



312 File Number: **SATMOD2020050100040**

Filing Description

Question	Response
Description	Application to Modify the Authorization for the Swarm NGSO Satellite System in VHF MSS band

Satellite Information

Question	Response
Select Orbit Type	NGSO
Space Station or Satellite Network Name	Swarm 1
Estimated Lifetime of Satellite(s) From Date of Launch	5 Years
Will the space station(s) operate on a Common Carrier basis?	No

**Operating
Frequency
Bands (2)**

Nature of service	Description	Frequency Band(s)	Mode Type
Mobile-Satellite Service		148.0 MHz -150.0 MHz	Receive
Mobile-Satellite Service		137.0 MHz -138.0 MHz	Transmit

**Orbital
Information For
Non-
Geostationary
Satellites**

Question	Response
Total Number of Satellites in the active constellation	150
Orbit Epoch Date	07/01/2020
Celestial Reference Body	Earth

Orbital Plane 1:

Question	Response
Number of Satellites in Plane	16
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	234.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	337.5
2	315.0
3	292.5
4	270.0
5	247.5
6	0.0
7	22.5
8	45.0
9	67.5
10	90.0
11	112.5
12	135.0
13	157.5

14	180.0
15	202.5
16	225.0

Orbital Plane 2:

Question	Response
Number of Satellites in Plane	16
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	168.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	337.5
2	315.0
3	292.5
4	270.0
5	247.5
6	225.0
7	202.5
8	180.0
9	157.5

10	135.0
11	112.5
12	0.0
13	22.5
14	45.0
15	67.5
16	90.0

Orbital Plane 3:

Question	Response
Number of Satellites in Plane	16
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	54.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	0.0
2	22.5
3	45.0
4	67.5
5	90.0

6	112.5
7	135.0
8	157.5
9	180.0
10	202.5
11	225.0
12	247.5
13	270.0
14	292.5
15	315.0
16	337.5

Orbital Plane 4:

Question	Response
Number of Satellites in Plane	18
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	332.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	340.0

2	320.0
3	300.0
4	280.0
5	260.0
6	0.0
7	20.0
8	40.0
9	60.0
10	80.0
11	100.0
12	120.0
13	140.0
14	160.0
15	180.0
16	200.0
17	220.0
18	240.0

Orbital Plane 5:

Question	Response
Number of Satellites in Plane	16
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	288.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km

Active Service Arc Begin Angle with respect to Ascending Node -90.0 degrees

Active Service Arc End Angle with respect to Ascending Node 90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	337.5
2	315.0
3	292.5
4	270.0
5	247.5
6	225.0
7	202.5
8	180.0
9	157.5
10	135.0
11	112.5
12	90.0
13	67.5
14	0.0
15	22.5
16	45.0

Orbital Plane 6:

Question	Response
Number of Satellites in Plane	16
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	127.0 degrees

Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	0.0
2	22.5
3	45.0
4	67.5
5	90.0
6	112.5
7	135.0
8	157.5
9	180.0
10	202.5
11	225.0
12	247.5
13	270.0
14	292.5
15	315.0
16	337.5

Orbital Plane 7:

Question	Response
Number of Satellites in Plane	12
Inclination Angle	97.7 degrees
Right Ascension of Ascending Node	105.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-90.0 degrees
Active Service Arc End Angle with respect to Ascending Node	90.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	90.0
2	120.0
3	0.0
4	300.0
5	270.0
6	180.0
7	150.0
8	240.0
9	330.0
10	60.0
11	30.0
12	210.0

Orbital Plane 8:

Question	Response
Number of Satellites in Plane	20
Inclination Angle	10.0 degrees
Right Ascension of Ascending Node	0.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-10.0 degrees
Active Service Arc End Angle with respect to Ascending Node	10.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	0.0
2	18.0
3	36.0
4	54.0
5	72.0
6	90.0
7	108.0
8	126.0
9	144.0
10	162.0
11	180.0
12	198.0
13	216.0
14	234.0

15	252.0
16	270.0
17	288.0
18	306.0
19	324.0
20	342.0

Orbital Plane 9:

Question	Response
Number of Satellites in Plane	20
Inclination Angle	45.0 degrees
Right Ascension of Ascending Node	0.0 degrees
Argument of Perigee	0.0 degrees
Orbital Period	5790.0 seconds
Apogee	585.0 km
Perigee	585.0 km
Active Service Arc Begin Angle with respect to Ascending Node	-45.0 degrees
Active Service Arc End Angle with respect to Ascending Node	45.0 degrees

