ANALOG DEVICES | ADI Power

LTpowerAnalyzer

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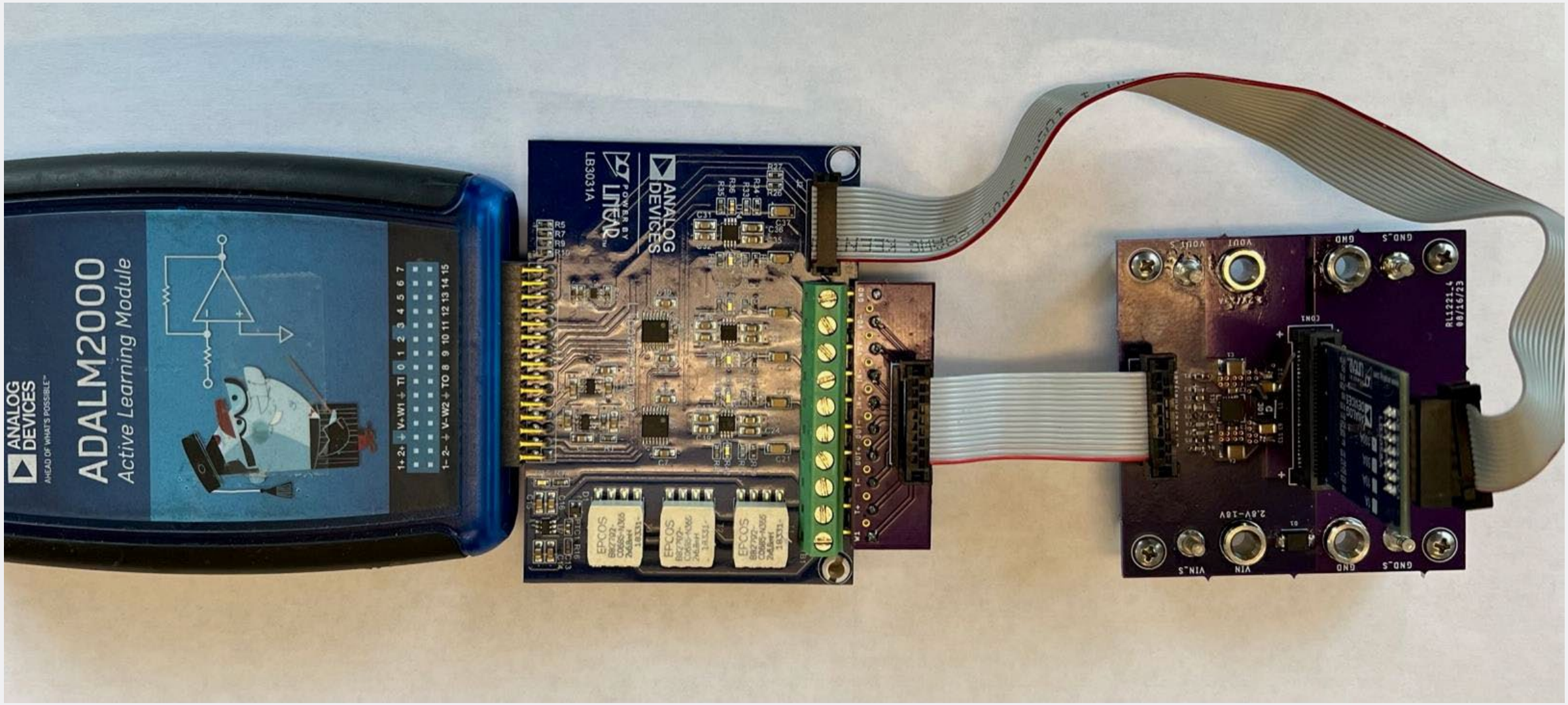
The LTPowerAnalyzer - Overview

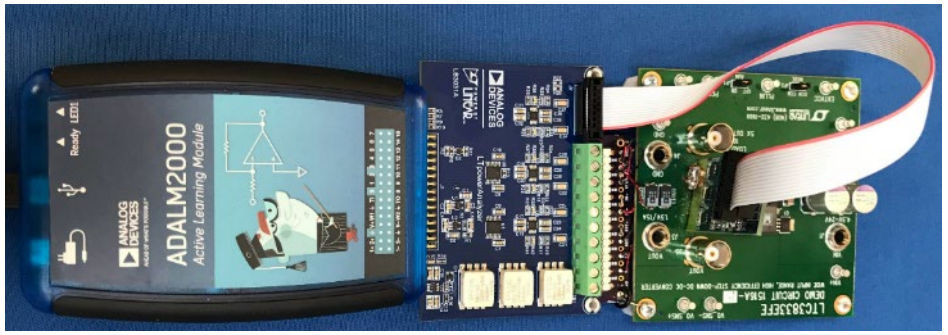


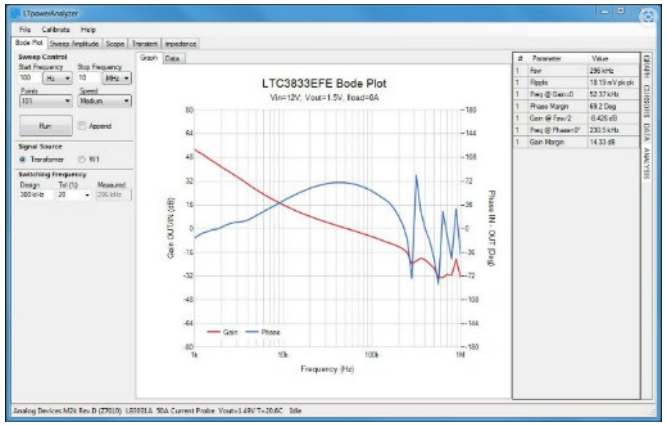
Overview

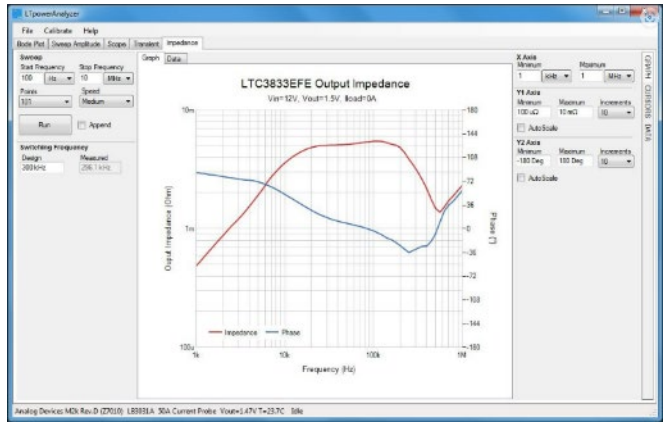
LTPOWERANALYZER – WHAT IS IT

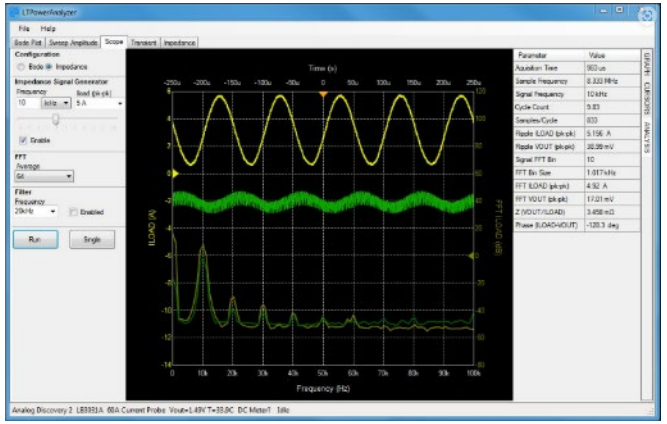
A very low overhead, portable, power converter test and measurement system!

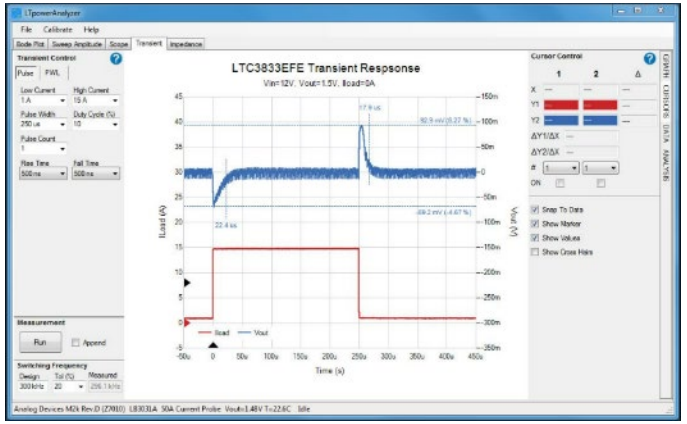
- What is it:
  - The LTpowerAnalyzer is a tool that analyzes the AC and DC performance of power converter hardware. It can be used to generate:
    - Bode Plots – Frequency Response
    - Transient Plots
    - Output Impedance Measurements
- Why?
  - This tool-set is the logical extension of our power product portfolio. As we further partner with our customers, test and measurement communication is the final step in closing the loop.
    - Analog Devices FAEs will be using the same tool to validate power and to communicate with our design partners. – This audience.





