Lifetime Test Capabilities

Reliability as a Key Factor for Success

JePPIX
Platform for Photonic Integration

Burn-In, Life-Test and Reliability

Photonic Integrated Circuits (PICs), already deployed in sensing, telecommunication, signal processing, and biophotonics applications, enable product development where, e.g., compactness and low weight are crucial for commercial success. Depending on the field of application, the PIC has to fulfill multiple requirements. Photonic integrated circuits for consumer applications will be operated under different environmental conditions compared to PICs deployed in, e.g., data centers. Besides the demand for compactness, the reliability of the photonic components plays a key role in product quality and needs to be determined before embedding the PIC into the final product.

Various partners in this manufacturing pilot line offer burn-in, life-test, and reliability tests to evaluate the lifetime of photonic components.

Aging Photonic Components

Photonic InP foundries frequently track building block performances on specifically designed wafer validation cells. Those validation measurements comprise of, e.g., determination of optical loss, distributed feedback (DFB) laser power, semiconductor optical amplifier (SOA) gain, and detector responsivities. Nevertheless, standard wafer validation measurements only reflect the performance at the particular moment of the characterization and do not reveal time-dependent effects like aging.

To accelerate photonic component degradation, the device under test needs to be operated under special environmental conditions for a long period.

JePPIX´s partner Fraunhofer HHI uses a standardized aging routine for DFB lasers presented in Figure 1.

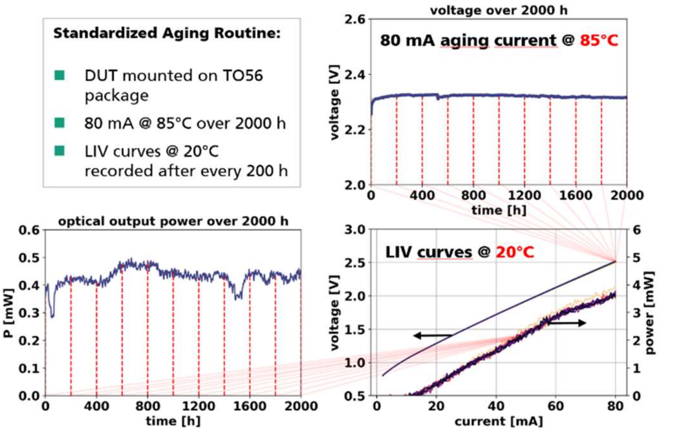

Figure 1: Standardized DFB aging routine demonstrated at HHI

The assembled laser is inserted into a Newport LRS9500 laser diode life-test and burn-in system.

During the presented standardized aging routine shown in Figure 1, the device under test is driven by 80 mA at 85°C for over 2000 hours. Every 200 hours, LIV curves at 20°C are recorded to allow frequent performance evaluation. During the aging procedure, the optical output power and voltage of the laser are continuously tracked.

In general, the aging procedure can be customized and adapted to individual needs.

Electrostatic Discharge Sensitivity Tests

PICs are electrostatic sensitive devices (ESDS). Like their electronic counterparts, PICs have to be handled with care to avoid ESD-related damages which often happen unnoticed. Investigating the impact of ESD in the prototype/product development phase helps to avoid rework and improves yield. For example, manual PIC handling can be emulated by the human body model (HBM). HHI uses the component level electrostatic discharge simulator NoiseKen EES-6002 with a HBM probe. ESD sensitivity results of a selection of standard building blocks are presented in Figure 2. During the test, the ESD bias voltage is continuously increased and the I-V characteristic is monitored. Qualitatively obvious changes towards linearity in reverse I-V characteristics indicate the dysfunctionality of the device. Here, grating and DFB building blocks resist pulses of above 500 V in the HBM configuration.

Similar to the aging procedure, ESD tests can be customized and adapted to individual needs.

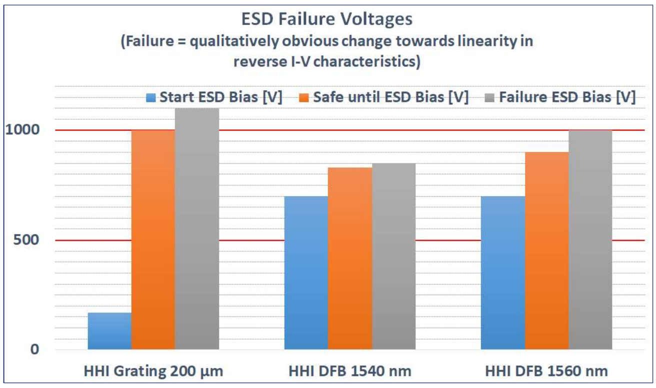

Figure 2: Electrostatic Discharge (ESD) measurement on photonic components from HHI platform based on human body model (HBM)

Environmental & Mechanical testing

JePPIX´s partner PhotonFirst offers packaging services to Jeppix pilot line customers. Besides electro-optical testing of packaged PICs, PhotonFirst also offers environmental testing and pull-shear-testing as an additional service.

Environmental performance evaluation of packaged PIC modules and systems, such as the one shown in Figure 4, can be validated by using the Espec ARS-220 climate chamber. The operational temperature

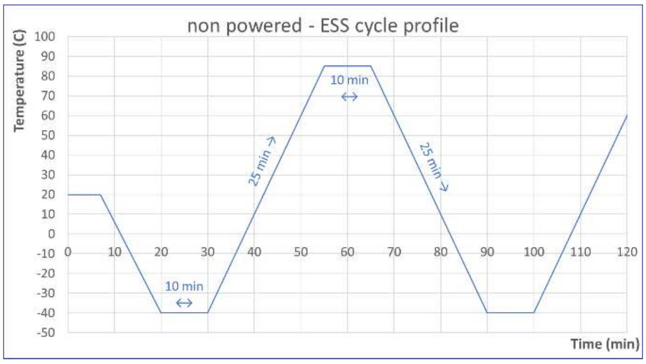

Figure 3: Environmental Stress Screening (ESS) cycle profile example

range of the climate chamber is -75°C up to +180°C, where a relative humidity between 10% and 98% can be realized simultaneously.

The climate chamber provides possibilities for powered and non-powered performance evaluation experiments. Figure 3 shows an example temperature profile for environmental stress screening, applied on packaged PICs.

The mechanical strength of wire-bonded electrical connections between the PIC and the surrounding electronics can be assessed with the Nordson Dage pull-shear tester. Environmental and mechanical testing parameters are customer and market-specific (Please consult PhotonFirst for details).

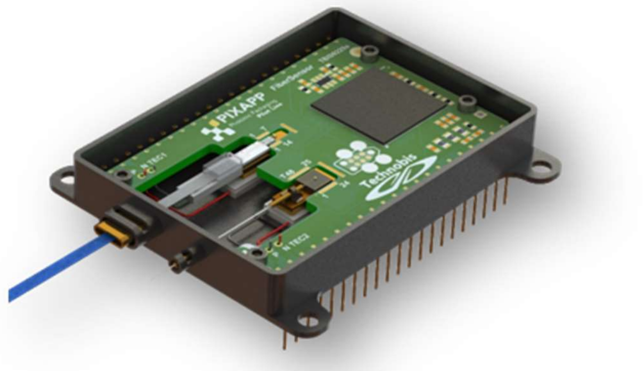

Figure 4: PhotonFirst System-in-a-Package module: integration of electronics and optics.