SCT53600 Evaluation Board User's Guide

FEATURES

- 4.7V to 65V Operating Range
- Evaluation board designed for 12V systems
- Other voltage conditions need to change or remove TVS
- –65V Reverse voltage rating
- Charge pump for external N-Channel MOSFET
- 20mV ANODE to CATHODE forward voltage drop regulation
- 12V Gate Drive Voltage
- With Enable Input
- Drive High Side External N-Channel MOSFET
- 1μA Shutdown current (EN=Low)
- 60μA Operating quiescent current (EN=High)
- 2.3-A Peak gate turnoff current
- Fast reverse current turn-off within 0.75us
- Meets automotive ISO7637 transient requirements with a suitable TVS Diode
- Available in an TSOT23-6L Package

APPLICATIONS

- Automotive Battery Protection
- Redundant Power Supplies
- Industrial Factory Automation
- Enterprise Power Supplies
- Network Telecom Power Systems
- Servers

DESCRIPTION

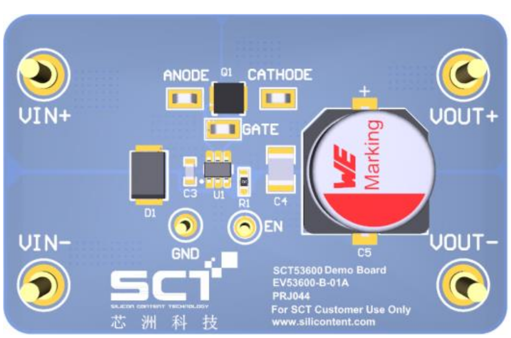
The EV53600-B-01A Evaluation Board is designed to demonstrate the capabilities of SCT53600, Typical applications of evaluation boards are automotive 12V systems. TVS can be applied to automotive 24V systems by changing them. Other voltages and applications can be changed or removed according to the actual situation. Prevent TVS from being damaged.
The SCT53600 controller provides a charge pump gate drive for an external N-channel MOSFET. The device regulates the forward voltage drop across the external MOSFET to 20mV allowing smooth, ring-free operation with providing very fast turn-off(< 0.75 μs) of the MOSFET during a reverse event to minimize reverse current if power source fails or input micro-short conditions. The fast response to Reverse Current Blocking makes the device suitable for systems with output voltage holdup requirements during ISO7637 pulse testing.

This user's guide describes the characteristics, operation and the use of the EV53600-B-01A Evaluation Module including EVM specifications, recommended test setup, test result, schematic diagram, bill of materials, and the board layout.

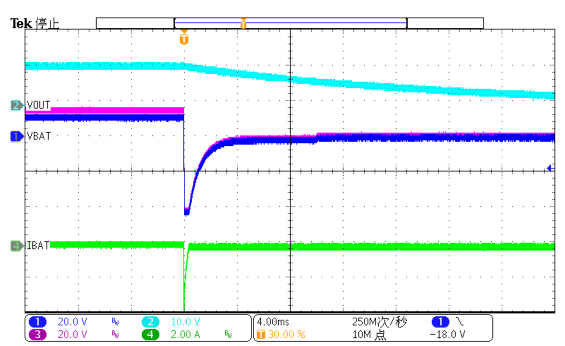
Board Number	IC Number
EV53600-B-01A	SCT53600

PERFORMANCE SUMMARY

Parameter	Condition	Value
Input Voltage	DC up to 18V	4.7V-18V
Output Current	Continuous DC current	5A



EV53600-B-01A Evaluation Board Top View



ISO 7637-2 Pulse 1 in 12V systems

QUICK START PROCESURE

Evaluation board EV53600-B-01A is easy to set up to evaluate the performance of SCT53600 ORing controller Refer to Figure 1 for proper measurement equipment setup and follow the procedure below:

1. Place jumpers in the following positions:
   - VIN+: Connect the power supply to the ANODE and MOS source.
   - VOUT+:Connect the load to the CATHODE and MOS drain.
   - VIN-: Connect the power supply GND.
   - VOUT-: Connect the load GND.
   - EN: Enable pin, Pull up to VIN through R1 resistor (0Ω). When external signals are required for control, remove the R1 resistor to prevent damage to the control end.
   - ANODE,CATHODE: Test ideal diode with load drop.
   - GATE: Test the control voltage of the MOS gate.
2. With power off, connect the input power supply to VIN+ connector and VIN- connector.Turn on the power at the input.
3. To use the enable function, After removing R1 apply a digital input to the EN.

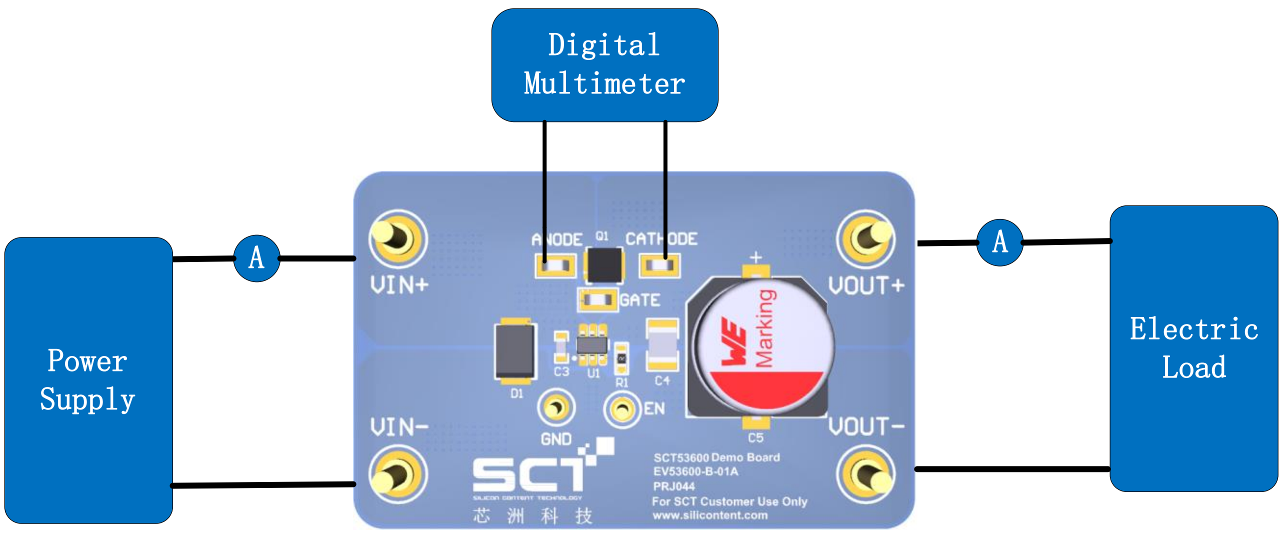


Figure 1. Power Supply, Load and Measurement Equipment Setup

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

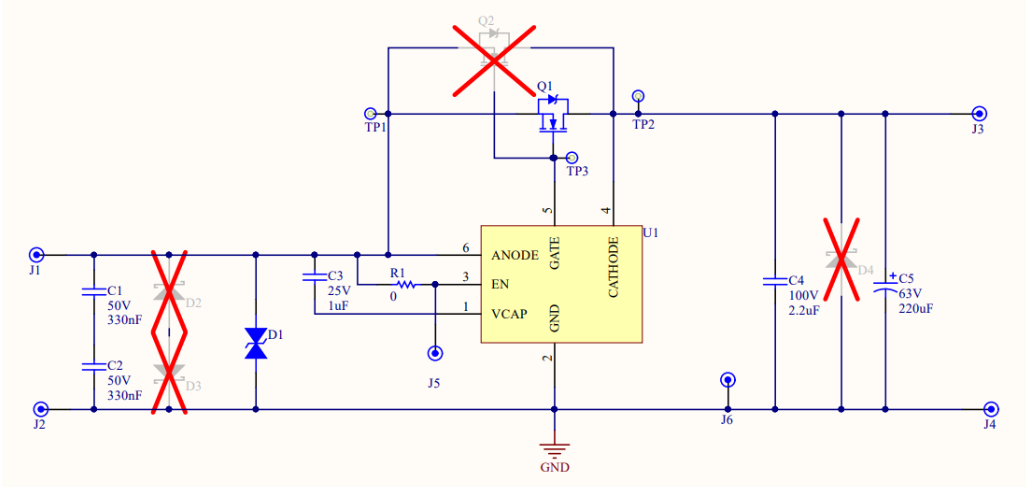


Figure 3. SCT53600 EVM Schematic

BILL OF MATERIALS

Table 2. SCT53600 EVM Bills of Materials

PartNumber	Manufacture	Designator	Description	Quantity
SCT53600	Silicontent Technology	U1	Low IQ Reverse Battery Protection Ideal Diode Controller	1
