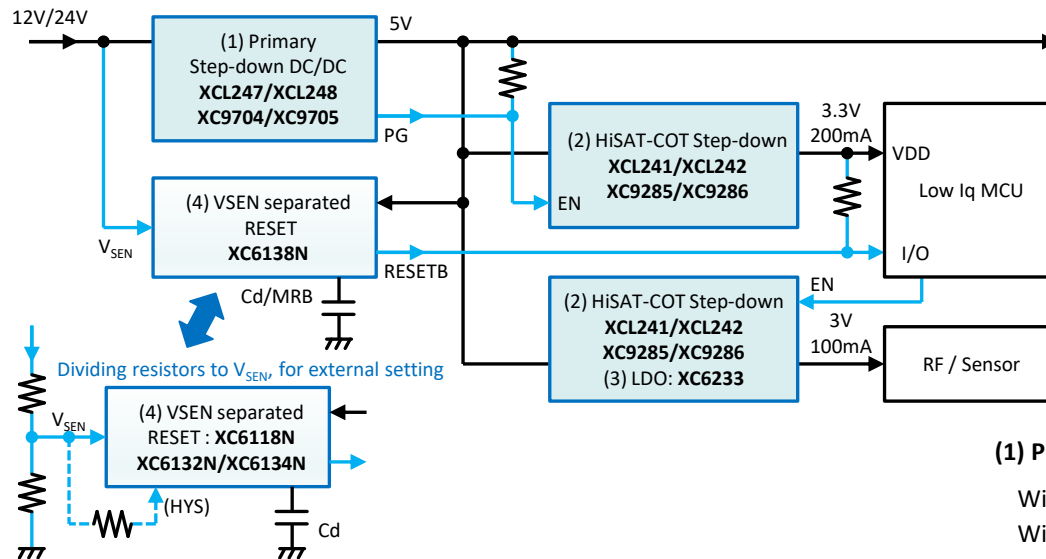


12V/24V Input : Small Solutions

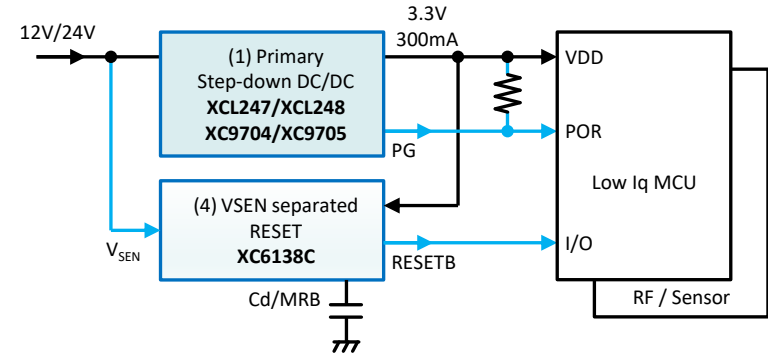
■ 12V/24V input : Small products, modules, industrial sensors, and IoT

- 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 : XCL247/XCL248

- Wide input voltage range for **fluctuating input**.
- With a **100% maximum duty ratio**, even if the input voltage drops significantly, the output voltage drop is minimized.
- Integrated inductor **saves board area** and enables device miniaturization
- High efficiency including light loads.**

(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.

Block	Product	Features
(1) Primary Step-down DC/DC	XCL247 / XCL248 FEATURED	36V, F-PWM, PWM/PFM, 1.2MHz/2.2MHz, 600mA Low Iq=11µA, Space-saving, High efficiency at light load
(2) Step-down DC/DC	XCL241 / XCL242 FEATURED	Built-in inductor, HiSAT-COT , F-PWM, PWM/PFM 1.2MHz, 500mA, Ultra-low EMI
	XC9285 / XC9286	HiSAT-COT , F-PWM, PWM/PFM 1.2MHz, 1A
(3) LDO	XC6233	High-speed PSRR=75dB, 200mA, Inrush prevention
(4) RESET IC	XC6138 FEATURED	High Voltage Sense pin: 76V, Ultra-low Iq V _{DD} : 0.5µA V _{SEN} : 0.15µA, Detect/Release Delay adj, Hysteresis: selectable
	XC6118	Separated Sense pin, Low Iq, Release Delay external adj. Others: XC6132/XC6134 , Externally adjustable hysteresis

Medium and High Voltage Input Step-down DC/DC

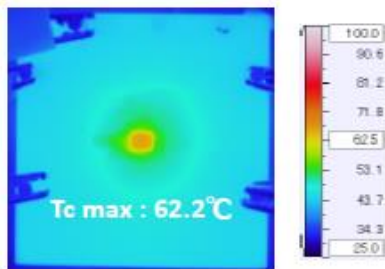
■ Step-down DC/DC for fluctuating 12V/24V and higher inputs.

