Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Venturi Astrolab, Inc.	)	File No. __________
	)	
Application for Authority to Launch and Operate a Short Duration Mission to Land a Technology Demonstration Rover on the Lunar Surface	))))	Call Sign:

APPLICATION

Emma Marion
DLA Piper LLP (US)
500 8th Street, NW
Washington, DC 20004
emma.marion@us.dlapiper.com
+1 (212)-335-4626
Counsel for Astrolab

Kevin Drumm
Interplanetary Communications Lead
Venturi Astrolab, Inc.
12536 Chadron Ave
Hawthorne, CA 90250
kevin@astrolab.space
+1 (323)-675-0266

Shane Laverty
Anysignal Inc.
111 Eucalyptus Drive
El Segundo, CA 90245
shane@anysignal.com
+1 (905)-726-0289
Preparation for Astrolab

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APPLICATION

Venturi Astrolab, Inc. ("Astrolab"), a U.S.-based interplanetary infrastructure company, seeks authority under the Federal Communications Commission's ("Commission") streamlined small spacecraft rules[1] to launch and operate its FLEX Lunar Innovation Platform ("FLIP") rover, a sub-scale rover technology demonstration mission on the Moon's surface. FLIP will be attached as a payload to an Astrobotic Technology ("Astrobotic") Griffin lander system during the Griffin-1 mission, contracted through NASA as part of its Commercial Lunar Payload Services initiative, and will be released on the surface at the lunar south pole.[2] Astrolab requests authority to operate FLIP for up to 90 days, using portions of the:

- 2025-2110 MHz (Earth-to-space) under the space research service ("SRS"),
- 2200-2290 MHz (space-to-Earth) under the SRS,
- 2400-2483.5 MHz (short-range, space-to-space) under the industrial, scientific, and medical ("ISM") designation, and

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[1] 47 C.F.R. § 25.123.

[2] The application to authorize the Griffin-1 mission itself, the Griffin lander, and any radiofrequency emissions of the Griffin spacecraft are considered separate from this application. *See* Application of Astrobotic, ICFS File No. SAT-LOA-20250407-00094 (filed April 7, 2025) ("Astrobotic Application").

- 8450-8500 MHz (space-to-Earth) under the SRS

to enable short-range communications between Griffin-1 and the FLIP rover and to communicate telemetry, tracking, and command ("TT&C") and payload data from the FLIP rover back to Earth. The Griffin-1 mission carrying the FLIP rover is currently expected to launch between December 4, 2025, and March 4, 2026.

The FLIP mission represents a significant step in advancing core technologies essential for Astrolab's later FLEX rover product line, intended to catalyze the lunar economy by providing last-mile logistics and utility infrastructure for the Artemis generation of exploration.

I. BACKGROUND

Astrolab is a Hawthorne, California-based company dedicated to advancing human exploration and settlement of space. As its first product-line, Astrolab is focused on designing, building, and operating a fleet of multi-purpose rovers to support various planetary surface needs and enhance humanity's presence in the solar system.

A. The FLEX Rover

Astrolab's primary mission is to facilitate a sustainable human presence on the Moon and Mars by providing versatile mobility platforms capable of crew transport, cargo delivery, scientific exploration, and infrastructure development. Astrolab's flagship vehicle, the Flexible Logistics and Exploration ("FLEX") rover, is designed to be the largest and most capable rover to operate on the lunar surface, supporting a wide range of missions and payloads.

In April 2024, NASA selected Astrolab, in partnership with Axiom Space and Odyssey Space Research, as one of three companies to develop the Lunar Terrain Vehicle ("LTV") for the Artemis program. This contract, valued at up to $1.9 billion for Astrolab, is part of a broader initiative with a total potential value of $4.6 billion over 13 years. The LTV will enable Artemis astronauts to explore more of the Moon's surface, conducting scientific research and preparing for future human missions to Mars. Astrolab has also secured agreements with eight enterprise customers to deploy their payloads on the future FLEX rover mission to the Moon. These contracts, collectively valued at over $160 million, include collaborations with companies such as Argo Space, Astroport, Avalon Space, Interstellar Lab, and LifeShip.

The FLIP rover, which is the subject of this application, will operate as a precursor test rover before the ultimate development and deployment of the FLEX rover, which will be the subject of a future application.

B. The FLIP Rover

In February 2025, Astrolab announced[3] a collaboration with Astrobotic to deploy its prototype rover FLIP as the primary payload on Astrobotic's Griffin Mission One ("Griffin-1"). This mission aims to deliver the FLIP rover to the Nobile region near the lunar south pole. The FLIP rover will serve as a technology demonstrator, testing critical components and subsystems intended for the larger FLEX rover, including full-sized batteries, tires, avionics systems, sensors, and software.

Through the FLIP mission, Astrolab aims to validate and mature technologies essential for future commercial missions. By demonstrating the rover's capabilities in the challenging environment of the lunar south pole, Astrolab seeks to gather valuable data to inform the development of the FLEX rover and other planetary mobility solutions. This mission represents a significant step toward establishing a robust infrastructure to support sustained human activities on the Moon and beyond and establishing the foundation for a scalable lunar economy.

