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TEST REPORT
CBSD-SAS Interoperability

Applicant Name:
Atos
Avenue Jean Jaurès,
Les Clayes sous Bois
France 78340

Date of Testing:
5/2 – 7/31/2023
Test Report Issue Date:
8/12/2023
Test Site/Location:
Element lab. Columbia, MD, USA
Test Report Serial No.:
1M2304200057-02.2A289

FCC ID:	**2A289-LFW-EXTENSE48**
APPLICANT:	**ATOS**

Application Type:	Certification
Model:	Panther 4X4 MIMO
EUT Type:	CBRS Remote Radio Head
Frequency Range:	3550 – 3700 MHz
FCC Classification:	Category B Citizens Band Radio Service Devices (CBSD)
FCC Rule Part(s):	96
Test Procedure(s):	WINNF-TS-0122-V1.0.2, CBRSA-TS-9001 V.1.0.0

This equipment has been shown to be capable of compliance with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in the test procedures listed above. Test results reported herein relate only to the item(s) tested.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

RJ Ortanez
Executive Vice President

Authorized Test Lab

ACCREDITED
CERT #2041.01

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1.0 INTRODUCTION

1.1 Scope

Measurement and determination of compliance with the technical rules and regulations of the Federal Communications Commission.

1.2 Element Test Location

These measurement tests were conducted at the Element laboratory located at 7195 Oakland Mills Road, Columbia, MD 21046.

1.3 Test Facility / Accreditations

Measurements were performed at Element lab located in Columbia, MD 21046, U.S.A.

- Element is a CBRS Alliance (OnGo) Approved Test Lab
- Element is a WInnForum Approved Test Lab
- Element is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for CBRS Alliance Certification Test Plan and WInnForum Conformance and Performance Test Technical Standard.
- Element is an ISO 17025-2017 accredited test facility under the American Association for Laboratory Accreditation (A2LA) with Certificate number 2041.01 for Specific Absorption Rate (SAR), Hearing Aid Compatibility (HAC) testing, where applicable, and Electromagnetic Compatibility (EMC) testing for FCC and Innovation, Science, and Economic Development Canada rules.
- Element TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC 17065-2012 by A2LA (Certificate number 2041.03) in all scopes of FCC Rules and ISED Standards (RSS).
- Element facility is a registered (2451B) test laboratory with the site description on file with ISED.
- Element Washington DC LLC is a Recognized U.S. Certification Assessment Body (CAB # US0110) for ISED Canada as designated by NIST under the U.S. and Canada Mutual Recognition Agreement.

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2.0 PRODUCT INFORMATION

2.1 Equipment Description

The Equipment Under Test (EUT) is the **Atos CBRS Remote Radio Head FCC ID: 2A289-LFW-EXTENSE48.** The test data contained in this report pertains only to CBSD-SAS interoperability. The EUT is a Cat. B CBSD that is tested with a Domain Proxy.

Test Device Serial Number(s): 22460003, 22460006
Test Device Hardware Version: PRB000195
Test Device Software Version: 0.45

2.2 Device Capabilities

This device contains the following capabilities:

LTE Band 48

This device supports the following conditional features:

	Conditional Test Case Definitions	Supported
C1	Mandatory for UUT which supports multi-step registration message	☒
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.	☐
C3	Mandatory for UUT which supports single-step registration containing CPI-signed data in the registration message.	☒
C4	Mandatory for UUT which supports RECEIVED_POWER_WITHOUT_GRANT measurement report type.	☐
C5	Mandatory for UUT which supports RECEIVED_POWER_WITH_GRANT measurement report type.	☒
C6	Mandatory for UUT which supports parameter change being made at the UUT and prior to sending a deregistration	☐

Table 2-1. Conditional Features

2.3 Test Configuration

The EUT was connected to the SAS Test Harness developed by WINNF WG4-CBSD. The SAS Test Harness (V1.0.0.2) provided by CBRS Alliance was used. The SAS Test Harness is synchronized to UTC time. For tests requiring two CBSDs to be monitored, outputs from both radio heads were coupled together and monitored simultaneously.

2.4 Modifications

No modifications were made to EUT during testing.

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3.0 TEST EQUIPMENT CALIBRATION DATA

Test Equipment Calibration is traceable to the National Institute of Standards and Technology (NIST).

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	N9020A	MXA Signal Analyzer	3/15/2023	Annual	3/15/2024	US46470561
Dell	Latitude 5580	Test Harness Laptop	N/A	N/A	N/A	N/A
HP	Elitebook HSN-113C-5	Testing Laptop	N/A	N/A	N/A	N/A
HP	Envy	DP Laptop	N/A	N/A	N/A	N/A

Table 3-1 Annual Test Equipment Calibration Schedule

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4.0 ENVIRONMENTAL CONDITIONS

The temperature is controlled within range of 15ºC to 35ºC. The relative humidity is controlled within range of 10% to 75%. The atmospheric pressure is monitored within the range 86-106kPa (860-1060mbar).

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5.0 EVALUATION PROCEDURE

The measurement procedure described in KDB 940660 D01 v03 and WINNF-TS-0122-V1.0.2 was used in the measurement of the EUT.

Deviation from measurement procedure…….....None

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6.0 TEST SUMMARY

6.1 Summary

Company Name: Atos

FCC ID: 2A289-LFW-EXTENSE48

FCC Part Section(s)	KDB940660 D01 Section 3.3 a)	Test Case Description	WInnForum Test Case	Test Result
96.39 (c)	1	Confirm that the device will only transmit after it receives authorization from a SAS	WINNF.FT.D.REG.2 WINNF.FT.D.REG.6 WINNF.FT.D.REG.9 WINNF.FT.D.REG.11 WINNF.FT.D.REG.13 WINNF.FT.D.REG.15 WINNF.FT.D.REG.17 WINNF.FT.D.REG.19 WINNF.FT.C.HBT.5 WINNF.FT.C.GRA.1 WINNF.FT.C.GRA.2	Pass
96.39 (c)	2	Check the device registration and authorization with the SAS – determine if the device behaves appropriately for successful and unsuccessful registrations. The device should not be transmitting without authorization from the SAS.	WINNF.FT.D.REG.2 WINNF.FT.D.REG.6 WINNF.FT.D.REG.9 WINNF.FT.D.REG.11 WINNF.FT.D.REG.13 WINNF.FT.D.REG.15 WINNF.FT.D.REG.17 WINNF.FT.D.REG.19	Pass
96.39(c)(1)	3	Confirm that the device changes its operating power and/or channel in response to a command from the SAS.	WINNF.FT.D.HBT.2	Pass
96.39	4	Confirm that the device correctly configures based on the different license classes	N/A	Pass
96.39(c)(1)	5	Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.	WINNF.PT.C.HBT.1	Pass
96.39(c)	6	Confirm that the device transmits with a bandwidth less than or equal to the SAS specified bandwidth.	WINNF.FT.D.HBT.2	Pass
96.39(c)(2)	7	Confirm that the device transmits on the SAS specified frequency.	WINNF.FT.D.HBT.2	Pass
96.39(c)(2)	8	Confirm that the device stops transmission in response to a command from the SAS, within a period as required by Part 96.	WINNF.FT.C.HBT.3 WINNF.FT.C.HBT.6 WINNF.FT.C.HBT.7 WINNF.FT.D.HBT.8 WINNF.FT.C.HBT.10 WINNF.FT.D.RLQ.2 WINNF.FT.D.DRG.2	Pass

Table 6-1. Summary of Test Results

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96.39 (d)	9	Confirm that the device sends measurements data in response to the command from the SAS.	WINNF.FT.D.MES.3 WINNF.FT.D.MES.5	Pass
96.39(a)	10	For devices with geo-location, confirm that it notifies the SAS of a new location when it is beyond the required distance parameter (±50 m) within the required time frame.	N/A	N/A
96.39 (d)	11	Confirm that the device is capable of reporting the signal level (measurement data) and frequency to SAS.	WINNF.FT.D.MES.3 WINNF.FT.D.MES.5	Pass
96 E	12	When CBSDs communicate through a management system, confirm compliance with all requirements.	N/A	Pass
96.39	13	When communication between the CBSD and SAS is lost: i) Describe how the CBSD would react if the communications between the device and the SAS is lost. Confirm that the CBSD stops transmission once it loses the link to the SAS. ii) Describe the process for re-establishment of the communications and confirm that the CBSD acts accordingly. iii) Confirm power-on restart process for registration (re-registration) occurs as expected. iv) Confirm the process for de-registration occurs as expected.	WINNF.FT.C.HBT.9 WINNF.FT.C.HBT.10	Pass
96.39(f)	KDB940660 D01 Section 4	SAS and Device Security Requirements	WINNF.FT.C.SCS.1 WINNF.FT.C.SCS.2 WINNF.FT.C.SCS.3 WINNF.FT.C.SCS.4 WINNF.FT.C.SCS.5	Pass

Table 6-2. Summary of Test Results (continued)

Notes:

- Test cases denoted as “N/A” in the table above are not applicable to the EUT and are either Optional or Conditional per Section 6 of WINNF-TS-0122.
- Please see Appendices for test data.

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7.0 CONCLUSION

The data collected relate only to the item(s) tested and show that the **Atos CBRS Remote Radio Head FCC ID: 2A289-LFW-EXTENSE48** has been tested to show compliance with Part 96 and WINNF-TS-0122.

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APPENDIX A – TEST RESULT AND DATA

A1 [WINNF.FT.D.REG.2] Domain Proxy Multi-Step registration

	Test Execution Steps	PASS	FAIL
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	• DP with two CBSD sends correct Registration request information, as specified in [n.5], in the form of one 2-element Array or as individual messages to the SAS Test Harness: • The required userId, fccId and cbsdSerialNumber registration parameters shall be sent for each 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.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or individual messages as follows: - cbsdId = Ci - measReportConfig shall not be included - responseCode = 0 for each CBSD	--	--
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 each 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	☒	☐

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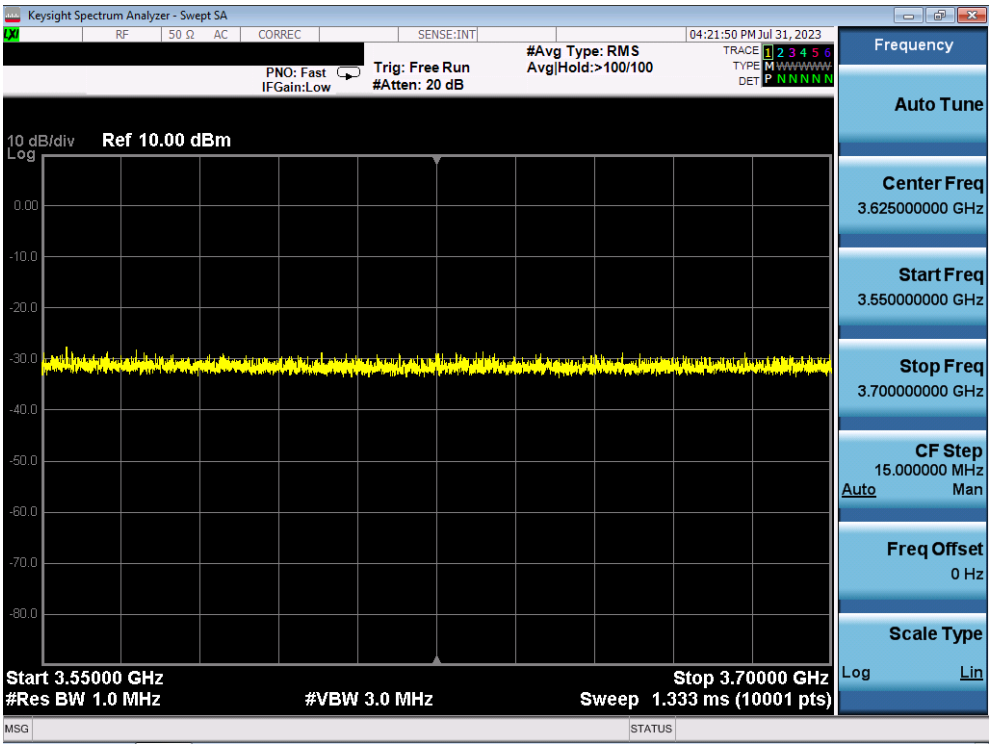
Test Plots:



Plot 1. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.2)

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A2 [WINNF.FT.D.REG.6] Domain Proxy Single-Step registration for CBSD with CPI signed data

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends Registration requests in the form of one 2-element Array or as individual messages 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. • 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 in the form of one 2-element Array or as individual messages as follows: - cbsdId = Ci - measReportConfig for each CBSD shall not be included - responseCode = 0 for each CBSD	--	--
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 each 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	☒	☐

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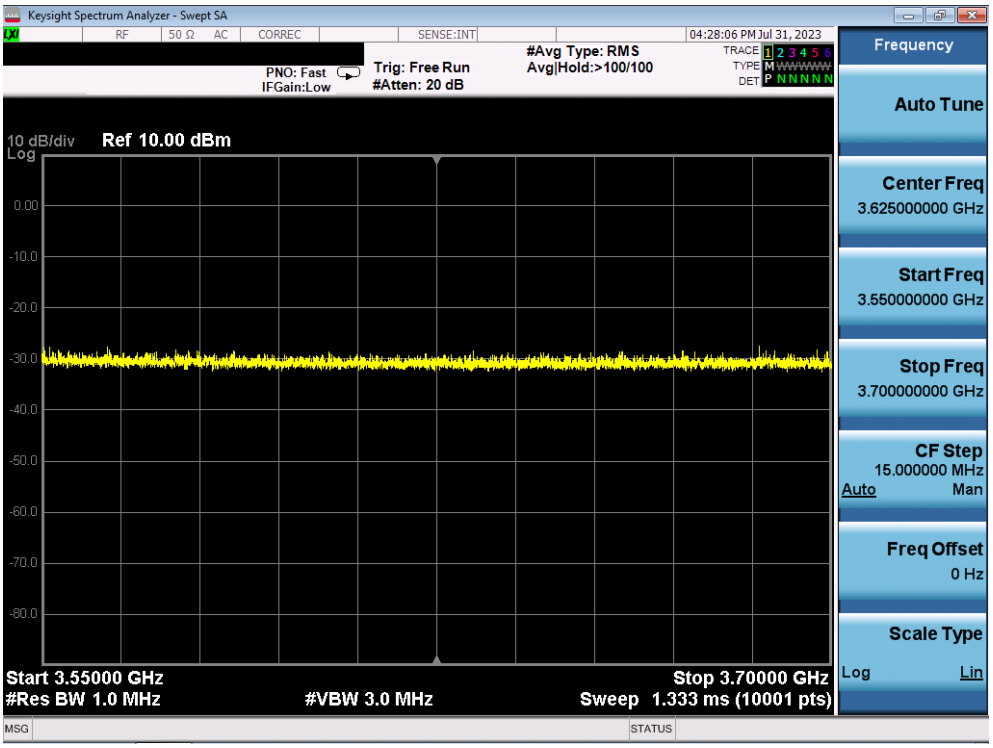
Test Plots:



Plot 2. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.6)

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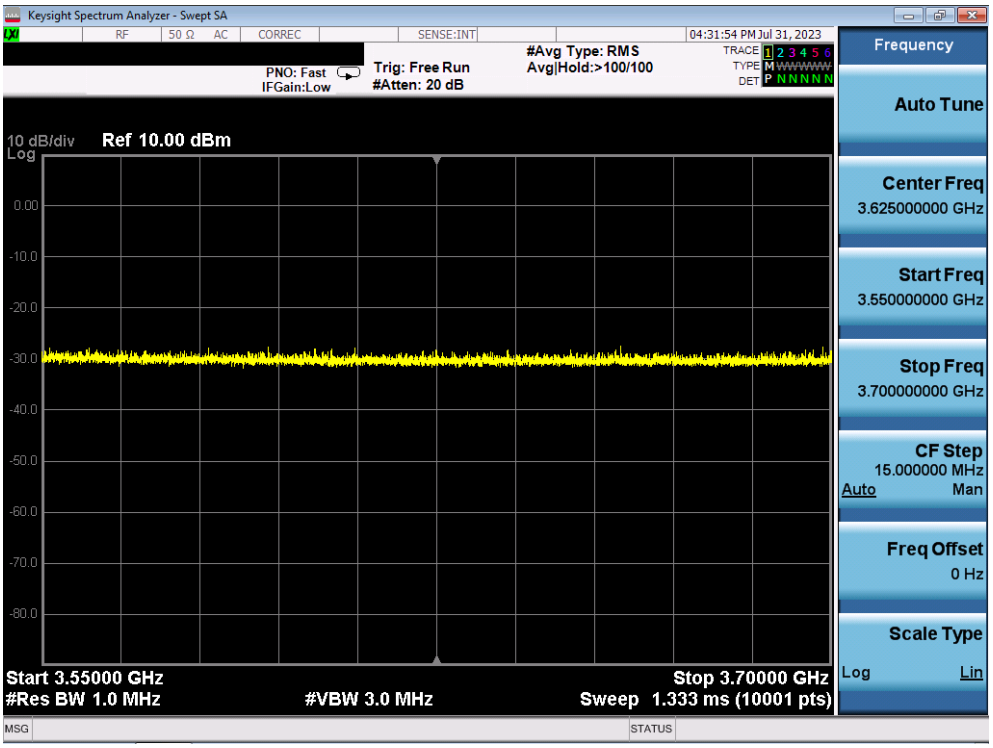
A3 [WINNF.FT.D.REG.9] Domain Proxy Missing Required parameters (responseCode 102)

