Verification and Test Plan
SatNOGS COMMS

Libre Space Foundation

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DRAFT

Contents

1. Introduction

1.1 Purpose and Scope

This document describes verification and test procedures which verify that implementation of 'SatNOGS-COMMS' complies with the defined System Requirement Specification. It includes verification plan, test plan and description of tools, GSE and facilities.

1.2 Acronyms

COTS Commercial off the Self

DM Development Model

E2E End to End

EFM Electrical and Functional Model

EMC Electromagnetic Compatibility

EQM Engineering Qualification Model

GSE Ground Support Equipment

HMI Human Machine Interface

LEO Low Earth Orbit

LSF Libre Space Foundation

MU Mock-Up

ROD Review of Design

SDR Software Defined Radio

STM Structural-Thermal Model

TC&C Tele-command & Control

UHF Ultra High Frequency

2. Product Presentation

The SatNOGS COMMS is a turnkey solution enabling robust and reliable communication for LEO Cubesats. It operates in the UHF and S frequency bands, providing uplink and downlink capabilities on both of these spectrum regions. Demodulation and decoding of telemetry and payload data produced by SatNOGS COMMS is fully compatible with SatNOGS ground stations. SatNOGS COMMS also integrates tightly to SatNOGS Network, supporting a mission control system for TC&C and real-time dashboards. The SatNOGS COMMS architecture consists of two major modules, the space and the ground segment. The space segment consists of the hardware and the corresponding software that controls it, while the ground segment is used for uplink and downlink.

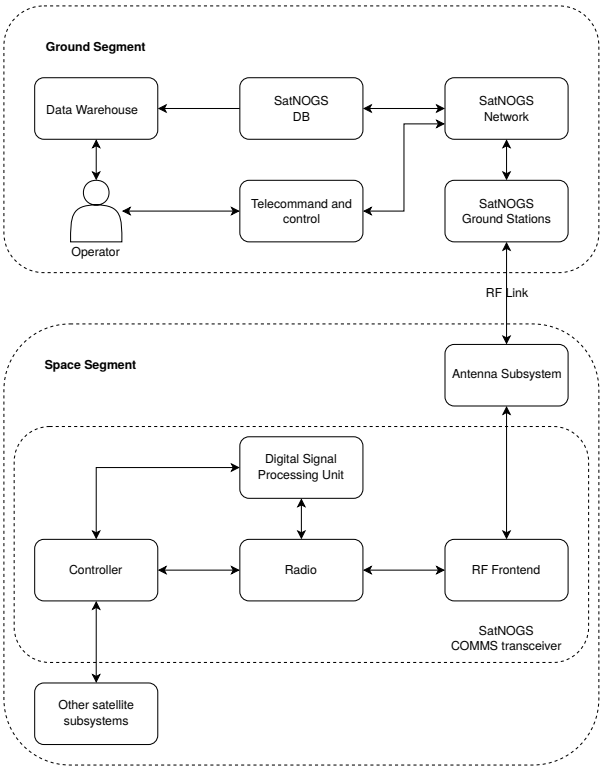

Figure 2.1: SatNOGS COMMS components

3. Verification Plan

3.1 Verification approach

3.1.1 Verification Methods

Verification is accomplished with at least one of the methods bellow depending on schedule and cost constraints:

- Inspection:
  Verification by inspection consists of visual determination of physical characteristics, for example constructional features, hardware conformance to document drawing or workmanship requirements, physical conditions, software source code conformance with coding standards etc.
- Review of design:
  Verification by ROD consists of using approved records or evidence that unambiguously show that the requirement is met.
- Analysis:
  Verification by analysis consists of performing theoretical or empirical evaluation using techniques, such as systematic, statistical and qualitative design analysis, modeling and computational simulation etc.
- Test:
  Verification by test consists of measuring product performance and functions under representative simulated environments.

3.1.2 Verification Levels

Requirements are verified in three different verification levels:

- System Level: The SatNOGS COMMS end-to-end system.
- Segment level: The ground and space segments.
- Equipment/Unit Level: The components of ground and space segments.

3.2 Model philosophy

The Model philosophy that is selected for SatNOGS COMMS is the hybrid model philosophy. The objective of following this approach is the reduction of risks while maintaining a balance in schedule and cost.

The output of this activity is an Engineering Qualification Model (EQM) for a new communication subsystem. By having a new design with COTS hardware and by following an agile development, the models needed for each verification level of SatNOGS COMMS are described bellow (*Note: Some of the models, that will be used in different verification levels, may be identical/represented by the same hardware*):

- System Level
  - Development Model (DM)
  - Electrical and Functional Model (EFM)
  - Structural-Thermal Model (STM)
  - Engineering Qualification Model (EQM)
  - Suitcase Model
- Segment level
  - Development Model (DM)
  - Electrical and Functional Model (EFM)
  - Engineering Qualification Model (EQM)
  - Ground Segment Models
    - Model for developing and verifying procedures and the Human Machine Interface (HMI)
    - Model for TC&C data processing and associated procedures
- Equipment/Unit Level
  - Mock-Up (MU)
  - Development Model (DM)

3.3 Verification strategy

Verification strategy of SatNOGS COMMS is a combination of the different verification methods, giving emphasis on test method, at the different verification levels as these described on the previous section. Following this strategy is the way to verify, test and fulfill requirements defined in System Requirement Specification and the corresponding GitLab requirement issues.

3.4 Verification control methodology

Monitoring and controlling the verification procedures is done through the issue tracker of open source git-repository manager GitLab by tracking verification issues for each method is applied at each level. GitLab issue tracker offers organizing and managing tools in order to effectively monitor and control the verification process.

4. Test Plan

Verification by test is performed at all three verification levels of the SatNOGS COMMS system in order to ensure that System Requirement Specification is satisfied, test case and the requirements that cover can be found in Appendix A.

