TOREX

Torex...Powerfully Small!

Highly functionality
1.4A Step-up DC/DC Converters
XC9147 / XC9148 Series Product Overview
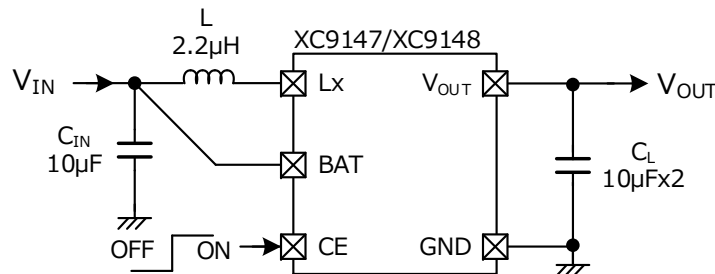
May 2023

TOREX Semiconductor

Rev. 1.0

XC9147/XC9148 : Highly functionality, 1.4A Step-up DC/DC Converters

TOREX

Large output current with 3MHz tiny size, Load Disconnection / Bypass / OR connection Selectable
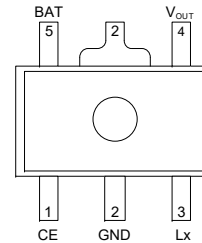
■ Features

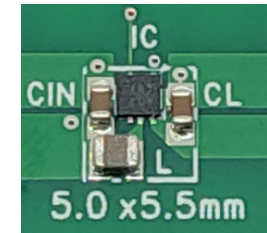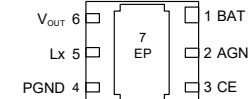|	
Input Voltage Range	: 0.65V ~ 6.0V (Absolute Max. : 7.0V)
Operation start voltage	: 0.9V
Fixed Output Voltage	: 1.8V ~ 5.5V (Accuracy:±2.0%)
Output Current	: 750mA @V_{OUT}=5.0V, V_{BAT}=3.3V
	500mA @V_{OUT}=3.3V, V_{BAT}=1.8V
Supply Current	: 19μA (1.2MHz)
Oscillation Frequency	: 1.2MHz, 3.0MHz
Control Mode Selection	: F-PWM (XC9147), PWM/PFM (XC9148)
Type	: Load Disconnection (A/D/G/J types)
	Bypass Mode (XC9148B/E/H/K types)
	OR connection (XC9148 C/F/M/L types)
	C_L Discharge (A/D/G/J types)
Function	: ON/OFF, Soft-start
	UVLO (G/H/M/J/K/L types)
Protection	: Current limit, Thermal shutdown
	Integral latch & Short protection (D/E/F/J/K/L types)
Packages	: USP-6C, SOT-89-5
Operating Ambient Temp.	: -40°C ~ 105°C

■ Typical Application Circuit

L 2.2μH

XC9147/XC9148

V_{IN}

C_{IN} 10μF

Lx

V_{OUT}

BAT

CE

GND

V_{OUT}

C_L 10μFx2

OFF ON

■ Packages

SOT-89-5
(4.5x4.6x1.6mm)

BAT 5   2 V_{OUT} 4

1 CE   2 GND   3 Lx

USP-6C
(1.8x2.0x0.6mm)

V_{OUT} 6   1 BAT
Lx 5   7 EP   2 AGND
PGND 4   3 CE

IC
CIN   CL
L
5.0 x5.5mm

■ TYPICAL CHARACTERISTICS: EFFICIENCY

$V_{OUT(T)}$=3.3V, f_{OSC}=1.2MHz

L = 4.7μH(XGL3530-472ME)
C_{IN} = 10μF(GRM188D71A106MA73)
C_L = 30μF(GRM188D71A106MA73 x3)

Efficiency : EFFI [%]

XC9147 V_{BAT}=0.9V	
XC9147 V_{BAT}=1.2V	
XC9147 V_{BAT}=1.8V	
XC9147 V_{BAT}=2.5V	
XC9148 V_{BAT}=0.9V	
XC9148 V_{BAT}=1.2V	
XC9148 V_{BAT}=1.8V	
XC9148 V_{BAT}=2.5V	

Output Current : I_{OUT} [mA]