Terminal_2.1	NA	VIN+, VIN-, VOUT+,VOUT-	Terminal, copper pillar, 2.1mm	4
Terminal_1.1	NA	EN,GND	Terminal, copper pillar, 1.1mm	2
5015	Keystone	ANODE,CATHODE,GATE	WCAP-ATUL Aluminum Electrolytic Capacitors 220uF, 35V, Dimension 10x12.5	3
BSZ100N06LS3G	Infineon	Q1	MOSFET, N-Channel, 60V, 10mΩ,	1
BSC067N06LS3G	Infineon	Q2	MOSFET, N-Channel, 60V, 6.7mΩ	0
RC0603FR-070RL	YAGEO	R1	Resistor, 0, 1% 0.1W, 0603	1
SMBJ36CAQ	DIODES	D1	TVS, 36V,58.1VC Bilateral,AEC-Q101	1
SMBJ58AQ	DIODES	D2,D4	TVS, 58V,93.6VC Unidirectional,AEC-Q101	0
SMBJ24AQ	DIODES	D3	TVS, 24V,38.9VC Unidirectional,AEC-Q101	0
885 012 208 090	Wurth Electronix	C1,C2	CAP, CERM, 330nF, 50V, +/- 10%, X7R, 1206	2
885 012 206 076	Wurth Electronix	C3	CAP, CERM, 1uF, 25V, +/- 10%, X7R, 0603	1
885 012 209 071	Wurth Electronix	C4	CAP, CERM, 2.2uF, 100V, +/- 10%, X7R, 1210	1
865 060 762 009	Wurth Electronix	C5	CAP, AL, 220uF, 63V, +/- 10%, SMT	1

Q2 is recommended for high current applications.

In a 24V system, you are advised to replace D1 with D2 and D3, The selection of devices is in the limit state to reflect product performance, and can be moderately reduced in practice.

