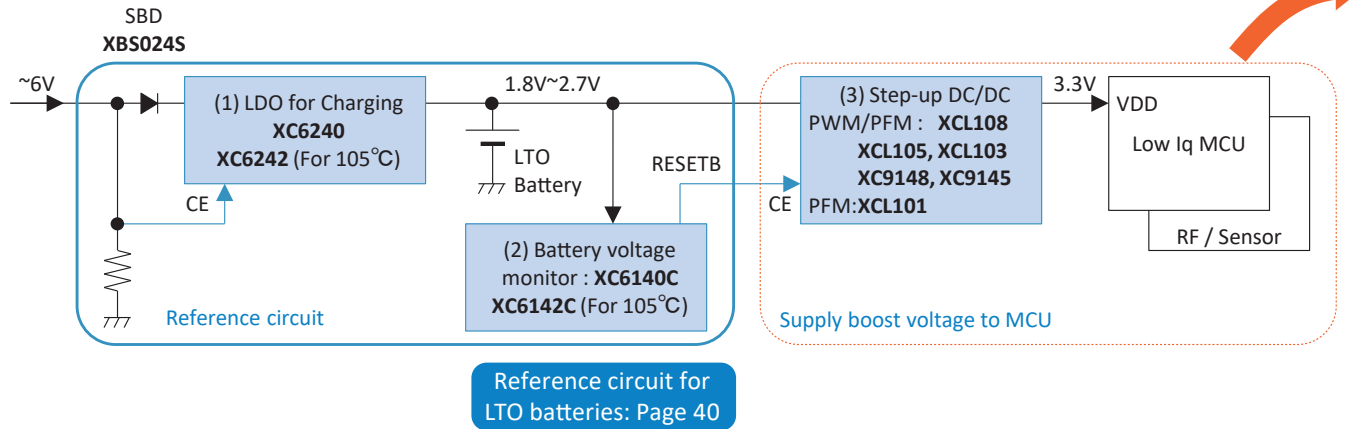
■ Step-up DC/DC for OR connection

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA) @3.3V→5V	Package
XCL105C FEATURED	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 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)
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)

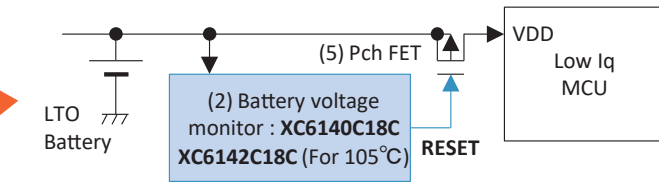
LTO Battery : Solutions for Small and Low Consumption Devices

■ Products using LTO battery : IoT Sensor/Wearable etc.

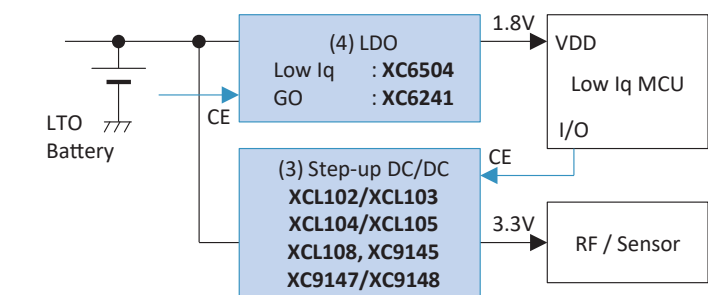
- Challenges : Simple structure / Small / Low Iq / High efficiency
Simple main and backup power supply / Power supply to the system during charging



Supply primary battery voltage to MCU (e.g. Detect: 1.8V)



Supplied to MCU by LDO and to RF/Sensor by Step-up DC/DC



Block	Product	Features
(1) LDO for Charging	XC6240 / XC6242 FEATURED	For LTO charging, 150mA, Topr=105°C (XC6242)
(2) LTO battery voltage monitor	XC6140 / XC6142 FEATURED UNDER DEVELOPMENT	LTO battery voltage monitoring Release voltage:2.475V/2.450V, Iq=104nA For 105°C compatible LTO battery: XC6142
(3) Step-up DC/DC	XCL102 / XCL103	Built-in inductor, F-PWM, PWM/PFM 3MHz, 450mA@3.3V→5V
	XCL104 / XCL105 FEATURED	Built-in inductor, F-PWM, PWM/PFM, 1.2MHz 710mA@3.3V→5V
	XCL108 NEW	Built-in inductor, Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 300mA@3.3V→5V, V _{ST} =1.6V
	XC9145 FEATURED	Ultra-low Iq: 400nA, PWM/PFM 1.2MHz, 430mA@3.3V→5V, V _{ST} =1.6V
(4) LDO	XC6241 FEATURED	Iq=0.6μA, PSRR=60dB, GO, 150mA
	XC6504	Iq=0.6μA, CL less, 150mA

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

Charging at max. 2.70V with low Iq LDO considering temperature range and LTO battery specifications

(2) LTO battery voltage monitor : XC6140, XC6142

Set the voltage to Release when charging starts using the LDO in accordance with the charging and discharging characteristics of the LTO battery.

Power supply for MCU and RF/Sensor

(3) Cases of Boosting voltage

Ultra-low Iq=400nA and high efficiency XCL108 and XC9145.

Built-in inductor Micro DC/DC for low EMI.

PWM for low ripple requirement for RF/Sensor (XCL102, XCL104, XC9147)

(4) LDO or (5) Pch FET cases

Supplied by **GO LDO XC6241** for lower consumption.

Also, **XC6140CxxC** with detection "H" output is used to drive Pch FET and supply battery voltage directly.

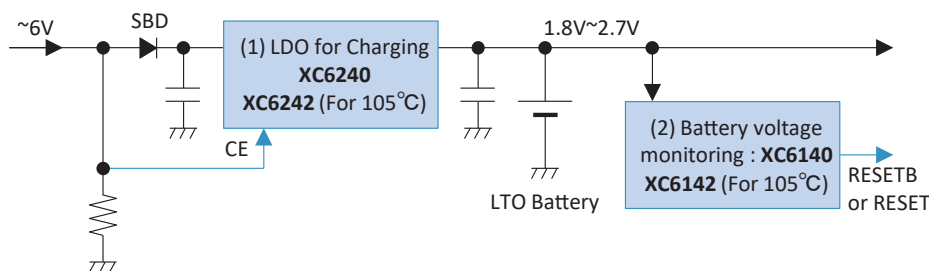
LTO Battery : Charge/Discharge Reference solutions

■ 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

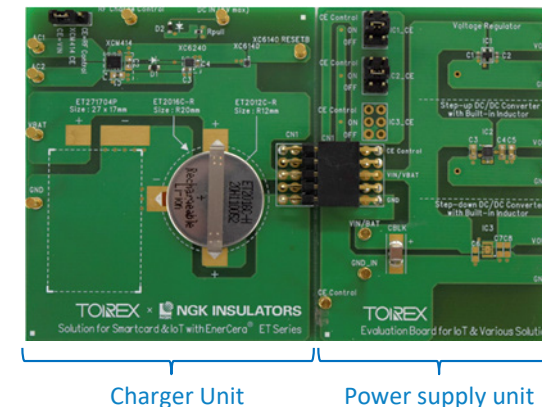
Adopted as reference designs for charger IC and battery monitoring IC for LTO batteries by each manufacturer

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.

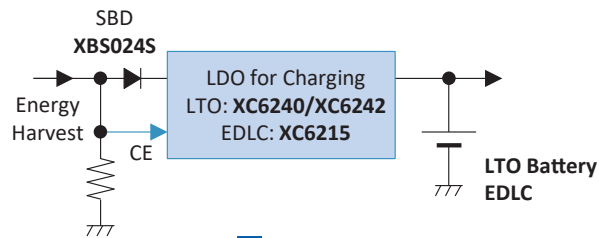
Solutions for Energy Harvesting

■ Examples of charging from Energy Harvesting to LTO battery or Supercap (EDLC)

- Challenges : Supporting various Energy Harvesting : Wireless power transfer (WPT), NFC, solar panels, piezo, etc.
Charge LTO battery or Supercap (EDLC) from unstable/micropower sources

Example of 3V~6V input + LTO battery / EDLC

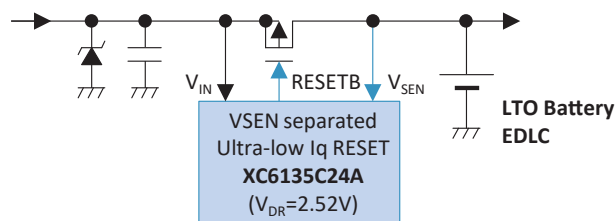
Supported by LTO charging reference circuit



At micro power source

Example of 3V~6V Rectenna and other micro power (a few μW) + LTO battery / EDLC

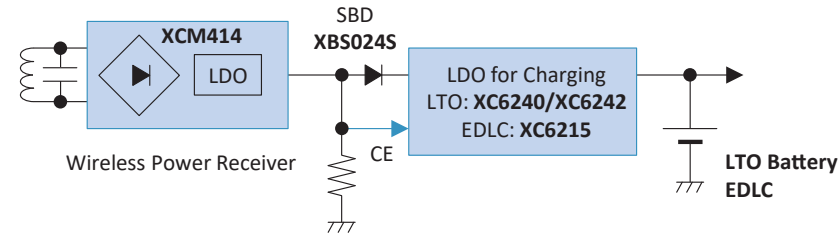
ON-OFF control of Pch FET with Ultra-low Iq Voltage Detector



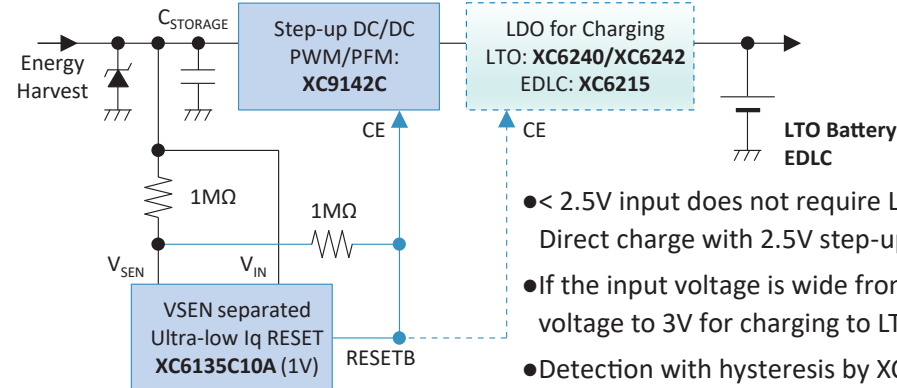
For Supercap (EDLC), select the appropriate charge/detect voltages.

Example of Wireless power transfer + LTO battery / EDLC

Charging with wireless power receiving IC + LDO



Example of 0.9V~2.7V / 0.9V~6V input + LTO battery



- < 2.5V input does not require LDO for charging. Direct charge with 2.5V step-up output.
- If the input voltage is wide from 0.9 to 6V, boost the voltage to 3V for charging to LTO battery with LDO.
- Detection with hysteresis by XC6135 and resistors. When C_{STORAGE} is charged to 2.1V, the step-up is started to charge, and stopped when it drops to 1V.

- Depending on the voltage characteristics and power of Energy Harvesting, the optimal charging circuit and control voltage varies.

TOREX offers optimal power supply configurations to match the characteristics of your energy harvesting.

Please contact : <https://product.torexsemi.com/en/contact-us/technical-inquiry>

Compact and Space-Saving Power Supply Solutions

World's smallest product line of area-saving solutions

XC9290/XC9291 NEW

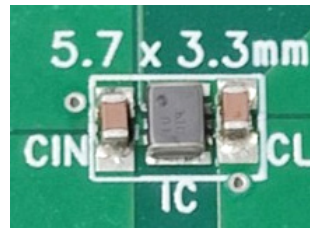
World's smallest 6.0V 600mA step-down DC/DC



Actual Size

XCL239/XCL240 NEW

1A Built-in inductor Micro DC/DC



Actual Size

XC9289 NEW

1.5A HiSAT-COT 1.5A Step-down DC/DC



Actual Size

XC9702 NEW

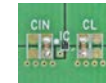
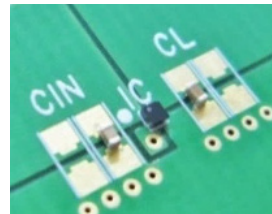
60V 300mA Step-down DC/DC



