SCT242x Evaluation Board User's Guide

FEATURES

- Wide Input Range: 3.8V-40V
- Up to 2A Continuous Output Current
- Integrated 160mΩ High-Side Rdson and 80mΩ Low-Side Rdson Power MOSFETs
- 25uA Low Quiescent Current with Pulse Skipping Mode PSM at Light Load
- 100KHz to 2.2MHz Adjustable Frequency and External Clock Synchronization (SCT2420, SCT2422)
- Adjustable Soft-start (SCT2421, SCT2422)
- Low Dropout Mode Operation
- Derivable Inverting Voltage Regulator
- EMI Reduction with Frequency Spread Spectrum FSS

APPLICATIONS

- Industrial Distributed Power Supplies
- Battery Pack Powered System - Cordless Power Tools, Cordless Home Appliance, Drone etc.
- Cigarette Lighter Adapters, USB Chargers
- USB Type-C Power Delivery
- Optical Communication and Networking System
- Automotive System

DESCRIPTION

The EV242x-B-04A Evaluation Board is designed to demonstrate the capabilities of SCT2420, SCT2421, and SCT2422, high efficiency fully integrated synchronous step-down DCDC converter supporting up to 2A continuous output current from an input source from 3.8V to 40V. The SCT2420, SCT2422 offer adjustable switching frequency ranging from 100kHz to 2.2MHz with internal 2ms soft-start, which provides flexibility to optimize either efficiency or external component size. The SCT2421 features adjustable soft-start with fixed 570KHz switching frequency. The SCT2422 features adjustable soft-start with internal compensation. All those devices are available in an easy-soldering 8-pin ESOP package.

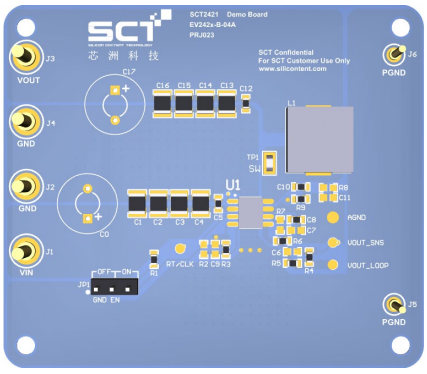
This user's guide describes the characteristics, operation and the use of the EV242x-B-01A Evaluation Module including EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

Board Number	IC Number
EV242x-B-01A	SCT2420
	SCT2421
	SCT2422

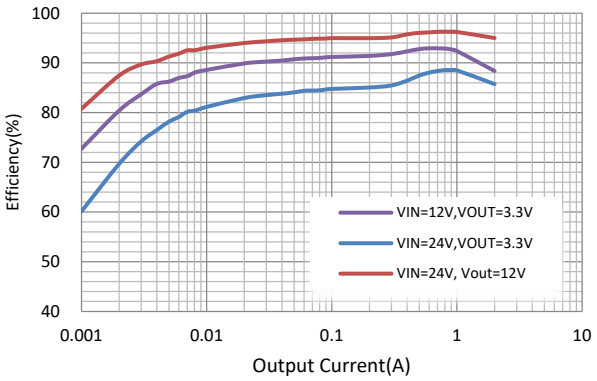
PERFORMANCE SUMMARY

Table 1. Performance — Specifications are at TA = 25°C

Parameter	Condition	Value
Input Voltage	DC up to 40V	3.8V-40V
Output Voltage	Iout=0A~2A	3.3V ± 1%
Output Current	Continuous DC current	2A



EV242x-B-01A Evaluation Board Top View



SCT2420 Efficiency, Freq.=500KHz

QUICK START PROCESURE

Evaluation board EV242x-B-01A is easy to set up to evaluate the performance of SCT2420, SCT2421 and SCT2422 synchronous step-down DCDC converter. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions:
   - J1, J2: Input terminal. Connect the power supply to the input of converter.
   - J3, J4: Output terminal. Connect the load to the output of converter.
   - JP1: Enable Jumper. Install ON shunt to connect EN pin to V_{in} through a 100KΩ resistor to enable IC. Install OFF shunt to disable IC.
2. With power off, connect the input power supply to J1 and J2 terminals. Make sure that the input voltage does not exceed 40V, and supports sufficient current limit. Turn on the power at the input.
3. Check the output voltage at J3 and J4 terminals. The output voltage should be 3.3V typical. Once the proper output voltage is established, adjust the load within the operating range and observe the output voltage regulation, output voltage ripple, efficiency and other parameters.
4. To use the enable function, apply a digital input to the EN pin of JP1.
5. Users can place C0 if input wire is long and C17 for better load transient performance.

