Brian Box Electrical Engineering test report

Developed in Ukarumpa PNG



Test period March 2018

|  |  |  |
| --- | --- | --- |
|  | Name or company | Date |
| EE Design: | Texas instruments© LM2596 datasheet recommended schematic | Rev.  May 2016 |
| Prototype concept  and idea: |  | Dec 2017 |
|  |
|  |
| Case design: | Marius Taciuc | Feb 2018 |
| Tested by: | Marius Taciuc | March 2018 |
| Approved by: |  |  |

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# Test result overview

|  |  |  |  |
| --- | --- | --- | --- |
| Test description | Date tested | Result | Observations |
| Operating voltages |  | Pass | See test details |
| Real solar panel operation |  |  |  |
| Slow increase/ decrease voltage |  | Pass |  |
| Voltage reset behaviour |  |  |  |
| Reverse polarity connection |  | Pass |  |
| Overload output |  |  |  |
| Short circuit output |  | Pass |  |
| Intermittent output |  |  |  |

# Introduction

This test report has the purpose of ensuring proper functionality in different environmental situations. Testing the reliability of the product can provide in some cases, real and accurate information and feedback about the product quality. The goal is to have a product that the final user can actually rely on. The tests were conducted using calibrated equipment and meters. Testing procedures were conducted using the international ISO 16750-1 and ISO 16750-2 standards for automotive electronic modules.

## Technical specification of the Brian Box LM2596 module

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Min | Typ | Max | Unit | Comment |
| Operating voltage | 6 | 22 | 40 | V |  |
| Output voltage | 4.98 | 5 | 5.057 | V |  |
| Input current | - | - | 3 | A |  |
| Output current |  |  | 2.5 | A |  |
| Operating frequency |  | 150 |  | KHz |  |
| Shut down junction temperature |  |  | 125 | ⁰C |  |
| Maximum device temperature |  |  | 90 | ⁰C | For 10 min |

## Sample information

The tested samples are also called DUT in this test report and this refers to Device Under Test.

The sample number and information is described in the chart below:

|  |  |  |
| --- | --- | --- |
| Device name | Case color | Observations |
| DUT1 | Red/ black | - |
| DUT2 | Black | - |

## Test equipment information

|  |  |  |  |
| --- | --- | --- | --- |
| Used equippment | Make | Model no | Observations |
| Variable bench power supply | GW | GPR-3060 | Held to maximum available current setting |
| Multimeter | Fluke | 87V | calibrated |
| Mobile phone real load (1) | Motorola | C139 |  |
| Mobile phone real load (2) | Samsung | J1 | Android power management software |
| Fixed resistive load | - |  | Up to 50W |
| Solar panel |  |  | 15W |