Actual Size

XC8110/XC8111 FEATURED

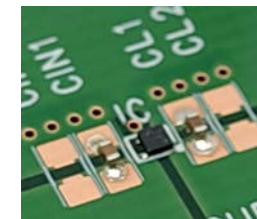
Ideal Diode Load Switch 0.5A/1A



Actual Size

XC6241 FEATURED, XC6135/XC6136

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



Actual Size

List of Compact and Space-saving Power Supply ICs

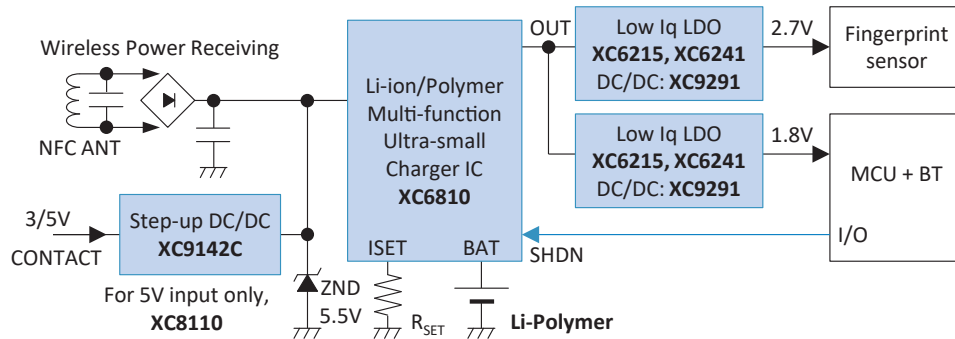
	Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package	Size
LDO	XC6241	High-speed, Iq=0.6μA, GO FEATURED	1.6 ~ 6.0	1.5 ~ 5.0	150	USPQ-4B05	1.0 x 1.0 x h 0.33mm
	XC6228	High-speed, PSRR=75dB, 300mA	1.6 ~ 5.5	1.2 ~ 4.0	300	USPQ-4B04	1.0 x 1.0 x h 0.6mm
	XC6504	Cap. Less, Iq=0.6μA	1.4 ~ 6.0	1.1 ~ 5.0	150	USPN-4B02	0.75 x 0.95 x h 0.40mm
Step-up DC/DC	XCL104/XCL105	Built-in inductor, F-PWM, PWM/PFM FEATURED	0.65 ~ 6.0	1.8 ~ 5.5	710 @3.3V→5V	DFN3030-10B	3.0 x 3.0 x h 1.7mm
	XCL102/XCL103	Built-in inductor, F-PWM, PWM/PFM	0.65 ~ 6.0	2.2 ~ 5.5	450 @3.3V→5V	CL-2025-02	2.0 x 2.5 x h 1.04mm
Step-down DC/DC	XCL243/XCL244	Built-in inductor, HiSAT-COT, 700mA, h=0.75mm max NEW	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 NEW	2.5 ~ 5.5	0.8 ~ 3.6	1000	CL-2025-02	2.0 x 2.5 x h 1.04mm
	XCL233	Iq=200nA, Step-down DC/DC, VSET NEW	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 NEW	2.5 ~ 6.0	0.7 ~ 3.6	600	WLP-5-08	0.96 x 0.88 x h 0.33 mm
	XC9289	HiSAT-COT, 1.5A, F-PWM, PWM/PFM selectable NEW	2.5 ~ 5.5	0.8 ~ 3.6	1500	LGA-8B01	1.2 x 1.4 x h 0.3mm
RESET IC	XC9702	60V, MODE: F-PWM, PWM/PFM, 1MHz, 300mA, Low Iq: 12μA NEW	4.5 ~ 60.0	2.5 ~ 12.0	300	USP-10B	2.6 x 2.9 x h 0.6mm
RESET IC	XC6135/XC6136	Ultra-low Iq: 88nA Voltage Detector	1.1 ~ 6.0	1.2 ~ 5.0	-	USPQ-4B05	1.0 x 1.0 x h 0.33mm
Charger IC	XC6810	For 1 cell Li-ion, Multi-function Charger IC FEATURED	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, VF=20mV, IEC 62368-1 certified FEATURED	1.5 ~ 6.0	-	1000	WLP-4-02	0.82 x 0.82 x h 0.5mm

Low Profile Power Supply Solutions for h=0.33mm/0.40mm max.

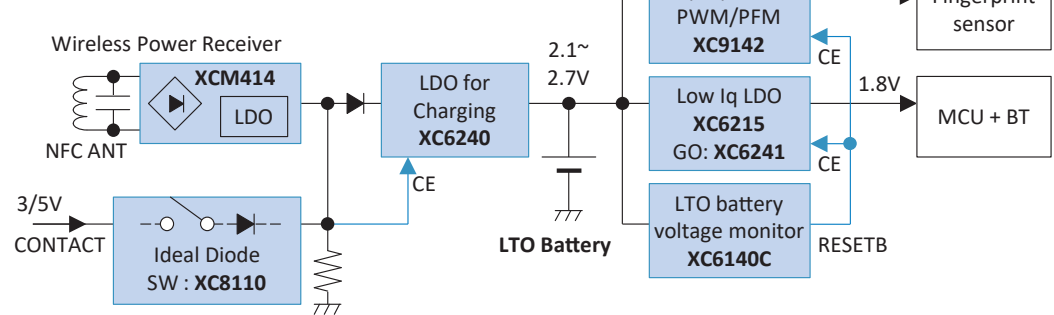
■ Example of thin power supply configuration with h = 0.33mm max for Smart card

- Challenges : Support h=0.33mm max. including external components
- High efficiency charging circuit for input sources such as NFC

Li-Polymer battery : Example of low-profile solution

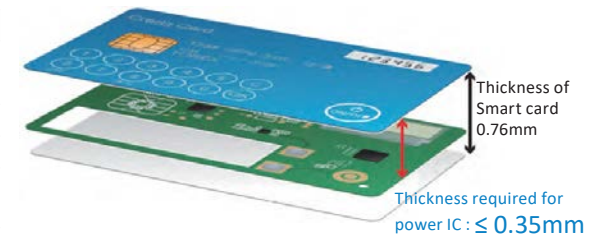


LTO battery : Example of low-profile solution



■ List of low-profile power supply ICs with h ≤ 0.33mm or 0.40mm

	Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package	Size
LDO	XC6216	28V	2.0 ~ 28.0	1.8 ~ 12.0	150	USP-6B06	1.8 x 1.5 x h 0.33mm
	XC6215	I _q =0.8μA	1.5 ~ 6.0	0.9 ~ 5.0	200		
	XC6241	High-speed, I _q =0.6μA, GO	1.6 ~ 6.0	1.5 ~ 5.0	150	USPQ-4B05	1.0 x 1.0 x h 0.33mm
	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
LDO + Bridge Diode	XCM414	For wireless power receiving LDO with internal bridge diode	2.0 ~ 26	2.0 ~ 12.0	150	USP-8B10	2.6 x 2.9 x h 0.33mm
Step-up DC/DC	XC9142	PWM/PFM Step-up DC/DC	V _{ST} =0.9	1.8 ~ 5.5	500	WLP-6-01	1.08 x 1.28 x h 0.40mm
	XC9145	I _q =400nA, PWM/PFM Step-up DC/DC	V _{ST} =1.6	3.0 ~ 5.5	430	WLP-6-05	1.28 x 1.08 x h 0.40mm
Charge pump	XC9802	PWM/PFM Charge Pump	1.8 ~ 5.5	2.5 ~ 6.0 or x2	80	USP-8B05	2.4 x 2.4 x h 0.33mm
Step-down DC/DC	XC9276	I _q =200nA, Step-down DC/DC, VSET	1.8 ~ 6.0	0.5 ~ 3.6	150	WLP-6-03	1.72 x 1.07 x h 0.33 mm
	XC9291	HiSAT-COT, PWM/PFM, 6MHz	2.5 ~ 6.0	0.7 ~ 3.6	600	LGA-6B01	1.2 x 1.2 x h 0.3mm
Battery voltage monitor	XC6140	For LTO battery voltage monitoring Release voltage:2.475V	1.1 ~ 6.0	1.6 ~ 2.2	-	USPQ-4B05	1.0 x 1.0 x h 0.33mm
	XC6136	I _q =88nA		1.5 ~ 5.0			
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
	XC6808	Charger IC for 1 cell Li-ion	4.5 ~ 6.0	4.2, 4.35, 4.4	5 ~ 40	USP-6B07	1.8 x 2.0 x h 0.33mm
	XC6240	LDO for charging LTO battery	1.5 ~ 6.0	2.63	150	USP-6B06	1.8 x 1.5 x h 0.33mm
Load SW	XC8102	Load SW, I _q =3uA	1.2 ~ 6.0		400		
	XC8110	Ideal Diode SW	1.5 ~ 6.0		500	USP-6B06	1.8 x 1.5 x h 0.33mm
	XC6194	Push Button Load SW I _{STB} =1nA	1.8 ~ 6.0		1000		



Inputs and energy storage for smart cards

Input sources : NFC
CONTACT input

Energy storages : Li-Polymer
LTO battery
Supercap (EDLC)
or battery less

Optimal power supply configuration for low-profile solutions varies depending on the input source and other factors.

TOREX offers **optimal power configurations.**

Built-In Inductor DC/DC Converter Micro DC/DC

Step-down DC/DC

F-PWM : Forced PWM Mode, PWM : PWM Mode

	Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	fosc [Hz]	I _q [μA]	Function			Topr max.	Package	
									External FET/SBD	V _{OUT} Setting	Protection			Other
I _{out} max	NEW XCL233	I _q =200nA, Ultra Low Power VSET (Selectable V _{OUT})	PFM	1.8~6.0	0.5~3.6	150	-	0.2	-	V _{OUT}	Short	UVLO/CL Dischg /VSET (Selectable V _{OUT})	85°C	CL-2025-03 (2.5x2.0xh1.04mm)
	XCL232	I _q =200nA Ultra Low Power	PFM	1.8~6.0	0.5~3.6	150	-	0.2	-	V _{OUT}	Short	UVLO/CL Dischg	85°C	CL-2025-03 (2.5x2.0xh1.04mm)
	XCL210	I _q =0.5μA Ultra Low Power	PFM	2.0~6.0	1.0~4.0	200	-	0.5	-	V _{OUT}	Short	UVLO/CL Dischg	85°C	CL-2025-02 (2.5x2.0xh1.04mm)
	XCL202	400mA, 1.2MHz Ultra Low EMI	PWM/PFM	2.0~6.0	0.8~4.0	400	1.2M	15	-	V _{OUT}	ILIM/Short	SS/UVLO/CL Dischg	85°C	CL-2025-02 (2.5x2.0xh1.04mm)
	XCL201		PWM											
NEW	XCL242	HiSAT-COT	PWM/PFM	2.5~5.5	0.8~3.6	500	1.2M	15	-	V _{OUT}	TSD/ILIM/Short	SS/UVLO/CL Dischg	105°C	CL-2025-02 (2.5x2.0xh1.04mm)
NEW	XCL241	500mA, 1.2MHz	F-PWM											
	XCL206	600mA, 3MHz Fixed V _{OUT} /FB Type	PWM/PFM	1.8~6.0	0.8~4.0	600	3.0M	45	-	V _{OUT} or FB	ILIM/Short	SS/UVLO/CL Dischg	85°C	CL-2025-02 (2.5x2.0xh1.04mm)
	XCL205		PWM											
NEW	XCL244	HiSAT-COT	PWM/PFM	2.5~5.5	0.8~3.6	700	3.0M	25	-	V _{OUT}	TSD/ILIM/Short	SS/UVLO/CL Dischg	105°C	USP-8B04 (2.25x1.5xh0.75mm)
NEW	XCL243	700mA, h=0.75mm max	F-PWM											
NEW	XCL240	HiSAT-COT	PWM/PFM	2.5~5.5	0.8~3.6	1000	3.0M	25	-	V _{OUT}	TSD/ILIM/Short	SS/UVLO/CL Dischg	105°C	CL-2025-02 (2.5x2.0xh1.04mm)
NEW	XCL239	1.0A, 3MHz	F-PWM											
NEW	XCL238	HiSAT-COT 1.5A, 3MHz	PWM/PFM	2.5~5.5	0.8~3.6	1500	3.0M	25	-	V _{OUT}	TSD/ILIM/Short	SS/UVLO/CL Dischg	105°C	USP-9B01(2.5x3.2xh1.05mm)
NEW	XCL237		F-PWM											
	XCL212	2A, 2.4MHz	PWM/PFM	2.7~6.0	0.9~6.0	2000	2.4M	53	-	FB	TSD/ILIM	SS/UVLO/CL Dischg	85°C	USP-11B01 (3.1x4.70xh1.35mm)
	XCL211		F-PWM											

Step-up DC/DC

	Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA] (V _{IN} =3.3V, V _{OUT} =5.0V)	fosc [Hz]	I _q [μA]	Function			Topr max.	Package	
									External FET/SBD	V _{OUT} Setting	Protection			Other
	XCL100 XCL101	Built in Inductor, I _q =6.3μA Low Power	PFM	0.7~5.5	1.8~5.0	80	-	6.3	-	V _{OUT}	-	UVLO/CL Dischg	85°C	CL-2025-02 (2.5x2.0xh1.04mm)
NEW	XCL108	Built in Inductor, I _{in} =0.5A I _q =400nA Low Power	PWM/PFM	0.65~5.5	3.0~5.5	300	1.2M	0.4	-	V _{OUT}	ILIM	SS	105°C	CL-2025-02 (2.5x2.0xh1.04mm)
	XCL103 XCL102	Built in Inductor, I _{in} =0.8A Load Disconnection or Bypass	PWM/PFM	0.65~6.0	2.2~5.5	450	3.0M	26	-	V _{OUT}	ILIM/Short	SS/CL Dischg	85°C	CL-2025-02 (2.5x2.0xh1.04mm)
	XCL102		F-PWM											
FEATURED	XCL105	Built in Inductor, I _{in} =1.4A Load Disconnection or Bypass or V _{OUT} OR	PWM/PFM	0.65~6.0	1.8~5.5	710	1.2M	19	-	V _{OUT}	ILIM/TSD/Short	SS/CL Dischg/UVLO	105°C	DFN3030-10B (3.0x3.0xh1.7mm)
FEATURED	XCL104		F-PWM											

