



*LOAD***SLAMMER**

# **LoadSlammer User Guide**

## **LS50 and LS1000**

# 1 CONTENTS

---

|       |   |    |
|-------|---|----|
| 2     | Introduction .....                        | 2  |
| 2.1   | Overview .....                            | 2  |
| 2.2   | Hardware .....                            | 2  |
| 2.3   | Specifications LS50 .....                 | 3  |
| 2.4   | Specifications LS1000 .....               | 4  |
| 3     | .....                                     | 5  |
| 3.1   | Physical Connection to DUT .....          | 5  |
| 3.1.1 | Placement Location .....                  | 5  |
| 3.1.2 | Connector vs Soldering .....              | 5  |
| 3.1.3 | Thermal Considerations .....              | 5  |
| 3.2   | LoadSlammer™ GUI.....                     | 6  |
| 3.2.1 | Connecting to your LoadSlammer .....      | 6  |
| 3.2.2 | GUI Overview .....                        | 6  |
| 3.2.3 | Protection Features .....                 | 7  |
| 3.2.4 | Testing with multiple LoadSlammers™ ..... | 7  |
| 3.2.5 | Frequency Sweep .....                     | 7  |
| 4     | Operation.....                            | 8  |
| 4.1   | Test Equipment Setup .....                | 8  |
| 4.1.1 | Oscilloscope.....                         | 8  |
| 4.1.2 | External DC Load .....                    | 8  |
| 5     | Product Feature List .....                | 9  |
| 6     | Change history.....                       | 10 |

