R1271L501A-EV

30 V, 1 A Synchronous PWM Step-down DC/DC Converter Evaluation Board

No.EEV-517-L501A-250219

R1271L501A-EV is the evaluation board for R1271 which has the below features, benefits and specifications.

OVERVIEW

The R1271x is a synchronous step-down DC/DC converter with a maximum input voltage rating of 42V. This device is suitable for small inductors with the switching frequency of 2 MHz. The external components are only an inductor and several capacitors and a resistance. The tiny DFN package option makes the power circuit compact .

KEY BENEFITS

- High efficiency 85% is realized with switching frequency of 2 MHz
- The output voltage is maintained at cranking by reducing a switching frequency to minimum 1/4 of normal frequency.
- EMI noise reduction by using a spread spectrum clock generator. (Diffusion Rate: +10%).

KEY SPECIFICATIONS

- Input Voltage Range (Maximum Ratings): 3.6 V to 30 V (42 V)
- Start-up Voltage: 4.5 V
- Standby Current: Typ. 4 μA
- Operating Temperature Range: -40°C to 105°C
- Output Voltage Accuracy: ±1.0% (Ta = 25°C)
- Oscillator Frequency: Typ.2 MHz (Fixed inside the IC)
- Minimum On-Time: Typ. 70 ns
- Minimum Off-Time: Typ. 120 ns
- Duty-over: Oscillation Frequency x 1 to 1/4
- Soft start function
- Thermal Shutdown: Typ. Tj = 160°C
- Undervoltage Lockout (UVLO): VCC = 3.3 V (Typ.)
- Overvoltage Lockout (OVLO): VIN = 35 V (Typ.)
- Overvoltage Detection (OVD): Output Voltage (VOUT) +10%
- LX Current Limit: Typ. 1.8 A (LIMIT Pin Open)
- High-side MOSFET On Resistance: Typ. 0.4 Ω
- Low-side MOSFET On Resistance: Typ. 0.2 Ω
- Package: DFN3030-12B
- For more details on R1271 IC, please refer to https://www.nisshinbo-microdevices.co.jp/en/products/dc-dc-switching-regulator/spec/?product=r1271

PART NUMBER INFORMATION

Product Name	Package
R1271L501A	DFN3030-12B

Select the Set Output Voltage (V_{SET}).

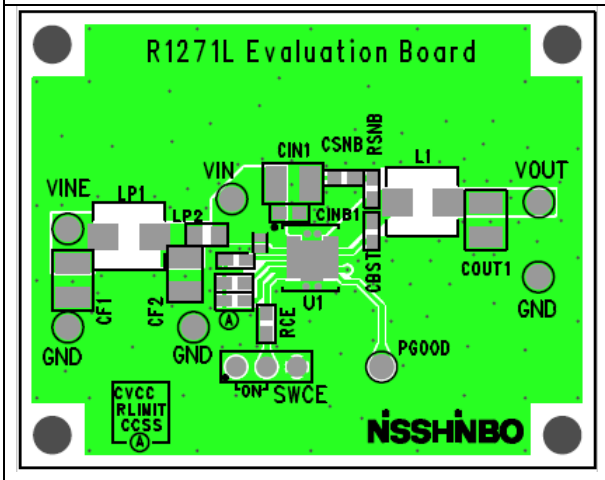
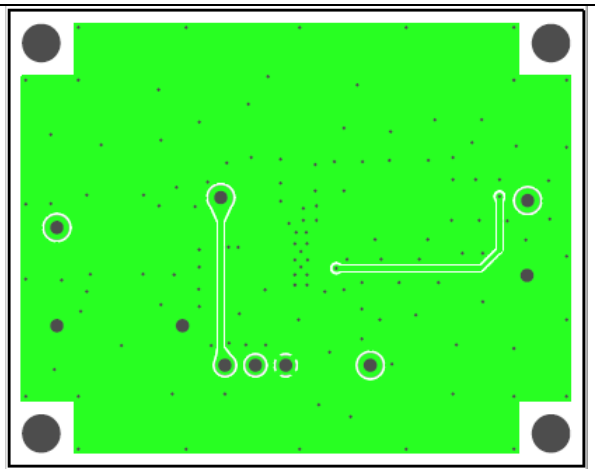
	Set Output Voltage (V_{SET})
501	5.0 V

Select the optional functions.

