Integrated Microwave Photonic Signal Generation System based on the External Modulation Technique

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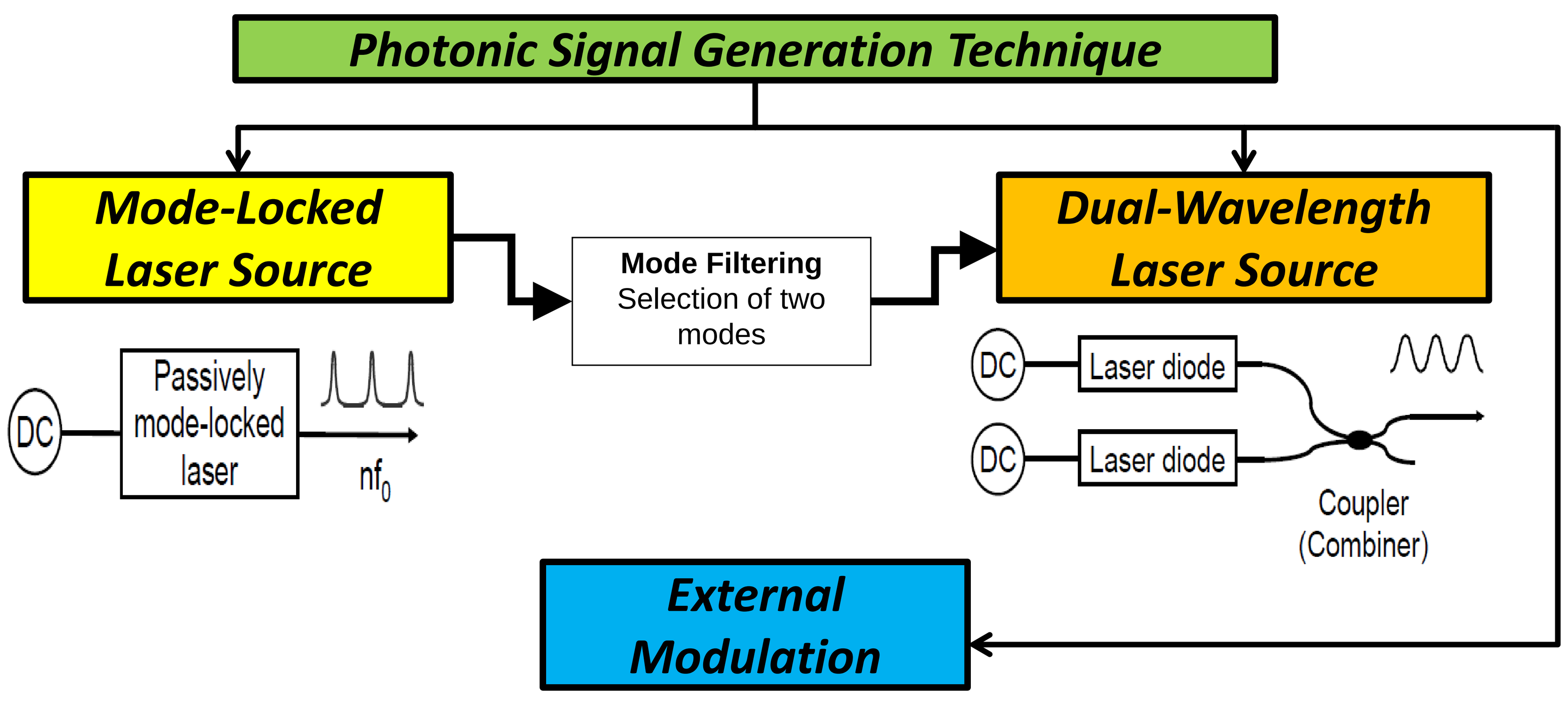
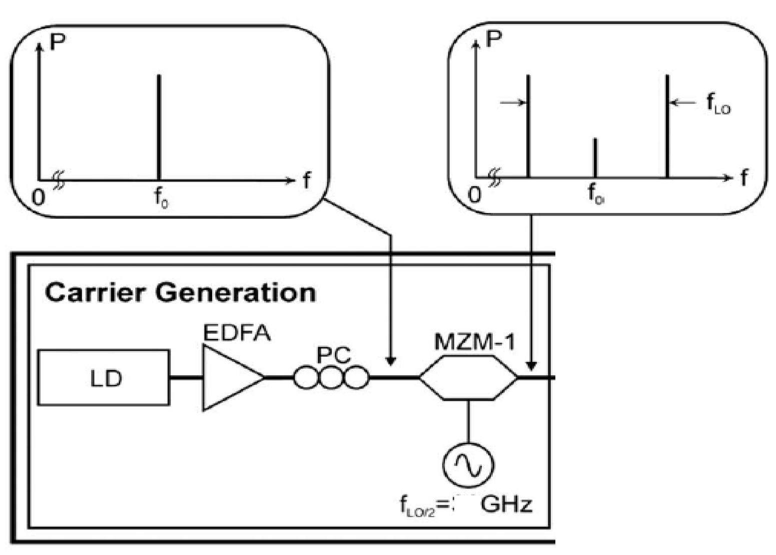
Introduction

