A DFB LDM in mini-DIL Package with Built-in Thermoelectric Cooler

1. INTRODUCTION

Data traffic over optical fibers has increased with the expansion of internet and mobile phone services, and distributed feedback (DFB) laser diode modules (LDMs) have been widely applied as the signal source. This LDM for DWDM, which contains a built-in thermoelectric cooler (TEC), is thought to be more suitable and cost effective for expanding data channels in the future.

A butterfly-type package with 14-pin layout has been widely employed for conventional DFB LDMs for DWDM applications.

On the other hand, optical transceivers and optical repeater modules for analog applications are highly required to be small in size, necessitating more compact signal sources.

We have therefore developed a new DFB laser in a mini-DIL package, which has been made suitable for such market demands by incorporating an ultra-compact TEC into the package. The new mini-DIL DFB LDM has proven its reliability by passing Telcodia GR-468 tests.

2. FEATURES

Figure 1 shows a comparison between the mini-DIL DFB LDM and a conventional 14-pin butterfly-packaged DFB LDM. The mini-DIL LDM measures 7.4 (W)×12.7 (L)×5 (H) mm^3, one fifth the volume of conventional modules and gives the same performance as conventional LDMs in terms of environmental working conditions, high bandwidth and high output power, with good fiber coupling efficiency. CuW is used for the bottom plate to achieve better heat dissipation.

Pin assignment is compatible with the Multi-Source Agreement (MSA) for uncooled lasers, with two additional pins for the TEC cooler at the back. Interfacing can be achieved not only for pigtailed fiber with any connector but also for a receptacle type suitable for plug-in transceivers.

3. PERFORMANCE

3.1 *L-I* Characteristic

Figure 2 shows the *L-I* curve for the new mini-DIL DFB LDMs. LD temperature is kept constant at 25°C by means of the built-in TEC cooler. Optical output is compatible with the conventional 14-pin packaged LDMs with a slope efficiency higher than 0.2 W/A.

Figure 3 shows the temperature dependence of the wavelength. Wavelength drifts no more than ±15 pm at case temperatures from −50 and 70°C, enabling this mini-DIL DFB LDM to be used in DWDM applications with 100-GHz spacing.

3.2 Transmission Characteristics under Direct Modulation

Eye patterns with and without filtering, and bit error rate (BER) before and after long-reach (160-km) transmission at 2.5 Gbps under direct modulation are shown in Figures 4 and 5, respectively.

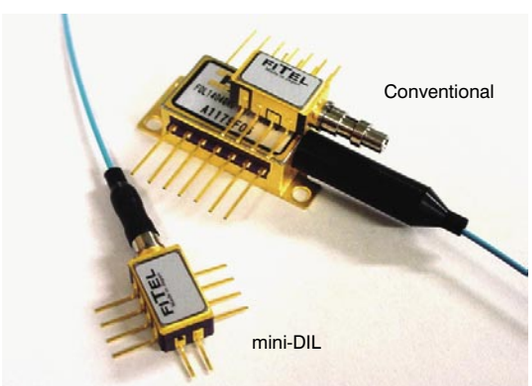


Figure 1 Comparison between mini-DIL and conventional LDMs.

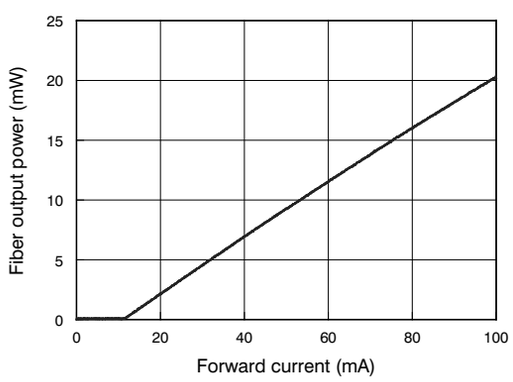


Figure 2 *L-I* characteristic of mini-DIL DFB LDM.

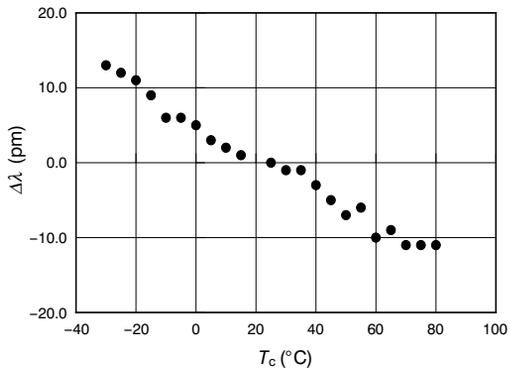
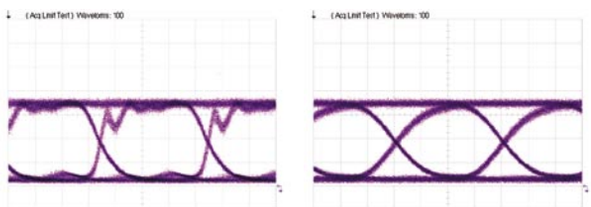


Figure 3 Wavelength drift vs. temperature.



