

Application Overview:

Using Multiple-Channel Power Supplies for Maximum Flexibility

Multiple-Channel DC Power Supplies

Most devices require multiple DC power supplies operating at different voltages to power all the analog and digital circuit sub systems. During development and testing, a number of single-channel power supplies can be used to power up each circuit section. Alternatively, a multiple-channel power supply could meet all your requirements and reduce the number of instruments needed. A single power supply will also take up less precious bench space or test rack space.

With Keithley multi-channel power supplies, there are no compromises compared with using two or more single-channel supplies. All the channels in Keithley multiple-channel power supplies can be controlled independently and are isolated just as if they were individual supplies. Each channel's output is programmable, and each channel's voltage output and load current are displayed simultaneously. Furthermore, each channel has remote sensing to ensure that the required voltage is accurately applied to the load. When a number of supplies are needed, consider the flexibility and convenience of a multi-channel power supply.

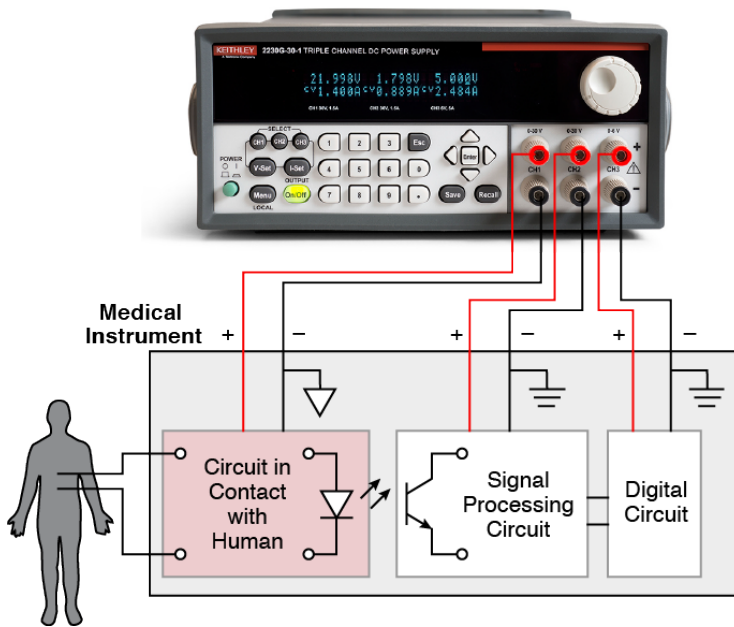


Test Devices with Isolated Circuitry

Circuits will often need to be isolated from each other on separate ground systems such as circuits used in medical devices that contact the human body, or that must measure a signal in a noisy environment, or that must transmit a signal over a distance,

The only way to test the device's isolated circuitry is to power the circuits with isolated power supplies. **A multi-channel power supply whose channels are all isolated provides an effective, cost-efficient solution for powering the circuits and keeping them properly isolated.**

Powering Isolated Circuits

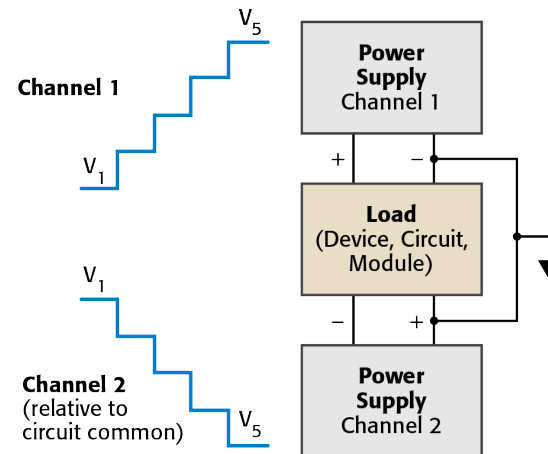
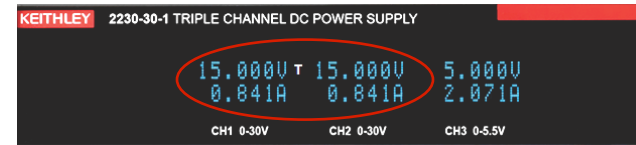


Test Bipolar Circuits

Even though the channels of a multi-channel supply are unipolar, they can be configured to power a bipolar circuit. Since the channels are isolated, they can be setup such that one circuit is a positive supply and the second output is a negative supply relative to the positive supply. Thus, the circuit-under-test can be tested over the range of supply voltages over which it is specified to operate.