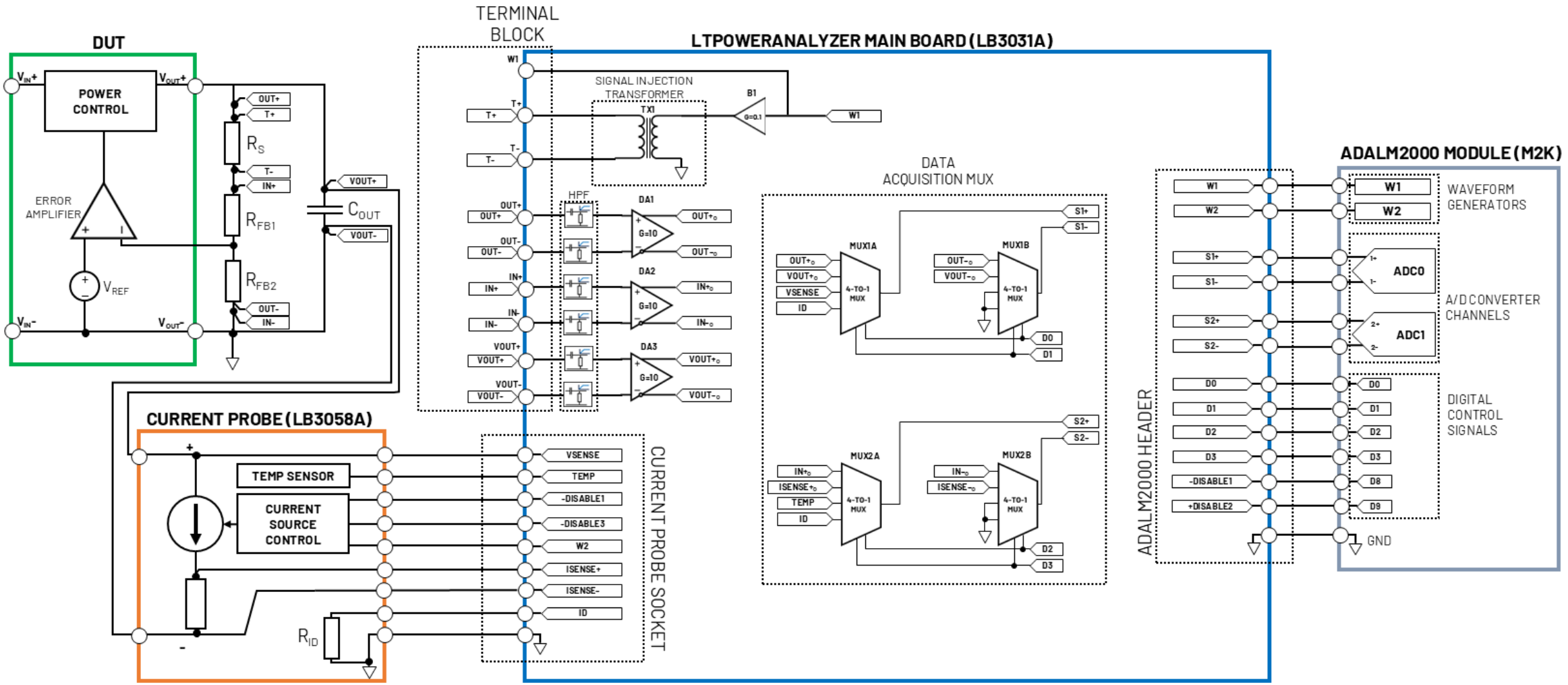






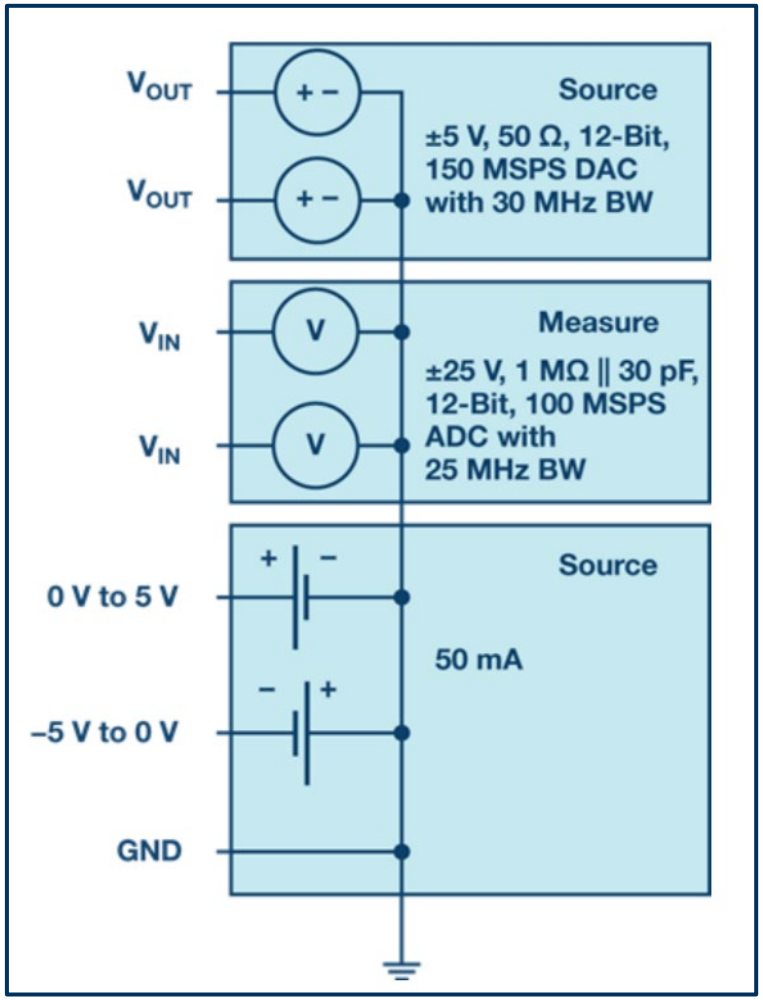
LTpowerAnalyzer Hardware

LTpowerAnalyzer System Block Diagram



Hardware

The main interface for the LTPA is the Analog Devices Advanced Learning Module – ADALM2000

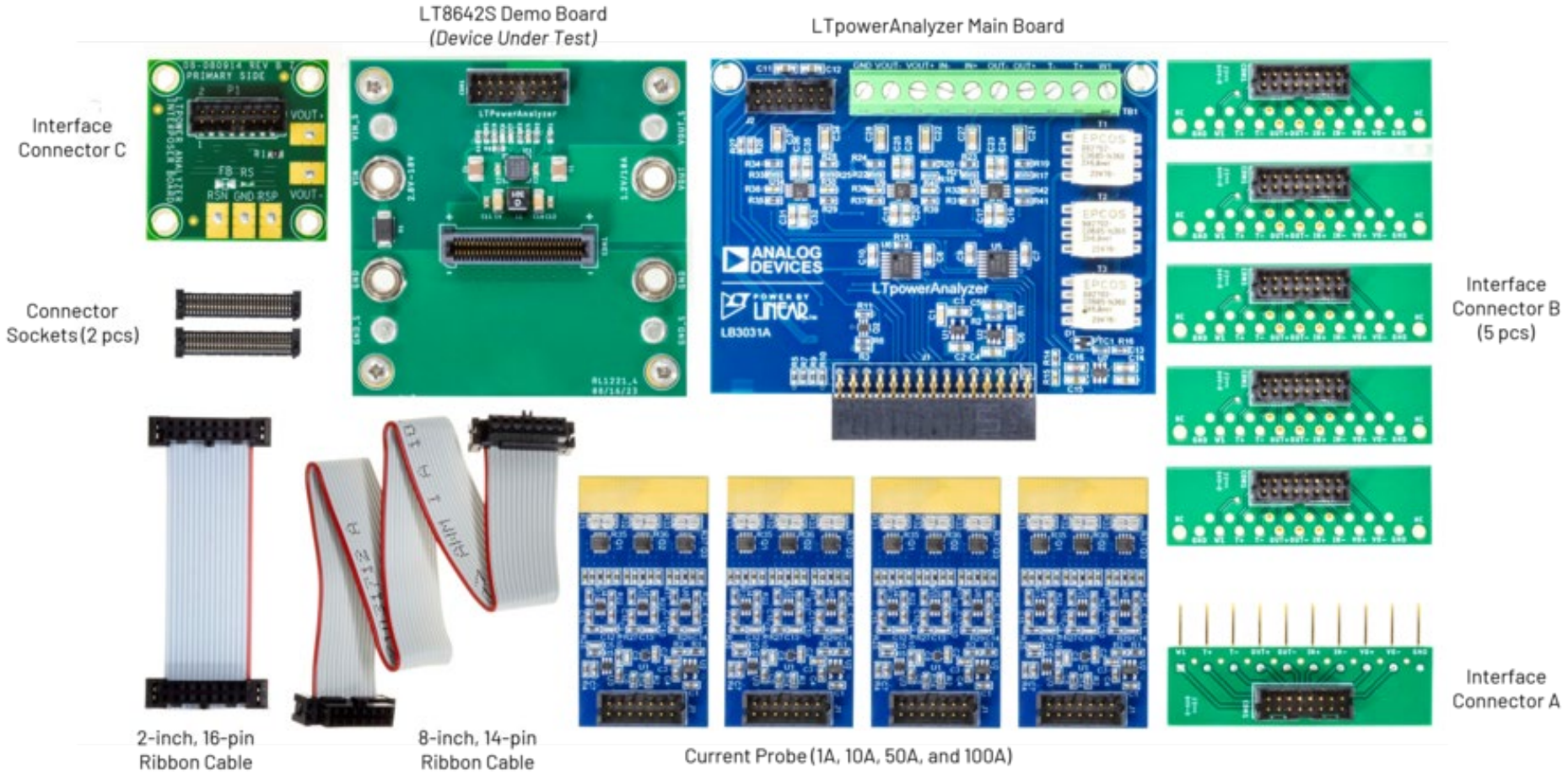


ADALM2000 - Overview

- Two-channel USB digital oscilloscope
- Two-channel arbitrary function generator
- 16-channel digital logic analyzer (3.3V CMOS and 1.8V or 5V tolerant, 100MS/s)
- 16-channel pattern generator (3.3V CMOS, 100MS/s)
- 16-channel virtual digital I/O
- Two input/output digital trigger signals for linking multiple instruments (3.3V CMOS)
- Single channel voltmeter (AC, DC, ±25V)
- Network analyzer – Bode, Nyquist, Nichols transfer diagrams of a circuit. Range: 1Hz to 10MHz
- Spectrum Analyzer – power spectrum and spectral measurements (noise floor, SFDR, SNR, THD, etc.)
- Digital Bus Analyzers (SPI, I²C, UART, Parallel)
- Two programmable power supplies (0…+5V , 0…-5V)

