

Output Drive Configurations for the ONET4201LD and the ONET4211LD

The ONET4201LD and ONET4211LD are laser drivers for fiber optic applications up to 4.25Gbps. The ONET4201LD has active back-termination at the outputs while the ONET4211LD has standard terminations. All other functionality between the devices is the same. The interface circuit connecting the laser driver to the laser diode is critical to achieve the optimal transmitter performance.

The ONET4201LD provides active 20Ω back-termination which minimizes jitter caused by reflections. In the frequency range of interest, the impedance is approximately resistive (phase about 0 degrees) and the magnitude about 20 ohms, as shown in Figure 1. The back-termination absorbs signal reflections from the TOSA end of the output transmission lines, thus easing the impedance matching requirements between the laser driver and TOSA. The active-back termination circuit adds approximately 10mA to the supply current.

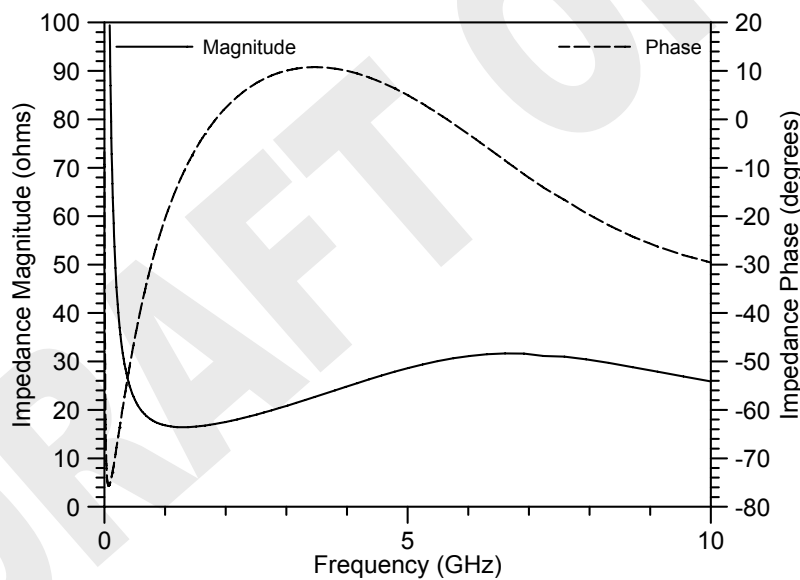


Figure 1: ONET4201LD Simulated Output Impedance

The ONET4211LD is optimized to drive a 20Ω load but for optimum power efficiency, it does not provide any on-chip back termination. More care to the layout must be taken when using the ONET4211LD to ensure a good impedance match between the laser driver and the TOSA.

Since the ONET4201LD and the ONET4211LD are pin compatible, the same output drive circuits can be used for both devices, however, the impedance match between the output of the ONET4211LD and the TOSA is more critical than for the ONET4201LD.

There are many ways to connect a laser driver to a laser diode. A simple, straight forward solution that requires few components and small board space is the DC-coupled, single-ended drive circuit as shown in Figure 2.

