Test Report

As per

FCC Part 96 SAS requirements (CBRS Test Plan)

Canada

Choose certainty.
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on the

Ericsson Remote Radio Unit LTE KRC 161 746/1
Radio 4408 B48 (3550-3700MHz)

Issued by:
TÜV SÜD Canada Inc.
1280 Teron Rd,
Ottawa, ON K2K 2C1
Canada

Testing produced for

Ericcson Canada

See Appendix A for full client & EUT details.

Scott Drysdale.
Test Personnel

Sivaratnam, Kasinathan
Technical Reviewer

Testing Laboratory
Certificate #2955.19

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Report Scope

This report addresses the EMC verification testing and test results of the **LTE KRC 161 746/1 Radio 4408 B48(3550-3700 MHz)** herein referred to as EUT (Equipment Under Test). The EUT was tested for compliance against the following standards:

FCC Part 96 SAS requirements (CBRS Test Plan)

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

For a more detailed list of the standards and the revision used, see the "Applicable Standards, Specifications and Methods" section of this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

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Summary

The results contained in this report relate only to the item(s) tested.

Equipment Under Test (EUT)	**LTE KRC 161 746/1 Radio 4408 B48(3550-3700 MHz)**
EUT passed all tests performed	Yes
Tests conducted by	Scott Drysdale

For testing dates, see 'Testing Environmental Conditions and Dates'.

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Test Results Summary

Section as per Working Document WINNF-TS-0122

Section	CBSD	DP	Test Case ID	Test Case Title	RF Measurement Requirement	Pass / Fail
6.1.4.1.1	X	--	WINNF.FT.C.REG.1	Multi-Step registration	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.1.2	--	X	WINNF.FT.D.REG.2	Domain Proxy Multi-Step registration	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.1.3	X	--	WINNF.FT.C.REG.3	Single-Step registration for Category A CBSD	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.1.4	--	X	WINNF.FT.D.REG.4	Domain Proxy Single-Step registration for Cat A CBSD (Note: Mandatory for without CPI, if EUT will always have signed CPI – asked for email waiver)	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.1.5	X	--	WINNF.FT.C.REG.5	Single-Step registration for CBSD with CPI signed data	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.1.6	--	X	WINNF.FT.D.REG.6	Domain Proxy Single-Step registration for CBSD with CPI signed data	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.1.7	X	X	WINNF.FT.C.REG.7	Registration due to change of an installation parameter	Test waits until transmission starts, then trigger an	P

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					installationParam change. • Record time at which transmission stops. Time must be within 60 seconds of the installationParam change taking effect.	
6.1.4.2.1	X	--	WINNF.FT.C.REG.8	Missing Required parameters (responseCode 102)	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.2.2	--	X	WINNF.FT.D.REG.9	Domain Proxy Missing Required parameters (responseCode 102)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.2.3	X	--	WINNF.FT.C.REG.10	Pending registration (responseCode 200)	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.2.4	--	X	WINNF.FT.D.REG.11	Domain Proxy Pending registration (responseCode 200)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.2.5	X	--	WINNF.FT.C.REG.12	Invalid parameter (responseCode 103)	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.2.6	--	X	WINNF.FT.D.REG.13	Domain Proxy Invalid parameters (responseCode 103)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.2.7	X	--	WINNF.FT.C.REG.14	Blacklisted CBSD (responseCode 101)	Monitor for 60 seconds after REG message sent. No	N/A

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					transmission during test.	
6.1.4.2.8	--	X	WINNF.FT.D.REG.15	Domain Proxy Blacklisted CBSD (responseCode 101)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.2.9	X	--	WINNF.FT.C.REG.16	Unsupported SAS protocol version (responseCode 100)	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.2.10	--	X	WINNF.FT.D.REG.17	Domain Proxy Unsupported SAS protocol version responseCode 100)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.2.11	X	--	WINNF.FT.C.REG.18	Group Error (responseCode 201)	Monitor for 60 seconds after REG message sent. No transmission during test.	N/A
6.1.4.2.12	--	X	WINNF.FT.D.REG.19	Domain Proxy Group Error (responseCode 201)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.1.4.3.1	X	X	WINNF.FT.C.REG.20	Category A CBSD location update		N/A
6.3.4.2.1	X	X	WINNF.FT.C.GRA.1 (TYPO FIXED D TO C)	Unsuccessful Grant responseCode=400 (INTERFERENCE)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.3.4.2.2	X	X	WINNF.FT.C.GRA.2	Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)	Monitor for 60 seconds after REG message sent. No transmission during test.	P
6.4.4.1.1	X	--	WINNF.FT.C.HBT.1	Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: • Transmission does not start until time of first	N/A

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					heartbeat response or after. • After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)	
6.4.4.1.2	--	X	WINNF.FT.D.HBT.2	Domain Proxy Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: • Transmission does not start until time of first heartbeat response or after. • After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)	P
6.4.4.2.1	X	X	WINNF.FT.C.HBT.3	Heartbeat responseCode=105 (DEREGISTER)	Monitor RF transmission. Ensure that: • CBSD stops transmission within 60 seconds of the heartbeatResponse which contains	P

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					responseCode = 105	
6.4.4.2.2	X	--	WINNF.FT.C.HBT.4	Heartbeat responseCode=500 (TERMINATED_GRANT)		N/A
6.4.4.2.3	X	X	WINNF.FT.C.HBT.5	Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response	Monitor RF transmission from start of test. Ensure there is no transmission during the test	p
6.4.4.2.4	X	X	WINNF.FT.C.HBT.6	Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	Monitor RF transmission. Ensure: • CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=501	p
6.4.4.2.5	X	X	WINNF.FT.C.HBT.7	Heartbeat responseCode=502 (UNSYNC_OP_PARAM)	Monitor RF transmission. Ensure: • CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=502	p
6.4.4.2.6	--	X	WINNF.FT.D.HBT.8	Domain Proxy Heartbeat responseCode=500 (TEMINATED_GRANT)	Monitor RF transmission. CBSDs will have different behavior: • CBSD1: will continue to transmit to end of test	P

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					(this is not a pass/fail criteria, but check) • CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500	
6.4.4.3.1	X	X	WINNF.FT.C.HBT.9	Heartbeat Response Absent (First Heartbeat)	Monitor RF from start of test to 60 seconds after last heartbeatResponse message was sent. CBSD should not transmit at any time during test	P
6.4.4.3.2	X	X	WINNF.FT.C.HBT.10	Heartbeat Response Absent (Subsequent Heartbeat)	Monitor RF transmission. Verify: • CBSD must stop transmission within transmitExpireTime+60 seconds, where transmitExpireTime is from last successful heartbeatResponse message	P
6.5.4.2.1	X	--	WINNF.FT.C.MES.1	Registration Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.2	--	X	WINNF.FT.D.MES.2	Domain Proxy Registration Response contains measReportConfig	No RF monitoring	P

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6.5.4.2.3	X	X	WINNF.FT.C.MES.3	Grant Response contains measReportConfig	No RF monitoring	P
6.5.4.2.4	X	--	WINNF.FT.C.MES.4	Heartbeat Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.5	--	X	WINNF.FT.D.MES.5	Domain Proxy Heartbeat Response contains measReportConfig	No RF monitoring	P
6.6.4.1.1	X	--	WINNF.FT.C.RLQ.1	Successful Relinquishment	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message.	N/A
6.6.4.1.2	--	X	WINNF.FT.D.RLQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message.	P
6.7.4.1.1	X	--	WINNF.FT.C.DRG.1	Successful Deregistration	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message or deregistrationRequest message (whichever is sent first)	N/A

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6.7.4.1.2	--	X	WINNF.FT.D.DRG.2	Domain Proxy Successful Deregistration	Monitor RF transmission. Ensure : • CBSD stops transmission at any time prior to sending the relinquishmentRequest message or deregistrationRequest message (whichever is sent first)	P
6.8.4.1.1	X	X	WINNF.FT.C.SCS.1	Successful TLS connection between UUT and SAS Test Harness	No RF transmission during test Check the tcpdump for the TLS information	P
6.8.4.2.1	X	X	WINNF.FT.C.SCS.2	TLS failure due to revoked certificate	No RF transmission during test Check the tcpdump for the TLS information	P
6.8.4.2.2	X	X	WINNF.FT.C.SCS.3	TLS failure due to expired server certificate	No RF transmission during test Check the tcpdump for the TLS information	P
6.8.4.2.3	X	X	WINNF.FT.C.SCS.4	TLS failure when SAS Test Harness certificate is issue by unknown CA	No RF transmission during test Check the tcpdump for the TLS information	P
6.8.4.2.4	X	X	WINNF.FT.C.SCS.5	TLS failure when certificate at the SAS Test Harness is corrupted	No RF transmission during test Check the tcpdump for the TLS information	P
7.1.4.1.1	X	X	WINNF.PT.C.HBT	UUT RF Transmit Power Measurement	Power Spectral Density test case. Assume we use 1 carrier bandwidth	P

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					(say, 5 or 10 MHz), one frequency (say middle channel in band) for test. Measure at max transmit power, and reduce in steps of 3 dB to minimum declared transmit power.	

If the product as tested complies with the specification, the EUT is deemed to comply with the standard and is deemed a 'PASS' or ‘P’ grade. If not 'FAIL' grade is issued. Where ‘N/A’ is stated this means the test case is not applicable, and see Notes, Justifications or Deviations Section for details.

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Notes, Justifications, or Deviations

The following notes, justifications for tests not performed or deviations from the above listed specifications apply:

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used is listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

For the N/A test cases, the following justifications apply:

a. EUT is a CBSD with Domain Proxy
b. EUT supports the following Conditional functionality from WINNF-TS-0122-V1.0.0, Table 6-2:
    i. C1 – Multi-step registration (WINNF.FT.D.REG.2)
    ii. C3 – Single step registration containing CPI-signed data in the registration message (WINNF.FT.D.REG.6)
    iii. C4 – RECEIVED_POWER_WITHOUT_GRANT measurement report (WINNF.FT.D.MES.2)
    iv. C5 – RECEIVED_POWER_WITH_GRANT measurement report (WINNF.FT.D.MES.3, WINNF.FT.D.MES.5)
    v. C6 – UUT supports installation parameter change (WINNF.FT.C.REG.7)
c. Optional test cases were not performed

The device does not use single-step registration (as defined in condition C2 in WINNF-TS-0122-V1.0.0, Table 6-2), therefore test cases 6.1.4.1.4, and 6.1.4.3.1 are not applicable as per WINNF-TS-0122-V1.0.0, Table 6-3 and therefore not required or performed.

Note, where graph sweeps are incomplete, this was used to set the time stamp of when the events occurred. This can be accomplished by determining the time at which the graph was captured and subtracting the remaining time. For example if there was a 30 second sweep, and 9 out of 10 is complete, that means the end occurred at the 27 second market. If the time on the graph was 12:03:35, this means the graph started at 12:03:08. This allows us to co-ordinate graph with timing provided in the logs.

Logs are kept on file.

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Applicable Standards, Specifications and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CFR47 FCC Part 96	Code of Federal Regulations – Citizens Broadband Radio Service
WINNF-TS-0122 Version V1.0.0 19 December 2017	Conformance and Performance Test Technical Specification; CBSD/DP as Unit Under Test (UUT) Working Document
ISO/IEC 17025:2005	General requirements for the competence of testing and calibration laboratories

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Document Revision Status

Revision 000: September 11, 2019 First release

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Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiliary Equipment. A digital accessory that feeds data into or receives data from another device (host) that in turn, controls its operation.

AM – Amplitude Modulation

Class A device – A device that is marketed for use in a commercial, industrial or business environment. A 'Class A' device should not be marketed for use by the general public and the instructions for use accompanying the product shall contain the following text:

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Class B device – A device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environments.

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMI – Electro-Magnetic Immunity. The ability to maintain a specified performance when the equipment is subjected to disturbance (unwanted) signals of specified levels.

Enclosure Port – Physical boundary of equipment through which electromagnetic fields may radiate or impinge.

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

NSA – Normalized Site Attenuation

RF – Radio Frequency

EMC Test Plan – An EMC test plan established prior to testing. See 'Appendix A – EUT & Client Provided Details'.

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Testing Facility

Testing for EMC on the EUT was carried out at customer location as described in Appendix A.

Calibrations and Accreditations

TÜV SÜD Canada Inc is accredited to ISO/IEC 17025 by A2LA with Testing Certificate #2955.19. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

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Testing Environmental Conditions and Dates

Following environmental conditions were recorded in the facility during time of testing

Date	Test	Initials	Temperature (ºC)	Humidity (%)	Pressure (kPa)
Sept 3 – 5, 2019	All	SD	20-23	40-55	96.106

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Detailed Test Results Section

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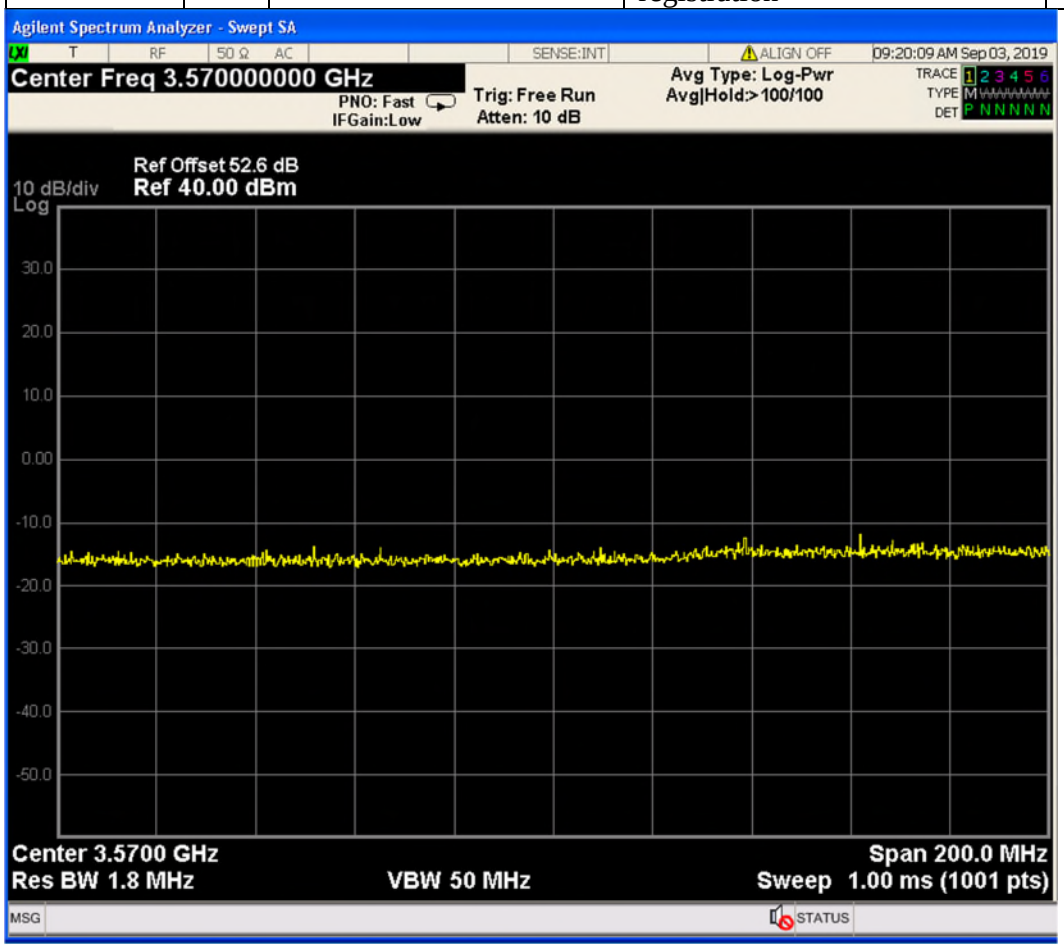
Authorization transmit after it receives authorization from a SAS.

