WINNF-TS-0122 Test Report

APPLICANT	Netcomm Wireless Pty Ltd
EQUIPMENT	CBRS 5G Cat B Outdoor CPE
BRAND NAME	Casa Systems
MODEL NAME	CFW-2832
FCC ID	XIA-CFW2832
REFERENCE	WINNF-TS-0122 Version V1.0.2
RF INTERFACE	NR n48

The product was received on Jul. 19, 2022 and testing was performed from Jul. 27, 2022 to Sep. 06, 2022. We, Sporton International (USA) Inc., 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 (USA) Inc., the test report shall not be reproduced except in full.

Neil Kao

Approved by: Neil Kao

Sporton International (USA) Inc.
1175 Montague Expressway, Milpitas, CA 95035

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Appendix A. RF measurement plots

Appendix B. Setup Plot

Revision History

Report No.	Version	Description	Issue Date
FG220615003A	01	Initial issue of report	Sep. 28, 2022

Conformity Assessment Condition:
The test results (PASS/FAIL) with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results.
Comments and Explanations:
The product specifications of the EUT presented in the report are declared by the manufacturer who shall take full responsibility for the authenticity.

1. Administration Data

1.1 Testing Laboratory

Test Site	Sporton International (USA) Inc.
Test Site Location	1175 Montague Expressway, Milpitas, CA 95035 TEL: (408) 904-3300
Test Engineer	Abi Lin / Thomas Chen
Temperature	21 ~ 25 ℃
Relative Humidity	50 ~ 56 %

1.2 Applicant

Company Name	Netcomm Wireless Pty Ltd
Address	Level 5, 18-20 Orion Road, Lane Cove, NSW, Australia, 2066

1.3 Manufacturer

Company Name	Casa Systems
Address	100 Old River Road, Andover MA 01810 USA

2. General Information

2.1 Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	CBRS 5G Cat B Outdoor CPE
Brand Name	Casa Systems
Model Name	CFW-2832
FCC ID	XIA-CFW2832
Professional Installation	■ Yes ☐ No
Unit Under Test Type	☐ BTS-CBSD product (Base Station) ■ CPE-CBSD product (Customer Premises Equipment)
UUT Category	☐ Category A ■ Category B
Domain Proxy support	☐ UUT with Domain Proxy ■ UUT without Domain Proxy
UUT Antenna Gain	17 dBi
UUT HW Version	1.0
UUT FW Version	1.1.29.0
UUT Serial Number	216322221600051

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
6.1.4.1.5	WINNF.FT.C.REG.5	Single-Step registration for CBSD with CPI signed data	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	45.7995ms	PASS
2	10 seconds	300 seconds	33ms	PASS
3	20 seconds	3600 seconds	0s	PASS

2.4 Support Equipment

Name	Brand Name	Type/Model	Serial Number	FCC ID
NR Base station	Airspan	AS2900	ED0863016648	PIDAS2900

2.5 Test Equipment List

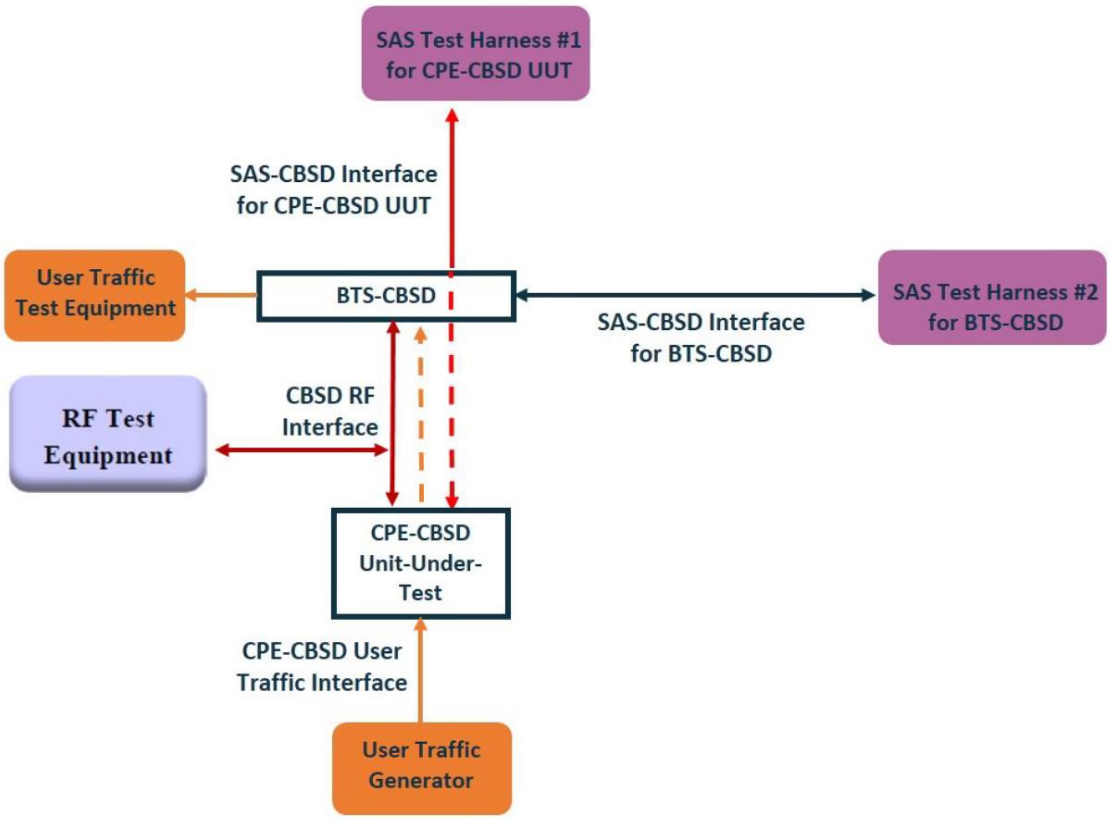
Name	Brand Name	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
Spectrum Analyzer	Rohde & Schwarz	FSW43	104042	Nov. 18, 2021	Nov. 17, 2022

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.
Yes	**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.
No	**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 1.2.6, “SAS to CBSD Technical Specification”, 25 November 2020

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: • UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness • UUT is in the Unregistered state	--
2	CBSD sends correct Registration request information, as specified in [n.5], to the SAS Test Harness: • The required userId, fccId and cbsdSerialNumber registration parameters shall be sent from the CBSD and conform to proper format and acceptable ranges. • 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. 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: – *cbsdId* = C – *measReportConfig* shall not be included – *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: • UUT shall not transmit RF	PASS

4.2 [WINNF.FT.C.REG.5] Single-Step registration for CBSD with CPI signed data

#	Test Execution Steps	Results
1	Ensure the following conditions are met for test entry: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • UUT is in the Unregistered state • All of the required and REG-Conditional parameters shall be configured and CPI signature provided	--
2	CBSD sends Registration request to the SAS Test Harness: • The required userId, fccId and cbsdSerialNumber and REG-Conditional cbsdCategory, airInterface, measCapability and cpiSignatureData registration parameters shall be sent from the CBSD and conform to proper format and acceptable ranges.	PASS
	• Any optional registration parameters that may be included in the message shall be verified that they conform to proper format and are within acceptable ranges.	
3	• SAS Test Harness sends a CBSD Registration Response as follows: – *cbsdId* = C – *measReportConfig* shall not be included. – *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: • UUT shall not transmit RF	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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • 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: – SAS response does not include *cbsdId* – *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • 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: – SAS response does not include *cbsdId* – *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • 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: – SAS response does not include *cbsdId* – *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • 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: – SAS response does not include *cbsdId* – *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • 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: – SAS response does not include *cbsdId* – *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • 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: – SAS response does not include *cbsdId* – *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: • 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: • 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 • *cbsdId*=C • *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: • 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: • 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 • *cbsdId*=C • *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: • 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: • UUT has registered successfully with SAS Test Harness, with *cbsdId* = C	--
2	UUT sends a message: • If message is type Spectrum Inquiry Request, go to step 3, or • If message is type Grant Request, go to step 5	--
3	UUT sends Spectrum Inquiry Request. Validate: • *cbsdId* = C • 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: • *cbsdId* = C • availableChannel is an array of availableChannel objects • *responseCode* = 0	--
5	UUT sends Grant Request message. Validate: • *cbsdId* = C • maxEIRP is at or below the limit appropriate for CBSD category as defined by Part 96 • 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: • *cbsdId* = C • *grantId* = G = a valid grant ID • grantExpireTime = UTC time greater than duration of the test • *responseCode* = 0	--
7	UUT sends a first Heartbeat Request message. Verify Heartbeat Request message is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = “GRANTED”	PASS