4.1 Roles

There are three roles that participate in the testing plan with respective responsibilities.

- Developer:
  Responsible for implementation of the technical specification and low-level test cases.
- Tester:
  Responsible for implementing E2E tests and testing the technical specification implementation.
- Test Manager:
  Responsible for test plan execution by reviewing test reports and based on that accepting each level of technical specification implementation.

4.2 Levels

There are three different levels of testing:

Unit Testing

The purpose of this level is to test the smallest units of implementation and facilitate the development process. Unit tests are implemented and executed by the developer. There is no mapping or traceability of unit tests to system requirements. Unit tests are executed automatically to generate test coverage reports, that are used as feedback for proof of testing, risk assessment and acceptance of implementation by the Test Manager.

Functional/Module Testing

The purpose of this level is to verify correct implementation of low-level functional requirements for each of ground and space segment. Functional tests

are implemented by the developer and executed by the tester. Mapping and traceability of functional tests to system requirements is provided indirectly through association of low-level functional requirements to high-level system requirements. Functional tests are executed automatically and generate pass/fail reports, that are used as feedback for proof of testing, risk assessment and acceptance of implementation by the Test Manager.

Integration/End-to-end Testing

The purpose of this level is to verify correct implementation of high-level system requirements. E2E tests are implemented and executed by the tester. There are direct mapping and traceability of E2E tests to system requirements. E2E tests are executed automatically and generate pass/fail reports, that are used as feedback for proof of testing, risk assessment and acceptance of implementation by the Test Manager.

5. Tools and test facilities

In this section are described tools, GSE and test facilities that are available and required to execute the verification.

Collection of test data

From previous development efforts and SatNOGS development there are available random and structured data, frames etc.

RF measurement equipment

The electronics lab of LSF facilities is equipped with Spectrum analyzers, power meters, attenuators, power supplies and vector network analyzers. Additionally EMC testing facilities can be coordinated with EMC Hellas.

UHF and S-band receivers and transmitters

SDR devices that meet required specifications are available in LSF facilities.

Software simulators/emulators

COTS and open source simulators and emulators have been used in previous COMMS development efforts by LSF and are available in LSF facilities

Microcontroller and FPGA equipment

Programmers and development kits for microcontroller and FPGA exists in LSF facilities.

TVAC for environment testing

LSF has secured access to a Greek University TVAC facility that meets the verification and test requirements.

Vibration testing equipment

LSF has secured access to the Hellenic Aerospace Industry Inc. vibrational testing facilities.

Appendices

A. Test Cases

A.1 Inspect and verify that COMMS exposes a PC/104 connector

Title

Inspect and verify that COMMS exposes a PC/104 connector

Description

Inspect and verify that COMMS exposes a PC/104 connector

Type

Interface

Requirements

- REQ-007

A.2 Verify communication with COMMS using CAN bus protocol

Title

Verify communication with COMMS using CAN bus protocol

Description

Create a basic subsystem testing module. Verify that the module communicates correctly with COMMS using CAN bus protocol through the PC/104 connector

Type

Interface

Requirements

- REQ-006
- REQ-007

A.3 Measure and verify COMMS maximum mass of COMMS

Title

Measure and verify COMMS maximum mass of COMMS

Description

Measure the mass of the COMMS and verify it does not exceed 250g

Type

Interface

Requirements

- REQ-063

A.4 Measure and verify COMMS physical dimensions

Title

Measure and verify COMMS physical dimensions

Description

Measure the physical dimensions of the COMMS and verify it does not exceed 96mm x 96mm x 35mm

Type

Interface

Requirements

- REQ-008

A.5 Verify COMMS UHF transmission shutdown after GS telecommand through UHF

Title

Verify COMMS UHF transmission shutdown after GS telecommand through UHF

Description

Initiate COMMS UHF transmission shutdown by sending telecommand from GS through UHF and verify its success

Type

E2E,Functional

Requirements

- REQ-009

A.6 Verify COMMS S-band transmission shutdown after GS telecommand through UHF

Title

Verify COMMS S-band transmission shutdown after GS telecommand through UHF

Description

Initiate COMMS S-band transmission shutdown by sending telecommand from GS through UHF and verify its success

Type

E2E,Functional

Requirements

- REQ-009

A.7 Verify COMMS UHF transmission shutdown after GS telecommand through S-band

Title

Verify COMMS UHF transmission shutdown after GS telecommand through S-band

Description

Initiate COMMS UHF transmission shutdown by sending telecommand from GS through S-band and verify its success

Type

E2E,Functional

Requirements

- REQ-009

A.8 Verify COMMS S-band transmission shutdown after GS telecommand through S-band

Title

Verify COMMS S-band transmission shutdown after GS telecommand through S-band

Description

Initiate COMMS S-band transmission shutdown by sending telecommand from GS through S-band and verify its success

Type

E2E,Functional

Requirements

- REQ-009

A.9 Verify COMMS UHF transmission shutdown persistence after power reset

Title

Verify COMMS UHF transmission shutdown persistence after power reset

Description

Initiate COMMS UHF transmission shutdown by sending telecommand from GS through UHF or S-band and perform several power resets. Verify that UHF transmission remains disabled

Type

Functional

Requirements

- REQ-009
- REQ-010

A.10 Verify COMMS S-band transmission shutdown persistence after power reset

Title

Verify COMMS S-band transmission shutdown persistence after power reset

Description

Initiate COMMS S-band transmission shutdown by sending telecommand from GS through UHF or S-band and perform several power resets. Verify that UHF transmission remains disabled

