



# LoadSlammer™ Pro 1000 User Guide

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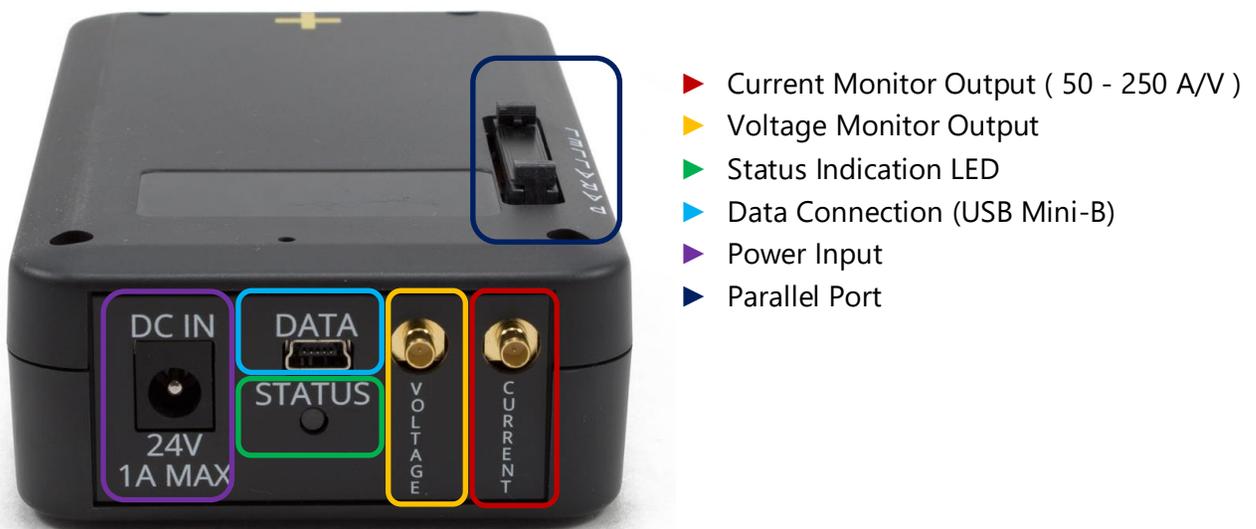
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## 2 INTRODUCTION

### 2.1 OVERVIEW

The LoadSlammer™ Pro 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 simple GUI, voltage sense and current sense output. In addition to the sense outputs, the onboard sampling and analysis allows for pass/fail testing all in one device.

### 2.2 HARDWARE



## 2.3 SPECIFICATIONS LSP1000

Table 1 - Device Characteristics

Parameter		Min	Typ.	Max	Unit
<b>Timing Characteristics</b>					
Minimum Rise Time	$V_{DUT}=1.8V$	180	200		nS
On Time Range		7.5 $\mu$		1	Sec
Off Time Range		7.5 $\mu$		10	Sec
<b>Load Characteristics</b>					
Current Range		5		500	A
Current Resolution			1		A
Current Output Accuracy			5		%
<b>Current Sense Output</b>					
Conversion Ratio		50		250	A/V
Max Current			500		A
Current Readout Accuracy			5		%
<b>Sampling System</b>					
Sampling Rate			10		MSPS
Bandwidth (-3dB)			5		MHz
<b>Current Resolution</b>	$I_{OUT\_MAX} = 90\text{ A}$		30m		A
Current Resolution	$I_{OUT\_MAX} = 180\text{ A}$		60m		A
Current Resolution	$I_{OUT\_MAX} = 270\text{ A}$		90m		A
Current Resolution	$I_{OUT\_MAX} = 360\text{ A}$		120m		A
Current Resolution	$I_{OUT\_MAX} = 500\text{ A}$		150m		A
<b>Voltage Resolution</b>	DC coupled		600 $\mu$		V
Voltage Resolution	AC coupled		120 $\mu$		V
<b>Power Dissipation Characteristics</b>					
Continuous Power Dissipation			25		W
Instantaneous Power Dissipation			500		W
<b>Device Connection</b>					
<b>DUT Connector</b>	Preferred	Samtec HSEC8-130-01-L-DV-A-WT-K-TR			
	Surface Mount Only	Samtec HSEC8-130-01-L-DV-K-TR			
	Drawing	<a href="https://loadslammer.com/connector/">https://loadslammer.com/connector/</a>			
<b>Non-Isolated</b>	LoadSlammer™ Pro must be used with a regulator that has a positive voltage and is ground earth referenced.				

