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Application Note AN-2131

DC Electrical Interface Examples for VCSELs

Introduction

This article is intended to provide examples of how to electrically interface an Advanced Optical Components (AOC) VCSEL. Examples of constant current and constant power circuits are given. Additional information on the electrical and optical parameters of a VCSEL, including temperature dependencies, is contained in the application note entitled VCSEL Spice Model. This, and other application notes and data sheets are available on the AOC website (www.adopco.com). While there are many circuits, both more simple and more complex than those shown, the general considerations such as the elimination of electrical transients during turn on/off, and protection from ESD/EOS should not be forgotten. For a complete description of the ESD sensitivity, please see the application note entitled VCSEL Reliability, available on the AOC website.

The circuits described below are intended as examples only, and are applicable to all VCSELs with slight modifications. AOC makes no guarantee, express or implied, about the suitability of these circuits for any application. In addition, these circuits do not in any way limit the laser output for eye safe operation, and AOC assumes no liability for their use.

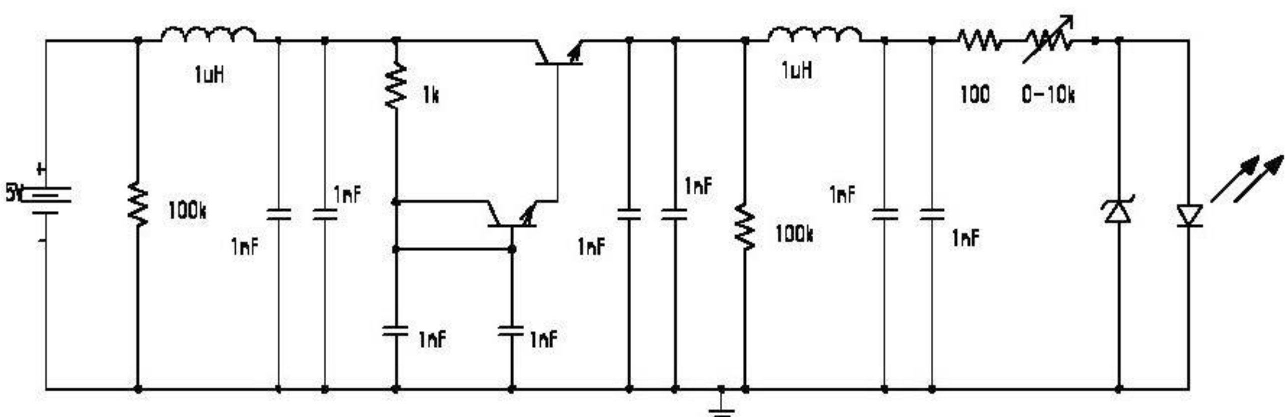

Figure 1. Schematic for a slow starting constant current source to drive a VCSEL.

CONSTANT CURRENT

The simplest way to drive a VCSEL is with a constant current source. An example circuit is given below that provide ESD/EOS protection, and provides the VCSEL with a slow current ramp to prevent thermal stress in the active region.

The current through the VCSEL is controlled between approximately 0.5 and 20mA by the 0-10k potentiometer. The current through the VCSEL can be read as the voltage across the 100Ù series resistor. In this circuit, heavy bypass filtering is provided by the ð network on both sides of the transistor network. Additional protection is also provided by placing a 3V zener diode in parallel with the VCSEL to prevent reverse breakdown in the VCSEL. The circuit has a turn on time of about 10us. The current through the VCSEL as a function of time is shown in figure 2a, 2b is the approximate current as a function of the control resistance.