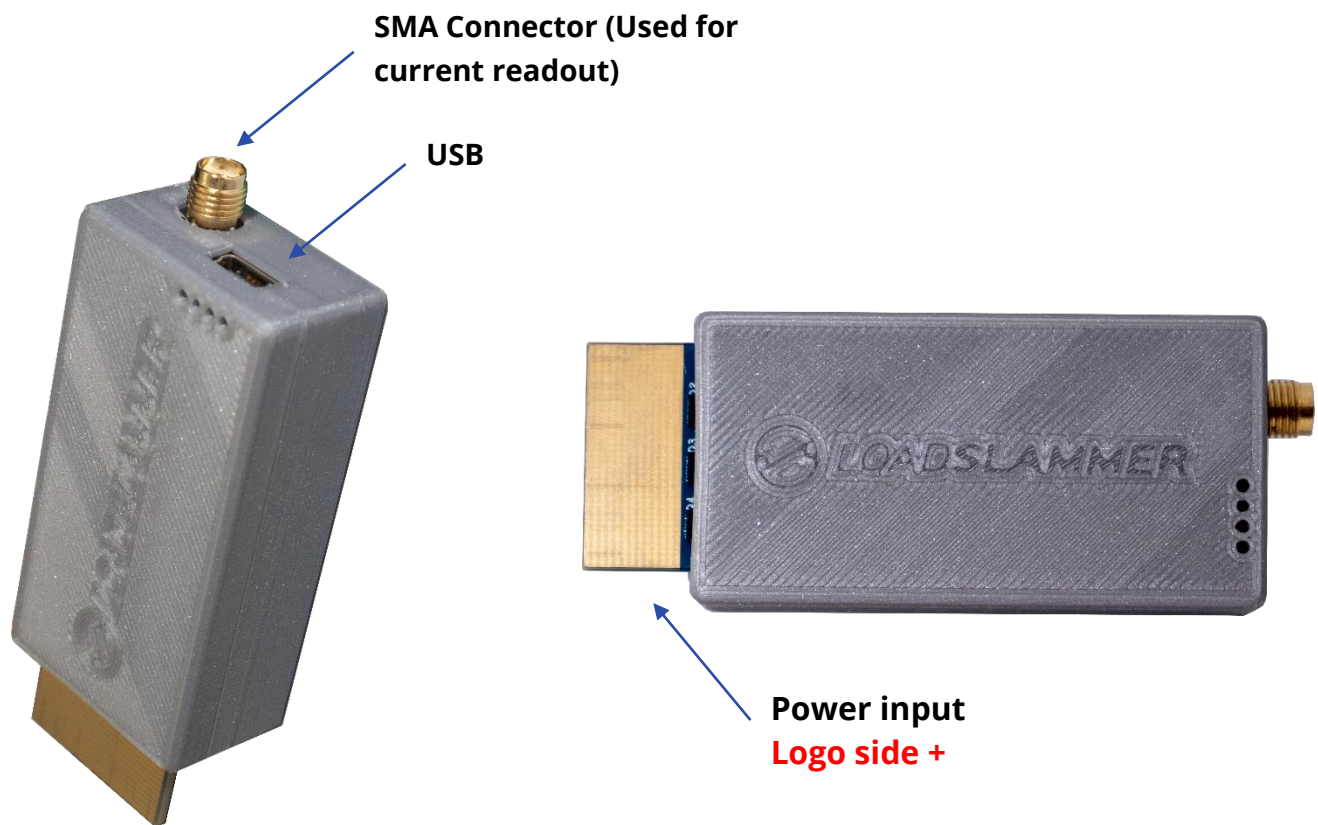
## 2 INTRODUCTION

---

### 2.1 OVERVIEW

The LoadSlammer™ is used to test high transient high current loads as seen in CPU, GPU, FPGA, and ASIC power profiles. It is designed to be easy to use with a GUI and current sense output. The Bootloader feature ensures your ability to obtain firmware updates.

### 2.2 HARDWARE



## 2.3 SPECIFICATIONS LS50

|   |  |     |      |
|---|--|-----|------|
| Slew Rate (Selectable)                      | 1, 2, 5, 10, 20, 50 (LS50)   |     | A/μS |
| Current (5A increments)                     | 5 – 75   |     | A    |
| Frequency Range (100 Hz steps) <sup>1</sup> | 100 – 2500   |     | Hz   |
| Duty Cycle (0.25% steps) <sup>2</sup>       | Active window is divided into 16 steps<br>Actual duration is based on frequency                    |     | %    |
| Input Voltage                               | 0.85 - 3.3   |     | V    |
| Current Sense Output                        | Conversion Ratio   | 75  | A/V  |
|   | Max Current  | 75  | A    |
|   | Bandwidth  | 10  | MHz  |
|   | Accuracy   | 10  | %    |
| Voltage Readout                             | Sample Rate  | 1   | MSPS |
|   | Accuracy   | 1   | %    |
| Current Readout                             | Sample Rate  | 1   | MSPS |
|   | Accuracy   | 10  | %    |
| Protection Thresholds                       | Over Voltage   | 3.5 | V    |
|   | Over Current   | 85  | A    |
|   | Over Temperature   | 80  | °C   |
| Average Power Dissipation                   | 3  |     | W    |
| Peak Power Dissipation (instantaneous)      | 250  |     | W    |
| Connector (optional)                        | Molex 45719-0007   |     |      |
| GUI   | The GUI was developed on Windows 10 with Chrome web browser version 61 and newer.                  |     |      |
| Non-Isolated                                | LoadSlammer™ must be used with a regulator that has a ground earth reference and positive voltage. |     |      |
| Frequency Sweep                             | 12kHz – 50kHz  |     |      |

## 2.4 SPECIFICATIONS LS1000

|   |  |      |      |
|---|--|------|------|
| Slew Rate (11 selectable settings)<br><u>Soldered in</u> LoadSlammer<br>50 A/μS – 1000 A/μS) <sup>3,4</sup>       | 1 50-65    2. 100-185    3. 150-270    4. 200-370<br>5. 260-390    6. 335-470    7. 400-573    8. 500-640<br>9. 610-750    10. 650-850    11. 650-1000 | A/μS |      |
| Slew Rate (11 selectable settings)<br><u>Molex connector</u> in LoadSlammer<br>50 A/μS – 500A/μS) <sup>3, 4</sup> | 1 47-65    2. 100-170    3. 150-270    4. 200-360<br>5. 250-380    6. 335-470    7. 400-565    8. 480-605<br>9. 490-590    10. 500-650    11. 520-770  | A/μS |      |
| Current (5A increments)   | 30-120   | A    |      |
| Frequency Range (100 Hz steps) <sup>1</sup>   | 100 – 2500   | Hz   |      |
| Duty Cycle (0.25% steps) <sup>2</sup>   | Active window is divided into 16 steps<br>Actual duration is based on frequency  | %    |      |
| Input Voltage   | 0.70 – 2.5V  | V    |      |
| Current Sense Output  | Conversion Ratio   | 100  | A/V  |
|   | Max Current  | 120  | A    |
|   | Bandwidth  | 10   | MHz  |
|   | Accuracy   | 10   | %    |
| Voltage Readout   | Sample Rate  | 10   | MSPS |
|   | Accuracy   | 1    | %    |
| Current Readout   | Sample Rate  | 10   | MSPS |
|   | Accuracy   | 10   | %    |
| Protection Thresholds   | Over Voltage   | 2.7  | V    |
|   | Over Current   | 130  | A    |
|   | Over Temperature   | 80   | °C   |
| Average Power Dissipation   | 3  | W    |      |
| Peak Power Dissipation (instantaneous)  | 300  | W    |      |
| Connector (optional)  | Molex 45719-0007   |      |      |
| GUI   | The GUI was developed on Windows 10 with Chrome web browser version 61 and newer.  |      |      |
| Non-Isolated  | LoadSlammer™ must be used with a regulator that has a ground earth reference and positive voltage.   |      |      |
| Frequency Sweep   | 20Khz – 1MHz   |      |      |

