



*LOAD***SLAMMER**

**LoadSlammer User Guide  
LS50 and LS1000**

# 1 CONTENTS

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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

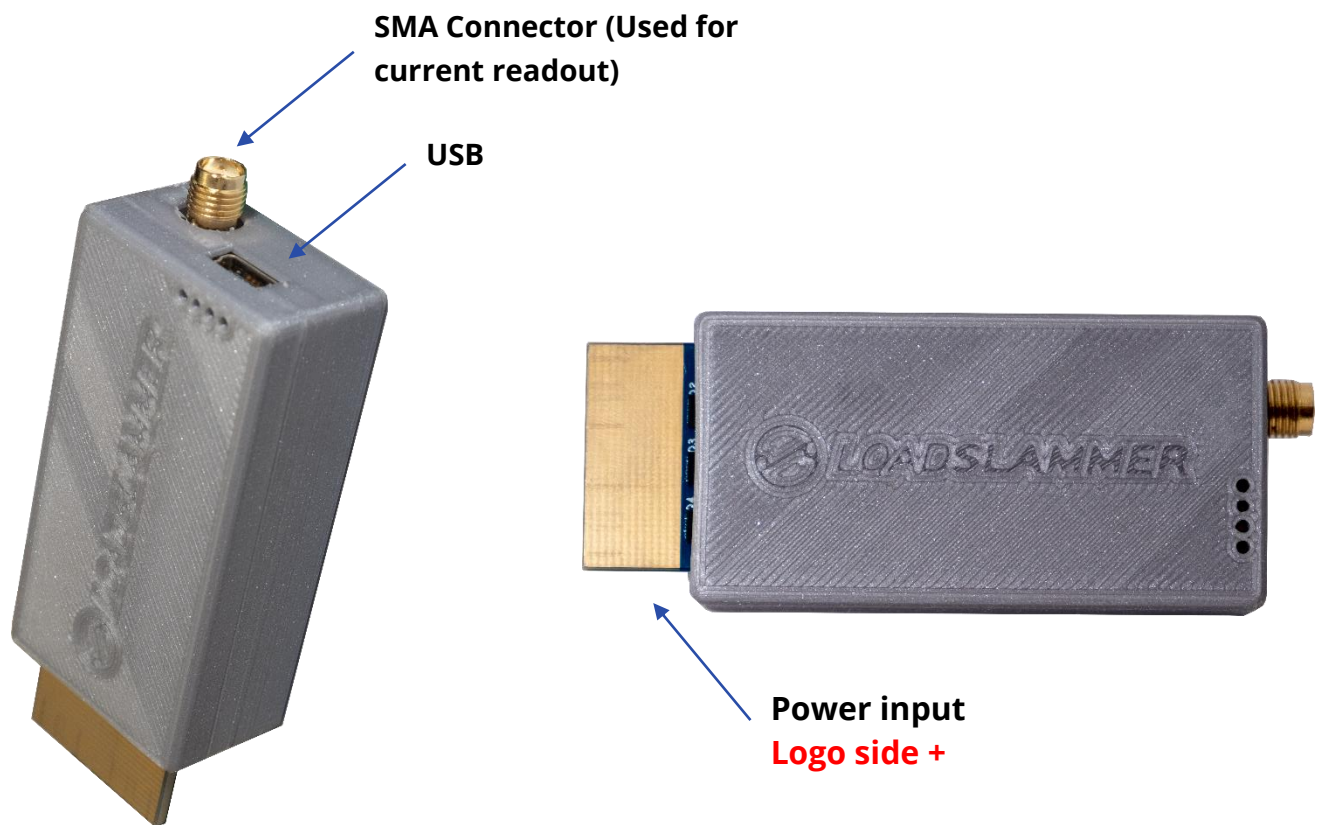
## 2 INTRODUCTION

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### 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/ $\mu$ S	
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 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) <u>Soldered in</u> LoadSlammer 50 A/ $\mu$ S – 1000 A/ $\mu$ S) <sup>3,4</sup>	1. 50-65    2. 100-185    3. 150-270    4. 200-370 5. 260-390    6. 335-470    7. 400-573    8. 500-640 9. 610-750    10. 650-850    11. 650-1000	A/ $\mu$ S	
Slew Rate (11 selectable settings) <u>Molex connector</u> in LoadSlammer 50 A/ $\mu$ S – 500A/ $\mu$ S) <sup>3,4</sup>	1. 47-65    2. 100-170    3. 150-270    4. 200-360 5. 250-380    6. 335-470    7. 400-565    8. 480-605 9. 490-590    10. 500-650    11. 520-770	A/ $\mu$ S	
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 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	$^{\circ}$ 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

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### 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

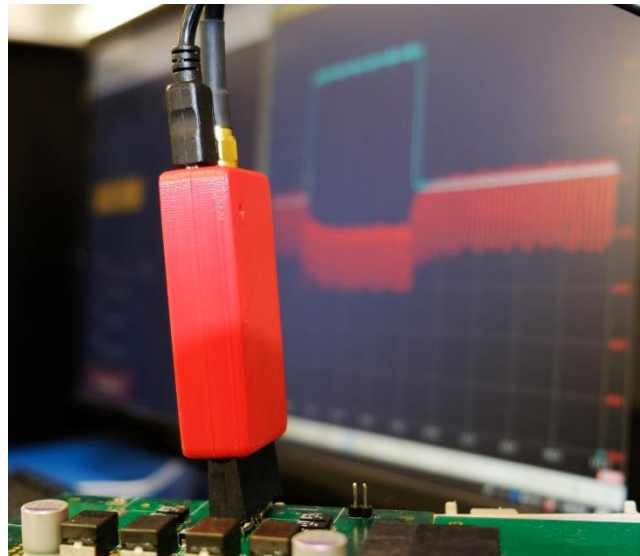
Using a connector provides ease of use and reduces wear on the PCB, but adds inductance and resistance to the power path. These factors may limit your maximum slew rate.

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

Label your Slammer to easily identify it

**Slamming controls**  
Adjust slew rate, current, duty cycle, and frequency of slamming

Output Enable Button

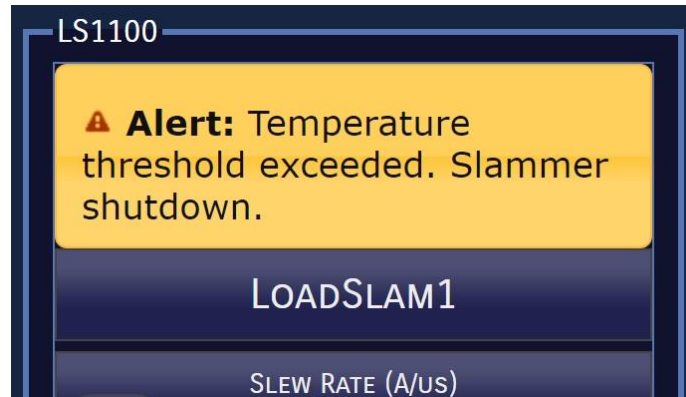
Frequency Sweep Control

**Status readout from slammer**  
Voltage Overshoot & Undershoot  
Current Readout  
Temperature Readout

Disconnect Button & Serial Number

### 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

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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  $1\text{M}\Omega$  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  $1\text{M}\Omega$ .

#### 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

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

<b>Feature</b>	<b>LS50</b>	<b>LS1000</b>	<b>LS1100</b>
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

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<b>Revision Number</b>	<b>Date</b>	<b>Reason for change</b>
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

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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.