

EMC Analysis of Globalstar Radios for UNITE Mission

FCC Application 0401-EX-CN-2018

Overview and Summary

The UNITE cubesat, from the University of Southern Indiana, will be deployed from the International Space Station via the NanoRacks CubeSat Deployer in early 2019. It will be inserted into a 400 km circular orbit, at an inclination of 51.6 degrees. Transmission to the Globalstar constellation will begin 50 minutes after deploy, and cease upon reentry, about 1.2 years after deployment. The two radios aboard the UNITE satellite are examined, the NearSpace Launch EyeStar D2 Duplex (“duplex”), and the NearSpace Launch EyeStar S3 Simplex (“simplex”).

Transmission Matrix Summary of Findings

Beam	Center Freq	Bandwidth	Conclusion
Simplex	1616.35 MHz	2.5 MHz	No Expected Interference
Duplex Channel 5	1515.65 MHz	1.23 MHz	No Expected Interference
Duplex Channel 6	1616.88 MHz	1.23 MHz	No Expected Interference

Simplex Radio EMC Analysis

Summary

Potential for interference with 3 services is considered. The results are summarized in Table 1. The basis for an expectation of no interference for 2 of the services considered, is the Earth Pointing Transmit Inhibit (EPTI) feature of the simplex radio.

For the MOBILE-SATELLITE Service (Earth to Space), the likelihood of interference with the receiver on the satellite is considered.

Service	Frequency	Result
AERONAUTICAL RADIONAVIGATION	1559 – 1626.5 MHz	Earth based receiver. No expectation of interference, because of EPTI.
RADIODETERMINATION SATELLITE	1610 – 1626.5 MHz	Earth based receiver. No expectation of interference, because of EPTI.
MOBILE-SATELLITE (Earth to Space)	1610.6 – 1660.5 MHz	Space based receiver. No expectation of interference.

Table 1 Services Reviewed for Potential Interference by Simplex

Aeronautical Radionavigation Service and Radiodetermination Satellite Service

These services support Earth based receivers. Transmission from UNITE EyeStar-S3 Simplex transmitter (“simplex”) in the direction of Earth is inhibited by use of a horizon sensor mounted on the antenna, to detect the direction of the antenna, and require non Earth pointing as a permissive to transmit. This is referred to as Earth Pointing Transmit Inhibit, or EPTI. This function is expected to protect all Earth based receivers using either Aeronautical Radionavigation Service, or Radiodetermination Satellite Service, from any possible interference.

Mobile-Satellite Service

In Band

Satellites in the Mobile-Satellite Service (earth to space), or MSS, receives transmissions from Earth at multiple satellites operated by multiple entities. The service is allocated in the range of 1610.6 – 1660.5 MHz. The simplex operates with the Globalstar constellation of satellites, which is one example of an MSS operator. UNITE has specifically sought coordination and support from Globalstar, and this coordination is confirmed by Globalstar companion license application 0578-EX-CN-2018. MSS operators use allocated frequencies; other MSS operators have allocations outside of the frequency allocated to Globalstar and used by simplex to transmit to Globalstar, so we expect no in-band interference with other MSS operators.

Out of Band

HIBLEO-2 is another MSS operation. The frequencies allocated to HIBLEO-2 are distinct from those used by simplex to transmit to Globalstar, so HIBLEO-2 is out of band from simplex, and vice versa; UNITE follows existing band segmentation arrangements involving the HIBLEO-2 network, thereby avoiding co-frequency operations with HIBLEO-2. No interference is expected.

Duplex Radio EMC Analysis

Summary

Potential for interference with 3 services is considered. The results are summarized in Table 2. The basis for an expectation of no interference for 2 of the services considered, is the Earth Pointing Transmit Inhibit (EPTI) feature of the simplex radio.

For the MOBILE-SATELLITE Service (Earth to Space), the likelihood of interference with the receiver on the satellite is considered.

Service	Frequency	Result
AERONAUTICAL RADIONAVIGATION	1559 – 1626.5 MHz	Earth based receiver. No expectation of interference, because of zenith pointing requirement.
RADIODETERMINATION SATELLITE	1610 – 1626.5 MHz	Earth based receiver. No expectation of interference, because of zenith pointing requirement.
MOBILE-SATELLITE (Earth to Space)	1610.6 – 1660.5 MHz	Space based receiver. No expectation of interference.

Table 2 Services Reviewed for Potential Interference by Duplex

Aeronautical Radionavigation Service and Radiodetermination Satellite Service

These services support Earth based receivers. The Duplex radio includes both a receiver and a transmitter. Unless it is receiving a validated signal from a satellite in the Globalstar constellation, it will not transmit. Because the Globalstar constellation orbits much higher than the UNITE deploy altitude, In order to receive such a signal from Globalstar, the spacecraft must be oriented with the antenna beam pointed near zenith. In this orientation no signal will be transmitted in the direction of Earth surface.

This feature of Duplex operation – transmitting in the zenith direction only - is expected to protect all Earth based receivers using either Aeronautical Radionavigation Service, or Radiodetermination Satellite Service, from any possible interference.

Mobile-Satellite Service

In Band

Satellites in the Mobile-Satellite Service (earth to space), or MSS, receives transmissions from Earth at multiple satellites operated by multiple entities. The service is allocated in the range of 1610.6 – 1660.5 MHz. The duplex operates with the Globalstar constellation of satellites, which is one example of an MSS operator. UNITE has specifically sought coordination and support from Globalstar, and this coordination is confirmed by Globalstar companion license application 0578-EX-CN-2018. MSS operators use allocated frequencies; other MSS operators have allocations outside of the frequency allocated to Globalstar and used by duplex to transmit to Globalstar, so we expect no in-band interference with other MSS operators.

Out of Band

HIBLEO-2 is another MSS operation. The frequencies allocated to HIBLEO-2 are distinct from those used by simplex to transmit to Globalstar, so HIBLEO-2 is out of band from simplex, and

vice versa; UNITE follows existing band segmentation arrangements involving the HIBLEO-2 network, thereby avoiding co-frequency operations with HIBLEO-2. No interference is expected.