## 3 OPERATING THE LOADSLAMMER™ PRO

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### 3.1 PHYSICAL CONNECTION TO DUT

#### 3.1.1 Placement Location

Placement of the LoadSlammer Pro on the DUT (Device Under Test) is crucial. For best results, place the LoadSlammer Pro as close to the load as possible to include the effects of the PDN. Placing the LoadSlammer Pro at the output of the regulator doesn't adequately test the real-world application.

**Do not connect the LoadSlammer Pro using wires. Wires increase the inductance of the system which prevents high slew rates. The results will not be valid.**

#### 3.1.2 Connection Options

There are several ways to connect to a DUT. 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. Additionally, LoadSlammer offers custom passive adapter design services to provide a higher level of confidence in the test results.

##### 3.1.2.1 Design in Connector

The connector provides ease of use for quickly testing different DUTs.

Drawings are available on our [website](#) detailing pinout and keepout regions.

The preferred connector is the Samtec HSEC8-130-01-L-DV-A-WT-K-TR, however it does require through holes. If design requirements prohibit through holes, there is a surface mount only variant: Samtec HSEC8-130-01-L-DV-K-TR.

Due to the design of card edge connectors, the socket does not support the LoadSlammer rigidly. There is a stabilizer accessory that prevents the device from tilting in the connector.

**Note:** For optimal performance when using a connector, ensure that the LoadSlammer is firmly seated and that the connector socket is clean. Failure to ensure a good connection can impact your test results.

##### 3.1.2.2 Solder Down

To solder the 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 on top of them.

Ensure the remote sense pins on the blade on the LoadSlammer is connected to the DUT.

### **3.1.2.3 Passive Adapter**

Passive adapters are the best way to connect the LoadSlammer to a DUT. The adapter sits in place of a large BGA package to allow connection of the LoadSlammer on an application board.

### **3.1.3 Test Equipment Setup**

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

1. Make sure DUT (Device Under Test) and LoadSlammer are both powered off
2. Install LoadSlammer unit onto DUT

**Note: Make sure you observe proper polarity. The case has polarity marked with "+" and "-"**

3. Connect mini USB cable from LoadSlammer to PC
4. (optional) Attach current & voltage monitoring of LoadSlammer to oscilloscope using an SMB cable. Make sure the oscilloscope channels are set to high input impedance
5. Power on the LoadSlammer by plugging in the 24V power adapter provided
6. Connect to the LoadSlammer through the GUI
7. Adjust test parameters to desired values
8. Hit the "Run" button to start slamming

#### **3.1.3.1 Oscilloscope Connection**

The current sense output has a gain that depends on the maximum amount of current and power dissipation.

Ensure the input impedance is set to  $1M\Omega$  or high impedance for both sense inputs. There is a series termination resistor on the LoadSlammer to prevent reflections. The current sense output has an offset, so it should be zeroed out before taking measurements.

#### **3.1.3.2 DC Measurements**

While the LoadSlammer Pro has limited power dissipation, preventing efficiency measurements, the LoadSlammer can create a 'shoulder' of current before each load transient. This allows the DUT to settle to a steady state before the load transient.

An external DC load unit can be connected to the DUT if more power continuous is needed.

