

Introduction

The AAT1149 Evaluation Board provides a platform for test and evaluation of the AAT1149 3MHz Fast Transient 400mA Step-Down Converter. The evaluation board demonstrates suggested size and placement of external components to achieve the best performance. The external components are limited and selected for small size to suit portable device applications while the layout has been optimized to achieve high efficiency and low output noise with the SC70JW-8 package. The design operates across an input voltage range from 2.7V to 5.5V.

The AAT1149 Evaluation Board provides an adjustable output voltage from 1V to V_{IN} at 400mA maximum output current. Resistors R1 and R2 program the output to regulate at a voltage higher than 0.6V. The suggested value for R2 is 59k Ω . Table 2 summarizes the resistor values for various output voltages. Connecting EN to IN will turn on the part while connecting EN to GND will disable the part.

Schematic and BOM

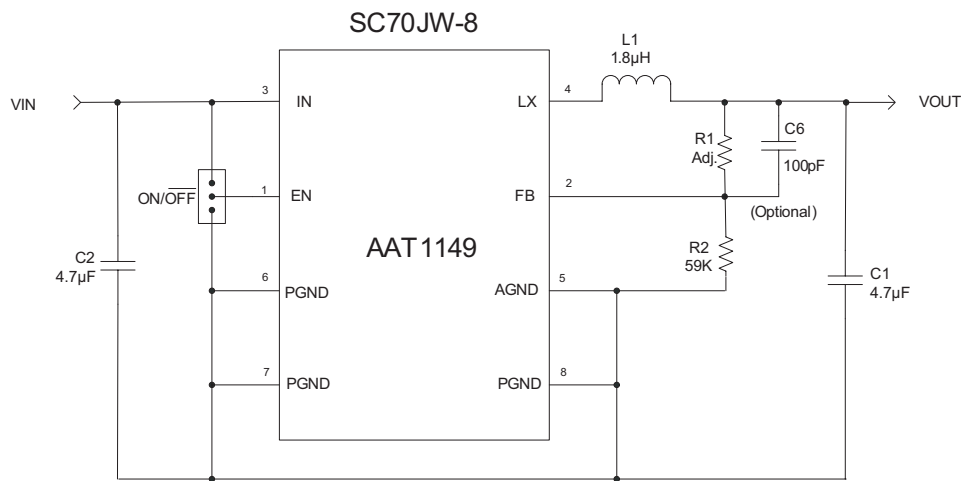


Figure 1: AAT1149 Evaluation Board Schematic.

Symbol	Description
U1	AAT1149 SC70JW-8
C1, C2,	4.7µF 10V 0805
C3	100pF 10V 0402(Optional)
L1	1.8µH Sumida CDRH2DO9
R1	See Table 2; 10V 0402
R2	59k Ω 10V 0402

Table 1: AAT1149 Evaluation Board Build of Materials (BOM).

V_{OUT} (V)	R2 = 59k Ω R1 (k Ω)	R2 = 221k Ω R1 (k Ω)
0.8	19.6	75
0.9	29.4	113
1.0	39.2	150
1.1	49.9	187
1.2	59.0	221
1.3	68.1	261
1.4	78.7	301
1.5	88.7	332
1.8	118	442
1.85	124	464
2.0	137	523
2.5	187	715
3.3	267	1000
3.6	295	1105

Table 2: AAT1149 Adjustable Resistor Values.

Test Equipment

1. Unit under test (UUT) is the AAT1149 Evaluation Board.
2. One (1) Keithley 2430 3A source meter or equivalent.
3. Two (2) XT30-2 power supplies or equivalent.
4. Two (2) 10 Ω , 100W variable resistors, or DC electronic loads.
5. Two (2) Fluke 189 multi-meters or equivalent.
6. A HP33120A 15MHz Function/ Arbitrary waveform generator. Set to PWM setting.
7. Oscilloscope Tektronix TDS3054B or equivalent, three (3) Tek P6139A oscilloscope voltage probes or equivalent, and one Tektronix TCP202 300V 15A peak current probe.
8. A Network Analyzer.
9. Miscellaneous test leads (banana plug to clip lead type is recommended).

Setup and Test

Test: Line-Load Regulation

1. Configure the specified test equipment as shown in Figure 2.
2. Enable UUT by connecting the jumper to the 'ON' position.
3. Turn on the input power supply and set to desired input voltage based on the DC voltmeter.
4. Vary the output load from 0 to 400mA and vary the input voltage from 2.7V to 5.5V while monitoring the output voltage.

5. $\% \text{ Error} = \frac{V_{\text{OUT}} - V_{\text{NOMINAL}}}{V_{\text{NOMINAL}}}$ where V_{NOMINAL} is the output voltage at 10mA output current.