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[3] *See* Jeff Foust, *"Astrolab to fly its FLIP lunar rover on Astrobotic's Griffin-1 lander"*, SpaceNews, Feb. 5, 2025, available at https://spacenews.com/astrolab-to-fly-its-flip-lunar-lander-on-astrobotics-griffin-1-lander/ (last accessed Apr. 3, 2025).

II. SMALL SPACECRAFT LICENSING CERTIFICATIONS

Section 25.123 of the Commission's rules states that applicants filing under the streamlined rules must certify that they meet certain criteria.[4] Astrolab certifies that the FLIP meets those criteria. Detailed statements for each of the criteria are provided below:

A. Beyond Earth's Orbit

Requirement: The space station(s) will operate and be disposed of beyond Earth's orbit.

Certification: The FLIP spacecraft will nominally operate beyond Earth's orbit. Following a brief, approximately one-hour S-band checkout performed during the lunar transit period, the FLIP spacecraft will begin nominal operations only after landing on the lunar surface to commence the egress operation from the Griffin lander. The rover and lander components will be passivated and deactivated on the lunar surface at the conclusion of the mission.

B. Limited Lifetime

Requirement: The total lifetime from deployment to spacecraft end-of-life for any individual space station will be six years or less.

Certification: The FLIP mission will not exceed six years in duration. The rover's nominal mission lifetime is 15 days after release, after which the rover will attempt to hibernate throughout the lunar night. Extended operations may be carried out if the rover can be successfully reactivated following the hibernation period. These extended operations will continue for a maximum of 90 days after mission start.

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[4] *See* 47 C.F.R. § 25.123(b); *see also* FCC Report and Order, *In the Matter of Streamlining Licensing Procedures for Small Satellites*, IB Docket No. 18-86, FCC 19-81, 34 FCC Rcd 13077 (2019) (*Streamlined Processing Order)*; FCC, *Small Satellite and Small Spacecraft Licensing Process*, https://www.fcc.gov/space/small-satellite-and-small-spacecraft-licensing-process (last accessed Apr 3. 2025).

C. Unique Telemetry Marker

Requirement: Each space station will be identifiable by a unique signal-based telemetry marker distinguishing it from other space stations or space objects.

Certification: All telemetry frames and packets transmitted by the FLIP spacecraft will carry a unique identifier to ensure it is distinguishable from other spacecraft and space objects.

D. No Operational Debris

Requirement: The space station(s) will release no operational debris.

Certification: FLIP will be securely stowed to the Griffin-1 lander from launch until egress on the lunar surface. No operational debris will be released by the FLIP rover at any point throughout the mission lifetime.

E. Mitigated Explosion Risks

Requirement: No debris will be generated in an accidental explosion resulting from the conversion of energy sources on board the space station(s) into energy that fragments the spacecraft.

Certification: The only source of potential energy aboard the FLIP spacecraft are its internal batteries. FLIP has no propulsion systems, pressurized fluids, or other sources of explosive risk. At the end of the mission, batteries will be passivated and energetically safed. Accordingly, no debris will be generated in an accidental explosion resulting from the conversion of energy sources on board the FLIP rover into energy that fragments the spacecraft.

F. Collision Risk Management

Requirement: The probability of a collision between each space station and any other large object (10 centimeters or larger) during the lifetime of the space station is 0.001 or less as calculated using current NASA software or higher fidelity models.

Certification: The spacecraft will reside in the payload compartment of the Griffin-1 lander for the entirety of its transit period, until deployed to the lunar surface. It will not reside in any geocentric orbit at any point during its mission lifetime and thus cannot be modelled using NASA's DAS. Therefore, calculation of a long-term collision risk is not applicable and is assumed to be zero. The collision risk analysis of the Griffin-1 lander itself is provided within the Astrobotic Application.[5]

G. Frequency Compatibility

Requirement: Operation of the space station(s) will be compatible with existing operations in the authorized frequency band(s). Operations will not materially constrain future space station entrants from using the authorized frequency band(s).

Certification: The frequency use for the FLIP spacecraft will be for a limited duration and will not interfere with or constrain existing or future authorized users of the relevant bands. *See* Section IV (discussing frequency use). Astrolab is coordinating with NASA's Lunar and Human Spaceflight Spectrum Management team to select channel frequencies that will be compatible with existing operations in these bands and will conduct operations subject to the outcomes of such coordination.

H. Command and Control

Requirement: The space station(s) can be commanded by command originating from the ground to immediately cease transmissions, and the licensee will have the capability to eliminate harmful interference when required under the terms of the license or other applicable regulations.

Certification: The FLIP spacecraft is capable of immediate cessation of emissions via ground command to eliminate harmful interference should it arise.

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[5] *See* Astrobotic Application, Revised Narrative at § 2.6 (filed May 22, 2025).

I. Dimensional Compliance

Requirement: Each space station is 10 cm or larger in its smallest dimension.

Certification: The FLIP spacecraft's dimensions are 218.2 cm x 155.1 cm x 196.1 cm. Accordingly, the FLIP spacecraft exceeds the minimum dimension of 10 cm along all axes.

J. Mass Limit

Requirement: Each space station will have a mass of 500 kg or less, including any propellant.