● Technical trend and challenges

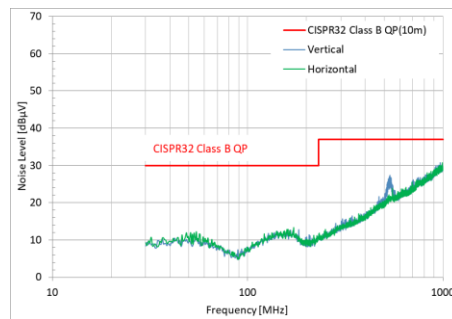
- The increased output current due to the higher functionality of devices makes the heat generated by using LDOs a problem.
- Large fluctuations in the power supply line due to impedance, load fluctuations and induction from motors, etc., must be addressed.

● TOREX Proposal : Built-in inductor Micro DC/DC that can be used like an LDO

- Built-in inductor DC/DC can be used like an LDO, and achieves high efficiency. Low EMI, low heat generation, ideal for replacing LDOs.
- **XCL249** 60V Built-in inductor step-down DC/DC that can handle voltage fluctuations such as motor operation



Surface temperature



Radiation Noise CISPR-32(10m)

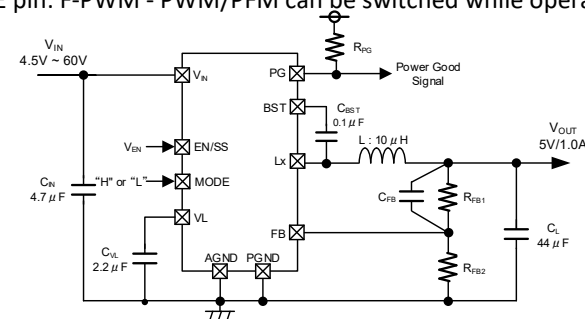
Built-in inductor step-down Micro DC/DC XCL247/XCL248 @12V→5V/600mA

■ 36V/60V Built-in inductor step-down Micro DC/DC

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package
XCL247 XCL248 FEATURED	Built-in inductor F-PWM, PWM/PFM 1.2MHz	3.0 ~ 36.0	2.8 ~ 6.0	600	DFN3030-10B (3.0x3.0x1.7mm)
XCL249 UNDER DEVELOPMENT	Built-in inductor F-PWM, PWM/PFM	4.5 ~ 60.0	2.5 ~ 6.0	150	CL-3225 (3.2x2.5x2.2mm)

● TOREX Proposal : 36V/60V Step-down DC/DC for main power supply.

- World's smallest class of low current consumption at high voltage
- Tj 150°C operation / Low ripple / High step-down ratio
- Large capacitance support (Soft-start external adj. + PG)
- MODE pin: F-PWM - PWM/PFM can be switched while operating.



Step-down DC/DC : XC9711, XC9714

■ 36V/60V Step-down DC/DC

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package
XC9704 XC9705 FEATURED	F-PWM, PWM/PFM 1.2MHz, 2.2MHz	3.0 ~ 36.0	2.8 ~ 15 2.8 ~ 18	600	SOT-89-5 (4.5x4.6x1.6mm) USP-6C (1.8x2.0x0.6mm)
XC9714 NEW	F-PWM, PWM/PFM 800kHz	4.5 ~ 36.0	2.5 ~ 18	2000	HSOP-8N (6.2x5.2x1.7mm) DFN3030-12A(3.0x3.0x0.75mm)
XC9711 NEW	F-PWM, PWM/PFM 800kHz	4.5 ~ 60.0	2.5 ~ 18	1000	HSOP-8N (6.2x5.2x1.7mm) DFN3030-12A(3.0x3.0x0.75mm)
XC9702 FEATURED	F-PWM, PWM/PFM 1MHz	4.5 ~ 60.0	2.5 ~ 12	300	HSOP-8N (6.2x5.2x1.7mm) DFN3030-12A(3.0x3.0x0.75mm) USP-10B(2.6x2.9x0.6mm)

Reset IC Application Examples

■ Monitoring of 12V/24V input lines with large voltage fluctuations

● Technical trend and challenges

- It is necessary to monitor large voltage fluctuations in the power supply line due to loads such as motors and input impedance.
Set the detect /release voltage to suit the application.