## 3

### 3.1 PHYSICAL CONNECTION TO DUT

#### 3.1.1 Placement Location

Placement of the LoadSlammer™ on the DUT (Device Under Test) is crucial. For best results, place the LoadSlammer™ as close to the load as possible to include the parasitic impedance of the PCB traces. Placing the LoadSlammer™ right near the output of the regulator doesn't adequately test the output filtering due to the lack of parasitic impedance in the PCB from regulator to load.

**Do not connect the LoadSlammer using wire. This increases the impedance of the system which prevents high slew rates.**

#### 3.1.2 Connector vs Soldering

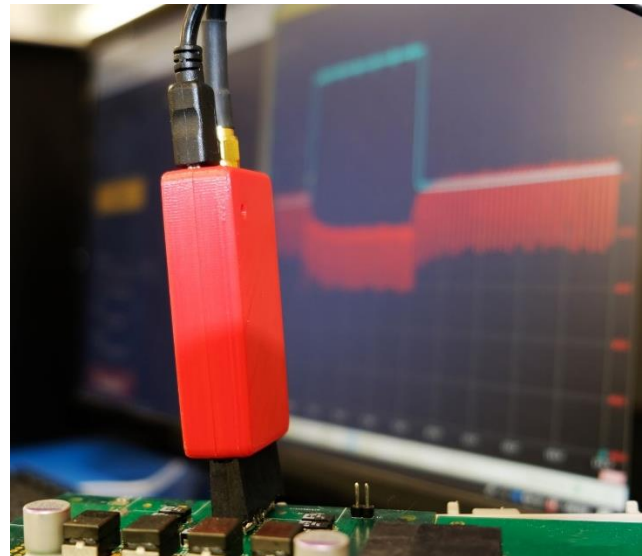
Using a connector provides ease of use and reduces wear on the PCB, but adds inductance and resistance to the power path. These factors may limit your maximum slew rate.

Soldering directly to the PCB helps minimize inductance which can provide a cleaner signal and a faster slew rate

To solder a slammer to the DUT, find a large ground and power plane butting up to each other, scrape some solder mask off, then solder it down with copper braid. Alternatively, if your PCB has many ceramic capacitors in a row, it's possible to solder directly over them.

#### 3.1.3 Thermal Considerations

While not strictly required, a fan moving air over the LoadSlammer™ will allow for higher duty cycles. The Over Temperature feature is set to 80° C, at which point it will automatically turn off and alert the user both through the GUI and a red LED on the LoadSlammer™ board. To reset the OTP (Over Temperature Protection), you need to disable the output then reenable it.



**Note:** For optimal performance when using a connector, ensure that the LoadSlammer™ is firmly seated and that the connector / blade are clear of debris. Failure to do so can result in unpredictable slewing behavior.

## 3.2 LOADSLAMMER™ GUI

### 3.2.1 Connecting to your LoadSlammer

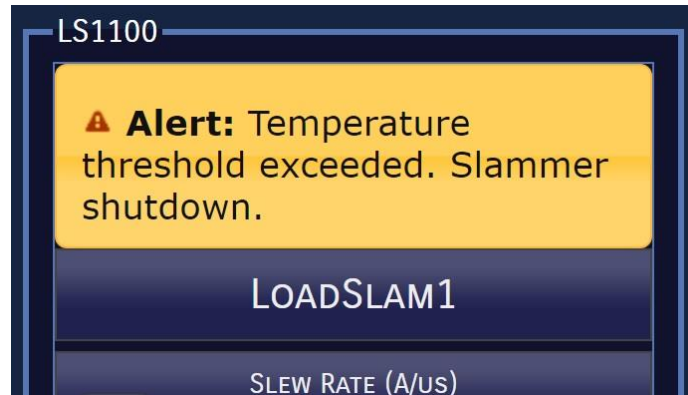
First, make sure a USB cable is connecting the slammer to a PC/laptop and the computer has Google Chrome installed. No drivers are necessary. Simply load up <https://guipower.com/>, click connect, and choose the LoadSlammer model you are using.