Microwave Photonics (MWP) has evolved from the combination of photonics and radiofrequency engineering, to exploit the best of both in the generation, transmission and signal processing of high frequency signals, starting at the **microwave range (3 GHz to 30 GHz)**, which has evolved to include the **millimeter (30 GHz to 300 GHz)** and above

Some of the Photonic Technique for microwave signal generation are





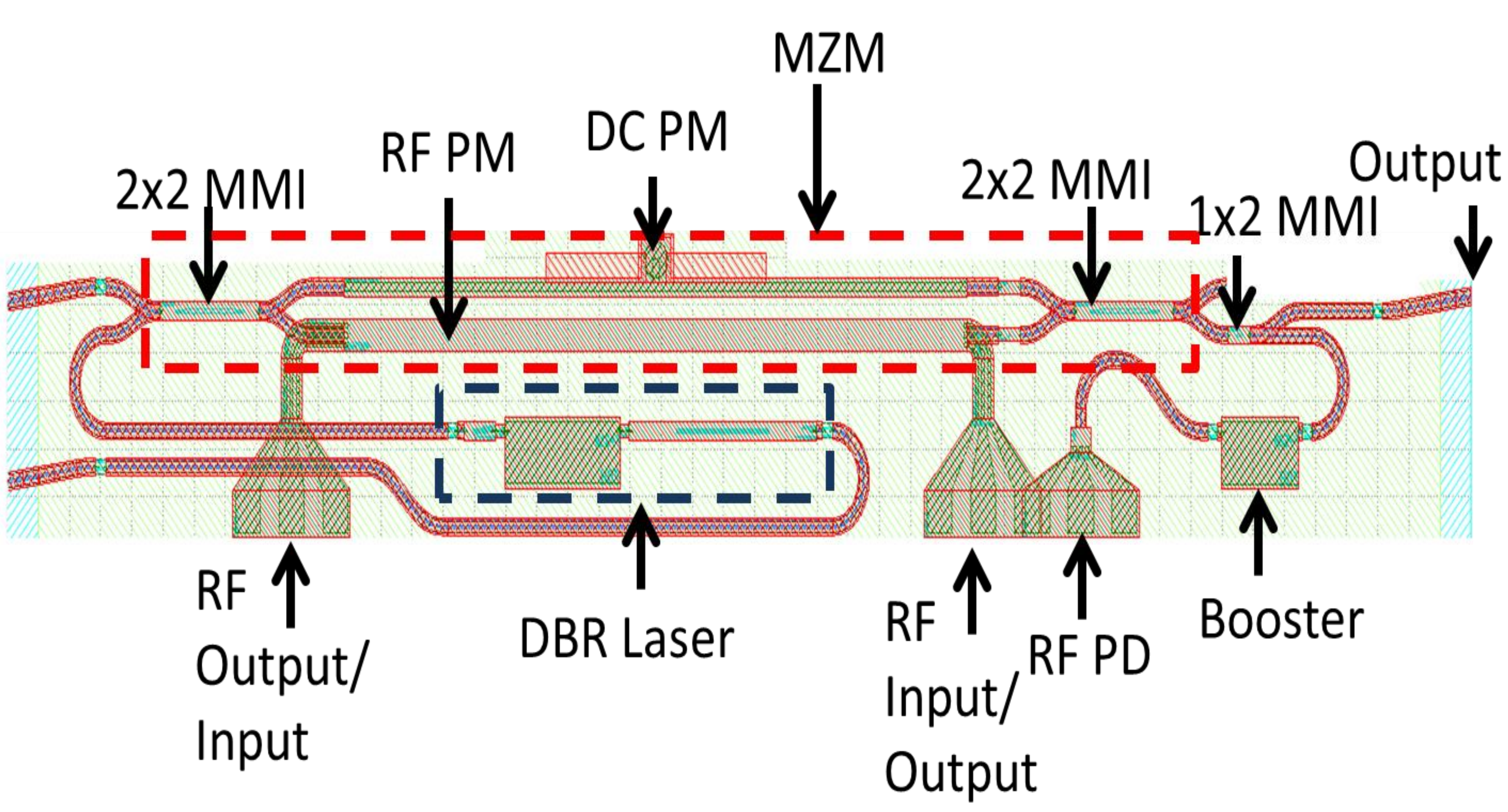
We present a **Photonic Technique** for the **Microwave Wave Signal (MMW)** generation based on external modulation using **Photonic Integrated Circuits (PIC)**, addressing size, cost, reliability and performance issues