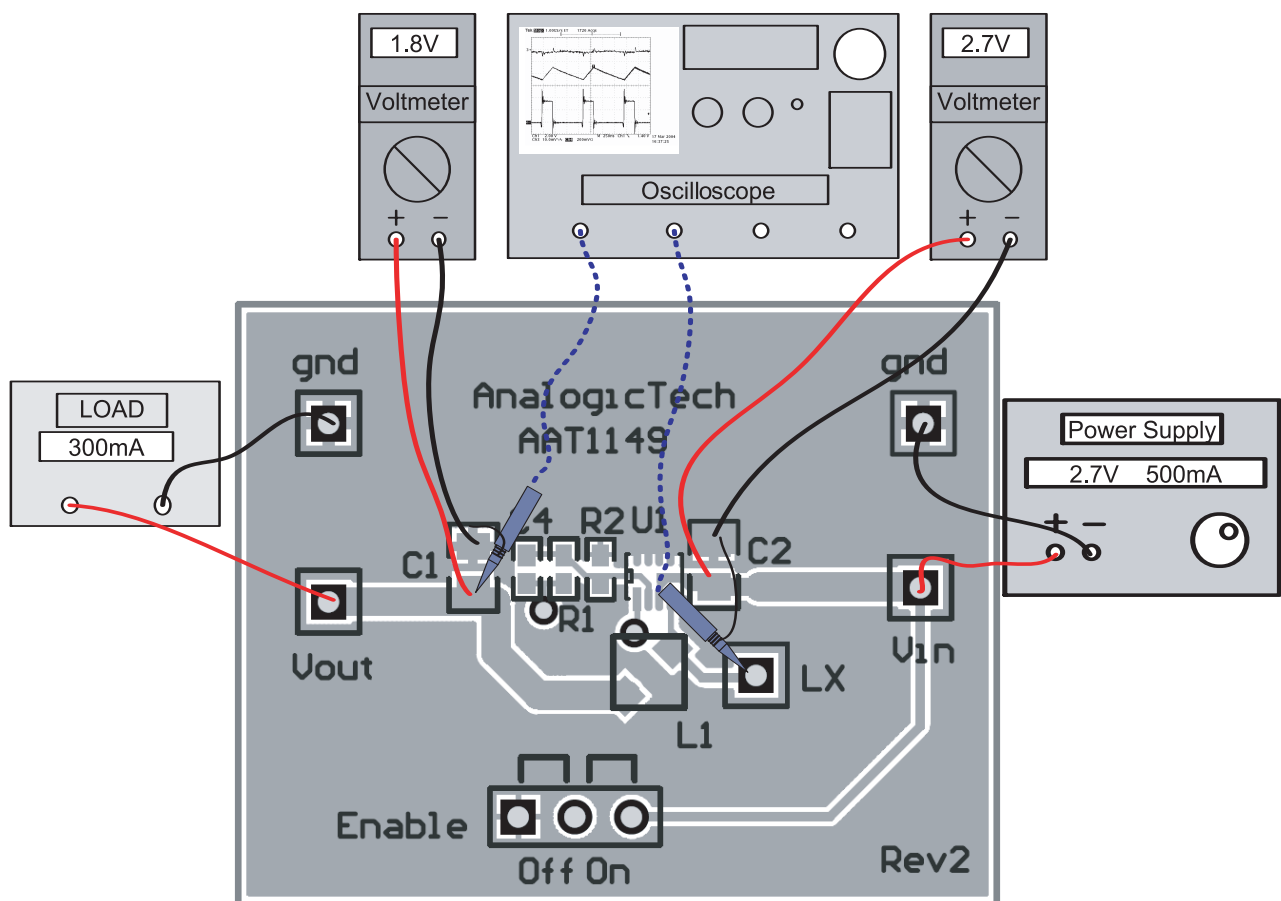


Figure 2: AAT1149 Evaluation Board Connection Diagram for Line and Load Regulation.

Test: Line Transient Response

1. Configure the specified test equipment as shown in Figure 3.
2. Enable UUT by connecting the jumper to the 'ON' position.
3. Use Line Transient Response Board to generate the input voltage step by setting the first power supply to 3.6V and the second one to 4.2V.
4. Toggle the input voltage from 3.6V to 4.2V by setting the magnitude of the PWM to 5Vpp at 5MHz while monitoring the AC input voltage and the AC output voltage on the oscilloscope.
5. Repeat step 4 for different input voltage steps and over the range of V_{OUT} .

