E-Load

1. What and Why do we even use one?

a. For starters the Electronic Load device is a super handy EE lab device to test the power capabilities of your device.

b. Imagine you have designed an embedded Device with your SAMW25. Your device needs to drive a DC Motor running at 12V with a nominal current rating of 2 Amperes.
The word Nominal here is important because when we say the motor draws 1A at 12V we mean that it is running normally with the intended load without any external obstructions.

c. But if some external force (lets say even your finger) tries to slow down or stop the spinning of the motor, the motor will in fact draw a higher current to overcome that external force.(Too much applied force can burn out your Motor!).

d. You have designed the Power Architecture(lets say its a boost converter stepping up your voltage from 5V to 12V) & the corresponding Motor Driver Circuitry. Your Power Architecture accounts for the Minimum Current Draw, i.e. Your Regulator, Motor driver, any other circuitry associated with it & even your PCB Traces & footprints are designed with a much higher rating, say 12V @ 5Amps.

e. But How do you know for sure that this will work?

f. How can you validate that your architecture can smoothly supply that much(higher than expected) current without any disruptions in the voltage?

g. How will you ensure that any sudden jump in current draw will not disrupt the working of your system,especially if its a time critical action that needs to be taken immediately?
Will this sudden jump in current cause any changes in the output voltage?, Can this affect your microcontrollers function? (Hint: Research upon BrownOut detection).

One solution would be to validate your working by attaching a resistor to your output voltage rail.
You select the resistor in such a way that it will draw that much current based on the output voltage rail. (Simple ohms law). But this has drawbacks:

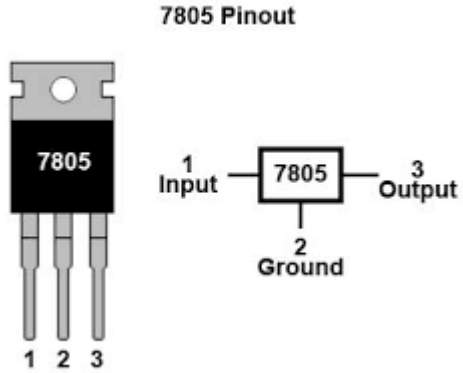
1. Resistor Value may or may not be available.
2. For higher currents, we need high power resistors, they are expensive, hard to find and come only in certain standard values. Also very bulky in size.
3. If you want to emulate a current change you will have to change the resistor, this is not ideal as swapping the resistor with hands will take time and not an effective way to view transient changes(on an oscilloscope).
4. Resistors cannot simulate non-linear behaviors of inductors & Capacitors.

This is where the E-Load becomes very handy. An E-Load can simulate a huge varieties of Electrical loads in different forms, are quick in response unlike you having to physically swap components & does not involve any external components.
There are 4 Modes Primarily available in an E-Load:

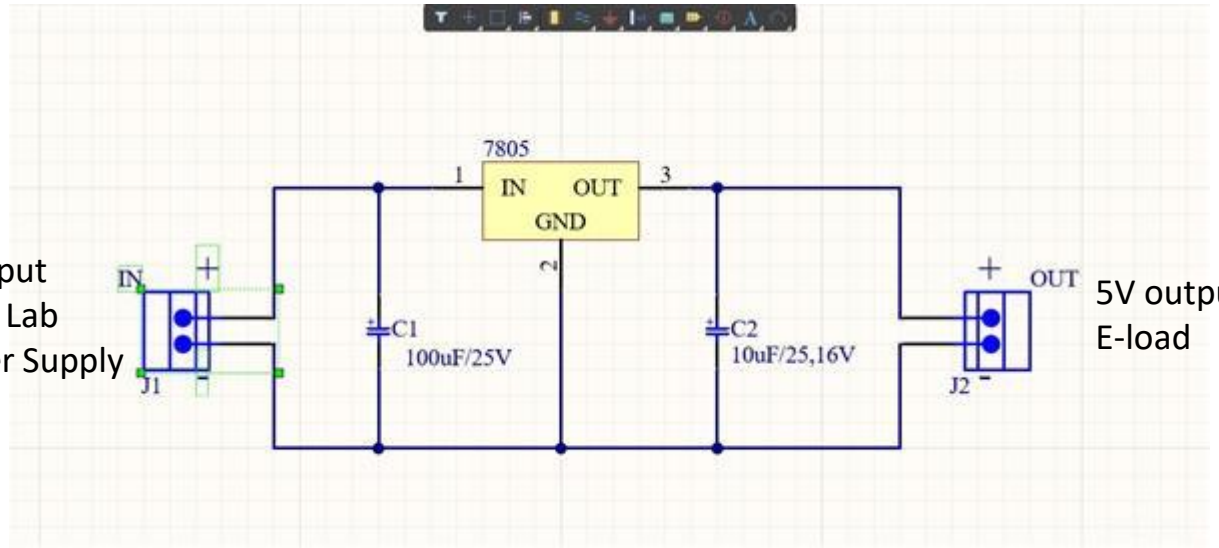
1. Constant Current Mode: Your E-load is set to continuously draw a specified current from your system.(You will be using this mode).
2. Constant Voltage Mode: Sets the E-load to be set at a constant voltage.
3. Constant Resistance Mode: This is similar to using a resistor but your E-oad can take in a large values of resistances without worrying about power.
4. Constant Power Mode: Also known as Constant W mode, where the E-load is set to consume a specified amount of power from your system.

