WAVELENGTH ELECTRONICS

Manage Grounding to Minimize Noise with the QCL Drivers

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INTRODUCTION

The QCL Series of Quantum Cascade Laser Drivers are very low noise current sources. Poor grounding during system integration can inadvertantly cause noise in the laser. This application note discusses grounding the chassis and avoiding ground loops so that your system can take full advantage of the cutting edge low noise driver circuitry.

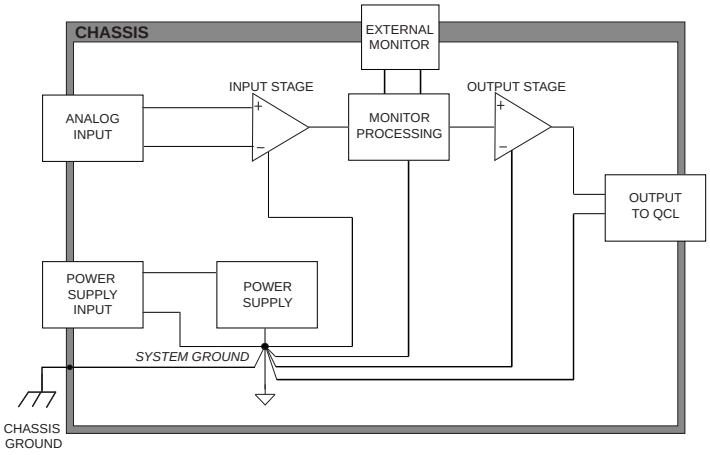
CONNECTING CHASSIS TO SYSTEM GROUND

Often, significant noise reduction can be achieved by tying the system ground to the chassis ground. Chassis ground is considered any conductor that is connected to the metal enclosure of the QCL driver. This connection provides several benefits if done correctly. The first benefit is a decrease in the effects of coupling electrostatic charge on the chassis and the QCL driver circuitry. Sources of external noise induce this charge and thus noise currents on the chassis. Since there is a radiated coupling between the floating chassis and the internal circuitry, noise on the chassis can pass to the QCL output. This coupling is minimized by connecting the chassis to the system ground. Another benefit is in reducing 50 / 60 Hz noise.

However, it is very important to connect the chassis to the internal ground in one, and only one, point. Wrong or multiple connections can allow the chassis noise to directly couple to signal carrying circuits. The proper connection for the chassis to the system ground is done through pin 15 of the QCL driver, which connects internally to the power supply ground. By connecting to this pin, the chassis noise currents are steered away from the sensitive signal path grounds and tie directly to the power supply return.

Sometimes, grounding the chassis does not improve noise performance. It may introduce ground loops, for example. Each system is different and you should evaluate the effect of chassis grounding on a case-by-case basis.

Figure 1. Grounding scheme of QCL Series Quantum Cascade Laser Drivers



GROUND LOOPS

To avoid ground loops, you must first be aware of your ground connections. In many cases, excess noise can be attributed to inadvertant ground loops. Each internal component of the QCL driver has a ground associated with it. Figure 1 shows these points schematically. All of these component grounds internally tie to a single ground at the power supply connection. This collection of component grounds is called the *System Ground*. The QCL load connection, the ANALOG INPUT ground, the MONITOR ground, and the Power Supply ground are critical individual component grounds because each of these grounds can connect to different external devices.

Ground is typically assumed to be an equipotential point that serves as a reference potential for different parts of the circuit. However, this definition is not quite practical in real world electronics. It does not emphasize the path that current takes in returning to its source. In practice, all conductors have some finite impedance and unplanned return currents are translated into noise voltages.

Under certain conditions, multiple connections to ground cause excessive electrical noise. This undesirable noise current is the result of a ground loop. A ground loop occurs when the grounds of two interconnecting devices are also tied together in places other than intended. This can be the third wire of a three-wire AC cable, chassis connected to equipment racks, etc. Figure 2 shows a typical example of a ground loop in a QCL system.

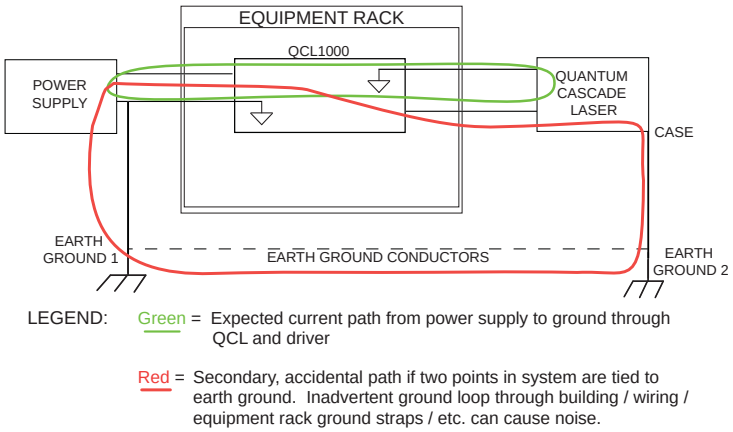
Here, the normal path to ground is back through the driver to the single point power supply ground. Where the QCL case is also tied to earth ground, current can flow in a loop from one ground to the other. Since there is some impedance inherent in every conductor, the current then induces a noise voltage that may interfere with the low-noise performance of the laser driver.

CONCLUSION

The best method to combat ground loops and their noise is to carefully design and setup a system with only one low impedance return path. Be aware of sneak paths to earth ground, such as USB ground, chassis connections, equipment rack metal rails and the like. All of the earth grounding in a system should be tied to one and only one point. Additionally, long cables will exacerbate ground loop problems because impedance increases with cable length.

With careful setup and attention to ground connections and conductor length, the effects of ground loops can be minimized or eliminated all together.

Figure 2. Example introduction of Ground Loop causing higher noise



References:

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2. *Macatee, Rane Note 151: "Grounding and Shielding Audio Devices," Rane Corporation, 1994.*
3. *Rane Technical Staff, Rane Note 110: "Sound System Interconnection," Rane Corporation, 2007.*

KEYWORDS

Quantum Cascade Laser Driver, Low Noise, current source

REVISION HISTORY

REV	DATE	NOTES
A	29-Nov-10	Release
B	10-Apr-13	Clarified coupling