



The International Amateur Radio Union

Since 1925, the Federation of National Amateur Radio Societies
Representing the Interests of Two-Way Amateur Radio Communication

AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST

Administrative information:

0	DOCUMENT CONTROL	
0a	Date submitted	
0b	Document revision number	1
1	SPACECRAFT (published)	
1a	Name	MAGNETO
1b	Notifying administration	US Federal Communications Commission (FCC)
1c	API/A number	
2	LICENSEE OF THE SPACE STATION (published) or responsible amateur in case of educational mission	
2a	First (given) name	Rahul
2b	Last (family) name	Rughani
2c	Amateur Radio Call sign	KN6BSR
2c1	licensed since	05/06/2019
2d	Postal address	4676 Admiralty Way, Suite 515, Marina del Rey, CA 90292
2e	Telephone number (including country code)	310-448-8503
2f	E-mail address (licensee will be IARU's point of contact and receive all correspondence)	rrughani@isi.edu
2g	Licensee's position in any organisation referenced in item 3a.	Graduate Research Assistant

3	ORGANISATIONS (published) — complete this section for EACH participating organization	
3a	Name of organization and/or educational institution	University of Southern California Informational Sciences Institute
3b	Postal address	4676 Admiralty Way, Suite 1001 Marina del Rey, CA 90292
3c	Telephone number (including country code)	+1-310-448-8644
3d	E-mail address	barnhart@isi.edu
3e	Web site URL	https://www.isi.edu/centers/serc/home
3f	National Amateur Radio Society (including contact information)	ARRL 225 Main Street Newington CT 06111-1494 Voice: 860-594-0200 Fax: 860-594-0259 E-Mail : hq@arrl.org Internet: http://arrl.org
3g	Does your National Amateur Satellite organization and/or National Amateur Radio Society endorse this request?	National AMSAT Organisation ☐ yes ☒ no National Amateur Radio Society ☐ yes ☒ no
3h	Name and email address(es) of the person(s) you've contacted in the National AMSAT Organisation or National Amateur Radio Society	Name: Email:
3i	Will any person or organisation involved with the project be, directly or indirectly, financially compensated for operating the satellite and ground station(s)	☐ yes, see 3j ☒ no
3j	If you've answered yes in 3i, please explain.	N/A

Space station information:

4	SPACE STATION (published)	
4a	Type of mission Tick applicable box(es)	☒ Amateur ☒ Amateur combined with Educational ☐ Amateur combined with other mission(s)
4a3	If mission type in 4a is Amateur combined with other missions, will the transmitters or receivers operating in the amateur radio frequencies be used to control, or retrieve data (telemetry, payload, etc.) from the non-amateur mission sub-systems?	☐ yes, see 4a4 ☒ no
4a4	If you've answered yes in 4a3, please explain.	
4b	Mission(s): List and describe in clear text the project mission(s)	Gather and transmit magnetic field data from LEO
4b1	Amateur Satellite Bands used:	☐ 144-146 MHz ☒ 435-438 MHz ☐ 1260-1270 MHz ☐ 2400-2450 MHz ☐ 3400-3410 MHz ☐ 5650-5670 MHz and/or 5830-5850 MHz ☐ 10.450-10.500 GHz ☐ 24.000-24.050 GHz ☐ Other (please describe)
4c	Planned duration of each part of the mission.	60 days
4d	Proposed space station transmitting frequency plan.	
4d1	List all the frequencies (or frequency bands) requested and describe the function of each	437.6MHz; periodic data beacon downlink
4d2	Frequency tuning range (in MHz) of transmitter	420MHz-450MHz, 100kHz increments

	and tuning step increment (in Hz or kHz)	
4d3	EIRP (in dBm)	34.77dBm (3W)
4d4	List all ITU emission designator For each transmitter	25k0F1D
4d5	Common description of the emission including modulation type AND data rate	1200bps health and status beacon, AX.25 modulated
4d6	Type of antenna, antenna gain and pattern	dual monopole; omnidirectional pattern
4d7	Attitude stabilisation, if used	N/A
4d8	Service Area	Worldwide
4e	Proposed space station receiving frequency plan. List for each frequency or frequency range:	
4e1	Requested frequency and function	N/A
4e2	Frequency tuning range (in MHz) of receiver and tuning step increment (in Hz or kHz)	N/A
4e3	ITU emission designator for each transmitter and emission type	N/A
4e4	Common description of the emission including modulation type AND data rate for each transmitter and emission type	N/A
4e5	Noise temperature for each receiver onboard the satellite	N/A
4e6	Associated antenna gain and pattern for each receiver onboard the satellite	N/A
4f	Physical structure, including dimension and mass:	N/A
4g	Functional Description of	Satellite consists of a flight processing module (Pumpkin PIC24

