

Torex...Powerfully Small!

60V Step-down DC/DC Product Overview

XC9702(300mA) Series

XC9711(1.0A) Series

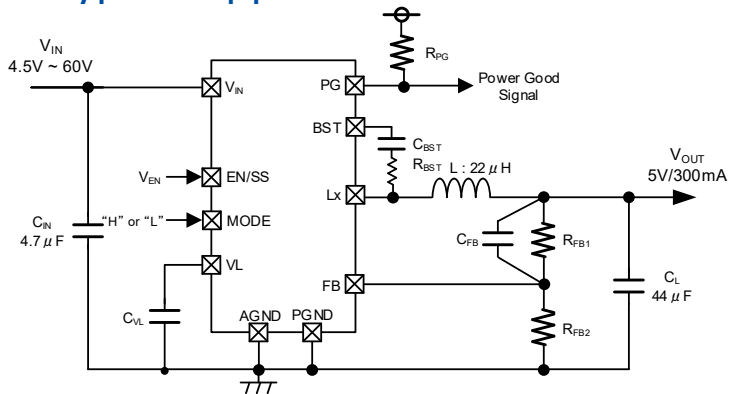
December 2025
TOREX Semiconductor
Rev. 1.3

60V Smallest solution size / Low Iq and high efficiency at light loads / Supports high step-down ratios

■ Features

- Input Voltage : 4.5V ~ 60.0V (Absolute Max. : 66.0V)
- Output Voltage Range : 2.5V ~ 12.0V (FB: 0.75V±1.5%)
- Output Current : 300mA
- Supply Current : 12µA
- Oscillation Frequency : 1.0MHz
- Efficiency : 85.5% ($V_{IN}=12V, V_{OUT}=5V, I_{OUT}=1mA$)
- Control Method : F-PWM (MODE="H")
PWM/PFM (MODE="L")
- Function : Soft-start (External Adj.)
Power Good
UVLO
- Protection : Current Limit, Over Voltage Protection
Thermal Shutdown
Lx Short Protection
- Package : HSOP-8N, USP-10B, DFN3030-12A
- Operating Ambient Temp : -40°C ~ 125°C

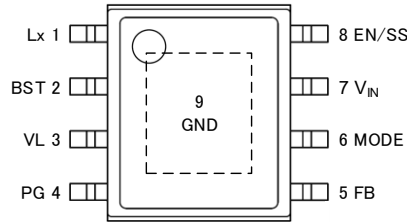
■ Typical Application Circuit



■ Package

HSOP-8N
(6.2x5.2x1.7mm)

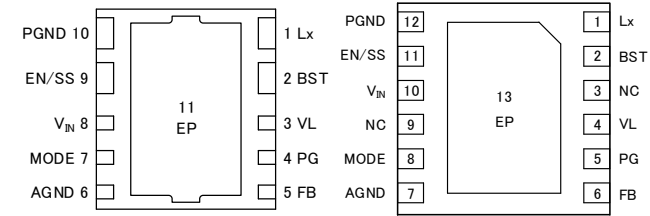
TOREX Longevity Program (TLP)



USP-10B
(2.6x2.9x0.6mm)

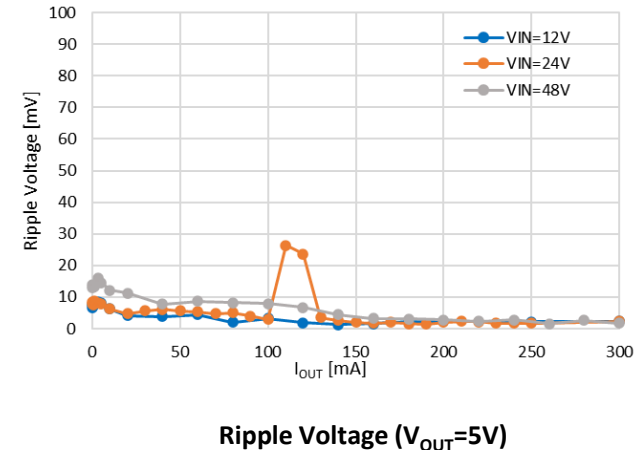
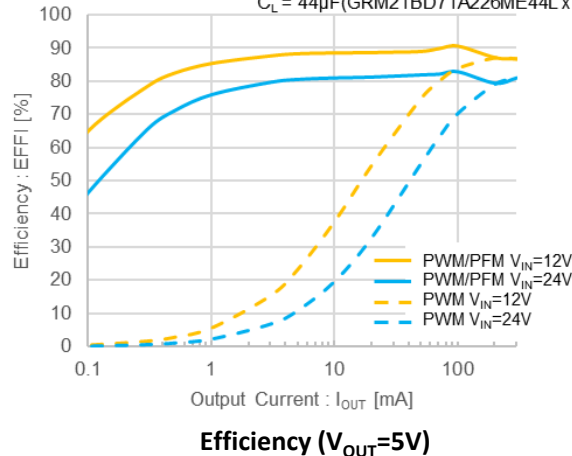
DFN3030-12A
(3.0x3.0x0.75mm)