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode = Ri for CBSD1 and CBSD2	--	--
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 each 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	☒	☐

Test Plots:



Plot 3. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.9)

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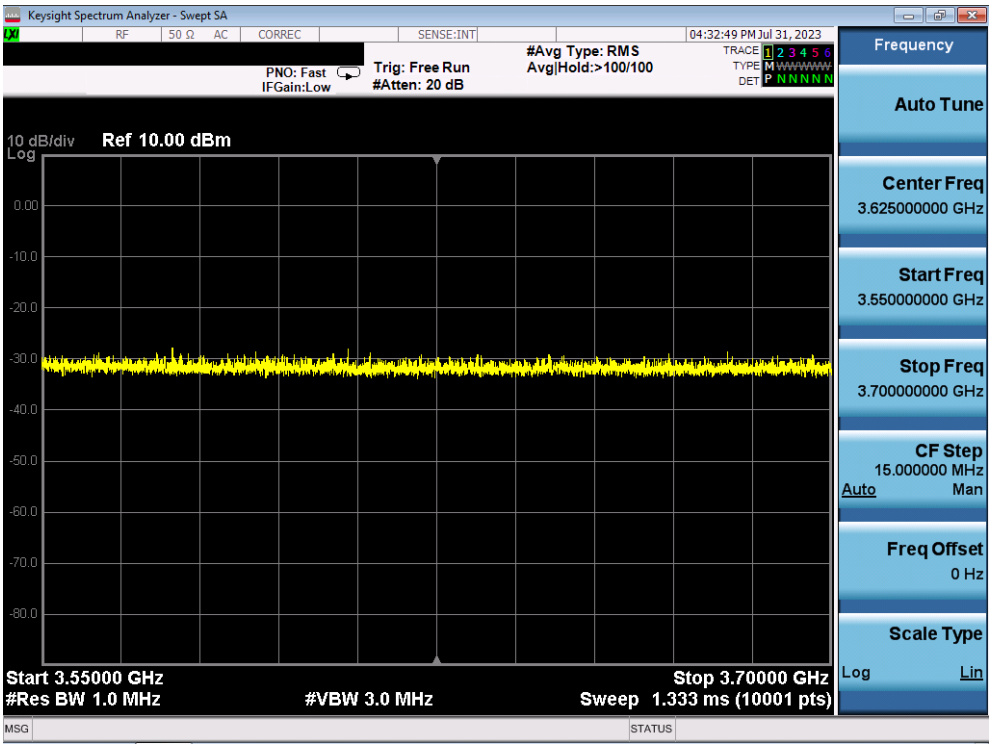
A4 [WINNF.FT.D.REG.11] Domain Proxy Pending Registration (responseCode 200)

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode (Ri) = 200 for each CBSD.	--	--
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 each 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	☒	☐

Test Plots:



Plot 4. Conducted Measurement - No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.11)

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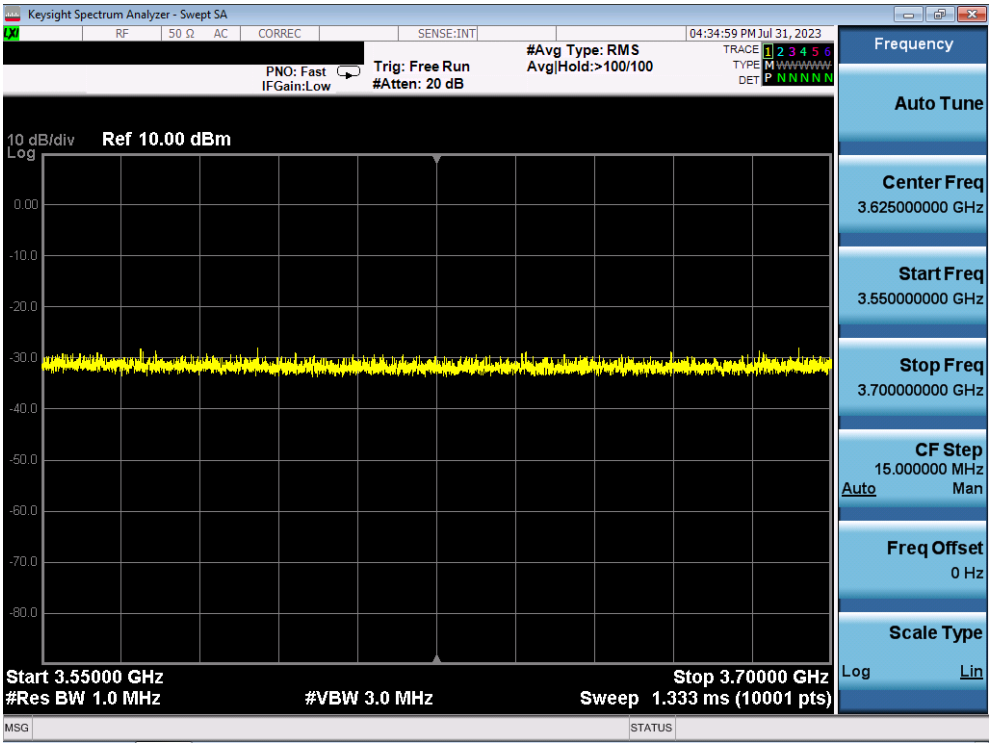
A5 [WINNF.FT.D.REG.13] Domain Proxy Invalid parameters (responseCode 103)

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode R1 = 0 for CBSD1 - responseCode R2 = 103 and CBSD2	--	--
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 each UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:	☒	☐

Test Plots:



Plot 5. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.13)

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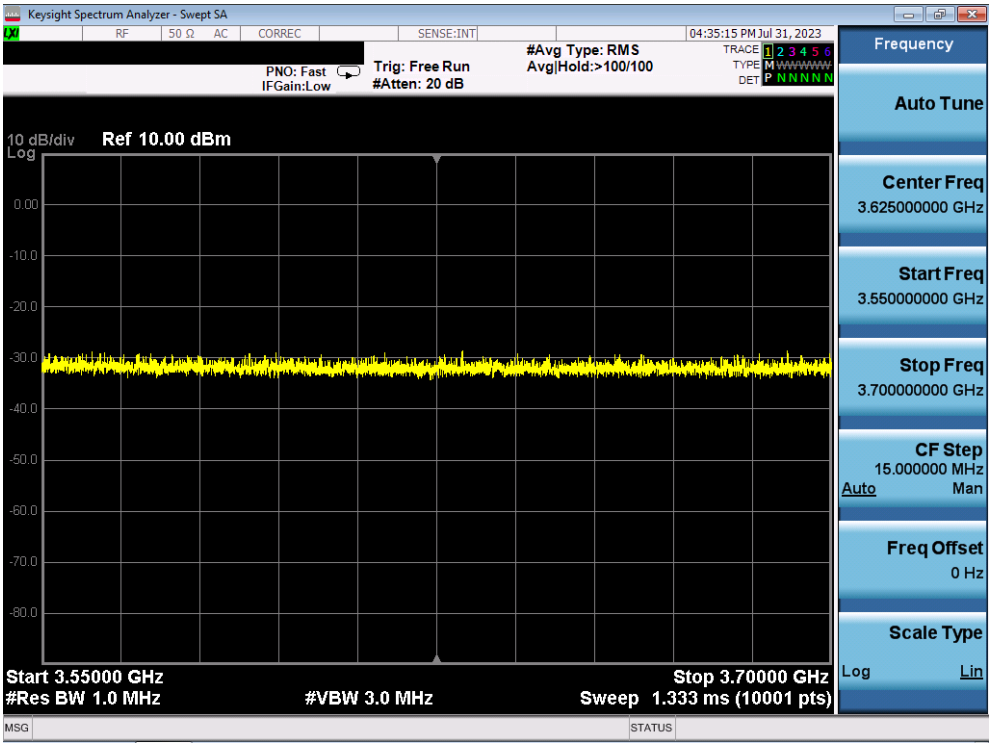
A6 [WINNF.FT.D.REG.15] Domain Proxy Blacklisted CBSD (responseCode 101)

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode R1= 0 for CBSD1 - responseCode R2 = 101 and CBSD2	--	--
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 each UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:	☒	☐

Test Plots:



Plot 6. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.15)

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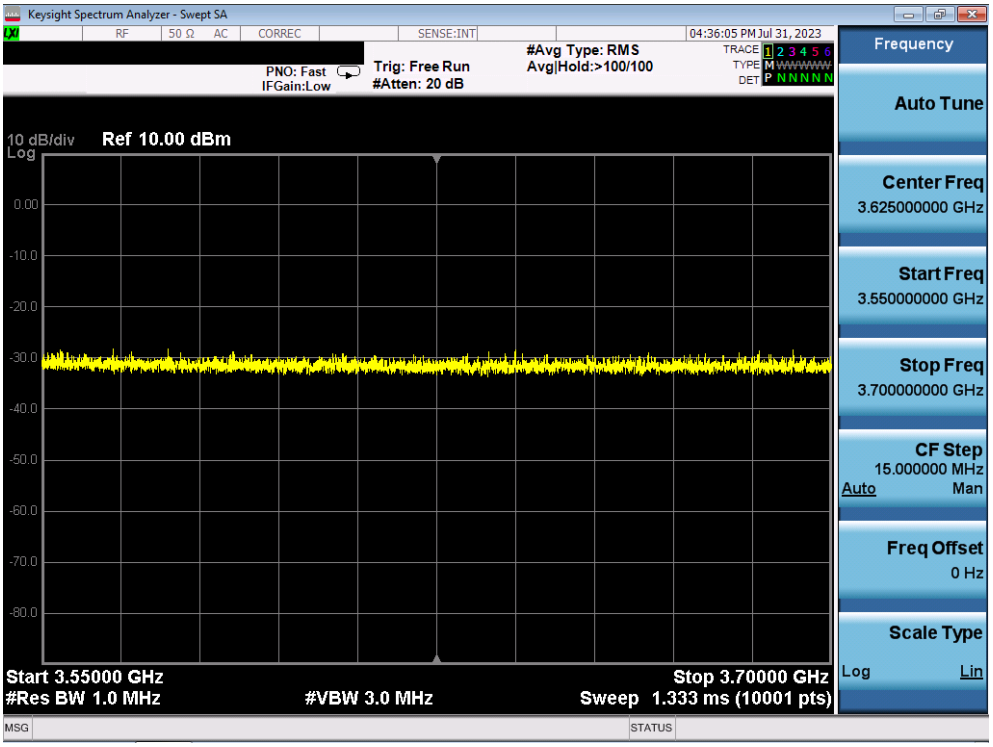
A7 [WINNF.FT.D.REG.17] Domain Proxy Unsupported SAS protocol version (responseCode100)

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode (Ri) = 100 for each CBSD	--	--
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 each UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:	☒	☐

Test Plots:



Plot 7. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.17)

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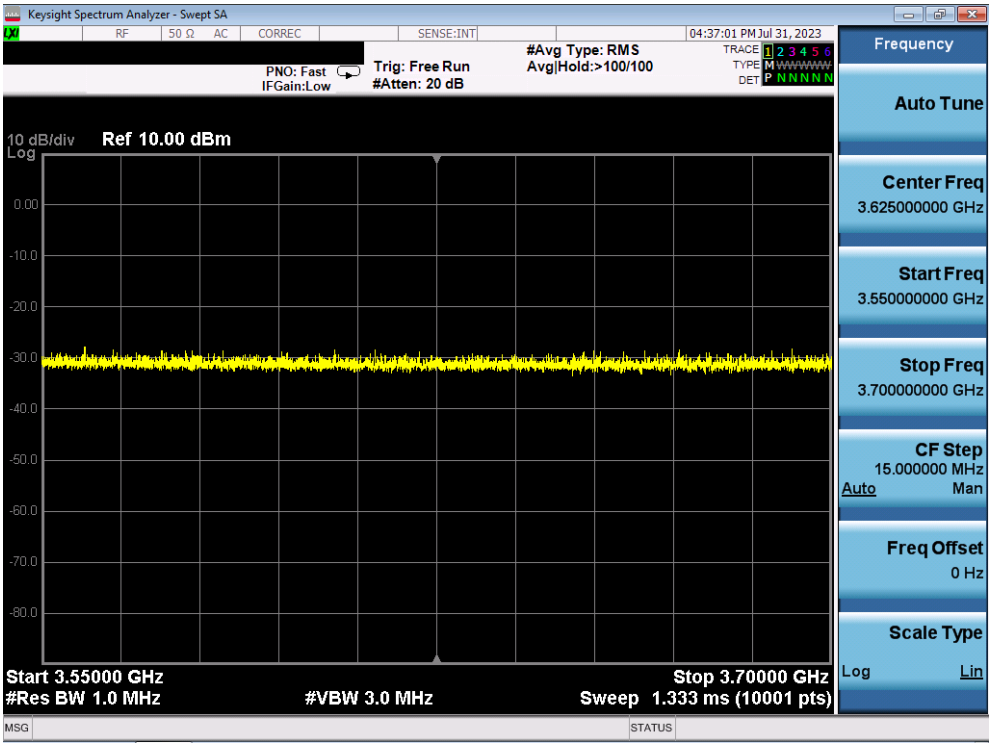
A8 [WINNF.FT.D.REG.19] Domain Proxy Group Error (responseCode 201)

	Test Execution Steps	PASS	FAIL
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	The DP with two CBSDs sends a Registration request in the form of one 2-element Array or as individual messages to SAS Test Harness.	☒	☐
3	• SAS Test Harness sends a CBSD Registration Response in the form of one 2-element Array or as individual messages as follows: - SAS response does not include a cbsdId. - responseCode R1 = 0 for CBSD1 - responseCode R2 = 201 and CBSD2	--	--
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 each UUT from start of test until 60 seconds after Step 3 is complete. This is the end of the test. Verify:	☒	☐

Test Plots:



Plot 8. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.D.REG.19)

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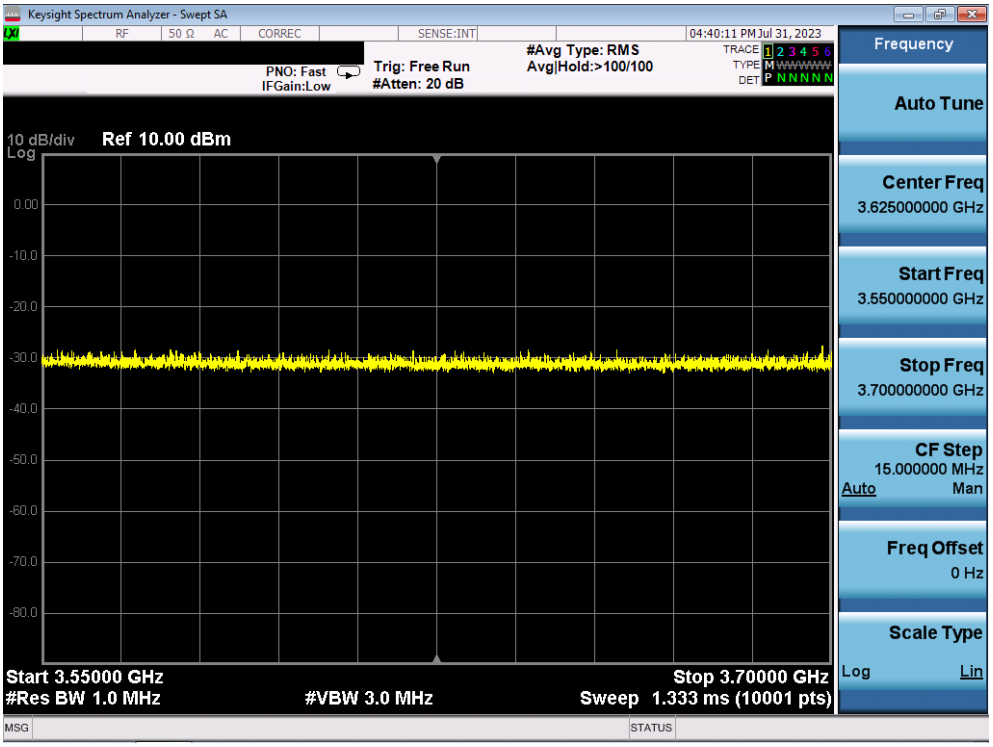
A9 [WINNF.FT.C.GRA.1] Unsuccessful Grant responseCode=400 (INTERFERENCE)

