

■ OUTLINE

The R1211X Series are PWM step-up DC/DC converter controllers with low supply current by CMOS process.

Each of the R1211X Series consists of an oscillator, a PWM control circuit, a reference voltage unit, an error amplifier, a reference current unit, a protection circuit, and an under voltage lockout circuit. A low ripple, high efficiency step-up DC/DC converter can be composed of this IC with some external components, or an inductor, a diode, a power MOSFET, divider resistors, and capacitors.

Phase compensation has been made internally in the R1211XB Series, while phase compensation can be made externally as for R1211XA Series. B version has stand-by mode. Max duty cycle is internally fixed typically at 90%. Soft start function is built-in, and Soft-starting time is set typically at 9ms(700kHz version) or 10.5ms(300kHz version). As for the protection circuit, after the soft-starting time, if the maximum duty cycle is continued for a certain time, the R1211X Series latch the external driver with its off state, or Latch-type protection circuit. The delay time for latch the state can be set with an external capacitor.

To release the protection circuit, restart with power-on (Voltage supplier is equal or less than UVLO detector threshold level), or once after making the circuit be stand-by with chip enable pin and enable the circuit again.

■ FEATURES

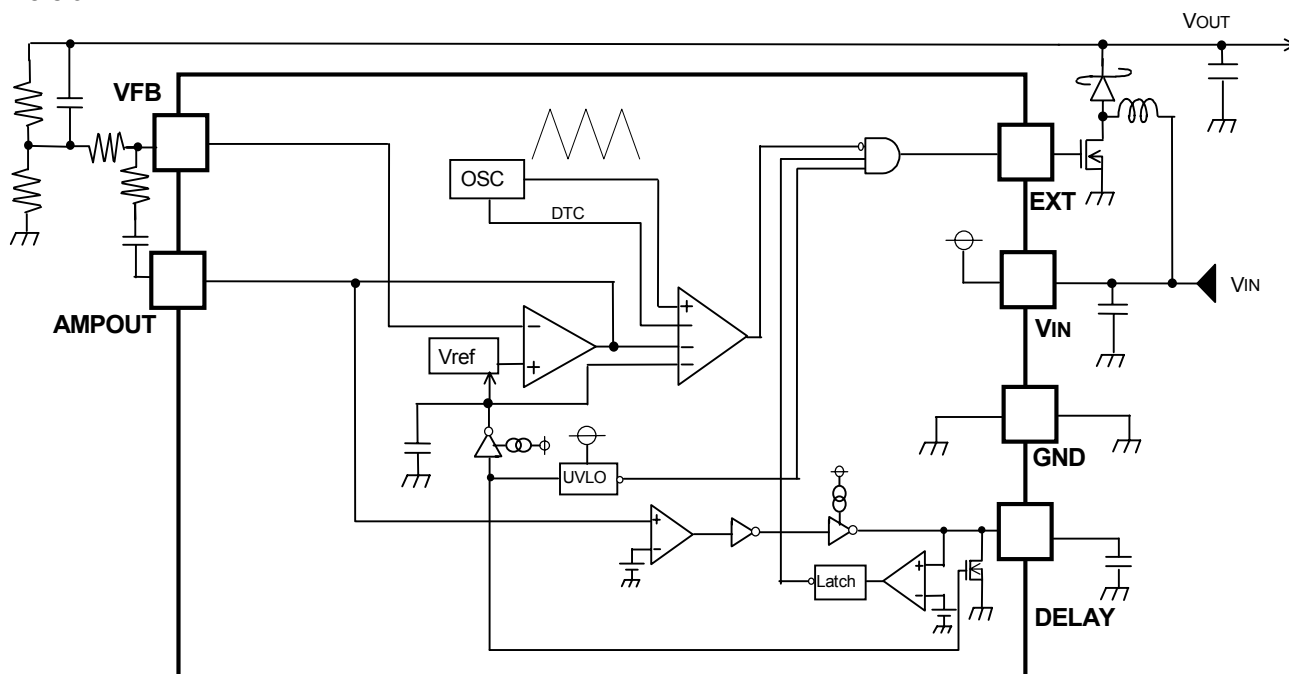
- Standby Current TYP. 0μA (for B version)
- Input Voltage Range 2.5V to 6.0V
- Built-in Latch-type Protection Function (Output Delay Time can be set with an external capacitor)
- Two choices of Basic Oscillator Frequency •• 300kHz, 700kHz
- Max Duty Cycle TYP. 90%
- High Reference Voltage Accuracy ±1.5%
- U.V.L.O. Threshold level TYP. 2.2V (Hysteresis TYP. 0.13V)
- Small Package SOT-23-6W or thin (package thickness MAX. 0.85mm) SON-6 (Under Development)