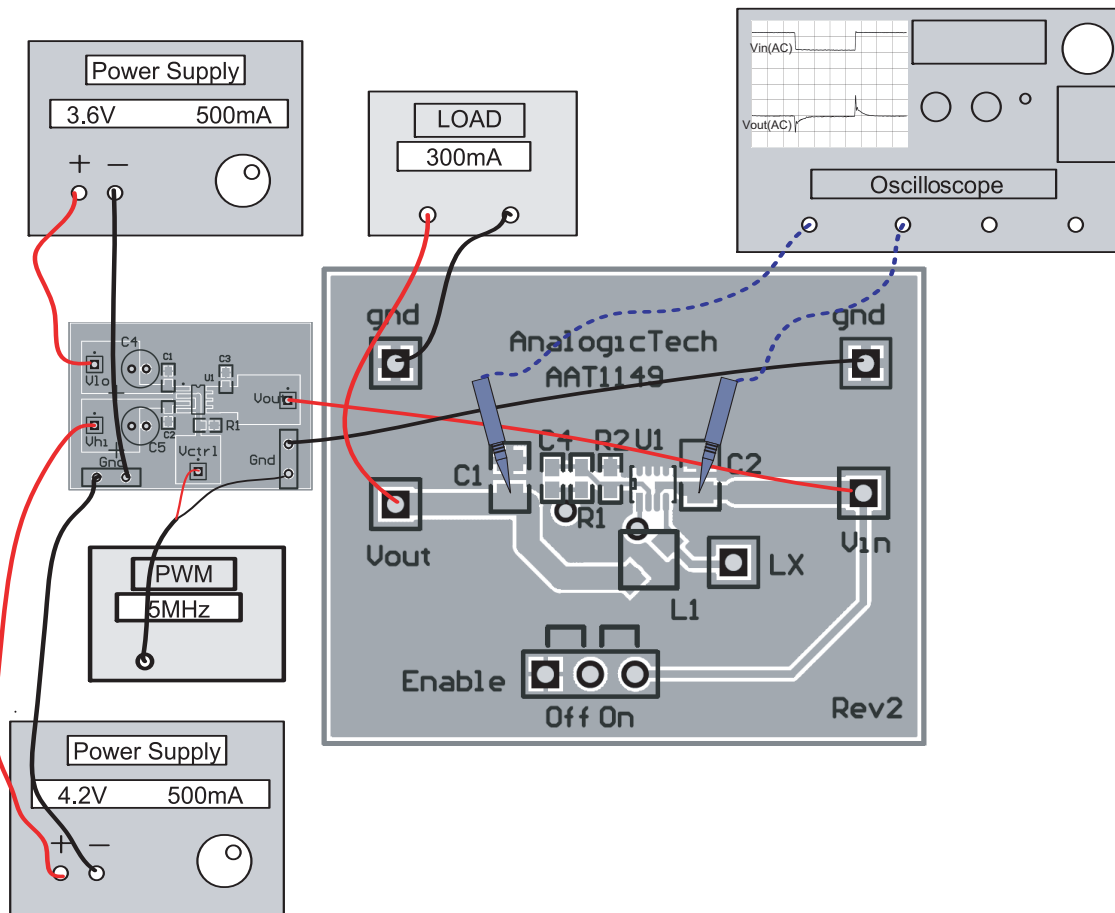


Figure 3: AAT1149 Evaluation Board Connection Diagram for Line Transient Response.

Test: Load Transient Response

1. Configure the specified test equipment as shown in Figure 4.
2. Enable UUT by connecting the jumper to the 'ON' position.
3. Generate the step output load using a PWM (set $V_{PP} = 5V$ at 5KHz), a power MOSFET, and adjustable resistors (R7, R8).
4. Adjust R7 and R8 to get the designed output current while monitoring the step output current and the output voltage response (AC coupling) on the oscilloscope.
5. Repeat step 4 for different output current steps and over the ranges of V_{IN} and V_{OUT} .