The following steps describe the test execution where the Grant response contains responseCode (R) = 400:

	Test Execution Steps	PASS	FAIL
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	☒	☐

Test Plots:



Plot 9. Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.C.GRA.1)

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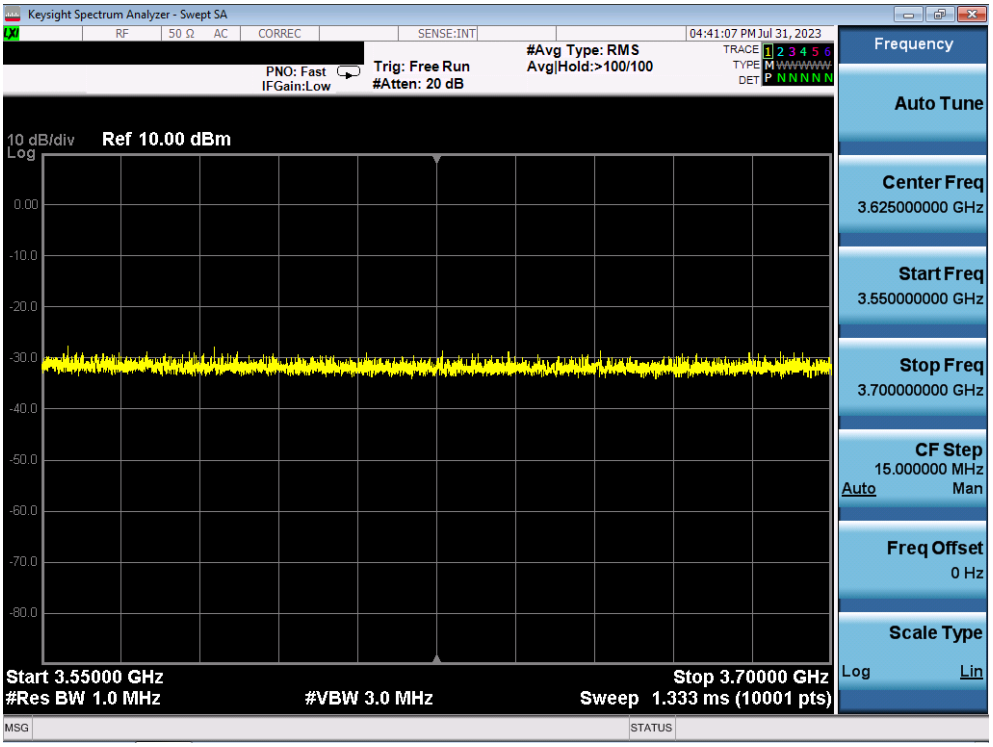
A10 [WINNF.FT.C.GRA.2] Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)

The following steps describe the test execution where the Grant response contains responseCode (R) = 401:

	Test Execution Steps	PASS	FAIL
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 (R) = 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	☒	☐

Test Plots:



Plot 10.Conducted Measurement – No RF transmission in entire band for 60s of elapsed time (WINNF.FT.C.GRA.2)

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A11 [WINNF.FT.D.HBT.2] Domain ProxyHeartbeat Success Case (first Heartbeat Response)

	Test Execution Steps	PASS	FAIL
1	Ensure the following conditions are met for test entry: • DP has two CBSD registered successfully with SAS Test Harness, with cbsdId = Ci, i={1,2}	--	--
2	DP sends a message: • If message is a Spectrum Inquiry Request, go to step 3 • If message is a Grant Request, go to step 5	--	--
3	DP sends a Spectrum Inquiry Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Spectrum Inquiry Request message is formatted correctly for each CBSD, including for CBSDi, i={1,2}: • cbsdId = Ci • List of frequencyRange objects sent by DP are within the CBRS frequency range	☒	☐
4	If a separate Spectrum Inquiry Request message was sent for each CBSD, the SAS Test Harness shall respond to each Spectrum Inquiry Request message with a separate Spectrum Inquiry Response message. If a single Spectrum Inquiry Request message was sent containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Spectrum Inquiry Response message containing a 2-object array. Verify parameters for each CBSD within the Spectrum Inquiry Response message are as follows, for CBSDi, i={1,2}: • cbsdId = Ci • availableChannel is an array of availableChannel objects • responseCode = 0	--	--
5	DP sends a Grant Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Grant Request message is formatted correctly for each CBSD, including for CBSDi, i={1,2}: • cbsdId = C • maxEIRP is at or below the limit appropriate for CBSD category as defined by Part 96 • operationFrequencyRange, Fi, sent by UUT is a valid range within the CBRS band	☒	☐

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6	If a separate Grant Request message was sent for each CBSD, the SAS Test Harness shall respond to each Grant Request message with a separate Grant Response message. If a single Grant Request message was sent containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Grant Response message containing a 2-object array. Verify parameters for each CBSD within the Grant Response message are as follows, for CBSDi, i={1,2}: • cbsdId = Ci • grantId = Gi = a valid grant ID • grantExpireTime = UTC time greater than duration of the test • responseCode = 0	--	--
7	Ensure DP sends first Heartbeat Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Heartbeat Request message is formatted correctly for each CBSD, including, for CBSDi i={1,2}: • cbsdId = Ci, i={1,2} • grantId = Gi, i={1,2} • operationState = "GRANTED"	☒	☐
8	If a separate Heartbeat Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each Heartbeat Request message with a separate Heartbeat Response message. If a single Heartbeat Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Heartbeat Response message containing a 2-object array. Verify parameters for each CBSD within the Heartbeat Response message are as follows, for CBSDi: • cbsdId = Ci • grantId = Gi • transmitExpireTime = current UTC time + 200 seconds • responseCode = 0	--	--
9	For further Heartbeat Request messages sent from DP after completion of step 8, validate message is sent within latest specified heartbeatInterval for CBSDi: • cbsdId = Ci • grantId = Gi • operationState = "AUTHORIZED"	☒	☐

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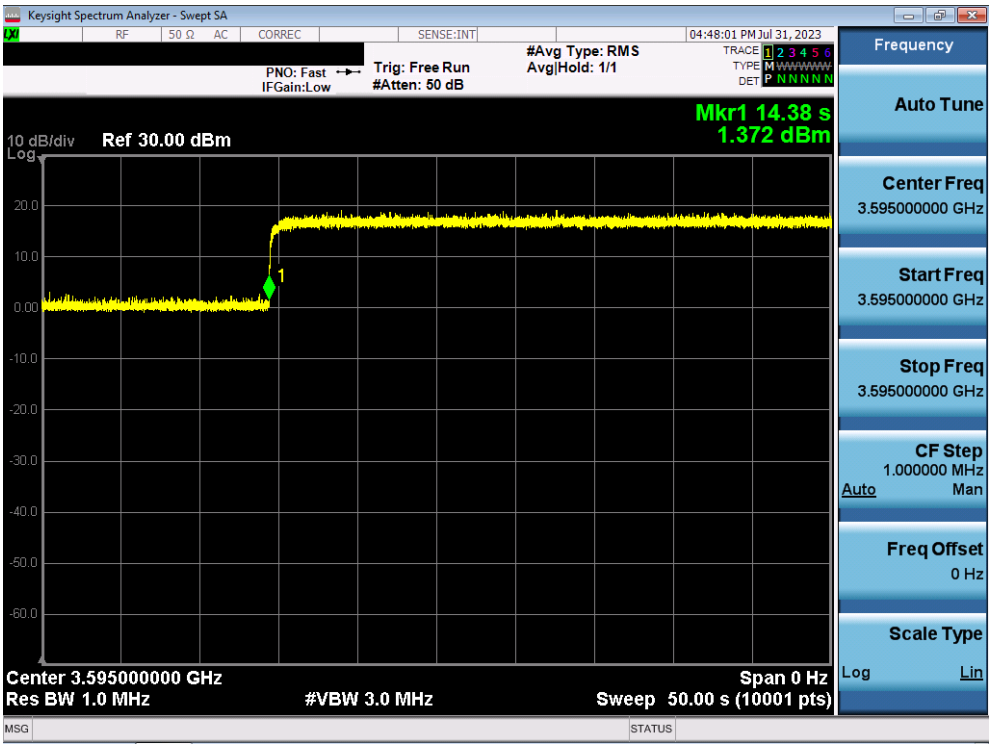
	and SAS Test Harness responds with a Heartbeat Response message including the following parameters, for CBSDi • cbsdId = Ci • grantId = Gi • transmitExpireTime = current UTC time + 200 seconds • responseCode = 0		
10	Monitor the RF output of each UUT from start of test until UUT transmission commences. Verify: • Each UUT does not transmit at any time prior to completion of the first heartbeat response • Each UUT transmits after step 8 is complete, and its transmission is limited to within the bandwidth range F	☒	☐

Test Plots:



Plot 11. Conducted Measurement - RF transmission after SAS heartbeat response. The SAS message is indicated by Marker 1 (X) (WINNF.FT.D.HBT.2)

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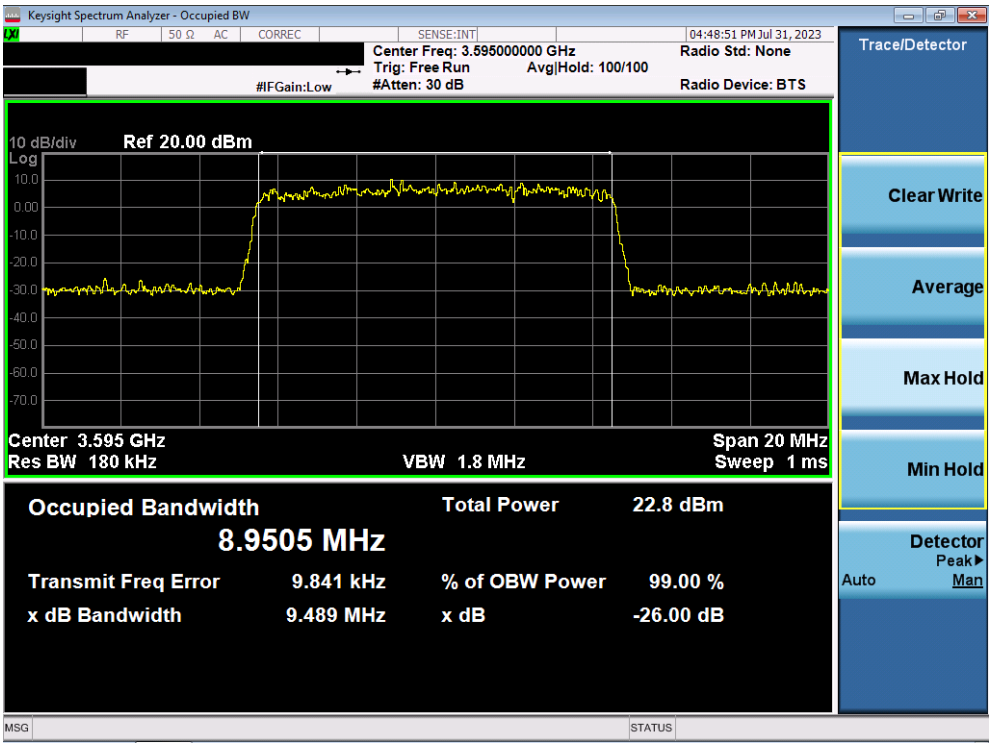

Plot 12.Conducted Measurement Occupied Bandwidth for 10MHz (WINNF.FT.D.HBT.2)

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A12 [WINNF.FT.C.HBT.3] Heartbeat responseCode=105 (DEREGISTER)

	Test Execution Steps	PASS	FAIL
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: o valid cbsdId = C o valid grantId = G o grant is for frequency range F, power P o 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”	☒	☐
3	SAS Test Harness sends a Heartbeat Response message, including the following parameters: 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	☒	☐

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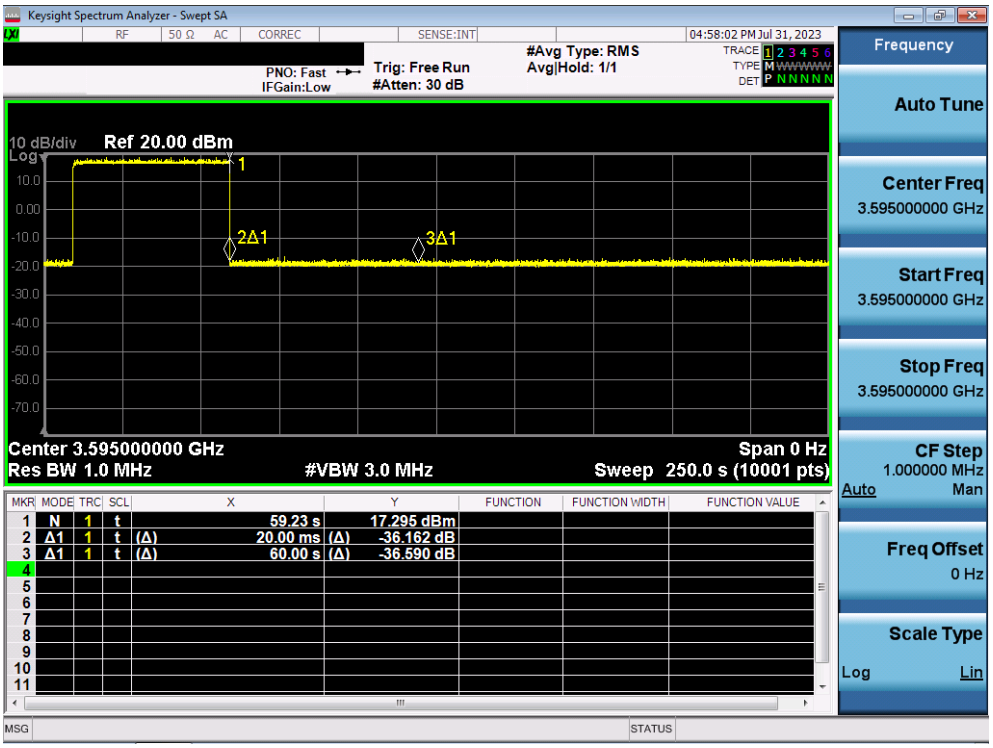
Test Plots:



Plot 13.Conducted Measurement - RF transmission stops within 60s of SAS message indicated by Marker 1 (X) (WINNF.FT.C.HBT.3)

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A13 [WINNF.FT.C.HBT.5] Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response

	Test Execution Steps	PASS	FAIL
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: o valid cbsdId = C o valid grantId = G o grant is for frequency range F, power P o 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”	☒	☐
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	☒	☐

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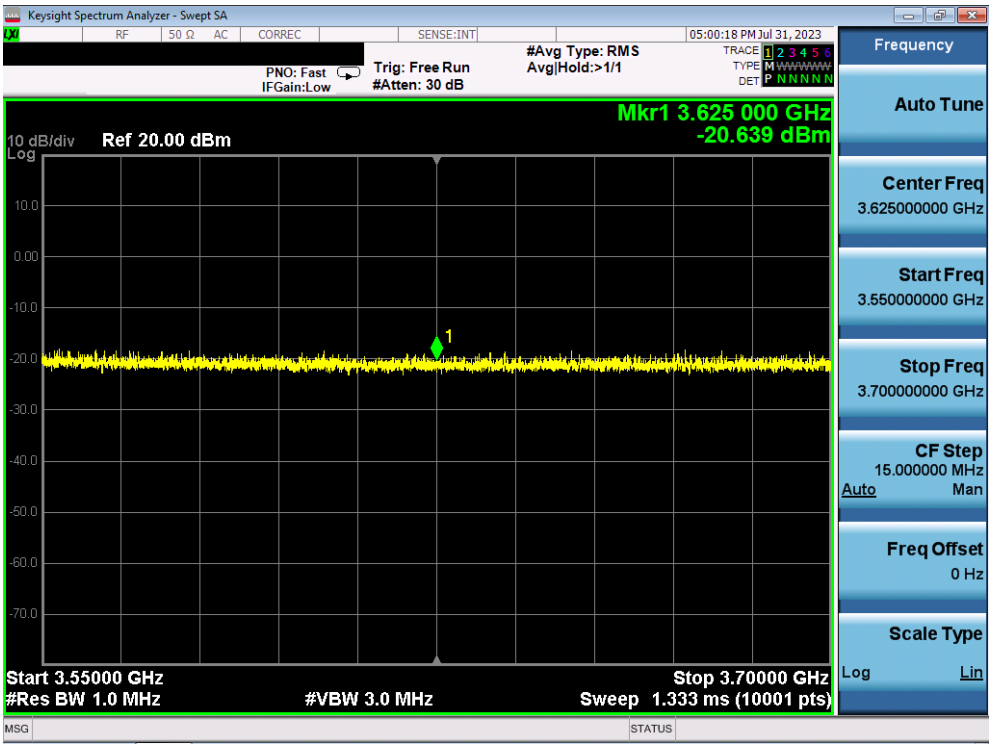
Test Plots:



Plot 14.Conducted Measurement – No RF transmission in entire band (WINNF.FT.C.HBT.5)