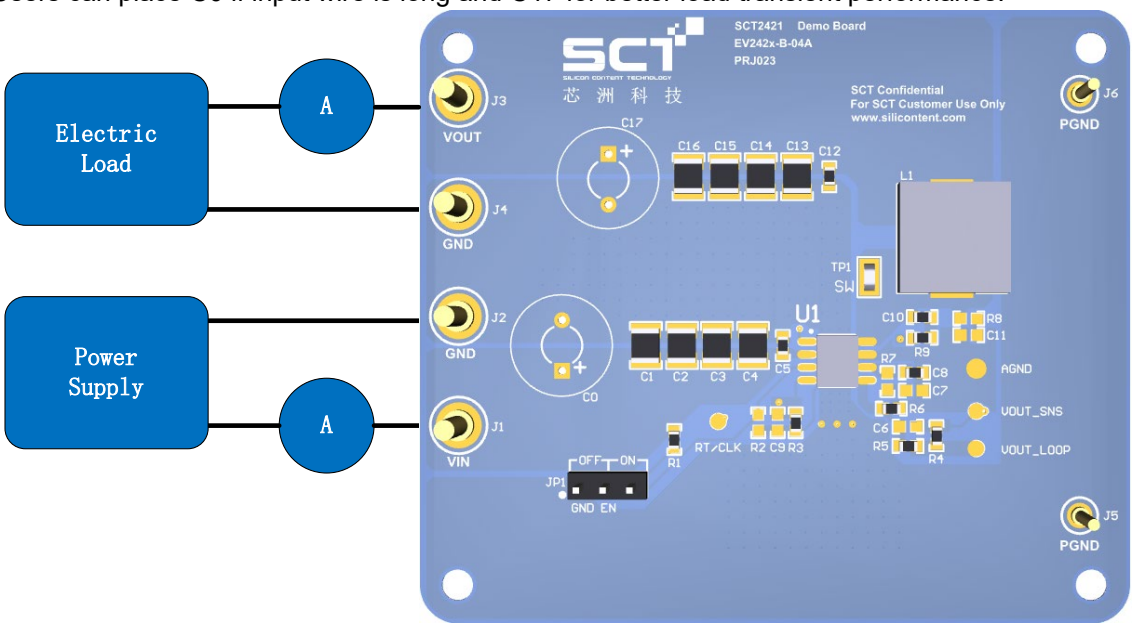


Figure 1. Power Supply, Load and Measurement Equipment Setup

NOTE: When measuring the voltage ripple, care must be taken to avoid a long ground lead on the oscilloscope probe. Measure the input or output voltage ripple by touching the probe tip directly across relevant capacitor of VIN or VOUT. See Figure 2 for proper scope probe technique.

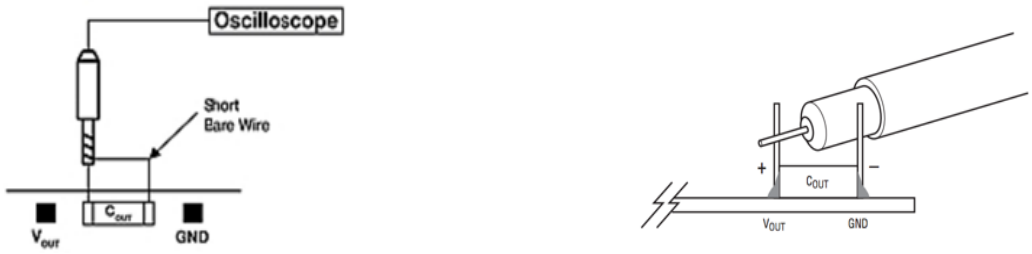


Figure 2. Measuring Voltage Ripple Across Terminals or Directly Across Ceramic Capacitor