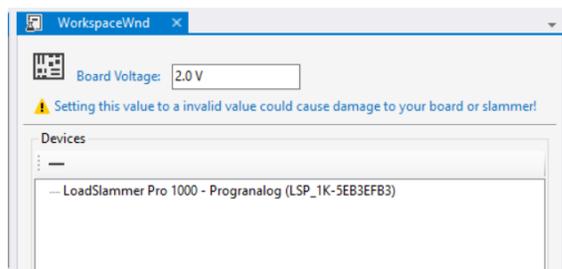
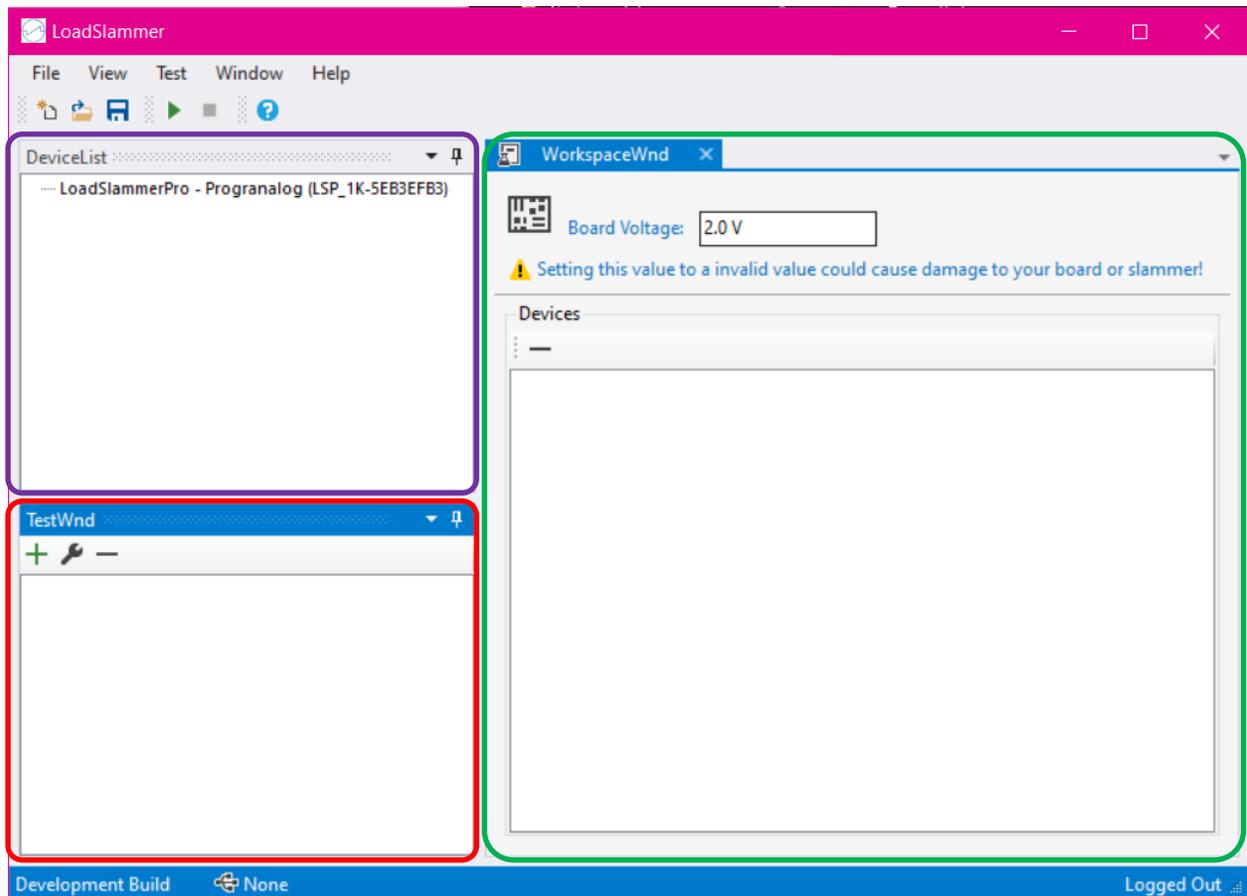
## 3.2 GUI QUICK START