PRINTED CIRCUIT BOARD LAYOUT

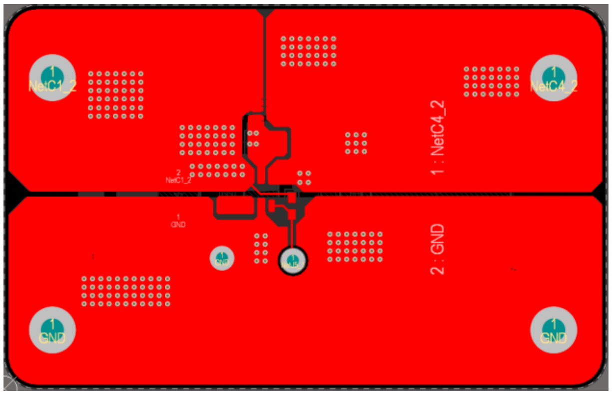


Figure 4. Top Layer

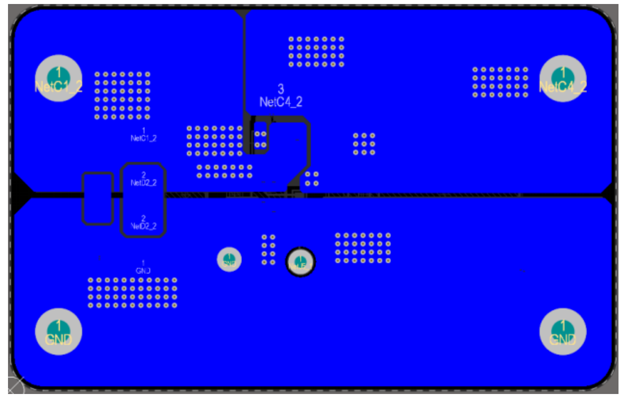


Figure 5. Bottom Layer

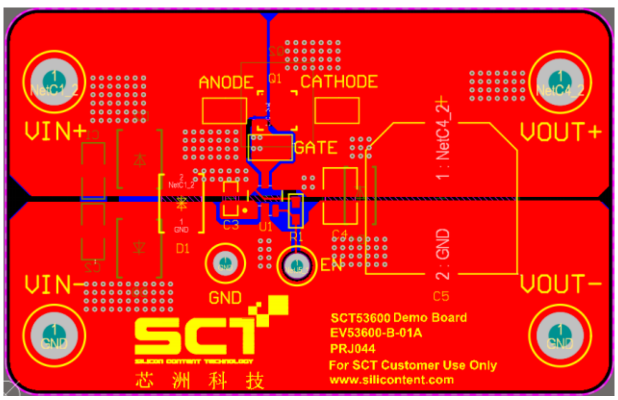


Figure 6. EVM composite view

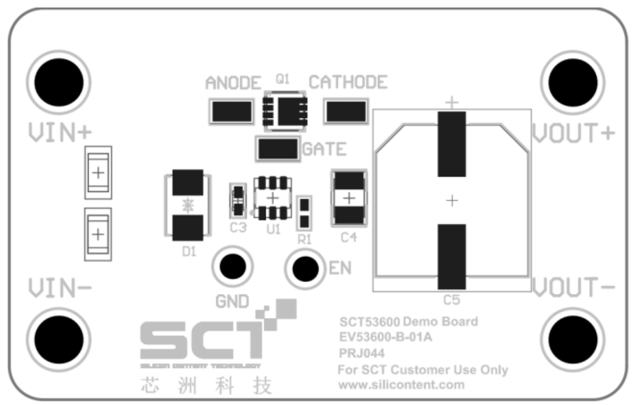


Figure 7. EVM Assemble Drawing

EVB TEST RESULTS

Power supply=12V, unless otherwise noted

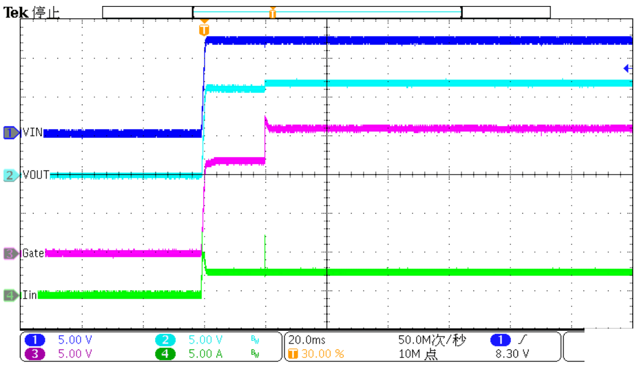


Figure 8. Start up with 2A load
(CH-1: Vin, CH-2: Vout, CH-3: Gate, CH-Iin)