TOREX Longevity Program (TLP)



■ High Efficiency / Low Ripple Voltage

$L = 100\mu H$ (LBXHF5050XAT101MMR)
 $C_{IN} = 4.7\mu F$ (GCM32DC72A475KE02L,
 $C_L = 44\mu F$ (GRM21BD71A226ME44L x 2)

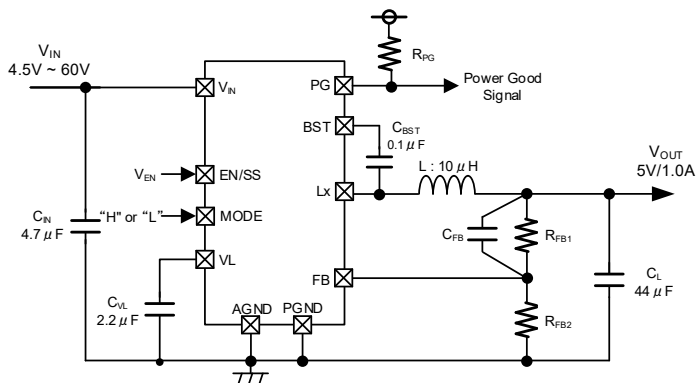


60V Smallest solution size / Low Iq and high efficiency at light loads / Supports high step-down ratios

■ Features

Input Voltage	: 4.5V ~ 60.0V (Absolute Max. : 61.5V)
Output Voltage Range	: 2.5V ~ 18.0V (FB: 0.75V±1.5%)
Output Current	: 1.0A
Supply Current	: 9μA
Oscillation Frequency	: 800kHz
Efficiency	: 85.6% (V _{IN} =12V, V _{OUT} =5V, I _{OUT} =1mA)
Control Method	: F-PWM (MODE="H") PWM/PFM (MODE="L")
Function	: Soft-start (External Adj.) Power Good UVLO
Protection	: Current Limit, Over Voltage Protection Thermal Shutdown Lx Short Protection
Package	: HSOP-8N, DFN3030-12A
Operating Ambient Temp	: -40°C ~ 125°C

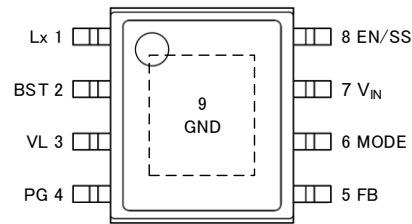
■ Typical Application Circuit



■ Package

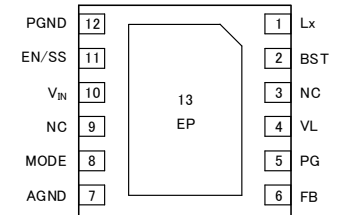
HSOP-8N
(6.2x5.2x1.7mm)

TOREX Longevity
Program (TLP)

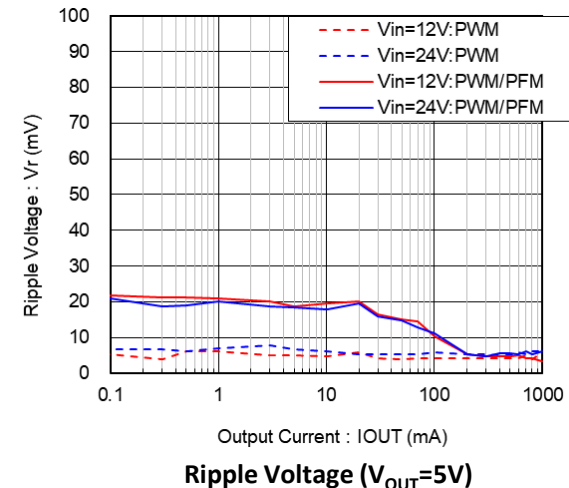
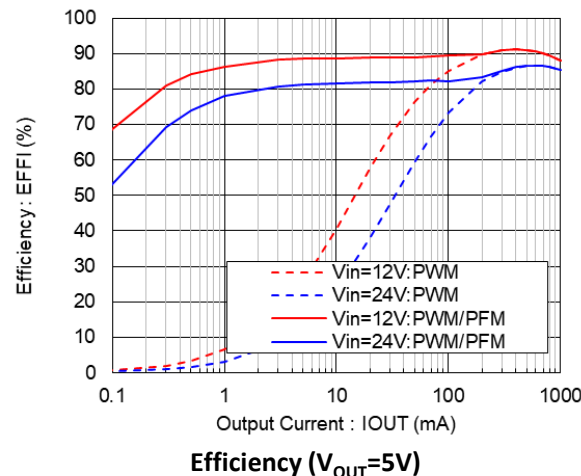