### 3.2.1.1 Opening the GUI

The GUI can be download from <https://loadslammer.com/downloads/>

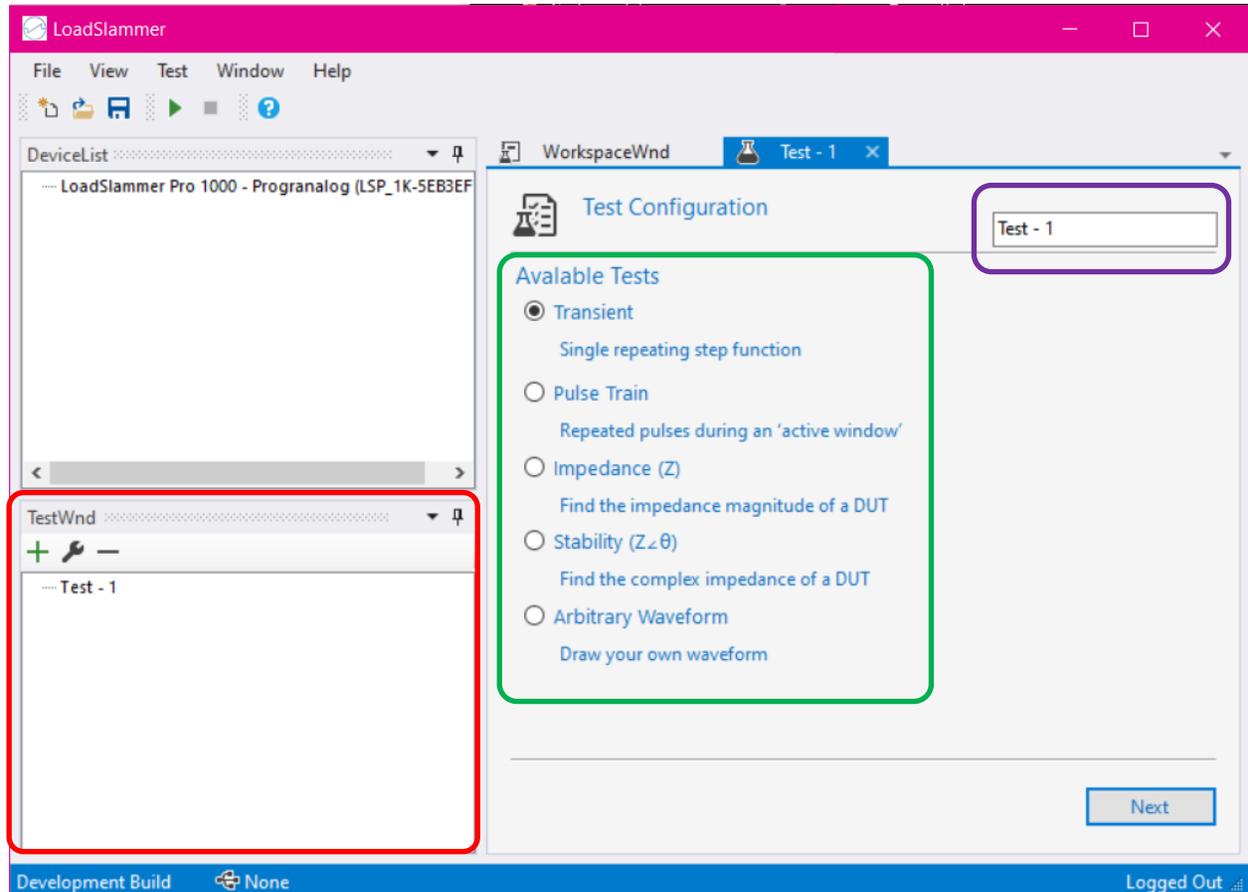
Opening the GUI will present a screen that looks similar to the shot below. The GUI starts with a new workspace by default. A workspace (green) is the combination of tests (red), attached devices, and results.