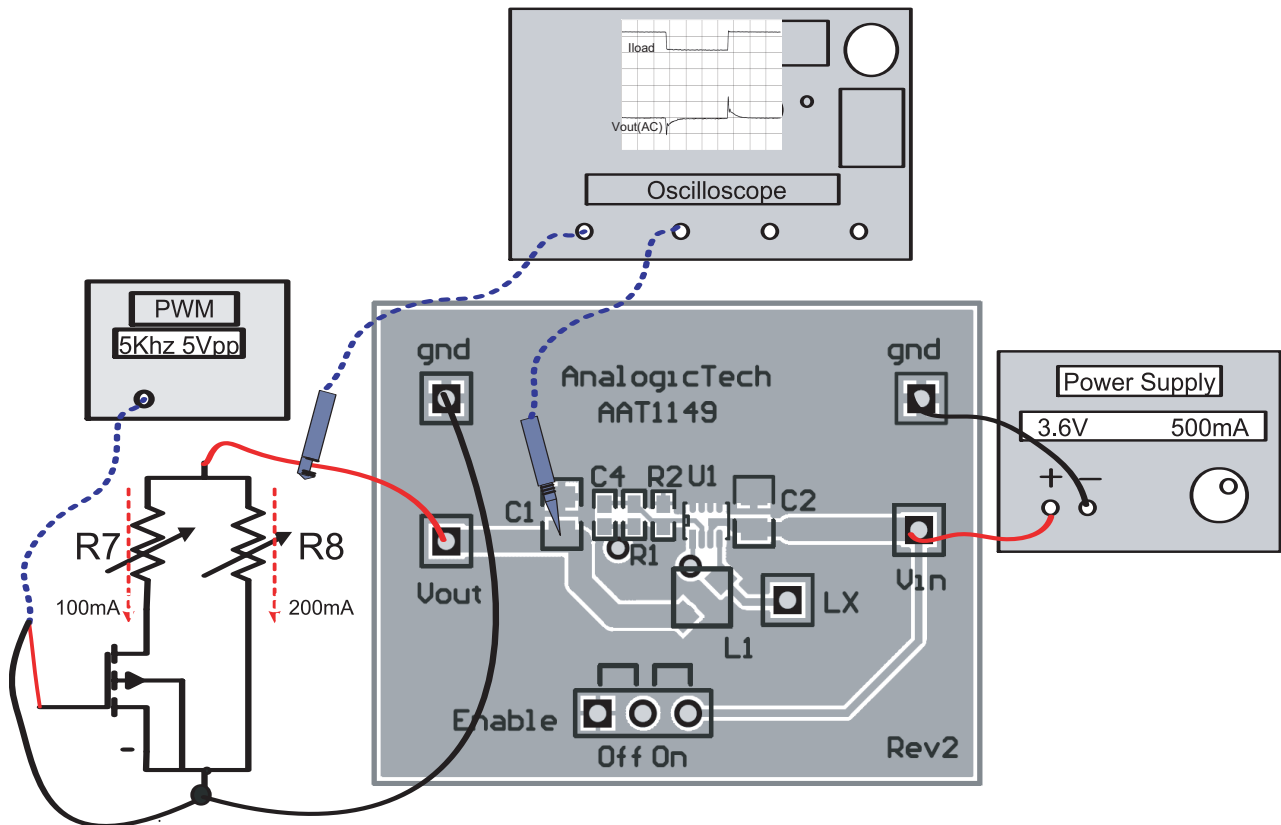


Figure 4: AAT1149 Evaluation Board Connection Diagram for Load Transient Response.

Test: Quiescent Current vs. Input Voltage

1. Configure the specified test equipment as shown in Figure 5.
2. Enable UUT by connecting the jumper to the 'ON' position.
3. Remove the output loads (open circuit).
4. Replace the input power supply by Keithley 2400 3A source meter or equivalent. Set V_{SRC} to the designed input voltage ($V_{SRC} = V_{OUT} + 1V$), and set the I_{COM} to $200\mu A$.
5. Turn on the Keithley and read the compliance current (quiescent current).
6. Vary the input voltage $V_{SRC} = V_{OUT} + 1V$ while monitoring the corresponding compliance current.

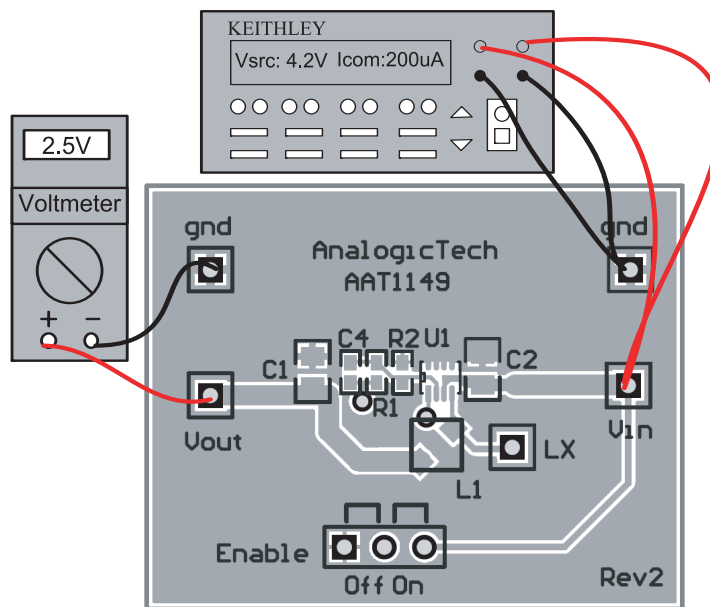


Figure 5: AAT1149 Evaluation Board Connection Diagram for Quiescent Current.

