WINNF-TS-0122 Test Report

Applicant	:	**Smawave Technology Co. ,Ltd**
Equipment	:	**5G ODU_NA**
Brand Name	:	**smawave**
Model Name	:	**SRU820**
FCC ID	:	**2AU8HSRU820**
Reference	:	**WINNF-TS-0122 Version V1.0.2**
TEST DATE(S)	:	**Sep. 28, 2024 ~ Oct. 14, 2024**

We, Sporton International Inc. (Kunshan), 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 of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia

Approved by: Jason Jia

ACCREDITED
Cert #5145.02

Sporton International Inc. (Kunshan)
No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China

Table of Contents

Revision History ---------- **4**
1. Administration Data ---------- **5**
1.1 Testing Laboratory ---------- 5
1.2 Applicant ---------- 6
1.3 Manufacturer ---------- 6
2. General Information ---------- **6**
2.1 Description of Equipment Under Test (EUT) ---------- 6
2.2 Protocol Test Summary ---------- 7
2.3 Time test for getting Grant Summary ---------- 8
2.4 Support Equipment ---------- 8
2.5 Test 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.3] Grant Response contains measReportConfig ----------32
4.20 [WINNF.FT.C.MES.4] Heartbeat Response contains measReportConfig ----------34
4.21 [WINNF.FT.C.RLQ.1] Successful Relinquishment ----------36
4.22 [WINNF.FT.C.DRG.1] Successful Deregistration ----------37
4.23 [WINNF.FT.C.SCS.1] Successful TLS connection between UUT and SAS Test Harness ----------38
4.24 [WINNF.FT.C.SCS.2] TLS failure due to revoked certificate ----------39
4.25 [WINNF.FT.C.SCS.3] TLS failure due to expired server certificate ----------40
4.26 [WINNF.FT.C.SCS.4] TLS failure when SAS Test Harness certificate is issued by an unknown CA41
4.27 [WINNF.FT.C.SCS.5] TLS failure when certificate at the SAS Test Harness is corrupted ----------42
4.28 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement ----------43
5. Result of Time test for getting Grant ----------45
5.1 1 second within any 10-second period ----------45
5.2 10 seconds within any 300-second period ----------46
5.3 20 seconds within any 3600-second period ----------47
6. UUT register with the SAS irrespective of power levels ----------48
6.1 Test Procedure ----------48
Appendix A. Setup Plot
Appendix B. RF measurement plots

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FG482211C	01	Initial issue of report	Oct. 28, 2024

1. Administration Data

1.1 Testing Laboratory

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Site	Sporton International Inc. (Kunshan)
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158
Test Site No.	Sporton Site No.
	DFS02-KS
Test Engineer	Chad Wang
Temperature	20 ~ 25 ℃
Relative Humidity	46 ~ 55 %

1.2 Applicant

Company Name	**Smawave Technology Co. ,Ltd**
Address	2/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai

1.3 Manufacturer

Company Name	**Smawave Technology Co. ,Ltd**
Address	2/F, Building 8, 1001 North Qinzhou Road, Xuhui District, Shanghai

2. General Information

2.1 Description of Equipment Under Test (EUT)

Product Feature & Specification	
Equipment	5G ODU_NA
Brand Name	smawave
Model Name	SRU820
FCC ID	2AU8HSRU820
Professional Installation	☒ Yes ☐ No
UUT Under Test Type	☐ BTS-CBSD product (Base Station) ☒ CPE-CBSD product (Customer Premises Equipment)
UUT Category	☐ Category A ☒ Category B
Domain Proxy support	☐ CBSD with Domain Proxy (Please see section 9 for more information) ☒ CBSD without Domain Proxy
UUT Antenna Gain	19.46 dBi
UUT HW Version	V1.0
UUT SW Version	SRU820-EUN-V1.0.0
Device Power Class	5G NR n78: Power Class 3

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
6.5.4.2.3	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
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	20.9368ms	PASS
2	10 seconds	300 seconds	46.8750ms	PASS
3	20 seconds	3600 seconds	5474.525ms	PASS