The first thing after opening the GUI is to connect a device, and assign it to the workspace. This is done by double clicking the device in the DeviceList (purple box) to connect the device to the PC. Then a double clicking the device a second time will add the device to the workspace.



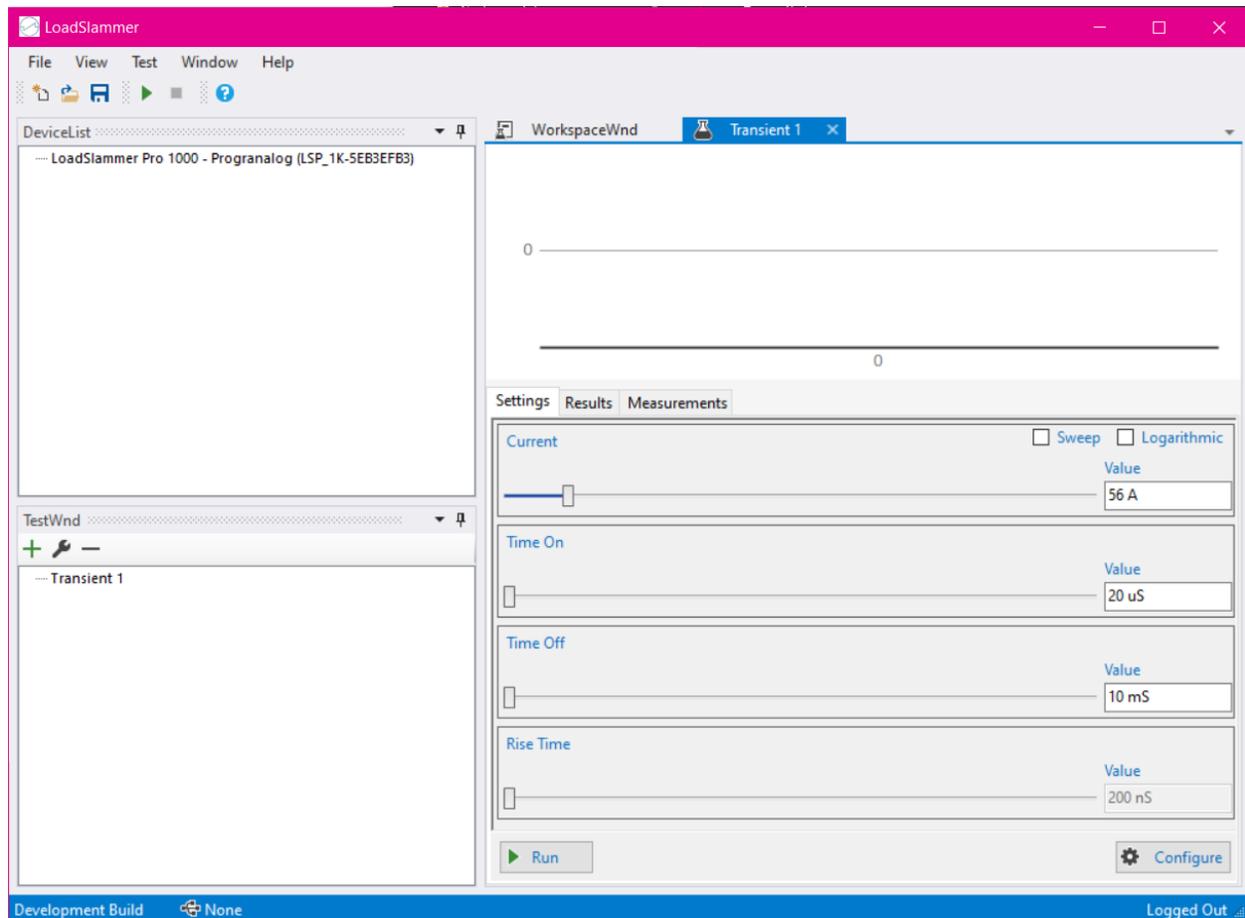
### 3.2.1.2 Creating a Test

Now that a device is connected to the workspace, to create a test, click the green plus in the tests window (red). This creates a new test in the workspace, and pops up a configuration tab. Select the type of test (green) and give the test a name (purple). To finish click next.



### 3.2.1.3 *Configuring a Test*

Now that the test is created, it needs to be configured. For example, how much current and the rise time. The graph will show a preview based on the selected settings, and either a live or historical view of sampled data. The tabs in the test window allow configuration, creating measurements, and review of results. Some parameters can be swept to collect a set of data to be analyzed.



### 3.2.1.4 *Running Tests*

There are two ways to run tests. The most basic is the test button at the bottom of the settings in each test tab. This button will run just the currently viewed tab's test. Alternatively, the run button, at the top of the window in the toolbar, can be clicked to run all the tests in the test window in sequence.

### 3.3 TEST MODES

The LSP1000 has several modes of operation and is field upgradeable to offer additional functionality

#### 3.3.1 Transient

Transient mode is the most basic mode of operation. In this mode, the main goal is to understand the step response of the DUT. A load transient is applied to the DUT to determine the output voltage response. Some of the primary measurements are the Droop and Liftoff amplitudes, and the recovery time of the regulator. Additionally, the load line can be calculated, and the recovery response gives an indication of phase margin.

#### 3.3.2 Pulse Train

Pulse Train mode is very similar to the transient mode. The main difference is the current step from the transient pulse is modulated with a square wave to give a specific frequency and duty cycle. This allows for the frequency and duty cycle to be swept over a range to generate a 3D graph or frequency alone to look for resonant peaks.