Type

Functional

Requirements

- REQ-009
- REQ-010

A.11 Verify COMMS API for TX and RX on UHF conforms with the CCSDS specification

Title

Verify COMMS API for TX and RX on UHF conforms with the CCSDS specification

Description

Transmit and Receive data frames on UHF by using COMMS and verify that communication conforms with the CCSDS specification

Type

Functional

Requirements

- REQ-013

A.12 Verify COMMS API for TX and RX on S-band conforms with the CCSDS specification

Title

Verify COMMS API for TX and RX on S-band conforms with the CCSDS specification

Description

Transmit and Receive data frames on S-band by using COMMS and verify that communication conforms with the CCSDS specification

Type

Functional

Requirements

- REQ-013

A.13 Verify GS API for TX and RX on UHF conforms with the CCSDS specification

Title

Verify GS API for TX and RX on UHF conforms with the CCSDS specification

Description

Transmit and Receive data frames on UHF by using GS and verify that communication conforms with the CCSDS specification

Type

Functional

Requirements

- REQ-070

A.14 Verify GS API for TX and RX on S-band conforms with the CCSDS specification

Title

Verify GS API for TX and RX on S-band conforms with the CCSDS specification

Description

Transmit and Receive data frames on S-band by using GS and verify that communication conforms with the CCSDS specification

Type

Functional

Requirements

- REQ-070

A.15 Verify signal timing “Pulse” and signal type “Push Pull 3.3V” for output of antenna deployment mechanism

Title

Verify signal timing “Pulse” and signal type “Push Pull 3.3V” for output of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure output with signal timing “Pulse” and signal type “Push Pull 3.3V” and verify signal output for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.16 Verify signal timing “PWM” and signal type “Open Drain” for output of antenna deployment mechanism

Title

Verify signal timing “PWM” and signal type “Open Drain” for output of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure output with signal timing “PWM” and signal type “Open Drain” and verify signal output for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.17 Verify signal timing “Pulse” and signal type “Push Pull 3.3V” for output of antenna deployment mechanism

Title

Verify signal timing “Pulse” and signal type “Push Pull 3.3V” for output of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure output with signal timing “Pulse” and signal type “Push Pull 3.3V” and verify signal output for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.18 Verify signal timing “PWM” and signal type “Open Drain” for output of antenna deployment mechanism

Title

Verify signal timing “PWM” and signal type “Open Drain” for output of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure output with signal timing “PWM” and signal type “Open Drain” and verify signal output for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.19 Verify "Pull-up" input of antenna deployment mechanism

Title

Verify "Pull-up" input of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure input as "Pull-up" and verify signal input for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.20 Verify "Pull-down" input of antenna deployment mechanism

Title

Verify "Pull-down" input of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure input as "Pull-down" and verify signal input for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.21 Verify "Floating" input of antenna deployment mechanism

Title

Verify "Floating" input of antenna deployment mechanism

Description

In each of four (4) I/O interfaces, configure input as "Floating" and verify signal input for the selected interface

Type

Interface,Configuration

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.22 Verify antenna deployment mechanism after GS telecommand through UHF

Title

Verify antenna deployment mechanism after GS telecommand through UHF

Description

Initiate antenna deployment by sending telecommand from GS through UHF and verify its success for each combination of I/O interfaces

Type

E2E,Interface,Functional

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.23 Verify antenna deployment mechanism after GS telecommand through S-band

Title

Verify antenna deployment mechanism after GS telecommand through S-band

Description

Initiate antenna deployment by sending telecommand from GS through S-band and verify its success for each combination of I/O interfaces

Type

E2E,Interface,Functional

Requirements

- REQ-015
- REQ-062
- REQ-149
- REQ-151

A.24 Verify power supply interface of COMMS

Title

Verify power supply interface of COMMS

Description

Inspect, measure and verify COMMS operation for different voltage levels in the range of 3.3V to 28V, supplied through power supply electrical interface

Type

Interface

Requirements

- REQ-017

A.25 Verify RF connector interface of COMMS

Title

Verify RF connector interface of COMMS

Description

Inspect, measure and verify COMMS RF connector interface. Insertion loss should be less than 0.2dB and frequency range should be at least 4GHz

Type

Interface

Requirements

- REQ-018

A.26 Verify operation of GS on UHF frequencies supported by COMMS

Title

Verify operation of GS on UHF frequencies supported by COMMS

Description

Configure GS on different UHF frequencies in the range of 395MHz to 500MHz, using different or same frequency for TX and RX each time and verify GS operation on these frequencies

Type

Functional,Configuration

Requirements

- REQ-067

A.27 Verify operation of GS on S-band frequencies supported by COMMS

Title

Verify operation of GS on S-band frequencies supported by COMMS

Description

Configure GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, using different or same frequency for TX and RX each time and verify GS operation on these frequencies

Type

Functional,Configuration

Requirements

- REQ-067

A.28 Verify half duplex communication of COMMS on UHF supported frequencies

Title

Verify half duplex communication of COMMS on UHF supported frequencies

Description

Initiate communication with COMMS on different UHF frequencies in the range of 395MHz to 500MHz, using different or same frequency for TX and RX each time and with different channel bandwidths in range of 1kHz to 2MHz. Verify half duplex communication on the set frequencies, granularity of frequency tuning to be at least 100Hz and channel bandwidth as configured.

Type

Functional,Configuration

Requirements

- REQ-019
- REQ-066
- REQ-136

A.29 Verify half duplex communication of COMMS on S-band supported frequencies

Title

Verify half duplex communication of COMMS on S-band supported frequencies

Description

Initiate communication with COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX, using different or same frequency for TX and RX each time and with different channel bandwidths in range of 1kHz to 2MHz. Verify half duplex communication on the set frequencies, granularity of frequency tuning to be at least 100Hz and channel bandwidth as configured.