8	SAS Test Harness sends a Heartbeat Response message, with the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = current UTC time + 200 seconds • *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: • *cbsdId* = C • *grantId* = G • *operationState* = “AUTHORIZED” and SAS Test Harness responds with a Heartbeat Response message including the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = current UTC time + 200 seconds • *responseCode* = 0	PASS
10	Monitor the RF output of the UUT from start of test until UUT transmission commences. Verify: • UUT does not transmit at any time prior to completion of the first heartbeat response • 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: • UUT has registered successfully with SAS Test Harness • UUT has a valid single grant as follows: ○ valid *cbsdId* = C ○ valid *grantId* = G ○ grant is for frequency range F, power P ○ *grantExpireTime* = UTC time greater than duration of the test • UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--
2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within Heartbeat Interval specified in the latest Heartbeat Response, and formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = "AUTHORIZED"	PASS
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime = T = Current UTC time* • *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: • 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: • UUT has registered successfully with SAS Test Harness • UUT has a valid single grant as follows: ○ valid *cbsdId* = C ○ valid *grantId* = G ○ grant is for frequency range F, power P ○ *grantExpireTime* = UTC time greater than duration of the test • UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--
2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = "AUTHORIZED"	PASS
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = T = current UTC time • *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: • 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: • UUT has registered successfully with SAS Test Harness • UUT has a valid single grant as follows: ○ valid *cbsdId* = C ○ valid *grantId* = G ○ grant is for frequency range F, power P ○ *grantExpireTime* = UTC time greater than duration of the test • UUT is in GRANTED, but not AUTHORIZED state (i.e. has not performed its first Heartbeat Request)	--
2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = "GRANTED"	PASS
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = T = current UTC time • *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: A. UUT sends a Heartbeat Request message. Ensure message is sent within latest specified heartbeatInterval, and is correctly formatted with parameters: • *cbsdId* = C • *grantId* = G • *operationState* = "GRANTED" B. UUT sends a Relinquishment request message. Ensure message is correctly formatted with parameters: • *cbdsId* = C • *grantId* = G Monitor the RF output of the UUT. Verify: • 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:
	• UUT has registered successfully with SAS Test Harness
	• UUT has a valid single grant as follows:
	  ○ valid *cbsdId* = C
	  ○ valid *grantId* = G
	  ○ grant is for frequency range F, power P
	  ○ *grantExpireTime* = UTC time greater than duration of the test
	• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface
		--

2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = “AUTHORIZED”	PASS
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = T = current UTC time • *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: A. UUT sends a Heartbeat Request message. Ensure message is sent within latest specified heartbeatInterval, and is correctly formatted with parameters: • *cbsdId* = C • *grantId* = G • *operationState* = “GRANTED” B. UUT sends a Relinquishment Request message. Ensure message is correctly formatted with parameters: • *cbdsId* = C • *grantId* = G Monitor the RF output of the UUT. Verify: • 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: • UUT has registered successfully with SAS Test Harness • UUT has a valid single grant as follows: ○ valid *cbsdId* = C ○ valid *grantId* = G ○ grant is for frequency range F, power P ○ *grantExpireTime* = UTC time greater than duration of the test • UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface	--
2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message is sent within latest specified *heartbeatInterval*,and is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = “AUTHORIZED”	PASS
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = T = Current UTC Time • *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: • UUT sends a Grant Relinquishment Request message. Verify message is correctly formatted with parameters: ○ *cbdsId* = C ○ *grantId* = G Monitor the RF output of the UUT. Verify: • 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:
	• UUT has registered successfully with SAS Test Harness
	• UUT has a valid single grant as follows:
	  ○ valid *cbsdId* = C
	  ○ valid *grantId* = G
	  ○ grant is for frequency range F, power P
	  ○ *grantExpireTime* = UTC time greater than duration of the test
	• UUT is in GRANTED, but not AUTHORIZED state (i.e. has not performed its first Heartbeat Request)
		--

2	UUT sends a Heartbeat Request message. Ensure Heartbeat Request message is sent within latest specified *heartbeatInterval*, and is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *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: • 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:
	• UUT has registered successfully with SAS Test Harness
	• UUT has a valid single grant as follows:
	  ○ valid *cbsdId* = C
	  ○ valid *grantId* = G
	  ○ grant is for frequency range F, power P
	  ○ *grantExpireTime* = UTC time greater than duration of the test
	• UUT is in AUTHORIZED state and is transmitting within the grant bandwidth F on RF interface
		--

2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message issent within the latest specified *heartbeatInterval*, and is formatted correctly, including: • *cbsdId* = C • *grantId* = G • *operationState* = “AUTHORIZED”	PASS
3	SAS Test Harness sends a Heartbeat Response message, with the following parameters: • *cbsdId* = C • *grantId* = G • *transmitExpireTime* = current UTC time + 200 seconds • *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness	--
2	UUT sends a Registration Request message. Validate the Registration Request message is formatted correctly, including: • *userId* is present and correct • *fccId* is present and correct • *cbsdSerialNumber* is present and correct • *measCapability* = "RECEIVED_POWER_WITHOUT_GRANT"	PASS
3	SAS Test Harness sends a Registration Response message, with the following parameters: • *cbsdId* = C = valid cbsdId for this UUT • *measReportConfig*= "RECEIVED_POWER_WITHOUT_GRANT" • *responseCode* = 0	--
4	UUT sends a message: • If message is type Spectrum Inquiry Request, go to step 5, or • 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: • *cbsdId* = C • *measReport* is present, and is a properly formatted *rcvdPowerMeasReport.*	PASS
6	SAS Test Harness sends a Spectrum Inquiry Response, with the following parameters: • *cbsdId* = C • *availableChannel* is an array of *availableChannel* objects • *responseCode* = 0	--

7	UUT sends message type Grant Request message. Verify message contains all required parameters properly formatted, and specifically: • *cbsdId* = C • *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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • UUT has successfully registered with SAS Test Harness, with *cbsdId*=C and *measCapability* = "RECEIVED_POWER_WITH_GRANT"	--
2	UUT sends a Grant Request message. Verify Grant Request message contains all required parameters properly formatted, and specifically: • *cbsdId* = C • *operationParam* is present and format is valid	PASS
3	SAS Test Harness sends a Grant Response message, with the following parameters: • *cbsdId* = C • *grantId* = G = valid grant ID • *grantExpireTime* = UTC time in the future • *heartbeatInterval* = 60 seconds • *measReportConfig*= "RECEIVED_POWER_WITH_GRANT" • *operationParam* is set to valid operating parameters • *channelType* = "GAA" • *responseCode* = 0	--
4	UUT sends a Heartbeat Request message. Verify message contains all required parameters properly formatted, and specifically: • *cbsdId* = C • *grantId* = G • *operationState* = "GRANTED"	PASS