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A14 [WINNF.FT.C.HBT.6] Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response

	Test Execution Steps	PASS	FAIL
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: o valid cbsdId = C o valid grantId = G o grant is for frequency range F, power P o 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”	☒	☐
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	☒	☐

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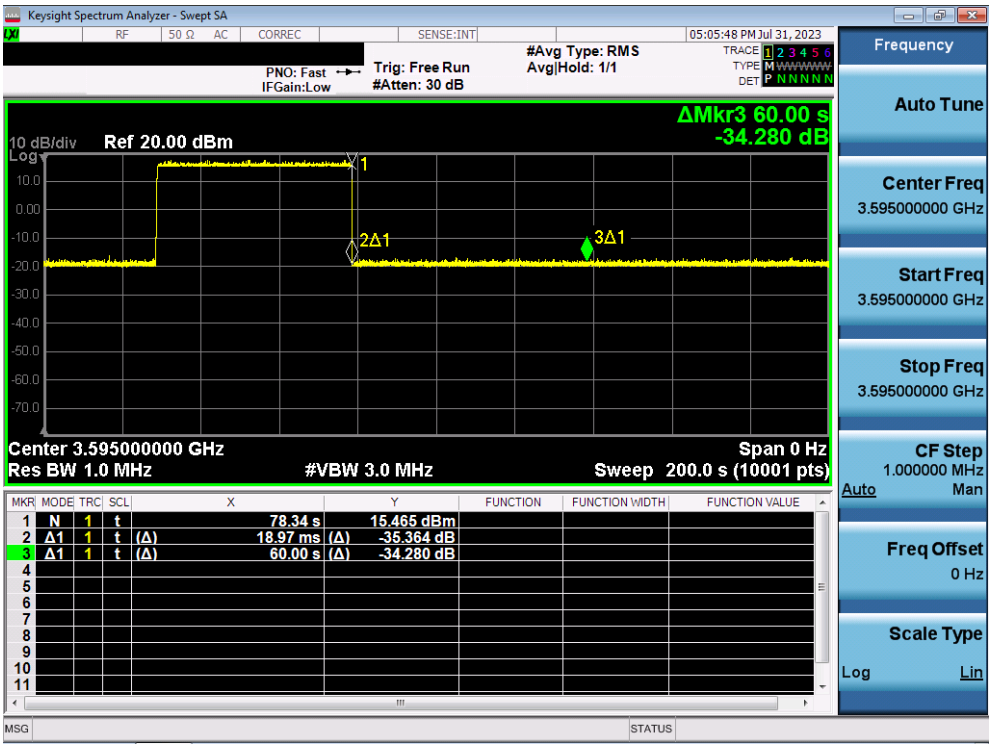
Test Plots:



Plot 15. Conducted Measurement - RF transmission stops within 60s of SAS message. The SAS message is indicated by Marker 1 (X) (WINNF.FT.C.HBT.6)

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A15 [WINNF.FT.C.HBT.7] Heartbeat responseCode=502 (UNSYNC_OP_PARAM)

	Test Execution Steps	PASS	FAIL
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: o valid cbsdId = C o valid grantId = G o grant is for frequency range F, power P o 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”	☒	☐
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: o cbdsId = C o grantId = G Monitor the RF output of the UUT. Verify: • UUT shall stop transmission within (T+60) seconds of completion of step 3.	☒	☐

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Test Plots:

Plot 16. Conducted Measurement - RF transmission stops within 60s of SAS message. The SAS message is indicated by Marker 1 (X) (WINNF.FT.C.HBT.7)

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A16 [WINNF.FT.D.HBT.8] Domain Proxy Hearbeat responseCode=500 (TERMINATED_GRANT)

	Test Execution Steps	PASS	FAIL
1	Ensure the following conditions are met for test entry: • DP has two CBSD registered successfully with SAS Test Harness • Each CBSD {1,2} has a valid single grant as follows: o valid cbsdId = Ci, i={1,2} o valid grantId = Gi, i={1,2} o grant is for frequency range Fi, power Pi o grantExpireTime = UTC time greater than duration of the test • Both CBSD are in AUTHORIZED state and transmitting within their granted bandwidth on RF interface	--	--
2	DP sends a Heartbeat Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of size 2. Verify Heartbeat Request message is sent within latest specified heartbeatInterval, and is formatted correctly for each CBSD, including, for CBSDi i={1,2}: • cbsdId = Ci, i={1,2} • grantId = Gi, i={1,2} • operationState = "AUTHORIZED"	☒	☐
3	If separate Heartbeat Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each Heartbeat Request message with a separate Heartbeat Response message. If a single Heartbeat Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Heartbeat Response message containing a 2-object array. Parameters for each CBSD within the Heartbeat Response message should be as follows, for CBSDi: • cbsdId = Ci, i={1,2} • grantId = Gi, i={1,2} For CBSD1: • transmitExpireTime = T = Current UTC time + 200 seconds • responseCode = 0 For CBSD2 • 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. If CBSD sends further Heartbeat Request messages for CBSD1, SAS Test Harness shall respond with a Heartbeat Response message with parameters: • cbsdId = C1 • grantId = G1 • transmitExpireTime = current UTC time + 200 seconds • response Code = 0 • Heartbeat Request message is within heartbeatInterval of previous Heartbeat Request message	--	--

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5	Monitor the RF output of CBSD2. Verify: • CBSD2 shall stop transmission within bandwidth F2 within (T + 60 seconds) of completion of step 3	☒	☐

Plot 17.Conducted Measurement - RF transmission, on CBSD1, continues transmitting after SAS message. The SAS message is indicated by Marker 1 (X) (WINNF.FT.C.HBT.8)

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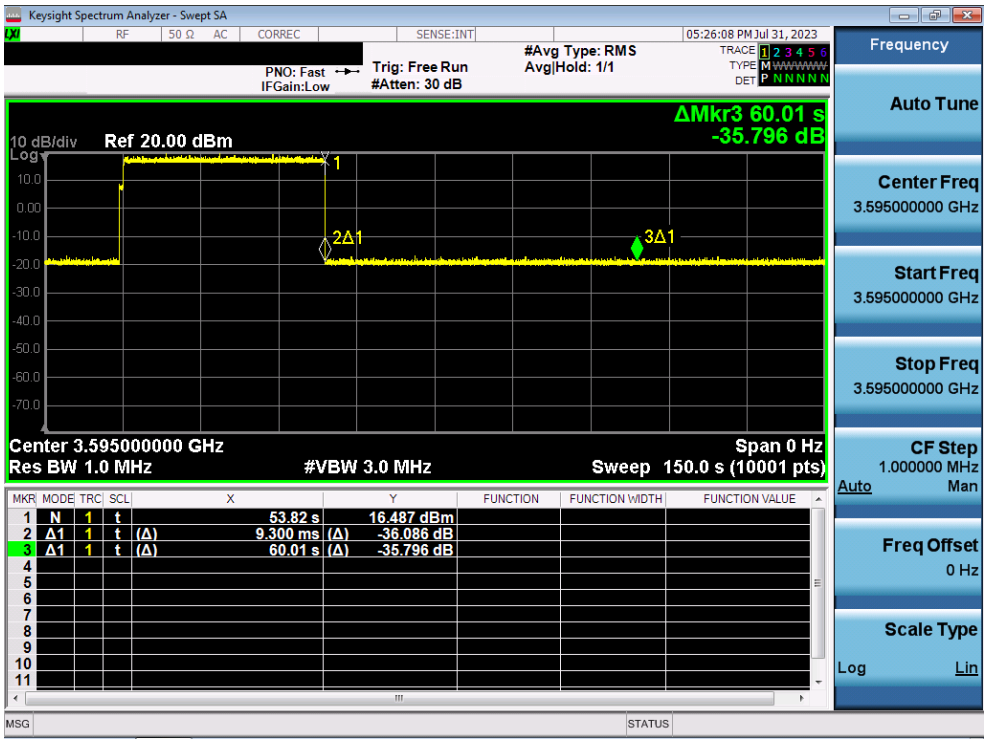

Plot 18. Conducted Measurement - RF transmission, on CBSD2, stops within 60s of SAS message. The SAS message is indicated by Marker 1 (X) (WINNF.FT.C.HBT.8)

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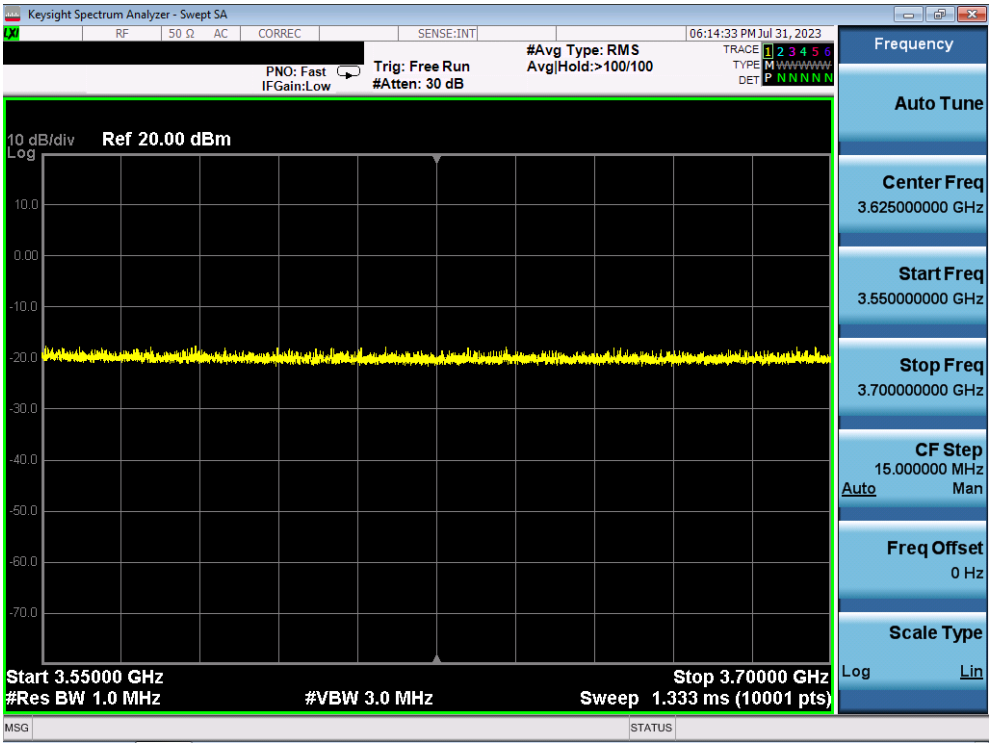
A17 [WINNF.FT.C.HBT.9] Heartbeat Response Absent (First Heartbeat)

	Test Execution Steps	PASS	FAIL
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: o valid cbsdId = C o valid grantId = G o grant is for frequency range F, power P o 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"	☒	☐
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	☒	☐

Test Plots:



Plot 19.Conducted Measurement – No RF transmission in entire band at anytime (WINNF.FT.C.HBT.9)

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A18 [WINNF.FT.C.HBT.10] Heartbeat Response Absent (Subsequent Heartbeat)

	Test Execution Steps	PASS	FAIL
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: o valid cbsdId = C o valid grantId = G o grant is for frequency range F, power P o 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 the latest specified heartbeatInterval, and is formatted correctly, including: • cbsdId = C • grantId = G • operationState = “AUTHORIZED”	☒	☐
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.	☒	☐

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Test Plots:

Plot 20. Conducted Measurement - RF transmission stops within transmitExpireTime + 60s. The last SAS heartbeat message is indicated by Marker 1 (X) (WINNF.FT.C.HBT.10)

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A19 [WINNF.FT.C.MES.3] Grant Response contains *measReportConfig*

	Test Execution Steps	PASS	FAIL
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	☒	☐
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"	☒	☐
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	☒	☐
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	--	--

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```
2023-07-31T22:12:45.257Z - INFO - heartbeat request from CBRS  : {
    "heartbeatRequest": [
        {
            "cbsdId": "2A289-LFW-EXTENSE48Mock-SAS22460003",
            "grantId": "677191230",
            "grantRenew": true,
            "measReport": {
                "rcvdPowerMeasReports": [
                    {
                        "measBandwidth": 10000000,
                        "measFrequency": 3590000000,
                        "measRcvdPower": -25.0
                    }
                ]
            },
            "operationState": "AUTHORIZED"
        }
    ]
}
```


Plot 21. Measurement Report in Grant Response (WINNF.FT.C.MES.3)

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A20 [WINNF.FT.D.MES.5] Domain Proxy Heartbeat Response contains measReportConfig

	Test Execution Steps	PASS	FAIL
1	Ensure the following conditions are met for test entry: • DP has successfully completed SAS Discovery and Authentication with SAS Test Harness • DP has successfully registered 2 CBSD with SAS Test Harness, each with cbsdId=Ci, i={1,2} and measCapability = "RECEIVED_POWER_WITH_GRANT" • DP has received a valid grant with grantId = Gi, i={1,2} for each CBSD • Both CBSD are in Grant State AUTHORIZED and actively transmitting within the bounds of their grants. • Grants have heartbeatInterval =60 seconds	--	--
2	Verify DP sends a Heartbeat Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Heartbeat Request message contains all required parameters properly formatted for each CBSD, specifically, for CBSDi: • cbsdId = Ci • grantId = Gi • operationState = "AUTHORIZED"	☒	☐
3	If a separate Heartbeat Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each Heartbeat Request message with a separate Heartbeat Response message. If a single Heartbeat Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Heartbeat Response message containing a 2-object array. Parameters for each CBSD within the Heartbeat Response message containing all required parameters properly formatted, and specifically: • cbsdId = Ci • grantId = Gi • measReportConfig= "RECEIVED_POWER_WITH_GRANT" • responseCode = 0	--	--
4	Verify DP sends a Heartbeat Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Heartbeat Request message contains all required parameters properly formatted for each CBSD, and specifically, for CBSDi, i = {1,2}: • cbsdId = Ci • grantId = Gi • operationState = "AUTHORIZED" • Check whether measReport is present, and if present, ensure it is a properly formatted rcvdPowerMeasReport object, and record its reception for each CBSDi, i = {1,2}.	☒	☐

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5	If Heartbeat Request message (step 4) contains measReport object, then: • Verify measReport is properly formatted as object rcvdPowerMeasReport • record which CBSD have successfully sent a measReport object If all CBSDi, i = {1,2} have successfully sent a measReport object, then • end test, with PASS result else, if the number of Heartbeat Requests sent per CBSD is 5 or more, then stop test with result of FAIL	☒	☐
6	If a separate Heartbeat Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each Heartbeat Request message with a separate Heartbeat Response message. If a single Heartbeat Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Heartbeat Response message containing a 2-object array. Parameters for each CBSD within the Heartbeat Response message containing all required parameters properly formatted, and specifically: • cbsdId = Ci • grantId = Gi • responseCode = 0 Go to Step 4, above	--	--

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```
2023-07-31T22:16:45.456Z - INFO - heartbeat request from CBRS  : {
    "heartbeatRequest": [
        {
            "cbsdId": "2A289-LFW-EXTENSE48Mock-SAS22460003",
            "grantId": "515781000",
            "grantRenew": true,
            "measReport": {
                "rcvdPowerMeasReports": [
                    {
                        "measBandwidth": 10000000,
                        "measFrequency": 3590000000,
                        "measRcvdPower": -25.0
                    }
                ]
            },
            "operationState": "AUTHORIZED"
        },
        {
            "cbsdId": "2A289-LFW-EXTENSE48Mock-SAS22460006",
            "grantId": "563733065",
            "grantRenew": true,
            "measReport": {
                "rcvdPowerMeasReports": [
                    {
                        "measBandwidth": 10000000,
                        "measFrequency": 3590000000,
                        "measRcvdPower": -25.0
                    }
                ]
            },
            "operationState": "AUTHORIZED"
        }
    ]
}
```


Plot 22.Measurement Report in Domain Proxy Heartbeat Response (WINNF.FT.C.MES.3)

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A21 [WINNF.FT.D.RLQ.2] Domain Proxy Successful Relinquishment

	Test Execution Steps	PASS	FAIL
1	Ensure the following conditions are met for test entry: • DP has successfully completed SAS Discovery and Authentication with SAS Test Harness • DP has successfully registered 2 CBSD with SAS Test Harness, each with cbsdId=Ci, i={1,2} • DP has received a valid grant with grantId = Gi, i={1,2} for each CBSD • Both CBSD are in Grant State AUTHORIZED and actively transmitting within the bounds of their grants. Invoke trigger to relinquish each UUT Grant from the SAS Test Harness	--	--
2	Verify DP sends a Relinquishment Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Relinquishment Request message contains all required parameters properly formatted for each CBSD, specifically, for CBSDi: • cbsdId = Ci • grantId = Gi	☒	☐
3	If a separate Relinquishment Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each request message with a separate response message. If a single Relinquishment Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Response message containing a 2-object array. Parameters for each CBSD within the Relinquishment Response shall be as follows: • cbsdId = Ci • grantId = Gi • 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 each 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 relinquishments and UUT sending the relinquishment requests for each CBSD.	☒	☐