DFN3030-12A
(3.0x3.0x0.75mm)

TOREX Longevity
Program (TLP)



■ High Efficiency / Low Ripple Voltage



60V High voltage Step-down DC/DC convertor : Lineup

	XC9702	XC9711
V_{IN}	4.5V to 60.0V (Abs.66.0V)	4.5V to 60.0V (Abs.61.5V)
V_{OUT}	2.5V to 12.0V	2.5V to 18.0V
I_{OUT}	300mA	1A
Fosc	1MHz	800kHz
Control Method	F-PWM (MODE="H") PWM/PFM (MODE="L")	
Topr	-40 to 125°C	
Protection	Current Limit, Over Voltage Protection Thermal Shutdown, Lx Short Protection	
Function	Soft-start (External Adj.), Power Good, UVLO	
Packages	DFN3030-12A(3.0x3.0x0.75mm) HSOP-8N(6.2x5.2x1.6mm) USP-10B(2.6x2.9x0.6mm)	DFN3030-12A(3.0x3.0x0.75mm) HSOP-8N(6.2x5.2x1.6mm)
Circuit	<p>※MODEの番号によって、外付け部品が異なります。</p>	
Solution Size		

60V High voltage Step-down DC/DC convertor

- High voltage step-down DC/DC converter to meet requirements for compact and low Iq step-down from 12V/24V line

60V High voltage Step-down DC/DC XC9702/XC9711

XC9702

Ultra-small and low Iq

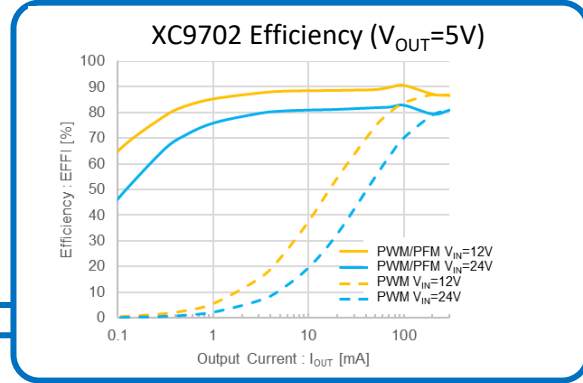
①

②

For FA / Industrial Products

① Ultra-small / High efficiency at light load

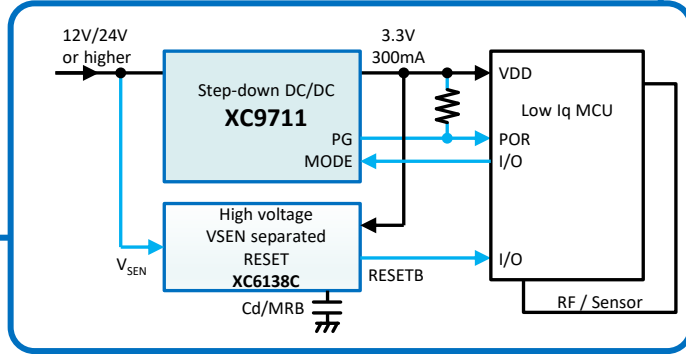
- ✓ 60V Smallest Class Solution Size
- ✓ For low consumption in standby
- ✓ Solving the heat problem of medium and high voltage input LDOs by replacing them with a smaller area.



② High voltage / Low ripple / High temp.

