# WINNF-TS-0122 Test Report

| | | |
|---|---|---|
| **FCC ID** | : | **QI3BECMX220UT5GAB** |
| **Equipment** | : | **Advanced 5G Industrial Router** |
| **Brand Name** | : | **BEC by BILLION®** |
| **Model Name** | : | **MX-220-UT-5G-A** |
| **Applicant** | : | **Billion Electric Co., Ltd.**<br>**8F, No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 23146, Taiwan** |
| **Manufacturer** | : | **Billion Electric Co., Ltd.**<br>**8F, No.192, Sec. 2, Zhongxing Rd., Xindian Dist., New Taipei City 23146, Taiwan** |
| **Standard** | : | **WINNF-TS-0122 Version V1.0.2** |
| **RF Interface** | : | **NR n48** |

**The product was received on Apr. 12, 2024 and testing was performed from Apr. 12, 2024 to May 14, 2024. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures given in WINNF-TS-0122 Version V1.0.2 and has been in compliance with the applicable technical standards.**

**The test results in this report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.**

**Approved by: Jones Tsai**

***Sporton International Inc. Wensan Laboratory***
*No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)*

TEL: 886-3-327-0868
FAX: 886-3-327-0855

# Table of Contents

**1. Administration Data ---------- 5**
1.1 Testing Laboratory---------- 5
**2. General Information ---------- 6**
2.1 Description of Unit Under Test (UUT)---------- 6
2.2 Protocol Test Summary ---------- 7
2.3 Time test for getting Grant Summary ---------- 8
2.4 Support Equipment---------- 8
2.5 Measuring Equipment List---------- 8
**3. Measurement Environment ---------- 9**
3.1 Test configuration without Domain Proxy ----------10
3.2 Standards ----------11
3.3 Protocol test procedure ----------11
3.4 Time test for getting Grant Procedure ----------11
**4. Protocol Test Results ----------12**
4.1 [WINNF.FT.C.REG.1] Multi-Step registration ----------12
4.2 [WINNF.FT.C.REG.7] Registration due to change of an installation parameter ----------13
4.3 [WINNF.FT.C.REG.8] Missing Required parameters (responseCode 102) ----------14
4.4 [WINNF.FT.C.REG.10] Pending registration (responseCode 200) ----------15
4.5 [WINNF.FT.C.REG.12] Invalid parameter (responseCode 103)----------16
4.6 [WINNF.FT.C.REG.14] Blacklisted CBSD (responseCode 101) ----------17
4.7 [WINNF.FT.C.REG.16] Unsupported SAS protocol version (responseCode 100) ----------18
4.8 [WINNF.FT.C.REG.18] Group Error (responseCode 201) ----------19
4.9 [WINNF.FT.C.GRA.1] Unsuccessful Grant responseCode=400 (INTERFERENCE) ----------20
4.10 [WINNF.FT.C.GRA.2] Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)----------21
4.11 [WINNF.FT.C.HBT.1] Heartbeat Success Case (first Heartbeat Response) ----------22
4.12 [WINNF.FT.C.HBT.3] Heartbeat responseCode=105 (DEREGISTER) ----------24
4.13 [WINNF.FT.C.HBT.4] Heartbeat responseCode=500 (TERMINATED_GRANT) ----------25
4.14 [WINNF.FT.C.HBT.5] Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response ----------26
4.15 [WINNF.FT.C.HBT.6] Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response ----------27
4.16 [WINNF.FT.C.HBT.7] Heartbeat responseCode=502 (UNSYNC_OP_PARAM) ----------29
4.17 [WINNF.FT.C.HBT.9] Heartbeat Response Absent (First Heartbeat) ----------30
4.18 [WINNF.FT.C.HBT.10] Heartbeat Response Absent (Subsequent Heartbeat)----------31
4.19 [WINNF.FT.C.MES.1] Registration Response contains measReportConfig----------32

4.20 [WINNF.FT.C.MES.3] Grant Response contains measReportConfig ----------34
4.21 [WINNF.FT.C.MES.4] Heartbeat Response contains measReportConfig ----------36
4.22 [WINNF.FT.C.RLQ.1] Successful Relinquishment ----------38
4.23 [WINNF.FT.C.DRG.1] Successful Deregistration ----------39
4.24 [WINNF.FT.C.SCS.1] Successful TLS connection between UUT and SAS Test Harness ----------40
4.25 [WINNF.FT.C.SCS.2] TLS failure due to revoked certificate ----------41
4.26 [WINNF.FT.C.SCS.3] TLS failure due to expired server certificate ----------42
4.27 [WINNF.FT.C.SCS.4] TLS failure when SAS Test Harness certificate is issued by an unknown CA43
4.28 [WINNF.FT.C.SCS.5] TLS failure when certificate at the SAS Test Harness is corrupted ----------44
4.29 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement ----------45
**5. Result of Time test for getting Grant ----------47**
5.1 1 second within any 10-second period ----------47
5.2 10 seconds within any 300-second period ----------48
5.3 20 seconds within any 3600-second period ----------49
**6. UUT register with the SAS irrespective of power levels ----------50**
6.1 Test Procedure ----------50
6.2 Result ----------50
**Appendix A. RF measurement plots**

# History of this test report

| Report No. | Version | Description | Issue Date |
|---|---|---|---|
| FG441121A | 01 | Initial issue of report | Jun. 18, 2024 |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

| Conformity Assessment Condition: |
|---|
| The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account. |
| **Disclaimer:** |
| The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity. |

**Reviewed by: William Chen**

**Report Producer: Rebecca Wu**

# 1. Administration Data

## 1.1 Testing Laboratory

| | |
|---|---|
| **Test Site** | Sporton International Inc. Wensan Laboratory |
| **Test Site Location** | No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)<br>TEL: +886-3-327-0868<br>FAX: +886-3-327-0855 |
| **Test Site No.** | **Sporton Site No.** |
| | TH05-HY |
| **Test Engineer** | Thomas Chen |
| **Temperature** | 21 ~ 25 ℃ |
| **Relative Humidity** | 50 ~ 56 % |

FCC Designation No.: TW3786

# 2. General Information

## 2.1 Description of Unit Under Test (UUT)

| Product Feature & Specification | |
|---|---|
| **UUT Type** | Advanced 5G Industrial Router |
| **Brand Name** | BEC by BILLION® |
| **Model Name** | MX-220-UT-5G-A |
| **FCC ID** | QI3BECMX220UT5GAB |
| **Professional Installation** | ■ Yes<br>☐ No |
| **Unit Under Test Type** | ☐ BTS-CBSD product (Base Station)<br>■ CPE-CBSD product (Customer Premises Equipment) |
| **UUT Category** | ■ Category A<br>☐ Category B |
| **Domain Proxy support** | ☐ UUT with Domain Proxy<br>■ UUT without Domain Proxy |
| **UUT Antenna Gain** | 9 dBi |
| **UUT HW Version** | V.1.0 |
| **UUT FW Version** | 1.00.1.148.3 |
| **UUT SW Version** | 1.00.1.148.3 |
| **UUT Serial Number** | B1X0324000007 |