Keithley's multi-channel power supplies have a tracking feature so that the voltages from the "positive" and "negative" supply channels can change at the same time. Thus, the magnitudes of the voltages on each channel can be the same values.

CH1 and CH2 Voltage Outputs Change Simultaneously in Tracking Mode

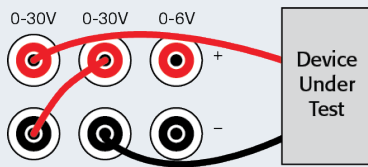


Increase the Output Voltage and Current Capacity with Series and Parallel Channels

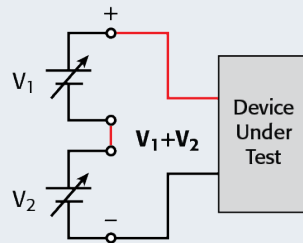
With multiple, isolated channels in one supply, channels can be combined in either series or parallel to increase the voltage or current output when greater than 30V or 1.5A is needed. **The Keithley Series 2200 and 2230 multi-channel power supplies have special display modes that show the total output of the combined channels.** This eliminates any confusion on what the actual output is since the outputs of the two channels do not have to be manually monitored and added. **The Series 2220 and 2230 power supplies perform all the adjustments for the two channels. One control adjusts the total output without having to adjust each channel individually.**

Doubling the Output Voltage Capacity up to 60V

Series Wiring Configuration



Schematic



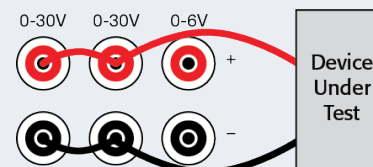
Instrument Setup: Combine Mode - Series



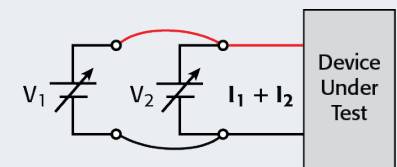
Combined Output Voltage

Doubling the Output Current Capacity up to 3A

Parallel Wiring Configuration



Schematic



Instrument Setup: Combine Mode - Parallel



Combined Output Current

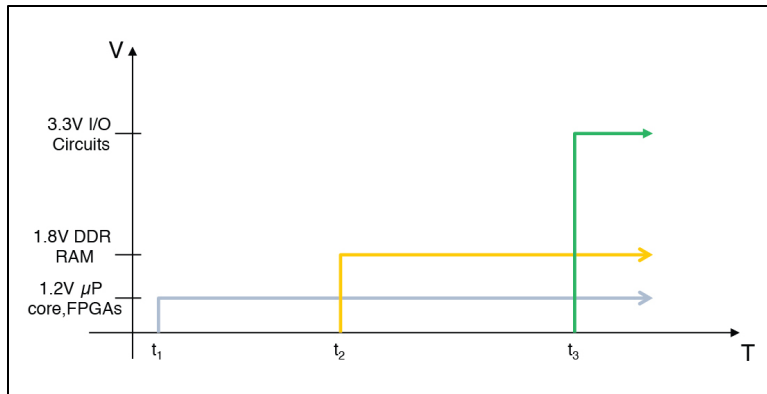
Power Up Circuits in the Proper Sequence

Digital board designs often have circuit blocks that operate at different voltages. When testing these circuit blocks with external power supplies, it is important to power the circuits in the correct order to avoid stressing and damaging the low voltage circuit blocks. **The Keithley Series 2220 and 2230 multi-channel power supplies allow independent control of each channel.** Rather than requiring three separate power supplies, the Keithley multi-channel supplies can turn on each channel in a desired sequence.

