

PLEC DE PRESCRIPCIONS TÈCNIQUES

SUPPLY OF A “THIN-FILM LITHIUM NIOBATE PHOTONIC INTEGRATED CHIPS FOR THE OPTOELECTRONICS GROUP” FOR ICFO, THROUGH AN OPEN PROCEDURE NOT SUBJECT TO HARMONIZED REGULATION

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1. Object of the contract

The ICFO Optoelectronics Group (OPTO) requires fabrication of two Photonic Integrated Chip (PIC) designs to be implemented in a thin-film Lithium Niobate (TFLN) platform. These PICs are required for several experiments in both classical and quantum photonic communication and signal processing.

Previous PICs used by OPTO have been fabricated in Silicon requiring programmable thermo-optic tuning elements to control their function. Such thermal tuning devices are relatively slow (~ 1 kHz bandwidth) compared to the bandwidth of optical communication signals (~ 100 MHz - 10 GHz). In addition, they are dissipative and power intensive (~ 3 mW per element) and the density of integration which can be achieved is limited by thermal crosstalk. In contrast, TFLN devices, which rely on the electro-optic effect, have been demonstrated with bandwidths comparable to those of optical communication signals (~ 100 GHz) with low power operation (~ 10 μ W) and can be integrated with a much higher component density due to the lack of thermal crosstalk.

OPTO has developed two designs to be implemented in z-cut TFLN, a photonic switch and an interferometric mesh. Fabricating and experimentally validating these designs is essential for our capacity to develop state of the art devices for photonic communication and signal processing. As ICFO does not have the highly specialized capabilities and facilities necessary to manufacture TFLN devices, a third party should be contracted to carry out these designs.

Once these chips are manufactured, they can serve as building blocks for a variety photonic communication and signal processing protocols. In addition, the performance of these protocols can be characterized in real-world demanding environments, and can be realized in a packaged form as a prototype or demonstrator.

2. System overview

The TFLN PICs will be used to form building blocks for photonic communication and signal processing systems at a nominal wavelength of 1550 nm. The detailed specifications for each of the two designs are as follows:

- General specifications
- Interferometric mesh specifications
- Optical switch PIC specific requirements
- Training
- Timing conditions
- Transportation
- Documentation
- Warranty and Support

3. General specifications

The optical switch (OS) and interferometric mesh (IM) must meet the following minimum specifications to be evaluated:

- The OS and IM PICs should achieve optical propagation losses less than 2 dB/cm.
- A nominal operating wavelength of 1550 nm is required for both the OS and IM PICs.
- The OS and IM should support modulation of the optical signal at a bandwidth of at least 100 MHz.

- Space on the PIC area not dedicated to the specific structures of the OS and IM should include test structures for the validation and characterization of individual photonic elements (e.g. waveguides, spiral modulators, ring resonators).
- The OS and IM must be fabricated in z-cut TFLN.
- The OS and IM must support the operation of optical modes with transverse-magnetic (TM) polarization.
- The optical inputs and outputs of the PICs must be edge-coupled.
- The edge coupling losses should be less than 3 dB.
- The platform should support a minimum waveguide bend radius of 100 μm to ensure losses near or below 0.1 dB.
- The Vpi voltage of the modulators should be less than or equal to 6 V.
- The proposals should offer the option of fabricating more than one design per run.
- The proposals should provide three or more copies of each design.
- The available design area of each PIC should be at least 14 mm x 6.5 mm.
- The PICs must be diced by the manufacturer before shipping.
- The PICs must be individually numbered.
- The manufacturer must supply documentation corresponding each chip number to its layout.

4. Interferometric mesh PIC specific requirements

The interferometric mesh (IM) PIC should specifically comply with the following requirements:

- The IM must offer programmable all-to-all connectivity between 6 input ports and 6 output ports.
- The connectivity of the IM must be provided by programmable Mach-Zehnder interferometers (MZIs) and linear phase shifters.
- Each MZI within the IM must consist of two multimode interference (MMI) 2x2 beam splitters enclosing two arms, each of which is implemented as a spiral waveguide with z-cut electro-optic modulator electrodes integrated on top.
- Each spiral waveguide must have a minimum length of 5 mm and their corresponding top electrodes should cover the entire spiral area.

5. Optical switch PIC specific requirements

The receiving platform (RxP) should specifically comply with the following requirements:

- The OS must offer fully programmable routing between 8 input ports and 8 output ports.
- The connectivity of the OS must be provided by programmable Mach-Zehnder interferometers (MZIs) and linear phase shifters.
- Each MZI within the IM must consist of two multimode interference (MMI) 2x2 beam splitters enclosing two arms, each of which is implemented as a spiral waveguide with z-cut electro-optic modulator electrodes integrated on top.
- Each spiral waveguide must have a minimum length of 5 mm and their corresponding top electrodes should cover the entire spiral area.
- The OS should include at least 4 layers of MZIs

6. Training

Manuals which cover any non-standard system use, specific maintenance or service training must be provided to ICFO research users.

7. Timing Conditions

After the signature of the contract (T0) these are the required activities that should be complied by T0+2 months:

- Delivery of the PICs.
- Delivery of training materials.

8. Transportation

The proposal will include transportation to ICFO's facilities and all export/import and customs duties

9. Documentations

- Complete set of manuals, drawings, schematics and layouts about system assembly and configuration.
- Complete systems user manual, including routine servicing, troubleshooting and basic repairs.
- All the above documentation will be supplied in English, in electronic format (USB drive) and in paper copy.

10. Warranty and Support

Minimum 1-year Full Warranty on all parts and components irrespective of the manufacturer. The warranty will include the replacement of any faulty or damaged part(s) during normal use of the part(s) or component(s). It will cover any cost related with the disassembly, transportation, reparation and re-assembly of the damaged parts or component(s), including all shipping costs.

System lifetime support: By phone and e-mail with a response within 48 hours.

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