2.4 Support Equipment

Name	Manufacturer	Type/Model	Serial Number	FCC ID
Airspeed 2900	Airspan	Airspeed 2900	ED0863016574	PIDAS2900

2.5 Test Equipment List

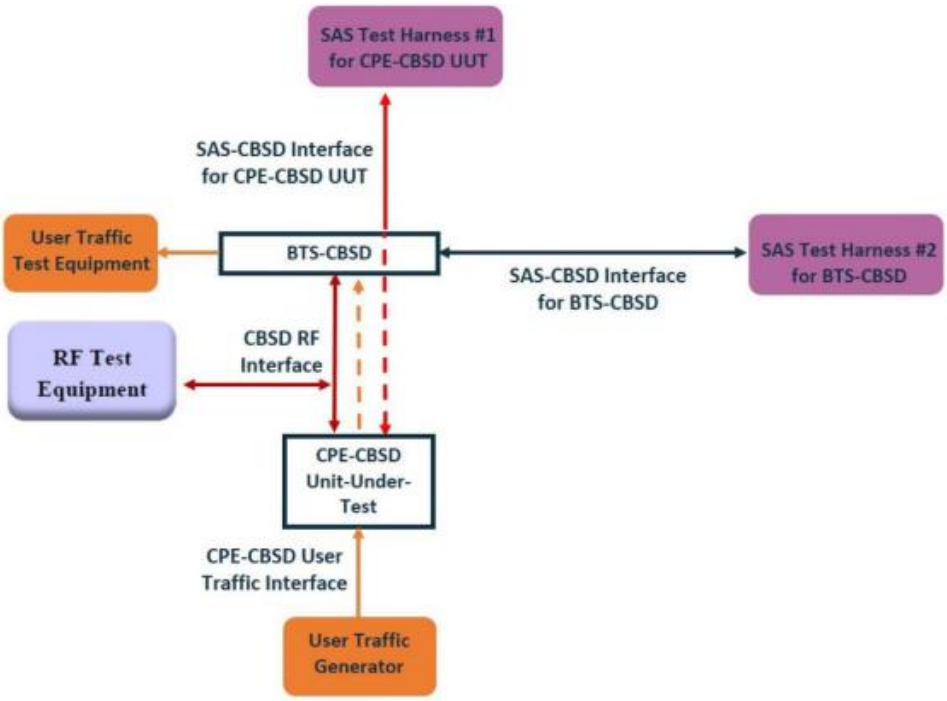
Name	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
Signal Analyzer	R&S	FSV7	101472	Jan. 04, 2024	Jan. 03, 2025
Oscilloscope	R&S	RTE1202	101334	Oct. 11, 2023	Oct. 10, 2024
				Oct. 10, 2024	Oct. 09, 2025

3. Measurement Environment

Measurement Environment Information	
SAS Test Harness version	1.0.0.3
Operating System	Windows 10
TLS version	V1.2
Python version	V2.7

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 CPI-signed data in the registration message.
no	**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]. W INNF-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: • 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.7] Registration due to change of an installation parameter

#	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 has successfully registered with SAS Test Harness	--
3	Change an installation parameters at the UUT (time T) Tester needs to record the current time at which the parameter change is executed.	--
4	Monitor the SAS-CBSD interface. UUT sends a deregistrationRequest to the SAS Test Harness 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: • 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

#	Test Execution Steps	Results
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.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:	PASS

	If number of Heartbeat Requests sent by UUT after Step 3 is = 5, then stop test with result of FAIL	
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	--

4.20 [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	--

4.21 [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

4.22 [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

4.23 [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

4.24 [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

4.25 [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

4.26 [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

4.27 [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 withthe 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.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.	--