See Page 31 for technical details of Micro DC/DC XCL Series

Low Voltage DC/DC : Input voltage 6V or less

F-PWM : Forced PWM Mode, PWM : PWM Mode

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
FEATURED XC9276	I _q =200nA, Ultra Low Power VSET (Selectable V _{OUT})	PFM	1.8~6.0	0.5~3.6	150	-	0.2	-	V _{OUT}	Short	UVLO/CL Dischg /VSET (Selectable V _{OUT})	85°C	WLP-6-03 (1.72x1.07x0.33mm) SOT-26W, USP-8B06 (2.0x2.0x0.33mm)
XC9265	I _q =0.5μA Ultra Low Power	PFM	2.0~6.0	1.0~4.0	200	-	0.5	-	V _{OUT}	Short	UVLO/CL Dischg	85°C	SOT-25 (2.9x2.8x1.3mm) USP-6EL (1.8x2.0x0.4mm)
NEW XC9291	World Smallest Solution Size 3.15mm ²	PWM/PFM	2.5~5.5	0.8~3.6	600	4.0M	11	-	V _{OUT}	ILIM	SS/UVLO/CL Dischg	105°C	LGA-6B01 (1.2x1.2x0.3mm) WLP-5-08 (0.88x0.96x0.33mm)
NEW XC9290	HISAT-COT, 600mA	F-PWM	2.5~5.5	0.8~3.6	600	6.0M	700	-	V _{OUT}	ILIM	SS/UVLO/CL Dischg	105°C	LGA-6B01 (1.2x1.2x0.3mm) WLP-5-08 (0.88x0.96x0.33mm)
XC9236	600mA, Low Noise/EMI Fixed V _{OUT} /FB Type	PWM/PFM	1.8~5.5	0.8~6.0	600	1.2M	15	-	V _{OUT} or FB	ILIM/Short	SS/UVLO/CL Dischg	85°C	SOT-25, USP-6C (1.8x2.0x0.6mm) USP-6EL (1.8x2.0x0.4mm) WLP-5-03 (1.06x1.26x0.4mm)
XC9235		PWM											
NEW XC9286	HISAT-COT, 1.0A	PWM/PFM	2.5~5.5	0.8~3.6	1000	1.2M	15	-	V _{OUT}	TSD/ILIM/Short	SS/UVLO/CL Dischg	105°C	SOT-25 (2.9x2.8x1.3mm) USP-6C (1.8x2.0x0.6mm)
NEW XC9285		F-PWM											
NEW XC9289	HISAT-COT, 1.5A	F-PWM or PWM/PFM	2.5~5.5	0.8~3.6	1500	1.2M	15	-	V _{OUT}	TSD/ILIM/Short	SS/UVLO/CL Dischg	105°C	LGA-8B01 (1.2x1.4x0.3mm)
NEW XC9288		PWM/PFM											SOT-89-5 (4.5x4.35x1.6mm) USP-6C (1.8x2.0x0.6mm)
NEW XC9287		F-PWM											USP-6C (1.8x2.0x0.6mm)
XC9243	2A	PWM/PFM	2.7~6.0	0.9~6.0	2000	1.2M	41	-	FB	TSD/ILIM	SS/UVLO/CL Dischg	85°C	USP-10B (2.9x2.60x0.6mm) SOP-8FD (4.9x6.0x1.75mm)
XC9242		F-PWM											

Medium Voltage DC/DC : Input voltage 18V or less

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
XCM526A	16V DC/DC Controller	PWM/PFM	4.0~16.0	1.2~15.0	3000	500k	1.0M	25	SBD	FB	ILIM/Short	85°C	USP-12B01 (2.3x2.8x0.6mm)
XCM526B		PWM											
XC9221	16V DC/DC Controller	PWM/PFM	2.8~16.0	1.2~15.0	5000	300k	500k	1.0M	Pch+SBD	FB	ILIM/Short	85°C	SOT-25 (2.9x2.8x1.3mm) USP-6C (1.8x2.0x0.6mm)
XC9220		PWM											

High Voltage DC/DC : Input voltage 60V or less

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
NEW XC9702	60V, 300mA	F-PWM or PWM/PFM	4.5~60.0	2.5~12.0	300	1.0M	12	-	FB	TSD/ILIM/OVP/ Lx Short	SS Adj/UVLO/PG	125°C	USP-10B (2.9x2.60x0.6mm) HSOP-8N (6.2x5.2x1.7mm)
XC9271	30V (46V/400ms), 2A Ext CLK Sync	PWM/PFM	7.0~30.0	1.2~12.0	2000	300k	500k	Ext CLK	SBD	FB	TSD/ILIM/Short	105°C	SOP-8FD (4.9x6.0x1.75mm)
XC9270		PWM											
XC9252	30V (46V/400ms) Ext CLK Sync, DC/DC Controller	PWM or PWM/PFM	3.0~30.0	1.5~30.0	10000	280k~550k	Ext CLK	30	Pch+SBD	FB	TSD/ILIM/Short	105°C	TSSOP-16 (5.10x6.4x1.4mm) USP-10B (2.9x2.60x0.6mm)

Step-Up DC/DC, Step-Up Charge Pump

Low Voltage Step-up DC/DC, Charge pump : Output Voltage 7V or less

F-PWM : Forced PWM Mode, PWM : PWM Mode

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA] (V _{IN} =3.3V, V _{OUT} =5.0V)	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
XC9802	Charge Pump, Regulated V _{OUT}	PWM/PFM	1.8~5.5	2.5~6.0 or V _{IN} x2	40	300k	80	-	V _{OUT}	-	-	85°C	MSOP-8A, USP-8 (2.7x2.5xh0.6mm) USP-8B05 (2.4x2.4xh0.33mm)
XC9801		PWM											
XC9111	2step PFM DC/DC	PFM	0.9~10.0	1.5~7.0	70	100k	2	SBD or SBD+Nch	V _{OUT}	ILIM	-	85°C	SOT-23, SOT-25, SOT-89, USP-6C SOT-25, USP-6C
XC9110	PFM DC/DC												
XC9140	I _q =6.3μA, Load Disconnection	PFM	0.7~5.5	1.8~5.0	80	-	6.3	-	V _{OUT}	-	UVLO/CL Dischg	85°C	SOT-25, USP-6EL (1.8x2.0xh0.4mm)
FEATURED XC9145	I _{in} =0.8A, Ultra Low I _q 400nA Load Disconnection	PWM/PFM	0.65~5.5	3.0~5.5	430	1.2M	0.4	-	V _{OUT}	ILIM	SS	105°C	SOT-25, USP-6C (1.8x2.0xh0.6mm) WLP-6-05(1.08x1.28xh0.4mm)
XC9142	I _{in} =0.8A, Load Disconnection or Bypass or V _{OUT} OR (XC9142 Only)	PWM/PFM	0.65~6.0	1.8~5.5	500	1.2M 3.0M	17	-	V _{OUT}	ILIM/Short	SS/CL Dischg	85°C	SOT-25, USP-6C (1.8x2.0xh0.6mm) WLP-6-01 (1.08x1.28xh0.4mm)
XC9141		F-PWM											
FEATURED XC9148	I _{in} =1.4A, Load Disconnection or Bypass or V _{OUT} OR	PWM/PFM	0.65~6.0	1.8~5.5	750	1.2M 3.0M	19	-	V _{OUT}	ILIM/TSD/Short	SS/CL Dischg/UVLO	105°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5 (4.5x4.6xh1.6mm)
FEATURED XC9147	I _{in} =1.4A, Load Disconnection	F-PWM											

Mid Voltage Step-up DC/DC : Output Voltage 7V~

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA] (V _{IN} =5.0V, V _{OUT} =12V)	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
XC9133	LED/Back Light Driver PWM Dimming	PWM	2.5~6.0	2.5~17.5	60	1.0M	60	SBD	FB	ILIM/OVP	PWM Dimming	85°C	SOT-25 (2.9x2.8xh1.3mm)
XC9119	Simple PWM	PWM	2.5~6.0	2.5~19.5	100	1.0M	55	SBD	FB	ILIM	SS Adj	85°C	SOT-25, USP-6C
XC9121	Max Duty=93% DC/DC Controller	PWM/PFM	0.9~6.0	1.5~30.0	2000	100k	13	-	-	-	-	85°C	SOT-25 (2.9x2.8xh1.3mm) USP-6C (1.8x2.0xh0.6mm)
XC9120		PWM											
XC9104	Standard DC/DC Controller	PWM/PFM	0.9~10.0	1.5~30.0	2000	100k/180k /300k/500k	14	Nch+SBD	FB	-	SS	85°C	SOT-25 (2.9x2.8xh1.3mm) USP-6B (1.8x2.0xh0.6mm)
XC9103		PWM											

Buck-Boost DC/DC, Inverting Charge Pump & DC/DC, LED/Back Light Driver

▷ Buck-Boost DC/DC

F-PWM : Forced PWM Mode, PWM : PWM Mode

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA] (V _{IN} =5.0V, V _{OUT} =5.0V)	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
XC9302	Buck-Boost DC/DC Controller	PWM/PFM	2.0~10.0	2.4~6.0	400	180k 300k	15	Pch+SBDx2	V _{out}	-	SS	85°C	SOT-25 (2.9x2.8x1.3mm)
XC9301		PWM											
XC9303	Basic Buck-Boost DC/DC Controller	PWM or PWM/PFM	2.0~10.0	2.0~6.0	1500	300k	55	Pch+Nchx2+SBD	FB	-	SS	85°C	MSOP-8A (4.9x3.0x1.22mm)

▷ Inverting DC/DC, Inverting Charge Pump

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA] (V _{IN} =3.3V, V _{OUT} =3.3V)	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
XC6351A	Charge Pump, Inverting	PWM	1.2~5.0	-1.2~-5.0	10	35k, 120k	100	-	-	-	-	80°C	SOT-25, USP-6B (1.8x2.0x0.6mm)
NEW XC9702	Step-down DC/DC(60V/300mA) for Inverting	PWM/PFM	4.5~60.0 + V _{OUT}	-12.0~-2.5	50 @12V→-5V	1.0M	12	-	FB	TSD/ILIM/OVP/Lx Short	SS Adj/UVLO/PG	125°C	USP-10B (2.9x2.60x0.6mm) HSOP-8N (6.2x5.2x1.7mm)
XC9271	Step-down DC/DC(30V/2A) for Inverting	PWM/PFM	7.0~30.0 + V _{OUT}	-12.0~-1.2	200 @12V→-5V	300k 500k Ext CLK	200	SBD	FB	TSD/ILIM/Short	SS Adj/UVLO/SYNC	105°C	SOP-8FD (4.9x6.0x1.75mm)

▷ LED/Back Light Driver

Product	Feature	Control Method	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA] (V _{IN} =5.0V, V _{OUT} =12V)	fosc [Hz]	I _q [μA]	Function				Topr max.	Package
								External FET/SBD	V _{OUT} Setting	Protection	Other		
XC9133	LED/Back Light Driver PWM Dimming	PWM	2.5~6.0	2.5~17.5	60	1.0M	60	SBD	FB	ILIM/OVP	PWM Dimming	85°C	SOT-25 (2.9x2.8x1.3mm)

Voltage Regulator : Low Iq Type, Medium-Speed Type

▷ Low Voltage Regulators : Input Voltage 6V or less

	Product	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	Ron [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
									CE	Current Limit	Other		
FEATURED	XC6242	Charger IC for LTO Battery I _q =0.8μA, 150mA	1.5~6.0	2.60	150	0.8	4.50	35	Yes	ILIM	-	105°C	USPN-4 (0.90x1.2xh0.4mm)
FEATURED	XC6240			2.63								85°C	SSOT-24, USPN-4 (0.90x1.2xh0.4mm)
FEATURED	XC6241	Go function I _q =0.6μA, High Speed, 150mA	1.6~6.0	1.2~5.0	150	0.6	0.87	60	Yes	FB+ILIM	GO/CL Dischg	105°C	USP-6B06 (1.8x1.5xh0.33mm) SSOT-24 (2.0x2.1xh1.1mm) USPQ-4B05 (1.0x1.0xh0.33mm)
	XC6506	I _q =0.8μA, 150mA	1.5~6.0	1.2~5.0	150	0.8	2.60	35	Yes	FB	-	105°C	USP-4 (0.9x1.2x0.4mm)
	XC6504	Cap Less, I _q =0.6μA, 150mA	1.4~6.0	1.1~5.0	150	0.6	2.13	30	Yes	FB+ILIM	Cap less/CL Dischg	85°C	SOT-25, SSOT-24 USPN-4B02, USPQ-4B04
	XC6217	Go function I _q =4.5μA, High Speed, 200mA	1.6~6.0	0.8~4.0	200	4.5	0.80	70	Yes	FB	GO/CL Dischg	85°C	SOT-25, SSOT-24 USP-4D, USPN-4
	XC6215P	I _q =0.8μA, 200mA	1.5~6.0	0.9~5.0	200	0.8	2.30	35	-	FB+ILIM	-	85°C	USP-3 (1.2x1.2xh0.6mm) SOT-25, SSOT-24
	XC6215B								Yes				
	XC6501P	Cap Less, High Speed, 200mA	1.4~6.0	1.2~5.0	200	13	1.20	50	-	FB	Cap less/CL Dischg	85°C	USP-3 (1.2x1.2xh0.6mm) SOT-25, SSOT-24
	XC6501A-D								Yes				
	XC6206	I _q =1μA, 250mA	1.8~6.0	1.2~5.0	250	1	1.75	35	-	FB+ILIM	-	85°C	USP-4, USPN-4, WLP-4-01 USP-6B (1.8x2.0xh0.6mm) SOT-89, SOT-23
	XC6503P	Cap Less, High Speed, 500mA	1.7~6.0	1.2~5.0	500	15	0.63	55	-	FB+ILIM	Cap less/TSD/CL Dischg	85°C	SOT-89 (4.5x4.0xh1.6mm) SOT-89-5, SOT-25
	XC6503A-D								Yes				
	XC6220	Go function I _q =8μA, High Speed 1A	1.6~6.0	0.8~5.0	1000	8	0.18	50	Yes	FB+ILIM	GO/Inrush/TSD/CL Dischg	85°C	USP-4 (1.2x1.6xh0.6mm) USP-6C (1.8x2.0xh0.6mm) SOT-25, SOT-89-5

▷ Middle Voltage Regulators : Input Voltage 20V or less

	Product	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	Ron [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
									CE	Current Limit	Other		
FEATURED	XC6706	Seamless GO I _q =1.2μA, High Speed 20V, 200mA	3.5~20.0	2.5~5.5	200	1.2	4.1	50	-	FB	GO/SoftStart/TSD	105°C	SOT-89 (4.5x4.0xh1.6mm) USP-4 (1.2x1.6xh0.6mm) SOT-25 (2.9x2.8xh1.3mm)
FEATURED	XC6705								GO/SoftStart/TSD /CL Discharge				
	XC6505	I _q =5.5μA 10.5V, 200mA	1.7~10.5	1.5~8.0	200	5.5	1.10	60	Yes	FB+ILIM	TSD/CL Dischg	105°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
	XC6201	I _q =2μA 10V, 200mA	1.8~10.0	1.3~6.0	200	2	2.00	35	-	ILIM	-	85°C	USP-6B (1.8x2.0xh0.6mm) SOT-89, SOT-25

