Keysight Technologies
Easily Create Power Supply Output Sequences with Data Logging

Application Brief
Why is Sequencing Important?

Microprocessors, FPGAs, memory, and many complex circuits require proper bias power up sequencing. Sequencing bias supplies ensures that circuits operate as expected, latch up conditions are detected and designed out, and component damage is prevented. Not only is power up bias sequencing important but power down sequencing might also be needed to ensure proper DUT shutdown.

Sequencing test setups can be challenging when you try to synchronize individual independent multiple power outputs. In cases where custom hardware control is required, precise delays for power up and power down can be cumbersome.

Keysight Technologies, Inc. recently introduced two new bench power supplies, the E36312A and E36313A, with built-in voltage sequencing capabilities. This provides the user with precise control over power up and power down sequences. You have the ability to create a single DC output sequence on one channel or group up to 3 DC outputs in the sequence. In addition to controlling the power on sequence you can also control the power down sequence with 1 msec resolution.

If more than three DC outputs are needed, you can use built-in digital I/O control signals to connect multiple E36312A or E36313A units together.

How to Set Up Power Up and Power Down Sequences

We created an example power on and power off sequence using a complex circuit board shown in Figure 1. We generated these sequences using all three E36313A DC outputs. First, we set up the three DC outputs for the voltages we needed; Channel 1 is set to 5V, Channel 2 is set for 15V, and Channel 3 is set to 20V.

For the power up sequence, we then programmed Channel 1 for a 1 second delay, Channel 2 for a 3 second delay, and Channel 3 for a 5 second delay.

For the power down sequence, we reversed the order and set Channel 3 to 0V, Channel 2 to 0V, and Channel 1 to 0V. On Channel 3 we programmed a 1 second delay, Channel 2, a 2 second delay, and Channel 1, a 3 second delay.

The sequence trigger is the All On/Off key and you can select your trigger source. Start the sequence and data logger by pressing the All On/Off key. Wait about 10 seconds and then initiate the power down sequence using the All On/Off key and wait for the data logger to finish recording.
Data Logging - Capturing Voltage and Current Measurements

Another nice built-in capability in the E36312A/E36313A is the data logger. The data logger will allow you to record voltage and current pairs over time. Having the data logger capability integrated in the power supply eliminates the need to add a second instrument to the test setup specifically for data logging. You must connect a USB drive on the front panel because this is where the data file will be saved. More information on using the built-in data logger can be found in the user’s manual.

How to Set Up Data Logging in Five Easy Steps

We provided the following step-by-step example to illustrate how to easily generate a voltage sequence on three DC outputs:

**Step 1:** Determine number of channels, voltage sequence, and delay times for each output channel

**Turn On Sequence:**
- Channel 1 wait 1 second then go to 5V
- Channel 2 wait 3 seconds then go to 15V
- Channel 3 wait 5 seconds then go to 20V

**Turn Off sequence:**
- Channel 3 wait 1 second then go to 0V
- Channel 2 wait 2 seconds then go to 0V
- Channel 1 wait 3 seconds then go to 0V

**Step 2:** Setup each channel voltage and current limit settings

Program channel 1 for 5V, channel 2 for 15V, and channel 3 for 20V. In our example, we used the default current limit settings. The color coded display makes it easy to see all three channel voltage and current settings.

**Step 3:** Configure the channel turn-on and turn-off delays and then couple the outputs together.

In the Output Settings display, the channels are color coded for a clear graphical representation of the programmed on and off delays. Since we are using all three DC outputs, we can use the On/Off Coupling button to set all three channels to On. All three channels are coupled into the sequence and will respond to the trigger command using the front panel All On/Off key. You have several choices for a trigger source (front panel, digital I/O signal, or programming command).

**Step 4:** Setup the data logger properties and waveform settings

The waveform settings (vertical / horizontal) are very similar to the settings on an oscilloscope. First, select the channels you want to see (in our example we have V1, V2, and V3 selected). Then for each channel, select the V/Div, T/Div, and any offset required. Next you program the data logger selections, the duration (time in hours, minutes, seconds) for the data capture, the sample period, and the trigger source to start the catalog (in our example we are using the data logger Run/Stop key).

A: Set Voltages:
- Set V1 to 5V/Div and Offset to 15V
- Set V2 to 10V/Div and Offset to 18V
- Set V3 to 10V/Div and Offset to 0V
Offsets adjustments were used so that we could position each channel on the waveform display. This allows us to see all three output channels at the same time.

**B: Set Horizontal Values to 5 sec/Div**

**C: Set Logging Parameters:**
- Duration 30 Sec
- Sample Period 200 ms
- Trigger Source Run/Stop Key

The data file size is automatically calculated for you based on the settings. In our example the required memory = 1.76 kbytes. You must connect a USB drive in the front panel USB port when performing a data log. This is where the data log results will be stored.

In the next three steps, we will start the data logger, then initiate the power up sequence trigger, wait a few seconds, then initiate the power down sequence, and then wait until the data logger finishes recording.

**Step 5:** Start the data logger by pressing the Run/Stop key, then press the Back key

**Step 6:** Start the power up sequence by pressing the front panel All On/Off key, wait about 10 seconds, then press the front panel All On/Off key again to initiate the power off sequence.

**Step 7:** The data logger captures all three DC outputs and displays the power up and power down voltage sequence

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**Summary**

We hope this information helps you easily sequence multiple DC bias voltages powering your DUT. Our goal is to provide built-in power supply capabilities to reduce your test setup complexity. For more information, visit: [www.keysight.com/find/E36312a](www.keysight.com/find/E36312a)
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