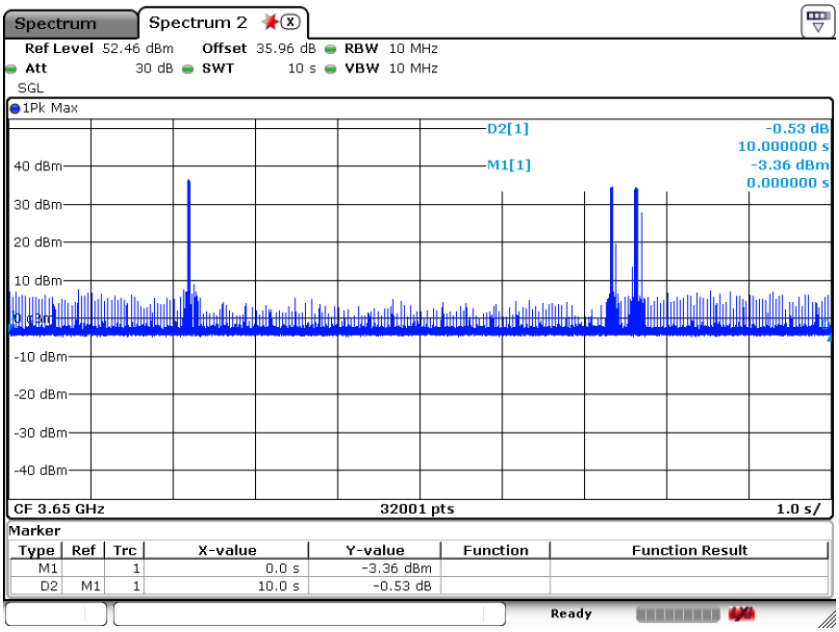
2	UUT and SAS Test Harness perform a series of Heartbeat Request/Response cycles, which continues until the other test steps are complete. Messaging for each cycle is as follows:
	• UUT sends Heartbeat Request, including:
	  ○ cbsdId = C
	  ○ grantId = G
	• SAS Test Harness responds with Heartbeat Response, 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

5. Result of Time test for getting Grant

5.1 1 second within any 10-second period

Oscilloscope

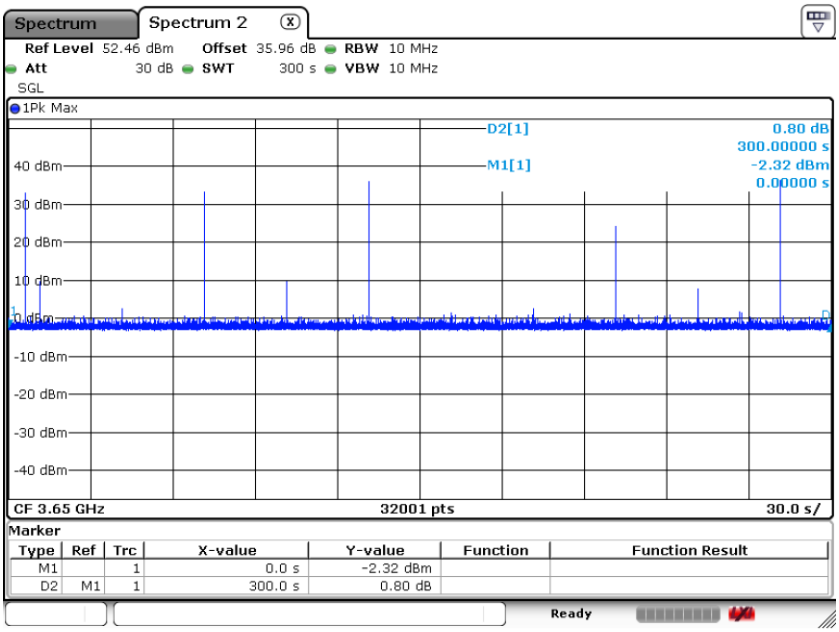


Calculated Result

The sum of On Time (aggregated time from marker 1 to 2): 20.9368ms < 1s, Pass.

