

**AMATEUR SATELLITE FREQUENCY COORDINATION REQUEST**

(Make a separate request for each space station to be operated in the amateur-satellite service.)

**Administrative information:**

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| **0** | **DOCUMENT CONTROL** |
| 0a | Date submitted | (dd-MMM-yyyy) |
| 0b | Expected launch date | (dd-MMM-yyyy) |
| 0c | Document revision number (start at zero and increment with each revised request) | **Ver.0.1** |
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| **1** | **SPACECRAFT (published)** |
| 1a | Name before launch | NEXUS |
| 1b | Proposed name after launch | NEXUS |
| 1c | Country of license | JAPAN |
| 1d | API/A special section number | TBD |
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| **2** | **LICENSEE OF THE SPACE STATION (published)** |
| 2a | First (given) name | Yasuyuki |
| 2b | Last (family) name | Miyazaki |
| 2c | Call sign | JQ1YGV |
| 2d | Postal address | 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan |
| 2e | Telephone number (including country code) | +81-47-469-5430 |
| 2f | E-mail address (licensee will be our point of contact and receive all correspondence) | miyazaki@forth.aero.cst.nihon-u.ac.jp |
| 2g | Skype or FaceTIme name (if available) | N/A |
| 2h | Licensee’s position in any organisation referenced in item 3a. | Professor |
| 2i | List names and e-mail addresses of *additional* people who should receive copies of correspondence. | tamura@forth.aero.cst.nihon-u.ac.jpsuzuki@forth.aero.cst.nihon-u.ac.jp |
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| **3** | **ORGANISATIONS (published) — complete this section for EACH participating organization** |
| 3a | Name of organisation | Department of Aerospace Engineering, College of Science and Technology, Nihon University The Japan AMSAT Association (JAMSAT)The Japan Amateur Radio League, Inc. (JARL) |
| 3b | Physical address | Department of Aerospace Engineering, College of Science and Technology, Nihon University 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan The Japan AMSAT Association (JAMSAT) 3-30-22 Wada, Suginami, Tokyo 166-8532, JapanThe Japan Amateur Radio League, Inc. (JARL) 3-43-1 Minamiothuka, Toshima, Tokyo 170-8073, Japan |
| 3c | Postal address | Department of Aerospace Engineering, College of Science and Technology, Nihon University 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan The Japan AMSAT Association (JAMSAT) 3-30-22 Wada, Suginami, Tokyo 166-8532, JapanThe Japan Amateur Radio League, Inc. (JARL)3-43-1 Minamiothuka, Toshima, Tokyo 170-8073, Japan |
| 3d | Telephone number (including country code) | Department of Aerospace Engineering, College of Science and Technology, Nihon University +81-47-469-5430 |
| 3e | E-mail address | miyazaki@forth.aero.cst.nihon-u.ac.jp |
| 3f | Web site URL | Department of Aerospace Engineering, College of Science and Technology, Nihon University <http://sat.aero.cst.nihon-u.ac.jp/nexus/>The Japan AMSAT Association (JAMSAT)<http://www.jamsat.or.jp/>The Japan Amateur Radio League, Inc. (JARL)<http://www.jarl.or.jp/> |
| 3g | National Amateur Radio Society (including contact information) | The Japan Amateur Radio League, Inc. (JARL)<http://www.jarl.or.jp/> |
| 3h | National Amateur Satellite organisation (including contact information) | The Japan AMSAT Association (JAMSAT)<http://www.jamsat.or.jp/> |
| 3i | Have you involved your National Amateur Satellite organization and/or National Amateur Radio Society? Please, explain. | We are the members of JARL and JAMSAT. |

**Space station information:**

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| **4** | **SPACE STATION (published)** |
| 4a | Mission(s).*Describe in detail what the space station is planned to do. Use as much space as you need.* | The main mission of NEXUS is as follows.* **Demonstration of π/4 shift QPSK transmitter.**

NEXUS performs data downlink by π/4 shift QPSK transmitter using the amateur radio band.We will perform the new radiowave format fast communication between satellite and groundstationTo evaluate its superiority, against the communication speed(1200~9600bps) which was the mainstream in conventional amateur radio communication.The demodulation performs the evaluation by using both hardware and software proprietary.* **Demonstration of transponder.**

We perform a space demonstration of transponder made by JAMSAT .We will operate the liner transponder for amateur radio operators.* **Demonstration of FM transceiver.**

We perform a space demonstration of FM transceiver which (FSK,AFSK,GMSK) made by JAMSAT.* **Demonstration of a camera system with high versatility and multifunction.**

Construction of a camera system with high versatility, focused on newly selected camera modules. We will take some pictures of the earth and use them for amateur radio operators. |
| 4b | Planned duration of each part of the mission. | Critical phase・Link verification between the satellite and the ground station.　The acquisition of House Keeping data by CW beacon.1 ~ 3 days after launch・Orbit determination　Specific object3 ~ 7 days after launch・Check out of satellite function Test operation of satellite system and equipment.1. FM transmitter and receiver(AFSK1200[bps]，GMSK9600[bps]).
2. Acquisition of sensor data.
3. FM transmitter and receiver (FSK(600[bps]~14400[bps]),GMSK(9600[bps]),AFSK(1200[bps])).
4. Confirmation of the power and heat balance.

