



APPLICATION NOTE AN-007

Modulating Output with a Second Driver

November 23, 2015, Rev A

We often get the question, “can you operate multiple lasers, each with its own laser driver, but with a common anode or common cathode wiring scheme?” Because the drivers are fully electrically isolated, that is not a problem. However, a more interesting question is: can you operate the one laser with multiple drivers? One example where this would be beneficial is when using a high current driver to provide the bulk of the power delivery, and add a second lower current driver to provide small signal modulation in addition to the current being provided by the high current driver. Short answer is yes, but there are risks involved. Read on for more details.

Test Setup

In the test setup, two drivers, a 4304 and 4308, were wired in parallel and connected to a 1Ω non-inductive resistive load. Current was measured via a non-contact current probe (Tektronix TCP202) on a 150MHz oscilloscope (Tektronix 3014). Because all Arroyo Instruments laser drivers have isolated, floating outputs, this could apply to those series as well (e.g., 4200-DR, 6300, LaserPak).

Test Process and Results

To prevent damage to the instruments, both drivers were set to 0mA with no modulation input and their outputs turned on (more on this below).

The 4308 was adjusted between 0mA and 4000mA without issues. Operation was limited to 4A due to the 5V compliance limit; testing was done only up to 4A to preclude any voltage limit errors that might shutdown the output. The 4304 did not indicate any current flowing through its terminals. The 4304 did, however, indicate the same voltage as the 4308, which is to be expected as both drivers are connected in parallel to the same load resistor.

Likewise, with the 4308 at zero, the 4304 was adjusted from 0mA to 4000mA without issues.

Next, both drivers were adjusted above zero at various set points. The total current measured via the current probe always agreed with the sum of the two set points. The actual current measured by each instrument always agreed with the instrument set point.

Next, the 4308 was adjusted to 1000mA and the 4304 was adjusted to 0mA. A sine-wave modulation signal of $2V \pm 1V$ was injected into the 4304 modulation input port. As expected, the measured current was a DC signal of $1800mA \pm 400mA$ was measured using the current probe:

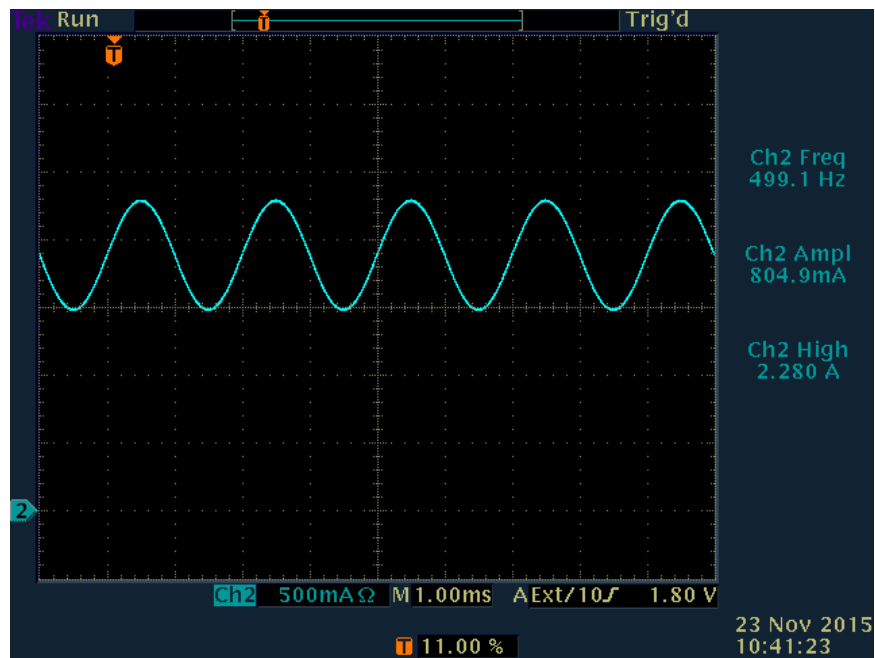


Figure 1 – 4308 at 1 Amp plus 4304 with modulation signal

Removing the modulation signal lower the drive current to 1 Amp, as contributed by the 4308:

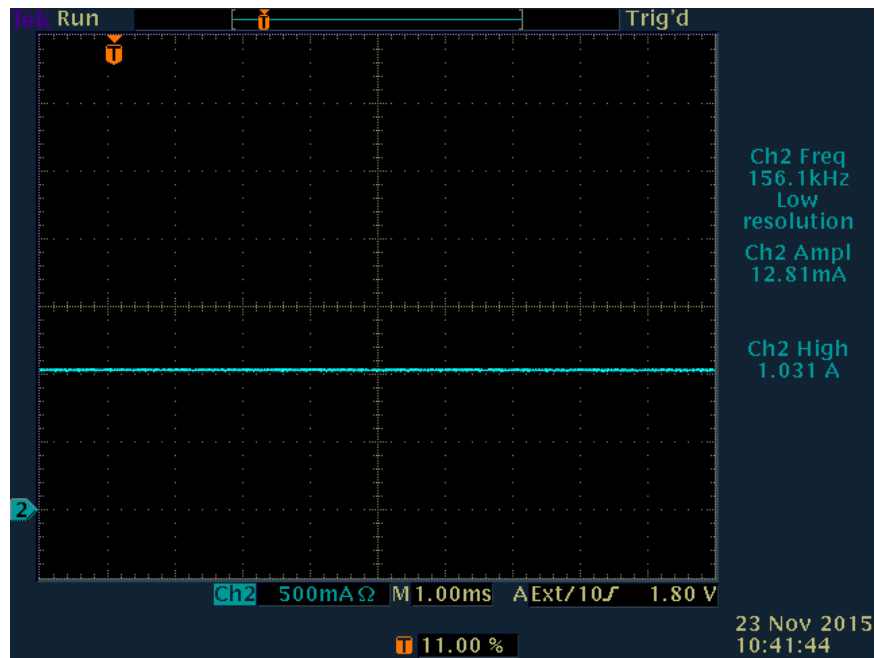


Figure 2 – 4308 at 1 Amp plus 4304 without modulation signal

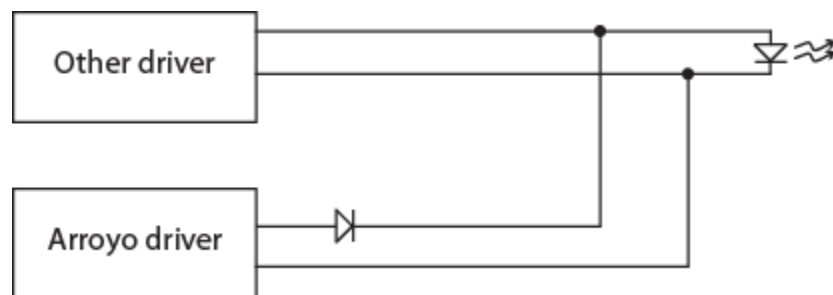
This was tested at other currents and frequencies with expected results that were within the specifications of the driver's modulation performance.

Observations and Conclusions

As expected, connecting two drivers together produced a consistent sum of the two outputs, whether operating both in DC mode or modulating one of the outputs. There are, however, a few important considerations that must be considered when attempting to do this testing.

Most critically, because the Arroyo drivers will short the laser output when turned off, if the Arroyo driver were to even shutdown due to error or otherwise, the full current of the other driver would be routed through the Arroyo driver, and could easily damage the instrument. One solution is to ensure both drivers are set to zero and without any modulation input, and turn on both drivers. At this point, no current is flowing, so even if the high current driver is turned on ahead of the Arroyo driver, no damage will occur.

A better solution is to insert a Schottky diode in series with the anode output of the Arroyo controller to prevent current from flowing from the high current driver into the Arroyo driver when the Arroyo driver is turned off. Ensure the diode is sufficiently rated for current and voltage, and can handle the thermal load that will be created by the voltage drop through the diode. This addition will increase the voltage needed to drive the diode equal to the drop across the protection diode. Heat generated by the diode will be equal to this voltage drop times the current ($P = I * V$). Also, because this protection diode is in series with the Arroyo output, it can also impact the modulation performance, so choose a diode with sufficiently high bandwidth to prevent it from interfering. A Schottky diode is recommended as they are fast and have a low voltage drop.



If the “other driver” has a shorting output, a protection diode can also be used on its output, but if it is a high power driver, significant heat can be generated by the protection diode, so that must be considered in the setup. If the Arroyo driver is only being used to produce a small signal, it’s possible the shorting feature of the other driver is rated sufficiently to handle any current generated by the Arroyo driver.

It is also important to note that the addition of the protection diode will eliminate the shorting protection normally provided by the Arroyo driver when its output is off.

Finally, the Arroyo driver must also have a compliance voltage rating greater than the voltage required by the laser (plus the protection diode, if used).