Hardware

What's in the LTpowerAnalyzer box

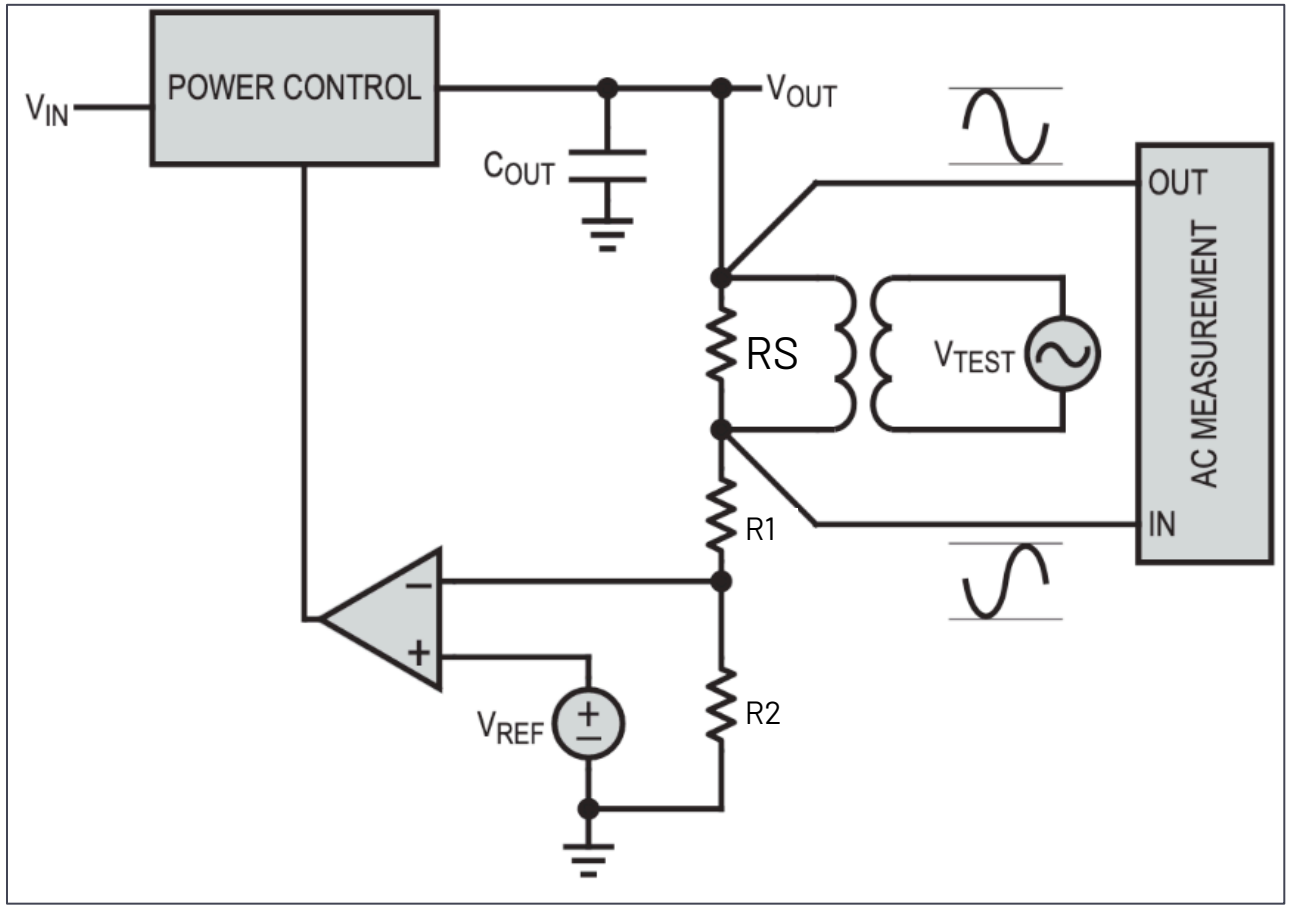


The LTpowerAnalyzer kit, along with the ADALM2000 provide many options for connecting to and assessing the performance of your power converter.

Hardware

BASIC THEORY

- The diagram to the right shows the signaling and connections required in general, to perform a frequency response measurement on a DUT
- Vtest is transformer coupled into the control loop of the DUT/Power Control block via R1.
    - This imposes an AC, small signal tone in the control loop.
- The output perturbation based on the small signal tone is measured and the transfer function of the control loop can be calculated and plotted.



Basic Frequency Response Measurement

Hardware

LTPA CONNECTION AND MEASUREMENT DESCRIPTION

The diagram to the right shows the connections necessary for performing measurements with the LTPA on a DC/DC power converter.

T+/- is the transformer coupled AC perturbation voltage

- Kelvin connected to **RS** resistor [Note +/- conventions in drawing]
  - **RS** is inserted into the FB divider in the basic converter schematic.
    - Typically, 10-50 Ohms
    - This is the point of signal injection

OUT+/- pair is connected across the entire FB divider, from the top of RS.

- This kelvin connection senses the perturbation across the FB circuit.

IN +/- pair is connected between the bottom of RS across the FB divider.

- This Kelvin connection senses the signal appearing at the top of the divider being injected into the DUT control loop.

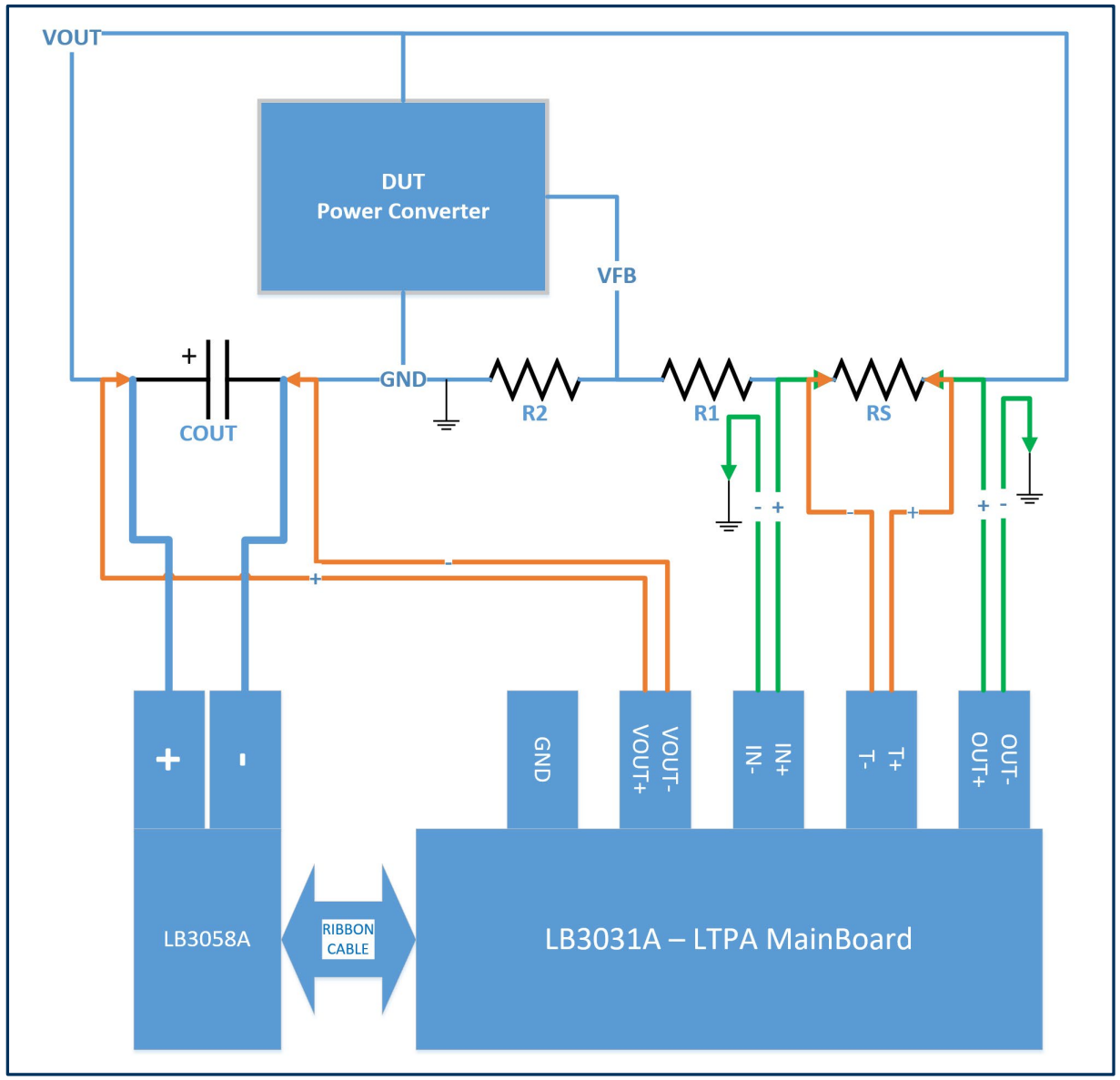
VOUT +/- pair is connected across the output capacitance.