5	If Heartbeat Request message (step 4) contains *measReport* object, then: • verify *measReport* is properly formatted as object *rcvdPowerMeasReport* • end test, with PASS result else, if Heartbeat Request message (step 4) does not contain measReport object, then: 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: • *cbsdId* = C • *grantId* = *G* • *transmitExpireTime* = current UTC time + 200 seconds • *responseCode* = 0 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • UUT has successfully registered with SAS Test Harness, with *cbsdId*=C and *measCapability* = "RECEIVED_POWER_WITH_GRANT" • UUT has received a valid grant with *grantId* = G • UUT is in Grant State AUTHORIZED and is actively transmitting within the bounds of its grant. • Grant has *heartbeatInterval* = 60 seconds	--
2	UUT sends a Heartbeat Request message. Verify Heartbeat Request message contains all required parameters properly formatted, and specifically: • *cbsdId* = C • *grantId* = G • *operationState* = "AUTHORIZED"	PASS
3	SAS Test Harness sends a Heartbeat Response message, containing all required parameters properly formatted, and specifically: • *cbsdId* = C • *grantId* = *G* • *measReportConfig*= "RECEIVED_POWER_WITH_GRANT" • *responseCode* = 0	--
4	UUT sends a Heartbeat Request message. Verify message contains all required parameters properly formatted, and specifically: • *cbsdId* = C • *grantId* = G • operationState = "AUTHORIZED"	PASS

5	If Heartbeat Request message (step 4) contains *measReport* object, then: • verify *measReport* is properly formatted as object *rcvdPowerMeasReport* • end test, with PASS result else, if Heartbeat Request message (step 4) does not contain measReport object, then: • 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: • *cbsdId* = C • *grantId* = *G* • *responseCode* = 0 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • UUT has successfully registered with SAS Test Harness, with *cbsdId*=C • UUT has received a valid grant with *grantId* = G • UUT is in Grant State AUTHORIZED and is actively transmitting within the bounds of its grant. 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: • *cbsdId* = C • *grantId* = G	PASS
3	SAS Test Harness shall approve the request with a Relinquishment Response message with parameters: – *cbsdId* = C – *grantId* = G – *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: • 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: • UUT has successfully completed SAS Discovery and Authentication with SAS Test Harness • UUT has successfully registered with SAS Test Harness, with *cbsdId*=C • UUT has received a valid grant with *grantId* = G • UUT is in Grant State AUTHORIZED and is actively transmitting within the bounds of its grant. 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: • *cbsdId* = C • *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: • UUT stopped RF transmission at any time between triggering the deregistration and either A OR B occurs: A. UUT sending a Registration Request message, as this is not mandatory 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 • The UUT shall establish a TLS handshake with the SAS Test Harness using configured certificate. • 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.
	• Make sure that UUT uses TLS v1.2
	• Make sure that cipher suites from one of the following is selected,
	  • TLS_RSA_WITH_AES_128_GCM_SHA256
	  • TLS_RSA_WITH_AES_256_GCM_SHA384
	  • TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA2 56
	  • TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA3 84
	  • 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. • 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: • 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. • Make sure UUT selects the correct cipher suite. • UUT shall use CRL or OCSP to verify the validity of the server certificate. • 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: • 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. • Make sure UUT selects the correct cipher suite. • UUT shall use CRL or OCSP to verify the validity of the server certificate. • 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: • 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. • Make sure UUT selects the correct cipher suite. • UUT shall use CRL or OCSP to verify the validity of the server certificate • 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: • 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. • Make sure UUT selects the correct cipher suite. • UUT shall use CRL or OCSP to verify the validity of the server certificate. • 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: • 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: • UUT has successfully completed SAS Discovery and Authentication with the SAS Test Harness • UUT has registered with the SAS, with CBSD ID = C • 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 *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:
	• UUT sends Heartbeat Request, including:
	  ○ *cbsdId* = C
	  ○ *grantId* = G
	• SAS Test Harness responds with Heartbeat Response, including:
	  ○ *cbsdId* = C
	  ○ *grantId* = G
	  ○ *transmitExpireTime* = current UTC time + 200 seconds
	  ○ *responseCode* = 0
		--

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. *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

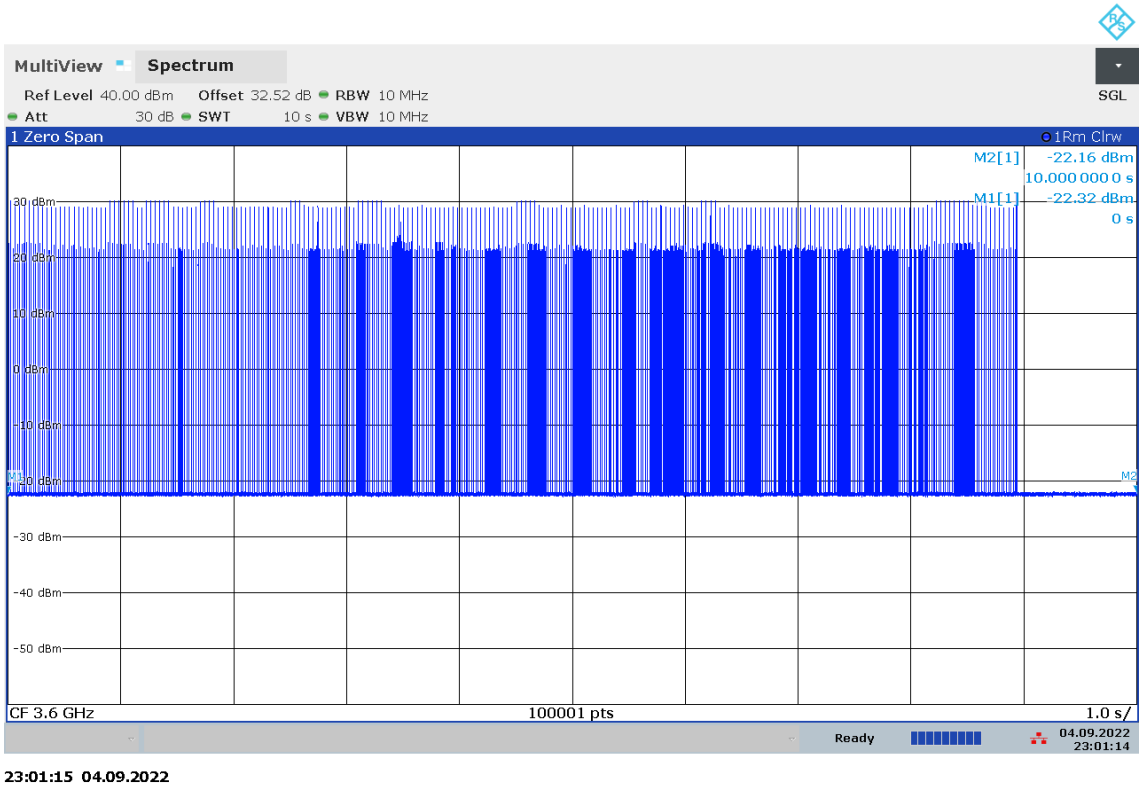
Note: For test 4.29, please find the Appendix B for RF measurement plots.

5. Result of Time test for getting Grant

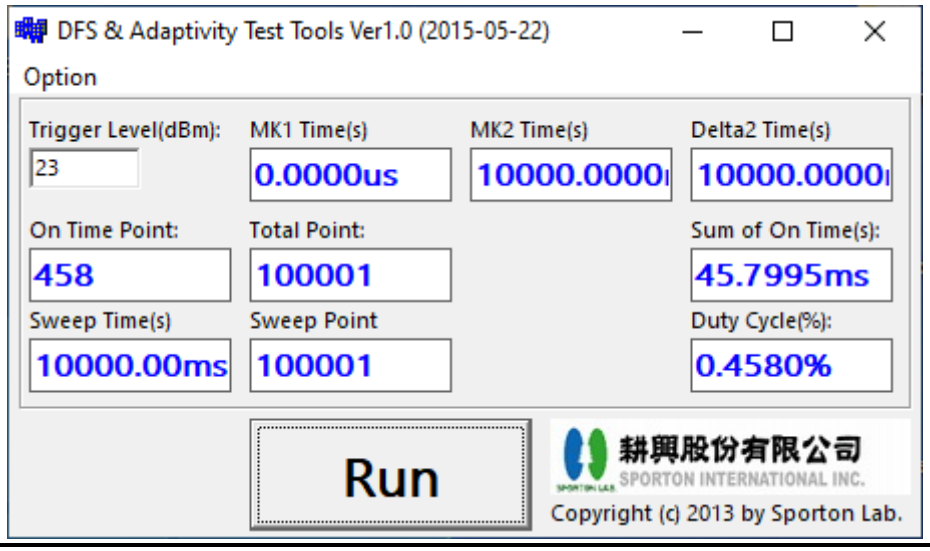
5.1 1 second within any 10-second period

Spectrum Analyzer

(The Ref Offset 32.52 dB includes the antenna gain 17 dBi and cable path loss 15.52 dB.)