	each satellite sub-system, including non-amateur payloads	processor) for command and data handling, a PyCubed Electrical power and regulation system, along with a set of LiPo batteries. Spectrolab UTJ solar cells mounted on 5 of 6 exterior surfaces. Data gathering payloads consists of 3 magnetometers to measure the Earth's magnetic field in orbit, one digital sun sensor (Sinclair Interplanetary) to get an attitude fix, and a triad of gyroscopes to track angular position and rotation rates. Two of the three magnetometers will be on deployable booms to isolate them from the structure, along with two whip antennas for Stensat beacon transmission																									
4h	Electrical Power budget. (average power consumption and power generation in Watts)	<table border="1"> <thead> <tr> <th>Mode</th><th>Power Drain (5) [W]</th><th>Power Drain (3.3) [W]</th><th>Power Drain (Raw) [W]</th><th>Power Drain (Total) [W]</th></tr> </thead> <tbody> <tr> <td>Eclipse</td><td>0.57475</td><td>0.00275</td><td>0.55</td><td>1.1275</td></tr> <tr> <td>Normal Cruise</td><td>1.10275</td><td>0.07425</td><td>0.55</td><td>1.727</td></tr> <tr> <td>Worse Case Mission Ops</td><td>12.00375</td><td>0.07425</td><td>0.99</td><td>13.068</td></tr> <tr> <td>Brownout Reboot</td><td>0.40975</td><td>0</td><td>0.55</td><td>0.95975</td></tr> </tbody> </table>	Mode	Power Drain (5) [W]	Power Drain (3.3) [W]	Power Drain (Raw) [W]	Power Drain (Total) [W]	Eclipse	0.57475	0.00275	0.55	1.1275	Normal Cruise	1.10275	0.07425	0.55	1.727	Worse Case Mission Ops	12.00375	0.07425	0.99	13.068	Brownout Reboot	0.40975	0	0.55	0.95975
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4i	Will all transmissions (telemetry formats and equations, payload data, etc.) from the satellite have descriptions of modulations, protocols, formats, etc., published and publicly available on the project web site?	☒ yes ☐ no, see 4j																									
4j	If you've answered no in 4i, please explain.																										
5	TELECOMMAND (NOT published)																										

5a	Telecommand frequency plan.	
5a1	Proposed space station telecommand frequencies	Telecommand N/A (downlink only)
5a2	List all ITU emission designators for each transmitter	N/A
5a3	Common description of the emission including modulation type AND data rate	N/A
5a4	Radio Link budget(s)	N/A
5a5	A general description of any cipher system	N/A
5b	Positive space station transmitter control. Explain how telecommand stations will turn off the space station transmitter(s) immediately, even in the presence of user traffic and/or space station computer system failure	N/A
5c	Telecommand stations. List telecommand station(s)	
5c1	Amateur Radio Callsign	N/A
5c2	Physical location (this is where the antennas are) lat/lon	N/A
5d	Optional: Give the complete space station turn off procedure.	N/A
6	Telemetry (published)	
6a	Telemetry frequencies	
6a1	All amateur telemetry frequencies or frequency bands	Beacon: Stensat Beacon Frequency Band: 437.6 MHz Output Power: 3W Antenna: dual monopole; omnidirectional pattern
6a2	ITU emission designator	25k0F1D
6a3	Common description of the emission including modulation type AND	AFSK - Audio Frequency Shift Keying Data Rate : 1200bps

	data rate																																																																																																																																																																																																																												
6a4	Radio Link budgets	USC Ground Station “Yagi”-type UHF Antenna: (see below)																																																																																																																																																																																																																											
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6b	Transmission formats	FM transmitter generating AX.25 UI packets at 1200 bps AFSK																																																																																																																																																																																																																											
7	Launch plans (published)																																																																																																																																																																																																																												
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7b	Launch location	Vandenberg Air Force Base																																																																																																																																																																																																																											
7c	Expected launch date	February/March 2020																																																																																																																																																																																																																											
7d	Planned orbit.																																																																																																																																																																																																																												