Section	DP	Test Case ID	Test Case Title	Pass / Fail
6.1.4.1.2	X	WINNF.FT.D.REG.2	Domain Proxy Multi-Step registration	P



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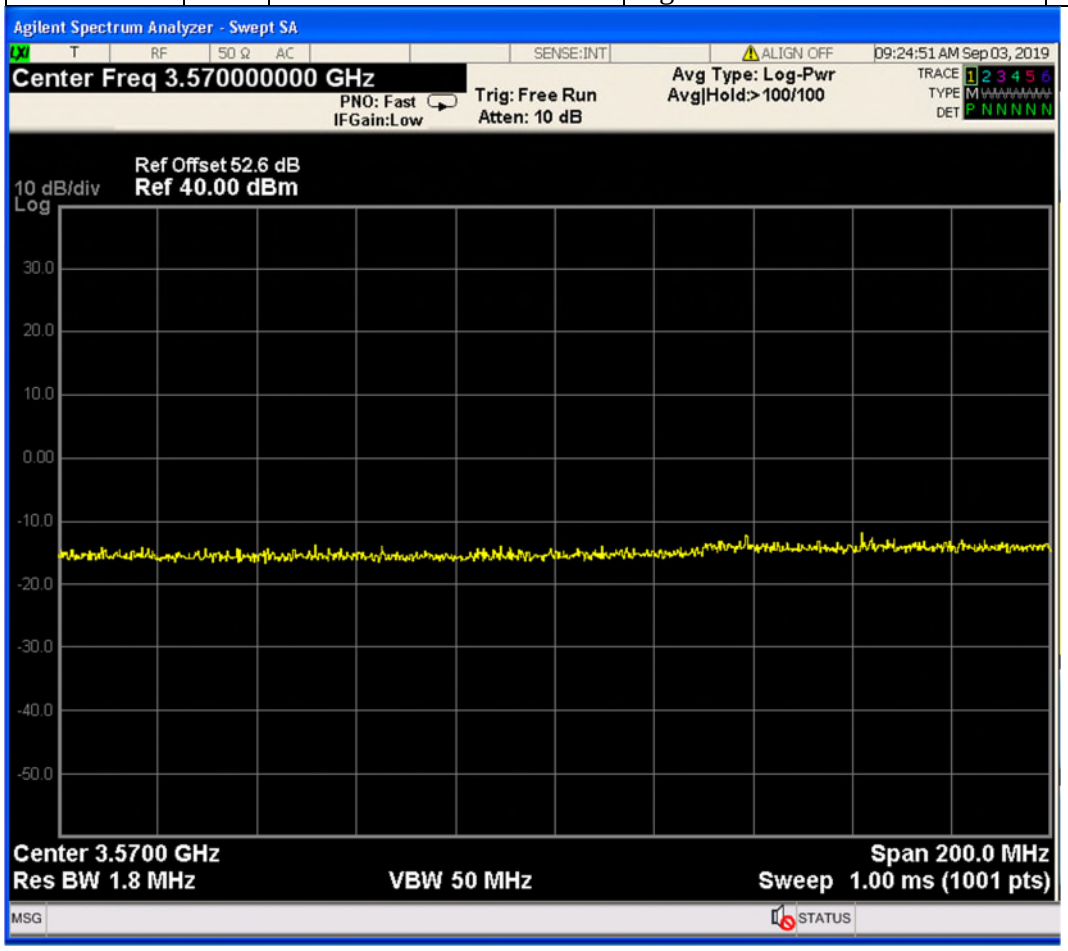
6.1.4.1.6	X	WINNF.FT.D.REG.6	Domain Proxy Single-Step registration for CBSD with CPI signed data	P



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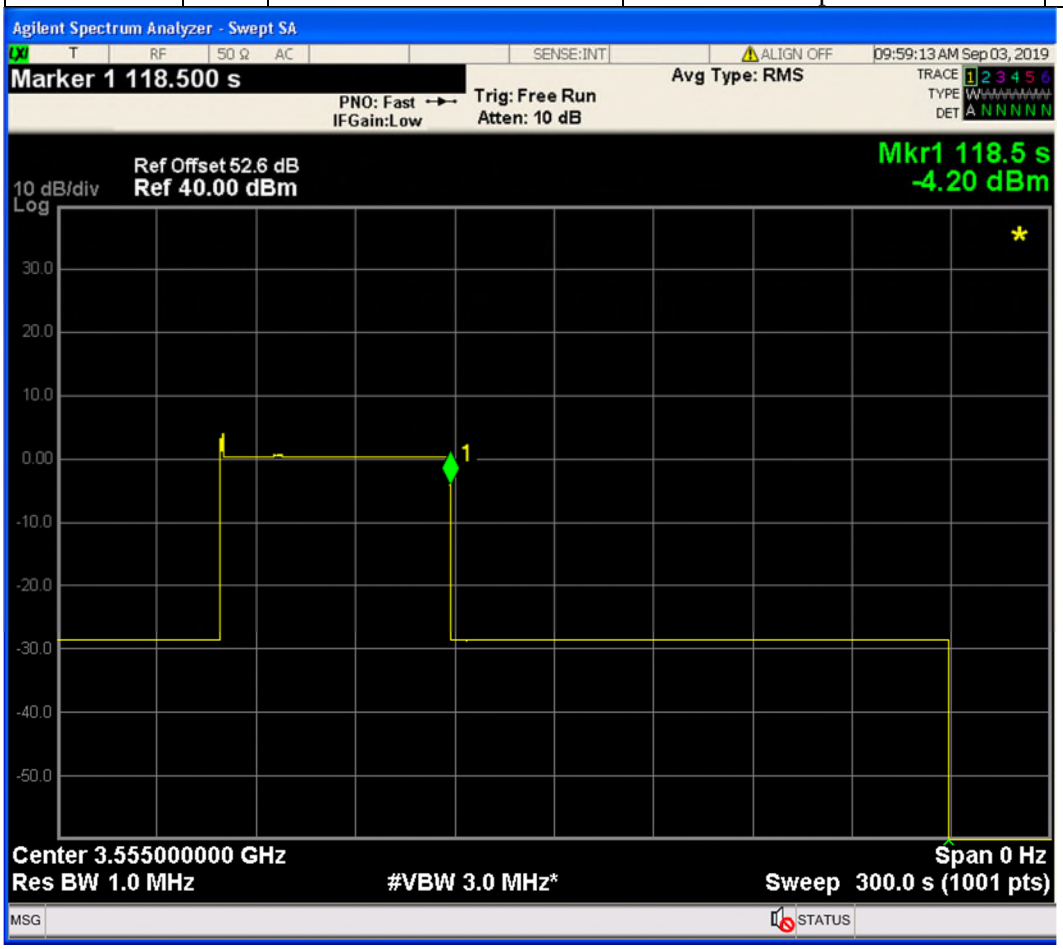
6.1.4.1.7	X	WINNF.FT.C.REG.7	Registration due to change of an installation parameter	P



Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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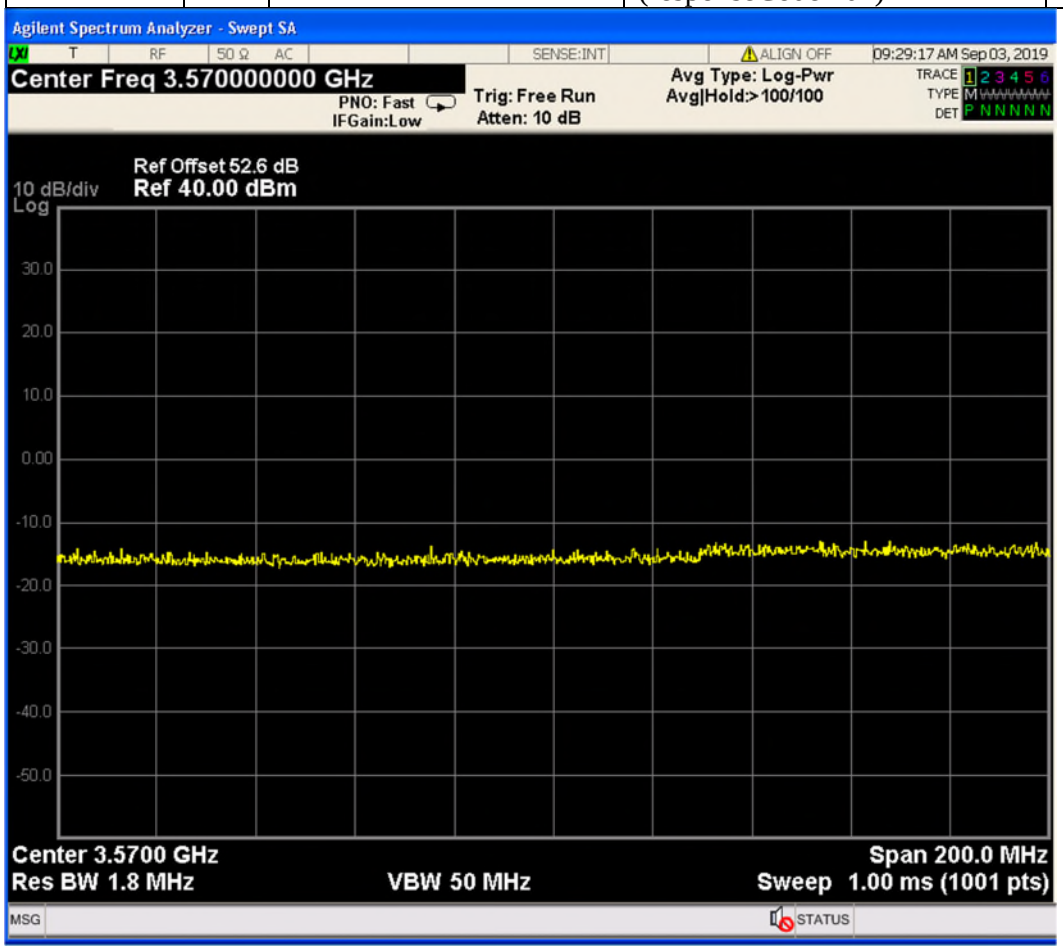
6.1.4.2.2	X	WINNF.FT.D.REG.9	Domain Proxy Missing Required parameters (responseCode 102)	P



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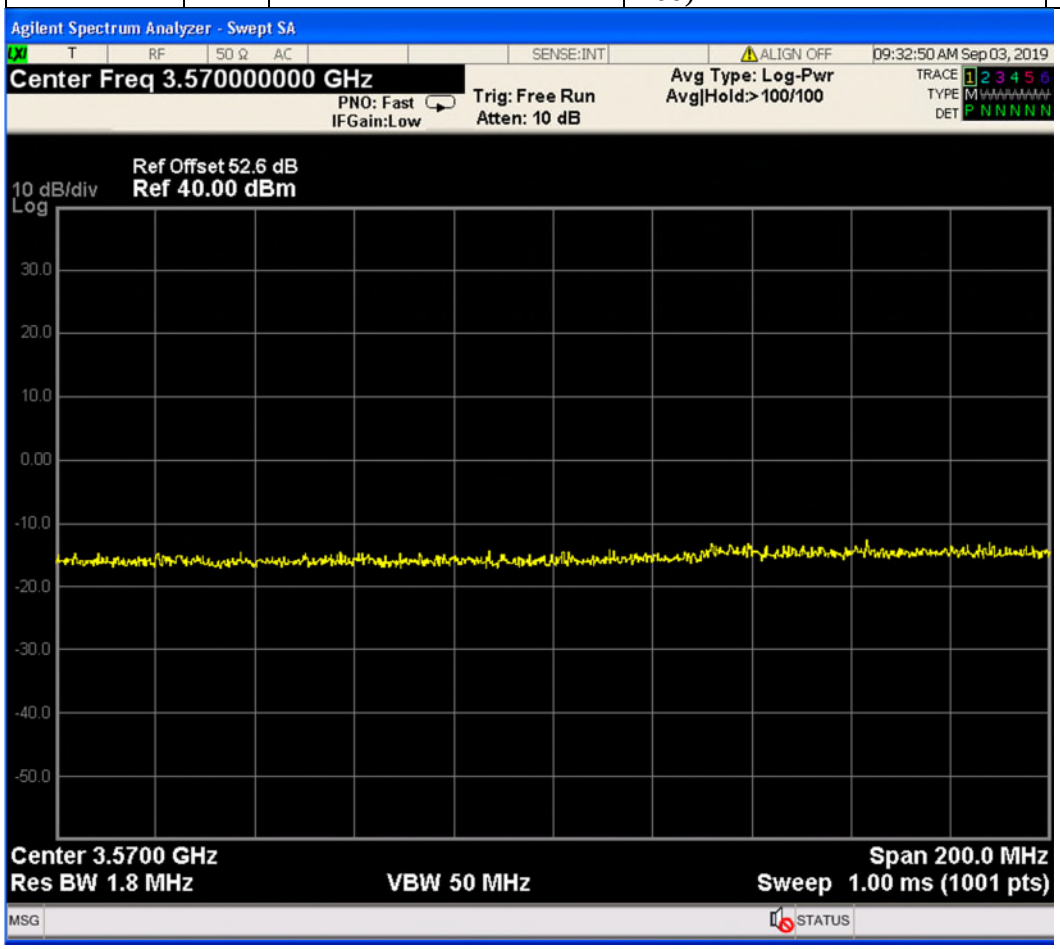
6.1.4.2.4	X	WINNF.FT.D.REG.11	Domain Proxy Pending registration (responseCode 200)	P



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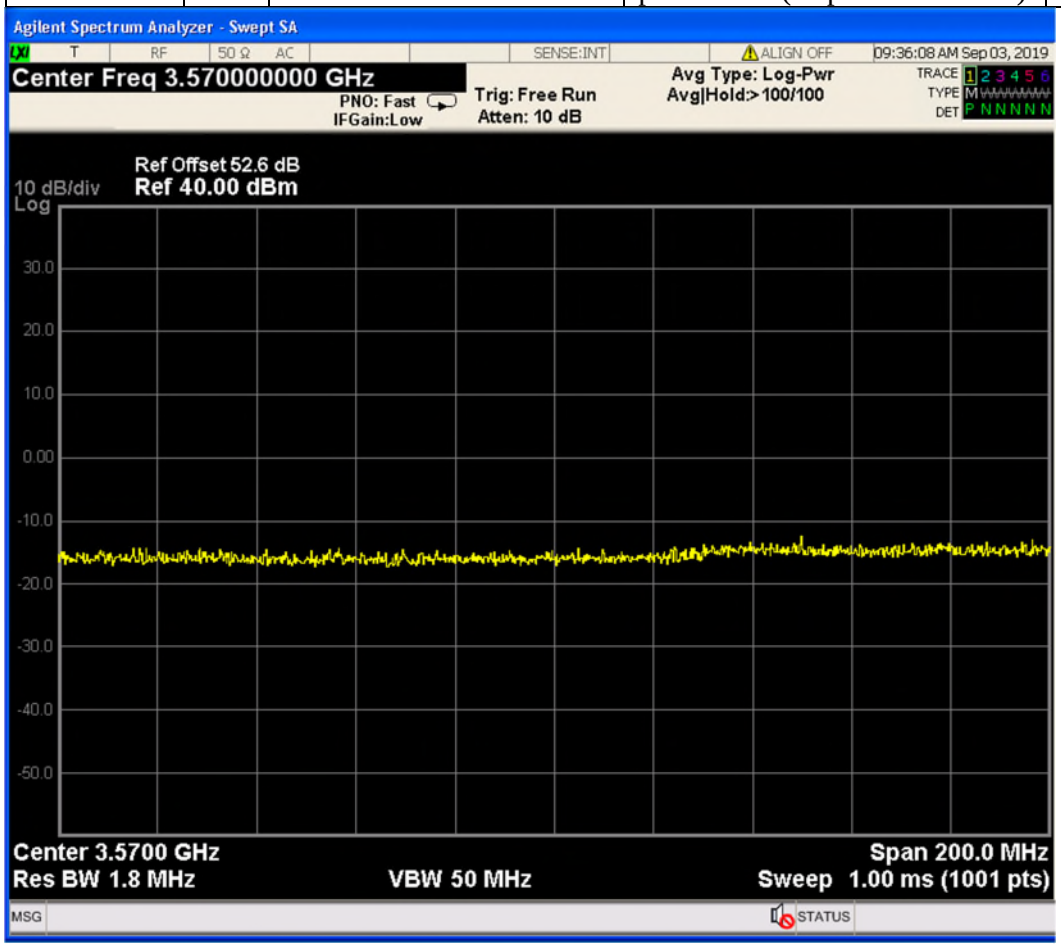
6.1.4.2.6	X	WINNF.FT.D.REG.13	Domain Proxy Invalid parameters (responseCode 103)	P



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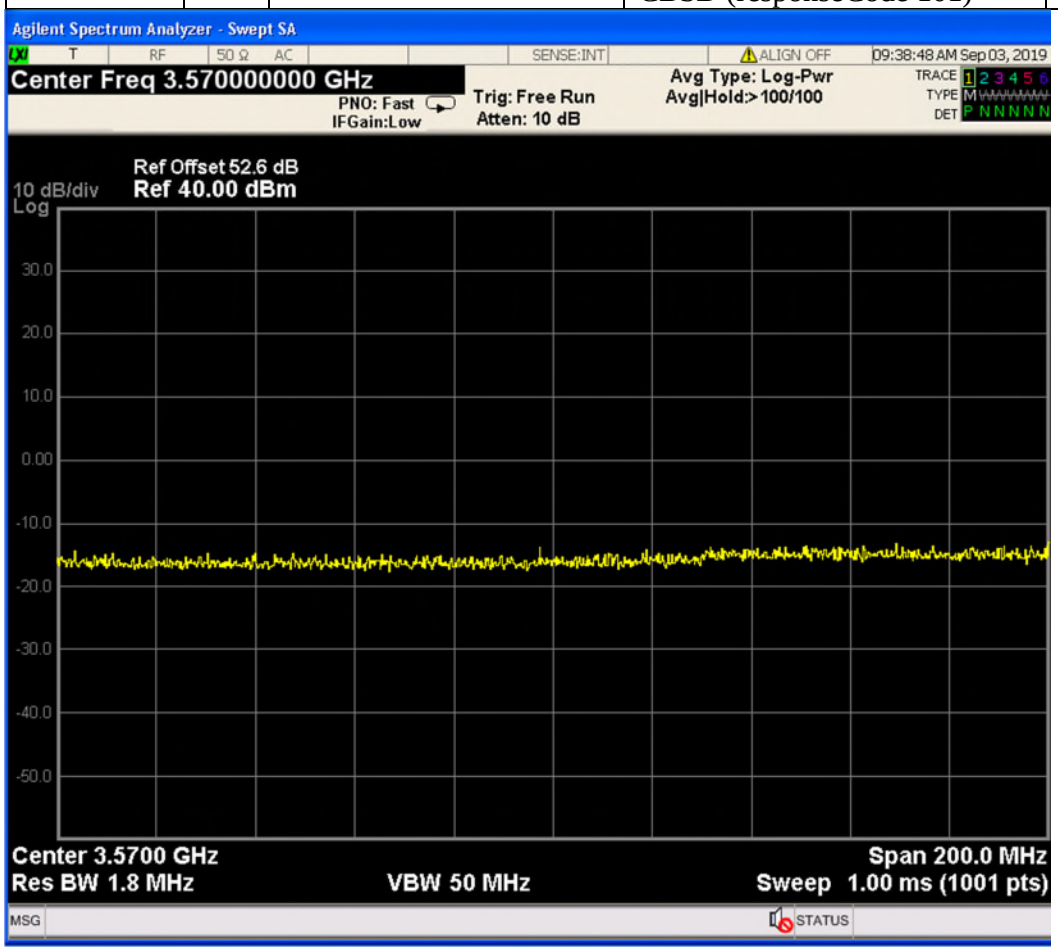
6.1.4.2.8	X	WINNF.FT.D.REG.15	Domain Proxy Blacklisted CBSD (responseCode 101)	P