The Photonic Integrated Circuit

The **PIC is designed using a generic approach for InP-based PICs** and fabricated within a multi-project wafer (MPW) run by SMART Photonics, where standardized building blocks are provided for the selection of the optical components which form photonic transmitter source structure.

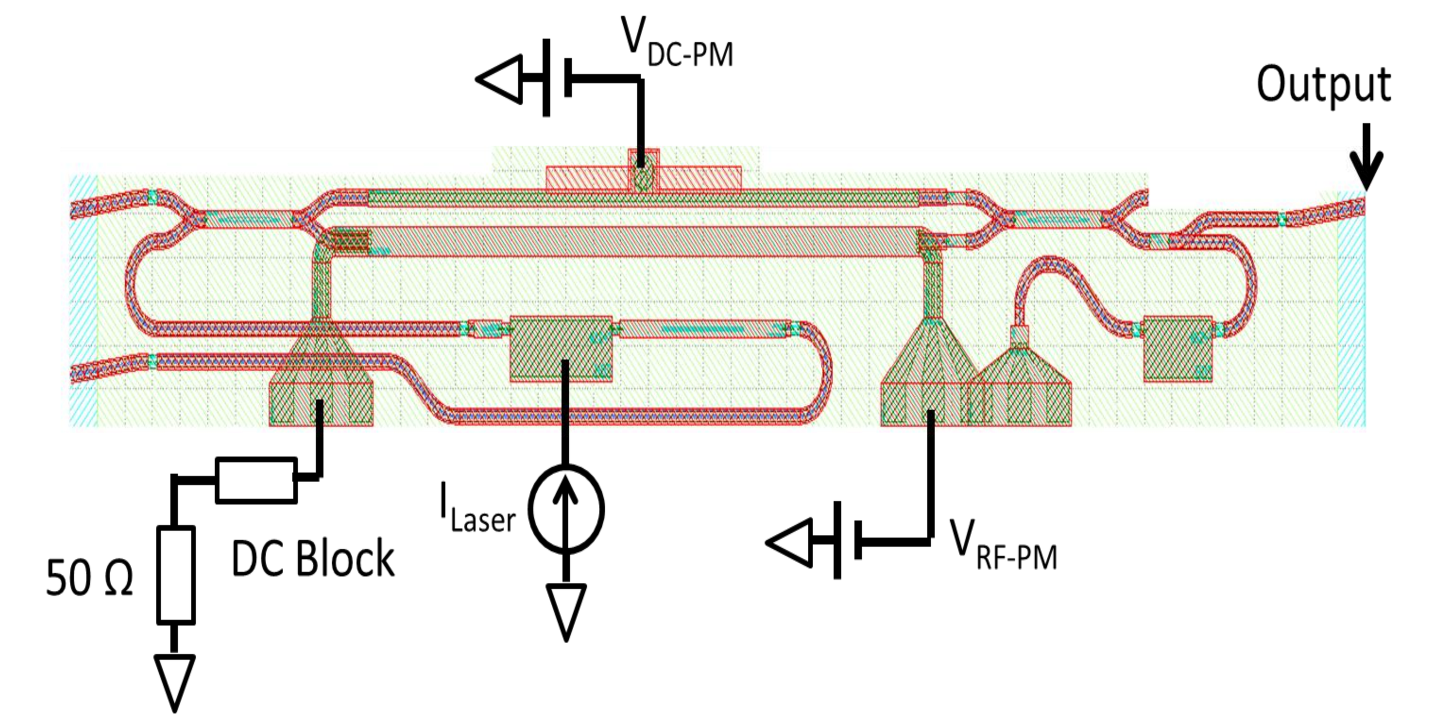
The PIC is composed of **DBR laser**, **Mach-Zehnder interferometer (MZM), boost amplifier, multimode interference (MMI) couplers, RF photodiode (PD)**, RF access tracks and straight/bent passive waveguides. The DBR laser structure is formed by a gain section and two mirrors located at the front and rear part of laser,

