Application Report
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TPS7B7702-Q1 Short Circuit Test Report

Application Engineer: Jason Song

Linear Regulator – LDO

ABSTRACT

The TPS7B770x-Q1 family of devices are single and dual high-voltage LDOs, with integrated thermal shutdown and short-circuit protection, in automotive systems. Therefore, the robustness of the device under repetitive short-circuit stress is crucial for the entire system. The AEC Q100-012, which specifies the reliability of this type of device, is the most recognized qualification certificate in the industry.

The Automotive Electronics Council (AEC) provides the AEC Q100-012 documentation, which specifies the short-circuit reliability test. The main purpose of this test is to determine the reliability of smart-power devices operating in a continuous short-circuit condition.

Tests discussed in this report have been developed and performed according to the AEC-Q100-012 (REV-September 14-2006) document. 31 units have passed 300 000 cycles of cold repetitive short-pulse, cold repetitive long-pulse, and hot repetitive tests. Pulses used in the tests are defined in the ATE-Q100-012 document.

No failures (including gross and parametric) have been observed with the 31 units of the tested TPS7B7702-Q1 devices. According to the AEC-Q100-012, the TPS7B7702 has been rated Grade B after 300000 cycles of stress.

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Trademarks

1 General Diagram for the Test Configuration

Figure 2 shows the edge board with 32 sites in use. Figure 1 shows a general diagram of how the board is set up in the oven. To create the short-circuit condition, a FET has been used at each site to short Vout to ground, which is being controlled with digital output (DI) channels from a Data-Acquisition-Card (NI USB-6363). An analog input (AI) channel has been used to measure the output of each individual site and collect output voltage read points.