Certification: The fully integrated FLIP spacecraft will have a mass of 480 kg, including the 30 kg attachment mount it uses to interface with the Griffin-1 lander. After landing, the rover will decouple from the mount to facilitate egress onto the lunar surface with a mass of 450 kg. However, the Griffin-1 lander itself will exceed 500 kg, in part because it includes the weight of the FLIP spacecraft assembly. Though a waiver of the mass limit requirement for the lander was already requested in the Astrobotic Application,[6] an additional waiver for the combined spacecraft has been requested herein out of an abundance of caution.

K. Collision Avoidance

Requirement: Upon receipt of a space situational awareness conjunction warning, the operator will review and take all possible steps to assess the collision risk, and will mitigate the collision risk, if necessary. As appropriate, steps to assess and mitigate the collision risk should include, but are not limited to: Contacting the operator of any active spacecraft involved in such a warning; sharing ephemeris data and other appropriate operational information with any such operator; and modifying space station attitude and/or operations.

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[6] *See* Astrobotic Application, FCC Small Spacecraft Waiver Request at § 1.1.

Certification: While FLIP is onboard the Griffin-1 lander, ephemeris data will be shared by Astrobotic. In the unlikely event that the spacecraft shuttling the FLIP rover receives a conjunction warning during its brief transit to lunar orbit, Astrolab will coordinate where necessary with relevant space situational awareness entities to assess and mitigate collision risks and will share any information required with the 18th SGS and any other relevant parties.

III. CONOPS

A. Facilities

Astrolab manages rover operations through a centralized Mission Operations Center ("MOC") located at its primary operational facility in Hawthorne, California. Its facilities include infrastructure dedicated to mission planning, system integration, testing, and rover operations, and it hosts controlled environments for subsystem validation and lunar surface simulation to ensure rover performance and mission readiness. Mission specialists and engineers staff the MOC continuously during critical phases, providing direct support to payload operations, and are responsible for real-time telemetry monitoring, command uplink, data analysis, and anomaly resolution.

B. Mission Phases and Rover

The FLIP rover will be delivered to the lunar surface aboard Astrobotic's Griffin lander.[7] The table below provides a high-level overview of the mission phases before and after deployment, with callouts to the points at which FLIP will conduct any RF communications.

[7] Supplementary technical information on the Griffin lander is publicly available on Astrobotic's website, including its hardware, typical operations, and measures taken towards contamination avoidance and other assurances. *See* Astrobotic Lunar Landers Payload User's Guide, https://www.astrobotic.com/wp-content/uploads/2022/01/PUGLanders_011222.pdf. For more specific details regarding the Griffin-1 mission, *see* Astrobotic Application.

Table 1: Mission Phases and RF Operations Schedule

#	Lander	FLIP	FLIP RF Operations
1	Launch integration	Pre-launch checkouts	RF checkouts at lander integration facility
2	Launch direct to Trans Lunar Injection Transfer Orbit	Launch as integrated payload to lunar lander	N/A
3	Possible Trajectory Correction Maneuver	N/A	
4	LEOP & Transit Through Cislunar Space	Power ON after lunar lander LEOP	
5		Perform in-space checkout	~1 hr S-band checkout during transit (minimum altitude of 1000 km)
6		Remain quiescent for remaining transit and landing	N/A
7	Lunar Orbit Insertion Maneuver	N/A	
8	Initial Lunar Orbit		
9	Lowering of Apoapsis towards Final 100 km Circular Orbit		
10	Autonomous Powered Descent Operations		
11	Touchdown on Lunar Surface		
12	Post-Landing Checkouts and Rover Release	Rover release	
13	**Post-Deployment**		
14	N/A	Enable nominal FLIP systems	S+X Direct-with-Earth RF support
15			Lander 2.4 GHz to support egress
16		Egress the lander	~8-24 hr critical operation for S+X RF support
17			2.4 GHz only active in proximity to lander
18		Snap a picture after egress	N/A
19	Griffin shutdown after ~ 5 days post-landing	Drive to hibernation site	~15 days S+X band 24/7 operations
20	N/A	Characterize system performance en route	
21		Perform customer payload operations objectives en route	
22		Survive one lunar night	~15 days S-band check-ins (30 min every 8-12 hrs)
23		Evaluate performance after one hibernation	~3 Earth-days S-X band 24/7 operations
24		Try to hibernate multiple nights	Continuous operations for no more than 90 Earth-days (repeat steps 9-12)

The launch vehicle carrying the FLIP rover will be launched into a direct trans-lunar injection ("TLI") trajectory with no intermediate Earth orbits. After integration with the launch vehicle, the FLIP rover will remain powered down throughout the early orbit phase and the majority of transit, except for a brief, approximately one-hour S-band checkout performed during the lunar transit period. This in-space checkout ensures proper operation of onboard avionics, communication equipment, and critical rover subsystems prior to lunar arrival.

The landing location will be on the rim of the Nobile Crater near the lunar south pole at approximately -85.4° latitude, 31.5° longitude. Astrobotic is targeting a landing area of 100 meters in diameter. Upon successful landing at Mons Mouton, near the western rim of Nobile crater in the lunar south polar region, following an approximately 10-day transit to the moon, FLIP will stay mounted on top of the lander for a brief checkout. While mounted to the lander, the rover will open its solar array 90 degrees along its longitudinal axis and in the process, deploying its X-band medium gain antenna ("MGA"), S-band low gain helical antenna ("LGA Helix"), and diagnostic camera.

