

# Department of the Navy SBIR/STTR Transition Program

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NAVAIR 2020-721

Topic # N182-101

Multicore Fiber Optic Package Optical Subassembly for Wideband Digital and Analog Photonic Links

Freedom Photonics LLC

## WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** PMA-234  
Airborne Electronic Attack Systems

**Transition Target:** TBD

**TPOC:**  
(301)342-4122

**Other transition opportunities:** The ultimate goal is to integrate and transition this component technology into government and prime contractor analog photonic link systems, especially for avionic environments.

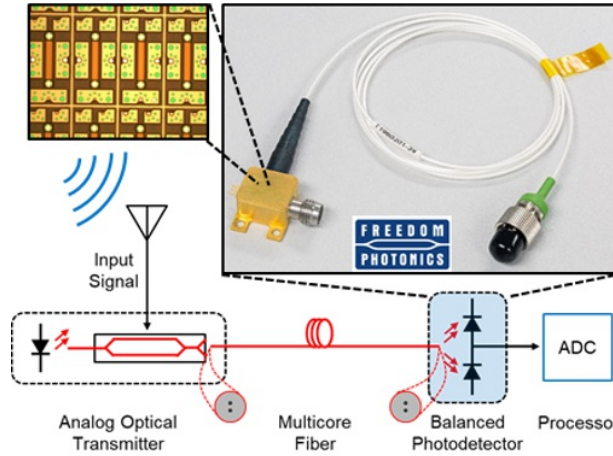


Image Courtesy of Freedom Photonics, LLC

## WHAT

**Operational Need and Improvement:** Modern military avionic systems employ a vast network of sophisticated sensors and communication equipment, requiring high-bandwidth digital and analog links. Fiber-optic communications have been proven to be the superior means to transmit digital information, compared to electronic transmission via lossy coaxial cable, where wideband operation and low-susceptibility to electromagnetic interference (EMI) is critical. Dynamic range and linearity requirements for advanced radar and electronic warfare (EW) systems, such as the Next Generation Jammer (NGJ), necessitates the use of a balanced receiver in an analog photonic link. At present, third-order distortion limits the spurious-free dynamic range (SFDR), requiring the use of balanced photodetector receivers to further increase dynamic range.

**Specifications Required:** The multicore fiber used in these modules will have two single-mode cores separated by a distance that enables low, 0.75 dB, optical insertion loss, low, 30 dB optical return loss, and low, -40 dB optical crosstalk. The balanced photodiode module is being developed to meet meet a 40 GHz bandwidth, 0.7 A/W responsivity, and 20 dB common-mode rejection ratio.

**Technology Developed:** Freedom Photonics is developing a balanced photodiode receiver, which is a low noise, high linearity component used in analog photonic links, with a multicore fiber input. This balanced receiver can greatly benefit from the phase stability and channel scalability provided by multicore fiber and is a focus of this effort. This work leverages many of our Government and commercial programs and technologies, including our current work on 40 GHz balanced receivers and 100 GHz, high-power photodetectors, both performed for the Navy where we have developed low-profile (5 mm) packaging technology for harsh environments.

**Warfighter Value:** These balanced detectors are used in RF photonic links, which support a lower cost, size, weight, and power than a standard RF link. It is anticipated that this technology will be integrated into optical data links onboard avionics, sensor, and electronic warfare platforms. The dual-core balanced photodiode offers a low-noise, high linearity subcomponent for these RF photonic links. To our knowledge, these detector modules are the only balanced photodiode components with a multicore fiber input, which adds phase stability and channel scalability, reducing link noise and improving spurious-free dynamic range.

## WHEN

**Contract Number:** N68335-20-C-0294 **Ending on:** February 10, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Detector Design Completed	Med	Simulations of detector structure suggests that devices will meet the specifications defined with the TPOC	3	August 2020
Balanced Device Testing	Med	Fabricated balanced devices are validated to meet key metrics at wafer level.	4	December 2020
Balanced Module Testing	Med	Packaged devices are characterized and validated to meet parameter specifications in module.	4	June 2021

## HOW

**Projected Business Model:** The business model for the multicore fiber photodiode module technology is to create a product line of detector modules which can be sold directly to the Department of Defense or DoD primes.

**Company Objectives:** We anticipate that the Navy SBIR/STTR Transition Program (STP) Forum will facilitate the development of a Technology Transition plan to define a clear path to the integration of this technology into analog photonic links onboard avionics, sensor, and electronic warfare platforms.

**Potential Commercial Applications:** This technology would be applicable to other analog photonic links, which are low-loss, lightweight alternatives to coaxial cable links. Analog photonic link applications include CATV distribution networks, radio over fiber for wireless systems, antenna remoting, and radio astronomy applications.

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