Mean Anomaly For Each Satellite

Satellite Number	Mean Anomaly (degrees) at the Orbit Epoch Date
1	0.0
2	342.0
3	324.0
4	306.0
5	288.0
6	270.0

7	252.0
8	234.0
9	216.0
10	198.0
11	180.0
12	162.0
13	144.0
14	126.0
15	108.0
16	90.0
17	72.0
18	54.0
19	36.0
20	18.0

Receiving Beams 1:

Question	Response
Beam ID	RB02
Receive Beam Frequency	148.635 MHz -148.75 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
G/T at Max. Gain Point	-24.8 dB/K
Min. Saturation Flux Density	-154.2 dBW/m ²
Max. Saturation Flux Density	-125.2 dBW/m ²
Co- or Cross Polar Mode	C
Service Area Description	Global

Receiving Beams 2:

Question	Response
Beam ID	RB03
Receive Beam Frequency	149.9 MHz -149.95 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees

Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
G/T at Max. Gain Point	-24.8 dB/K
Min. Saturation Flux Density	-154.2 dBW/m2
Max. Saturation Flux Density	-125.2 dBW/m2
Co- or Cross Polar Mode	C
Service Area Description	Global

**Receiving
Beams 3:**

Question	Response
Beam ID	RB01
Receive Beam Frequency	148.25 MHz -148.585 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
G/T at Max. Gain Point	-24.8 dB/K
Min. Saturation Flux Density	-154.2 dBW/m2
Max. Saturation Flux Density	-125.2 dBW/m2
Co- or Cross Polar Mode	C
Service Area Description	Global

Receiving Channels (14)

Channel ID	Channel Bandwidth (MHz)	Center Frequency s (MHz)	Feeder Link, Service Link or TT&C
R014	0.03	149.925	Service Link
R001	0.03	148.2825	Service Link
R002	0.03	148.3125	Service Link
R003	0.03	148.3425	Service Link
R005	0.03	148.4025	Service Link
R006	0.03	148.4325	Service Link
R007	0.03	148.4625	Service Link
R004	0.03	148.3725	Service Link
R008	0.03	148.4925	Service Link
R013	0.03	148.7225	Service Link
R012	0.03	148.6925	Service Link
R011	0.03	148.6625	Service Link
R010	0.03	148.5525	Service Link
R009	0.03	148.5225	Service Link

Transmitting Beams 1:

Question	Response
Beam ID	TB05
Transmit Beam Frequency	137.813 MHz -138.0 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz
Max. Transmit EIRP	1.76 dBW
Co- or Cross Polar Mode	C
Service Area Description	Global

Max. Power Flux Density

	* 0° - 5°	* 5° - 10°	* 10° - 15°	* 15° - 20°	* 20° - 25°	* 25° - 90°
*	(dBW/m ²	(dBW/m ²	(dBW/m ²	(dBW/m ²	(dBW/m ²	(dBW/m ²
BW:	/BW):	/BW):	/BW):	/BW):	/BW):	/BW):
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

Transmitting Beams 2:

Question	Response
Beam ID	TB04
Transmit Beam Frequency	137.585 MHz -137.65 MHz

Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz
Max. Transmit EIRP	1.76 dBW
Co- or Cross Polar Mode	C
Service Area Description	Global

Max. Power Flux Density

	* 0° - 5° (dBW/m ² /BW):	* 5° - 10° (dBW/m ² /BW):	* 10° - 15° (dBW/m ² /BW):	* 15° - 20° (dBW/m ² /BW):	* 20° - 25° (dBW/m ² /BW):	* 25° - 90° (dBW/m ² /BW):
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

Transmitting Beams 3:

Question	Response
Beam ID	TB03
Transmit Beam Frequency	137.473 MHz -137.535 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees

Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz
Max. Transmit EIRP	1.76 dBW
Co- or Cross Polar Mode	C
Service Area Description	Global

Max. Power Flux Density

	* 0° - 5°	* 5° - 10°	* 10° - 15°	* 15° - 20°	* 20° - 25°	* 25° - 90°
*	(dBW/m ²	(dBW/m ²	(dBW/m ²	(dBW/m ²	(dBW/m ²	(dBW/m ²
BW:	/BW):	/BW):	/BW):	/BW):	/BW):	/BW):
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