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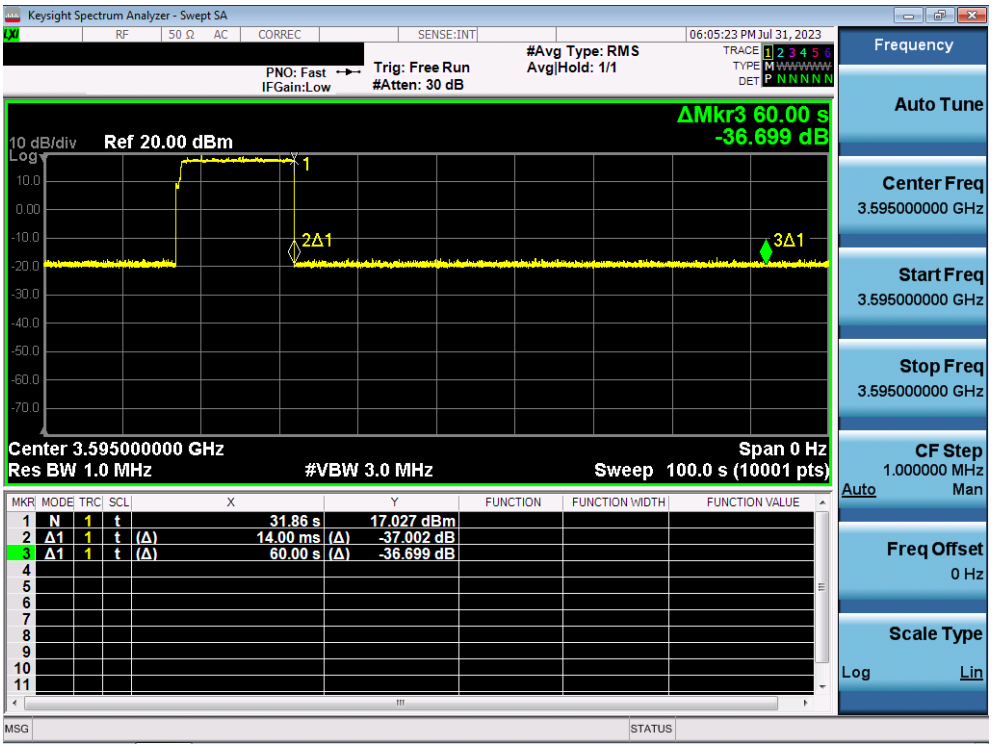
Test Plots:



Plot 23.Conducted Measurement - RF transmission stops (WINNF.FT.D.RLQ.2)

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A22 [WINNF.FT.D.DRG.2] Domain Proxy Successful Deregistration

	Test Execution Steps	PASS	FAIL
1	Ensure the following conditions are met for test entry: • Each UUT has successfully registered with SAS Test Harness • Each UUT is in the authorized state • DP has successfully completed SAS Discovery and Authentication with SAS Test Harness • DP has successfully registered 2 CBSD with SAS Test Harness, each with cbsdId=Ci, i={1,2} • DP has received a valid grant with grantId = Gi, i={1,2} for each CBSD • Both CBSD are in Grant State AUTHORIZED and actively transmitting within the bounds of their grants. Invoke trigger to deregister each UUT from the SAS Test Harness	--	--
2	UUT may send a Relinquishment request and receives Relinquishment response with responseCode=0	--	--
3	Verify DP sends a Deregistration Request message for each CBSD. This may occur in a separate message per CBSD, or together in a single message with array of 2. Verify Deregistration Request message contains all required parameters properly formatted for each CBSD, specifically, for CBSDi: • cbsdId = Ci	☒	☐
4	If a separate Deregistration Request message was sent for each CBSD by the DP, the SAS Test Harness shall respond to each request message with a separate response message. If a single Deregistration Request message was sent by the DP containing a 2-object array (one per CBSD), the SAS Test Harness shall respond with a single Response message containing a 2-object array. Parameters for each CBSD within the Deregistration Response shall be as follows: • cbsdId = Ci • responseCode = 0	--	--
5	After completion of step 4, SAS Test Harness will not provide any positive response (responseCode=0) to further request messages from the UUT.	--	--
6	Monitor the RF output of each 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	☒	☐

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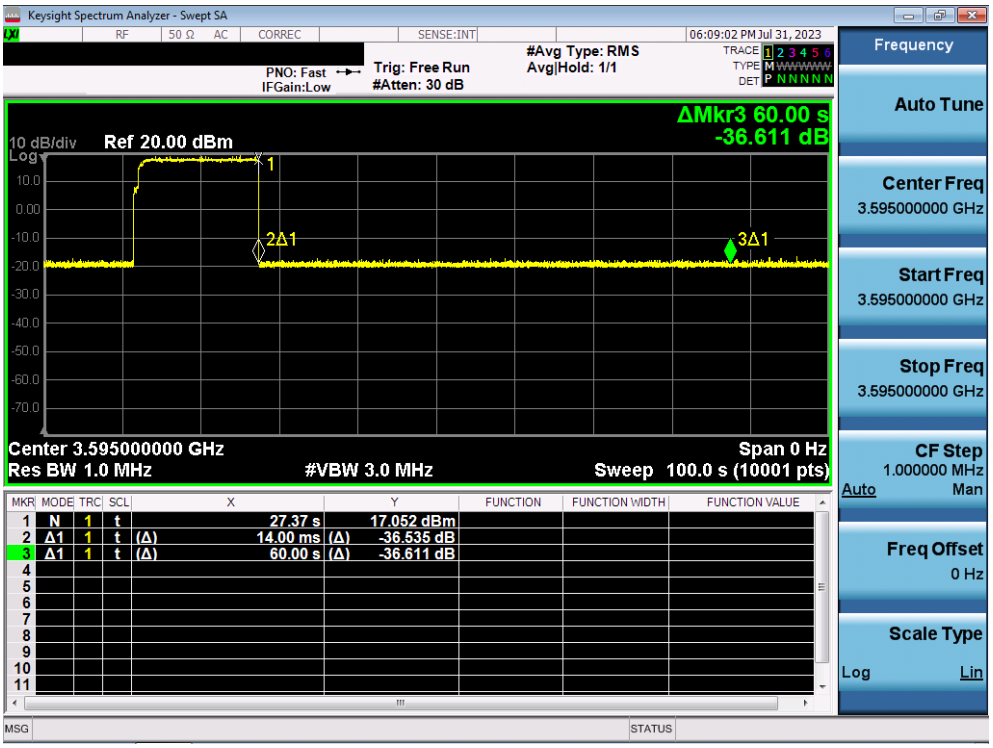
Test Plots:



Plot 24.Conducted Measurement - RF transmission stops within 60s. The SAS message is indicated by Marker 1 (X) (WINNF.FT.D.DRG.2)

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A23 [WINNF.FT.C.SCS.1] Successful TLS connection between UUT and SAS Test Harness

	Test Execution Steps	PASS	FAIL
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	☒	☐
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_SHA256 • TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384 • TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	☒	☐
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.	☒	☐
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	☒	☐

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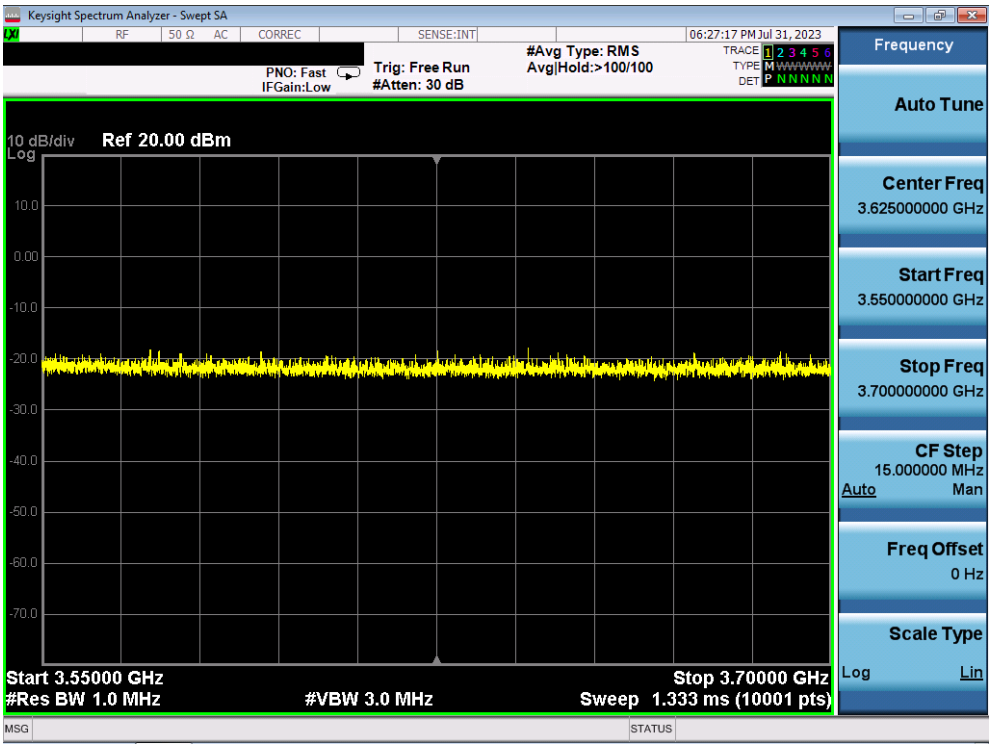
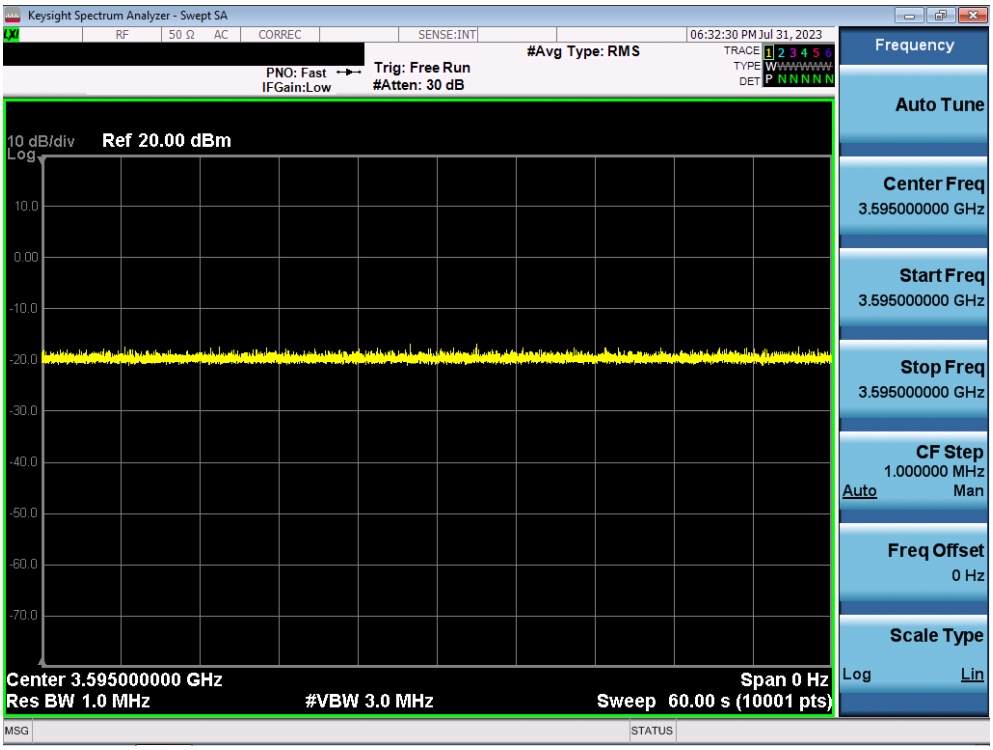
Test Plots:



Plot 25.Conducted Measurement – No RF transmission in entire band at anytime (WINNF.FT.C.SCS.1)



Plot 26.Conducted Measurement – No RF transmission for 60s (WINNF.FT.C.SCS.1)

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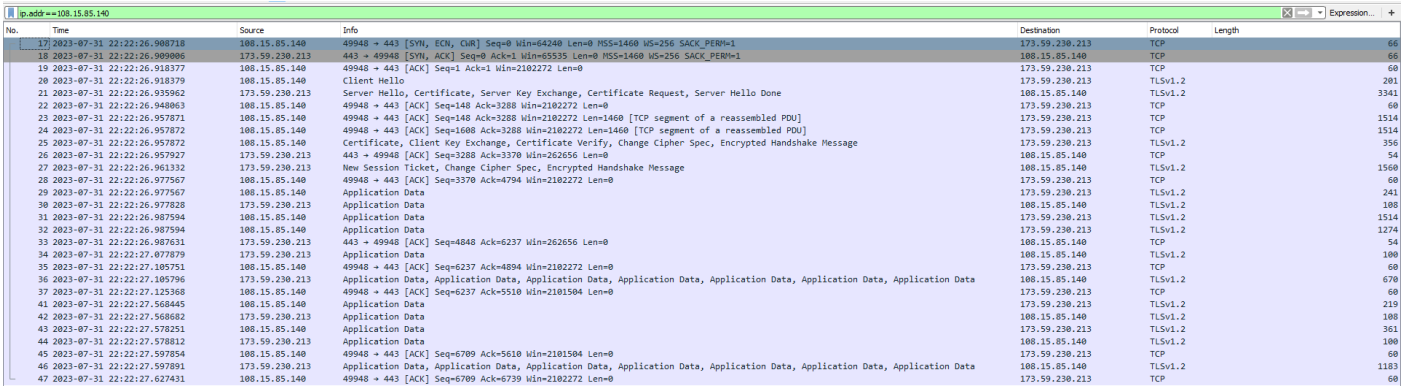

ip.addr==108.15.85.140

No.	Time	Source	Info	Destination	Protocol	Length
17	2023-07-31 22:22:26.908718	108.15.85.140	49948 → 443 [SYN, ECN, CWR] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1	173.59.230.213	TCP	66
18	2023-07-31 22:22:26.909006	173.59.230.213	443 → 49948 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS=256 SACK_PERM=1	108.15.85.140	TCP	66
19	2023-07-31 22:22:26.918377	108.15.85.140	49948 → 443 [ACK] Seq=1 Ack=1 Win=2102272 Len=0	173.59.230.213	TCP	60
20	2023-07-31 22:22:26.918379	108.15.85.140	Client Hello	173.59.230.213	TLSv1.2	201
21	2023-07-31 22:22:26.935962	173.59.230.213	Server Hello, Certificate, Server Key Exchange, Certificate Request, Server Hello Done	108.15.85.140	TLSv1.2	3341
22	2023-07-31 22:22:26.948063	108.15.85.140	49948 → 443 [ACK] Seq=148 Ack=3288 Win=2102272 Len=0	173.59.230.213	TCP	60
23	2023-07-31 22:22:26.957871	108.15.85.140	49948 → 443 [ACK] Seq=148 Ack=3288 Win=2102272 Len=1460 [TCP segment of a reassembled PDU]	173.59.230.213	TCP	1514
24	2023-07-31 22:22:26.957872	108.15.85.140	49948 → 443 [ACK] Seq=1608 Ack=3288 Win=2102272 Len=1460 [TCP segment of a reassembled PDU]	173.59.230.213	TCP	1514
25	2023-07-31 22:22:26.957872	108.15.85.140	Certificate, Client Key Exchange, Certificate Verify, Change Cipher Spec, Encrypted Handshake Message	173.59.230.213	TLSv1.2	356
26	2023-07-31 22:22:26.957927	173.59.230.213	443 → 49948 [ACK] Seq=3288 Ack=3370 Win=262656 Len=0	108.15.85.140	TCP	54
27	2023-07-31 22:22:26.961332	173.59.230.213	New Session Ticket, Change Cipher Spec, Encrypted Handshake Message	108.15.85.140	TLSv1.2	1560
28	2023-07-31 22:22:26.977567	108.15.85.140	49948 → 443 [ACK] Seq=3370 Ack=4794 Win=2102272 Len=0	173.59.230.213	TCP	60
29	2023-07-31 22:22:26.977567	108.15.85.140	Application Data	173.59.230.213	TLSv1.2	241
30	2023-07-31 22:22:26.977828	173.59.230.213	Application Data	108.15.85.140	TLSv1.2	108
31	2023-07-31 22:22:26.987594	108.15.85.140	Application Data	173.59.230.213	TLSv1.2	1514
32	2023-07-31 22:22:26.987594	108.15.85.140	Application Data	173.59.230.213	TLSv1.2	1274
33	2023-07-31 22:22:26.987631	173.59.230.213	443 → 49948 [ACK] Seq=4848 Ack=6237 Win=262656 Len=0	108.15.85.140	TCP	54
34	2023-07-31 22:22:27.077879	173.59.230.213	Application Data	108.15.85.140	TLSv1.2	100
35	2023-07-31 22:22:27.105751	108.15.85.140	49948 → 443 [ACK] Seq=6237 Ack=4894 Win=2102272 Len=0	173.59.230.213	TCP	60
36	2023-07-31 22:22:27.105796	173.59.230.213	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data	108.15.85.140	TLSv1.2	670
37	2023-07-31 22:22:27.125368	108.15.85.140	49948 → 443 [ACK] Seq=6237 Ack=5510 Win=2101504 Len=0	173.59.230.213	TCP	60
41	2023-07-31 22:22:27.568445	108.15.85.140	Application Data	173.59.230.213	TLSv1.2	219
42	2023-07-31 22:22:27.568682	173.59.230.213	Application Data	108.15.85.140	TLSv1.2	108
43	2023-07-31 22:22:27.578251	108.15.85.140	Application Data	173.59.230.213	TLSv1.2	361
44	2023-07-31 22:22:27.578812	173.59.230.213	Application Data	108.15.85.140	TLSv1.2	100
45	2023-07-31 22:22:27.597854	108.15.85.140	49948 → 443 [ACK] Seq=6709 Ack=5610 Win=2101504 Len=0	173.59.230.213	TCP	60
46	2023-07-31 22:22:27.597891	173.59.230.213	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data	108.15.85.140	TLSv1.2	1183
47	2023-07-31 22:22:27.627431	108.15.85.140	49948 → 443 [ACK] Seq=6709 Ack=6739 Win=2102272 Len=0	173.59.230.213	TCP	60