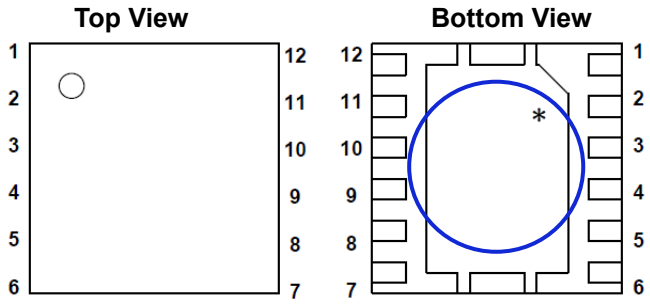
	Overcurrent Protection	SSCG
A	Hiccup-type	Disable

PCB LAYOUT

Evaluation board of R1271L (Package: DFN3030-12)

TOP VIEW	BOTTOM VIEW
	

PIN DESCRIPTIONS



R1271L (DFN3030-12B) Pin Configuration

* The tab on the bottom of the package is substrate level (GND). The tab must be connected to the ground plane on the board.

R1271L (DFN3030-12B) Pin Description

Pin No.	Pin Name	Description
1	VIN	Power Supply Pin
2	NC(1)	No Connection
3	VCC	VCC Output Pin
4	LIMIT	Current Limit Adjustment Pin
5	CSS	Soft-start Adjustment Pin
6	CE	Chip Enable Pin, Active-high
7	PGOOD	Power Good Pin
8	VOUT	Output Voltage Feedback Input Pin
9	NC(1)	No Connection
10	GND	GND Pin
11	BST	Bootstrap Pin
12	LX	Switching Pin

(1) It is recommended to set the NC pin left open to prevent failure caused by adjacent pins' short circuit.

ABSOLUTE MAXIMUM RATINGS

Absolute Maximum Ratings

Symbol	Parameter	Rating	Unit
V_{IN}	VIN Pin Input Voltage	−0.3 to 42	V
V_{CE}	CE Pin Voltage	−0.3 to V_{IN}+0.3 ≤ 42	V
V_{CSS}	CSS Pin Voltage	−0.3 to 3	V
V_{OUT}	VOUT Pin Voltage	−0.3 to 30	V
V_{CC}	VCC Pin Voltage	−0.3 to 6	V
	VCC Pin Output Current	Internally Limited	mA
V_{BST}	BST Pin Voltage	LX−0.3 to LX+6	V
V_{LX}	LX Pin Voltage	−0.3 to V_{IN} +0.3 ≤ 36	V
V_{PGOOD}	PGOOD Pin Voltage	−0.3 to 16	V
V_{LIMIT}	LIMIT Pin Voltage	−0.3 to 6	V
P_D	Power Dissipation	Refer to Appendix *"POWER DISSIPATION"*	
Tj	Junction Temperature Range	−40 to 125	°C
Tstg	Storage Temperature Range	−55 to 125	°C

ABSOLUTE MAXIMUM RATINGS

Electronic and mechanical stress momentarily exceeded absolute maximum ratings may cause permanent damage and may degrade the lifetime and safety for both device and system using the device in the field. The functional operation at or over these absolute maximum ratings is not assured.

RECOMMENDED OPERATING CONDITIONS

Recommended Operating Conditions

Symbol	Parameter	Rating	Unit
V_{IN}	Operating Input Voltage	3.6 to 30	V
Ta	Operating Temperature Range	−40 to 105	°C
V_{UP}	PGOOD Pin Pull-up Voltage	0 to 5.5	V

RECOMMENDED OPERATING CONDITIONS

All of electronic equipment should be designed that the mounted semiconductor devices operate within the recommended operating conditions. The semiconductor devices cannot operate normally over the recommended operating conditions, even if they are used over such conditions by momentary electronic noise or surge. And the semiconductor devices may receive serious damage when they continue to operate over the recommended operating conditions.