“60V input”, “High step-down ratio”, “+125°C operation”, “MODE(PWM↔PWM/PFM)” (XC9711)

- ✓ Low ripple 3.3V/5V output from unstable 24V input to FA/sensors
- ✓ Handling input overshoots and high temperatures

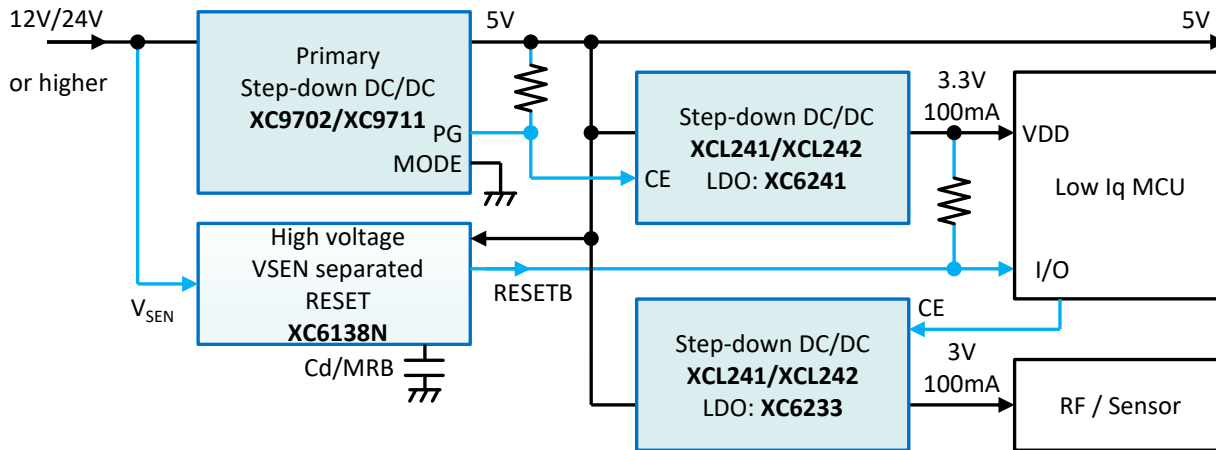


Ideal for miniaturization / heat reduction due to high voltage / small size / low Iq.
 Also suitable for replacing conventional high-voltage LDOs.
 ➤ Sensors and security for Factories / Buildings / Facilities, etc.

In addition, 125°C operating temperature and 24V line overshooting
 ➤ Suitable for various FA sensors

■ Various small devices and modules with 12V/24V or higher input : Industrial sensors / IoT

- Once step-down to 5V, then generate 3.3V

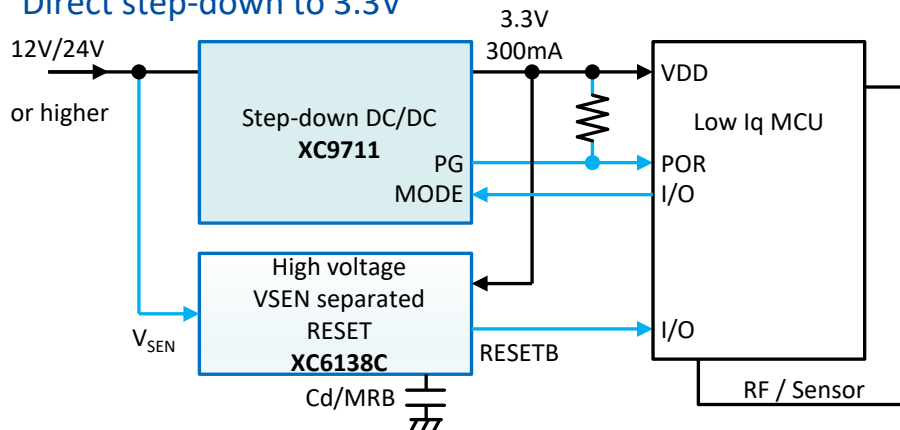


Supplies power to MCUs, sensors, etc., by stepping down from 12V/24V or higher to 5V, and then stepping down to 3.3V, 3.0V, etc.

Controls the sequence of the subsequent power supply with the PG of the XC9702.
 MODE "H" ⇒ PWM
 MODE "L" ⇒ PWM/PFM

Supervises 12V/24V power voltage with XC6138N and monitor output to MCU.

- Direct step-down to 3.3V



Direct step-down from 12V/24V to 3.3V.
 Power source for small sensors used in FA.

Control method can be changed dynamically with the MODE pin. (XC9711 Only)

MODE "H" : PWM ⇒ Low noise (For sensors, etc.)
 MODE "L" : PWM/PFM ⇒ High efficiency at light load