SCHEMATIC DIAGRAM

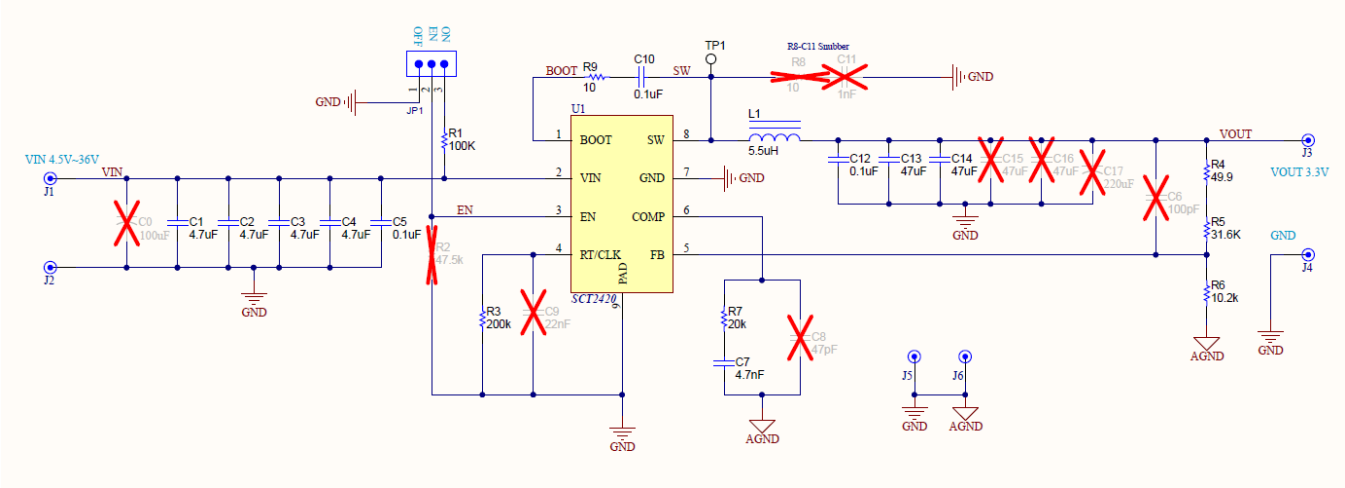


Figure 3. SCT2420 EVM Schematic

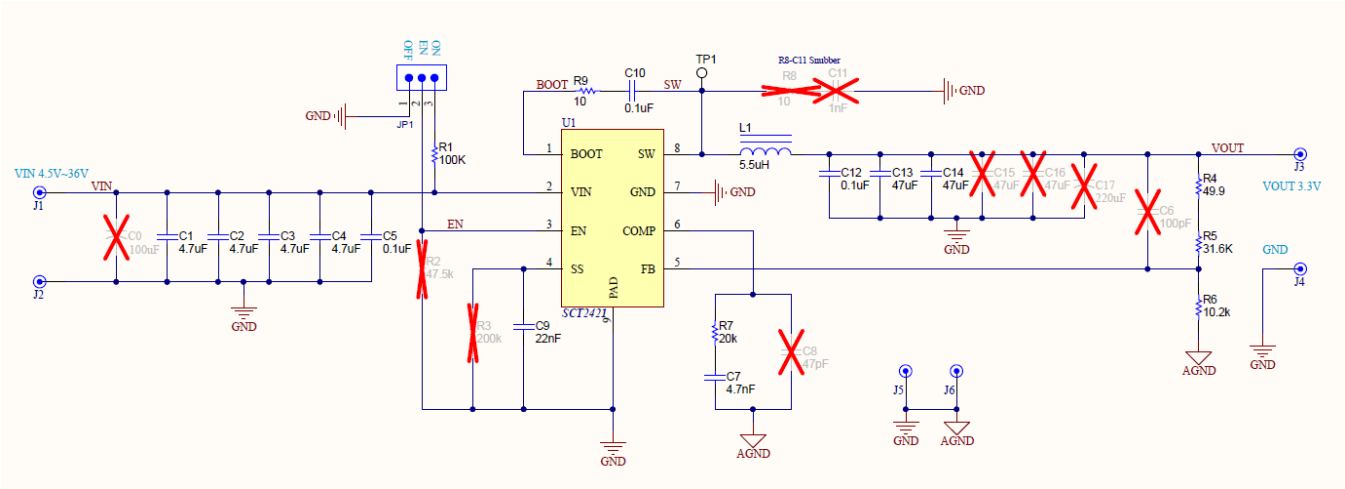


Figure 4. SCT2421 EVM Schematic

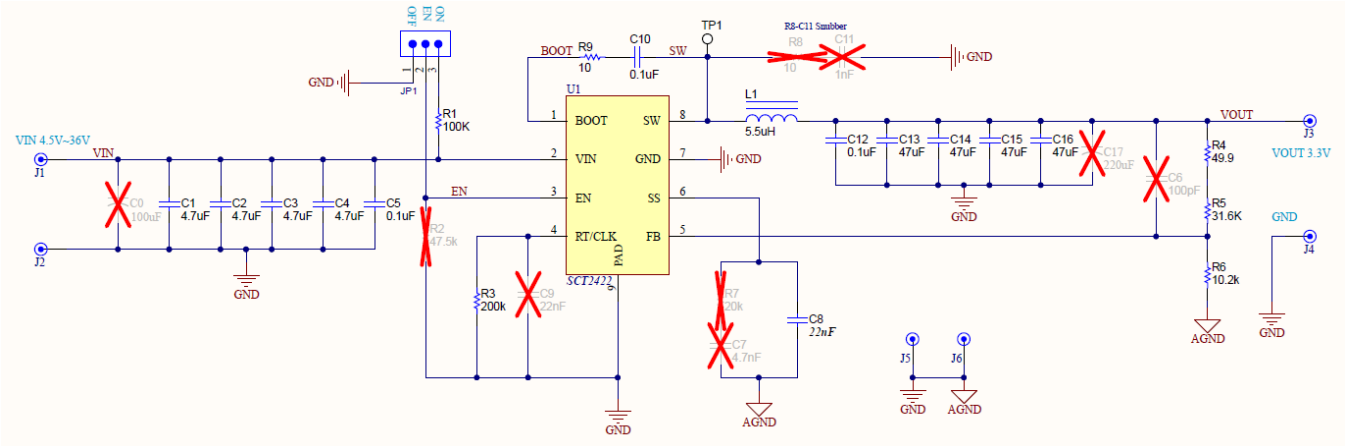


Figure 5. SCT2422 EVM Schematic

BILL OF MATERIALS

Table 2. SCT2420 EVM Bills of Materials

Manufacture	Comment	Designator	Description	Quantity
Silicon Content Technology	SCT2420	U1	SCT2420, 3.8V-36V Vin, 2A, Low Quiescent Current Synchronous Step-down Converter ESOP-8, 4.0mmX5.0mm with thermal pad	1
Wurth Elektronix	613 003 111 21	JP1	Header, 100mil, 3x1, Tin, TH	1
QJCJ Factory	Terminal 2.1	J1, J2, J3, J4	Terminal 2.1	4
QJCJ Factory	Terminal 1.1	J5,J6	Terminal 1.1	2
Wurth Elektronix	Not Installed	C0	WCAP-ATUL Aluminum Electrolytic Capacitors 100uF, 63V, Dimension 10x12.5	0
Wurth Elektronix	Not Installed	C17	WCAP-ATUL Aluminum Electrolytic Capacitors 220uF, 35V, Dimension 10x12.5	0
Wurth Elektronix	885 012 209 048	C1, C2, C3, C4	CAP, CERM, 4.7uF, 50V, +/-10%, X7R, 1210	4
Wurth Elektronix	885 012 206 095	C5, C12	CAP, CERM, 100nF, 50V, +/-10%, X7R, 0603	2
Wurth Elektronix	Not Installed	C9	CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	0