Calculated Result

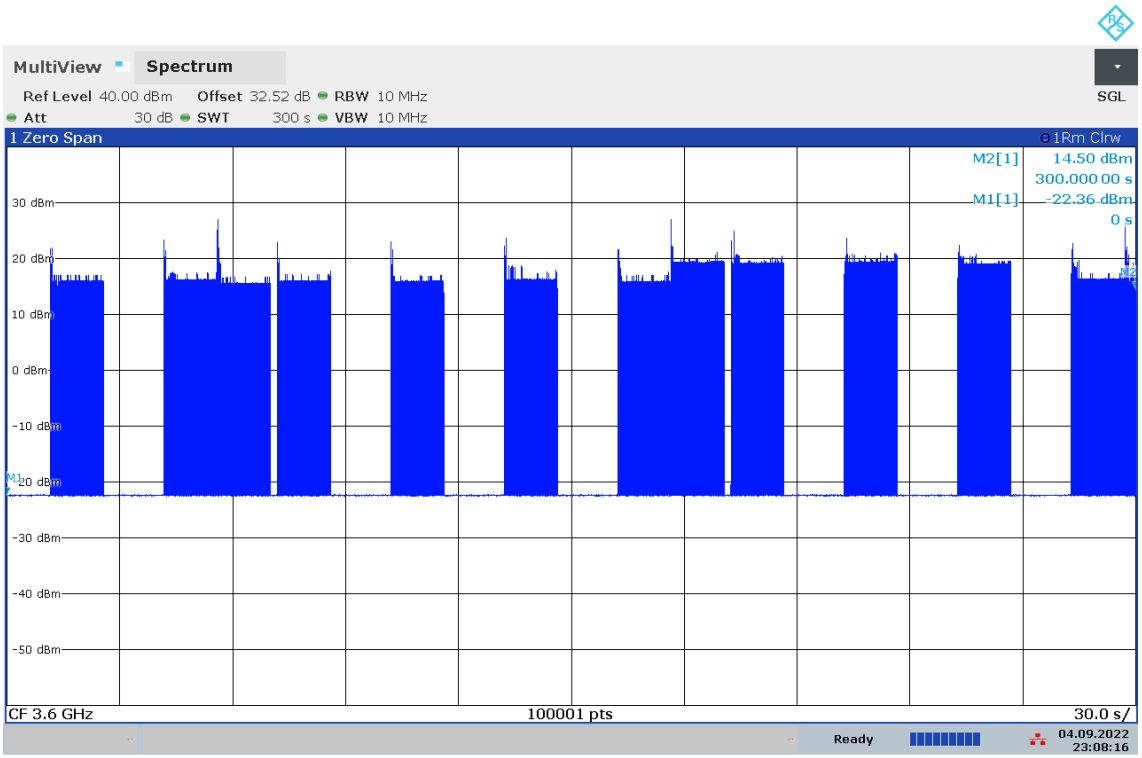


The sum of On Time (aggregated time from marker 1 to 2): 45.7995ms < 1s, Pass.

5.2 10 seconds within any 300-second period

Spectrum Analyzer

(The Ref Offset 32.52 dB includes the antenna gain 17 dBi and cable path loss 15.52 dB.)



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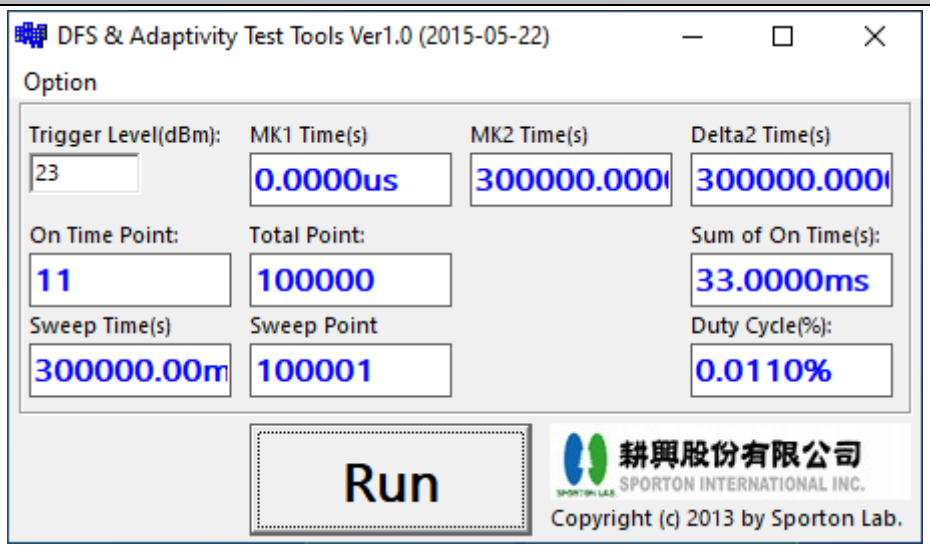
Calculated Result

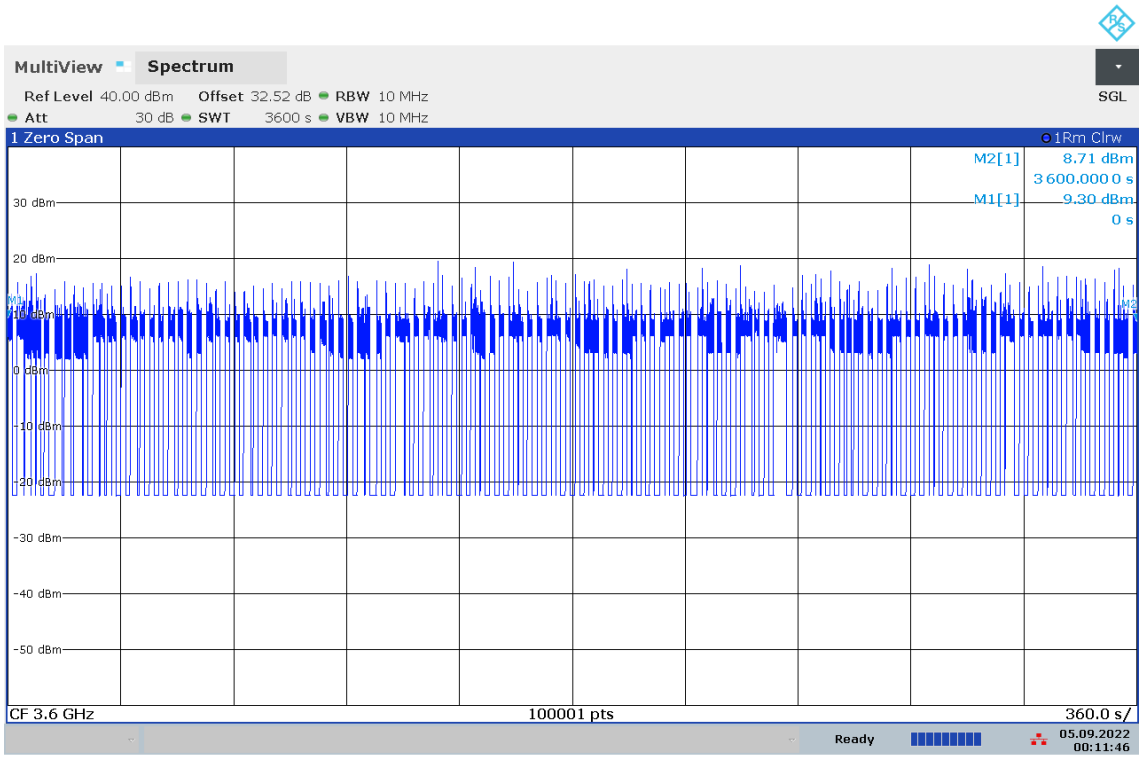


The sum of On Time (aggregated time from marker 1 to 2): 33ms < 10s, Pass.