XC9147/XC9148: Overview / Features
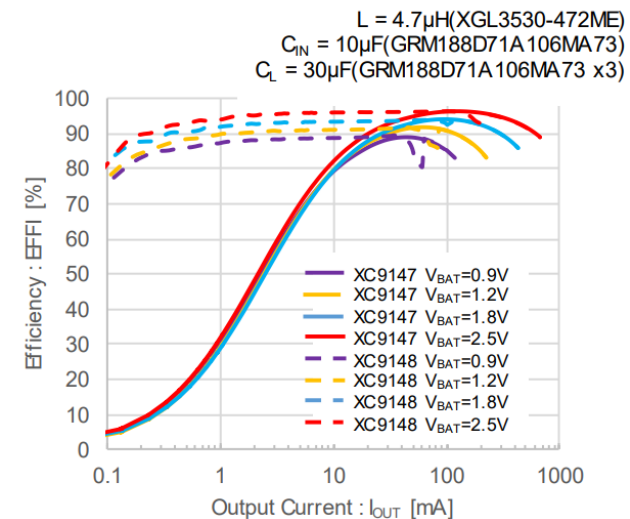
■ Step-up DC/DC to achieve low power consumption of MCUs and high performance of IoT devices.

**New generation
Step-up DC/DC
XC9147 : PWM
XC9148 : PWM/PFM**

IC
CIN   CL
L
5.0 x5.5mm

Significant improvements

XC9147 / XC9148 ①
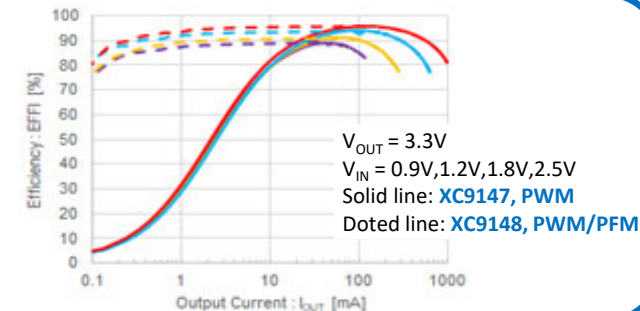
Support for low consumption MCUs

②

XC9148

③
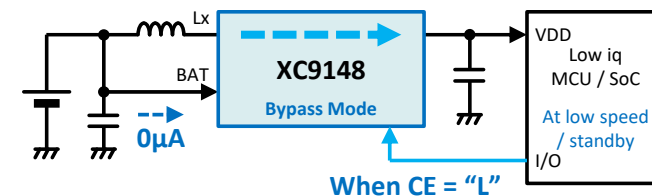
For Backup

① To achieve **higher performance** in IoT devices.

✓ 1.5 times higher output current than conventional model.
✓ Wider operating temperature range.
✓ Enhanced various protection circuits.

V_{OUT} = 3.3V
V_{IN} = 0.9V,1.2V,1.8V,2.5V
Solid line: **XC9147, PWM**
Doted line: **XC9148, PWM/PFM**

② **For lower power consumption of MCUs and SoCs**

"Bypass type"

✓ Significantly reduced total power consumption.
✓ Achieving long battery life.

Lx
BAT
**XC9148
Bypass Mode**
0μA
VDD
Low iq
MCU / SoC
At low speed / standby
I/O
When CE = "L"

③ **For Backup Power Supply** in various devices.

VOUT "OR" type

✓ Almost 0 μA in standby mode.
✓ Long battery life for backup batteries.