Wurth Elektronix	885 012 206 071	C10	CAP, CERM, 100nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	885 012 109 011	C13, C14	CAP, CERM, 47uF, 16V, +/- 10%, X5R, 1210	2
Wurth Elektronix	Not Installed	C15, C16	CAP, CERM, 47uF, 16 V, +/- 10%, X5R, 1210	0
Wurth Elektronix	Not Installed	C6	CAP, CERM, 100pF, 50V, +/- 10%, X7R, 0603	0
Wurth Elektronix	885 012 206 069	C7	CAP, CERM, 4.7nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	Not Installed	C8	CAP, CERM, 47pF, 25V, +/- 10%, NPO, 0603	0
Wurth Elektronix	Not Installed	C11	CAP, CERM, 1000pF, 25 V, +/- 10%, X7R, 0603	0
Wurth Elektronix	744325550	L1	Inductor, Shielded Drum Core, WE-HCI SMD Flat Wire High Current, 5.5 uH, Rate current IR 10A, Saturation Current ISAT 12A, DCR 0.0123 ohm,	1
Vishay	RC0603JR-07100KL	R1	RES 100k OHM 5% 1/10W 0603	1
Vishay	Not Installed	R2	RES, 47.5k, 1%, 0.1 W, 0603	0
Vishay	RC0603FR-07200KL	R3	RES, 200k OHM 1% 1/10W 0603	1
Vishay	CRCW060349R9FKEA	R4	RES, 49.9, 1%, 0.1 W, 0603	1
Vishay	CR0603-FX-3162ELF	R5	RES, 31.6k, 1%, 0.1 W, 0603	1
Vishay	CRCW060310K2FKEA	R6	RES, 10.2k, 1%, 0.1 W, 0603	1
Vishay	RC0603FR-0720KL	R7	RES 20k 1% 1/10W 0603	1
Vishay	Not Installed	R8	RES, 10, 1%, 0.1 W, 0603	0
Vishay	CRCW060310RFKEA	R9	RES, 10, 1%, 0.1 W, 0603	1
Keystone	5015	TP1	Test Point, Miniature, SMT	1

