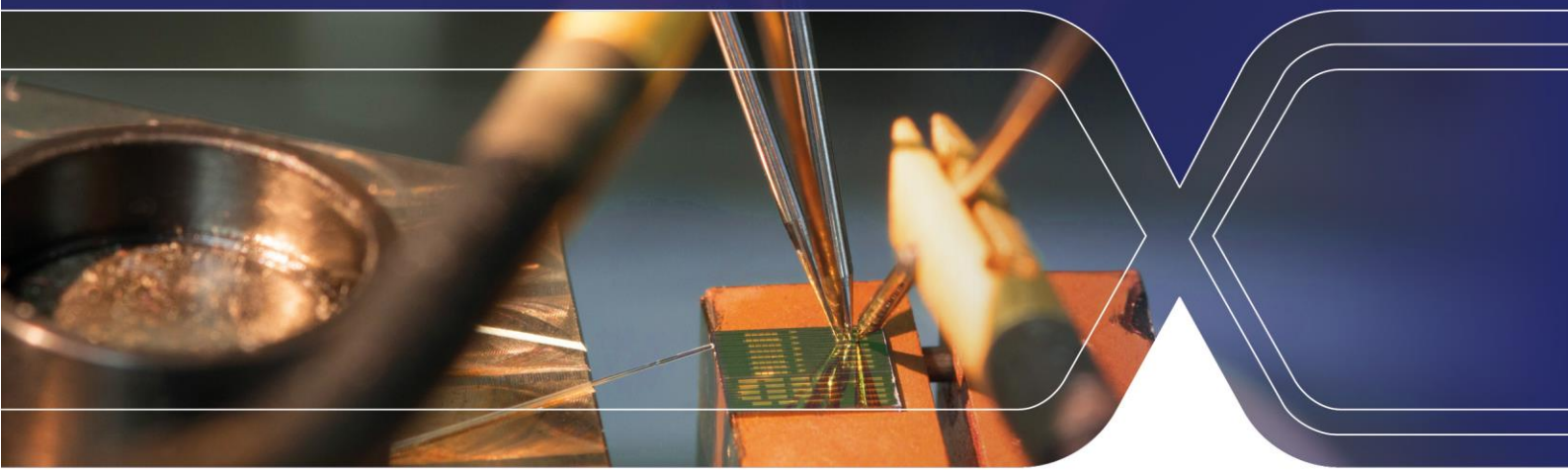
Technical Note

PIC Evaluation with PIConnect

JePPIX Platform for Photonic Integration



PIC Characterization

Indium phosphide (InP) PICs present appealing solutions for low-cost and small-size solutions for applications in optical communications and beyond. Open-access foundry services allow low-threshold entrance for product development in this state of the art technology. Foundries provide pre-defined building blocks of components at layout and circuit level through process design kits (PDKs), enabling the complete design flow for developing PICs.

Measuring PICs with 10s or 100s of actively controlled on-chip components quickly gets complicated.

After design and fabrication, experimental verification of PIC prototypes requires knowledge and experience, as well as the proper measurement equipment[1].

Conventional PIC Measurement Setup

PIC evaluation typically requires a measurement setup with a temperature-controlled chuck for mounting the bare PIC, e.g., by vacuum. For fiber coupling, translation stages with piezo motors of sub-micron step sizes are required for alignment of each fiber. Active control is required by means of current sources for, e.g., gain sections (SOAs) and voltage sources for electro-absorption modulators (EAMs) and photodiodes (PDs). For PICs that require electrical biasing, corresponding meters and high-frequency (RF) contacts for, e.g., data transmission experiments, the setup can quickly become complicated and costly. While testing can be contracted out to a qualified service partner, an affordable plug and play solution for in-house

InP Photonic Integrated Circuits (PICs)

Optical chips or PICs can contain tens to hundreds of optical components. While electronic ICs consist of transistors, capacitors and resistors, a PIC consists of, for example, lasers, modulators, photodetectors and filters, all integrated on a single substrate. Commercially, datacom and telecom uses these PICs nowadays extensively. PIC technology has now become accessible to users without a cleanroom, through so-called multi-project wafer runs and open access foundries. Indium phosphide based technology is commercially available through SMART Photonics and Fraunhofer Heinrich-Hertz-Institut. Access is coordinated by the JePPIX platform.

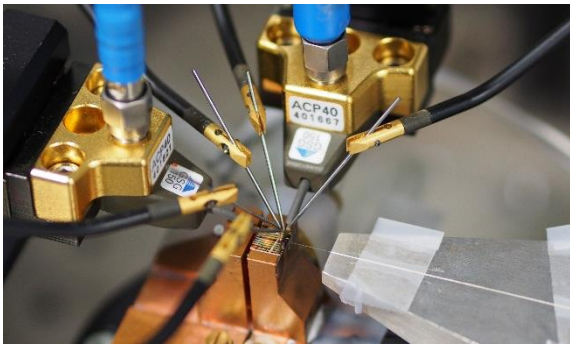


Figure 1: Probing of a PIC with RF and DC probes (image courtesy of Weiming Yao).