5.2 10 seconds within any 300-second period

Oscilloscope

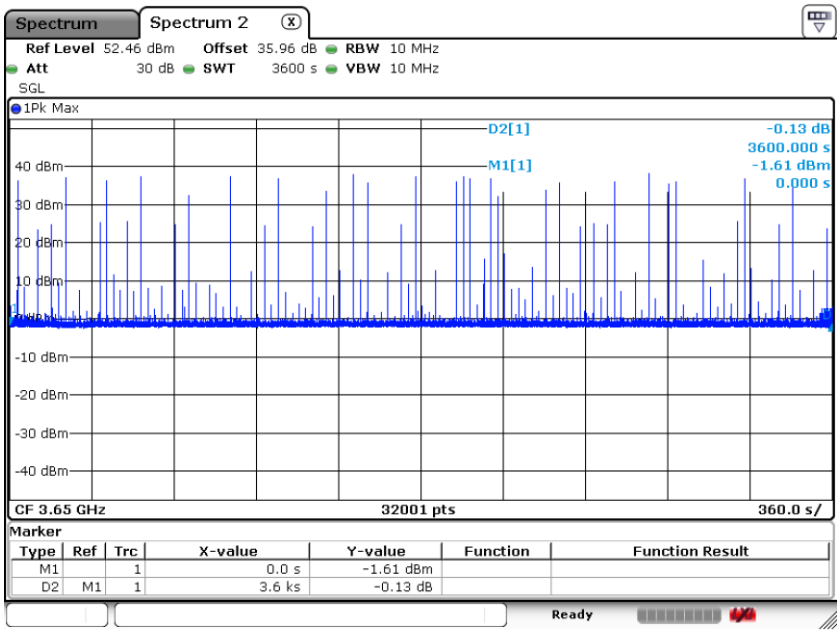


Calculated Result

The sum of On Time (aggregated time from marker 1 to 2): 46.8750 ms < 10s, Pass.

5.3 20 seconds within any 3600-second period

Oscilloscope



Calculated Result

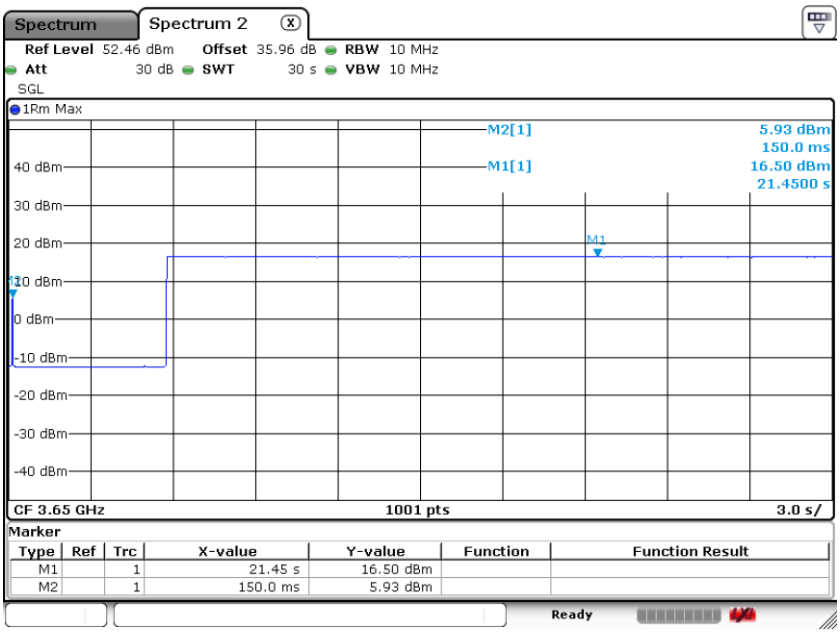
The sum of On Time (aggregated time from marker 1 to 2): 5474.525ms < 20s, Pass.

6. UUT register with the SAS irrespective of power levels

6.1 Test Procedure

1. Ensure the UUT power be below 23 dBm EIRP.
2. Make SAS test harness to grant UUT power level above 23 dBm EIRP.
3. Enable UUT, then check UUT power will follow the power limit that SAS test harness authorized.