## 2.2 Protocol Test Summary

| Section | Test Case ID | Test Case Title | Test Result |
|---|---|---|---|
| 6.1.4.1.1 | WINNF.FT.C.REG.1 | Multi-Step registration | PASS |
| 6.1.4.1.7 | WINNF.FT.C.REG.7 | Registration due to change of an installation parameter | PASS |
| 6.1.4.2.1 | WINNF.FT.C.REG.8 | Missing Required parameters (responseCode 102) | PASS |
| 6.1.4.2.3 | WINNF.FT.C.REG.10 | Pending registration (responseCode 200) | PASS |
| 6.1.4.2.5 | WINNF.FT.C.REG.12 | Invalid parameter (responseCode 103) | PASS |
| 6.1.4.2.7 | WINNF.FT.C.REG.14 | Blacklisted CBSD (responseCode 101) | PASS |
| 6.1.4.2.9 | WINNF.FT.C.REG.16 | Unsupported SAS protocol version (responseCode 100) | PASS |
| 6.1.4.2.11 | WINNF.FT.C.REG.18 | Group Error (responseCode 201) | PASS |
| 6.3.4.2.1 | WINNF.FT.C.GRA.1 | Unsuccessful Grant responseCode=400 (INTERFERENCE) | PASS |
| 6.3.4.2.2 | WINNF.FT.C.GRA.2 | Unsuccessful Grant responseCode=401 (GRANT_CONFLICT) | PASS |
| 6.4.4.1.1 | WINNF.FT.C.HBT.1 | Heartbeat Success Case (first Heartbeat Response) | PASS |
| 6.4.4.2.1 | WINNF.FT.C.HBT.3 | Heartbeat responseCode=105 (DEREGISTER) | PASS |
| 6.4.4.2.2 | WINNF.FT.C.HBT.4 | Heartbeat responseCode=500 (TERMINATED_GRANT) | PASS |
| 6.4.4.2.3 | WINNF.FT.C.HBT.5 | Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response | PASS |
| 6.4.4.2.4 | WINNF.FT.C.HBT.6 | Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response | PASS |
| 6.4.4.2.5 | WINNF.FT.C.HBT.7 | Heartbeat responseCode=502 (UNSYNC_OP_PARAM) | PASS |
| 6.4.4.3.1 | WINNF.FT.C.HBT.9 | Heartbeat Response Absent (First Heartbeat) | PASS |
| 6.4.4.3.2 | WINNF.FT.C.HBT.10 | Heartbeat Response Absent (Subsequent Heartbeat) | PASS |
| 6.5.4.2.1 | WINNF.FT.C.MES.1 | Registration Response contains measReportConfig | PASS |
| 6.5.4.2.3 | WINNF.FT.C.MES.3 | Grant Response contains measReportConfig | PASS |
| 6.5.4.2.4 | WINNF.FT.C.MES.4 | Heartbeat Response contains measReportConfig | PASS |
| 6.6.4.1.1 | WINNF.FT.C.RLQ.1 | Successful Relinquishment | PASS |
| 6.7.4.1.1 | WINNF.FT.C.DRG.1 | Successful Deregistration | PASS |

| Section | Test Case ID | Test Case Title | Test Result |
|---|---|---|---|
| 6.8.4.1.1 | WINNF.FT.C.SCS.1 | Successful TLS connection between UUT and SAS Test Harness | PASS |
| 6.8.4.2.1 | WINNF.FT.C.SCS.2 | TLS failure due to revoked certificate | PASS |
| 6.8.4.2.2 | WINNF.FT.C.SCS.3 | TLS failure due to expired server certificate | PASS |
| 6.8.4.2.3 | WINNF.FT.C.SCS.4 | TLS failure when SAS Test Harness certificate is issue by unknown CA | PASS |
| 6.8.4.2.4 | WINNF.FT.C.SCS.5 | TLS failure when certificate at the SAS Test Harness is corrupted | PASS |
| 7.1.4.1.1 | WINNF.PT.C.HBT | UUT RF Transmit Power Measurement | PASS |

## 2.3 Time test for getting Grant Summary

| Trail | Time limit | Monitoring time | Measured result | Verdict |
|---|---|---|---|---|
| 1 | 1 second | 10 seconds | 82.999ms | PASS |
| 2 | 10 seconds | 300 seconds | 407.996ms | PASS |
| 3 | 20 seconds | 3600 seconds | 2.988s | PASS |

## 2.4 Support Equipment

| Name | Brand Name | Type/Model | Serial Number | FCC ID |
|---|---|---|---|---|
| NR BTS-CBSD | BTI | M4370 | b23000022S | WBK-RU4370 |

## 2.5 Measuring Equipment List

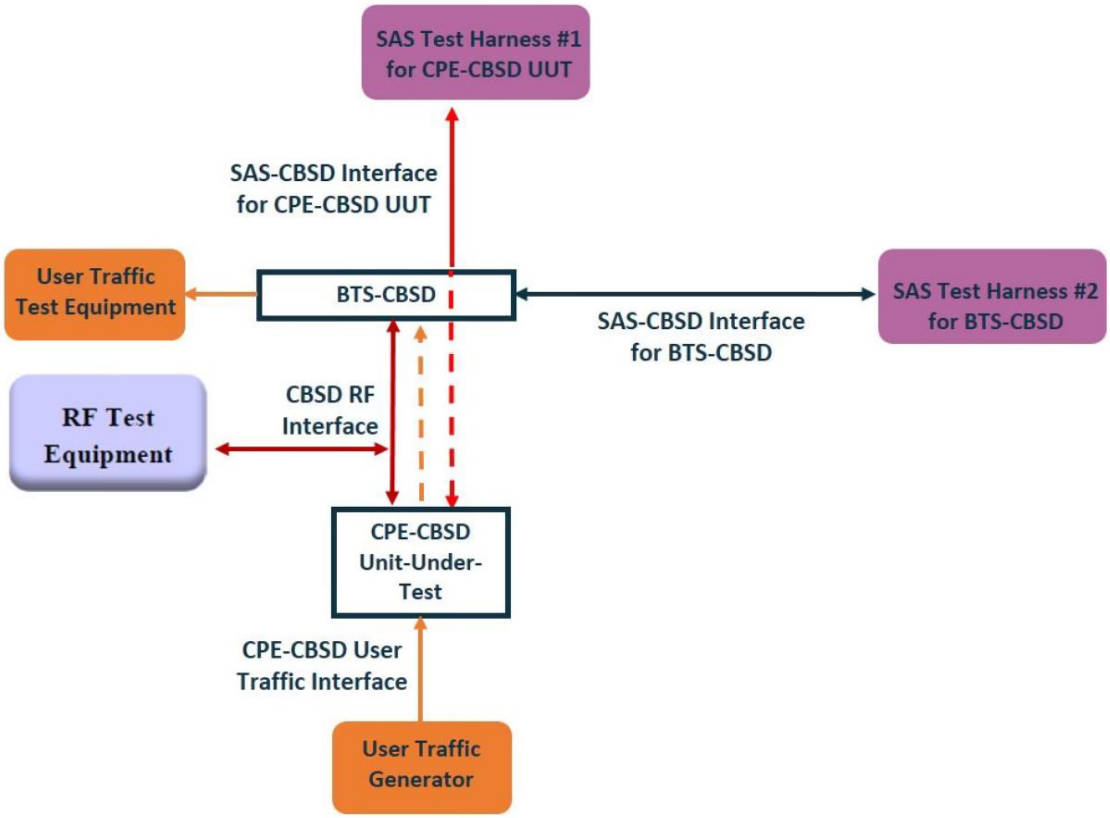
| Name | Brand Name | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Cal. | Due Date |
| Signal Analyzer | R&S | FSV3044 | 101435 | Nov. 01, 2023 | Oct. 31, 2024 |

# 3. Measurement Environment

| Measurement Environment Information | |
|---|---|
| **SAS Test Harness version** | 1.0.0.3 |
| **Operating System** | Windows 10 |
| **TLS version** | V 1.2 |
| **Python version** | V 2.7 |

| Conditional Test Case | | |
|---|---|---|
| **Support (Yes / No)** | **Condition** | **Definition** |
| Yes | C1 | Mandatory for UUT which supports multi-step registration message |
| No | C2 | Mandatory for UUT which supports single-step registration with no CPI-signed data in the registration message. By definition, this is a subset of Category A devices which determine all registration information, including location, without CPI intervention. |
| No | C3 | Mandatory for UUT which supports single-step registration containing CPIsigned data in the registration message. |
| Yes | C4 | Mandatory for UUT which supports RECEIVED_POWER_WITHOUT_GRANT measurement report type |
| Yes | C5 | Mandatory for UUT which supports RECEIVED_POWER_WITH_GRANT measurement report type. |
| Yes | C6 | Mandatory for UUT which supports parameter change being made at the UUT and prior to sending a deregistration. |

## 3.1 Test configuration without Domain Proxy




CPE-CBSD as UUT, BTS-CBSD direct communication.

## 3.2 Standards

[n.1]. FCC KDB 940660 D02 CPE-CBSD Handshake Procedures v02, 22 October 2019

[n.2]. WINNF-TS-0122 Version 1.0.2, “Conformance and Performance Test Technical Specification; CBSD/DP as Unit Under Test (UUT)”, 25 November 2020

[n.3]. WINNF-TS-0016 Version 1.2.7, “SAS to CBSD Technical Specification”, 21 March 2022

## 3.3 Protocol test procedure

The test cases for SAS<->CBSD protocol in [n.2] apply for CPE-CBSD device type. Following the [n.1], when running the test cases in [n.2] for CPE-CBSD device type, verify that:

1. CPE-CBSD can begin transmitting its RF only after receiving radio signal from its compatible BTS-CBSD.
2. For all CPE-CBSD RF transmissions, the CPE-CBSD UUT radio frequency range and bandwidth are less or equal to the frequency range and bandwidth of its compatible BTS-CBSD.
3. Judging the last execution step appearing in [n.2] with “User data traffics” instead of “RF transmission.”

