

# Single-to-differential-Converter for OptoElectronics

Degree programme : BSc in Micro- and Medical Technology  
Specialisation : Embedded Systems  
Thesis advisor : Michel Wenzel Moser  
Expert : Felix Sarbach  
Industrial partner : Lumiphase AG, Stäfa

Device-integrated electro-optic modulators require differential signals to operate optimally. This thesis project aims to design, implement and test a unipolar to differential signal converter to drive modulators developed by Lumiphase AG.

## Introduction

Lumiphase has developed technology to control the phase shifting of light on a chip, that is the way light travels inside tiny optical circuits. There are two types of devices on the chip: High-Speed Phase Shifters (HSPS), which exploit the properties of Barium Titanate to achieve fast and efficient control, and Thermal Phase Shifters (TPS), which are slower but suitable for stable adjustments over time.

## Goal

The objective of the project is to design, implement and test a unipolar to differential signal converter for driving electro-optical modulators. The system should ensure reliability, accuracy, compatibility with Lumiphase optical components, and be ready for use in industrial testing.

## Methods

The concept was developed by analyzing different circuit types. Once the most suitable approach was chosen, two variants were designed to ensure signal symmetry, low noise and compatibility with modulators. The system was then prototyped, tested and

optimized. Image 1 shows the PCB layout of the single to differential board for the TPS variant. To ensure the integrity of the differential signals, it is essential that the lengths of the traces of the two output lines are perfectly equal. This ensures correct signal propagation and reduces any distortion or interference.

## Results

The prototypes created had good performance in a controlled environment and integrate a differential operational amplifier to convert a unipolar signal to a differential one. The two outputs are connected to shunt resistors, on which the average voltage is measured. A microcontroller calculates the current and sends the data to a computer, where it can be displayed via Python script.

In the TPS variant, a DC phase-shifting network is included to match the signal to the specifications of the component.

Image 2 shows the differential signals of the HSPS displayed on the oscilloscope: the input signal CH3 (purple), the two outputs CH1 (blue) and CH2 (yellow) and the differential signal „CH1 - CH2“ (red).

## Outlook

Next steps include optimizing the circuit, finalizing the project and providing Lumiphase with the necessary materials to manufacture the components, so they can use them for their own testing.



Yanick Mansour Sartori  
078 755 80 60  
sartoriyanick1@gmail.com

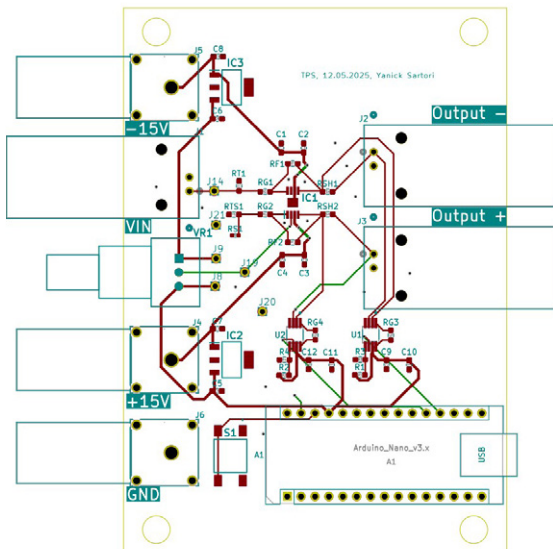


Image 1 : PCB layout of the first prototype of the single to differential board for the TPS variant

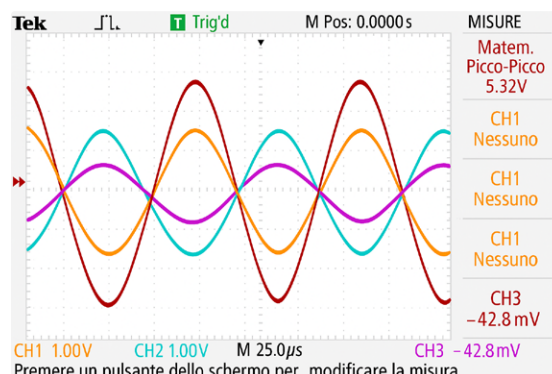


Image 2 : Differential signal of HSPS variant at 10 kHz frequency