Within 1 months after launch・Mission phase　Mission equipment operation check.1. π/4 shift QPSK transmitter test transmission.
2. Open part of the transponder.
3. FM transmitter and receiver test operate.
4. Photographed by the on board camera.

Within 3 months after launch・Evaluation of the success level1. Performance evaluation of the π/4 shift QPSK transmitter.
2. Demonstration of the transponder.
3. Demonstration of camera system.

Within 1 years after launch |
| 4c | Proposed space station **transmitting** frequency plan. *List for each frequency or frequency band:* *frequency or frequency band (e.g. 435-438 MHz)**requested frequency, if any**output power** ITU emission designator[[1]](#footnote-1),[[2]](#footnote-2)* * common description of the emission including modulation type AND data rate [[3]](#footnote-3)** antenna gain and pattern** attitude stabilisation, if used* | **CW/FM integrated transmitter**Frequency: 437.--- [MHz]Output power: 0.1[W](CW), 0.8[W](FM)Emission designator: 500HA1A (CW)16K0F2D, 16K0F3E, 16K0F3F, 26K0F1D (FM)Modulation method: Morse(CW) AFSK1200bps,GMSK9600bpsAntenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern.**Linear transponder** Transmit frequency: 435.--- [MHz] (e.g. 435.480-435.500)Total pass band: 20kHzOutput power: 0.5[W]Antenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern.**π/4 shift QPSK transmitter**Transmit frequency: 435.--- [MHz](Using the same frequency as the center frequency of the transponder)Output power: 0.8[W]Emission designator: 30K0G1DModulation method: π/4 shift QPSK 38400bpsAntenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern.**FM transceiver** Transmit frequency: 435.--- [MHz] (e.g. 435.480-435.500)(Same of Linear transponder downlink frequency)Output power: 0.4[W]Emission designator: 09K0F1D,18K5F1D,15K0F1D,09K0F2DModulation method: FSK600-9600bps(variability),GMSK9600bps,AFSK1200bpsAntenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern. |
| 4d | Proposed space station **receiving** frequency plan. *List for each frequency or frequency band:** frequency band**requested frequency, if any** ITU emission designator* * common description of the emission including modulation type AND data rate** noise temperature** associated antenna gain and pattern* | **FM receiver** Frequency: 145.--- [MHz]Emission designator: 20K0F2DModulation method: AFSK 1200bpsAntenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern.Noise temperature: 300[K]**Linear transponder**Reception frequency: 145.--- [MHz]（Using a different frequency from the FM receiver） (e.g. 145.850-145.870MHz)Total pass band: 20kHzNoise temperature: 300[K]Antenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern.**FM transceiver** Frequency: 145.--- [MHz] (Same of transponder uplink frequency)Emission designator: 16K0F1DModulation method: FSK 1200bpsAntenna gain: -2[dB]Antenna pattern: nearly same as mono-pole antenna pattern.Noise temperature: 600[K] |
| 4e | Physical structure.*General description, including dimensions, mass, antennas and antenna placement, whether stabilized or tumbling, etc. Give URL’s for drawings.* | Structure material: A7075-T7351Satellite mass: 1.19kgDimension: 109.2×105.2×113.5[mm]Antenna: mono-pole antennaAntenna material: elastic phosphorus bronze strip with Teflon coating on the antenna surfacePlease refer to Appendix 1 for the details of the structure. |
| 4f | Functional Description.*Describe each sections function within the satellite.* | The abbreviations used in the following are as follows.・SG(Sensor Group Sub System)・EPS(Electric Power Supply Sub System)・FMR(Flight Management Receiver Sub System)・CW(Continuous Wave Sub System)・C&DH (Command & Data Handling Sub System) ・CAM(Camera Sub System)**Transponder**: Transponder is a radio repeater with an uplink frequency of 145MHz, and a downlink frequency of 435MHz. The transmission power is 0.5[W].**π/4 shift QPSK transmitter**: The π/4 shift QPSK transmitter is a transmitter with a communication speed of 38400bps. It will be used for downlink of data in the band of 435MHz. The transmission power is 0.8[W].**SG**: SG a geomagnetism sensor, gyro sensor, temperature sensor, and a galvanometer is on board of NEXUS. SG has a function of relaying the sensor data to other sub systems. **EPS**: Six Li-ion secondary batteries (3.7V-1880mAh) in parallel are stored in NEXUS. NEXUS has 12 solar cells arranged 2 in series and 6 in parallel.**Communication system**: a total of 4 transceivers; an integrated CW/FM(AFSK1200bps，GMSK9600bps) transmitter, FM receiver, QPSK transmitter, and a transponder are on board. Each of the integrated CW/FM transmitter’s transmission powers are; CW:0.1[W], FM(AFSK，GMSK):0.8[W]. The 437MHz band will be used for downlink, and 145MHz band for uplink. Also, for an antenna, a monopole antenna will be used.**FMR**: FMR receives the uplink command from the earth station, it sends a command received in each of the sub-system.**CW**: This system transmits the housekeeping data to the earth station in Morse code.**C&DH**: C&DH transmits the camera data and the sensor data of the downlink, also SSTV, degi-talker sound by using FM transmitter(AFSK1200bps, GMSK9600bps). In addition, C&DH manages a mission equipment π / 4 shift QPSK transmitter, linear transponder and the CAM.**CAM**: This using for shooting of Earth images by a small camera module. Captured image data is stored in a Flash EPROM, and camera sends the data to the ground station through the C&DH. |