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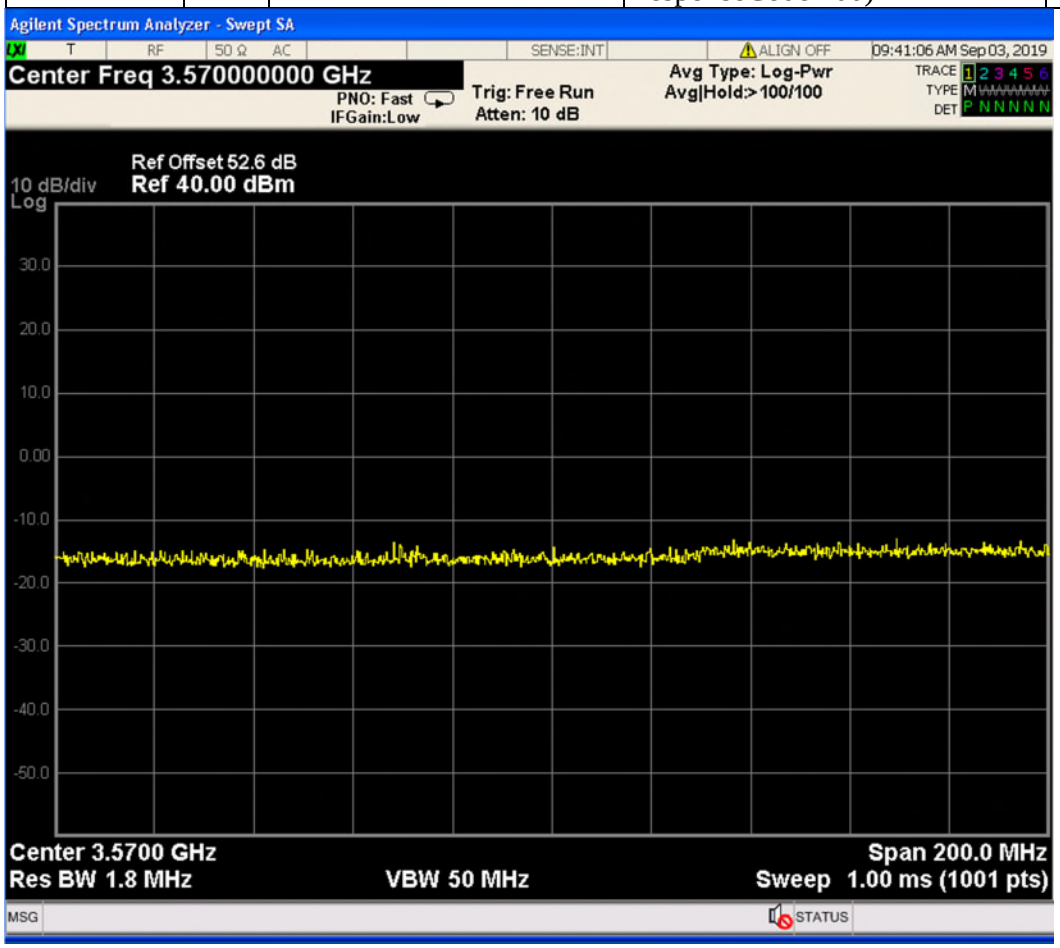
6.1.4.2.10	X	WINNF.FT.D.REG.17	Domain Proxy Unsupported SAS protocol version responseCode 100)	P



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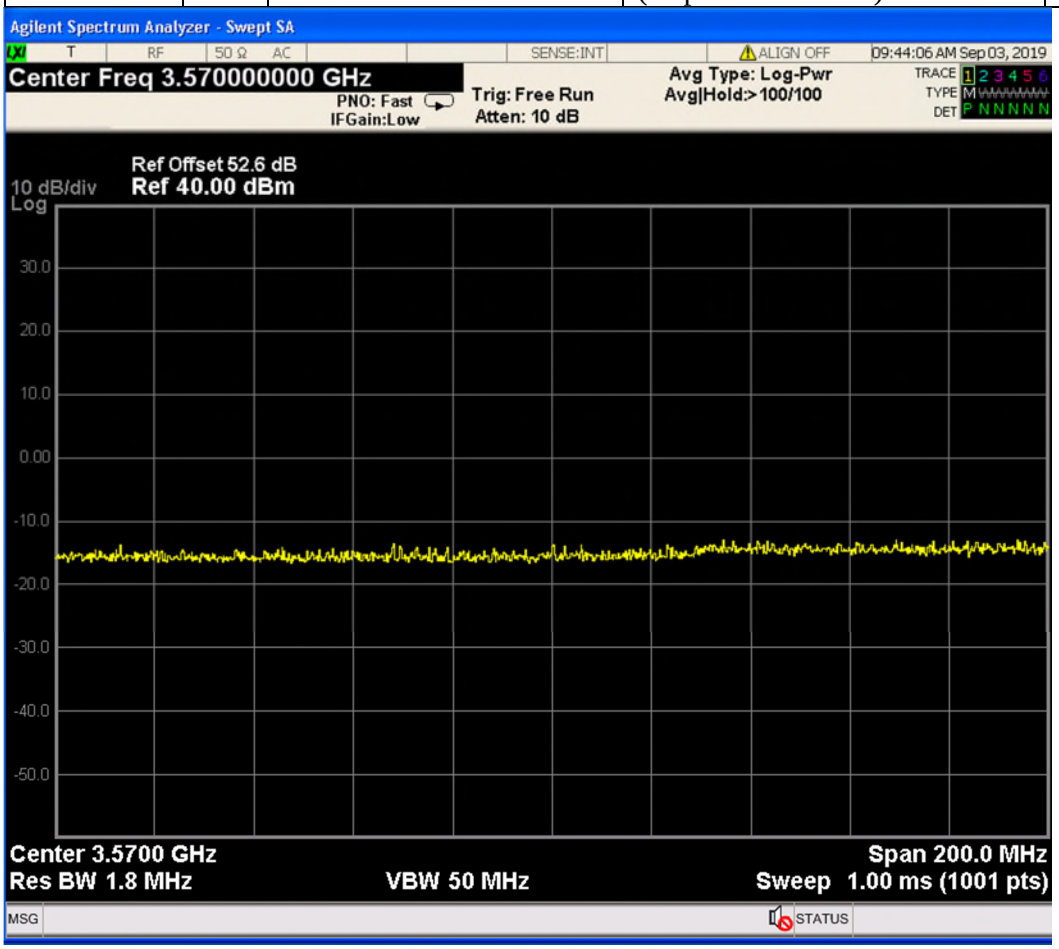
6.1.4.2.12	X	WINNF.FT.D.REG.19	Domain Proxy Group Error (responseCode 201)	P



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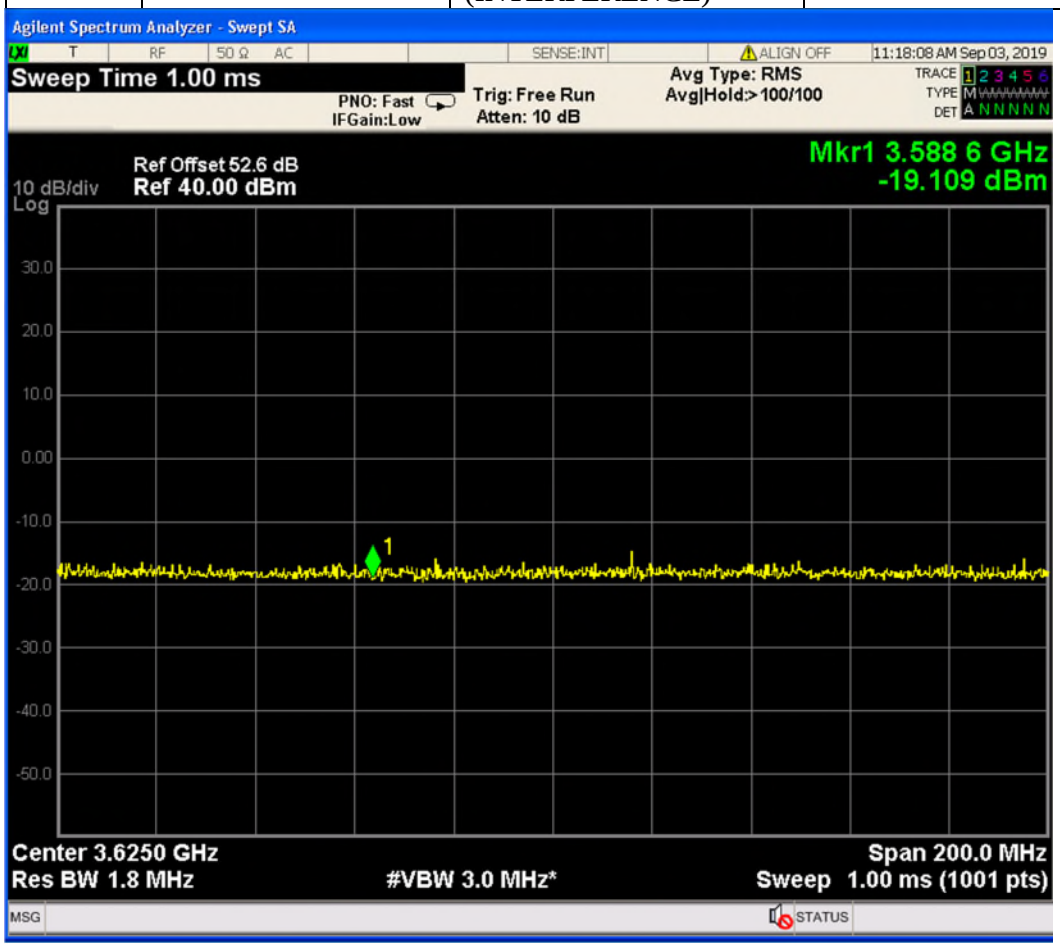
Check the device registration and authorization with the SAS*, *Confirm that the device changes its operating power and/or channel in response to a command from the SAS and Confirm that the device correctly configures based on the different license classes.

6.3.4.2.1	WINNF.FT.C.GRA.1	Unsuccessful Grant responseCode=400 (INTERFERENCE)	Monitor for 60 seconds after REG message sent. No transmission during test.	P



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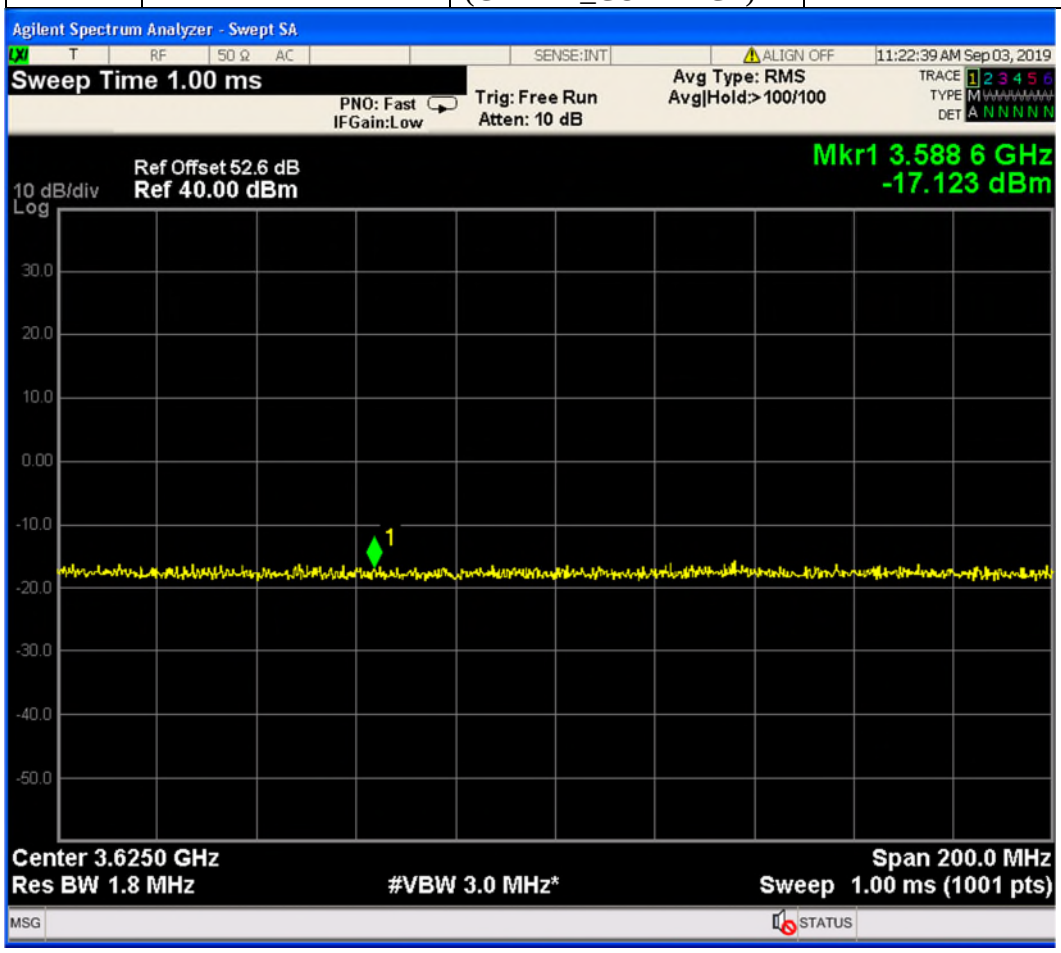
6.3.4.2.2	WINNF.FT.C.GRA.2	Unsuccessful Grant responseCode=401 (GRANT_CONFLICT)	Monitor for 60 seconds after REG message sent. No transmission during test.	P



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6.4.4.1.2	WINNF.FT.D.HBT.2	Domain Proxy Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: • Transmission does not start until time of first heartbeat response or after. • After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)	P

Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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6.4.4.2.1	WINNF.FT.C.HBT.3	Heartbeat responseCode=105 (DEREGISTER)	Monitor RF transmission. Ensure that: • CBSD stops transmission within 60 seconds of the heartbeatResponse which contains responseCode = 105	P

Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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6.4.4.2.3	WINNF.FT.C.HBT.5	Heartbeat responseCode=501 (SUSPENDED_GRANT) in First Heartbeat Response	Monitor RF transmission from start of test. Ensure there is no transmission during the test	p

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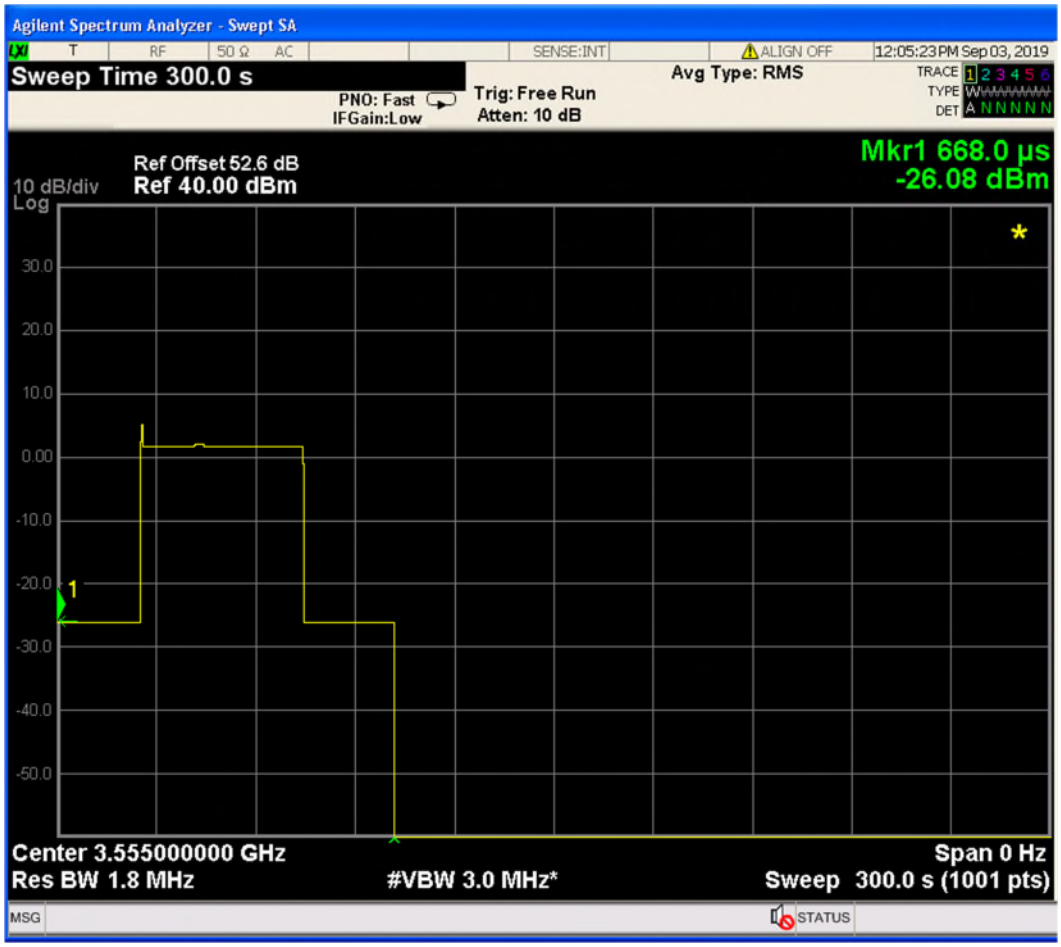
6.4.4.2.4	WINNF.FT.C.HBT.6	Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	Monitor RF transmission. Ensure: • CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=501	p



Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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6.4.4.2.5	WINNF.FT.C.HBT.7	Heartbeat responseCode=502 (UNSYNC_OP_PARAM)	Monitor RF transmission. Ensure: • CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=502	p