Test: Startup Using Enable

1. Configure the specified test equipment as shown in Figure 6.
2. Set the oscilloscope to single sequence, and trigger the rising edge of V_{OUT} .
3. Turn on input power supply and toggle EN to the “ON” position while monitoring the EN, V_{OUT} , LX, and I_{LOAD} on the oscilloscope.
4. Repeat steps 2 and 3 for different I_{OUT} , V_{IN} , and V_{OUT} .

Test: Startup using V_{IN}

1. Configure the specified test equipment as shown in Figure 6.
2. Enable UUT by connecting the jumper to the “ON” position.
3. Set the oscilloscope to single sequence, and trigger the rising edge of V_{OUT} .
4. Disconnect V_{IN} to input power supply.
5. Turn on input power supply and toggle V_{IN} by connecting the banana clip to the power supply while monitoring the V_{IN} , V_{OUT} , LX, and I_{LOAD} on the oscilloscope.
6. Repeat steps 3 through 5 for different I_{OUT} , V_{IN} , and V_{OUT} .

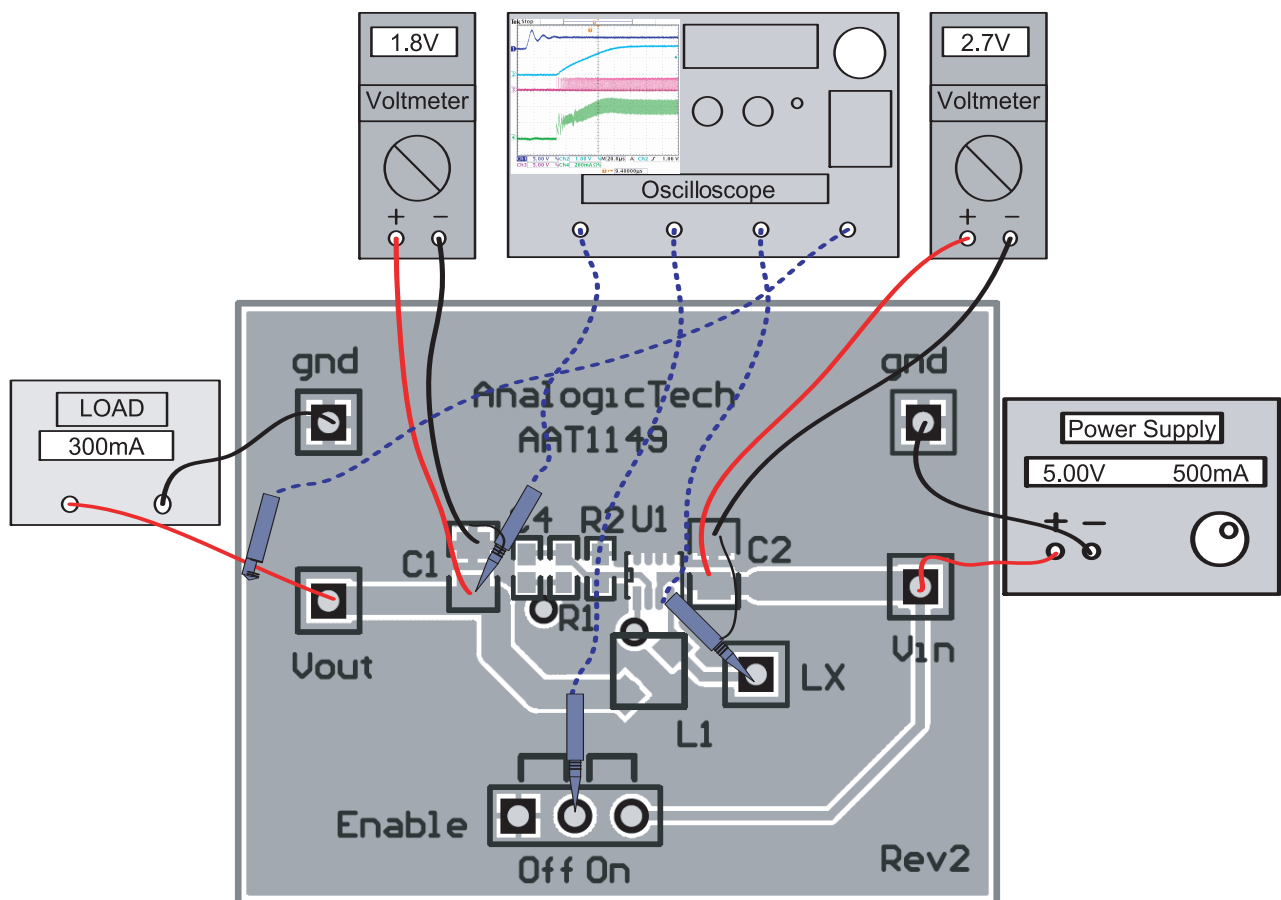


Figure 6: AAT1149 Evaluation Board Connection Diagram for Startup.