■ APPLICATIONS

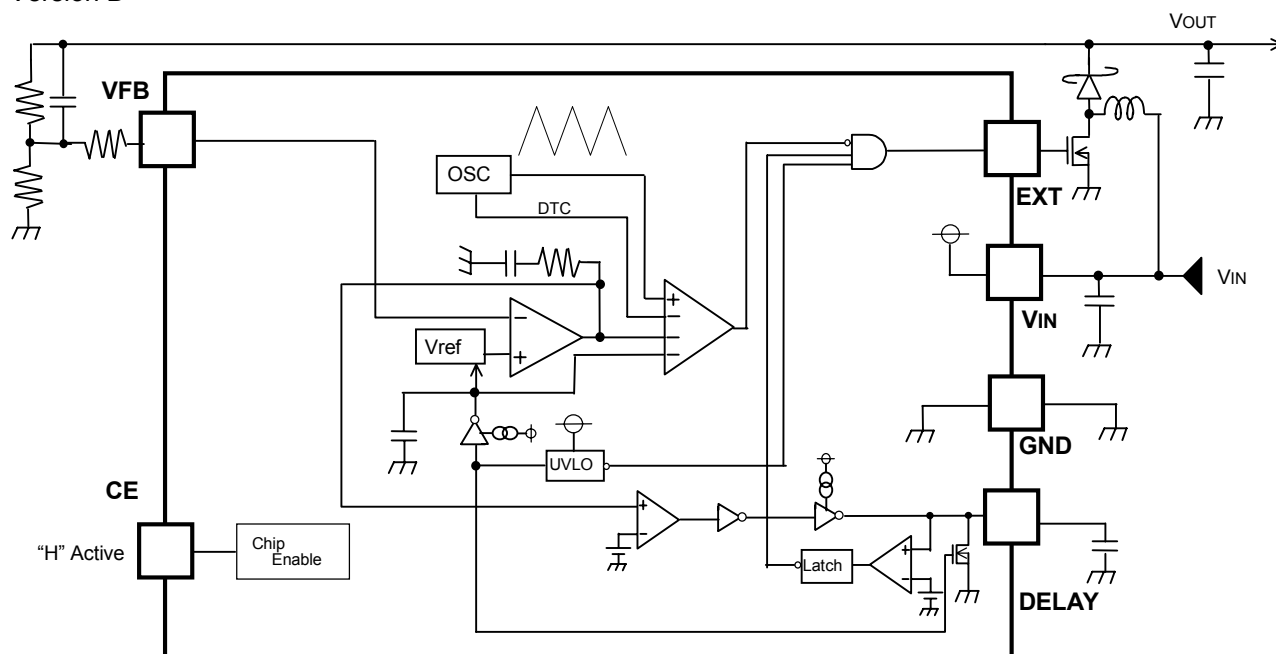
- Constant Voltage Power Source for portable equipment.
- Constant Voltage Power Source for LCD and CCD.

■ BLOCK DIAGRAM

Version A



Version B



■ SELECTION GUIDE

In the R1211X Series, the oscillator frequency, the optional function, and the package type for the ICs can be selected at the user's request.