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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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6.4.4.2.6	--	X	WINNF.FT.D.HBT.8	Domain Proxy Heartbeat responseCode=500 (TEMINATED_GRANT)	Monitor RF transmission. CBSDs will have different behavior: • CBSD1: will continue to transmit to end of test (this is not a pass/fail criteria, but check) • CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500	P

Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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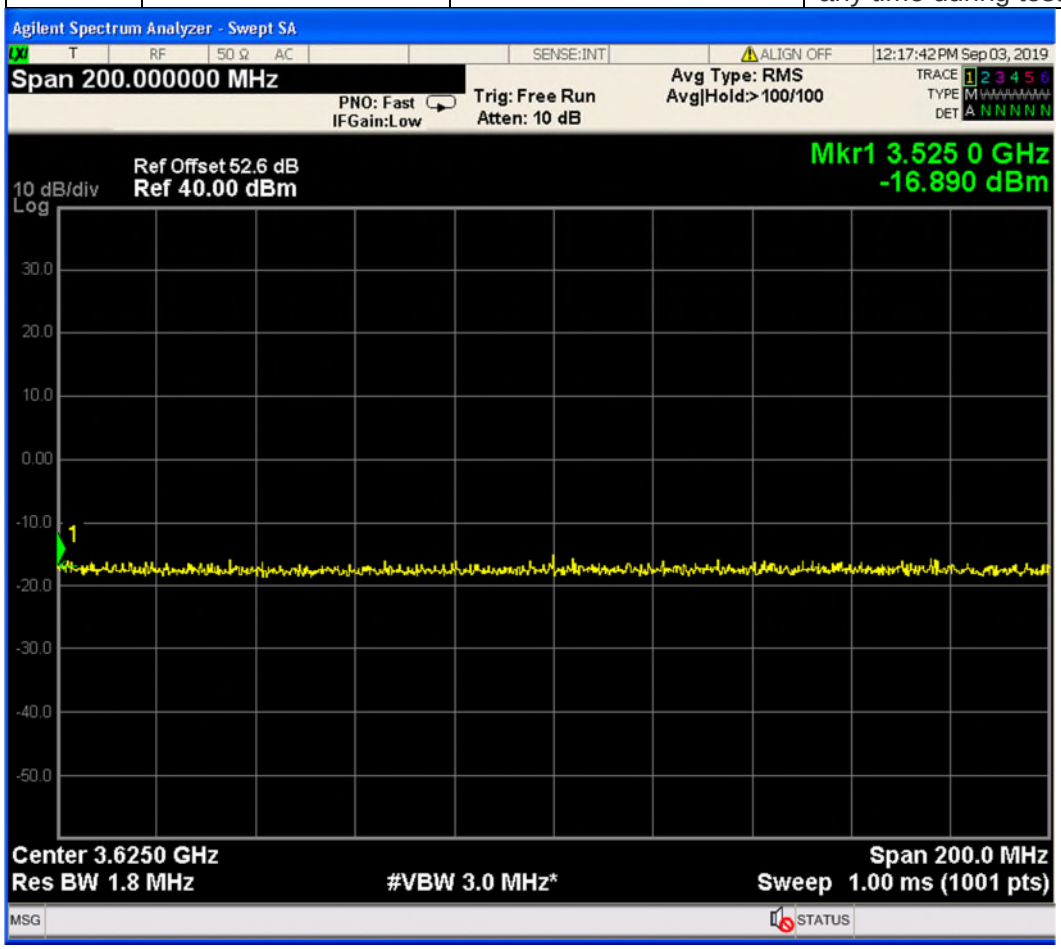
6.4.4.3.1	WINNF.FT.C.HBT.9	Heartbeat Response Absent (First Heartbeat)	Monitor RF from start of test to 60 seconds after last heartbeatResponse message was sent. CBSD should not transmit at any time during test	P



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6.4.4.3.2	WINNF.FT.C.HBT.10	Heartbeat Response Absent (Subsequent Heartbeat)	Monitor RF transmission. Verify: • CBSD must stop transmission within transmitExpireTime+60 seconds, where transmitExpireTime is from last successful heartbeatResponse message	P

Test Harness logs and timing on graph was verified, the EUT passed the requirement.

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6.5.4.2.2	WINNF.FT.D.MES.2	Domain Proxy Registration Response contains measReportConfig	No RF monitoring	P

Pass. “measreportconfig” in logs. All other requirements verified.

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6.5.4.2.3	WINNF.FT.C.MES.3	Grant Response contains measReportConfig	No RF monitoring	P

Pass. “measreportconfig” in logs. All other requirements verified.

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6.5.4.2.5	WINNF.FT.D.MES.5	Domain Proxy Heartbeat Response contains measReportConfig	No RF monitoring	P

Pass. “measreportconfig” in logs. All other requirements verified.

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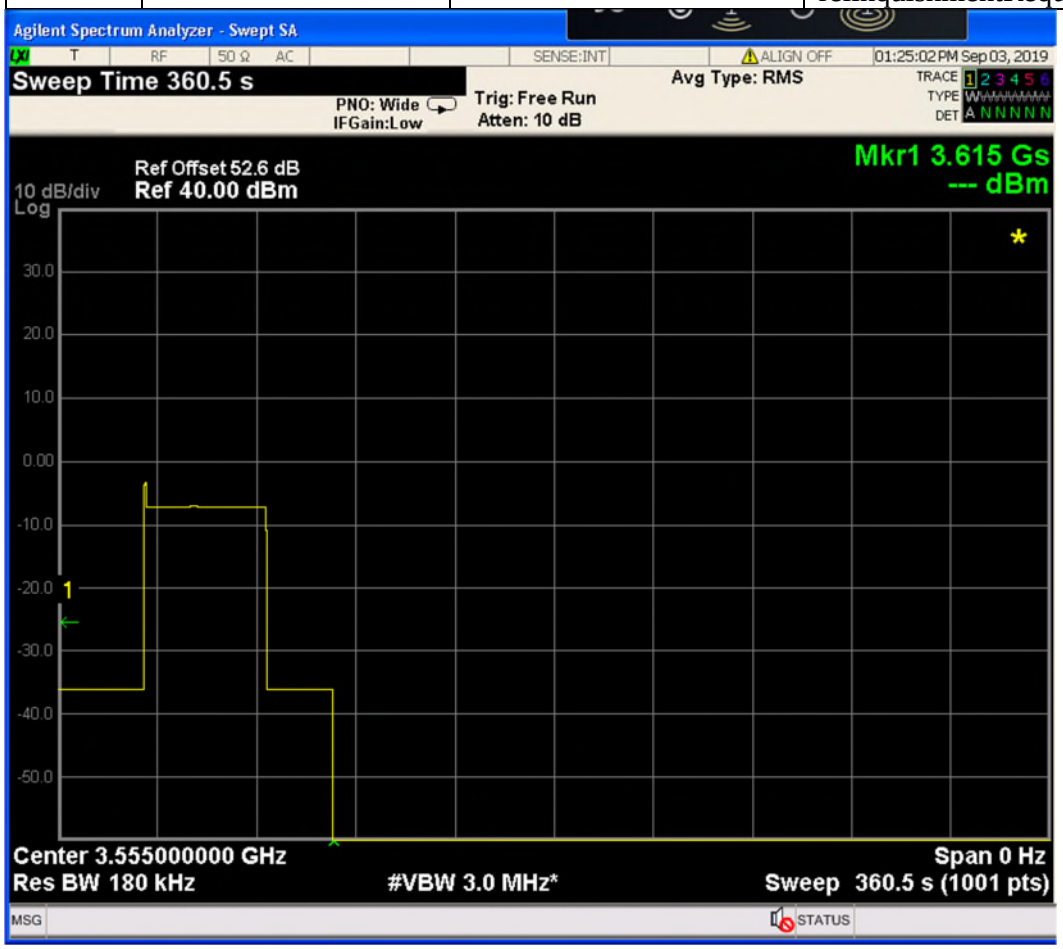
6.6.4.1.2	WINNF.FT.D.RLQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message.	P



Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Shutdown time taken from Domain Proxy logs, and shutdown confirmed by RF monitoring.

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6.7.4.1.2	WINNF.FT.D.DRG.2	Domain Proxy Successful Deregistration	Monitor RF transmission. Ensure: • CBSD stops transmission at any time prior to sending the relinquishmentRequest message or deregistrationRequest message (whichever is sent first)	P

Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Shutdown time taken from Domain Proxy logs, and shutdown confirmed by RF monitoring.

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Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.

7.1.4.1.1	X	X	WINNF.PT.C.HBT	UUT RF Transmit Power Measurement	Power Spectral Density test case. Assume we use 1 carrier bandwidth (say, 5 or 10 MHz), one frequency (say middle channel in band) for test. Measure at max transmit power, and reduce in steps of 3 dB to minimum declared transmit power.	P

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Freq	1MHz EIRP limit (target) dBm	Raw 10 MHz	Raw 1MHz	External Losses (dB)	Raw dBm/MHz	antenna gain dBi	ports	port gain (dB)	EIRP 1MHz dBm/MHz	EIRP 10 MHz dBm	margin dB
3555 low	20	-10.7	-19.4	19.93	0.53	12	4	6.02	18.55	27.25	1.45
3555-mid	32	1.3	-7.4	19.93	12.53	12	4	6.02	30.55	39.25	1.45
3555-High	37	-23	-32.8	50.53	17.73	12	4	6.02	35.75	45.55	1.25
3630 low	20	-9.36	-18.14	19.93	1.79	12	4	6.02	19.81	28.59	0.19
3630-mid	32	1.74	-6.3	19.93	13.63	12	4	6.02	31.65	39.69	0.35
3630-high	37	-22.79	-31.8	50.53	18.73	12	4	6.02	36.75	45.76	0.25
3695 low	20	-9.53	-18.3	19.93	1.63	12	4	6.02	19.65	28.42	0.35
3695-mid	32		-6.4	19.93	13.53	12	4	6.02	31.55	37.95	0.45
3695-high	37	-22.7	-31.6	50.53	18.93	12	4	6.02	36.95	45.85	0.05

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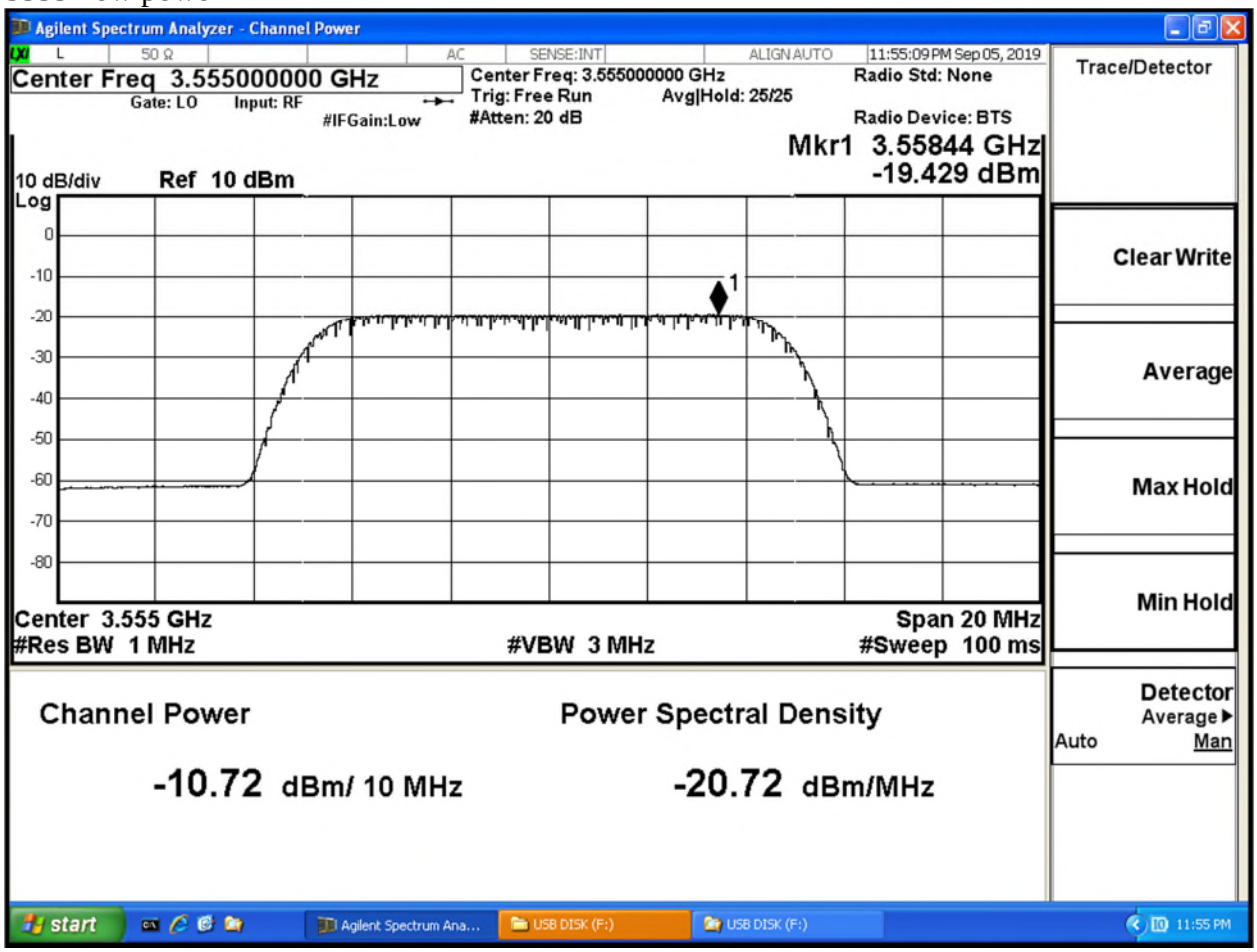
3555 low power



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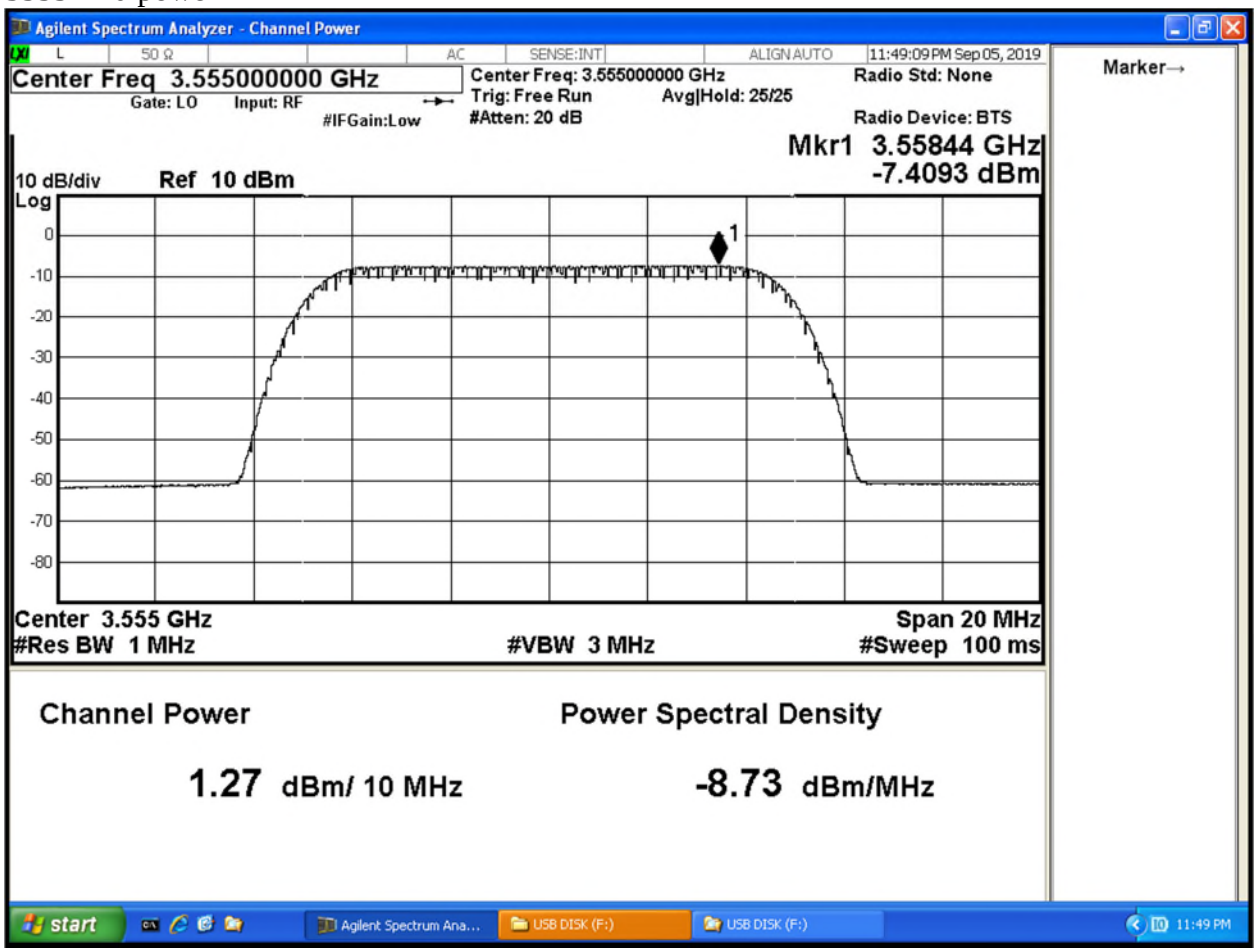
3555-mid power