- This Kelvin connection senses the output voltage + AC across the output capacitor.

LB3058A

- This is the main Current Probe connection. *Make note of the probe polarity when connecting.*
  - This is a high current path and requires low inductance, high conductivity implementation.

Using these connections, the LTPA signal and measurement system can perform: Frequency and Transient response, as well as Output Impedance Measurements and return analytic information useful in the verification and validation of power system implementations.

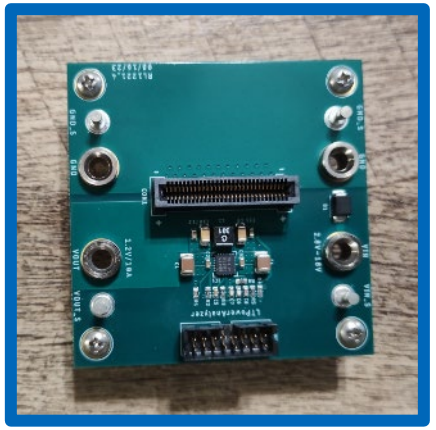


Basic LTpowerAnalyzer Connections With general Power Converter

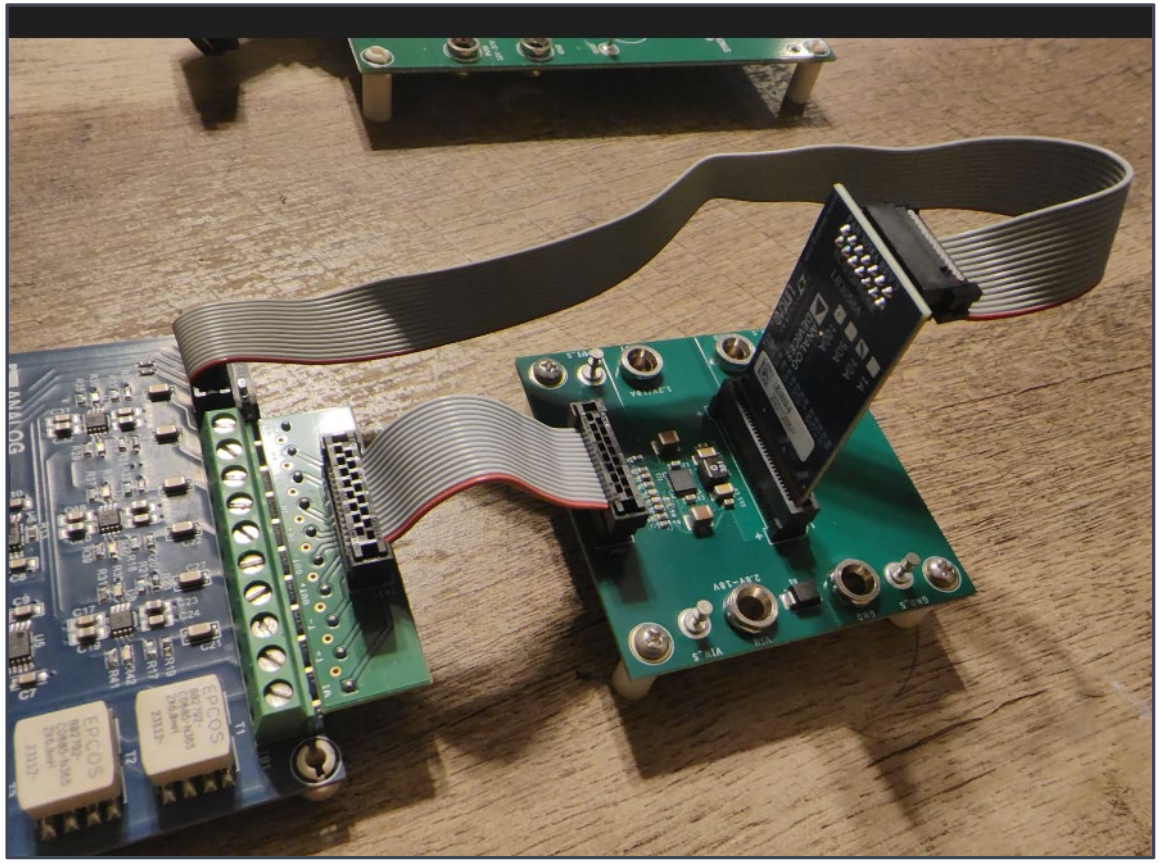
LTpowerAnalyzer First Measurements

First Measurements

TAKING MEASUREMENTS USING THE INCLUDED LT8642S HARDWARE



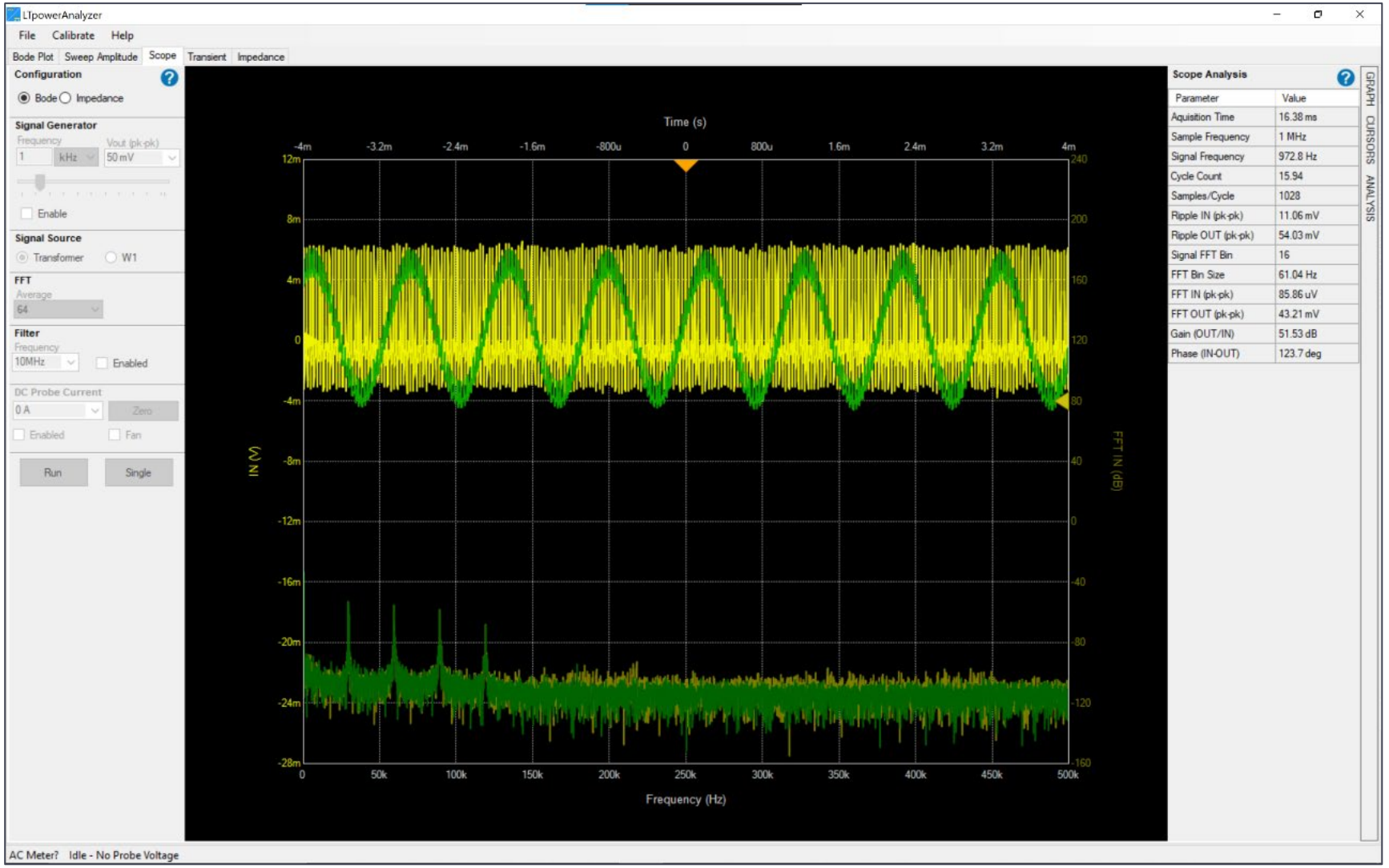
- SETUP STEPS [Image of setup on Lower Right]
  - The Main Board Connector Block Should be inserted and screwed into the main board terminal block.
  - A 10A Current Probe should be plugged into the 60-pin vertical card edge port included on the DUT. [**CON1**]
    - **NOTE POLARITY MARKINGS ["+"]**
    - This provides the output for transient and DC loading, and impedance measurement.
  - **14-pin Ribbon** should be plugged in between main board and Current Probe [long ribbon]
  - **16-pin Bode ribbon** should be plugged into the Main Board Connector Block 16-pin connector and the DUT **LTpowerAnalyzer** connector.
    - The Main Ribbon Receiver should be inserted and fixed into the terminal block of the main board per the image to the right.
- Main power should be available via a bench or lab supply. [not included with kit]