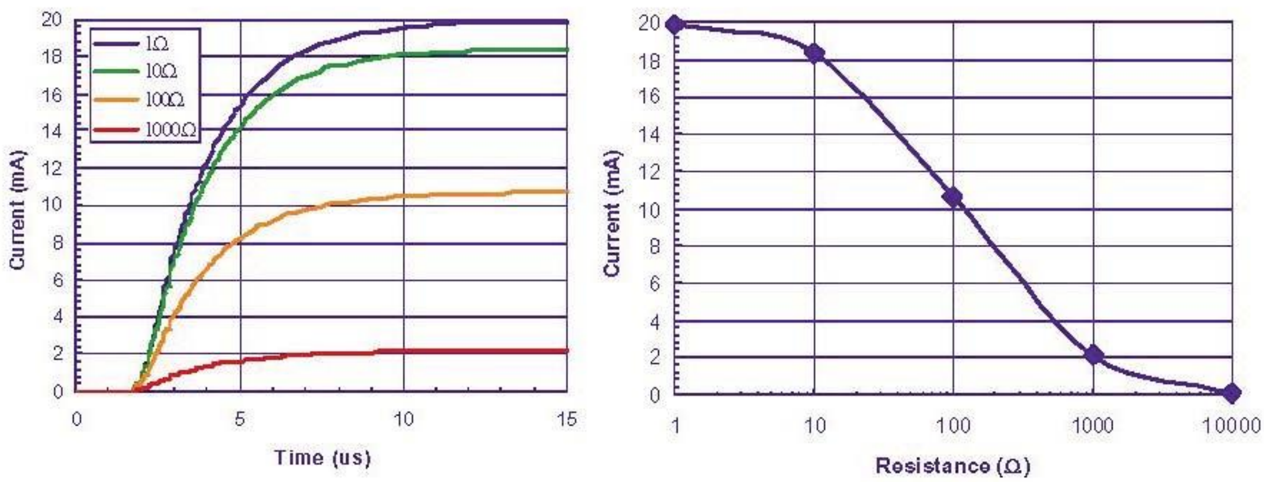

Figure 2 (a) Turn response of the circuit in Figure 1 for several potentiometer values.
Figure 2 (b) Current in the VCSEL as a function of the control resistance.

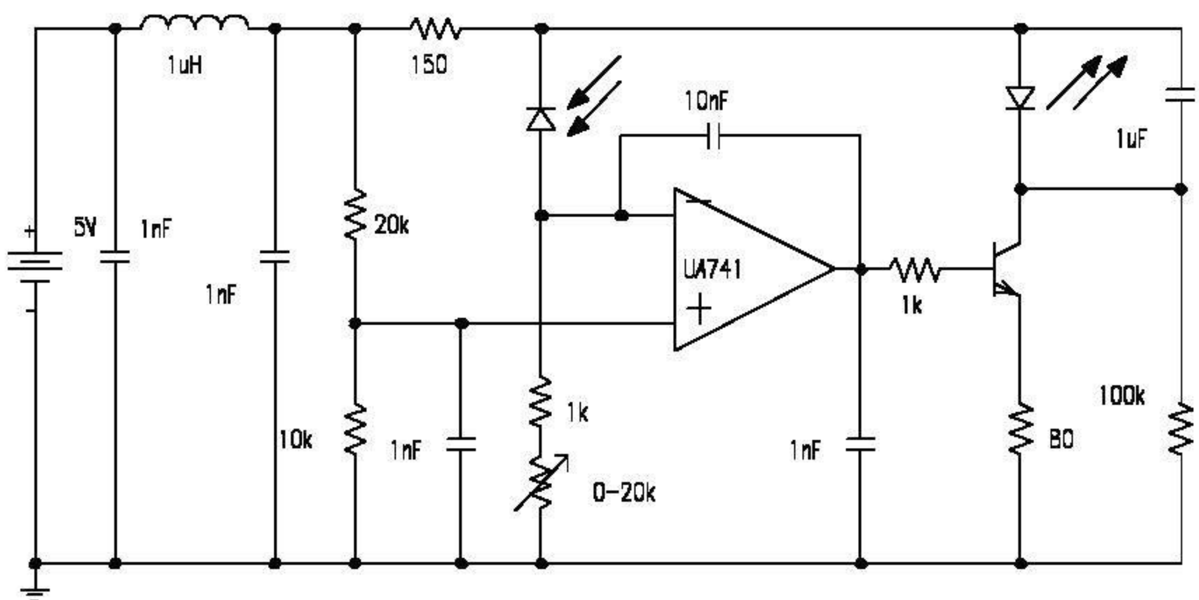

Figure 3. Schematic for an Average Power Control Circuit

The current in the VCSEL is set by adjusting the 0 to 20k potentiometer. The feedback loop adjusts the VCSEL current until the monitor current in the photodiode is equal to the current in the potentiometer. The time constant of the power control circuit is set by the 10nF feedback capacitor.

Care should be taken with the time constant of the feedback in order to prevent oscillations or instabilities in the control circuit. The values of the circuit elements given here assume a particular tracking ratio (current in the photodiode to total light output). Some values will need to be adjusted in order to use widely divergent monitor currents. In this circuit, the current through the VCSEL can be monitored as the voltage measured across the 150Ù resistor. When using small diameter VCSELs, such as a single mode device, the maximum current should be further limited by increasing the 150Ù resistor value. Figure 4 depicts the turn on transients of the average power control circuit.

