Topic: N141-013

Freedom Photonics LLC

Ruggedized Wideband High-Power Balanced Photodiode Receiver

Modern military avionic systems employ a vast network of sophisticated sensors and communication equipment, requiring digital and analog links with high-bandwidth, high link margin, and low-susceptibility to electromagnetic interference (EMI). Fiber-optic communications have been proven as the superior means of transmission. High link gain, noise figure (NF), and spurious-free dynamic range (SFDR) can be achieved with higher optical powers – thus, there is a need for high performance photodetector receivers. For practical realization of avionic sensor and communication micro-networks using high-speed high-performance photonic links, there is a need for military-grade, ruggedized components with low size, weight, and power (SWaP). One of the key missing components for analog avionic photonic links is a ruggedized, wideband, high-power, balanced photodiode receiver with high linearity.

Technology Category Alignment:

None
None
None

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SYSCOM: NAVAIR
Contract: N68335-15-C-0308

Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-15-C-0308

Department of the Navy SBIR/STTR Transition Program

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NAVAIR JSF16-1028

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Freedom Photonics, LLC

WHO

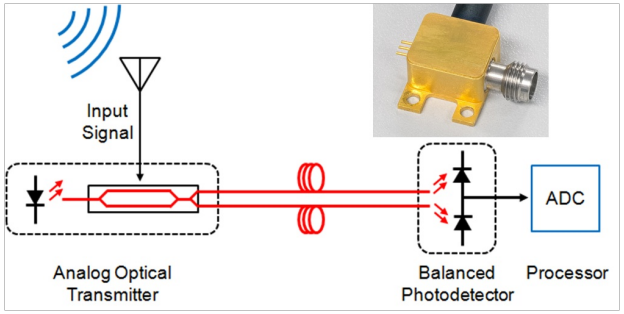
SYSCOM: NAVAIR

Sponsoring Program: JSF-MS

Transition Target: Aircraft and ship RF photonic Systems

TPOC:
(301)342-9116

Other transition opportunities: All DOD Branches:
Microwave photonic links for radars
Antenna remoting and sensing,
Electronic warfare (airplanes, helicopters, ships, submarines)
Commercial Markets:
Telecommunications (5G standard)
Fiber-wireless Infrastructure
Sensing markets



WHAT

Operational Need and Improvement: Avionic RF coaxial cable systems are bulky, heavy, have high RF loss over longer path lengths, and require heavy shielding for electro-magnetic interference (EMI). Optical fibers provide a nearly loss-less transmission medium for RF signals, are very lightweight, EMI immune with no shielding requirement. Replacing coaxial cables by RF photonic links promises drastic weight reduction and low-loss ultra-broadband RF signal transport. High power, wideband balanced photodiode receivers are a key component required for the realization of these links.

Specifications Required: Balanced photodiodes operating at 1.3 micron and 1.55 micron, 20 GHz bandwidth per pair at 100 mA (50mA per photodiode) and 40 GHz bandwidth at 50mA (25mA per photodiode). Target OIP3 is 40dB at 20GHz at 50mA per photodiode, with minimum of 30dB. The minimum required rejection for both common-mode noise and even-order distortion is 20 dB. Linearity specifications met across 20GHz bandwidth. Required output power at 1-dB compression for packaged balanced photodetector receiver is 14 dBm. The efficiency target of 0.7 A/W effective DC responsivity referenced to the fiber inputs. Hermetic package with standard RF connector, volume of approximately 2.5 cubic centimeters. Temperature range of -40 to 100˚C resistance to vibration, thermal shock, mechanical shock, and temperature cycling environments.

Technology Developed: Freedom Photonics is using InP based vertically illuminated receiver architecture, successfully demonstrated in Phase I, and a ruggedized, hermetic package design. This is a wafer-scale, low production cost, low size, weight and power solution.

Warfighter Value: Coaxial cable replacement by lightweight optical fiber RF photonic links, weight reduction, EMI immunity, broadband transmission of electronic signals for data acquisition, sensing and surveillance, very efficient links, ability to carry more payload and process more information.

WHEN

Contract Number: N68335-15-C-0308 **Ending on:** January 2, 2017

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Advanced device demonstration	Low	Key specs met on chip	4	February 2016
Preliminary rugged package demonstration	Med	Key specs met by package	4	December 2016
Passing preliminary qualification	Med	Package maintain spec post qualification	5	September 2017

HOW

Projected Business Model: Freedom Photonics will search in Year 2 of this SBIR Phase II program for government and private investment to bring these products to market in Phase III.

Company Objectives: Freedom Photonics will design and manufacture balanced photodiodes and receivers for specific and demanding requirements in terms of size, weight, performance, reliability, ruggedness, and cost. These photodiodes will provide many advantages in terms of performance over existing photodiode technologies. During this technology development phase, we will maintain close relationships with the NAVAIR customer and potential prime DoD system integration companies. We will establish a transition plan to reach the highest technical and manufacturing readiness levels required to incorporate these receivers into deliverable systems.

Potential Commercial Applications: Commercial RF photonic systems and links (5G wireless phone, television, etc), sensing and surveillance systems; fiber-optic telecommunications and data communications networks; and high speed communications within a vehicle, such as airplanes, ships, or trains.

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