Low-Loss Ferrite Components for NASA Missions
Micro Harmonics Corporation
PI: David Porterfield, Proposal#: S1.02-9516

OBJECTIVES

The goal was to develop high-frequency Faraday rotation isolators that exhibit significantly reduced loss, higher power handling and improved bandwidth over commercially available products. Insertion loss was minimized by saturating the magnetic bias and reducing the length of the lossy ferrite to the minimum possible. CVD diamond discs were used to improve the thermal path from the resistive layers in the cones to the block and increase the amount of reverse power that can be safely absorbed. Another goal was to develop mm-wave circulators in WR-15, WR10 and WR-8 with significantly improved bandwidth over the current state-of-the-art. We also wanted to demonstrate the accuracy of our simulation models.

ACCOMPLISHMENTS

NOTABLE DELIVERABLES PROVIDED
WR-15 Y-Junction Circulator (Qty = 1)
WR-10 Y-Junction Circulator (Qty = 1)
WR-8 Y-Junction Circulator (Qty = 1)
WR-12 Faraday Rotation Isolator (Qty =1)
WR-10 Faraday Rotation Isolator (Qty =1)
WR-8 Faraday Rotation Isolator (Qty =1)
WR-6.5 Faraday Rotation Isolator (Qty =1)
WR-5.1 Faraday Rotation Isolator (Qty =1)
WR-4.3 Faraday Rotation Isolator (Qty =1)
WR-3.4 Faraday Rotation Isolator (Qty =1)

KEY MILESTONES MET
A full line of Faraday rotation isolators was developed with state-of-the-art performance in every standard waveguide band from WR-15 (50-75 GHz) through WR-3.4 (220-325 GHz). The insertion loss is the lowest in the industry. The isolators incorporate a unique CVD diamond substrate for improved power handling. Circulators were developed with 20 dB bandwidths of 7 GHz in WR-15, 6 GHz in WR-10 and 5 GHz in WR-8, a 300% increase in bandwidth over the previously existing state-of-the-art.

FUTURE PLANNED DEVELOPMENTS

PLANNED POST-PHASE II PARTNERS
Virginia Diodes, Inc. (VDI) is a leader in the field of mm-wave, sub-mm-wave and terahertz technology. They develop and manufacture frequency extension modules for Keysight’s vector network analyzers, extending the range to beyond 1 THz. We are currently in negotiations with VDI to become a volume supplier of isolators for their mm-wave VNA extenders.

PLANNED/POSSIBLE MISSION INFUSION
Isolators and circulators have application in a broad range of systems for NASA’s Submillimeter Missions (e.g., Marvel, VESPER, MACO, SIRICE, SOPHIA, STO-2). There is potential application in the high-resolution heterodyne array receivers at 1.9 THz being developed for SOFIA and the STO-2 as well as the 4.7 THz multiplied local oscillator source for the observation of neutral oxygen.

PLANNED/POSSIBLE COMMERCIALIZATION
All of the developed components are being actively marketed. They are broadly used in scientific instruments for plasma diagnostics, chemical spectroscopy, biomaterial analysis, and radio astronomy. Military applications include radar, imaging, covert communications, and chemical and bio-agent detection. There are applications in biomedical systems, portal security, high frequency data links, etc.

CONTRACT (CENTER) NNX16CP07C (JPL)
SOLICITATION-PHASE SBIR 2015-II

SUBTOPIC S1.02 Microwave Technologies for Remote Sensing TA 8.1.4 Microwave/Radio

TRL 1 2 3 4 5 6 7 8 9 IN OUT