▷ High Voltage Regulators : Input Voltage 36V or less

	Product	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	Ron [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
									CE	Current Limit	Other		
	XC6216B	28V, 150mA FB Type (XC6216C)	2.0~28.0	1.8~12.0	150	5	6.50	30	Yes	FB+ILIM	TSD	85°C	USP-6C, SOT-25 USP-6B06, SOT-89-5 USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
	XC6216C			2.0~23.0									
	XC6216D			1.8~12.0									
	XC6408	28V, 150mA RESET	2.0~28.0	2.0~18.0	150	8	3.50	40	-	FB+ILIM	TSD /RESET	85°C	TO-252, SOT-89, SOT-223 USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25

Voltage Regulator : High-Speed Type

▷ Low Voltage Regulators : Input Voltage 6V or less

Product	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	Ron [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
								CE	Current Limit	Other		
FEATURED XC6241	GO function I _q =0.6μA, High Speed, 150mA	1.6~6.0	1.2~5.0	150	0.6	0.87	60	Yes	FB+ILIM	GO/CL Dischg	105°C	SSOT-24 (2.0x2.1xh1.1mm) USPQ-4B05 (1.0x1.0xh0.33mm)
XC6233	Inrush Protection, High Speed, 200mA	1.7~5.5	1.2~3.6	200	45	1.20	75	Yes	FB+ILIM	Inrush/CL Dischg	85°C	SOT-25, SSOT-24 USP-4, USPQ-4B04
XC6221	High Speed, 200mA	1.6~6.0	0.8~5.0	200	25	0.80	70	Yes	FB	CL Dischg	85°C	SOT-25, SSOT-24 USP-4, USPN-4
XC6217	GO function I _q =4.5μA, High Speed, 200mA	1.6~6.0	0.8~4.0	200	4.5	0.80	70	Yes	FB	GO/CL Dischg	85°C	SOT-25, SSOT-24 USP-4D, USPN-4
XC6415	2ch LDO, 200mA x 2ch	1.5~6.0	0.8~5.0	200 x 2ch	28/ch	1.00	65	Yes	FB	CL Dischg	85°C	USP-6C (1.8x2.0xh0.6mm) SOT-26, USPN-6
XC6229	High Speed, 300mA Inrush Protection	1.6~5.5	1.2~4.0	300	100	0.53	80	Yes	FB+ILIM	Inrush/TSD/CL Dischg	85°C	LGA-4B01 (0.75x0.75xh0.3mm)
Inrush/CL Dischg												
Inrush/TSD/CL Dischg												
XC6223						0.67				105°C	SOT-25, SSOT-24, SOT-89-5 USP-4, USPQ-4B03	
XC6219	High Speed, 300mA	2.0~6.0	0.9~5.0	300	25	1.60	70	Yes	FB+ILIM	-	85°C	USP-6B (1.8x2.0xh0.6mm) SOT-25, SOT-89-5
XC6227	Reverse Current Protection, High Speed, 700mA	1.7~6.0	0.8~5.0	700	100	0.40	65	Yes	FB	Reverse/TSD	85°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
XC6222	High Speed, 700mA	1.7~6.0	0.8~5.0	700	100	0.40	65	Yes	FB	Reverse/TSD/CL Dischg	85°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
XC6220	GO function I _q =8μA, High Speed 1A	1.6~6.0	0.8~5.0	1000	8	0.18	50	Yes	FB+ILIM	GO/Inrush/TSD/CL Dischg	85°C	USP-6C (1.8x2.0xh0.6mm) SOT-25, SOT-89-5
XC6230	High Speed, 2A FB Type	1.7~6.0	1.2~5.0	2000	45	0.18	70	Yes	FB+ILIM	Reverse/Inrush/TSD/ ILIM Adj/CL Dischg	105°C	USP-6C (1.8x2.0xh0.6mm) SOP-8FD (6.0 x 4.9 xh1.55mm)

▷ Middle Voltage Regulators : Input Voltage 20V or less

Product	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	Ron [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
								CE	Current Limit	Other		
FEATURED XC6706	Seamless GO I _q =1.2μA, High Speed 20V, 200mA	3.5~20.0	2.5~5.5	200	1.2	4.1	50	-	FB	GO/SoftStart/TSD	105°C	SOT-89 (4.5x4.0xh1.6mm)
FEATURED XC6705								Yes		GO/SoftStart/TSD /CL Discharge		USP-4 (1.2x1.6xh0.6mm) SOT-25 (2.9x2.8xh1.3mm)
XC6505	I _q =5.5μA 10.5V, 200mA	1.7~10.5	1.5~8.0	200	5.5	1.10	60	Yes	FB+ILIM	TSD/CL Dischg	105°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
XC6209	10V, 300mA High Speed	2.0~10.0	0.9~6.0	300	25	1.60	80	Yes	FB+ILIM	-	85°C	USP-6B (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
XC6231	10V, 500mA High Speed	2.0~10.0	0.9~5.5	500	35	1.60	65	-	FB+ILIM	-	85°C	SOT-89-5 (4.5x4.6xh1.6mm)

▷ High Voltage Regulators : Input Voltage 36V or less

Product	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	Ron [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
								CE	Current Limit	Other		
XC6701A	28V, 150mA High Speed	2.0~28.0	1.8~18.0	150	50	6.50	50	Yes	FB+ILIM	TSD	105°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOT-25
XC6701D								-				
XC6702	36V (46V/400ms), High Speed, Low I _q	4.5~36.0	1.8~18.0	300	40	3.50	65	Yes	FB	SoftStart/TSD	105°C	USP-6C (1.8x2.0xh0.6mm) SOT-89-5, SOP-8FD

Voltage Regulator : For Low Input Voltage, Negative Voltage and WPT

▷ Low Input Voltage ($V_{IN}=0.5V \sim 3.0V$)

Product	Feature	V_{IN} [V]	V_{OUT} [V]	I_{OUT} [mA]	I_q [μA]	R_{on} [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
								CE	Current Limit	Other		
XC6601	Low Voltage input, $V_{bias}=2.5\sim 6V$, 400mA	1.0~3.0	0.7~1.8	400	25	0.34	60	Yes	FB+ILIM	UVLO/TSD/SoftStart/CL Dischg	85°C	USP-6C (1.8x2.0x0.6mm) SOT-89-5, SOT-25
XC6604	Low Voltage input, 1A $V_{bias}=2.5\sim 6V$ Current Limit adj. (XC6604) SoftStart adj. (XC6603)	0.5~3.0	0.5~1.8	1000	100	0.15	75	Yes	FB	UVLO/TSD/SoftStart/CL Dischg ILIM Adj (XC6604) SoftStart Adj (XC6603)	85°C	USP-6C (1.8x2.0x0.6mm) SOT-26W (2.9x2.8x1.3mm)
XC6603												
XC6602												

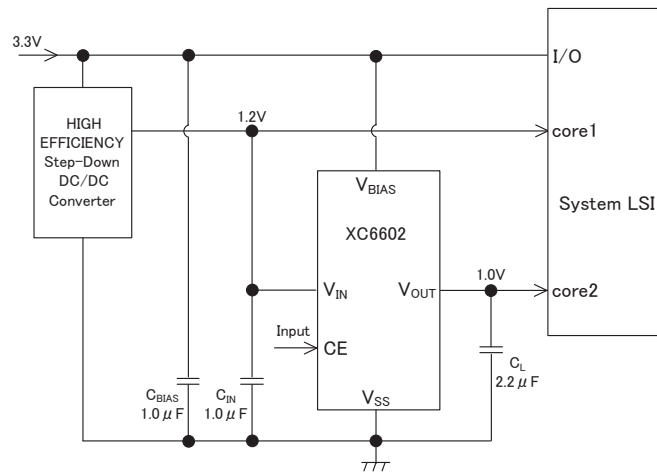
▷ Negative Voltage Regulator

Product	Feature	V_{IN} [V]	V_{OUT} [V]	I_{OUT} [mA]	I_q [μA]	R_{on} [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
								CE	Current Limit	Other		
XC62KN	-10V, 100mA	-10.0~-2.1	-6.0~-2.1	100	3	3.80	40	-	ILIM	-	85°C	USP-6B (1.8x2.0x0.6mm) SOT-89, SOT-23
XC6902	-16V, 200mA High Speed	-16.0~-2.4	-12.0~-0.9	200	100	3.90	45	-	FB	TSD/SoftStart	85°C	USP-6C (1.8x2.0x0.6mm) SOT-89, SOT-23
XC6901	-12.4V, 200mA High Speed	-12.4~-2.4	-12.0~-0.9	200	100	2.50	45	Yes	FB	TSD/SoftStart/CL Dischg	85°C	USP-6C (1.8x2.0x0.6mm) SOT-89-5, SOT-25

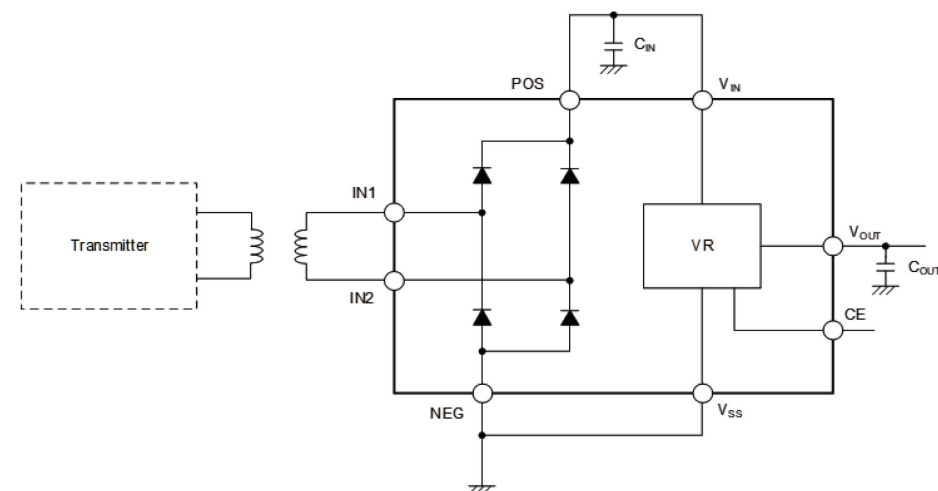
▷ Voltage Regulator with Bridge Diode for Wireless Power Receiver

Product	Feature	V_{IN} [V]	V_{OUT} [V]	I_{OUT} [mA]	I_q [μA]	R_{on} [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
								CE	Current Limit	Other		
XCM414	For Wireless Power Receiver Built-in Bridge Diode	2.0~26.0	2.0~12.0	150	5	6.50	30	Yes	FB+ILIM	TSD	85°C	USP-8B10 (2.6x2.9x0.33mm)

Low Input Voltage Regulator



Voltage Regulator with Bridge Diode for Wireless Power Receiver



Voltage Detector, Watchdog Timer

Low Voltage Voltage Detectors : Input Voltage/Sense pin Voltage 6V or less

UNDER DEVELOPMENT
FEATURED

Product	Feature	V _{IN} [V]	V _{DF} [V]	Accuracy	I _q [μA]	Output		Voltage Detect					Watchdog		Topr max.	Package	
						Config.	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Unstable operation prevention	Timeout Period			EN/ENB
XC6142	LTO Battery/EDLC Monitor	1.1~6.0	1.6~2.1	0.8%	0.104	CMOS N-ch	Detect "H" Detect "L"	-	-	-	0.350V-0.850V	-	CMOS Only	-	-	105°C	USPQ-4B05(1.0x1.0xh0.33mm)
XC6140			1.6~2.2								0.275V-0.875V						USPQ-4B05(1.0x1.0xh0.33mm) SSOT-24(2.0x2.1xh1.1mm)
XC6136	Ultra Low Power	1.1~6.0	1.2~5.0	1.0%	0.088	CMOS N-ch	Detect "H" Detect "L"	-	-	-	VDFx0.1% VDFx5%	-	CMOS Only	-	-	105°C	USPQ-4B05(1.0x1.0xh0.33mm) SSOT-24 (2.0x2.1xh1.1mm)
XC6135	Ultra Low Power, Separated Sense Pin		0.5~5.0		0.044			Yes									SOT-25 (2.9x2.8xh1.3mm)
XC6134	Ta=-40~125°C, Hys Adj, Adj Release/Detect Delay	1.6~6.0	0.8~5.0	1.2%	1.32	CMOS N-ch	Detect "H" Detect "L"	Yes	Adj	Adj	Adj	Yes	-	-	-	125°C	SOT-26 (2.9x2.8xh1.3mm) USP-6C (1.8x2.0xh0.6mm)
XC6133			1.0~5.0								VDFx5%						
XC6132	Separate Sense pin		0.8~2.0								Adj						
XC6127	Built-in Release Delay, Manual Reset	0.7~6.0	1.5~5.5	0.8%	0.7	CMOS N-ch	Detect "H" Detect "L"	-	-	50ms ~800ms	VDFx5%	Yes	-	-	-	85°C	SOT-25,SSOT-24 USPN-4 (0.90x1.2xh0.4mm)
XC6126	High Accuracy	0.7~6.0	1.5~5.5	0.8%	0.7	CMOS N-ch	Detect "L"	-	-	-	VDFx5%	-	-	-	-	85°C	SSOT-24 (2.0x2.1xh1.1mm) USPN-4B02(0.75x0.95xh0.4mm)
XC6119	Adj Release Delay	0.7~6.0	0.8~5.0	2.0%	0.9	CMOS N-ch	Detect "L"	-	-	Adj	VDFx5%	-	CMOS Only	-	-	85°C	SSOT-24 (2.0x2.1xh1.1mm) USPN-4 (0.90x1.2xh0.4mm)
XC6118	Separate Sense pin, Adj Release Delay	1.0~6.0			0.8			Yes			VDFx1% VDFx5%						SOT-25 (2.9x2.8xh1.3mm) USP-4 (1.2x1.6xh0.6mm)

Low Voltage Voltage Detectors with Watchdog function : Input Voltage/Sense pin Voltage 6V or less

