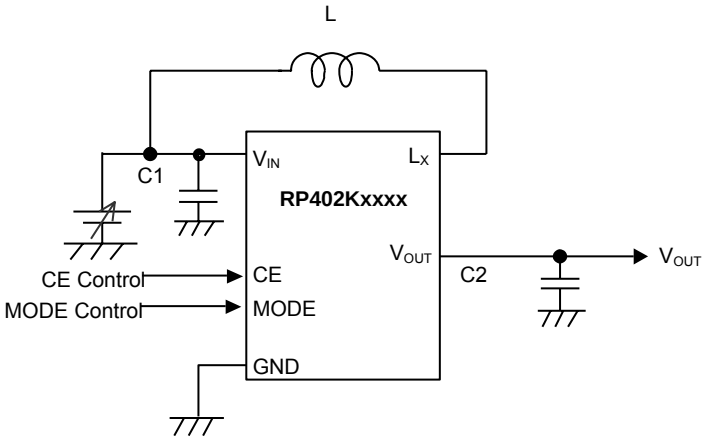
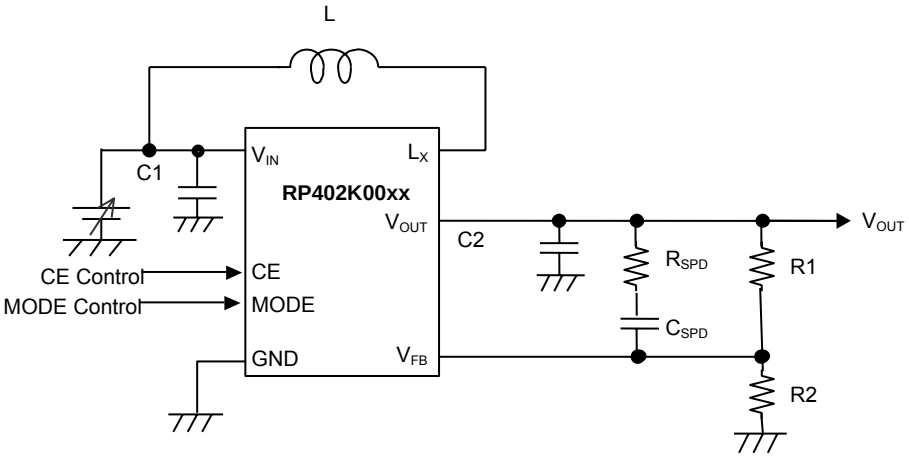
Design Guide

NO.JD-317-140221

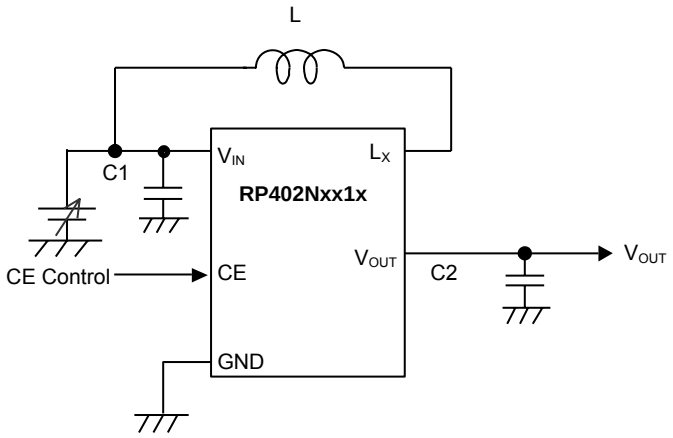
TYPICAL APPLICATION



RP402Kxxxx Typical Application (Fixed Output Voltage Type)



RP402K00xx Typical Application (Adjustable Output Voltage Type)



RP402Nxxxx Typical Application (Fixed Output Voltage Type)

Recommended External Components

Symbol	Descriptions
L	VLF403215MT-2R2M, 2.2 µH, TDK
C1	GRM188R60J106ME84, 10µF, Murata
C2	GRM188R60J106ME84, 10µF x 2, Murata As for the fixed output voltage type (RP402x50xx), 10 µF x 1 can be used if the mounting area is limited.
C_{SPD}	The speedup capacitor (C_{SPD}) is required for the adjustable output voltage type. Connect C_{SPD} in parallel with the output resistor (R1). To calculate the C_{SPD} value, the following equation can be used: $f = 1 / (2 \pi \times C_{SPD} \times R1)$ Adjust the C_{SPD} value to make the oscillator frequency (f) approximately 20 kHz. For example, V_{OUT} = 5.0 V, R1 = 2 MΩ, R2 = 500 kΩ and C_{SPD} = 4 pF. The R1 and R2 values are calculated based on the operation efficiency under a light load, therefore R1 and R2 are having high-resistance values. The feedback voltage (V_{FB}) can be affected by noise. To stabilize the device operation, decrease the R1 and R2 values.
R_{SPD}	The speedup resistor (R_{SPD}) is required for the adjustable output voltage type. Using R_{SPD} can prevent the deterioration of the characteristics due to noise. If there's a possibility of generation of a spike noise, use an approximately 1 kΩ R_{SPD}.