Type

Functional,Configuration

Requirements

- REQ-020
- REQ-066
- REQ-137

A.30 Verify concurrent UHF and S-band operation when hardware modem provided by the IC is used for both bands.

Title

Verify concurrent UHF and S-band operation when hardware modem provided by the IC is used for both bands.

Description

Initiate communication with COMMS on different frequencies for UHF (in the range of 395MHz to 500MHz) and for S-band (in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX) concurrently, by using hardware modem provided by the IC and verify that communication on both bands is successful

Type

Functional

Requirements

- REQ-021
- REQ-066
- REQ-136
- REQ-137

A.31 Verify I/Q data streaming on UHF at 4 MSPS

Title

Verify I/Q data streaming on UHF at 4 MSPS

Description

Initiate communication in I/Q data streaming mode with COMMS on different UHF frequencies in the range of 395MHz to 500MHz and verify that communication is successful, sampling rate is 4 MSPS with a maximum passband of 2 MHz and that resolution of each I/Q sample is at least 12bits (12 bits for the I, 12 bits for the Q component) for both TX and RX I/Q streams

Type

Functional

Requirements

- REQ-022
- REQ-066
- REQ-136

A.32 Verify I/Q data streaming on S-band at 4 MSPS

Title

Verify I/Q data streaming on S-band at 4 MSPS

Description

Initiate communication in I/Q data streaming mode with COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX, and verify that communication is successful, sampling rate is 4 MSPS with a maximum passband of 2 MHz and that resolution of each I/Q sample is at least 12bits (12 bits for the I, 12 bits for the Q component) for both TX and RX I/Q streams

Type

Functional

Requirements

- REQ-022
- REQ-066
- REQ-137

A.33 Verify I/Q data streaming on UHF with sampling rates less than 4 MSPS

Title

Verify I/Q data streaming on UHF with sampling rates less than 4 MSPS

Description

Initiate communication in I/Q data streaming mode with COMMS on different UHF frequencies in the range of 395MHz to 500MHz, using sampling rates less than 4 MSPS and verify that communication is successful, sampling rate is the selected one and that resolution of each I/Q sample is at least 12bits (12 bits for the I, 12 bits for the Q component) for both TX and RX I/Q streams

Type

Functional

Requirements

- REQ-022
- REQ-066
- REQ-136

A.34 Verify I/Q data streaming on S-band with sampling rates less than 4 MSPS

Title

Verify I/Q data streaming on S-band with sampling rates less than 4 MSPS

Description

Initiate communication in I/Q data streaming mode with COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX, using sampling rates less than 4 MSPS and verify that communication is successful, sampling rate is the selected one and that resolution of each I/Q sample is at least 12bits (12 bits for the I, 12 bits for the Q component) for both TX and RX I/Q streams

Type

Functional

Requirements

- REQ-022
- REQ-066
- REQ-137

A.35 Verify cognitive radio capabilities of COMMS

Title

Verify cognitive radio capabilities of COMMS

Description

Enable spectrum monitoring and spectrum sensing of COMMS and verify the existence and validity of monitoring and sensing results

Type

Functional

Requirements

- REQ-026

A.36 Verify RF operational stability of COMMS

Title

Verify RF operational stability of COMMS

Description

Measure and verify that COMMS RF operational stability conforms with ECSS-E-ST-50–05C, clauses 5.2, 6.2.5

Type

Functional

Requirements

- REQ-029
- REQ-061

A.37 Verify maximum permissible spurious emissions on UHF

Title

Verify maximum permissible spurious emissions on UHF

Description

Measure and verify that COMMS on UHF complies with SFCG 21–2R4 recommendation spectrum mask and the total power contained in any single spurious emission does not exceed -60 dBc

Type

Functional

Requirements

- REQ-032

A.38 Verify maximum permissible spurious emissions on S-band

Title

Verify maximum permissible spurious emissions on S-band

Description

Measure and verify that COMMS on S-band complies with SFCG 21–2R4 recommendation spectrum mask and the total power contained in any single spurious emission does not exceed -60 dBc

Type

Functional

Requirements

- REQ-032

A.39 Verify maximum permissible spurious emissions on combined UHF and S-band

Title

Verify maximum permissible spurious emissions on combined UHF and S-band

Description

Measure and verify that COMMS on combined UHF and S-band complies with SFCG 21–2R4 recommendation spectrum mask and the total power contained in any single spurious emission does not exceed -60 dBc

Type

Functional

Requirements

- REQ-032

A.40 Verify software maintainability of COMMS

Title

Verify software maintainability of COMMS

Description

Initiate upgrade of COMMS software from GS and verify that upgrade was successful

Type

E2E,Functional

Requirements

- REQ-037

A.41 Verify fall-back mechanism of software maintainability of COMMS

Title

Verify fall-back mechanism of software maintainability of COMMS

Description

Initiate upgrade of COMMS software from GS and force it to fail and verify that COMMS is responsive after the failed software upgrade

Type

E2E,Functional

Requirements

- REQ-037

A.42 Verify minimum data rate of COMMS on UHF

Title

Verify minimum data rate of COMMS on UHF

Description

Measure and verify that COMMS on UHF supports downlink and uplink data rate of at least 25kbps

Type

Performance

Requirements

- REQ-039

A.43 Verify minimum data rate of COMMS on S-band

Title

Verify minimum data rate of COMMS on S-band

Description

Measure and verify that COMMS on S-band supports downlink and uplink data rate of at least 600kbps

Type

Performance

Requirements

- REQ-040

A.44 Verify TX power configuration and capabilities of COMMS on UHF

Title

Verify TX power configuration and capabilities of COMMS on UHF

Description

Configure, measure and verify that transmit power of COMMS on UHF is at least 30dBm and the difference between set and measured output power is less than 1dB