First Measurements

SCOPE OPERATION

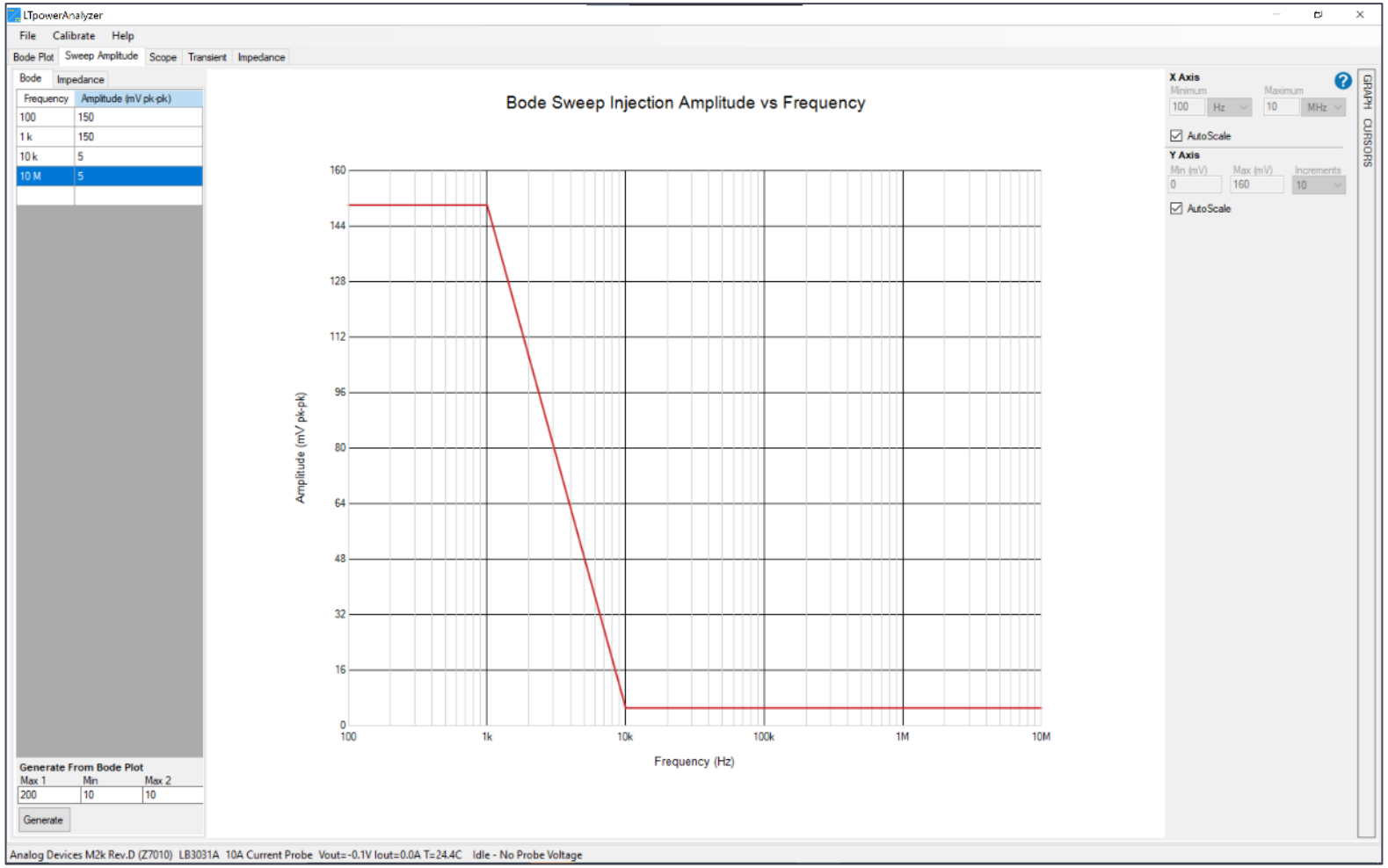
- Select the **SCOPE** tab
- Select **BODE** Configuration
- In the **Signal Generator** section enter the following:
  - **Frequency:** 1 kHz
  - **Vout (pk-pk):** 50 mV
- **Select the following:**
  - **Signal Source:** Transformer
  - **FFT: Average:** 64
  - **Filter:** 10 MHz, Disabled [no filtering]
  - **DC Probe Current:** 0 A, Disabled [no DC current into Current Probe]
- Press the **RUN** button
- The measurement should appear similar to the screen capture on the right



First measurements

SWEEP AMPLITUDE

- Select the Bode sub tab
- Set the following values in **SWEEP AMPITUDE** for the following measurement.
  - **150 mV pk-pk@ 100 Hz**
  - **150 mV pk-pk@ 1 KHz**
  - **5mV pk-pk@ 10KHz**
  - **5 mV pk-pk@ 10MHz**
- This will produce an output of 150mV pk-pk from 100Hz to 10KHz
- At 80KHz+ the amplitude will be 5mV pk-pk
- The output amplitude will be linearly interpolated between 10KHz and 80KHz
  - Starts @ 150mV
  - Ends @ 5mV
- The display should appear similar to the screen capture on the right

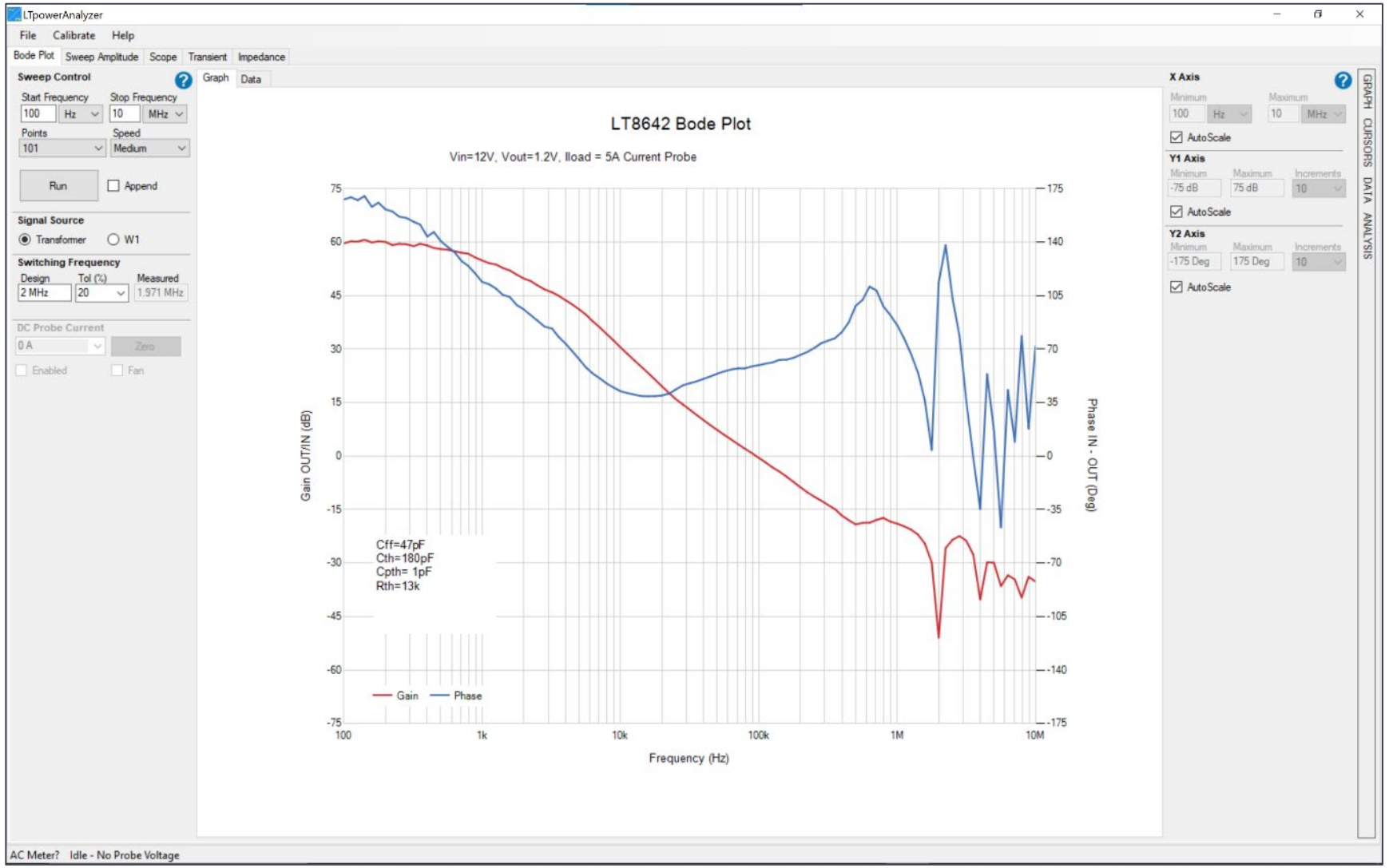


Sweep Amplitude Settings

First measurements

BODE PLOT EXECUTION

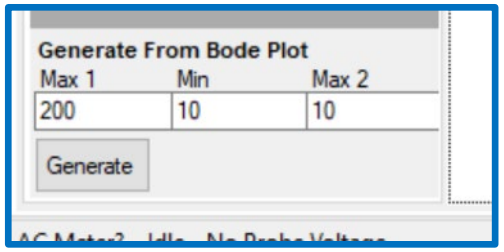
- **Calibrate!**
- Set the control fields in the **BODE** tab to the following values.
  - **Start Freq: 100 Hz**
  - **Stop Freq: 10 MHz**
- **Select Points: 101**
- **Select Speed: Medium**
- **Signal Source: Transformer**
- Set the Switching Frequency Field to
  - **2 MHz**
  - **Tol(%): 20**
- **Calibrate!**
- Apply power to the DUT
- Press the **RUN** button
- The measurement should appear similar to the image on the right