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

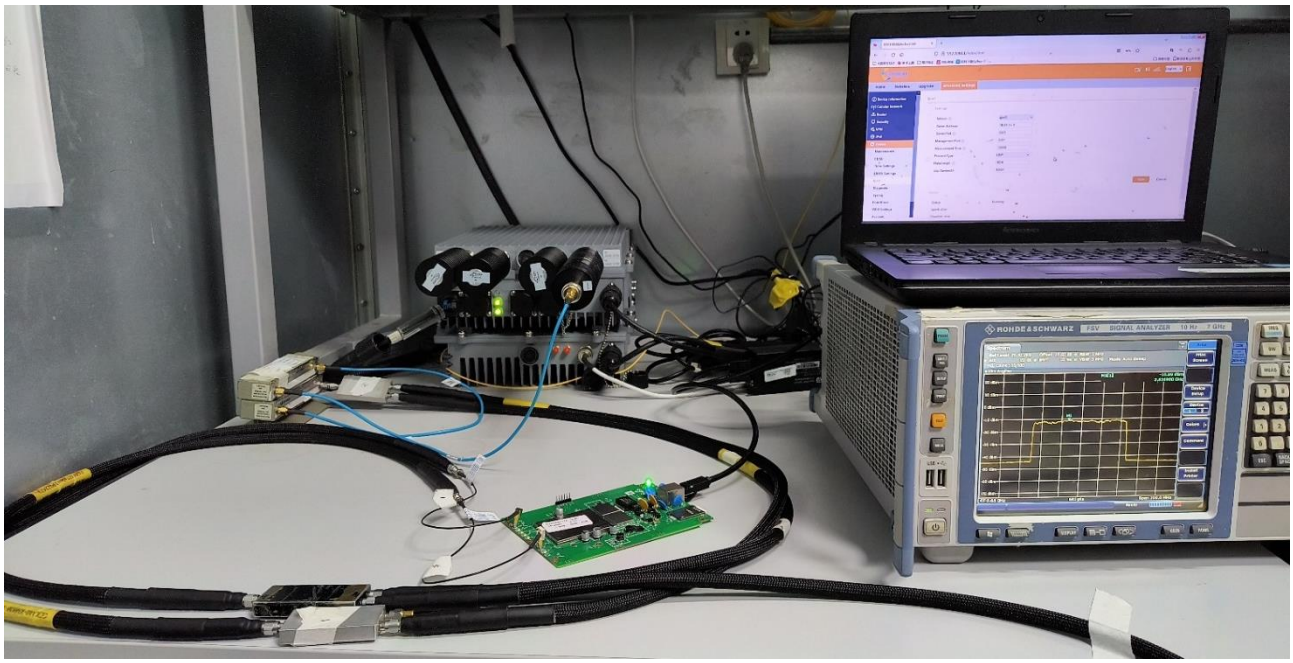
Note: The Ref Offset 35.96 dB includes the antenna gain 19.46 dBi and cable path loss 16.5 dB.

Marker 1: The UUT successfully registered with SAS Test Harness, when operating 5.93 dBm EIRP.

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

END of this report

Appendix A. Setup Plot



Appendix B. RF measurement plots

B.1 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement

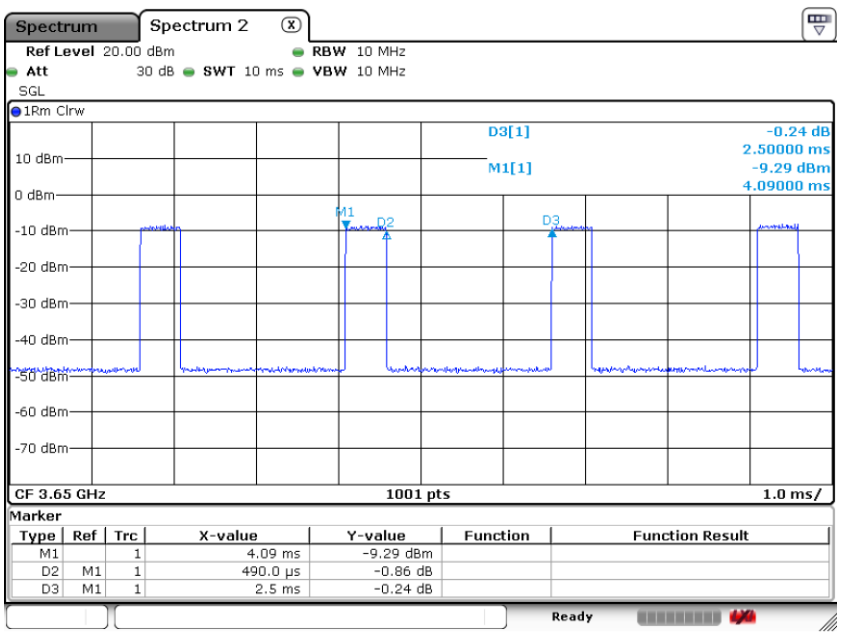
Report Clause 4.28 [WINNF.PT.C.HBT] UUT RF Transmit Power Measurement