## 3.4 Time test for getting Grant Procedure

Use the WinnForum SAS Harness run test case WINNF.FT.C.GRA.1. Without answering the last question in WINNF.FT.C.GRA.1 will keep UUT’s grant request being rejected, then measure the time.

# 4. Protocol Test Results

## 4.1 [WINNF.FT.C.REG.1] Multi-Step registration

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends correct Registration request information, as specified in [n.5], to the SAS Test Harness:<br>• The required userId, fccId and cbsdSerialNumber registration parameters shall be sent from the CBSD and conform to proper format and acceptable ranges.<br>• Any REG-conditional or optional registration parameters that may be included in the message shall be verified that they conform to proper format and are within acceptable ranges.<br>Note: It is outside the scope of this document to test the Registration information that is supplied via another means. | PASS |
| 3 | • SAS Test Harness sends a CBSD Registration Response as follows:<br>– *cbsdId* = C<br>– *measReportConfig* shall not be included<br>– *responseCode* = 0 | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=0) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.2 [WINNF.FT.C.REG.7] Registration due to change of an installation parameter

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness | -- |
| 2 | UUT has successfully registered with SAS Test Harness | -- |
| 3 | Change an installation parameters at the UUT (time T)<br>Tester needs to record the current time at which the parameter change is executed. | -- |
| 4 | Monitor the SAS-CBSD interface.<br>UUT sends a deregistrationRequest to the SAS Test Harness<br>The deregistration request shall be sent within (T + 60 seconds) from step 3. | PASS |

## 4.3 [WINNF.FT.C.REG.8] Missing Required parameters (responseCode 102)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends a Registration request to SAS Test Harness. | -- |
| 3 | SAS Test Harness rejects the request by sending a CBSD Registration Response as follows:<br>– SAS response does not include *cbsdId*<br>– *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=0) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.4 [WINNF.FT.C.REG.10] Pending registration (responseCode 200)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends a Registration request to SAS Test Harness. | -- |
| 3 | SAS Test Harness rejects the request by sending a CBSD Registration Response as follows:<br>– SAS response does not include *cbsdId*<br>– *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=200) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.5 [WINNF.FT.C.REG.12] Invalid parameter (responseCode 103)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends a Registration request to SAS Test Harness. | -- |
| 3 | SAS Test Harness rejects the request by sending a CBSD Registration Response as follows:<br>– SAS response does not include *cbsdId*<br>– *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=103) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.6 [WINNF.FT.C.REG.14] Blacklisted CBSD (responseCode 101)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends a Registration request to SAS Test Harness. | -- |
| 3 | SAS Test Harness rejects the request by sending a CBSD Registration Response as follows:<br>– SAS response does not include *cbsdId*<br>– *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=101) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.7 [WINNF.FT.C.REG.16] Unsupported SAS protocol version (responseCode 100)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends a Registration request to SAS Test Harness. | -- |
| 3 | SAS Test Harness rejects the request by sending a CBSD Registration Response as follows:<br>– SAS response does not include *cbsdId*<br>– *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=100) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.8 [WINNF.FT.C.REG.18] Group Error (responseCode 201)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT is in the Unregistered state | -- |
| 2 | CBSD sends a Registration request to SAS Test Harness. | -- |
| 3 | SAS Test Harness rejects the request by sending a CBSD Registration Response as follows:<br>– SAS response does not include *cbsdId*<br>– *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=201) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.9 [WINNF.FT.C.GRA.1] Unsuccessful Grant responseCode=400 (INTERFERENCE)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness, with *cbsdId* = C | -- |
| 2 | UUT sends valid Grant Request. | -- |
| 3 | SAS Test Harness sends a Grant Response message, including<br>• *cbsdId*=C<br>• *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=0) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.10 [WINNF.FT.C.GRA.2] Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness, with *cbsdId* = C | -- |
| 2 | UUT sends valid Grant Request. | -- |
| 3 | SAS Test Harness sends a Grant Response message, including<br>• *cbsdId*=C<br>• *responseCode* = R | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any positive response (*responseCode*=401) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.11 [WINNF.FT.C.HBT.1] Heartbeat Success Case (first Heartbeat Response)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness, with *cbsdId* = C | -- |
| 2 | UUT sends a message:<br>• If message is type Spectrum Inquiry Request, go to step 3, or<br>• If message is type Grant Request, go to step 5 | -- |
| 3 | UUT sends Spectrum Inquiry Request. Validate:<br>• *cbsdId* = C<br>• List of frequencyRange objects sent by UUT are within the CBRS frequency range | PASS |
| 4 | SAS Test Harness sends a Spectrum Inquiry Response message, including the following parameters:<br>• *cbsdId* = C<br>• availableChannel is an array of availableChannel objects<br>• *responseCode* = 0 | -- |
| 5 | UUT sends Grant Request message. Validate:<br>• *cbsdId* = C<br>• maxEIRP is at or below the limit appropriate for CBSD category as defined by Part 96<br>• operationFrequencyRange, F, sent by UUT is a valid range within the CBRS band | PASS |
| 6 | SAS Test Harness sends a Grant Response message, including the parameters:<br>• *cbsdId* = C<br>• *grantId* = G = a valid grant ID<br>• grantExpireTime = UTC time greater than duration of the test<br>• *responseCode* = 0 | -- |
| 7 | UUT sends a first Heartbeat Request message.<br>Verify Heartbeat Request message is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “GRANTED” | PASS |

| # | Test Execution Steps | Results |
|---|---|---|
| 8 | SAS Test Harness sends a Heartbeat Response message, with the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = current UTC time + 200 seconds<br>• *responseCode* = 0 | -- |
| 9 | For further Heartbeat Request messages sent from UUT after completion of step 8, validate message is sent within latest specified heartbeatInterval, and:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “AUTHORIZED”<br>and SAS Test Harness responds with a Heartbeat Response message including the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = current UTC time + 200 seconds<br>• *responseCode* = 0 | PASS |
| 10 | Monitor the RF output of the UUT from start of test until UUT transmission commences. Verify:<br>• UUT does not transmit at any time prior to completion of the first heartbeat response<br>• UUT transmits after step 8 is complete, and its transmission is limited to within the bandwidth range F. | PASS |

## 4.12 [WINNF.FT.C.HBT.3] Heartbeat responseCode=105 (DEREGISTER)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>  ○ valid *cbsdId* = C<br>  ○ valid *grantId* = G<br>  ○ grant is for frequency range F, power P<br>  ○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Ensure Heartbeat Request message is sent within Heartbeat Interval specified in the latest Heartbeat Response, and formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = "AUTHORIZED" | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, including the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime = T = Current UTC time*<br>• *responseCode* = 105 (DEREGISTER) | -- |
| 4 | After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT. | -- |
| 5 | Monitor the RF output of the UUT. Verify:<br>• UUT shall stop transmission within (T + 60 seconds) of completion of step 3 | PASS |

## 4.13 [WINNF.FT.C.HBT.4] Heartbeat responseCode=500 (TERMINATED_GRANT)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>  ○ valid *cbsdId* = C<br>  ○ valid *grantId* = G<br>  ○ grant is for frequency range F, power P<br>  ○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Ensure Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = "AUTHORIZED" | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, including the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = T = current UTC time<br>• *responseCode* = 500 (TERMINATED_GRANT) | -- |
| 4 | After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT. | -- |
| 5 | Monitor the RF output of the UUT. Verify:<br>• UUT shall stop transmission within (T + 60 seconds) of completion of step 3 | PASS |

