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The Director

of the United States Patent and Trademark Office has received an application for a patent for a new and useful invention. The title and description of the invention are enclosed. The requirements of law have been complied with, and it has been determined that a patent on the invention shall be granted under the law.

Therefore, this United States

Patent

grants to the person(s) having title to this patent the right to exclude others from making, using, offering for sale, or selling the invention throughout the United States of America or importing the invention into the United States of America, and if the invention is a process, of the right to exclude others from using, offering for sale or selling throughout the United States of America, products made by that process, for the term set forth in 35 U.S.C. 154(a)(2) or (c)(1), subject to the payment of maintenance fees as provided by 35 U.S.C. 41(b). See the Maintenance Fee Notice on the inside of the cover.

Katherine Kelly Vidal

DIRECTOR OF THE UNITED STATES PATENT AND TRADEMARK OFFICE



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(12) **United States Patent**
Aguiar Dantas de Britto et al.

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(54) **UP/DOWN PHOTONIC FREQUENCY CONVERTER FOR INCOMING RADIO FREQUENCY (RF) SIGNALS BUILT INTO THE OPTOELECTRONIC OSCILLATOR (OEO)**

(58) **Field of Classification Search**
CPC G02F 2/002; H04B 10/90; H04B 10/2575; H04B 2210/006; H04B 10/25759
(Continued)

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 257 days.

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H04B 10/2575 (2013.01)

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(57) **ABSTRACT**

A compact photonic converter for radio frequency (RF) signals comprising fewer components than in the prior art. The fields of the invention are electronics, oscillating circuits, radio frequency circuits and optoelectronics. The converter comprises an optoelectronic oscillator (OEO), which is the local oscillator (LO) for the frequency conversion operation, and an RF signal injection circuit. The OEO uses a single Mach-Zehnder (MZ) electro-optic modulator and a single photodetector to enable simultaneous up/down frequency conversion of the radio frequency signal from the

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