TECHNICAL NOTES

The performance of power source circuits using this IC largely depends on the peripheral circuits. When selecting the peripheral components, consider the conditions of use. Do not allow each component, PCB pattern and the IC to exceed their respected rated values (voltage, current and power) when designing the peripheral circuits.

- Ensure the V_{IN} and GND lines are firmly connected. A large switching current flows through the GND lines and the V_{IN} line. If their impedance is too high, noise pickup or unstable operation may result. When the built-in switch is turned off, the inductor may generate a spike-shaped high voltage. Use the high-breakdown voltage capacitor (C_{OUT}) which output voltage is 1.5 times or more than the set output voltage.

- After a boosting of the step-up converter, the converter uses V_{OUT} as a main power source. Therefore, the ceramic capacitor between the V_{OUT} pin and the GND pin acts as a bypass capacitor. Considering the bias dependence, place a 10 µF or more ceramic capacitor (C_{OUT}) between the V_{OUT} pin - the GND pin as close as possible. Also, place an approximately 10 µF ceramic capacitor (C_{IN}) between the V_{IN} pin - the GND pin.

- Use a 2.2 µH inductor which is having a low equivalent series resistance, having enough tolerable current and which is less likely to cause magnetic saturation.

- Placing a snubber circuit (Serial connection of CR) in parallel with a diode can reduce the spike noise caused by the Lx pin. The conditions of circuit board has a strong influence on the CR time constant and the efficiency of the converter. The evaluation has to be done using an actual converter (10 Ω and 300 pF).

PCB LAYOUT CONSIDERATIONS

Current Path on PCB

Figure 1 and Figure 2 show the current pathways of application circuits when MOSFET is turned ON or when MOSFET is turned OFF, respectively. As shown in Figure 1 and Figure 2, the currents flow in the directions of blue or green arrows. The parasitic components (impedance, inductance or capacitance) formed in the pathways indicated by the red arrows affect the stability of the system and become the cause of noise. Reduce the parasitic components as much as possible. The current pathways should be made by short and thick wirings.