## 4.14 [WINNF.FT.C.HBT.5] Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>○ valid *cbsdId* = C<br>○ valid *grantId* = G<br>○ grant is for frequency range F, power P<br>○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in GRANTED, but not AUTHORIZED state (i.e. has not performed its first Heartbeat Request) | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Verify Heartbeat Request message is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = "GRANTED" | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, including the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = T = current UTC time<br>• *responseCode* = 501 (SUSPENDED_GRANT) | -- |
| 4 | After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT. | -- |
| 5 | Monitor the SAS-CBSD interface. Verify either A OR B occurs:<br>A. UUT sends a Heartbeat Request message. Ensure message is sent within latest specified heartbeatInterval, and is correctly formatted with parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = "GRANTED"<br>B. UUT sends a Relinquishment request message. Ensure message is correctly formatted with parameters:<br>• *cbdsId* = C<br>• *grantId* = G<br>Monitor the RF output of the UUT. Verify:<br>• UUT does not transmit at any time | PASS |

## 4.15 [WINNF.FT.C.HBT.6] Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>  ○ valid *cbsdId* = C<br>  ○ valid *grantId* = G<br>  ○ grant is for frequency range F, power P<br>  ○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Verify Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “AUTHORIZED” | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, including the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = T = current UTC time<br>• *responseCode* = 501 (SUSPENDED_GRANT) | -- |
| 4 | After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT. | -- |

| # | Test Execution Steps | Results |
|---|---|---|
| 5 | Monitor the SAS-CBSD interface. Verify either A OR B occurs:<br>A. UUT sends a Heartbeat Request message. Ensure message is sent within latest specified heartbeatInterval, and is correctly formatted with parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “GRANTED”<br>B. UUT sends a Relinquishment Request message. Ensure message is correctly formatted with parameters:<br>• *cbdsId* = C<br>• *grantId* = G<br>Monitor the RF output of the UUT. Verify:<br>• UUT shall stop transmission within (*T* + 60 seconds) of completion of step 3 | PASS |

## 4.16 [WINNF.FT.C.HBT.7] Heartbeat responseCode=502 (UNSYNC_OP_PARAM)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>○ valid *cbsdId* = C<br>○ valid *grantId* = G<br>○ grant is for frequency range F, power P<br>○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Verify Heartbeat Request message is sent within latest specified *heartbeatInterval*,and is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “AUTHORIZED” | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, including the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = T = Current UTC Time<br>• *responseCode* = 502 (UNSYNC_OP_PARAM) | -- |
| 4 | After completion of step 3, SAS Test Harness shall not allow any further grants to the UUT. | -- |
| 5 | Monitor the SAS-CBSD interface. Verify:<br>• UUT sends a Grant Relinquishment Request message. Verify message is correctly formatted with parameters:<br>○ *cbdsId* = C<br>○ *grantId* = G<br>Monitor the RF output of the UUT. Verify:<br>• UUT shall stop transmission within (T+60) seconds of completion of step 3. | PASS |

## 4.17 [WINNF.FT.C.HBT.9] Heartbeat Response Absent (First Heartbeat)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>  ○ valid *cbsdId* = C<br>  ○ valid *grantId* = G<br>  ○ grant is for frequency range F, power P<br>  ○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in GRANTED, but not AUTHORIZED state (i.e. has not performed its first Heartbeat Request) | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Ensure Heartbeat Request message is sent within latest specified *heartbeatInterval*, and is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “GRANTED” | PASS |
| 3 | After completion of Step 2, SAS Test Harness does not respond to any further messages from UUT to simulate loss of network connection | -- |
| 4 | Monitor the RF output of the UUT from start of test to 60 seconds after step 3. Verify:<br>• At any time during the test, UUT shall not transmit on RF interface | PASS |

## 4.18 [WINNF.FT.C.HBT.10] Heartbeat Response Absent (Subsequent Heartbeat)

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has registered successfully with SAS Test Harness<br>• UUT has a valid single grant as follows:<br>  ○ valid *cbsdId* = C<br>  ○ valid *grantId* = G<br>  ○ grant is for frequency range F, power P<br>  ○ *grantExpireTime* = UTC time greater than duration of the test<br>• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Verify Heartbeat Request message issent within the latest specified *heartbeatInterval*, and is formatted correctly, including:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = “AUTHORIZED” | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, with the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *transmitExpireTime* = current UTC time + 200 seconds<br>• *responseCode* = 0 | -- |
| 4 | After completion of Step 3, SAS Test Harness does not respond to any further messages from UUT | -- |
| 5 | Monitor the RF output of the UUT. Verify:<br>• UUT shall stop all transmission on RF interface within (*transmitExpireTime* + 60 seconds), using the transmitExpireTime sent in Step 3. | PASS |

## 4.19 [WINNF.FT.C.MES.1] Registration Response contains measReportConfig

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness | -- |
| 2 | UUT sends a Registration Request message.<br>Validate the Registration Request message is formatted correctly, including:<br>• *userId* is present and correct<br>• *fccId* is present and correct<br>• *cbsdSerialNumber* is present and correct<br>• *measCapability* = "RECEIVED_POWER_WITHOUT_GRANT" | PASS |
| 3 | SAS Test Harness sends a Registration Response message, with the following parameters:<br>• *cbsdId* = C = valid cbsdId for this UUT<br>• *measReportConfig*= "RECEIVED_POWER_WITHOUT_GRANT"<br>• *responseCode* = 0 | -- |
| 4 | UUT sends a message:<br>• If message is type Spectrum Inquiry Request, go to step 5, or<br>• If message is type Grant Request, go to step 7 | -- |
| 5 | UUT sends message type Spectrum Inquiry Request. Verify message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *measReport* is present, and is a properly formatted *rcvdPowerMeasReport.* | PASS |
| 6 | SAS Test Harness sends a Spectrum Inquiry Response, with the following parameters:<br>• *cbsdId* = C<br>• *availableChannel* is an array of *availableChannel* objects<br>• *responseCode* = 0 | -- |

| # | Test Execution Steps | Results |
|---|---|---|
| 7 | UUT sends message type Grant Request message. Verify message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *measReport* is present, and is a properly formatted *rcvdPowerMeasReport.* | PASS |

## 4.20 [WINNF.FT.C.MES.3] Grant Response contains measReportConfig

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT has successfully registered with SAS Test Harness, with *cbsdId*=C and *measCapability* = "RECEIVED_POWER_WITH_GRANT" | -- |
| 2 | UUT sends a Grant Request message.<br>Verify Grant Request message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *operationParam* is present and format is valid | PASS |
| 3 | SAS Test Harness sends a Grant Response message, with the following parameters:<br>• *cbsdId* = C<br>• *grantId* = G = valid grant ID<br>• *grantExpireTime* = UTC time in the future<br>• *heartbeatInterval* = 60 seconds<br>• *measReportConfig*= "RECEIVED_POWER_WITH_GRANT"<br>• *operationParam* is set to valid operating parameters<br>• *channelType* = "GAA"<br>• *responseCode* = 0 | -- |
| 4 | UUT sends a Heartbeat Request message. Verify message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = "GRANTED" | PASS |
| 5 | If Heartbeat Request message (step 4) contains *measReport* object, then:<br>• verify *measReport* is properly formatted as object *rcvdPowerMeasReport*<br>• end test, with PASS result<br>else, if Heartbeat Request message (step 4) does not contain measReport object, then:<br>If number of Heartbeat Requests sent by UUT after Step 3 is = 5, then stop test with result of FAIL | PASS |

| # | Test Execution Steps | Results |
|---|---|---|
| 6 | SAS Test Harness sends a Heartbeat Response message, containing all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = *G*<br>• *transmitExpireTime* = current UTC time + 200 seconds<br>• *responseCode* = 0<br>Go to Step 4, above | -- |

## 4.21 [WINNF.FT.C.MES.4] Heartbeat Response contains measReportConfig

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT has successfully registered with SAS Test Harness, with *cbsdId*=C and *measCapability* = "RECEIVED_POWER_WITH_GRANT"<br>• UUT has received a valid grant with *grantId* = G<br>• UUT is in Grant State AUTHORIZED and is actively transmitting within the bounds of its grant.<br>• Grant has *heartbeatInterval* = 60 seconds | -- |
| 2 | UUT sends a Heartbeat Request message.<br>Verify Heartbeat Request message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = G<br>• *operationState* = "AUTHORIZED" | PASS |
| 3 | SAS Test Harness sends a Heartbeat Response message, containing all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = *G*<br>• *measReportConfig*= "RECEIVED_POWER_WITH_GRANT"<br>• *responseCode* = 0 | -- |
| 4 | UUT sends a Heartbeat Request message. Verify message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = G<br>• operationState = "AUTHORIZED" | PASS |

| # | Test Execution Steps | Results |
|---|---|---|
| 5 | If Heartbeat Request message (step 4) contains *measReport* object, then:<br>• verify *measReport* is properly formatted as object *rcvdPowerMeasReport*<br>• end test, with PASS result<br>else, if Heartbeat Request message (step 4) does not contain measReport object, then:<br>• If number of Heartbeat Requests sent by UUT after Step 3 is = 5, then stop test with result of FAIL | PASS |
| 6 | SAS Test Harness sends a Heartbeat Response message, containing all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = *G*<br>• *responseCode* = 0<br>Go to Step 4, above | -- |

