SBT3000 - Power Line Smart AC Switch Controller Evaluation Module

1.1 - Introduction & Background

This user's guide aims to provide information on how to use the SBT3000 Revision 3 evaluation board. Please refer to the SBT3000 datasheet for further product information and technical details. A step-by-step instruction on how to configure and operate the SBT3000 EVB is shown in this guide. You can further get in touch with SiliconBrite Technologies at info@siliconbrite.com if you have any questions.

The SBT3000 is a patent-pending, high voltage AC switch controller IC, which monitors incoming line voltage to ensure that the downstream load only operates within its safe maximum continuous voltage ratings. In an over-voltage line condition, the SBT3000 will automatically disable the AC switch to protect and isolate the load, which minimizes the potential of catastrophic overvoltage failures.

To avoid excessive in-rush current, the SBT3000 connect (turn-on) is synchronized to the zero voltage crossing of the AC line. Likewise, the turn-off is synchronized to zero load current, as sensed across the IBGT's, after an overvoltage condition occurs.

The SBT3000 Evaluation Module (EVB)* is an "engineering" (not production) type circuit board designed for testing the operation of the SBT3000 integrated circuit. The SBT3000 EVB contains an SO8 IC socket and all the necessary support components to apply an input voltage and an optional, moderate load to evaluate the device's overvoltage protection features. Although the SBT3000 EV Board contains a 10nF capacitor as the necessary minimum load, an external load may be connected between "OUT" and "NEUT"; however, the IGBT's may require an additional heat sink, depending on the load.

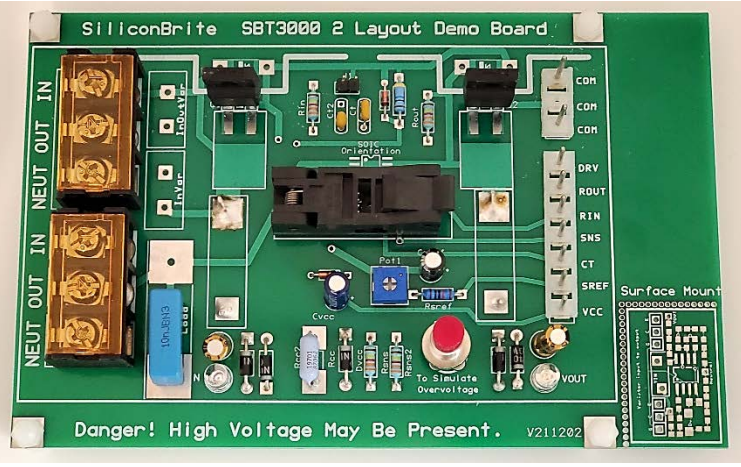

Figure 1: Top View of SBT3000 Revision 3 SBT3000 EVB

**Caution: When the SBT3000is energized, it may contain dangerous or potentially lethal voltages.*

It is simple to use the SBT3000 EV Board. The minimum operational setup, is to connect it to input power on the "IN" to "NEUT" screw terminals on the yellow plastic-covered blocks on the left-hand side of the board. If desired, a load can be connected between the "OUT" and "NEUT" terminals, but no load is necessary for the basic operation of the EV board because it has a 10nF 630V capacitor on it as the minimum load. Both the upper and lower terminal blocks are connected in parallel, as shown in Figure 3 below.

The SBT3000 IC can be monitored via the test pins on the right-side terminal strips. The signal names are the same as the pin names of the SBT3000 IC. All voltage measurements are referenced to the COM pin of the IC, which is not isolated from the line power. As the SBT3000 is a very low current IC, caution should be taken not to put a meter or scope with less than 10Meg input resistance on these test pins, or it may affect the operation of the SBT3000.

Referring to Figure 3: The SBT3000 EVB has a Red LED (bottom left) to show the presence of the input voltage. The intensity of the LED indicates the magnitude of the input voltage. At 60VAC input, the LED is barely visible. At 400VAC input, the Red LED is quite bright. The EV board also has a Green LED (bottom right) to show the output voltage. If the SBT3000 is turned on, the Green LED will be illuminated. Like the Red LED, at 60VAC input, the Green LED is barely visible. If the output remains turned on, as the red LED, the Green LED intensity will increase with increasing input voltage.

The Red button is intended to demonstrate a surge condition in user environments where a surge generator is unavailable, like at a customer location. The button connects a second sense resistor parallel with the primary Rsns resistor. This lowers the overvoltage threshold voltage to about ½ of what it is set to. This is used to simulate an overvoltage condition without a surge generator.

As a convenience and for flexibility, SBT3000 EVB also incorporates a potentiometer so that the end-user can make overvoltage threshold adjustments. However, it is recommended that the potentiometer be removed in the final applications so that the overvoltage threshold is not accidentally changed. The test report (that is provided with each EV Board) specifies the tested overvoltage limits of each board at both extremes of the potentiometer wiper position. The Retry time is also tested with J1 in and out.

There are several components on the EVB that are configurable. If desired, SiliconBrite will populate the associated components and create a custom EVB for specific end-user applications before shipment.