Test: Efficiency vs. Output Current

1. Configure the specified test equipment as shown in Figure 7. Connect voltmeters as closely as possible to the input and output capacitors to avoid voltage drop along the trace resistance.
2. Enable UUT by connecting the jumper to the "ON" position.
3. Set Keithley load to 4 Wire Sensing Mode (the two sensing wires should connect as closely as possible to the output cap).
4. Vary the output current ($I_{OUT} = I_{SRC}$) from -1mA to -400mA and keep the input voltage the same while monitoring the input current (I_{IN}), and the output voltage (V_{OUT}).
5. Calculate the efficiency as the following equation:

$$\text{Efficiency} = \eta\% = \frac{100 \cdot (V_{OUT} I_{OUT})}{V_{IN} I_{IN}}$$

6. Repeat steps 4 and 5 for different input and output voltages.

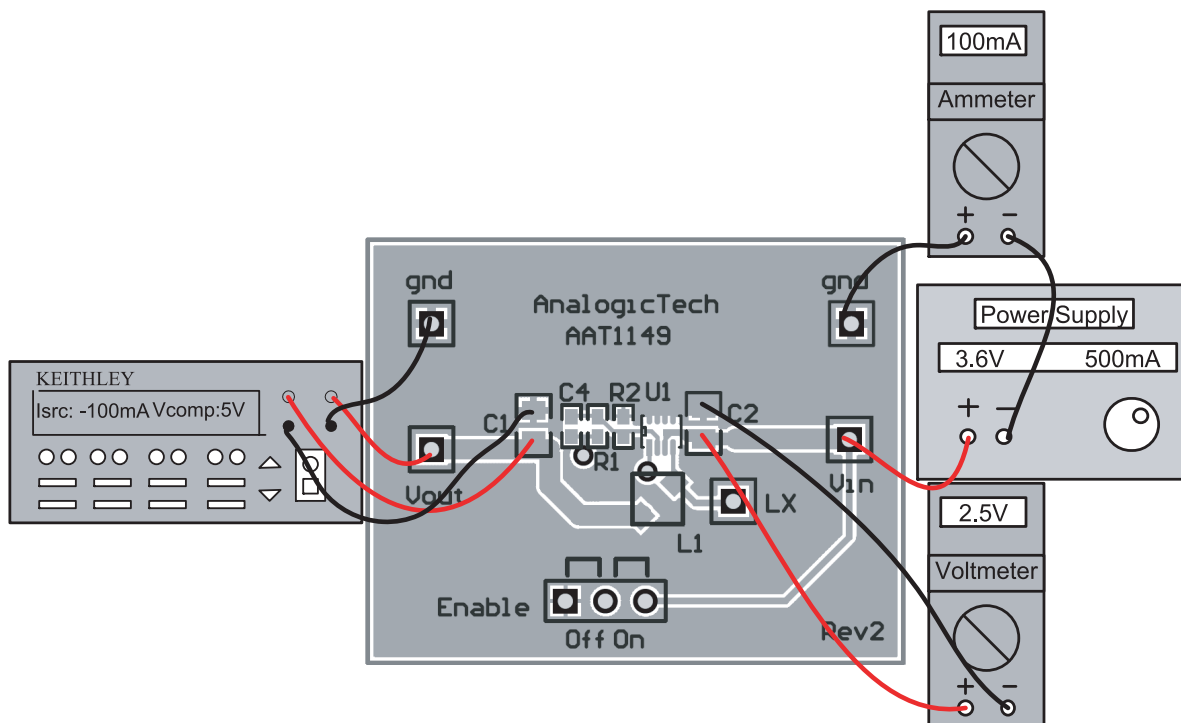


Figure 7: AAT1149 Evaluation Board Connection Diagram for Efficiency vs. Load Current.

