

3.8V-40V Vin, 3.5A High Efficiency Synchronous Step-down DCDC Converter Evaluation Board

FEATURES

- Wide Input Range: 3.8V-40V
- Up to 3.5A Continuous Output Current
- 0.8V \pm 1% Feedback Reference Voltage
- Integrated 80m Ω High-Side R_{ds(on)} and 50m Ω Low-Side R_{ds(on)} Power MOSFETs
- 25 μ A Low Quiescent Current with Pulse Skipping Mode PSM at Light Load
- 100KHz to 2.2MHz Adjustable Frequency and External Clock Synchronization (SCT2430, SCT2432, SCT2439)
- Adjustable Soft-start (SCT2431, SCT2432)
- Low Dropout Mode Operation
- Derivable Inverting Voltage Regulator
- EMI Reduction with Frequency Spread Spectrum FSS
- Over-voltage and Over Temperature Protection
- Available in an ESOP-8 Package

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 EV2430-B-03A Evaluation Board is designed to demonstrate the capabilities of SCT2430, SCT2431, SCT2432 and SCT2439, high efficiency fully integrated synchronous step-down DCDC converter supporting up to 3.5A continuous output current from an input source from 3.8V to 40V. The SCT2430, SCT2432 and SCT2439 offer adjustable switching frequency ranging from 100kHz to 2.2MHz with internal 4ms soft-start, which provides flexibility to optimize either efficiency or external component size. The SCT2431 features adjustable soft-start with fixed 570kHz switching frequency. Both devices are available in an easy-soldering 8-pin ESOP package.

This user's guide describes the characteristics, operation and the use of the EV2430-B-03A Evaluation Module including EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

Board Number	IC Number
EV2430-B-03A	SCT2430, SCT2431, SCT2432, SCT2439

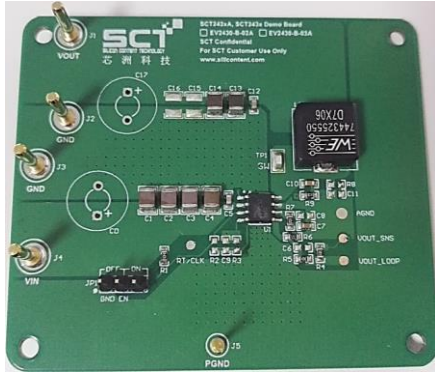
PERFORMANCE SUMMARY

Table 1. Performance

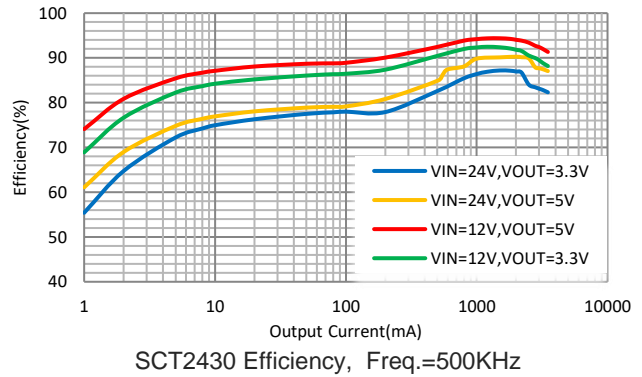
Specifications are at TA = 25°C

Parameter	Condition	Value
Input Voltage	DC up to 40V	3.8V-40V
Output Voltage	I _{out} =0A~3.5A	3.3V \pm 1%
Output Current	Continuous DC current	3.5A
Frequency	Default R3=200K Ω	500KHz

EV2430-B-03A



EV2430-B-03A Evaluation Board Top View



QUICK START PROCEDURE

Evaluation board EV2430-B-03A is easy to set up to evaluate the performance of SCT2430, SCT2431, SCT2432 and SCT2439 synchronous step-down DCDC converter. Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

- Place jumpers in the following positions:
 - J1: Connect the power supply to the input of converter.
 - J2: Connect the load to the output of converter.
 - JP1: Enable. ON Connect EN pin to V_{in} through a 100K Ω resistor to enable IC. OFF Disable IC
- With power off, connect the input power supply to J1 V_{in} connector and J1 GND connector. Make sure that the input voltage does not exceed 40V, and supports sufficient current limit. Turn on the power at the input.
- Check the output voltage at J2. 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.
- To use the enable function, apply a digital input to the EN pin of JP1.
- Users can place C0 if input wire is long and C17 for better load transient performance.