Type

Performance

Requirements

- REQ-041
- REQ-068

A.45 Verify TX power configuration and capabilities of COMMS on S-band

Title

Verify TX power configuration and capabilities of COMMS on S-band

Description

Configure, measure and verify that transmit power of COMMS on S-band is at least 30dBm and the difference between set and measured output power is less than 1dB

Type

Performance

Requirements

- REQ-041
- REQ-068

A.46 Verify impedance of RF components and transmission lines of COMMS

Title

Verify impedance of RF components and transmission lines of COMMS

Description

Measure and verify that RF components and transmission lines of COMMS have an impedance of 50 Ohm

Type

Performance

Requirements

- REQ-043

A.47 Verify success of thermal vacuum cycling test

Title

Verify success of thermal vacuum cycling test

Description

Execute a thermal vacuum cycling test on the COMMS as specified in ECSS-E-ST-10–03C. Evaluate the test results and verify that test is successful

Type

Environmental

Requirements

- REQ-033
- REQ-035
- REQ-052
- REQ-076

A.48 Verify success of resonance survey test

Title

Verify success of resonance survey test

Description

Execute a resonance survey test on the COMMS as specified in ECSS-E-ST-10–03C. Evaluate the test results and verify that test is successful

Type

Environmental

Requirements

- REQ-033
- REQ-053

A.49 Verify success of sinusoidal vibration test

Title

Verify success of sinusoidal vibration test

Description

Execute a sinusoidal vibration test on the COMMS as specified in ECSS-E-ST-10–03C. Evaluate the test results and verify that test is successful

Type

Environmental

Requirements

- REQ-033
- REQ-054
- REQ-085

A.50 Verify success of random vibration test

Title

Verify success of random vibration test

Description

Execute a random vibration test on the COMMS as specified in ECSS-E-ST-10–03C. Evaluate the test results and verify that test is successful

Type

Environmental

Requirements

- REQ-033
- REQ-055
- REQ-085

A.51 Verify success of shock test

Title

Verify success of shock test

Description

Execute a shock test on the COMMS as specified in ECSS-E-ST-10–03C. Evaluate the test results and verify that test is successful

Type

Environmental

Requirements

- REQ-033
- REQ-056
- REQ-085

A.52 Verify success of EMC test

Title

Verify success of EMC test

Description

Execute a EMC test on the COMMS as specified in ECSS-E-ST-10–03C and ECSS-E-ST-20–07C. Evaluate the test results and verify that test is successful

Type

Environmental

Requirements

- REQ-057
- REQ-078
- REQ-079

A.53 Verify product documentation

Title

Verify product documentation

Description

Inspect and verify that COMMS documentation includes “Hardware operational requirements”, “Setup guide”, “Configuration guide”, “Example configuration”, “Troubleshooting guide” and “Information to contact the developer of the product if an undocumented question arises”

Type

Documentation

Requirements

- REQ-059

A.54 Verify configuration and support of FSK modulation for TX on UHF RF frontend of COMMS

Title

Verify configuration and support of FSK modulation for TX on UHF RF frontend of COMMS

Description

Configure COMMS RF frontend on UHF to use FSK modulation for TX with custom FSK modulation index and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-072
- REQ-080

A.55 Verify configuration and support of FSK modulation for RX on UHF RF frontend of COMMS

Title

Verify configuration and support of FSK modulation for RX on UHF RF frontend of COMMS

Description

Configure COMMS RF frontend on UHF to use FSK modulation for RX with custom FSK modulation index and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-074
- REQ-080

A.56 Verify configuration and support of FSK modulation for TX on UHF RF frontend of GS

Title

Verify configuration and support of FSK modulation for TX on UHF RF frontend of GS

Description

Configure GS RF frontend on UHF to use FSK modulation for TX with custom FSK modulation index and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-071

A.57 Verify configuration and support of FSK modulation for RX on UHF RF frontend of GS

Title

Verify configuration and support of FSK modulation for RX on UHF RF frontend of GS

Description

Configure GS RF frontend on UHF to use FSK modulation for RX with custom FSK modulation index and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-073

A.58 Verify configuration and support of MSK modulation for TX on UHF RF frontend of COMMS

Title

Verify configuration and support of MSK modulation for TX on UHF RF frontend of COMMS

Description

Configure COMMS RF frontend on UHF to use MSK modulation for TX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-072
- REQ-081

A.59 Verify configuration and support of MSK modulation for RX on UHF RF frontend of COMMS

Title

Verify configuration and support of MSK modulation for RX on UHF RF frontend of COMMS

Description

Configure COMMS RF frontend on UHF to use MSK modulation for RX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-074
- REQ-081

A.60 Verify configuration and support of MSK modulation for TX on UHF RF frontend of GS

Title

Verify configuration and support of MSK modulation for TX on UHF RF frontend of GS

Description

Configure GS RF frontend on UHF to use MSK modulation for TX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-071

A.61 Verify configuration and support of MSK modulation for RX on UHF RF frontend of GS

Title

Verify configuration and support of MSK modulation for RX on UHF RF frontend of GS

Description

Configure GS RF frontend on UHF to use MSK modulation for RX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-073

A.62 Verify configuration and support of MSK modulation for TX on S-band RF frontend of COMMS

Title

Verify configuration and support of MSK modulation for TX on S-band RF frontend of COMMS

Description

Configure COMMS RF frontend on S-band to use MSK modulation for TX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-072
- REQ-081

A.63 Verify configuration and support of MSK modulation for RX on S-band RF frontend of COMMS

Title

Verify configuration and support of MSK modulation for RX on S-band RF frontend of COMMS

Description

Configure COMMS RF frontend on S-band to use MSK modulation for RX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-074
- REQ-081

