

Topic: N13A-T005

## Freedom Photonics LLC

Ultra-Wideband, Low-Power Compound Semiconductor Electro-optic Modulator

Freedom Photonics is developing a low drive voltage, low SWAP semiconductor optical modulator needed for deployment of low-loss, low-weight, electro-magnetic interference (EMI) immune, high-capacity optical fibers to replace heavy, bulky and "lossy" coaxial cables currently used in aircraft. Freedom Photonics is a domestic communications and sensing photonics devices manufacturer. This technology is broadly applicable to aircraft, ships, and submarines as well as commercial applications. This product offers unique performance, wafer-scale low-cost production, yielding reliable, small size and weight devices and modules with extreme operational stability and low power consumption. Program risk has been reduced by early working prototype demonstrations. We are looking to partner with primes for modulator insertion into communication links under development as well as legacy systems based on coaxial cable interconnect.

### Technology Category Alignment:

EO/IR Components for sensing, transmission and communication

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**SYSCOM:** NAVAIR

**Contract:** N68335-15-C-0070

 Corporate Brochure: [https://navystp.com/vtm/open\\_file?type=brochure&id=N68335-15-C-0070](https://navystp.com/vtm/open_file?type=brochure&id=N68335-15-C-0070)

# Department of the Navy SBIR/STTR Transition Program

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Freedom Photonics LLC

## WHO

**SYSCOM:** NAVAIR

**Sponsoring Program:** PMA-290

**Transition Target:** Aircraft and Ship RF Systems

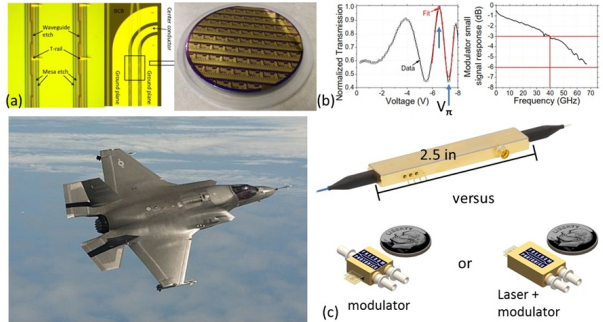
**TPOC:**

(301)342-9115

**Other transition opportunities:** All DOD Branches: Microwave photonic links for radars, antenna remoting and sensing, electronic warfare (airplanes, helicopters, ships, submarines)

**Commercial Markets:**

Telecommunications, fiber-wireless infrastructure, sensing markets



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## WHAT

**Operational Need and Improvement:** Current 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). In contrast, optical fiber provide a nearly loss-less transmission medium for RF signals, is very lightweight, and is EMI immune with no shielding requirement. The replacement of coaxial cable by RF photonic links promises drastic weight reduction and the potential for low-loss ultra-broadband RF signal transport. A high power, low drive voltage optical modulator is a key component required for the realization of these links.

**Specifications Required:** Compound semiconductor electro-optic modulator with low drive voltage (<1 V), high optical power loading (up to 100 mW), broad frequency/bandwidth (>40 GHz, approaching 100 GHz), characteristic impedance (~ 50 ohms), and low optical loss (< 5 dB)

**Technology Developed:** Freedom Photonics is developing a low drive voltage modulator in a semiconductor platform, able to handle large optical input power and meeting Navy performance targets for high performance RF photonic links. The modulator is developed on a Gallium Arsenide semiconductor fabrication platform.

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, faster transmission of electronic signals for data acquisition, sensing and surveillance, very efficient electro-optic modulation.

## WHEN

**Contract Number:** N68335-15-C-0070 **Ending on:** February 15, 2016

Milestone	Risk Level	Measure of Success	Ending TRL	Date
EO Modulator demonstration	Med	Modulator specs met	3	December 2015
Preliminary ruggedized package demonstration (per Phase II Option)	Med	Device functionality demonstrated	3	December 2016
Packaged EO modulator tested by lead customer (per Phase II Option)	Med	Operational specs met in relevant environment	5	March 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 electro-optic modulators for specific and demanding requirements in terms of size, weight, performance, reliability, ruggedness, and cost. These modulators will provide many advantages over competing modulator technologies, such as polymer or LiNbO3 platforms. 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 EO modulators into deliverable systems.

**Potential Commercial Applications:** 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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