Product	Feature	V _{IN} [V]	V _{DF} [V]	Accuracy	I _q [μA]	Output		Voltage Detect					Watchdog		Topr max.	Package	
						Config.	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Unstable operation prevention	Timeout Period			EN/ENB
XC6131	Ta=-40~125°C, RESET with Watchdog, Adj Delay time	1.5~6.0	1.6~6.0	1.0%	2.5@EN=L 9.8@EN=H	N-ch	Detect "L"	-	-	Adj	VDFx5%	-	-	Adj	Yes	125°C	SOT-26 (2.9x2.8xh1.3mm) DFN1515-6A (1.5x1.5xh0.38mm)
XC6130					9.8							Yes					
XC6121-XC6124	RESET with Watchdog, EN Built-in Delay time	1.0~6.0	1.6~5.0	2.0%	10	N-ch	Detect "L"	-	-	3.13ms ~400ms	VDFx5%	-	-	50ms ~1600ms	Yes	85°C	SOT-25 (2.9x2.8xh1.3mm) USP-6C (1.8x2.0xh0.6mm)

Middle Voltage Voltage Detectors : Input Voltage/Sense pin Voltage 10V or less

Product	Feature	V _{IN} [V]	V _{DF} [V]	Accuracy	I _q [μA]	Output		Voltage Detect					Watchdog		Topr max.	Package	
						Config.	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Unstable operation prevention	Timeout Period			EN/ENB
XC61G	10V	0.7~10.0	0.8~6.0	2.0%	0.7	CMOS N-ch	Detect "L"	-	-	-	VDFx5%	-	-	-	-	85°C	USP-3 (1.2x1.2xh0.6mm)
XC61C																	
XC61H	10V, Built-in Release Delay	0.7~10.0	1.6~6.0	2.0%	1	CMOS N-ch	Detect "L"	-	-	1ms ~400ms	VDFx5%	-	-	-	-	80°C	SOT-23 (2.9x2.8xh1.3mm)
XC61F																	

High Voltage Voltage Detectors

NEW

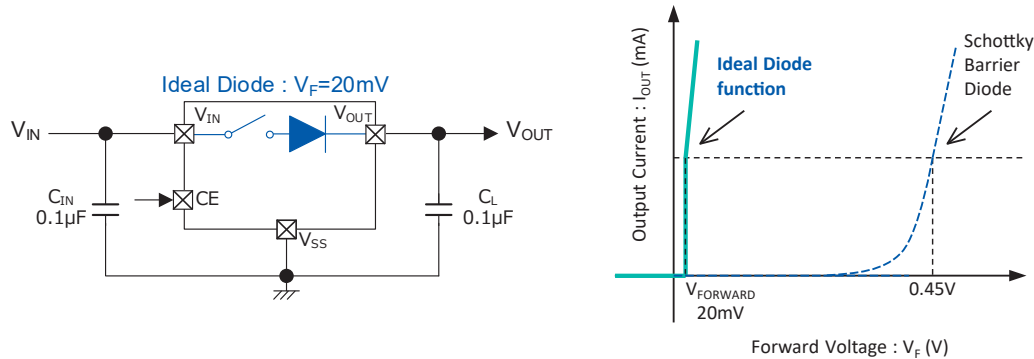
Product	Feature	V _{IN} [V]	V _{DF} [V]	Accuracy	I _q [μA]	Output		Voltage Detect					Watchdog		Topr max.	Package	
						Config.	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Unstable operation prevention	Timeout Period			EN/ENB
XC6138	VSEN pin 76V operation Hysteresis 5~50%, Adj Delay time	2.2~6.0	2.3~20.0	1.5%	0.5	CMOS N-ch	Detect "H" Detect "L"	Yes	Adj	Adj	5~50%	Yes	-	-	-	125°C	SOT-25 (2.8x2.9xh1.3mm) DFN1515-6A (1.5x1.5xh0.38mm)

Load SW

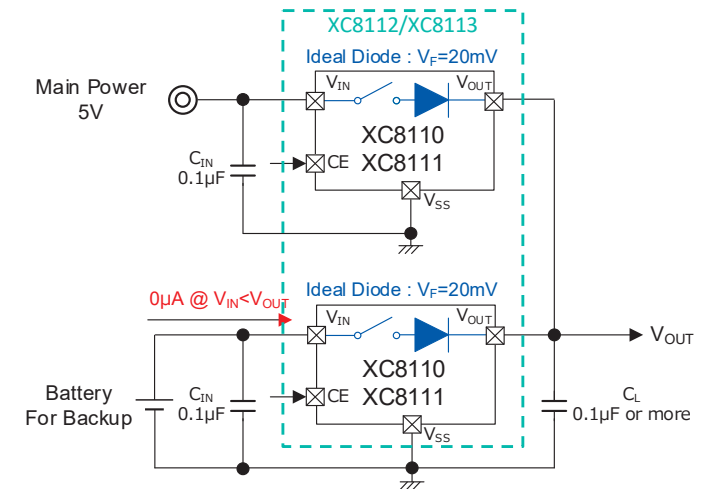
Product	Features	V _{IN} [V]	I _{OUT} [mA]	Current Limit		I _q [μA]	I _{STB} [μA]	Ron [Ω]	Function		Topr max.	Package
				ILIM Value [mA]	Setting Method				Current Limit	Other		
XC8101	I _q =3μA, 200mA	1.8~6.0	200	300	Fixed	3	0.01	550	FB+ILIM	CL Dischg	85°C	SOT-25 (2.9x2.8xh1.3mm) SSOT-24 (2.0x2.1xh1.1mm) USP-4 (1.2x1.6xh0.6mm)
XC8102	I _q =3μA, 400mA	1.2~6.0	400	480	Fixed	3	0.01	280	FB+ILIM	CL Dischg	85°C	SOT-25, SSOT-24, USP-4 (1.2x1.6xh0.6mm) USP-6B06 (1.8x1.5xh0.33mm) USPN-4 (0.90x1.2xh0.4mm)
XC8109	900mA, 85mΩ, Multifunction	2.5~5.5	900	75~1300	Adj by External Resister	40	0.01	85	FB+ILIM or ILIM+Latch	TSD SS UVLO Reverse FLG	105°C	USP-6C (1.8x2.0xh0.6mm)
XC8107	0.5A~2A, 85mΩ, Multifunction		500/1000 1500/2000	900/1400 1900/2400	Fixed							SOT-25 (2.9x2.8xh1.3mm) USP-6C (1.8x2.0xh0.6mm)
XC8108	2A, 85mΩ, Multifunction Load SW		2000	900~2400	Adj by External Resister							USP-6C (1.8x2.0xh0.6mm)

I_{out} max

Diode Replacement / Forward Voltage Characteristics



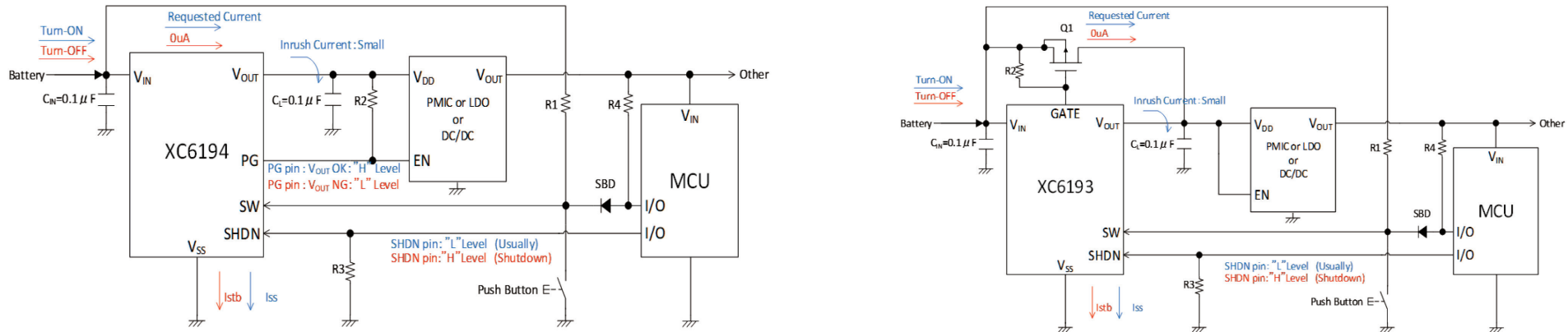
OR connection : For backup circuit, etc.



Product	Features	V _{IN} [V]	I _{OUT} [mA]	Current Limit		I _q [μA]	I _{STB} [μA]	Ron [mΩ]	Function		Topr max.	Package
				ILIM Value [mA]	Setting Method				Current Limit	Other		
FEATURED XC8110	Ideal Diode VF=20mV, I _q =3.6μA 500mA (XC8110), 1A (XC8111) IEC 62368-1 Certified	1.5~6.0	500	850	Fixed	3.6	0.65	120	FB+ILIM	TSD Inrush True Reverse	105°C	WLP-4-02 (0.82x0.82xh0.5mm) SOT-25 (2.9x2.8xh1.3mm) USP-6B06 (1.8x1.5xh0.33mm)
FEATURED XC8111	1000		1700									
UNDER DEVELOPMENT XC8112	Ideal Diode VF=20mV, I _q =3.6μA 500mA (XC8112), 1A (XC8113)	1.5~6.0	2ch x 500	850	Fixed	3.6/ch	0.65/ch	150	FB+ILIM	TSD Inrush True Reverse	105°C	USP-8B06 (2.0x2.0xh0.33mm)
UNDER DEVELOPMENT XC8113	2ch Load SW		2ch x 1000	1700								

Push Button Load Switch, Push Button Reboot Controller

■ Push Button Load SW



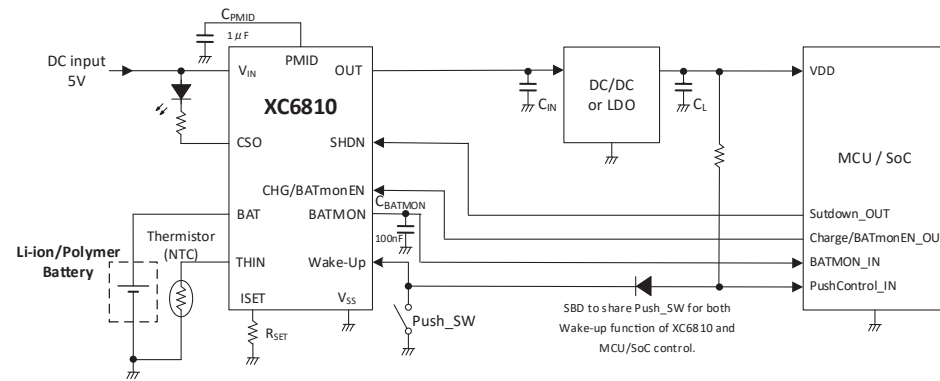
Product	Features	V _{IN} [V]		I _{OUT} [mA]	I _{stb} [µA]	I _q [µA]	Turn-on		Turn-off		Function	Topr max.	Package
		Min.	Max.				Operation Method	SW "L" time	Operation Method	SW "L" time			
FEATURED XC6194A	I _{STB} =1nA Shutdown function (Ship function/System Power SW) Freeze measures	1.80	6.00	1000	0.001	0.13	SW pin	0.2s / 1s / 3s / 5s	SHDN pin or SW pin	3s / 5s / 10s / 15s	Forced Shutdown Inrush Current Protection UVLO / Short Protection Thermal Shutdown Output CL Dischg Power Good (XC6194)	85°C	USPN-8B06 (2.0x2.0xh0.33mm)
FEATURED XC6194B									SHDN pin	-			
FEATURED XC6193A				SHDN pin or SW pin					3s / 5s / 10s / 15s				
FEATURED XC6193B				SHDN pin					-				

■ Push Button Reboot Controller

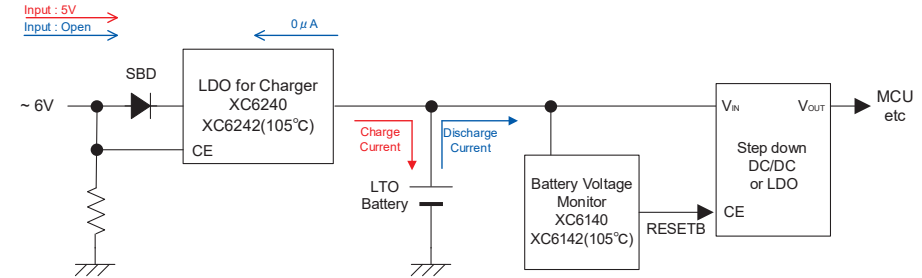
Product	Features	V _{IN} [V]		I _q [µA]	RSTB Sink Current [mA]	Output Configuration	Reboot Delay Time			Topr max.	Package
		Min.	Max.				Adjustable Method	Reboot Delay time	Reboot time		
XC6190A	Push Button Reboot Controller	1.75	6.00	0.01	30	N-ch CMOS	External Resister	1s ~ 20s (±5%)	0.4s (±5%)	85°C	USPN-6 (1.3x1.3x0.4mm) USPN-6B01 (1.0x1.45x0.4mm)
XC6190B							Internal Fix	7.5s or 12.5s (±5%)			

Charger IC : For Li-ion/Polymer & LTO Batteries

XC6810 Typical application circuit



LTO battery Reference circuit



Charger IC for Li-ion/ Li-polymer

Product	Features	Battery / Cell	VIN [V]	Charge Voltage [V]	Charge Current[mA]	Iq [µA]	Battery Sink Current [µA]	Function					Topr max.	Package
								Temp. Monitor	Current Path	Safety Timer	Protection	Other		
FEATURED XC6810xxxC/D/G	1mA~25mA 3.80V~4.40V Multi-function 1Cell Li-ion Linear Charger	Li-ion/Polymer 1Cell	3.5~28.0	3.80~4.40	1~25	330	3.0	-	Yes	Main:5h/10h Trickle:0.5h	Thermal Reg UVLO Short ILIM	Shutdown(Ship) BAT Monitor	85°C	WLP-12-01 (1.57x1.17x0.33mm)
FEATURED XC6810xxxA/B/E/F								Yes	-	-	Shutdown(Ship) BAT Monitor Charge Enable			
FEATURED XC6810xxxH/J								Yes	Yes	-	-	Trickle Charge Selectable		
XC6808x2/3/4	5mA~40mA, 4.20V/4.35V/4.40V, 1Cell Li-ion Linear Charger	Li-ion/Polymer 1Cell	4.5~6.0	4.20 4.35 4.40	5~40	100	0.1	Yes	-	Main:5h/10h Trickle:0.5h	TSD UVLO ILIM	Trickle Charge Selectable	85°C	USP-6B07 (1.8x2.0x0.33mm)
XC6808xN								-	-	-	-			
XC6803	40mA~280mA (XC6803) 200mA~800mA (XC6804) 1Cell Li-ion Linear Charger	Li-ion/Polymer 1Cell	4.5~6.0	4.20	40~280	100	0.5	Yes	-	Main:5h Trickle:0.5h Main:10h Trickle:2h	TSD UVLO ILIM	-	85°C	USP-6EL (1.8x2.0x0.4mm) SOP-8FD (4.9x6.0x1.75mm) USP-6EL (1.8x2.0x0.4mm)
XC6804								-	-	-	-			

