2.488 Gb/s DFB Laser Module with Integral Optical Isolator

Application Note 1117

LSC2500

Introduction

The LSC2500 is a Multi Quantum Well DFB laser diode with internal optical isolation and temperature control designed for digital operation up to 2.488 Gb/s (STM-16, OC-48) data rate. This document outlines the relevant aspects of operation for the LSC2500 in order to achieve optimum performance.

Signal and pre-bias inputs

Data input signal can be applied via pin 12 with pre-bias current applied through pin 3. In instances where the laser driver IC used (e.g. Lucent LG1625AXF, Fujitsu FMM311DG) has provision for pre-biasing at the modulation output then only pin 12 is used. It is then recommended that pin 3 be bypassed with a 100 nF capacitor to ground. The internal RF block on pin 3 comprises a 180 nH inductor and a 10 ohm resistor in series connection.

The data input pin 12 is 25 Ω matched and comprises an internal resistor plus the resistance of the laser chip. The LSC2500 contains a low pass filter (3.9 pF capacitor to ground) to reduce chirp penalty. It may be necessary to have additional external filtering depending on the type of laser driver IC used. In such an instance it is recommended that pin 12 be bypassed to ground with a 13 Ω resistor and 1.5 pF capacitor in series connection (see Figure 2). Optimum high speed performance is obtained through minimizing the distance between the laser driver IC and the LSC2500 module. Separations of more than 5 mm are not recommended.

Pin Connections

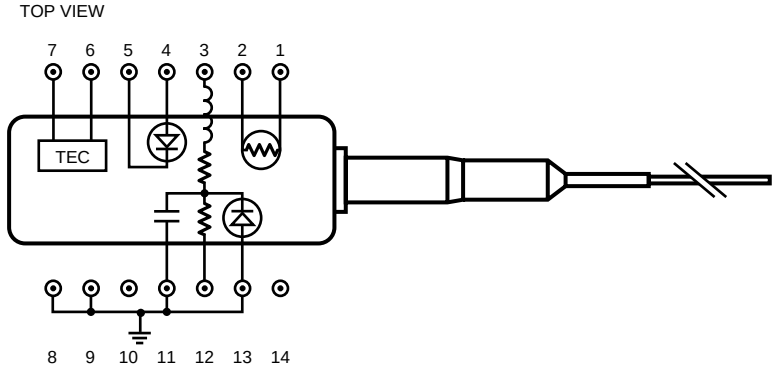

Figure 1. Pin Connections and Block Diagram

Pin Connections

1	Thermistor
2	Thermistor
3	Laser dc bias
4	Monitor Anode
5	Monitor Cathode
6	TEC
7	TEC
8	Ground
9	Ground
10	Not connected
11	Ground
12	Laser modulation
13	Ground
14	Not connected

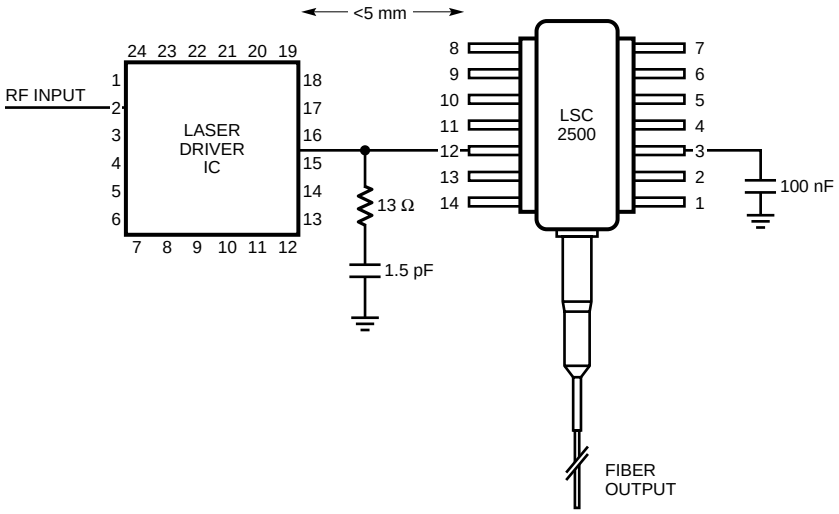

Figure 2.