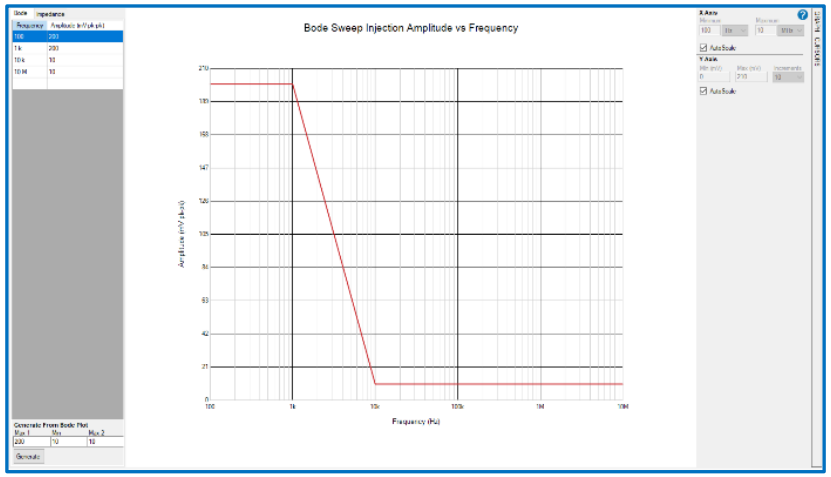


First measurements

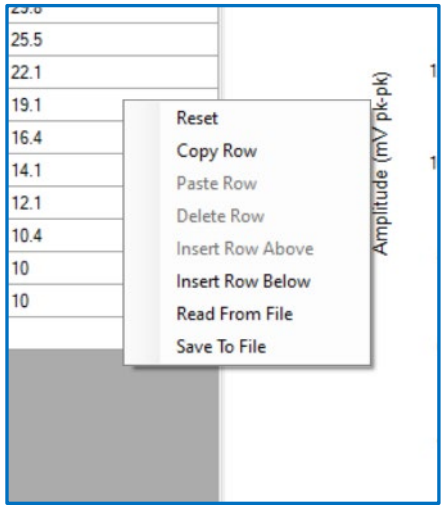
SWEEP AMPLITUDE AUTOMATIC
SWEEP AMPLITUDE GENERATION

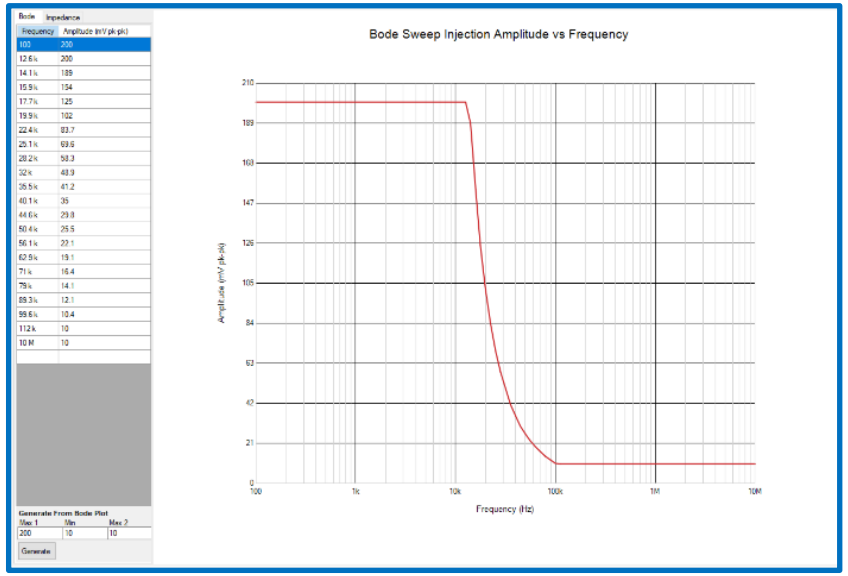
- After the initial sweep, the tool can make an analytic determination of the necessary output level from the injector across varying frequency in order to maximize the SNR of the measurement.
- At the bottom-left corner of the sweep amplitude screen press the “generate” button.
- An automatically generated curve will result based on the results of the initial Bode Plot.
  - Rerun the Bode with the new settings.
- To reset the settings float the cursor over the table and right click. Select “RESET”. This will reset the table to the default values.