Charger IC for LTO Battery

Product	Features	Battery / Cell	VIN [V]	Charge Voltage [V]	Charge Current[mA]	Iq [µA]	Battery Sink Current [µA]	Function					Topr max.	Package
								Temp. Monitor	Current Path	Safety Timer	Protection	Other		
FEATURED XC6242	Charger IC for LTO Battery Iq=0.8µA, 150mA LDO	LTO Batteries /EDLC	1.5~6.0	2.63	~150	0.8	0.24	-	-	-	ILIM	-	105°C	USPN-4 (0.90x1.2x0.4mm)
FEATURED XC6240								-	-	-	-	SSOT-24, USPN-4 (0.90x1.2x0.4mm) USP-6B06 (1.8x1.5x0.33mm)		

Battery Monitor IC for LTO Battery

Product	Features	Battery / Cell	VIN [V]	VDF [V]	Accuracy	Iq [µA]	Output		Voltage Detect						Topr max.	Package
							Configuration	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Unstable operation prevention		
UNDER DEVELOPMENT XC6142	LTO Battery/EDLC Monitor IC Release=2.450V (XC6142) Release=2.475V (XC6140)	LTO Batteries /EDLC	1.1~6.0	1.6~2.1	0.8%	0.104	CMOS N-ch	Active "H" Active "L"	-	-	-	0.350V-0.850V	-	CMOS Only	105°C	USPQ-4B05(1.0x1.0x0.33mm)
FEATURED XC6140				1.6~2.2								0.275V-0.875V				USPQ-4B05(1.0x1.0x0.33mm) SSOT-24(2.0x2.1x1.1mm)

Automotive IC (AEC-Q100 Compliant)

■ Voltage Regulator

Product	AEC-Q100	Feature	V _{IN} [V]	V _{OUT} [V]	I _{OUT} [mA]	I _q [μA]	R _{on} [Ω]	PSRR @1kHz [dB]	Function			Topr max.	Package
									CE	Current Limit	Other		
XD6506	Grade2	I _q =0.8μA, 150mA	1.5~6.0	1.2~5.0	150	0.8	2.60	35	Yes	FB+ILIM	-	105°C	SOT-25 (2.9x2.8xh1.3mm)
NEW XD6239	Grade1	300mA High Speed	2.0~6.0	1.2~3.4	300	100	0.66	75	Yes	FB+ILIM	Inrush/TSD/CL Dischg	125°C	DFN1010-4C (1.0x1.0xh0.6mm) SOT-25 (2.9x2.8xh1.3mm) SOT-89-5 (4.5x4.35xh1.6mm)
XD6216	Grade2	28V, 150mA	2.0~28.0	1.8~12.0	150	5	6.50	30	Yes	FB+ILIM	TSD	105°C	SOT-25 (2.9x2.8xh1.3mm) SOT-89-5 (4.5x4.35xh1.6mm)
XD6702	Grade2	36V (46V/400ms), High Speed, Low I _q	4.5~36.0	1.8~18.0	300	40	3.50	65	Yes	FB+ILIM	SoftStart/TSD	105°C	SOT-89-5 (4.5x4.60xh1.6mm)

■ Voltage Detector, Watchdog Timer

▷ Voltage Detector

Product	AEC-Q100	Feature	V _{IN} [V]	V _{DF} [V]	Accuracy	I _q [μA]	Output		Voltage Detect					Watchdog		Topr max.	Package
							Configuration	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Timeout Period	EN/ENB		
XD6132	Grade1	Ta=-40~125°C, Hys adj, Separate Sense pin, Adj Release/Detect Delay	1.6~6.0	0.8~2.0	1.2%	1.32	CMOS N-ch	Active "H" Active "L"	Yes	adj	adj	adj	Yes	-	-	125°C	SOT-26 (2.9x2.8xh1.3mm) USP-6C(1.8x2.0xh0.6mm)
XD6133				1.0~5.0								VDFx5%					

▷ Voltage Detectors with Watchdog function

Product	AEC-Q100	Feature	V _{IN} [V]	V _{DF} [V]	Accuracy	I _q [μA]	Output		Voltage Detect					Watchdog		Topr max.	Package
							Configuration	Logic	Separate Sense Pin	Detect Delay time	Release Delay time	Hys	Manual Reset	Timeout Period	EN/ENB		
XD6130	Grade1	Ta=-40~125°C, RESET with Watchdog, Adj Delay time	1.5~6.0	1.6~5.0	1.0%	9.8	N-ch	Active "L"	-	-	adj	VDFx5%	Yes	adj	-	125°C	SOT-26 (2.9x2.8xh1.3mm)
XD6131						2.5@EN=L 9.8@EN=H							-				
XD6121-XD6124	Grade3	RESET with Watchdog, EN Built-in Delay time	1.0~6.0	1.6~5.0	2.0%	10	N-ch	Active "L"	-	-	3.13ms ~400ms	VDFx5%	-	50ms ~1600ms	Yes	85°C	SOT-25 (2.9x2.8xh1.3mm)

N-Channel Single MOSFET

Product	Package	V _{DSS} [V]	V _{GSS} [V]	I _D [A]	R _{DS(on)} (Max.) [Ω]				Ciss [pF]	
					V _{GS} =1.5V	V _{GS} =2.5V	V _{GS} =4.5V	V _{GS} =10V		
XP222N03017R-G	SOT-723 (8,000pcs/Reel)	20	±8	0.3	-	1.8	1.3	-	18	
XP231N02017R-G		30	±20	0.2	-	11	5	-	6.5	
XP232N03017R-G		30	±20	0.3	-	-	2.5	2	22	
XP261N70027R-G		60	±20	0.15	-	-	5.5	5	18	
XP222N03015R-G	SOT-523 (3,000pcs/Reel)	20	±8	0.3	-	1.8	1.3	-	18	
XP231N02015R-G		30	±20	0.2	-	11	5	-	6.5	
XP232N03015R-G		30	±20	0.3	-	-	2.5	2	22	
XP261N70025R-G		60	±20	0.15	-	-	5.5	5	18	
XP222N03013R-G	SOT-323-3A (3,000pcs/Reel)	20	±8	0.3	-	1.8	1.3	-	18	
XP224N06013R-G				0.6	-	0.85	0.7	-	60	
XP223N10013R-G				1.0	10	0.35	0.3	-	99	
XP231N02013R-G				0.2	-	11	5	-	6.5	
XP232N03013R-G				0.3	-	-	2.5	2	22	
XP233N05013R-G				0.5	-	4	1.5	-	40	
XP234N08013R-G		0.8	-	-	0.4	0.29	64			
XP261N70023R-G		0.15	-	-	5.5	5	18			
XP262N70023R-G		0.3	-	-	2.1	1.6	30			
XP222N0301TR-G		SOT-23(TO-236) (3,000pcs/Reel)	20	±8	0.3	-	1.8	1.3	-	18
XP224N0601TR-G					0.6	-	0.85	0.7	-	60
XP223N1001TR-G					1.0	10	0.35	0.3	-	99
XP225N2001TR-G	2.0				-	0.13	0.1	-	280	
XP231N0201TR-G	0.2				-	11	5	-	6.5	
XP232N0301TR-G	0.3				-	-	2.5	2	22	
XP233N0501TR-G	0.5		-	4	1.5	-	40			
XP234N0801TR-G	0.8		-	-	0.4	0.29	64			
XP235N2001TR-G	2.0		-	-	0.14	0.11	220			
XP236N2001TR-G	2.0		-	-	0.14	0.11	230			
XP261N7002TR-G	0.15		-	-	5.5	5	18			
XP262N7002TR-G	0.3		-	-	2.1	1.6	30			
XP264N0301TR-G	0.3	-	-	2.1	1.6	30				
XP263N1001TR-G	1.0	-	-	0.33	0.25	180				
XP151A13A0MR-G	SOT-23 (3,000pcs/Reel)	20	±8	1.0	0.25	0.14	0.1	-	220	
XP151A12A2MR-G		30	±12	1.0	-	0.16	0.1	-	180	
XP151A11B0MR-G		30	±20	1.0	-	-	0.17	0.12	150	
XP161A1265PR-G	SOT-89 (1,000pcs/Reel)	20	±12	4.0	-	0.095	0.055	-	320	
XP161A1355PR-G		30	±8	4.0	0.15	0.07	0.05	-	390	
XP161A11A1PR-G		30	±20	4.0	-	-	0.105	0.065	270	

N-Channel Single MOSFET : 10A or more

Product	Package	V _{DSS} [V]	V _{GSS} [V]	I _D [A]	R _{DS(on)} (Max.)				Ciss [pF]
					V _{GS} =1.5V	V _{GS} =2.5V	V _{GS} =4.5V	V _{GS} =10V	
NEW XPJ102N09N8R	DFN5060-8L (3,000pcs/Reel)	100	±20	61	-	-	15.6mΩ	9.4mΩ	1370
NEW XPJ101N04N8R		100	±20	122	-	-	6.5mΩ	4.4mΩ	3010

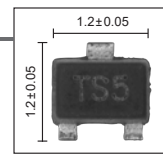
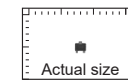
P-Channel Single MOSFET

Product	Package	V _{DSS} [V]	V _{GSS} [V]	I _D [A]	R _{DS(on)} (Max.) [Ω]				Ciss [pF]
					V _{GS} =1.5V	V _{GS} =2.5V	V _{GS} =4.5V	V _{GS} =10V	
XP231P02017R-G	SOT-723 (8,000pcs/Reel)	-30	±8	-0.2	-	8	5	-	34
XP231P02015R-G	SOT-523 (3,000pcs/Reel)	-30	±8	-0.2	-	8	5	-	34
XP221P05013R-G	SOT-323-3A (3,000pcs/Reel)	-20	±8	-0.5	-	1.9	1.3	-	60
XP222P08013R-G				-0.8	-	0.65	0.56	-	118
XP231P02013R-G				-0.2	-	8	5	-	34
XP232P05013R-G				-0.45	-	2.15	1.25	-	56
XP221P0501TR-G	SOT-23(TO-236) (3,000pcs/Reel)	-20	±8	-0.5	-	1.9	1.3	-	60
XP222P0801TR-G				-0.8	-	0.65	0.56	-	118
XP223P1501TR-G				-1.5	-	0.23	0.17	-	165
XP231P0201TR-G				-0.2	-	8	5	-	34
XP232P0501TR-G				-0.45	-	2.15	1.25	-	56
XP233P1501TR-G				-1.5	-	-	0.33	0.19	160
XP152A12C0MR-G	SOT-23 (3,000pcs/Reel)	-20	±12	-0.7	-	0.5	0.3	-	180
XP152A11E5MR-G		-30	±20	-0.7	-	0.45	0.25	-	160
XP202A0003MR-G		-3.0	-	-	0.095	0.067	435		
XP162A12A6PR-G	SOT-89 (1,000pcs/Reel)	-20	±12	-2.5	-	0.3	0.17	-	310
XP162A11C0PR-G		-30	±20	-2.5	-	0.28	0.15	-	280
XP202A0003PR-G		-5.0	-	-	0.1	0.059	450		

Package

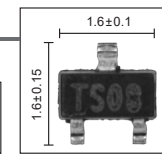
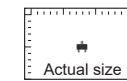
SOT-723

h=0.5 MAX.
p=0.8



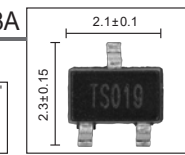
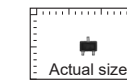
SOT-523

h=0.9 MAX.
p=1.0



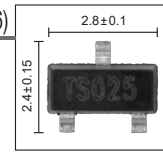
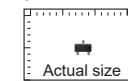
SOT-323-3A

h=1.1 MAX.
p=1.3



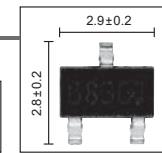
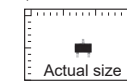
SOT-23 (TO-236)

h=1.15 MAX.
p=1.9



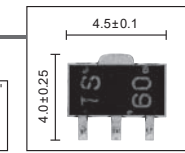
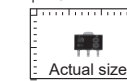
SOT-23

h=1.3 MAX.
p=1.9



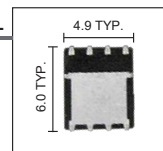
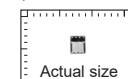
SOT-89

h=1.6 MAX.
p=1.5



DFN5080-8L

h=1.1 MAX.
p=1.27



Schottky Barrier Diode, Transient Voltage Suppressor (TVS)

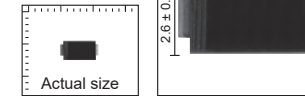
Schottky Barrier Diodes

Product	Package	VR [V]	IF [A]	VF [V]	IR [mA]	Ct [pF]
XBS013S16R-G	SOD-723 (3,000pcs/Reel)	30	0.1	0.71	0.002	6
XBS053V15R-G	SOD-523 (8,000pcs/Reel)	20	0.5	0.40	0.1	12
XBS013S15R-G		30	0.1	0.71	0.002	6
XBS024S15R-G		40	0.2	0.53	0.002	5
XBS053V13R-G	SOD-323A (3,000pcs/Reel)	20	0.5	0.40	0.1	12
XBS104S13R-G	SOD-123A (3,000pcs/Reel)	40	1.0	0.49	0.2	35
XBS104S14R-G		40	1.0	0.49	0.2	35
XBS104V14R-G		40	1.0	0.37	2	150
XBS203V19R-G	SMA-XG (2,000pcs/Reel)	30	2.0	0.35	3	280
XBS303V19R-G			3.0	0.36	3	385
XBS204S19R-G		40	2.0	0.49	0.2	180
XBS204V19R-G			2.0	0.46	0.1	75
XBS304S19R-G		3.0	0.47	0.3	180	
XBS206S19R-G		60	2.0	0.62	0.3	120
XBS306S19R-G	3.0		0.59	0.3	195	

Package

SMA-XG

h=2.3 MAX.