Table 3. SCT2421 EVM Bills of Materials

Manufacture	Comment	Designator	Description	Quantity
Silicon Content Technology	SCT2421	U1	SCT2421, 3.8V-36V Vin, 2A, Low Quiescent Current Synchronous Step-down Converter ESOP-8, 4.0mmX5.0mm with thermal pad	1
Wurth Elektronix	613 003 111 21	JP1	Header, 100mil, 3x1, Tin, TH	1
QJCJ Factory	Terminal 2.1	J1, J2, J3, J4	Terminal 2.1	4
QJCJ Factory	Terminal 1.1	J5,J6	Terminal 1.1	2
Wurth Elektronix	Not Installed	C0	WCAP-ATUL Aluminum Electrolytic Capacitors 100uF, 63V, Dimension 10x12.5	0
Wurth Elektronix	Not Installed	C17	WCAP-ATUL Aluminum Electrolytic Capacitors 220uF, 35V, Dimension 10x12.5	0
Wurth Elektronix	885 012 209 048	C1, C2, C3, C4	CAP, CERM, 4.7uF, 50V, +/-10%, X7R, 1210	4
Wurth Elektronix	885 012 206 095	C5, C12	CAP, CERM, 100nF, 50V, +/-10%, X7R, 0603	2
Wurth Elektronix	885 012 206 067	C9	CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	885 012 206 071	C10	CAP, CERM, 100nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	885 012 109 011	C13, C14	CAP, CERM, 47uF, 16V, +/- 10%, X5R, 1210	2
Wurth Elektronix	Not Installed	C15, C16	CAP, CERM, 47uF, 16 V, +/- 10%, X5R, 1210	0
Wurth Elektronix	Not Installed	C6	CAP, CERM, 100pF, 50V, +/- 10%, X7R, 0603	0
Wurth Elektronix	885 012 206 069	C7	CAP, CERM, 4.7nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	Not Installed	C8	CAP, CERM, 47pF, 25V, +/- 10%, NPO, 0603	0
Wurth Elektronix	Not Installed	C11	CAP, CERM, 1000pF, 25 V, +/- 10%, X7R, 0603	0
Wurth Elektronix	744325550	L1	Inductor, Shielded Drum Core, WE-HCI SMD Flat Wire High Current, 5.5 uH, Rate current IR 10A, Saturation Current ISAT 12A, DCR 0.0123 ohm,	1
Vishay	RC0603JR-07100KL	R1	RES 100k OHM 5% 1/10W 0603	1
Vishay	Not Installed	R2	RES, 47.5k, 1%, 0.1 W, 0603	0
Vishay	RC0603FR-07200KL	R3	RES, 200k OHM 1% 1/10W 0603	0
Vishay	CRCW060349R9FKEA	R4	RES, 49.9, 1%, 0.1 W, 0603	1
Vishay	CR0603-FX-3162ELF	R5	RES, 31.6k, 1%, 0.1 W, 0603	1
Vishay	CRCW060310K2FKEA	R6	RES, 10.2k, 1%, 0.1 W, 0603	1
Vishay	RC0603FR-0720KL	R7	RES 20k 1% 1/10W 0603	1
Vishay	Not Installed	R8	RES, 10, 1%, 0.1 W, 0603	0
Vishay	CRCW060310RFKEA	R9	RES, 10, 1%, 0.1 W, 0603	1
Keystone	5015	TP1	Test Point, Miniature, SMT	1

Table 4. SCT2422 EVM Bills of Materials

Manufacture	Comment	Designator	Description	Quantity
Silicon Content Technology	SCT2422	U1	SCT2422A, 3.8V-36V Vin, 2A, Low Quiescent Current Synchronous Step-down Converter ESOP-8, 4.0mmX5.0mm with thermal pad	1
Wurth Elektronix	613 003 111 21	JP1	Header, 100mil, 3x1, Tin, TH	1
QJCJ Factory	Terminal 2.1	J1, J2, J3, J4	Terminal 2.1	4
QJCJ Factory	Terminal 1.1	J5	Terminal 1.1	1
Wurth Elektronix	Not Installed	C0	WCAP-ATUL Aluminum Electrolytic Capacitors 100uF, 63V, Dimension 10x12.5	0
Wurth Elektronix	Not Installed	C17	WCAP-ATUL Aluminum Electrolytic Capacitors 220uF, 35V, Dimension 10x12.5	0
Wurth Elektronix	885 012 209 048	C1, C2, C3, C4	CAP, CERM, 4.7uF, 50V, +/-10%, X7R, 1210	4
Wurth Elektronix	885 012 206 095	C5, C12	CAP, CERM, 100nF, 50V, +/-10%, X7R, 0603	2
Wurth Elektronix	Not Installed	C9	CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	0
Wurth Elektronix	885 012 206 071	C10	CAP, CERM, 100nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	885 012 109 011	C13, C14,C15, C16	CAP, CERM, 47uF, 50 V, +/- 10%, X5R, 1210	4
Wurth Elektronix	Not Installed	C6	CAP, CERM, 100pF, 50V, +/- 10%, X7R, 0603	0
Wurth Elektronix	Not Installed	C7	CAP, CERM, 4.7nF, 25 V, +/- 10%, X7R, 0603	0
Wurth Elektronix	885 012 206 067	C8	CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	1
Wurth Elektronix	Not Installed	C11	CAP, CERM, 1000pF, 25 V, +/- 10%, X7R, 0603	0
Wurth Elektronix	744325550	L1	Inductor, Shielded Drum Core, WE-HCI SMD Flat Wire High Current, 5.5 uH, Rate current IR 10A, Saturation Current ISAT 12A, DCR 0.0123 ohm,	1
Vishay	RC0603JR-07100KL	R1	RES 100k OHM 5% 1/10W 0603	1
Vishay	Not Installed	R2	RES, 47.5k, 1%, 0.1 W, 0603	0
Vishay	RC0603FR-07200KL	R3	RES, 200k OHM 1% 1/10W 0603	1
Vishay	CRCW060349R9FKEA	R4	RES, 49.9, 1%, 0.1 W, 0603	1
Vishay	CR0603-FX-3162ELF	R5	RES, 31.6k, 1%, 0.1 W, 0603	1
Vishay	CRCW060310K2FKEA	R6	RES, 10.2k, 1%, 0.1 W, 0603	1
Vishay	Not Installed	R7	RES 20k 1% 1/10W 0603	0
Vishay	Not Installed	R8	RES, 10, 1%, 0.1 W, 0603	0
Vishay	CRCW060310RFKEA	R9	RES, 10, 1%, 0.1 W, 0603	1
Keystone	5015	TP1	Test Point, Miniature, SMT	1