Initial Sweep Amplitude Setting



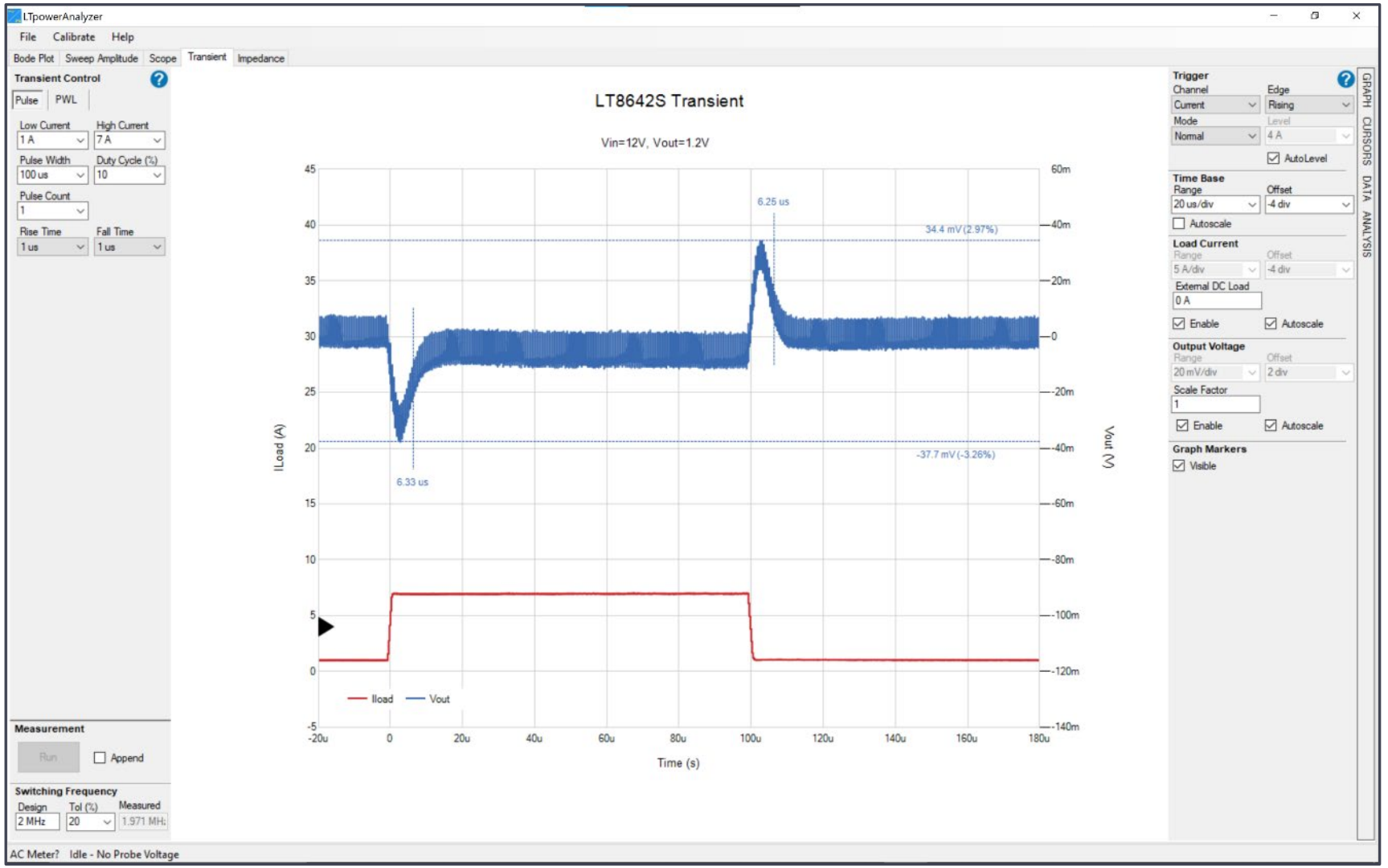


Generated Sweep Amplitude Settings

First Measurements

Transient test execution

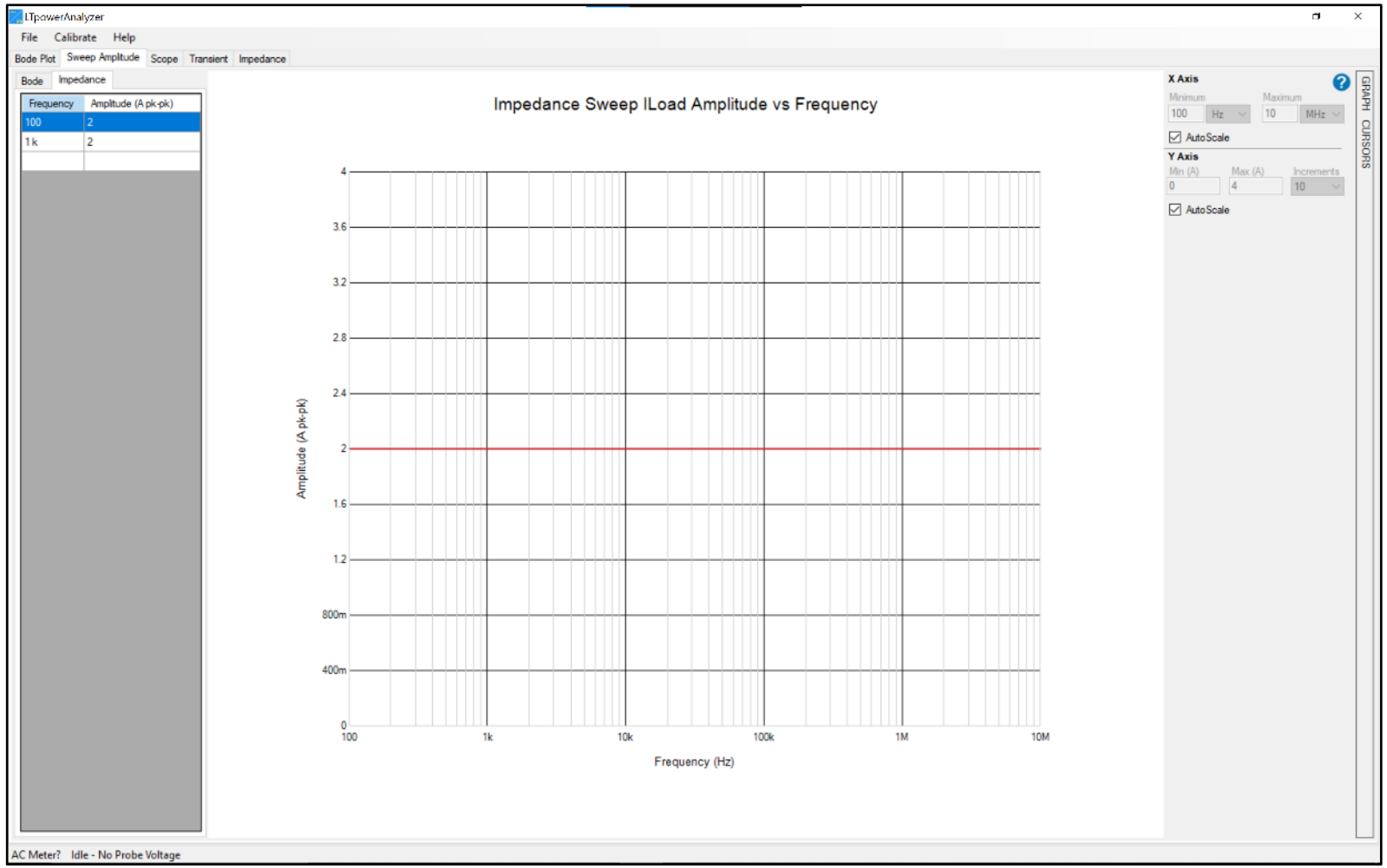
- **Calibrate!**
- Select the **TRANSIENT** tab
- Select the **PULSE** tab under TRANSIENT CONTROL [see image to right]
- Set the control fields to the following values.
  - **Low Current: 1 A**
  - **High Current: 7 A**
  - **Pulse Width: 100 us**
  - **Duty Cycle: 10 %**
  - **Pulse Count: 1**
- **Select:**
  - **Rise Time: 1 us**
  - **Fall Time: 1 us**
- Set the Switching Frequency Field to
  - **2 MHz**
  - **Tol(%): 20**
- **Calibrate!**
- Press the **RUN** button
- The measurement should appear similar to the image on the right



First Measurements

SWEEP AMPLITUDE

- Select the Impedance sub-tab
- Set the following values in **SWEEP AMPITUDE** for the following measurement.
  - **2A pk-pk@ 100 Hz**
  - **2A pk-pk@ 1 KHz**
- This will produce an output of 2A pk-pk across the bandwidth of operation
- Amplitude compensation should not be required for the current probe due to the DC coupling.
- The display should appear similar to the screen capture on the right

