Integration Platform of Dual Wavelength Signal Source for 120GHz Wireless Communication Systems

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Abstract

Monolithically integrated photonic signal sources at subterahertz frequencies are becoming an attractive and compact solution for the future wireless communication systems. An optical packaging of dual wavelength DFB laser is presented with the assembly steps required for the optimum optical coupling, RF modulation and DC biasing with optimum wiring circuitry in the housing, and better thermal management while preserving the mechanical stability of housing. The laminate based integration platform to be designed for the various modulating inputs in addition to direct modulation input and active section of laser such as phase shifter and SOAs are illustrated. The additional metallic parts required for better mechanical stability and efficient heat removal during laser operation and high temperature assembly steps are utilized in the packing process. The glass blocks for the optimum fiber positioning in the optical coupling are also the important parts in the assembly process to be highlighted. The whole customized package is illustrated as an example of reliable laser packaging.

1 Introduction

Optical communication has been increasing its importance and presence from backbone to access and premise applications in spite of the recent market slump. DWDM is definitely an epoch-making breakthrough in the industry and promisingly introduced to metropolitan area network. It's now very crucial to reduce the cost and the size of light sources to penetrate deeper into the practical use [1]. Very compact wavelength-tunable optical transmitter modules are therefore important system components in metro WDM applications. This reality results the reliable source packaging of compact transmitters to be an important task. A directly modulated DFB chip can be the choice as an optical source for the cost reason.

In this paper, the customized packaging of currently developed module is explained in combination with additional submounts to optimize DC and RF wiring circuitry and respective assembly steps in the packaged module.

2 Laser Source Packaging Design Issues

The main design issue in monolithic signal source packaging is to have the required DC and RF contacts with possibly small wire lengths and large separation distance inbetween due to small inductance and capacitance for reduced RF coupling. The optimum contact positioning and dimensioning are also important not to have additional reflections at RF ports for high SNR and optical modulation efficiency. Especially for the proper operation of active SOA/EAM and laser sections, the resulting heat has to be removed effectively from chip during data modulation. In addition to the operation point drift and linearity degradation of active components, the dimensional change of optical waveguides in the passive components leads mode profile to be degraded with possible multimode operation due to larger cross-section. Therefore, not only RF and DC transmission lines have to be positioned and geometrical parameters have to be determined in optimum manner, but also the temperature gradient resulting from active components has to be minimized throughout the submount for high data rate modulation. The geometrical parameters and electrical properties of laser chip are shown in Figure 1 with the laser geometry.

	SOAopt out1	SOAopt out2	DFB1	DFB2	SOA-DFB1	SOA-DFB2	SOA-PD1-1	SOA-PD2-1	MOD-PD1	MOD-PD2	SOA-PD1-2	SOA-PD2-2	PD1	PD2
length (µm)	400	400	1000	1000	400	400	500	500	100	100	500	500	15	15
current (mA)	100	100	200	200	100	100	100	100	10	10	100	100	10	10
voltage (V)	2	2	2	2	2	2	2	2	5	5	2	2	5	5
power (W)	0.2	0.2	0.4	0.4	0.2	0.2	0.2	0.2	0.05	0.05	0.2	0.2	0.05	0.05
total power (W)	2.6													

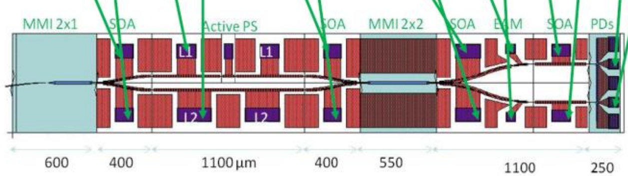


Figure 1: DFB laser chip

3 Monolithically integrated Dual Wavelength Signal Source Package Design

In order to protect the laser chip from unwanted environmental effects to sustain EMC between each components of the system, and especially for the mechanical/thermal stability and to supply the required I/Os for the external connections as test and control pins, the packaging design is quite important. To ensure the optimal performance of the whole monolithic signal source system, the following requirements must be fulfilled:

1-) Thermal and Thermo-Mechanical Requirements:

To ensure optimal thermal flow by avoiding thermo-mechanical mismatch due to different thermal expansion coefficients of materials of assembled components and smoothing occurring temperature gradients inside the laser chip are necessary for optimal positioning and assembling of the different components and whole system into the package. For the thermal analysis, the main heat sources are the active and passive optical components with the respective loss powers as indicated in Figure 1. Total thermal power to be removed from the chip is 2.6W. Therefore, a thermoelectric module has to be used in combination with a high thermally conductive material such as brass block as a support material underneath.

2-)Optical and Electrical Requirements :

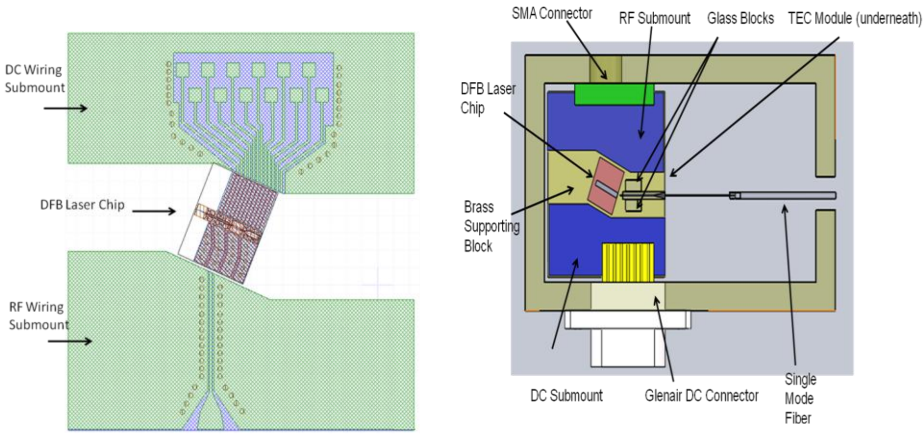
There is one optical access in the target housing design to satisfy an optical access on the left hand side of monolithic DFB laser source. Optimal fiber- coupling through accurate and stable optical alignment is important along with DC and RF-input contacts to feed the active optical components and modulating baseband data in optimal manner. Therefore, two precisely micro machined glass blocks are used to manage accurate optical alignment for the tilted optical input on the chip left-hand side. Due to 23° tilt of optical input for low optical reflection at the chip edge, new laminate based submounts have to be designed to accommodate this angle with appropriate wiring distribution. These submounts are shown in Figure 2.a.

3-) I/O count (DC and RF):

There are totally one RF (SMAs) and 12 DC input accesses resulting from the additional submounts designed in the final packaged monolithic laser module.

Furthermore 4 pins are required for the biasing and controlling TEC including NTC-Thermistor.

The customized housing and respective package is shown in Figure 2.b.



(a) (b)

Figure 2: (a) iDWSS laser chip with respective DC and RF wiring submounts
(b) Customized housing and laser chip package

4 Conclusion

In this paper, the customized optical package of dual wavelength DFB laser is explained with the important design parameters to be taken into account for reliable laser packaging. The optimum optical coupling, laminate based RF modulation and DC biasing submounts with optimum wiring circuitry, thermal management with metallic support material and TEC in a customized housing design are illustrated as an optical integration platform.

References:

[1] Harufi Yoneda, et al.," A Compact 2.5Gbps Wavelength-Tunable DWDM Transmitter with Direct-Modulated DFB", Electronic Components and Technology Conference, 2002