Main Power= 3.3V   SBD
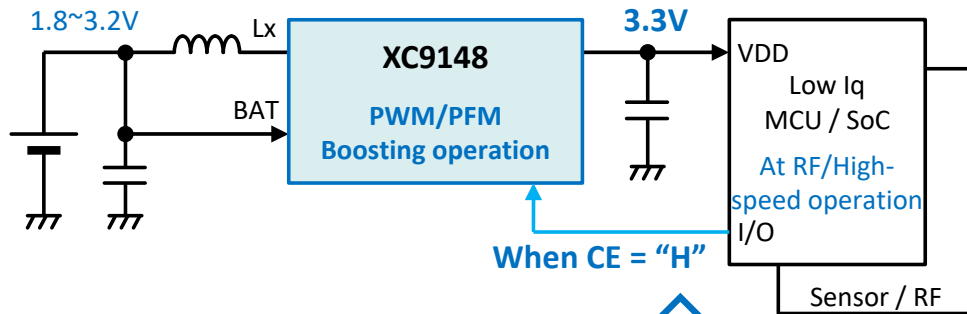VDD
MCU / SoC
Only
0.1μA
Lx
BAT
**XC9148
Boosting operation stopped**
V_{OUT}
Battery For Backup
When V_{OUT} voltage is given.
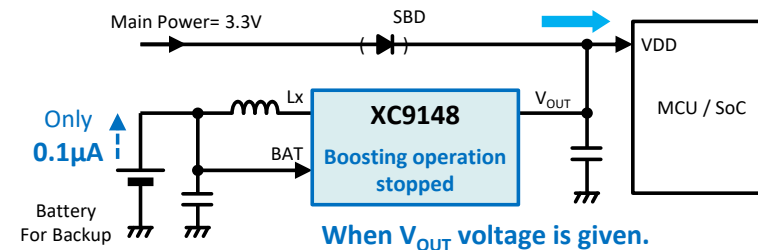
The two types, "Bypass" and "VOUT OR", contribute to long battery life, as well as high performance.
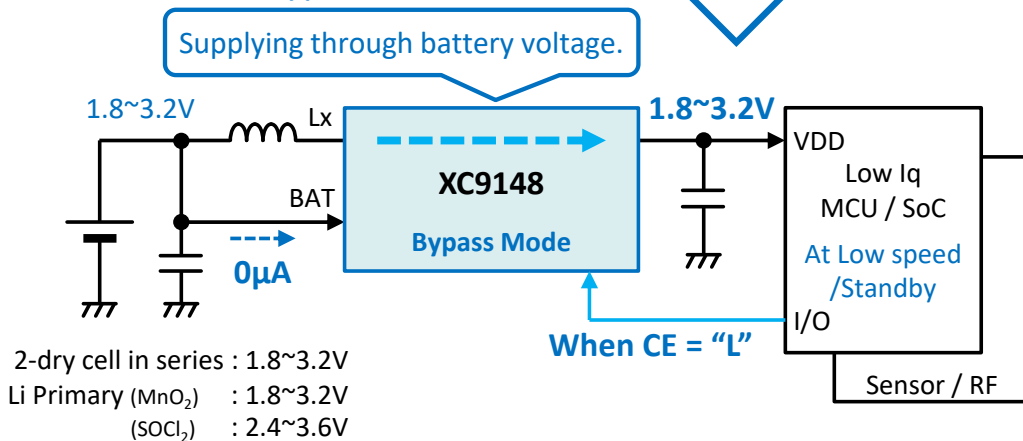
XC9148: Bypass type Application circuits

② Bypass mode control by MCU/SoC for low power consumption

■ XC9148 Bypass type operation

a. CE = "H" : Step-up operation

1.8~3.2V Lx **XC9148** 3.3V
BAT **PWM/PFM Boosting operation**

VDD
Low Iq
MCU / SoC
At RF/High-speed operation
I/O

When CE = "H"

Sensor / RF

b. CE = "L" : Bypass Mode

Supplying through battery voltage.

1.8~3.2V Lx **XC9148** 1.8~3.2V
BAT **Bypass Mode**
0µA

VDD
Low Iq
MCU / SoC
At Low speed /Standby
I/O

When CE = "L"

Sensor / RF

2-dry cell in series : 1.8~3.2V
Li Primary (MnO_2) : 1.8~3.2V
$(SOCl_2)$: 2.4~3.6V

■ Power requirements for low power MCU/SoC

a. RF/High-speed operation : Stable voltage, e.g. 3.3 V

b. Low speed/Standby :
Acceptable at low voltages, e.g. 1.8~2.4 V
This period is major for IoT equipment

Boosting the voltage only during the "a." period ensures low consumption by supplying battery energy without waste.

■ Features of XC9148 Bypass type

a. Boosting : High efficiency with PWM/PFM operation.

b. Bypass mode : Supplying through battery voltage.

XC9148 bypass mode with no voltage loss and no current consumption, 0 µA.

→ **Approximately twice the battery life**
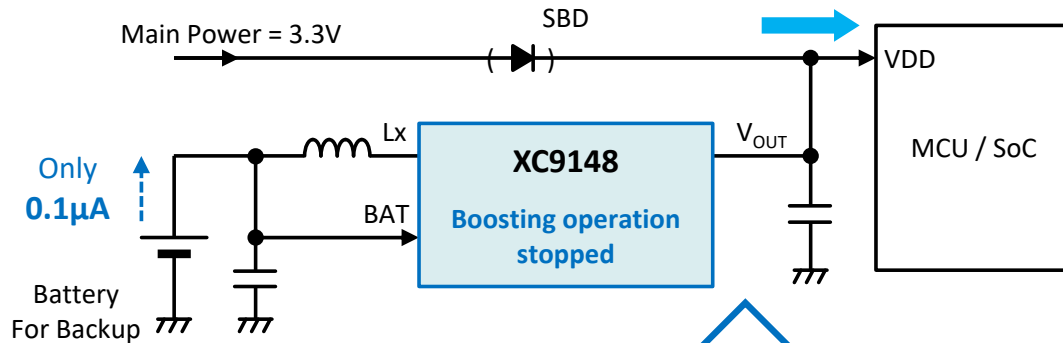in a typical IoT device.
※ Sleep 5µA⇔ Active 5mA/Duty0.1%⇔RF100mA/Duty 0.01%