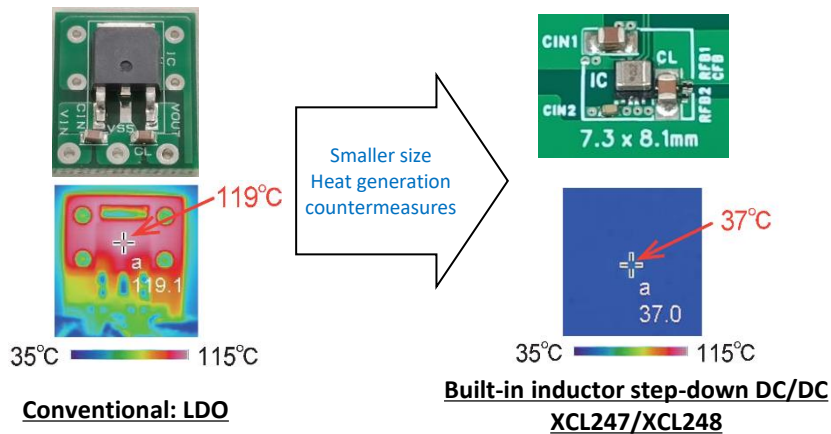
Step-down DC/DC for fluctuating 12V/24V and higher inputs.

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 : Small step-down 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 heat generation, ideal for replacing LDOs.
- XCL249** 60V Built-in inductor step-down DC/DC that can handle voltage fluctuations such as motor operation

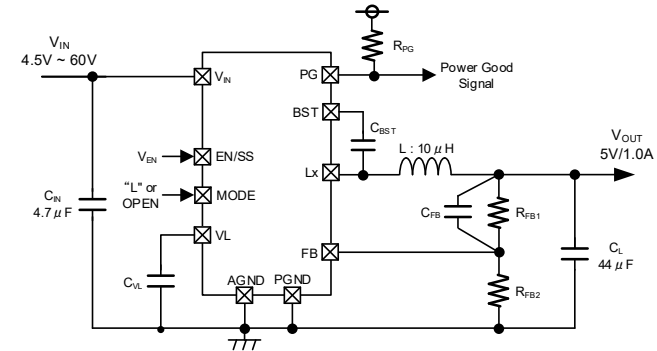


36V/60V Built-in inductor step-down DC/DCs and Step-down DC/DCs

Product	Features	V _{IN} (V)	V _{OUT} (V)	I _{OUT} (mA)	Package
XC9704 XC9705	F-PWM, PWM/PFM 1.2MHz, 2.4MHz	3.0 ~ 36.0	2.8 ~ 15 2.8 ~ 18	600	SOT-89-5 (4.5x4.6x1.6mm) USP-6C (1.8x2.0x0.6mm)
XCL247 XCL248	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 <small>UNDER DEVELOPMENT</small>	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
- T_j 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
XC9714 <small>UNDER DEVELOPMENT</small>	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	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	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)

■ 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

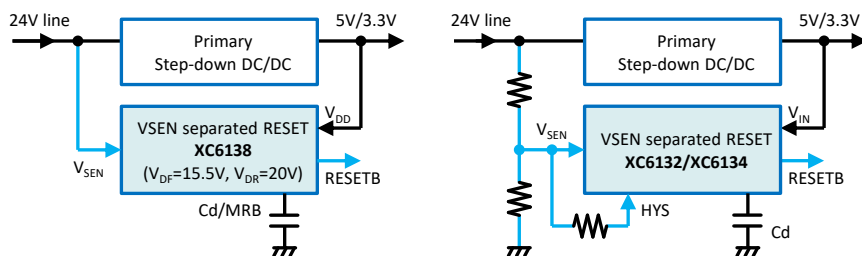
76V High voltage Sense pin

Wide hysteresis range selectable.

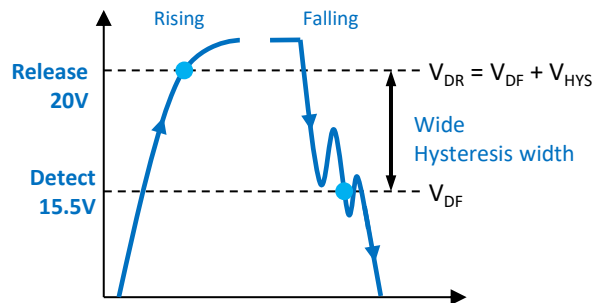
XC6132/XC6134

Detect and release voltages are set using external resistors.

(XC6132 has V_{SEN} pin surge protection)



Example of 24V line voltage monitoring



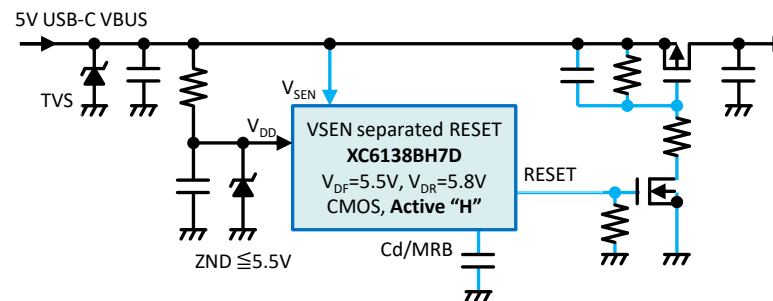
■ USB port Overvoltage protection (OVP)

● Technical trend and challenges

- 5V USB overshoot is an issue due to the spread of low-cost USB-PD adapters.