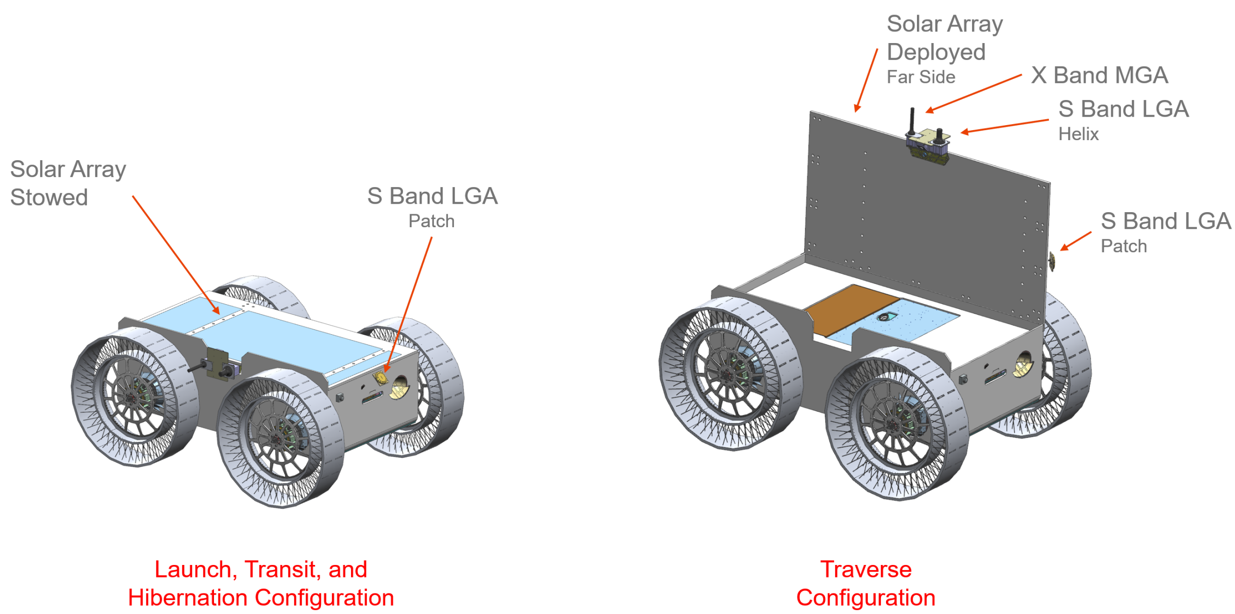

Figure 1: FLIP Stowed/Transverse Configurations

The rover's egress from the lander is a mission-critical event lasting approximately 8 to 24 hours. Throughout this period, continuous dual-band (S and X) communication support will be maintained to ensure real-time monitoring, diagnostics, and the rapid resolution of any anomalies. After pre-deployment checkouts, Griffin will release the FLIP rover onto the lunar surface. As discussed below, FLIP will use a local 2.4 GHz support link to support communications with the lander throughout the release and egress process.

Once safely on the lunar surface, FLIP will transition to normal mission operations, which include continuous monitoring of system performance, navigation and mobility checks, and execution of customer payload operations objectives. During transit between lunar surface sites, the rover will maintain communication with Earth to assess system performance and ensure mission progress. Astrolab will attempt to maintain 24/7 contact with the rover over this approximately 15 day main period until lunar nightfall.

To survive the lunar night, the rover will enter a hibernation mode lasting approximately 15 days. During this time, periodic S-band check-ins will occur, with sessions of approximately 30 minutes every 8 to 12 hours to monitor rover health status. Upon completion of hibernation, the FLIP rover will resume full S-band and X-band operations for approximately three days to thoroughly evaluate subsystem performance, rover health, and environmental conditions following the extended lunar night.

If the rover survives the hibernation period, FLIP will begin its extended mission phase, continuing operations and communication management as determined by mission performance and payload objectives for a period of up to 90 days.[8]

C. Ground Stations

Astrolab will use third-party ground stations at the following locations:

Table 2: FLIP Ground Stations

Partner	Location	Latitude	Longitude	Antenna Size
A	Santiago, Chile	-33.1483	-70.6676	13.5m
A	Southpoint, Hawaii	19.0140	-155.6631	13m
A	Western Australia	-29.0458	115.3487	13.5m
A	Ventspils, Latvia	57.55354	21.85497	32m
A	Kiruna, Sweden	67.889558	21.06565	13m
B	Inuvik, Canada	68.3192	-133.5457	13m
B	Svalbard, Norway	78.2298	15.4078	13m
B	Byalalu, India	12.9018	77.3699	18m & 32m
B	Maspalomas, Spain	27.76295	-15.63386	15m

[8] Due to limitations in the Schedule S software, the mission lifetime is listed as the minimum value of 1 year. However, this application clarifies the request of license duration to be 90 days starting from the day of launch.

Astrolab has partnered with two ground station providers for its mission with stations available between 13 m and 32 m diameter. Stations have been chosen such that at least one is always in view of the moon at any given time, ensuring always-on access to FLIP throughout the course of the mission. With the exception of the Southpoint, Hawaii station, all stations are located outside of the United States to minimize interference impact towards U.S. Federal operations in the S-band. Astrolab will coordinate use of the Southpoint, Hawaii station with Federal spectrum managers and will conduct operations subject to conditions arising from such coordination.