Plot 27.WireShark Screenshot – Successful Handshake (WINNF.FT.C.SCS.1)

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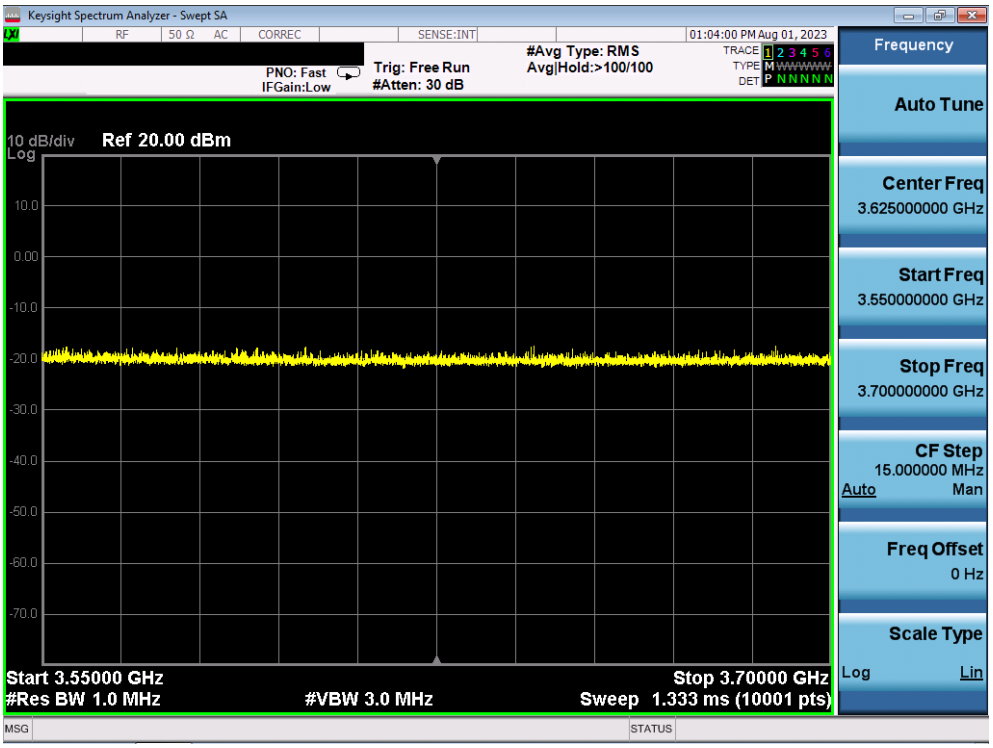
A24 [WINNF.FT.C.SCS.2] TLS failure due to revoked certificate

	Test Execution Steps	PASS	FAIL
1	• UUT shall start CBSD-SAS communication with the security procedures	☒	☐
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.	☒	☐
3	UUT may retry for the security procedure which shall fail	☒	☐
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	☒	☐

Test Plots:



Plot 28.Conducted Measurement – No RF transmission in entire band at anytime (WINNF.FT.C.SCS.2)

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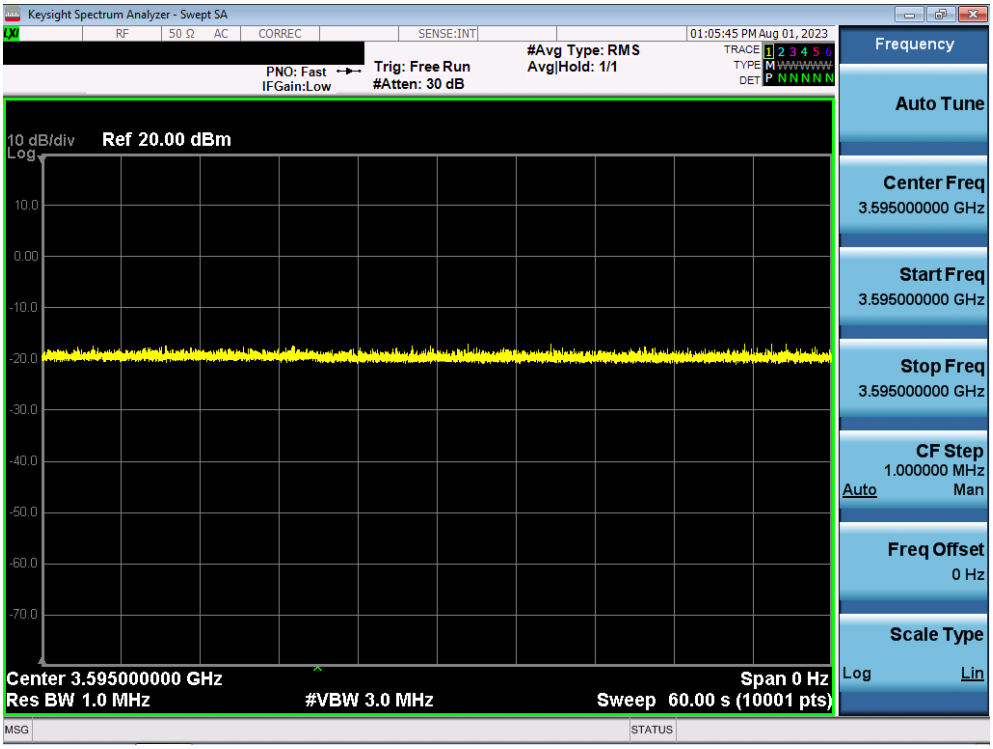
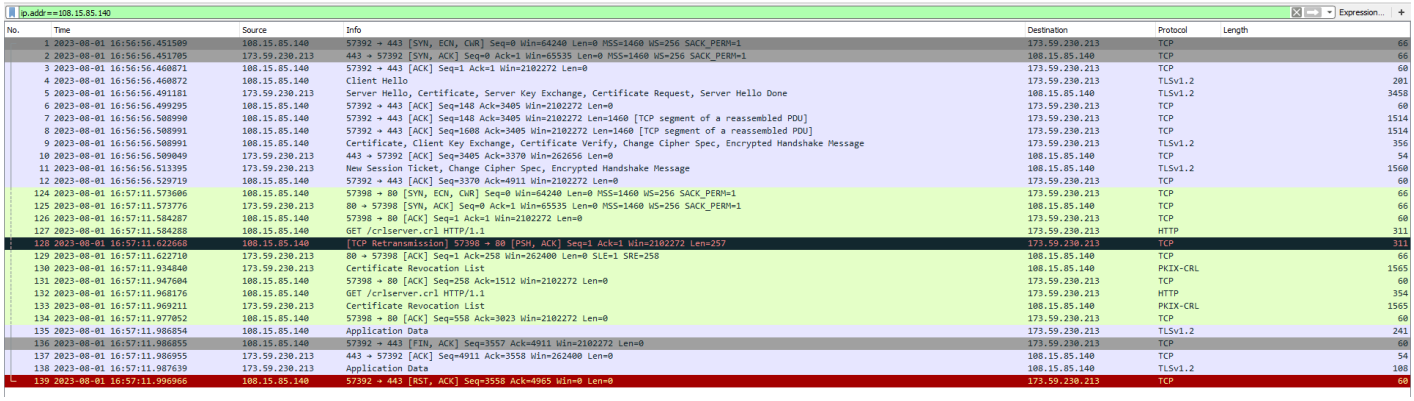


Plot 29.Conducted Measurement – No RF transmission for 60s (WINNF.FT.C.SCS.2)



Plot 30. UUT SAS Server Log - Failed Handshake (WINNF.FT.C.SCS.2)

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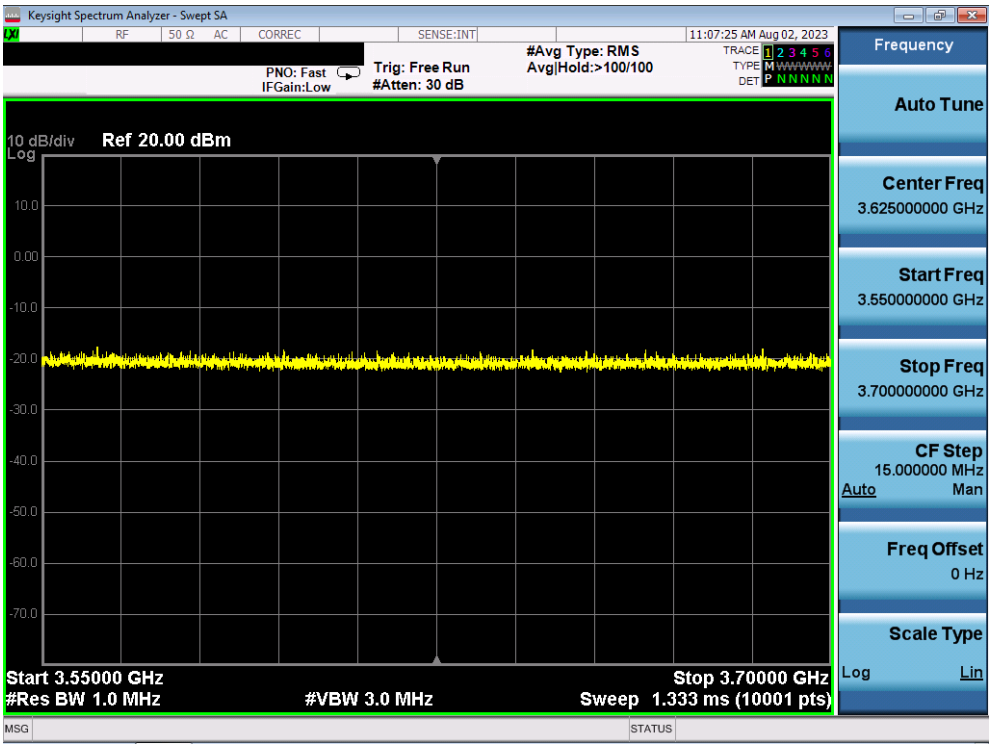
A25 [WINNF.FT.C.SCS.3] TLS failure due to expired server certificate

	Test Execution Steps	PASS	FAIL
1	• UUT shall start CBSD-SAS communication with the security procedures	☒	☐
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.	☒	☐
3	UUT may retry for the security procedure which shall fail.	☒	☐
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	☒	☐

Test Plots:



Plot 31.Conducted Measurement – No RF transmission in entire band at anytime (WINNF.FT.C.SCS.3)

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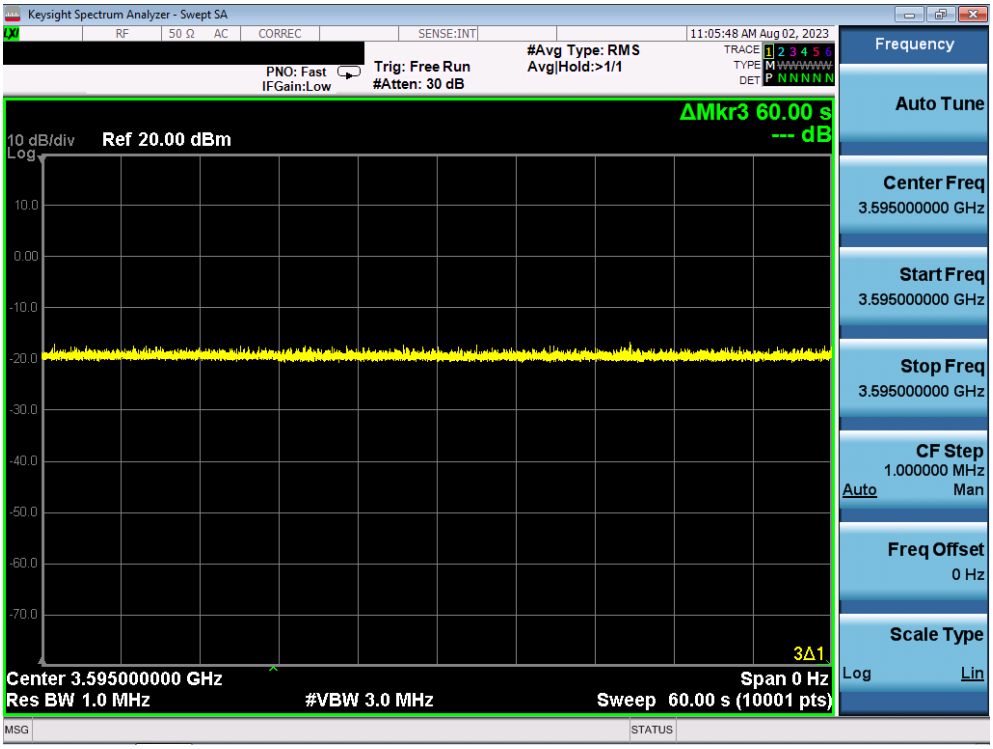
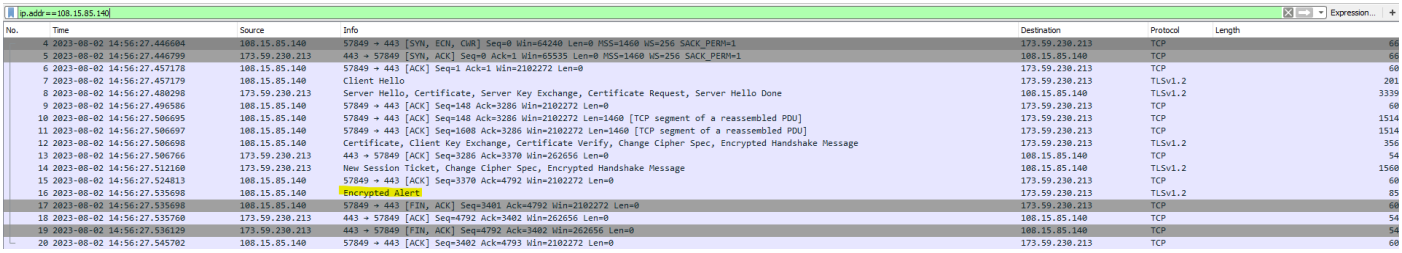


Plot 32.Conducted Measurement – No RF transmission for 60s (WINNF.FT.C.SCS.3)



Plot 33.WireShark Screenshot - Failed Handshake (WINNF.FT.C.SCS.3)

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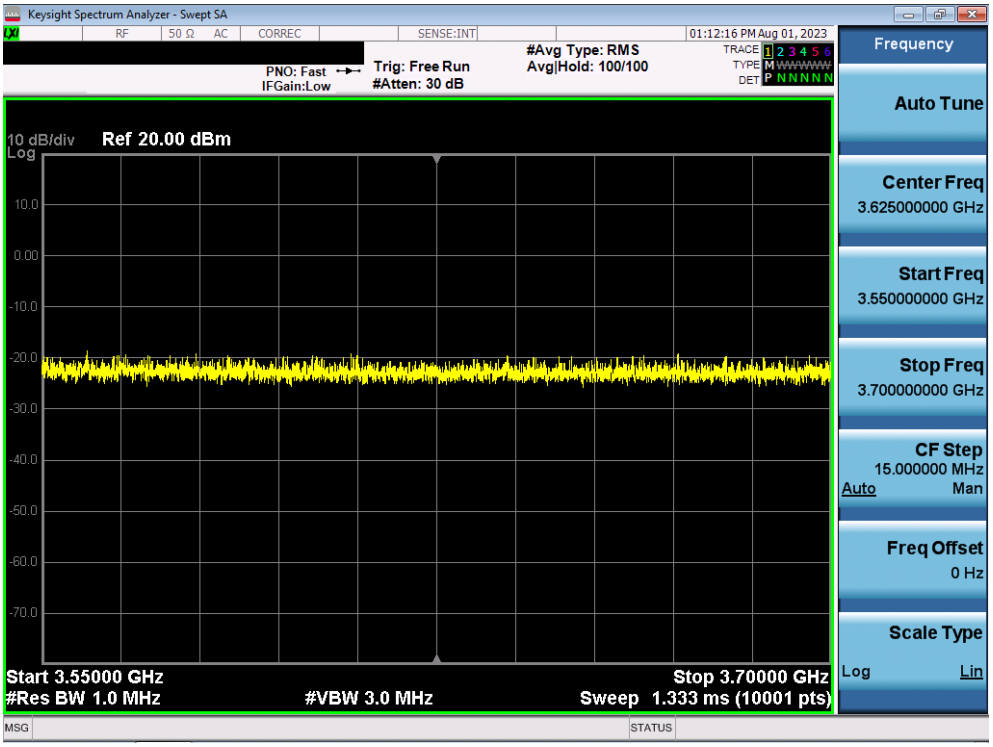
A26 [WINNF.FT.C.SCS.4] TLS failure when SAS Test Harness certificate is issued by an unknown CA