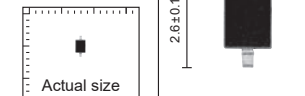
SOD-123A

h=1.25 MAX.



SOD-323A

h=1.0 MAX.



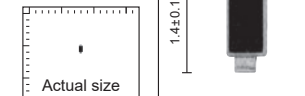
SOD-523

h=0.77 MAX.



SOD-723

h=0.65 MAX.

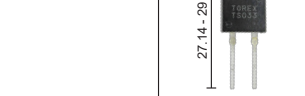


SiC Schottky Barrier Diodes

Product	Package	VR [V]	IF [A]	VF [V]	IR [mA]	Ct [pF]
NEW XBSC11A108CS	TO-220AC (1,000pcs/20Tubes)	850	10	1.5	0.002	400

TO-220AC

h=4.75 MAX.



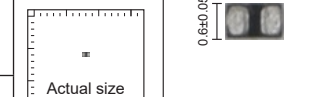
Transient Voltage Suppressors (TVS)

Product	Package	Application	Protected Lines	V _{RWM} (MAX) [V]	V _{BR} (MIN) [V]	IR (MAX) [μA]	C _j [pF]	Electrostatic discharge voltage (IEC61000-4-2)	Internal circuit
XBP06V0U25R-G	FBP1006-2A (10,000pcs/Reel)	USB3.0	1	5.0	6.0	1.0	0.35	Air : ±15kV Contact : ±15kV	
XBP06V0U2MR-G	SOT-23 (3,000pcs/Reel)	USB2.0	2	5.0	6.0	1.0	0.8	Air : ±15kV Contact : ±15kV	

Package

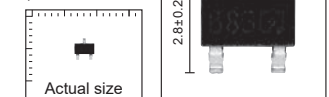
FBP1006-2A

h = 0.55 MAX.



SOT-23

h=1.3 MAX.
p=1.9



Design Support Tool : DC/DC Measured Electrical Characteristics Comparison

Web DC/DC Measured Electrical Characteristics Comparison Tool (<https://product.torexsemi.com/en/design-support/dcdc-efficiency-size-comparison>)

For those looking to select a DC/DC converter!

- You can easily compare the actual device characteristics and mounting area among products!
- You can select the optimum IC for the power supply specifications even if you are not very familiar with the products!

Point 1

There is data for various products/power supply specifications/peripheral components to allow you to check data that is close to the actual conditions.

Power supply specification selection

Topology: Step-down Step-up Inverter
 Mode: PWM/PFM or FFM PWM
 Vin: 3.6 V Vout: 1.8 V Iout: 10 mA

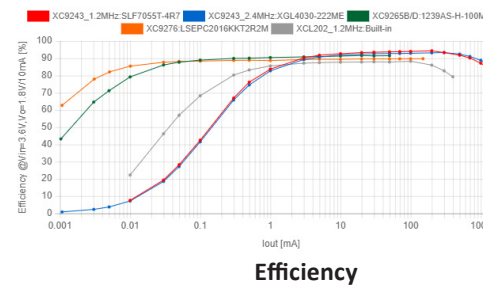
Product	Inductor	Efficiency	Total Mount Area	Iout max.	HISAT-COT
<input checked="" type="checkbox"/> XC9243_1.2MHz	SLF7055T-4R7 (4.7uH)	92.67%	90.05mm ²	2000mA	-
<input checked="" type="checkbox"/> XC9243_2.4MHz	XGL4030-222ME (2.2uH)	91.86%	55.3mm ²	2000mA	-
<input type="checkbox"/> XC9273_1.2MHz(NRND)	XAL6030-561ME (0.56uH)	91.72%	108.35mm ²	3000mA	Yes
<input checked="" type="checkbox"/> XC9265B/D	1239AS-H-100M (10uH)	91.29%	19.24mm ²	50mA	-
<input type="checkbox"/> XC9258_1.2MHz(NRND)	LTF5022T-4R7N2R0 (4.7uH)	90.98%	46.69mm ²	1000mA	Yes
<input type="checkbox"/> XC9236_1.2MHz	DFE252012F-4R7M=P2 (4.7uH)	90.52%	14.56mm ²	600mA	-
<input type="checkbox"/> XC9276	GLUHK2R201A (2.2uH)	89.81%	16.37mm ²	150mA	-
<input type="checkbox"/> XCL210B/D	Built-in Inductor	89.72%	13.74mm ²	50mA	-
<input type="checkbox"/> XC9276	DFE252010F-2R2M (2.2uH)	89.61%	19.62mm ²	150mA	-
<input type="checkbox"/> XCL222_1.2MHz(NRND)	Built-in Inductor	89.58%	13.74mm ²	500mA	Yes
<input checked="" type="checkbox"/> XC9276	LSEPC2016KKT2R2M (2.2uH)	89.41%	17.75mm ²	150mA	-
<input type="checkbox"/> XC9223/24_1MHz	DFE252012F-4R7M=P2 (4.7uH)	89.29%	27.91mm ²	1000mA	-
<input type="checkbox"/> XC9236_1.2MHz	LSXB0404TKL4R7M (4.7uH)	89.1%	33.49mm ²	600mA	-
<input type="checkbox"/> XC9223/24_1MHz	XGL4030-472ME (4.7uH)	88.95%	39.91mm ²	1000mA	-
<input type="checkbox"/> XC9276	MVTC201608S2R2M (2.2uH)	88.71%	17.75mm ²	150mA	-
<input type="checkbox"/> XC9262_1.2MHz(NRND)	LTF5022T-4R7N2R0 (4.7uH)	88.23%	45.36mm ²	1500mA	Yes
<input type="checkbox"/> XC9282_4MHz(NRND)	DFE18SAN1R0MG0L (1uH)	87.96%	5.79mm ²	600mA	Yes
<input type="checkbox"/> XCL220_3MHz(NRND)	Built-in Inductor	87.95%	13.74mm ²	1000mA	Yes
<input type="checkbox"/> XC9276	MPL2520V2R2MT0S1 (2.2uH)	87.94%	19.62mm ²	150mA	-
<input type="checkbox"/> XC9262_1.2MHz(NRND)	LTF5022T-4R7N2R0 (4.7uH)	87.75%	13.74mm ²	400mA	-
<input type="checkbox"/> XC9276	DFE18SB2R2MELL (2.2uH)	87.58%	14.37mm ²	150mA	-
<input type="checkbox"/> XC9265A/C	1239AS-H-100M (10uH)	87.54%	22.17mm ²	200mA	-
<input type="checkbox"/> XC9282_4MHz(NRND)	LSANB2016KKT1R0M (1uH)	87.47%	13.87mm ²	1500mA	Yes
<input type="checkbox"/> XC9282_6MHz(NRND)	XAL4020-221ME (0.22uH)	87.35%	78.77mm ²	3000mA	Yes
<input type="checkbox"/> XCL214_3MHz(NRND)	LSCNB1005EET4R7MB (0.47uH)	87.16%	4.58mm ²	600mA	Yes
<input type="checkbox"/> XC9236_3MHz	LSCNB1005EET1R0MB (1uH)	87.15%	4.58mm ²	600mA	Yes
<input type="checkbox"/> XC9236_3MHz	MCCC1005TR4MJN (0.47uH)	86.97%	6.04mm ²	600mA	Yes
<input type="checkbox"/> XC9236_3MHz	Built-in Inductor	86.78%	17.09mm ²	1500mA	Yes
<input type="checkbox"/> XC9236_3MHz	DFE252012F-1R5M=P2 (1.5uH)	86.75%	14.56mm ²	600mA	-
<input type="checkbox"/> XC9236_3MHz	LSCNB160HKT1R5MD (1.5uH)	86.51%	9.53mm ²	600mA	-

Select products to compare

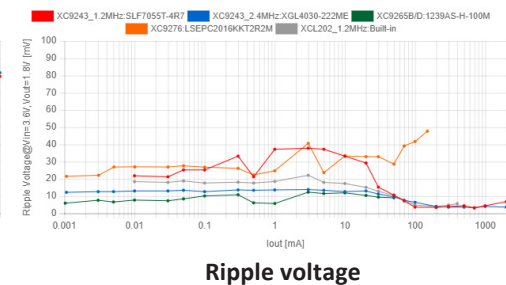
Point 2

Shows the “efficiency”, “ripple voltage”, and “load regulation” that are hard to grasp from the data sheet/simulation. Measured data available from 1μA minimum, an ideal for comparing characteristics at light loads.

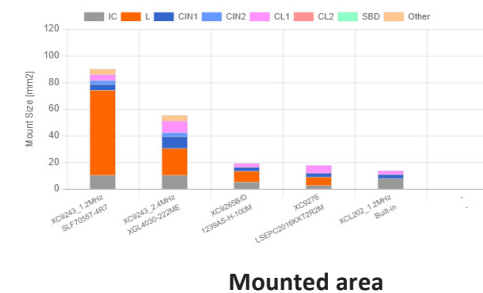
Efficiency vs Iout



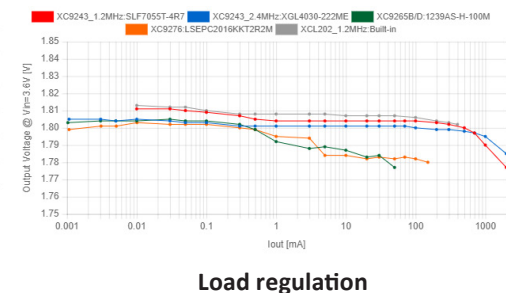
Ripple Voltage vs Iout



Total Mount Size vs Product



Vout vs Iout (Load Regulation)



Design Support Tool : DC/DC Simulation

Web DC/DC Simulation (<https://product.torexsemi.com/en/design-support/dcdc-simulation>)

For those who want to check the detailed operation of the products!

- Simulation results are displayed as soon as power supply specifications are entered.
- Helping to reduce IC selection and design man-hours.

Point 1

Junction temperature of DC/DC is calculated considering various losses/heat dissipation performance.

Product	XCL212
Switching frequency	2400 [kHz]
Control Method	PWM/PFM
Sim Condition	
Vin	5 [V] Range: 2.7V~6V
Vout	3.3 [V] Range: 0.9V~6V
Iout	100 [mA] Range: 0~2000mA
Rvin (Battery Impedance etc)	0 [Ω]
Ta	25 [°C] Range: -40~85°C
Thermal resistance: θja	55.56 [°C/W] Range: 0~1000°C/W
External Components	
CL (Effective Value)	11 [μF]
ESR	2.27 [mΩ]

Entry fields

Schematic Summary | Waveform | **Efficiency Tj, Duty** | Ripple Voltage Vin Voltage | Coil Current Input Current | Switching frequency

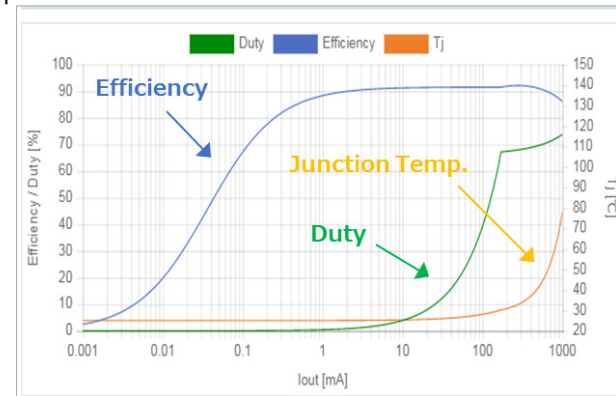
Schematic

Summary

Summary@Iout=100mA

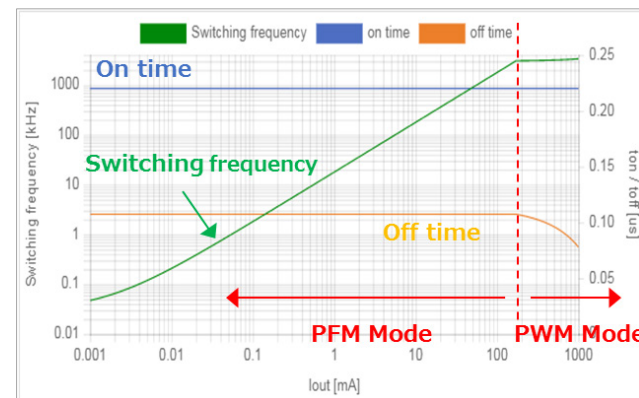
Efficiency:	91.12 [%]	IC Loss:	31.85 [mW]	Input Power:	0.3622 [W]
Inductor Loss:	16.56 [mW]	Output Power:	0.33 [W]	Vin Pin:	5 [V]
Tj:	26.77 [°C]	Input Current:	72.43 [mA]	Bottom Coil Current:	0 [mA]
Peak Coil Current:	784.5 [mA]	MODE:	PWM/PFM_DCM	On time:	0.7233 [us]
Switching frequency:	251 [kHz]	Duty:	18.16 [%]	Off time:	0.3485 [us]
Ripple Voltage:	30.65 [mV]				

Simulation results



Point 2

The frequency of PFM, which varies with input/output voltage and peripheral components, and the current at transition to PWM can be calculated. Possible to select products that do not interfere with peripherals or RF.



Point 3

Simulation with input resistance (Battery impedance) is possible. Enables calculation of the maximum output current of Step-up DC/DC, which is greatly affected by the input voltage drop cause by the input resistance.