D. Customer Payloads

The FLIP rover will carry customer payloads largely intended for commercial use, commercial technology demonstration and marketing opportunities, education, and science and technology demonstrations. None of the payloads carried by the FLIP rover contain any of their own intentional radiators, conduct any RF operations, or do they carry any separate sources of potential energy that may contribute to explosive risk.

IV. FREQUENCY USE

Throughout the mission, Astrolab will communicate with the FLIP rover through third-party ground stations. The FLIP rover will use the 2025-2110 MHz and 2200-2290 MHz bands for low data-rate TT&C using the rover's omnidirectional S-band antennas, and, wherever possible, will use the 8450-8500 MHz band for payload data/TT&C as the primary downlink. FLIP will also operate in the 2.4 GHz ISM band to communicate with Griffin-1 (space-to-space) to facilitate egress from the lander.

Astrolab will coordinate its frequency use with Federal spectrum managers and with NASA's Lunar Spectrum Management to ensure protection of existing Federal users and will conduct all operations subject to any conditions arising from such coordination. An overview of Astrolab's requested frequency use is provided in Table 3 below.

Table 3: FLIP Frequency Plan

Purpose	**Direction**	**Service**	**FLIP Gain**	**Freq. Min (MHz)**	**Freq. Max (MHz)**	**Freq. Center (MHz)[9]**	**BW (MHz)**	**Pol.**	**Transmitter**	**Max EIRP (dBW)**	**Receiver**
Payload Downlink & TT&C	Tx	SRS	4	8450	8500	8455	3.7	Lin	FLIP X-MGA	12[10]	13 m GS
											32 m GS
TT&C Downlink, Backup Payload Downlink	Tx	SRS	2	2200	2290	2247.024869	3.7	RC	FLIP S-LGA (Patch)	10[10]	13 m GS
											32 m GS
TT&C Uplink	Rx	SRS	3	2025	2110	2069.1354	3.7	RC	13 m GS	67.5	FLIP S-LGA (Helix)
									15 m GS	73	
									18 m GS	74.6	
									32 m GS	80	
Lander Egress	Tx/Rx	ISM	2	2400	2483.5	2462	20	Lin	Lander/FLIP	3.6	Lander/FLIP

A. 2025-2110 MHz

The 2025-2110 MHz band is allocated internationally to the Space Research Service ("SRS") and Space Operation Service ("SOS") (Earth-to-space), *inter alia*, on a primary basis. In the U.S. Table of Frequency Allocations the band is allocated for Federal use for those same services; non-Federal use may be authorized for space research services on a secondary, non-interference, case-by-case basis pursuant to footnote US347.[11] Space research service is a radio communication service in which a spacecraft is used for scientific or technological research

[9] These center frequencies were chosen pursuant to coordination with NASA's Lunar Spectrum Management group.

[10] Includes 2 dB of cable loss.

[11] *See* 47 C.F.R. § 2.106, footnote US347.

purposes.[12] Space research services include communications used for lunar missions.[13] Accordingly, the proposed use is consistent with the U.S. Table of Frequency Allocations.

Astrolab requests authority to use a single 3.7 MHz channel centered at 2069.1354 MHz for all of its S-band uplinks to FLIP. The link will carry only those telecommand signals needed for critical spacecraft operations and occasional equipment checkout.

B. 2200-2290 MHz

This band is allocated internationally to the SRS and SOS (space-to-Earth), *inter alia*, on a primary basis. In the U.S. Table of Frequency Allocations, this band is allocated for Federal use for those same services.

Astrolab requests authority to use a one 3.7 MHz-wide downlink channel centered at 2247.024869 MHz to transmit essential spacecraft telemetry and customer payload data only when the primary X-band (8450-8500 MHz) payload link is unavailable. With the exception of the Southpoint, Hawaii station, all communications in this band will be conducted using non-U.S. ground stations that have been individually coordinated with co-frequency users. Further, Astrolab has already completed discussions with NASA Spectrum Management to confirm that the selected center frequency will not impact TDRSS, SGLS or aeronautical telemetry activities. While operations will conform to the international allocations, as discussed in Section VI below, Astrolab seeks waiver of the U.S. Table of Frequency Allocations for use of this band to the extent necessary.

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[12] *See* 47 C.F.R. § 2.1.

[13] *See* Stamp Grant, Astrobotic Technology, Inc., ICFS File Nos. SAT-LOA-20210512-00065, SAT-AMD-20220107-00004, SAT-AMD-20231009-00242, at Condition ¶ 3 (granted Dec. 6, 2023); Stamp Grant, Intuitive Machines, LLC, ICFS File Nos. SAT-LOA-20210423-00055, SAT-AMD-20220510-00049, at Condition ¶ 3 (granted Oct. 5, 2023).