● TOREX Proposal : Reset IC with high voltage tolerance and a wide range of detect/release voltages

➤ Wide range of detect/release voltage difference (hysteresis) supported

- Separate sense pin type, monitoring 12V/24V lines.
- Select a release voltage high enough to ensure a stable rise and select a detect voltage sufficiently different from the release voltage.

XC6138, XD6138

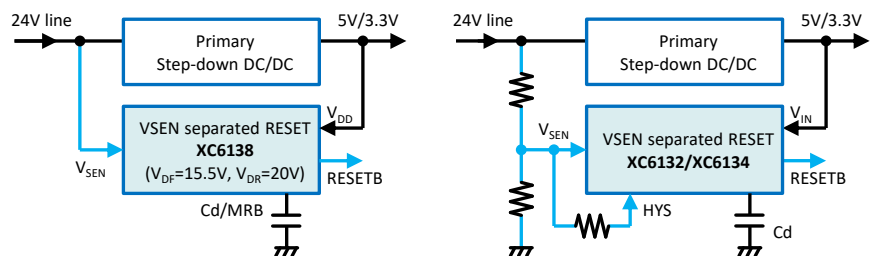
76V High voltage Sense pin

Wide hysteresis range selectable.

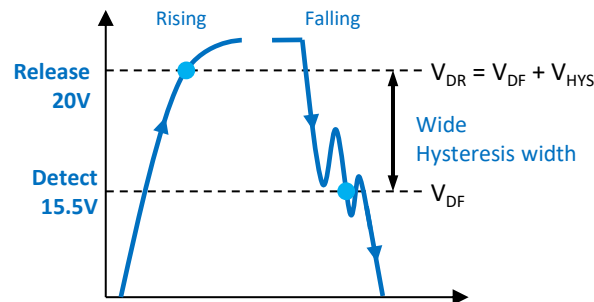
XC6132/XC6134, XD6132/XD6134

Detect and release voltages are set using external resistors.

(XC/XD6132 has V_{SEN} pin surge protection)



Example of 24V line voltage monitoring



■ USB port Overvoltage protection (OVP)

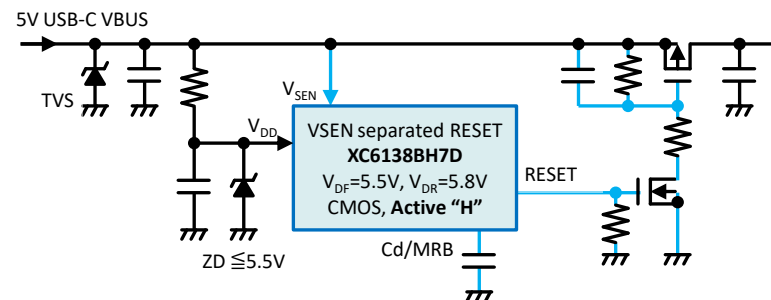
● Technical trend and challenges

- The proliferation of low-cost USB-PD adapters poses a challenge, as overshoot on 5V USB or the application of voltages exceeding specifications can damage downstream systems.

● TOREX Proposal : Overvoltage protection with a reset IC suitable for 5V USB

➤ Simple implementation with XC6138BH7D + external Pch FETs.

- XC6138BH7D** : Outputs 'L' at 5.8V, turning the Pch FET OFF
Outputs 'H' at 5.5V, turning the Pch FET ON
- TVS and each FET are selected to match the permissible input voltage.
- Apply <6V to the V_{DD} pin via ZD.
- To counter inrush current during start-up, implement a simple soft-start by adding capacitance between the gate and source of the Pch FET.



Block	Product	Features
RESET IC	XC6138 FEATURED	High Voltage Sense pin: 76V, Ultra-low $I_{q V_{DD}}$: 0.5 μ A, V_{SEN} : 0.15 μ A@12V Detect/Release Delay external adj., Selectable Hysteresis
	XC6118 XC6134	Separated Sense pin, Low I_{q} , Adj. Release delay, Hysteresis adj. (XC6134)