Applications Overview

Monitoring Sleep and Standby Currents from Low Power Devices
Determining Device Power Consumption when Device Current is Drawn in Short Pulses

Series 2280S Precision Measurement Programmable DC Power Supplies


KEITHLEY
A Tektronix Company

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Application Overview:
Monitoring Sleep and Standby Currents from Low Power Devices

Measuring sleep mode and standby mode currents drawn by low power, portable devices such as consumer products (cellular phones, tablets, laptops), industrial products (wireless transmitters, intrinsically safe instruments), and implantable medical devices (pacemakers, defibrillators, neurological stimulators) is essential to ensure that critical power consumption specifications are met. These tests require precise low current measurements down to microamp levels, which requires not only good measurement techniques but also sensitive instrumentation with special capabilities for measuring very small load currents. However, specialized, sensitive instrumentation is costly and adds more complexity to the test circuit. A readback power supply for both sourcing voltage and measuring current is one solution, but most conventional programmable power supplies have a measuring resolution of only milliamps at best and, therefore, cannot be used for low current measurements.

Unlike conventional power supplies, Keithley's Series 2280S Precision Measurement, Low Noise, Programmable DC Power Supplies make digital multimeter- (DMM) quality measurements with up to 6½ digits. Users can employ filtering and control the number of power line cycles used to measure load currents from amps to 100nA. Resolution is optimized with four ranges of load current measurement - 10A, 1A, 100mA, and 10mA – so full load currents as well as standby mode and sleep mode currents can be measured accurately. With up to 6½ digits, even very small changes in load currents can be confidently detected.
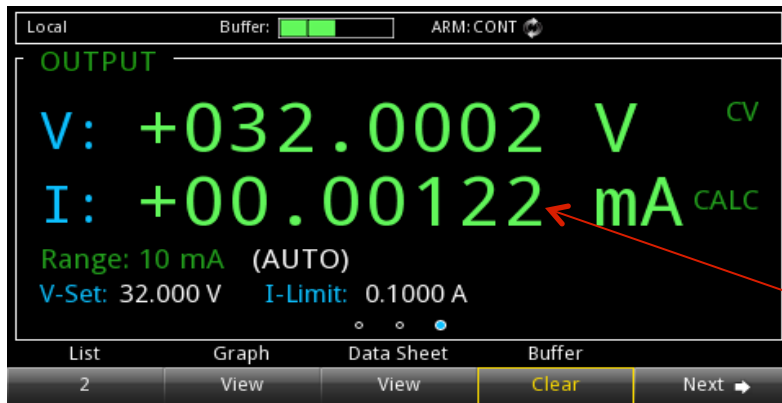

10nA Resolution

With its flexibility for controlling the number of power line cycles for the measurement and ability to use filtering, the Series 2280S can measure very low currents down to 100nA.

# Application Overview: Determining Device Power Consumption When Device Current is Drawn in Short Pulses

Design engineers need to minimize the total power consumption of their designs to maximize battery life so they need to be able to monitor the current consumption for all the operating states of their devices. However, many electronic devices, including automotive keyless entry devices, remotely-located wireless transmitters used in industrial processes, portable and implantable medical devices, and portable consumer electronics, operate in standby mode most of the time and are only fully active for short intervals. Their current loads during their active states are pulse-like.

To measure load currents during short active periods, test instruments need to have a wide current measurement range and the capability to measure dynamic load currents that are extremely narrow pulses. Traditional power supplies take measurements only over an integral number of power line cycles, but the pulse-like load currents may only last for 100s of microseconds, so a digital multimeter (DMM) or data acquisition instrument is needed in series with the power supply. When an additional instrument is used as a voltage measuring device, then a sense resistor must also be added to the circuit. This technique adds significant cost, more complexity to a test configuration, and an additional source of error.