Test: $R_{DS(ON)H}$ and $R_{DS(ON)L}$

1. Configure the specified test equipment as shown in Figure 8.
2. Enable UUT by connecting the jumper to the 'ON' position, and connect the FB pin to GND to turn-on the high side PMOS and turn-off the low side NMOS.
3. Connect 4 wires (Force and Sense) from the Keithley power supply between V_{IN} and LX node. Set the compliance to $V_{SRC} = 40mV$ at $I_{COMP} = 300mA$.
4. Power up and measure $R_{DS(ON)H} = \frac{V_{SRC}}{I_{COMP}}$
5. To measure the $R_{DS(ON)L}$, repeat steps 2 through 4 with the FB pin connected to V_{CC} (to turn on the low side NMOS) and connect the 4 wires (Force and Sense) between LX and GND.

$$R_{DS(ON)L} = \frac{V_{SRC}}{I_{COMP}}$$

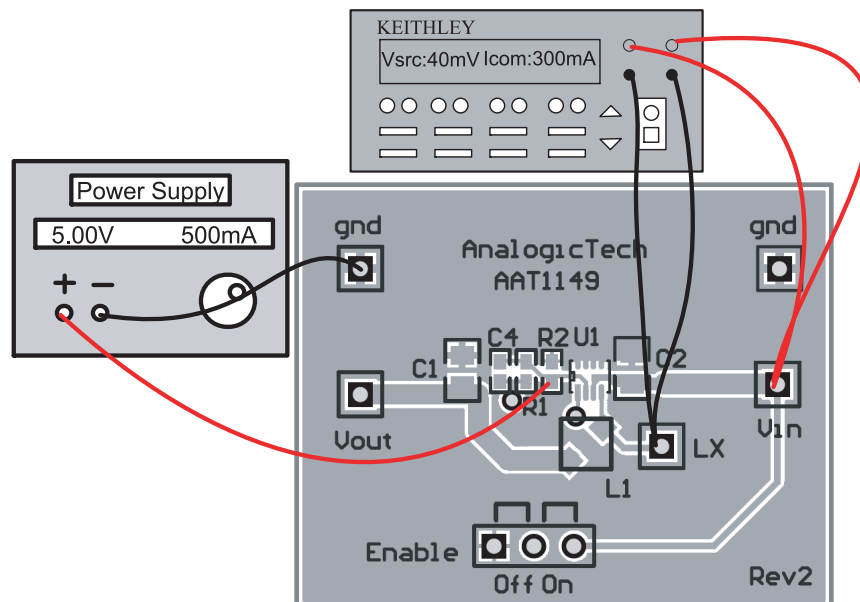


Figure 8: AAT1149 Schematic Connection Diagram for $R_{DS(ON)}$.

Test: Gain and Phase Margin (Loop Gain)

1. Break the feedback loop and insert a one-to-one isolation transformer between the broken original connection. Configure the specified test equipment as shown in Figure 9.
2. Inject a signal from SOURCE OUT to the loop through the isolation transformer while monitoring the ratio of CHA and CHB on the Network Analyzer.
3. Set the output current to heavy load while monitoring the LX node of the converter on the oscilloscope (to obtain a good result the converter must be in continuous PWM mode).
4. Sweep the frequency from SOURCE OUT of the Network Analyzer from 10Hz to 1MHz and adjust the magnitude of the injected signal (around 10mV to 100mV) in order to have a clean PWM waveform at the LX node.
5. Repeat the measurement for different V_{IN} , V_{OUT} , and I_{LOAD} .