PRINTED CIRCUIT BOARD LAYOUT

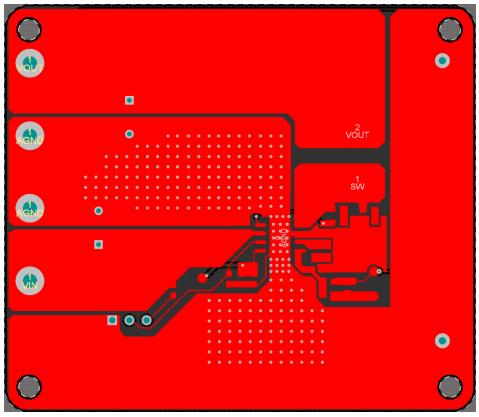


Figure 6. Top Layer

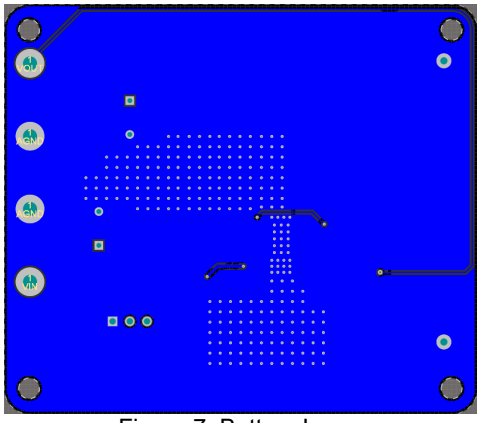


Figure 7. Bottom Layer

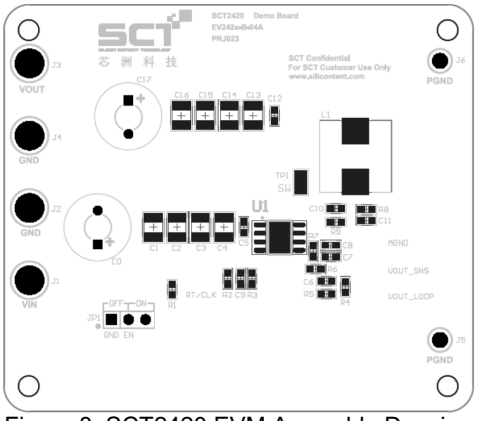


Figure 8. SCT2420 EVM Assemble Drawing

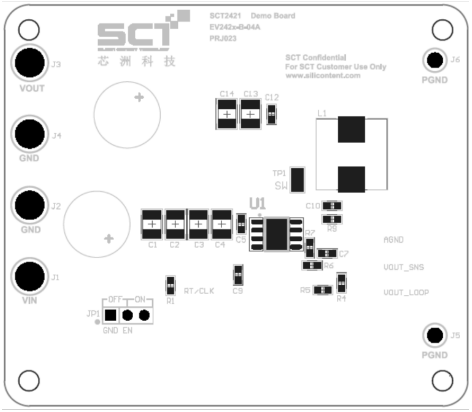


Figure 9. SCT2421 EVM Assemble Drawing

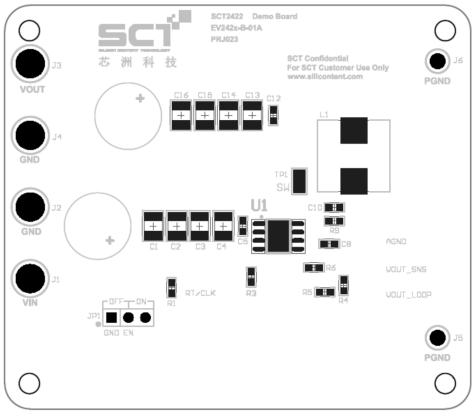


Figure 10. SCT2422 EVM Assemble Drawing

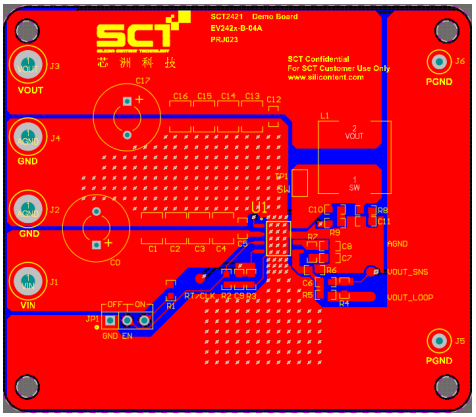


Figure 11. SCT2421 EVM composite view