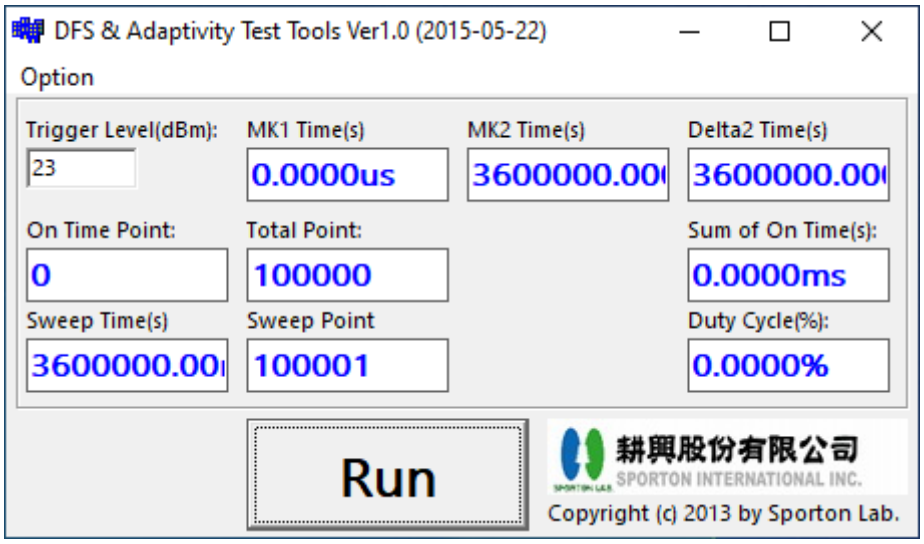
5.3 20 seconds within any 3600-second period

Spectrum Analyzer

(The Ref Offset 32.52 dB includes the antenna gain 17 dBi and cable path loss 15.52 dB.)



Calculated Result



The sum of On Time (aggregated time from marker 1 to 2): 0s < 20s, Pass.

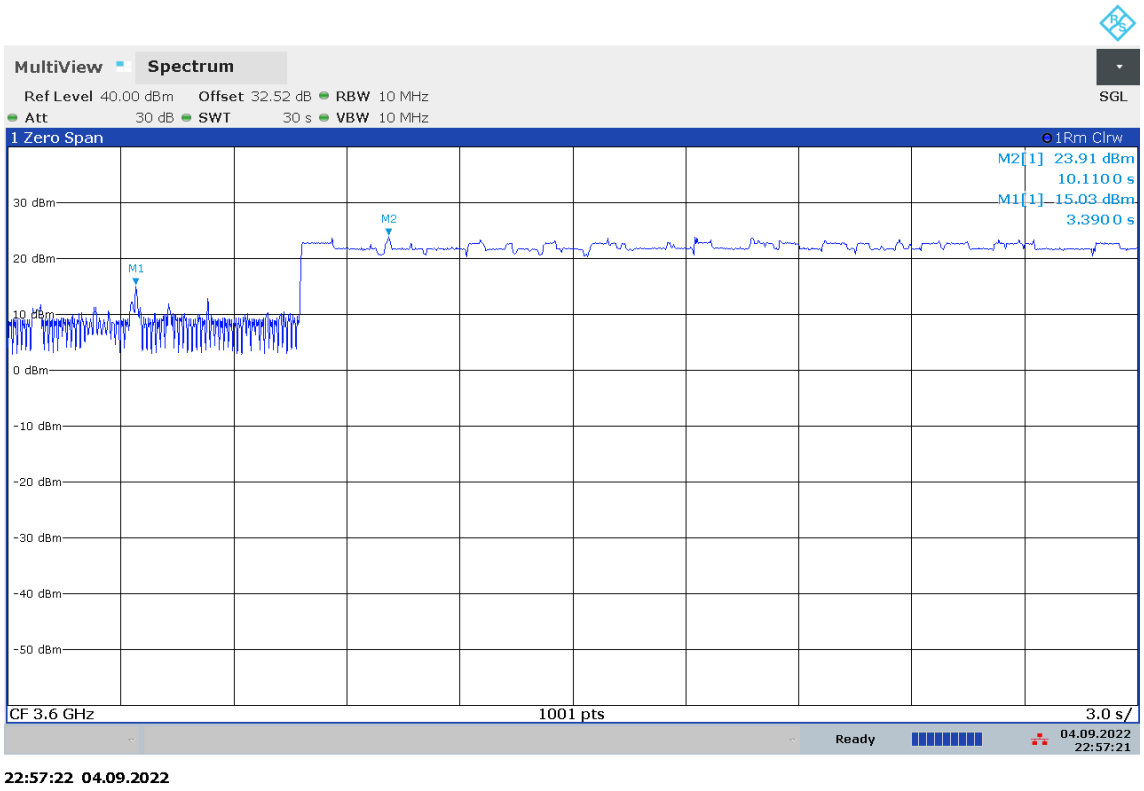
6. UUT register with the SAS irrespective of power levels

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 32.52 dB includes the antenna gain 17 dBi and cable path loss 15.52 dB.

Marker 1: The UUT successfully registered with SAS Test Harness, when operating 15.03 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

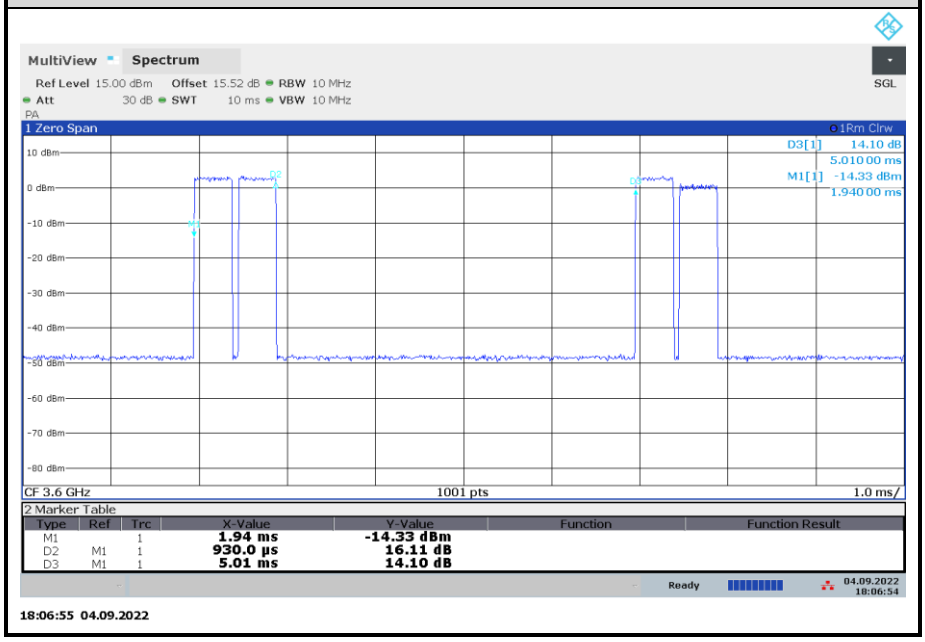
Report Clause 4.29 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement

Center Frequency [MHz]	Bandwidth [MHz]	Granted MaxEIRP [dBm/MHz]	Conducted PSD / 2TX MIMO Gain [dBm/MHz]		Duty Cycle Factor [dB]	Antenna Gain [dBi]	UUT total MaxEIRP [dBm/MHz]
3600	20	14	-13.36	3.01	7.31	17	13.96
		18	-9.57	3.01			17.75
		20	-7.79	3.01			19.53
		22	-5.68	3.01			21.64
		24	-4.08	3.01			23.24
		26	-2.69	3.01			24.63
		28	-1.77	3.01			25.55
		30	-1.68	3.01			25.64

Note: The total path loss is offset with 15.52 dB.