1) Is there a specific size requirement? If so, what is it?
2) What is the minimum startup voltage?
3) What is the overvoltage trip voltage?
4) What is time out after the overvoltage has ended but before the SBT3000 turns on again?
5) What is the preferred package type for the IGBTs (TO220, D-Pack/TO252, or D2-Pack/TO263)?
6) What is the temperature requirement of the end application?
7) What is the load requirement? (<5W) on the EVB or an external load applied by the customer?

1.2 – SBT3000 EVB Set-up and Operation

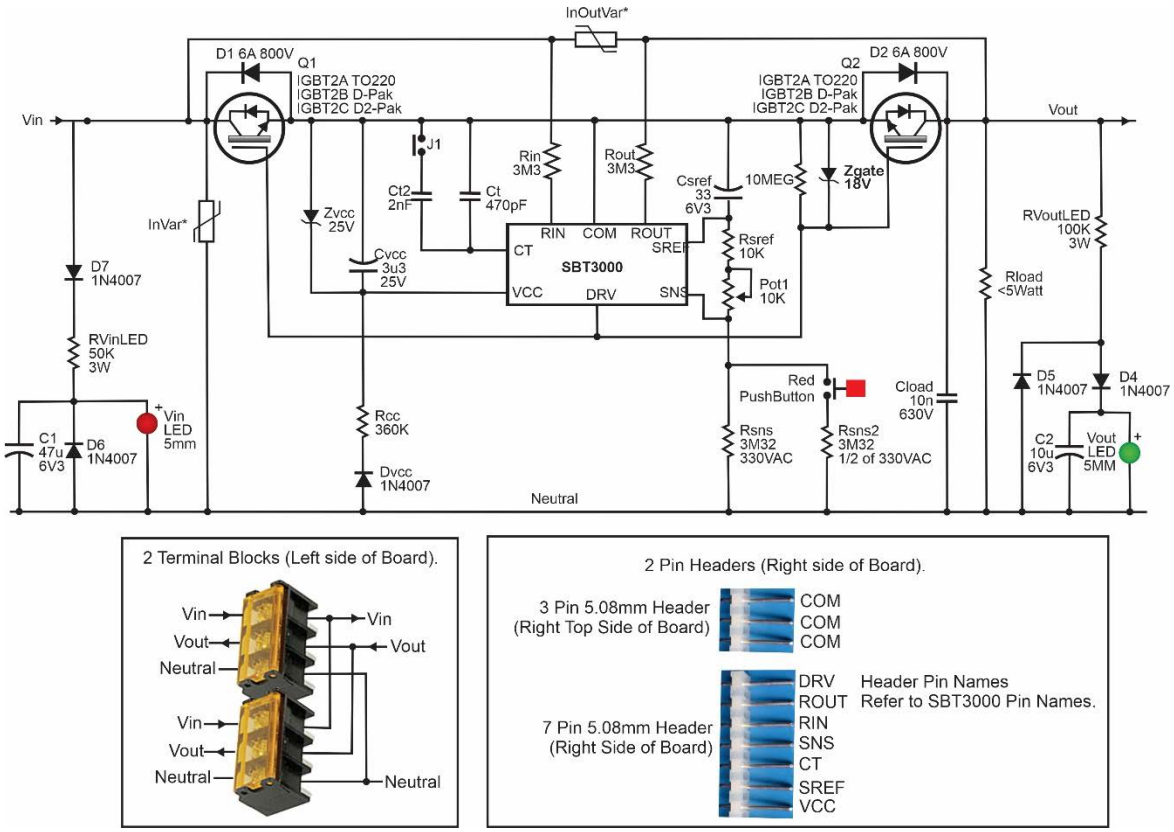

Figure 2: SBT3000 EVB Schematic

*Please note that there are positions on the PCB for the Varistors on the input to neutral and from the input to the output, but they are not populated on the physical PCB.

The SBT3000 EVB has a single jumper (J1) which, when installed, connects to a second timing capacitor, adding about 1.9 seconds to the time the SBT3000 tries to turn back on (the retry time).

The formulas in the Datasheet guide how to set the retry time (Ct), overvoltage threshold (Rsns and the potentiometer position), and startup voltage (Rcc). However, the provided EV board has these parameters tested and documented in the provided test report.

The SBT3000 EVB schematic includes several components on the EV Board for demonstration purposes. These parts can be removed in the final customer PCB layout. The parts that can be removed are all components connected to the two LED's, Z_{VCC}, J1, C12, the 10K Potentiometer, Rsns2, and the Red Pushbutton. Customers may consider adding the Varistors (shown in Figure 2 above).

SBT3000 EVB Operation:

1). The SBT3000 EV Board was tested and shipped with an SBT3000 IC in the socket; however, if you need to change it: Please make sure there is no power applied while inserting the SBT3000 IC in the SO8 test socket. Pin 1 of the SBt3000 IC is located at the top left-hand side of the socket. The orientation is also shown on the PCB silkscreen.

2). Connect a suitable AC voltage source to one of the left-hand screw terminal blocks, between “IN” and “NEUT.”