Unlike most power supplies on the market, Keithley's Series 2280S Precision Measurement, Low Noise, Programmable DC Power Supplies measure narrow pulse-like loads currents without the need for additional instruments. They offer a wide current measurement range from 100nA to 6A and can also make fast measurements to capture load changes that occur in intervals as short as 140µs. With the Series 2280S, designers and manufacturers of portable, battery-operated devices can easily monitor load currents during all a device's operating modes; and, as a result, determine the its total power consumption.
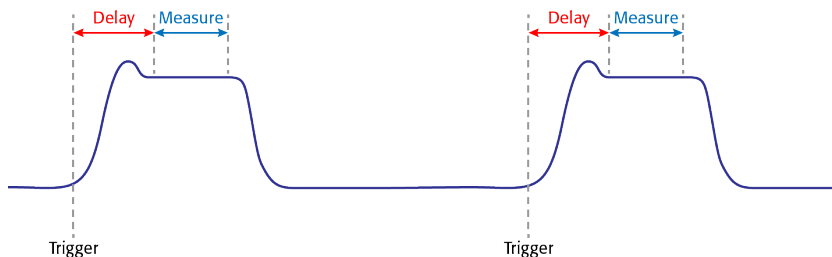
Series 2280S power supplies enable time-critical measurements on fast-changing or pulse-like loads. An external trigger initiates the acquisition. Programmable delay and measure times enable measurements at a specific time on the load current pulse such as when the peak has stabilized.
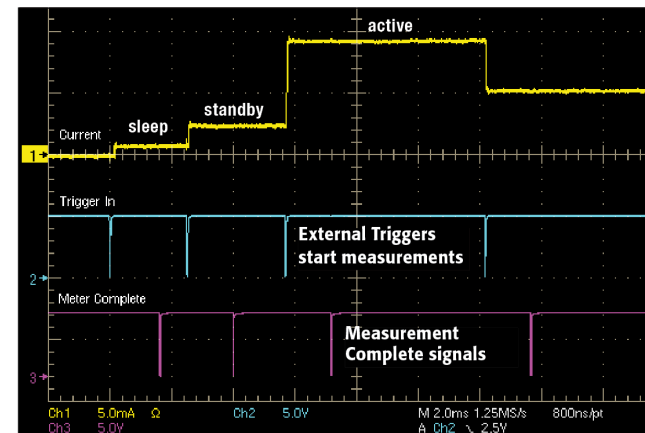

Series 2280S power supplies measure the start-up load currents as a device powers up. An external trigger tells the Series 2280S when to make a measurement. The Series 2280S signals when the measurement is completed so that the device can be put in its next state.

Series 2280S Feature Spotlight: Graphical Icon-based Display Saves Time and Effort Monitoring Circuit Stability

Circuit design reliability tests typically involve stressing sample circuits for long periods of time and monitoring the drift or changes that result from these stressed conditions. To determine the stability of the circuit, designers usually set up parameters and run the test for a long time interval to see the trend.

Keithley Series 2280S Precision Measurement, Low Noise, Programmable DC Power Supplies feature a high resolution graphical icon-based display that enables users to easily navigate through the menus and quickly set up all the parameters needed to perform the testing. The instrument can take measurements quickly and store up to 2,500 data points within its internal buffer. Data can be displayed as trend plots or in tabular format on screen and can easily be saved as a .csv file on a flash drive plugged into the front panel USB port .

In addition to displaying voltage, current, or both waveforms, the Series 2280S can compute statistics on the stored data. Statistical measures include average, maximum, minimum, peak-to-peak, and standard deviation. With the built in plotting capability in Keithley's Model 2280S power supply, engineers can easily perform data collection without the need to develop software to control the supply and acquire data.
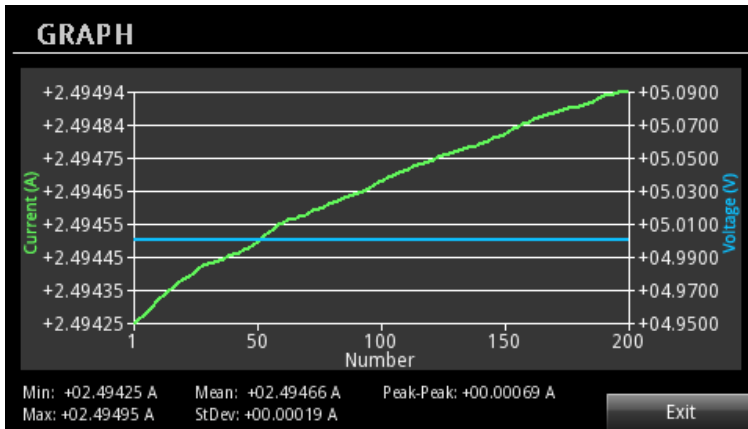
Use the Series 2280S' built-in graphing capability to monitor load current. Up to 2,500 data points can be stored, and statistics on the data can be automatically displayed on the graph for a quick and easy analysis of the results.

Series 2280S Feature Spotlight: Built-in List Mode Function Simplifies Verifying Performance Over a Device's Operating Range

Engineers need to test their designs over the entire operating voltage range or study how their designs respond to voltage changes. However, this type of testing can require complex waveform setup to stimulate the device with levels that are within or beyond the device's operation range, so performing these tests can be difficult with conventional power supplies.