C. 2400-2483.5 MHz

This band is one of the globally designated Industrial, Scientific and Medical ("ISM") ranges identified in ITU-RR No. 5.150; radiocommunication services operating here must accept any interference generated by ISM equipment. This band is also allocated internationally and in the U.S. to the Fixed and Mobile allocations on a primary basis.[14] For lunar operations, the 2.4 GHz frequency band recommended by SFCG for space-to-space Lunar operations transmissions for Extra Vehicular Activity ("EVAs"), Rover – Lunar Communications Terminal , and EVAs – Landers, Rover.[15]

Astrolab requests authority to use this band only for a short-range (less than 1 km), short duration space-to-space link between the FLIP rover and the Griffin-1 lander to support communications during initial egress on the lunar surface. The link employs an IEEE 802.11 Channel 11 carrier (center frequency 2462 MHz, 20 MHz occupied bandwidth) configured as a serial bridge that streams status data and low-rate telemetry needed to guide the rover off the lander deck. Transmissions cease once the rover has separated from the lander and has established its primary S- and X-band links to Earth. Because emissions remain on the lunar surface and meet the criteria identified by the SFCG for lunar use, they present no potential for harmful interference to terrestrial, deep-space, or amateur-satellite operations. Further, given the low power operations, this space-to-space link should not cause harmful interference to existing or future authorized operators, and will accept interference from other authorized users of the band. Astrolab will

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[14] This band also includes allocations to the Radiolocation service and, from 2400-2450, to the Amateur service.

[15] *See* Space Frequency Coordination Group, Recommendation SFCG 32-2R6, Communication and Positioning, Navigation, and Timing Frequency Allocations and Sharing in the Lunar Region, https://www.sfcgonline.org/Recommendations/REC%20SFCG%2032-2R6%20(Freqs%20for%20Lunar%20Region).pdf.

address any interference concerns raised by incumbent users or Federal spectrum managers. As discussed below, Astrolab sees a waiver of the U.S. Table of Frequency Allocations for use of this band.

D. 8450-8500 MHz

This band is allocated internationally and in the United States to the SRS on a primary basis for Federal and non-Federal users.[16] As discussed above, space research services include communications used for lunar missions.[17] Accordingly, the proposed use is consistent with the U.S. Table of Frequency Allocations.[18] This frequency band is also recommended by SFCG, LunaNet, and the Lunar Spectrum Management department at NASA as the identified band for space-to-Earth Lunar operations transmissions.

Astrolab requests authority to use one 3.7 MHz-wide downlink channel centered at 8455 MHz. This X-band carrier will serve as FLIP's primary payload data and TT&C path. As demonstrated in the Technical Annex, all emissions will meet power-flux-density limits. Astrolab's coordination with NASA spectrum managers led to the selection of the 8455 MHz center frequency such that it poses no conflict with the deep space network ("DSN") or other incumbent operations.

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[16] *See* 47 C.F.R. § 2.106. Internationally, this band is also authorized for fixed and mobile (except aeronautical mobile) services on a primary basis, and in the U.S., this band is also authorized for Federal fixed services on a primary basis.

[17] *See e.g.,* Stamp Grant, Astrobotic Technology, Inc., ICFS File Nos. SAT-LOA-20210512-00065, SAT-AMD-20220107-00004, SAT-AMD-20231009-00242, at Condition ¶ 3 (granted Dec. 6, 2023); Stamp Grant, Intuitive Machines, LLC, ICFS File Nos. SAT-LOA-20210423-00055, SAT-AMD-20220510-00049, at Condition ¶ 3 (granted Oct. 5, 2023).

[18] *See, e.g.,* Stamp Grant, Astrobotic Technology, Inc., ICFS File Nos. SAT-LOA-20210512-00065, SAT-AMD-20220107-00004, SAT-AMD-20231009-00242, at Condition ¶ 3 (granted Dec. 6, 2023) (granting use of the 7190-7235 and 8450-8500 MHz bands).

V. PUBLIC INTEREST CONSIDERATIONS

The FLIP mission serves the public interest by advancing United States leadership in space exploration and commercial development on the Moon, directly supporting the goals of NASA's Artemis program and complementing international initiatives for establishing sustainable lunar operations. Specifically, the mission drives innovation in space technology by increasing the Technology Readiness Level of mobility and logistics systems, which are essential for future scientific, commercial, and crewed lunar missions. Additionally, the FLIP mission strengthens the U.S. lunar economy by laying groundwork for scalable lunar infrastructure, thereby creating new opportunities for government, academic, and commercial stakeholders.

FLIP will also advance the establishment of international interoperability and collaboration for future missions by elevating the Technology Readiness Level of hardware applicable to global lunar communication and navigation standards such as NASA's LunaNet initiative. Finally, the scientific and technological advancements gained from FLIP will significantly inform future lunar exploration strategies and technology development, benefiting the broader space exploration community. Astrolab respectfully requests approval of this application and associated waivers to facilitate timely preparation and execution of the FLIP mission.

VI. WAIVER REQUESTS

The Commission may waive its rules for "good cause."[19] Waiver is appropriate when special circumstances warrant a deviation from the general rule, and when such deviation better

[19] *See* 47 C.F.R. § 1.3; *Northeast Cellular Tel. Co. v. FCC*, 897 F.2d 1164 (D.C. Cir. 1990); *WAIT Radio v. FCC*, 418 F.2d 1153 (D.C. Cir. 1969).

serves the public interest than strict adherence.[20] Typically, waivers are granted if the requested relief does not undermine the policy objectives of the rule and would otherwise serve the public interest.[21] In this case, good cause exists to waive the following rules, as necessary.