Laser Rear Facet Monitor

The LSC2500 DFB laser module contains a photodiode for monitoring mean optical output. This photodiode has a bandwidth of >400 MHz and has an anode connection to pin 4 and cathode to pin 5. This photodiode is typically used in a mean power control loop and requires reverse biasing (max. 10 V) for proper operation. The responsivity of this photodiode is typically between 0.1 A/W to 1.0 A/W. An example of a mean power controller is shown in Figure 3.

Adjustment of VR1 in conjunction with the photocurrent (generated by the laser output) sets a dc level at the inverting input of the op-amp IC2. A voltage reference at the non-inverting input is provided by IC1. IC2, configured as an integrator, controls the biasing for the TR1/2 darlington pair. The collector current through TR2 provides the laser pre-bias.

Temperature Control

The LSC2500 contains a Peltier thermoelectric cooler and thermistor for monitoring and maintaining the desired laser temperature. The graph in Figure 4 shows a typical performance curve for the thermocooler for 2 mW mean optical output and heat extraction equivalent to +3°C/W. A temperature differential of approximately +45°C can be supported for 1 A of current. The thermistor has a nominal resistance of 10 kΩ at +25°C with 5% tolerance and its temperature response is shown in Figure 5.

Operation of thermoelectric coolers (TECs) requires low ripple dc power supplies. These may range from simple batteries to elaborate closed loop power supply circuits.

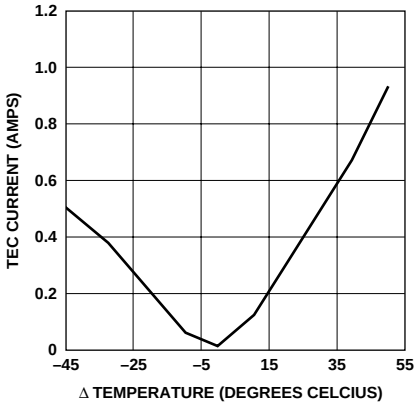

Figure 4. Graph of TEC current versus change in temperature with respect to +25°C

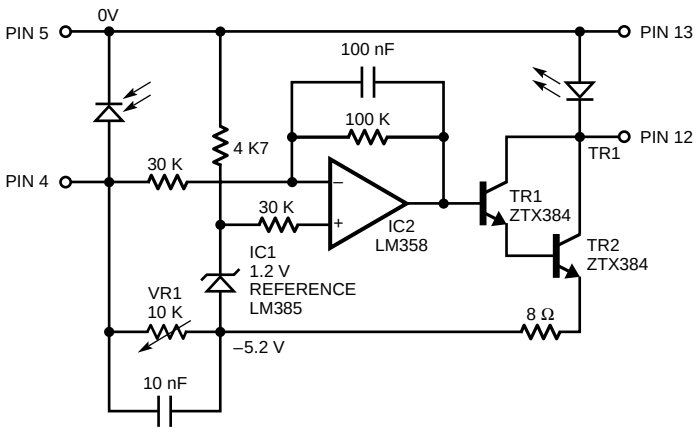

Figure 3. Mean Power Control Circuit

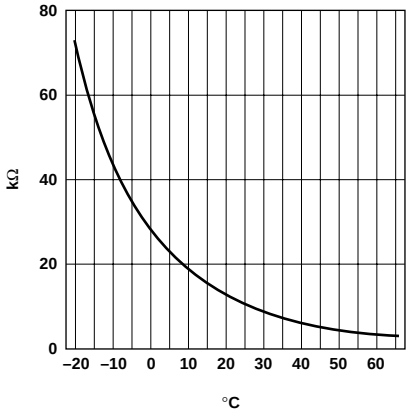

Figure 5. Thermistor Temperature Characteristic

Both linear and switching mode power supplies can be used to operate TECs.