3). If desired, connect a load between “OUT” and “NEUT” on the left-hand screw terminal blocks. However, there is already a “minimal” load on the EV Board. This load comprises a 10nF 630V capacitor “Cload”, and the Green output indicator “Vout LED.”

4). Slowly increase the input voltage. The Red LED on the bottom left side should start to illuminate as the input voltage increases and is visible around an input voltage of at least 40VAC RMS.

5). At or around 1.5 seconds after the input voltage has reached the minimum operating voltage (usually 60VRMS), the green LED on the bottom right-hand side of the EVB will illuminate. The green LED indicates that the output power has been turned on and the input voltage is ok, within its “normal” operating range. The intensity of both LEDs will increase as the input voltage increases.

6). Increase the input voltage until the expected overvoltage threshold is reached. *Caution: The EVB may be operating at high voltage; thus, necessary precautions must be taken to prevent potential damage and personal harm*. Notice that the green LED will turn off, indicating that the SBT3000 has disconnected the input voltage from the load. AT THIS VOLTAGE, the IC is in a protect mode and will remain protected as long as the over-voltage condition lasts.

7). Decrease the input voltage below to the turn-on voltage (overvoltage -10%) and observe that after the retry lockout time (as set by the Ct capacitor), the load is reconnected to the source.

8). The procedure of increasing and decreasing the input voltage may be repeated as desired to demonstrate the capability of the SBT3000 to protect the load from overvoltage conditions automatically.

Please be careful using this high voltage product, taking the necessary high voltage handling precautions. You can further get in touch with SiliconBrite Technologies at info@siliconbrite.com if you have any questions.

1.3 – SBT3000 EVB PCB Layout

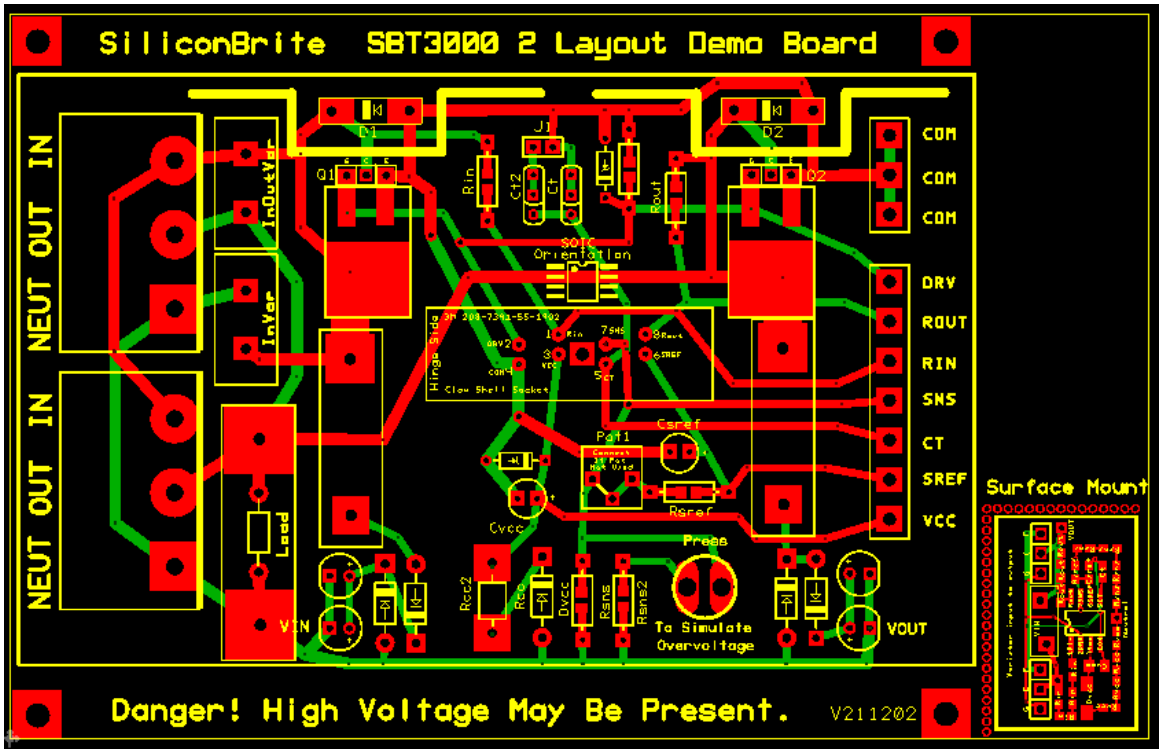

Figure 3: Top PCB (Red), Silkscreen (Yellow), and Bottom (Green) PCB Layout.

Figure 3 is viewed from the front of the PCB. The PCB backside is shown in green. The backside traces are viewed as if the PCB is transparent (x-ray vision).

The right-hand side of the PCB has an alternate SBT3000 layout, showing the small size of a minimalist (no LEDs, jumper push button, etc..) surface mount version of the SBT3000 overvoltage protector. The surface-mount version has vertical TO251-sized power transistors on it.

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