For example: With the triple-channel Model 2230G-30-1, channel 1 can output 1.2V to power a microprocessor core and FPGA circuit block, then channel 2 can power up to 1.8V DDR memory circuits, and, finally, channel 3 can output 3.3V for an I/O section. In a similar fashion, the circuits can be turned off in the appropriate order of highest voltage circuit first and the lowest voltage circuit last.

Turn On Circuits in the Appropriate Sequence:

Lowest voltage circuit first and the highest voltage circuit last.



Know the Voltage at the Load at All Times

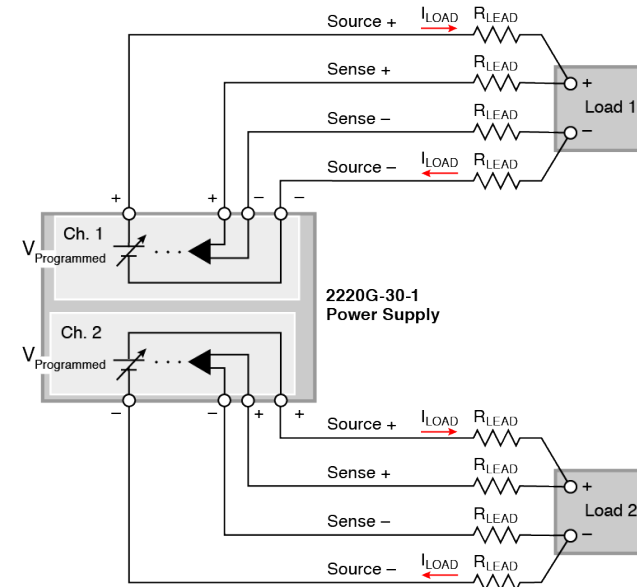
Test leads have resistance and can be modeled at DC as a resistor. Thus, some voltage can be dropped across the test leads, and the voltage drop can become significant at higher currents.

So what is the voltage at the load?

$$V_{\text{Load}} = V_{\text{Programmed}} - 2 * I_{\text{Load}} * R_{\text{Lead}}$$

If the power supply only has a two-wire output, then it is controlling the voltage at its output terminals. The voltage at the load will be lower than the programmed voltage. The Keithley Series 2220 and 2230 power supplies solve that problem by having four-wire remote sensing on all channels. With remote sensing, the power supply feedback loop is monitoring the voltage at the load. The feedback loop causes the output voltage to rise to overcome the voltage drop in the source leads. Thus, remote sensing ensures that the programmed voltage is accurately delivered to the load. For maximum accuracy, use remote sensing to ensure that you know the voltage at the load at all times.

Using Remote Sense Connections on Two Channels



New Series 2220G and 2230G Multi-Channel Programmable DC Power Supplies



Feature	Dual-Channel Power Supplies	Triple-Channel Power Supplies
Model	2220-30-1, 2220J-30-1, 2220G-30-1, 2220GJ-30-1	2230-30-1, 2230J-30-1, 2230G-30-1, 2230GJ-30-1
Channels	2	3
Max output voltage	Ch1 (30V) Ch2 (30V)	Ch1 (30V) Ch2 (30V) Ch3 (6V)
Max output current	Ch1 (1.5A) Ch2 (1.5A)	Ch1 (1.5A) Ch2 (1.5A) Ch3 (5A)
Power	Ch1, Ch2 (45W each); 90W total	Ch1, Ch2 (45W each); Ch3 (30W); 120W total
Ripple and noise	<1mV _{RMS} ; <3mV _{P-P}	
Resolution	1mV, 1mA	
Voltage accuracy	0.03%	
Current accuracy	0.1%	
Interface	USB-TMC Interface (All versions); GPIB Interface (with "G" versions)	
Special features	All channels are isolated from each other; each channel can be independently turned on and off; all channel outputs are displayed simultaneously; two 30V channels can track each other; two 30V channels can be connected either in series or in parallel to deliver up to 60V or 3A.	

Note: "J" versions operate at 100VAC nominal input voltage.
Non-"J" versions operate at 120VAC/240VAC nominal input voltage.