Switch between **"Bypass mode"** and **"Boost operation"** by controlling the CE pin from the MCU.
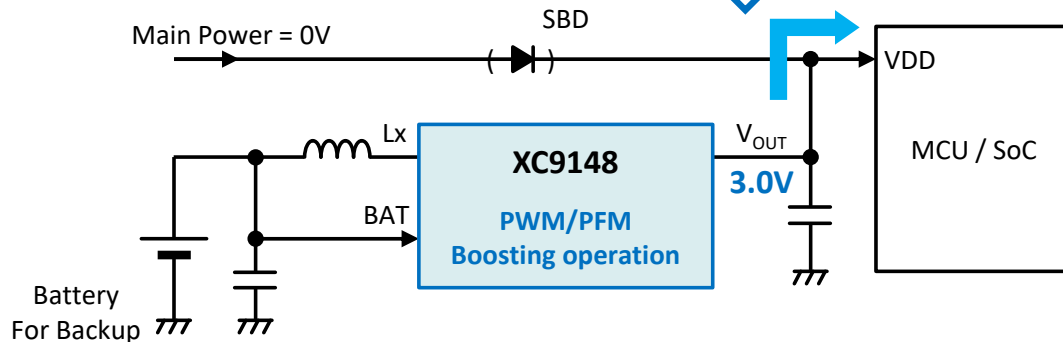
XC9148: VOUT "OR" type Application circuits

③ Backup circuit with Primary battery / Rechargeable battery / Super Cap (EDLC)

■ XC9148 VOUT "OR" type operation

a. Mains power supplied / Backup on standby

Main Power = 3.3V
SBD
VDD
MCU / SoC
Lx
XC9148
Boosting operation stopped
V_{OUT}
BAT
Only **0.1μA**
Battery For Backup

b. When supplied from Backup

Main Power = 0V
SBD
VDD
MCU / SoC
Lx
XC9148
PWM/PFM Boosting operation
V_{OUT}
3.0V
BAT
Battery For Backup

When the mains power falls, **boost operation starts automatically**.
The voltage supplied from the backup source to the MCU can be supplied without any drop in voltage.

■ Requests for backup circuits

a. No power should be consumed from the backup source when mains power is supplied

b. Starts boosting immediately when the mains power supply drops.

➢ Backup sources are,

Li Primary Batteries
LTO Batteries, High reliability Rechargeable batteries
(Semi-solid-state/All-solid-state batteries)
Super Cap (EDLC)

■ Features of XC9148 VOUT "OR" type

a. Current consumption from the backup battery when the backup is on standby is **only 0.1 μA**.

b. When the output voltage falls below a set value, boost operation is immediately activated, and power is supplied from a backup source. No external control is required.

Select from the line-up below according to your purpose.

IC	Type	Purpose	Input to Output (at CE=L)	Latch	C$_L$ Discharge	UVLO	Reference page for usage examples
XC9147 / XC9148	A	Load Disconnection	Disconnect		✓		• Power is supplied only during the post-stage operation.
	D			✓	✓		
	G				✓	✓	
	J			✓	✓	✓	
XC9148	B	Bypass	Bypass				• Supporting low Iq MCU • Reduction of power consumption at receiving of RF communication
	E			✓			
	H					✓	
	K			✓		✓	
	C	VOUT "OR"	Disconnect				• Backup power supply
	F			✓			
	M					✓	
	L			✓		✓	

Options

● **Current Limit / Short Protection**

  ✓ Current Limit : Monitors and limits the current of the Nch FETs at Lx pin. Combined type with current limit and latch-stop also available.

  ✓ Short Protection : Types with latch-stop function also stop and latch when the short-circuit protection threshold voltage is reached in an overcurrent condition.

● **C$_L$ Discharge**

  ✓ The Nch FET connected between the V$_{OUT}$ and GND enables high-speed discharge from the CL capacitor when shutting down (CE= "L").

  ✓ Prevents malfunctions of the subsequent system due to the remaining voltage in the CL capacitor during shutdown.

● **UVLO**

  ✓ Function for 2-cell dry cell batteries and primary lithium batteries to reduce the risk of battery liquid leakage by stopping the IC operation when the battery voltage drops. (UVLO release/detection = 1.6 V/1.45 V).