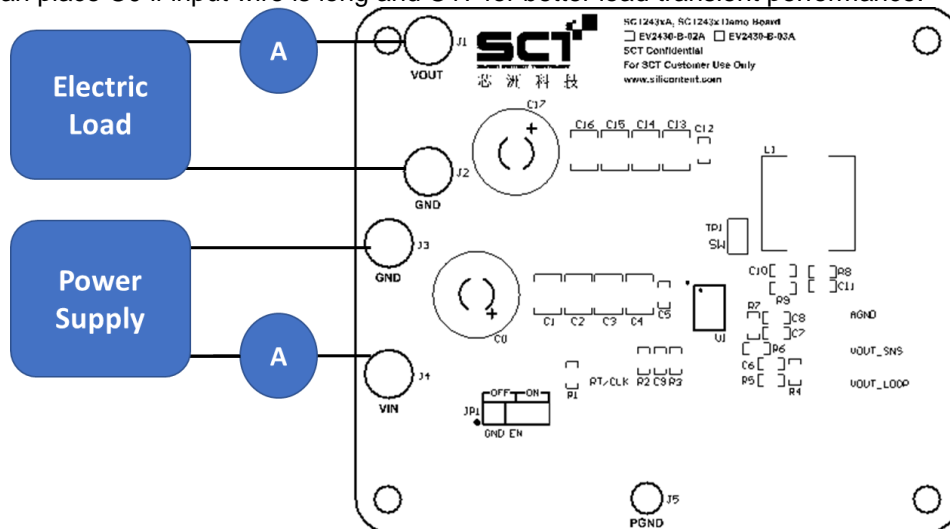


Figure 1. Power Supply, Load and Measurement Equipment Setup

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

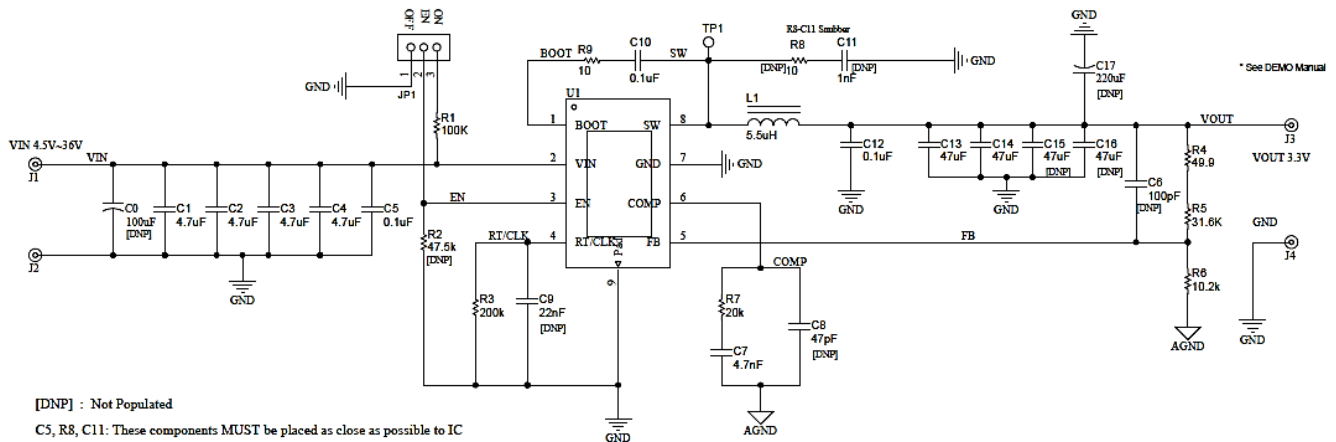


Figure 3. Evaluation Board Schematic

BILL OF MATERIALS

Table 2. Bills of Materials

Manufacture	Comment	Designator	Description	Quantity
Silicon Content Technology	SCT2430	U1	SCT2430A, 3.8V-36V Vin, 3.5A, Low Quiescent Current Synchronous Step-down Converter ESOP-8, 4.0mmX5.0mm with thermal pad	1
Würth Elektronik	613 002 111 21	JP1	Header, 100mil, 2x1, Tin, TH	1
QJCJ Factory	Terminal 2.1	J2, J2, J3, J4	Terminal 2.1	4
QJCJ Factory	Terminal 1.1	J5	Terminal 1.1	1
Würth Elektronik	860 040 775 006	C0	WCAP-ATUL Aluminum Electrolytic Capacitors 100uF, 63V, Dimension 10x12.5	Not Installed
Würth Elektronik	860 040 575 007	C17	WCAP-ATUL Aluminum Electrolytic Capacitors 220uF, 35V, Dimension 10x12.5	Not Installed