## 4.22 [WINNF.FT.C.RLQ.1] Successful Relinquishment

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT has successfully registered with SAS Test Harness, with *cbsdId*=C<br>• UUT has received a valid grant with *grantId* = G<br>• UUT is in Grant State AUTHORIZED and is actively transmitting within the bounds of its grant.<br>Invoke trigger to relinquish UUT Grant from the SAS Test Harness | -- |
| 2 | UUT sends a Relinquishment Request message. Verify message contains all required parameters properly formatted, and specifically:<br>• *cbsdId* = C<br>• *grantId* = G | PASS |
| 3 | SAS Test Harness shall approve the request with a Relinquishment Response message with parameters:<br>– *cbsdId* = C<br>– *grantId* = G<br>– *responseCode* = 0 | -- |
| 4 | After completion of step 3, SAS Test Harness will not provide any additional positive response (*responseCode*=0) to further request messages from the UUT. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall stop RF transmission at any time between triggering the relinquishment and UUT sending the relinquishment request | PASS |

## 4.23 [WINNF.FT.C.DRG.1] Successful Deregistration

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness<br>• UUT has successfully registered with SAS Test Harness, with *cbsdId*=C<br>• UUT has received a valid grant with *grantId* = G<br>• UUT is in Grant State AUTHORIZED and is actively transmitting within the bounds of its grant.<br>Invoke trigger to deregister UUT from the SAS Test Harness | -- |
| 2 | UUT sends a Relinquishment request and receives Relinquishment response with *responseCode*=0 | -- |
| 3 | UUT sends Deregistration Request to SAS Test Harness with *cbsdId* = C. | PASS |
| 4 | SAS Test Harness shall approve the request with a Deregistration Response message with parameters:<br>• *cbsdId* = C<br>• *responseCode* = 0 | -- |
| 5 | After completion of step 3, SAS Test Harness will not provide any additional positive response (*responseCode*=0) to further request messages from the UUT. | -- |
| 6 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 4 is complete. This is the end of the test. Verify:<br>• UUT stopped RF transmission at any time between triggering the deregistration and either A OR B occurs:<br>A. UUT sending a Registration Request message, as this is not mandatory<br>B. UUT sending a Deregistration Request message | PASS |

## 4.24 [WINNF.FT.C.SCS.1] Successful TLS connection between UUT and SAS Test Harness

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | • UUT shall start CBSD-SAS communication with the security procedure<br>• The UUT shall establish a TLS handshake with the SAS Test Harness using configured certificate.<br>• Configure the SAS Test Harness to accept the security procedure and establish the connection | PASS |
| 2 | • Make sure that Mutual authentication happens between UUT and the SAS Test Harness.<br>• Make sure that UUT uses TLS v1.2<br>• Make sure that cipher suites from one of the following is selected,<br>  • TLS_RSA_WITH_AES_128_GCM_SHA256<br>  • TLS_RSA_WITH_AES_256_GCM_SHA384<br>  • TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA2 56<br>  • TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA3 84<br>  • TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 | PASS |
| 3 | A successful registration is accomplished using one of the test cases described in section 6.1.4.1, depending on CBSD capability.<br>• UUT sends a registration request to the SAS Test Harness and the SAS Test Harness sends a Registration Response with *responseCode* = 0 and *cbsdId*. | PASS |
| 4 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.25 [WINNF.FT.C.SCS.2] TLS failure due to revoked certificate

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | • UUT shall start CBSD-SAS communication with the security procedures | PASS |
| 2 | • Make sure that UUT uses TLS v1.2 for security establishment.<br>• Make sure UUT selects the correct cipher suite.<br>• UUT shall use CRL or OCSP to verify the validity of the server certificate.<br>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness. | PASS |
| 3 | UUT may retry for the security procedure which shall fail | PASS |
| 4 | SAS Test-Harness shall not receive any Registration request or any application data. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.26 [WINNF.FT.C.SCS.3] TLS failure due to expired server certificate

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | • UUT shall start CBSD-SAS communication with the security procedures | PASS |
| 2 | • Make sure that UUT uses TLS v1.2 for security establishment.<br>• Make sure UUT selects the correct cipher suite.<br>• UUT shall use CRL or OCSP to verify the validity of the server certificate.<br>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness. | PASS |
| 3 | UUT may retry for the security procedure which shall fail. | PASS |
| 4 | SAS Test-Harness shall not receive any Registration request or any application data. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.27 [WINNF.FT.C.SCS.4] TLS failure when SAS Test Harness certificate is issued by an unknown CA

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | • UUT shall start CBSD-SAS communication with the security procedures | PASS |
| 2 | • Make sure that UUT uses TLS v1.2 for security establishment.<br>• Make sure UUT selects the correct cipher suite.<br>• UUT shall use CRL or OCSP to verify the validity of the server certificate<br>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness. | PASS |
| 3 | UUT may retry for the security procedure which shall fail. | PASS |
| 4 | SAS Test-Harness shall not receive any Registration request or any application data. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.28 [WINNF.FT.C.SCS.5] TLS failure when certificate at the SAS Test Harness is corrupted

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | • UUT shall start CBSD-SAS communication with the security procedures | PASS |
| 2 | • Make sure that UUT uses TLS v1.2 for security establishment.<br>• Make sure UUT selects the correct cipher suite.<br>• UUT shall use CRL or OCSP to verify the validity of the server certificate.<br>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness. | PASS |
| 3 | UUT may retry for the security procedure which shall fail. | PASS |
| 4 | SAS Test-Harness shall not receive any Registration request or any application data. | -- |
| 5 | Monitor the RF output of the UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:<br>• UUT shall not transmit RF | PASS |

## 4.29 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement

| # | Test Execution Steps | Results |
|---|---|---|
| 1 | Ensure the following conditions are met for test entry:<br>• UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness<br>• UUT has registered with the SAS, with CBSD ID = C<br>• UUT has a single valid grant G with parameters {lowFrequency = $F_L$, highFrequency = $F_H$, maxEirp = $P_i$}, with grant in AUTHORIZED state, and grantExpireTime set to a value far past the duration of this test case<br><br>*Note: in order for the UUT to request a grant with the parameters {lowFrequency, highFrequency, maxEirp), the SAS Test Harness may need to provide appropriate guidance in the availableChannel object of the spectrumInquiry response message, and the operationParam object of the grant response message. Alternately, the UUT vendor may provide the ability to set those parameters on the UUT so that the UUT will request a grant with those parameters.* | -- |
| 2 | UUT and SAS Test Harness perform a series of Heartbeat Request/Response cycles, which continues until the other test steps are complete. Messaging for each cycle is as follows:<br>• UUT sends Heartbeat Request, including:<br>  ○ *cbsdId* = C<br>  ○ *grantId* = G<br>• SAS Test Harness responds with Heartbeat Response, including:<br>  ○ *cbsdId* = C<br>  ○ *grantId* = G<br>  ○ *transmitExpireTime* = current UTC time + 200 seconds<br>  ○ *responseCode* = 0 | -- |

| # | Test Execution Steps | Results |
|---|---|---|
| 3 | Tester performs power measurement on RF interface(s) of UUT, and verifies it complies with the maxEirp setting, $P_i$. The RF measurement method is out of scope of this document, but may include additional configuration of the UUT, as required, to fulfil the requirements of the power measurement method.<br><br>*Note: it may be required for the vendor to provide a method or configuration to bring the UUT to a mode which is required by the measurement methodology. Any such mode is vendor-specific and depends upon UUT behavior and the measurement methodology.* | PASS |