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

➢ Simple implementation with XC6138BH7D + external FETs.



■ Simple MPPT using an ultra-low Iq reset IC and a step-up DC/DC

● Technical trend and challenges

- ON/OFF control of step-up DC/DC in response to changes in input voltage is important for energy harvesting and backup power supply from EDLC.

● TOREX Proposal : Input voltage monitoring using an ultra-low Iq reset IC

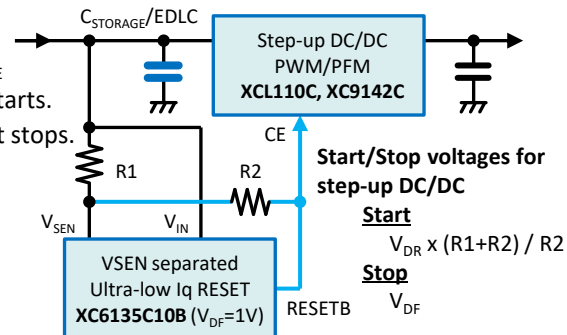
➢ Creating hysteresis with XC6135 + resistors

● Energy Harvesting

When voltage of $C_{STORAGE}$ rises enough, boosting starts. When the voltage falls, it stops.

● EDLC for backup

When the EDLC voltage rises enough, backup supply starts. When the voltage falls, it stops.



Application circuit1 : Voltage inverting using step-down DC/DC

■ Voltage inverting using step-down DC/DC

To obtain an inexpensive inverting voltage using step-down DC/DC.
To generate an inverting voltage of -2.5V~-18V from 5V/12V/24V.

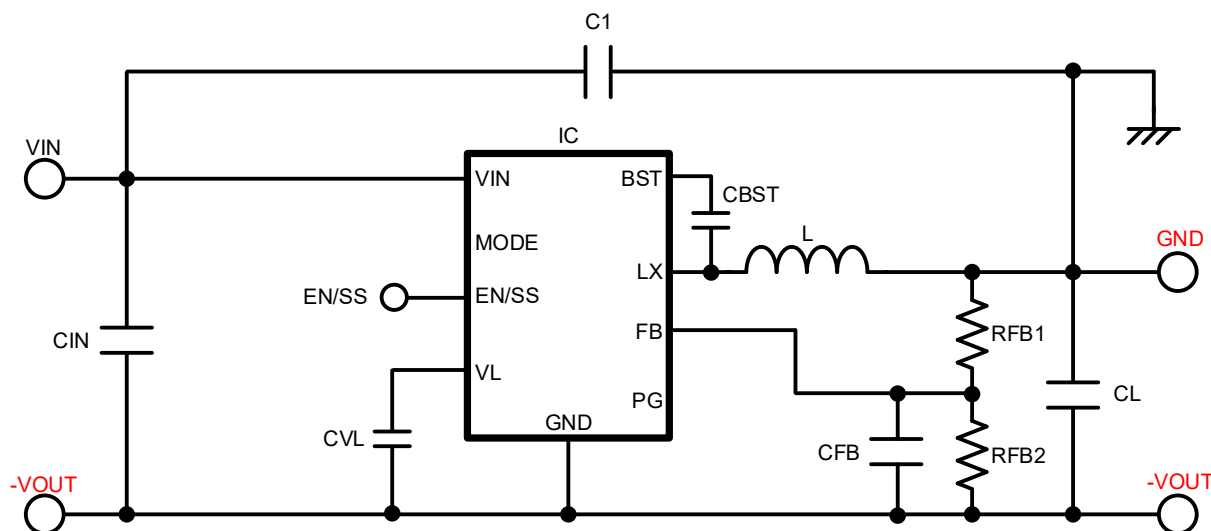
● Applications

- Various negative power supplies (OP amp/measuring amplifiers $\pm 12V$ etc.)
- Gate drive bias (floating power supply / negative power supply)