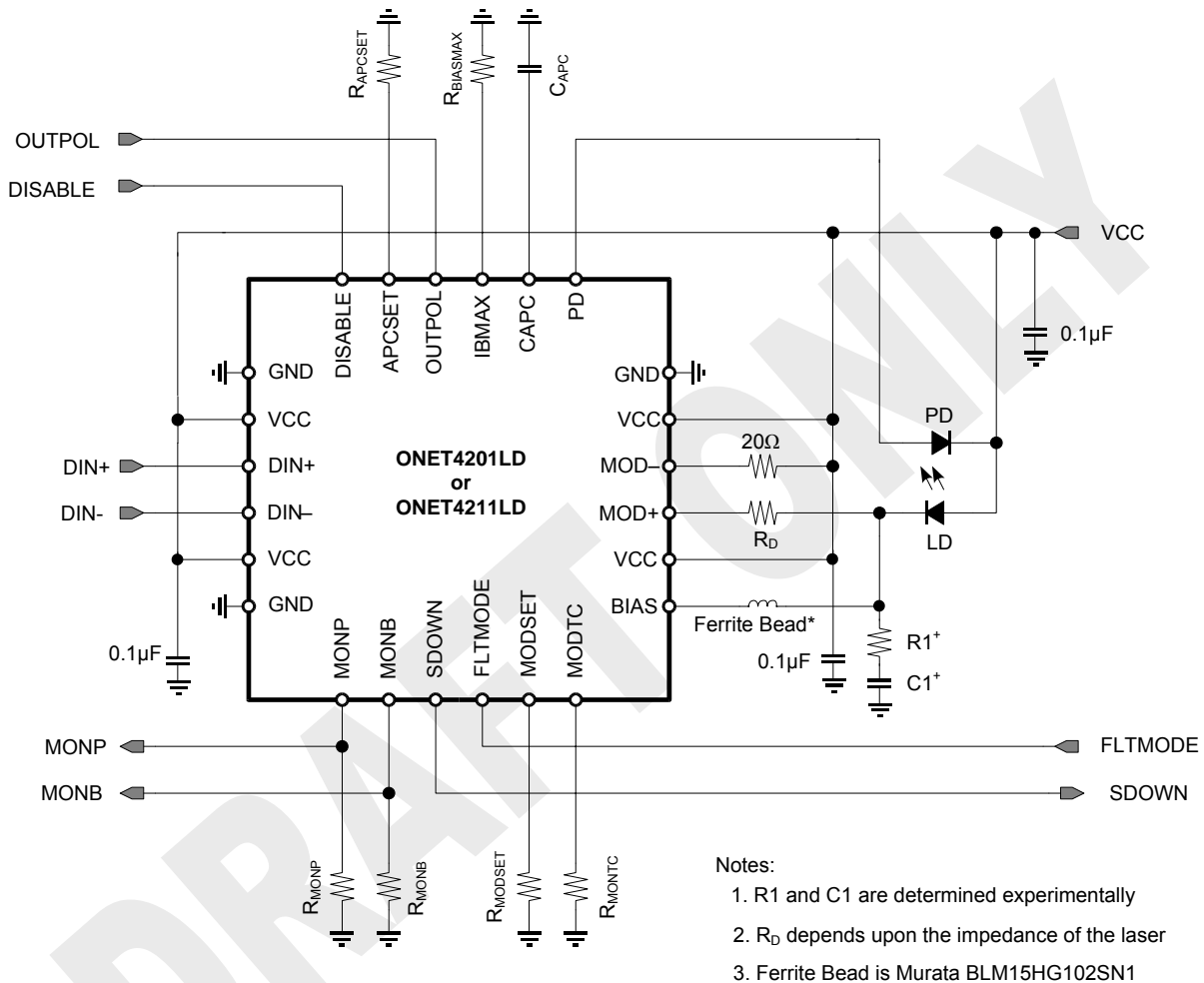


Figure 2: DC-Coupled, Single-Ended Drive Circuit

Referring to Figure 2, the bias current is supplied to the laser diode through a ferrite bead that has no effect on the DC bias current but appears as a high impedance to the modulation current. The series resistor R_D is used to damp reflections as well as damp the overshoot and ringing caused by laser and stray inductance. R_D also helps to present a more stable load to the modulation output, as the laser diode impedance can vary significantly versus frequency. The value of R_D depends upon the series resistance of the laser diode, which is typically 4Ω to 7Ω for DFB or FP lasers in a TO-can, and the amount of voltage headroom required. The ONET4201LD and ONET4211LD allow DC voltages on the modulation outputs as low as 0.4V. Furthermore, to reduce peaking caused by the lead and bond wire inductance of the laser package, the RC shunt network consisting of R₁ and C₁ may be used. Typically R₁ and C₁ are determined experimentally.

The single-ended drive circuit is relatively simple but improved performance can be achieved by using a differential drive circuit as shown in Figure 3 or Figure 4. With a single-ended drive circuit, the laser is actively tuned on but the laser's properties and parasitic capacitance limit the turn-off time. Differential drive, although requiring more components, actively turns the laser on and off, thus reducing the falling edge speed. Another advantage of differential drive is reduced EMI from the closed current loop.