Würth Elektronik	885 012 209 048	C1, C2, C3, C4	CAP, CERM, 4.7uF, 50V, +/-10%, X7R, 1210	4
Würth Elektronik	885 012 206 095	C5, C12	CAP, CERM, 100nF, 50V, +/-10%, X7R, 0603	2
Würth Elektronik	885 012 206 067	C9	CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	Not Installed For SCT2430/9 Demo
			CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	1 For SCT2431 Demo
			CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	Not Installed For SCT2432 Demo
Würth Elektronik	885 012 206 071	C10	CAP, CERM, 100nF, 25 V, +/- 10%, X7R, 0603	1
Würth Elektronik	885 012 109 011	C13, C14	CAP, CERM, 47uF, 50 V, +/- 10%, X5R, 1210	2
Würth Elektronik	885 012 109 011	C15, C16	CAP, CERM, 47uF, 50 V, +/- 10%, X5R, 1210	2 for SCT2432
Würth Elektronik	885 012 206 077	C6	CAP, CERM, 100pF, 50V, +/- 10%, X7R, 0603	Not Installed
Würth Elektronik	885 012 206 069	C7	CAP, CERM, 4.7nF, 25 V, +/- 10%, X7R, 0603	1 For SCT2430/1/9, Demo
				Not Installed For SCT2432 Demo
Würth Elektronik	885 012 006 036	C8	CAP, CERM, 47pF, 25V, +/- 10%, NPO, 0603	Not Installed
	885 012 206 067		CAP, CERM, 22nF, 25 V, +/- 10%, X7R, 0603	1 For SCT2432 Demo
Würth Elektronik	885 012 206 059	C11	CAP, CERM, 1000pF, 25 V, +/- 10%, X7R, 0603	Not Installed
Würth Elektronik	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	CRCW060347K5FKEA	R2	RES, 47.5k, 1%, 0.1 W, 0603	Not Installed
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 For SCT2430/1/9 Demo
				Not Installed For SCT2432 Demo
Vishay	CRCW060310RFKEA	R8	RES, 10, 1%, 0.1 W, 0603	Not Installed
Vishay	CRCW060310RFKEA	R9	RES, 10, 1%, 0.1 W, 0603	1
Keystone	5015	TP1	Test Point, Miniature, SMT	1