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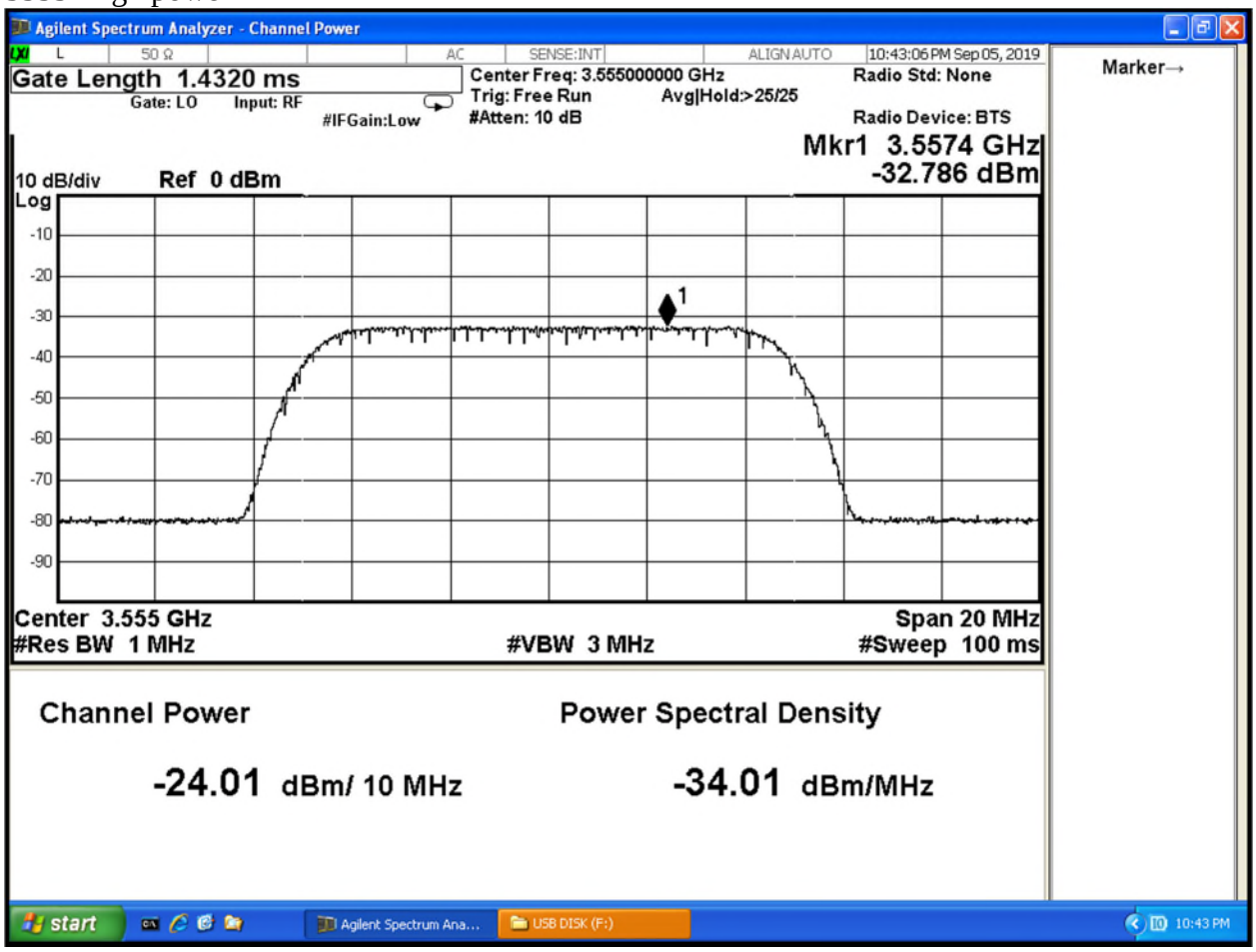
3555-High power



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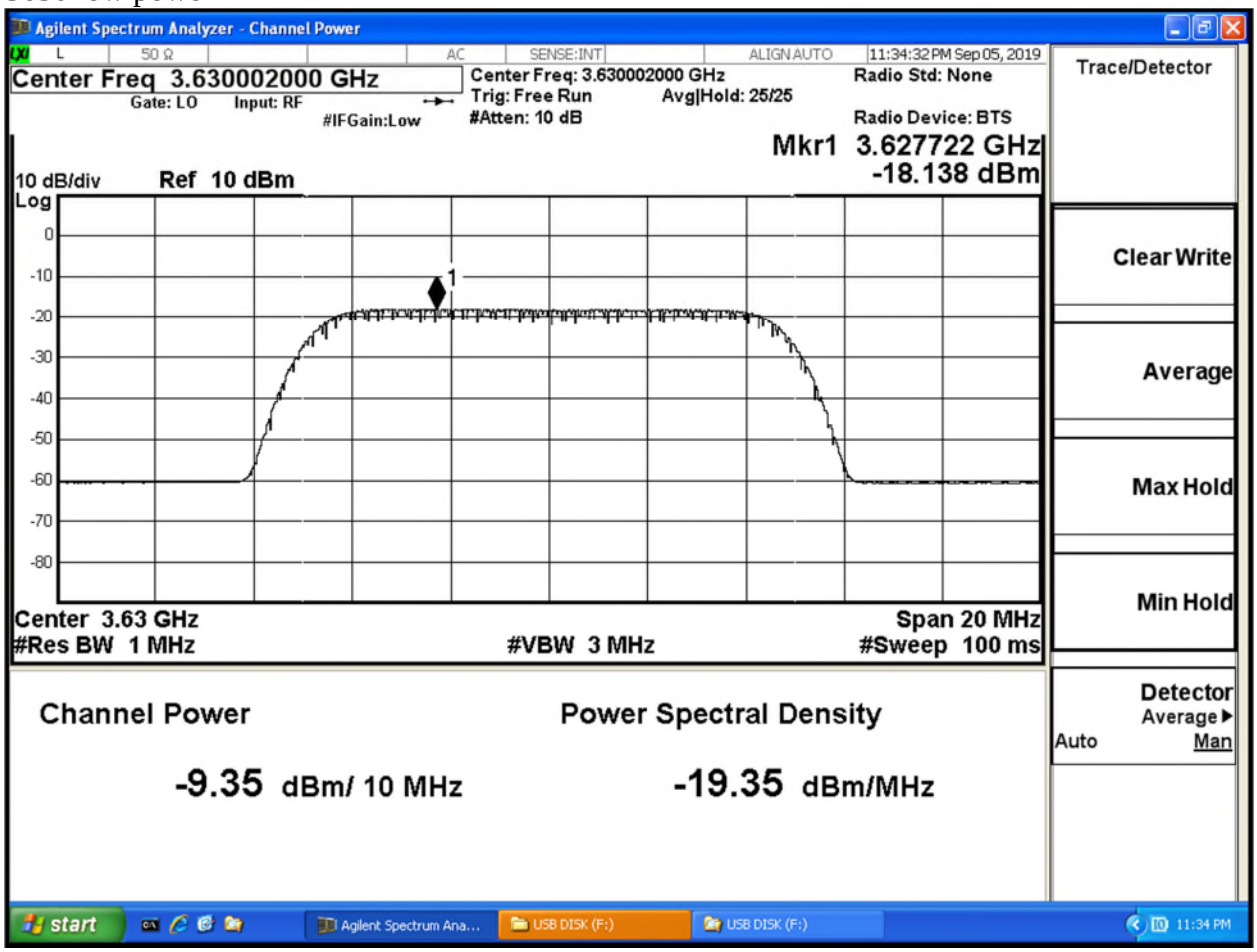
3630 low power



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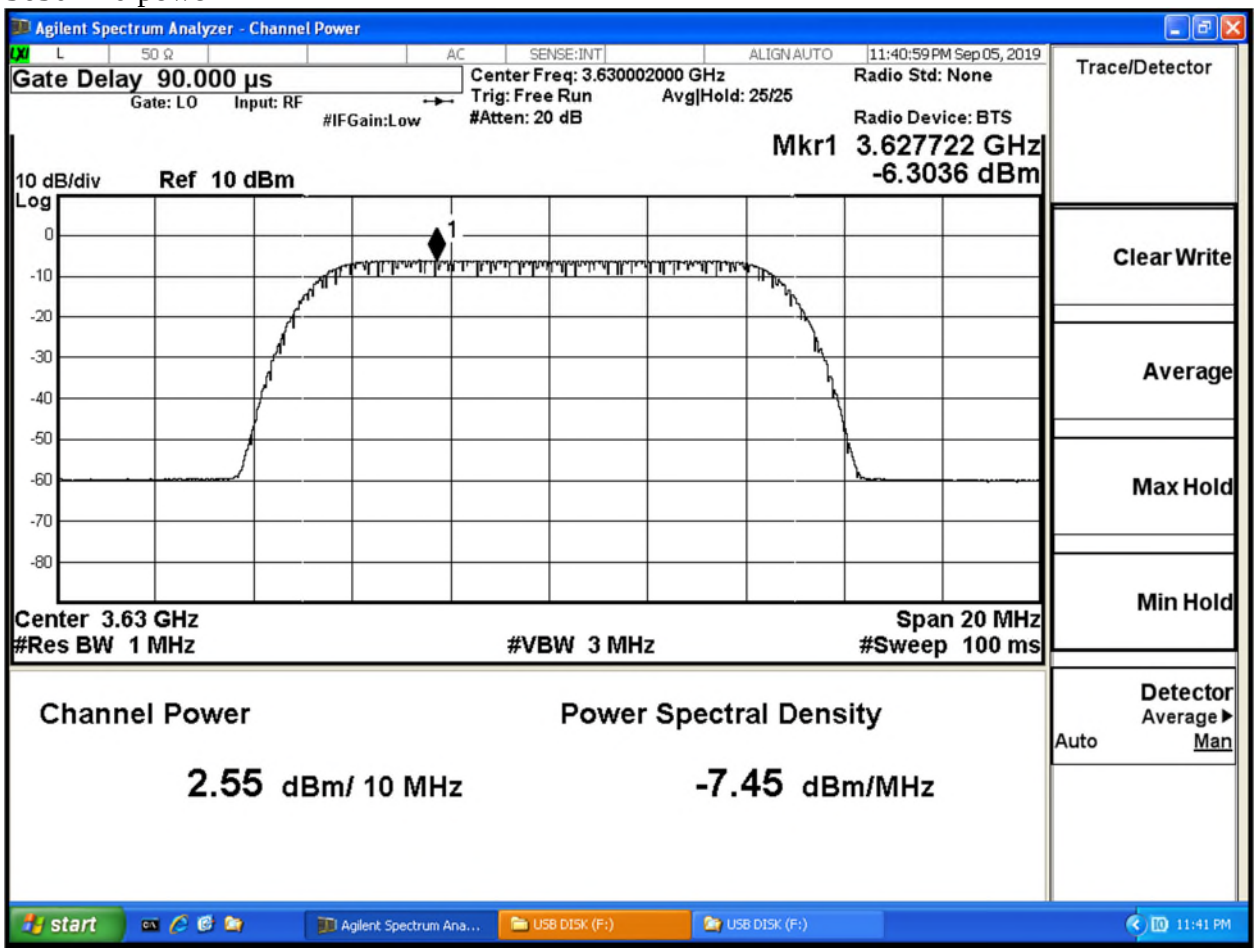
3630-mid power



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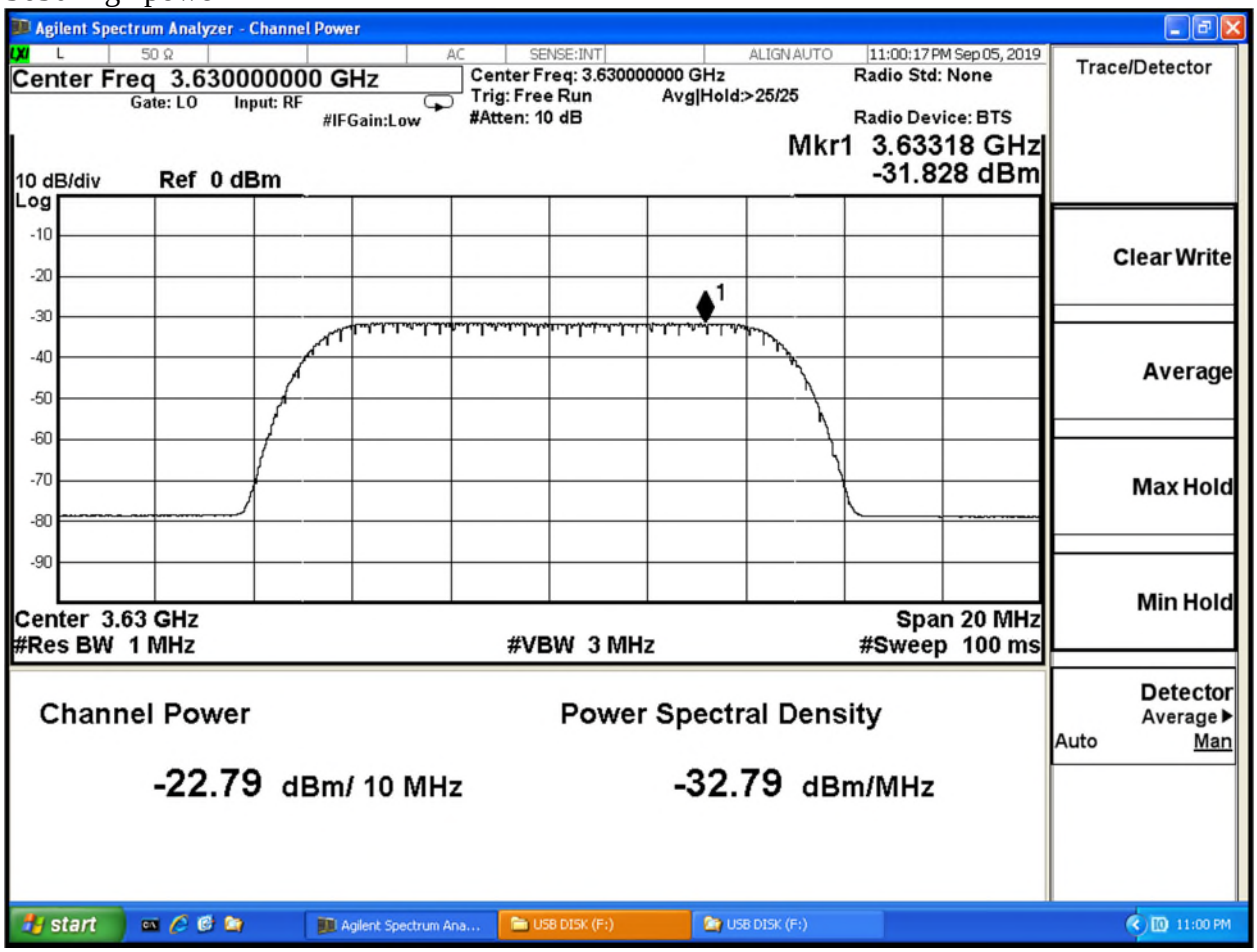
3630-high power



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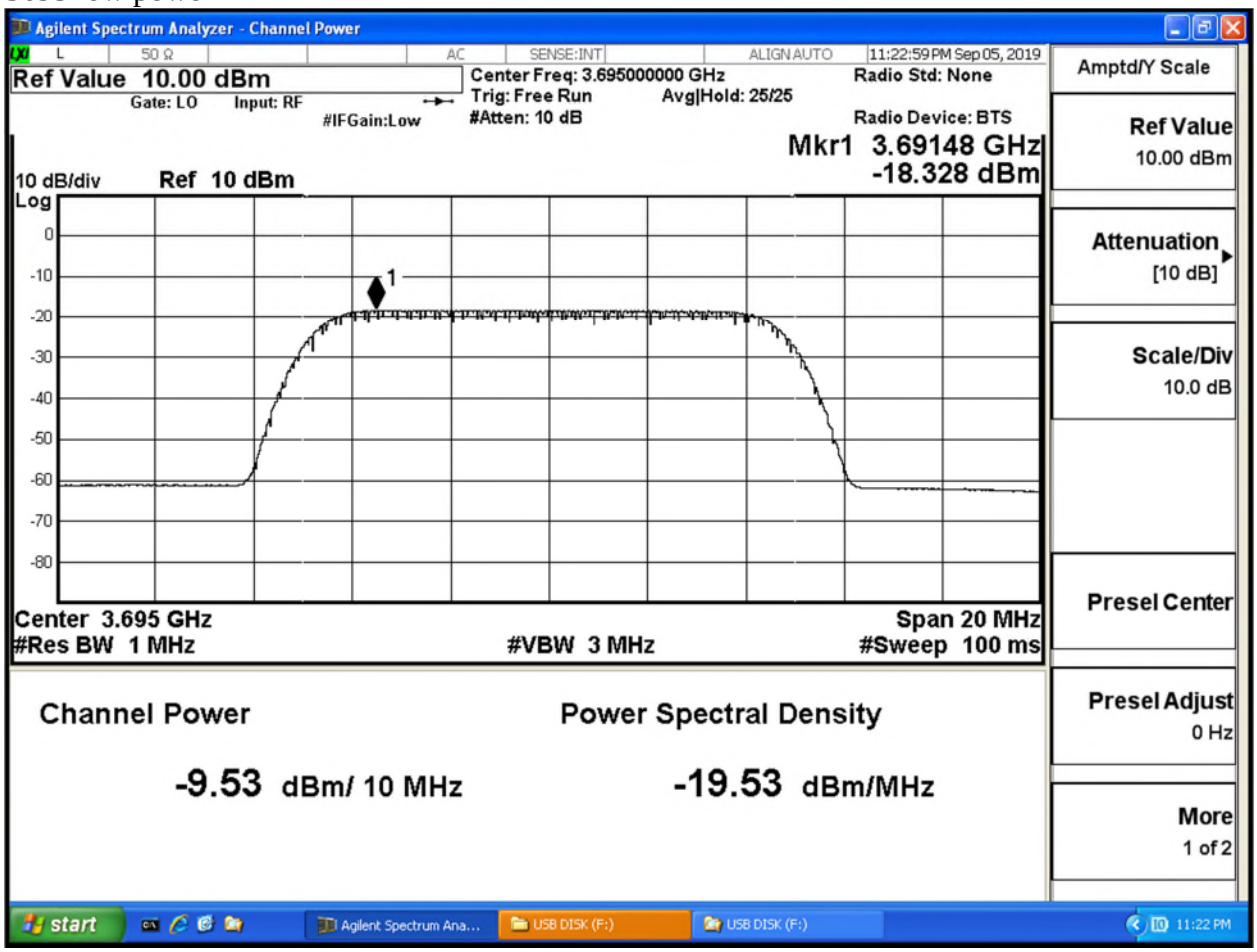
3695 low power