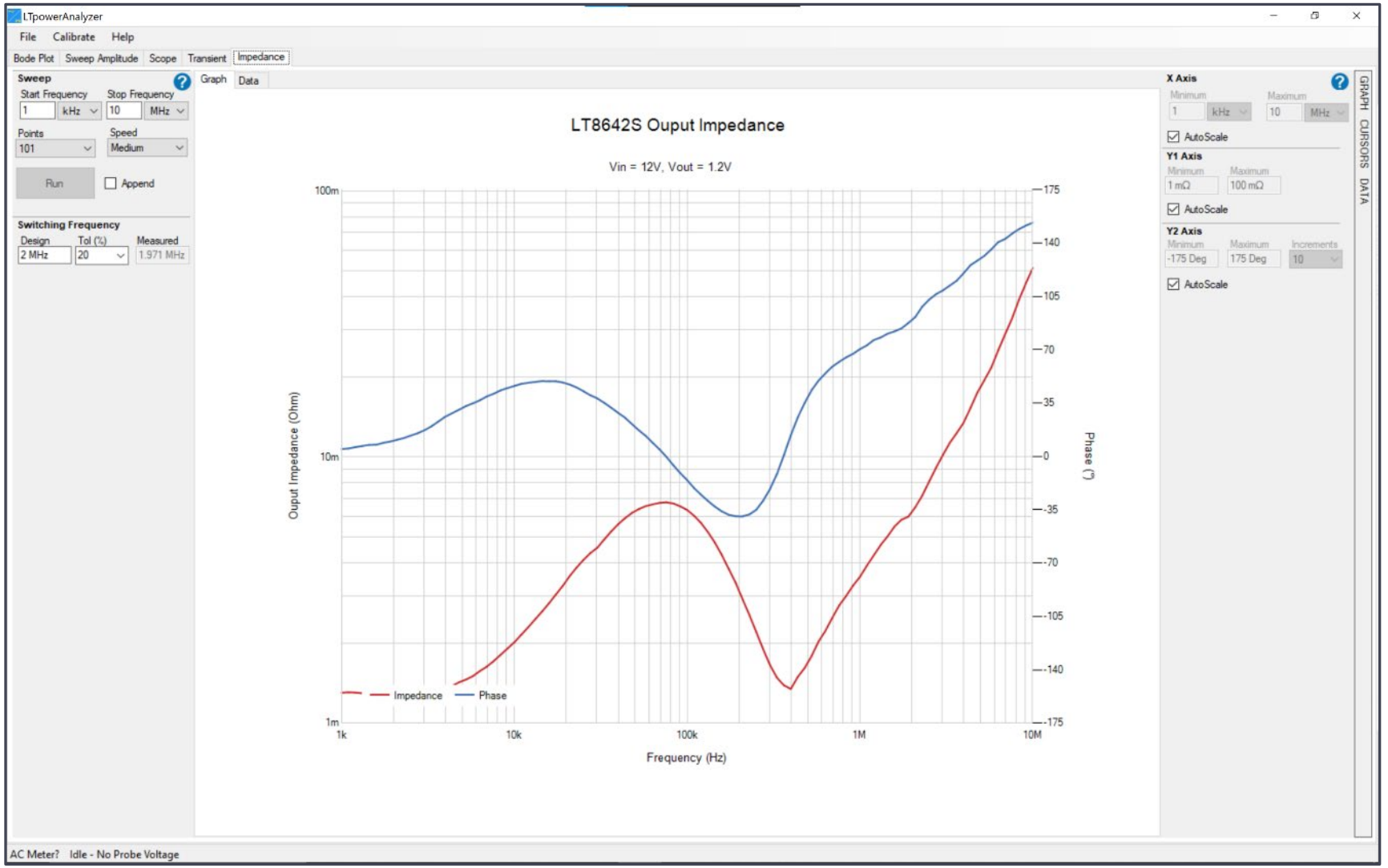


Sweep Amplitude Settings

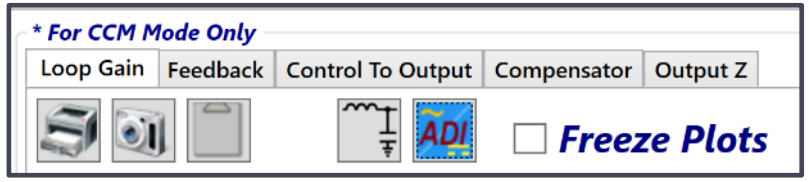
First Measurements

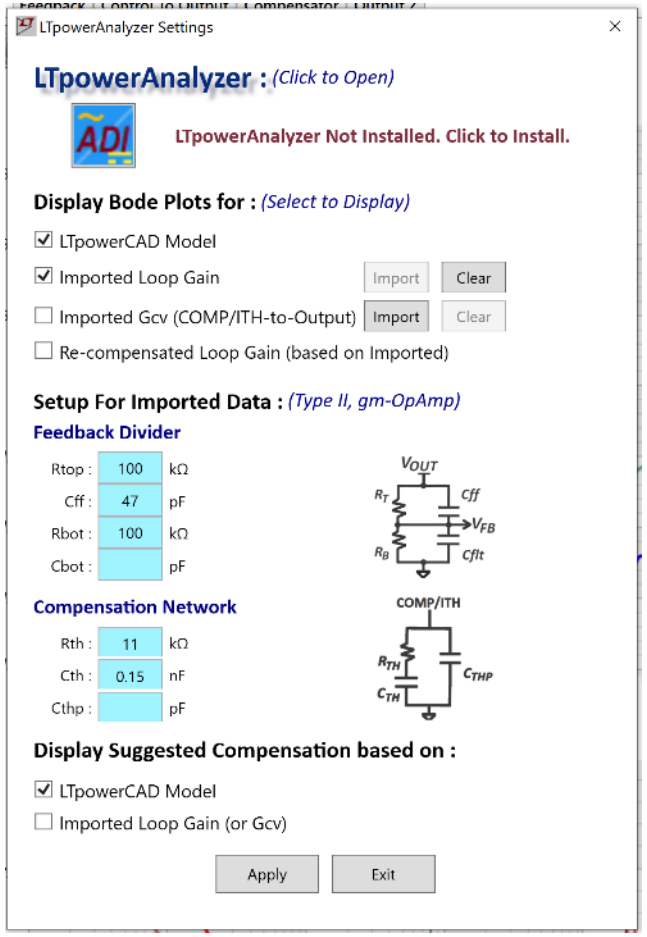
OUTPUT IMPEDANCE MEASUREMENT

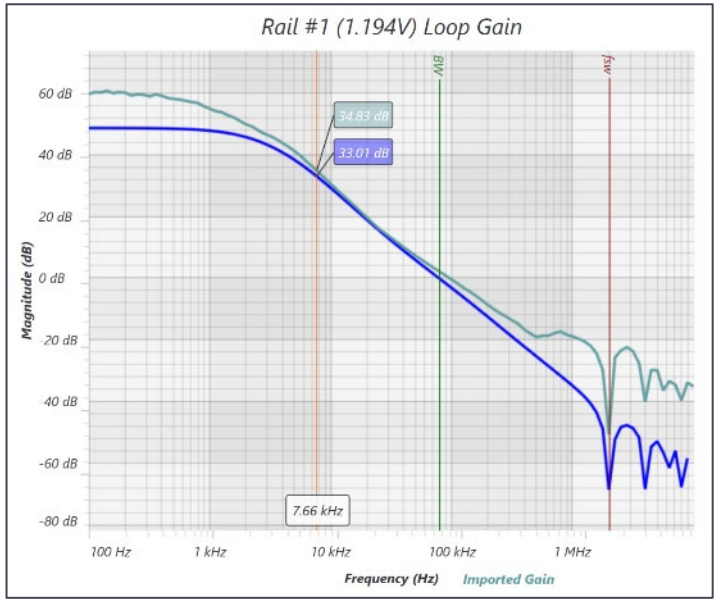
- **Calibrate!**
- Set the control fields in the **IMPEDANCE** tab to the following values.
  - **Start Freq: 1 kHz**
  - **Stop Freq: 10 MHz**
- **Select Points: 101**
- **Select Speed: Medium**
- Set the Switching Frequency Field to
  - **2 MHz**
  - **Tol(%): 20**
- **Calibrate!**
- Press the **RUN** button
- The measurement should appear similar to the image on the right

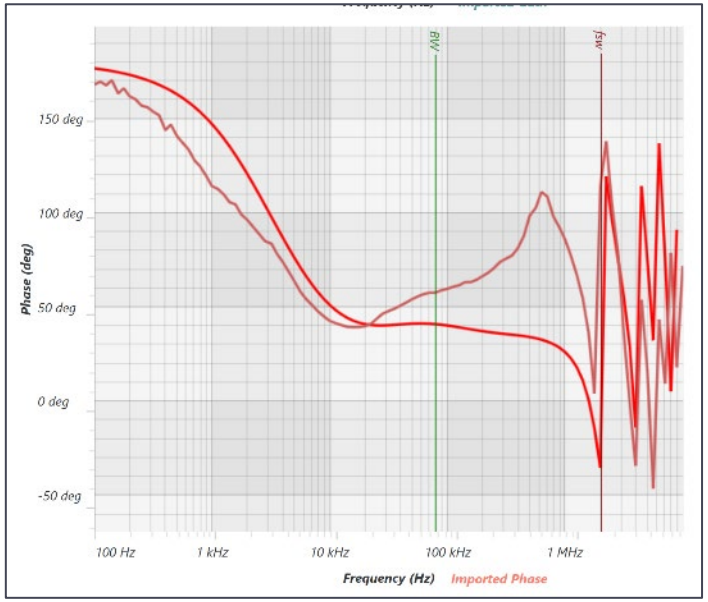


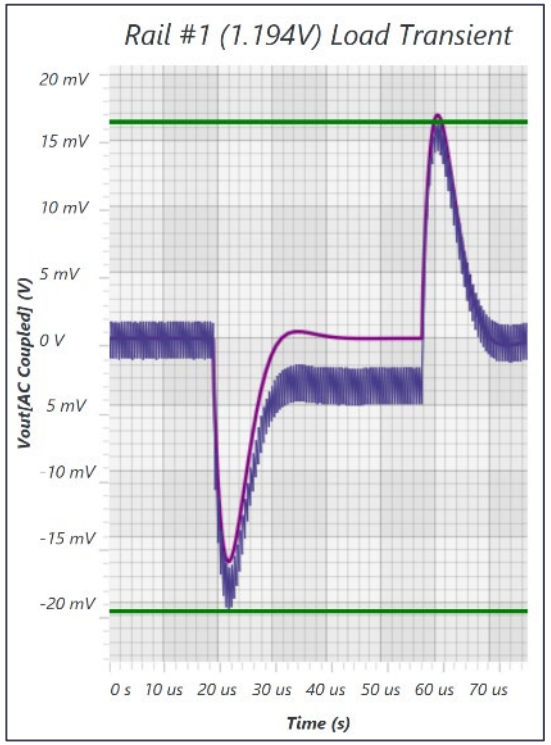
LTPowercad integration

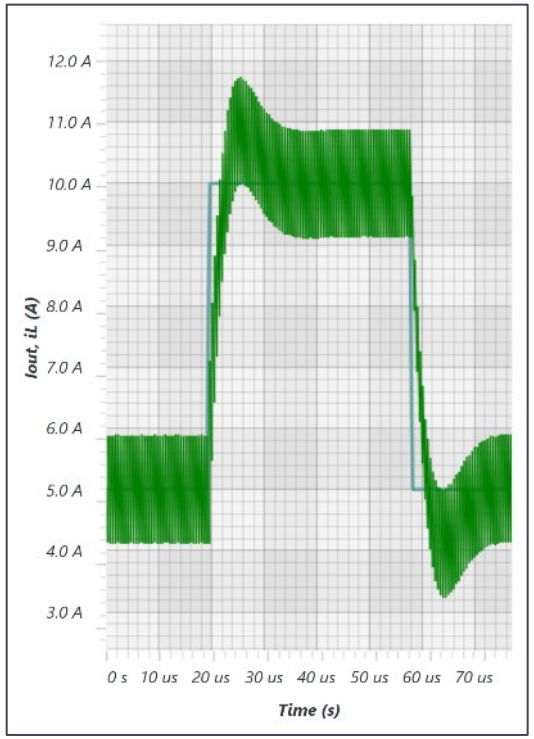




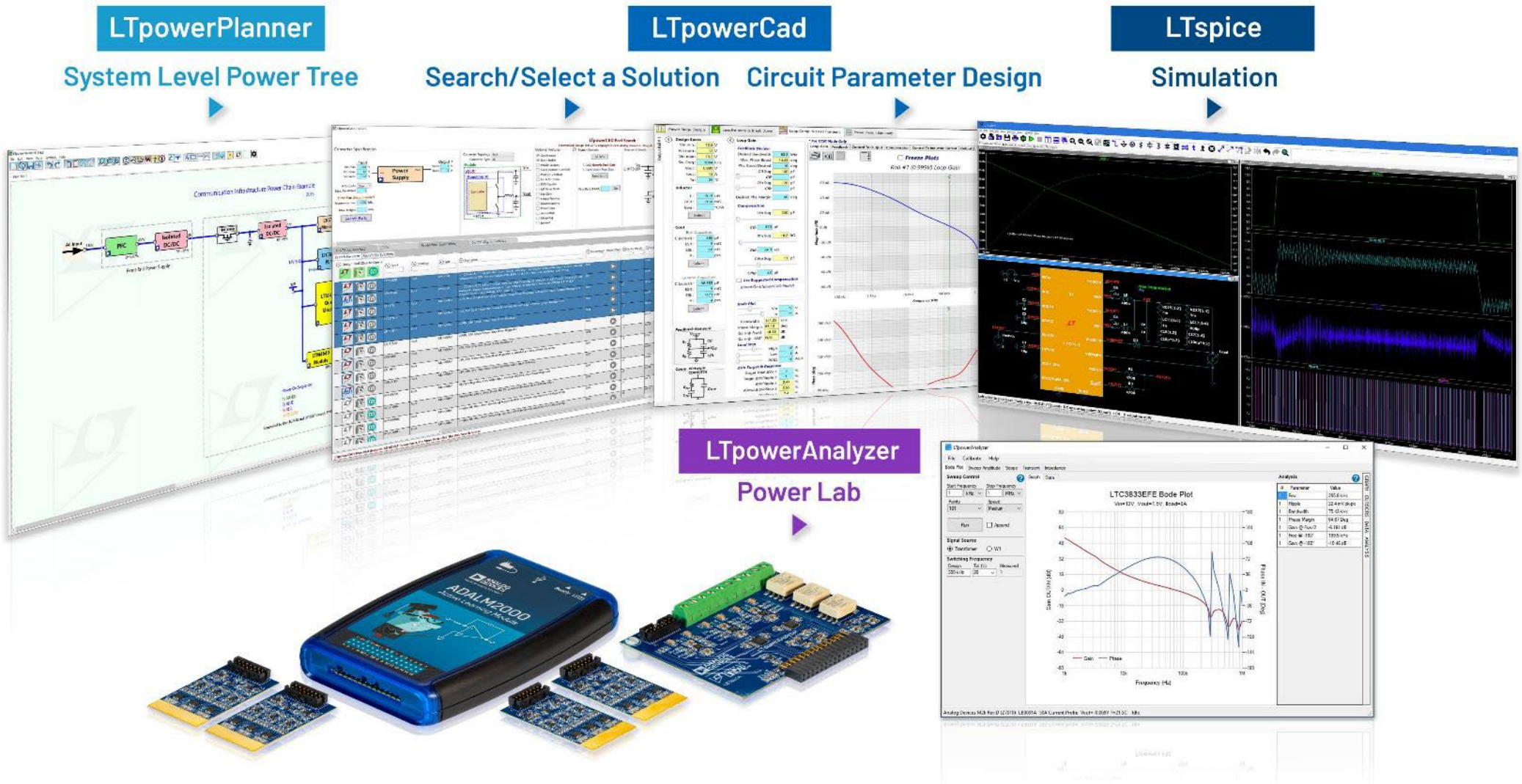








Closing the Loop on Power Supply Design!



AHEAD OF WHAT'S POSSIBLE

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