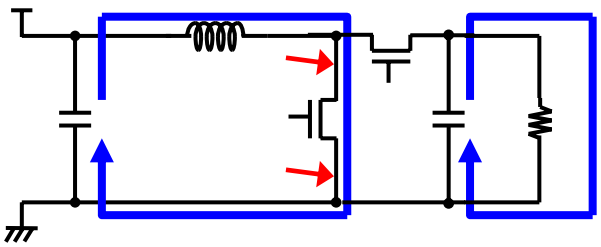


Figure 1. MOSFET-ON

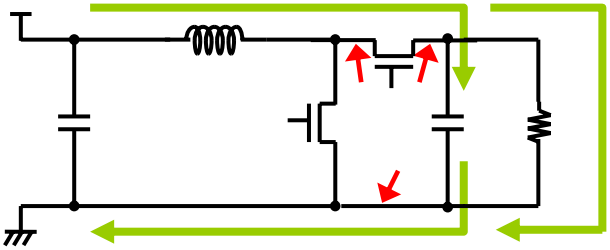
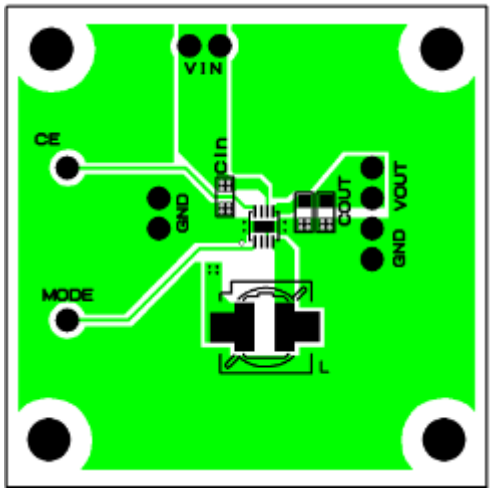
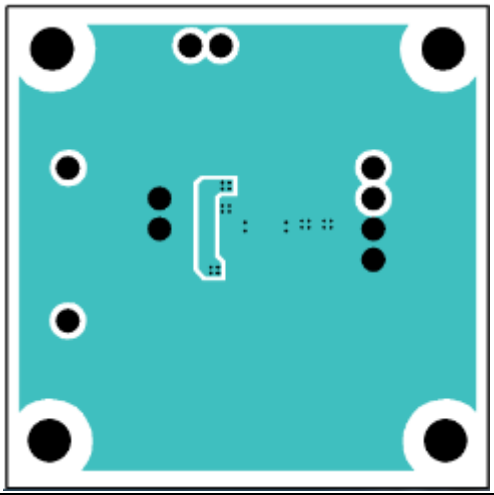
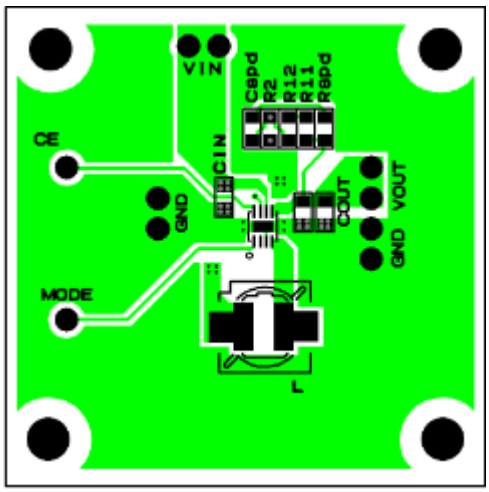
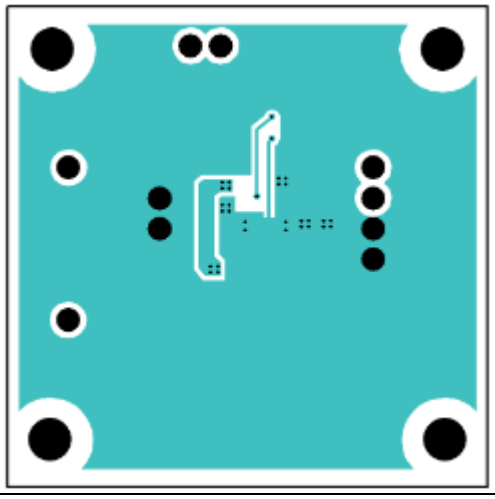


Figure 2. MOSFET-OFF

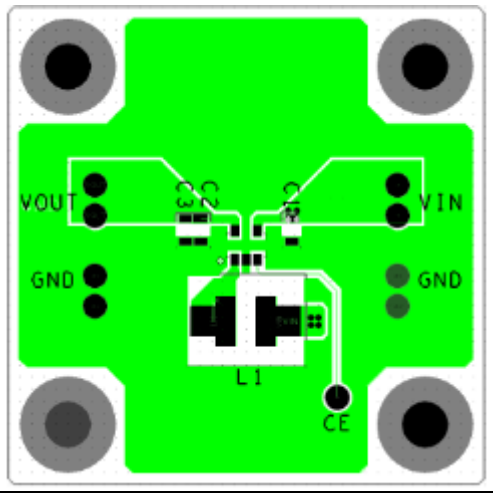
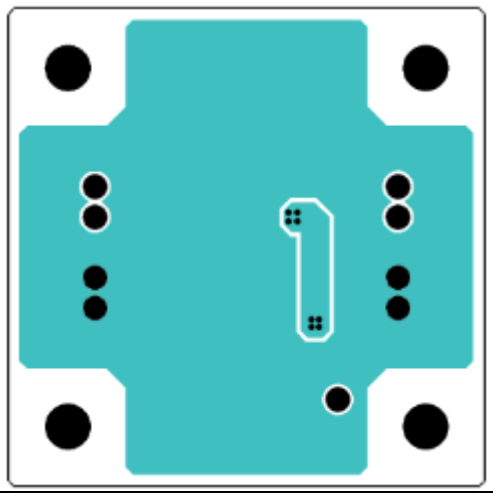
RP402Kxxxx (PKG: DFN(PLP)2020-8pin) Typical Board Layout

Top View	Bottom View
	

RP402K00xx (PKG: DFN(PLP)2020-8pin) Typical Board Layout

Top View	Bottom View
	

RP401Nxxxx (PKG: SOT-23-5pin) Typical Board Layout

Top View	Bottom View
	

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