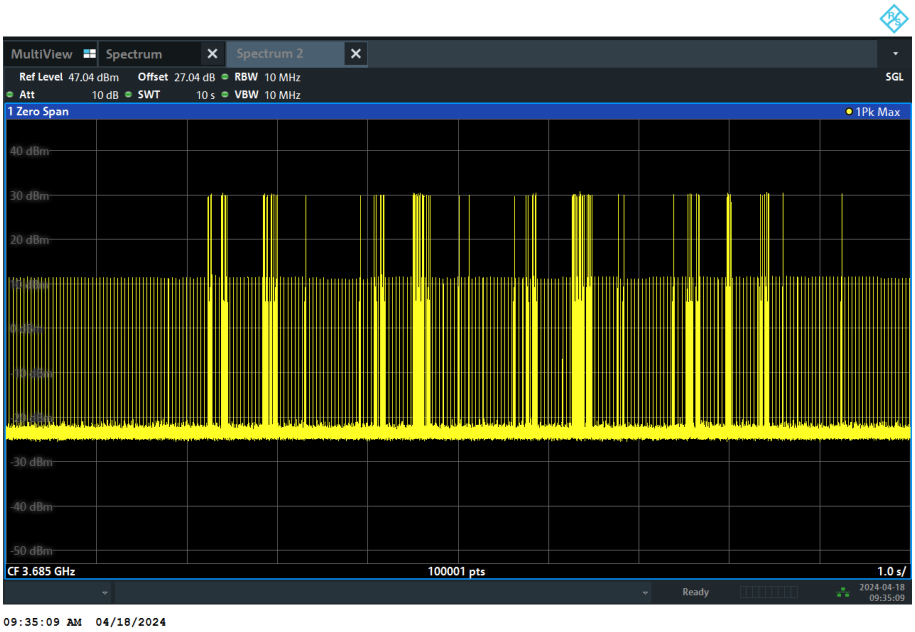
Note: For test 4.29, please find the Appendix A for RF measurement plots.

# 5. Result of Time test for getting Grant

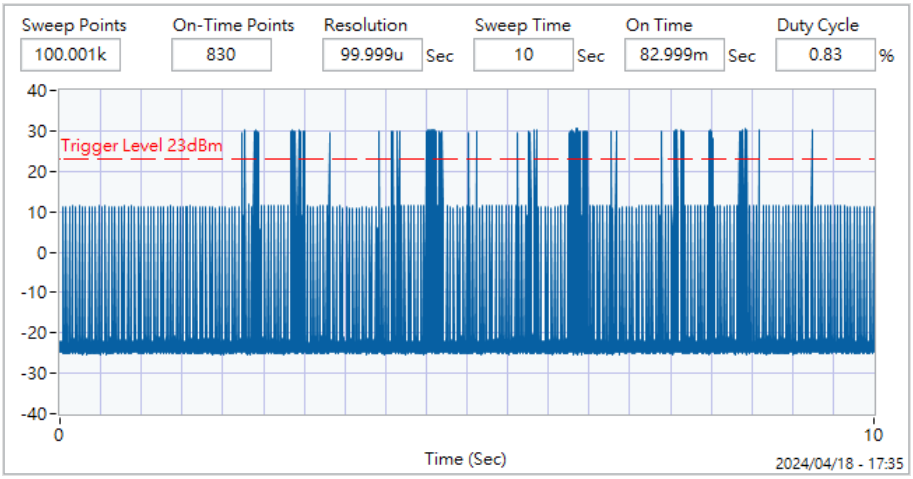
## 5.1 1 second within any 10-second period

**Spectrum Analyzer**

(The Ref Offset 27.04 dB includes the antenna gain 9 dBi and cable path loss 18.04 dB.)




**Calculated Result**

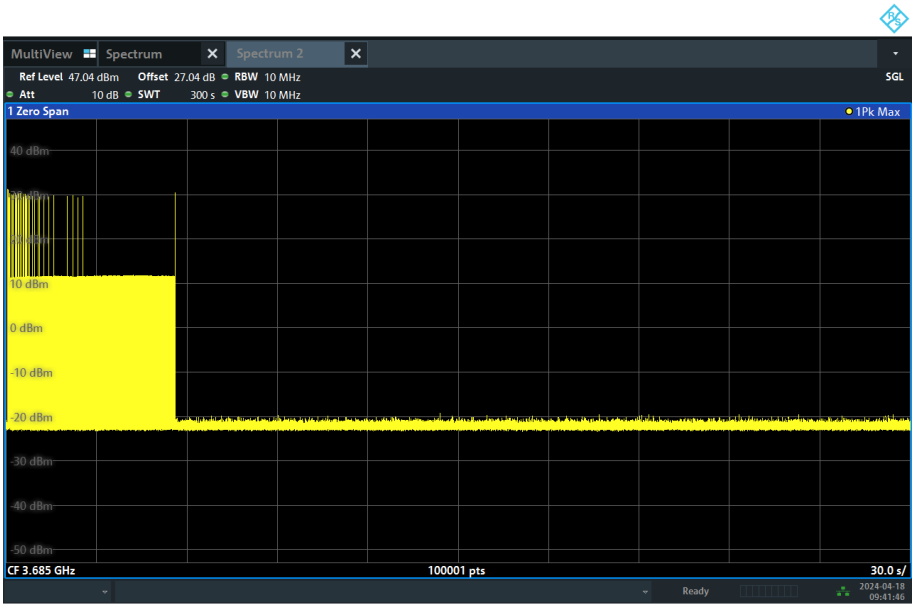



**The sum of On Time: 82.999ms < 1s, Pass.**

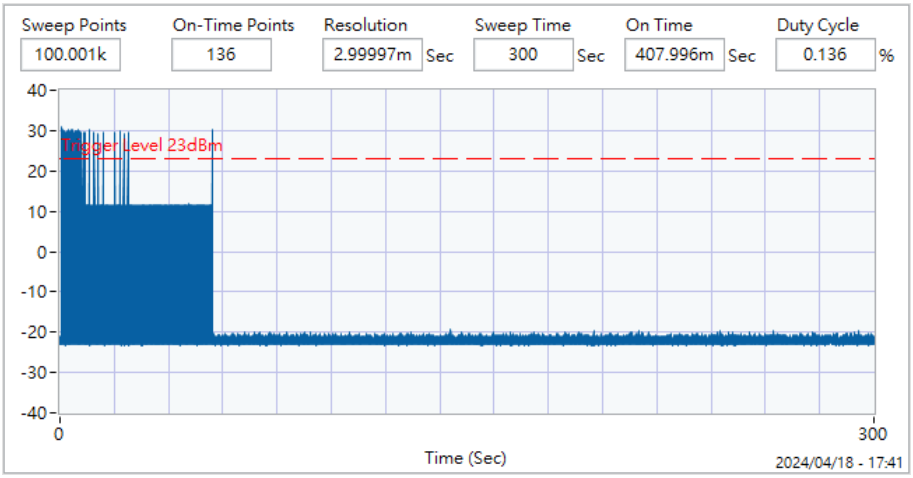
## 5.2 10 seconds within any 300-second period

**Spectrum Analyzer**

(The Ref Offset 27.04 dB includes the antenna gain 9 dBi and cable path loss 18.04 dB.)