ELECTRICAL CHARACTERISTICS

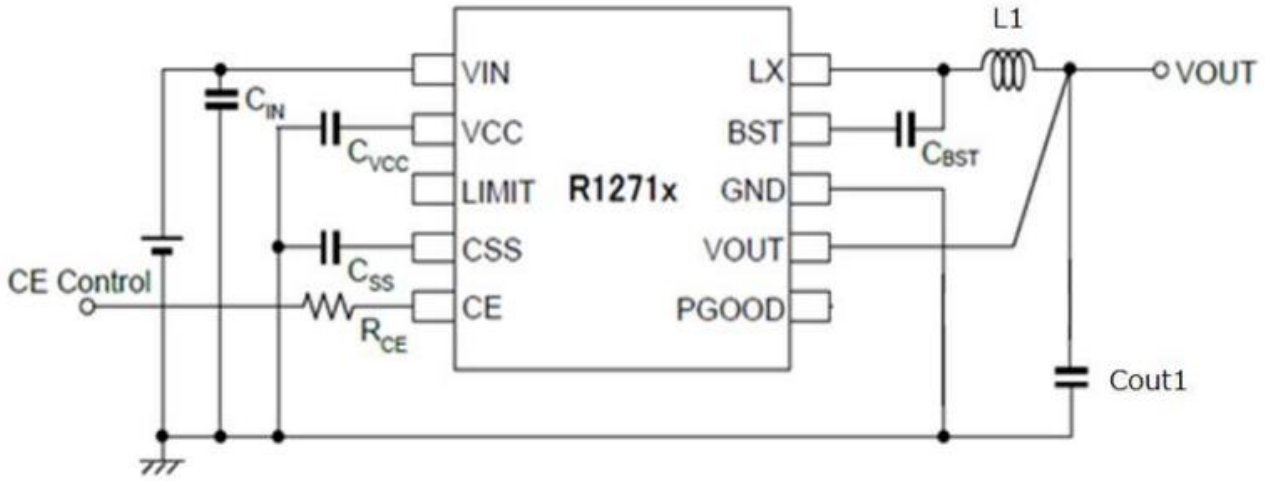
V_{IN} = 12 V, V_{CE} = V_{IN}, unless otherwise specified.
The specifications surrounded by [ ] are guaranteed by design engineering at −40°C ≤ Ta ≤ 105°C.