	Test Execution Steps	PASS	FAIL
1	• UUT shall start CBSD-SAS communication with the security procedures	☒	☐
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.	☒	☐
3	UUT may retry for the security procedure which shall fail.	☒	☐
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	☒	☐

Test Plots:



Plot 34.Conducted Measurement – No RF transmission in entire band at anytime (WINNF.FT.C.SCS.4)

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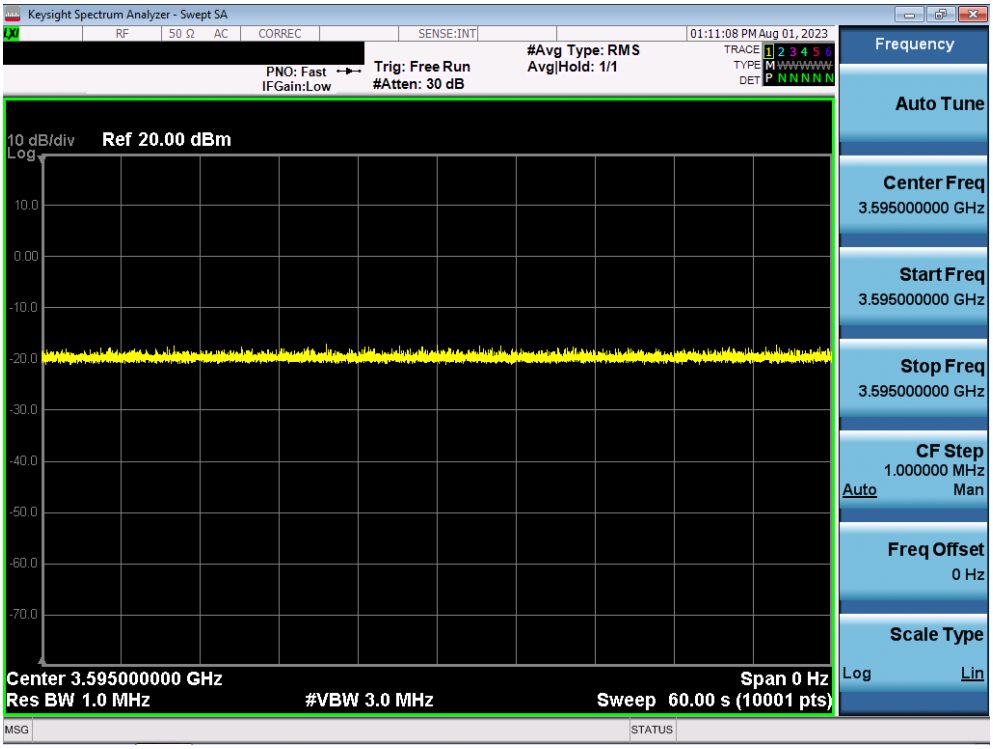
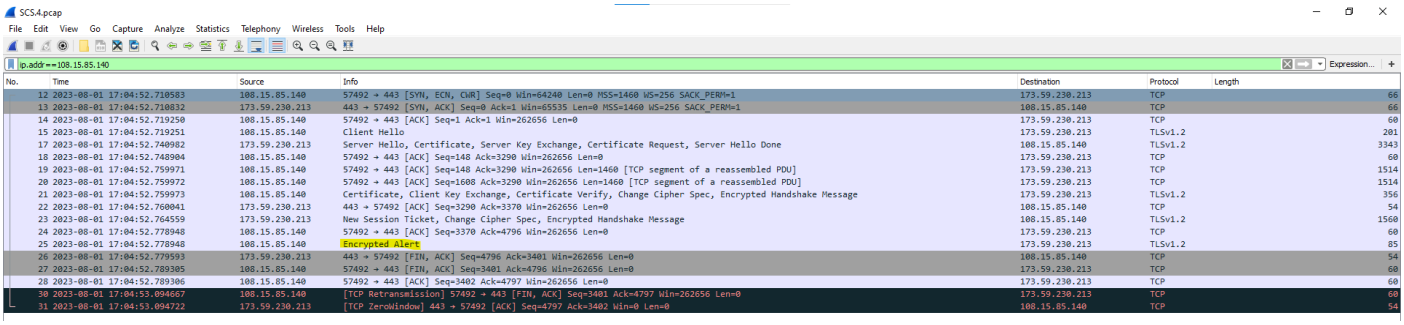


Plot 35.Conducted Measurement – No RF transmission for 60s (WINNF.FT.C.SCS.4)



Plot 36.WireShark Screenshot - Failed Handshake (WINNF.FT.C.SCS.4)

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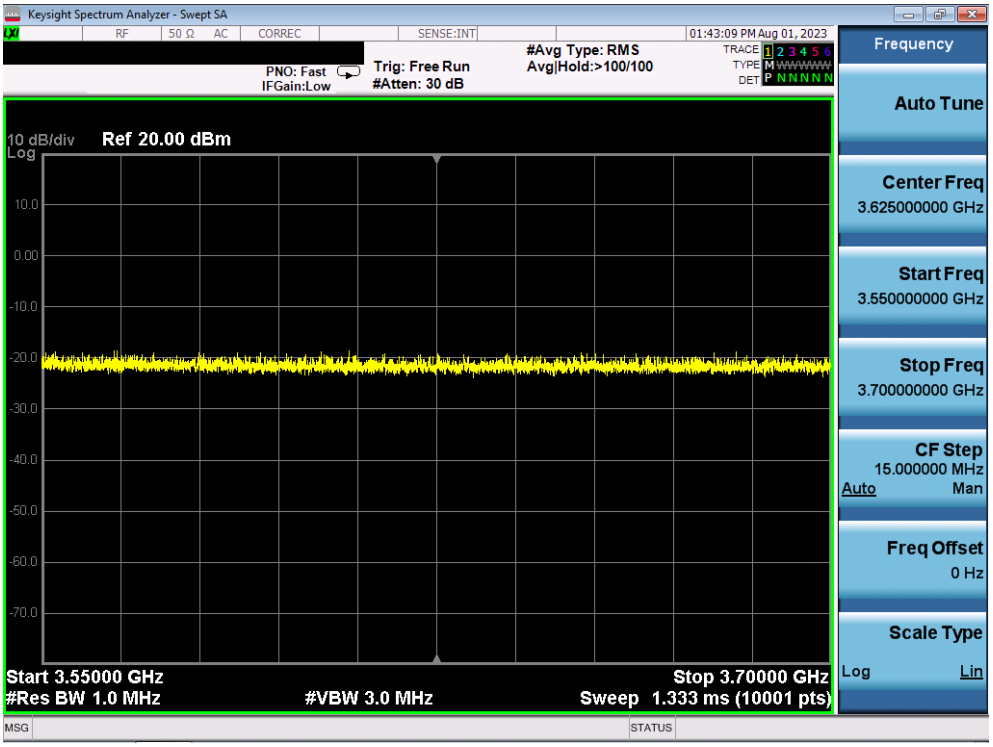
A27 [WINNF.FT.C.SCS.5] TLS failure when certificate at the SAS Test Harness is corrupted

	Test Execution Steps	PASS	FAIL
1	• UUT shall start CBSD-SAS communication with the security procedures	☒	☐
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.	☒	☐
3	UUT may retry for the security procedure which shall fail.	☒	☐
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	☒	☐

Test Plots:



Plot 37.Conducted Measurement – No RF transmission in entire band at anytime (WINNF.FT.C.SCS.5)

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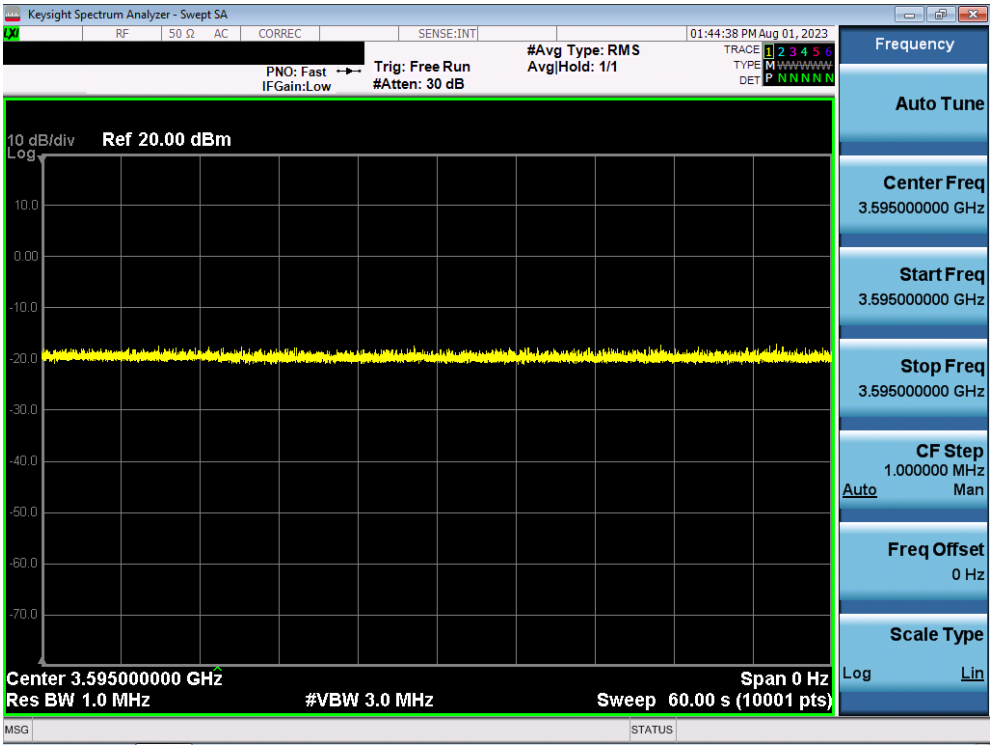
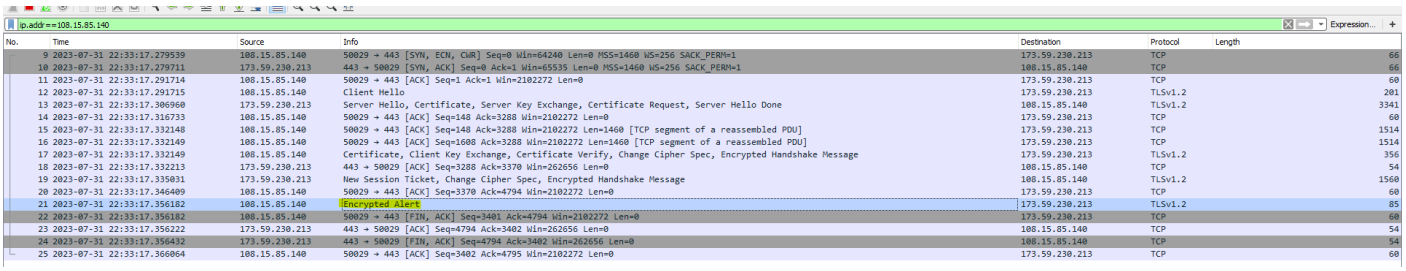


Plot 38.Conducted Measurement – No RF transmission for 60s (WINNF.FT.C.SCS.5)



Plot 39.WireShark Screenshot - Failed Handshake (WINNF.FT.C.SCS.5)

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A28 [WINNF.PT.C.HBT.1] UUT RF Transmit Power Measurement

	Test Execution Steps	PASS	FAIL
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 = FL, highFrequency = FH, maxEirp = Pi}, 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: o cbsdId = C o grantId = G • SAS Test Harness responds with Heartbeat Response, including: o cbsdId = C o grantId = G o transmitExpireTime = current UTC time + 200 seconds o responseCode = 0	--	--
3	Tester performs power measurement on RF interface(s) of UUT, and verifies it complies with the maxEirp setting, Pi. 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 themeasurement methodology. Any such mode is vendor-specific and depends upon UUT behavior and the measurement methodology.*	☒	☐

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RF Power Measurements:

Testing is performed per KDB 971168 D01 and across the transmit dynamic range of 36dBm/MHz to 24dBm/MHz for 10MHz Bandwidth.

The UUT has two outputs, Ant 2 and Ant 4, and it operated with two antennas which can be either cross-polarized or co-polarized. such that the total EIRP is the gain of one antenna added to the conducted power spectral density summed across ANT 2 and ANT 4. Therefore, the calculation is based on directional gain for the co-polarized antenna which results in worst-case operation.

SAS Granted EIRP [dBm/MHz]	ANT2 Conducted PSD [dBm/MHz]	ANT4 Conducted PSD [dBm/MHz]	Summed Conducted PSD [dBm/MHz]	Directional Antenna Gain [dBi]	Total EIRP (dBm/MHz)	Margin
36	25.66	25.62	28.65	7	35.65	-0.35
30	19.68	19.65	22.68	7	29.68	-0.32
24	13.65	13.60	16.64	7	23.64	-0.36

Table A.1 RF Output Power Measurements (WINNF.PT.C.HBT.1)

Sample MIMO Calculation:

At 36 dBm/MHz on SAS Granted EIRP, the average Peak Power Spectral Density was measured to be 25.66 dBm/MHz for Ant 2 and 25.62 dBm/MHz for Ant 4

Ant 2 + Ant 4 = MIMO

(25.66 dBm/MHz + 25.62 dBm/MHz) = (368.129 mW/MHz + 364.754 mW/MHz) = 732.883 mW/MHz
= 28.65 dBm/MHz

Sample e.i.r.p Power Spectral Density Calculation:

At 36 dBm/MHz on SAS Granted EIRP, , the average MIMO Peak Power Spectral Density was calculated to be 28.65 dBm/MHz with directional gain of 7 dBi. Therefore, the calculation is based on directional gain for the co-polarized antenna which results in worst-case operation.

e.i.r.p. Power Spectral Density(dBm) = MIMO Power Spectral Density (dBm) + Ant gain (dBi)