Transmitting Beams 4:

Question	Response
Beam ID	TB02
Transmit Beam Frequency	137.328 MHz -137.375 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz

Max. Transmit EIRP	1.76 dBW
Co- or Cross Polar Mode	C
Service Area Description	Global

Max. Power Flux Density

	* 0° - 5° (dBW/m ²) /BW:	* 5° - 10° (dBW/m ²) /BW:	* 10° - 15° (dBW/m ²) /BW:	* 15° - 20° (dBW/m ²) /BW:	* 20° - 25° (dBW/m ²) /BW:	* 25° - 90° (dBW/m ²) /BW:
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

Transmitting Beams 5:

Question	Response
Beam ID	TB01
Transmit Beam Frequency	137.025 MHz -137.175 MHz
Beam Type	Fixed
Polarization	RHCP
Peak Gain	0.0 dBi
Antenna Pointing Error	2.0 degrees
Antenna Rotational Error	2.0 degrees
Polarization Switchable	
Polarization Alignment Relative to the Equatorial Plane	45.0 degrees
Max. Transmit EIRP Density	-41.4 dBW/Hz
Max. Transmit EIRP	1.76 dBW
Co- or Cross Polar Mode	C
Service Area Description	Global

Max. Power Flux Density

	* 0° - 5°	* 5° - 10°	* 10° - 15°	* 15° - 20°	* 20° - 25°	* 25° - 90°
* BW:	(dbW/m ²) /BW:	(dbW/m ²) /BW:	(dbW/m ²) /BW:	(dbW/m ²) /BW:	(dbW/m ²) /BW:	(dbW/m ²) /BW:
4.0 kHz	-129.4	-129.3	-129.2	-129.0	-128.8	-125.9

Transmitting Channels (12)

Channel ID	Channel Bandwidth (MHz)	Center Frequency s (MHz)	Feeder Link, Service Link or TT&C
T010	0.03	137.9063	Service Link
T009	0.03	137.8763	Service Link
T012	0.03	137.9663	Service Link
T001	0.03	137.055	Service Link
T002	0.03	137.085	Service Link
T003	0.03	137.115	Service Link
T004	0.03	137.145	Service Link
T005	0.03	137.3513	Service Link
T006	0.03	137.5038	Service Link
T007	0.03	137.6175	Service Link
T008	0.03	137.8463	Service Link
T011	0.03	137.9363	Service Link

Certification Questions

Question	Response
Are the applicable service area coverage requirements of 25.143(b)(2) (ii) and (iii), or 25.144(a)(3)(i), or 25.145 (c)(1) and (2), or 25.146(i)(1) and (2), or 25.148(c), or 25.225 met?	N/A
Are the applicable frequency tolerances of 25.202(e) and out-of-band emission limits of 25.202(f)(1),(2), and (3) met?	Yes
Are the cessation of emissions requirements of 25.207 met?	Yes
Are the applicable power-flux-density limits of 25.208 met, and is the appropriate technical showing provided within the application?	
For NGSO applications, are the applicable equivalent-power-flux-density limits of 25.208 met, and is the appropriate technical showing provided within the application?	N/A
Are the applicable full-frequency-reuse requirements of 25.210 met?	
If the application is for a 17/24 GHz BSS space station, will it be operated at an offset location with full power and interference protection in accordance with 25.262(b)?	

Attachments

File Name	Beam	Field	Attachment Type	Description
<u>Transmit Antenna Pattern.pdf</u>	TB01	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite transmit beam
<u>Receive Antenna Pattern.pdf</u>	RB01	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite receive beam
<u>Receive Antenna Pattern.pdf</u>	RB03	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite receive beam
<u>Transmit Antenna Pattern.pdf</u>	TB03	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite transmit beam
<u>Transmit Antenna Pattern.pdf</u>	TB04	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite transmit beam
<u>Transmit Antenna Pattern.pdf</u>	TB05	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite transmit beam
<u>Transmit Antenna Pattern.pdf</u>	TB02	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite transmit beam
<u>Receive Antenna Pattern.pdf</u>	RB02	NGSO Antenna Gain Data	PDF file (*.pdf)	Antenna pattern for satellite receive beam