(a) Without filter (b) With filter

Figure 4 Eye patterns at 2.5 Gbps under direct modulation.

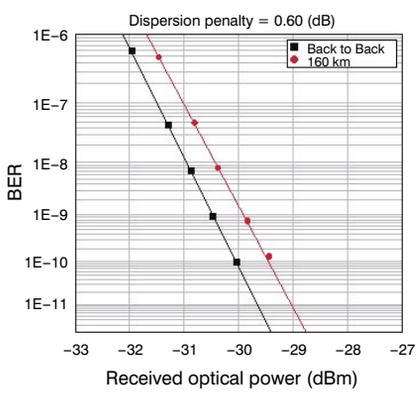


Figure 5 Bit error rate for back-to-back and 160-km data transmission.

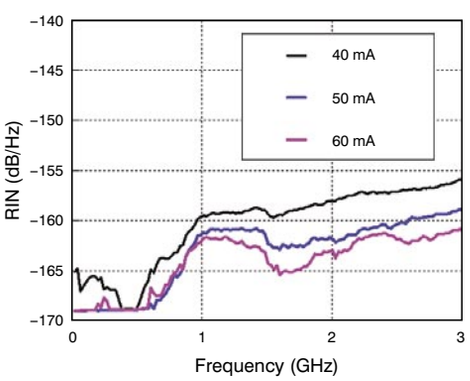


Figure 6 Relative intensity noise (RIN) vs. frequency.

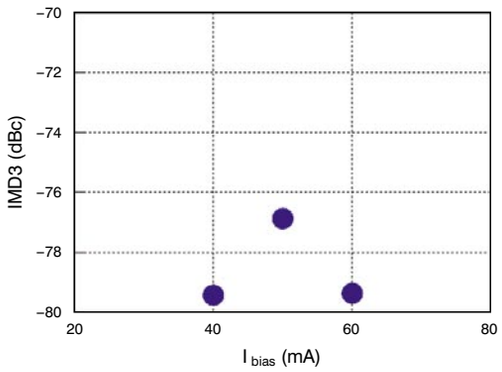


Figure 7 3rd order intermodal distortion (IMD3) characteristics.

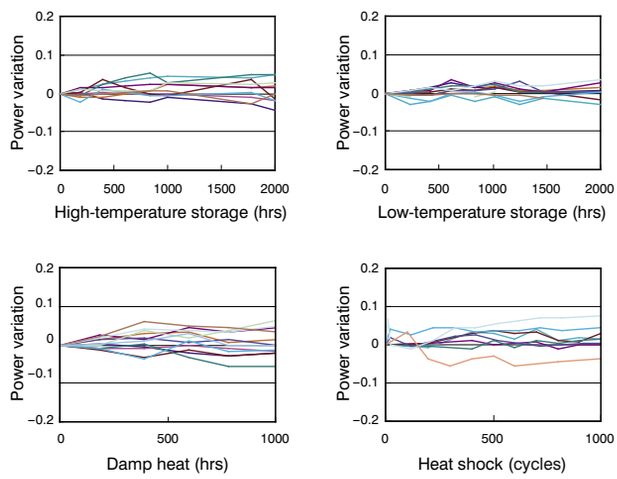


Figure 8 Results of reliability tests in accordance with Telcordia GR-468.

A good eye pattern with sufficient margin is observed at a peak output power of 10 mW and an extinction ratio of 10 dB. And the dispersion penalty through the 160-km fiber demonstrates promising high performance for long-reach transmission.

3.3 Analog Modulation Characteristics

Relative intensity noise (RIN) and 3rd order intermodal distortion (IMD3) characteristics are shown in Figures 6 and 7, respectively.

The results show outstanding performance over a wider bandwidth, providing suitable characteristics for 3rd generation mobile phone systems such as IMT-2000.

4. RELIABILITY

Long-term tests were carried out in accordance with Telcordia GR-468, with results that demonstrate high reliability.

5. CONCLUSION

We have developed a new type of DFB LDMs in a mini-DIL package which can be applied in applications such as DWDM or mobile phone systems. The new mini-DIL DFB LDMs will provide customers with high performance and extra functionality in an ultra-compact configuration.

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