The selection can be made with designating the part number as shown below;

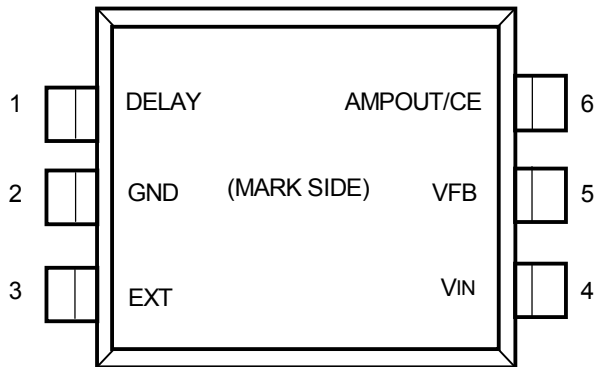
R1211X002X-TR

↑ ↑
a b

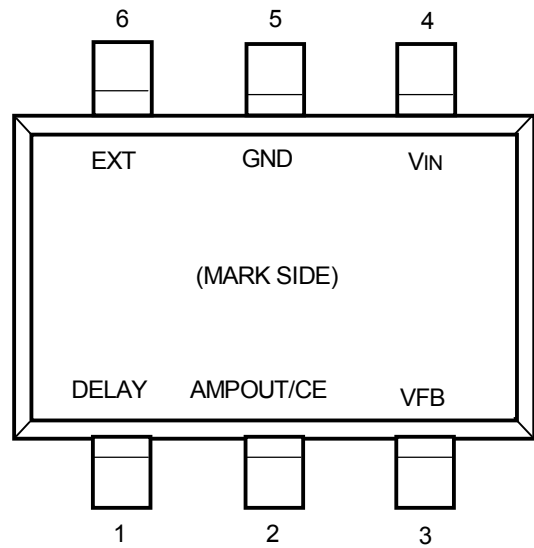
Code	Contents
a	Designation of Package Type: D: SON-6 N: SOT23-6W
b	Designation of Optional Function A : 700kHz, with AMPOUT pin B : 700 kHz, with CE pin C : 300kHz, with AMPOUT pin D : 300kHz, with CE pin

■ PIN CONFIGURATION

SON-6



SOT-23-6W



■ PIN DESCRIPTION

Pin No.		Symbol	Description
SON6	SOT23-6W		
1	1	DELAY	Pin for External Capacitor (for Setting Output Delay of Protection)
2	5	GND	Ground Pin
3	6	EXT	External FET Drive Pin (CMOS Output)
4	4	V _{IN}	Power Supply Pin
5	3	V _{FB}	Feedback Pin for monitoring Output Voltage
6	2	AMPOUT or CE	Amp Output Pin(A/C Version) or Chip Enable Pin(B/D Version)

■ ABSOLUTE MAXIMUM RATINGS

Symbol	Item	Rating	Unit
V _{IN}	V _{IN} Pin Voltage	6.5	V
V _{EXT}	EXT Pin Output Voltage	-0.3~V _{IN} +0.3	V
V _{DLY}	DELAY Pin Voltage	-0.3~V _{IN} +0.3	V
V _{AMP}	AMPOUT Pin Voltage	-0.3~V _{IN} +0.3	V
V _{CE}	CE Pin Input Voltage	-0.3~V _{IN} +0.3	V
V _{FB}	V _{FB} Pin Voltage	-0.3~V _{IN} +0.3	V
I _{AMP}	AMPOUT Pin Current	±10	mA
I _{EXT}	EXT Pin Inductor Drive Output Current	±50	mA
P _D	Power Dissipation	250	mW
T _{opt}	Operating Temperature Range	-40~+85	°C
T _{stg}	Storage Temperature Range	-55~+125	°C

■ ELECTRICAL CHARACTERISTICS

●R1211X002A

(T_{opt}=25°C)