Getting started with the E-Load

1. To understand the E-Load we will test it out using the following Circuit:
2. 7805 Voltage regulator rated at 5V at 1.5A Max.
3. Input Voltage rail: 9V from Lab Power Supply
4. Output Voltage rail: 5V to E-load.
5. Testing Conditions:
    a. No-Load (No current Draw)
    b. 100mA
    c. 500mA
    d. 1A



9V Input From Lab Power Supply

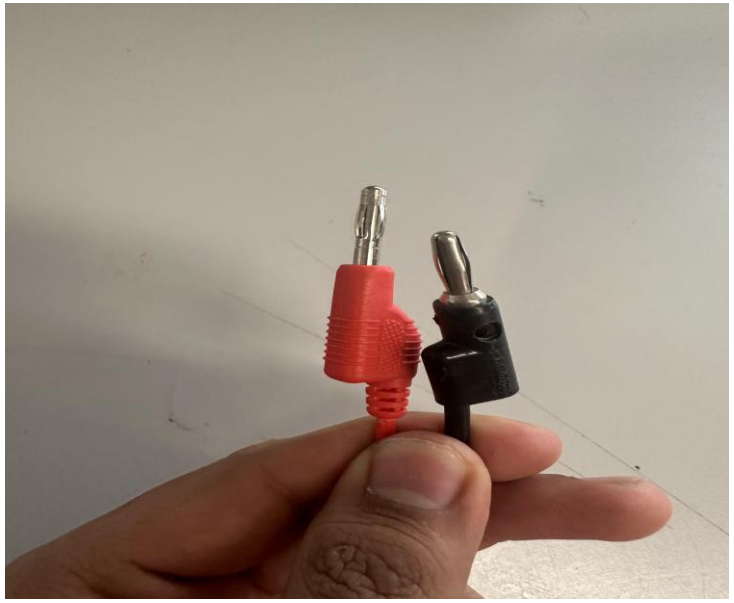


5V output to E-load

Note: The 5V output rail will be replaced by the output rail that you want to test in your circuit

Getting started with the E-Load

1. Once your circuit is assembled connect it using appropriate probes to the power supply(Do not Switch it on yet).
2. Connect the output side to the E-load using the probes shown(Make sure the polarities are correct!)
3. Unscrew the terminals to insert the probe and then screw them back to fasten them.
4. Press the power button on the E-load
5. Observe the home-screen, what all do you see?