### 3.2.2 GUI Overview



### 3.2.3 Protection Features

The LoadSlammer™ has built in protection to prevent over temperature, over voltage, and over current events. In the case of an overload event, the output is automatically turned off, and a warning is displayed. To re-enable the slammer, simply enable the output again.



### 3.2.4 Testing with multiple LoadSlammers™

It is possible to use the LS50, and LS1000 at the same time to test different voltage rails.

### 3.2.5 Frequency Sweep

A frequency Sweep test can identify changes in the frequency response of the circuit and approximate phase margin. Very fast slew rates can provide useful information regarding the regulator output decoupling solution.

To activate the function, simply set the current slider to the desired level, and press the "Frequency Sweep" button during testing."



## 4 OPERATION

---

Use the following steps to get started with the LoadSlammer™:

1. Make sure system is powered off
2. Install LoadSlammer™ unit onto DUT (Device Under Test)  
Note: Make sure you observe proper polarity. The case has polarity marked with + and GND
3. Connect USB cable from LoadSlammer™ to PC
4. Attach current output of LoadSlammer™ to an oscilloscope channel set to 1M $\Omega$  input impedance (optional)
5. Adjust the current output to rest at 0 V
6. Connect to LoadSlammer™ through the GUI
7. Turn on DUT and verify voltage read from GUI is correct
8. Adjust GUI parameters to desired values
9. Hit the "Slam!" button to start slamming
10. Use appropriate conversion ratio on current monitor output (see table).

### 4.1 TEST EQUIPMENT SETUP

#### 4.1.1 Oscilloscope

The current output has an offset of a few mV, so it should be zeroed out before taking measurements. Also make sure the input impedance is set to 1M $\Omega$ .

#### 4.1.2 External DC Load

An external DC load unit can be connected to the DUT to keep the VR from entering power saving modes. A DC load may also simulate a more real-world scenario. Load stepping from 20A – 70A will show how the converter responds with a light load already applied.

## 5 PRODUCT FEATURE LIST

The table below shows the options available with each product. Check [www.loadslammer.com](http://www.loadslammer.com) for new announcements and product updates.

| Feature                              | LS50             | LS1000   | LS1100   |
|--------------------------------------|------------------|----------|----------|
| Programmable Slew Rate               | ●                | ●        | ●        |
| Output Voltage + Current Measurement | ●                | ●        | ●        |
| 3D Plot (4 Axis Sweep) + CSV out     |                  |          | ●        |
| Pass/Fail Markers                    |                  |          | ●        |
| Ripple + DC Measurement              |                  |          | ●        |
| Load Range                           | 75A              | 120A     | 120A     |
| Maximum Slew rate                    | 50A/μs           | 1000A/μs | 1000A/μs |
| Duty Cycle Step Granularity          | 0.25-100%        |          |          |
| Current Readout accuracy             | 10%              |          |          |
| Voltage Readout accuracy             | 1%               |          |          |
| OVP/OCP/OTP                          | Yes/Yes/Yes      |          |          |
| Recommended Connector                | Molex 45719-0007 |          |          |

## 6 CHANGE HISTORY

---

| Revision Number | Date              | Reason for change  |
|-----------------|-------------------|--|
| 1.0             | November 12, 2018 | Initial Release  |
| 1.1             | November 14, 2018 | Updated product feature table (page 9)   |
| 1.2             | February 6, 2019  | <ol style="list-style-type: none"><li>1. Updated introduction by adding boot loader comment</li><li>2. Updated LS50 and LS1000 tables with new slew rates</li><li>3. Added Notes section</li><li>4. Changed document part number to match new process.</li><li>5. Updated product feature list</li><li>6. General text cleanup</li></ol> |

## 7 NOTES

---

1. Minimum pulse width is 6 $\mu$ S
2. Active window >250 $\mu$ s
3. It should be noted that circuit inductance can significantly limit the performance of the LoadSlammer. Reduced performance has been noted when using connectors. For maximum performance the LoadSlammer should be soldered to the test board as close to the load as possible. It is recommended that the LoadSlammer is soldered down for testing over 500 A/ $\mu$ S.
4. High slew rates require high current for optimal results. (Ex 1V @ 85A load current can achieve 800 A/ $\mu$ S.
5. Always place your slammer as close to the load as possible.
6. Maximize current draw for optimal results.