7d1	planned orbit apogee	300 km
7d2	planned orbit perigee	300 km
7d3	planned orbit inclination	97 deg
7d4	planned orbit period	5431.18 seconds
7e	List other amateur satellites expected to share the same launch.	Hawaii Science Museum (1U) Naval Post-Graduate School (3U) Teachers in Space (3U)

Earth station information:

8	Typical Earth station — transmitting	
8a	Describe the hardware and software of a typical Earth station used to transmit signals to the planned satellite	N/A
8b	Radio Link budget. Show complete link budgets for all Earth station transmitting frequencies, except telecommand.	N/A
9	Typical Earth station — receiving	
9a	Describe the hardware and software of a typical Earth station to receive signals from the planned satellite.	(Downlink Beacon: 437.6MHz) Ground Station: Frequency Band: 432-440MHz Antenna: UHF “Yagi” type antenna Antenna Pattern: Unidirectional, 30 deg circular beamwidth Antenna Gain: 15.5dBi Processing: HackRF or similar ADC peripheral; PC computer; GNU Radio SDR and signal processing
9b	Radio Link budget. Show complete link budgets for all Earth station receiving frequencies.	USC Ground Station “Yagi”-type UHF Antenna: (see below)

		USC UHF Antenna			
		MAGNETO			
Item	Units	Downlink			
Frequency	Mhz	437.6			
Transmitter		Stensat Flight Beacon			
Transmitter Power	W	3.0			
Transmitter Power	dBW	4.8			
Amplifier Gain	dB	N/A			
Power Out	W	3.0			
Transmitter Line Loss	dB	-1.5			
Transmit Antenna Beamwidth	deg	360.0			
Peak Transmit Antenna Gain	dBi	0.0			
Transmit Antenna Pointing Error	deg	0.0			
Transmit Antenna Pointing Loss	dB	0.0			
Transmit Antenna Gain (net)	dBi	0.0			
EIRP	dBW	4.8			
Polarization	-	Linear			
Lossess					
Elevation Angle	deg	90.0	45.0	1.0	
Circular Orbit Altitude	km		300.0		
Propagation Path Length (Slant Range)	km	300	415	1869	
Space Loss	dB	-135	-138	-151	
Impl. Loss (cable/connector/filter)	dB		-4.0		
Propagation & Polarization Loss	dB		-3.0		
Receiver		SDR ADC + PC			
Polarization	-				
Peak Receive Antenna Gain	dBi	15.5			
Receive Antenna Beamwidth	deg	30.0			
Receive Antenna Pointing Error	deg	1.0			
Receive Antenna Pointing Loss	dB	0.0			
LNA Gain	dB	18.0			
Antenna Noise Temperature	K	10.0			
Receiver Noise Temperature	K	315.0			
System Noise Temperature	K	325.0			
Receiver Total Gain	dBi	33.5			
Power Out	dBm	-71.1	-73.9	-86.9	
Rates					
Data Rate	bps	1200			
Required Eb/No	dB	13.3			
Eb/No	dB	73.1	70.3	57.2	
Bit Error Rate (MSK)					
Carrier to Noise Density Ratio	dB-Hz	103.9	101.1	88.0	
Link Margin	dB		55.8	53.0	39.9

Additional information:

Do not attach large files. Indicate the URL where the information is available.

10	Please, supply any additional information that may assist the Satellite Advisor to coordinate your request(s).
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Certification:

11 *	☒ The licensee of the planned space station has reviewed all relevant laws, rules, and regulations, and certifies that this request complies with all requirements as understood by IARU to the best of his/her knowledge and confirms to meet the requirements of RR 1.56 and RR 1.57 in that the proposed satellite will operate without pecuniary interest. Please list any commercial interests. If none, please state none.
	☐ The licensee of the planned space station has reviewed all relevant laws, rules, and regulations and disagrees with IARU interpretations of Treaty requirements. The IARU Satellite Advisor is asked to consider the following interpretation. Explanation follows.

Please tick ONE appropriate box.

Signature:

12	(REQUIRED!) Signature of space station licensee. coordination. Date submitted for
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