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V _{IN}	Operating Input Voltage		2.5		6.0	V
V _{FB}	V _{FB} Voltage Tolerance	V _{IN} =3.3V	0.985	1.000	1.015	V
ΔV _{FB} / ΔT	V _{FB} Voltage Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±150		ppm/°C
I _{FB}	V _{FB} Input Current	V _{IN} =6V, V _{FB} =0V or 6V	-0.1		0.1	μA
f _{OSC}	Oscillator Frequency	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	595	700	805	kHz
Δf _{OSC} / ΔT	Oscillator Frequency Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±1.4		kHz/°C
I _{DD1}	Supply Current 1	V _{IN} =6V, V _{DLY} =V _{FB} =0V, EXT at no load		600	900	μA
maxdty	Maximum Duty Cycle	V _{IN} =3.3V, EXT "H" side	82	90	94	%
R _{EXTH}	EXT "H" ON Resistance	V _{IN} =3.3V, I _{EXT} =-20mA		5	10	Ω
R _{EXTL}	EXT "L" ON Resistance	V _{IN} =3.3V, I _{EXT} =20mA		3	6	Ω
I _{DLY1}	Delay Pin Charge Current	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	2.5	5.0	7.5	μA
I _{DLY2}	Delay Pin Discharge Current	V _{IN} =V _{FB} =2.5V, V _{DLY} =0.1V	2.5	5.5	9.0	mA
V _{DLY}	Delay Pin Detector Threshold	V _{IN} =3.3V, V _{FB} =0V, V _{DLY} =0V→2V	0.95	1.00	1.05	V
T _{START}	Soft-start Time	V _{IN} =3.3V at 90% of rising edge	4.5	9.0	13.5	ms
V _{UVLO1}	UVLO Detector Threshold	V _{IN} =3.3V→0V, V _{DLY} =V _{FB} =0V	2.1	2.2	2.3	V
V _{UVLO2}	UVLO Detector Hysteresis	V _{IN} =0V→3.3V, V _{DLY} =V _{FB} =0V	0.08	0.13	0.18	V
I _{AMP1}	AMP "H" Output Current	V _{IN} =3.3V, V _{AMP} =1V, V _{FB} =0.9V	0.45	0.90	1.50	mA
I _{AMP2}	AMP "L" Output Current	V _{IN} =3.3V, V _{AMP} =1V, V _{FB} =1.1V	30	60	90	μA

●R1211X002B

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V _{IN}	Operating Input Voltage		2.5		6.0	V
V _{FB}	V _{FB} Voltage Tolerance	V _{IN} =3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta T$	V _{FB} Voltage Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±150		ppm/°C
I _{FB}	V _{FB} Input Current	V _{IN} =6V, V _{FB} =0V or 6V	-0.1		0.1	μA
f _{OSC}	Oscillator Frequency	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	595	700	805	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±1.4		kHz/°C
I _{DD1}	Supply Current 1	V _{IN} =6V, V _{DLY} =V _{FB} =0V, EXT at no load		600	900	μA
maxdty	Maximum Duty Cycle	V _{IN} =3.3V, EXT "H" side	84	90	94	%
R _{EXTH}	EXT "H" ON Resistance	V _{IN} =3.3V, I _{EXT} =-20mA		5	10	Ω
R _{EXTL}	EXT "L" ON Resistance	V _{IN} =3.3V, I _{EXT} =20mA		3	6	Ω
I _{DLY1}	Delay Pin Charge Current	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	2.5	5.0	7.5	μA
I _{DLY2}	Delay Pin Discharge Current	V _{IN} =V _{FB} =2.5V, V _{DLY} =0.1V	2.5	5.5	9.0	mA
V _{DLY}	Delay Pin Detector Threshold	V _{IN} =3.3V, V _{FB} =0V, V _{DLY} =0V→2V	0.95	1.00	1.05	V
T _{START}	Soft-start Time	V _{IN} =3.3V	4.5	9.0	13.5	ms
V _{UVLO1}	UVLO Detector Threshold	V _{IN} =3.3V→0V, V _{DLY} =V _{FB} =0V	2.1	2.2	2.3	V
V _{UVLO2}	UVLO Detector Hysteresis	V _{IN} =0V→3.3V, V _{DLY} =V _{FB} =0V	0.08	0.13	0.18	V
I _{STB}	Standby Current	V _{IN} =6V, V _{CE} =0V		0	1	μA
I _{CEH}	CE "H" Input Current	V _{IN} =6V, V _{CE} =6V	-0.5		0.5	μA
I _{CEL}	CE "L" Input Current	V _{IN} =6V, V _{CE} =0V	-0.5		0.5	μA
V _{CEH}	CE "H" Input Voltage	V _{IN} =6V, V _{CE} =0V→6V	1.5			V
V _{CEL}	CE "L" Input Voltage	V _{IN} =2.5V, V _{CE} =2V→0V			0.3	V