**Calculated Result**

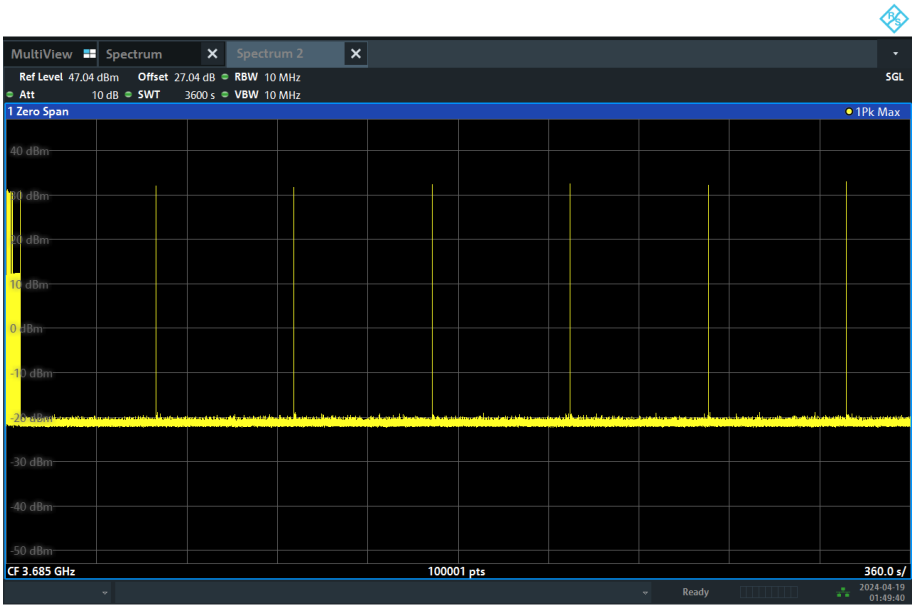



**The sum of On Time: 407.996ms < 10s, Pass.**

## 5.3 20 seconds within any 3600-second period

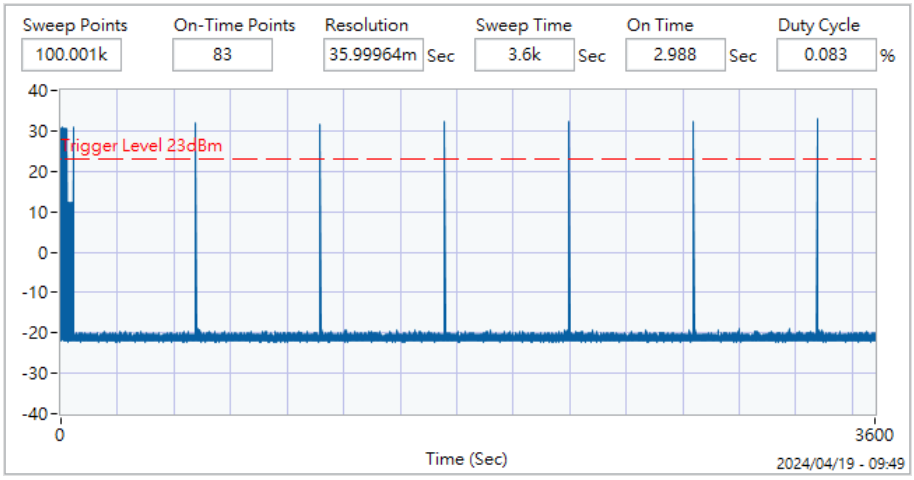
**Spectrum Analyzer**

(The Ref Offset 27.04 dB includes the antenna gain 9 dBi and cable path loss 18.04 dB.)




01:49:40 AM 04/19/2024

**Calculated Result**




**The sum of On Time: 2.988s < 20s, Pass.**

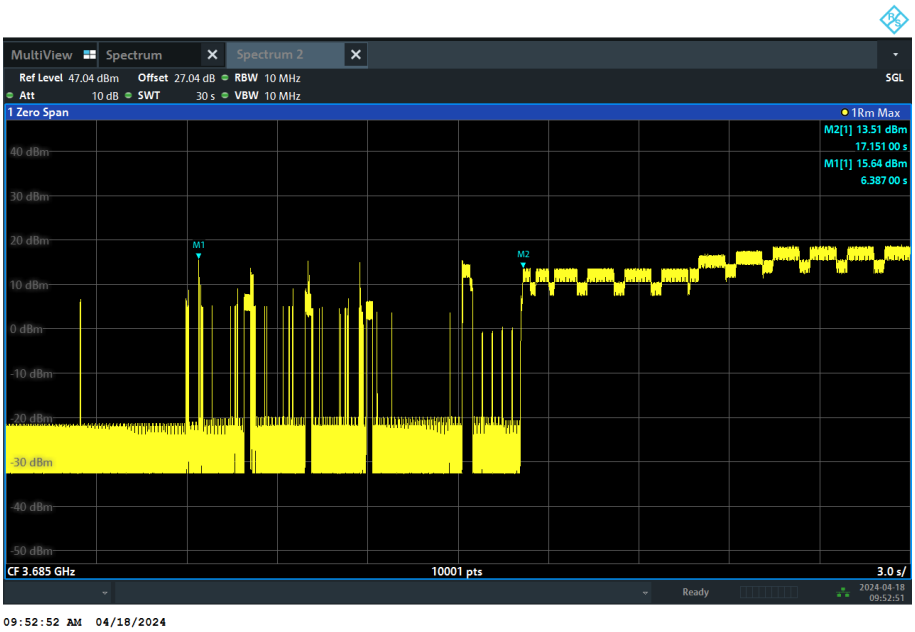
# 6. UUT register with the SAS irrespective of power levels

## 6.1 Test Procedure

1. Set the SAS test harness to grant UUT with the highest EIRP higher than 23 dBm.
2. Check if UUT has successfully registered with SAS Test Harness, when operating EIRP less than 23 dBm.
3. After the UUT granted/authorized by the SAS, it can transmit with power less than the maxEIRP granted from SAS.

## 6.2 Result

The UUT can register with SAS under above operating conditions to meet the FCC criteria that the UUT will register with the SAS irrespective of power levels at which the device is set to operate – even below 23 dBm.




| The UUT successfully registered with SAS Test Harness, when operating EIRP less than 23 dBm. |
|---|
| Test Result: PASS |

Note: The total offset 27.04 dB includes the antenna gain 9 dBi and cable path loss 18.04 dB.

Marker 1: The UUT successfully registered with SAS Test Harness, when operating 15.64 dBm EIRP.

Marker 2: After the UUT granted/authorized by the SAS, it can transmit with power less than the maxEIRP granted from SAS.

# Appendix A. RF measurement plots

## Appendix A.1 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement

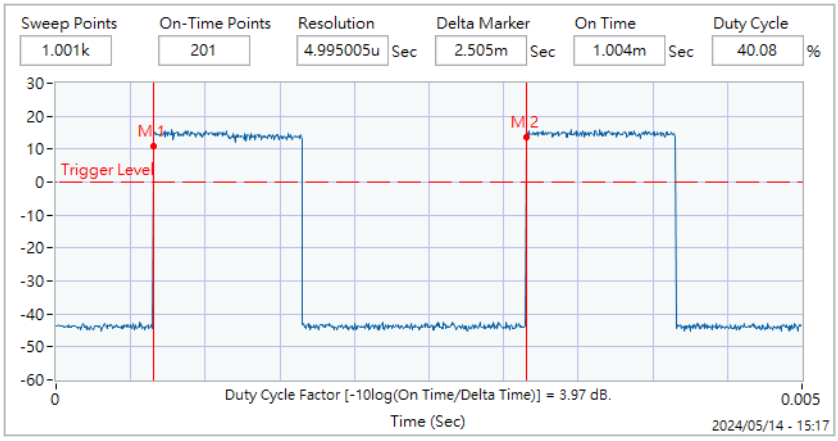
Report Clause 4.29 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement

| Center Frequency [MHz] | Bandwidth [MHz] | Granted MaxEIRP [dBm/MHz] | Conducted PSD [dBm/MHz] TX 0 | Duty Cycle Factor [dB] | Antenna Gain [dBi] | UUT total MaxEIRP [dBm/MHz] |
|---|---|---|---|---|---|---|
| 3610 | 20 | 20 | 3.33 | 3.97 | 9 | 16.30 |
| | | 16 | 1.05 | | | 14.02 |
| | | 10 | -5.17 | | | 7.80 |
| | | 6 | -8.86 | | | 4.11 |
| | | 4 | -10.81 | | | 2.16 |

Note: The total path loss is offset with 15.2 dB.

Duty Cycle factor:

**Spectrum Analyzer**



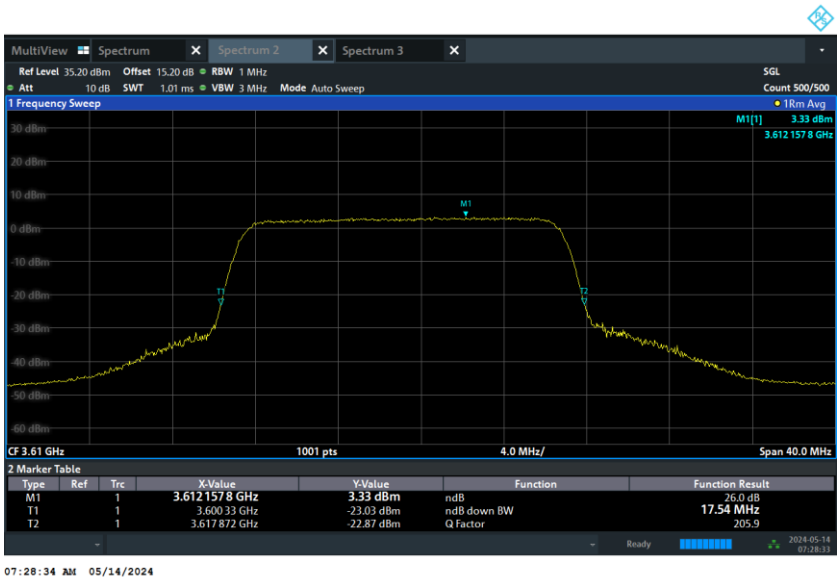

Note: The duty cycle value is 40.08%, add 10log(1/duty cycle) to the measured power level to compute the average power during continuous transmission.