| 4g | Power budget.*Describe each power source, power consuming section, power storage, and overall power budget.* | Please refer to Appendix 2 for the details of the power budget. |
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| **5** | **TELECOMMAND (NOT published)** |
| 5a | **Telecommand** frequency plan.*List:** space station telecommand frequencies,* * ITU emission designator(s)** common description of the emission* *including modulation type AND data rate** link power budget(s)** a general description of any cipher system* | **FM receiver**Frequency: 145.--- [MHz]ITU emission designator: 20K0F2DModulation method: AFSK1200bpsNoise temperature: 300[K]Antenna pattern: nearly same as mono-pole antenna patternLink power budget: 50W(Earth Station)Cipher system: N/A (NEXUS is based on AX.25 protocol.)Please refer to Appendix 3 for the details of the link budget. |
| 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.****NOTE:*** *Transmitter turn off control from the ground is absolutely required. Good engineering practice is to make this capability independent of all other systems.*Be sure to read the paper at: [http://www.iaru.org/satellite/ControllingSatellites v27.pdf](http://www.iaru.org/satellite/ControllingSatellites%20v27.pdf). | NEXUS turns off the system by the kill command from the following earth station.Department of Aerospace Engineering, College of Science and Technology, Nihon University Amateur Radio StationCall sign: JQ1YGVLocation: Latitude 35:43:30.0000 N\_DMS Longitude 140:03:25.2000 E\_DMS Altitude 50.0[m]Address: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan |
| 5c | Telecommand stations.*List telecommand stations, including contact details, for sufficient Earth command stations to be established before launch to insure that any harmful interference caused by emissions from a station in the amateur-satellite service can be terminated**immediately. See RR 25.11 and RR 22.1* | Department of Aerospace Engineering, College of Science and Technology, Nihon University Amateur Radio StationCall sign: JQ1YGVLocation: Latitude 35:43:30.0000 N Longitude 140:03:25.2000 E Altitude 50.0[m]Address: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, JapanTel: +81-47-469-5430 |
| 5d | Optional: Give the complete space station turn off procedure.*As a service, the IARU Satellite Advisor will keep the space station turn off procedure as a backup for your operation. Only the space station licensee may request the information. If interference occurs and the licensee cannot be located, the licensee grants the Satellite Advisor permission to use the turn off procedure. Please note that the Satellite Advisor will use his best efforts, but cannot guarantee success. The space station licensee is still held responsible for the space station transmitter(s) by the licensing administration.* | N/A |
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| **6** | **Telemetry (published)** |
| 6a | Telemetry frequencies*List:** all telemetry frequencies or frequency bands,* * ITU emission designators** common description of the emission including modulation type AND data rate** link budgets* | Frequency: 437.---[MHz]ITU emission designators: 500HA1A, 16K0F2D,26K0F1D09K0F1D,18K5F1D,15K0F1DModulation method: CW, AFSK1200bps, GMSK9600bps, 600~14400bps(variability)Link budgets: 9.37[dB](CW), 3.35[dB](AFSK), 1.10[dB](GMSK)2.12[dB]~4.33[dB](FSK)Please refer to Appendix 3 for the details of the link budget. |
| 6b | Telemetry formats and equations.*Describe telemetry format(s), including telemetry equations. NOTE: Final equations must be published as soon as available.* | TBDTo the following URL we have published the HP of the NEXUS project.<http://sat.aero.cst.nihon-u.ac.jp/nexus/>In the future, in the pages of "Amateur Radio", it will be release the telemetry format. |
| 6c | Is the telemetry transmission format commonly used by radio amateurs? If not, describe how and where it will be published.Be sure to read: RR 25.2A. Text is included in the paper available at: <http://www.iaru.org/satellite/sat-freq-coord.html>. | To the following URL we have published the HP of the NEXUS project.<http://sat.aero.cst.nihon-u.ac.jp/nexus/>In the future, in the pages of "Amateur Radio", it will be release the telemetry format. |
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| **7** | **Launch plans (published)** |
| 7a | Launch agency | TBD |
| 7b | Launch location | TBD |
| 7c | Expected launch date | TBD |
| 7d | Planned orbit.*Include planned orbit apogee, perigee, inclination, and period.* | - Orbit: sun-synchronous polar orbit- altitude: 500-600㎞The details are being adjusted. |
| 7e | List other amateur satellites expected to share the same launch. | なし |