Center Frequency [MHz]	Bandwidth [MHz]	Granted maxEIRP [dBm/MHz]	Conducted PSD [dBm/MHz]	Duty Cycle Factor [dB]	Antenna Gain [dBi]	Additional MIMO Gain	UUT MaxEIRP [dBm/MHz]
3650	40	26	-5.56	7.08	19.46	3.01	23.99
		24	-6.06				23.49
		22	-8.01				21.54
		20	-10.46				19.09
		18	-11.9				17.65
		17	-12.9				16.65

Note: The total path loss is offset with 16.5 dB.

Duty Cycle factor:

Spectrum Analyzer



Note: The duty cycle value is 19.60%, add 10log(1/duty cycle) to the measured power level to compute the average power during continuous transmission.

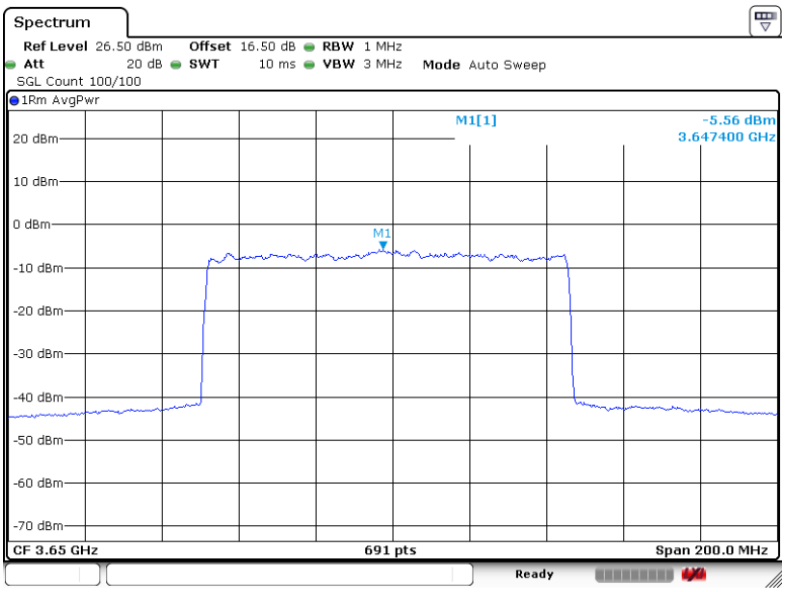
B.1.1 Test Procedure

[WINNF.PT.C.HBT] UUT RF Transmit Power Measurement defined in clause 4.28 of this test report.

B.1.2 Test Result

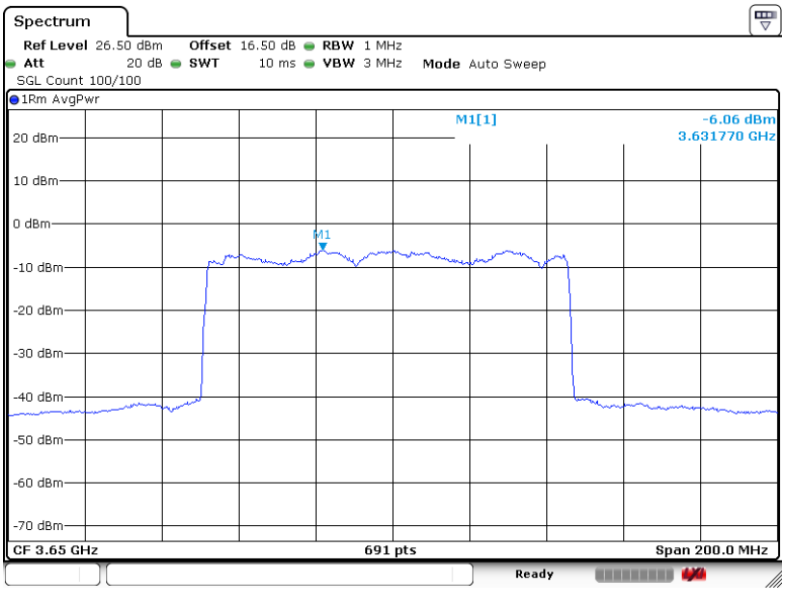
SAS Granted MaxEIRP 26 [dBm/MHz]