●R1211X002C

(T_{opt}=25°C)

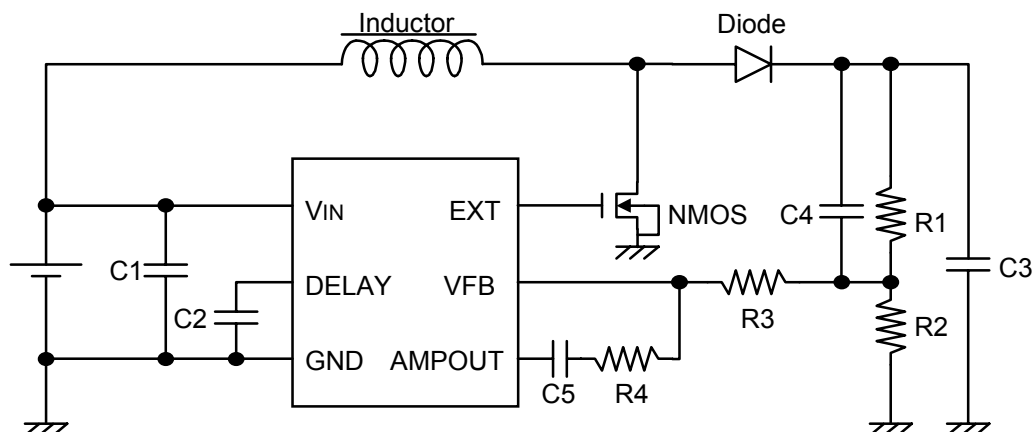
Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V _{IN}	Operating Input Voltage		2.5		6.0	V
V _{FB}	V _{FB} Voltage Tolerance	V _{IN} =3.3V	0.985	1.000	1.015	V
ΔV _{FB} / ΔT	V _{FB} Voltage Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±150		ppm/°C
I _{FB}	V _{FB} Input Current	V _{IN} =6V, V _{FB} =0V or 6V	-0.1		0.1	μA
f _{OSC}	Oscillator Frequency	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	240	300	360	kHz
Δf _{OSC} / ΔT	Oscillator Frequency Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±0.6		kHz/°C
I _{DD1}	Supply Current 1	V _{IN} =6V, V _{DLY} =V _{FB} =0V, EXT at no load		300	500	μA
maxdty	Maximum Duty Cycle	V _{IN} =3.3V, EXT "H" side	84	90	94	%
R _{EXTH}	EXT "H" ON Resistance	V _{IN} =3.3V, I _{EXT} =-20mA		5	10	Ω
R _{EXTL}	EXT "L" ON Resistance	V _{IN} =3.3V, I _{EXT} =20mA		3	6	Ω
I _{DLY1}	Delay Pin Charge Current	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	2.0	4.5	7.0	μA
I _{DLY2}	Delay Pin Discharge Current	V _{IN} =V _{FB} =2.5V, V _{DLY} =0.1V	2.5	5.5	9.0	mA
V _{DLY}	Delay Pin Detector Threshold	V _{IN} =3.3V, V _{FB} =0V, V _{DLY} =0V→2V	0.95	1.00	1.05	V
T _{START}	Soft-start Time	V _{IN} =3.3V	5.0	10.5	16.0	ms
V _{UVLO1}	UVLO Detector Threshold	V _{IN} =3.3V→0V, V _{DLY} =V _{FB} =0V	2.1	2.2	2.3	V
V _{UVLO2}	UVLO Detector Hysteresis	V _{IN} =0V→3.3V, V _{DLY} =V _{FB} =0V	0.08	0.13	0.18	V
I _{AMP1}	AMP "H" Output Current	V _{IN} =3.3V, V _{AMP} =1V, V _{FB} =0.9V	0.45	0.90	1.50	mA
I _{AMP2}	AMP "L" Output Current	V _{IN} =3.3V, V _{AMP} =1V, V _{FB} =1.1V	25	50	75	μA