#### 3.3.3 Impedance

Impedance mode applies a sinusoidal current load transient and measures voltage ripple to determine the large signal impedance.

There are several ways to interpret this data. One way is to look at the amplitude response of the voltage over frequency. Complementary, analyzing the spectral content at each applied frequency can inform on where the non-linearities of the system are located.

#### 3.3.4 Arbitrary

Arbitrary mode enables the user to configure a custom pattern.

#### 3.3.5 Vender Specific

Vender specific tests are available upon request. Contact us at [support@loadslammer.com](mailto:support@loadslammer.com). We work with many ASIC vendors and can offer specific pass/ fail tests for fast and confident testing.

### 3.4 TESTING WITH LOADSLAMMERS™ IN PARALLEL

It is possible to use multiple LSP1000s in parallel to increase the current handling capability using the parallel cable.

To enable the parallel mode, all devices need to be connected to the parallel cable and the devices must have their power plugged in. Only once device needs a USB data connection; This device is referred to as the 'master'. Any device in the chain can be the master device.

Operation of the LoadSlammer in parallel is the same as a single device. The slave devices simply 'mirror' the current in the master device.

If you take external measurements with the sense outputs, the current sense output will need to be adjusted based on the number of devices attached. Measure the output of a single device and multiply the conversion factor by the number of LoadSlammers in parallel.

While all 3 devices will produce the same load response, only the master will sample the voltage and current to be transmitted up to the PC. Select the device closest to the point of interest to use as the master in order to get the best results.

Currently, up to 3 devices are supported in parallel.



## 4 CHANGE HISTORY

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<b>Revision Number</b>	<b>Date</b>	<b>Reason for change</b>
0.1	September 10, 2019	Initial Release
0.2	September 11, 2019	Added Parallel Info
0.3	November 05, 2019	Added final HW revision level characteristics
0.5	March 03, 2020	Updated to reflect SW & FW development.