A.64 Verify configuration and support of MSK modulation for TX on S-band RF frontend of GS

Title

Verify configuration and support of MSK modulation for TX on S-band RF frontend of GS

Description

Configure GS RF frontend on S-band to use MSK modulation for TX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-071

A.65 Verify configuration and support of MSK modulation for RX on S-band RF frontend of GS

Title

Verify configuration and support of MSK modulation for RX on S-band RF frontend of GS

Description

Configure GS RF frontend on S-band to use MSK modulation for RX and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-073

A.66 Verify configuration and support of BPSK modulation for TX on UHF RF frontend of COMMS

Title

Verify configuration and support of BPSK modulation for TX on UHF RF frontend of COMMS

Description

Configure COMMS RF frontend on UHF to use BPSK modulation for TX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-072
- REQ-082

A.67 Verify configuration and support of BPSK modulation for RX on UHF RF frontend of COMMS

Title

Verify configuration and support of BPSK modulation for RX on UHF RF frontend of COMMS

Description

Configure COMMS RF frontend on UHF to use BPSK modulation for RX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-074
- REQ-082

A.68 Verify configuration and support of BPSK modulation for TX on UHF RF frontend of GS

Title

Verify configuration and support of BPSK modulation for TX on UHF RF frontend of GS

Description

Configure GS RF frontend on UHF to use BPSK modulation for TX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-071

A.69 Verify configuration and support of BPSK modulation for RX on UHF RF frontend of GS

Title

Verify configuration and support of BPSK modulation for RX on UHF RF frontend of GS

Description

Configure GS RF frontend on UHF to use BPSK modulation for RX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-073

A.70 Verify configuration and support of BPSK modulation for TX on S-band RF frontend of COMMS

Title

Verify configuration and support of BPSK modulation for TX on S-band RF frontend of COMMS

Description

Configure COMMS RF frontend on S-band to use BPSK modulation for TX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-072
- REQ-082

A.71 Verify configuration and support of BPSK modulation for RX on S-band RF frontend of COMMS

Title

Verify configuration and support of BPSK modulation for RX on S-band RF frontend of COMMS

Description

Configure COMMS RF frontend on S-band to use BPSK modulation for RX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-074
- REQ-082

A.72 Verify configuration and support of BPSK modulation for TX on S-band RF frontend of GS

Title

Verify configuration and support of BPSK modulation for TX on S-band RF frontend of GS

Description

Configure GS RF frontend on S-band to use BPSK modulation for TX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-071

A.73 Verify configuration and support of BPSK modulation for RX on S-band RF frontend of GS

Title

Verify configuration and support of BPSK modulation for RX on S-band RF frontend of GS

Description

Configure GS RF frontend on S-band to use BPSK modulation for RX with custom pulse shaping parameters and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-073

A.74 Verify configuration and support of QPSK modulation for TX on S-band RF frontend of COMMS

Title

Verify configuration and support of QPSK modulation for TX on S-band RF frontend of COMMS

Description

Configure COMMS RF frontend on S-band to use QPSK modulation for TX with custom pulse shaping parameters and custom constellation points mapping and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-072
- REQ-083

A.75 Verify configuration and support of QPSK modulation for RX on S-band RF frontend of COMMS

Title

Verify configuration and support of QPSK modulation for RX on S-band RF frontend of COMMS

Description

Configure COMMS RF frontend on S-band to use QPSK modulation for RX with custom pulse shaping parameters and custom constellation points mapping and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-074
- REQ-083

A.76 Verify configuration and support of QPSK modulation for TX on S-band RF frontend of GS

Title

Verify configuration and support of QPSK modulation for TX on S-band RF frontend of GS

Description

Configure GS RF frontend on S-band to use QPSK modulation for TX with custom pulse shaping parameters and custom constellation points mapping and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-071

A.77 Verify configuration and support of QPSK modulation for RX on S-band RF frontend of GS

Title

Verify configuration and support of QPSK modulation for RX on S-band RF frontend of GS

Description

Configure GS RF frontend on S-band to use QPSK modulation for RX with custom pulse shaping parameters and custom constellation points mapping and verify successful configuration and operation

Type

Functional,Configuration

Requirements

- REQ-073

A.78 Verify high speed interconnection link of COMMS

Title

Verify high speed interconnection link of COMMS

Description

Test and verify that link is able to pass through module interface connector, link throughput, excluding protocol overhead and retransmissions, exceeds maximum achievable data rates of S-band and that bus allows multiple devices to controll COMMS one at a time

Type

Interface

Requirements

- REQ-084

A.79 Verify transmitted signal quality of COMMS

Title

Verify transmitted signal quality of COMMS

Description

Measure and verify that COMMS transmitted signals performance using the provided TX methods conforms with the ECSS-E-ST-50–05C Rev 2, Clause 5.5, 6.1, 6.2 and 6.3

Type

Performance

Requirements

- REQ-138

A.80 Verify single event mitigation techniques

Title

Verify single event mitigation techniques

Description

Test and verify that COMMS utilizes hardware and software techniques to avoid catastrophic failure due to memory errors caused by single events or other sources

Type

Functional

Requirements

- REQ-139

A.81 Verify temperature sensors

Title

Verify temperature sensors

Description

Measure and verify that COMMS at least two temperature sensors are located near critical components and at least one of the sensors doesn't share the same communication bus with the others

Type

Functional

Requirements

- REQ-140

A.82 Verify COMMS Doppler tracking performance

Title

Verify COMMS Doppler tracking performance

Description

Measure and verify that COMMS Doppler tracking mechanism performance conforms with the ECSS-E-ST-50–02C

Type

Functional

Requirements

- REQ-143

A.83 Verify GS Doppler tracking performance

Title

Verify GS Doppler tracking performance

Description

Measure and verify that GS Doppler tracking mechanism performance conforms with the ECSS-E-ST-50–02C

Type

Functional

Requirements

- REQ-143

A.84 Verify GS performance of demodulation and decoding

Title

Verify GS performance of demodulation and decoding

Description

Measure and verify that GS should be able to demodulate and decode frames originating from the COMMS with a BER at most 6 dB worst than the BER curves provided by CCSDS 130.1-G-2 for the supported modulation and coding schemes. The BER performance measurements shall assume no frequency offset.

