

Output Noise of LDC500/501 Current Source

LDC500 and LDC501 are equipped with an ultra low noise current source for laser diodes. The noise in the output current is a combination of thermal noise (Johnson Noise) in resistors, shot noise in semiconductors, flicker noise (1/f noise), and electromagnetic interference (EMI) inside or outside of the instrument. The noise in the output current can be regarded as an addition to the setting current.

We measure the output noise through a 25 Ω resistor which converts the output current noise into a voltage noise which is then AC coupled to an HP89410A signal analyzer. Figure 1 shows the measurement setup. Figure 2 shows the measurement result. The output current was set at 100 mA for LDC501 and 50 mA for LDC500.

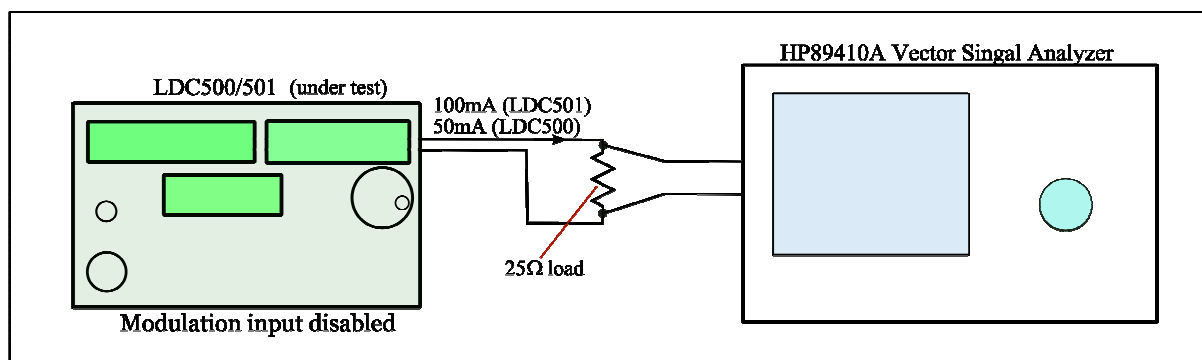


Figure 1: Laser driver noise spectrum measurement setup

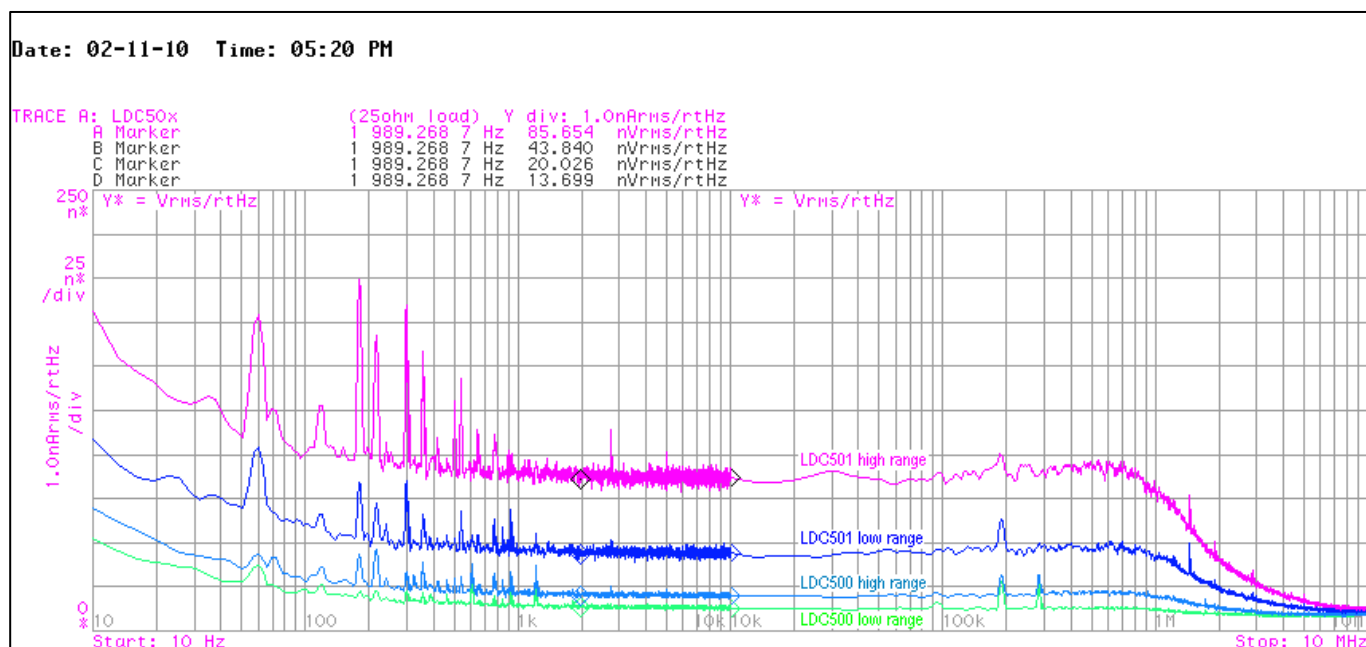


Figure 2: Voltage noise and current noise measured across a 25 Ω load driven by LDC500 or LDC500