UUT Center Frequency 3650 MHz, Bandwidth 40 MHz, MaxEIRP 23.99 [dBm/MHz]



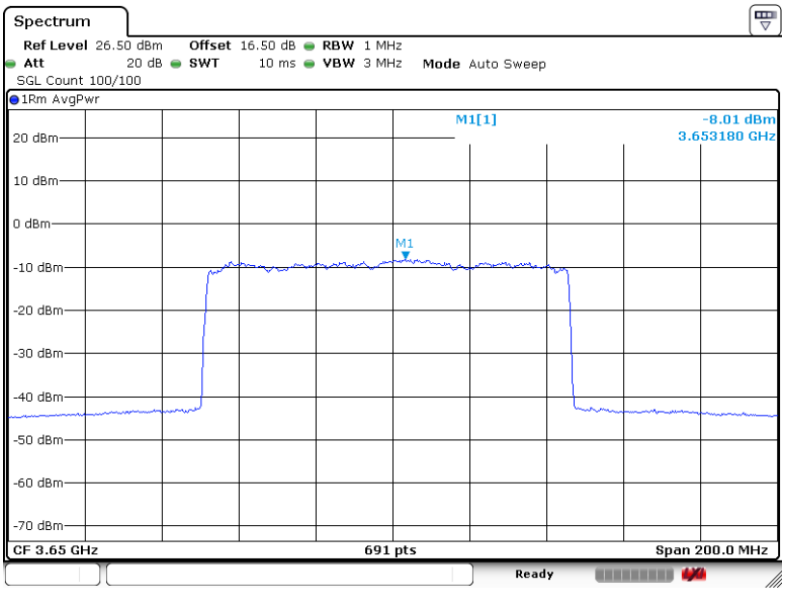
SAS Granted MaxEIRP 24 [dBm/MHz]

UUT Center Frequency 3650 MHz, Bandwidth 40 MHz,MaxEIRP 23.49 [dBm/MHz]



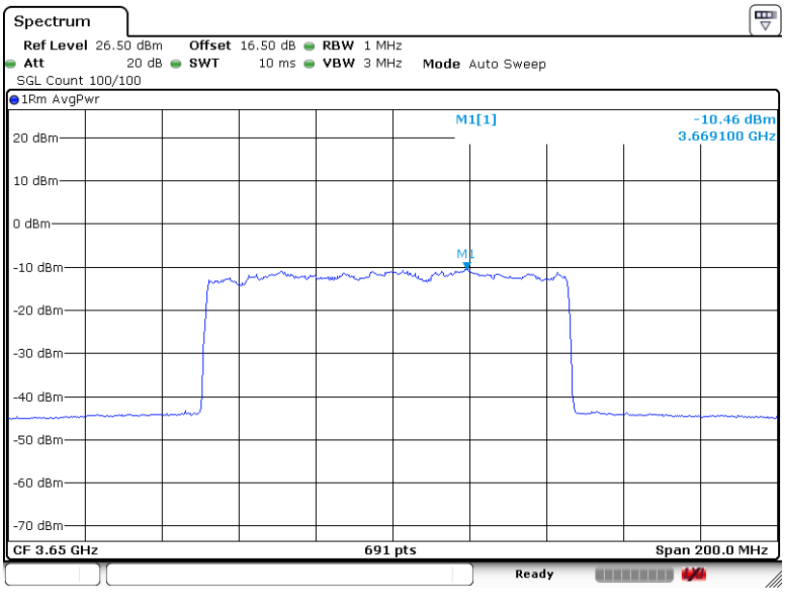
SAS Granted MaxEIRP 22 [dBm/MHz]