Type

Performance

Requirements

- REQ-142

A.85 Verify COMMS performance of demodulation and decoding

Title

Verify COMMS performance of demodulation and decoding

Description

Measure and verify that COMMS should be able to demodulate and decode frames originating from the GS with a BER at most 2 dB worst than the BER curves or tables provided by CCSDS 130.1-G-2 and CCSDS 230.1-G-2 for the supported modulation and coding schemes. The BER performance measurements shall assume no frequency offset.

Type

Performance

Requirements

- REQ-144

A.86 Verify COMMS power consumption of RX mode on UHF

Title

Verify COMMS power consumption of RX mode on UHF

Description

Measure and verify that COMMS power consumption of RX mode on UHF doesn't exceed 5.5W

Type

Performance

Requirements

- REQ-145

A.87 Verify COMMS power consumption of TX mode on UHF

Title

Verify COMMS power consumption of TX mode on UHF

Description

Measure and verify that COMMS power consumption of TX mode on UHF doesn't exceed 8.0W

Type

Performance

Requirements

- REQ-146

A.88 Verify COMMS power consumption of RX mode on S-band

Title

Verify COMMS power consumption of RX mode on S-band

Description

Measure and verify that COMMS power consumption of RX mode on S-band doesn't exceed 6.0W

Type

Performance

Requirements

- REQ-147

A.89 Verify COMMS power consumption of TX mode on S-band

Title

Verify COMMS power consumption of TX mode on S-band

Description

Measure and verify that COMMS power consumption of TX mode on S-band doesn't exceed 8.3W

Type

Performance

Requirements

- REQ-148

A.90 Verify COMMS recovery mechanisms from failure

Title

Verify COMMS recovery mechanisms from failure

Description

Test and verify COMMS software and hardware mechanisms to recover from short-circuits and latch-up failures

Type

Functional

Requirements

- REQ-150

A.91 Verify COMMS internal reset mechanism

Title

Verify COMMS internal reset mechanism

Description

Test and verify COMMS mechanism to reset its operation and restoration to its nominal operation in case of software malfunction

Type

Functional

Requirements

- REQ-152

A.92 Verify COMMS external reset mechanism

Title

Verify COMMS external reset mechanism

Description

Test and verify COMMS mechanism to inform other sub-system of its operating status in order to perform external reset if needed

Type

Interface,Functional

Requirements

- REQ-153

A.93 Verify of software reliability of COMMS

Title

Verify of software reliability of COMMS

Description

Inspect, test and verify that software of COMMS follows quality assurance software development guidelines and software behavior is predictable in all cases

Type

Functional

Requirements

- REQ-042

A.94 Verify that GS stores telemetry data in a time series database

Title

Verify that GS stores telemetry data in a time series database

Description

Transmit telemetry data from COMMS to GS and verify that telemetry data are stored in a time series database

Type

E2E,Functional

Requirements

- REQ-045

A.95 Verify graphical visualization of telemetry data

Title

Verify graphical visualization of telemetry data

Description

Transmit telemetry data from COMMS to GS and verify that telemetry data are graphically visualized in a telemetry dashboard with configurable layout and configurable displayed data

Type

E2E,Functional

Requirements

- REQ-046
- REQ-075

A.96 Verify E2E telemetry communication between GS and COMMS on UHF with FSK modulation without simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on UHF with FSK modulation without simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different UHF frequencies in the range of 395MHz to 500MHz with FSK modulation and without simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-064
- REQ-066
- REQ-067
- REQ-080

A.97 Verify E2E telemetry communication between GS and COMMS on UHF with FSK modulation with simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on UHF with FSK modulation with simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different UHF frequencies in the range of 395MHz to 500MHz with FSK modulation and with simulating realistic conditions. Verify that telemetry data are received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-049
- REQ-064
- REQ-066
- REQ-067
- REQ-080

A.98 Verify E2E TC&C communication between GS and COMMS on UHF with FSK modulation without simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on UHF with FSK modulation without simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different UHF frequencies in the range of 395MHz to 500MHz with FSK modulation and without simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-065
- REQ-066
- REQ-067
- REQ-080

A.99 Verify E2E TC&C communication between GS and COMMS on UHF with FSK modulation with simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on UHF with FSK modulation with simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different UHF frequencies in the range of 395MHz to 500MHz with FSK modulation and with simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-050
- REQ-065
- REQ-066
- REQ-067
- REQ-080

A.100 Verify E2E telemetry communication between GS and COMMS on UHF with MSK modulation without simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on UHF with MSK modulation without simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different UHF frequencies in the range of 395MHz to 500MHz with MSK modulation and without simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-064
- REQ-066
- REQ-067
- REQ-081

A.101 Verify E2E telemetry communication between GS and COMMS on UHF with MSK modulation with simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on UHF with MSK modulation with simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different UHF frequencies in the range of 395MHz to 500MHz with MSK modulation and with simulating realistic conditions. Verify that telemetry data are received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-049
- REQ-064
- REQ-066
- REQ-067
- REQ-081

A.102 Verify E2E TC&C communication between GS and COMMS on UHF with MSK modulation without simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on UHF with MSK modulation without simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different UHF frequencies in the range of 395MHz to 500MHz with MSK modulation and without simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-065
- REQ-066
- REQ-067
- REQ-081