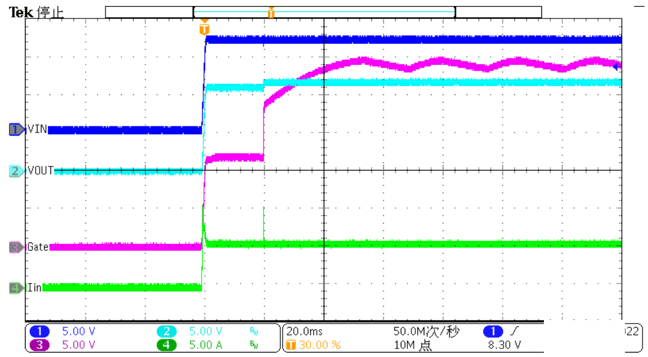


Figure 9. Start up with 5A load
(CH-1: Vin, CH-2: Vout, CH-3: Gate, CH-Iin)

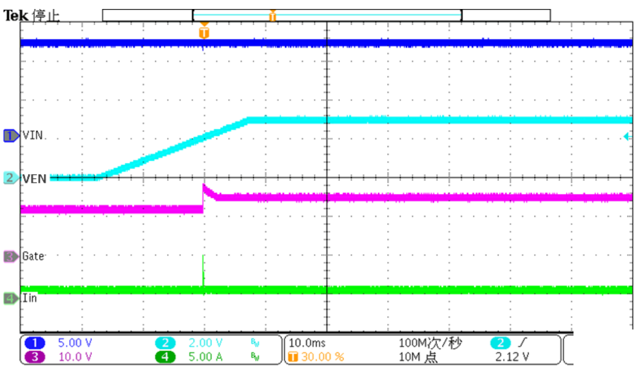


Figure 10. Enable Threshold
(CH-1: Vin, CH-2: VEN, CH-3: Gate, CH-Iin)

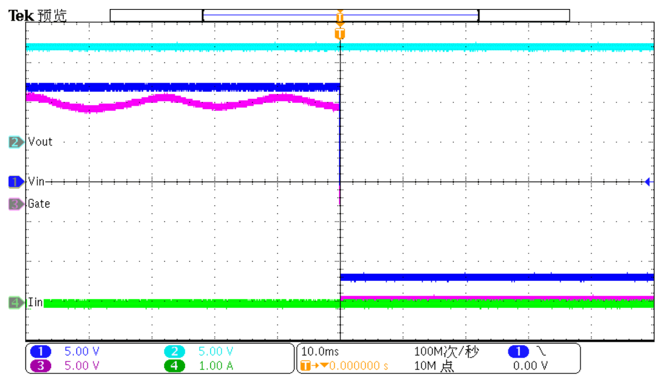


Figure 11. Static Reverse Polarity
(CH-1: Vin, CH-2: Vout, CH-3: Gate, CH-Iin)

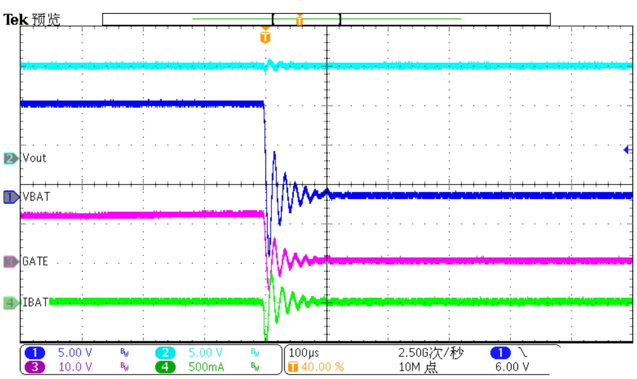


Figure 12. Input Short Response
(CH-1: Vin, CH-2: Vout, CH-3: Gate, CH-IBat)

