

# Test Report

As per

## FCC Part 96 SAS requirements (CBRS Test Plan)



Add value.  
Inspire trust.

on the

**Ericsson Remote Radio Air 6488 B48 KRD901160**

**(3550-3700MHz)**

**FCC ID(s): TA8AKRD901160**

**TA8BKRD901160**

Issued by:

**TÜV SÜD Canada Inc.**

1280 Teron Rd,  
Ottawa, ON K2K 2C1  
Canada

Testing produced  
for

Ericsson Canada

See Appendix A for  
full client & EUT  
details.

Scott Drysdale.  
Test Personnel

Handwritten signature of Scott Drysdale in black ink, positioned above a horizontal line.

Glen Westwell  
Report Reviewer

Handwritten signature of Glen Westwell in black ink, positioned above a horizontal line.



Testing Laboratory  
Certificate #2955.19

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## Table of Contents

Table of Contents .....	2
Report Scope .....	4
Summary .....	5
Test Results Summary .....	6
Notes, Justifications, or Deviations .....	15
Applicable Standards, Specifications and Methods.....	17
Document Revision Status .....	18
Definitions and Acronyms .....	19
Testing Facility .....	21
Calibrations and Accreditations.....	21
Testing Environmental Conditions and Dates .....	22
Detailed Test Results Section .....	23
Authorization transmit after it receives authorization from a SAS.....	24
Check the device registration and authorization with the SAS.....	33
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. ....	33
Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.....	48
WINNF Security Test Case Analysis .....	55
WINNF.FT.C.SCS.1 .....	55
WINNF.FT.C.SCS.2 .....	59
WINNF.FT.C.SCS.3 .....	63
WINNF.FT.C.SCS.4.....	66
WINNF.FT.C.SCS.5 .....	69
Appendix A – EUT & Client Provided Details .....	73
Technical Description .....	75
Appendix B – EUT, Peripherals, and Test Setup Photos.....	77
Appendix C – Additional Test Information .....	79
Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS.....	80

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

Appendix D – Additional Test Information..... 88

Confirm that the device transmits at a power level less than or equal to the maximum power level approved by the SAS..... 89

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## Report Scope

This report addresses the EMC verification testing and test results of the **Ericsson Remote Radio Air 6488 B48 KRD 901160 (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.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc, unless otherwise stated.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
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## Summary

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

Equipment Under Test (EUT)	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160 (3550-3700 MHz)</b>
EUT passed all tests performed	Yes
Tests conducted by	Scott Drysdale

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## Test Results Summary

Section as per Working Document WINNF-TS-0122

Section	CBS D	D P	Test Case ID	Test Case Title	RF Measurement Requirement	Pass / Fail
6.1.4.1.1	X	--	WINNF.FT.C.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.7	Registration due to change of an installation parameter	Test waits until transmission starts, then trigger an	P

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					installationParam change. <ul style="list-style-type: none"> <li>Record time at which transmission stops. Time must be within 60 seconds of the installationParam change taking effect.</li> </ul>	
6.1.4.2.1	X	--	WINNF.FT.C.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.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.R EG.20	Category A CBSD location update		N/A
6.3.4.2.1	X	X	WINNF.FT.C.G RA.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.G RA.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.H BT.1	Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: <ul style="list-style-type: none"> <li>Transmission does not start until time of first</li> </ul>	N/A



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					<p>heartbeat response or after.</p> <ul style="list-style-type: none"> <li>• After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)</li> </ul>	
6.4.4.1.2	--	X	WINNF.FT.D.H BT.2	Domain Proxy Heartbeat Success Case (first Heartbeat Response)	<p>Monitor RF from start of test. Ensure that:</p> <ul style="list-style-type: none"> <li>• Transmission does not start until time of first heartbeat response or after.</li> <li>• After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)</li> </ul>	P
6.4.4.2.1	X	X	WINNF.FT.C.H BT.3	Heartbeat responseCode=105 (DEREGISTER)	<p>Monitor RF transmission. Ensure that:</p> <ul style="list-style-type: none"> <li>• CBSD stops transmission within 60 seconds of the heartbeatResponse which contains</li> </ul>	P

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					responseCode = 105	
6.4.4.2.2	X	--	WINNF.FT.C.H BT.4	Heartbeat responseCode=500 (TERMINATED_GRANT)		N/A
6.4.4.2.3	X	X	WINNF.FT.C.H BT.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.H BT.6	Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=501</li> </ul>	p
6.4.4.2.5	X	X	WINNF.FT.C.H BT.7	Heartbeat responseCode=502 (UNSYNC_OP_PARAMETER)	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=502</li> </ul>	p
6.4.4.2.6	--	X	WINNF.FT.D.H BT.8	Domain Proxy Heartbeat responseCode=500 (TERMINATED_GRANT)	Monitor RF transmission. CBSDs will have different behavior: <ul style="list-style-type: none"> <li>• CBSD1: will continue to transmit to end of test</li> </ul>	P

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					<p>(this is not a pass/fail criteria, but check)</p> <ul style="list-style-type: none"> <li>• CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500</li> </ul>	
6.4.4.3.1	X	X	WINNF.FT.C.H BT.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.H BT.10	Heartbeat Response Absent (Subsequent Heartbeat)	Monitor RF transmission. Verify: <ul style="list-style-type: none"> <li>• CBSD must stop transmission within transmitExpirationTime+60 seconds, where transmitExpirationTime is from last successful heartbeatResponse message</li> </ul>	P
6.5.4.2.1	X	--	WINNF.FT.C.M ES.1	Registration Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.2	--	X	WINNF.FT.D.M ES.2	Domain Proxy Registration Response contains measReportConfig	No RF monitoring	P

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.5.4.2.3	X	X	WINNF.FT.C.M ES.3	Grant Response contains measReportConfig	No RF monitoring	P
6.5.4.2.4	X	--	WINNF.FT.C.M ES.4	Heartbeat Response contains measReportConfig	No RF monitoring	N/A
6.5.4.2.5	--	X	WINNF.FT.D.M ES.5	Domain Proxy Heartbeat Response contains measReportConfig	No RF monitoring	P
6.6.4.1.1	X	--	WINNF.FT.C.R LQ.1	Successful Relinquishment	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission at any time prior to sending the relinquishmentRequest message.</li> </ul>	N/A
6.6.4.1.2	--	X	WINNF.FT.D.R LQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission at any time prior to sending the relinquishmentRequest message.</li> </ul>	P
6.7.4.1.1	X	--	WINNF.FT.C.D RG.1	Successful Deregistration	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission at any time prior to sending the relinquishmentRequest message or deregistrationRequest message (whichever is sent first)</li> </ul>	N/A

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Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.7.4.1.2	--	X	WINNF.FT.D.D RG.2	Domain Proxy Successful Deregistration	Monitor RF transmission. Ensure : • CBSD stops transmission at any time prior to sending the relinquishmentReque st message or deregistrationReques t message (whichever is sent first)	P
6.8.4.1.1	X	X	WINNF.FT.C.SC S.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.SC S.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.SC S.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.SC S.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.SC S.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.H BT	UUT RF Transmit Power Measurement	Power Spectral Density test case.  Assume we use 1 carrier bandwidth	P

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Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

					(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.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### **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.

Test results were obtained using the KRD 901 160/2 model, the client attests the test results are representative or worst case of all models as listed in appendix A

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 mark. 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.

Additional testing for power spectral density (PSD) requirements were evaluated in Dec 2019 as the original EUT firmware was changed to allow for higher conducted power with different antenna gains. All other parameters were deemed to not be affected as there was no other changes.

Client	<b>Ericsson</b>	
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Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

Additional testing for power spectral density (PSD) requirements were evaluated in Aug 2024, the original EUT firmware was changed to support NR Air Interface. (as defined in WINNF-TS-0122-V1.0.2, section 5.3.4). All other parameters were deemed to not be affected as there was no other changes.

Logs are kept on file.



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## Applicable Standards, Specifications and Methods

- ANSI C63.26:2015 American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
- CFR47 FCC Part 96 Code of Federal Regulations – Citizens Broadband Radio Service
- WINNF-TS-0122 Conformance and Performance Test Technical Specification;  
 Version V1.0.0 CBSD/DP as Unit Under Test (UUT)  
 19 December 2017 Working Document  
 (before 25 Nov, 2020)
- WINNF-TS-0122 Conformance and Performance Test Technical Specification;  
 Version V1.0.2 CBSD/DP as Unit Under Test (UUT)  
 25 November 2020 Working Document  
 (After 25 November, 2020)
- ISO/IEC 17025:2017 General requirements for the competence of testing and calibration laboratories

Client	<b>Ericsson</b>	
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## Document Revision Status

- 7169006619 000: September 16, 2019    First release
  
- 7169006619 001: September 17, 2019    Minor typo fixes as per client request.
  
- 7169007158 000: December 20, 2019    Added appendix C for additional testing performed, changed FCC ID. See justifications for further details.
  
- 7169015031 000: Aug 23, 2024            Added appendix D for additional testing performed.  
See Justifications for further details.
  
- 7169015031 001: Aug 26, 2024            Added reference to ANSI C 63.26 as per review.
  
- 7169015031 002: Sept 4, 2024            Minor revisions as per client request.

Client	<b>Ericsson</b>	
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Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## 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

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Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## 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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Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### ***Testing Environmental Conditions and Dates***

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

<b>Date</b>	<b>Test</b>	<b>Initials</b>	<b>Temperature (°C)</b>	<b>Humidity (%)</b>	<b>Pressure (kPa)</b>
Sept 3 – 5, 2019	All	SD	20-23	40-55	96.106
Dec 18, 2019	PSD retesting	SD	20-23	40-55	96.106
Aug 21, 2024	PSD retesting	SD	22.0	40-55	101.5

Client	<b>Ericsson</b>	
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Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## Detailed Test Results Section

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

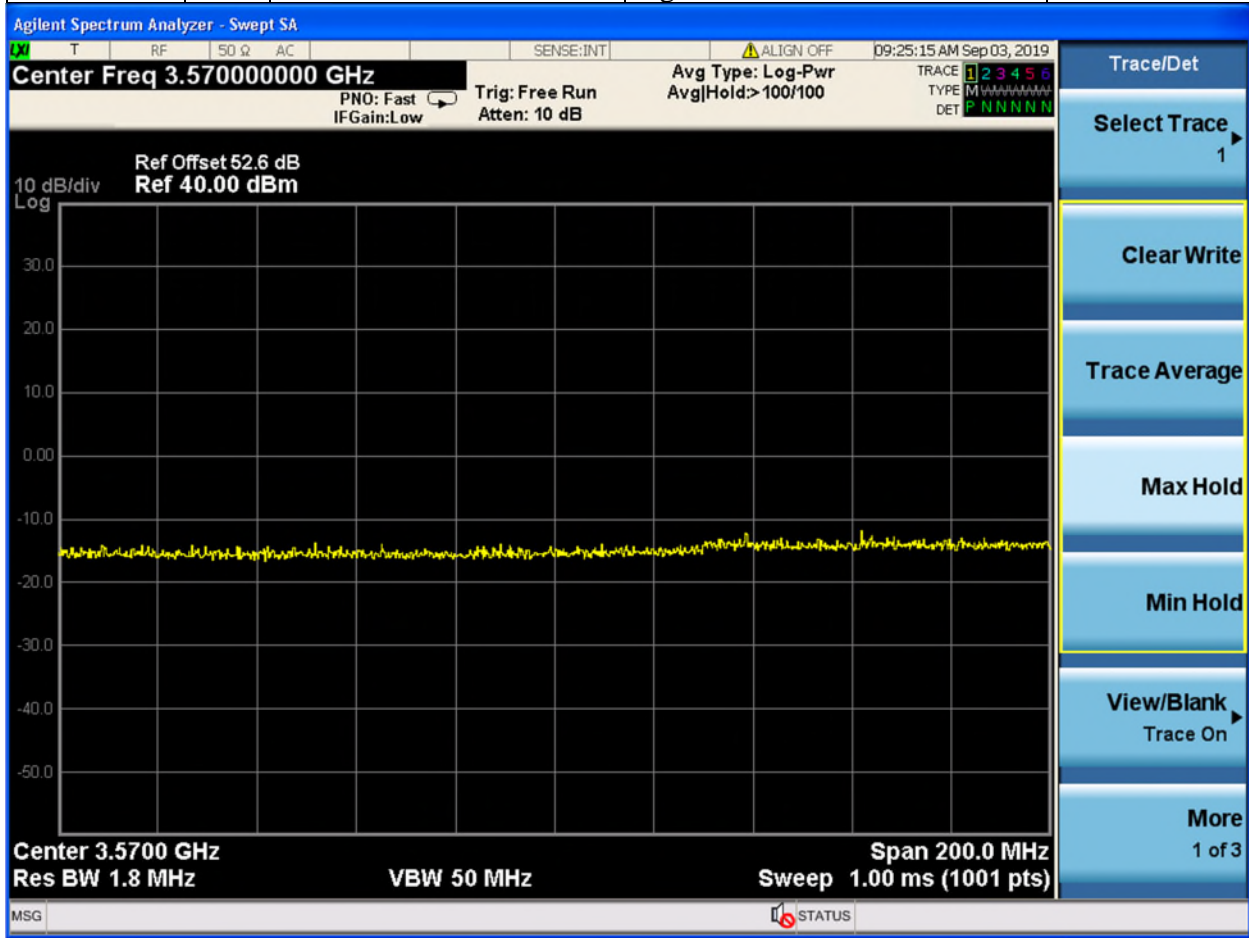
***Authorization transmit after it receives authorization from a SAS.***

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



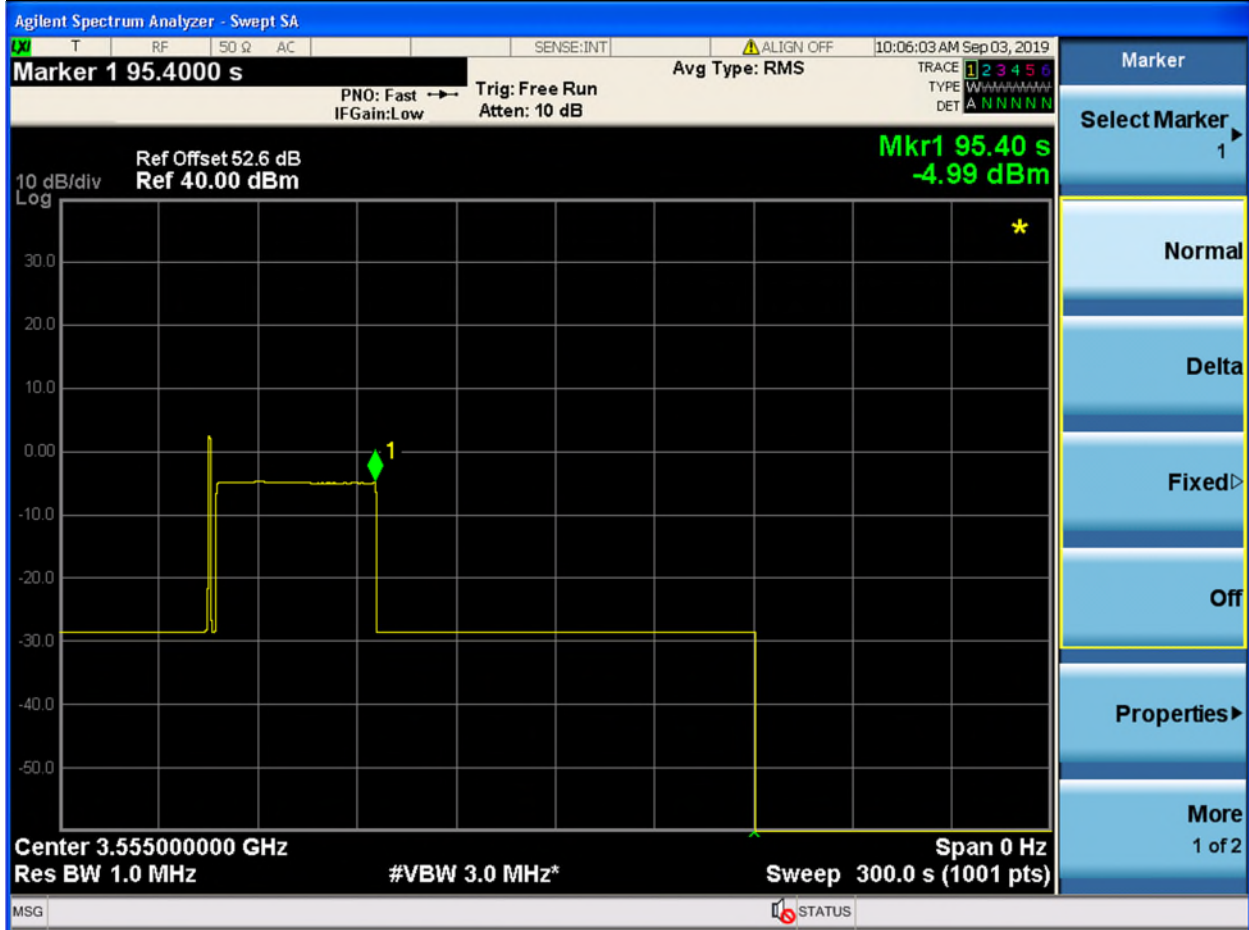
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

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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Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

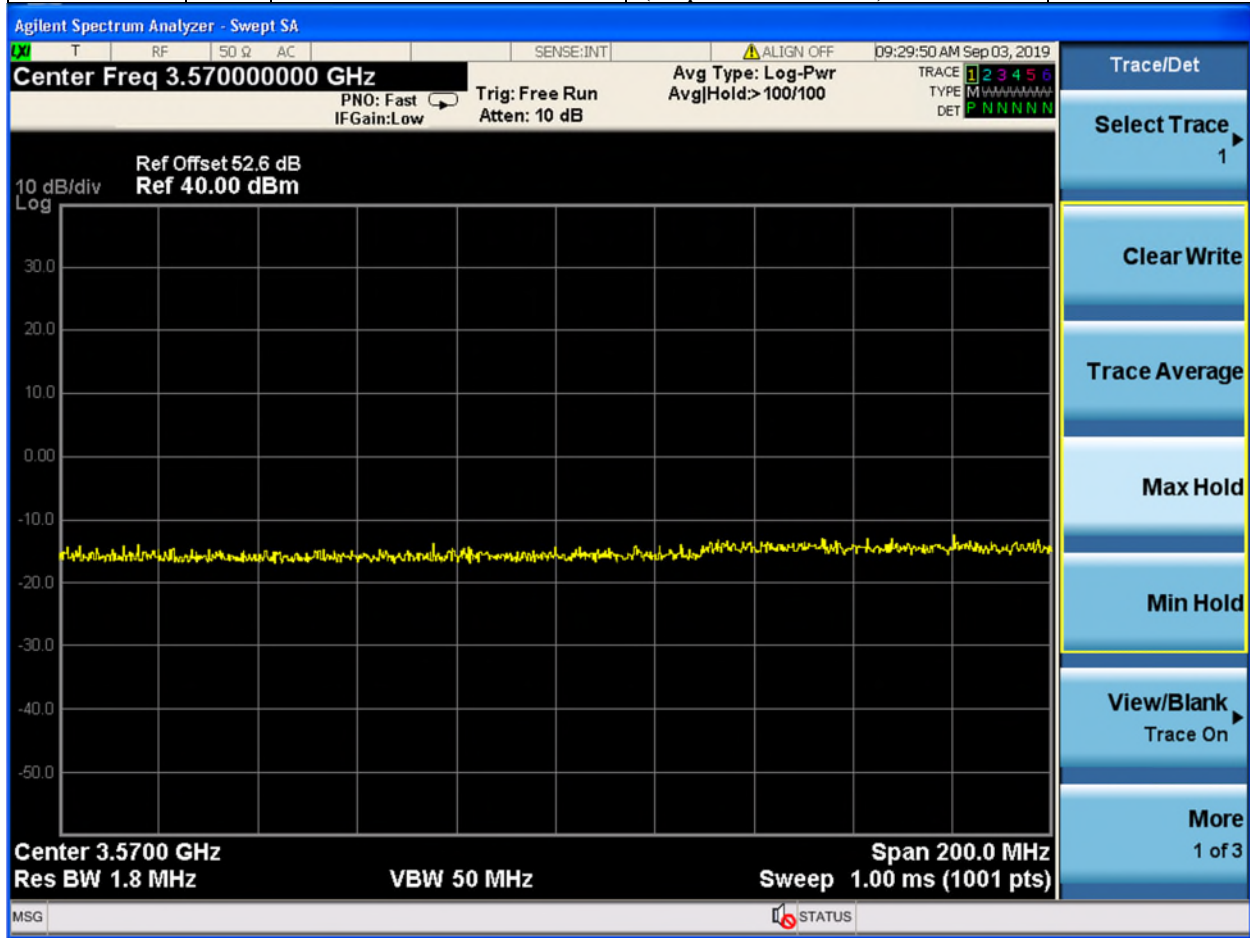
6.1.4.1.7	X	WINNF.FT.C.REG.7	Registration due to change of an installation parameter	P
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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