## Appendix A.1.1 Test Procedure

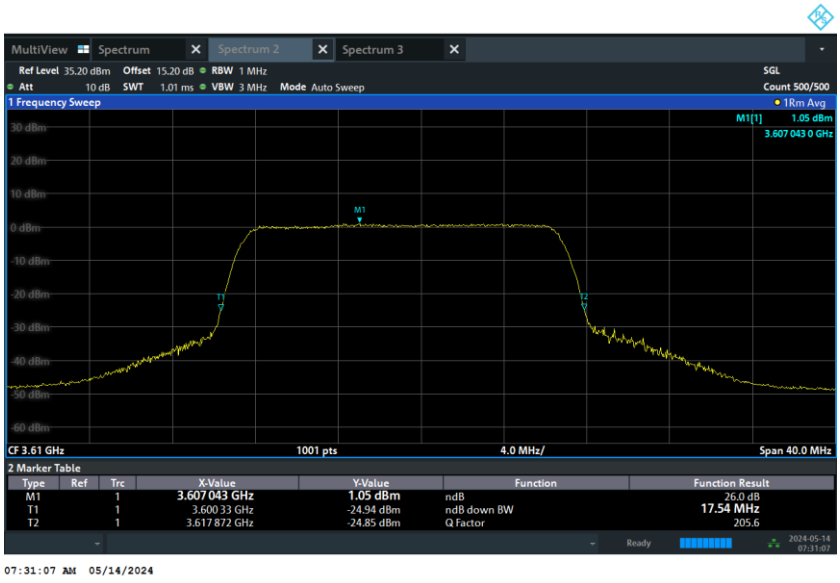
[WINNF.PT.C.HBT] UUT RF Transmit Power Measurement defined in clause 4.29 of this test report.

## Appendix A.1.2 Test Result

| SAS Granted MaxEIRP 20 [dBm/MHz]<br>UUT Center Frequency 3610 MHz, Bandwidth 20 MHz, MaxEIRP 16.30 [dBm/MHz] |
|---|
| TX 0 |



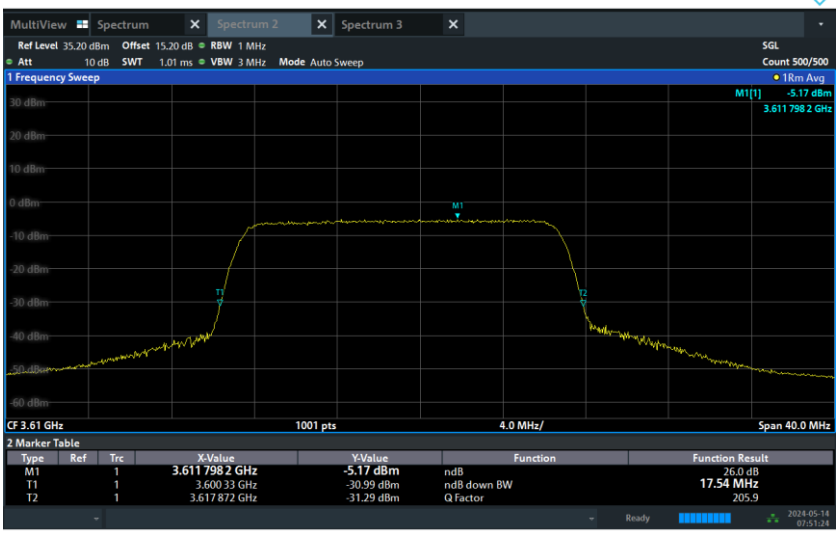

| SAS Granted MaxEIRP 16 [dBm/MHz]<br>UUT Center Frequency 3610 MHz, Bandwidth 20 MHz, MaxEIRP 14.02 [dBm/MHz] |
|---|
| TX 0 |



**SAS Granted MaxEIRP 10 [dBm/MHz]**

**UUT Center Frequency 3610 MHz, Bandwidth 20 MHz, MaxEIRP 7.80 [dBm/MHz]**

**TX 0**

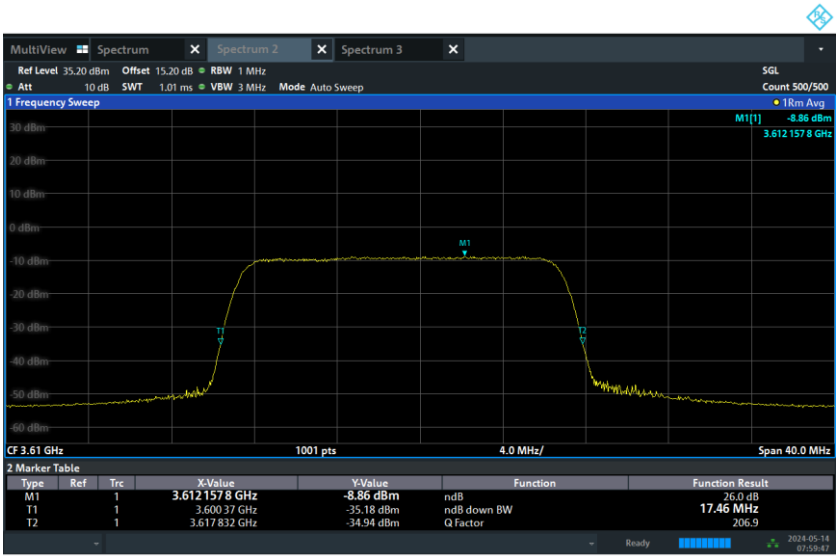



07:51:25 AM 05/14/2024

**SAS Granted MaxEIRP 6 [dBm/MHz]**

**UUT Center Frequency 3610 MHz, Bandwidth 20 MHz, MaxEIRP 4.11 [dBm/MHz]**

**TX 0**

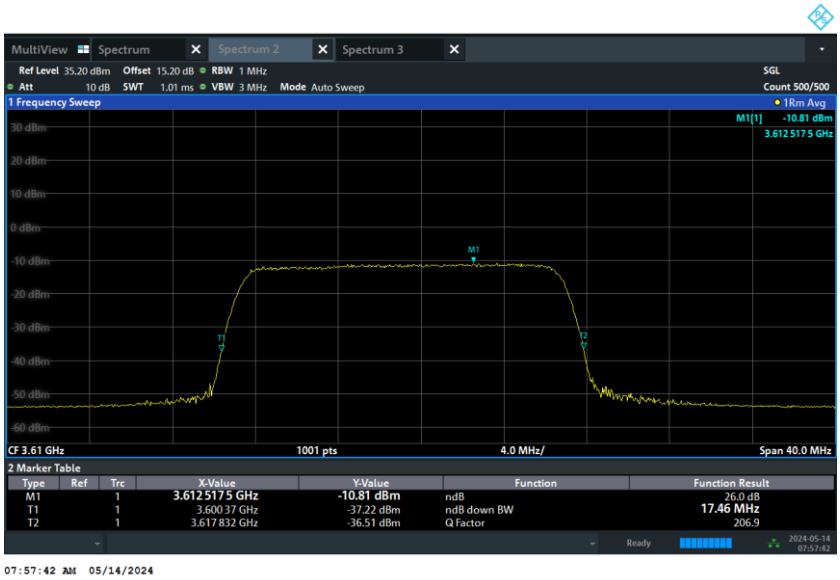



07:59:48 AM 05/14/2024

**SAS Granted MaxEIRP 4 [dBm/MHz]**

**UUT Center Frequency 3610 MHz, Bandwidth 20 MHz, MaxEIRP 2.16 [dBm/MHz]**

**TX 0**




———THE END———