●R1211X002D

Symbol	Item	Conditions	MIN.	TYP.	MAX.	Unit
V _{IN}	Operating Input Voltage		2.5		6.0	V
V _{FB}	V _{FB} Voltage Tolerance	V _{IN} =3.3V	0.985	1.000	1.015	V
$\Delta V_{FB}/\Delta T$	V _{FB} Voltage Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±150		ppm/°C
I _{FB}	V _{FB} Input Current	V _{IN} =6V, V _{FB} =0V or 6V	-0.1		0.1	μA
f _{OSC}	Oscillator Frequency	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	240	300	360	kHz
$\Delta f_{OSC}/\Delta T$	Oscillator Frequency Temperature Coefficient	-40°C ≤ T _{opt} ≤ 85°C		±0.6		kHz/°C
I _{DD1}	Supply Current 1	V _{IN} =6V, V _{DLY} =V _{FB} =0V, EXT at no load		300	500	μA
maxdty	Maximum Duty Cycle	V _{IN} =3.3V, EXT "H" side	84	90	94	%
R _{EXTH}	EXT "H" ON Resistance	V _{IN} =3.3V, I _{EXT} =-20mA		5	10	Ω
R _{EXTL}	EXT "L" ON Resistance	V _{IN} =3.3V, I _{EXT} =20mA		3	6	Ω
I _{DLY1}	Delay Pin Charge Current	V _{IN} =3.3V, V _{DLY} =V _{FB} =0V	2.0	4.5	7.0	μA
I _{DLY2}	Delay Pin Discharge Current	V _{IN} =V _{FB} =2.5V, V _{DLY} =0.1V	2.5	5.5	9.0	mA
V _{DLY}	Delay Pin Detector Threshold	V _{IN} =3.3V, V _{FB} =0V, V _{DLY} =0V→2V	0.95	1.00	1.05	V
T _{START}	Soft-start Time	V _{IN} =3.3V	5.0	10.5	16.0	ms
V _{UVLO1}	UVLO Detector Threshold	V _{IN} =3.3V→0V, V _{DLY} =V _{FB} =0V	2.1	2.2	2.3	V
V _{UVLO2}	UVLO Detector Hysteresis	V _{IN} =0V→3.3V, V _{DLY} =V _{FB} =0V	0.08	0.13	0.18	V
I _{STB}	Standby Current	V _{IN} =6V, V _{CE} =0V		0	1	μA
I _{CEH}	CE "H" Input Current	V _{IN} =6V, V _{CE} =6V	-0.5		0.5	μA
I _{CEL}	CE "L" Input Current	V _{IN} =6V, V _{CE} =0V	-0.5		0.5	μA
V _{CEH}	CE "H" Input Voltage	V _{IN} =6V, V _{CE} =0V→6V	1.5			V
V _{CEL}	CE "L" Input Voltage	V _{IN} =2.5V, V _{CE} =2V→0V			0.3	V