Duty Cycle factor:

Spectrum Analyzer



Note: The duty cycle value is 18.56%, add 10log(1/duty cycle) to the measured power level to compute the average power during continuous transmission.

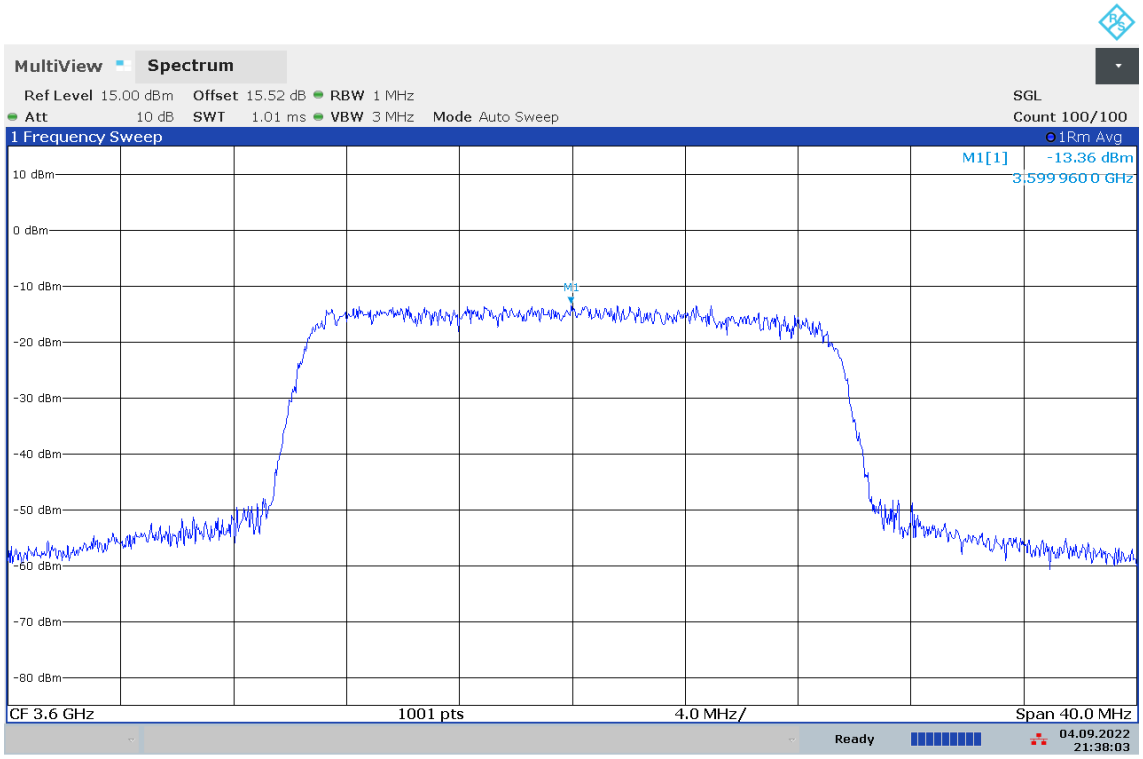
Appendix A.1.1 Test Procedure

[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 14 [dBm/MHz]

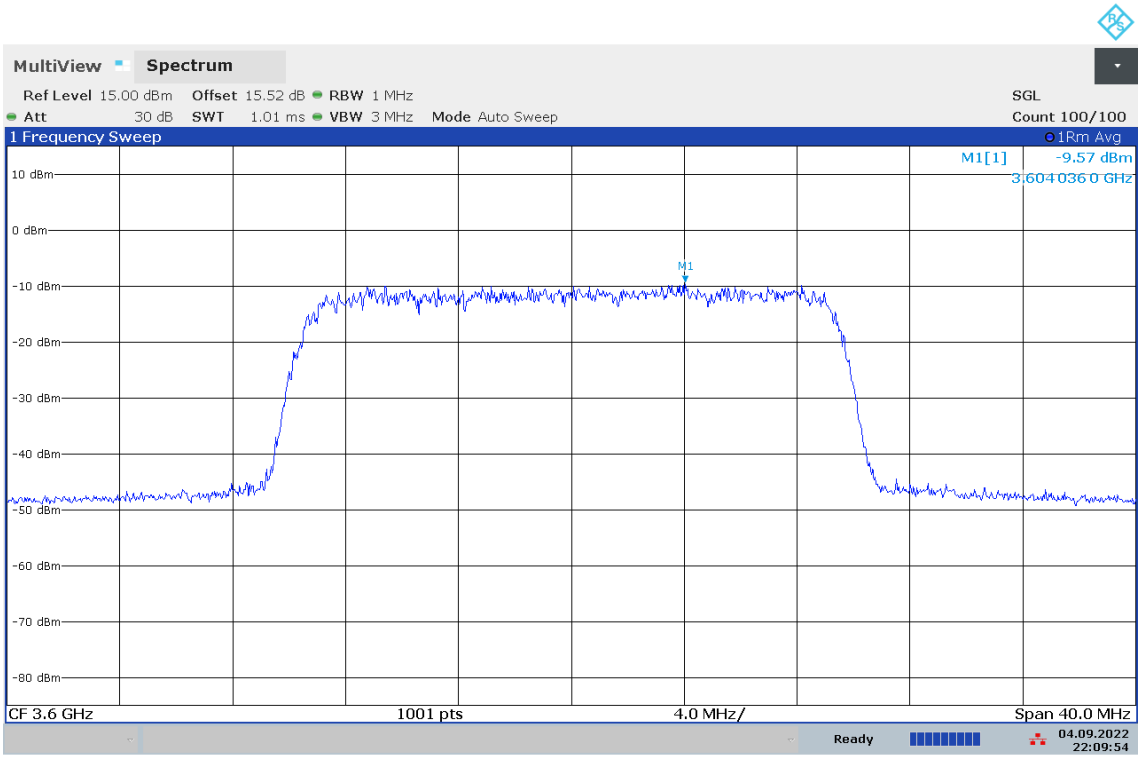
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 13.96 [dBm/MHz]



21:38:04 04.09.2022

SAS Granted MaxEIRP 18 [dBm/MHz]

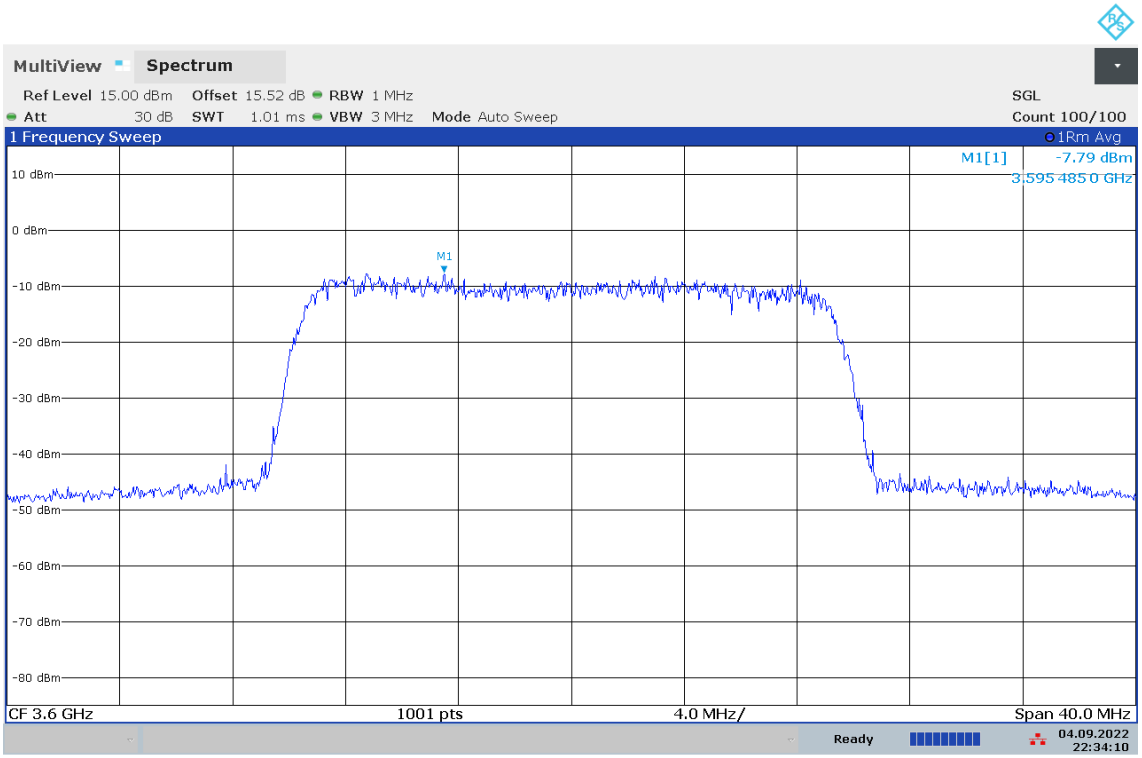
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 17.75 [dBm/MHz]