The **MZM interferometer structure has two arms** in which one of the arms has a DC phase modulator (PM) whilst the other arm has an RF PM. The RF PM arm allows us to inject an RF signal for the modulation of the optical signal supplied by the DBR laser. As for the DC PM is used for the setting of the MZM's biasing point, performing one of the four working points of the MZM's transfer function – **Null point, Maximum point, and +Q/-Q point.**

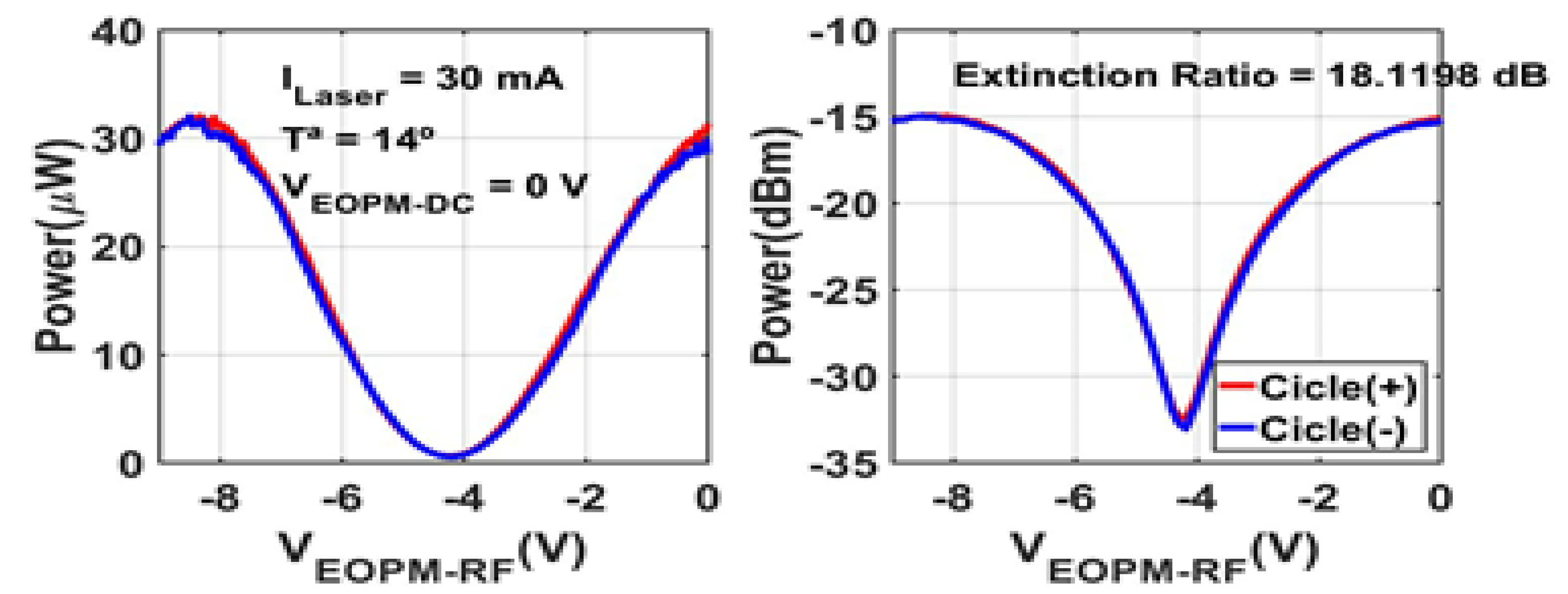


Experimental Results

Characterization of the MZM, transfer function.