UUT Center Frequency 3650 MHz, Bandwidth 40 MHz, MaxEIRP 21.54 [dBm/MHz]



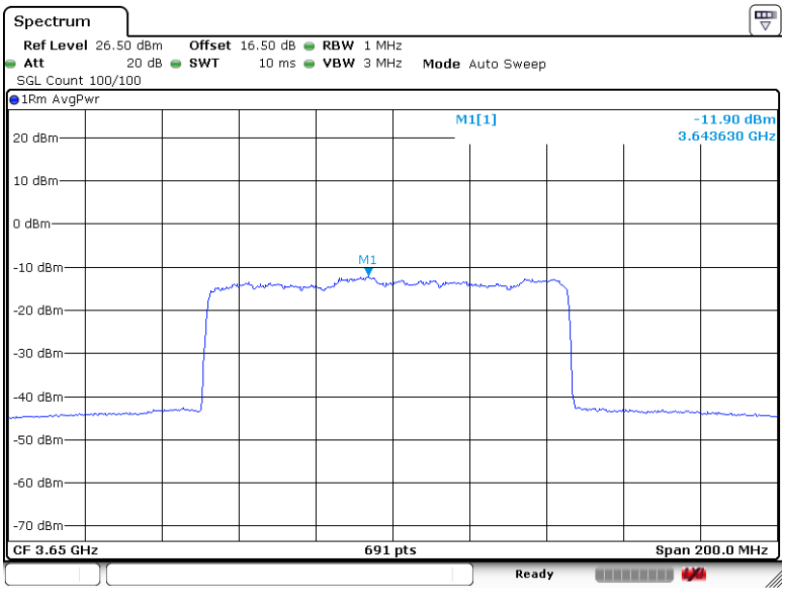
SAS Granted MaxEIRP 20 [dBm/MHz]

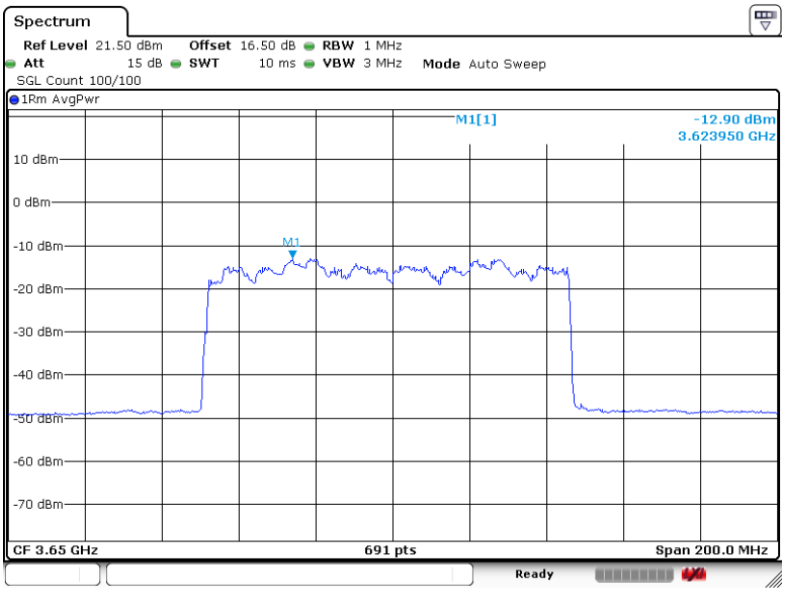
UUT Center Frequency 3650 MHz, Bandwidth 40 MHz, MaxEIRP 19.09 [dBm/MHz]



SAS Granted MaxEIRP 18 [dBm/MHz]

UUT Center Frequency 3650 MHz, Bandwidth 40 MHz, MaxEIRP 17.65 [dBm/MHz]



SAS Granted MaxEIRP 17 [dBm/MHz]

UUT Center Frequency 3650 MHz, Bandwidth 40 MHz, MaxEIRP 16.65 [dBm/MHz]