■ TYPICAL APPLICATION AND TECHNICAL NOTES

<A/C Version>

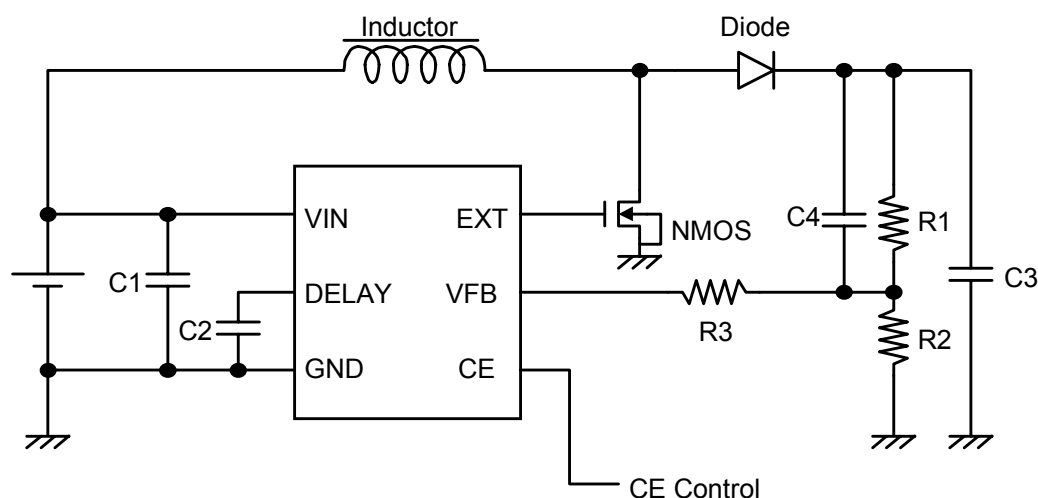


NMOS: IRF7601 (International Rectifier)
Inductor: 10 μ H (TDK, LDR Series)
Diode: CRS02 (Toshiba)

C1: 4.7 μ F (Ceramic)
C2: 0.22 μ F (Ceramic)
C3: 22 μ F (Tantalum)
C4: 680pF (Ceramic)
C5: 2200pF (Ceramic)

R1: Output Voltage Setting Resistor 1
R2: Output Voltage Setting Resistor 2
R3: 30k Ω
R4: 30k Ω

<B/D Version>



NMOS: IRF7601 (International Rectifier)
Inductor: 10 μ H (TDK, LDR Series)
Diode: CRS02 (Toshiba)

C1: 4.7 μ F (Ceramic)
C2: 0.22 μ F (Ceramic)
C3: 22 μ F (Tantalum)
C4: 680pF (Ceramic)

R1 : Setting Output Voltage Resistor1
R2 : Setting Output Voltage Resistor2
R3 : 30k Ω

When you use these ICs, consider the following issues;

- Use a 1 μ F or more capacitance value of bypass capacitor between VIN pin and GND, C1 as shown in the typical applications above.

● In terms of the capacitor for setting delay time of the latch protection, C2 as shown in typical applications of the previous page, connect between Delay pin and GND pin of the IC with the minimum wiring distance.

● Connect a 1μF or more value of capacitor between VOUT and GND, C3 as shown in typical applications of the previous page. (Recommended value is from 10μF to 22μF.)

● Connect a capacitor between VOUT and the dividing point, C4 as shown in typical applications of the previous page. The capacitance value of C4 depends on divider resistors for output voltage setting. Typical value is between 100pF and 1000pF.

● Output Voltage can be set with divider resistors for voltage setting, R1 and R2 as shown in typical applications of the previous page. Refer to the next formula.

$$\text{Output Voltage} = V_{FB} \times (R1 + R2) / R2$$

R1+R2=100kΩ is recommended range of resistance.

● We recommend adding a resistor with resistance value from 20kΩ to 100kΩ between divider point of voltage setting and VFB pin, R3 as shown in typical applications of the previous page. If R3 is not connected as shown, the noise of VOUT could be transmitted to VFB input and accuracy of output voltage could be worse.

● The operation of Latch protection circuit is as follows: When the IC detects maximum duty cycle, charge to an external capacitor, C2 of DELAY pin starts. And maximum duty cycle continues and the voltage of DELAY pin reaches delay voltage detector threshold, VDLY, outputs “L” to EXT pin and turns off the external power MOSFET.

To release the latch protection operation, make the IC be standby mode with CE pin and make it active in terms of B/D version. Otherwise, restart with power on.

The delay time of latch protection can be calculated with C2, VDLY, and Delay Pin Charge Current, IDLY1, as in the next formula.

$$t = C2 \times VDLY / IDLY1$$

Once after the maximum duty is detected and released before delay time, charge to the capacitor is halt and delay pin outputs “L”.

● As for A/C version, connect a capacitor between AMPOUT pin and VFB pin and a resistor for phase compensation, C5 and R4 as shown in typical applications of the previous page. The resistance value of R4 is as same as R3. The recommended capacitance value of C5 is between 1nF and 10nF.

Recommended value of R3 is from 20kΩ to 100kΩ.

● As for B/D version, EXT pin outputs GND level at standby mode.

● Select the Power MOSFET, the diode, and the inductor within ratings (Voltage, Current, Power) of this IC. Choose the power MOSFET with low threshold voltage depending on Input Voltage. Choose the diode with low VF such as Schottky type, and with low IR.