22:09:54 04.09.2022

SAS Granted MaxEIRP 20 [dBm/MHz]

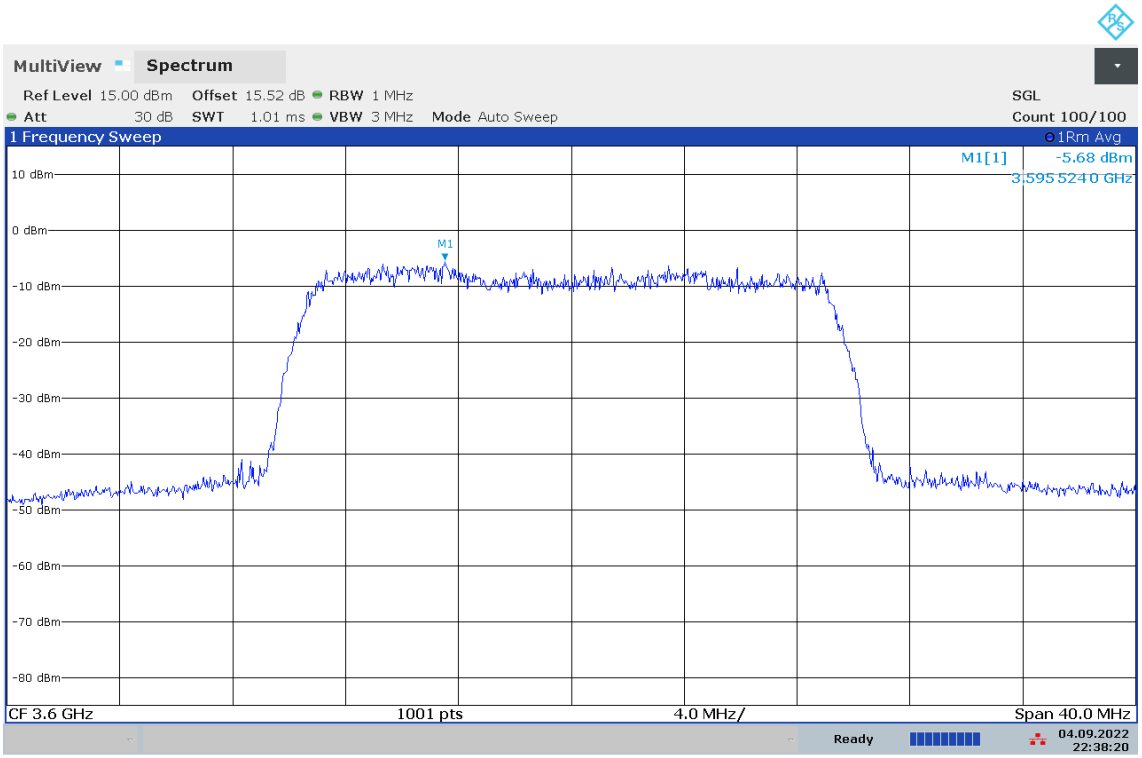
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 19.53 [dBm/MHz]



22:34:11 04.09.2022

SAS Granted MaxEIRP 22 [dBm/MHz]

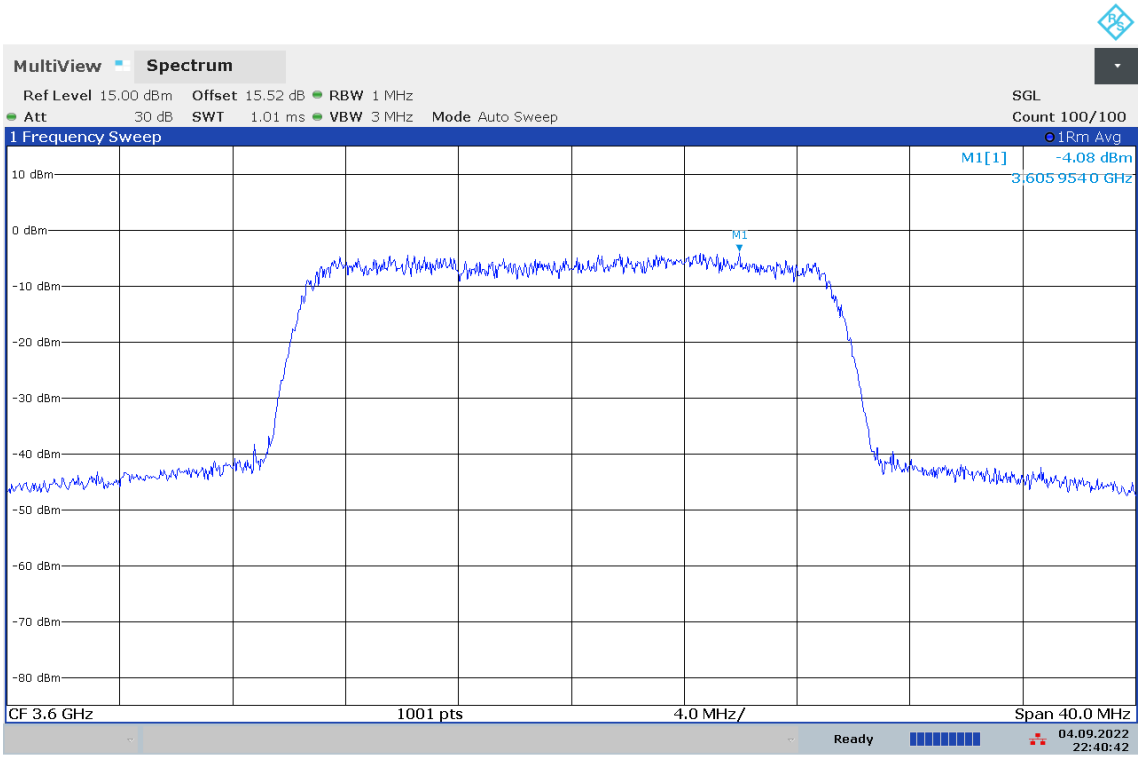
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 21.64 [dBm/MHz]



22:38:21 04.09.2022

SAS Granted MaxEIRP 24 [dBm/MHz]