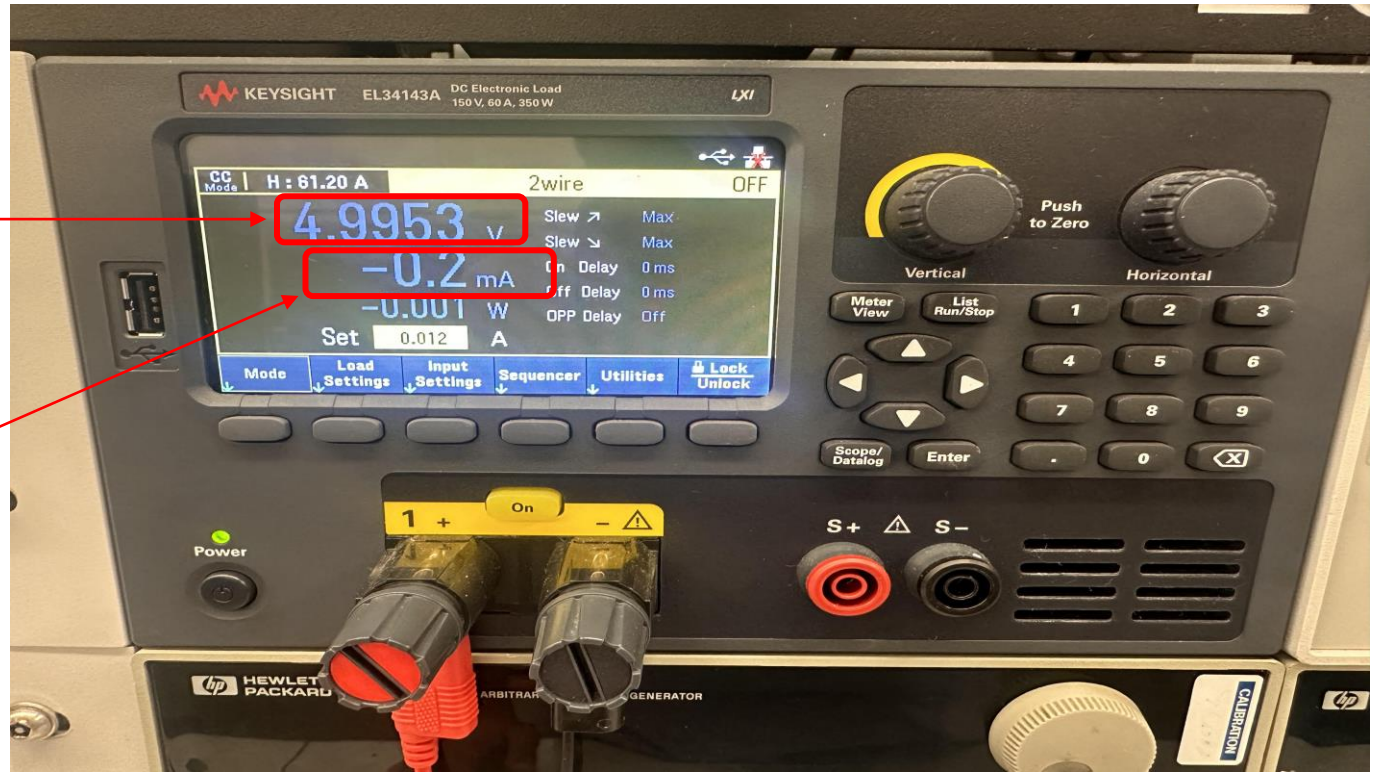


No-Load Condition

1. Set the Lab power supply to desired input voltage (9V here) and switch the output of the power supply on.
2. Observe the E-load screen, What do you see?
3. The voltage of your E-load under no-load condition is displayed.
4. This is the ideal/correct voltage(5V in this case) and verifies your circuit is correct.
5. Since the E-Load is not set to draw any current we see on the screen that no current is being drawn.