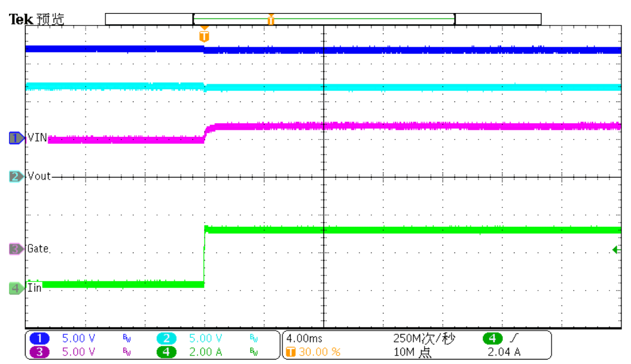


Figure 13. Load Transient Response
(CH-1: Vin, CH-2: Vout, CH-3: Gate, CH-IBat,LOAD=1A-2A)

OPTIONAL MODIFICATION

MOSFET Selection

MOSFET selection is critical to designing a proper protection circuit. Several factors must be considered: gate capacitance, maximum continuous drain current I_D, maximum drain-to-source voltage rating, on-resistance $R_{DS(ON)}$, maximum source current through body diode, peak power dissipation capability and the average power dissipation limit. Gate capacitance is not as critical, but it does determine the length of turn-on and turn-off times. MOSFETs with more gate capacitance tend to respond more slowly.

The maximum continuous drain current, I_D, rating must exceed the maximum continuous load current. The maximum drain-to-source voltage, $V_{DS(MAX)}$, must be high enough to withstand the highest differential voltage seen in the application. It is recommended to use MOSFETs with voltage rating up to 60 V maximum with the SCT53600 because anode-cathode maximum voltage is 65V. The maximum V_{GS} SCT53600 can drive is 13-V, so a MOSFET with 15-V minimum V_{GS} should be selected. If a MOSFET with <15-V V_{GS} rating is selected, a zener diode can be used to clamp V_{GS} to safe level. During startup, inrush current flows through the body diode to charge the bulk hold-up capacitors at the output. The maximum source current through the body diode must be higher than the inrush current that can be seen in the application.

To reduce the MOSFET conduction losses, lowest possible $R_{DS(ON)}$ is preferred, but selecting a MOSFET based on low $R_{DS(ON)}$ may not be beneficial always. Higher $R_{DS(ON)}$ will provide increased voltage information to SCT53600 reverse comparator at a lower reverse current. Reverse current detection is better with increased $R_{DS(ON)}$. It is recommended to operate the MOSFET in regulated conduction mode during nominal load conditions and select $R_{DS(ON)}$ such that at nominal operating current, forward voltage drop VDS is close to 20 mV regulation point and not more than 50 mV.

As a guideline, it is suggested to choose (20 mV / ILoad(Nominal)) ⩽ $R_{DS(ON)}$ ⩽ (50 mV / ILoad(Nominal)).

MOSFET manufacturers usually specify $R_{DS(ON)}$ at 4.5-V V_{GS} and 10-V V_{GS}. $R_{DS(ON)}$ increases drastically below 4.5-V V_{GS} and $R_{DS(ON)}$ is highest when VGS is close to MOSFET Vth. For stable regulation at light load conditions, it is recommended to operate the MOSFET close to 4.5V VGS, i.e., much higher than MOSFET gate threshold voltage. It is recommended to choose MOSFET gate threshold voltage Vth of 2-V to 2.5V maximum. Choosing a lower Vth MOSFET also reduces the turn ON time.

Based on the design requirements, preferred MOSFET ratings are:

- 60-V $V_{DS(MAX)}$ and ±20-V $V_{GS(MAX)}$
- $R_{DS(ON)}$ at 3A nominal current: (20 mV / 3A) ⩽ $R_{DS(ON)}$ ⩽ (50 mV / 3A) = 6.67 mΩ ⩽ $R_{DS(ON)}$ ⩽ 16.67 mΩ.
- MOSFET gate threshold voltage Vth: 2V maximum

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