EVB TEST RESULTS

Unless otherwise noted, VIN=12V, VOUT=3.3V, Load=2A, Freq= 500KHz

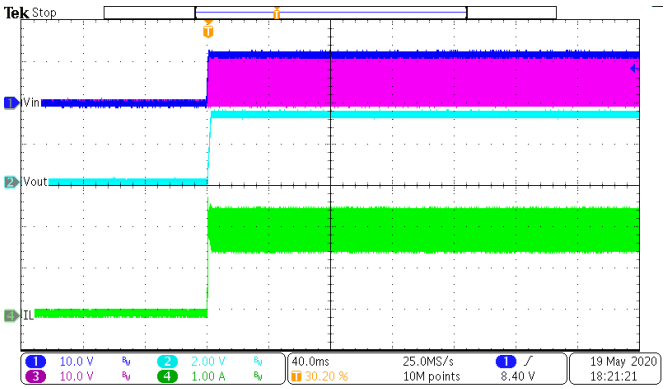


Figure 12. Power up

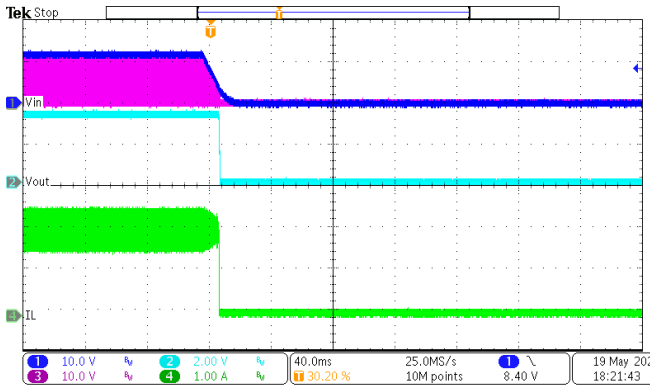


Figure 13. Power down

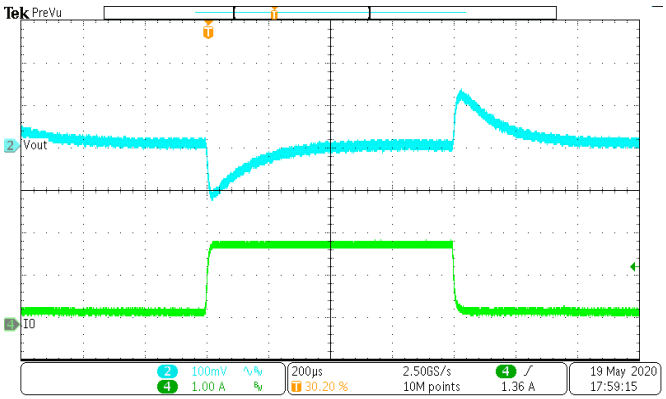


Figure 14. Load Transient (0.2A-1.8A, 1.6A/us)

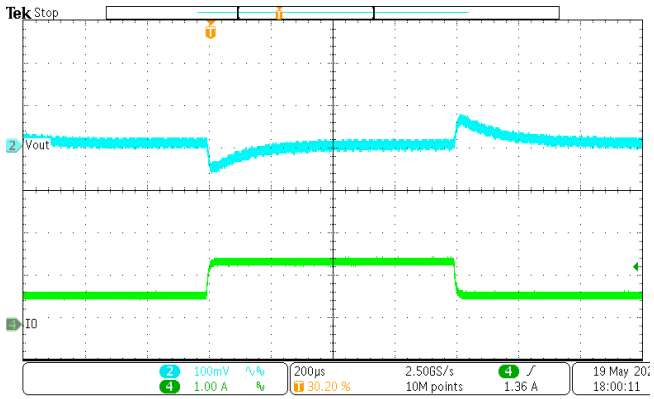


Figure 15. Load Transient (0.6A-1.4A, 1.6A/us)

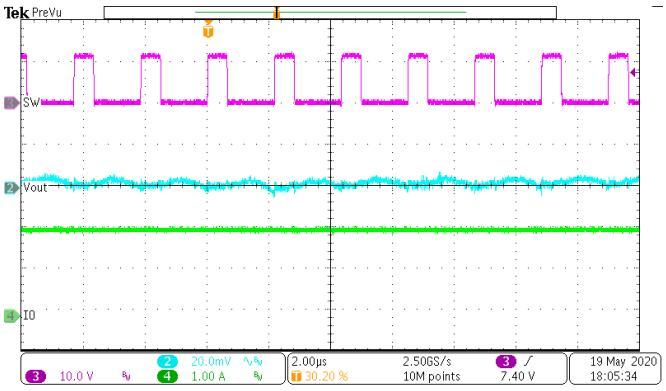


Figure 16. SW and Vout Ripple (Iout=2A)