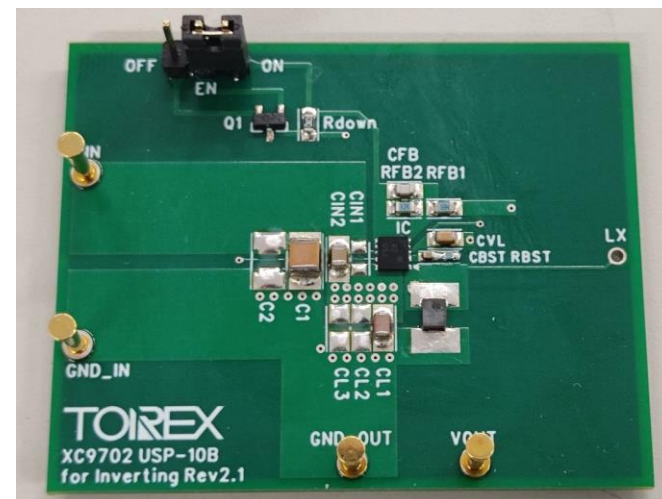
■ Example specifications

Input Voltage	: 4.5V ~ 60.0V + V_{OUT}
Output Voltage	: -2.5V ~ -18.0V
Output Current	: XC9702 Max. 50mA ~ 100mA XC9711 Max. 200mA ~ 500mA
Features	: Inverting voltage generation using step-down DC/DC Small size solution

■ Typical Application Circuit



■ Evaluation Board



Application circuit2-1 : Multi-channel isolated power supplies using transformers

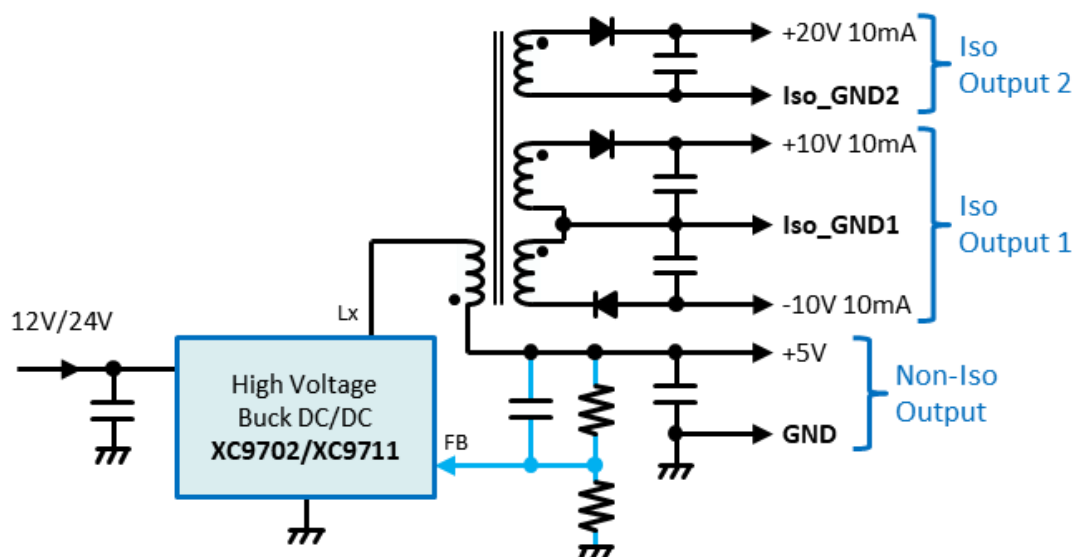
Multi-channel isolated power supplies using transformers

To obtain an inexpensive isolated power supplies using transformers.
Ideal for Multi-channel Small, Isolated Power Supply Designs.
Applicable to Floating, Inverting, and Similar Configurations.

Applications

- Isolated power supply
- Various negative power supplies (OP amp/measuring amplifiers $\pm 12V$, $\pm 15V$, etc.)
- Gate drive bias (floating power supply / negative power supply)