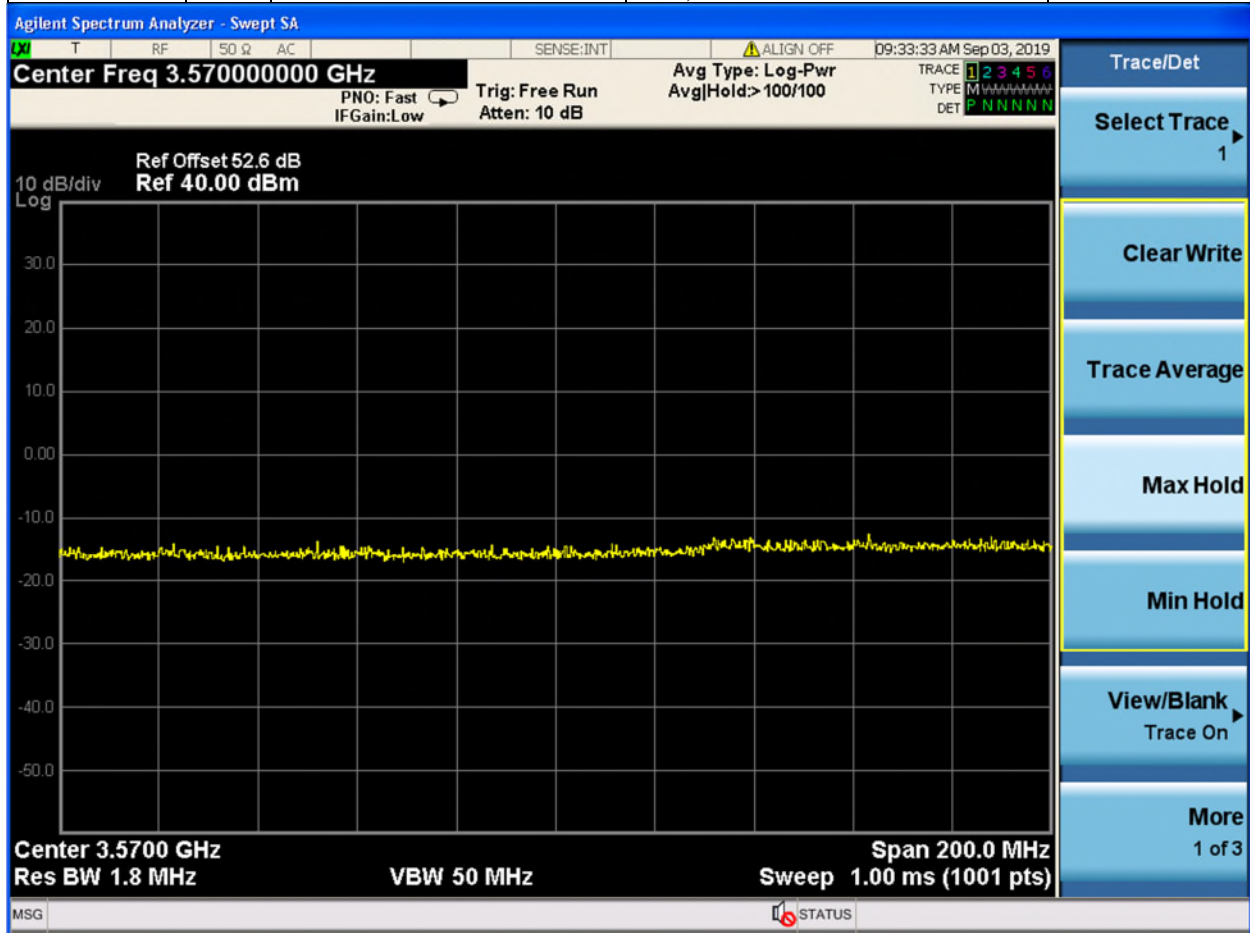
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.1.4.2.2	X	WINNF.FT.D.REG.9	Domain Proxy Missing Required parameters (responseCode 102)	P
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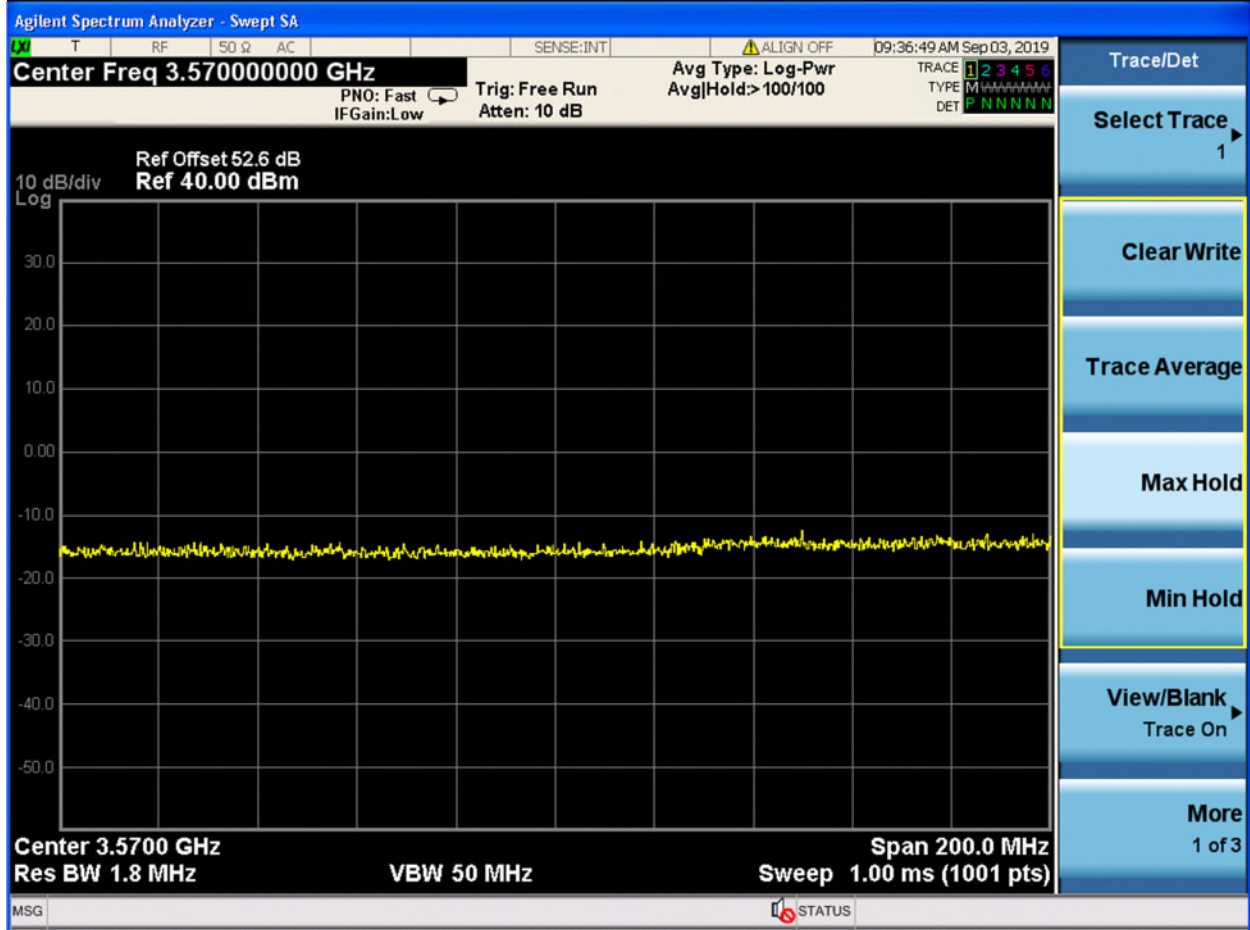
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.1.4.2.4	X	WINNF.FT.D.REG.11	Domain Proxy Pending registration (responseCode 200)	P
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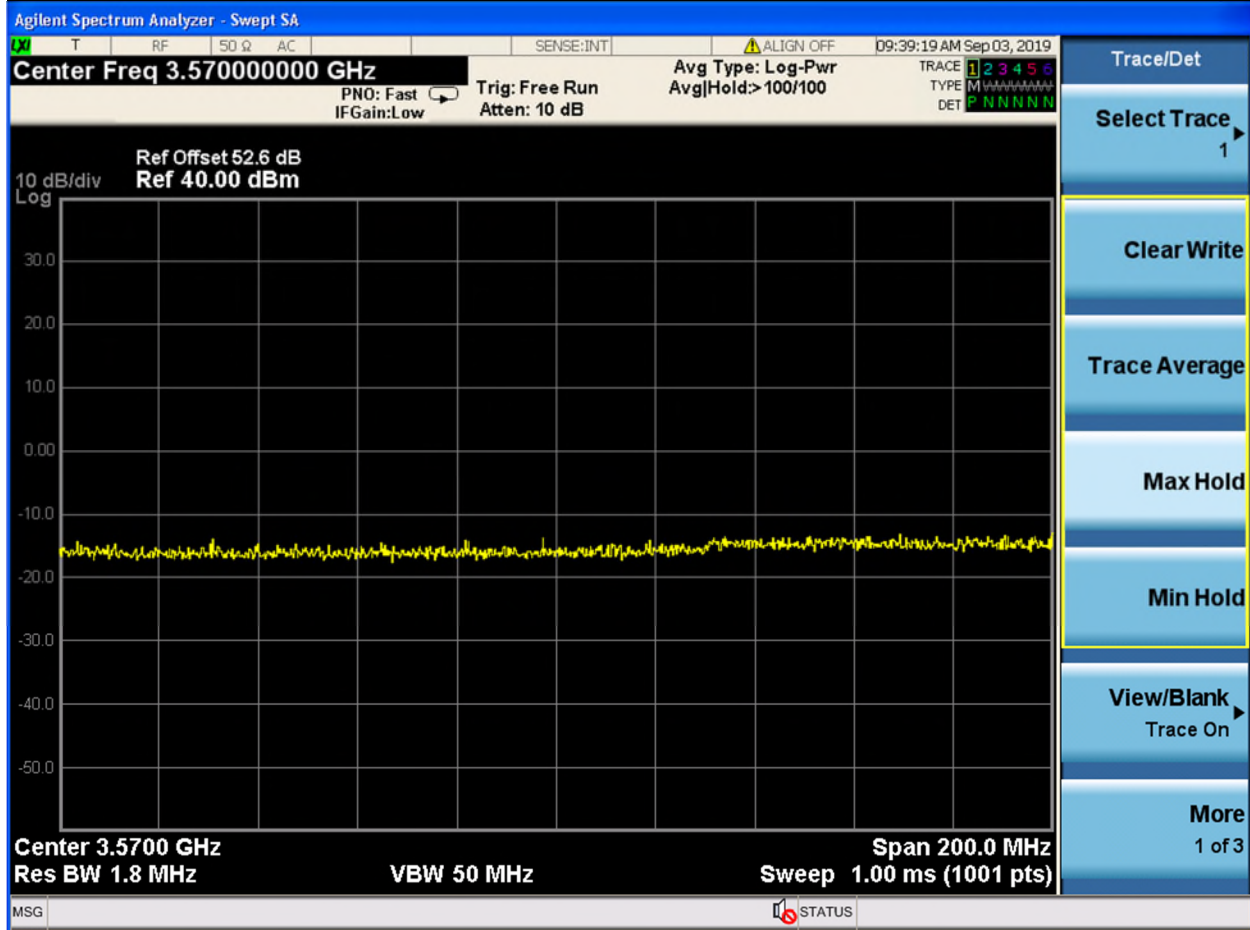
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.1.4.2.6	X	WINNF.FT.D.REG.13	Domain Proxy Invalid parameters (responseCode 103)	P
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Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

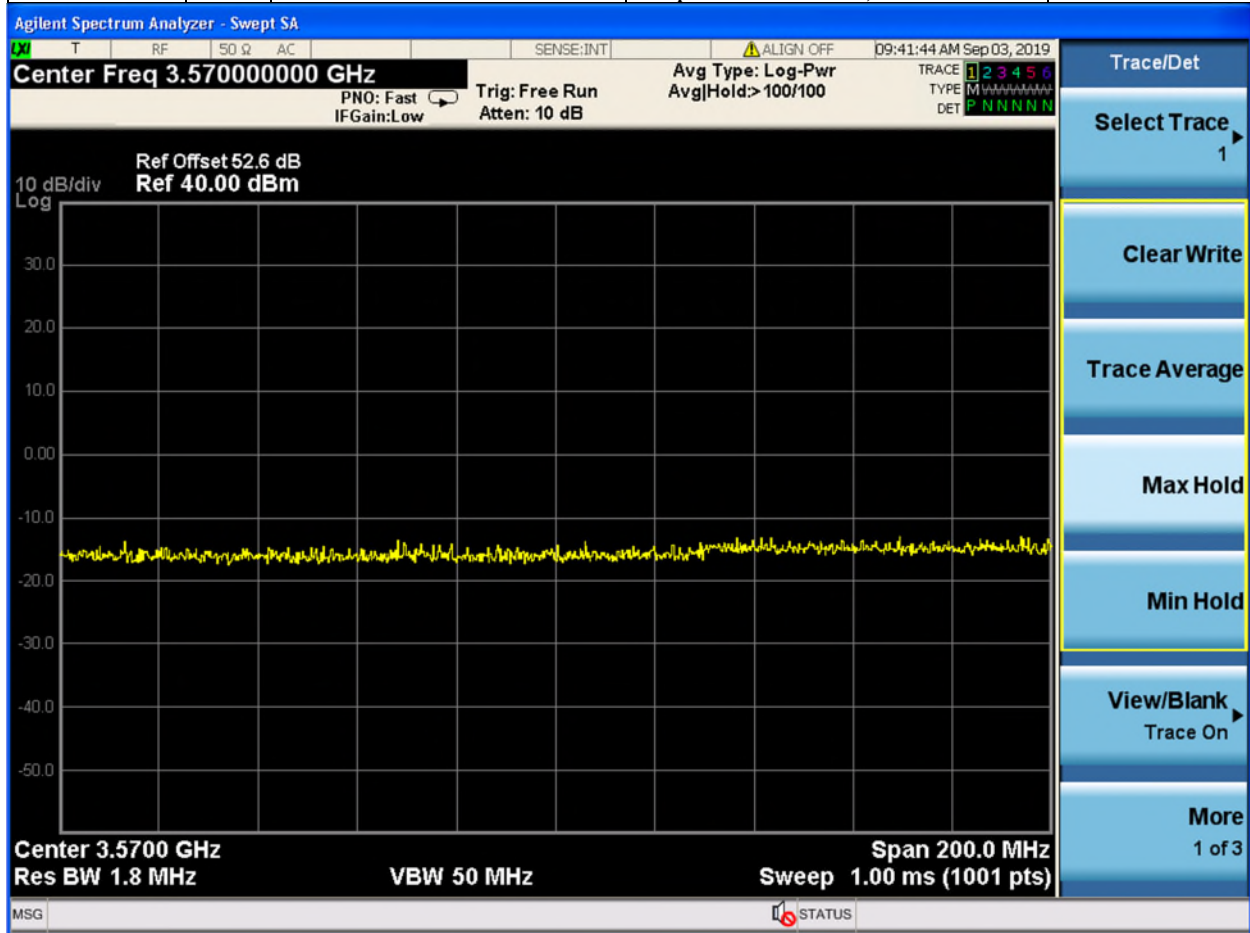
6.1.4.2.8	X	WINNF.FT.D.REG.15	Domain Proxy Blacklisted CBSD (responseCode 101)	P
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Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.1.4.2.10	X	WINNF.FT.D.REG.17	Domain Proxy Unsupported SAS protocol version responseCode 100)	P
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Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

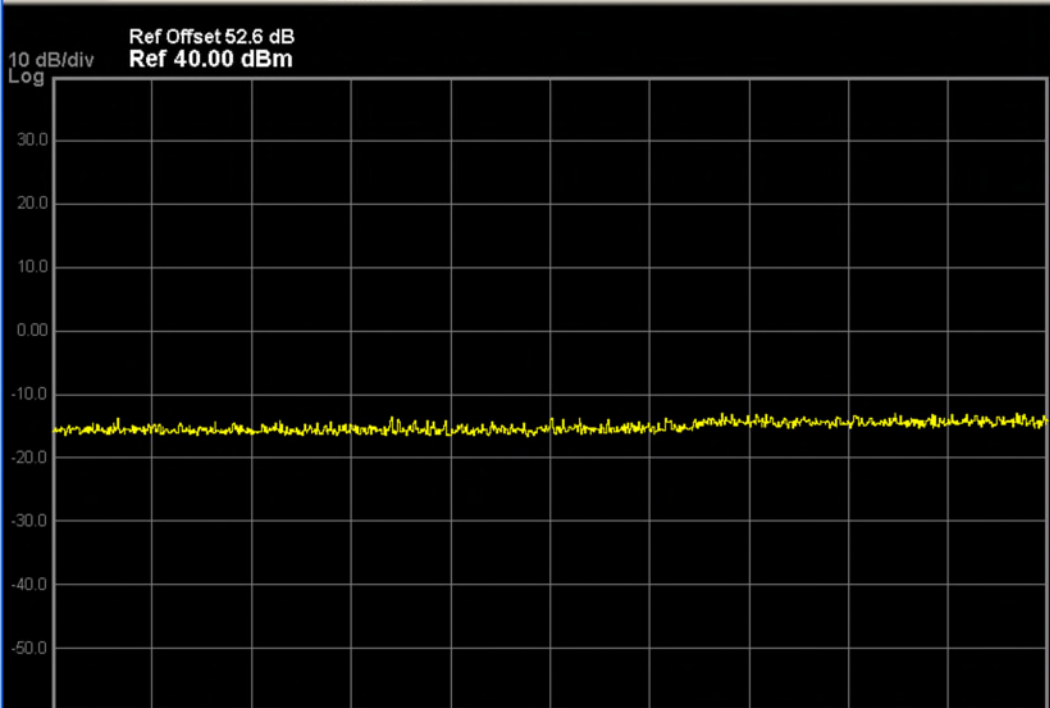
6.1.4.2.12	X	WINNF.FT.D.REG.19	Domain Proxy Group Error (responseCode 201)	P
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Agilent Spectrum Analyzer - Swept SA

Center Freq 3.57000000 GHz

Ref Offset 52.6 dB  
Ref 40.00 dBm

10 dB/div  
Log



Center 3.5700 GHz  
Res BW 1.8 MHz  
VBW 50 MHz  
Span 200.0 MHz  
Sweep 1.00 ms (1001 pts)