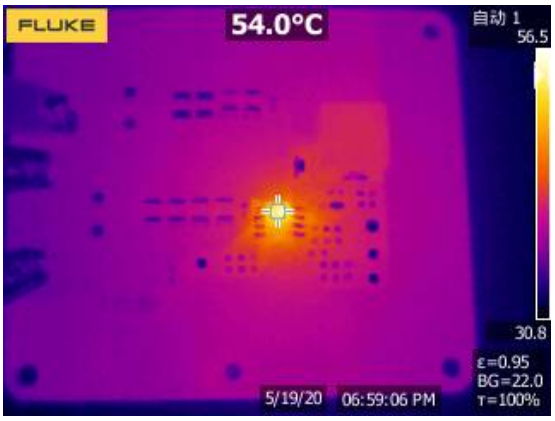


Figure 17. Thermal, 3.3Vout/2A

OPTIONAL MODIFICATION

Switching Frequency

The resistor R3 connected from SCT2420, and SCT2422 RT/CLK pin to ground (Default 200KΩ) sets switching frequency of the converter. Use equation 1 to set a desired frequency.

The switching frequency in SCT2421 is fixed at 570KHz.

Eq. (1)

$$R_3 = \frac{100000}{fsw\ (KHz)} \tag{1}$$

where:

- f_{SW} is the desired switching frequency

Table 3. R_3 Value for Common Switching Frequencies (Room Temperature)

fsw	R_3
200 KHz	500 KΩ
330 KHz	301 KΩ
500 KHz	200 KΩ
1100 KHz	90.9 KΩ

Soft-Start

The SCT2420 integrates an internal soft-start circuit that ramps the reference voltage from zero volts to its final reference voltage in 2ms. If the EN pin is pulled below 1.1V, switching stops and the internal soft-start resets. The soft-start also resets in thermal shutdown.

The SCT2421 and SCT2422 features programmable soft-start time by easily connect a capacitor C9 from SS pin to ground. Without connecting any capacitor, the soft-start time is default 2ms generated from the internal circuitry. Using a capacitor, the programmed soft-start time should be larger than 2ms. The capacitor value can be calculated going with following Eq. (2)

$$C_9 = t_{soft-start} * \frac{5uA}{0.8V} \tag{2}$$

where:

- $t_{soft-start}$ is the programmed soft-start time

Output Voltage

The output voltage is set by an external resistor divider R_5 and R_6 in EVM schematic. The values of R_5 and R_6 can be calculated by equation 3A minimum current of typical 20uA flowing through feedback resistor divider gives good accuracy and noise covering.

$$R_5 = \frac{(V_{OUT} - V_{REF}) \times R_6}{V_{REF}} \tag{3}$$

where:

- V_{REF} is the feedback reference voltage, typical 0.8V

Table 4. Feedback Resistor R_5 and R_6Value for Output Voltage (Room Temperature)

V_{OUT}	R_5	R_6
1.8 V	12.7 KΩ	10.2 KΩ
2.5 V	21.5 KΩ	10.2 KΩ
3.3 V	31.6 KΩ	10.2 KΩ
5 V	53.6 KΩ	10.2 KΩ
12 V	143 KΩ	10.2 KΩ
24V	294 KΩ	10.2 KΩ

Under Voltage Lockout Threshold

The SCT2420, SCT2421and SCT2422 are enabled when the VIN pin voltage rises about 3.5V and the EN pin voltage exceeds the enable threshold of 1.18V. The device is disabled when the VIN pin voltage falls below 3.1V or when the EN pin voltage is below 1.1V. An internal1.5uA pull up current source to EN pin allows the device enable when EN pin is floating.

If an application requires a higher system under voltage lockout threshold, two external resistors divider (R1 and R2) in Figure 3 can be used to achieve an expected system UVLO. The UVLO rising and falling threshold can be calculated by Equation 4 and Equation 5 respectively.

$$V_{rise} = 1.18 * \left(1 + \frac{R1}{R2}\right) - 1.5uA * R1 \qquad (3)$$

$$V_{fall} = 1.1 * \left(1 + \frac{R1}{R2}\right) - 5.5uA * R1 \qquad (4)$$

where:

- V_{rise} is the rising threshold of Vin UVLO.
- V_{fall} is the falling threshold of Vin UVLO

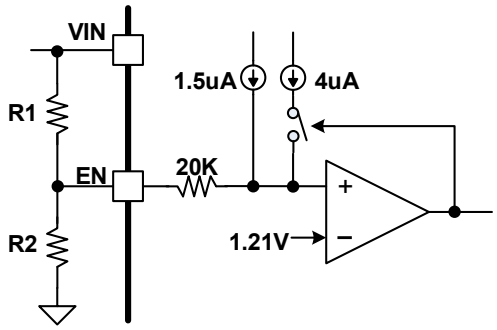


Figure 18. VIN UVLO Programmable by EN Dividers

IMPORTANT NOTICE

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