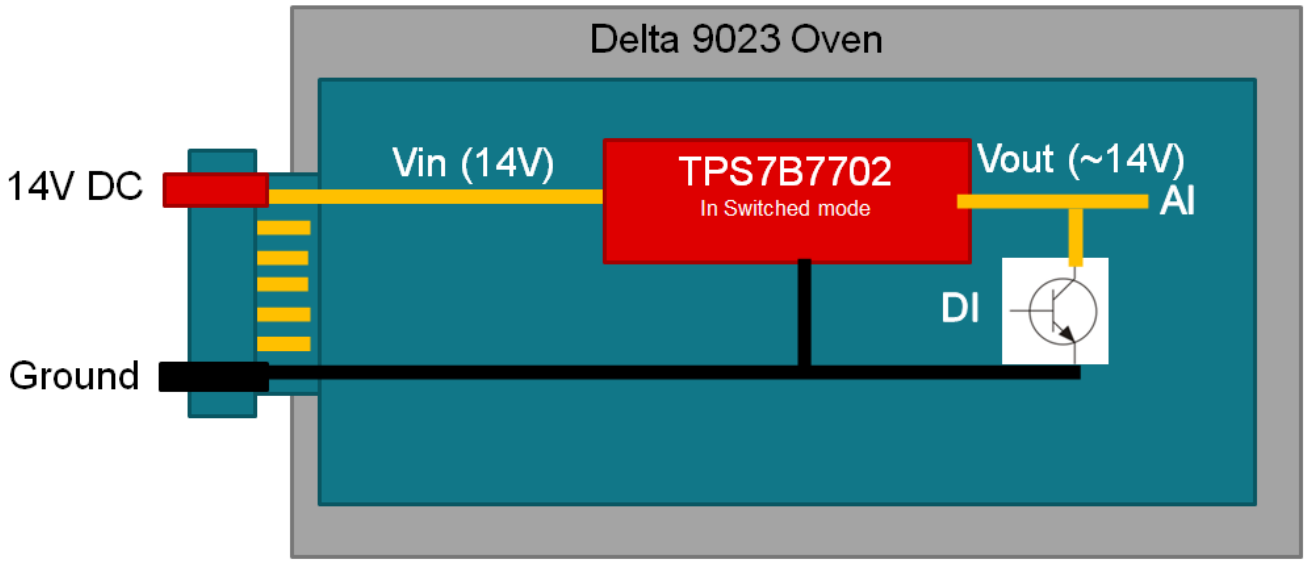

Figure 1. Boards With 32 Sites in an Oven Connected Through an Edge Connector

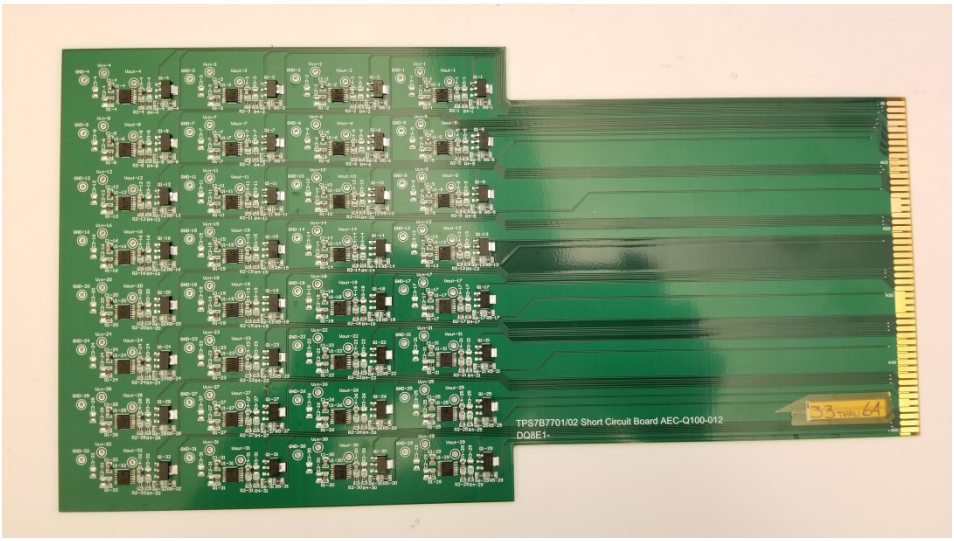

Figure 2. PCB Board With 32 Sites

2 Test Schematic and Materials Used

Figure 3 shows the schematic for a single site. The TPS7B7702-Q1 device is configured in switched mode, and the output has a voltage divider to make the voltage lower than 10 V. This is so the analog input channel can measure, as the analog input channel from the DAQ being used can only measure up to 10 V. Not everything has been populated for the actual board. Figure 4 shows the actual components that have been mounted on the boards.

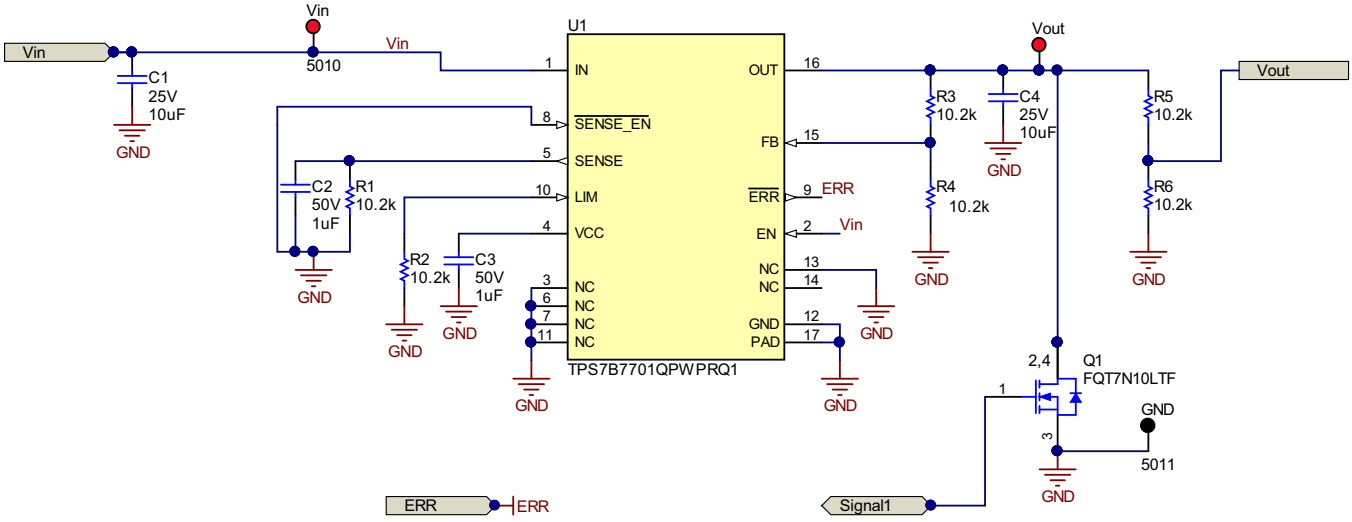

Figure 3. Circuit Schematic for One Site

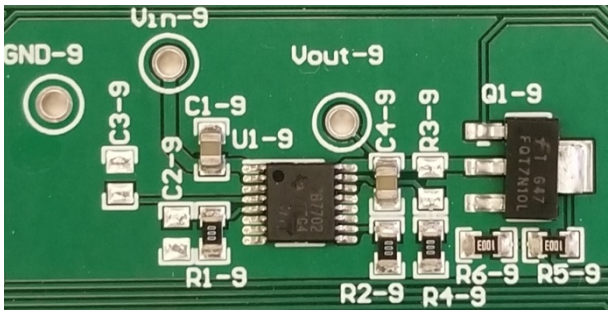

Figure 4. Zoomed-in View for One Site with Populated Components

Table 1. BOM From a Single Site

Designator	Value	Manufacturer	Package Reference	Part Number
C1, C4	10 µF	Taiyo Yuden	0805	TMK212BBJ106KG-T
R5, R6	100 kΩ	Yageo	0805	RC0805FR-07100KL
R1, R2, R4	0 Ω	Vishay	0805	CRCW08050000ZSTA

3 Test Flow

Units are tested at a manufacturer site using the final test production program.

1. Apply a 14-V input across all 32 sites (Site 2 is reserved for the control unit. No stress is applied on Site 2).
2. Read 32 Vouts with analog input channels from the DAQ to ensure all sites power on.
   - If one site fails, change the corresponding digital output to “0”.
   - If all pass, proceed to the next step.
3. Apply digital 5 V on the FET to start shorting OUTPUT to GND with pulse
4. Check for gross failure:
   - If failed open and the analog input from the DAQ reads floating: Mark as a “failed open” error and record the failed cycle and site
   - If failed open and the analog input from the DAQ reads 7 V: Mark as a “failed short” error and record the failed cycle and site
5. Keep pulsing the device for the remaining number of cycles

4 Test Items and Test Results

Table 2. Test Items and Test Results

Test Procedures	Devices	Temperature (°C)	Cycles	Gross Failures	Parametric Failures
Cold Repetitive Short Pulse	31 units with 1 controlled unit	–40	300 000	0/31	0/31
Cold Repetitive Long Pulse	31 units with 1 controlled unit	–40	300 000	0/31	0/31
Hot Repetitive	31 units with 1 controlled unit	25	300 000	0/31	0/31

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265