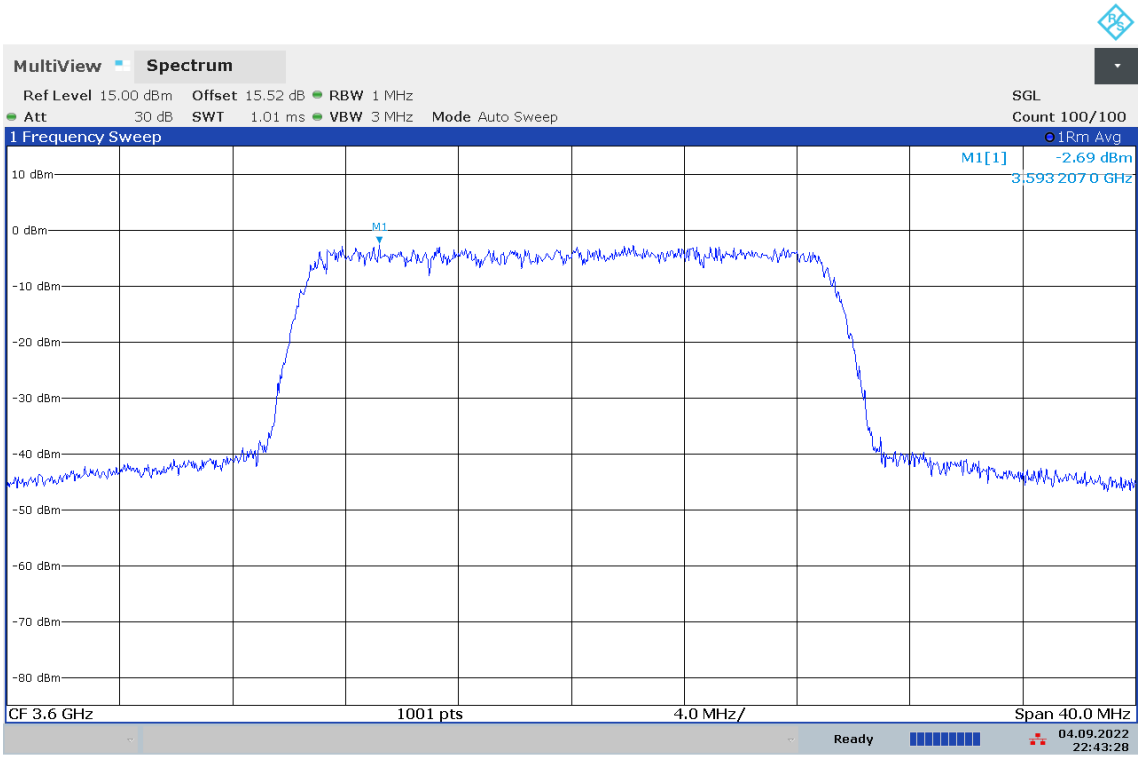
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 23.24 [dBm/MHz]



22:40:43 04.09.2022

SAS Granted MaxEIRP 26 [dBm/MHz]

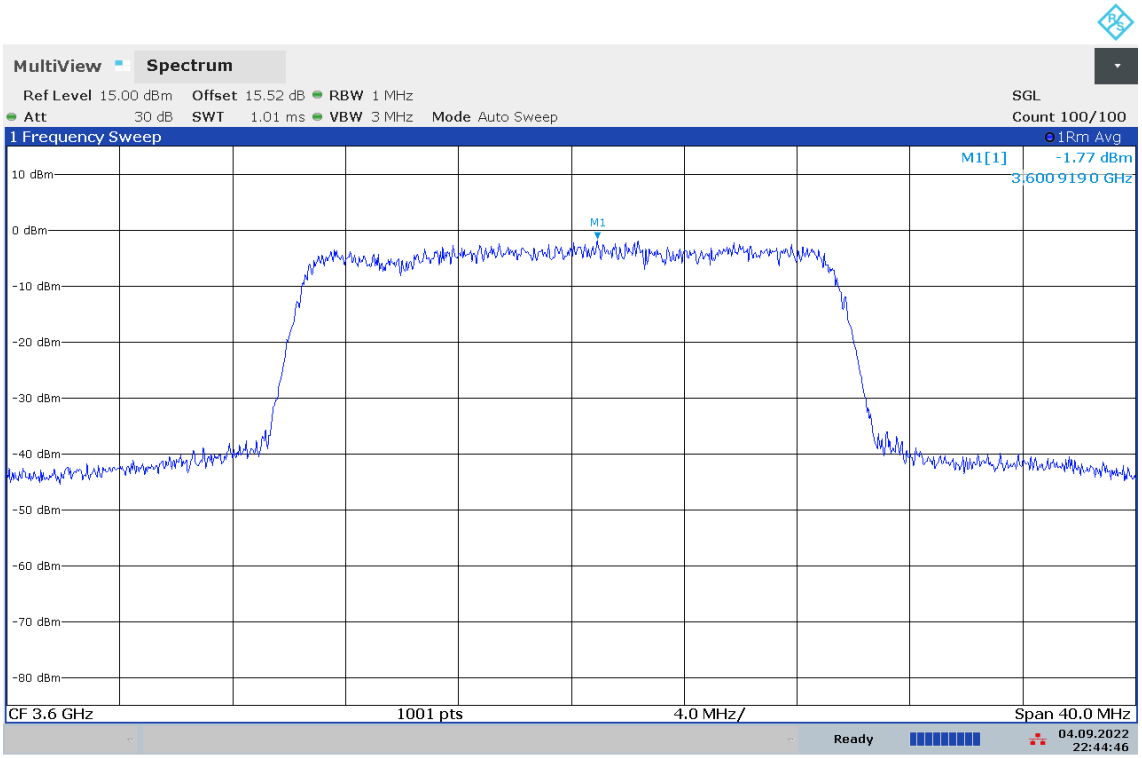
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 24.63 [dBm/MHz]



22:43:28 04.09.2022

SAS Granted MaxEIRP 28 [dBm/MHz]

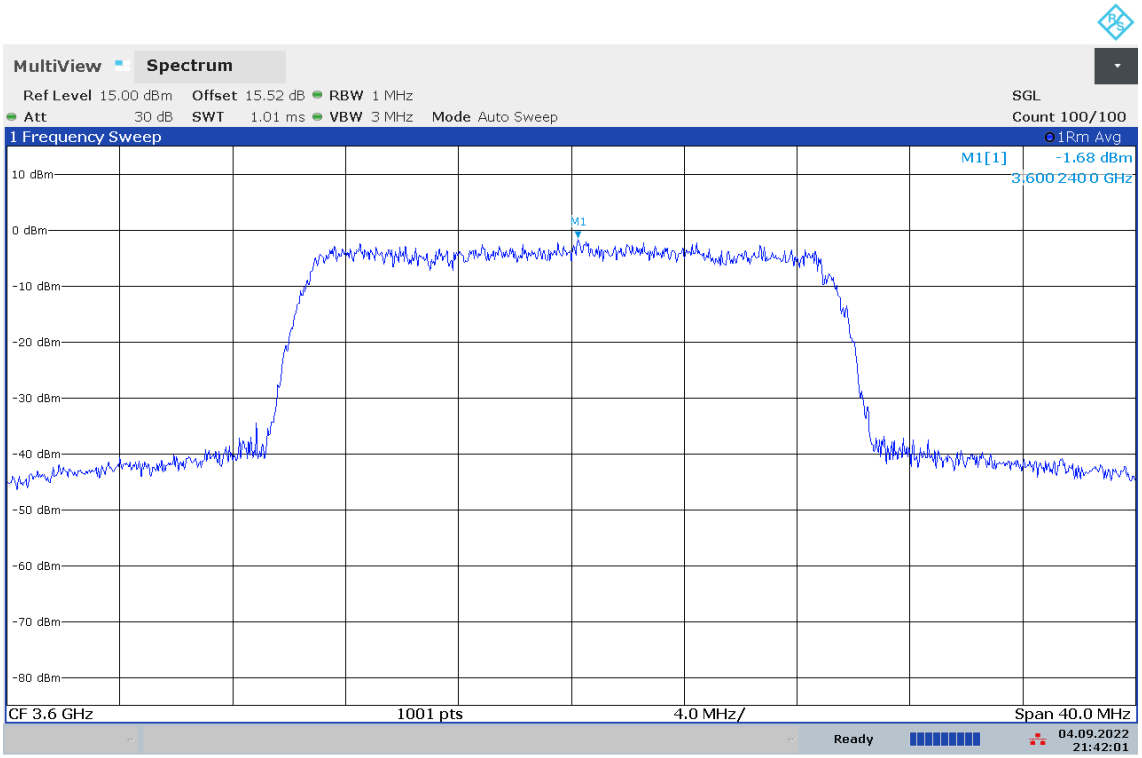
UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 25.55 [dBm/MHz]



22:44:46 04.09.2022

SAS Granted MaxEIRP 30 [dBm/MHz]

UUT Center Frequency 3600 MHz, Bandwidth 20 MHz, MaxEIRP 25.64 [dBm/MHz]



21:42:02 04.09.2022