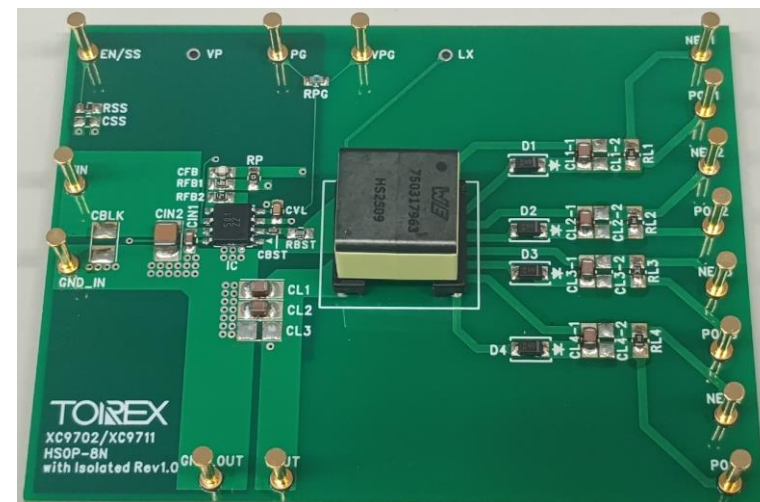
Typical Application Circuit



Example specifications

Input Voltage	: 4.5V ~ 60.0V
Output Voltage 1	: 2.5V ~ 18.0V
Output Voltage 2~	: 5V/12V/15V etc
	*depending on the winding ratio
Output Current 1	: XC9702 Max 100mA ~ 200mA XC9711 Max 400mA ~ 800mA
Output Current 2~	: XC9702 Max 10mA ~ 20mA XC9711 Max 20mA ~ 50mA
Features	: Floating voltage available. Multi-channel are possible by transformers.

Evaluation Board



Application circuit2-2 : Multi-channel isolated power supplies using couple inductors

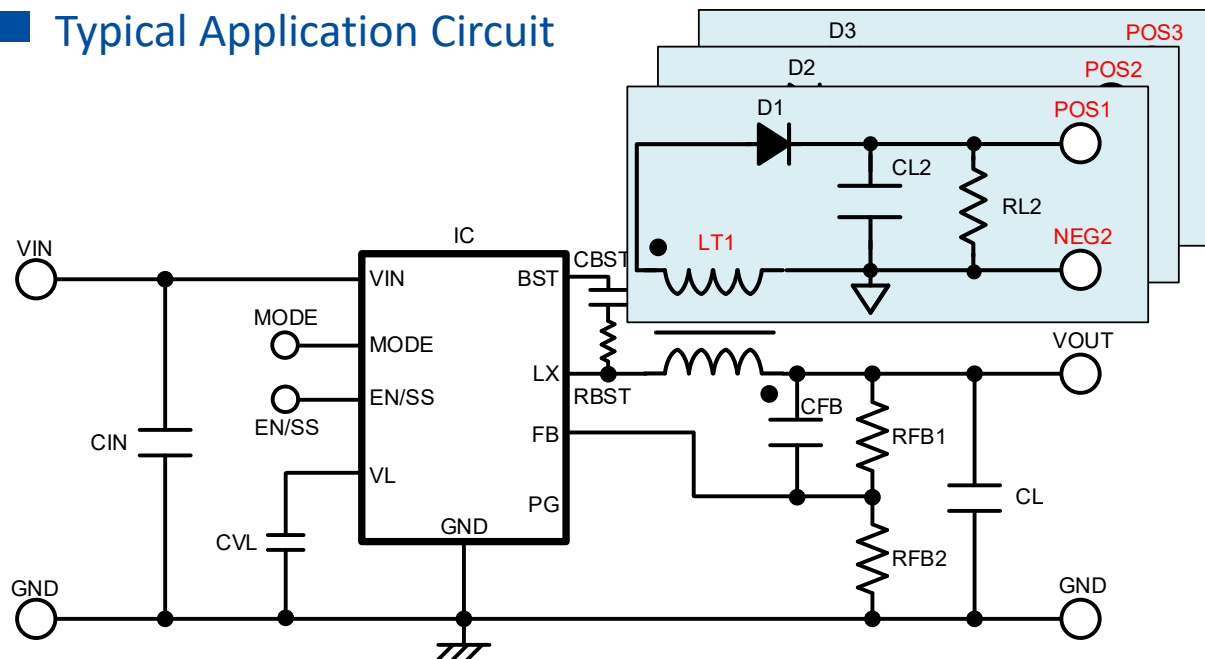
Multi-channel isolated power supplies using couple inductors

To obtain an inexpensive isolated power supplies using couple inductors.
Ideal for Small, Isolated Power Supply Designs.
Applicable to Floating and Inverting Configurations.

Applications

- Isolated power supply
- Various negative power supplies (OP amp/measuring amplifiers $\pm 12V$, $\pm 15V$, etc.)
- Gate drive bias (floating power supply / negative power supply)
* For 3-phase motor drive, etc

Typical Application Circuit



Example specifications

Input Voltage	: 4.5V ~ 60.0V
Output Voltage 1	: 2.5V ~ 18.0V
Output Voltage 2~	: 5V/12V/15V etc *depending on the winding ratio
Output Current 1	: XC9702 Max 100mA ~ 200mA XC9711 Max 400mA ~ 800mA
Output Current 2~	: XC9702 Max 10mA ~ 20mA XC9711 Max 20mA ~ 50mA
Features	: Floating voltage available. Low Cost.

Evaluation Board