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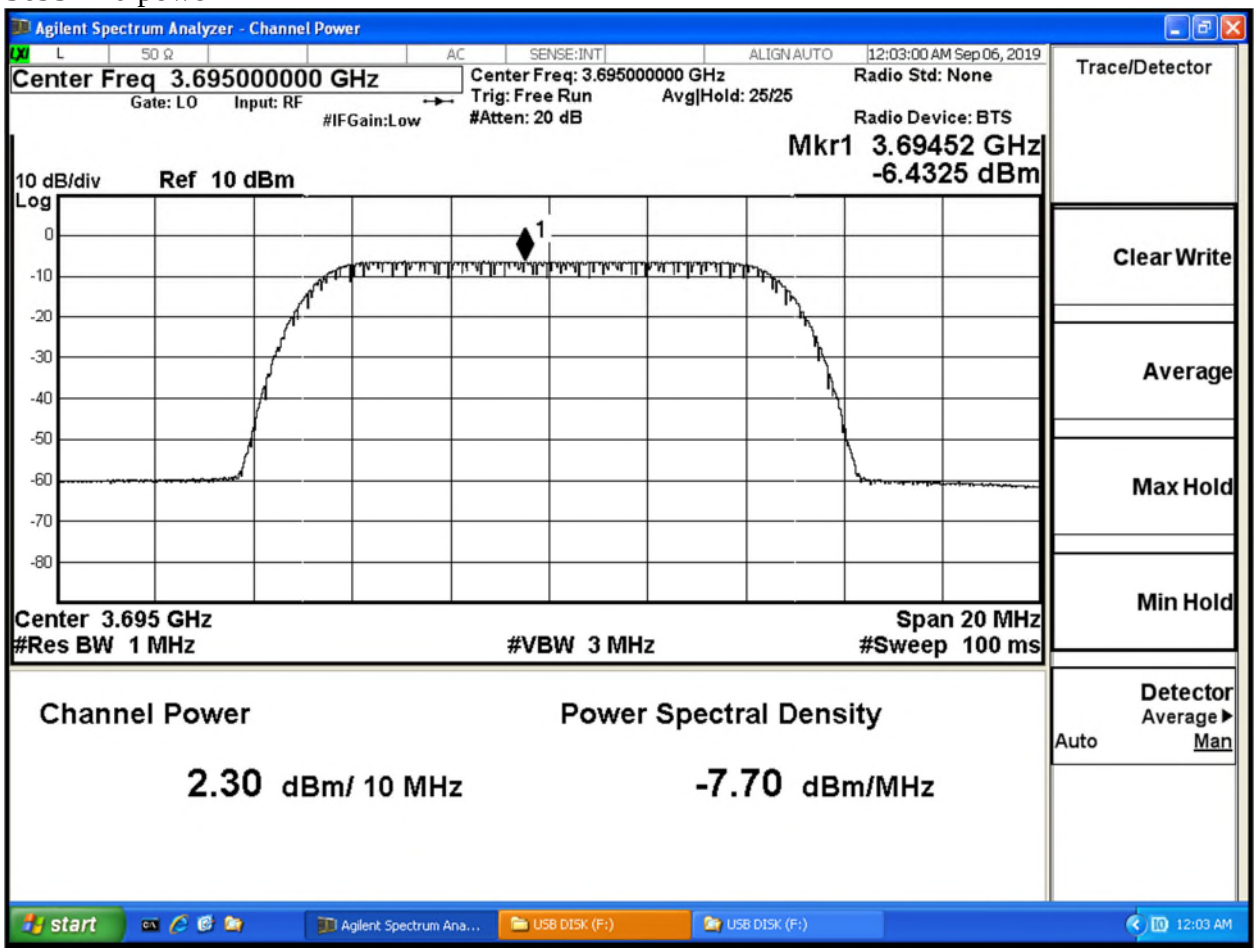
3695-mid power



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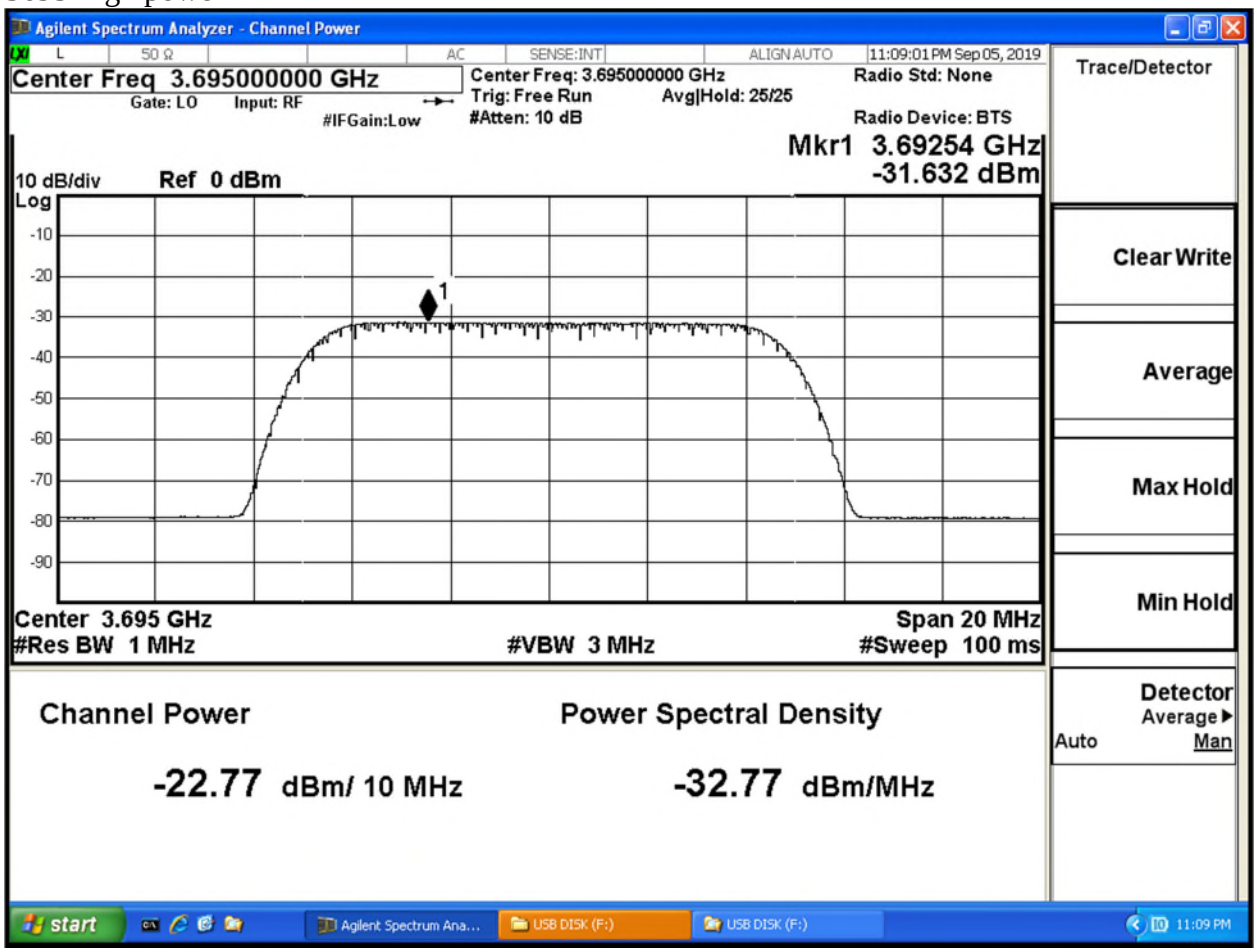
3695-high power



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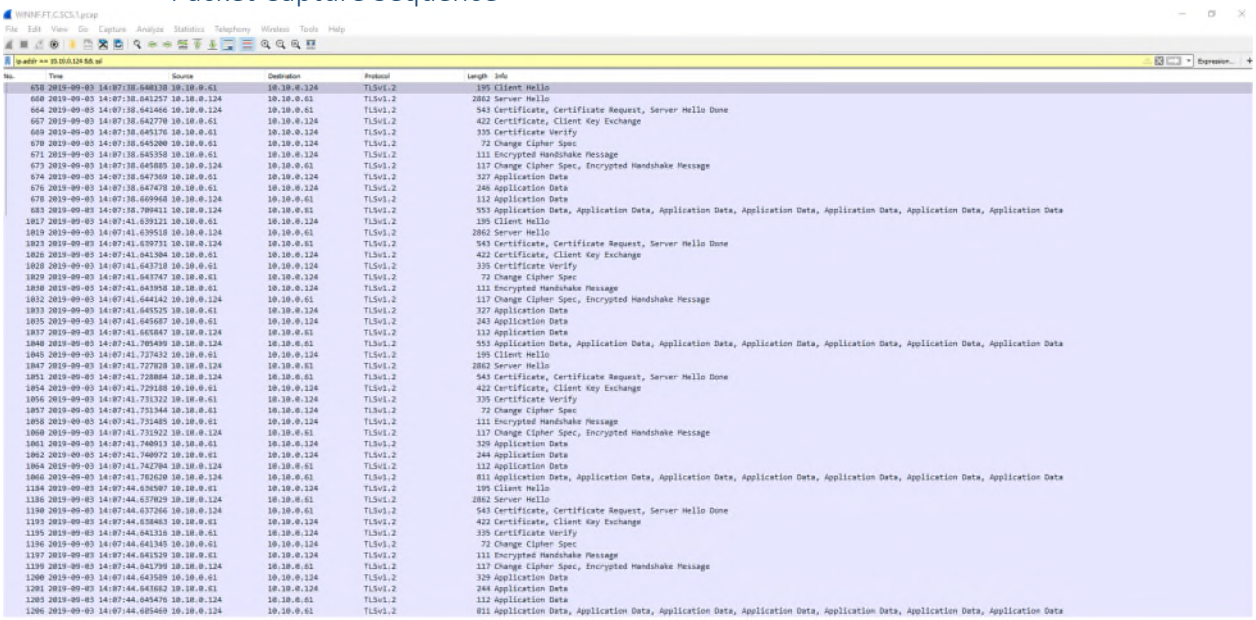
DOT CBRS Radio: WINNF / Security Test Case Analysis

WINNF Security Test Case Analysis

WINNF.FT.C.SCS.1

Packet Capture Sequence



No.	Time	Source	Destination	Protocol	Length	Info
658	2019-09-03 14:07:38.640138	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
660	2019-09-03 14:07:38.641257	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
664	2019-09-03 14:07:38.641466	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
667	2019-09-03 14:07:38.642770	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
669	2019-09-03 14:07:38.645176	10.10.0.61	10.10.0.124	TLSv1.2	335	Certificate Verify
670	2019-09-03 14:07:38.645200	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
671	2019-09-03 14:07:38.645358	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
673	2019-09-03 14:07:38.645885	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
674	2019-09-03 14:07:38.647369	10.10.0.61	10.10.0.124	TLSv1.2	327	Application Data
676	2019-09-03 14:07:38.647478	10.10.0.61	10.10.0.124	TLSv1.2	246	Application Data
678	2019-09-03 14:07:38.669968	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
683	2019-09-03 14:07:38.709411	10.10.0.124	10.10.0.61	TLSv1.2	553	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
1017	2019-09-03 14:07:41.639121	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
1019	2019-09-03 14:07:41.639518	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
1023	2019-09-03 14:07:41.639731	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
1026	2019-09-03 14:07:41.641304	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
1028	2019-09-03 14:07:41.643718	10.10.0.61	10.10.0.124	TLSv1.2	335	Certificate Verify
1029	2019-09-03 14:07:41.643747	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
1030	2019-09-03 14:07:41.643958	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
1032	2019-09-03 14:07:41.644142	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1033	2019-09-03 14:07:41.645525	10.10.0.61	10.10.0.124	TLSv1.2	327	Application Data
1035	2019-09-03 14:07:41.645687	10.10.0.61	10.10.0.124	TLSv1.2	243	Application Data
1037	2019-09-03 14:07:41.665847	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
1040	2019-09-03 14:07:41.705490	10.10.0.124	10.10.0.61	TLSv1.2	553	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
1045	2019-09-03 14:07:41.727432	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
1047	2019-09-03 14:07:41.727828	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
1051	2019-09-03 14:07:41.728864	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
1054	2019-09-03 14:07:41.729108	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
1056	2019-09-03 14:07:41.731322	10.10.0.61	10.10.0.124	TLSv1.2	335	Certificate Verify
1057	2019-09-03 14:07:41.731344	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
1058	2019-09-03 14:07:41.731485	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
1060	2019-09-03 14:07:41.731922	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1061	2019-09-03 14:07:41.740913	10.10.0.61	10.10.0.124	TLSv1.2	329	Application Data
1062	2019-09-03 14:07:41.740972	10.10.0.61	10.10.0.124	TLSv1.2	244	Application Data
1064	2019-09-03 14:07:41.742704	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
1066	2019-09-03 14:07:41.782620	10.10.0.124	10.10.0.61	TLSv1.2	811	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data
1184	2019-09-03 14:07:44.636507	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
1186	2019-09-03 14:07:44.637029	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
1190	2019-09-03 14:07:44.637266	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
1193	2019-09-03 14:07:44.638463	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
1195	2019-09-03 14:07:44.641316	10.10.0.61	10.10.0.124	TLSv1.2	335	Certificate Verify
1196	2019-09-03 14:07:44.641345	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
1197	2019-09-03 14:07:44.641529	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
1199	2019-09-03 14:07:44.641799	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1200	2019-09-03 14:07:44.643509	10.10.0.61	10.10.0.124	TLSv1.2	329	Application Data
1201	2019-09-03 14:07:44.643682	10.10.0.61	10.10.0.124	TLSv1.2	244	Application Data
1203	2019-09-03 14:07:44.645476	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
1206	2019-09-03 14:07:44.685469	10.10.0.124	10.10.0.61	TLSv1.2	811	Application Data, Application Data, Application Data, Application Data, Application Data, Application Data, Application Data

WINNF test requirements:

WINNF test requirements from WINNF-TS-0122-V1.0.0 CBRS CBSD Test Specification:

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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
		PASS

Analysis of WINNF Test Requirements

1. From Client Hello: TLS version = TLS 1.2

```
> Frame 658: 195 bytes on wire (1560 bits), 195 bytes captured (1560 bits)
> Ethernet II, Src: fa:16:3e:17:b4:ec (fa:16:3e:17:b4:ec), Dst: fa:16:3e:41:fa:8b (fa:16:3e:41:fa:8b)
> Internet Protocol Version 4, Src: 10.10.0.61, Dst: 10.10.0.124
> Transmission Control Protocol, Src Port: 55482, Dst Port: 5000, Seq: 1, Ack: 1, Len: 129
v Transport Layer Security
  v TLSv1.2 Record Layer: Handshake Protocol: Client Hello
      Content Type: Handshake (22)
      Version: TLS 1.2 (0x0303)
      Length: 124
    v Handshake Protocol: Client Hello
        Handshake Type: Client Hello (1)
        Length: 120
        Version: TLS 1.2 (0x0303)
      > Random: 5d6e73aaa319bed5672f75f9f4ac9b12db5d59130b44f1cc…
        Session ID Length: 0
        Cipher Suites Length: 6
      v Cipher Suites (3 suites)
          Cipher Suite: TLS_RSA_WITH_AES_128_GCM_SHA256 (0x009c)
          Cipher Suite: TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256 (0xc02b)
          Cipher Suite: TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256 (0xc02f)
        Compression Methods Length: 1
      > Compression Methods (1 method)
        Extensions Length: 73
      > Extension: supported_groups (len=22)
      > Extension: ec_point_formats (len=2)
      > Extension: signature_algorithms (len=28)
      > Extension: extended_master_secret (len=0)
      > Extension: renegotiation_info (len=1)
```


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2. Cipher suite list from Client Hello is from WINNF approved list:
   TLS_RSA_WITH_AES_128_GCM_SHA25
   TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
   TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