Keithley Series 2280S Precision Measurement, Low Noise, Programmable DC Power Supplies feature a built–in list mode function that simplifies the process of automating a test:

- Create a set of sequenced voltage levels that can be as many as 99 distinct voltages
- Set the current limit at each point in the list
- Set the time duration at each point in the list (as short as 1ms and as long as 60s)
- Save up to nine sequence lists within the instrument's non-volatile internal memory
- Create simple linear ramps or any custom configuration from either the front panel or an interface bus
- One trigger automatically executes the list one time or multiple times
- Make single or multiple current measurements at each voltage level

With the list mode, these tests can be performed easily:
- Device behavior at some percentage above its maximum voltage
- Device behavior at some percentage below its minimum voltage
- Characterization when operating a device over its specified range
- Variation in performance over the operating range when the device is in different states
- Device response to large voltage swings
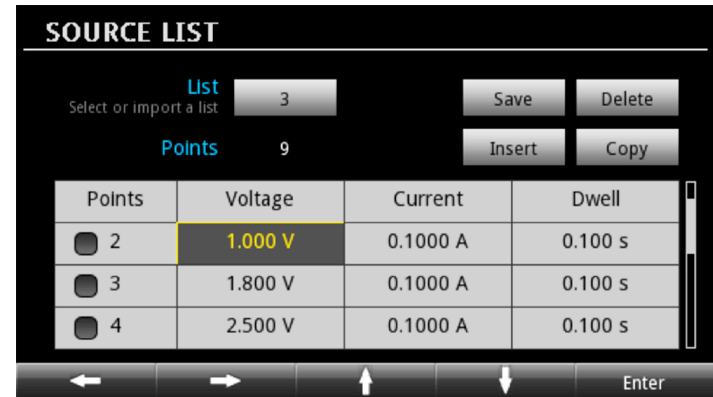
Create a test consisting of a number of output voltage levels using the Series 22280S' **List Mode** setup screen. Alternatively, download a list using a USB flash drive.
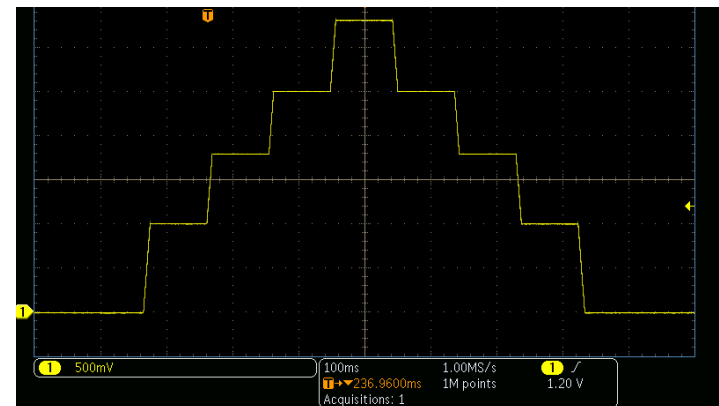
List Mode automatically steps the voltage through the programmed steps. With the Series 2280S supplies, the output can be displayed using the internal graphing capability.

Series 2280S Precision Measurement DC Power Supplies -
Much More than Just Sources of Clean Power

Keithley's Series 2280S Precision Measurement, Low Noise, Programmable DC Power Supplies can source stable, low noise voltages as well as monitor load currents over a wide dynamic range from amps to 100 nanoamps. The Model 2280S-32-6 can output up to 32V at up to 6A; the Model 2280S-60-3 can output up to 60V at up to 3.2A.

These precision measurement power supplies combine a high resolution color screen display with soft-key buttons and a navigation wheel to provide an easy-to-navigate user interface that speeds instrument setup and operation. Built-in plotting functions allow monitoring trends such as drift. Series 2280S power supplies provide the flexibility required for both benchtop and automated test system applications and even provide a list mode, triggers, and other speed optimization functions to minimize test time in automated testing applications.

Features	2280S-32-6	2280S-60-3
Max Voltage	32V	60V
Max Current	6A	3.2A
Max Power	192W	192W
Voltage Setting Accuracy	± (0.02% + 3 mV)	± (0.02% + 6 mV)
Voltage Setting Resolution	1 mV	1 mV
Voltage Measurement Accuracy	± (0.02% + 2 mV)	± (0.02% + 4 mV)
Voltage Measurement Resolution	0.1 mV	0.1 mV
Output Ripple and Noise (Bandwidth 20Hz-20MHz)	< 1mV$_{RMS}$	< 2mV$_{RMS}$
Current Limit Setting Accuracy	±(0.05% + 5 mA)	±(0.05% + 5 mA)
Current Limit Setting Resolution	0.1 mA	0.1 mA
Current Measurement		
Range	**Resolution**		
10 mA	10 nA	±(0.05% + 10 µA)	±(0.05% + 10 µA)
100 mA	100 nA	±(0.05% + 10 µA)	±(0.05% + 10 µA)
1 A	1 µA	±(0.05% + 250 µA)	±(0.05% + 250 µA)
10 A	10 µA	±(0.05% + 250 µA)	±(0.05% + 250 µA)
Minimum load Current Measurement Pulse Width (1A and 10A range)	140µs	140µs
Interfaces	GPIB, USB, LAN LXI	
Front/Rear Output Connections:	Front – 2 wire, Rear – 4 wire	
Digital I/O:	6 input/out pins	

Specifications are subject to change without notice.