**Earth station information:**

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| **8** | **Typical Earth station — transmitting** |
| 8a | Describe a typical Earth station used to transmit signals to the planned space station. | **Location**: Latitude 35:43:30.0000 N\_DMS Longitude 140:03:25.2000 E\_DMS Altitude 50.0[m]**Address**: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan**Ground Station Devices**:\* Antenna (Oscar Hunter WHS32N (MASPRO))\* Radio (IC-910D (ICOM))\* TNC (TNC-505 (Tasco))\* Antenna Control Unit(Satellite Tracker RAC805, Direction controller RC5B-3, Elevation controller ERC5A (Creative Design Corp))**Antenna specification**: 144 MHz Band1 stack antennaActual gain 10-12[db]VSWR 1.1-1.5Approximately rate 20.7-22.5[db]Half value rate 33-35[deg]Sustainable power 50[W] |
| 8b | Link power budget.*Show complete link budgets for all Earth station transmitting frequencies, except telecommand.* | Command uplink : 27.31[dB]Transponder : 19.35[dB]Please refer to Appendix 3 for the link budget of the details. |
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| **9** | **Typical Earth station — receiving** |  |
| 9a | Describe a typical Earth station to receive signals from the planned satellite. | **Location**: Latitude 35:43:30.0000 N\_DMS Longitude 140:03:25.2000 E\_DMSAltitude 50.0[m]**Address**: 7-24-1 Narashinodai, Funabashi, Chiba 274-8501, Japan**Ground Station Devices**:\* Antenna (Oscar Hunter WHS32N (MASPRO))\* Radio (IC-910D (ICOM))\* TNC (TNC-555 (Tasco))\* Antenna Control Unit(Satellite Tracker RAC805, Direction controller RC5B-3, Elevation controller ERC5A (Creative Design Corp))**Antenna specification**: 430 MHz Band 2 stack antennaActual gain 12.5-13.4[db]VSWR 1.1-1.5Approximately rate 16.5-18.3[db]Half value rate 27-29[deg] |
| 9b | Link power budget.S*how complete link budgets for all Earth station receiving frequencies.* | 1. 437.---[MHz]

CW transmission: 9.37[dB]FM transmisson(AFSK1200[bps]): 3.35[dB]FM transmisson(GMSK9600[bps): 1.10[dB]1. 435.---[MHz]

Transponder 2.75[dB]π/4 shift QPSK 4.25[dB]Please refer to Appendix 3 for the link budget of the details. |

**Additional information:**

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

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| **10** | Please, supply any additional information that may assist the Satellite Advisor to coordinate your request(s).NEXUS project web site<http://sat.aero.cst.nihon-u.ac.jp/nexus/> |

**Certification:**

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| **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. *We confirm we 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:**

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| **12** | (REQUIRED!)　　　　　　　　　　15 December, 2016\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Signature of space station licensee. Date submitted for coordination. |

1. ITU emission designators are explained at: <http://life.itu.int/radioclub/rr/ap01.htm>. (Thank you, 4U1ITU.) Effect of Doppler shift is NOT included when determining bandwidth. [↑](#footnote-ref-1)
2. If using a frequency changing transponder, indicate the transmitting bandwidth. Effect of Doppler shift is NOT included when determining bandwidth. [↑](#footnote-ref-2)
3. Common emission description means terms like transponder, NBFM, PSK31, 1200 baud packet (AFSK on FM), etc. [↑](#footnote-ref-3)