3. Cipher suite chosen (from Server Hello):
   TLS_RSA_WITH_AES_128_GCM_SHA256

4. The Registration request message arrived at the Test Harness, so authentication was completed.

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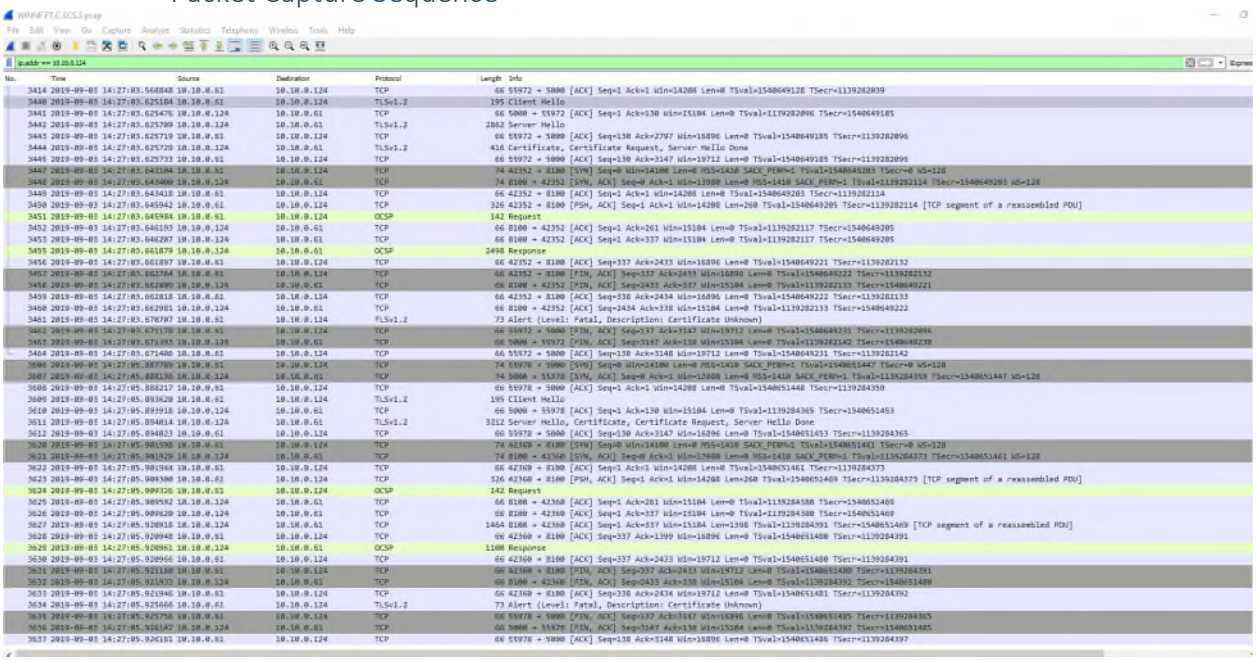
WINNF.FT.C.SCS.2

Packet Capture Sequence



WINNF Test Requirements:

WINNF test requirements from WINNF-TS-0122-V1.0.0 CBRS CBSD Test Specification:

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

Analysis of WINNF Test Requirements

1. From Client Hello can read: TLS version = TLS 1.2

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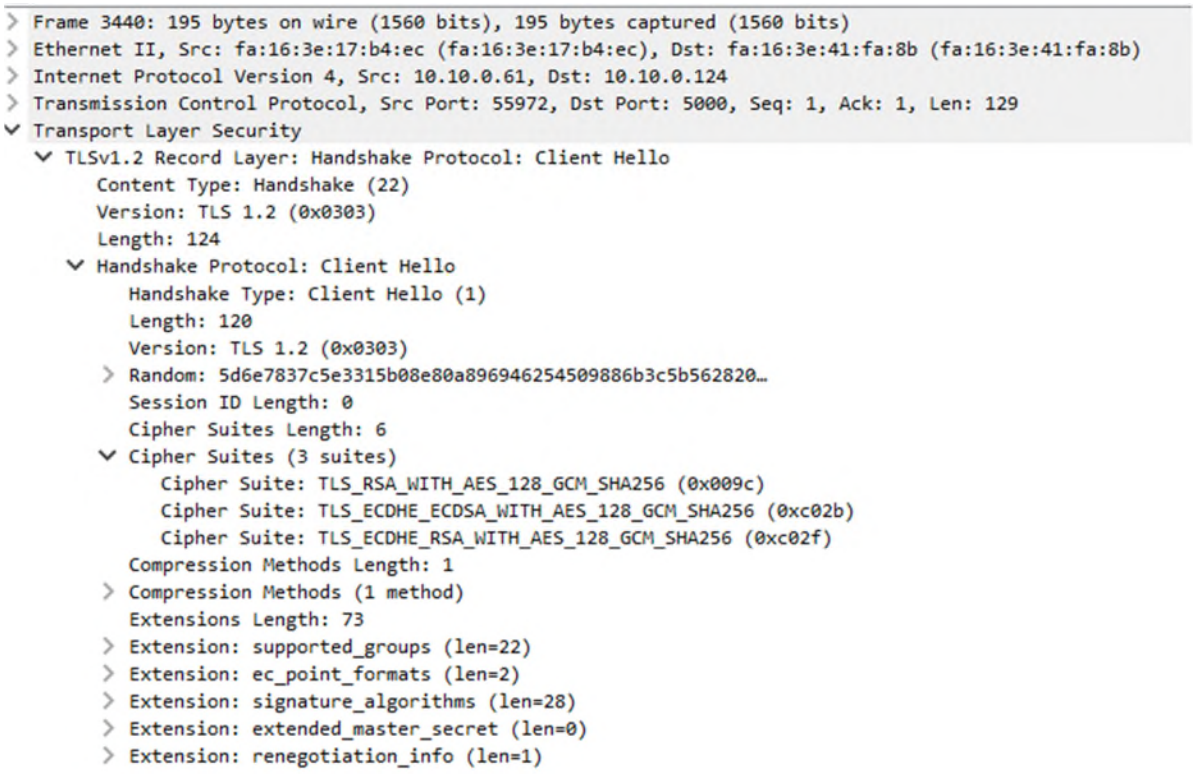

2. From Client Hello, cipher suite list is from WINNF approved list:

   TLS_RSA_WITH_AES_128_GCM_SHA25
   TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
   TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

3. From Server Hello, cipher suite chosen:
   TLS_RSA_WITH_AES_128_GCM_SHA256

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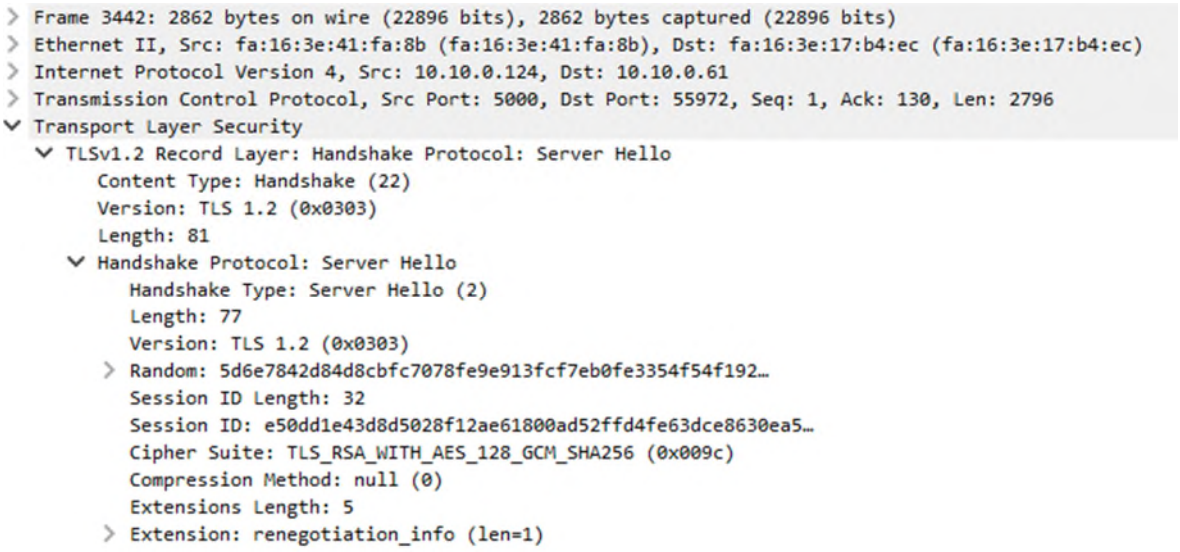
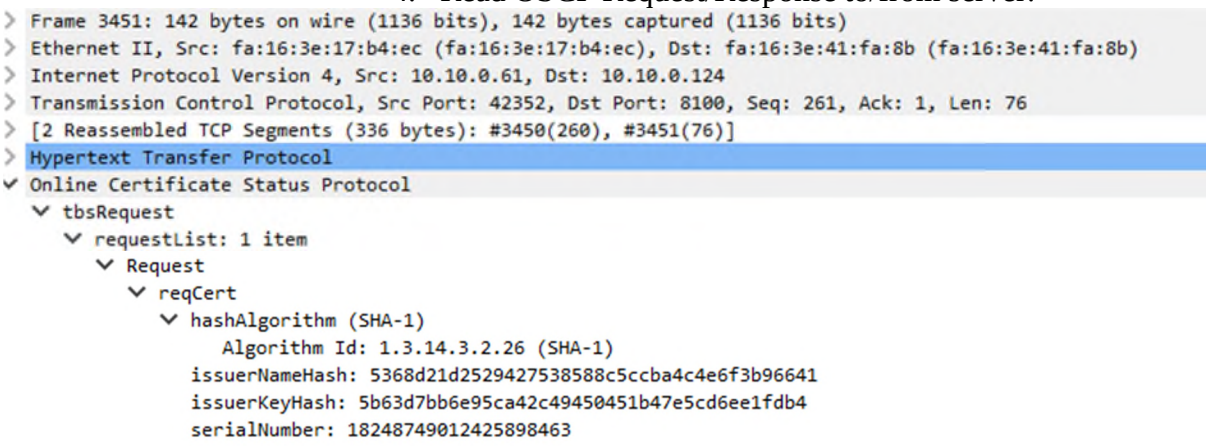


4. Read OSCP Request/Response to/from server:



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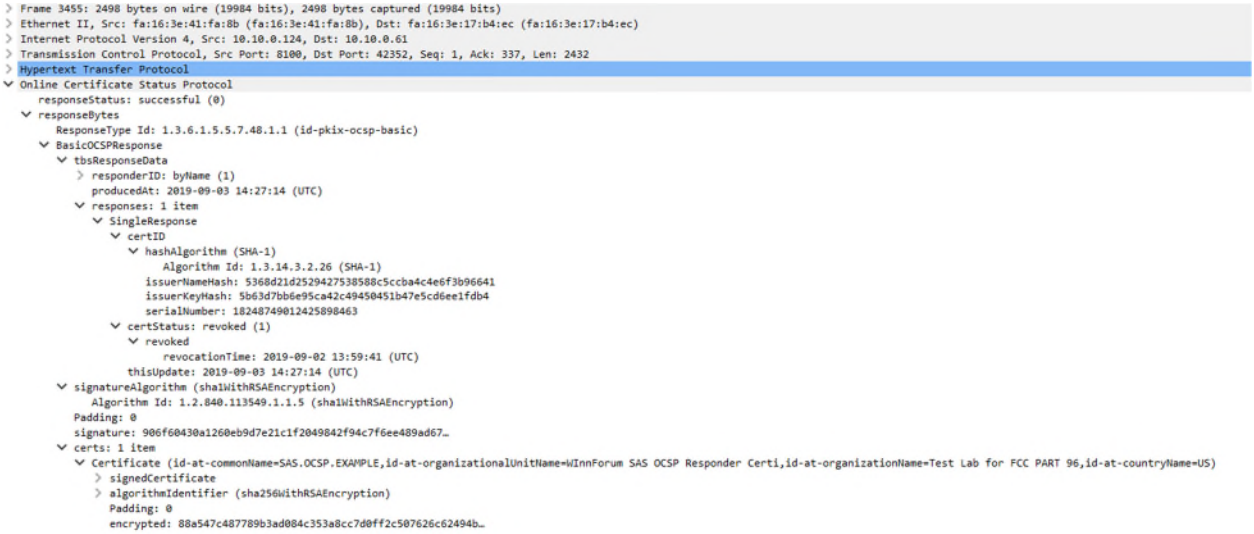
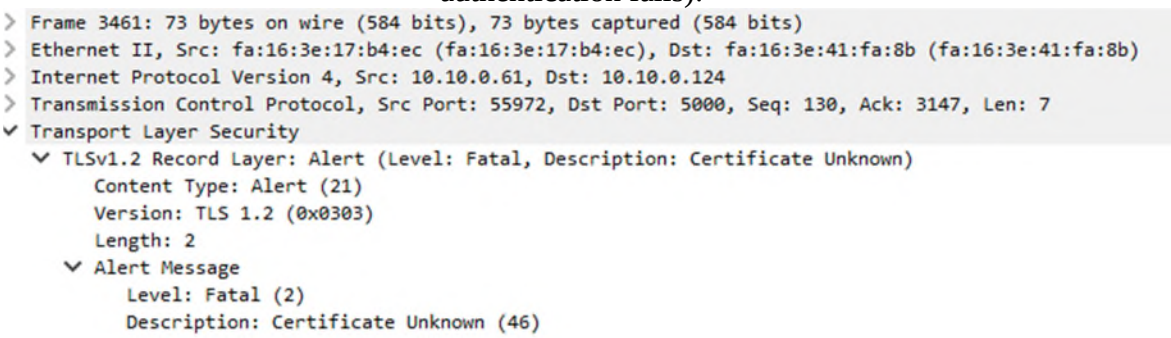


5. Authentication exchange ends with TLS Alert message (i.e. authentication fails):



6. Registration request message is not received at Test Harness (authentication fails)

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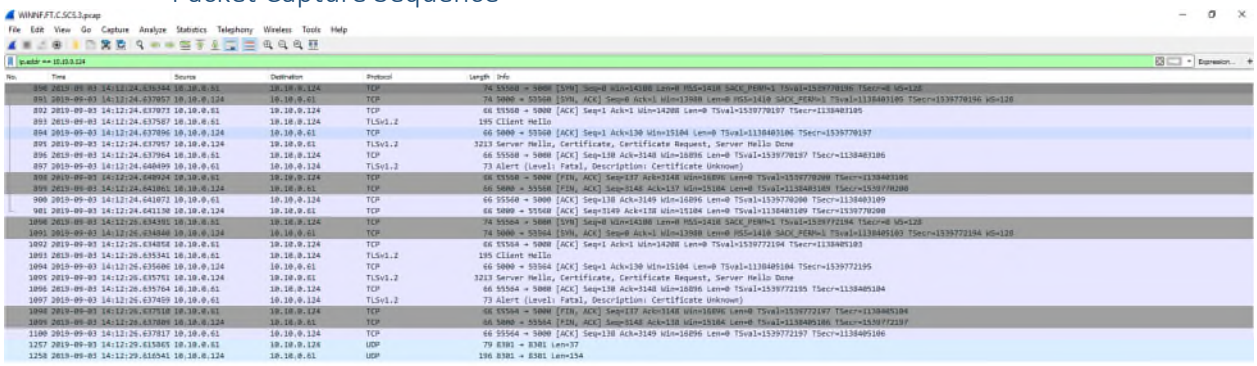
WINNF.FT.C.SCS.3

Packet Capture Sequence



WINNF Test Requirements:

WINNF test requirements from WINNF-TS-0122-V1.0.0 CBRS CBSD Test Specification:

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

Analysis of WINNF Test Requirements

1. From Client Hello can read: TLS version = TLS 1.2

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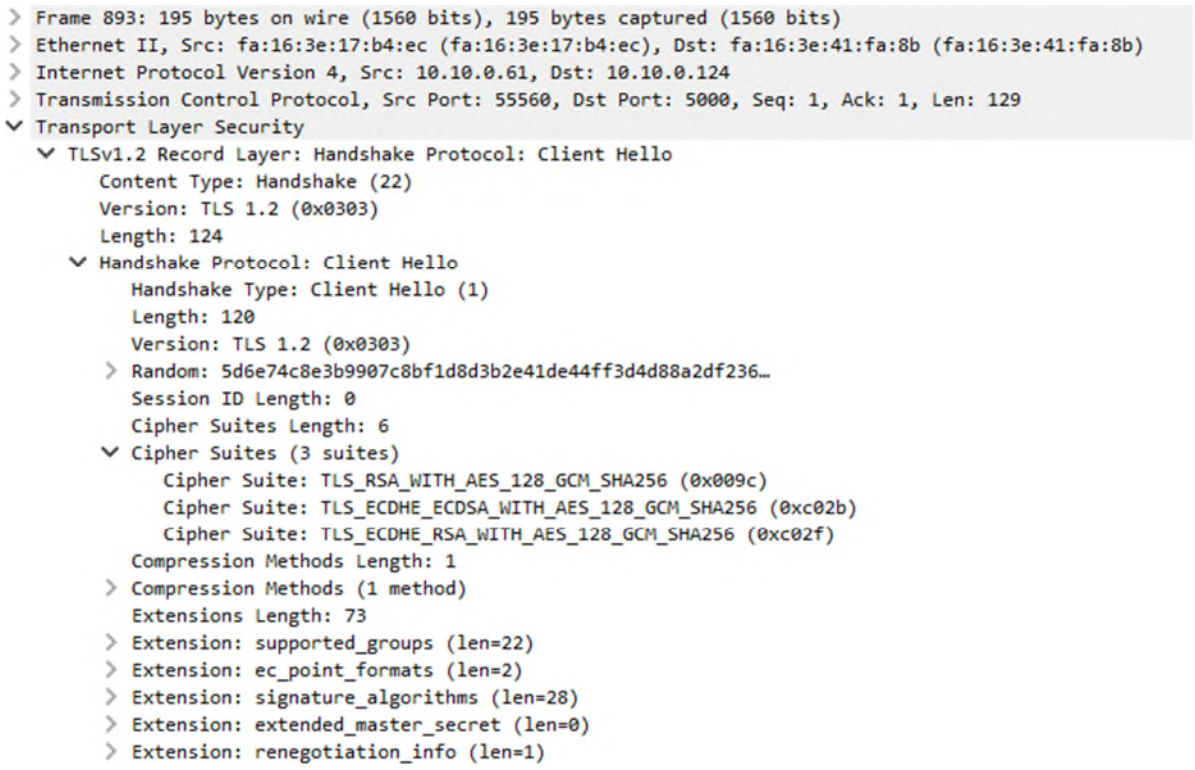

2. From Client Hello, cipher suite list is from WINNF approved list:

   TLS_RSA_WITH_AES_128_GCM_SHA25
   TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
   TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