## Defined functionality classes

According to ISO 16750-1

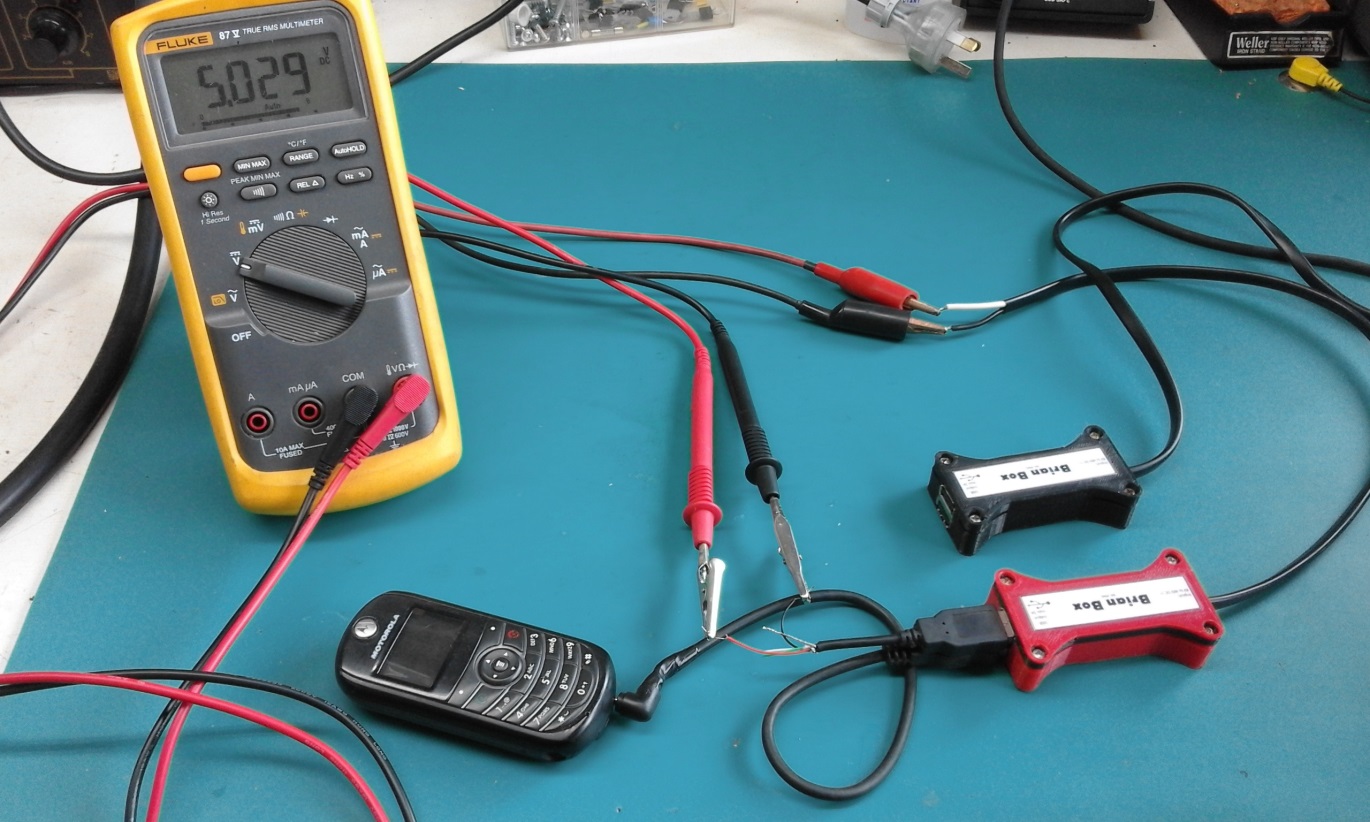
|  |  |
| --- | --- |
| Class A | All functions of the device/system perform as designed during and after the test. |
| Class B | All functions of the device/system perform as designed during the test. However, one or more may go beyond the specified tolerance. All functions return automatically to within normal limits after the test. Memory functions shall remain Class A. |
| Class C | One or more functions of a device/system do not perform as designed during the test but return automatically to normal operation after the test. |
| Class D | One or more functions of a device/system do not perform as designed during the test and do not return to normal operation after the test until the device/system is reset by simple “operator/use” action. |
| Class E | One or more functions of a device/system do not perform as designed during and after the test and cannot be returned to proper operation without repairing or replacing the device/system. |

Specific definition of functionality class that matches the design

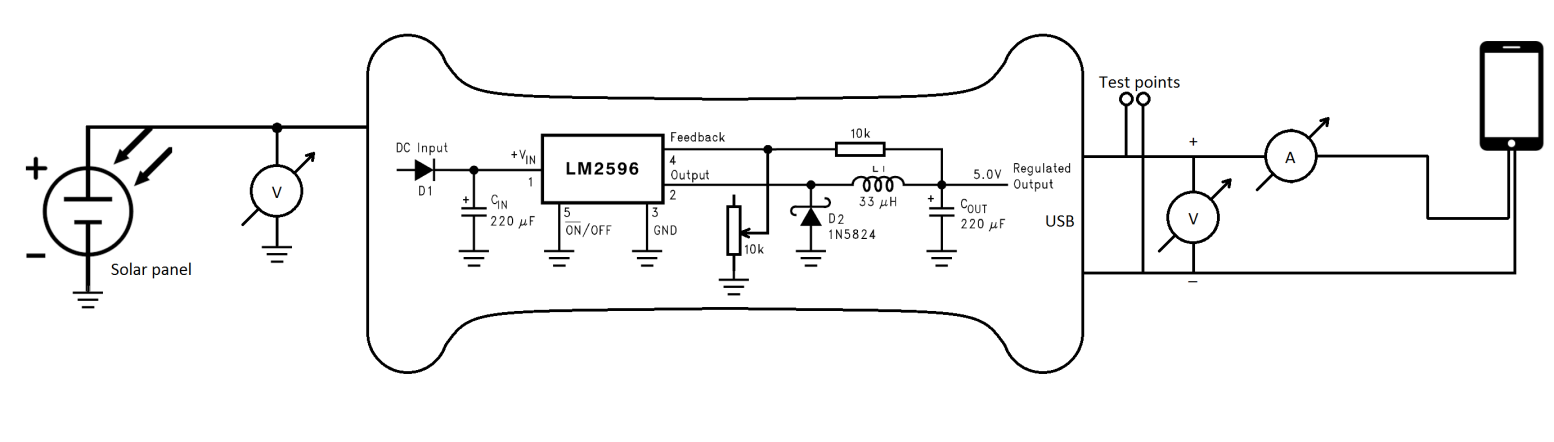
|  |  |
| --- | --- |
| Class A | All functions of the device/system perform as designed during and after the test.  No other behaviour of the mobile phone load than charging  All the Brian Box functions remain within the normal operating conditions and parameters  The output voltage can vary with ±50mV outside the normal operating output voltages |
| Class B | All functions of the device/system perform as designed during the test. However, one or more may go beyond the specified tolerance. All functions return automatically to within normal limits after the test.  Output voltage might vary with maximum ±150mV, but the voltage should return to normal after the end of the test |
| Class C | One or more functions of a device/system do not perform as designed during the test but return automatically to normal operation after the test.  Output voltage might vary below -500mV but NOT above +150mV. The voltage should return to normal after the end of the test |
| Class D | One or more functions of a device/system do not perform as designed during the test and do not return to normal operation after the test until the device/system is reset by simple “operator/use” action.  (burned fuse on the voltage source) |
| Class E | One or more functions of a device/system do not perform as designed during and after the test and cannot be returned to proper operation without repairing or replacing the device/system.  (damaged unit, or damaged phone) |