A. U.S. Table of Frequency Allocations

1. **2200-2290 MHz**

As discussed above, Astrolab requests to use the 2200-2290 MHz band (center frequency 2247.024869 MHz) (space-to-Earth) to transmit spacecraft telemetry and customer payload data only when the primary X-band (8450-8500 MHz) payload link is unavailable. The 2200-2290 MHz band is allocated for Federal space research, space operations, and EESS services. With the exception of the Southpoint, Hawaii station, all communications in this band will be conducted using non-U.S. ground stations that have been individually coordinated with co-frequency users. Astrolab seeks waiver of the U.S. Table of Frequency Allocations for use of this band.

Transmissions in this band will only be on a limited basis when the primary payload link is unavailable. Astrolab has already completed discussions with NASA Spectrum Management to confirm that the selected center frequency will not impact TDRSS, SGLS or aeronautical telemetry activities, and will coordinate use of the band with relevant Federal spectrum managers. Grant of the waiver for limited use of these frequencies will support safe execution of lunar TT&C activities and development of lunar communications. For these reasons, grant of a waiver to allow limited use of these frequencies, as proposed in this application, is warranted.

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[20] *See Northeast Cellular*, 897 F.2d at 1166.

[21] *See WAIT Radio*, 418 F.2d at 1157.

2. **2400-2483.5 MHz**

As discussed above, Astrolab requests to use this band to support communications for transporter departure. The 2400-2483.5 MHz band is allocated internationally and in the U.S. to the Fixed and Mobile allocations on a primary basis.[22] The 2.4 GHz frequency band is identified by SFCG as the recommended band for space-to-space Lunar operations transmissions for EVAs, Rover – Lunar Communications Terminal, and EVAs – Landers, Rover.[23] Astrolab seeks waiver of the U.S. Table of Frequency Allocations for use of this band.

The proposed use of this band is consistent with the SFCG recommendations, selected pursuant to coordination with NASA, and will only be utilized for short-range, space-to-space links between the FLIP rover and the Griffin-1 lander to support communications during initial egress on the lunar surface for a period. Because emissions are low-power and remain on the lunar surface, they present no potential for harmful interference to terrestrial, deep-space, or amateur-satellite operations. Astrolab will not cause harmful interference to existing or future authorized operators, will accept interference from other authorized users of the band, and is able to disable the 2.4 GHz link if interference concerns are raised by incumbent users or Federal spectrum managers. Grant of the waiver for limited use of these frequencies will facilitate the deployment of lunar vehicle communications and, accordingly, of NASA objectives. For these reasons, grant of a waiver to allow limited use of these frequencies, as proposed in this application, is warranted.

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[22] This band also includes allocations to the Radiolocation service and, from 2400-2450, to the Amateur service.

[23] *See* Space Frequency Coordination Group, Recommendation SFCG 32-2R6, Communication and Positioning, Navigation, and Timing Frequency Allocations and Sharing in the Lunar Region, https://www.sfcgonline.org/Recommendations/REC%20SFCG%2032-2R6%20(Freqs%20for%20Lunar%20Region).pdf.

B. 47 C.F.R. § 25.123(b)(10) (Wet Mass Cutoff of 500 kg)

Spacecraft seeking authorization under the streamlined licensing process must have a mass of 500 kg or less, inclusive of propellant, to qualify. The FLIP rover is 480 kg, inclusive of its attachment mount to the larger Griffin-1 lander. Though FLIP itself meets the wet mass requirement, out of an abundance of caution Astrolab seeks a waiver of the 500 kg mass requirement for the mated FLIP and Griffin-1 spacecraft, which exceeds 500 kg, to the extent necessary. Such a waiver has also been requested by the Astrobotic Application.[24]

The intent of the wet mass requirement is to limit the physical capacity for debris-generation potential by spacecraft licensed under the streamlined process. In the case of the FLIP mission, the spacecraft will at no point reside in any kind of Earth orbit. It will only be in lunar orbit for a matter of days, within the payload bay of the Griffin lander. After deployment on the lunar surface and the completion of its mission, it will be energetically passivated and disposed where it can pose no further risk for debris generation. Therefore, waiver of this requirement is appropriate and necessary in this case.

Further, although the Commission adopted a 500 kg "wet" mass limit for non-Earth orbiting spacecraft, the adopted metric was selected as suggested by commenters in the rulemaking proceeding as a better alternative to the 180-kg limit for Earth-orbiting satellites.[25] The Commission acknowledged that it would consider revisiting restrictions for non-Earth orbiting spacecraft licensed under the streamlined process once it has additional experience authorizing these missions.[26] Spacecraft destined for non-Earth orbits, including lunar missions, have greater

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[24] *See* supra, note 6.

[25] *See*, *e.g.*, *Streamlined Processing Order*, ¶ 66.

