STATEMENT OF WORK

E-Band Gallium Nitride (GaN) Solid-State Power Amplifier Demonstration Module including DC Biasing Circuitry

Introduction:

The next generation satellites to be launched by the NASA, U.S. Government Agencies, and the U.S. commercial SATCOM industry will require a new design for the radio frequency (RF) transmitter on board the satellite communication terminals for returning large quantities of data on the order of multi-giga bits per second (Gbps) directly to Earth. This requires the development of a high-power high-efficiency gallium nitride (GaN) monolithic microwave integrated circuit (MMIC) based solid-state power amplifier (SSPA) module. Upon successful completion of the above demo module development, NASA GRC would like to enter into an agreement to develop an engineering qualification model and procure a flight version of a E-band GaN SSPA module for a potential flight opportunity.

1.0 Scope of Work:

The Contractor shall furnish the necessary personnel, facilities, services, and materials and otherwise do all things necessary and incident to the analysis, design, fabrication, assembly, testing/evaluation of E-band GaN MMIC based SSPA demo module as described in Section 2.0 below.

2.0 Tasks:

Task 1: The contractor shall design, fabricate, assemble, test/evaluate, and demonstrate in a laboratory environment a SSPA demo module at TRL4 that make use of Northrop Grumman's E-band GaN MMICs. A set of specifications for the SSPA module are listed in Appendix A below.

Task 2: The SSPA demo module shall have an internal DC biasing circuitry.

Task 3: The contractor shall deliver the SSPA demo modules to NASA GRC. The module will have standard waveguide as input and output ports. Additionally, a multi-pin DC connector will be integrated on one side of the module for providing the drain and gate bias voltages and currents.

Task 4: The bottom lower side of the SSPA demo module shall have a screw hole and shall be capable of attaching the module to the surface of a cold plate for temperature regulation and control during RF testing.

Task 5: Additional deliver item:

(a) Electrical interface drawings indicating the DC connector pin connections and the corresponding DC Bias voltages and currents.

Appendix A

Technical Specifications:

GaN SSPA Demo Module:

- Module Operating Frequency Range 70-75 GHz
- Driver amplifier chip for 70-75 GHz
- Power amplifier chip for 70-75 GHz
- Module Linear or Small Signal Gain: ~ 40 dB
- Gain Stability Over Temperature: +/- 2.0 dB
- Operating Temperature: 25 deg C
- Module Saturated Output Power (CW): 30 dBm (Minimum)
- Input RF Drive Power: ~ 0 dBm
- Power Added Efficiency (at Saturation): 5% or higher
- Input/Output Ports: Standard WR-12 Waveguide
- Input Return Loss: -10 dB or lower
- Output Return Loss: -10 dB or lower
- Drain DC Voltage and Current: +28 Volts and ~ 700 mA IdQ
- Gate DC Voltage: -3.2 Volts to -3.7 Volts adjusted to meet IdQ
- Module Size: 0.6” (H) x 2.5” (L) x 1.5” (W) or smaller
- Module Mass: 0.5 lbs. or lower

GaN MMIC:

- MMIC Device Type: GaN High Electron Mobility Transistor (HEMT)
- Transistor Gate Length: 0.2 microns or smaller
- MMIC Substrate Type: Silicon Carbide (SiC)
- Substrate Thickness: 100 microns or smaller
- DC Voltage: 28 Volts
- DC Current: 900 mA or less