## Test setup description

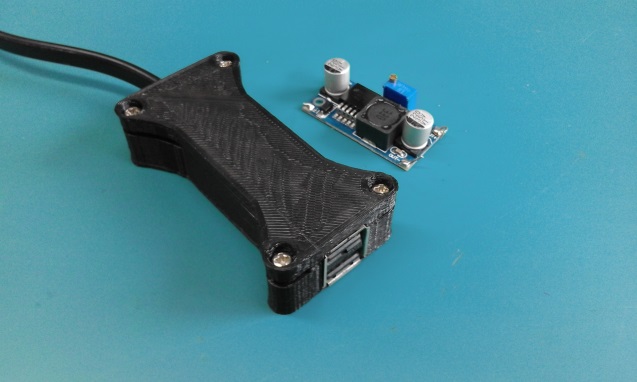
Test setup picture



Test setup diagram and schematic of the Brian Box



Overall picture of the Brian Box module And inside view

Note:

At the beginning of each functional test that has been listed in this document, a functionality test shall be performed to make sure that the DUT and the load performs according to the specifications.

# Tests

## Operating voltages

**Test method:**

Connect the DUT to the power supply for the following voltages and keep the DUT powered for 10min: 6.5V, 12V, 14V, 22.5V, 35V. Real phone should be used for this test.

**Requirements:**

The DUT and the phone shall remain class A

**Test:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Unit | Time per voltage range | 6.5V | 12V | 14V | 22.5V | 35V | Result | Comment |
| DUT1 | 10 min | A | A | A | A | A | Pass | 1,2,3 |
| DUT2 | 10 min | A | A | A | A | A | Pass | 1,2 |

1. At 6V, the output voltage was 4.597V
2. The power supply only allows maximum voltages of 33V
3. Both 1 and 2 phone samples used for this test

## Real solar panel operation

**Test method:**

Connect the DUT to the solar panel and keep the DUT powered for 30min. Real phone should be used for this test. The test shall be performed in full sun conditions and the shading of the solar panel shall be changed every 10min. In the last third part of the test, the solar panel shall be completely covered for 2 minutes and then fully exposed for 8 minutes.

**Requirements:**

The DUT shall be class C and the phone must remain Class A

**Test:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Unit | Time operating | First  10min | Second  10min | Covered  2min | Full sun 8min | Result | Comment |
| DUT1 |  |  |  |  |  |  |  |
| DUT2 |  |  |  |  |  |  |  |

## Slow increase/ decrease voltage

**Purpose**

This test simulates a gradual discharge and recharge of the battery.

**Test method**

Apply the following test simultaneously to all applicable inputs (connections) of the DUT.