MSG STATUS

Trace/Det

Select Trace 1

Clear Write

Trace Average

Max Hold

Min Hold

View/Blank Trace On

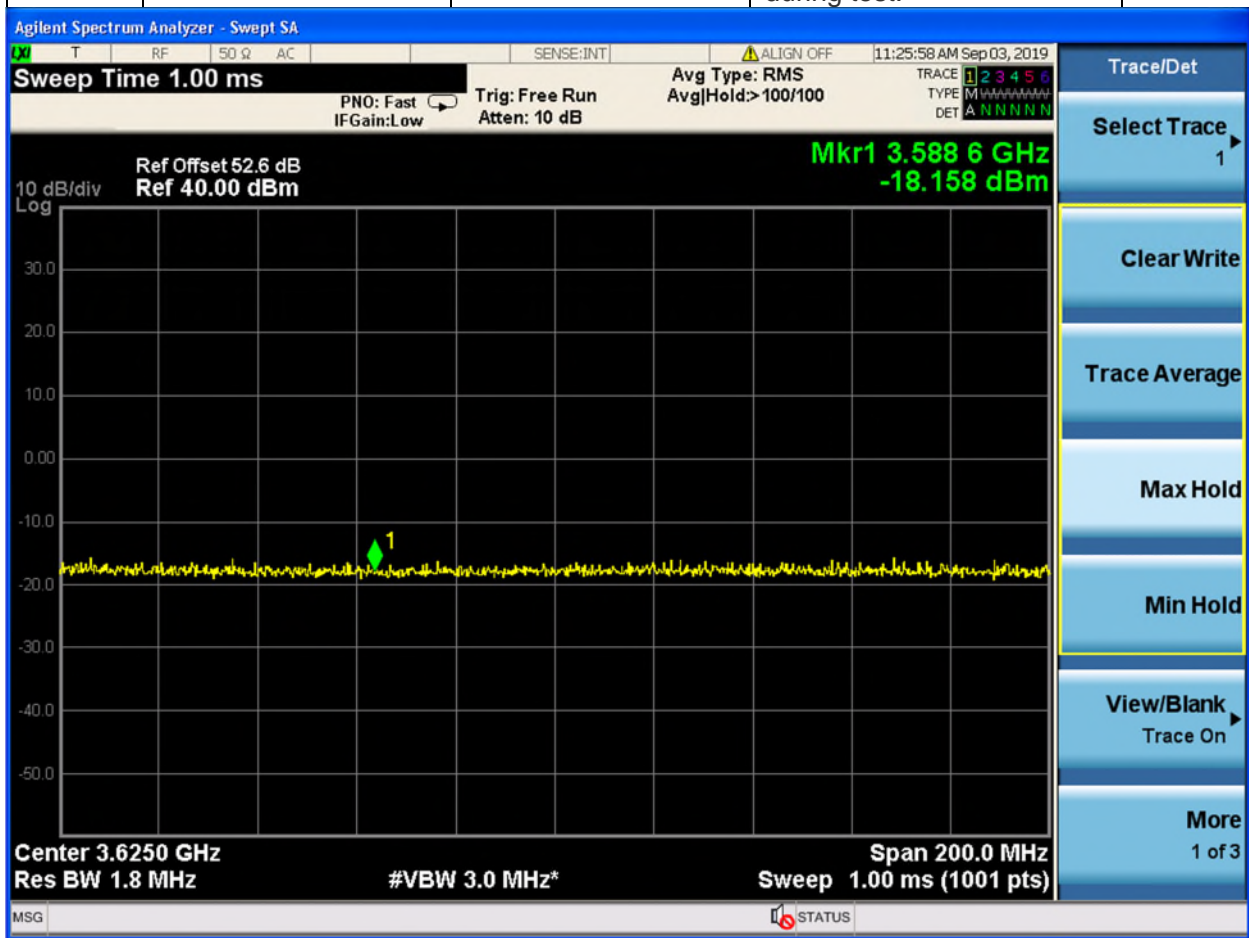
More 1 of 3



Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

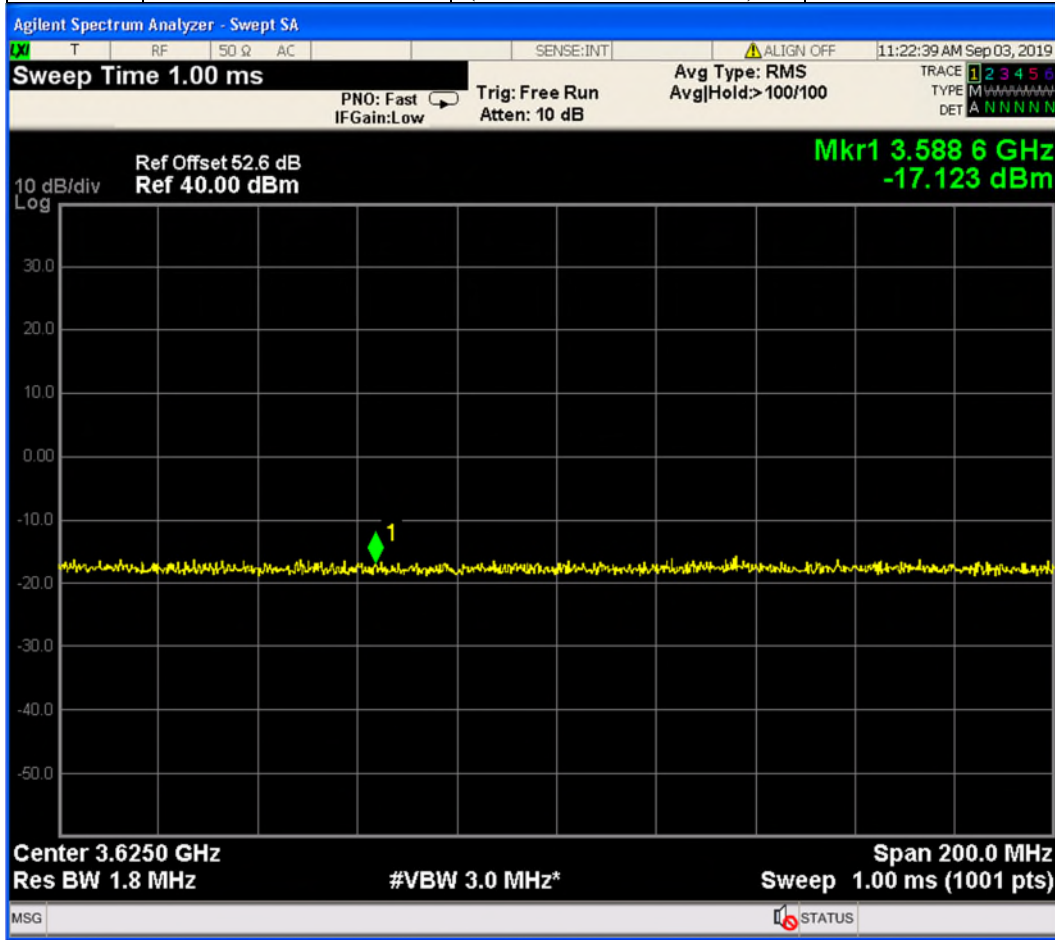
**Check the device registration and authorization with the SAS, Confirm that the device changes its operating power and/or channel in response to a command from the SAS and Confirm that the device correctly configures based on the different license classes.**

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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Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

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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Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

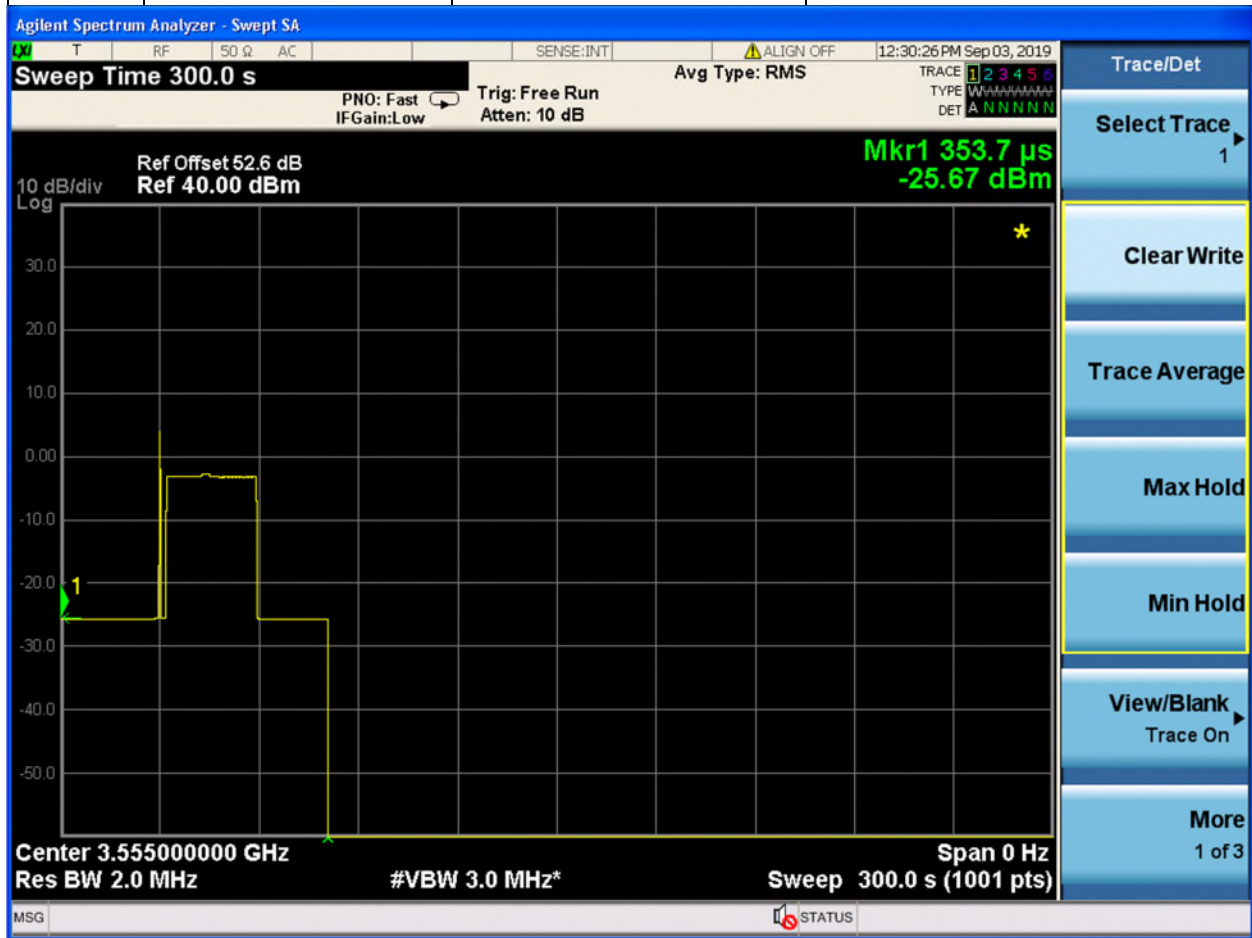
6.4.4.1.2	WINNF.FT.D.HBT.2	Domain Proxy Heartbeat Success Case (first Heartbeat Response)	Monitor RF from start of test. Ensure that: <ul style="list-style-type: none"> <li>• Transmission does not start until time of first heartbeat response or after.</li> <li>• After transmission starts, measure that transmission is within the granted channel (frequencyLow, frequencyHigh)</li> </ul>	P
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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.4.4.2.1	WINNF.FT.C.HBT.3	Heartbeat responseCode=105 (DEREGISTER)	Monitor RF transmission. Ensure that: <ul style="list-style-type: none"> <li>• CBSD stops transmission within 60 seconds of the heartbeatResponse which contains responseCode = 105</li> </ul>	P
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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

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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Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

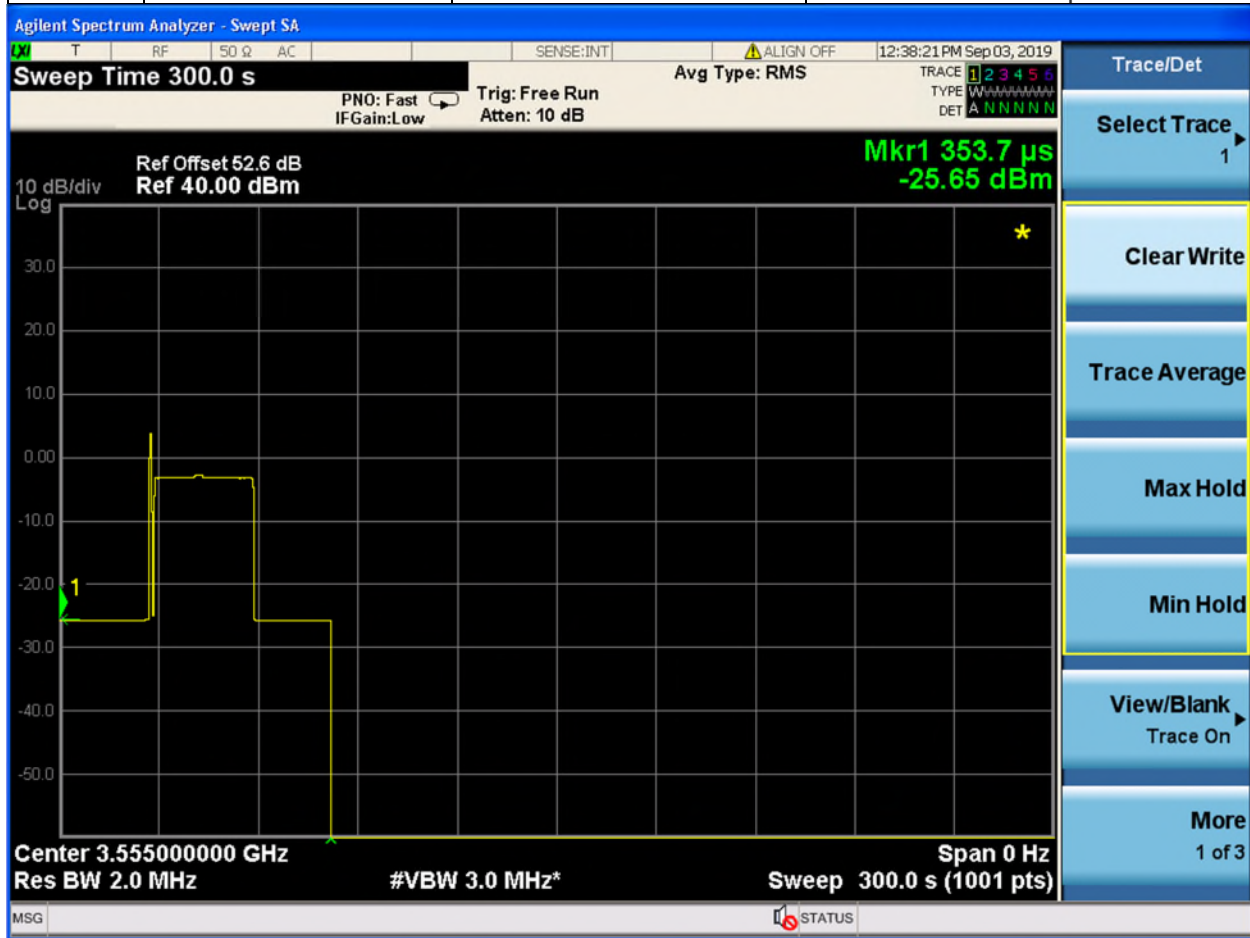
6.4.4.2.4	WINNF.FT.C.HBT.6	Heartbeat responseCode=501 (SUSPENDED_GRANT) in Subsequent Heartbeat Response	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=501</li> </ul>	p
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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.4.4.2.5	WINNF.FT.C.HBT.7	Heartbeat responseCode=502 (UNSYNC_OP_PARAM )	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission within 60 seconds of heartbeatResponse which contains responseCode=502</li> </ul>	p
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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.4.4.2.6	--	X	WINNF.FT.D.H BT.8	Domain Proxy Heartbeat responseCode=500 (TEMINATED_GRANT)	Monitor RF transmission. CBSDs will have different behavior: <ul style="list-style-type: none"> <li>• CBSD1: will continue to transmit to end of test (this is not a pass/fail criteria, but check)</li> <li>• CBSD2: must stop transmission within 60 seconds of being sent heartbeatResponse with responseCode = 500</li> </ul>	P
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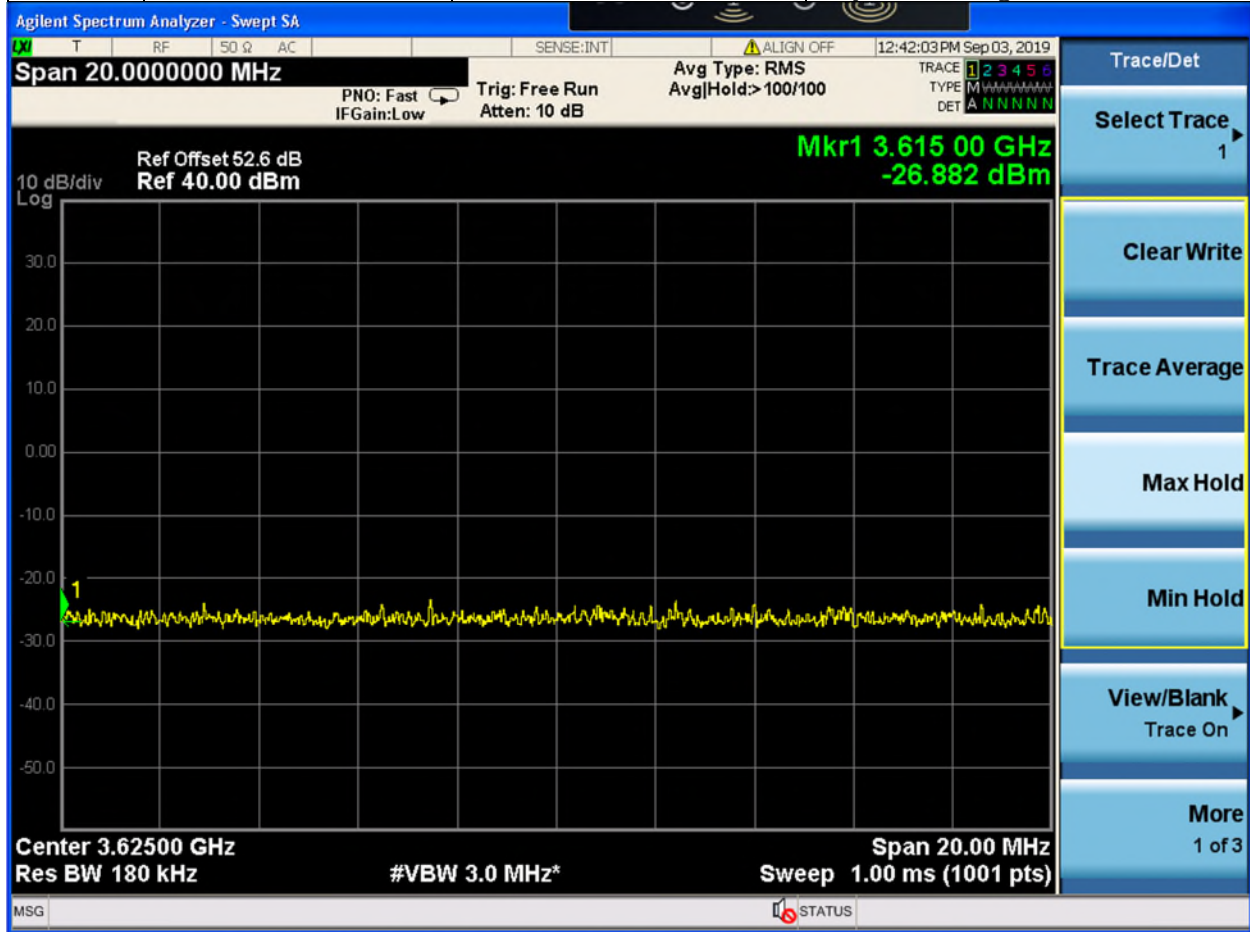


Test Harness logs and timing on graph was verified, the EUT passed the requirement.



Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

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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Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.4.4.3.2	WINNF.FT.C.HBT.10	Heartbeat Response Absent (Subsequent Heartbeat)	Monitor RF transmission. Verify: <ul style="list-style-type: none"> <li>• CBSD must stop transmission within transmitExpireTime+60 seconds, where transmitExpireTime is from last successful heartbeatResponse message</li> </ul>	P
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Test Harness logs and timing on graph was verified, the EUT passed the requirement.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.5.4.2.2	WINNF.FT.D.MES.2	Domain Proxy Registration Response contains measReportConfig	No RF monitoring	P
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Pass. “measreportconfig” in logs. All other requirements verified.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.5.4.2.3	WINNF.FT.C.MES.3	Grant Response contains measReportConfig	No RF monitoring	P
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Pass. “measreportconfig” in logs. All other requirements verified.

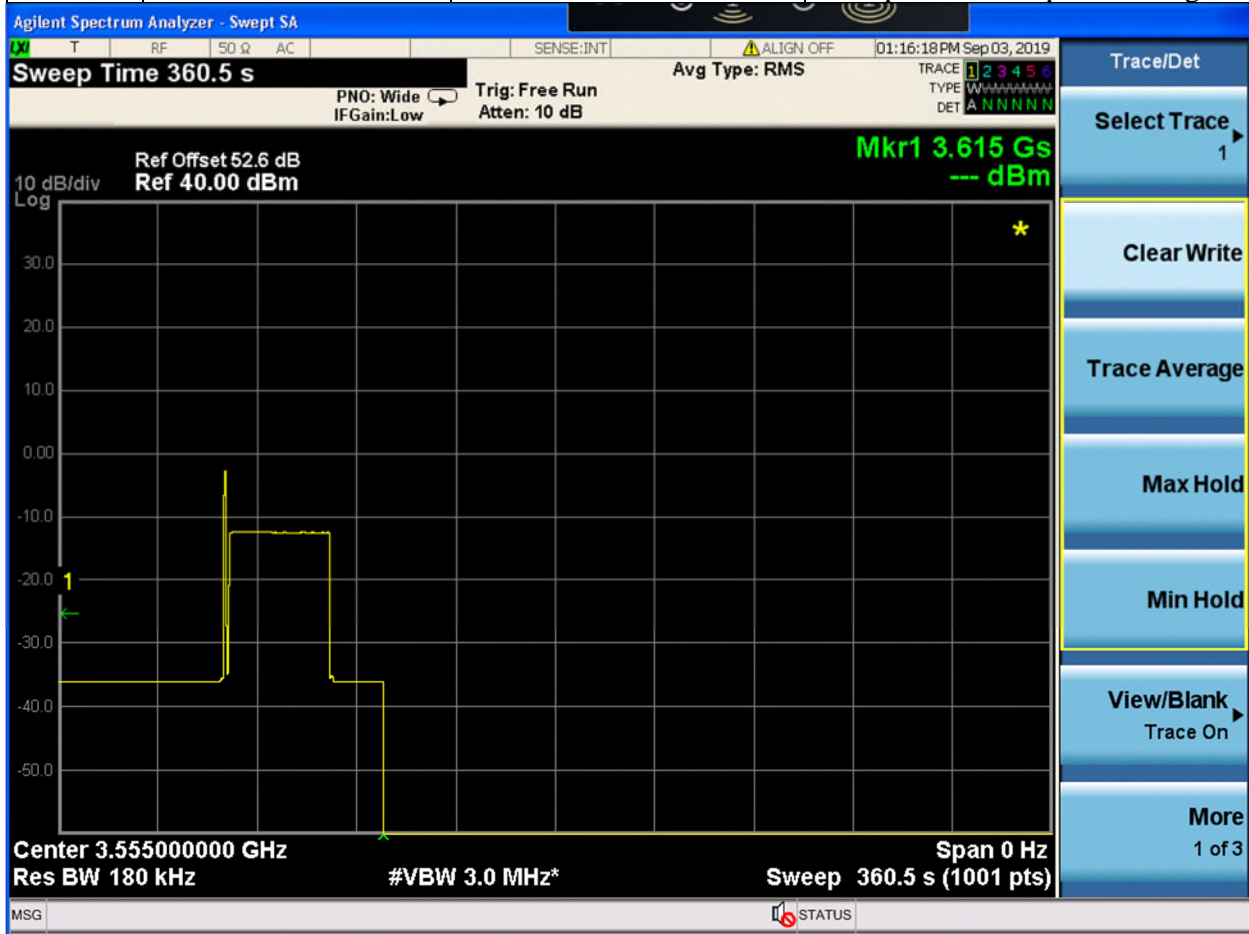
Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.5.4.2.5	WINNF.FT.D.MES.5	Domain Proxy Heartbeat Response contains measReportConfig	No RF monitoring	P
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Pass. “measreportconfig” in logs. All other requirements verified.