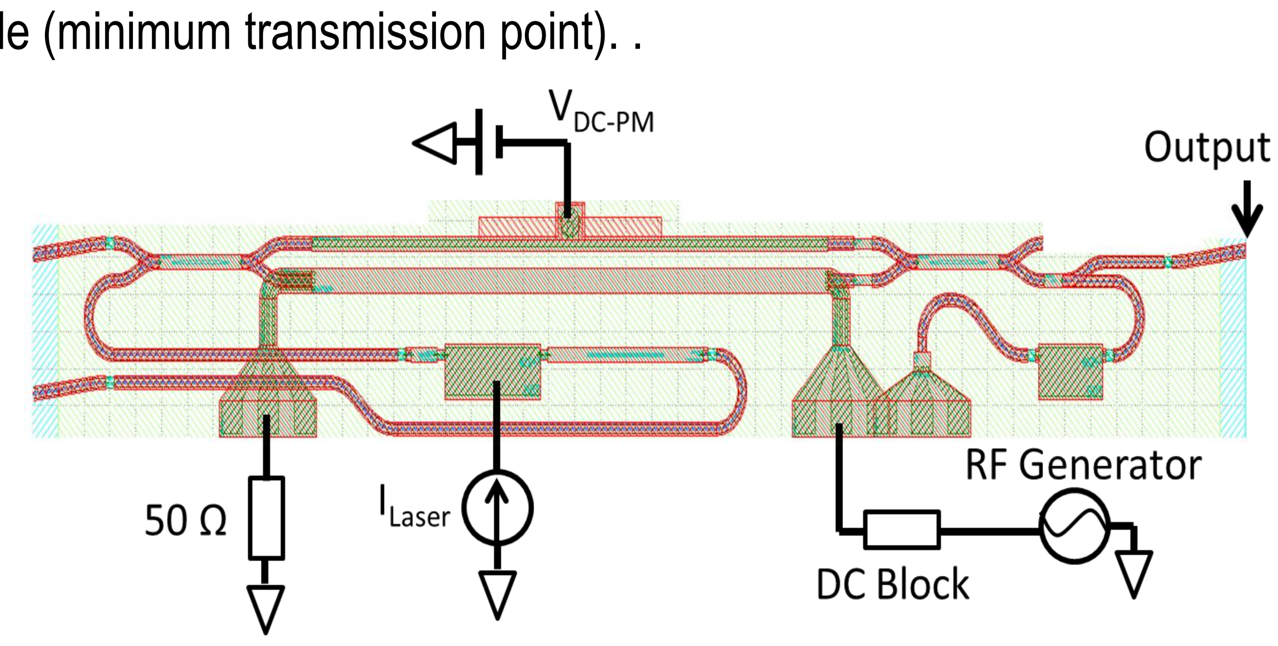


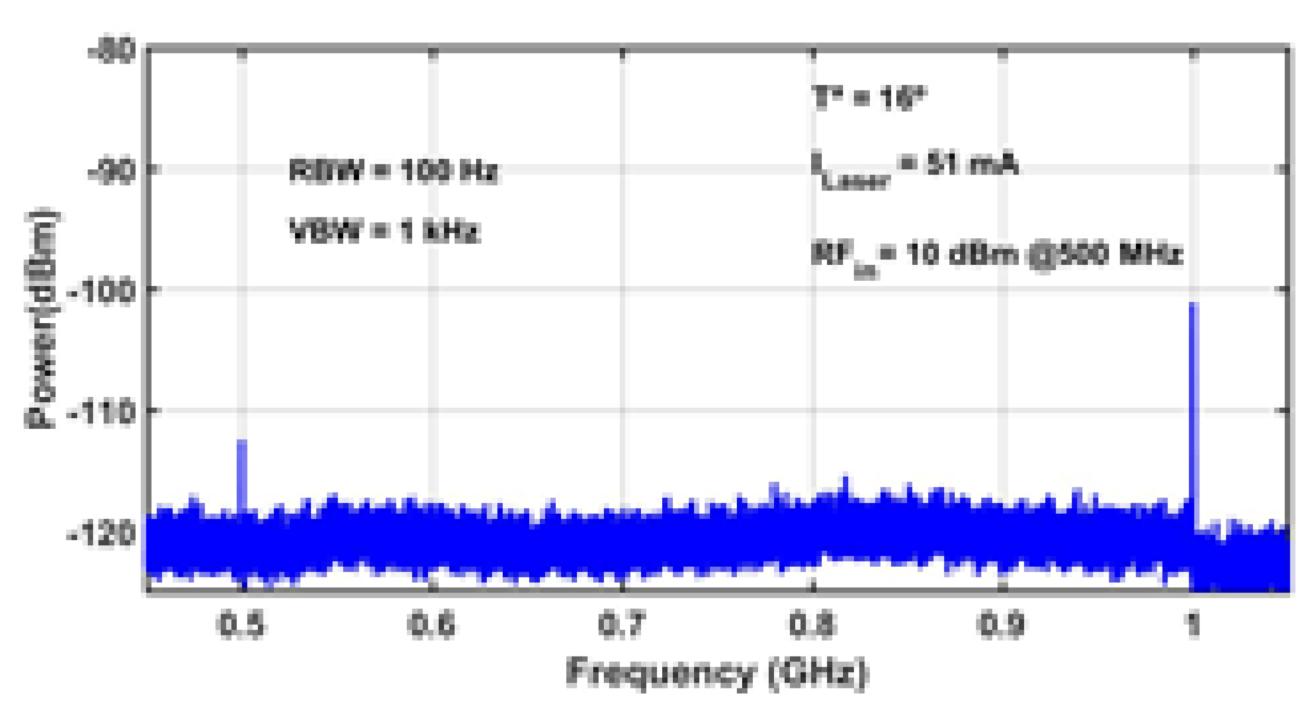
MZM's Transfer function response sweeping V_{RF-PM} from 0 to -9 Vand fixing V_{DC-PM} to 0 V.



Microwave Signal Generation

The RF input of the RF-PM is connected to a DC block and followed by an external RF signal generator. An SMD 50 Ω resistor for matching of the RF signal is connected to the other end of the RF-PM. In order to achieve the second harmonic generation of the external RF signal injected into the RF-PM input, the DC_PM must be biased at null point mode (minimum transmission point). .





Electrical Response biasing the DC-PM at the Null Point

Conclusions

We show for the first time a photonic integrated circuit for signal generation, based on the external modulation technique, including a semiconductor laser, optical modulator and photodiode on a single chip. We demonstrate that optical carrier suppress double sideband modulation allows us to multiply the RF signal injected into the device, doubling the output frequency. Due to low frequency probe accesses, this demonstration is limited to 500 MHz RF input. The 1 GHz signal on the photodiode inherits the quality of the signal from this reference oscillator and the power level can be furtherly improve with propertly RF probes.

Acknowledgements

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