28.65 dBm/MHz + 7 dBi = 35.65 dBm

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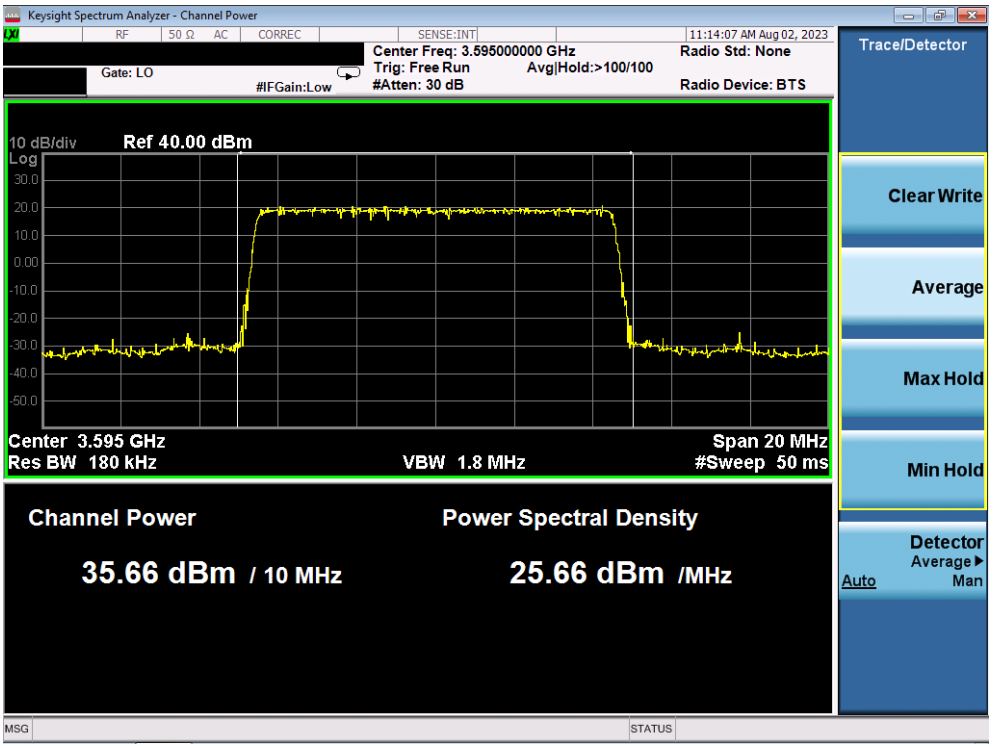
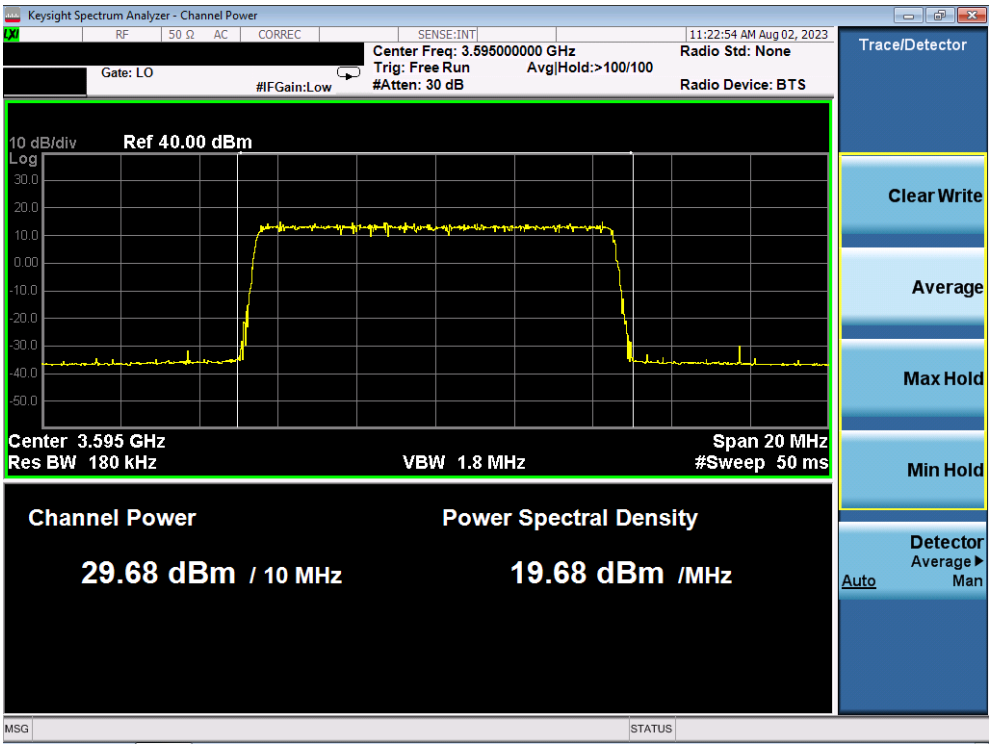
Test Plots:



Plot 40. Conducted PSD, SAS Granted maxEIRP 36 dBm/MHz – ANT 2



Plot 41. Conducted PSD, SAS Granted maxEIRP 30 dBm/MHz– ANT 2

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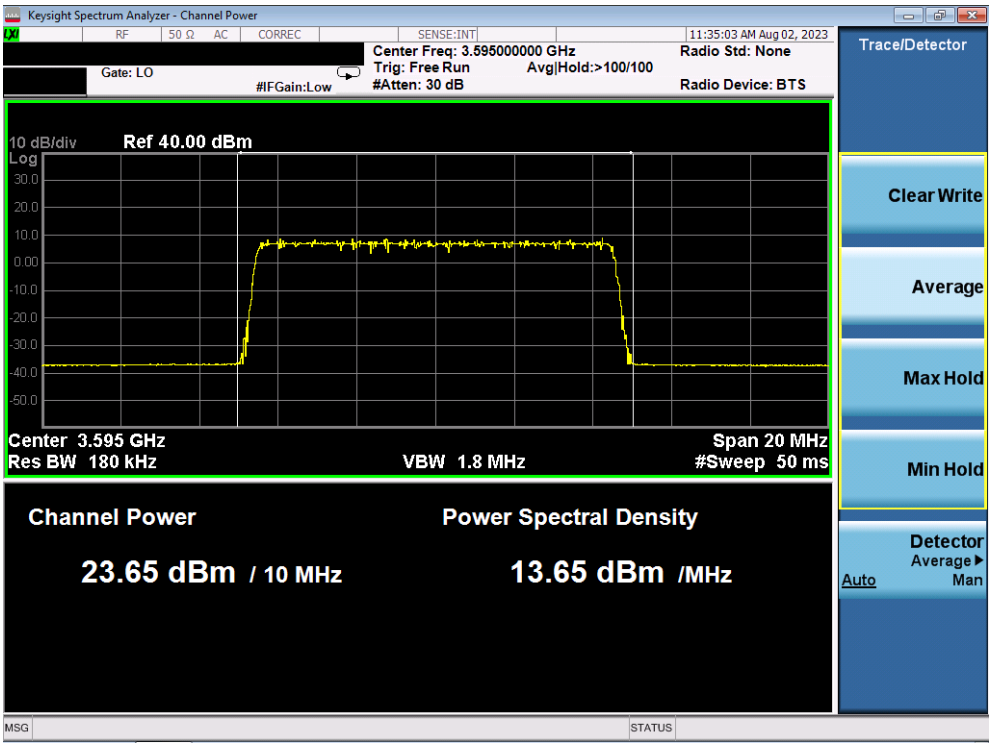
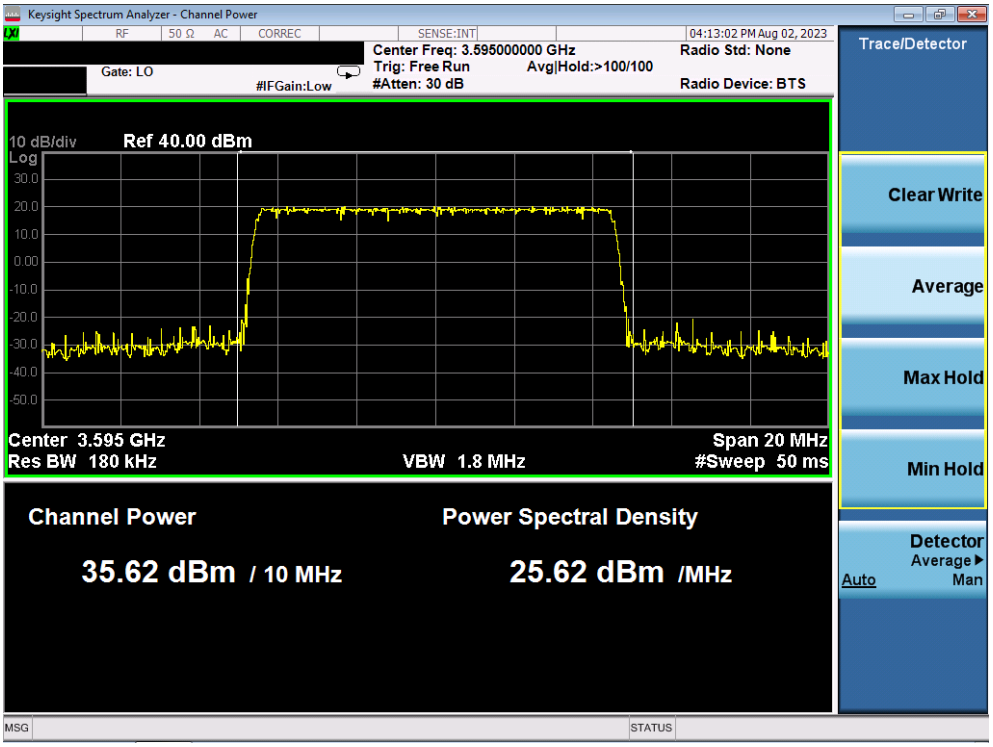


Plot 42. Conducted PSD, SAS Granted maxEIRP 24 dBm/MHz– ANT 2



Plot 43. Conducted PSD, SAS Granted maxEIRP 36 dBm/ MHz– ANT 4

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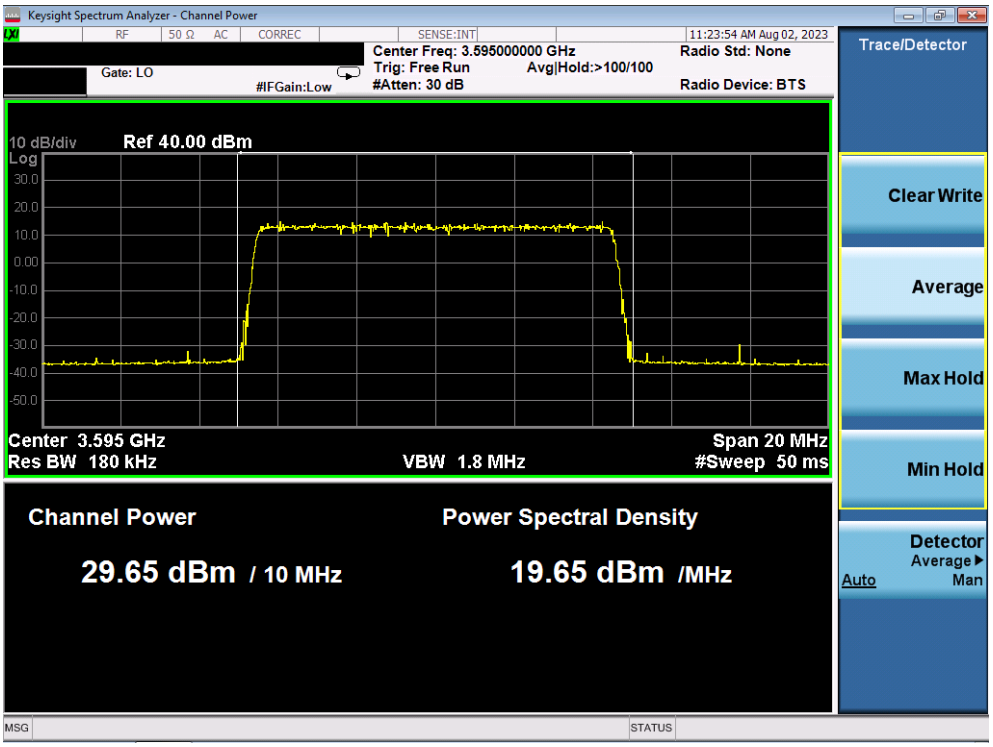
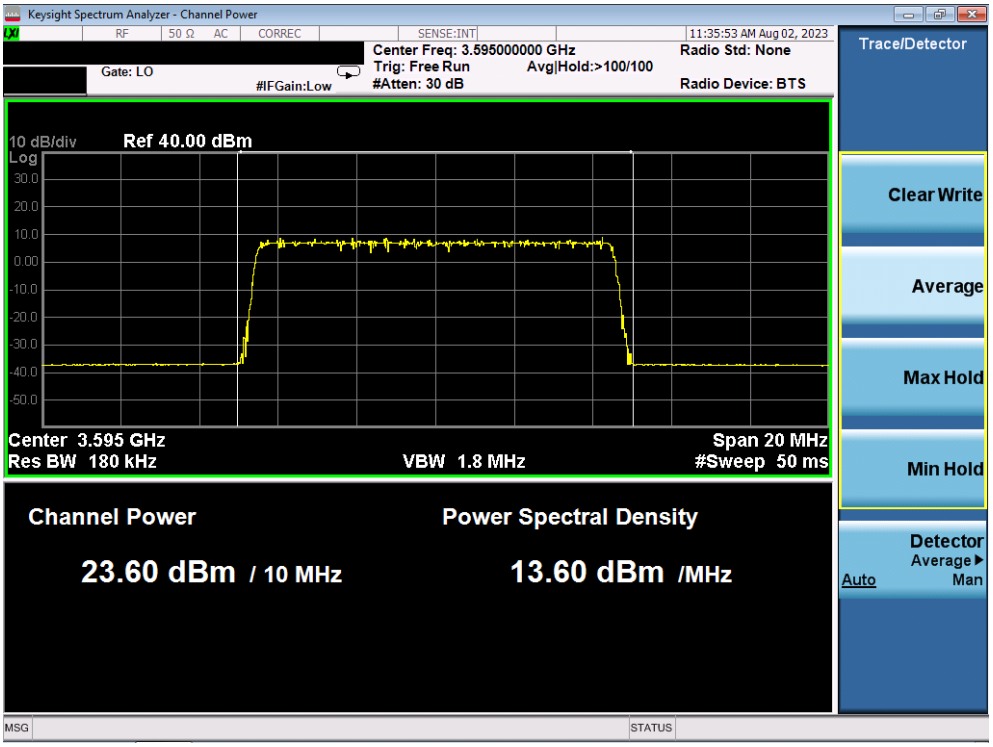


Plot 44. Conducted PSD, SAS Granted maxEIRP 30 dBm/ MHz– ANT 4



Plot 45. Conducted PSD, SAS Granted maxEIRP 24 dBm/ MHz– ANT 4

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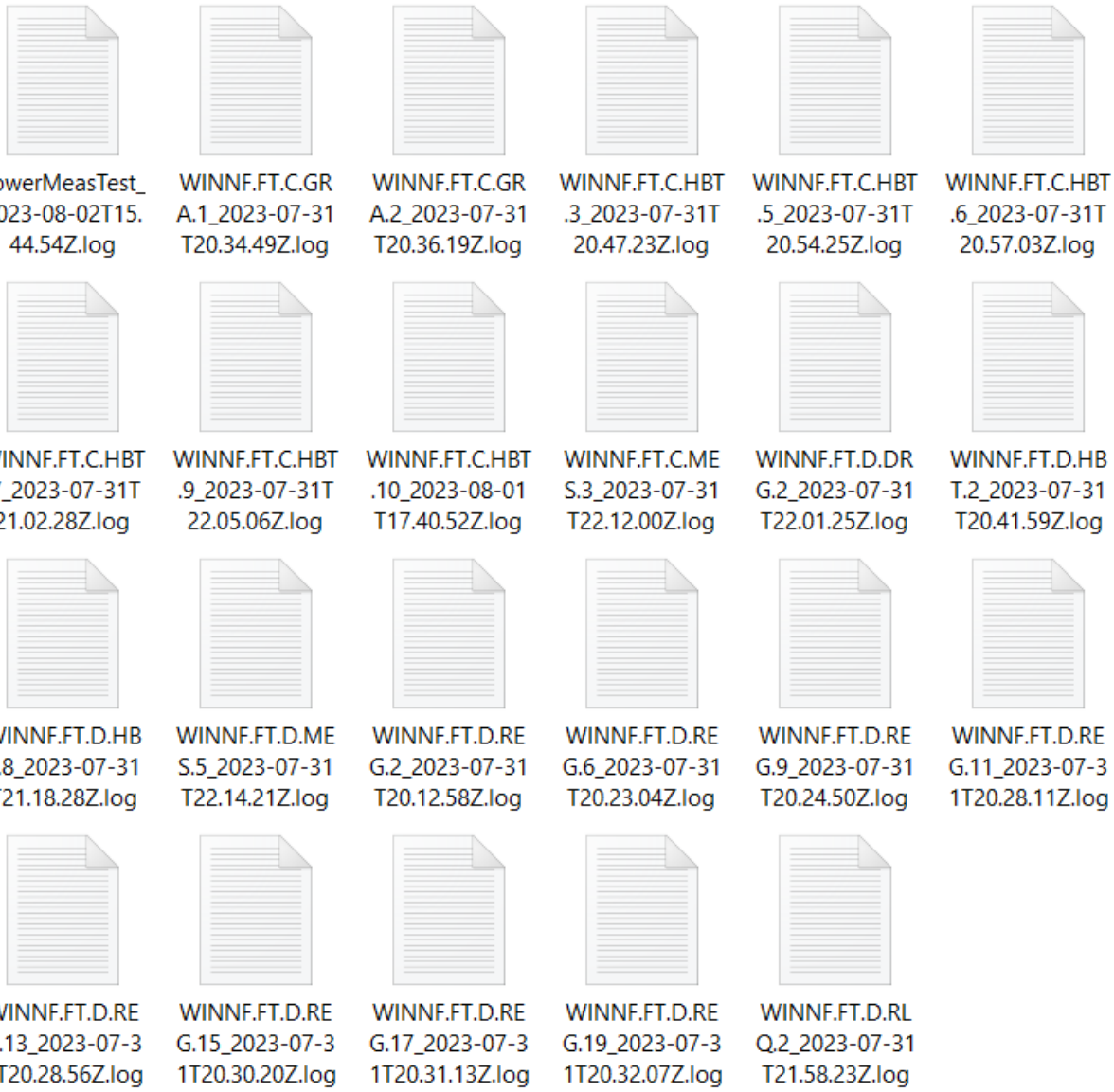
APPENDIX B – TEST LOGS

Logs are available upon request



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