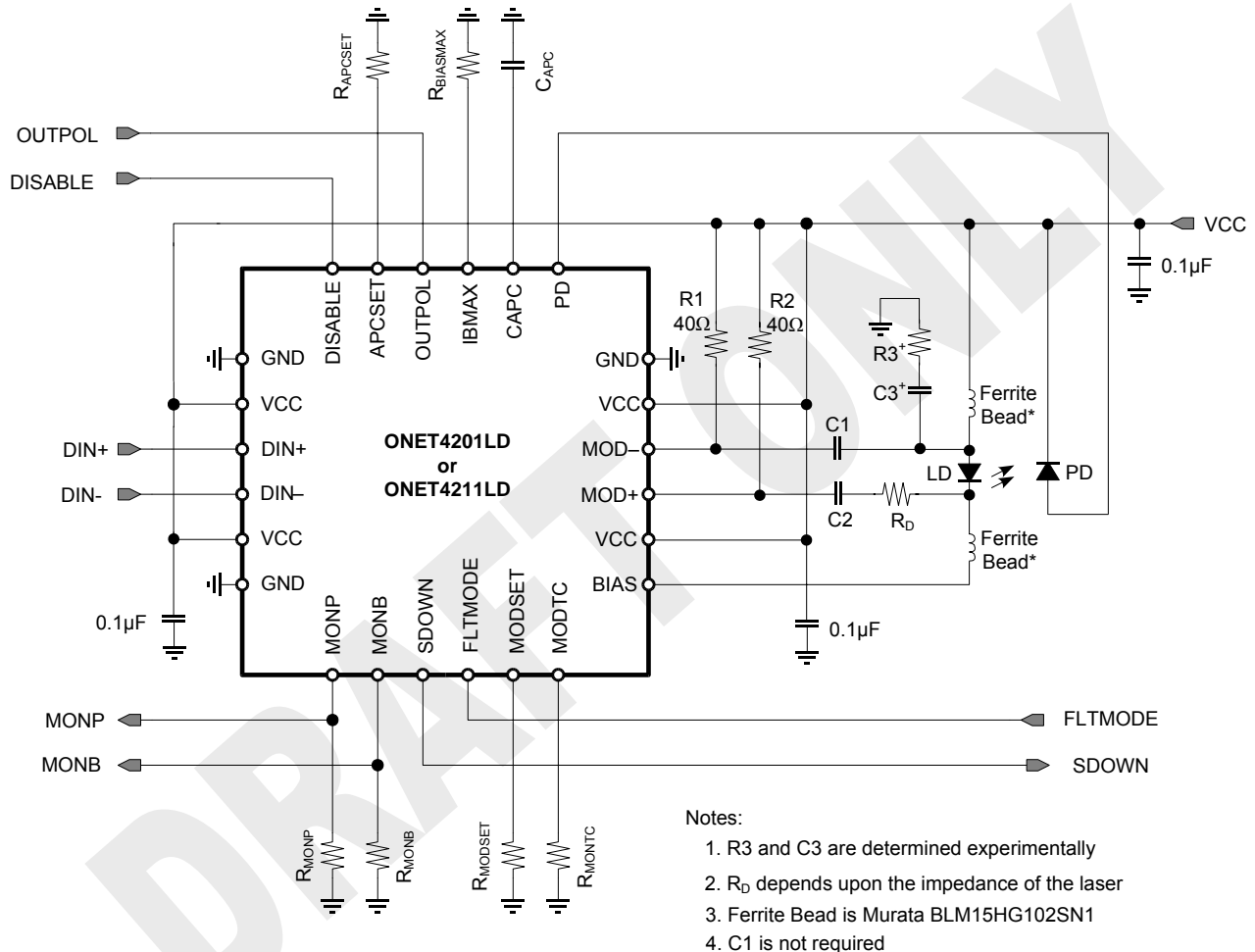


Figure 3: Differential Drive Circuit with Resistive Pull-Ups

Referring to Figure 3, R1 and R2 are used to pull the open collector outputs to VCC and provide back-termination. C2 is used to isolate the forward voltage of the laser from the MOD+ output and increases the available headroom. C1 is used to keep the DC level on the outputs of the differential pair the same but is not necessary and can be removed or replaced by a small value resistor as part of the optimization process. As in the single-ended circuit of Figure 2, R_D is used to damp reflections, overshoot and ringing caused by laser and stray inductance and present a more stable load to the modulation output. The shunt network of R3 and C3 is used to reduce the peaking caused by the inductive load presented by the laser package and are determined experimentally. Alternatively, the shunt network of R3 and C3 can be placed in parallel with the laser diode.