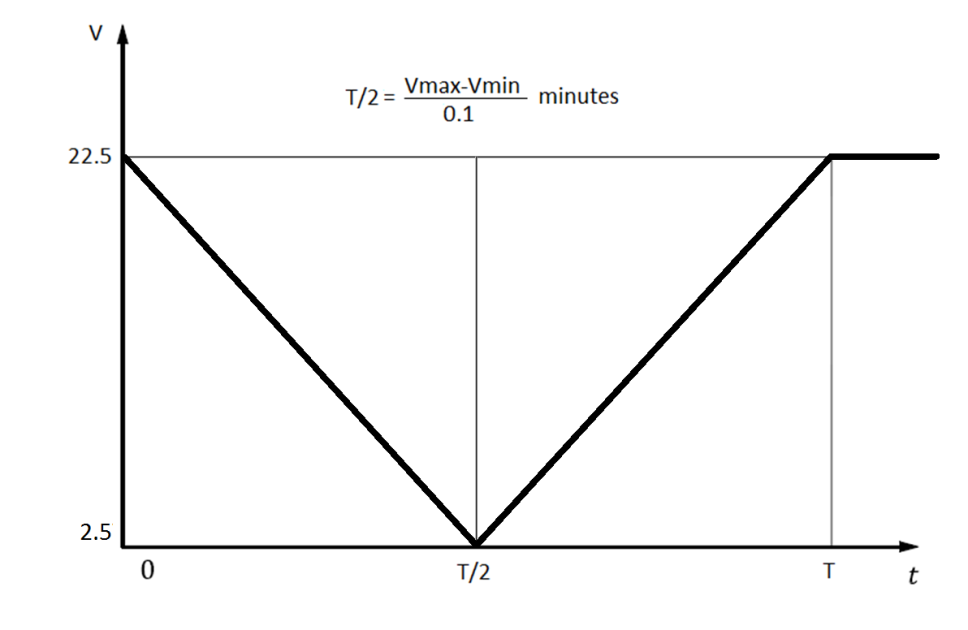
Decrease the supply voltage from 22.5V to 0 V, then increase it from 2.5V to 22.5V, applying a change rate of (0,5 ± 0,1) V/min.

**Requirement**

The functional status inside the 7V - 22.5V interval shall be class A.

Outside these voltage ranges, the functional status of the DUT shall be minimum class C.

The phone (load) shall sustain no damage during this test and shall remain class A through-out the entire testing period.



**Test results**

|  |  |  |
| --- | --- | --- |
| Unit | Result | Observations |
| DUT1 | Pass | Test performed for 2\*200 minutes, 1),2) |
| DUT2 | Pass | Test performed for 2\*200 minutes |

1. For the increase phase, phone number1 was used. For the decrease phase, phone number 2 was used.
2. The Android phone reconnects back the charging sequence with a hysteresis of almost 0.8V in the voltage increase phase.

## Voltage reset behaviour

## Reverse polarity connection

**Purpose**

This test checks the ability of a DUT to withstand against the connection of a reversed battery in case of

using a custom solar panel connector or a different voltage source.

**Test method**

Set the power supply to the specified voltages and connect the DUT to the output of the power supply for the specified number of minutes.

**Requirement**

Functional class of the DUT shall be A after proper reconnection and Functional class of the phone, shall remain A during the test and after the test.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Unit** | **Voltage (V)** | **Time (min)** | **Functional class after reconnection** | **Test result** | **Observations** |
| DUT1 | -22.5 | 10 | A | PASS | 1 |
| -12 | 15 | A | PASS | 1 |
| DUT2 | -22.5 | 10 | A | PASS | 1 |
| -12 | 15 | A | PASS | 1 |

1. Mobile phone remained Class A

## Overload output

## Short circuit output

**Purpose**

These tests simulate short circuits to the inputs and outputs of a device.

**Test method**

Connect all outputs of the DUT in sequence for duration of 60 s ±10 % to +(VCC)

and to ground. All other outputs remain open.

Perform this test with 22.5V and with 12V input voltages. During the test, the load(mobile phone) must remain connected in parallel to the shorted output. Class and functionality of the load shall be also investigated

**Requirements**

The functional status shall be minimum class C as defined in ISO 16750-1.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **DUT1 input voltage (V)** | **Output terminals shorted** | | **Functional class** | **Result** | **Observations** |
| 12 | USB+5V | GND | C | Pass | 1 |
| USB+5V | USB+5V | A | Pass | 1 |
| GND | USB+5V | C | Pass | 1 |
| GND | GND | A | Pass | 1 |
| 22.5 | USB+5V | GND | C | Pass | 1 |
| USB+5V | USB+5V | A | Pass | 1 |
| GND | USB+5V | C | Pass | 1,2 |
| GND | GND | A | Pass | 1 |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **DUT2 input voltage (V)** | **Output terminals shorted** | | **Functional class** | **Result** | **Observations** |
| 12 | USB+5V | GND | C | Pass | 1 |
| USB+5V | USB+5V | A | Pass | 1 |
| GND | USB+5V | C | Pass | 1 |
| GND | GND | A | Pass | 1 |
| 22.5 | USB+5V | GND | C | Pass | 1 |
| USB+5V | USB+5V | A | Pass | 1 |
| GND | USB+5V | C | Pass | 1,2 |
| GND | GND | A | Pass | 1 |

1 Mobile phone remains class A at all times

2 After 2 minutes of short circuit, the plastic case was measuring approximately 50⁰C

## Intermittent output

## Observations and final conclusions