R1271x Electrical Characteristics **(Ta = 25°C)**

Symbol	Parameter	Conditions	Min.	Typ.	Max.	Unit
V_{START}	Start-up Voltage				4.5	V
V_{CC}	VCC Pin Voltage (VCC-GND)	V_{OUT} = V_{SET} x 1.05	4.75	5	5.25	V
$I_{STANDBY}$	Standby Current	V_{CE} = 0 V		4		µA
		V_{IN} = 30 V, V_{CE} = 0 V			30	
I_{VIN1}	VIN Consumption Current 1 at PWM switching stop	V_{OUT} = V_{SET} x 1.05		1.0	1.35	mA
V_{UVLOF}	Undervoltage Lockout (UVLO) Threshold Voltage	V_{CC} Falling	3.10	3.3	3.50	V
V_{UVLOR}		V_{CC} Rising	4.10	4.3	4.49	V
V_{OVLOR}	Overvoltage Lockout (OVLO) Threshold Voltage	V_{IN} Rising	33.6	35	36.75	V
V_{OVLOF}		V_{IN} Falling	32.0	34	36.2	V
V_{OUT}	Output Voltage (R1271x501x)	Ta = 25°C	4.950	5.0	5.050	V
		−40°C ≤ Ta ≤ 105°C	4.900		5.100	
f_{OSC0}	Oscillator Frequency 0	8 V ≤ V_{IN} ≤ 16 V, I_{OUT} = 0 A	1800	2000	2200	kHz
t_{SS1}	Soft-start Time 1	CSS = OPEN	0.36	0.5	0.75	ms
t_{SS2}	Soft-start Time 2	CSS = 4.7 nF	1.4		2.0	ms
I_{TSS}	Soft-start Pin Charging Current	V_{CSS} = 0 V	1.8	2	2.2	µA
V_{SSEND}	CSS Pin Voltage at soft-start stop		0.635	0.64	0.705	V
R_{DIS_CSS}	CSS Pin Discharge Resistance	V_{IN} = 4.5 V, V_{CE} = 0 V, V_{CSS} = 3 V	1.8	3	5	kΩ
$I_{LXLIMIT}$	LX Current Limit (High-side MOSFET)	DC Current, LIMIT = OPEN	1.5	1.8	2.3	A
		DC Current, LIMIT = 0V	0.75	1.0	1.25	
V_{CEH}	CE ”High” Input Voltage		1.3			V
V_{CEL}	CE ”Low” Input Voltage				1.1	V
I_{CEH}	CE ”High” Input Current	V_{IN} = V_{CE} = 30 V		1.2	2.45	µA
I_{CEL}	CE ”Low” Input Current	V_{IN} = 30V, V_{CE} = 0 V	-0.1	0	0.1	µA
I_{VOUTH}	VOUT ”High” Pin Current		130		390	µA
$V_{PGOODOFF}$	PGOOD “Low” Output Voltage	V_{IN} = 3.6 V, I_{PGOOD} = 1 mA			0.35	V
$I_{PGOODOFF}$	PGOOD Pin Leakage Current	V_{IN} = 30V, V_{PGOOD} = 6 V	-0.1	0	0.1	µA
V_{OVDR}	Overvoltage Detection (OVD) Threshold Voltage	V_{OUT} Rising	V_{SET} x1.06	V_{SET} x1.10	V_{SET} x1.14	V
V_{OVDF}	Overvoltage Release (OVD) Threshold Voltage	V_{OUT} Falling	V_{SET} x1.02	V_{SET} x1.07	V_{SET} x1.12	V
V_{UVDF}	Undervoltage Detection (UVD) Threshold Voltage	V_{OUT} Falling	V_{SET} x0.86	V_{SET} x0.90	V_{SET} x0.94	V
V_{UVDR}	Undervoltage Release (UVD) Threshold Voltage	V_{OUT} Rising	V_{SET} x0.88	V_{SET} x0.93	V_{SET} x0.98	V

All test items listed under Electrical Characteristics are done under the pulse load condition (Tj ≈ Ta = 25°C).

TYPICAL APPLICATION CIRCUIT



R1271x Typical Application Circuit

Recommended values for components

Symbol	Capacitance
CIN	10 µF
COUT1	10 µF
CBST	0.1 µF
CVCC	1.0 µF
CSS	OPEN
RCE	1.0 kΩ
L1	2.2uH

It is recommended to set 1 kΩ or higher for R_{CE} and 10 kΩ or higher for R_{PG}

TECHNICAL NOTES

The performance of a power source circuit using this device is highly dependent on a peripheral circuit. A peripheral component or the device mounted on PCB should not exceed a rated voltage, a rated current or a rated power. When designing a peripheral circuit, please be fully aware of the following points.

- External components must be connected as close as possible to the ICs and make wiring as short as possible. Especially, the capacitor connected in between VIN pin and GND pin must be wiring the shortest. If their impedance is high, internal voltage of the IC may shift by the switching current, and the operating may be unstable. Make the power supply and GND lines sufficient.

- Place a capacitor (C_{BST}) as close as possible to the LX pin and the BST pin.

- The tab on the bottom of the package must be connected to GND when mounted on the board. To improve thermal dissipation on the multilayer board, surface, secure the GND layer as large as possible and set via to release the heat to the other layer in the connecting part of the tab on the bottom.

- It is recommended that NC pin left open to prevent failure caused by adjacent pins' short circuit.

- If V_{OUT} is forced negative voltage before start-up, the IC may not be able to ramp up.

- Make the wiring between the LX pin and the inductor as short as possible to reduce the parasitic capacitance.

- Place the input capacitor (C_{IN}) on the same side of the IC. If it is placed on the different side of the IC by using via, the parasitic inductance of the via may increase the noise.

- Feedback the output voltage from the closest point of C_{OUT}.

- Thermal shutdown function is designed for preventing risk of smoke and fire. The function does not have the effect under the input over voltage or damaged by beyond the absolute maximum rating condition.

- Do not design with depending on the thermal shutdown function as the system protection. The thermal shutdown function is designed for the IC.

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