Table 1: LDC500 and LDC500 Current Source Output Noise

Frequency	Model	Measurement result	
		Voltage noise on 25 Ω resistor (nV/ $\sqrt{\text{Hz}}$)	Output current noise (nA/ $\sqrt{\text{Hz}}$)
1 kHz~1 MHz	LDC501 500 mA range	85.7	3.43
	LDC501 250 mA range	43.8	1.75
	LDC500 100 mA range	20.0 (18.0*)	0.80 (0.72*)
	LDC500 50 mA range	13.7 (10.0*)	0.55 (0.40*)

*A gain block of $\times 100$ is used before HP89410A.

In order to see details in the noise spectrum, the measurement was divided into two bands: 10 Hz ~ 10kHz and 10 kHz ~ 10 MHz. Captured screens from the HP89410A are cascaded at 10 kHz as shown in Figure 2. During test, the LDC500 modulation input was disabled to reduce internal cable pickup. The voltage noise is read close to 2 kHz (Marker A and Marker B) and the output current noise is calculated using the formula: Voltage noise / 25 Ω .

Table 1 shows the noise at 2 kHz. Because of the measurement limits of HP89410A, we added

a gain block of $\times 100$ before the HP89410A and the measured noise density is shown in parentheses.

A comparative test was also done with a competitor's controller, and the result is plotted in Figure 3. Both instruments are set at 500 mA range and 100 mA output. Although the competitor's laser driver has a bandwidth of DC ~ 200k, its noise level goes up after 7 MHz. At 60 Hz, the competitor's current noise is 5.1755 $\mu\text{V}/\sqrt{\text{Hz}}$, which is 30 times worse than that of the LDC501.

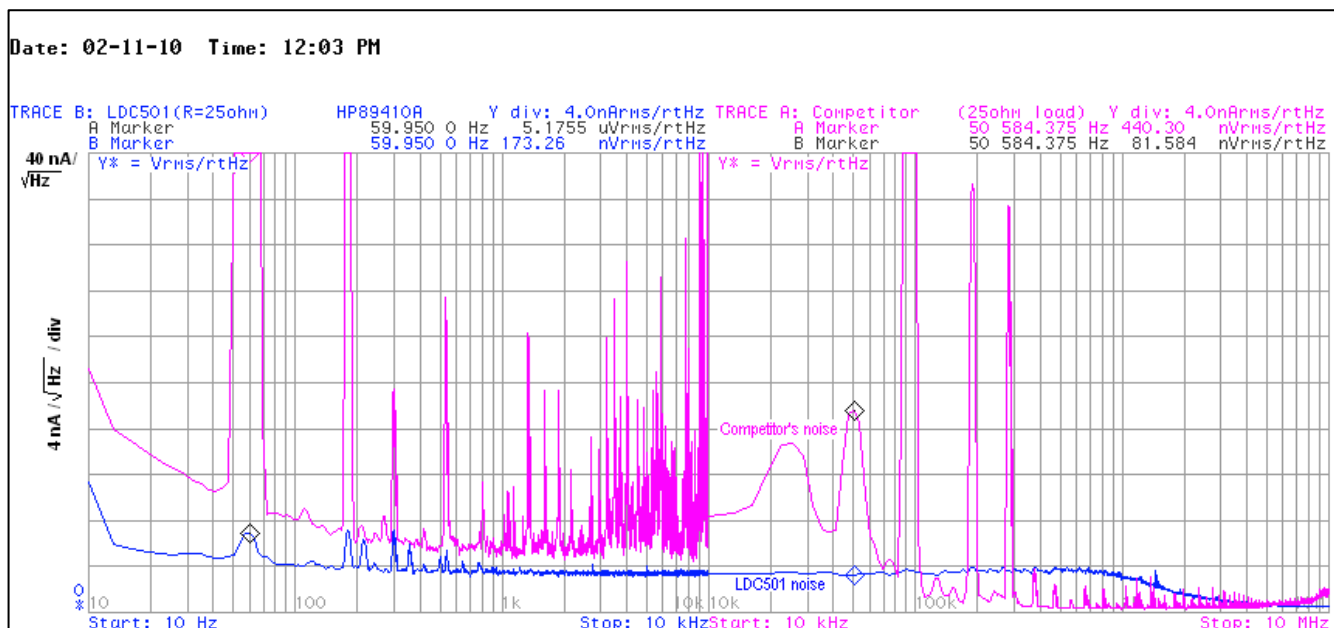


Figure 3: Voltage noise and current noise measured across a 25 Ω load