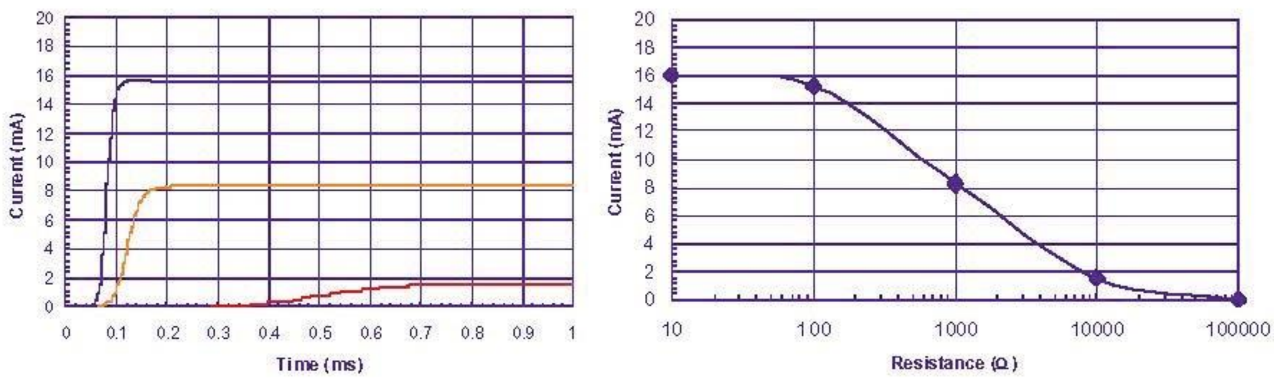

Figure 4 (a) Turn on transient of the APC circuit of figure 3 for various values of the potentiometer, and (b) the final current value as a function of the control resistance

While the previous example control circuits are useful for laboratory testing, dedicated integrated circuits are readily available. One example is from ICHaus, part number iC-WK. More information on its operation can be found on the website www.laserdrivers.com. Care should be taken not to exceed the maximum VCSEL current with commercial laser drivers, which can supply in hundreds of milliamps.

ADVANCED OPTICAL COMPONENTS

Finisar's ADVANCED OPTICAL COMPONENTS division was formed through strategic acquisition of key optical component suppliers. The company has led the industry in high volume Vertical Cavity Surface Emitting Laser (VCSEL) and associated detector technology since 1996. VCSELs have become the primary laser source for optical data communication, and are rapidly expanding into a wide variety of sensor applications. VCSELs' superior reliability, low drive current, high coupled power, narrow and circularly symmetric beam and versatile packaging options (including arrays) are enabling solutions not possible with other optical technologies. ADVANCED OPTICAL COMPONENTS is also a key supplier of Fabrey-Perot (FP) and Distributed Feedback (DFB) Lasers, and Optical Isolators (OI) for use in single mode fiber data and telecommunications networks

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LOCATION

- Allen, TX - Business unit headquarters, VCSEL wafer growth, wafer fabrication and TO package assembly.
- Fremont, CA – Wafer growth and fabrication of 1310 to 1550nm FP and DFB lasers.
- Shanghai, PRC – Optical passives assembly, including optical isolators and splitters.

SALES AND SERVICE

Finisar's ADVANCED OPTICAL COMPONENTS division serves its customers through a worldwide network of sales offices and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact a nearby sales office or call the number listed below.

AOC CAPABILITIES

ADVANCED OPTICAL COMPONENTS' advanced capabilities include:

- 1, 2, 4, 8, and 10Gbps serial VCSEL solutions
- 1, 2, 4, 8, and 10Gbps serial SW DETECTOR solutions
- VCSEL and detector arrays
- 1, 2, 4, 8, and 10Gbps FP and DFB solutions at 1310 and 1550nm
- 1, 2, 4, 8, and 10Gbps serial LW DETECTOR solutions
- Optical Isolators from 1260 to 1600nm range
- Laser packaging in TO46, TO56, and Optical subassemblies with SC, LC, and MU interfaces for communication networks
- VCSELs operating at 670nm, 780nm, 980nm, and 1310nm in development
- Sensor packages include surface mount, various plastics, chip on board, chipscale packages, etc.
- Custom packaging options

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