Another possible differential drive configuration is to replace the pull-up resistors with pull-up inductors, as shown in Figure 4. While this improves the circuit efficiency, as more modulation current is delivered to the laser, it may require more optimization. The combination of the AC-coupling capacitors and the pull-up inductors introduces a low frequency cutoff. The inductors should have a small DC impedance and a large impedance in the MHz to GHz range. Ferrite beads should work well but additional series inductance may be required as part of the optimization process. The ferrite bead or inductor used to provide the bias current to the laser diode can also be used to pull-up the MOD- output to VCC.

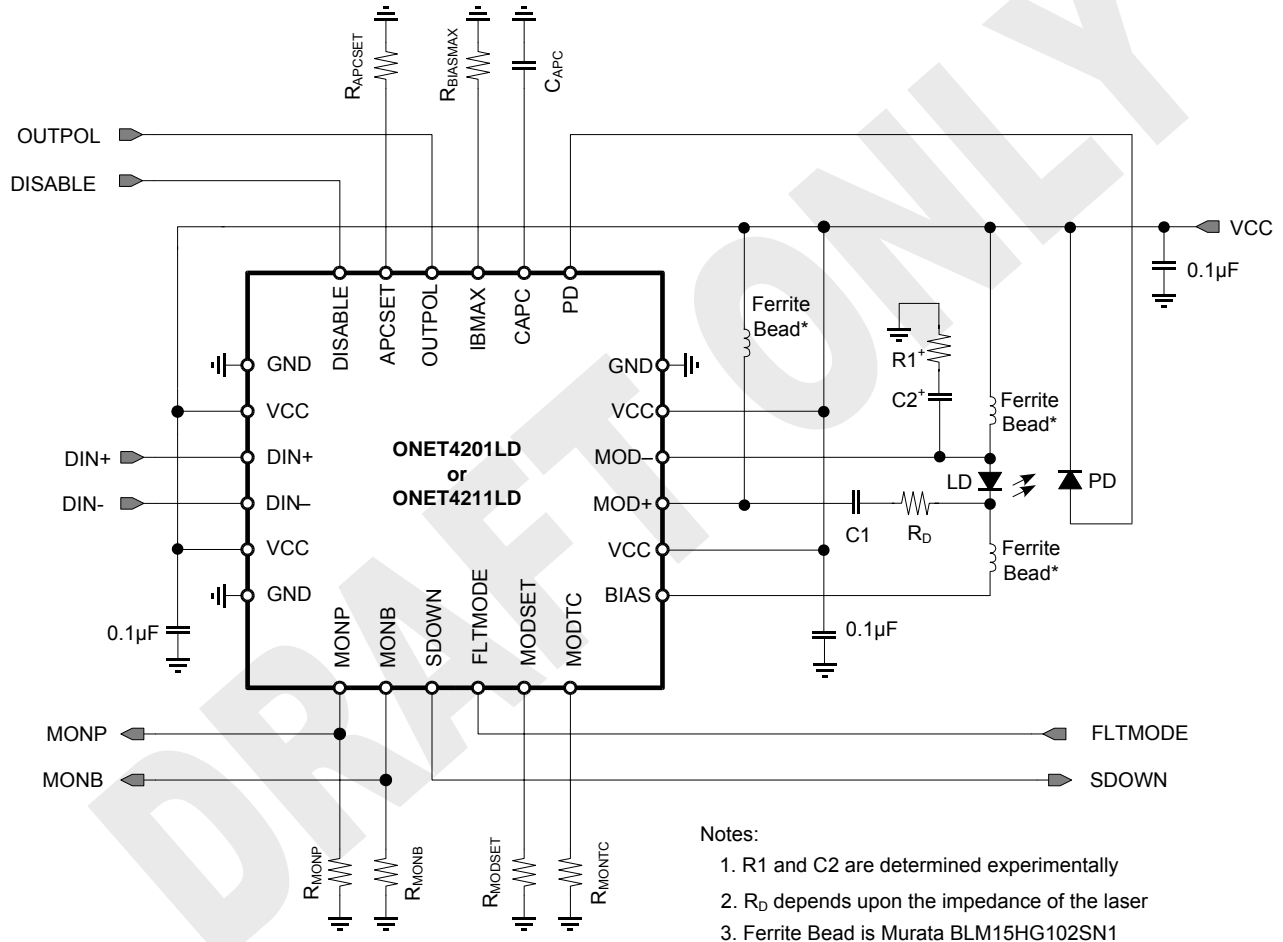


Figure 4: Differential Drive Circuit with Inductive Pull-Ups