There are several methods for controlling TECs of which the proportional control method is quite common. A proportional controller offers stable performance and good temperature tracking ability. Figure 6 shows a typical proportional controller for TECs.

Regulatory Compliance

The LSC2500 products are intended to enable commercial system designers to develop equipment that complies with the various regulations governing certification of Information Technology Equipment (See Table 5). Additional information is available from your Hewlett-Packard sales representative.

Electrostatic Discharge (ESD)

During handling of the laser diode prior to mounting it on the circuit board, it is important to use normal ESD handling precautions for ESD sensitive devices. These precautions include using grounded wrist straps, work benches and floor mats in ESD controlled areas.

Laser Safety

The LSC2500 product is classed as 3A in the IEC classification system and class IIIb in the CDRH system.

According to the Montreal Protocol, no ozone depleting substances are used in the manufacture of this product.

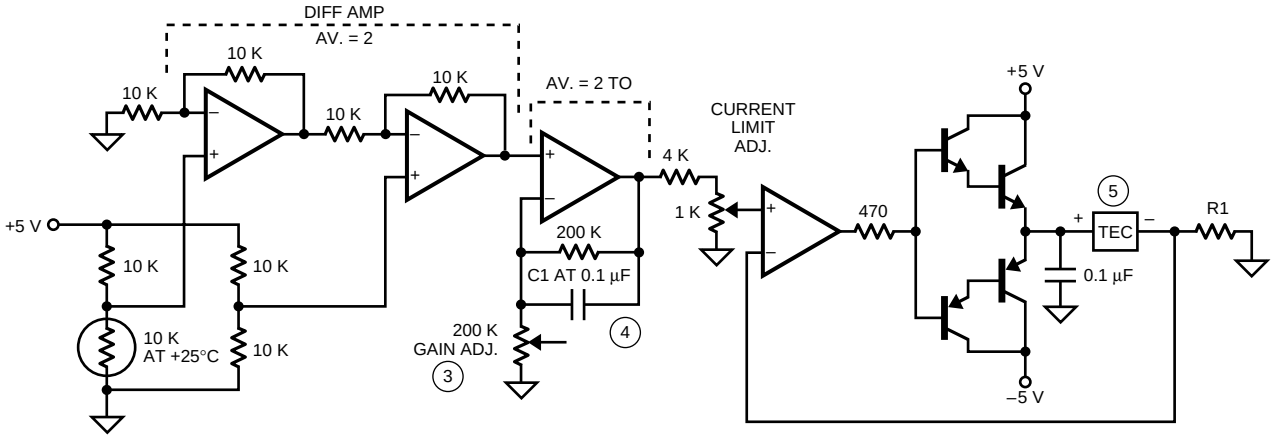

Figure 6. Proportional Controller for Thermoelectric Cooler (TEC)

Fiber Pigtail: Tight jacketed, self-mode stripping, single mode fiber

Parameter	Minimum	Maximum	Units
Length	1.0	—	m
Spot Size (Mode Radius)	4.5	5.5	µm
Cladding Diameter	122	128	µm
Core/Cladding Concentricity	—	1.0	µm
Secondary Jacket Diameter	0.8	1.0	mm
Effective Cut-Off Wavelength	1150	1240	nm

Table 5. Regulatory Compliance - Typical Performance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	Bellcore TR-NWT-000870 Human Body Model Class 3	>500 V
Eye Safety		IEC Class 3A CDRH Class IIIb

For technical assistance or the location of your nearest Hewlett-Packard sales office, distributor or representative call:

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Far East/Australasia: Call your local HP sales office.

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Data Subject to Change

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