3. From Server Hello, cipher suite chosen:
   TLS_RSA_WITH_AES_128_GCM_SHA256

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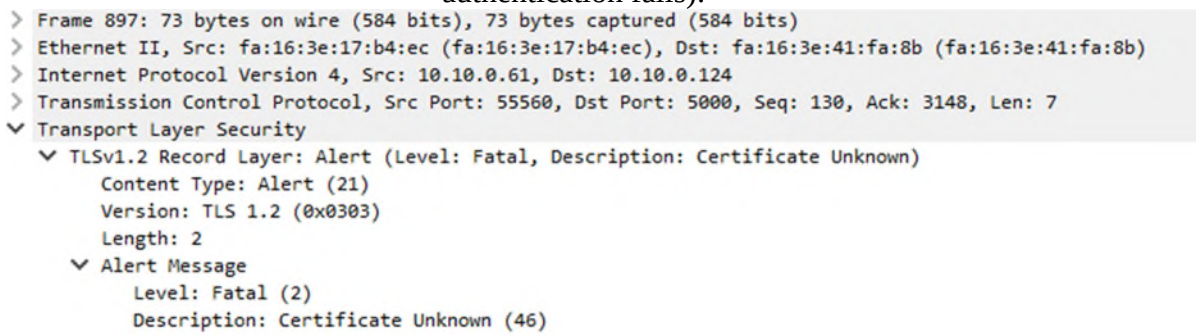
4. Authentication exchange ends with TLS Alert message (i.e. authentication fails):



5. Registration request message is not received at Test Harness (authentication fails)

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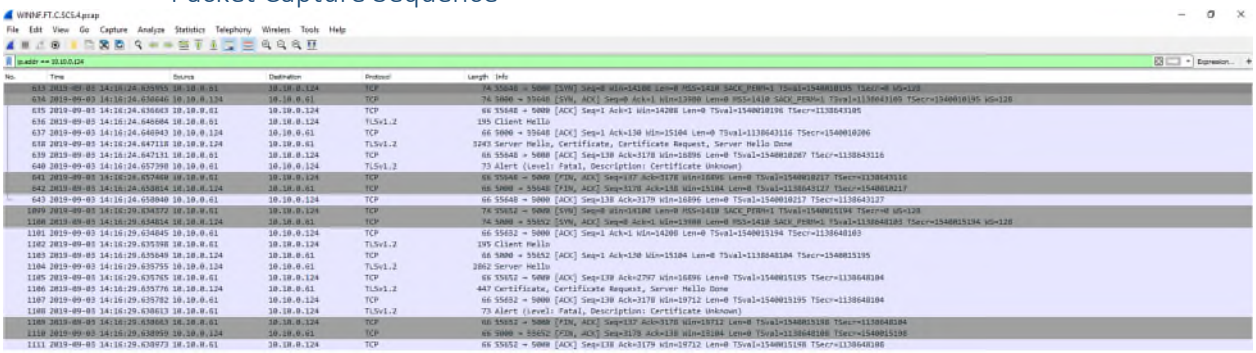
WINNF.FT.C.SCS.4

Packet Capture Sequence



WINNF Test Requirements:

WINNF test requirements from WINNF-TS-0122-V1.0.0 CBRS CBSD Test Specification:

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

Analysis of WINNF Test Requirements

1. From Client Hello can read: TLS version = TLS 1.2

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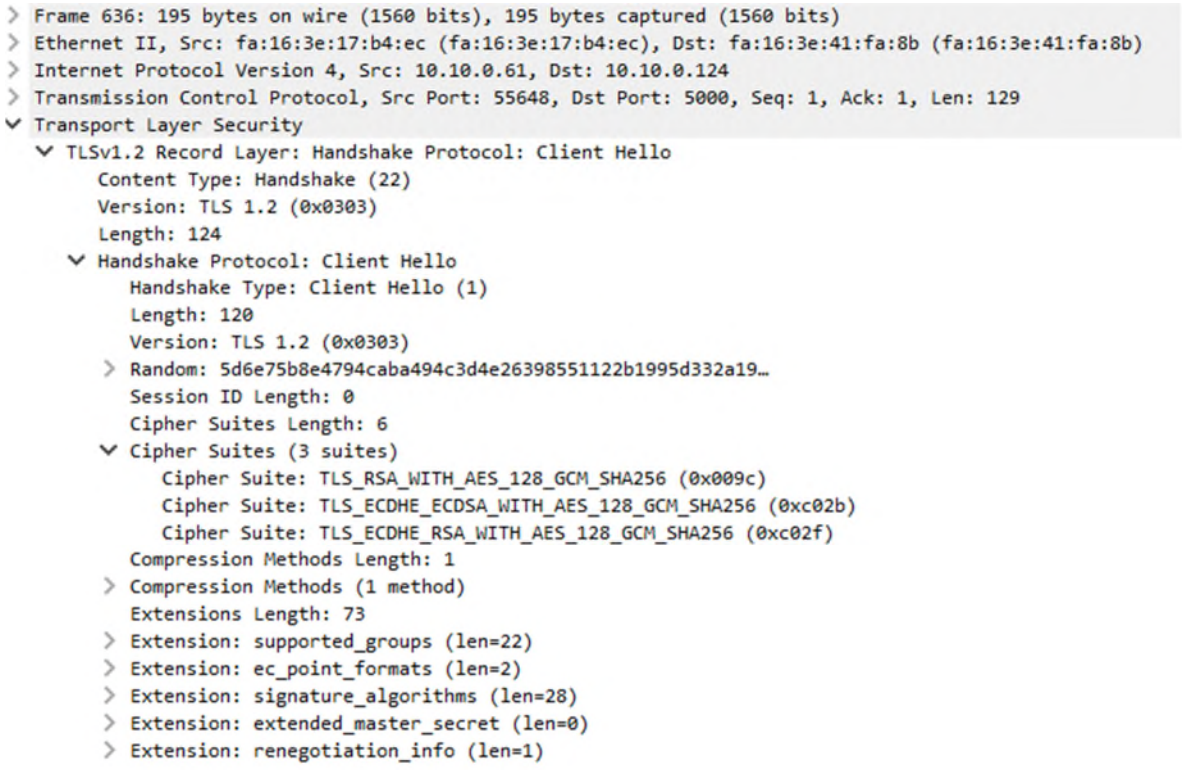

2. From Client Hello, cipher suite list is from WINNF approved list:

   TLS_RSA_WITH_AES_128_GCM_SHA25
   TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
   TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

3. From Server Hello, cipher suite chosen:
   TLS_RSA_WITH_AES_128_GCM_SHA256

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```
> Frame 638: 3243 bytes on wire (25944 bits), 3243 bytes captured (25944 bits)
> Ethernet II, Src: fa:16:3e:41:fa:8b (fa:16:3e:41:fa:8b), Dst: fa:16:3e:17:b4:ec (fa:16:3e:17:b4:ec)
> Internet Protocol Version 4, Src: 10.10.0.124, Dst: 10.10.0.61
> Transmission Control Protocol, Src Port: 5000, Dst Port: 55648, Seq: 1, Ack: 130, Len: 3177
v Transport Layer Security
  v TLSv1.2 Record Layer: Handshake Protocol: Server Hello
      Content Type: Handshake (22)
      Version: TLS 1.2 (0x0303)
      Length: 81
    v Handshake Protocol: Server Hello
        Handshake Type: Server Hello (2)
        Length: 77
        Version: TLS 1.2 (0x0303)
      > Random: 5d6e75c348790b56a8a2b2e56c0448af8a18c8b5f0ca8790…
        Session ID Length: 32
        Session ID: 51f334de8b50d6a093491444515eaa5feb9995af54e66e30…
        Cipher Suite: TLS_RSA_WITH_AES_128_GCM_SHA256 (0x009c)
        Compression Method: null (0)
        Extensions Length: 5
      > Extension: renegotiation_info (len=1)
  > TLSv1.2 Record Layer: Handshake Protocol: Certificate
  > TLSv1.2 Record Layer: Handshake Protocol: Multiple Handshake Messages
```

4. Authentication exchange ends with TLS Alert message (i.e. authentication fails):

```
> Frame 640: 73 bytes on wire (584 bits), 73 bytes captured (584 bits)
> Ethernet II, Src: fa:16:3e:17:b4:ec (fa:16:3e:17:b4:ec), Dst: fa:16:3e:41:fa:8b (fa:16:3e:41:fa:8b)
> Internet Protocol Version 4, Src: 10.10.0.61, Dst: 10.10.0.124
> Transmission Control Protocol, Src Port: 55648, Dst Port: 5000, Seq: 130, Ack: 3178, Len: 7
v Transport Layer Security
  v TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Certificate Unknown)
      Content Type: Alert (21)
      Version: TLS 1.2 (0x0303)
      Length: 2
    v Alert Message
        Level: Fatal (2)
        Description: Certificate Unknown (46)
```

5. Registration request message is not received at Test Harness (authentication fails)

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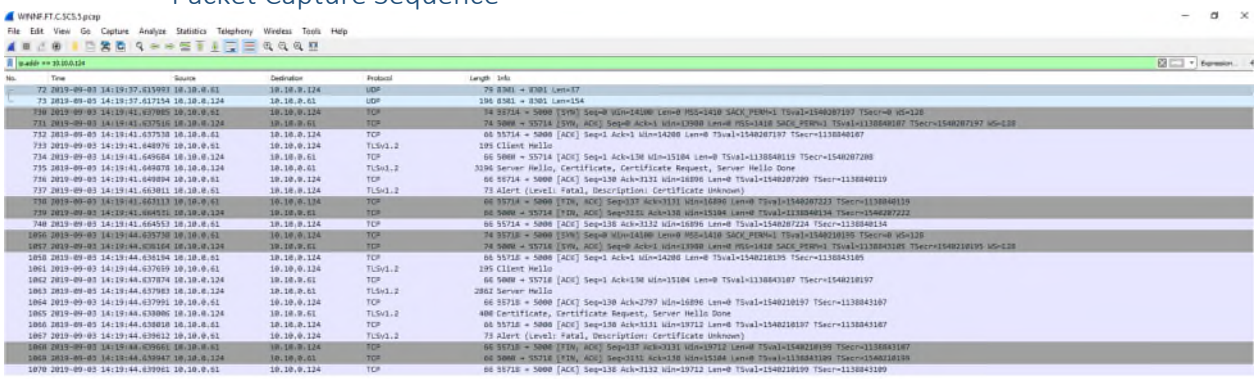
WINNF.FT.C.SCS.5

Packet Capture Sequence



WINNF Test Requirements:

WINNF test requirements from WINNF-TS-0122-V1.0.0 CBRS CBSD Test Specification:

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

Analysis of WINNF Test Requirements

1. From Client Hello can read: TLS version = TLS 1.2

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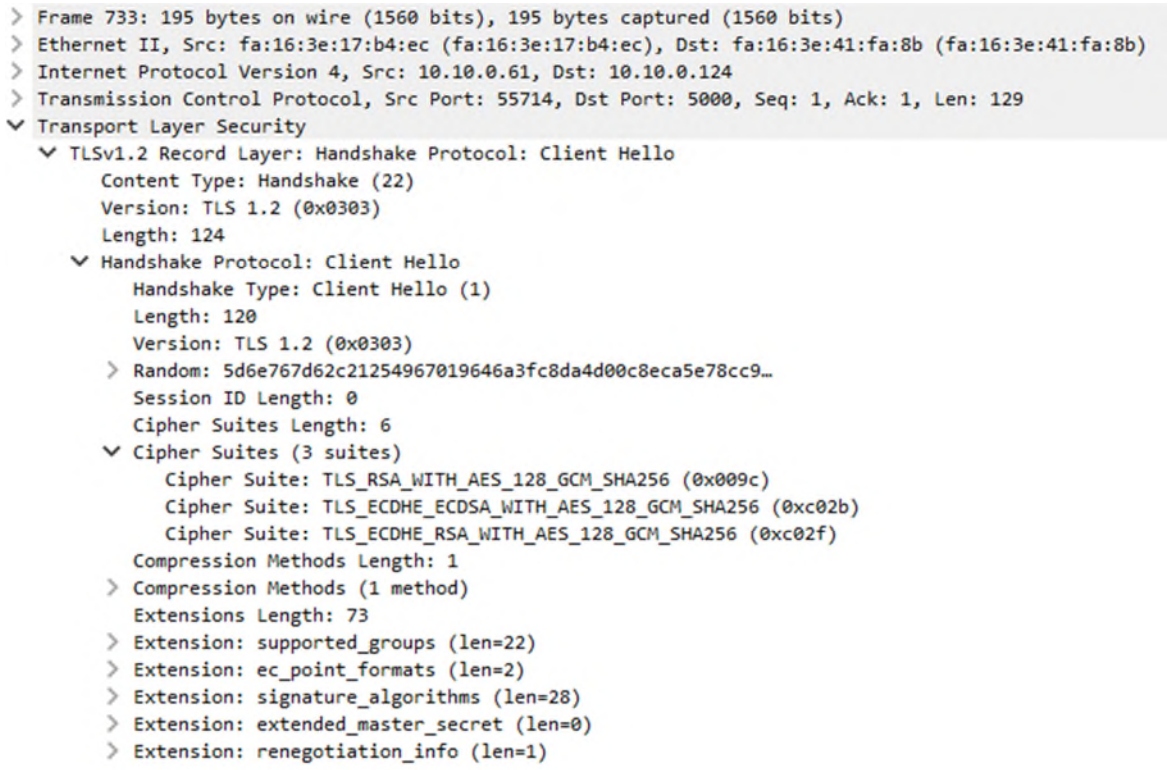

2. From Client Hello, cipher suite list is from WINNF approved list:

   TLS_RSA_WITH_AES_128_GCM_SHA25
   TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
   TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

3. From Server Hello, cipher suite chosen:
   TLS_RSA_WITH_AES_128_GCM_SHA256

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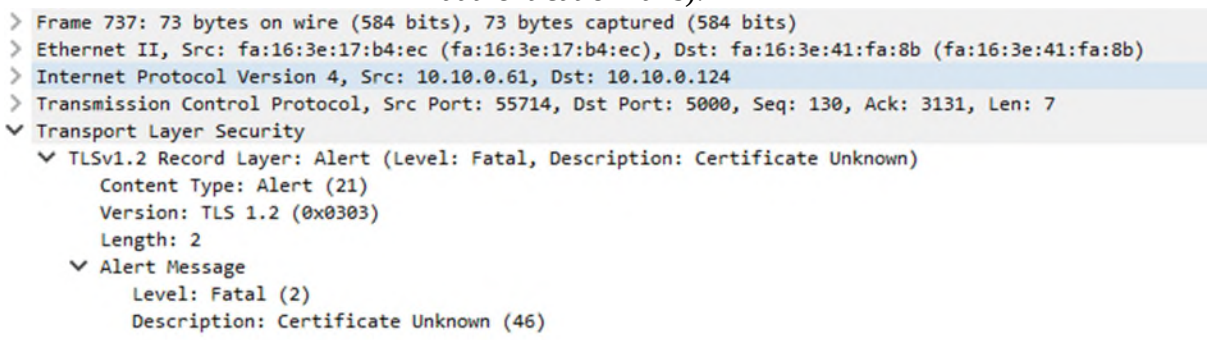
4. Authentication exchange ends with TLS Alert message (i.e. authentication fails):



5. Registration request message is not received at Test Harness (authentication fails)

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Test Equipment

Instrument	Manufacturer	Type No.	Serial No	Calibration Period (months)	Calibration Due
Power Supply	Xantrex	XKW 60-50	E00109863	O/P Mon	-
Signal Analyzer	Agilent	MXA	SSG013930	12 months	2020-01-15
Attenuator	Pasternack	PE7004-10	N/S	O/P Mon	-
Switching Control Unit	Hewlett Packard	11713A	3748A060876	O/P Mon	-
RF Switch Unit	Burnsco	RARFSW 4x1	001	O/P Mon	-
Power Supply	Leader	730-3D	9801135	O/P Mon	-

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Appendix A – EUT & Client Provided Details

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General EUT Description

Manufacturer	Ericsson
Address	Torshamnsgatan 23 Kista SE-16480 Stockholm Sweden
Product Name	Radio 4408 B48
Product Number	KRC 161 746/1
Serial Number(s)	D829203626
Software Version	CXP 901 3268/15_R79GC
Hardware Version	R1B
Test Specification/Issue/Date	FCC CFR 47 Part 96: 2018

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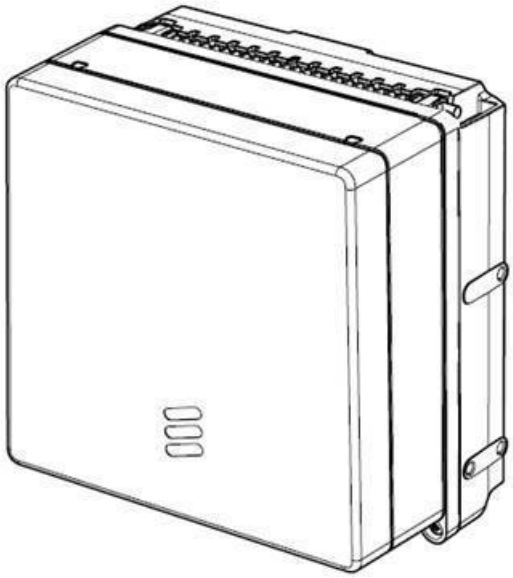
Technical Description

The Equipment Under Test (EUT) Radio 4408 B48 KRC 161 746/1 is an Ericsson AB Radio Unit working in the public mobile service (3550-3700 MHz) band which provides communication connections to 3550-3700 MHz network. The Radio 4408 B48 KRC 161 746/1 operates from a -48V DC or a 120V AC power supply.

The Equipment Under Test (EUT) is shown in the photograph below. A full technical description can be found in the Manufacturer's documentation.



EUT Configuration

Please see Appendix B for close up pictures of the unit as configured during testing

- Cables and earthing when applicable were connected as per manufacturer's specification.

Domain Proxy Software Version: = 1.36.1 (ENM version ENM 19.14)

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Appendix B – EUT, Peripherals, and Test Setup Photos

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Test setup

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