PRINTED CIRCUIT BOARD LAYOUT

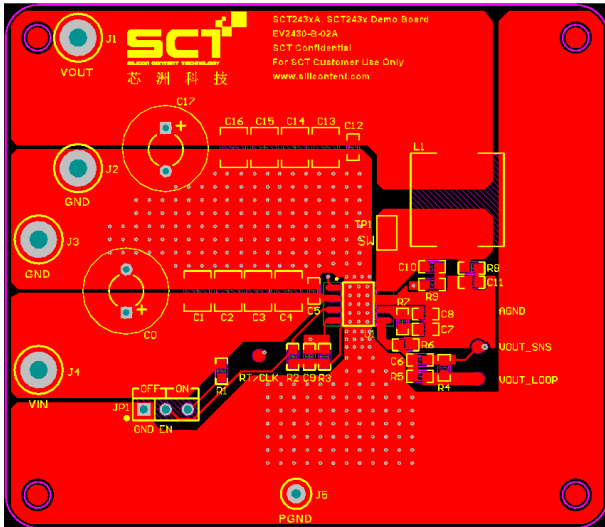


Figure 4. Top Layer

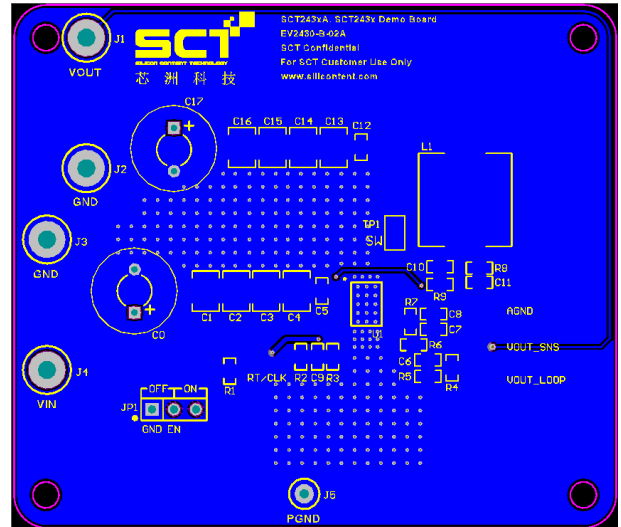


Figure 5. Bottom Layer

EVB TEST RESULTS

Vin=24V, Vout=3.3V, unless otherwise noted

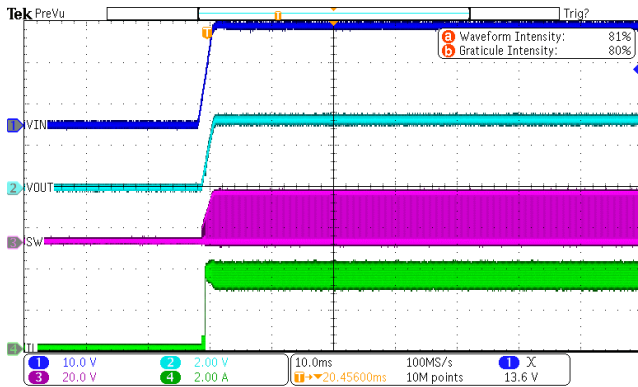


Figure 6. Power Up
 (CH-1: Vin, CH-2: Vout, CH-3: SW, CH-4: IL)

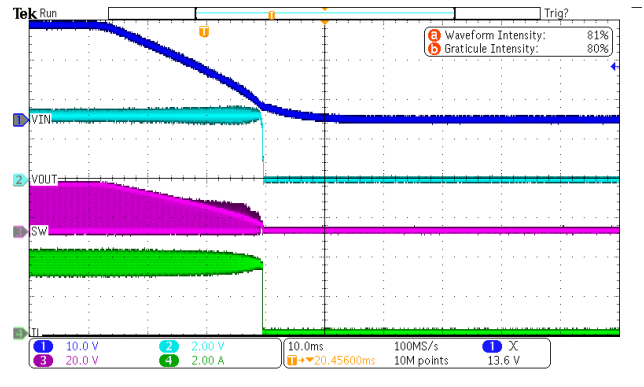


Figure 7. Power Down
 (CH-1: Vin, CH-2: Vout, CH-3: SW, CH-4: IL)

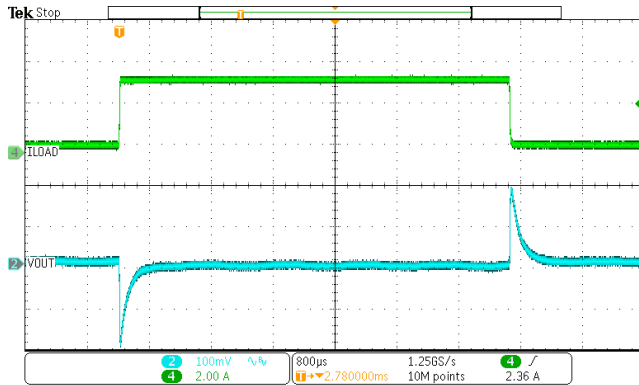


Figure 8. Load Transient
 (0.35A-3.15A, SR=250mA/us, CH-1: Iout, CH-2: Vout)

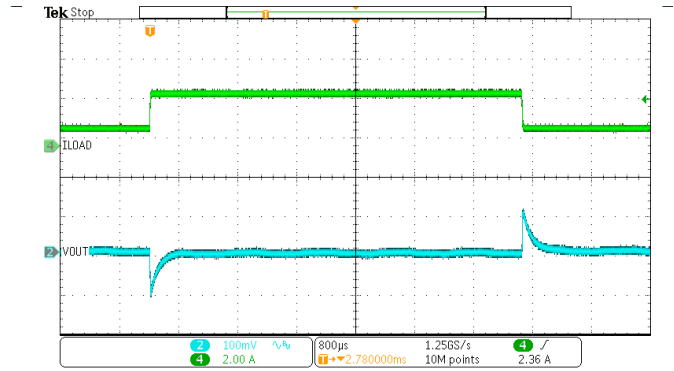


Figure 9. Load Transient
 (0.87A-2.7A, SR=250mA/us, CH-1: Iout, CH-2: Vout)