[26] *See Streamlined Processing Order*, ¶ 67.

propellant needs given the distance and cargo requirements. The Commission has recognized these differences previously, and accordingly, has waived the mass limit for other lunar missions.[27] The Commission should do so here as well. Astrolab believes there is good cause in this case to waive the mass limit, to the extent necessary, to fulfill the public interest objectives of the FLIP mission while conforming to the Commission's intended goal of creating a streamlined authorization process for use of the commercial spectrum for commercial lunar missions.[28]

C. 47 C.F.R. § 25.114 (Schedule S)

Astrolab has included a Schedule S form with this application.[29] However, due to inherent format limitations within Schedule S, Astrolab is unable to fully and accurately describe FLIP rover operations. Accordingly, Astrolab respectfully requests a waiver of the Schedule S requirements to the extent necessary. Specifically, Astrolab requests to waive the requirements to provide the following information:

- GXT Files: Astrolab requests waiver of the requirement to provide GXT files with the Schedule S because there are no contours at the -2 dB, -4 dB, -6 dB, -8 dB, -10 dB, -15 dB, or -20 dB levels that will intersect the Earth's surface.
- Saturation Flux Density Values: Astrolab requests waiver of the section 25.114(c)(4)(v) requirement to provide the minimum and maximum saturation flux density ("SFD") values for each space station receive antenna that is connected to transponders.

[27] *See, e.g.*, Stamp Grant, Intuitive Machines, LLC, ICFS File Nos. SAT-LOA-20210423-00055, SAT-AMD-20220510-00049, at Condition ¶ 14 (granted Oct. 5, 2023); Stamp Grant, Astrobotic Technology, Inc., ICFS File Nos. SAT-LOA-20210512-00065, SAT-AMD-20220107-00004, SAT-AMD-20231009-00242, at Condition ¶ 4 (granted Dec. 6, 2023).

[28] *Streamlined Processing Order*, ¶ 65 ("We adopt the NPRM proposal to allow small spacecraft with planned non-Earth orbiting missions, such as commercial lunar missions, to file under the streamlined process.").

[29] *See* 47 C.F.R. § 24.114(c).

The concept of SFD generally applies to "bent pipe" satellite systems, and thus is not relevant to the FLIP rover. However, because the Schedule S software requires a numerical entry for SFD (which must be different for maximum and minimum), Astrolab has entered a placeholder value to pass the Schedule S data validation.

Additional details and clarifications regarding specific Schedule S entries are provided in the accompanying Technical Annex. As demonstrated in the Technical Annex, these requirements are inapplicable to the FLIP mission, and waiver is warranted.

D. 47 C.F.R. §§ 25.123(c), 25.122(d) (Orbital Debris Mitigation Plan)

Astrolab requests a partial waiver of the requirements to provide an orbital debris mitigation plan, pursuant to 47 C.F.R. §§ 25.123(c), 25.122(d)(4-9), to the extent that the requirements are fully or partially fulfilled by reference to the Astrobotic Application. Specifically, Astrolab requests a partial waiver to provide the requirements of 47 CFR 25.122(d)(4)-(6), and (9), which are either fully or partially fulfilled by reference to the Astrobotic Application, as described in Exhibit A.

FLIP will be attached as a payload to Astrobotic's Griffin-1 lander up until the point it is deployed to the lunar surface. Up until that point, its orbital debris considerations will be subsumed by those of the lander vehicle. The aspects of FLIP's orbital debris risk and disposal plan that are distinct from those of the lander have been included in Exhibit A of this application. Astrolab respectfully requests this partial waiver be granted for procedural and operational clarity. By doing so, the Bureau will avoid duplication of information, and the potential implication that Astrolab will have any control over the maneuverability of the primary spacecraft between the launch and lunar landing events. Accordingly, waiver of the orbital debris mitigation plan requirements, to the extent they are not applicable to the FLIP rover, is warranted.

VII. OTHER MATTERS

A. NOAA Remote Sensing Licensing

Astrolab acknowledges that operation of remote sensing systems requires licensing by the National Oceanic and Atmospheric Administration ("NOAA"). Neither Astrolab nor its own payloads will conduct any remote sensing operations during its mission, and therefore will not seek licensure from NOAA. Astrolab understands that Astrobotic has received confirmation from NOAA that no remote sensing authorization is required for planned imagery operations.

B. ITU Compliance

Astrolab has prepared the ITU Advance Publication Information for the FLIP mission and is contemporaneously providing this information to the Commission under separate cover. Astrolab accepts, without condition, all ITU cost-recovery responsibilities associated with its API submission. Submitted contemporaneously with this application is Astrolab's signed ITU cost-recovery letter.

VIII. CONCLUSION

Astrolab respectfully submits this application to authorize the FLIP rover mission to the lunar surface. Approval of this application serves the public interest by supporting U.S. leadership in space exploration, advancing critical space technologies, and fostering international cooperation. Astrolab requests prompt consideration and approval of the application, along with the associated waivers, to enable timely mission preparation and successful execution.

Respectfully submitted,

<u>*/s/ Kevin Drumm*</u>

Emma Marion
DLA Piper LLP (US)
500 8th Street, NW
Washington, DC 20004
emma.marion@us.dlapiper.com
+1 (212)-335-4626
Counsel for Astrolab

Kevin Drumm
Interplanetary Communications Lead
Venturi Astrolab, Inc.
12536 Chadron Ave
Hawthorne, CA 90250
kevin@astrolab.space
+1 (323)-675-0266

Shane Laverty
Anysignal Inc.
111 Eucalyptus Drive
El Segundo, CA 90245
shane@anysignal.com
+1 (905)-726-0289
Preparation for Astrolab

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