[1] *https://www.jeppix.eu/wp-content/uploads/2020/05/InP-PIC-handling-instructions.pdf*

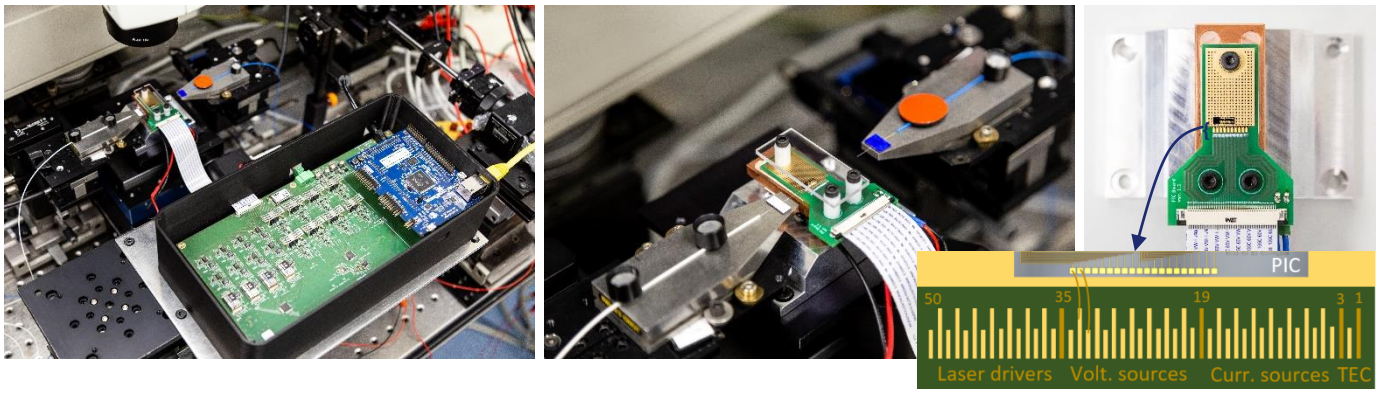


Figure 2: PIConnect mainboard with microcontroller board and PIC Board integrated in a measurement setup (left). PIC Board mounted and assembled (centre), with a close-up of the PIC Board on the top right and the pinout of the PIC Board bond pads on the bottom right.

characterization lowers the complexity of PIC testing, making PIC development and testing more accessible and flexible for the user.

PIConnect Evaluation Setup

Fraunhofer HHI[2] has developed a new PIC evaluation setup, named PIConnect[3], with integrated laser drivers, and current and voltage sources. The system enables parallel operation of the building blocks and, thus, convenient evaluation of PICs. A mainboard with 8 current sources, 8 voltage sources, 4 laser drivers and a temperature controller is combined with a microcontroller board and a temperature controllable PIC Board, as shown in the figure above. The board's components and their specifications are detailed in the table below. The PIC prototype can be mounted on and wire-bonded to the PIC Board, reducing handling and manual probing of the bare PIC by the user. Connecting the PIC Board to the mainboard with a flexible flat cable makes the mounted PIC easily interchangeable. Communication to a PC is possible through an Ethernet connection. A Python-based GUI allows setting and extraction of basic measurement parameters. The Python API allows full user control for customized automated measurements. Compared to dedicated measurement setups, requiring multiple sourcemeters, thermal controllers and probing mechanics, this solution provides an all-in-one solution at a fraction of the equipment cost.

Easy handling of fragile and sensitive PICs.

HHI will introduce PIConnect as an additional offer to their InP PIC technology platform. In connection with the JePPIX pilot line services, foundries and companies from the InP ecosystem are working together to reduce time to market for PIC based products. This includes standardized routines for PIC characterization. Together with PIC design rules put in place, this evaluation setup simplifies the handling and characterization of PICs by the user and lowers the financial investment at an exploration stage by reducing the complexity of dedicated measurement setups. For further information, please contact Axel Schoenau (axel.schoenau@hhi.fraunhofer.de).

Table 1: Components of the mainboard with specifications and pinout.

Controller/Sources	Amount	Pin	Specs	Resolution	Monitoring
TEC controller	1	extra	5-45°C, ±1.5 A		
NTC controller	1	1-2	10 kΩ thermistor	0.01 K	Temperature
Current source	8	3-18	Max. 200 mA @ max. 5 V	50 µA, 1.2 mV	Voltage
Voltage source	8	19-34	-10…+10 V @ max. ±20 mA	5 mV, 10 µA	Current
Laser driver	4	35-50	Max. 200 mA @ max. 3 V	50 µA, 0.7 mV	

[2] https://www.hhi.fraunhofer.de/en.html

[3] Schönau et al." Plug and Play PIC Characterization", PICmagazine, 2020/03, p.30.