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.6.4.1.2	WINNF.FT.D.RLQ.2	Domain Proxy Successful Relinquishment	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission at any time prior to sending the relinquishmentRequest message.</li> </ul>	P
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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.

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

6.7.4.1.2	WINNF.FT.D.DRG.2	Domain Proxy Successful Deregistration	Monitor RF transmission. Ensure: <ul style="list-style-type: none"> <li>• CBSD stops transmission at any time prior to sending the relinquishmentRequest message or deregistrationRequest message (whichever is sent first)</li> </ul>	P
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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.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

**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.H BT	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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### Test Table

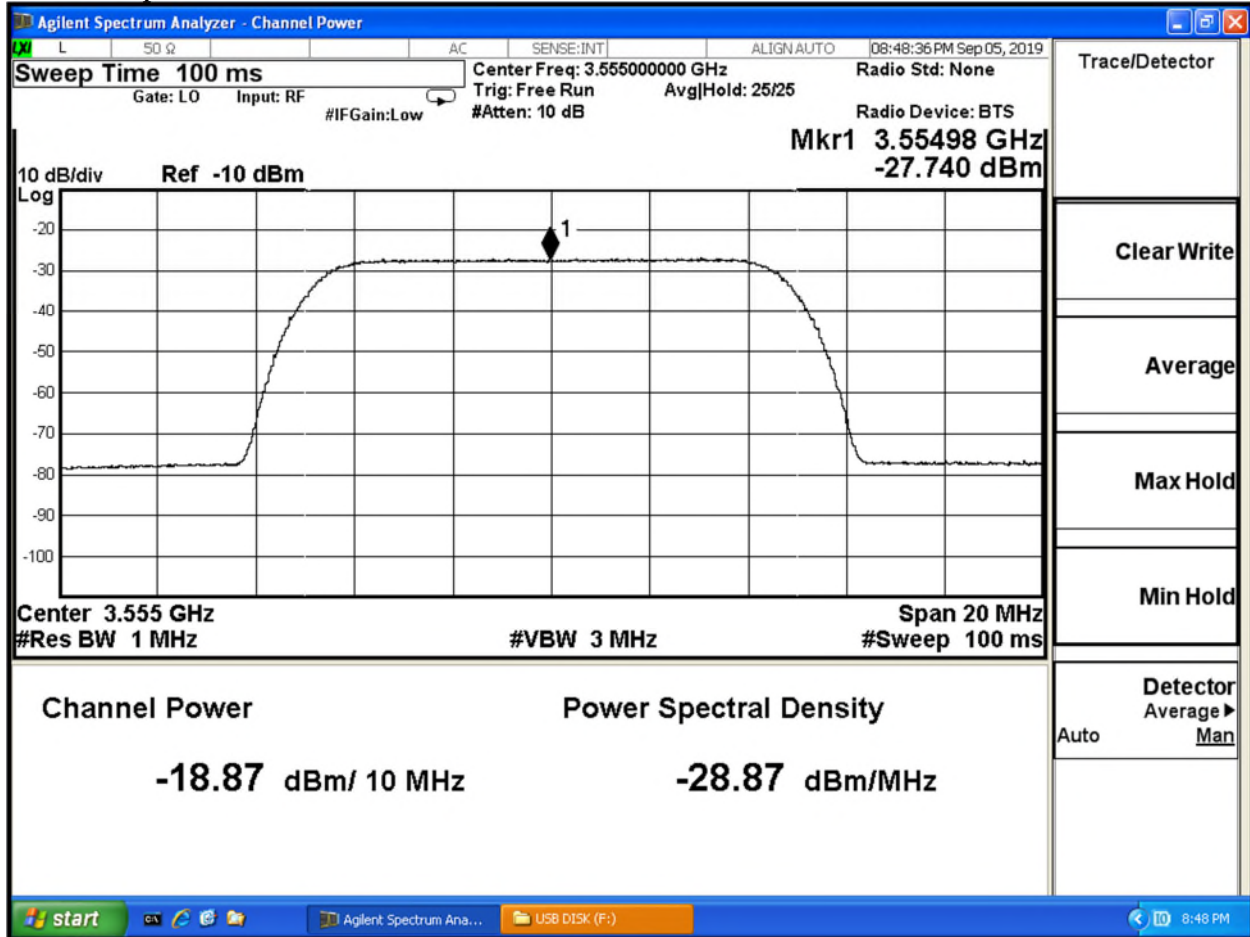
Freq	1MHz EIRP limit (target) dBm	Raw 10 MHz	Raw 1MHz	External Losses (dB)	Raw dBm/MHz	antenna gain dBi	ports	port gain (dB)	EIRP 1MHz dBm/MHz	EIRP 10 MHz dBm	margin dB
3555-Low	34	-18.9	-27.7	19.93	-7.77	22	64	18.0618	32.2918	41.0918	1.7082
3555-High	37	-15.87	-24.6	19.93	-4.67	22	64	18.0618	35.3918	44.1218	1.6082
3630-low	34	-17.91	-26.29	19.93	-6.36	22	64	18.0618	33.7018	42.0818	0.2982
3630-high	37	-14.93	-23.2	19.93	-3.27	22	64	18.0618	36.7918	45.0618	0.2082
3695-low	34	-17.33	-26.27	19.93	-6.34	22	64	18.0618	33.7218	42.6618	0.2782
3695-high	37	-14.31	-24.31	19.93	-4.38	22	64	18.0618	35.6818	45.6818	1.3182

Note: 3555 MHz and 3630 MHz were performed under max hold of average as worst case.



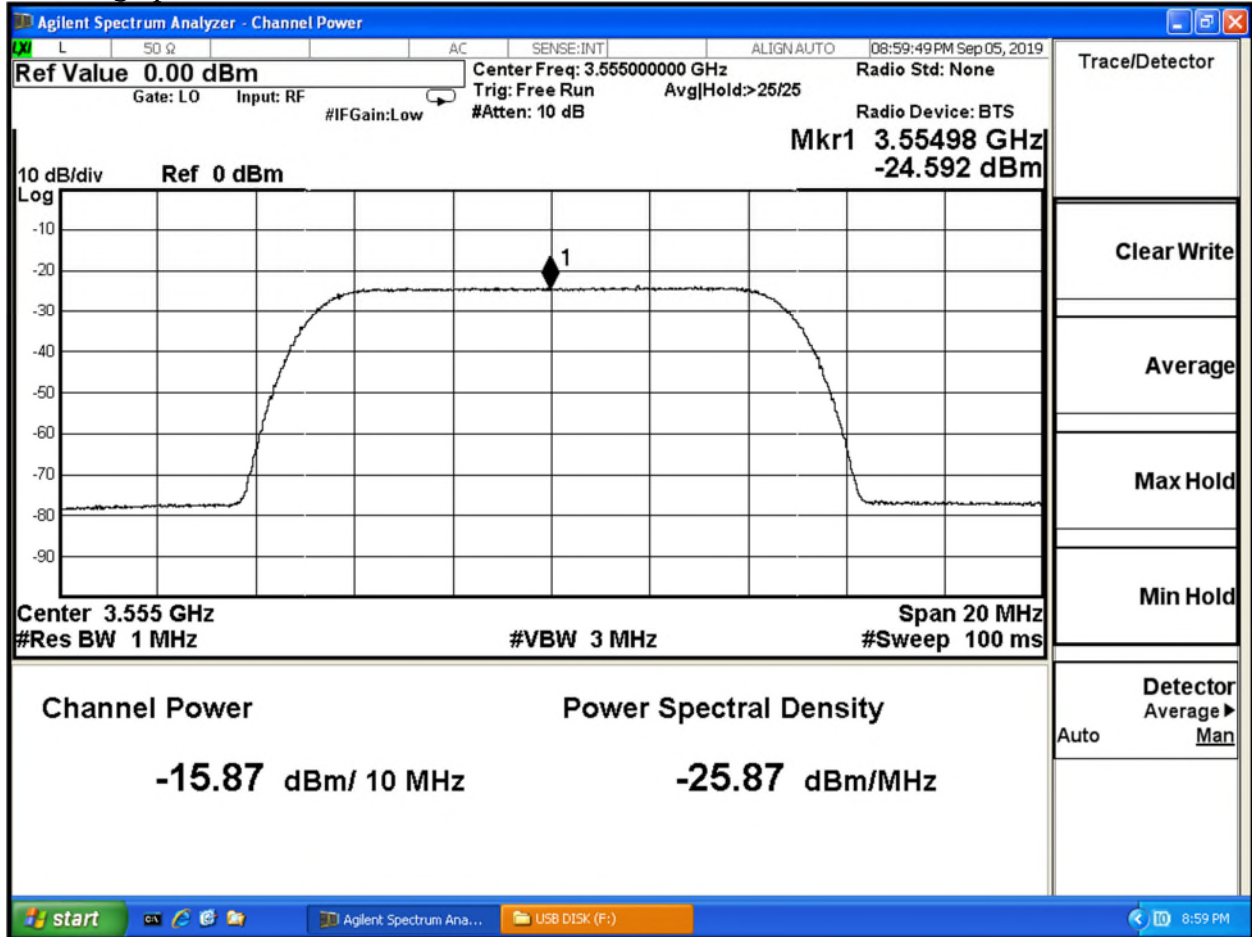
Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	<b>FCC Part 96 SAS requirements (CBRS Test Plan)</b>	

3555 low power



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

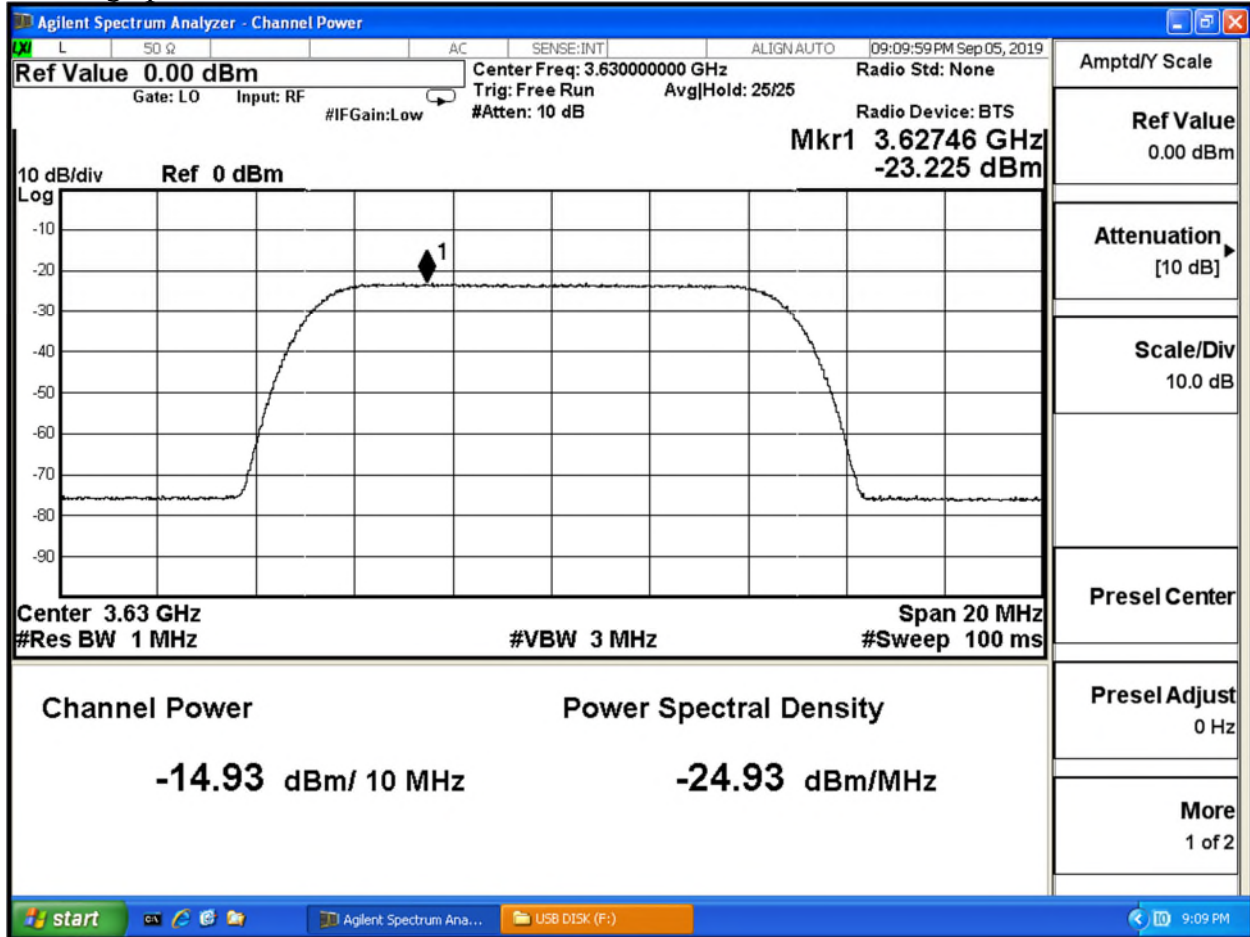
3555-High power





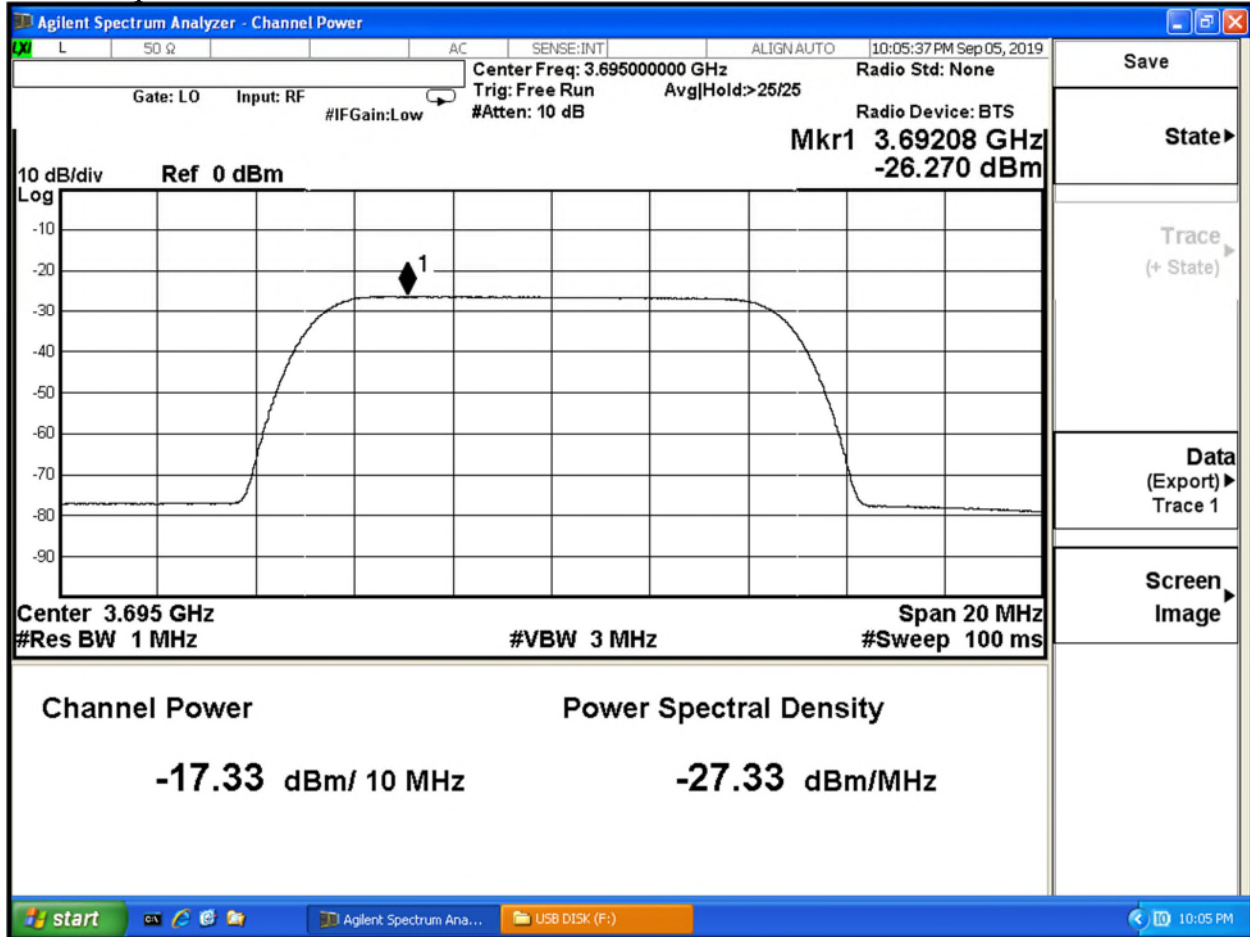
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3630-high power



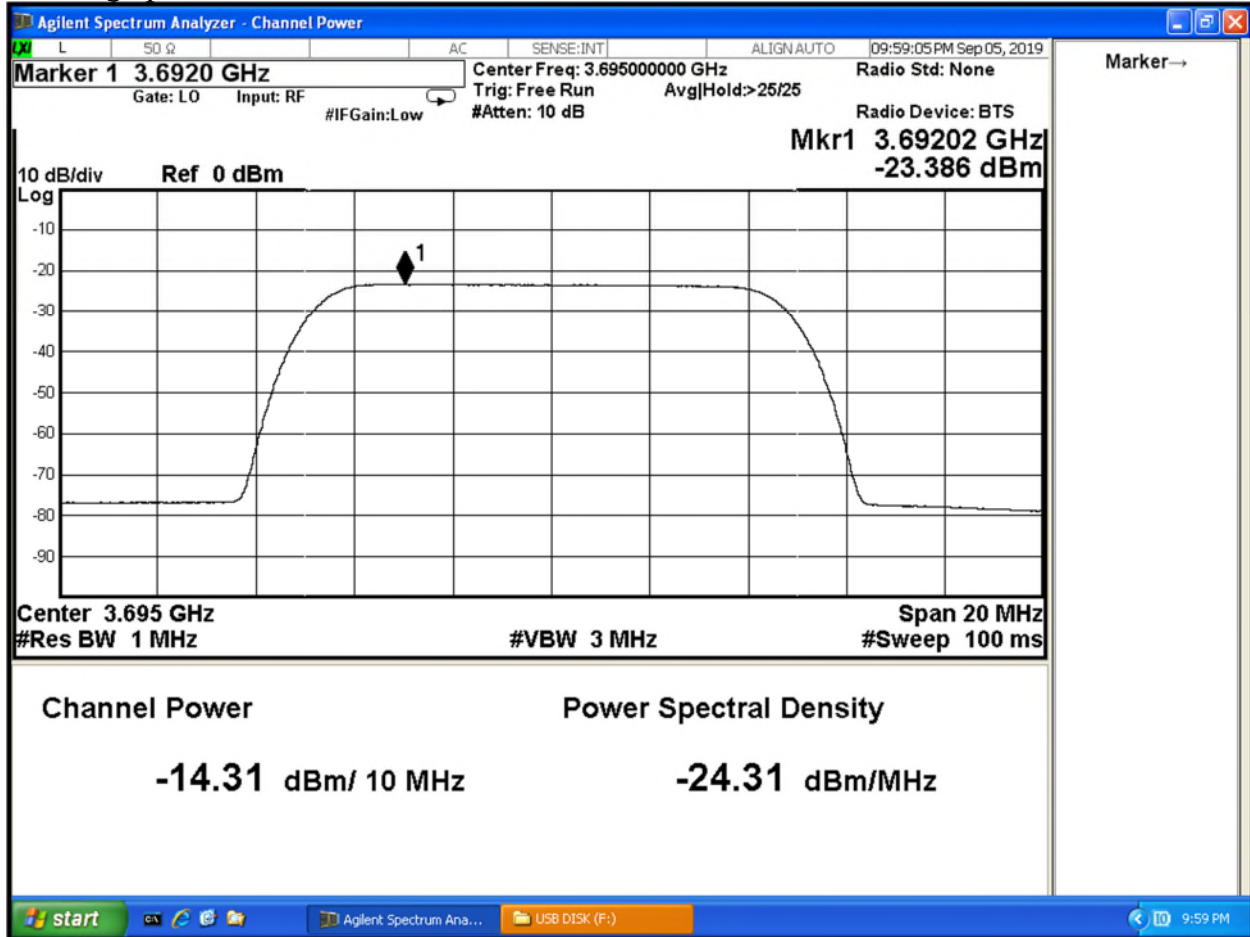
Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3695 low power



Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3695-high power





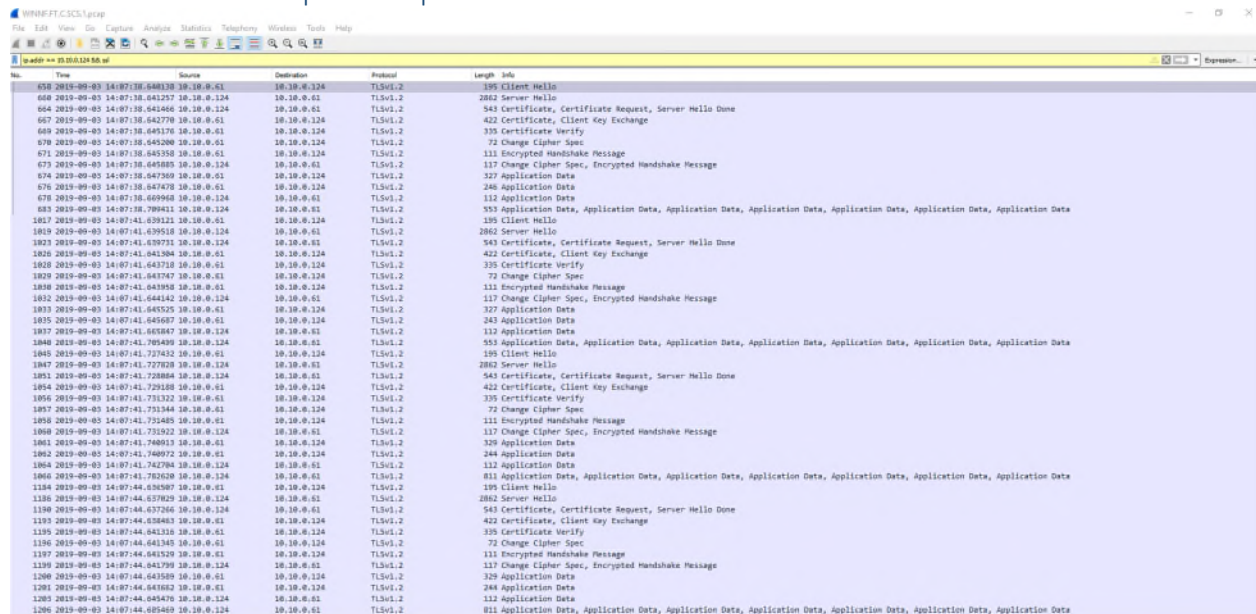
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## 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
638	2019-09-03 14:07:18.648136	10.10.0.124	10.10.0.124	TLSv1.2	395	Client Hello
639	2019-09-03 14:07:18.641257	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
644	2019-09-03 14:07:18.641466	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
647	2019-09-03 14:07:18.642776	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
649	2019-09-03 14:07:18.643176	10.10.0.61	10.10.0.124	TLSv1.2	329	Certificate Verify
679	2019-09-03 14:07:18.645280	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
671	2019-09-03 14:07:18.645350	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
673	2019-09-03 14:07:18.645885	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
674	2019-09-03 14:07:18.647369	10.10.0.61	10.10.0.124	TLSv1.2	327	Application Data
676	2019-09-03 14:07:18.647478	10.10.0.61	10.10.0.124	TLSv1.2	246	Application Data
678	2019-09-03 14:07:18.649960	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
683	2019-09-03 14:07:18.799421	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
1617	2019-09-03 14:07:41.639321	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
1619	2019-09-03 14:07:41.639518	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
1623	2019-09-03 14:07:41.639731	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
1626	2019-09-03 14:07:41.641384	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
1628	2019-09-03 14:07:41.641710	10.10.0.61	10.10.0.124	TLSv1.2	329	Certificate Verify
1629	2019-09-03 14:07:41.641747	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
1630	2019-09-03 14:07:41.641958	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
1632	2019-09-03 14:07:41.644142	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1633	2019-09-03 14:07:41.645525	10.10.0.124	10.10.0.61	TLSv1.2	327	Application Data
1635	2019-09-03 14:07:41.645687	10.10.0.61	10.10.0.124	TLSv1.2	243	Application Data
1637	2019-09-03 14:07:41.645847	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
1640	2019-09-03 14:07:41.796498	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
1645	2019-09-03 14:07:41.737432	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
1647	2019-09-03 14:07:41.737628	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
1651	2019-09-03 14:07:41.738864	10.10.0.124	10.10.0.61	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
1654	2019-09-03 14:07:41.739160	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
1656	2019-09-03 14:07:41.731322	10.10.0.61	10.10.0.124	TLSv1.2	329	Certificate Verify
1657	2019-09-03 14:07:41.731344	10.10.0.61	10.10.0.124	TLSv1.2	72	Change Cipher Spec
1658	2019-09-03 14:07:41.731480	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
1659	2019-09-03 14:07:41.731922	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1661	2019-09-03 14:07:41.740913	10.10.0.61	10.10.0.124	TLSv1.2	329	Application Data
1662	2019-09-03 14:07:41.740972	10.10.0.61	10.10.0.124	TLSv1.2	244	Application Data
1664	2019-09-03 14:07:41.742794	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
1666	2019-09-03 14:07:41.752626	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
1184	2019-09-03 14:07:44.636387	10.10.0.61	10.10.0.124	TLSv1.2	195	Client Hello
1186	2019-09-03 14:07:44.637628	10.10.0.124	10.10.0.61	TLSv1.2	2862	Server Hello
1193	2019-09-03 14:07:44.638483	10.10.0.61	10.10.0.124	TLSv1.2	543	Certificate, Certificate Request, Server Hello Done
1195	2019-09-03 14:07:44.641345	10.10.0.61	10.10.0.124	TLSv1.2	422	Certificate, Client Key Exchange
1196	2019-09-03 14:07:44.641345	10.10.0.61	10.10.0.124	TLSv1.2	329	Certificate Verify
1197	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 14:07:44.641320	10.10.0.61	10.10.0.124	TLSv1.2	111	Encrypted Handshake Message
1199	2019-09-03 14:07:44.641790	10.10.0.124	10.10.0.61	TLSv1.2	117	Change Cipher Spec, Encrypted Handshake Message
1200	2019-09-03 14:07:44.643588	10.10.0.61	10.10.0.124	TLSv1.2	329	Application Data
1201	2019-09-03 14:07:44.643882	10.10.0.61	10.10.0.124	TLSv1.2	244	Application Data
1205	2019-09-03 14:07:44.645476	10.10.0.124	10.10.0.61	TLSv1.2	112	Application Data
1206	2019-09-03 14:07:44.645469	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

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Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

WINNF test requirements:

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

2	<ul style="list-style-type: none"> <li>• Make sure that Mutual authentication happens between UUT and the SAS Test Harness.</li> <li>• Make sure that UUT uses TLS v1.2</li> <li>• Make sure that cipher suites from one of the following is selected, <ul style="list-style-type: none"> <li>• TLS_RSA_WITH_AES_128_GCM_SHA256</li> <li>• TLS_RSA_WITH_AES_256_GCM_SHA384</li> <li>• TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256</li> <li>• TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384</li> <li>• TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</li> </ul> </li> </ul>	PASS
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Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## 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
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Client Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 124
  ▼ 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
    ▼ 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)

```

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

```

TLS_RSA_WITH_AES_128_GCM_SHA256
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

```

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 660: 2862 bytes on wire (22896 bits), 2862 bytes captured (22896 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: 55482, Seq: 1, Ack: 130, Len: 2796
✓ Transport Layer Security
  ✓ TLSv1.2 Record Layer: Handshake Protocol: Server Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 81
    ✓ Handshake Protocol: Server Hello
      Handshake Type: Server Hello (2)
      Length: 77
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e73b5267853f94c269c3818f0a575ac5d562d15e544eb...
        Session ID Length: 32
        Session ID: 22698059d7a584ee0cd7b1905af413c1fa4241c12a49862c...
        Cipher Suite: TLS_RSA_WITH_AES_128_GCM_SHA256 (0x009c)
        Compression Method: null (0)
        Extensions Length: 5
      > Extension: renegotiation_info (len=1)

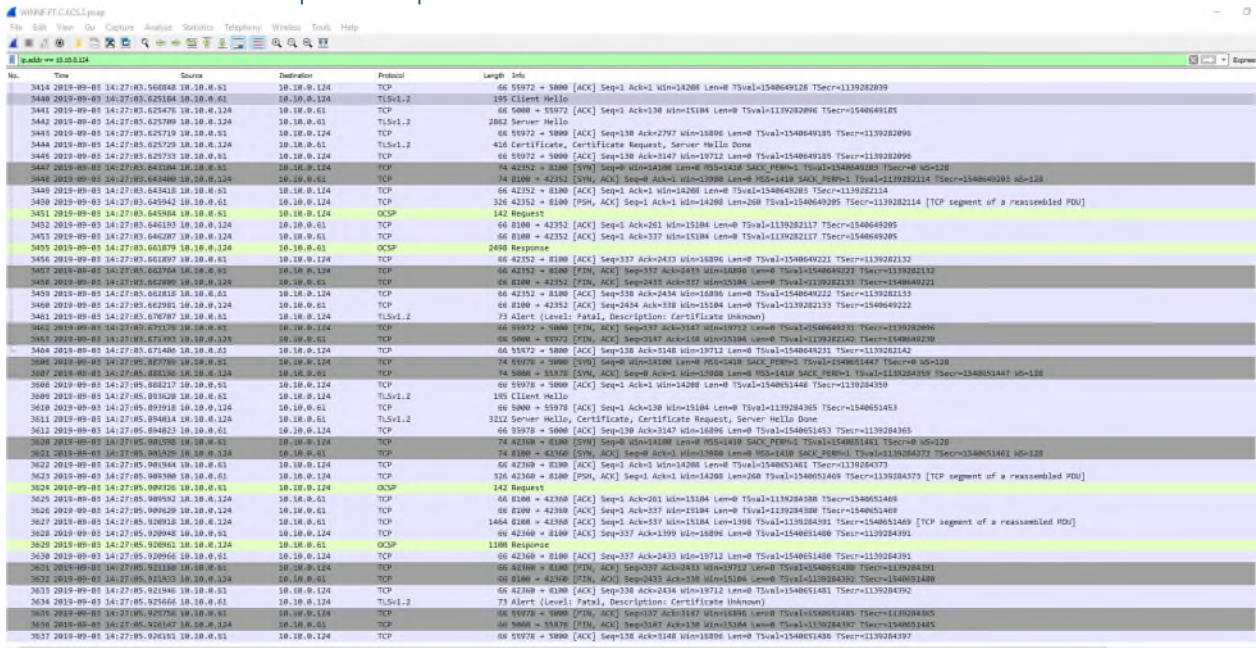
```

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	<b>FCC Part 96 SAS requirements (CBRS Test Plan)</b>	

## WINNF.FT.C.SCS.2

### Packet Capture Sequence



The screenshot shows a packet capture sequence in Wireshark. The interface includes a menu bar, toolbar, and a packet list pane. The packet list pane shows a series of packets numbered 3414 to 3537. The selected packet 3414 is expanded to show the raw bytes and the corresponding TLS structure. The TLS structure includes the Client Hello message, which contains the TLS version (3.1), cipher suites, and other parameters. The subsequent packets show the Server Hello, Certificate, Certificate Request, and Server Hello Done messages, indicating a successful TLS handshake.

### WINNF Test Requirements:

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

2	<ul style="list-style-type: none"> <li>• Make sure that UUT uses TLS v1.2 for security establishment.</li> <li>• Make sure UUT selects the correct cipher suite.</li> <li>• UUT shall use CRL or OCSP to verify the validity of the server certificate.</li> <li>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.</li> </ul>	PASS
---	--	------

### Analysis of WINNF Test Requirements

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 3440: 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: 55972, Dst Port: 5000, Seq: 1, Ack: 1, Len: 129
✓ Transport Layer Security
  ✓ TLSv1.2 Record Layer: Handshake Protocol: Client Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 124
    ✓ Handshake Protocol: Client Hello
      Handshake Type: Client Hello (1)
      Length: 120
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e7837c5e3315b08e80a896946254509886b3c5b562820...
      Session ID Length: 0
      Cipher Suites Length: 6
      ✓ 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)

```

- 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

```

- From Server Hello, cipher suite chosen:  
 TLS\_RSA\_WITH\_AES\_128\_GCM\_SHA256



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 3442: 2862 bytes on wire (22896 bits), 2862 bytes captured (22896 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: 55972, Seq: 1, Ack: 130, Len: 2796
✓ Transport Layer Security
  ✓ TLSv1.2 Record Layer: Handshake Protocol: Server Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 81
    ✓ Handshake Protocol: Server Hello
      Handshake Type: Server Hello (2)
      Length: 77
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e7842d84d8cbfc7078fe9e913fcf7eb0fe3354f54f192...
      Session ID Length: 32
      Session ID: e50dd1e43d8d5028f12ae61800ad52ffd4fe63dce8630ea5...
      Cipher Suite: TLS_RSA_WITH_AES_128_GCM_SHA256 (0x009c)
      Compression Method: null (0)
      Extensions Length: 5
      > Extension: renegotiation_info (len=1)

```

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

```

> Frame 3451: 142 bytes on wire (1136 bits), 142 bytes captured (1136 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: 42352, Dst Port: 8100, Seq: 261, Ack: 1, Len: 76
> [2 Reassembled TCP Segments (336 bytes): #3450(260), #3451(76)]
> Hypertext Transfer Protocol
✓ Online Certificate Status Protocol
  ✓ tbsRequest
    ✓ requestList: 1 item
      ✓ Request
        ✓ reqCert
          ✓ hashAlgorithm (SHA-1)
            Algorithm Id: 1.3.14.3.2.26 (SHA-1)
            issuerNameHash: 5368d21d2529427538588c5ccba4c4e6f3b96641
            issuerKeyHash: 5b63d7bb6e95ca42c49450451b47e5cd6ee1fdb4
            serialNumber: 18248749012425898463

```

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 3455: 2498 bytes on wire (19984 bits), 2498 bytes captured (19984 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: 8100, Dst Port: 42352, Seq: 1, Ack: 337, Len: 2432
> Hypertext Transfer Protocol
> Online Certificate Status Protocol
  responseStatus: successful (0)
  responseBytes
    responseType: 1.3.6.1.5.5.7.40.1.1 (id-pkix-ocsp-basic)
    basicOCSPResponse
      tbsResponseData
        responderID: byName (1)
        producedAt: 2019-09-03 14:27:14 (UTC)
        responses: 1 item
          singleResponse
            certID
              hashAlgorithm (SHA-1)
                algorithmId: 1.3.14.3.2.26 (SHA-1)
                issuerNameHash: 5368421d2529427538588c5c3ba4c4e6f3b96641
                issuerKeyHash: 5b63d7bb6e95ca42c49450451b47e5cd6ee1fdb4
                serialNumber: 18248749012425898463
              certStatus: revoked (1)
                revoked
                  revocationTime: 2019-09-02 13:59:41 (UTC)
                  thisUpdate: 2019-09-03 14:27:14 (UTC)
            signatureAlgorithm (sha1WithRSAEncryption)
              algorithmId: 1.2.840.113549.1.1.5 (sha1WithRSAEncryption)
              padding: 0
              signature: 906f60430a1260eb9d7e21cf2049842f94c7f6ee489ad67...
          certs: 1 item
            certificate (id-at-commonName=SAS.OCSF.EXAMPLE,id-at-organizationalUnitName=WinnFornum SAS OCSF Responder Cert1,id-at-organizationName=Test Lab for FCC PART 96,id-at-countryName=US)
              signedCertificate
                algorithmIdentifier (sha256WithRSAEncryption)
                  padding: 0
                  encrypted: 88a547c487789b3ad084c353a8cc7d0ff2c507626c62494b...

```

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

```

> Frame 3461: 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: 55972, Dst Port: 5000, Seq: 130, Ack: 3147, Len: 7
> Transport Layer Security
  TLV1.2 Record Layer: Alert (Level: Fatal, Description: Certificate Unknown)
    Content Type: Alert (21)
    Version: TLS 1.2 (0x0303)
    Length: 2
  Alert Message
    Level: Fatal (2)
    Description: Certificate Unknown (46)

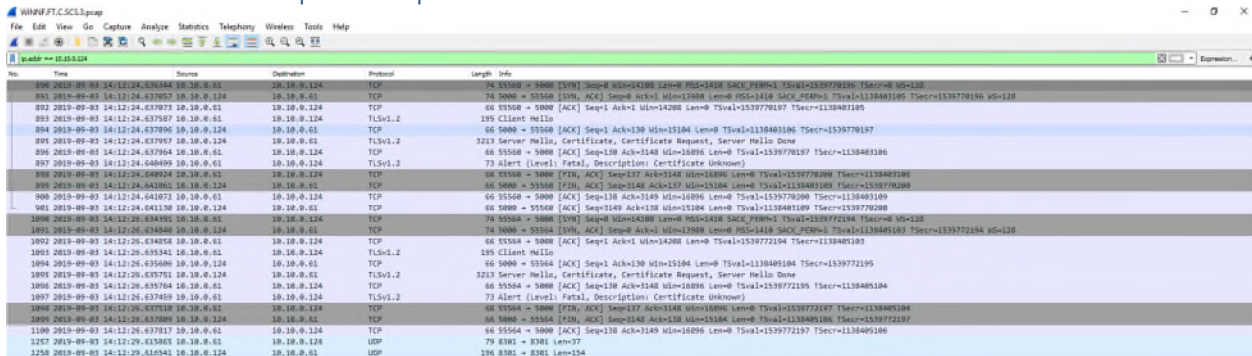
```

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	<b>FCC Part 96 SAS requirements (CBRS Test Plan)</b>	

## 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	<ul style="list-style-type: none"> <li>• Make sure that UUT uses TLS v1.2 for security establishment.</li> <li>• Make sure UUT selects the correct cipher suite.</li> <li>• UUT shall use CRL or OCSP to verify the validity of the server certificate.</li> <li>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.</li> </ul>	PASS
---	--	------

### Analysis of WINNF Test Requirements

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 893: 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: 55560, Dst Port: 5000, Seq: 1, Ack: 1, Len: 129
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Client Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 124
    ▼ Handshake Protocol: Client Hello
      Handshake Type: Client Hello (1)
      Length: 120
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e74c8e3b9907c8bf1d8d3b2e41de44ff3d4d88a2df236...
      Session ID Length: 0
      Cipher Suites Length: 6
      ▼ 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)

```

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