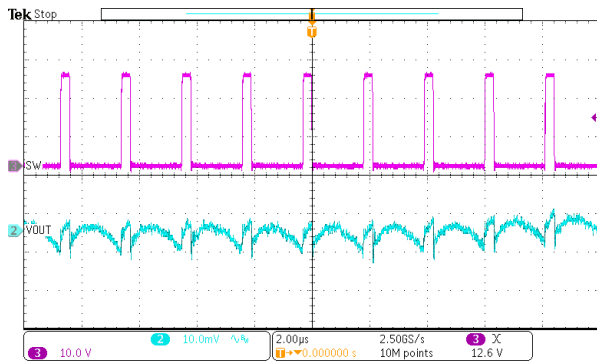


Figure 10. Output Ripple, PWM, Iout=3.5A
 (CH-1: Vin, CH-2: Vout, CH-3: SW, CH-4: IL)

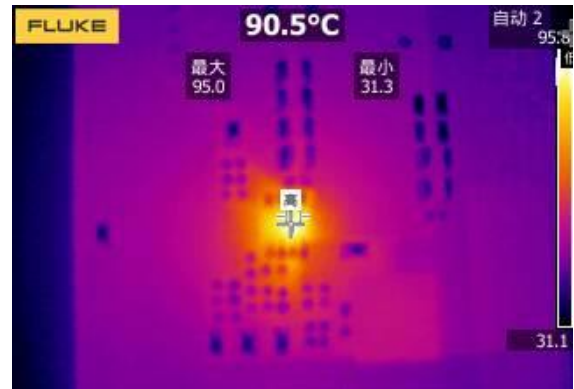


Figure 11. Thermal, 3.3Vout/3.5A
 (CH-1: Vin, CH-2: Vout, CH-3: SW, CH-4: IL)

OPTIONAL MODIFICATION

Switching Frequency

The resistor R3 connected from SCT2430, SCT2432 and SCT2439 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 SCT2431 is fixed 570KHz.

Eq. (3)

$$R_3 = \frac{100000}{f_{sw} (KHz)} \quad (1)$$

where:

- f_{sw} is the desired switching frequency

**Table 3. R₃ 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 SCT2430 and SCT2439 integrates an internal soft-start circuit that ramps the reference voltage from zero volts to its final reference voltage in 4ms. 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 SCT2431 and SCT2432 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 4ms generated from the internal circuitry. Using a capacitor, the programmed soft-start time should be larger than 4ms. The capacitor value can be calculated going with following Eq. (3)

$$C_9 = t_{soft-start} * \frac{5\mu A}{0.8V} \quad (2)$$

where:

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

Output Voltage

The output voltage is set by an external resistor divider R₅ and R₆ in EVM schematic. The values of R₅ and R₆ can be calculated by equation 3A minimum current of typical 20uA flowing through feedback resistor divider gives good accuracy and noise covering.

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

where:

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

**Table 4. Feedback Resistor R₅ and R₆ Value 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 SCT2430, SCT2431, SCT2432 and SCT2439 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 internal 1.5uA 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.

$$V_{\text{rise}} = 1.18 * \left(1 + \frac{R1}{R2}\right) - 1.5\mu\text{A} * R1 \quad (3)$$

$$V_{\text{fall}} = 1.1 * \left(1 + \frac{R1}{R2}\right) - 5.5\mu\text{A} * R1 \quad (4)$$

where:

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

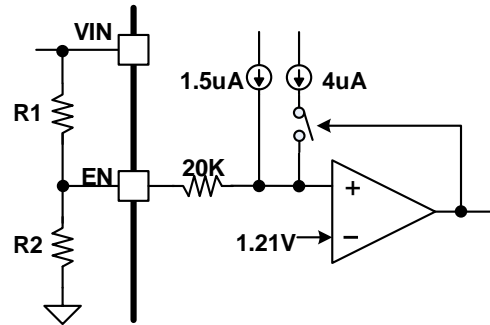


Figure 12. VIN UVLO Programmable by EN Dividers

IMPORTANT NOTICE

This evaluation board kit being sold or provided by Silicon Content Technology is intended for use for ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY and is not provided by SCT for commercial use. As such, the evaluation board herein may not be complete in terms of required design, marketing, and/or manufacturing related protective considerations, including but not limited to product safety measures typically found in finished commercial goods. The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user releases SCT from all claims arising from the handling or use of the goods. Due to the open construction of the product, it is the user's responsibility to take all appropriate precautions regarding electrostatic discharge. Also, be aware that the products herein may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). No License is granted under any patent right or other intellectual property whatsoever. SCT assumes no liability for applications assistance, customer product design, software performance, or infringement of patents or any other intellectual property rights of any kind. Please read the Evaluation Board user's guide prior to handling the product. Persons handling this product must have electronics training and observe good laboratory practice standards. Common sense is encouraged. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact a SCT application engineer.