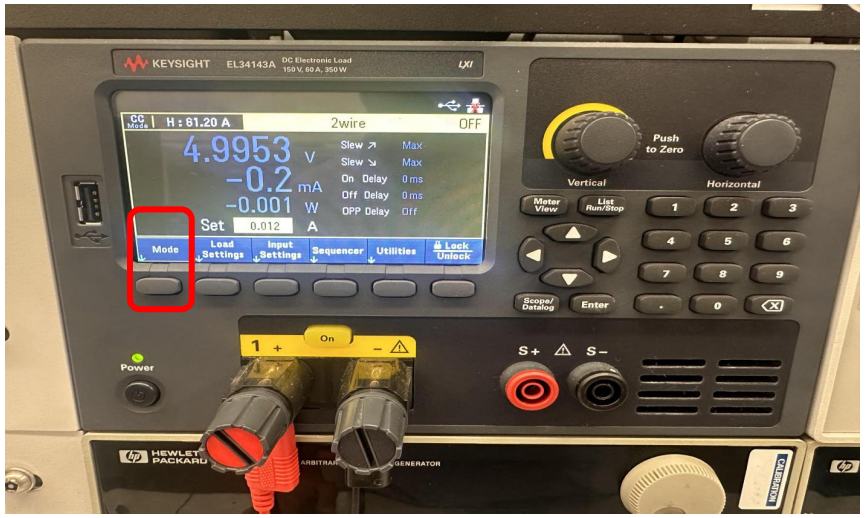
Actual Voltage rail

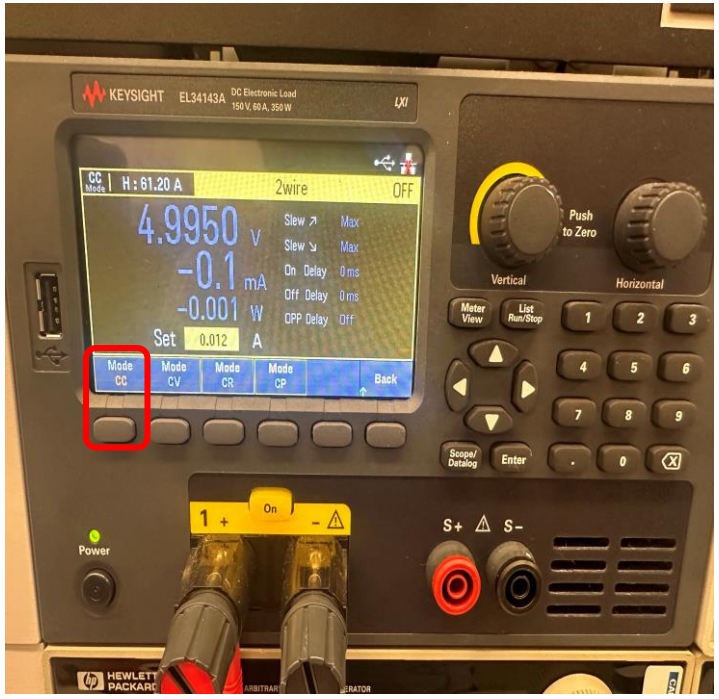
Current Draw

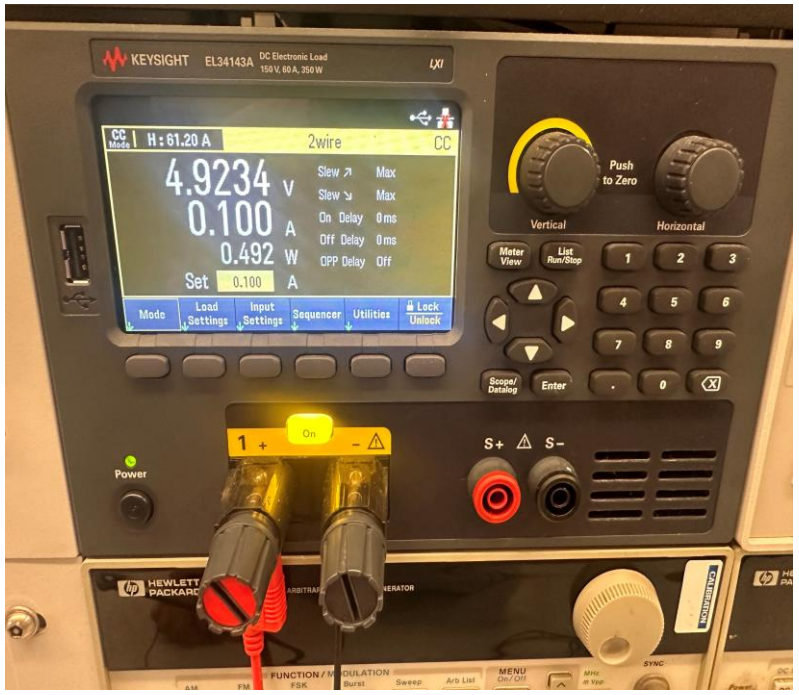


Setting the Load(Input Current)

1. On the Home Screen click on mode button(button below the mode option)
2. Now press on “Mode CC”(constant current) and then press back.
3. Now press Load Settings.
4. Enter the desired load current using the keypad and hit enter.
5. Make sure you start with a small value of current.
6. Hit Back and press the On button to enable the Load.







What is happening?

1. Now that your Load is on, it is drawing 100mA from the 5V Rail of the circuit.
2. Observe the E-load screen, What do you see?
3. Recall the voltage in No-Load condition compared to now. Is it any different?
4. We can see that at 100mA output current the voltage drops slightly to 4.91V
5. This means as the Load current increases the ability of your regulator to provide a constant output voltage reduces.
6. The voltage regulator is fighting to be able to supply the set output current and hold the voltage constant too.
7. Let us now observe the output voltage for higher current values.

500 mA

1. Expected:4.9-5V
2. Actual: 4.5872 V

1 A

1. Expected: 4.9-5V
2. Actual: 1.9053V !!!!!
3. So can I use a 7805 regulator to power a 1 Amp Load at 5V?
4. Will a Switching Regulator(Buck, Boost, Buck-Boost) perform better than this linear voltage regulator?