```

TLS_RSA_WITH_AES_128_GCM_SHA256
TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

```

- From Server Hello, cipher suite chosen:  
 TLS\_RSA\_WITH\_AES\_128\_GCM\_SHA256



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 895: 3213 bytes on wire (25704 bits), 3213 bytes captured (25704 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: 55560, Seq: 1, Ack: 130, Len: 3147
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Server Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 81
    ▼ Handshake Protocol: Server Hello
      Handshake Type: Server Hello (2)
      Length: 77
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e74d363b38c017e0456ec16e593567a70151d81f72696...
      Session ID Length: 32
      Session ID: 9736c983db797e9cedf3a8d3ff5cde8d50f9f0d983a75c99...
      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 897: 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: 55560, Dst Port: 5000, Seq: 130, Ack: 3148, Len: 7
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Certificate Unknown)
    Content Type: Alert (21)
    Version: TLS 1.2 (0x0303)
    Length: 2
    ▼ Alert Message
      Level: Fatal (2)
      Description: Certificate Unknown (46)

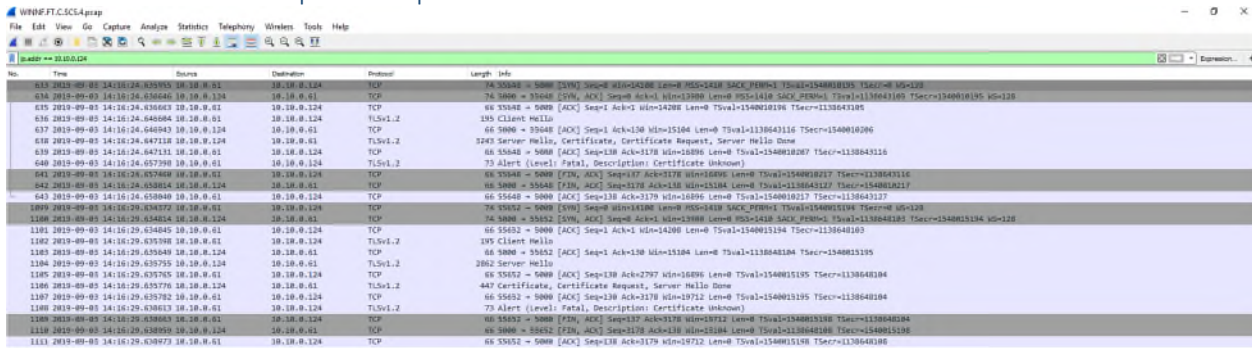
```

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	<b>FCC Part 96 SAS requirements (CBRS Test Plan)</b>	

## WINNF.FT.C.SCS.4

### Packet Capture Sequence



No.	Time	Source	Destination	Protocol	Length	Info
613	2019-09-03 14:16:24.935953	10.10.0.1	10.10.0.124	TCP	74	55642 → 5000 [SYN] Seq=0 Win=14288 Len=0 MSS=1440 SACK_PERM=1 TSval=1540011395 TSecr=0 Win=138
614	2019-09-03 14:16:24.936045	10.10.0.124	10.10.0.1	TCP	74	5000 → 55642 [RST] Seq=0 Win=0 Len=0 RST=14288 SACK_PERM=1 TSval=1138641185 TSecr=1540011395 Win=138
615	2019-09-03 14:16:24.936663	10.10.0.1	10.10.0.124	TCP	66	55642 → 5000 [ACK] Seq=1 Ack=1 Win=14288 Len=0 TSval=1540011395 TSecr=1138641185
616	2019-09-03 14:16:24.940684	10.10.0.1	10.10.0.124	TLSv1.2	195	Client Hello
617	2019-09-03 14:16:24.940943	10.10.0.124	10.10.0.1	TCP	66	5000 → 55642 [ACK] Seq=1 Ack=138 Win=15184 Len=0 TSval=1138641185 TSecr=1540011395
618	2019-09-03 14:16:24.941718	10.10.0.124	10.10.0.1	TLSv1.2	2062	Server Hello, Certificate, Certificate Request, Server Hello Done
619	2019-09-03 14:16:24.947131	10.10.0.1	10.10.0.124	TCP	66	55642 → 5000 [ACK] Seq=138 Ack=1378 Win=18896 Len=0 TSval=1540012067 TSecr=1138641185
640	2019-09-03 14:16:24.957390	10.10.0.1	10.10.0.124	TLSv1.2	73	Alert (level: Fatal), Description: Certificate Unknown
642	2019-09-03 14:16:24.957460	10.10.0.124	10.10.0.124	TCP	66	55642 → 5000 [RST] Seq=138 Ack=1378 Win=18896 Len=0 TSval=1540012117 TSecr=1138641185
643	2019-09-03 14:16:24.958014	10.10.0.124	10.10.0.1	TCP	66	5000 → 55642 [FIN, ACK] Seq=1378 Ack=138 Win=15184 Len=0 TSval=1138641127 TSecr=1540012117
643	2019-09-03 14:16:24.958040	10.10.0.1	10.10.0.124	TCP	66	55642 → 5000 [ACK] Seq=138 Ack=1378 Win=18896 Len=0 TSval=1540012117 TSecr=1138641127
1009	2019-09-03 14:16:29.938772	10.10.0.124	10.10.0.1	TCP	74	55642 → 5000 [SYN] Seq=0 Win=14288 Len=0 MSS=1440 SACK_PERM=1 TSval=1540011194 TSecr=0 Win=138
1100	2019-09-03 14:16:29.938814	10.10.0.124	10.10.0.1	TCP	74	5000 → 55642 [RST] Seq=0 Win=0 Len=0 RST=14288 SACK_PERM=1 TSval=1138641185 TSecr=1540011194 Win=138
1101	2019-09-03 14:16:29.938845	10.10.0.1	10.10.0.124	TCP	66	55642 → 5000 [ACK] Seq=1 Ack=1 Win=14288 Len=0 TSval=1540011194 TSecr=1138641185
1102	2019-09-03 14:16:29.939398	10.10.0.1	10.10.0.124	TLSv1.2	195	Client Hello
1103	2019-09-03 14:16:29.939404	10.10.0.124	10.10.0.1	TCP	66	5000 → 55642 [ACK] Seq=1 Ack=138 Win=15184 Len=0 TSval=1138641184 TSecr=1540011195
1104	2019-09-03 14:16:29.939755	10.10.0.124	10.10.0.1	TLSv1.2	2062	Server Hello
1105	2019-09-03 14:16:29.939765	10.10.0.1	10.10.0.124	TCP	66	55642 → 5000 [ACK] Seq=138 Ack=2797 Win=18896 Len=0 TSval=1540011195 TSecr=1138641184
1106	2019-09-03 14:16:29.939776	10.10.0.124	10.10.0.1	TLSv1.2	447	Certificate, Certificate Request, Server Hello Done
1107	2019-09-03 14:16:29.939782	10.10.0.1	10.10.0.124	TCP	66	55642 → 5000 [ACK] Seq=138 Ack=1378 Win=18896 Len=0 TSval=1540011195 TSecr=1138641184
1108	2019-09-03 14:16:29.939813	10.10.0.1	10.10.0.124	TLSv1.2	73	Alert (level: Fatal), Description: Certificate Unknown
1109	2019-09-03 14:16:29.939855	10.10.0.124	10.10.0.1	TCP	66	55642 → 5000 [RST] Seq=138 Ack=1378 Win=18896 Len=0 TSval=1540011195 TSecr=1138641184
1110	2019-09-03 14:16:29.939919	10.10.0.124	10.10.0.1	TCP	66	5000 → 55642 [FIN, ACK] Seq=1378 Ack=138 Win=15184 Len=0 TSval=1138641184 TSecr=1540011195
1111	2019-09-03 14:16:29.939973	10.10.0.124	10.10.0.1	TCP	66	55642 → 5000 [ACK] Seq=138 Ack=1378 Win=18896 Len=0 TSval=1540011195 TSecr=1138641184

### WINNF Test Requirements:

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

2	<ul style="list-style-type: none"> <li>• Make sure that UUT uses TLS v1.2 for security establishment.</li> <li>• Make sure UUT selects the correct cipher suite.</li> <li>• UUT shall use CRL or OCSP to verify the validity of the server certificate</li> <li>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.</li> </ul>	PASS
---	---	------

### Analysis of WINNF Test Requirements

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 636: 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: 55648, Dst Port: 5000, Seq: 1, Ack: 1, Len: 129
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Client Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 124
    ▼ Handshake Protocol: Client Hello
      Handshake Type: Client Hello (1)
      Length: 120
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e75b8e4794caba494c3d4e26398551122b1995d332a19...
      Session ID Length: 0
      Cipher Suites Length: 6
      ▼ 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)

```

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

```

TLS_RSA_WITH_AES_128_GCM_SHA256
TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

```

- From Server Hello, cipher suite chosen:  
 TLS\_RSA\_WITH\_AES\_128\_GCM\_SHA256

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> 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
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Server Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 81
    ▼ 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
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Certificate Unknown)
    Content Type: Alert (21)
    Version: TLS 1.2 (0x0303)
    Length: 2
    ▼ Alert Message
      Level: Fatal (2)
      Description: Certificate Unknown (46)

```

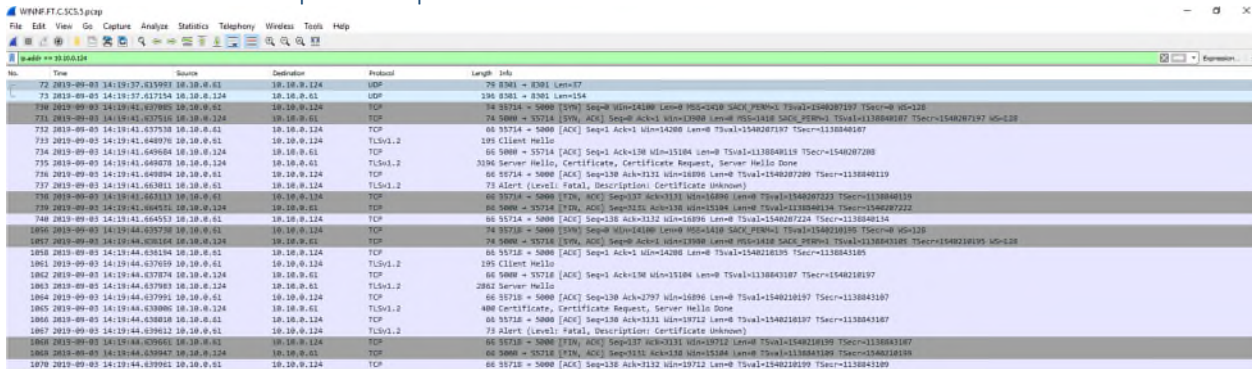
5. Registration request message is not received at Test Harness (authentication fails)



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	<b>FCC Part 96 SAS requirements (CBRS Test Plan)</b>	

## WINNF.FT.C.SCS.5

### Packet Capture Sequence



No.	Time	Source	Destination	Protocol	Length	Info
72	2019-09-03 14:19:37.615991	10.10.0.0.1	10.10.0.124	UDP	78	8301 → 8301 Len=77
73	2019-09-03 14:19:37.61754	10.10.0.124	10.10.0.1	UDP	196	8301 → 8301 Len=154
170	2019-09-03 14:19:41.607965	10.10.0.124	10.10.0.124	TCP	74	83716 → 5000 [RST] Seq=0 Win=14100 Len=0 MSS=1410 SACK_PERM=1 TSval=1540207197 TSecr=0 WS=128
731	2019-09-03 14:19:41.637516	10.10.0.124	10.10.0.1	TCP	74	5000 → 53716 [SYN, ACK] Seq=0 Ack=1 Win=13908 Len=0 MSS=1410 SACK_PERM=1 TSval=1138849187 TSecr=1540207197 WS=655
732	2019-09-03 14:19:41.637530	10.10.0.1	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=1 Ack=1 Win=14200 Len=0 TSval=1540207197 TSecr=1138849187
733	2019-09-03 14:19:41.640970	10.10.0.1	10.10.0.124	TLSv1.2	195	Client Hello
734	2019-09-03 14:19:41.640684	10.10.0.124	10.10.0.1	TCP	60	5000 → 53716 [ACK] Seq=1 Ack=138 Win=15104 Len=0 TSval=1138849118 TSecr=1540207208
735	2019-09-03 14:19:41.640678	10.10.0.124	10.10.0.1	TLSv1.2	3396	Server Hello, Certificate, Certificate Request, Server Hello Done
736	2019-09-03 14:19:41.640994	10.10.0.1	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=138 Ack=131 Win=18996 Len=0 TSval=1540207209 TSecr=1138849119
737	2019-09-03 14:19:41.643011	10.10.0.124	10.10.0.1	TLSv1.2	73	Alert (Level: Fatal, Description: Certificate unknown)
738	2019-09-03 14:19:41.643113	10.10.0.124	10.10.0.124	TCP	60	53716 → 5000 [FIN, ACK] Seq=137 Ack=131 Win=16896 Len=0 TSval=1540207213 TSecr=1138849119
739	2019-09-03 14:19:41.643451	10.10.0.124	10.10.0.1	TCP	60	5000 → 53716 [FIN, ACK] Seq=138 Ack=138 Win=15104 Len=0 TSval=1138849124 TSecr=1540207222
740	2019-09-03 14:19:41.644551	10.10.0.124	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=138 Ack=132 Win=18996 Len=0 TSval=1540207223 TSecr=1138849124
1896	2019-09-03 14:19:44.637520	10.10.0.1	10.10.0.124	TCP	74	53716 → 5000 [RST] Seq=0 Win=14100 Len=0 MSS=1410 SACK_PERM=1 TSval=1540210195 TSecr=0 WS=128
1897	2019-09-03 14:19:44.638164	10.10.0.124	10.10.0.1	TCP	74	5000 → 53716 [SYN, ACK] Seq=0 Ack=1 Win=13908 Len=0 MSS=1410 SACK_PERM=1 TSval=1138849195 TSecr=1540210195 WS=655
2050	2019-09-03 14:19:44.638258	10.10.0.1	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=1 Ack=1 Win=14200 Len=0 TSval=1540210200 TSecr=1138849195
1861	2019-09-03 14:19:44.637659	10.10.0.1	10.10.0.124	TLSv1.2	195	Client Hello
1862	2019-09-03 14:19:44.637874	10.10.0.124	10.10.0.1	TCP	60	5000 → 53716 [ACK] Seq=1 Ack=138 Win=15104 Len=0 TSval=1138849187 TSecr=1540210197
2052	2019-09-03 14:19:44.637980	10.10.0.124	10.10.0.1	TLSv1.2	2862	Server Hello
1864	2019-09-03 14:19:44.637991	10.10.0.1	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=130 Ack=13797 Win=18996 Len=0 TSval=1540210197 TSecr=1138849187
1865	2019-09-03 14:19:44.638006	10.10.0.124	10.10.0.1	TLSv1.2	488	Certificate, Certificate Request, Server Hello Done
1866	2019-09-03 14:19:44.638020	10.10.0.1	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=130 Ack=131 Win=18712 Len=0 TSval=1540210197 TSecr=1138849187
1867	2019-09-03 14:19:44.639112	10.10.0.124	10.10.0.1	TLSv1.2	73	Alert (Level: Fatal, Description: Certificate unknown)
1868	2019-09-03 14:19:44.639651	10.10.0.124	10.10.0.1	TCP	60	53716 → 5000 [FIN, ACK] Seq=137 Ack=131 Win=18712 Len=0 TSval=1540210199 TSecr=1138849187
1869	2019-09-03 14:19:44.639847	10.10.0.124	10.10.0.1	TCP	60	5000 → 53716 [FIN, ACK] Seq=130 Ack=130 Win=15104 Len=0 TSval=1138849189 TSecr=1540210199
1870	2019-09-03 14:19:44.639961	10.10.0.124	10.10.0.124	TCP	60	53716 → 5000 [ACK] Seq=130 Ack=132 Win=18712 Len=0 TSval=1540210199 TSecr=1138849189

### WINNF Test Requirements:

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

2	<ul style="list-style-type: none"> <li>• Make sure that UUT uses TLS v1.2 for security establishment.</li> <li>• Make sure UUT selects the correct cipher suite.</li> <li>• UUT shall use CRL or OCSP to verify the validity of the server certificate.</li> <li>• Make sure that Mutual authentication does not happen between UUT and the SAS Test Harness.</li> </ul>	PASS
---	--	------

### Analysis of WINNF Test Requirements

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 733: 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: 55714, Dst Port: 5000, Seq: 1, Ack: 1, Len: 129
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Client Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 124
    ▼ Handshake Protocol: Client Hello
      Handshake Type: Client Hello (1)
      Length: 120
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e767d62c21254967019646a3fc8da4d00c8eca5e78cc9...
      Session ID Length: 0
      Cipher Suites Length: 6
      ▼ 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)

```

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

TLS\_RSA\_WITH\_AES\_128\_GCM\_SHA256  
 TLS\_ECDHE\_ECDSA\_WITH\_AES\_128\_GCM\_SHA256  
 TLS\_ECDHE\_RSA\_WITH\_AES\_128\_GCM\_SHA256

- From Server Hello, cipher suite chosen:  
 TLS\_RSA\_WITH\_AES\_128\_GCM\_SHA256

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