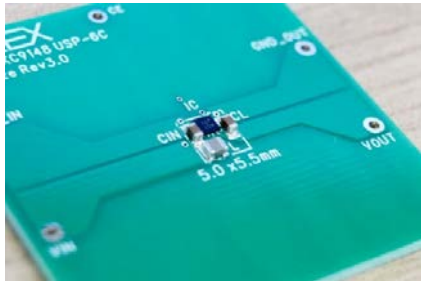
TOREX Customer Support

Free Evaluation Board support

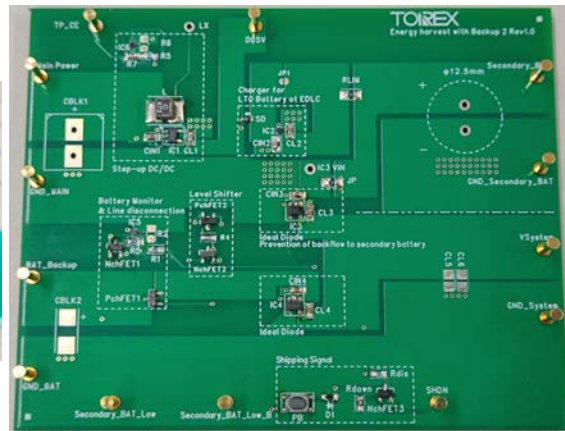
We provide [evaluation boards](#) for various ICs as [free of charge](#).

For evaluation boards, we provide “[evaluation boards optimized for power supply specifications](#)” by selecting “the most suitable IC” and “peripheral components” according to the power supply specifications.

In addition to evaluation boards for single ICs, we also provide evaluation boards for application circuits.

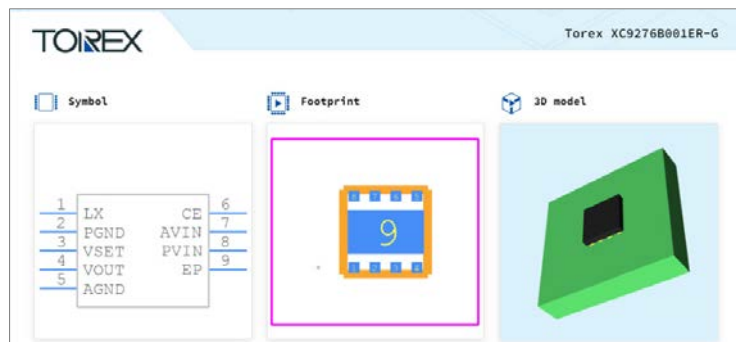


Example of evaluation board



Example of application circuit board

Provision of ECAD model and Gerber files

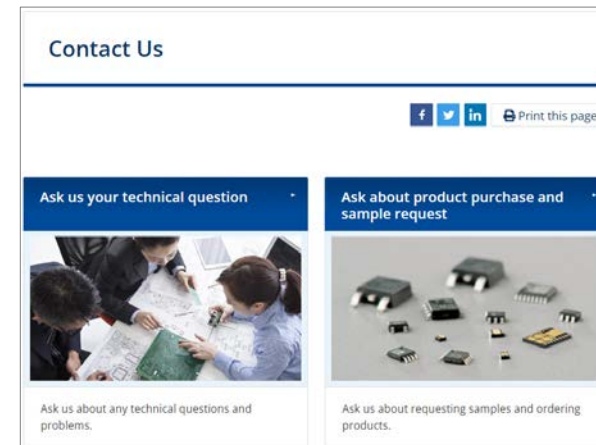


Technical Inquiries / Online Technical Consultation

For power supply IC and power supply circuit related technical consultations, please contact TOREX website “[Ask us your technical question](#)” page or the TOREX Sales Department or a sales agent.

Technical consultation with TOREX FAE is also available via online

We can also support [your individual inquiries](#) such as “[schematic verification](#)” or “[PCB layout verification](#)”.



Online Purchase of ICs and Evaluation Boards



(USA / Japan Only)

■ Design Support Tools

●Web DC/DC Simulation

From the website : “Design Tools” > “DC/DC Simulation”

URL : <https://product.torexsemi.com/en/design-support/dcdc-simulation>

●Web DC/DC Measured Electrical Characteristics Comparison Tool

From the website : “Design Tools”

> “DC/DC Measured Electrical Characteristics Comparison Tool”

URL : <https://product.torexsemi.com/en/design-support/dcdc-efficiency-size-comparison>

●Spice Model

From the website : “Design Tools” > “SPICE Model”

URL : <https://product.torexsemi.com/en/design-support#spicemodel>

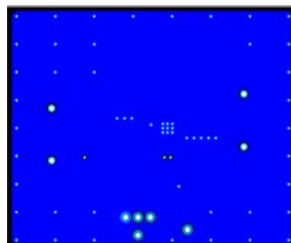
●ECAD Model

From the website : “Product Pages” > “Sample Request” → “EDA”

Part number	Sample	CE pin logic	Function	Package	EDA
	<input type="checkbox"/> in stock now	<input type="checkbox"/> CE High Active	<input type="checkbox"/> Ideal Diode function Equipped	<input type="checkbox"/> WLP-4-02 <input type="checkbox"/> SOT-25 <input type="checkbox"/> USP-6806	
XC8110AAQ10R-G	Sample Request (in stock now)	CE High Active	Ideal Diode function Equipped	WLP-4-02	
XC8110AAQ18R-G	Sample Request (in stock now)	CE High Active	Ideal Diode function Equipped	USP-6806	
XC8110AAQ1MR-G	Sample Request (in stock now)	CE High Active	Ideal Diode function Equipped	SOT-25	

●Gerber File

From the website : “Product Pages” > “Technical Document”



■ Technical Inquiries / Online Technical Consultation

From the website : “Contact Us” > “Ask us your technical question”

URL : <https://product.torexsemi.com/en/contact-us/technical-inquiry>



■ Evaluation Board Requests

From the website : “Sample and Buy” > “About applying for Evaluation Board”

URL : <https://product.torexsemi.com/en/sample-and-purchase/evaboard>

■ Technical Information / FAQ

From the website : “Technical Information”

URL : <https://product.torexsemi.com/en/technical-support>

■ Download PDF of this brochure

From the website : “Home” > “Selection Guide” > “Product Brochure Download”

URL : <https://product.torexsemi.com/en/selection-guide/catalog>

Package Lineup

Product Model No.

h=Height (mm)
p=Pin Pitch (mm)

Product Magnified View Photograph (Unit: mm)

Product Actual Size Photograph

CL-2025

h=1.04 MAX.
p=0.55

Actual size

CL-2025-02

h=1.04 MAX.
p=0.55

Actual size

CL-2025-03

h=1.04 MAX.
p=0.55

Actual size

DFN1010-4C

h=0.6 MAX.
p=0.65

Actual size

DFN1515-6A

h=0.375±0.05
p=0.5

Actual size

HSOP-8N

h=1.50 ±0.1
p=1.27

Actual size

LGA-4B01

h=0.3 MAX.
p=0.4

Actual size

LGA-6B01

h=0.3 MAX.
p=0.4

Actual size

LGA-8B01

h=0.3 MAX.
*p = 0.40,485

Actual size

MSOP-8A

h=1.22 MAX.
p=0.65

Actual size

MSOP-10

h=1.16 MAX.
p=0.5

Actual size

SOP-8FD

h=1.55±0.2
p=1.27

Actual size

SOT-223

h=1.8 MAX.
p=2.3

Actual size

SOT-23

h=1.3 MAX.
p=1.9

Actual size

SOT-25

h=1.3 MAX.
p=0.95

Actual size

SOT-26

h=1.3 MAX.
p=0.95

Actual size

SOT-26W

h=1.3 MAX.
p=0.95

Actual size

SOT-89

h=1.6 MAX.
p=1.5

Actual size

SOT-89-5

h=1.5 MAX.
p=1.5

Actual size

SSOT-24

h=1.1 MAX.
p=1.3

Actual size

TO-252

h=2.4 MAX.
p=2.29

Actual size

TSSOP-16

h=1.4 MAX.
p=0.65

Actual size

USP-3

h=0.6 MAX.
p=0.6

Actual size

USP-4/USP-4D

h=0.6 MAX.
p=0.6

Actual size

USP-6B/USP-6C

h=0.6 MAX. *(0.7 MAX)
p=0.5

Actual size

*USP-6B

USP-6B06

h=0.33 MAX.
p=0.5

Actual size

USP-6B07

h=0.33 MAX.
p=0.55

Actual size

USP-6EL

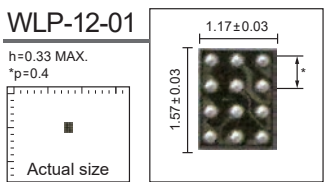
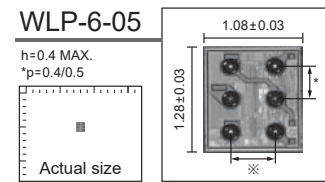
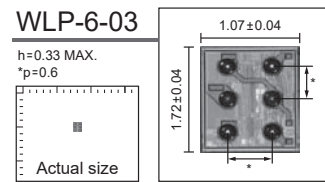
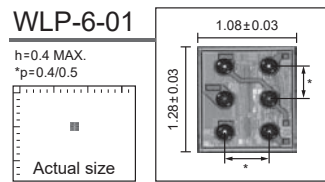
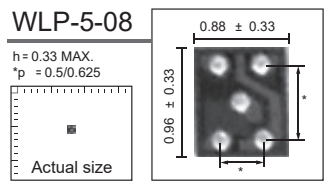
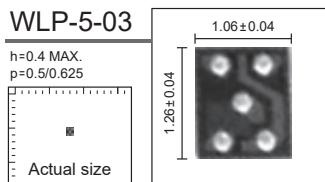
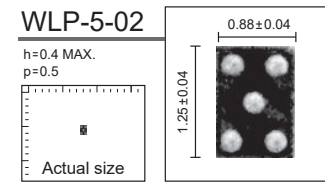
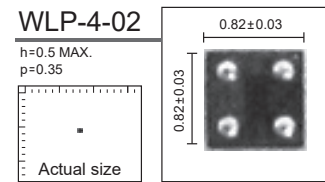
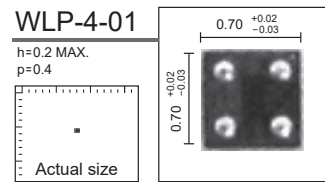
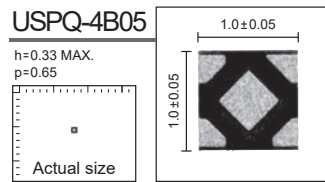
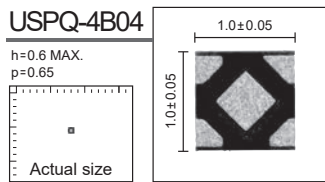
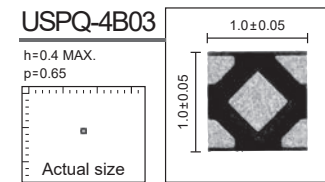
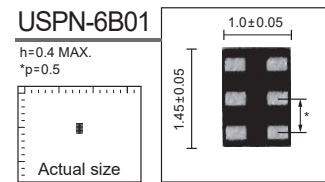
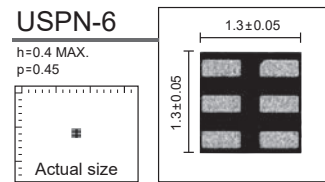
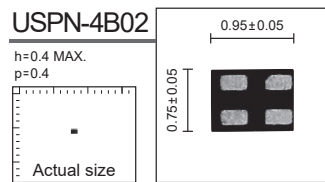
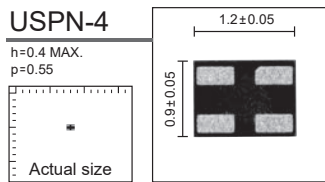
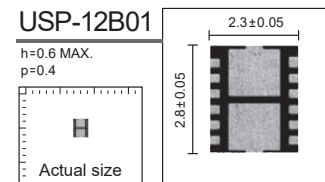
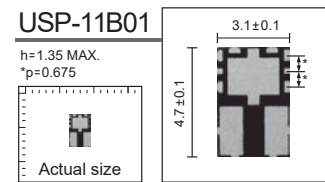
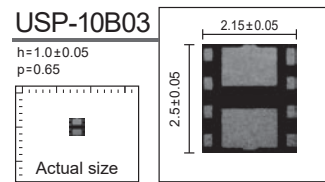
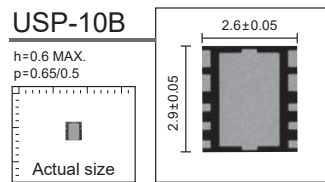
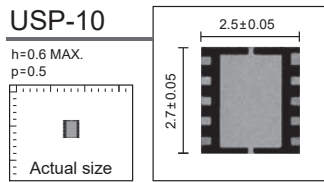
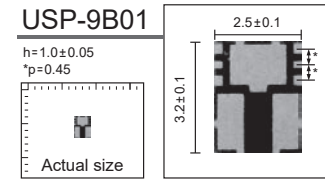
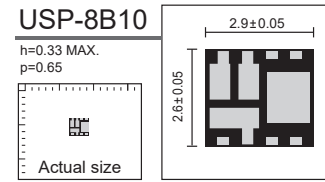
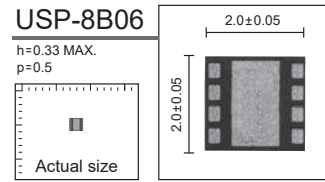
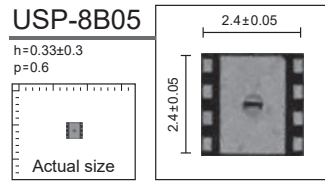
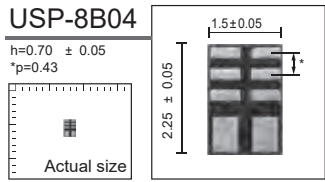
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USP-8

h=0.6 MAX.
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Actual size



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