# Special Temporary Authority Request SatLab duplex transceiver module Test

Lynk Global, Inc.

14 September 2020

## Introduction

The following document details an STA Request to the FCC by Lynk Global, Inc. (Lynk) to operate the SatLab duplex transceiver module on board our satellite *Lynk the World*, which was granted the call sign **WQ9XDP** under file number 2130-EX-ST-2019. This satellite commenced operations 13 May 2020. **This additional request will enable increased capacity and timely T&C delivery to provide additional testing opportunities** [redacted].

The SatLab module will permit a second, method for spacecraft commanding and spacecraft telemetry. In addition to providing redundancy, the SatLab module provides a higher data rate and timely T&C delivery which is desired for uploading code scripts and downloading large log files. These capabilities will allow increase the test capability and data exchange, expanding the test parameters and increasing the value [redacted].

The SatLab module can be turned off for coordination activities with other S-Band users. If necessary, it can be commanded off using the GlobalStar T&C, which can use time based commands to disable the SatLab module or to activate a Kill switch in the Lynk spacecraft, which terminates power to the SatLab module. The Kill switch will be actuated via the same process and with the same means of contact as the Lynk mission spacecraft.

The SatLab module will communicate between the Lynk spacecraft and ground stations using licensed commercial TT&C ground stations already approved for similar use. These service providers maintain global shared networks which include ground sites in the US and other countries. The only change from SatLab's currently licensed operations with other small satellites will be the chosen S-Band frequency. We are requesting that our Experimental License cover these space to ground transmissions.

The S-Band SatLab transceiver module uses separate transmit and receive antennas. Each antenna is a small patch (55 by 55 mm), which is mounted to the nadir deck of the Lynk spacecraft and a small distance from the UHF payload mission antenna.

[redacted]

**Test Time Frame: 01 September 2020 to 01 March 2021**

The ITU emission designation would be: 563KF1DXN
Bandwidth: 563.2 KHz
Modulation Nature: [1] Digital, on-off or quantized, no modulation
ERP: 2.1 W

The Emissions Designator 563KF1DXN signifies a wireless radio which transfers data over a modulated wave using Digital, on-off or quantized, no modulation signal. This signal transmits at a 563.2 KHz maximum bandwidth based on a bit rate of 512 kbps and a BT=0.5 (Time- Bandwidth

factor). The transmitter can produce a signal within the 2200-2290 MHz band, but is planned to be operated at a Transmission center frequency of 2260 MHz.

## Point of Contact to Suspend Transmission

Lynk Mission Operations for the mission will control the power to the Lynk SatLab module via TT&C system commands.

The Point of Contact for the Kill Switch is the
Operations Director: [redacted]

If Kill Switch is to be initiated, please contact to inform that the request is made:
Mr. Tyghe Speidel, [redacted]
Mr. Robert Noteboom, [redacted]

Mr. Speidel and Mr. Noteboom are also the points of contact if additional assistance is required to turn payload power off or any other related matter.

This will be performed using either of 2 methods:

- The SatLab module must be enabled by and may be disabled by a command over the TT&C system.
- All DC Power to the SatLab module may be disabled by a command to the electrical power system on the Lynk satellite bus.

[redacted]

Antenna Characteristics Table

## Transmitter Characteristics

The transmitter will operate at a BT=0.5, however, the vendor's power spectrum and tabular data (shown in the figures below) shows representative performance with a BT=0.35 Gaussian Filter at 3 normalized power levels and using a PRBS9 sequence, 512 kbps channel rate and at 2245 MHz carrier center frequency.

Representative Transmitter Specification Table

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Center frequency | 2200 | – | 2290 | MHz |
| Center frequency resolution | – | 20 | – | Hz |
| Bit rate | 128 | 512 | 512 | kbps |
| GMSK BT product | – | 0.35 | – | – |
| Output power | 20 | – | 30 | dBm |
| Output power adjust resolution | – | – | 0.1 | dB |
| Occupied bandwidth (99%, normalized freq.) | – | 1.0 | – | – |
| SFDR | 60 | – | – | dBc |
| Output harmonics | 60 | – | – | dBc |
| Adjacent Channel Power (CH BW = 512 kHz, CH Spacing = 750 kHz) | – | -44 | – | dB |
| RF Power sensor directivity | 11 | 18 | – | dB |
| ALC loop resolution (20 to 30 dBm output power) | – | – | 0.1 | dB |
| Initial frequency error (20 ℃ ) | – | – | 0.5 | ppm |
| Frequency error (over temperature) | – | 1.0 | 2.5 | ppm |
| Frequency error (aging per year) | – | – | 1.0 | ppm |
| Frequency error (20 kRad(Si) board level) | – | 1.0 | – | ppm |
| PA protection threshold (reflected power) | – | 25 | – | dBm |

## Service Description

Ground Station general description and performance

The Provider's Ground Station (GS) is designed to provide TT&C services to small satellites in the S-band commercial frequencies, a description of one of these ground stations follows.

A 3-meter parabolic dish is used for S-Band operations. The polarization is switchable between RHCP and LHCP (the Lynk antennas are RHCP). A ground Software Defined Radio (SDR) will manage the TT&C operations. A summary of the GS performance capability is provided in the tables below.

| **Mechanical Specifications** | | |
|---|---|---|
| Mount configuration | AZ/EL | |
| Rotors maximum speed | Azimuth: 20 °/s<br>Elevation: 2 °/s | |
| Rotation ranges | Azimuth: 0°± 270°<br>Elevation: 0°- 90° | |
| Keyhole | 5° for a 400km altitude satellite | |
| Tracking mode | Program tracking | |
| **S-Band TT&C Specifications** | | |
| | RX | TX |
| Frequency range [Mhz] | 2260 | 2080 |
| Polarization | RHCP/LHCP (switchable) | RHCP/LHCP (switchable) |
| Antenna gain [dBi] | 33.7 @2250 | 32.7 @2025 |
| G/T [dB/K] @5° | 10.7 @2250 MHz with 70 K of Antenna Temperature | |
| Beamwidth [°] @3dB | 3 | 3.33 |
| EIRP @2025 [dBW] | - | 43 |

The provisioned Ground Stations for the Lynk mission are listed in the table below.

| **Location** | **Latitude [N]** | **Longitude [E]** |
|---|---|---|
| [redacted] Italy | [redacted] | [redacted] |
| [redacted] USA | [redacted] | [redacted] |
| [redacted] USA | [redacted] | [redacted] |
| [redacted] Ireland | [redacted] | [redacted] |
| [redacted] USA | [redacted] | [redacted] |

Operations is a completely automated cloud-based ground segment solution to operate satellites. This architecture allows rapid scalability, native redundancy and high flexibility minimizing operations overhead.

Ground Stations are connected through dedicated single point VPN tunnels.

Network operation is automatically planned by the vendor provided Line Scheduler. It optimizes the

usage of the ground network sites by distributing satellite passages over all the specified GSs while satisfying Lynk's constraints (contact time, latency, link quality, etc.) and balancing the load during high peak activity and demanding operations. The output is a schedule with a moving window of 72 hours with TLE updates occurring every 6 hours.