```

> Frame 735: 3196 bytes on wire (25568 bits), 3196 bytes captured (25568 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: 55714, Seq: 1, Ack: 130, Len: 3130
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Handshake Protocol: Server Hello
    Content Type: Handshake (22)
    Version: TLS 1.2 (0x0303)
    Length: 81
    ▼ Handshake Protocol: Server Hello
      Handshake Type: Server Hello (2)
      Length: 77
      Version: TLS 1.2 (0x0303)
      > Random: 5d6e768814d017b54b1c55f0176bf996f1b41c32231ba2fd...
      Session ID Length: 32
      Session ID: fb8025d3eec7ffc9f97f61f574942c6276f822812fac30f4...
      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 737: 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: 55714, Dst Port: 5000, Seq: 130, Ack: 3131, Len: 7
▼ Transport Layer Security
  ▼ TLSv1.2 Record Layer: Alert (Level: Fatal, Description: Certificate Unknown)
    Content Type: Alert (21)
    Version: TLS 1.2 (0x0303)
    Length: 2
    ▼ Alert Message
      Level: Fatal (2)
      Description: Certificate Unknown (46)

```

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

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## 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	-



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

**Appendix A – EUT & Client Provided Details**

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Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### General EUT Description

Manufacturer	Ericsson
Address	Torshamnsgatan 23 Kista SE-16480 Stockholm Sweden
Product Name	Radio 6488 B48
Product Number	KRD 901 160/2 (with un-security software and RDNB board for testing purpose). KRD 901 160/21 (with security software and RDNB board for testing purpose). KRD 901 160/1 (with un-security software and antenna). KRD 901 160/11 (with security software and antenna).
Serial Number(s)	D829153166
Software Version	CXP 901 3268/15_R79GC
Hardware Version	R1A
Test Specification/Issue/Date	FCC CFR 47 Part 96: 2018

Note: For the testing performed in Dec 2019, the following EUT details were additionally recorded:

Node HW:

AAS-1 fru\_2048 AIR6488B48 1 OFF ON OFF N/A KRD901160/2 R1A  
D829153166 20190628 4 (OK) 62.0 0.08

ENM/DC Version:

ENM 19.12 (ISO Version: 1.79.131) AOM 901 151 R1CX/2

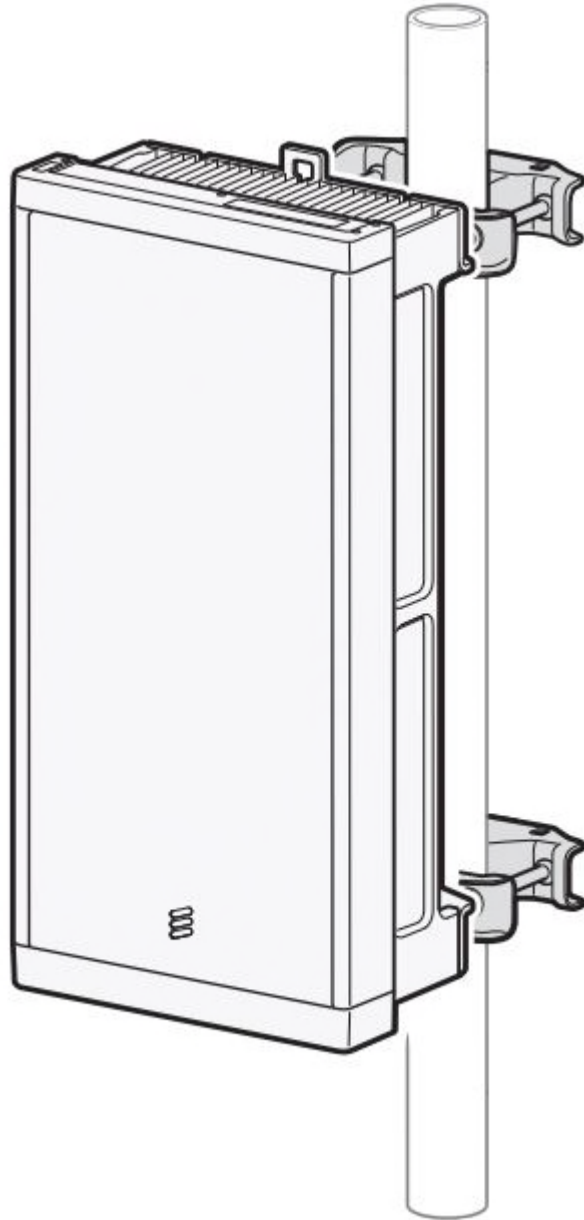
Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

**Technical Description**

The Equipment Under Test (EUT) Radio 6488 B48 KRD 901 160 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 6488 B48 KRD 901 160 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.

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	



#### 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)

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

**Appendix B – EUT, Peripherals, and Test Setup Photos**

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

Test setup

<Photos kept on file>

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## Appendix C – Additional Test Information

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

**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.H BT	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
-----------	---	---	--------------------	--------------------------------------	--	---

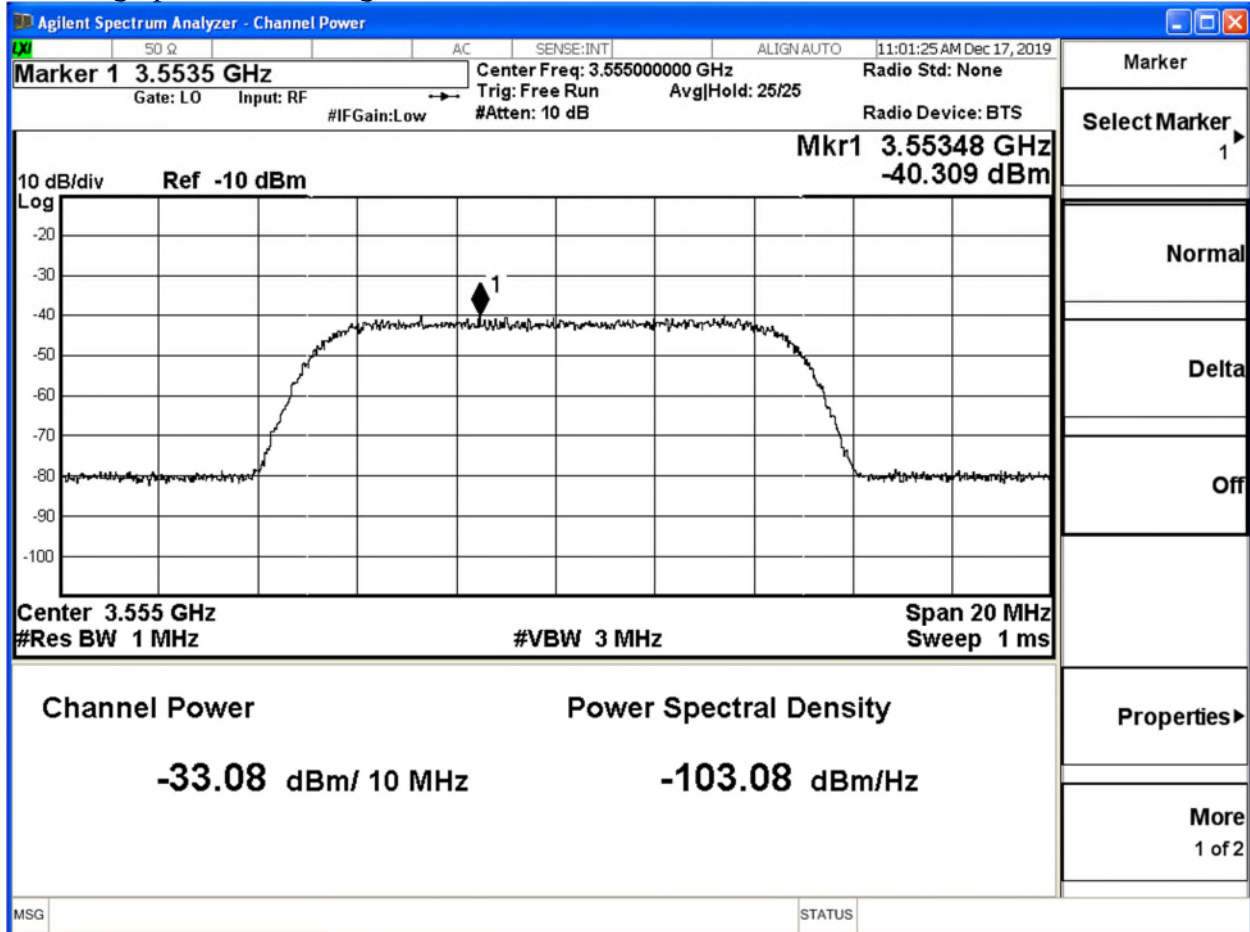
### Test Table

		Raw	Raw	External	Conduct				EIRP 1MHz	EIRP 10 MHz	marg in
Freq	1MHz EIRP limit (target) dBm	10 MHz	1MHz	Losses (dB)	dBm/M Hz	antenna gain dBi	ports	port gain (dB)	dBm/M Hz	dBm	dB
3555- High	37	-33.08	-40.31	41.93	1.62	17.00	64	18.06	36.68	43.91	0.32
3630- high	37	-33.01	-41.85	42.26	0.41	17.00	64	18.06	35.47	44.31	1.53
3695- high	37	-32.74	-40.82	42.33	1.51	17.00	64	18.06	36.57	44.65	0.43
3555- High	37	-27.94	-35.54	41.93	6.39	11.00	64	18.06	35.45	43.05	1.55
3630- high	37	-27.11	-34.76	42.26	7.50	11.00	64	18.06	36.56	44.21	0.44
3695- high	37	-27.48	-35.93	42.33	6.40	11.00	64	18.06	35.46	43.91	1.54



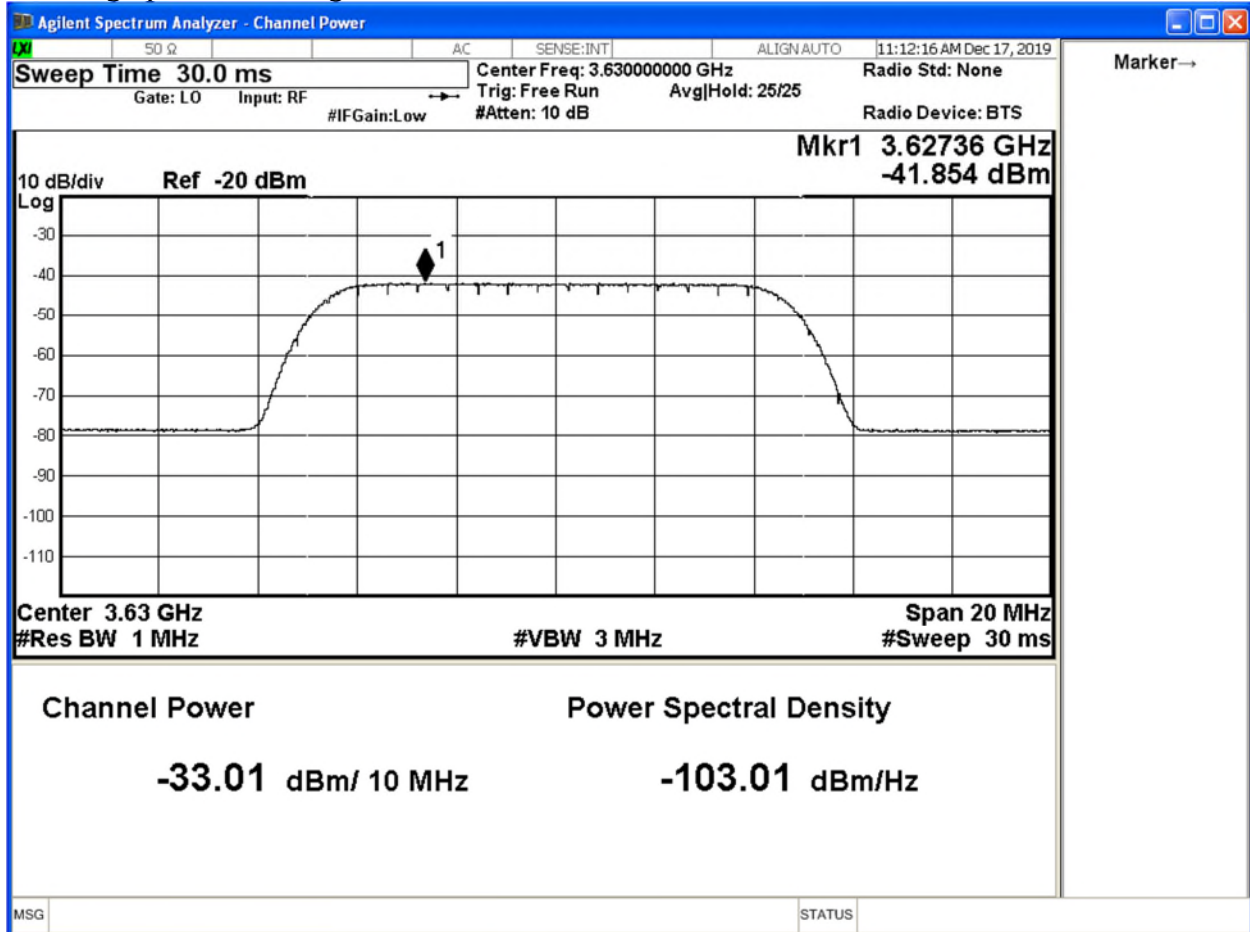
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3555-High power – 17 dBi gain



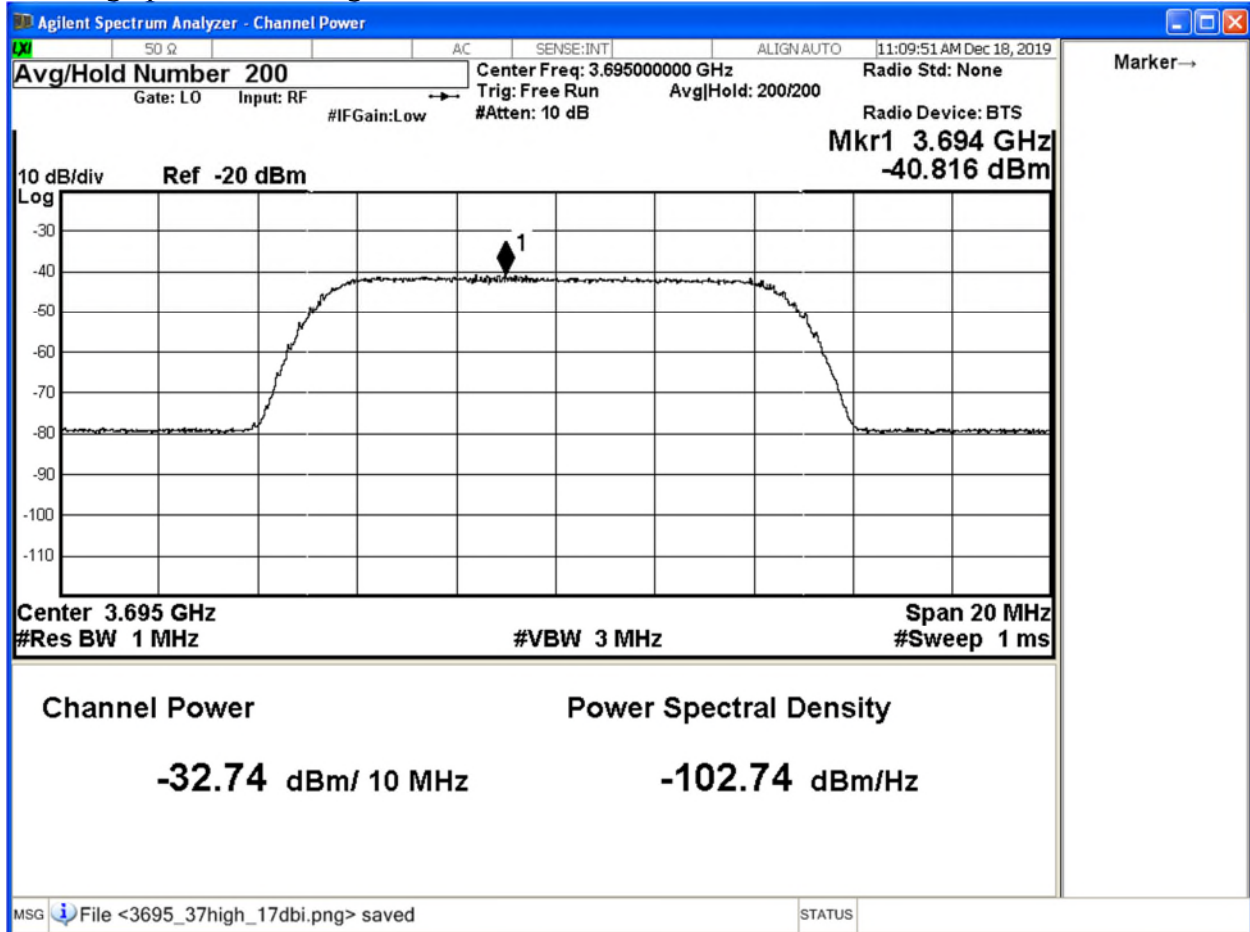
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3630-high power 17 dBi gain