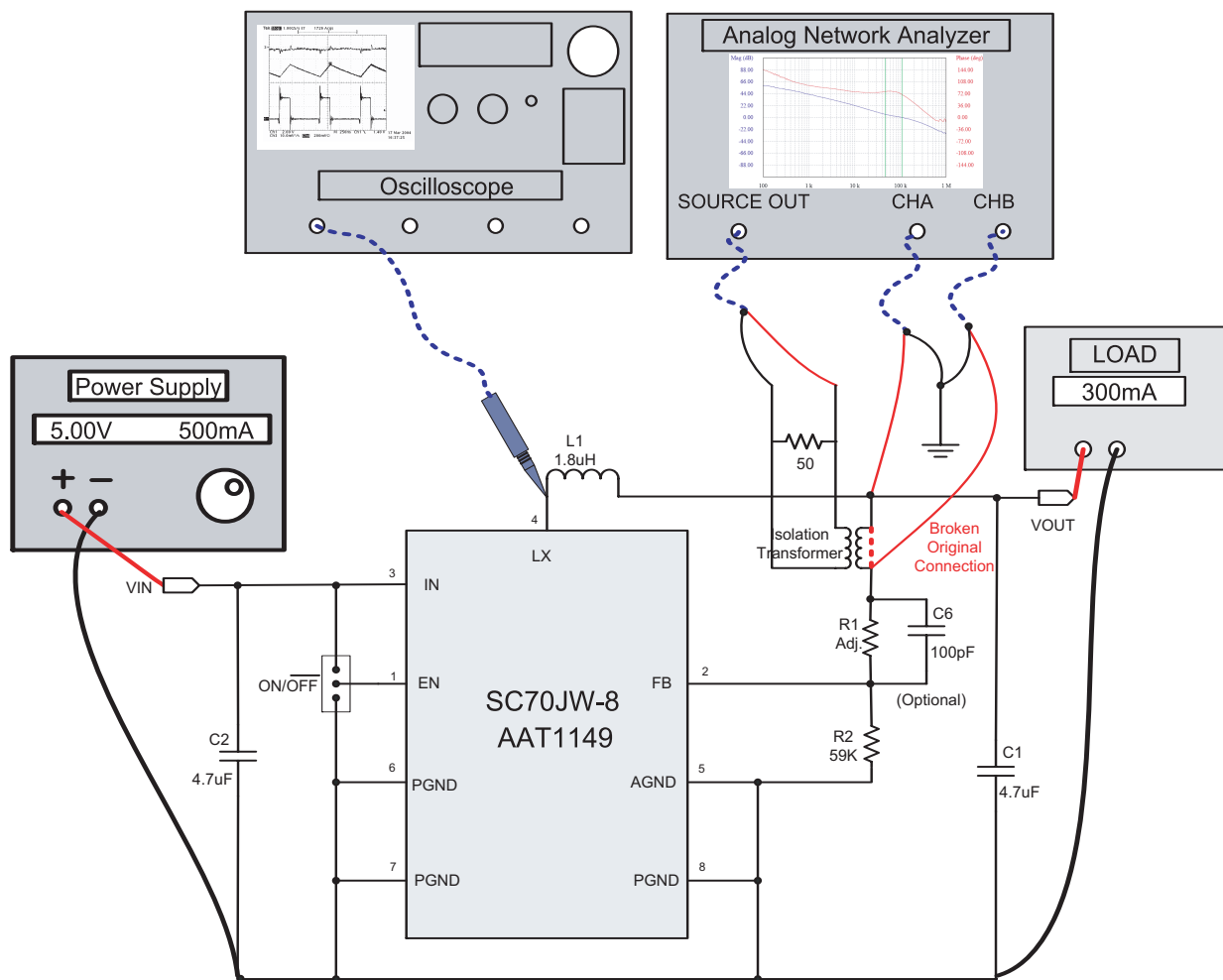


Figure 9: AAT1149 Schematic Connection Diagram for Gain and Phase Margin.

Printed Circuit Board

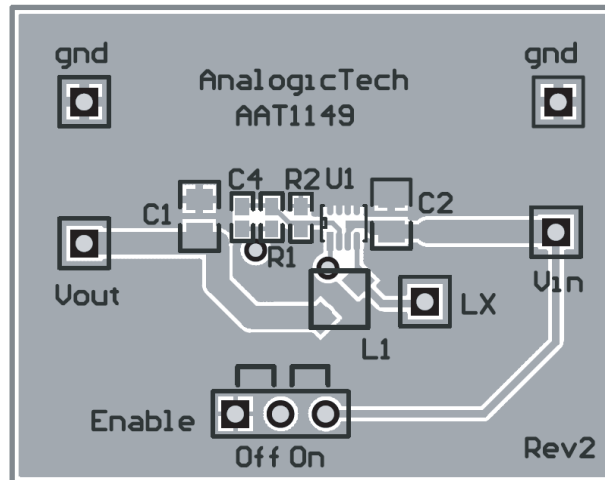


Figure 10: AAT1149 Evaluation Board Top Layer (not to scale).

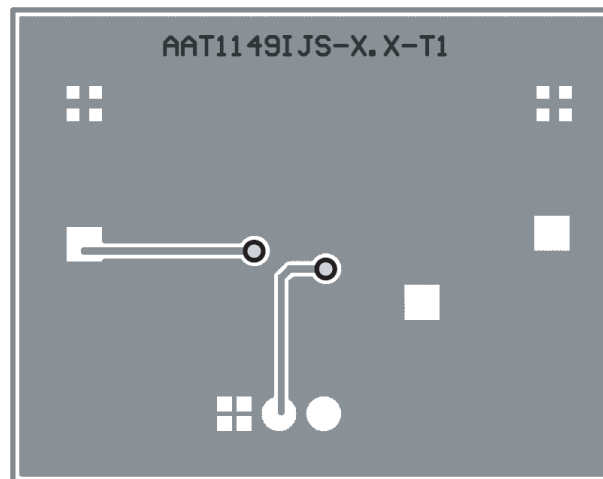


Figure 11: AAT1149 Evaluation Board Bottom Layer (not to scale).

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