A.103 Verify E2E TC&C communication between GS and COMMS on UHF with MSK modulation with simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on UHF with MSK modulation with simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different UHF frequencies in the range of 395MHz to 500MHz with MSK modulation and with simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-050
- REQ-065
- REQ-066
- REQ-067
- REQ-081

A.104 Verify E2E telemetry communication between GS and COMMS on S-band with MSK modulation without simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on S-band with MSK modulation without simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz with MSK modulation and without simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-064
- REQ-066
- REQ-067
- REQ-081

A.105 Verify E2E telemetry communication between GS and COMMS on S-band with MSK modulation with simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on S-band with MSK modulation with simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz with MSK modulation and with simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-049
- REQ-064
- REQ-066
- REQ-067
- REQ-081

A.106 Verify E2E TC&C communication between GS and COMMS on S-band with MSK modulation without simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on S-band with MSK modulation without simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, with MSK modulation and without simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-065
- REQ-066
- REQ-067
- REQ-081

A.107 Verify E2E TC&C communication between GS and COMMS on S-band with MSK modulation with simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on S-band with MSK modulation with simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, with MSK modulation and with simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-050
- REQ-065
- REQ-066
- REQ-067
- REQ-081

A.108 Verify E2E telemetry communication between GS and COMMS on UHF with BPSK modulation without simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on UHF with BPSK modulation without simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different UHF frequencies in the range of 395MHz to 500MHz with BPSK modulation and without simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-064
- REQ-066
- REQ-067
- REQ-082

A.109 Verify E2E telemetry communication between GS and COMMS on UHF with BPSK modulation with simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on UHF with BPSK modulation with simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different UHF frequencies in the range of 395MHz to 500MHz with BPSK modulation and with simulating realistic conditions. Verify that telemetry data are received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-049
- REQ-064
- REQ-066
- REQ-067
- REQ-082

A.110 Verify E2E TC&C communication between GS and COMMS on UHF with BPSK modulation without simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on UHF with BPSK modulation without simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different UHF frequencies in the range of 395MHz to 500MHz with BPSK modulation and without simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-065
- REQ-066
- REQ-067
- REQ-082

A.111 Verify E2E TC&C communication between GS and COMMS on UHF with BPSK modulation with simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on UHF with BPSK modulation with simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different UHF frequencies in the range of 395MHz to 500MHz with BPSK modulation and with simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-050
- REQ-065
- REQ-066
- REQ-067
- REQ-082

A.112 Verify E2E telemetry communication between GS and COMMS on S-band with BPSK modulation without simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on S-band with BPSK modulation without simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz with BPSK modulation and without simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-064
- REQ-066
- REQ-067
- REQ-082

A.113 Verify E2E telemetry communication between GS and COMMS on S-band with BPSK modulation with simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on S-band with BPSK modulation with simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz with BPSK modulation and with simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-049
- REQ-064
- REQ-066
- REQ-067
- REQ-082

A.114 Verify E2E TC&C communication between GS and COMMS on S-band with BPSK modulation without simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on S-band with BPSK modulation without simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, with BPSK modulation and without simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-065
- REQ-066
- REQ-067
- REQ-082

A.115 Verify E2E TC&C communication between GS and COMMS on S-band with BPSK modulation with simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on S-band with BPSK modulation with simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, with BPSK modulation and with simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-050
- REQ-065
- REQ-066
- REQ-067
- REQ-082

A.116 Verify E2E telemetry communication between GS and COMMS on S-band with QPSK modulation without simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on S-band with QPSK modulation without simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz with QPSK modulation and without simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-064
- REQ-066
- REQ-067
- REQ-083

A.117 Verify E2E telemetry communication between GS and COMMS on S-band with QPSK modulation with simulating realistic conditions

Title

Verify E2E telemetry communication between GS and COMMS on S-band with QPSK modulation with simulating realistic conditions

Description

Transmit telemetry data from COMMS to GS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz with QPSK modulation and with simulating realistic conditions. Verify that telemetry data has been received from GS, are demodulated and decoded, stored in time series database and graphically visualized in telemetry dashboard.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-049
- REQ-064
- REQ-066
- REQ-067
- REQ-083

A.118 Verify E2E TC&C communication between GS and COMMS on S-band with QPSK modulation without simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on S-band with QPSK modulation without simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, with QPSK modulation and without simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-065
- REQ-066
- REQ-067
- REQ-083

A.119 Verify E2E TC&C communication between GS and COMMS on S-band with QPSK modulation with simulating realistic conditions

Title

Verify E2E TC&C communication between GS and COMMS on S-band with QPSK modulation with simulating realistic conditions

Description

Initiate TC&C communication from GS to COMMS on different S-band frequencies in the range of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for RX and in the range of 2025MHz to 2110MHz or of 2200MHz to 2290MHz or of 2400MHz to 2450MHz for TX, with QPSK modulation and with simulating realistic conditions. Verify that TC&C packets and responses are received from GS and COMMS, are demodulated and decoded and the TC&C session is executed correctly.

Type

E2E,Functional

Requirements

- REQ-027
- REQ-045
- REQ-046
- REQ-050
- REQ-065
- REQ-066
- REQ-067
- REQ-083

A.120 Non Tested Requirements

Title

Non Tested Requirements

Description

Non Tested Requirements

Type

Non Tested Requirements

Requirements

- REQ-030
- REQ-031
- REQ-034
- REQ-036
- REQ-058
- REQ-038
- REQ-086
- REQ-087
- REQ-088
- REQ-089
- REQ-090
- REQ-091
- REQ-092
- REQ-051