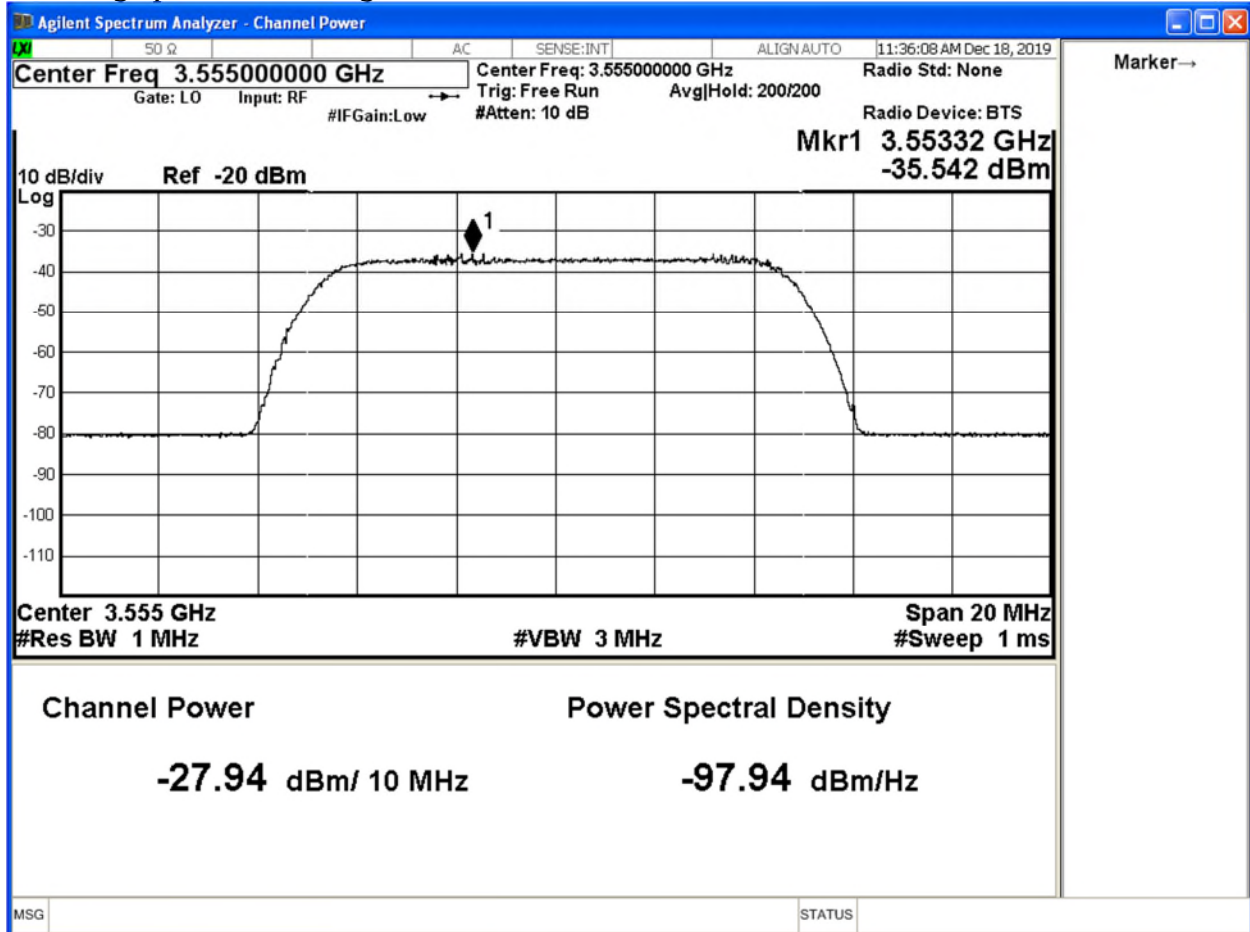
Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3695-high power – 17 dbi gain



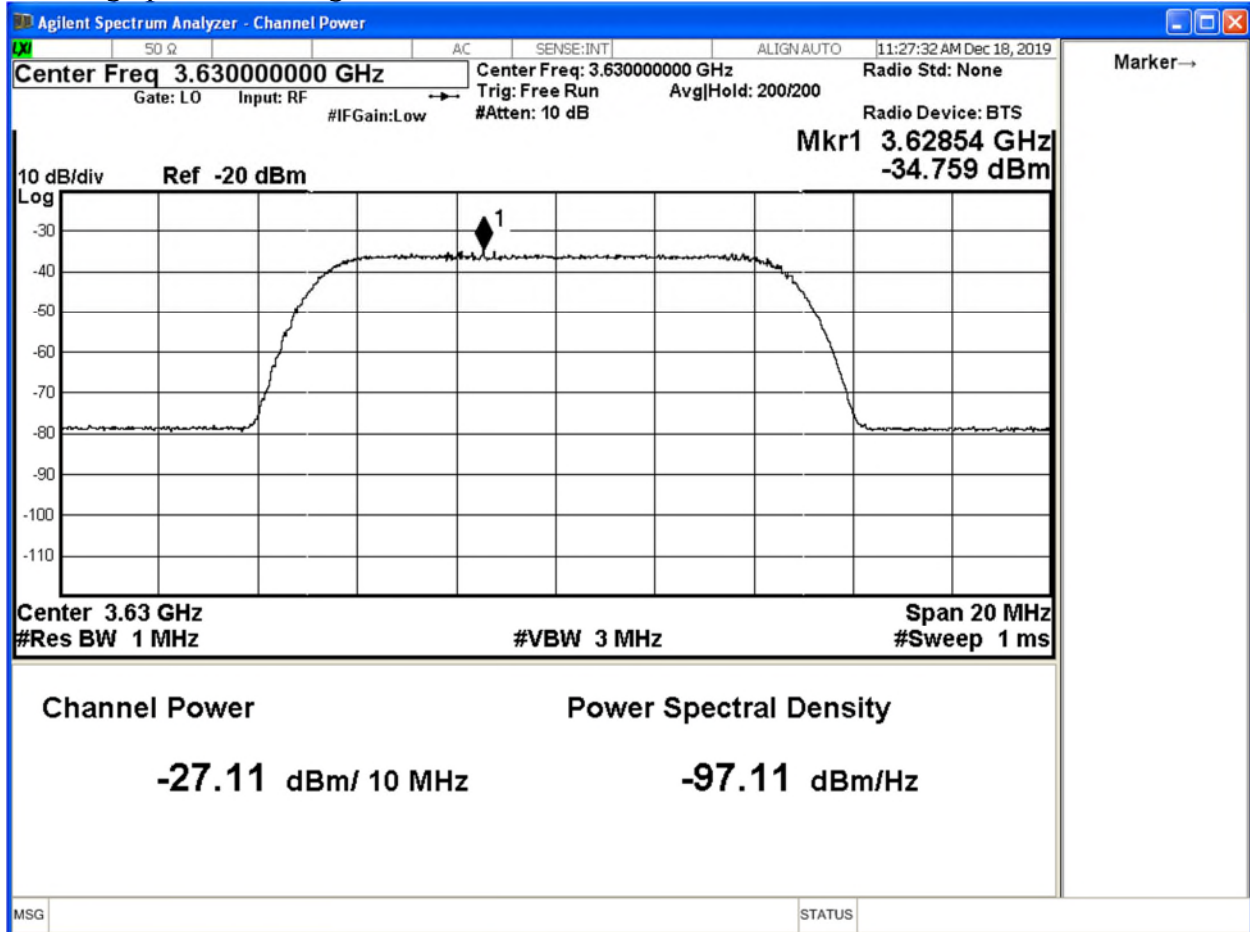
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3555-High power – 11 dBi gain



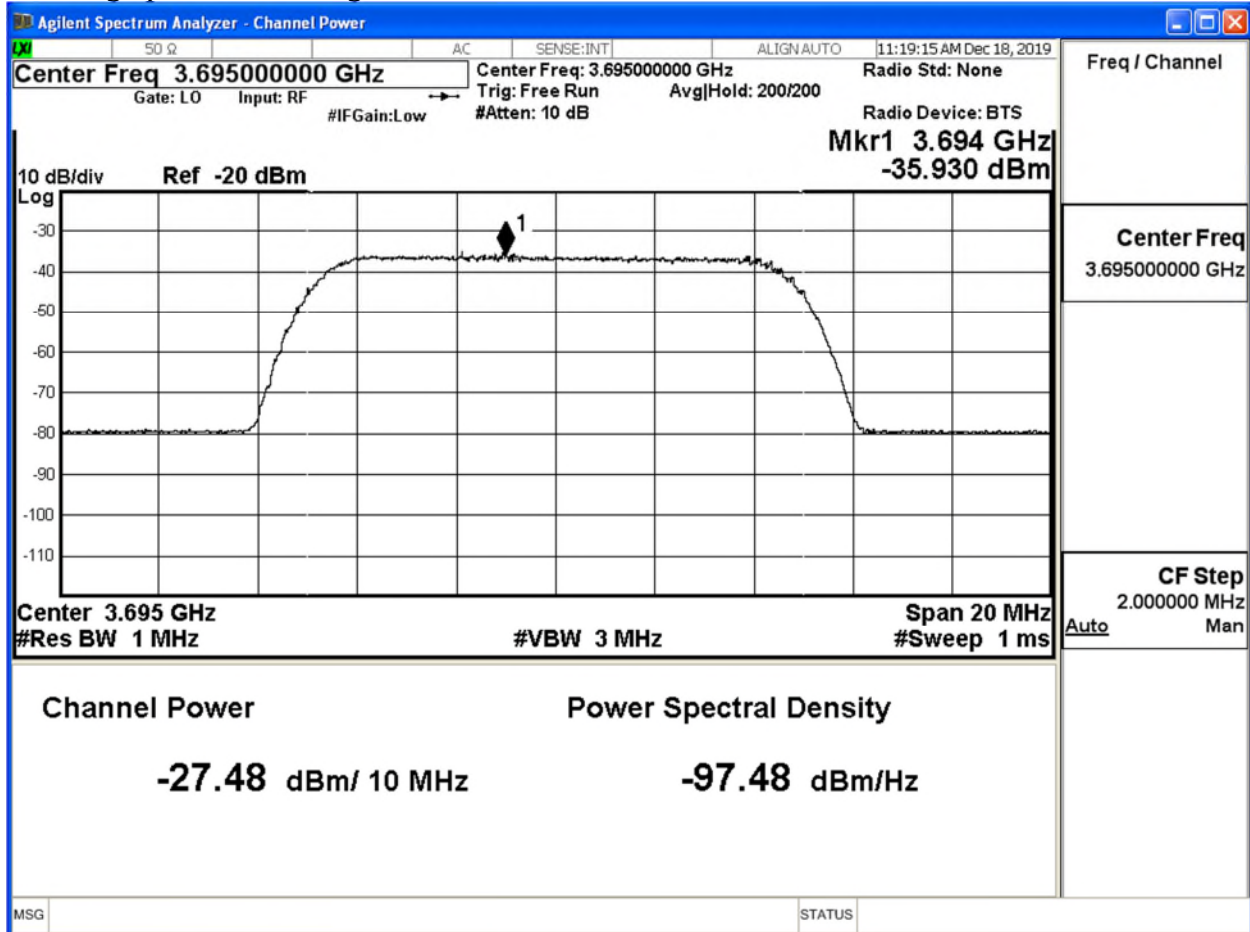
Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3630-high power 11 dBi gain



Client	Ericsson	 Canada
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

3695-high power – 11 dbi gain



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

Test equipment used for Dec 2019 testing

Instrument	Manufacturer	Type No.	Serial No	Calibration Period (months)	Calibration Due
THG	Fluke	77 IV	34770264	12	18-Apr-2020
DVM	VWR	61161-378	170120564	24	17-Feb-2021
Power Supply	Xantrex	XKW 60-50	E00109863	O/P Mon	-
Spectrum Analyser	Keysight	N9020A	MY49100827	24	27-Dec-2021
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	-



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

## Appendix D – Additional Test Information

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

**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.H BT	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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### Test Table(s)

#### 1 MHz EIRP (PSD)

		Raw	External	Conducted				EIRP 1 MHz	Margin 1 MHz
Freq	1MHz EIRP limit (target) dBm	1 MHz dBm	Losses (dB)	dBm/MHz	Antenna gain dBi	Ports	Port gain (dB)	dBm/MHz	dB
3560	34	-27.13	31.5	4.37	11	64	18.06	33.43	0.57
3560	37	-24.3	31.5	7.2	11	64	18.06	36.26	0.74
3650	34	-27.75	31.5	3.75	11	64	18.06	32.81	1.19
3650	37	-24.48	31.5	7.02	11	64	18.06	36.08	0.92
3690	34	-27.31	31.5	4.19	11	64	18.06	33.25	0.75
3690	37	-24.33	31.5	7.17	11	64	18.06	36.23	0.77

Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### 10 MHz EIRP (PSD)

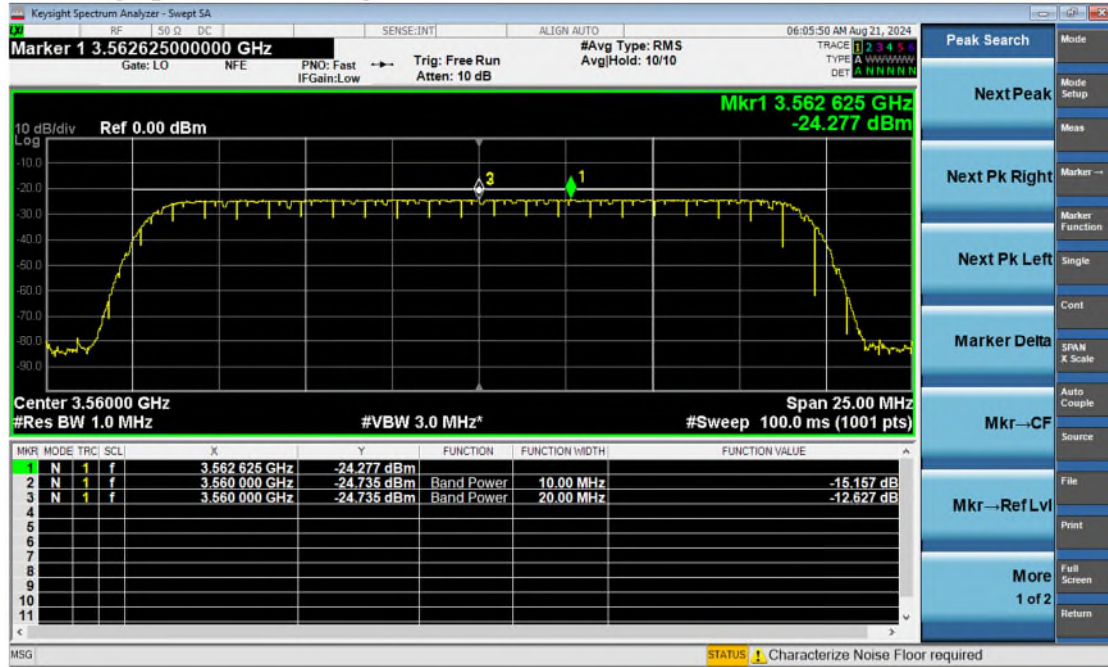
		Raw	External	Conducted				EIRP 10 MHz	Margin 10 MHz
Freq	10MHz EIRP limit (target) dBm	10 MHz dBm	Losses (dB)	dBm/MHz	Antenna gain dBi	Ports	Port gain (dB)	dBm/10 MHz	dB
3560	44	-17.67	31.5	13.83	11	64	18.06	42.89	1.11
3560	47	-15.1	31.5	16.40	11	64	18.06	45.46	1.54
3650	44	-18.67	31.5	12.83	11	64	18.06	41.89	2.11
3650	47	-15.62	31.5	15.88	11	64	18.06	44.94	2.06
3690	44	-18.41	31.5	13.09	11	64	18.06	42.15	1.85
3690	47	-15.36	31.5	16.14	11	64	18.06	45.20	1.80

### 20 MHz EIRP (for information purposes)

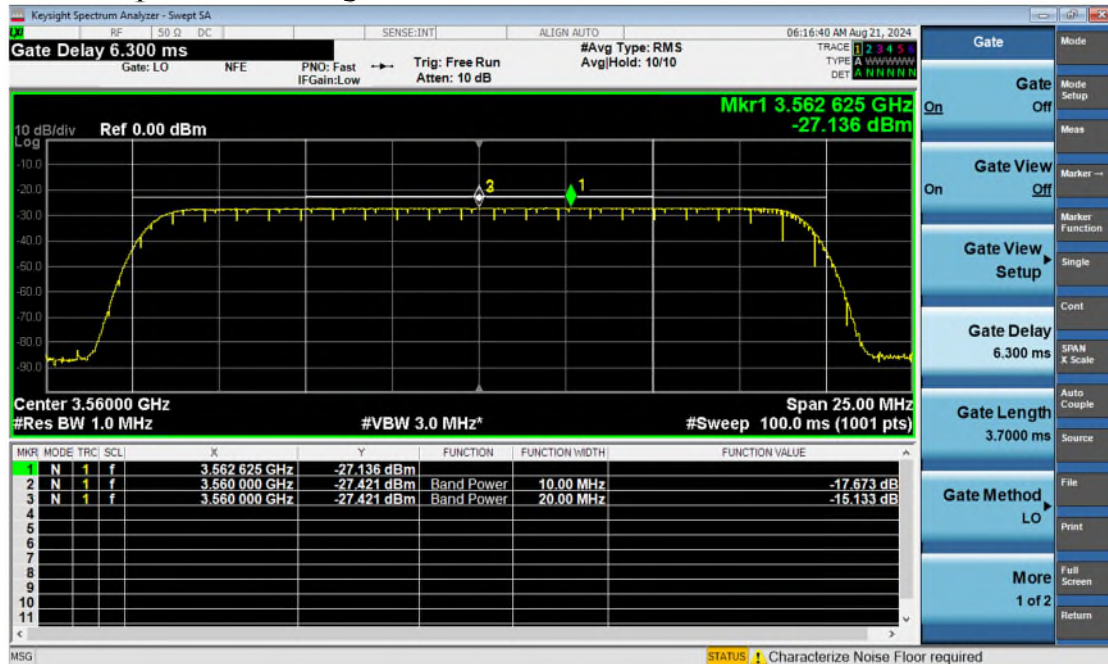
		External				EIRP 20 MHz
Freq	20 MHz (dBm)	Losses (dB)	Antenna gain dBi	Ports	Port gain (dB)	dBm
3560	-15.13	31.5	11	64	18.06	45.43
3560	-12.6	31.5	11	64	18.06	47.96
3650	-16.04	31.5	11	64	18.06	44.52
3650	-12.97	31.5	11	64	18.06	47.59
3690	-15.85	31.5	11	64	18.06	44.71
3690	-12.8	31.5	11	64	18.06	47.76

Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### 3560-High power – 11 dBi gain

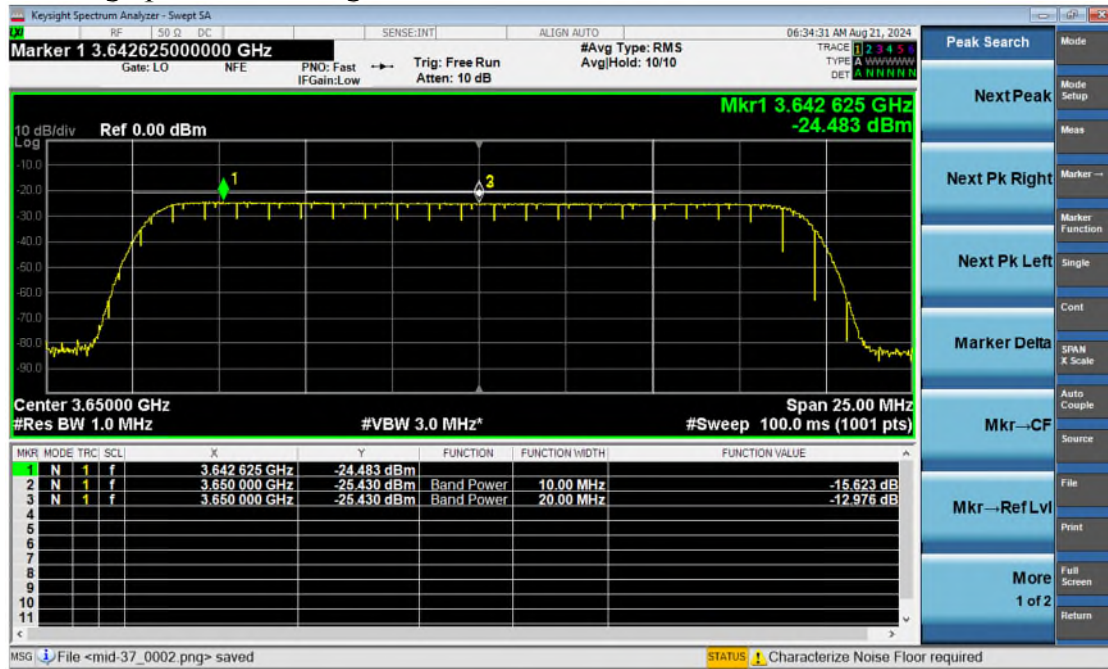


### 3560-low power – 11 dBi gain

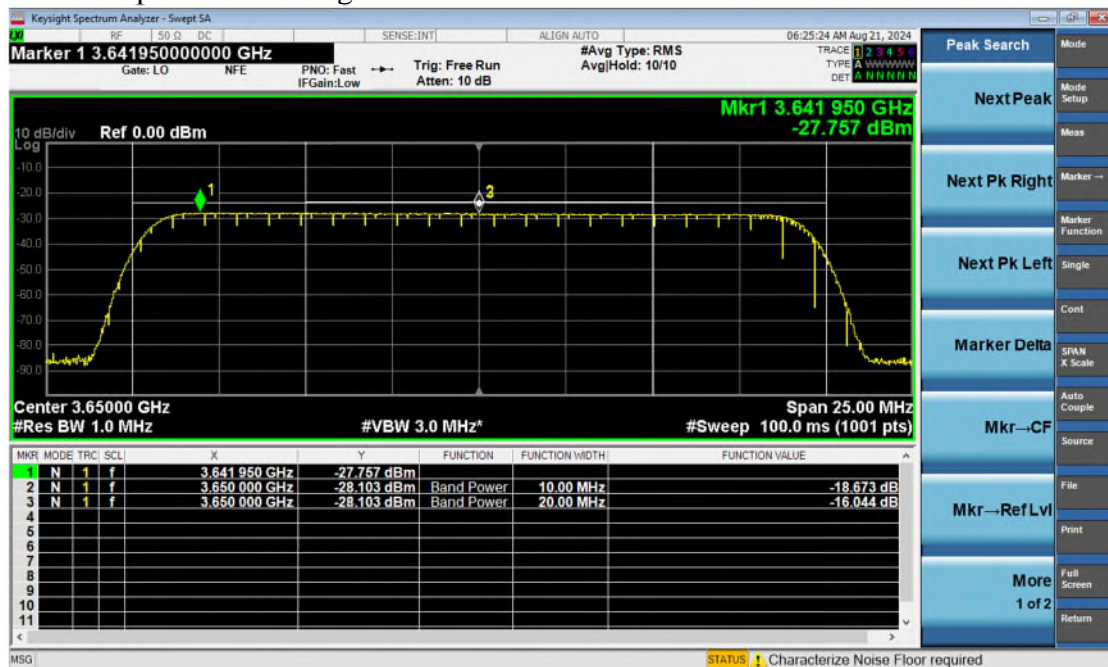


Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### 3650-high power - 11 dBi gain



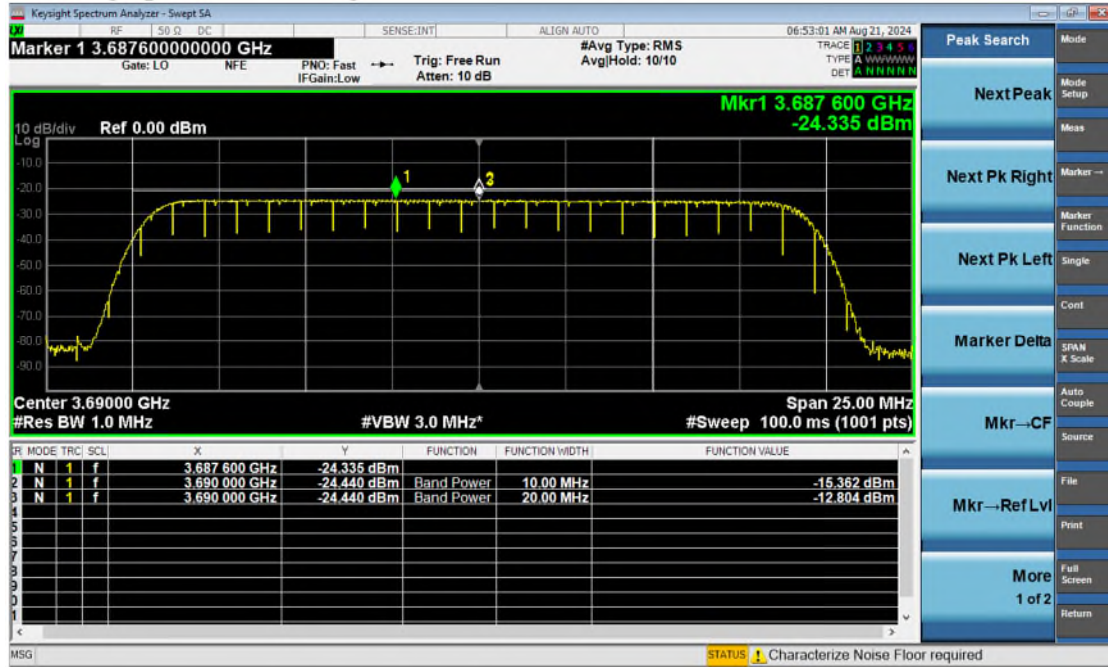
### 3650-low power - 11 dBi gain



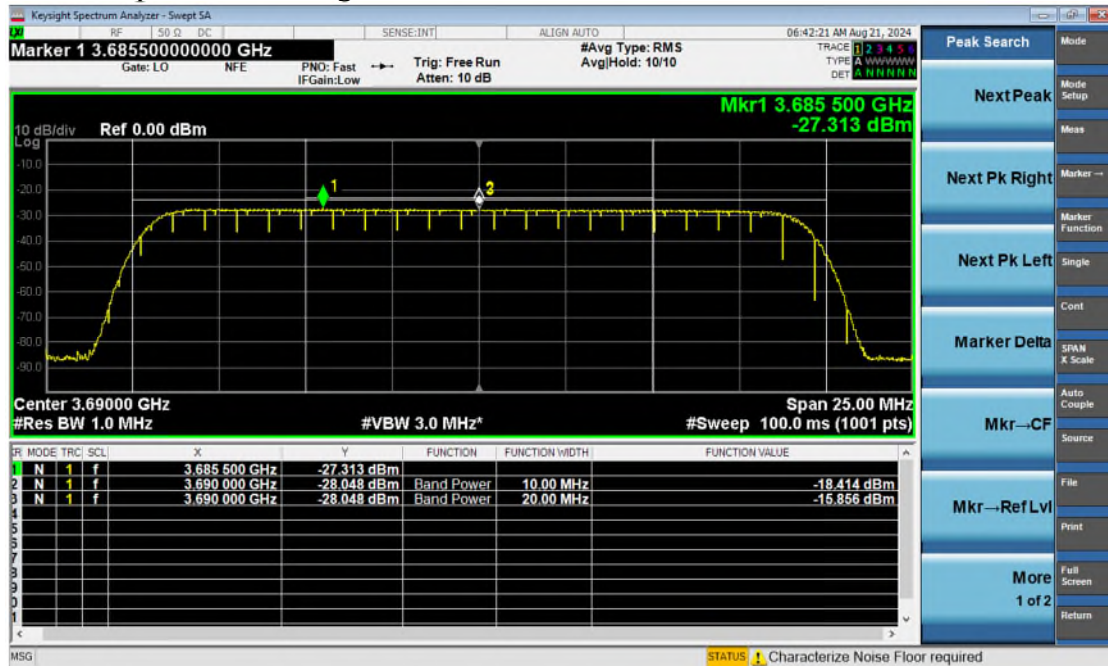


Client	Ericsson	
Product	Ericsson Remote Radio Air 6488 B48 KRD 901160	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

### 3690-high power – 11 dbi gain



### 3690-low power – 11 dbi gain



Client	<b>Ericsson</b>	
Product	<b>Ericsson Remote Radio Air 6488 B48 KRD 901160</b>	
Standard(s)	FCC Part 96 SAS requirements (CBRS Test Plan)	

Test equipment used for Aug 2024 testing

Instrument	Manufacturer	Type No.	Serial No	Calibration Period (months)	Calibration Due
Power Supply	Xantrex	XXW 60-50	E00109863	O/P Mon	-
Spectrum Analyser	Keysight	N9030B	MY61330816	12	24-Apr-2025
Attenuator	Pasternack	PE7004-10	N/S	O/P Mon	-
Switching Control Unit	Hewlett Packard	11713A	3748A060876	O/P Mon	-
RF Switch Unit	Bumscot	RARFSW 4x1	001	O/P Mon	-
Power Supply	Leader	730-3D	9801135	O/P Mon	-

EUT Details used for Aug 2024 Testing:

KRD 901 160/2 R1B

Serial Number: D829305451

Software Version CXP2010174/2-R17A247

Hardware Version R1B

ENM/DC SW Version: ENM 24.15, AOM 901 151

Test setup photo(s) kept on file.